Plastic Bushings for the Automotive Industry

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**Introduction**

Although plastic bushings have been a common choice in the machine tool industry for many years, they are also becoming widely accepted in the automotive industry. Today, many new vehicles are equipped with plastic bushings. To meet industry demands, plastic bearings must have high wear resistance, while being lightweight and low noise.

The growing prevalence in using plastic bushings can be largely attributed to the development of high-performance polymers, which can directly replace bronze, metal or metal-backed bushings. These plastic materials are subjected to intensive testing and offer significant cost advantages. They are also recyclable and meet current End-of-Life Vehicle (ELV) directives.

Plastic bushings can be used in numerous automotive applications, from simple car-seat systems, to under-the-hood applications subject to high thermal stress. Convertible tops, hinges, seats, chassis, windshield wipers, steering systems, foot pedals, transmissions, throttle bodies, turbochargers, and engine compartments are other areas in which these bearings can be used.  

*Plastic bushings are used in several automotive applications.*
Development of High-Performance Plastics

The adoption of plastic bushings in automotive engineering is predominantly due to the development of high-performance, self-lubricating plastics. Any disadvantages associated with polymers have been substantially reduced due to both material development and bearing design in the last few decades.

I. Traditional solution

One traditional plain bearing solution is a hard metallic shell covered with a soft lubricating layer. However, this coating can be stripped away when subjected to high edge loads or oscillations - or even during the installation process.

II. Alternative solution

igus® adopts an alternative solution, which injection molds plastic bearings with solid lubricants and technical fibers for mechanical reinforcement. This positively affects friction and wear behavior. Additionally, a thin bearing wall permits higher thermal conductivity, thereby facilitating rapid heat flow and directly enhancing the load capacity of a bearing.

igus® typically develops more than 100 new polymer compounds per year from different blends of base plastics, fibers, and solid lubricants. These ingredients are not applied in layers, but homogenously compounded. The advantage of this over-layering becomes clear if you consider that the coefficient of friction, which is determined by the surface of the bearing, should be as low as possible. The surface must not be pushed aside under forces acting on the bearing and the bearing should be especially resistant to wear forces at work on its surface. Any radial pressure acting on the bearing is absorbed by the base plastic, which ensures that the solid lubricants do not receive a surface pressure that is too high. This additionally enables enhanced wear resistance.
The fibers and filling materials reinforce the bearing against high forces or edge loads. They stabilize the bearing for applications involving continuous stress. The solid lubricants automatically lubricate the bearings and reduce friction in the system. They are embedded as microscopic particles in millions of tiny chambers in the fiber-reinforced material. From these chambers, the plain bearings release small amounts of solid lubricant during movement. This lubricant is embedded in such a way, it can not be pressed out. Lubricant is always there as soon as the bearing or shaft is set in motion.

The bearings do not require additional lubrication and so regular maintenance is not necessary. Other technical benefits of these bearings include low noise operation, dirt and corrosion resistance, vibration dampening, high temperature resistance up to 320 degrees Fahrenheit, and a high load capacity up to 21,750 pounds per square inch.

igus® owns several hundred injection molding machines from which it produces its plastic plain bearings. By using this method of production and stocking parts in large quantities, igus® is able to offer significant cost savings for vehicle manufacturers.

**The End-of-Life Vehicle Directive**

In the United States, no national regulation exists for the disposal of automotive waste. However, the European Union’s End-of-Life Vehicle (ELV) Directive serves as an initial model for uniform, dictating the means for responsible recycling, reuse treatment, and ultimate disposal of automotive waste arising at the end of a vehicle’s useful life.¹

No iglide® materials contain forbidden or controlled substances, such as the lead found in many metal-backed bearings. iglide® plain bearings are recyclable and so meet current ELV regulations. Additionally, the injection-molding process means no external coatings or substances are used or required.

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¹ 18 Minn. J. Int’l L. 431 (2009)
Testing

Vehicle safety is a critical factor in automotive manufacturing. For this reason, it is vital that suppliers can provide test data to support product performance.

iglide® plastic plain bearings are tested in more than 5,000 experiments in a dedicated on-site laboratory at the company’s headquarters every year. Over the last few decades, igus® has been able to incrementally add test results to a comprehensive database containing each plastic’s tribological properties. This means that each iglide® plain bearing is supported by empirical lifetime data from which its precise service life dependent upon various application parameters.

The comprehensive test-reference center also enables igus® to specify the most suitable shaft material for a customer. Whenever test data is not available for a particular application, igus® can carry out tests on a short-term basis on test benches specifically developed for this purpose. For example, igus® engineers developed a plain-bearing material for a thermo-set shaft in a vehicle’s lighting system. The development of this new customer-specific bearing solution took less than eight weeks.

Applications

Plastic plain bearings can be implemented in a wide range of applications, from seating systems to complex applications subject to high thermal stress, such as transmission linkages and throttle valves.
Other applications include convertible tops, door hinges, locks, latches and mechanisms, shock absorbers, brakes, windshield wipers, steering systems, foot pedals, and throttle bodies.

**Conductivity**

igus® offers 28 different material blends, each one developed with specific properties designed to fit different application scenarios. For example, when conductive materials are required, iglide® RN89 is the recommended material. When other components provide a conductive path, lower cost insulating materials such as iglide® G, GLW or RN56 can be used.

### Automotive applications for plastic plain bearings:

- **Convertible tops**: latch and linkage, kinematics
- **Hinges**: door hinges, multi-articulation hinges
- **Seats**: lift links, headrests, gears
- **Chassis**: shock absorbers, brakes, control arms
- **Windshield wipers**: arm and blade, kinematics
- **Steering systems**: shaft and column
- **Foot pedals**: pedals, angle transmitters, sensors
- **Transmissions**: actuator and fork
- **Engine compartments**: variable air intake manifolds, EGR (exhaust gas re-circulation), belt tensioner, throttle body valves

**Seat Systems**

Quite often seat systems must work with low-cost bar stock and metal stamping systems. However, the bearing system needs to possess a low clearance to ensure adequate noise reduction. To resolve these conflicting requirements, one option is to instead install an iglide® plastic plain bearing prior to the E-coat paint process, creating a transition fit between the bearing and shaft.

By doing so, the bearings are calibrated after painting during the drying process in temperatures up to 428 degrees Fahrenheit for as long as 60 minutes at a time. The result is a bearing system with ease of movement and minimum clearance. A large contact surface between the bearing and the shaft is also achieved due to the transition fit of the shaft.
Transmission Linkages
Roller bearings and metal plain bearings are susceptible to contact corrosion in transmission linkages, whereas plastics, such as polyamides, are capable of withstanding the thermal requirements, are chemical resistant and can support the load capacity. However, polyamides are generally very expensive. In contrast, iglide® H4 bearings from igus® are comparably inexpensive and deliver long-term operating temperatures of 392 degrees Fahrenheit.

A plain bearing made from this material is also resistant to synthetic transmission oils and offers enhanced vibration dampening in comparison to its metal counterparts.

Pedal Boxes
Pedal-box applications require rattle-free bearings and usually use plain tubes or plastic bolts, typically consisting of glass-fiber reinforced polyamide (PA) materials. Both solutions have roughly specified tolerances. However, in order to eliminate noise effectively, a bearing system must have minimum play.

The pre-tensioned iglide® JVSM bearing overcomes both of these challenges. Spring elements at both ends of the sleeve bearing result in a system without play, even when no loads are present. iglide® JVSM also offers an excellent coefficient of friction versus abrasive glass-fiber reinforced PA materials.

Intake Manifolds
For many years, PA materials have been tested in intake manifolds for reliability and efficiency. Today, aluminum die-cast housing is frequently replaced with plastic housing, such as in the case of throttle valves.

In this application, iglide® bearings can be over-molded with PA or PPS materials at approximately 644 degrees Fahrenheit. In addition to the tribological combination of different bearing materials, a high thermal stability is necessary. iglide® Z plastic plain bearing can be used here without an issue.
About igus®

igus® develops industry-leading products based on a belief in making functionally advanced, yet affordable plastic components and assemblies, including iglide® plastic plain bearings, igubal® spherical bearings, and DryLin® linear bearings and guide systems. No lubrication, less maintenance, lower costs, longer life cycles – these key principles apply to all igus® products, systems and services. Tried and tests in terms of durability, friction properties and stability, igus® plastics are the technological core of the company’s range.

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