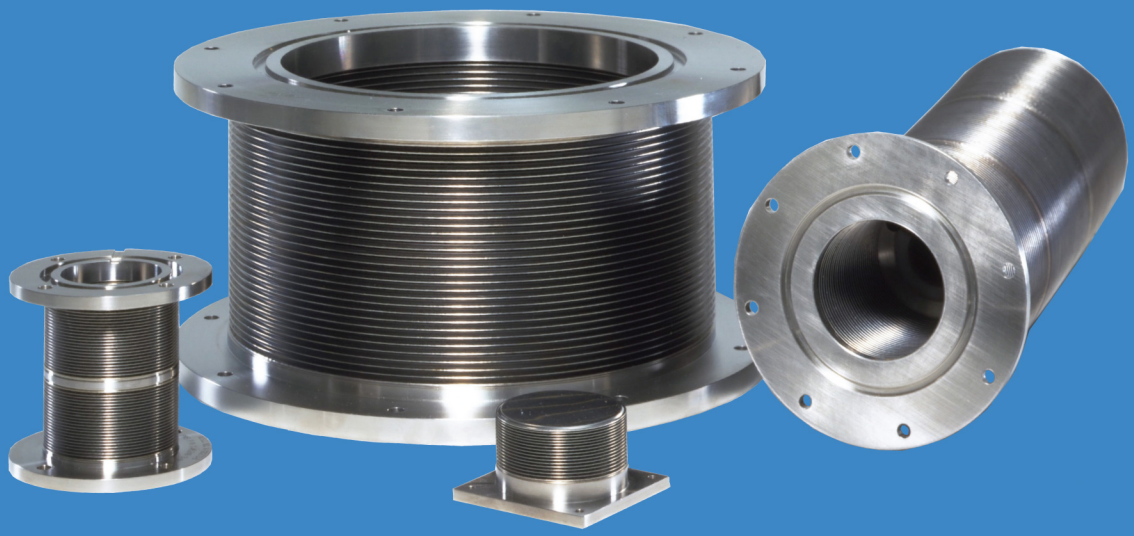
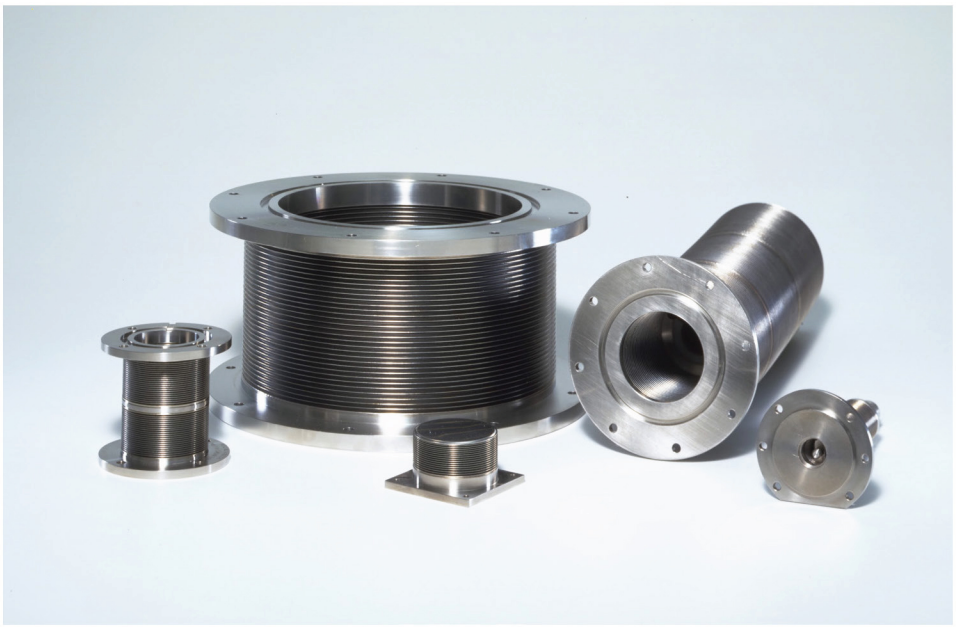
STANDARD DESIGN BELLOWS SOLUTIONS



STANDARD DESIGN WELDED DIAPHRAGM METAL BELLOWS

senior Metal Bellows

CONTENTS



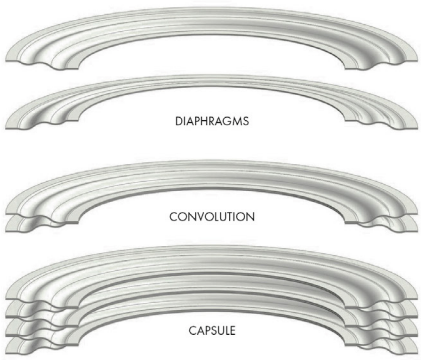
DESCRIPTION

Two contoured diaphragms – each constructed from thin stainless steel – are welded at the inside diameter to form a convolution. Capsules are formed when convolutions are stacked on a horizontal arbor and welded at the outside diameter.

- Most SMB (Senior Metal Bellows) bellows have a nested ripple diaphragm configuration that provides maximum stroke, minimum stress, superior flexibility, and full nesting when collapsed or compressed. Customized bellows, including those with flat plate, single sweep, and torus contours, are available for special applications.

- 347 stainless steel ensures corrosion resistance, weldability, and engineering properties that perform in temperature ranges from cryogenic to 800°F and beyond. 347 is ideal for high-vacuum applications, research, instrumentation, and volume compensators – wherever moderate pressure, maximum stroke and constant spring rates are required. Other commonly used materials include AM 350 stainless steel, Inconel, titanium and hastelloy.

- Depending on the application, the service life ranges anywhere between 5,000 cycles to infinity. Reduced stroke and additional capsules increase the bellows life.



SMB FEATURES

- Wide range of operating temperatures
- Constant effective area with change in pressure
- Excellent spring and pressure deflection characteristics
- Ability to withstand high pressure
- Long stroke per unit length
- Short nested length
- Corrosion resistance
- Leak tightness to less than $1X10^{-7}$ scc/sec

APPLICATIONS

Standard welded bellows are ideal for moderate pressure and high vacuum applications where lead time is critical. Such applications include:

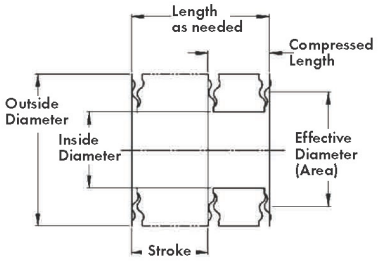
- High vacuum seals
- Leak-free motion feedthroughs
- Flexible joints
- Volume compensators, accumulators
- Pressure and temperature actuators

WELDED DIAPHRAGM METAL BELLOWS

Diaphragm

Convolution

Capsule



Force = EA x ΔP

ΔV = EA x Stroke

Stroke/ΔP = EA ÷ K

Data shown is for one capsule

OD CODE	Number of Conv.	OD in. mm.	ID in. mm	Effective Area In.² cm²	Max. External Pressure psi kPa	Stroke per Capsule[1] in. mm	Length as Welded [1,3] in. mm	Compressed Length[1,2] in. mm	Spring Rate[2] lbs./in. N/mm
05	10	.375 9.5	.125 3.2	.049 .316	100 689	.14 3.6	.21 5.3	.07 1.8	13 2.3
10	10	.50 12.7	.19 4.8	.093 .60	150 1034	.33 8.4	.46 11.7	.13 3.3	55 9.6
20	7	.75 19.0	.25 6.4	.196 1.26	50 345	.30 7.6	.39 9.9	.09 2.3	24 4.2
30	10	1.03 26.2	.55 14.0	.49 3.16	30 207	.53 13.5	.66 16.8	.13 3.3	25 4.4
35	12	1.50 38.1	.97 24.6	1.19 7.68	40 276	.29 7.4	.43 10.9	.14 3.6	22 3.9
40	9	1.63 41.4	.75 19.0	1.10 7.10	30 297	.31 7.9	.43 10.9	.12 3.0	12 2.1
50	16	1.89 48.0	1.39 35.3	2.11 13.61	45 310	.86 21.8	1.05 26.7	.19 4.8	15 2.6
60	15	2.55 64.8	1.75 44.4	3.63 23.42	50 345	.71 18.0	.97 24.6	.26 6.6	27 4.7
70	13	2.99 75.9	2.00 50.8	4.89 31.55	40 276	.94 23.9	1.17 29.7	.23 5.8	29 5.1
80	11	3.99 101.3	2.69 68.3	8.76 56.52	40 276	1.00 25.4	1.25 31.8	.25 6.4	50 8.8

NOTES:

The values listed represent an average value and are subject to manufacturing tolerance.

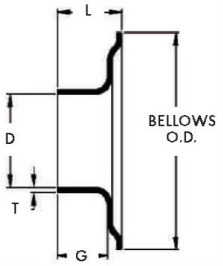
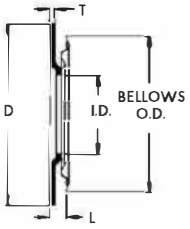
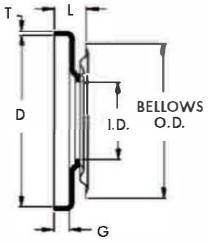
Squirm pressure (Ps) of an internally pressurized bellows without eccentricity and fixed ends is: Ps = 2πK/L, where K is the overall spring rate and L is the maximum working length.

A more conservative formula allowing for some eccentricity tolerance is: Ps = 5.02[K/L x ID/OD]

Do not exceed the maximum external pressure.

1. For a bellows consisting of more than one capsule, multiply the value listed by the desired number of capsules.
2. For a bellows consisting of more than one capsule, divide the value listed by the desired number of capsules.
3. Length for bellows only. Fitting length (L) must be added to obtain overall dimensions.
4. Tolerance sizes 05 through 35 ±.002"
   40 through 80 ±.003"
5. Mass spectrometer leak tight to less than $1x10^{-7}$ ($1x10^{-10}$ by request) scc/sec He
6. Flange material 304/347 stainless steel

METAL BELLOWS END FITTINGS

	Neck				Flange			Cup				Closed	
													
OD CODE	D[4] in. mm	T in. mm	G in. mm	L in. mm	D[4] in. mm	T in. mm	L in. mm	D[4] in. mm	T in. mm	G in. mm	L in. mm	T in. mm	L in. mm
05	.125 3.2	.004 .1	.03 .8	.40 1.0	.500 12.7	.004 .1	.025 .6	.385 9.8	.004 .1	.026 .7	.060 1.5	.004 .1	.014 .4
10	.260 6.6	.008 .2	.04 1.0	.070 1.8	.625 15.9	.008 .2	.050 1.3	.510 12.9	.008 .2	.06 1.5	.110 2.8	.008 .2	.028 .7
20	.385 9.8	.008 .2	.06 1.5	.09 2.3	.875 22.2	.008 .2	.055 1.4	.760 19.3	.008 .2	.08 2.0	.140 3.6	.008 .2	.033 .8
30	.635 16.1	.012 .3	.06 1.5	.105 2.7	1.155 29.3	.012 .3	.065 1.7	1.010 25.6	.012 .3	.10 .25	.170 4.3	.012 .3	.042 1.1
35	.760 19.3	.012 .3	.12 3.0	.145 3.7	1.625 41.3	.012 .3	.040 1.0	1.510 38.4	.012 .3	.10 2.5	.155 3.9	.012 .3	.027 .77
40	.885 22.5	.012 .3	.12 3.0	.160 4.1	1.824 46.3	0.12 .3	.040 1.0	1.640 41.7	.012 .3	.12 3.0	.175 4.4	.012 .3	.033 .8
50	1.640 41.7	.012 .3	.14 3.6	.170 4.3	2.025 51.4	.012 .3	.065 1.7	1.890 48.0	.012 .3	.12 3.0	.185 4.7	.012 .3	.042 1.4
60	1.890 48.0	.016 .4	.16 4.1	.215 5.5	2.375 60.3	.016 .4	.050 1.3	2.265 57.5	.016 .4	.13 3.3	.190 4.8	.016 .4	.041 1.0
70	2.148 54.6	.016 .4	.16 4.1	.210 5.3	3.125 79.4	.016 .4	.080 2.0	3.015 76.6	.016 .4	.20 5.1	.290 7.4	.016 .4	.056 1.4
80	2.890 73.4	.020 .5	.18 4.6	.250 6.4	4.125 104.8	.020 .5	.110 2.8	4.020 102.1	.020 .5	.20 5.1	.310 7.9	.020 .5	.070 1.8

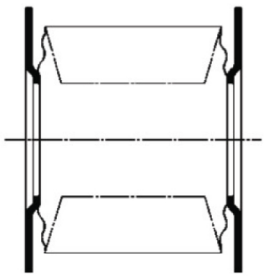
CONTACT SENIOR METAL BELLOWS
FOR CUSTOM SIZE BELLOWS AND CONFIGURATIONS

+1 781-784-1400 | marketing@metalbellows.com

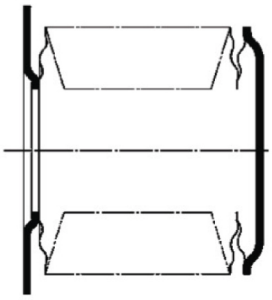
INDUSTRY TERMS AND SYMBOLS			
OD	Outside diameter of the bellows	K	Spring rate of a bellows. The ratio of force to stroke expressed in lbs/in
ID	Inside diameter of the bellows	Mean Diameter	(OD+ID)/2
Span	Depth of a convolution measured from the OD to the ID and is equal to (OD-ID)/2. The ratio of the span to the OD should be less than 1/3.	EA	Effective Area. That surface on which pressure acts to produce thrust. $EA=\pi[(OD+ID)/4]^2$
P	Pitch, height or length of a convolution	A/K	EA/K = stroke in inches per psi
NP	Nested pitch (solid height of convolution)	V	Volume displacement = EA x stroke
T	Diaphragm thickness	P	Pressure (differential across the bellows)
Free Length	Length of bellows with no load Δ	N	Number of convolutions
Length as welded	Length of bellows prior to operation Δ		

END FITTING COMBINATIONS

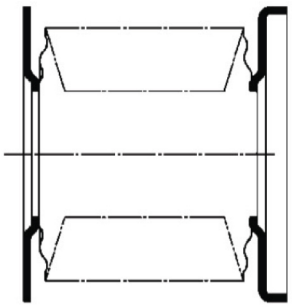
600
Flange Ends



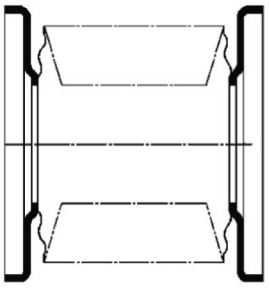
610
Closed End
Flange End



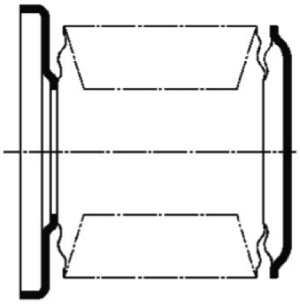
620
Cup End
Flange End



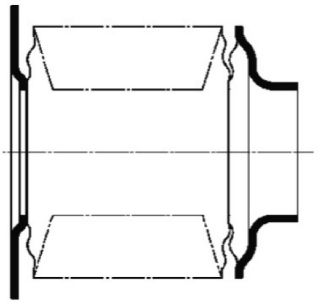
601
Cup Ends



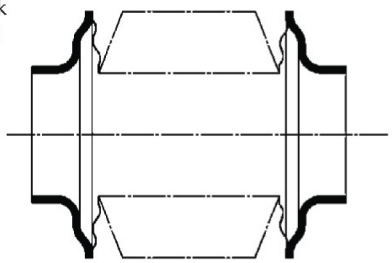
611
Closed End
Cup End



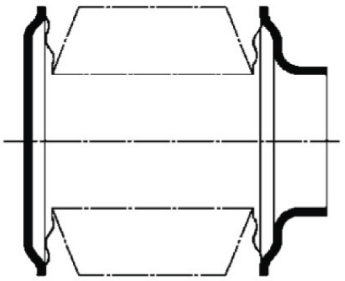
621
Flange End
Neck End



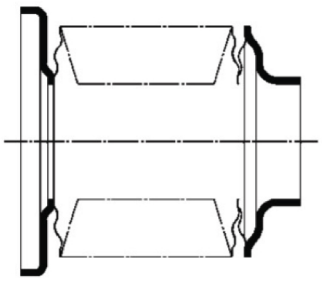
602
Neck
Ends



612
Closed End
Neck End



622
Cup End
Neck End



ORDERING INFORMATION (Order by Part Number)				
	TYPE FITTINGS	DIAMETER CODE	STROKE	CAPSULES
Example	Flange both ends	.50"OD	1.65"	
PN 60010-5	600	10	1.65"	5

Available upon Request

- Special End Fittings
- Bellows with rotatable/ non-rotatable high-vacuum flange configuration

ORDERING & SELECTION

Indicate specifications from these four areas:

1. End Fitting Types
2. Stroke
3. Bellows Diameters
4. Single Or Multiple Capsules

Please contact **Marketing@metalbellows.com** if you would like to discuss custom solutions.

- Each additional capsule increases allowable stroke while introducing a proportionate decrease in spring rate
- Order by part number, as indicated in the chart above
- Many other non-standard bellows are available beyond those listed in this catalog

1075 PROVIDENCE HIGHWAY
SHARON, MASSACHUSETTS 02067

PHONE:
+1 781-784-1400
FROM THE USA 1(800)BELLOWS

FAX:
781-784-1405

WEB SITE:
WWW.METALBELLOWS.COM

EMAIL:
MARKETING@METALBELLOWS.COM

senior Metal Bellows