

Flexible Coupling Solutions from Tanks to Medical Devices

**Electrodeposited nickel bellows couplings
flex to fit misaligned shafts yet remain
torsionally stiff**

Produced by:



FROM MILITARY TANKS TO MEDICAL DEVICES



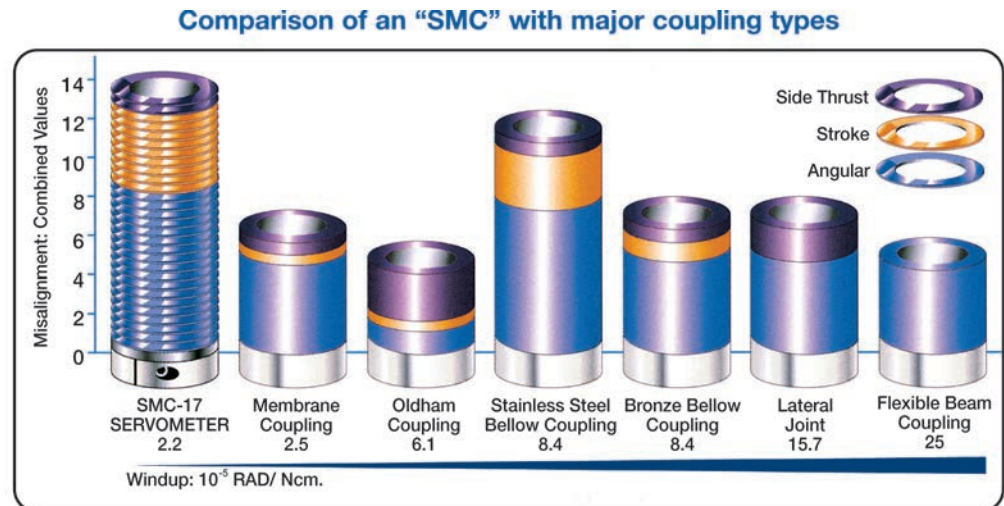
What do a micron-precision silicon wafer cutter, a surgical microscope focusing mechanism, and a target sighting system for an M1A2 Abrams tank all have in common? Each contains an electrodeposited nickel bellows coupling. Such couplings excel in instrumentation and fractional-horsepower applications but are occasionally overlooked because they tend to cost more than other types. Couplings are typically rated by their torque capacity, rotational inertia, resistance to the elements, service life, windup and backlash levels, and flexibility. By all these measures, electrodeposited bellows couplings compare favorably to competitive designs.

IT'S ALL ABOUT THE MANUFACTURING

Making this possible is the electrodepositing process itself. Servometer builds its nickel bellows by electrodepositing a nickel layer upon a machined aluminum mandrel to a precise thickness and diameter. Dissolving the mandrel leaves behind a lightweight, convoluted tube, which is the flexible bellows. Servometer then bonds the bellows to the aluminum hubs or soft-solders them to stainless-steel hubs. Electrodeposited bellows can be made as small as 0.5 mm (.020 inch) in diameter and with walls as thin as .008 mm (.0003 inch), smaller in diameter or thinner in wall thickness than comparable mechanically formed hydroformed bellows. The geometry of electro-deposited bellows allows Servometer to fit more convolutions in to a given length than hydroformed bellows, giving them even more dynamic flexibility. Thinner walls lower the rotational inertia which, in turn, cuts drive power losses during intermittent operation. The thinner convolutions, along with the highly ductile nickel material, boost flexibility to minimize side forces between misaligned shafts. A test instrument maker, for example, saved on production costs by connecting a servomotor and tachometer with a nickel bellows coupling rather than a rigid couplings.

The bellows coupling paid for itself by eliminating a costly laser alignment procedure. Other precision positioning applications, such as the silicon wafer cutter, need exceptionally tight mechanisms to keep input and output shafts rotationally aligned. Here, less-costly rigid couplings work because they handle the high torque levels without windup or backlash. However, shafts and bearings may fail prematurely when they encounter angular or parallel misalignment or axial forces.

Electrodeposited nickel bellows couplings have less windup and tolerate greater misalignment than other flexible coupling types.

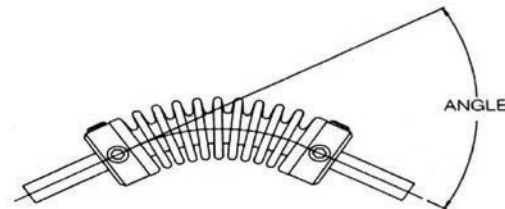


Bellows-type couplings, in contrast, tolerate deliberate lateral and axial motion or assembly misalignment yet remain torsionally rigid. Their convoluted bellows transmit torque with negligible windup as they bend, compress, and extend.

HANDLING MISALIGNMENT WITH EASE

They can handle over 30 times the angular misalignment and can compress or extend 15 times more than Oldham couplings. Electrodeposited bellows couplings, depending on design, can operate with up to 31° angular or 1.73 mm (.068 inch) parallel misalignment. Side thrust in most cases is limited to about 4N/.1 mm of offset.

Electrodeposited Nickel bellows couplings handle up to 1.93 mm parallel and 31° angular misalignment.



Angular Misalignment



Parallel Misalignment

Good flexibility also helps isolate vibration. Elastic windup is typically less than 10 arc-sec/N-cm, or about one-fourth that of hydroformed bronze or stainless-steel bellows. This is why a maker of windup-measurement instruments specified a Servometer electroformed nickel bellows coupling to connect a drive to a position encoder. The couplings are also ideal for linking encoders with controls in printing and converting equipment. A high torsional rigidity helps the machines maintain precise registration.

Other important metrics include concentricity and service life. Servometer typically holds concentricity of electrodeposited bellows couplings to within 12.7µm (.0005 inch). Cyclic speed variation through 360° rotation is effectively zero. When run within recommended limits, the couplings have a near-infinite life (108 cycles). Designers of the Abrams tank sighting system chose a Servometer bellows coupling for its high cycle life because they could not tolerate a coupling failure inside the sealed sensor assembly. Likewise, Global Positioning Systems satellites use multiple electrodeposited nickel bellows to tune microwave antennas that cannot be repaired on orbit. The seamless, non-porous electrodeposited bellows hold up to the harsh space environment and keep the precision drives they connect contamination-free.

SOME DESIGN CONSIDERATIONS

Maximum instantaneous torque from a clutch start or brake stop

For a low-inertia motor coupled to a gear reduction drive, multiply motor-starting torque by the reductions ratio. For bellows couplings operating compressed, use 75% of rated torque, max. Extended couplings use normal torque ratings.

Duty Cycle

Consider torque spikes, especially for quick reversals or frequent start-stops, such as short stepping moves of an index table. These put added loads on drive couplings.

Axial compression or extension

Electrodeposited nickel bellows can compress up to 60% of their extended length.

Temperature extremes

Soldered-hub electrodeposited bellows couplings can operate continuously at temperatures from -58° F to 260° F (-50 to 126° C).

Chemical environment

Nickel bellows will not oxidize in air or alkaline fluids.

Windup

Shorter length or larger diameter couplings lessen windup.

ABOUT SERVOMETER AND BELLOWSTECH

Making the Impossible Possible

Servometer, the pioneer of electrodeposited miniature metal bellows, bellows assemblies, contact springs, flexible shaft couplings and rigid electroforms offers over 50 years of engineering and manufacturing experience servicing the aerospace, defense, medical, test, semiconductor, UHV, solar and oil and gas industries. Servometer is ISO 9001:2008 certified. In 2007, Servometer acquired BellowsTech of Ormond Beach, Florida, a premiere manufacturer of edge welded bellows and bellows assemblies encompassing a wide array of alloys and dimensional configurations for oil and gas, semiconductor and vacuum technology industries. BellowsTech is AS9100-C compliant.