



Precision Electrodeposited Nickel Flexible Shaft Couplings

BELLOWS TYPE COUPLINGS

Servometer flexible shaft couplings are bellows-type couplings. Bellows couplings are indispensable for applications such as resolvers, encoders, servos, and computers. The unique characteristics of the bellows coupling are:

1. Zero Backlash
2. Zero Cyclic Speed variation during 360° rotation
3. Very low elastic wind-up
4. Low side thrust on bearings

ELECTRODEPOSITED BELLOWS COUPLINGS

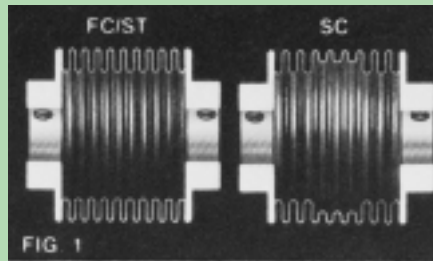
Among bellows couplings there are three types of bellows used: formed, welded and deposited. Only the deposited type is manufactured to lathe tolerances. Also, they are made with thinner walls than any other type. Servometer couplings use electrodeposited bellows, and therefore have the following advantages over others:

1. Tolerances on bellows diameters are to $\pm .005''$.
2. Since mandrels are machined in one lathe chucking, concentricities are within $.0005''$.
3. Servometer couplings are more flexible than any other type.
4. Predictable Life

THREE SIZES AVAILABLE

1. Standard Torque (FC)
2 to 280 in. oz.
2. Hi-Torque (SC)
4 to 420 in. oz.
3. Servo-Torque™ (ST)
1500 to 4000 in. oz.

The FC & ST lines of couplings have equal depth convolutions. (See Fig. 1) The SC series are nearly identical to the FC except the center 1/3 convolutions are shallower. This allows for greater torsional capacity while maintaining offset capability.



HOW TO SELECT A COUPLING

1. Determine the maximum instantaneous torque which the coupling will receive. If there is a clutch start or brake stop, measure the maximum instantaneous value and use this. If a low inertia motor with gear reduction drives a massive load through the coupling, the maximum torque will be the starting torque of the motor multiplied by the gear speed reduction ratio. Acceleration of rotational inertias generates resisting torques and the engineer must compute these and take them into account. Failure to realize the true maximum may result in frequent coupling failures.

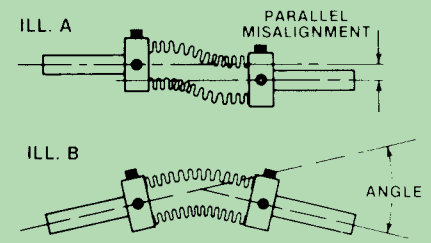
(a) WHEN COUPLING IS USED COMPRESSED: Use 75% of rated torque as maximum since bellows buckle more easily when compressed.

(b) WHEN COUPLING IS USED EXTENDED: Apply the normal torque rating.

2. Determine the maximum parallel misalignment to be encountered. Misalignment of shafts, with axes parallel but off-set, is the severest load that can be applied to a coupling. (SEE ILL. A)

3. Determine the maximum angular misalignment to be expected of the 2 shafts and specify it. (SEE ILL. B)

4. Specify maximum allowable wind-up. A shorter length or larger diameter coupling may be required for low values.



5. Determine whether axial compression or extension will require a special length of bellows.

6. Take the five performance values just determined and find them on the performance chart. The size of coupling which will meet all the requirements will become apparent. If the size of the coupling is not satisfactory, a larger coupling can be used with no loss in performance, whereas a smaller coupling would result in inferior performance and short life.

Servometer can also design special couplings using multi-ply bellows and other methods to meet special application needs.

Couplings can also be used in severe motion applications for a shorter life. Predicted life may be determined by applying the factors below to the dynamic characteristics of the coupling. Torque ratings are maximum and should not be exceeded.

Life Expectancy Table

Life Required in cycles	10 ⁴	10 ⁵	10 ⁶	10 ⁷	10 ⁸
Life Factor	1.9	1.4	1.14	1.03	1

NOTE: 2 cycles = 1 revolution

- Torque range from 2.0 to 4000 in. oz.
- Zero backlash
- Windups from less than 1 arc sec / in. oz.
- Bore sizes from .0903 to 1.0 in. (stock)
- Application assistance from our engineering staff

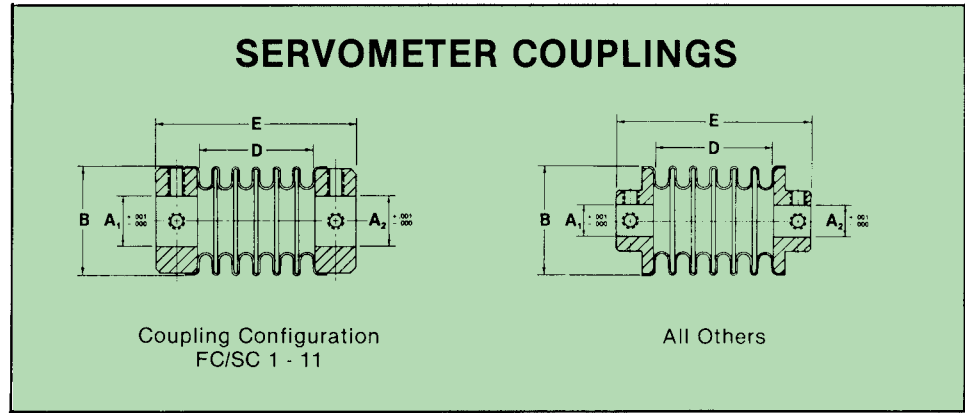


Servometer®

Phone: (973) 785-4630
Fax: (973) 785-0756

NOTES:

1. Minimum life expectancy of 10^8 cycles for values shown in tables (1 Rev. = 2 Cycles)
2. Parallel misalignment, angular misalignment & compression stroke values are mutually exclusive. If combinations of these are required, consult factory
3. Due to its short length P/N SC-4 is identical to P/N FC-4
4. For other bores see Tables 4, 5, & 6.



COUPLING SIZES & PERFORMANCE SPECIFICATIONS

FC Series (Standard)

Table 1

P/N	Stock Bore Size A1 = A2	Bellows O.D. B	Bellows Length D	Overall Length E	Screw Size	Torque (in-oz)	Windup (arc sec/ in-oz)	Parallel ² Misalignment (in)	Side Thrust (oz/.001)	Angular ² Misalignment (°)	Stroke ² Compression (in)
FC-1	.0903"	.250"	.740"	1.035"	#2-56	2	616	.076	.02	31	.107
FC-2	.0903	.250	.370	.665	2-56	5	306	.017	.18	15	.051
FC-3	.1200	.250	.245	.540	2-56	7	202	.007	.64	9	.032
FC-4	.1200	.250	.185	.480	2-56	9	152	.004	1.55	7	.023
FC-5	.1875	.375	.740	1.035	2-56	7	134	.066	.07	27	.139
FC-6	.1875	.375	.550	.845	2-56	9	99	.036	.17	20	.103
FC-7	.1875	.375	.370	.665	2-56	14	67	.015	.58	13	.066
FC-8	.1875	.375	.305	.600	2-56	18	55	.010	1.00	10	.054
FC-9	.2500	.500	.740	1.085	4-40	33	37	.044	.32	18	.125
FC-10	.2500	.500	.490	.835	4-40	50	24	.018	1.13	12	.081
FC-11	.2500	.500	.370	.715	4-40	65	18	.010	2.73	9	.059
FC-12	.2500	.750	.980	1.325	4-40	105	11	.046	.59	14	.149
FC-13	.2500	.750	.730	1.075	4-40	140	8.4	.026	1.40	11	.112
FC-14	.2500	.750	.540	.885	4-40	188	6.2	.014	3.50	8	.083
FC-15	.3125	1.000	1.230	1.625	6-32	152	5.3	.068	.54	17	.230
FC-16	.3125	1.000	.730	1.125	6-32	280	3.1	.020	2.85	9	.121

SC Series (High Torque)

Table 2

P/N	Stock Bore Size A1 = A2	Bellows O.D. B	Bellows Length D	Overall Length E	Screw Size	Torque (in-oz)	Windup (arc sec/ in-oz)	Parallel ² Misalignment (in)	Side Thrust (oz/.001)	Angular ² Misalignment (°)	Stroke ² Compression (in)
SC-1	.0903"	.250"	.625"	.920"	#2-56	4	413	.050	.03	17	.060
SC-2	.0903	.250	.370	.665	2-56	7	205	.017	.18	9	.032
SC-3	.1200	.250	.245	.540	2-56	11	135	.007	.64	7	.023
SC-4 ¹	.1200	.250	.185	.480	2-56	9	152	.004	1.55	7	.023
SC-5	.1875	.375	.740	1.035	2-56	11	90	.066	.07	17	.090
SC-6	.1875	.375	.550	.845	2-56	14	67	.036	.17	13	.066
SC-7	.1875	.375	.370	.665	2-56	21	45	.015	.58	8	.042
SC-8	.1875	.375	.273	.568	2-56	26	39	.009	1.39	6	.030
SC-9	.2500	.500	.740	1.085	4-40	49	25	.044	.32	12	.082
SC-10	.2500	.500	.490	.835	4-40	75	16	.018	1.13	9	.059
SC-11	.2500	.500	.370	.715	4-40	97	12	.010	2.73	5	.038
SC-12	.2500	.750	.980	1.325	4-40	158	8	.046	.59	9	.096
SC-13	.2500	.750	.730	1.075	4-40	210	5.6	.026	1.40	7	.067
SC-14	.2500	.750	.500	.845	4-40	281	4.2	.013	4.41	5	.053
SC-15	.3125	1.000	1.230	1.625	6-32	227	3.6	.068	.54	11	.149
SC-16	.3125	1.000	.730	1.125	6-32	420	2.1	.020	2.85	5	.067

SERVO-TORQUE® Couplings

Table 3

P/N	Stock Bore Size A1 = A2	Bellows O.D. B	Bellows Length D	Overall Length E	Screw Size	Torque (in-oz)	Windup (arc sec/ in oz)	Parallel ² Misalignment (in)	Side Thrust (oz/.001)	Angular ² Misalignment (°)	Stroke ² Compression (in)
ST-100	.375"	1.43"	.916"	1.510"	# 8-32	1500	.85	.018	8.1	6	.129
ST-150	.375	1.43	.226	.820	8-32	1500	.25	.001	304	1	.026
ST-200	.500	2.00	1.508	2.160	10-32	2500	.40	.042	5.35	8	.240
ST-300	.500	2.40	.946	1.600	10-32	4000	.17	.014	20.6	4	.160

CUSTOM BORE COUPLING HUBS IN STOCK, UNASSEMBLED

- Servometer also has custom bore size hubs in stock (unassembled). To order a custom bore coupling; specify part number and bore sizes A₁ and A₂.

- Bore sizes not listed can be made on a special order basis, please consult factory.
- Call factory for pricing information.
- Please allow three weeks delivery for first 50 pieces.

CUSTOM BORE SET SCREW COUPLING HUBS

Table 4

COUPLING SIZES	CUSTOM BORE SIZES AVAILABLE FROM STOCK							
FC-1	.0903	.094	.120	.125				
FC-2	.0903	.094	.120	.125				
FC-3	.0903	.094	.120	.125				
FC-4	.0903	.094	.120	.125				
FC-5	.0903	.120	.125	.156	.236			
FC-6	.0903	.120	.125	.156	.236			
FC-7	.0903	.120	.125	.156	.236			
FC-8	.0903	.120	.125	.156	.236			
FC-9	.0903	.093	.118	.120	.125	.1875	.197	.218 .236
FC-10	.0903	.093	.118	.120	.125	.1875	.197	.218 .236
FC-11	.0903	.093	.118	.120	.125	.1875	.197	.218 .236
FC-12	.118	.120	.125	.236	.375	.500		
FC-13	.118	.120	.125	.236	.375	.500		
FC-14	.118	.120	.125	.236	.375	.500		
FC-15	.156	.250	.315	.344	.375	.394	.500	.625
FC-16	.156	.250	.315	.344	.375	.394	.500	.625

Table 5

COUPLING SIZES	CUSTOM BORE SIZES AVAILABLE FROM STOCK							
SC-1	.0903	.094	.120	.125				
SC-2	.0903	.094	.120	.125				
SC-3	.0903	.094	.120	.125				
SC-4	.0903	.094	.120	.125				
SC-5	.0903	.120	.125	.156	.236			
SC-6	.0903	.120	.125	.156	.236			
SC-7	.0903	.120	.125	.156	.236			
SC-8	.0903	.120	.125	.156	.236			
SC-9	.0903	.093	.118	.120	.125	.1875	.197	.218 .236
SC-10	.0903	.093	.118	.120	.125	.1875	.197	.218 .236
SC-11	.0903	.093	.118	.120	.125	.1875	.197	.218 .236
SC-12	.118	.120	.125	.236	.375	.500		
SC-13	.118	.120	.125	.236	.375	.500		
SC-14	.118	.120	.125	.236	.375	.500		
SC-15	.156	.250	.315	.344	.375	.394	.500	.625
SC-16	.156	.250	.315	.344	.375	.394	.500	.625

COUPLING SIZES	CUSTOM BORE SIZES AVAILABLE FROM STOCK					
ST-100	.250	.3125	.394	.500	.625	.750 .875
ST-150	.250	.3125	.394	.500	.625	.750 .875
ST-200	.375	.394	.625	.750	.875	1.000
ST-300	.625	.750	.875	1.000		

Table 6

SPLIT HUB FLEXIBLE COUPLINGS

Series SHFC / SHSC

Table 7

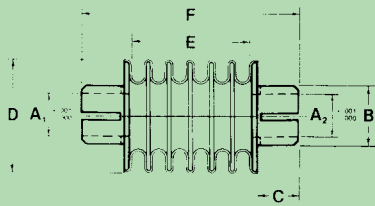
P/N	BORE SIZE A1 = A2	HUB O.D. B	HUB LENGTH C	BELLOWS O.D. D	BELLOWS LGTH. E FC/SC	OVERALL LGTH. F FC/SC
SHFC-3 / SHSC-3 Stock	.120	.187	.281	.250	.245	.871
Custom	.125	.187				
SHFC-4 / SHSC-4 Stock	.120	.187	.281	.250	.185	.811
Custom	.125	.187				
SHFC-5 / SHSC-5 Stock	.1875	.250	.281	.375	.740	1.366
Custom	.120	.187				
Custom	.125	.187				
SHFC-6 / SHSC-6 Stock	.1875	.250	.281	.375	.550	1.176
Custom	.120	.187				
Custom	.125	.187				
SHFC-7 / SHSC-7 Stock	.1875	.250	.281	.375	.370	.996
Custom	.120	.187				
Custom	.125	.187				
SHFC-8 / SHSC-8 Stock	.1875	.250	.281	.375	.305/.273	.931/.899
Custom	.120	.187				
Custom	.125	.187				
SHFC-9 / SHSC-9 Stock	.250	.312	.281	.500	.740	1.366
Custom	.120	.187				
Custom	.125	.187				
Custom	.1875	.250				
SHFC-10 / SHSC-10 Stock	.250	.312	.281	.500	.490	1.116
Custom	.120	.187				
Custom	.125	.187				
Custom	.1875	.250				
SHFC-11 / SHSC-11 Stock	.250	.312	.281	.500	.370	.996
Custom	.120	.187				
Custom	.125	.187				
Custom	.1875	.250				

For performance characteristics see corresponding series number for FC in table 4; SC in table 5.

SPLIT HUB FLEXIBLE COUPLINGS

Series SHFC / SHSC

Table 7 continued



Split Hub Coupling Configuration

Split hub couplings are sold from stock without clamps. Hubs have been designed to accept commercially available clamps. Servometer will supply clamps upon request at moderate cost. (See Table 12).

P/N	BORE SIZE A1=A2	HUB O.D. B	HUB LENGTH C	BELLOWS O.D. D	BELLOWS LGTH. E FC/SC	OVERALL LGTH. F FC/SC
SHFC-12 / SHSC-12	Stock	.250	.312	.281	.750	1.606
	Custom	.120	.187			
	Custom	.125	.187			
	Custom	.375	.437	.343		1.730
	Custom	.500	.562	.437		1.918
SHFC-13 / SHSC-13	Stock	.250	.312	.281	.750	1.356
	Custom	.120	.187			
	Custom	.125	.187			
	Custom	.375	.437	.343		1.480
	Custom	.500	.562	.437		1.668
SHFC-14 / SHSC-14	Stock	.250	.312	.281	.750	1.166/1.126
	Custom	.120	.187			
	Custom	.125	.187			
	Custom	.375	.437	.343		1.290
	Custom	.500	.562	.437		1.478
SHFC-15 / SHSC-15	Stock	.3125	.375	.343	1.000	1.980
	Custom	.250	.312	.281		1.856
	Custom	.375	.437	.343		1.980
	Custom	.500	.562	.437		2.168
	Custom	.625	.687	.437		2.168
SHFC-16 / SHSC-16	Stock	.3125	.375	.343	1.000	1.480
	Custom	.250	.312	.281		1.350
	Custom	.375	.437	.343		1.480
	Custom	.500	.562	.437		1.668
	Custom	.625	.687	.437		1.668

For performance characteristics see corresponding series number for FC in table 4; SC in table 5.

Series S.H.S.T. 100

Table 8

S.H.S.T.	A	B	C	D	E	F
100	.375*	.437	.343	1.43	.916	1.735
	.500	.562	.437	1.43	.916	1.925
	.625	.687	.437	1.43	.916	1.925
	.750	.812	.500	1.43	.916	2.05
	.3125	.375	.343	1.43	.916	1.735
	.250	.312	.281	1.43	.916	1.61
	.236	.312	.281	1.43	.916	1.61
	.551	.625	.437	1.43	.916	1.925

Series S.H.S.T. 150

Table 9

S.H.S.T.	A	B	C	D	E	F
150	.375*	.437	.343	1.43	.226	1.045
	.500	.562	.437	1.43	.226	1.233
	.625	.687	.437	1.43	.226	1.233
	.750	.812	.500	1.43	.226	1.359
	.3125	.375	.343	1.43	.226	1.045
	.250	.312	.281	1.43	.226	.921
	.236	.312	.281	1.43	.226	.921
	.551	.625	.437	1.43	.226	1.233

Series S.H.S.T. 200

Table 10

S.H.S.T.	A	B	C	D	E	F
200	.375	.437	.343	2.00	1.506	2.38
	.500*	.562	.437	2.00	1.506	2.57
	.625	.687	.437	2.00	1.506	2.57
	.750	.812	.500	2.00	1.506	2.70
	1.000	1.062	.500	2.00	1.506	2.70

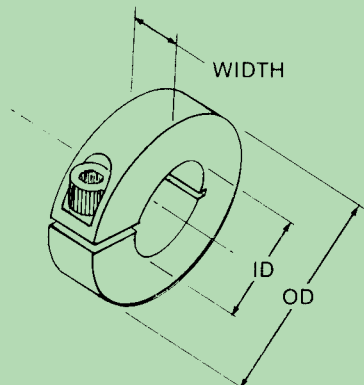
Series S.H.S.T. 300

Table 11

S.H.S.T.	A	B	C	D	E	F
300	.375	.437	.343	2.40	.946	1.825
	.500*	.562	.437	2.40	.946	2.01
	.625	.687	.437	2.40	.946	2.01
	.750	.812	.500	2.40	.946	2.14
	1.00	1.062	.500	2.40	.946	2.14

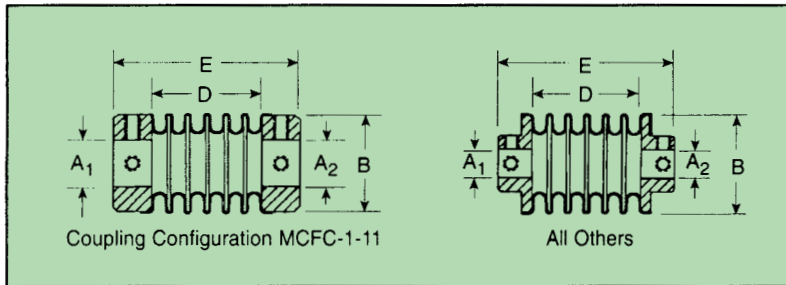
*Bore size stocked, assembled

Table 12



Split Hub Bore Size	Clamping Collar			Screw Size	Part No.
	ID	OD	Width		
.120	3/16	5/8	.281	4-40	CL3SS
.125	3/16	5/8	.281	4-40	CL3SS
.1875	1/4	5/8	.281	4-40	CL4SS
.250	5/16	11/16	.281	4-40	CL5SS
.3125	3/8	7/8	.343	6-32	CL6SS
.375	7/16	15/16	.343	6-32	CL7SS
.500	9/16	1 1/4	.437	10-32	CL9SS
.625	11/16	1 5/16	.437	10-32	CL11SS
.750	13/16	1 5/8	1/2	1/4-28	CL13SS
1.000	1 1/16	1 7/8	1/2	1/4-28	CL17SS

SERVOMETRIC® METRIC BELLOWS TYPE FLEXIBLE SHAFT COUPLINGS



The unique characteristics of the bellows couplings are:

1. Zero Backlash
2. Very Low Elastic Wind-Up
3. Zero Cyclic Speed Variation During 360° Rotation
4. Low Side Thrust On Bearings

COUPLING SIZES	SET-SCREW	METRIC BORE SIZES AVAILABLE (mmH7) A ₁ /A ₂	BELLOWS PART NOS.	BELLOWS DIAMETER mm (inch) B	BELLOWS LENGTH mm (inch) D	OVERALL LENGTH mm (inch) E	TORQUE Ncm (in-oz)	WINDUP arcsec/Ncm (arcsec/in oz)	PARALLEL Misalignment mm (inch)	SIDE THRUST N/.1 mm (oz/.001")	ANGULAR Misalignment degree'	STROKE Compression mm (inch)
MCFC-1	M2	3	FC-1	6.4 (.250)	18.8 (.740)	26.8 (1.055)	1.4 (2)	872 (616)	1.93 (.076)	0.02 (.02)	31	2.72 (.107)
MCFC-2	M2	3	FC-2	6.4 (.250)	9.4 (.370)	17.4 (.685)	3.5 (5)	433 (306)	0.43 (.017)	0.20 (.18)	15	1.30 (.051)
MCFC-3	M2	3	FC-3	6.4 (.250)	6.2 (.245)	14.2 (.559)	4.9 (7)	286 (202)	0.18 (.007)	0.70 (.64)	9	0.81 (.032)
MCFC-4	M2	3	FC-4	6.4 (.250)	4.7 (.185)	12.7 (.500)	6.4 (9)	215 (152)	0.10 (.004)	1.70 (1.55)	7	0.58 (.023)
MCFC-5	M2	3 4	FC-5	9.5 (.375)	18.8 (.740)	26.8 (1.055)	4.9 (7)	190 (134)	1.68 (.066)	0.08 (.07)	27	3.53 (.139)
MCFC-6	M2	3 4	FC-6	9.5 (.375)	14.0 (.550)	22.0 (.866)	6.4 (9)	140 (99)	0.91 (.036)	0.19 (.17)	20	2.62 (.103)
MCFC-7	M2	3 4	FC-7	9.5 (.375)	9.4 (.370)	17.4 (.685)	9.9 (14)	95 (67)	0.38 (.015)	0.63 (.58)	13	1.68 (.066)
MCFC-8	M2	3 4	FC-8	9.5 (.375)	7.7 (.305)	15.7 (.618)	13 (18)	78 (55)	0.25 (.010)	1.09 (1.00)	10	1.37 (.054)
MCFC-9	M2 M3	3 4	FC-9	12.7 (.500)	18.8 (.740)	28.8 (1.133)	23 (33)	52 (37)	1.12 (.044)	0.35 (.32)	18	3.18 (.125)
MCFC-10	M2 M3	3 4, 6	FC-10	12.7 (.500)	12.4 (.490)	22.4 (.882)	35 (50)	34 (24)	0.46 (.018)	1.24 (1.13)	12	2.06 (.081)
MCFC-11	M2 M3	3 4, 6	FC-11	12.7 (.500)	9.4 (.370)	19.4 (.764)	46 (65)	25 (18)	0.25 (.010)	2.99 (2.73)	9	1.50 (.059)
MCFC-12	M3	6	FC-12	19 (.750)	24.9 (.980)	34.9 (1.374)	74 (105)	16 (11)	1.17 (.046)	0.65 (.59)	14	3.78 (.149)
MCFC-13	M3	6	FC-13	19 (.750)	18.5 (.730)	28.5 (1.122)	99 (140)	12 (8.4)	0.66 (.026)	1.53 (1.40)	11	2.84 (.112)
MCFC-14	M3	6	FC-14	19 (.750)	13.7 (.540)	23.7 (.933)	133 (188)	8.8 (6.2)	0.36 (.014)	3.83 (3.50)	8	2.11 (.083)
MCFC-15	M3 M4	4 6, 8	FC-15	25.4 (1.00)	31.2 (1.230)	43.2 (1.701)	107 (152)	7.5 (5.3)	1.73 (.068)	0.59 (.54)	17	5.84 (.230)
MCFC-16	M3 M4	4 6, 8	FC-16	25.4 (1.00)	18.5 (.730)	30.5 (1.201)	198 (280)	4.4 (3.1)	0.51 (.020)	3.12 (2.85)	9	3.07 (.121)

Notes: 1. Minimum life expectancy of 10⁸ cycles for values shown in table (1 Rev. = 2 Cycles).

2. Parallel misalignment, angular misalignment and compression stroke values are mutually exclusive. If combinations of these are required, consult factory.

How to specify your Servometric® Metric Bore Flexible Shaft Coupling:

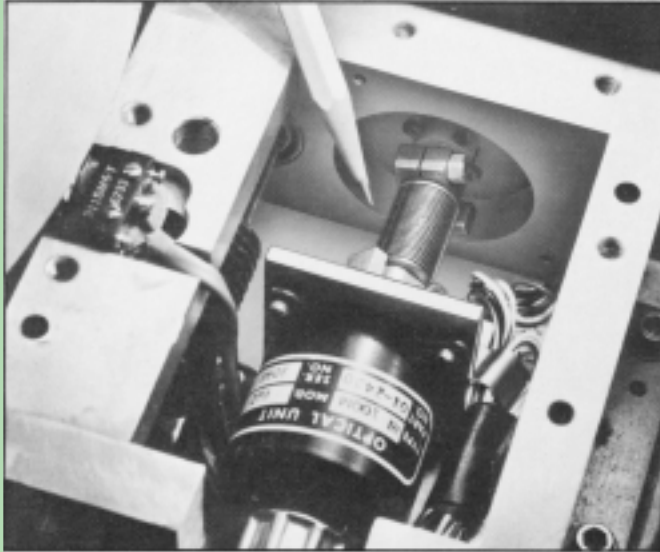
The Metric couplings follow the following convention: MCFC-ZZ-YYxYY, where "MCFC-ZZ" gives the coupling size, "-YYxYY" gives the size of the two bores (at each end).

Example: A P/N MCFC-15 with bores of 8mm by 8mm would be specified as follows:

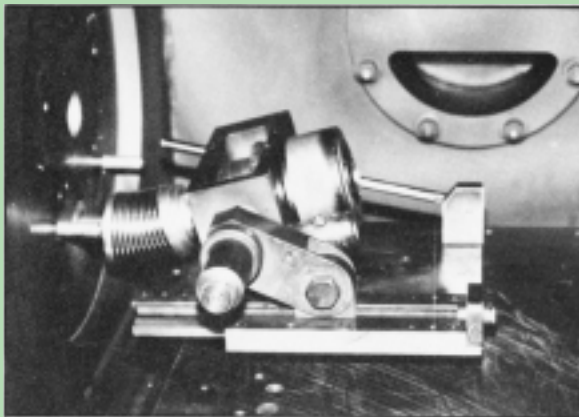
P/N MCFC-15-08X08.

Typical Applications

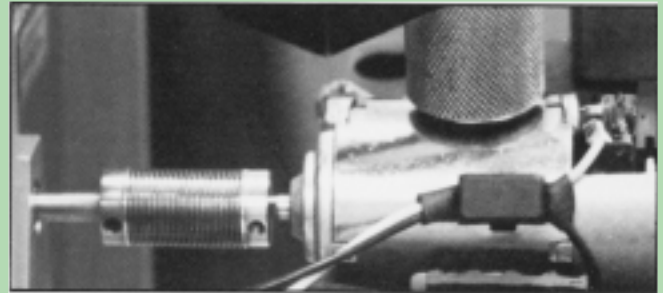
- Robotics • Encoders • Resolvers
- Servomotors • Computers • Tachometers



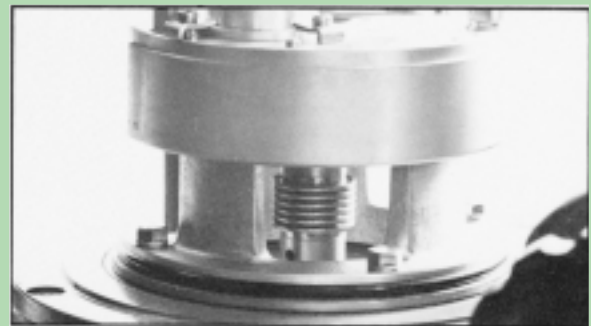
Bellows couplings prevent damage to delicate encoders by absorbing shaft misalignments.



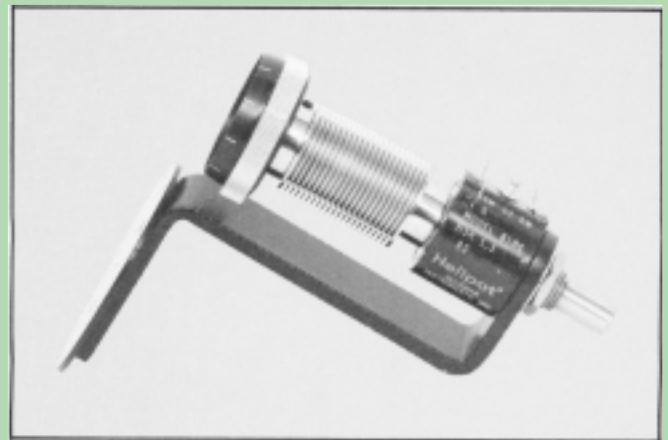
Bellows couplings can be supplied with custom end configurations for special tooling applications.



When the motor is positioned for testing, the coupling allows the system to generate performance curves, statistical data, and calculate servo parameters without tedious line-up.



Bellows couplings can be used in critical positioning applications where low radial windup is required.



Bellows couplings can be used with 10 turn potentiometers to absorb linear motion while accurately indicating angular position.



SERVOMETER® ALSO MANUFACTURERS

CONTACTS

Servometer bellows contacts are widely used as electrical spring contacts in radio transmitters and receivers, radar systems and micro-wave applications, where negligible inductance and insertion loss are necessary.



ELECTROFORMS

Servometer is capable of manufacturing many speciality electroforms which normal electroplating companies cannot produce. Extremely close tolerances can be held and we solicit your inquiries.



MINIATURE METAL BELLOWS AND ASSEMBLIES

Servometer Miniature metal bellows for flexible seals, volume compensation, pressure responsive devices, EMI shields, vibration dampeners, etc. A 12 page Bellows and Electroform Design Manual contains detailed formulas for designing miniature nickel bellows plus parts which lend themselves to electroforming.



Precision Manufacturing Group, LLC

Servometer®

"The Specialists in Precision Miniature Bellows" Since 1957