

A Guide to

Ball Bearing Materials

Ball bearings can be used in a range of applications, from medical and packaging technology to electronics and office technology. Since these components are available in different types of materials, each with their own set of features and benefits, weighing the pros and cons of a specific kind of ball bearing can become an important part of the design process. Ball bearings are most commonly made of steel, ceramic or plastic. While every ball bearing is comprised of four main parts—an outer race, an inner race, a cage and balls—each has its own set of unique characteristics.

Steel Ball Bearings

Partly because they are an older technology, steel ball bearings are a trusted solution for many design engineers. Typically, these types of bearings are comprised of all-steel parts, but are available with different types of steel races and balls, or with a phenolic cage.

Steel ball bearings are ideal for robust applications handling extremely high loads and fast rotations per minute (RPMs), and some feature a radial load capacity of up to 30,000 pounds. Another advantage of steel ball bearings is that they tend to be very precise due to the clearance that can be achieved during the manufacturing process.

There are also quite a few disadvantages to steel ball bearings. They are heavy and noisy, and, depending on the grade of steel, they lack chemical resistance. They require constant lubrication, which means time and money spent on maintenance. Steel is susceptible to corrosion in humid or wet environments. Due to the need for lubrication, most steel ball bearings must also be sealed to eliminate dirt and debris from getting in and lubricant from getting out. Failure to seal them adequately can lead to bearing failure. Furthermore, in medical applications, their magnetic properties can cause problems.

In addition, the extremely large number of steel ball bearing manufacturers leads to tremendous price variances, ranging from inexpensive to extremely costly. This could be perceived as an advantage or disadvantage but, either way, the options can be overwhelming, leaving steel ball bearing buyers wondering if they are getting the quality they desire.



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Ceramic Ball Bearings

The most common type of ceramic ball bearing is often considered a “hybrid”, which indicates that the outer race, inner race, and cage of the bearing are comprised of steel, while the balls are made from ceramic. The ceramic material enables the bearing to run faster while maintaining a cooler operating temperature and simultaneously reducing noise, vibration and wear. Since they are a hybrid design and still contain steel races, hybrid ceramic ball bearings are as equally susceptible to corrosion as steel ball bearings.

Fully ceramic ball bearings tend to be more corrosion resistant, more rigid and lighter in weight than most steel ball bearings. Additionally, fully ceramic ball bearings are non-magnetic, which is useful for applications where this might be critical (e.g. MRI equipment). Lower coefficients of friction and higher RPMs are also possible and, since they are non-conductive, ceramic ball bearings can be used in electrical applications. In addition, most ceramic balls bearings can operate in temperatures up to 1,800° F.

With these advantages, ceramic ball bearings are an attractive solution. However, these types of bearings are extremely expensive, which is a strong argument in itself for seeking out an alternative solution when extremely high speeds and high temperatures are not needed.

Plastic Ball Bearings

While plastic ball bearings are a newer technology, they have advantages that are not offered by steel or ceramic ball bearings. Plastic ball bearings are comprised of all-plastic races and a plastic cage, and are typically available with a choice of three different types of balls: plastic, glass or stainless steel. The choice of material is often dependent on the environment in which the bearing will be used.

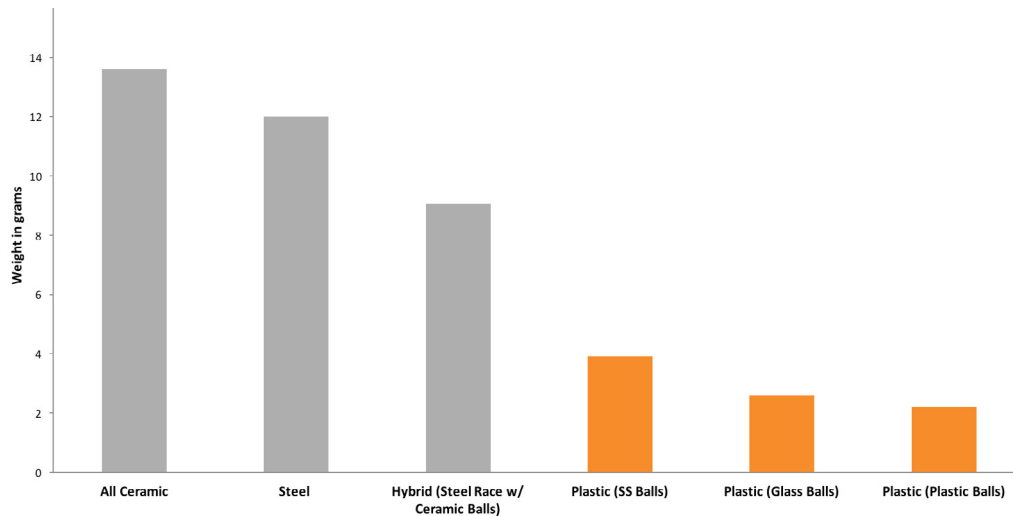


igus® xiros® ball bearings

The most common ball material within a ball bearing is stainless steel. Stainless steel balls are the most cost-effective choice, but they are heavier than both the plastic and glass options, and they are magnetic, which can be a detriment to some applications. Glass balls are ideal when a metal-free solution is needed. Glass balls also offer excellent chemical resistance and weigh less than the steel balls. Plastic balls are another ideal option. They weigh less than both the steel and glass balls, and offer excellent wear resistance while still being resistant to a wide variety of chemicals.

Whatever configuration you choose, plastic ball bearings are ideal for applications with normal to high speeds and have a number of additional attractive features. Due to their plastic construction, plastic ball bearings are self-lubricating, corrosion resistant and they deliver a quiet operation. Another major advantage is that they are lightweight.

Weight of Various Ball Bearing Materials (size 608)



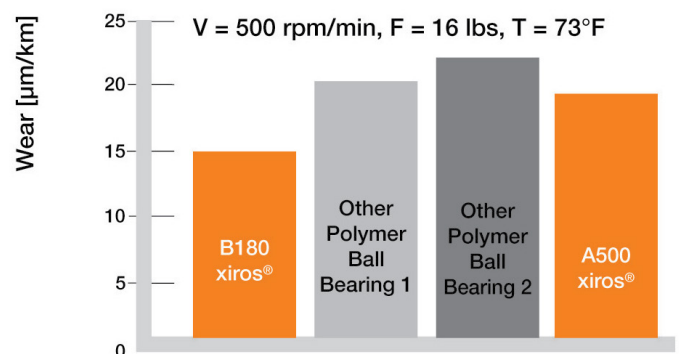
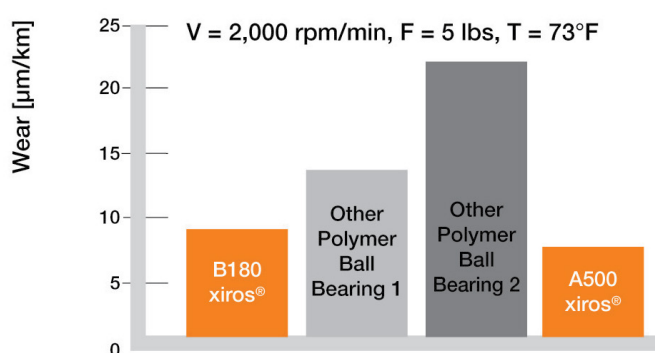
There are a few different plastic ball bearing manufacturers on the market. There are those producing simple plastic ball bearings typically made with acetal, and then there is igus®, producing bearings with homogeneously blended materials including a base plastic, solid lubricants, fibers and filaments. Your particular application would indicate if using a simple plastic is sufficient, as it offers a lightweight quiet solution and corrosion resistance. If wear is a serious concern, a thermoplastic might be more advantageous.

Still, there are instances where plastic ball bearings should not be used, including applications with high loads or long-term temperatures exceeding 300° F.

Conclusion

Every manufacturer offers its own versions of ball bearings with varying features. Manufacturers of steel ball bearings, for example, often offer their products in a number of different types of steel, including a 300 series (soft stainless), a 400 series, or chrome steel.

Comparison tests in the igus® lab:



These graphs compare igus® xiros® plastic ball bearings made from specially engineered thermoplastics, B180 and A500, to polymer ball bearings from two competitors.

In the same way, igus® now offers its line of xiros® plastic ball bearings in nine different thermoplastic race materials:

- **A500** for extreme chemical resistance, temperatures reaching 302° F and FDA compliance.
- **B180** for high wear resistance, temperatures up to 176° F and FDA compliance.
- **C160** for applications exposed to chemicals and where temperatures remain 176° F or lower.
- **D180** for higher speeds and lower loads in comparison to other xiros® options.
- **F180** is a conductive option with ESD protection and offers FDA compliance.
- **G220** is xiros® standard for excellent wear properties and a high temperature range of up to 212° F.
- **M180** is a detectable material option for use in packaging equipment.
- **S180** is the newest material option from igus®, offering even more wear resistance than the B180 for applications that require more duty cycles.
- **T220** is made of materials that are permitted in the tobacco industry, so it is ideal for use in that field.

igus® offers online tools for xiros® plastic ball bearings, including a **service life predictor** that allows you to input a few pieces of information and then receive the anticipated service life of the bearings.


xiros® service life calculator
plastics for longer life

Settings
Configurations
Contact

1 Dimension and load
2 Result

443 Suitable parts

xiros® service life calculator

With the xiros® service life calculator you can determine in a few steps a xiros® ball bearing suitable for your application and calculate its expected service life. Finally, you can order your ball bearing or request further information from us.

i The calculated service life refers to the application in dry operation and assumes a continuous operation.

Dimensions

To fill in the dimensions, please enter either a xiros® part number or select your desired dimensions manually.

Select part number

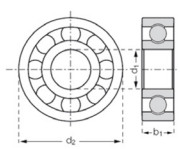
Unit ☒ mm ☐ inch

Installation size

Inner diameter (d1) mm

Outer diameter (d2) mm

Width (b1) mm



Load

Max. radial load * N

Speed * 1/min

Environmental parameters

Min. temperature * °C

Max. temperature * °C

Further requirements

☐ FDA

☐ Underwater use **i**

☐ Use in vacuum

☐ ESD protection

☐ Non-metallic

☐ Detectable

Contact with chemicals **+** [Select chemicals \(0\)](#)