senior Aerospace

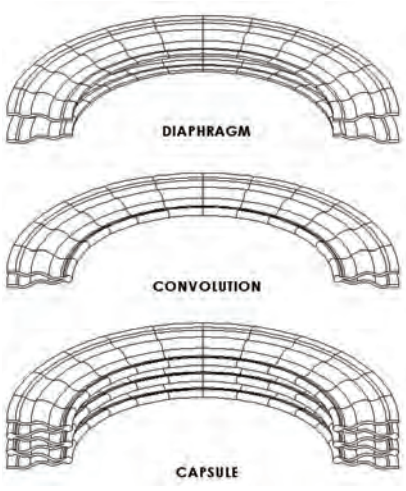
Metal Bellows

OTS BELLOWS

Off-The-Shelf
Welded Diaphragm Metal Bellows

Description

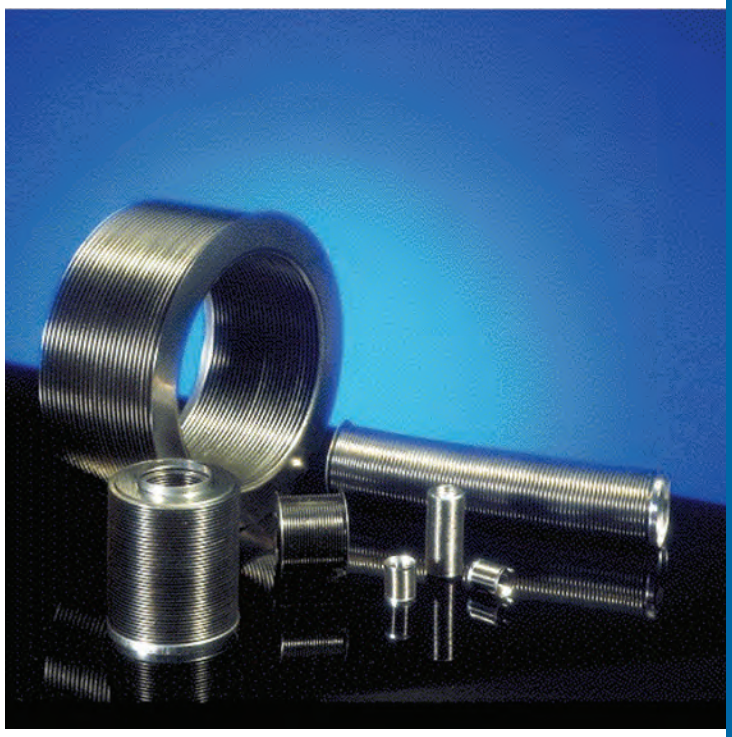
Two contoured diaphragms – each constructed from thin stainless steel – are welded at the inside diameter to form a convolution. Capsules are formed when convolutions are stacked on a horizontal arbor and welded at the outside diameter.



- Most SAMB 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 con tours, are available for special applications.
- 374 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 applications, the service life ranges anywhere between 5,000 cycles to infinity. Reduced stroke and additional capsules increase bellows life.

SAMB Features

- Wide range of operating temperatures
- Constant effective area with change in pressure



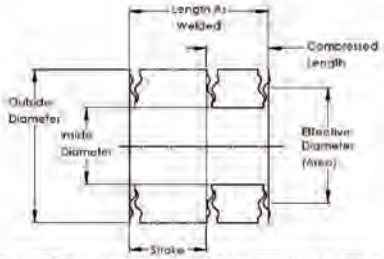
- Excellent spring and pressure deflection characteristics
- Ability to withstand high pressure
- Long stroke per unit length
- Short nestled length
- Corrosion resistance
- Leak tightness to less than $1X10^{-10}$scc/sec

Applications

OTS welded bellows are ideal for moderate pressure and high vacuum applications where immediate availability 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: Off-The-

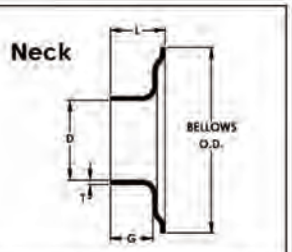


Force = EA × ΔP

ΔV = EA × 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} cm^2	Max. External Pressure psi kPa	Stroke per Capsule[1] in. mm	Length as Welded[1,3] in. mm	Compressed Length[1,3] in. mm	Spring Rate[2] lbs. / in. N/mm	D[4] in. mm	T in. mm	G in. mm	L in. 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	.125 3.2	.004 .1	.03 .8	.40 1.0
10	10	.50 12.7	.19 4.8	.093 .60	150 1034	.33 8.4	.46 11.7	.13 3.3	55 9.6	.260 6.6	.008 .2	.04 1.0	.070 1.8
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	.385 9.8	.008 .2	.06 1.5	.09 2.3
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	.635 16.1	.012 .3	.06 1.5	.105 2.7
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	.760 19.3	.012 .3	.12 3.0	.145 3.7
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	.885 22.5	.012 .3	.12 3.0	.160 4.1
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	1.640 41.7	.012 .3	.14 3.6	.170 4.3
55	15	2.25 57.2	1.50 38.1	2.75 17.74	50 345	.50 12.7	.72 18.3	.22 5.6	21 3.7	1.765 44.8	.016 .4	.13 3.3	.175 4.4
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	1.890 48.0	.016 .4	.16 4.1	.215 5.5
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	2.148 54.6	.016 .4	.16 4.1	.210 5.3
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	2.890 73.4	.020 .5	.18 4.6	.250 6.4
85	12	4.25 108.0	3.20 81.3	11.00 70.97	45 310	.80 20.3	1.13 28.7	.33 8.4	75 13.1	3.500 88.9	.020 .5	.18 4.6	.240 6.1
90	13	4.97 126.2	4.00 101.6	15.79 101.87	50 345	.80 20.3	1.15 29.2	.35 8.9	75 13.1	4.270 108.5	.020 .5	.18 4.6	.240 6.1
93	7	6.979 177.3	4.979 126.5	28.1 181.3	25 172	1.00 25.4	1.190 30.2	.190 4.8	42 7.4				
95	5	11.00 279.4	9.50 241.3	82.48 532.1	20 138	1.00 25.4	1.140 29.0	.14 3.6	250 43.8				
98	4	18.00 457.2	16.00 406.4	226.9 1463.9	20 138	1.00 25.4	1.170 29.7	.17 4.3	650 113.8				

Notes:

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

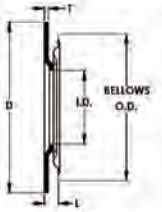
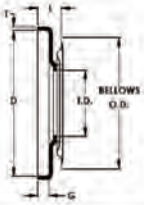
Squirm pressure (P_S) of an internally pressurized bellows without eccentricity and fixed ends is: $P_S = 2\pi K/L$, where K is the overall spring rate and L is the maximum working length.

A more conservative formula allowing for some eccentricity tolerance is: $P_S = 5.02[K/L \times ID/OD]$

Do not exceed the maximum external pressure.

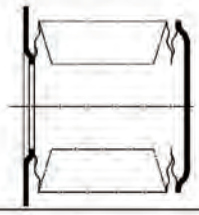
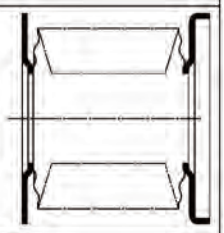
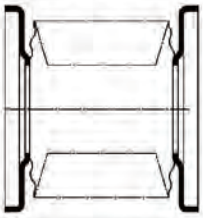
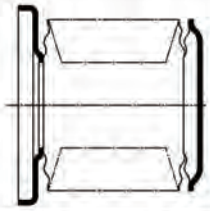
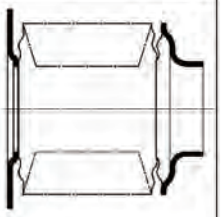
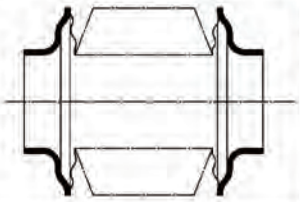
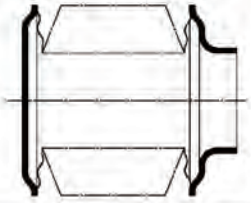
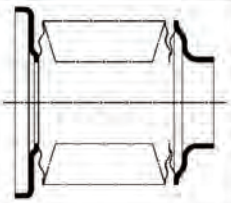
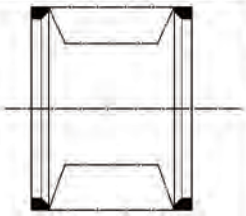
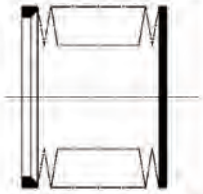
1. For a bellows consisting of more than one capsule, multiply the value listed by the desired number of capsules.
2. For a bellows consisting of more than one capsule, divide the value listed by the desired number of capsules.
3. Length for bellows only. Fitting length (L) must be added to obtain overall dimensions.
4. Tolerance-sizes
   - 05 through 35 ±.002"
   - 40 through 80 ±.003"
   - 80 through 90 ±.004"
   - 93 ±.010"
   - 95 ±.030"
   - 98 ±.050"
5. Mass spectrometer leak tight to less than 1×10^{-7} (1×10^{-10} by request) scc/sec He
6. Flange material 304/347 stainless steel

-Shelf

Flange			Cup				Closed		Ring Closed		
											
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	L in. mm	T in. mm	T in. mm
.500 12.7	.004 .1	.025 .6	.385 9.8	.004 .1	.026 .7	.060 1.5	.004 .1	.014 .4			
.625 15.9	.008 .2	.050 1.3	.510 12.9	.008 .2	.06 1.5	.110 2.8	.008 .2	.028 .7			
.875 22.2	.008 .2	.055 1.4	.760 19.3	.008 .2	.08 2.0	.140 3.6	.008 .2	.033 .8			
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			
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			
1.824 46.3	.012 .3	.040 1.0	1.640 41.7	.012 .3	.12 3.0	.175 4.4	.012 .3	.033 .8			
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			
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			
2.687 68.2	.016 .4	.055 1.4	2.515 63.9	.016 .4	.18 4.6	.260 6.6	.016 .4	.046 1.2			
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			
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			
4.375 111.1	.020 .5	.155 3.9	4.290 109.0	.020 .5	.20 5.1	.355 9.0	.020 .5	.060 1.5			
5.125 130.2	.020 .5	.125 3.2	5.020 127.5	.020 .5	.20 5.1	.325 8.3	.020 .5	.060 1.5			
CONTACT SENIOR AEROSPACE METAL BELLOWS									.25 6.4	.30 7.6	.125 3.2
									.25 6.4 .375 9.5	.50 12.7 .50 12.7	.125 3.2 .220 6.4

INDUSTRY TERM 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)	ΔV	Volume displacement = EA × stroke
T	Diaphragm thickness	ΔP	Pressure (differential across the bellows)
Free Length	Length of bellows with no load	N	Number of convolutions
Length as Welded	Length of bellows prior to operation		

END FITTING COMBINATION

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 
603 Ring Ends 	613 Ring End Closed End 	Available on Request • Special End Fittings • Bellows with rotatable/ non-rotatable high-vacuum flange configuration

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

Ordering & Selection

Indicate specifications from these four areas:

End Fitting Types — Stroke

Bellows Diameters — Single Or Multiple Capsules

- Each additional capsule increases allowable stroke while introducing a proportionate decrease in spring rate
- Order by part number, as indicated in the chart above
- Bellows are delivered from stock, except those with size 93 diameters and above
- Many other non-OTS bellows are available beyond those listed in this catalog

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