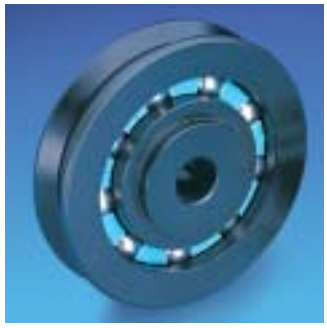
DUROBAL®
THERMOPLASTIC BALL BEARINGS

THERMOPLASTIC BALL BEARING SOLUTIONS



Busak+Shamban

SYSTEM SOLUTION PHILOSOPHY

With over 45 years of experience in the design, manufacture and supply of seals and bearings, Busak + Shamban has developed the capability to provide comprehensive system solutions.

Through an exchange of ideas and expertise, Busak + Shamban engineers consider all system variables in their approach to any engineering task. Hardware, design parameters, operating conditions and performance expectations are thoroughly evaluated to achieve quality solutions.

Busak + Shamban service is based on an in-depth understanding of your needs. To meet ever-increasing expectations for service excellence, each marketing company within the Busak + Shamban global network offers local customer support. Compliance and inventory management programs help you maximize production efficiencies. This level of responsive service, backed by global resources, provides you with a competitive commercial advantage.

BUSINESS PARTNERS

To achieve and maintain a proactive service for industry, Busak + Shamban regularly pursues the development of partnerships with customers throughout the world. Cultivating alliances ensures a highly focused service is provided through a true understanding of our business partners' needs. These alliances open avenues for collaboration and solutions throughout all stages of product development, applications engineering, quality control, manufacturing and inventory management.

MANUFACTURING

Each Busak + Shamban manufacturing facility focuses on specific product lines to enhance technological expertise. Together, 13 manufacturing sites worldwide produce a full range of sealing and bearing products. The highest quality standards are in place at all stages of production including compound mixing, molding and manufacturing, ensuring compliance with international and customer certification standards.

DUROBAL® THERMOPLASTIC BALL BEARINGS

Busak + Shamban has produced quality bearing and friction reducing materials from advanced, engineered thermoplastics for over thirty years. A dedicated Durobal® manufacturing facility ensures every bearing produced achieves maximum performance and reliability. Resources include:

- Laboratory material testing to meet international quality standards
- In-house tooling, compounding, injection molding and machining to meet prototype and production schedules
- Engineering assistance
- Custom product design
- High volume capability
- Automation equipment for high-speed assembly

ISO 9001

THE DUROBAL® SYSTEM

The basic principle underlying the Durobal® System is the development of custom-engineered anti-friction bearing assemblies. Durobal® utilizes the integration of proven rolling element bearing performance coupled with the design flexibility inherent in polymeric material technology.

Durobal® offers many advantages, including:

- Self lubricating
- Maintenance reduction
- Corrosion resistance
- Low friction
- Design freedom
- Lightweight
- Low noise
- Non-metallic
- Wide temperature range
- Environmentally friendly

The interim design solution (*Figure 2*) consisted of a single Durobal® system comprising of three bearing races combined into a single non-metallic housing. This system requires no component assembly and is corrosion resistant.

The final design solution (*Figure 3*) was developed after a detailed engineering analysis concluded that although the primary bearing load during operation is radial, a significant axial (*thrust*) load was found to exist. For optimum performance, Busak + Shamban engineers developed a combination system that addressed both operational loads. The system also incorporates a threaded inner body, thereby further eliminating the stainless steel shaft and associated secondary machining processes.

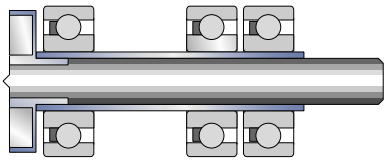


Figure 1

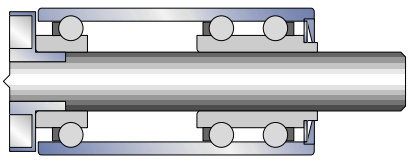


Figure 2

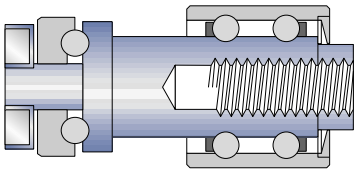
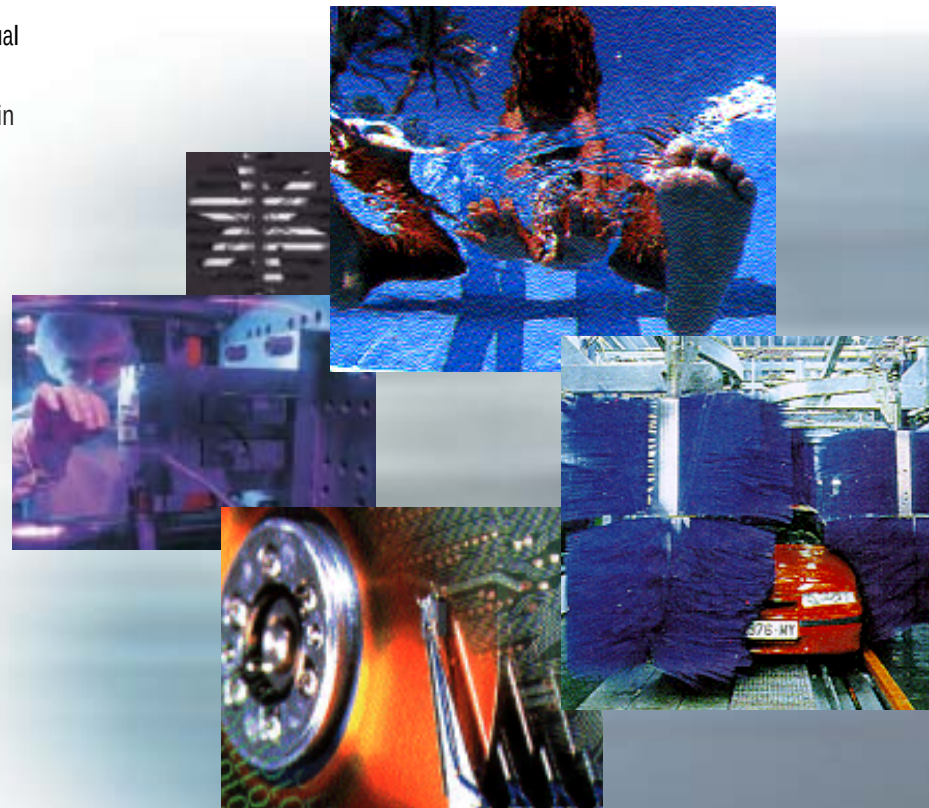


Figure 3

The following case history illustrates the evolution of an actual multi-component, all-metallic subassembly (*Figure 1*) through the progressive engineering design stages resulting in a totally integrated Durobal® System. This system concept addresses all functional aspects of the original design parameters with an emphasis on manufacturing economics.

The original assembly consisted of three stainless steel sealed and shielded bearings press fitted on stainless steel tubing operating as an anti-friction support for a rotating shaft in a chemically aggressive environment. It was plagued by excessive corrosion which resulted in reduced operation life. In addition, customer unit costs associated with multi-component assembly were quite significant.



DUROBAL® DESIGN CONCEPT

Durobal® custom-designed thermoplastic ball bearings begin their manufacturing evolution as close tolerance injection molded components. All raceways (*ball tracks*) are fully machined utilizing precision lathes. This equipment, along with statistical process control procedures, ensures close tolerance and concentric raceways free of imperfections. Within the raceways, the load carrying balls rotate freely. It is this high quality raceway and proprietary compounds which enhance the performance of Durobal® thermoplastic ball bearings.

Radial Open

This concept has been designed for both wet and dry applications carrying radial and/or thrust loads.

It features deep-groove raceways and a snap-in cage to retain the maximum allowable ball complement. Typical applications include swimming pool cleaning machines, flow meters and photo processing equipment. It operates effectively in fresh or salt water, detergents, photo-chemicals and weak acids.

Radial Shielded and Sealed

Low torque seals manufactured from Busak + Shamban proprietary PTFE-based Turcon® material are contained between the outer ring shield and an inner ring recess.

Sealed bearings are utilized for unclean environments to keep contaminants away from the raceway area. Seals are helpful in retaining grease inside the bearings where long life and low noise are critical. Typical applications include rooftop turbines, computer peripheral equipment, X-Y recorders, credit card imprinters and fishing reels.

Angular Contact

Designed for high thrust (axial) load applications where the load is applied from only one direction.

Typical applications include those with low revolutions in corrosive environments such as printing press rollers, credit card imprinters, conveyor lines, computer peripherals and chemical processing equipment.

Thrust

Two basic bearing designs carry pure thrust loading at moderate speeds. In one design, two injection molded rings 'sandwich' balls captured in a retainer. In another design, stainless steel balls captured in a retainer work in conjunction with existing mating surfaces to form a low-cost anti-friction unit. Typical applications include home and industrial ceiling fans, computer disk drives, water meters and revolving spray heads.

Full Ball Complement

The basic bearing design is that of an extra deep groove bearing which has no cage, but comes with a full complement of balls. It can be used as a pure radial bearing, thrust bearing or combined radial-thrust bearing. Its advantage is its capability to carry a substantially higher load at slightly lower speeds as compared to a caged radial bearing. A full ball complement bearing needs to be lubricated because the steel balls are rubbing against one another.

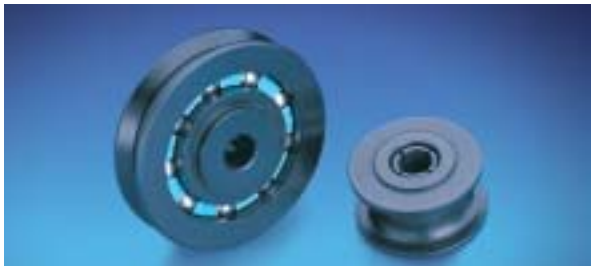
Depending upon its application, its own noise level during operation may also be substantially higher than that of an equivalent sized caged radial bearing. Typical applications include conveyor bearings, rotating platforms, pump shafts and other slow speed, medium load applications.

APPLICATIONS STUDY

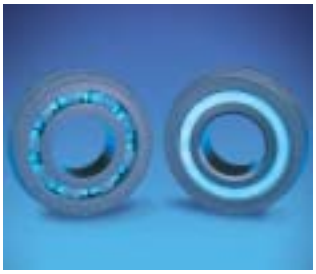
Following are descriptions of typical bearing problems encountered with various applications and a summary of effective solutions engineered by Busak + Shamban.

Problem: Expensive precision bearings assembled with machined metallic or non-metallic components requiring additional procurement steps, machining operations, increased inventory and assembly costs.
Solution: A non-metallic system where the components are integrated into the bearing races, ready for installation, thereby reducing cost.

Problem: Metallic bearing with special configurations were causing increasingly longer lead times and commanded higher prices.
Solution: Any quantity of unique bearing configurations can be successfully handled through injection molding. This eliminates the additional production costs associated with the secondary machining operations required in the production of custom metallic bearing designs.



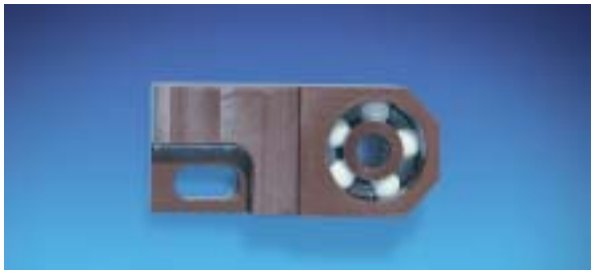
Problem: A sophisticated medical device could not contain any metallic components.
Solution: Incorporate glass rolling elements into the non-metallic bearing assembly producing a structurally reliable, all non-metallic bearing assembly.



Problem: Bearing must fit a square shaft and operate lubricant-free in a paper dust environment.
Solution: Non-metallic flange bearing which operates lubricant-free. Sealed and shielded, this non-metallic square bore bearing provides long service life in a contaminated environment. Square bore is injection molded, thus avoiding extensive machining operations.

Problem: Hostile chemical environment necessitates frequent replacement of metallic bearings due to corrosion.
Solution: A non-metallic bearing assembly provides maximum resistance to a large spectrum of chemically hazardous materials.

Problem: Space environment with temperature extremes from cryogenic to + 215 °C *+ 420 °F*.
Solution: Units are manufactured from a unique polymeric material capable of withstanding ± 250 °C *± 480 °F*. Depending upon the applications, units are equipped with either ceramic or ruby balls and operate lubricant-free for extended periods of time.



ENGINEERING DATA

Ball bearing systems can be complex. In addition to many application variables, the bearing design, material characteristics and manufacturing methods are important factors affecting performance. The only comprehensive method to establish the suitability of a particular bearing system relevant to a specific application is by actual operational performance.

Within the context of each application's operational parameters, consideration must be given to load, speed, environment, lubrication and required service life.

Lubrication

Many Durobal® system designs feature Turcite® engineered materials. This proprietary line of polymeric compounds was developed by Busak + Shamban to exhibit outstanding performance in rolling element bearing applications. Turcite® requires no additional lubrication under typical operating conditions. This feature is of significant importance where oil- or grease-free contamination is essential to performance such as with medical or other hygenic applications.

Many applications require Durobal® to perform fully or partially immersed in a passive or more chemically aggressive aqueous environment. Under such conditions, the chemical resistance of the materials selected often allow the medium (*such as photoprocessing, agricultural chemicals, detergents, sea water, weak acids or bases, etc.*) to function as a lubricant. When specified, or where metallic raceway materials are used, Busak + Shamban can assist in the selection of standard or special lubricants to fulfill customer requirements.

Bearing Life

Ball bearing performance is a complex function dependent on many variables. In defining bearing life, these variables are categorized into two groups. One group represents the application conditions (*i.e. load, speed, temperature, mounting and lubrication*). The other group focuses on characteristics of the bearing (*i.e. design, material and manufacturing method*).

The life of individual bearings cannot be accurately predicted, but the dispersion in life of identical bearings operating under the same conditions follows a definite statistical distribution. Because of variation in the lives of individual bearings, the life of a bearing can be defined as the number of operating hours at a given speed that 90% of a group of bearings will attain or exceed before excessive wear occurs. This definition is called the B10 life.

Estimation of B10 life under load for Durobal® systems is based upon calculations in accordance with Anti-Friction Bearing Manufacturers Association Standards and supported by extensive laboratory testing.

Standard Durobal® Sizes

US - Imperial (Inch Dimensions)

Bearing Number	Bore	O.D.	Width	Chamfer x45	No. Balls	Ball size	Flange Diameter	Flange Width	Max. Dyn. Load (lbf)	Max. RPM	Radial Play $x10^{-3}$
GWE**0316	0.188	0.500	0.195	0.015	7	3/32	0.565	0.042	8	5700	1-3
GWE**0420	0.250	0.625	0.195	0.020	7	1/8	0.690	0.042	13	4500	1-4
GWE**0628	0.375	0.875	0.280	0.020	8	5/32	0.968	0.061	21	3200	1-4
GWE**0844	0.500	1.375	0.436	0.035	8	1/4	1.500	0.094	50	2000	1-6
GWE**1044	0.625	1.375	0.436	0.035	8	1/4	1.500	0.094	50	2000	1-6
GWE**1252	0.750	1.625	0.500	0.035	9	1/4	1.750	0.094	54	1700	1-6

When ordering the above, please specify as follows:

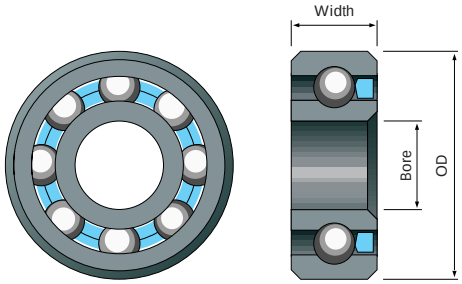
GWERS = Radial Ball Bearings with Stainless Steel Balls

GWERG = Radial Ball Bearings with Glass Balls

GWEFS = Flanged Radial Ball Bearings with Stainless Steel Balls

GWEFG = Flanged Radial Ball Bearings with Glass Balls

Radial Open Ball Bearings



Flanged Radial Open Ball Bearings