

HiMod[®] THERMOPLASTIC BEARINGS

THERMOPLASTIC BEARING SOLUTIONS



SYSTEM SOLUTION PHILOSOPHY

With over 45 years 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.



SINGLE SOURCE GLOBAL BEARING 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 responsive level of service, backed by global resources, provides you with a competitive commercial advantage.

Busak+ Shamban is a pioneer in material development for Durobal[®], HiMod[®], Luytex[®], Orkot[®], Slydway[®] and Turcite[®] bearings. Our research and development takes place at development centers around the world, each specializing in unique materials and designs. By controlling composition and structure of our materials, we can offer optimum designs for specific operating conditions, leading to improved solutions.

BUSINESS PARTNERS

To achieve and maintain a proactive service for specialized industries, Busak + Shamban regularly pursues the development of partnerships with customers throughout the world. Cultivating alliances ensures a highly focused service is provided through 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 maximize technological specialization. Together, thirteen 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.



HiMod[®] THERMOPLASTIC BEARINGS

Busak + Shamban has produced quality bearing and friction reducing materials from advanced engineered thermoplastics for over thirty years.



A dedicated HiMod[®] 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
- Personalized engineering assistance
- Customized product design

HiMod® HIGH-PERFORMANCE BEARING MATERIALS

HiMod® is a range of high-performance thermoplastic bearing materials available as machined or injection molded components. To ensure maximum performance of these thermoplastic bearings, Busak + Shamban maintains in-house laboratories to continually test materials against criteria for the most demanding applications. HiMod® thermoplastic materials offer considerable design freedom and therefore a broad range of effective solutions.

HiMod® HM911

An excellent self-lubricating, acetal-based material with low friction additives and good wear characteristics compared to unfilled acetal and nylon. HiMod® HM911 is ideally suited to applications with moderate loads and speeds.

HiMod® HM912

HiMod® HM912 is a higher performance bearing material with lower friction and improved wear resistance. It was developed to extend the performance characteristics of HiMod® HM911.

HiMod® HM913

A self-lubricating PPS-based material designed for high performance bearing applications with high operating temperatures. HiMod® HM913 has an excellent resistance to chemical attack.

HiMod® HM914

An advanced PEEK-based compound that meets criteria for the most demanding bearing applications. HiMod® HM914 has an extremely high limiting PV (pressure x velocity), excellent chemical resistance and low thermal expansion. Its low friction and wear rate are ideal for applications where polyimide materials are typically used.

HiMod® HM924

This PEEK-based compound offers the highest thermal and mechanical properties of any material in the HiMod® range. It is ideal for extreme applications requiring high strength, high compressive properties, high chemical resistance and low thermal expansion.

Physical properties of HiMod® grades					
Physical Property	HM911	HM912	HM913	HM914	HM924
Compressive strength (psi)	13,000	10,000	15,000	19,500	26,000
Tensile strength (psi)	7,600	7,800	11,000	14,500	20,400
Elongation at break (%)	15	9.0	2.0	2.0	1.0
Impact strength-Notched (ft-lb/in)	.57	.55	.40	.60	.70
Impact strength-Unnotched (ft-lb/in)	8.4	9.6	3.9	7.0	5.1
Flexural strength (psi)	11,000	10,500	15,000	20,000	29,500
Flexural modulus (psi)	350,000	355,000	900,000	1,000,00	2,450,000
Maximum continuous temperature (°F)	180	180	400	500	500
Intermittent temperature (°F)	250	250	445	555	555
Linear coefficient of thermal expansion (in/(in°F)-10 ⁵)	5.2	6.3	1.4	.80	.50
Coefficient of friction (dry)	.30	.22	.29	.30	.36
Limiting PV (psi-fpm) (dry)	7,500	9,000	50,000	110,000	45,000
Hardness Rockwell M scale	81	74	88	100	105
Water absorption (%)	.20	.20	.03	.07	.05

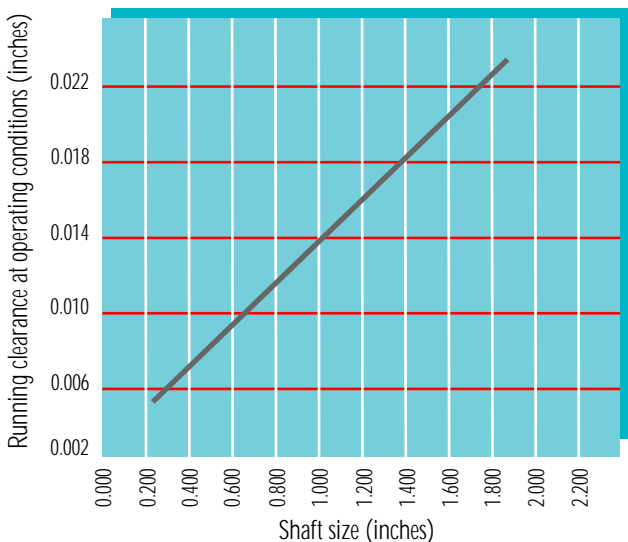
To obtain optimum performance from HiMod® bearings, the following guidelines and design recommendations should be observed.

Pressure and velocity

PV ratings were established to provide safe working limits for thermoplastics. Generally, the materials are tested at a constant speed with varying loads applied to determine their limitations. The limiting PV is the maximum pressure and velocity a bearing material can withstand and expresses a point beyond which the material will typically fail from excessive frictional heat build-up. Division of the limiting PV by 2 is recommended to achieve a realistic working PV. The limiting PV for HiMod® materials can be found on the Physical Properties chart on the opposite page.

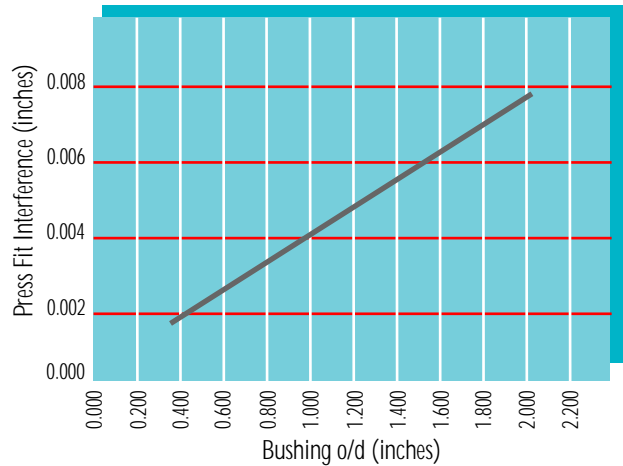
Running clearance

Running clearance is the least understood and most frequently encountered problem in the design of thermoplastic bearings. It is also one of the most common causes of premature thermoplastic bearing failure due to the material's thermal behavior during operation. Thermoplastic bearings require larger running clearances than metal bearings. Metal bearings installed with excessive clearance often result in vibration and brinnelling of the bearing and shaft. Thermoplastics behave differently. They are far more resilient and tend to dampen vibration, allowing them to operate satisfactorily with larger running clearances.



Press fit

A press fit is the usual method to retain the bearing in a housing. The recommended interference fit should be between .002" and .005" of the outside diameter of the bearing. Care should be taken to ensure that sufficient clearance remains on the inside diameter of the bearing so it does not seize onto the shaft.



Recommended running surface

The surface finish of the shaft plays an important role in any HiMod® material's ability to transfer internal lubricant onto the shaft, creating a self-lubricating system with low wear and friction. Laboratory tests show the optimum surface finish is between 8 to 16 Ra. Shaft hardness is equally important. Most Busak + Shamban materials are designed for optimum performance against a surface hardness greater than 30Rc. The wear rate flattens out with Rc values over 45, so there is no added benefit from using harder shafts. Soft metals should be avoided if at all possible. Aluminum should be hard anodized, although it can perform at reduced levels without this treatment.

Wall thickness

A nominal wall thickness in the range of .04" - .19" is recommended. Where a wall thickness greater than .19" is required, the part should be cored out if possible. A thin wall will facilitate better heat transfer through the

The Busak+Shamban technical department will be pleased to provide application and material selection assistance.

HiMod® APPLICATIONS

Busak + Shamban engineering expertise and product knowledge is the result of many years experience in the development and manufacture of bearing materials and components. Complex application problems are routinely solved by utilizing HiMod® high-performance thermoplastic bearings. In addition, custom compounding is available to suit application requirements.

PROBLEM SOLVED USING HiMod® HM911

A major bicycle manufacturer required help to eliminate noises emanating from critical components. Busak + Shamban engineers analyzed the assembly design and provided a bearing solution that, as well as solving the noise problem, significantly reduced the total number of components and overall costs as well.



PROBLEM SOLVED USING HiMod® HM924

A maintenance-free under-the-hood automotive component was required for operation in a temperature range -60°F to $+284^{\circ}\text{F}$ without losing dimensional stability or structural integrity. HiMod® HM924 was selected since it offered the lowest thermal expansion within the required operating range. The solution met all operational and cost objectives.



PROBLEM SOLVED USING HiMod® HM914

A manufacturer of pneumatic dental and surgical equipment was experiencing problems with reduced bearing life due to premature failure of the sliding vanes. Busak + Shamban conducted its own in-house test program and selected HiMod® HM914 as a solution. The results were a significant reduction in the friction and wear of the sliding vanes providing improved service life. An additional benefit came from the reduction in component cost.



PROBLEM SOLVED USING CUSTOM BEARING COMPOUND

Extremely high maintenance costs and downtime brought a leading plywood drying equipment manufacturer to look for a new bearing solution. Components had to be replaced every 90 days in a 400°F high friction environment where wear was a significant problem. Busak + Shamban developed a special thermoplastic compound to produce a structurally sound part that offered significant reductions in frictional wear and reduced the unit cost.

