TechTIPS

Designing with Metal Bellows Couplings

INSIDE

How to Design with Bellows Couplings

Courtesy of Servometer

DESIGN ENGINEERS with precision rotary motion requirements such as instrumentation and fractional horsepower applications often choose electrodeposited nickel bellows because of their high performance characteristics like positive displacement , zero windup and low or minimal backlash. Servometer's compact bellows couplings accommodate more than 30 times the angular misalignment and 15 times the compression or extension tolerated by other types of couplings.

Essentially, a Servometer bellows coupling is an assembly of two hubs and a thin walled metallic bellows. The assembly is created in most cases by either welding the hubs to the bellows or by using an adhesive of some variety. Servometer, nickel bellows are manufactured using an electrodeposition method. This method involves machining a solid mandrel in the shape of the finished bellows. The nickel is electrodeposited onto the mandrel and the mandrel is then chemically dissolved, leaving behind the finished bellows. This method allows us to precisely control the wall thickness of the bellows and also allows for thinner walls than other methods of bellows forming. The thinner walls give the coupling greater sensitivity and responsiveness making them ideally suited for extremely precise small instrumentation applications. The uniform thin walls of the bellows allow it to bend easily under loads caused by the three basic types of misalignment between shafts (angular, parallel, axial motion). The thin, uniform walls result in low bearing loads that remain constant at all points of rotation, without the damaging cyclical high and low loading points found in some other types of couplings. All of this is accomplished while remaining rigid under torsional loads, which is a major factor for high performance applications that require a high degree of accuracy and repeatability.

ABOUT SERVOMETER

Servometer,has been the trusted supplier and contract manufacturer to the OEM industry for more than 50 years. Today, Servometer remains a privately owned company originally established in New Jersey and continues to operate as a full service production and manufacturing facility out of Cedar Grove. Sales subsidiaries are located strategically across North America, Europe and Asia. A full-time staff of experienced engineers provides a comprehensive knowledge base that enables customers the ability to engineer completely custom bellows couplings suited to their unique applications. They also offer a large selection of standard bellows for testing

Servometer's product lines are beneficial for design engineers across a wide variety of markets including Aerospace, Defense, Medical, Instrumentation, Oil and Gas and Semiconductor. Servometer takes pride in developing the highest level of quality products from design through production to delivery. The company practices lean

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to learn more about Servometer products and request a free sample!

How to Design with Bellows Couplings

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manufacturing techniques and standards and recognizes the importance of ITAR, RoHs and DFARS compliance. Servometer is ISO 9001:2008 certified.

TECHNOLOGIES

Servometer® employs a unique, patented *electrodeposition process* to manufacture its bellows, couplings, contacts and assemblies. Servometer is able to hold tight tolerances and use various materials to ensure the right size and spring rate are chosen to implement within a customer's assembly. Servometer's custom designed products are typically made of electrodeposited nickel, copper, gold or combinations of all three. The resulting electroforms are thin walled, hollow metal parts as small as 0.20 inches (.5mm) in diameter; 0.24 inches (.6 mm) in length and .0003 inches (.008 mm) in thickness.

In 2007, Servometer acquired *BellowsTech of Ormond Beach, Florida.* BellowsTech is a premier manufacturer of edge welded bellows and assemblies, encompassing a wide array of alloys and dimensional configurations. BellowsTech and Servometer have a synergistic relationship to offer custom solutions. The technologies complement each other in size, compatibility, pressure and temperature limitations without sacrificing performance.

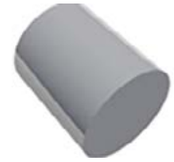
Learn the Five Steps that Are Key To Manufacturing Electrodeposited Bellows

Courtesy of Servometer

SERVOMETER PRODUCES parts by the process of **electrodeposition**, building thin layers of metal onto a precision-machined mandrel and chemically removing the mandrel. Electroforming technology is centuries old, yet Servometer has refined its technique to make intricate parts with unusual shapes, thin walls, deep crevices and other design features. Tightly controlled electrodepositing baths ensure the highest part quality. Modern test instruments, over 120 years of in-house design engineering experience, and highly skilled chemists ensure exceptional quality.

The process begins with a piece of Aluminum.

Step 1



Next, the internal geometry of the electroform or bellows is machined into the Aluminum. This machined part is called a mandrel.

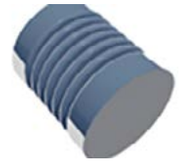
Step 2

After inspection, nickel (nickel alloy), copper, gold, silver or combinations thereof, are electrodeposited (electroplated) onto the mandrel to precise wall thicknesses. The thickness of the electroform is dependent on the time and current in the plating process.

Step 3

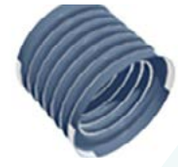
Following post-plate inspection, the plated mandrel is trimmed to produce the desired end configuration dimensions.

Step 4



Finally, the aluminum mandrel is dissolved in caustic solution leaving behind the completed electroform or bellows. At this point, special finishes or coatings may be applied. Bellows are leak-tested and spring rate tested as required.

Step 5



Learn the Five Steps that Are Key To Manufacturing Electrodeposited Bellows

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Servometer's electroforming process is especially crafted for tolerance-critical, miniature parts. The precision electroforming process produces hollow parts with walls as thin as 0.0003" [.008 mm]. Miniature applications include *electrical contact springs* with walls 0.0005" [.013 mm] thick for circuit boards and *flexible nickel bellows* just 0.020" [.51 mm] diameter for laboratory instruments. Larger parts are produced with walls up to 0.025" [0.64 mm] thick. Servometer has even electroformed ultra lightweight reflectors several feet in diameter.

Electroforms can add the structural rigidity and temperature capability of metal with only the weight of plastic. Materials such as nickel, copper, gold, silver or a combination thereof can be used with custom finishes on the inside or outside surfaces. Servometer also offers different types of materials depending on the installation method; for example, if the part is going to be welded or brazed, the chemistry of the nickel can be altered to accommodate the installation requirements. The metal composition is critical to the performance and ruggedness of the electroform.

Complex geometry is achievable. Aluminum mandrels can be combined prior to plating to yield a seamless electroform assembly. Engineering design, machining and tooling are controlled at Servometer's New Jersey facility. DW

For product information, view the following links:

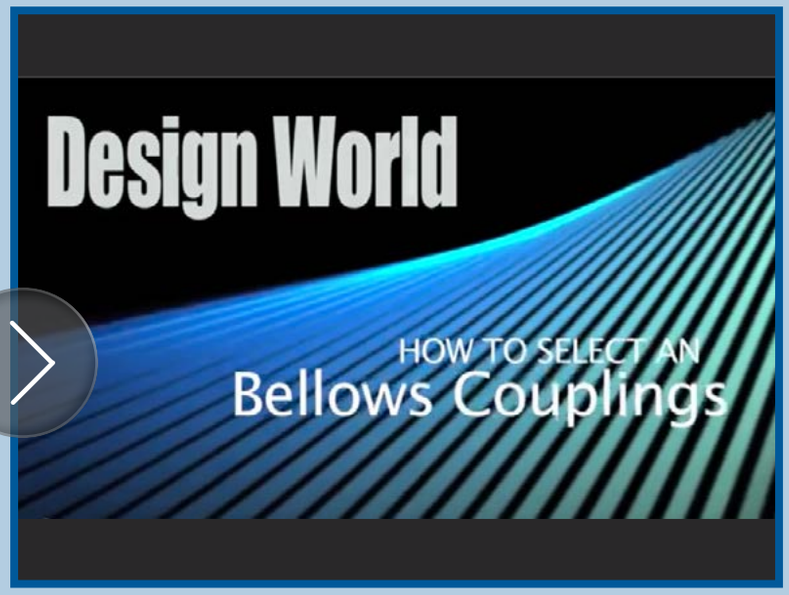
Metal Bellows >>

Electrical Contact Springs >>

Precision Electroforms >>

Bellows Couplings

Assembly Services



Related Video:

How to Select a Bellows Coupling

DOWNLOAD THE WHITE PAPER (PDF)

What's the Difference Between Spring Rate and Life Cycle?

Courtesy of Servometer

THIS WEB PAGE helps you speak the language of bellows and understand the fundamental differences between parameters that define the performance of electrodeposited bellows. You will learn the difference between stroke and spring rate and how to calculate each parameter and more.

SEE THE OTHER KEY FACTORS HERE!

SNEAK PEEK

THE FOLLOWING ITEMS are 12 key ingredients in defining a custom bellows. Each must be specified before the design can be established. Be advised that the information provided here is only a guide, not an exhaustive design manual. Contact Servometer engineering for a review of your requirements prior to finalizing your design.

1. Stress Modes: Specify extension, compression, bending, swiveling, parallel-end offset, torque, and speed of rotation. Provide a drawing or sketch showing extremes of flexing where possible.

2. Quantify Flexing: Specify the maximum amount of stroke (axial compression or extension) and offset in inches, or bend angle in degrees, or by dimensions on a diagram.

3. Pressure Differential: Specify pressure difference between the inside and outside of the bellows, maximum instantaneous pressure, and whether higher pressure is applied inside or outside the bellows.

4. Rigid Stops: Specify whether rigid stops will limit the extension or compression of the bellows to its rated stroke, or if the bellows will be required to withstand pressure unrestrained. Note that a restrained bellows usually provides better performance because it will continually operate within the design parameters.

5. Spring Rate: Specify the required spring rate in pounds per inch, or conversely, the amount of force available to flex the bellows the desired amount.

Flexible Coupling Solutions from Tanks to Medical Devices

Some couplings are built just for minimizing side thrust, others are meant to lower rotational inertia. Some bellows are constructed to handle high torque and there are those that are capable of handling high temperatures and harsh environments. Each and every one has a purpose, however, there are very few, like Servometer's electrodeposited couplings which are manufactured with a "Twist" and that can handle almost any condition you put it to test.

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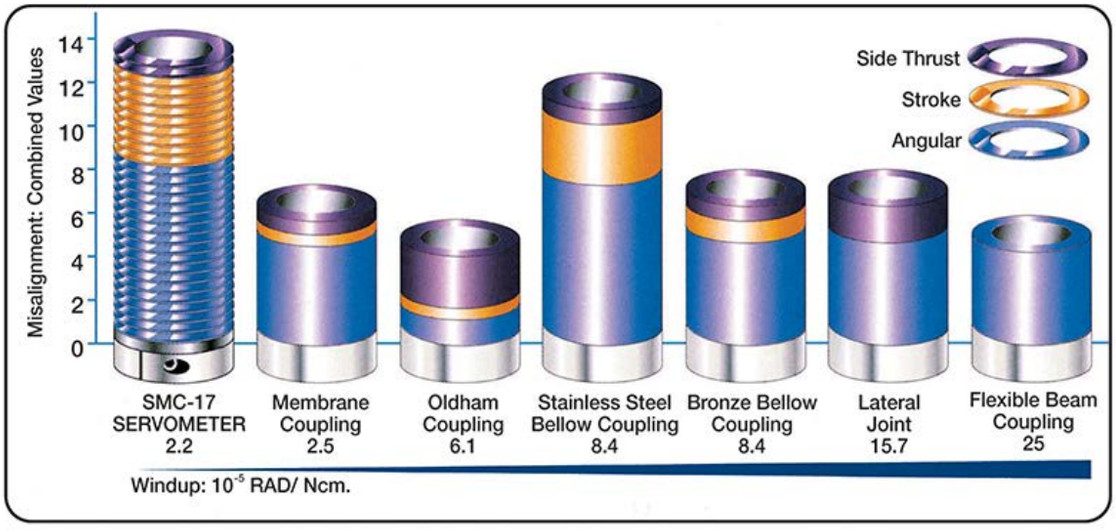
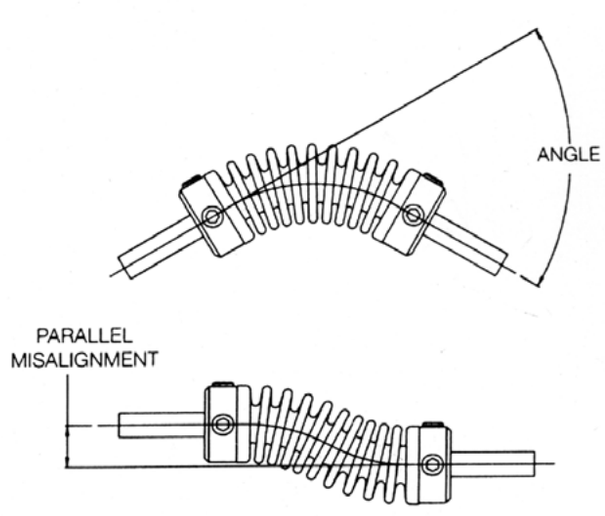
Comparison of an "SMC" with major coupling types



Flexible Shaft Couplings



For more information about Servometer:
Click, email or call:

servometer.com

info@servometer.com

973.785.4630