



FPBB - Fully Printable Ball Bearing



FH

[VIEW IN BROWSER](#)

updated 6. 8. 2025 | published 6. 8. 2025

Summary

A scaled up, functional version of the beloved 608ZZ ball bearing

[Hobby & Makers](#) > [Mechanical Parts](#)

Tags: [fidget](#) [mechanical](#) [education](#) [bearing](#)

Additional Hardware

None. Great care was taken to make this model fully printable without any fasteners or glue.

Print Settings

Use your favourite print profile with a 0.4mm nozzle. For all parts, set the '**Seam position**' to 'Random', to even out imperfections, that would otherwise interfere with the movement. Turning on **Scarf Joints** might be beneficial as well. The material choice is not critical, I used **PLA** for all prototypes. The seals will be easier to install when printed in PETG.

Features

This design incorporates several carefully considered features aimed at optimizing printability, functionality, and usability. The following sections detail these features and the reasoning behind their implementation.

Fully printable design

A key feature of this design is its full printability, with a primary focus on ease of printing. This includes design considerations such as eliminating any overhangs above 45 degrees and aligning the load-bearing axis with the printer's Z-axis to enhance strength and reduce print complexity. Consistent wall thickness is maintained, particularly for thin-walled structures, which is crucial for improving print quality, especially around overhangs. Specific elements of the design informed by these requirements include the bearing ball design, composed of five separate parts, and the specially engineered cage structure. These design choices collectively ensure reliability, ease of manufacture, and optimal functionality.

The Cage

In bearing design, a cage plays a critical role by evenly spacing the rolling elements, balls in this case, around the bearing's circumference. Although it might seem practical to fit as many rolling elements as possible, filling the available space completely would cause the elements to rub against each other. This friction increases wear and significantly shortens the bearing's operational lifespan. Therefore, the cage ensures proper separation of the rolling elements, facilitating smooth, efficient operation and longevity.

Designing an effective bearing cage can present various challenges, making it the most complex component apart from the rolling elements themselves.

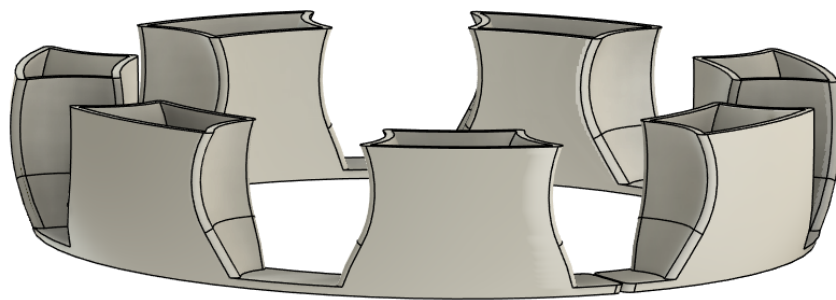
Several different approaches have been explored within the maker community. One common method, exemplified by [JacksonGodbold's Ball Bearing](#) model, involves creating a realistic cage composed of two separate halves. While authentic and visually appealing, this design introduces complications such as delicate overhangs, numerous short toolpaths requiring frequent retractions, and the necessity for additional hardware or glue to join the halves.

An alternative approach, represented by [blecheimer's Simplified Cages Ball Bearing](#), utilizes compliant pockets. While innovative and straightforward, this method introduces shear forces in the XY plane during installation. Although typically minor in practical terms, these forces were not ideal for creating a highly printable and user-friendly bearing.

Split race designs with solid cages, such as the [Ball Bearing Using 6mm Airsoft BBs by Zapador](#), also exist but are less realistic compared to continuous-race bearings. The goal of achieving maximum ease of

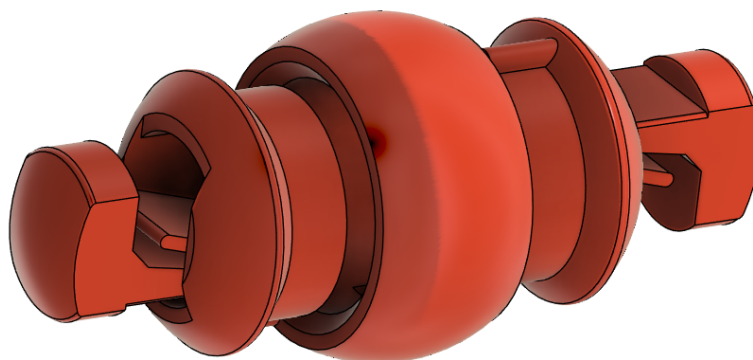
printability, assembly, and usability ultimately guided the development of a more authentic and practical alternative design.

The final solution emerged unexpectedly during experimentation with a thin-walled adaptation of [dho1337's 608 Bearing](#). Initially intended to be flexible enough for installation, the thin-walled design broke during testing. Surprisingly, the resulting structure maintained effective ball retention while greatly simplifying the installation process. This final cage design offers clear advantages: long continuous toolpaths, manageable overhangs, a lightweight structure, and ease of installation and removal, making it a highly practical and efficient choice for printable bearing assemblies.



The Balls

They're the complicated answer to an iterative approach to load bearing spherical elements.



Assembly

The assembly of this model, or bearings in general, is a puzzle in itself. If you want to know how it's done you can find the guide down below.

Customization

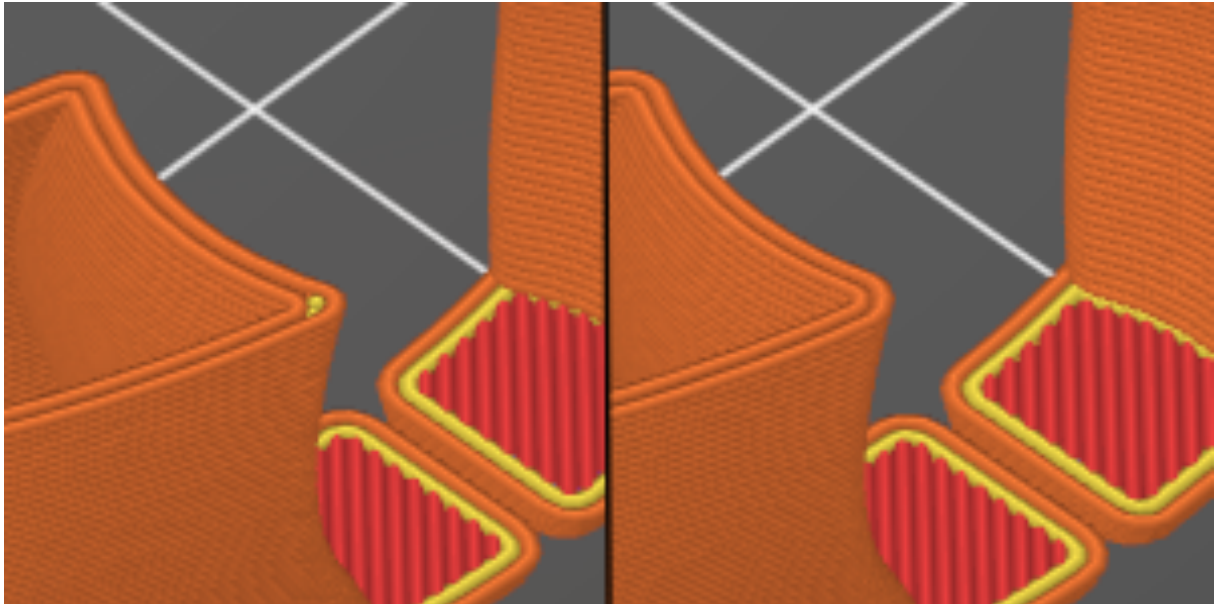
The Fusion 360 source files for the bearing can be found in the download section.

Related Models

- [MRBL - Printable bearing ball](#)
The model that started all this, the baseline version of the ball design that is now part of this bearing model. It has a different locking feature.
- [608 Bearing by drho1337](#)
The model which gave me the inspiration to come up with the cage design.

Changelog

- 2025-07-07 Fixed an issue on the ball STL files that had misplaced indexing notched on the ring part. If you've printed the balls already the easiest fix is to download the most recent version of the fpbb-[size]-mrbl-[diameter].stl, then 'Split to Objects' in the slicer and print only the ring section.
- 2025-07-07 Improved printability by increasing some fillet radii.



Model files



Normal (32x88x28 mm)

4 files



mrbl-16mm.stl



fpbb-normal-races.stl



cage.stl



fpbb-normal-shield.stl

☐ Optional; Print 2x



Big (40x110x35 mm)

4 files



mrbl-20mm.stl



fpbb-big-races.stl



cage.stl



fpbb-big-shield.stl

☐ Optional; Print 2x



Too Big (48x132x42 mm)

4 files



mrbl-24mm.stl



fpbb-too-big-races.stl



fpbb-too-big-cage.stl



fpbb-too-big-shield.stl

☐ Optional; Print 2x



mrbl (High Resolution STL)

3 files



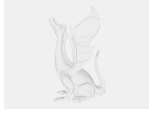
mrbl-16mm-high-res.stl



mrbl-20mm-high-res.stl



mrbl-24mm-high-res.stl



printable-bearing-20250705.f3d



printable-bearing-20250717-alpha.f3d

☐ [Pre-Release Version] Fully parametric upgrage

License



This work is licensed under a
Creative Commons (4.0 International License)

Attribution-ShareAlike

- ✗ | Sharing without ATTRIBUTION
- ✓ | Remix Culture allowed
- ✓ | Commercial Use
- ✓ | Free Cultural Works
- ✓ | Meets Open Definition