

# Adjustable Bearing Preload Solutions

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Angular roller bearings and ball bearings in an assembly typically require **preloading** in order to maintain a minimum designed axial force in the assembly. This minimum force is called the **bearing preload** and is designed to overcome the stack up of tolerances within the assembly and ensure no slop or gaps exist for a smooth and tight rotation.

There are many options available to the designer to compensate for the assembly's tolerances and achieve the desired preload force.

This technical paper offers a few of the options available followed by the key benefits and drawbacks of each approach.

### Threaded Systems

#### Preload adjusted by a threaded stop nut or bolt.

**Benefits:** Preload is infinitely adjustable and able to be serviced in the field with minimal stocked parts.

**Drawbacks:** Preload amount is limited and dependant on torquing to specification. Threaded systems are also expensive by comparison.



Stop Nuts

### Springs (Conical, Coil/Compression, Wave)

#### Preload achieved by a spring and is dependant on the spring constant "K" and is only adjustable by replacing the spring with a different strength or configuration.

**Benefits:** Simple design and allows small yield during impact.

**Drawbacks:** Dissipating preload as spring fatigues, and allows yield during impact which may be detrimental to assembly (such as with a ring and pinion meshing gear set). Difficult to adjust.



Wave Spring, Belleville Washer and Coil Spring



Preload is critical to ensure the proper function and prolonged life cycle of a bearing. Shim packs, or sets, are used for preloading bearings and positioning for proper gear tooth meshing.

### Single Thickness Shims

#### Preload adjusted by displacing the gaps with a Shim of the required thickness during assembly.

**Benefits:** Simple and inexpensive design, and maintains constant preload between service intervals.

**Drawbacks:** Requires multiple stocked Shim thicknesses to achieve the proper force during assembly.



Single Thickness Shims

### Surface Bonded Laminated Shim Pack

#### Preload achieved using the same method as a single thickness Shim, but a glued, multiple-layer Shim pack is used to adjust the thickness at the point of assembly.

**Benefits:** Simple and inexpensive design, maintains constant preload between service intervals, and allows for easier service in the field with less parts stocking.

**Drawbacks:** Sometimes it is difficult to peel layers, and discarded layers must be scrapped.



Surface Bonded Shims

## Edge Bonded Shim Set

**Preload achieved with multiple layers of Shims, but the Shims are held together only by their edges making peeling to the desired thickness relatively simple.**

*Benefits:* Easy to peel layers. Simple and inexpensive design, maintains constant preload between service intervals, and allows for the easiest service in the field with less parts stocking. Unused layers may be used in a different assembly.



Edge Bonded Shims are easy to peel. Unused layers can be used for another application.

Edge Bonded Shim Sets are ideal for bearing preload applications and have distinct benefits over conventional and laminated Shims. The key distinction between an **Edge Bonded Shim Set** and a **Laminated Shim Pack** is the method of attachment between each layer of material:

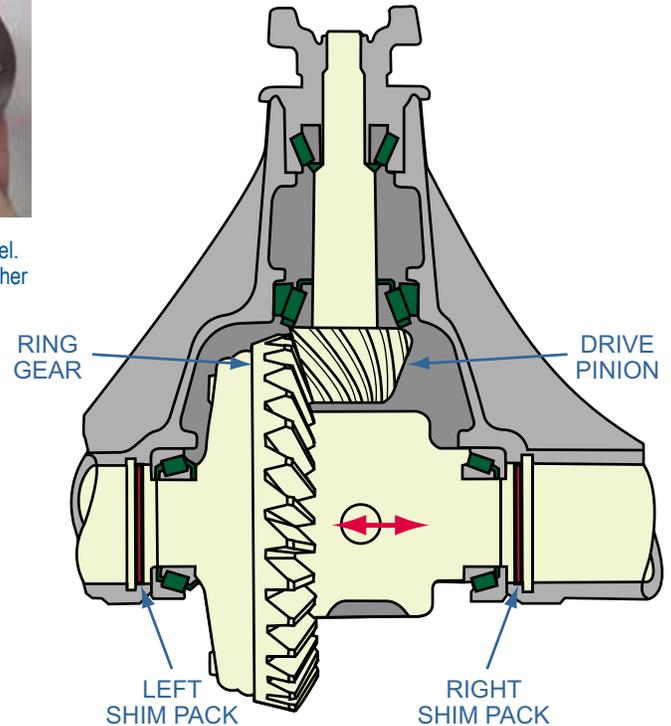
- Laminated Shim Packs are adhered throughout the entire surface between each layer of material and the layers are pressed together to cure much like how particle board is manufactured.
- The layers of an Edge Bonded Shim Set are first pressed together, and then adhered by the edges of the Shim's profile. This allows for a much easier separation of the layers in the field.

Furthermore, in a Laminated Shim Pack, the unwanted layers must be discarded due to their deformation during peeling. Since Edge Bonded Shim Sets are easier to peel, the layers that are not needed are preserved and can be used for a later application.

Note: Coarse and fine adjustment layers.



Edge Bonded Shim Sets in a ring-and-pinion axle gear assembly. Red arrows illustrate preload forces.



An additional benefit of Edge Bonded Shim Sets over conventional preloading techniques is more versatility with size and shape. With spring or threaded preload systems, the preload force must be distributed in a circular design, while with Edge Bonded Shim Sets, the Shims can be manufactured to any shaped design — large or small. Additionally, Edge Bonded Shim Sets provide a more

accurate and consistent preloading throughout the service life of the assembly without requiring a precise torque set, such as with a threaded system.

In most cases, Edge Bonded Shim Sets offer the most cost-effective solution to any angular bearing preload system, especially during repair or service in the field.

## Edge Bonded Shim Set in other applications

The **SPIROL Edge Bonded Shim Set** provides cost-saving advantages over surface-bonded Shims because the materials are less expensive. Edge-Bonded Shim Sets offer safe adjustment in seconds rather than time consuming and difficult to peel surface bonded laminates. Safety improvement is realized because no knife is needed to remove the edge-bonded layers. Cost savings can also be realized because removed layers are reusable functional parts.

## The following case study illustrates the benefits of **SPIROL Edge Bonded Shim Set** solutions in a manufacturing application.

### Case Study:

A military ground assault vehicle manufacturer approached **SPIROL** to provide quick delivery of adjustable Shim packs for spacing of armored vehicle door hinges. The spacing is critical to the welding process, providing proper sealing and locking engagement of the door systems.



### Problem:

The customer designed an adjustable Shim pack based on surface bonded Shim material requiring 94 layers of 0.002" thick laminates. Because of the size and configuration of the parts, surface bonded materials were problematic in cost, the amount of time needed for dimensional adjustment, as well as a long lead-time required for manufacturing.

### SPIROL Solution:

**SPIROL** Application Engineers worked with the customer to determine the required adjustment and developed three **Edge-Bonded Shim Set** proposals. The customer evaluated the advantages and selected a proposal offering safe, quick adjustment, a 70% cost reduction, and a short manufacturing lead-time. **SPIROL** provided the solution without tooling cost using **SPIROL's** tool-less manufacturing technology.

Original article written by Justin Singleton and Michael Morehouse.

## **SPIROL offers free samples and application engineering support.**

**SPIROL** manufactures non-threaded types of bearing preload systems including Disc Springs, Shims, Laminated Shims, and Edge Bonded Shims.

**SPIROL** Application Engineers will review your application needs and work with your design team to recommend the best solution. One way to start the process is to select **Shim Applications** in our **Optimal Application Engineering** portal at [www.SPIROL.com](http://www.SPIROL.com).

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