



**MW Components**

# Tech Tips

## Designing with Edge Welded Metal Bellows

Digital Ebook | A Design World Resource



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- Mechanical Seals for Harsh Environments
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### Welcome to MW Components - Ormond Beach, an MW Industries company.

MW Components - Ormond Beach is a premiere US manufacturer of high quality, dependable edge welded bellows and assemblies and a trusted supplier to the OEM industry. Engineers in Aerospace, Medical, Semiconductor, UHV, and Oil and Gas industries rely on MW Components products for the highest cycle life, responsive design, wide material selection and leak tight performance. We support our customers with expert engineering assistance helping them produce optimized designs to meet their exacting requirements. Whether producing parts for fast prototyping or full production runs we can manufacture in all sizes, shapes and material combinations to fit our customers' unique applications. With proprietary welding, in-house tooling and machining, and custom solutions, MW Components can supply a completed assembly with the best price to performance ratio in the industry. We excel at new designs with custom capabilities and short lead times and also offer repair and replacement services. MW Components is ISO 9001:2015 certified and is dedicated to overall customer satisfaction.

### Product Features:

- Wide material selection (300 series SS, AM350, Inconel.....)
- Up to 90% stroke length
- Wide operating temperature range (-420 °F to 1300 °F)
- Maximum pressure 1000 PSI
- All metal construction
- [Over 100 die sizes to choose from](#)
- Corrosion resistant
- Highest cycle life
- Custom dies available



### Application Types

MW Components edge welded bellows are typically used as face seals, vibration dampeners and feedthroughs. We offer low cost standard bellows for fast testing and development, however we specialize in custom designs that offer unique benefits and distinct advantages over other solutions. Unlike hydroformed or hydraulically formed bellows which only travel about 20% of their free length, MW Components edge welded metal bellows have the ability to stroke up to 90% of their free length, which allows for increased expansion and contraction of the bellows. This same 90% stroke length can be achieved in smaller, lighter weight assemblies also. Metal bellows accumulators are used to store energy of a liquid or gas, and are typically used in the aerospace, military, defense, and oil and gas industries. MW Components edge welded metal bellows can be manufactured from a variety of materials, to match an application's specific media compatibility and stroke length.

### Volume Compensators for High Pressure

Edge Welded Bellows can be pressurized internally and externally. As pressure or temperature increases or decreases metal bellows will compensate for the volumetric changes of the liquid or gas through expansion and contraction. Custom machined components or standard threads and fittings can be integrated to ensure that the system or mechanism remains completely operational.



### Valve Seals Eliminate O-Rings to Increase Compatibility and Reduce Potential Leak Paths

MW Components valve seals, manufactured using bellows technology, can eliminate O-rings to increase compatibility and reduce potential leak paths. Bellows technology creates a uniform outside wall for consistent movement under hydraulic pressure. Various stroke lengths and sizes are offered, and can be manufactured with O-ring grooves, flanges, and carbon-face seals to make the best possible connection to customer assemblies. MW Components valve seals are 100% visually inspected throughout the manufacturing process and confirmed with mass spectrometer testing.



## Metal Bellow Actuators for Hydraulic and Pneumatic Systems

Use MW Components edge welded metal bellows in actuator assemblies to transfer pressure or temperature into linear motion. Edge welded bellows allow a long stroke length, excellent media compatibility, and high temperature and pressure capabilities. Custom flanges, end-pieces and hardware can be integrated to produce a complete assembly for maximum axial movement and lateral offset.

## Semiconductor Lifter Bellows Solutions

Lifter bellows are designed with custom face seals for semiconductor processing equipment. In order to move the silicon wafers being produced, the lifter bellows and actuator assembly produce a leak tight mechanism to transport the wafer. MW Components edge welded bellows have low leak rates, custom designs and flexibility for motion. MW Components' goal is to ensure proper wafer placement and seating. With in-house design expertise, our engineers will build a solution to match the speed and size requirements of the application. Lifter bellows assemblies are available in a variety of materials including AM350, 304L and 316L stainless steel. For applications requiring reduced weight, Titanium is also available.

## Bellows Comparison: Electrodeposited vs. Edge Welded

Not all metal bellows are created equal. When deciding which bellows type would be the best choice for an application, 13 key performance factors or "bellows basics" should be considered to make an educated selection. To help you choose the proper bellows for your application, we have created the bellow comparison chart that compares the performance factors of both electrodeposited and edge welded metal bellows.



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# Metal Bellows Comparison



Electrodeposited	vs.	Edge Welded	vs.	Hydroformed
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Measurements				
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0.020 inches (0.5 mm)	<b>vs.</b>	<b>Smallest OD (Min OD)</b> 0.358 inches (9.1 mm)	<b>vs.</b>	0.25 inches (6.35 mm)
9 inches (228 mm)	<b>vs.</b>	<b>Largest OD (Max OD)</b> 26 inches (660 mm)	<b>vs.</b>	43" (tooled) 50" max (not tooled)
10 inches (254 mm)	<b>vs.</b>	<b>Max Convolution Length (One Section)</b> 96 inches (2438 mm)	<b>vs.</b>	Varies by ID size and material Wall thickness 3" - 200 ft.

Stroke				
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35% free length (typical) up to 50% possible for certain applications.	<b>vs.</b>	Certain bellows designs can stroke as long as the free length. Typically with a max 25% of stroke in extension with 75% of stroke in compression. These percentages can be modified with heat treatment.	<b>vs.</b>	Typical 15% compression 10% extension free length. Special design up to 35% between compression and extension.
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Sensitivity				
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Very Sensitive. Can be designed to deflect with a force as low as 4 grams (0.14 oz.).	<b>vs.</b>	Varies with bellows size, material thickness, and length. Spring rates of 1 pound/inch or less are easily achievable if desired.	<b>vs.</b>	Varies with material thickness and convolution design.
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Minimum Wall Thickness				
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0.0002 inch (0.005 mm)	<b>vs.</b>	0.002 inch (0.051 mm)	<b>vs.</b>	0.002 inch (0.051 mm)
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Leak Rate				
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1x10 <sup>-6</sup> cc He/sec @ 1 atm standard (1x10 <sup>-9</sup> cc He/sec @ 1 atm as required)	<b>vs.</b>	1x10 <sup>-5</sup> to 1x10 <sup>-9</sup> cc He/sec. (standard based on material)	<b>vs.</b>	1x10 <sup>-9</sup> cc He/sec
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Corrosion Resistance				
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MW Components FlexNickel® Alloy suited for air and hydrocarbon environment. Not recommended for sea water or acidic environments without Gold plate or Parylene coating to enhance corrosion resistance.	<b>vs.</b>	Wide material selection available for many applications including seawater, acidic, alkaline, and downhole environment.	<b>vs.</b>	SS 300 Series - appropriate for basic corrosion protection; Hastelloy® C22, C276 - corrosive resistant; Monel™ - seawater; Inconel® - heat & corrosion resistant.
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# Metal Bellows Comparison

Electrodeposited	vs.	Edge Welded	vs.	Hydroformed
<b>Maximum Pressure (Differential)</b>				
Depending on design, up to 10,000 psi.	vs.	Certain designs can withstand up to 2,500 psi (external). We have achieved over 15,000 psi (external) with an oil filled (internal design).	vs.	Varies based on wall thickness of material with braid (1,000 - 3500 PSI).
<b>Temperature Range</b>				
MW Components FlexNickel®Alloy: 350°F (177°C): Copper Bellows: 200°F (93°C)	vs.	<b>High Temperature</b> 1500°F (815°C)	vs.	Stainless Steel – 900°F Inconel over 900° F (recommended)
-423°F (-253°C) or lower may be possible.	vs.	<b>Low Temperature</b> -420°F (-251°C)	vs.	-420°F (251°C)”
<b>Tooling Cost</b>				
Bellows typically have no tooling cost. NRE charges for Leak Test, Spring Rate, and Assembly fixtures may apply.	vs.	For a complete set of new bellows tooling, for OD’s between 0.5” and 10”, typically ranges between \$4500 to \$8000.	vs.	\$500 - \$2500
<b>Material</b>				
MW Components FlexNickel®Alloy and Copper. Coatings Available: Gold, Silver, Tin, Parylene.	vs.	AM350, 304L SS, 316L SS, 321 SS, 347 SS, Titanium Gr 2, Haynes 242, Hastelloy® C276, Inconel® 600, 625, 718 Aluminum.	vs.	Nickel alloys, 321 SS, 316L SS, Inconel® 600, 625, 718, Hastelloy® C22, C276, Copper, Brass, Phosphorous Bronze, Titanium, Monel®.
<b>Life Cycles</b>				
Up to 1,000,000,000 cycles (Theoretical “Infinite” Life).	vs.	Many designs guaranteed up to 3,000,000 with even greater cycles achieved in use.	vs.	Varies: 1,000,000 - 30,000,000 or more.

These variables represent guidelines for typical user applications and designs. Consult a technical support engineer for parameters outside these industry best practices.




To learn more visit [MWComponents.com](http://MWComponents.com) or contact us at 704.280.8875 | [sales@mwcomponents.com](mailto:sales@mwcomponents.com)

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**Are You Spending Too Much on Edge Welded Metal Bellows?**

Finding the right material for your application’s performance requirements at the right price is easy. MW Components edge welded bellows are available in a wide variety of materials from Stainless Steel to Inconel with a range of media compatibilities. Our one-page “Material Selection Guideline” quickly helps you compare leak rates, temperature ranges, tensile strengths and more, of various typical applications and of course, our engineers can guide you in your selection for the best available options within your budget.

*View chart below and on the next page for further detail.*



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MATERIAL	STANDARD LEAK RATE	TYPICAL APPLICATIONS	TEMPERATURE	STRENGTHS & WEAKNESSES
<b>AM350</b>	1x10-9	Industrial, High Vacuum and other liquids and gases with low corrosive properties	-100 to 800° F	Highest strength/ cycle life with low leak rate
<b>300 Series SS</b>	1x10-9	Industrial, High Vacuum and other liquids and gases with mild corrosive properties	-420 to 800° F	Lowest cost materials with low leak rate
<b>Inconel 718 625 600</b>	1x10-5	High temperature and corrosive applications such as exhaust, seawater, hydrogen sulfide, and heavy oil	-420 to 1500° F	Good corrosion resistance, yet limited leak rate
<b>Hastelloy 276 C Haynes 242</b>	1x10-5	Highly corrosive media such as petrochemical processing equipment	-420 to 1500° F (Haynes 242 up to 1300° F)	Excellent compatibility; high price point
<b>Titanium Grades 1 through 4 (ASTM-B265)</b>	1x10-9	Light-weight aerospace and invasive medical equipment	-420 to 800° F	Extremely light-weight and capable of being implanted; highest price performance ratio

MW Components offers a wide variety of materials with a range of media compatibilities. Consult factory for additional information.

## Six Key Metal Bellows Design Factors Critical to Semiconductor and Ultra-High Vacuum Applications

Semiconductor manufacturing facilities and other high-vacuum environments have a reputation for being tough on components. These environments involve exposure to corrosive conditions or media (gases and/or liquids), and the equipment used in such extremes has an extremely low tolerance for contamination. Metal bellows find wide use in these industries because of their repeatable positioning capabilities and ability to work in severe conditions.



## **MW Components**

Six Key Design Features

### **Metal Bellows for Semiconductor and Ultra-High Vacuum Applications**

Highly exacting manufacturing techniques and design tolerances are needed to meet the demanding performance specifications for these applications