

# METAL BELLOWS COMPARISON

## ELECTRODEPOSITED VS. EDGE WELDED VS. HYDROFORMED

### MEASUREMENTS

#### SMALLEST OD (MIN OD)

0.020 inches  
(0.5 mm)

VS.

0.358 inches  
(9.1 mm)

VS.

0.25 Inches  
(6.35 mm)

#### LARGEST OD (MAX OD)

9 inches  
(228 mm)

VS.

26 inches  
(660 mm)

VS.

43" (tooled)  
50" max (not tooled)

#### MAX CONVOLUTION LENGTH (One Section)

10 inches  
(254 mm)

VS.

96 inches  
(2438 mm)

VS.

Varies by ID size and material  
Wall thickness 3"- 200 ft.

### STROKE

35 % free length (typical)  
up to 50% possible for  
certain applications

VS.

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.

VS.

Typical 15% compression  
10% extension free length  
Special design up to 35%  
compression/extension

### SENSITIVITY

Very Sensitive. Will deflect  
with a force as low as  
4 grams (0.14 oz.)

VS.

Varies with bellows size,  
material thickness, and length.  
Spring rates of 1 pound/inch or less  
are easily achievable if desired.

VS.

Varies with  
material thickness and  
convolution design

### MINIMUM WALL THICKNESS

0.0002 inch  
(0.005 mm)

VS.

0.002 inch  
(0.051 mm)

VS.

0.002 inch  
(.051 mm)

### LEAK RATE

$1 \times 10^{-6}$  cc He/sec @ 1 atm standard  
( $1 \times 10^{-9}$  cc He/sec @ 1 atm possible)

VS.

$1 \times 10^{-5}$  to  $1 \times 10^{-9}$  cc He/sec.  
(standard based on material)

VS.

$1 \times 10^{-9}$  He/sec

### CORROSION RESISTANCE

Servometer Flex Nickel® suited for  
air and hydrocarbon environment.  
Not recommended for sea water or  
acidic environments without Gold  
plate or Parylene coating to enhance  
corrosion resistance.

VS.

Wide material selection  
available for many applications  
including seawater, acidic,  
alkaline, and downhole  
environments

VS.

SS 300 Series- appropriate for  
basic corrosion protection;  
Hastelloy c276/c22- corrosive resistant;  
Monel – seawater;  
Inconel – heat & corrosion resistant

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### MAXIMUM PRESSURE (Differential)



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)

### TEMPERATURE RANGE

#### HIGH TEMPERATURE

Servometer FlexNickel®:  
350°F (177°C) ;  
Copper Bellows: 200°F (93°C)

VS.

1500°F ( 815°C)

VS.

Stainless Steel – 900°F  
Inconel over 900° F  
(recommended)

#### LOW TEMPERATURE

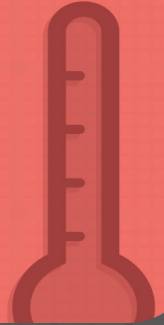
-423°F (-253°C) or lower  
may be possible

VS.

-420°F (-251°C)

VS.

-420°F (251°C)



### TOOLING COST



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

### MATERIAL

Servometer FlexNickel®  
and Copper Bellows.  
Coatings Available: Gold, Silver,  
Tin, Parylene

VS.

AM350, 304L SS, 316L SS,  
321 SS, 347 SS, Titanium Gr 2,  
Haynes 242, Hasteloy® C276,  
Inconel® 600, 625, 718,  
Aluminum

VS.

Nickel alloys, 321 SS, 316L SS,  
Inconel® 600, 625, 718,  
Hasteloy® c22,c276, Copper, Brass,  
Phosphorous Bronze, Titanium, Monel®

### LIFE CYCLES



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