

APPENDIX M - MANUFACTURERS' SPECIFICATIONS

The following pages are manufacturers' specifications for parts provided in the Official Kit of Parts.

Additional booklets are in the Kit.

Be sure to read these spec sheets in order to properly allocate and use components.

Specification sheets in this section are in the order listed below for the following suppliers:

Supplier	Kit Part
Air Logic	Check Valves
Associated Spring Raymond	Springs
AMP Incorporated	Connector Housing
Bourns, Inc.	Potentiometer
S&B Power Tool	Drill Motors
CP Clare	Reed Switch
Gast Manufacturing Corporation	Air Compressor
Honeywell - Microswitch Division	Photoelectric Sensor
National Welding Alloys, Inc.	Welding Wire
Numatics, Inc.	Pressure Switch
Associated Power Products	Battery
Skyway Recreation Products	Wheel Chair Wheels
SMC Pneumatics, Inc.	Pneumatics Devices
Snap-Action, Inc.	Circuit Breakers
The Torrington Company	Ball Bearings

F-2804 Series Check Valves



The F-2804 Series Check Valves permit flow in one direction only. The operation of the check valve is based on the movement of a small disc. The disc shifts within the housing as the pressure differential changes from forward to reverse. A flat surface on one side of the disc seals off flow, while the other side allows flow to pass.

Two models are available from the Standard Units, F-2804-401, 402 & 403 to the High Flow Unit, F-2804-404.

The advantages of the check valve design is the low "cracking pressure", minimum differential required for forward flow, which is less than 0.005 PSI differential in the Standard Units. Secondly, there is no residual pressure difference across the check valve once flow has ceased. Flow in the forward direction is relatively unrestricted, approximately equivalent to the restriction of a 0.040 inch orifice in the Standard Units. The amount of flow permitted in the reverse direction, which is the sealing side, and the forward direction, which is full flow, is shown in the graphs below.

ORDERING INFORMATION (Order by model number and specify accessory letters required.)

F-2804 - 404 - B85

Model Number	Color	Port Connection
F-2804-401	Orange	B80—Barbs for 1/16" I.D. tubing B85—Barbs for 1/8" I.D. tubing No accessory numbers required for straight ports
F-2804-402	Green	
F-2804-403	Blue	
F-2804-404	Black	B80—Barbs for 1/16" I.D. tubing B85—Barbs for 1/8" I.D. tubing 10-32 threads. No accessory numbers required.

FEATURES

- Minimum Cracking Pressure
- Miniature Size
- Low Cost

SPECIFICATIONS

- Maximum Supply: F-2804-401 • 10 PSI
 F-2804-402 • 10 PSI
 F-2804-403 • 10 PSI
 F-2804-404 • 75 PSI
- Operating Temperature: 40° to 120°F. (5° to 48°C.)
- Recommended Filtration: 5 micron
- Cracking Pressure: F-2804-401 • Less than .8" H₂O
 F-2804-402 • Less than .8" H₂O
 F-2804-403 • Less than .8" H₂O
 F-2804-404 • Less than 10" H₂O

MATERIALS

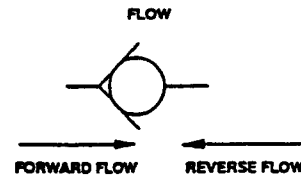
- Housing: Polysulfone
- Disc: F-2804-401 • Celcon Disc
 F-2804-402 • Celcon Disc
 F-2804-403 • Silicone
 F-2804-404 • Silicone

MOUNTING

Inline

PORT CONNECTIONS

Straight ports for 1/16" I.D. flexible tubing
 Barbs for 1/16" or 1/8" I.D. flexible tubing
 The F-2804-404 has 10-32 Threads

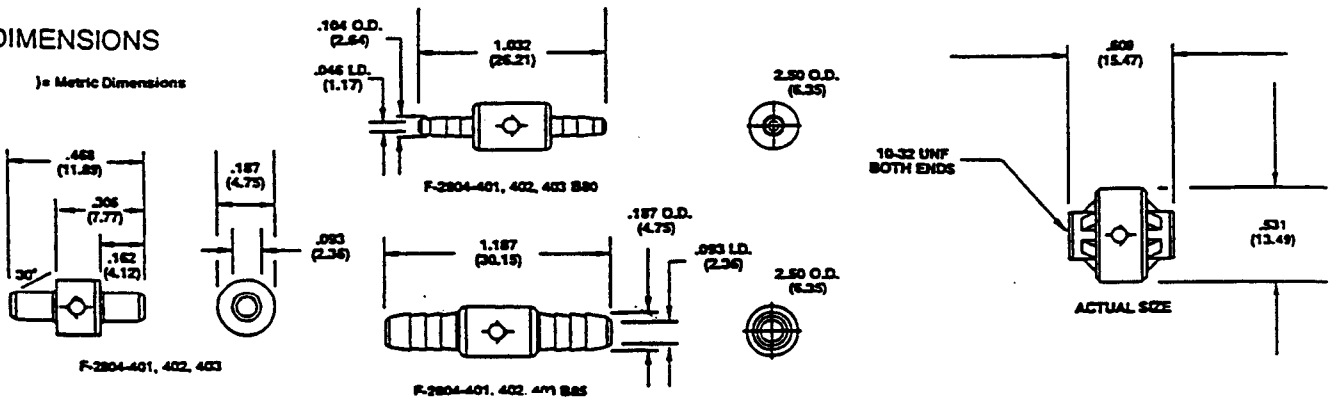


TYPICAL FLOW CHARACTERISTICS

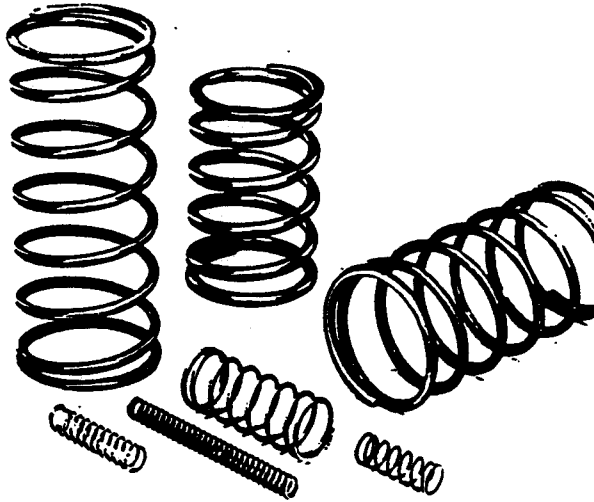
Model Number	Reverse Flow (PSI Differential)	Forward Flow (PSI Differential)
F-2804-401	Less than 2.98 SCFM	0.12 SCFM 1 PSI Supply
F-2804-402	Less than 1.00 SCFM	
F-2804-403	Less than 0.20 SCFM	
F-2804-404	Less than 0.06 SCFM	2.0 SCFM 75 PSI Supply

DIMENSIONS

() = Metric Dimensions



Compression Springs



Stock sizes in music wire and stainless steel

Associated Spring offers a broad variety of helical compression springs in the SPEC selection. They are reliable, inexpensive and efficient — the right combination for general-purpose use throughout industry.

Material

Music wire

ASTM-A228 or AMS 5112

Stainless steel

Commercial Type 302, ASTM-A313 or

AMS 5688 spring temper. (chemical & physical only)

No charge for certificate of compliance when requested; certificate of chemical analysis available, see price book.

Music wire will be furnished unless stainless steel is specified. When inquiring or ordering, use letter "M" or letter "S" as suffix on catalog numbers to designate music wire or stainless steel wire, respectively.

Music wire springs are not recommended for applications where the temperature exceeds 250 deg F (121 deg C). Stainless steel springs are not recommended for applications where the temperature exceeds 500 deg F (260 deg C).

Direction of Helix

Right hand.

Ends

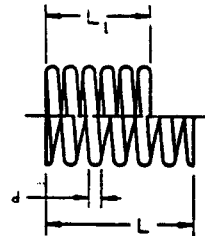
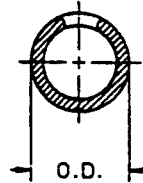
Squared and ground. Ends to be square within 3° with axis. O.D. sizes 0.057-0.088 in (1.45-2.24 mm) squared ends not ground.

Free length L is for reference use only. Load P is attained at length L₁. For stainless steel multiply P by 0.833.

Load values shown are for music wire.

For normal service, springs should not be compressed below L.

To determine load P at any length other than L₁, multiply the proposed deflection by the rate R. $*[P + (L-L_x) \times R]$ When stainless steel is used the value for rate R must be corrected by multiplying R by 0.833.



Finishes

Standard finish is that of the normal wire. Shot-peened and plated finishes furnished on request. Allow sufficient additional time for special finishes.

Tolerances

O.D. (English)	O.D. (Metric)
0.057 to 0.119 in \pm 0.003 in	1.45 to 3.02 mm \pm 0.08 mm
0.120 to 0.240 in \pm 0.005 in	3.05 to 6.10 mm \pm 0.13 mm
0.241 to 0.500 in \pm 0.008 in	6.12 to 12.70 mm \pm 0.20 mm
0.501 to 1.000 in \pm 0.015 in	12.73 to 25.40 mm \pm 0.38 mm
1.001 to 1.225 in \pm 0.020 in	25.43 to 31.12 mm \pm 0.51 mm
1.226 to 1.460 in \pm 0.030 in	31.14 to 37.08 mm \pm 0.76 mm
1.461 to 2.000 in \pm 0.040 in	37.11 to 50.80 mm \pm 1.02 mm

Load, P = 10%

Spring Rate, R = 10%

*L_x = Desired Load Length

STOCK COMPRESSION SPRINGS

Music Wire and Stainless Steel



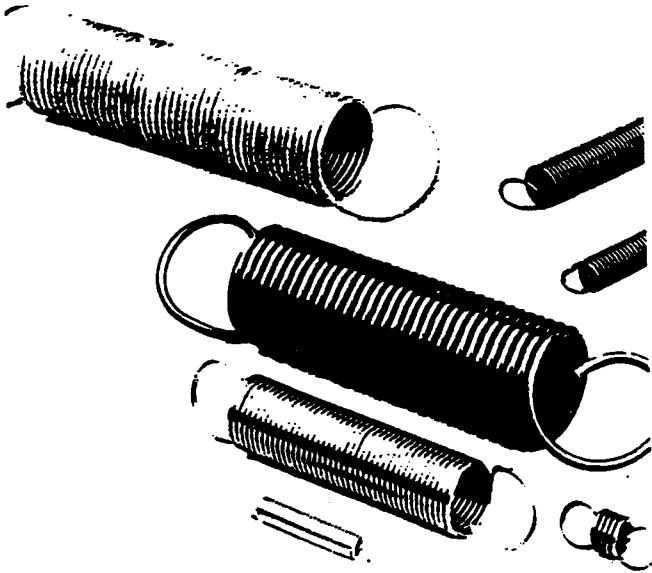
Associated Spring
Raymond BARNES

CATALOG NUMBER	Outside Diameter		Wire Diameter		Free Length L, Approx.		Load, P at L ₁		Length, L ₁		Solid Height, Approx.		Spring Rate, R																									
	in	mm	in	mm	in	mm	lbf	N†	in	mm	in	mm	lb/in†	N/mm†																								
C0480-081-2000	0.480	12.19	0.081	2.06	2.00	50.80	44.34	197.22	1.460	37.08	1.204	30.58	82.2	14.39																								
C0480-081-2250					2.25	57.15			1.637	41.58	1.334	33.88	72.3	12.66																								
C0480-081-2500					2.50	63.50			1.813	46.05	1.465	37.21	64.6	11.31																								
C0480-081-2750					2.75	69.85			1.990	50.55	1.595	40.51	58.3	10.21																								
C0480-081-3000					3.00	76.20			2.167	55.04	1.726	43.84	53.2	9.32																								
C0480-081-3250					3.25	82.55			2.343	59.51	1.857	47.17	48.9	8.56																								
C0480-081-3500					3.50	88.90			2.520	64.01	1.987	50.47	45.2	7.92																								
C0600-045-0500					0.600	15.24			0.045	1.14	0.50	12.70	6.00	26.69	0.257	6.53	0.153	3.89	24.7	4.33																		
C0600-045-0625											0.62	15.75			0.292	7.42	0.179	4.55	18.0	3.15																		
C0600-045-0750											0.75	19.05			0.330	8.38	0.205	5.21	14.0	2.45																		
C0600-045-0880	0.88	22.35	0.375	9.53			0.224	5.69			12.0	2.10																										
C0600-045-1000	1.00	25.40	0.400	10.16			0.251	6.38			10.0	1.751																										
C0600-045-1250	1.25	31.75	0.500	12.70			0.292	7.42			8.0	1.401																										
C0600-045-1380	1.38	35.05	0.540	13.72			0.306	7.77			7.1	1.243																										
C0600-045-1500	1.50	38.10	0.575	14.61			0.338	8.59			6.5	1.138																										
C0600-045-1750	1.75	44.45	0.764	19.41			0.366	9.30			6.7	1.173																										
C0600-045-2000	2.00	50.80	0.866	22.00			0.401	10.19			5.8	1.016																										
C0600-045-2250	2.25	57.15	0.967	24.56			0.436	11.07			5.2	0.911																										
C0600-045-2500	2.50	63.50	1.069	27.15			0.471	11.96			4.6	0.805																										
C0600-045-2750	2.75	69.85	1.170	29.72			0.540	13.72			3.8	0.665																										
C0600-045-3000	3.00	76.20	1.272	32.31			0.585	14.86			3.5	0.613																										
C0600-045-3500	3.50	88.90	1.475	37.47			0.659	16.74			3.0	0.525																										
C0600-049-0620	0.600	15.24	0.049	1.24			0.62	15.75			8.40	37.37			0.320	8.13	0.234	5.94	28.0	4.90																		
C0600-049-0750							0.75	19.05							0.375	9.53	0.255	6.48	22.4	3.92																		
C0600-049-1000							1.00	25.40							0.481	12.22	0.297	7.54	16.2	2.84																		
C0600-049-1250							1.25	31.75							0.587	14.91	0.338	8.59	12.7	2.22																		
C0600-049-1500							1.50	38.10							0.693	17.60	0.380	9.65	10.4	1.821																		
C0600-049-1750							1.75	44.45							0.800	20.32	0.422	10.72	8.8	1.541																		
C0600-049-2000							2.00	50.80							0.906	23.01	0.463	11.76	7.7	1.348																		
C0600-049-2250							2.25	57.15							1.012	25.70	0.505	12.83	6.8	1.191																		
C0600-049-2500							2.50	63.50							1.118	28.40	0.546	13.87	6.1	1.068																		
C0600-049-2750							2.75	69.85							1.224	31.09	0.588	14.94	5.5	0.963																		
C0600-049-3000							3.00	76.20							1.330	33.78	0.629	15.98	5.0	0.876																		
C0600-055-0625							0.600	15.24							0.055	1.40	0.62	15.75	12.00	53.38	0.325	8.26	0.226	5.74	40.0	7.00												
C0600-055-0750																	0.75	19.05			0.385	9.78	0.251	6.38	33.0	5.78												
C0600-055-0880																	0.88	22.35			0.450	11.43	0.276	7.01	28.0	4.90												
C0600-055-1000																	1.00	25.40			0.500	12.70	0.304	7.72	24.0	4.20												
C0600-055-1250																	1.25	31.75			0.580	14.73	0.369	9.37	18.0	3.15												
C0600-055-1500																	1.50	38.10			0.700	17.78	0.420	10.67	15.0	2.63												
C0600-055-1750																	1.75	44.45			0.856	21.74	0.509	12.93	13.0	2.28												
C0600-055-2000																	2.00	50.80			0.970	24.64	0.562	14.27	11.3	1.979												
C0600-055-2250																	2.25	57.15			1.083	27.51	0.614	15.60	10.0	1.751												
C0600-055-2500																	2.50	63.50			1.197	30.40	0.667	16.94	8.9	1.558												
C0600-055-2750																	2.75	69.85			1.311	33.30	0.701	17.81	8.3	1.453												
C0600-055-3000																	3.00	76.20			1.424	36.17	0.752	19.10	7.6	1.331												
C0600-059-0620																	0.600	15.24			0.059	1.50	0.62	15.75	14.13	62.85	0.357	9.07	0.298	7.57	53.7	9.40						
C0600-059-0750																							0.75	19.05			0.419	10.64	0.329	8.36	42.7	7.48						
C0600-059-0880																							0.88	22.35			0.481	12.22	0.360	9.14	35.4	6.20						
C0600-059-1000																							1.00	25.40			0.538	13.67	0.389	9.88	30.6	5.36						
C0600-059-1250																							1.25	31.75			0.657	16.69	0.449	11.40	23.8	4.17						
C0600-059-1500																							1.50	38.10			0.776	19.71	0.510	12.95	19.5	3.41						
C0600-059-1750																							1.75	44.45			0.895	22.73	0.570	14.48	16.5	2.89						
C0600-059-2000																							2.00	50.80			1.014	25.76	0.630	16.00	14.3	2.50						
C0600-059-2250																							2.25	57.15			1.133	28.78	0.690	17.53	12.6	2.21						
C0600-059-2500																							2.50	63.50			1.252	31.80	0.750	19.05	11.3	1.979						
C0600-059-2750																							2.75	69.85			1.371	34.82	0.811	20.60	10.2	1.786						
C0600-059-3000																							3.00	76.20			1.490	37.85	0.871	22.12	9.4	1.646						
C0600-063-0625																							0.600	15.24			0.063	1.60	0.62	15.75	18.00	80.07	0.335	8.51	0.280	7.11	62.0	10.86
C0600-063-0750																													0.75	19.05			0.400	10.16	0.314	7.98	51.0	8.93
C0600-063-0880																													0.88	22.35			0.465	11.81	0.343	8.71	44.0	7.70
C0600-063-1000																													1.00	25.40			0.525	13.34	0.378	9.60	38.0	6.65
C0600-063-1250																													1.25	31.75			0.670	17.02	0.435	11.05	31.0	5.43
C0600-063-1500																													1.50	38.10			0.750	19.05	0.526	13.36	24.0	4.20
C0600-063-1750																													1.75	44.45			0.935	23.75	0.632	16.05	20.8	3.64

†For stainless steel, multiply values by 0.833.

*When inquiring or ordering, use letter "M" or letter "S" as suffix on catalog numbers to designate music wire or stainless-steel wire, respectively.

Extension Springs



Stock sizes in music wire and stainless steel

All SPEC stock helical extension springs have uniform body diameter and are produced with full twist loops the same diameter as the body. They are wound with initial tension; some force is required before the coils are initially separated. As with other Associated Spring stock components, they are capable of wide application for experimental, development, prototype and maintenance work.

Material

Music wire

ASTM-A228 or AMS 5112

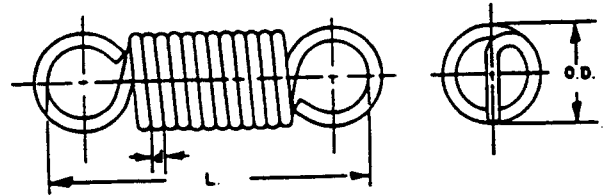
Stainless steel

Commercial Type 302, ASTM-A313 or AMS 5688 spring temper. (chemical & physical only)

No charge for certificate of compliance when requested; certificate of chemical analysis available, see price book.

Music wire will be furnished unless stainless steel is specified. When inquiring or ordering, use letter "M" or letter "S" as suffix on catalog numbers to designate music wire or stainless steel wire, respectively.

Music wire springs are not recommended for applications where the temperature exceeds 250 deg F (121 deg C). Stainless steel springs are not recommended for applications where the temperature exceeds 500 deg F (260 deg C).



Direction of Helix

Right or left according to machine set-up at time of run.

Ends

Full twist loop. Special ends on request.

Initial tension T is for reference only; free length dimension L is approximate.

Maximum load P is attained at extended length L₁.

To determine load P, rate R or initial tension T, for stainless steel, multiply the values given by 0.833. To determine load P* at any extension other than L₁, multiply the distance in inches that the spring will be extended from the free length L by the spring rate R and add the initial tension T.

Finishes

Standard finish is that of the normal wire. Shot-peened and plated finishes furnished on request. Allow additional time for special finishes.

Tolerances

O.D. (English)	O.D. (Metric)
0.063 to 0.119 in = 0.003 in	1.60 to 3.02 mm = 0.08 mm
0.120 to 0.240 in = 0.005 in	3.05 to 6.10 mm = 0.13 mm
0.241 to 0.500 in = 0.008 in	6.12 to 12.70 mm = 0.20 mm
0.501 to 1.000 in = 0.015 in	12.73 to 25.40 mm = 0.38 mm
1.001 to 1.225 in = 0.020 in	25.43 to 31.12 mm = 0.51 mm
1.226 to 1.460 in = 0.030 in	31.14 to 37.08 mm = 0.76 mm
1.461 to 2.000 in = 0.040 in	37.11 to 50.80 mm = 1.02 mm

Load, P = 10%

Spring Rate, R = 10%

Position of Ends = 22 deg

$$*P = (Lx - L) \times R + T$$

Lx = Desired Load Length

STOCK EXTENSION SPRINGS

Music Wire and Stainless Steel



Associated Spring
Raymond BARNES

CATALOG NUMBER*	Outside Diameter		Wire Diameter		Free Length L, Approx.		Load, P at L ₁		Initial Tension, T**		Ext. L ₁		Spring Rate, R			
	in	mm	in	mm	in	mm	lb†	N†	lb†	N†	in	mm	lb/in†	N/mm†		
E0420-055-1500	0.420	10.67	0.055	1.40	1.50	38.10	15.80	70.28	1.40	6.23	2.24	56.90	19.5	3.41		
E0420-055-1750					1.75	44.45					2.73	69.34	14.7	2.57		
E0420-055-2000					2.00	50.80					3.22	81.79	11.8	2.07		
E0420-055-2250					2.25	57.15					3.71	94.23	9.8	1.716		
E0420-055-2500					2.50	63.50					4.21	106.93	8.4	1.471		
E0420-055-2750					2.75	69.85					4.70	119.38	7.4	1.296		
E0420-055-3000	3.00	76.20	5.19	131.83	6.6	1.156										
E0500-034-1250	0.500	12.70	0.034	0.86	1.25	31.75	3.49	15.52	0.31	1.38	2.56	65.02	2.4	0.420		
E0500-034-1370					1.37	34.80					3.27	83.06	1.7	0.298		
E0500-034-1500					1.50	38.10					4.04	102.62	1.3	0.228		
E0500-034-1750					1.75	44.45					5.52	140.21	0.8	0.140		
E0500-034-2000					2.00	50.80					7.00	177.80	0.6	0.105		
E0500-034-2250					2.25	57.15					8.48	215.39	0.5	0.088		
E0500-037-1250			0.037	0.94	0.037	0.94	1.25	31.75	4.40	19.57	0.40	1.78	2.65	67.31	2.8	0.490
E0500-037-1370							1.37	34.80					3.20	81.28	2.1	0.368
E0500-037-1500							1.50	38.10					3.81	96.77	1.7	0.298
E0500-037-1750							1.75	44.45					4.98	126.49	1.2	0.210
E0500-037-2000							2.00	50.80					6.12	155.45	1.0	0.175
E0500-037-2250							2.25	57.15					7.37	187.20	0.8	0.140
E0500-037-2500					2.50	63.50	8.54	216.92	0.7	0.123						
E0500-037-2750					2.75	69.85	9.82	249.43	0.6	0.105						
E0500-037-3000					3.00	76.20	11.10	281.94	0.5	0.088						
E0500-037-3500					3.50	88.90	13.59	345.19	0.4	0.070						
E0500-037-4000					4.00	101.60	16.08	408.43	0.3	0.053						
E0500-037-4500					4.50	114.30	18.57	471.68	0.3	0.053						
E0500-037-5000			5.00	127.00	21.06	534.92	0.2	0.035								
E0500-041-1250			0.041	1.04	0.041	1.04	1.25	31.75	5.80	25.80	0.50	2.22	2.34	59.44	4.8	0.841
E0500-041-1370							1.37	34.80					2.83	71.88	3.6	0.630
E0500-041-1500							1.50	38.10					3.32	84.33	2.9	0.508
E0500-041-1750							1.75	44.45					4.29	108.97	2.0	0.350
E0500-041-2000							2.00	50.80					5.33	135.38	1.5	0.263
E0500-041-2250	2.25	57.15					6.30	160.02					1.3	0.228		
E0500-041-2500	2.50	63.50			7.31	185.67	1.1	0.193								
E0500-041-2750	2.75	69.85			8.34	211.84	1.0	0.175								
E0500-041-3000	3.00	76.20			9.38	238.25	0.8	0.140								
E0500-041-3500	3.50	88.90			11.32	287.53	0.7	0.123								
E0500-041-4000	4.00	101.60			13.34	338.84	0.6	0.105								
E0500-041-4500	4.50	114.30			15.41	391.41	0.5	0.088								
E0500-041-5000	5.00	127.00	17.43	442.72	0.4	0.070										
E0500-045-1250	0.045	1.14	0.045	1.14	1.25	31.75	7.50	33.36	0.70	3.11	2.00	50.80	9.3	1.629		
E0500-045-1370					1.37	34.80					2.58	65.53	5.6	0.981		
E0500-045-1500					1.50	38.10					2.94	74.68	4.6	0.806		
E0500-045-1750					1.75	44.45					3.79	96.27	3.3	0.578		
E0500-045-2000					2.00	50.80					4.61	117.09	2.6	0.455		
E0500-045-2250					2.25	57.15					5.49	139.45	2.1	0.368		
E0500-045-2500			2.50	63.50	6.36	161.54	1.8	0.315								
E0500-045-2750			2.75	69.85	7.23	183.64	1.6	0.280								
E0500-045-3000			3.00	76.20	8.10	205.74	1.4	0.245								
E0500-045-3500			3.50	88.90	9.64	244.86	1.1	0.193								
E0500-045-4000			4.00	101.60	11.39	289.31	0.9	0.158								
E0500-045-4500			4.50	114.30	13.08	332.23	0.8	0.140								
E0500-045-5000	5.00	127.00	14.78	375.41	0.7	0.123										
E0500-049-1250	0.049	1.24	0.049	1.24	1.25	31.75	9.75	43.37	0.88	3.91	1.88	47.75	14.0	2.45		
E0500-049-1370					1.37	34.80					2.25	57.15	10.1	1.769		
E0500-049-1500					1.50	38.10					2.64	67.06	7.8	1.366		
E0500-049-1750					1.75	44.45					3.39	86.11	5.4	0.946		
E0500-049-2000					2.00	50.80					4.14	105.16	4.2	0.736		
E0500-049-2250					2.25	57.15					4.89	124.21	3.4	0.595		
E0500-049-2500			2.50	63.50	5.64	143.26	2.8	0.490								
E0500-049-2750			2.75	69.85	6.39	162.31	2.4	0.420								
E0500-049-3000			3.00	76.20	7.14	181.36	2.1	0.368								
E0500-049-3500			3.50	88.90	8.64	219.46	1.7	0.298								
E0500-049-4000			4.00	101.60	10.15	257.81	1.4	0.245								
E0500-049-4500			4.50	114.30	11.67	296.42	1.2	0.210								
E0500-049-5000	5.00	127.00	13.15	334.01	1.1	0.193										

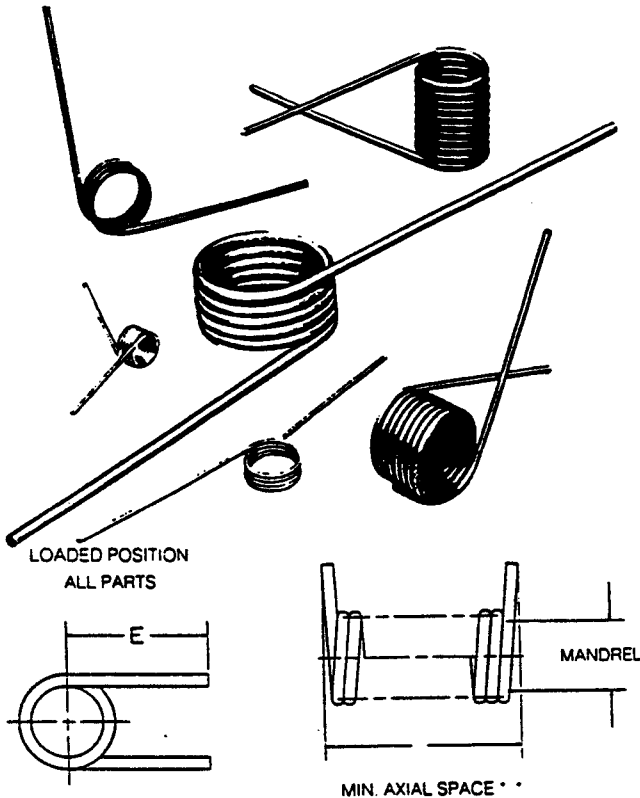
†For stainless steel, multiply values by 0.833.

*When inquiring or ordering, use letter "M" or letter "S" as suffix on catalog numbers to designate music wire or stainless-steel wire, respectively.

**Initial tension is for reference only and may vary.

Torsion Springs

Stock sizes in stainless steel



Associated Spring torsion springs are widely used to store and release energy of rotation or to maintain a pressure over a short distance. Our stock selection includes torsion springs with four end positions, as shown in the drawings on this page.

SPEC torsion springs are normally used over a supporting mandrel or arbor. Suggested mandrel sizes allow about 10% clearance at the deflections listed. If greater deflections are used, the arbor size should be reduced. Sufficient room (minimum axial space) must be provided in the assembly for the spring to function properly. The minimum axial space does not refer to the length of the coils.

SPEC torsion springs should be used in the direction that winds the coils. In the unwinding direction the maximum load is lower because of residual stresses.

Torque values listed are recommended maximum torques. These values can be increased about 20% for static conditions with only slight setting.

For inspection purposes the load should be applied at $\frac{1}{2}$ leg length (E). Using other lengths appreciably alter the active length of wire and affect the test results.

The torque values listed can be translated to direct load

by use of the formula $P = \frac{M}{E_n}$ where P is the load applied

at the new leg length E_n . Example: For part T012-090-055, what is the load when $E_n = 0.187$? $P = \frac{M}{E_n} = \frac{0.047}{0.187} = 0.25$ lb.

The torque values listed will be attained at the deflections listed. Torque values at intermediate deflections can be computed by direct proration. Example: For part T030-180-250, the torque at 90 deg deflection is 0.312 in-lb.

Material

Stainless steel

Commercial Type 302 ASTM-A313 or AMS 5688 (chemical & physical only)

No charge for certificate of compliance when requested; certificate of chemical analysis available, see price book. See Page 77 for music wire torsion springs.

Direction of Helix

Must be specified by suffix to catalog number. Use L for left-hand wound, R for right-hand wound.

Ends

Straight torsion ends are standard.

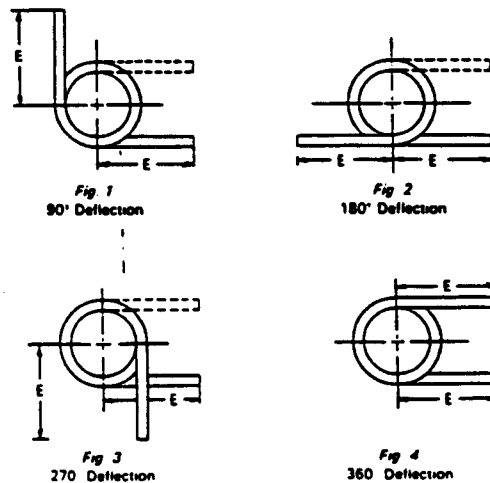
Finish

Plain finish is standard. Allow additional time for special finishes.

Tolerances

Torque = 10%
O.D. = 5%

Figures show springs wound left-hand



Dotted lines represent final loaded position.

STOCK TORSION SPRINGS

Stainless Steel



Associated Spring
Raymond BARNES

CATALOG NUMBER	Wire Diameter		Outside Diameter		Pos. of Ends	Def. Deg.	Torque M		Test Point % E		Suggested Mandrel Size		E		Min. Axial Space**	
	in	mm	in	mm			Fig.	in-lb	N-mm	in	mm	in	mm	in	mm	in
T032-090-172	0.032	0.81	0.288	7.32	1	90	0.820	92.7	0.500	12.70	0.172	4.36	1.000	25.40	0.152	3.86
T032-180-156			0.270	6.86	2	180			0.500	12.70	0.156	3.96	1.000	25.40	0.272	6.91
T032-270-156			0.264	6.71	3	270			0.500	12.70	0.156	3.96	1.000	25.40	0.382	9.70
T032-180-218			0.366	9.30	2	180			0.500	12.70	0.218	5.54	1.000	25.40	0.208	5.28
T032-270-218			0.354	8.99	3	270			0.500	12.70	0.218	5.54	1.000	25.40	0.296	7.52
T032-360-234			0.382	9.70	4	360			0.500	12.70	0.234	5.95	1.000	25.40	0.352	8.94
T035-090-187	0.035	0.89	0.315	8.00	1	90	1.000	113.0	0.625	15.88	0.187	4.75	1.250	31.75	0.135	3.43
T035-180-187			0.303	7.70	2	180			0.625	15.88	0.187	4.75	1.250	31.75	0.290	7.37
T035-270-187			0.311	7.90	3	270			0.625	15.88	0.187	4.75	1.250	31.75	0.442	11.23
T035-180-281			0.450	11.43	2	180			0.625	15.88	0.281	7.14	1.250	31.75	0.212	5.38
T035-270-281			0.435	11.05	3	270			0.625	15.88	0.281	7.14	1.250	31.75	0.328	8.33
T035-360-312			0.471	11.96	4	360			0.625	15.88	0.312	7.92	1.250	31.75	0.405	10.29
T038-090-234	0.038	0.97	0.386	9.80	1	90	1.190	134.5	0.625	15.88	0.234	5.94	1.250	31.75	0.180	4.57
T038-180-218			0.368	9.35	2	180			0.625	15.88	0.218	5.54	1.250	31.75	0.323	8.20
T038-270-218			0.353	8.97	3	270			0.625	15.88	0.218	5.54	1.250	31.75	0.465	11.81
T038-180-312			0.487	12.37	2	180			0.625	15.88	0.318	8.08	1.250	31.75	0.247	6.27
T038-270-312			0.477	12.12	3	270			0.625	15.88	0.312	7.92	1.250	31.75	0.352	8.94
T038-360-328			0.514	13.06	4	360			0.625	15.88	0.328	8.33	1.250	31.75	0.418	10.62
T040-090-187	0.040	1.02	0.309	7.85	1	90	1.375	155.4	0.625	15.88	0.187	4.75	1.250	31.75	0.198	5.03
T040-180-218			0.348	8.84	2	180			0.625	15.88	0.218	5.54	1.250	31.75	0.374	9.50
T040-270-218			0.358	9.09	3	270			0.625	15.88	0.218	5.54	1.250	31.75	0.550	13.97
T040-180-343			0.518	13.16	2	180			1.000	25.40	0.343	8.71	2.000	50.80	0.242	6.15
T040-270-343			0.511	12.98	3	270			1.000	25.40	0.343	8.71	2.000	50.80	0.374	9.50
T040-360-343			0.507	12.88	4	360			1.000	25.40	0.343	8.71	2.000	50.80	0.508	12.90
T045-090-203	0.045	1.14	0.357	9.07	1	90	2.000	226.	0.625	15.88	0.203	5.16	1.250	31.75	0.259	6.58
T045-180-218			0.377	9.58	2	180			0.625	15.88	0.218	5.54	1.250	31.75	0.427	10.85
T045-270-234			0.382	9.70	3	270			0.625	15.88	0.234	5.94	1.250	31.75	0.595	15.11
T045-180-359			0.575	14.61	2	180			1.000	25.40	0.359	9.12	2.000	50.80	0.293	7.44
T045-270-359			0.556	14.12	3	270			1.000	25.40	0.359	9.12	2.000	50.80	0.415	10.54
T045-360-359			0.549	13.94	4	360			1.000	25.40	0.359	9.12	2.000	50.80	0.540	13.72
T048-090-218	0.048	1.22	0.375	9.53	1	90	2.500	282.	0.625	15.88	0.218	5.54	1.250	31.75	0.238	6.05
T048-180-250			0.404	10.26	2	180			0.625	15.88	0.250	6.35	1.250	31.75	0.450	11.43
T048-270-250			0.416	10.57	3	270			0.625	15.88	0.250	6.35	1.250	31.75	0.660	16.76
T048-180-406			0.618	15.70	2	180			1.000	25.40	0.406	10.31	2.000	50.80	0.292	7.42
T048-270-406			0.600	15.24	3	270			1.000	25.40	0.406	10.31	2.000	50.80	0.450	11.43
T048-360-406			0.594	15.09	4	360			1.000	25.40	0.406	10.31	2.000	50.80	0.610	15.49
T051-090-234	0.051	1.30	0.408	10.36	1	90	2.900	328.	1.000	25.40	0.234	5.94	2.000	50.80	0.293	7.44
T051-180-250			0.430	10.92	2	180			1.000	25.40	0.250	6.35	2.000	50.80	0.485	12.32
T051-270-266			0.439	11.15	3	270			1.000	25.40	0.266	6.76	2.000	50.80	0.675	17.15
T051-180-344			0.556	14.12	2	180			1.000	25.40	0.344	8.74	2.000	50.80	0.382	9.70
T051-270-359			0.571	14.50	3	270			1.000	25.40	0.359	9.12	2.000	50.80	0.522	13.26
T051-360-406			0.628	15.95	4	360			1.000	25.40	0.406	10.31	2.000	50.80	0.615	15.62
T054-090-296	0.054	1.37	0.484	12.29	1	90	3.275	370.	1.000	25.40	0.296	7.52	2.000	50.80	0.310	7.87
T054-180-312			0.509	12.93	2	180			1.000	25.40	0.312	7.92	2.000	50.80	0.512	13.00
T054-270-312			0.514	13.06	3	270			1.000	25.40	0.312	7.92	2.000	50.80	0.715	18.16
T054-180-421			0.654	16.61	2	180			1.000	25.40	0.421	10.69	2.000	50.80	0.405	10.26
T054-270-437			0.664	16.61	3	270			1.000	25.40	0.437	11.10	2.000	50.80	0.555	14.10
T054-360-453			0.694	16.61	4	360			1.000	25.40	0.453	11.51	2.000	50.80	0.705	17.91
T059-090-296	0.059	1.50	0.499	12.67	1	90	4.200	475.	1.000	25.40	0.296	7.52	2.000	50.80	0.340	8.64
T059-180-328			0.526	13.36	2	180			1.000	25.40	0.328	8.33	2.000	50.80	0.560	14.22
T059-270-328			0.537	13.64	3	270			1.000	25.40	0.328	8.33	2.000	50.80	0.785	19.94
T059-180-437			0.681	17.30	2	180			1.000	25.40	0.437	11.10	2.000	50.80	0.445	11.30
T059-270-453			0.699	17.75	3	270			1.000	25.40	0.453	11.51	2.000	50.80	0.605	15.37
T059-360-459			0.709	18.01	4	360			1.000	25.40	0.459	11.66	2.000	50.80	0.770	19.56
T063-090-343	0.063	1.60	0.560	14.22	1	90	5.150	582.	1.000	25.40	0.343	8.71	2.000	50.80	0.362	9.19
T063-180-359			0.591	15.01	2	180			1.000	25.40	0.359	9.12	2.000	50.80	0.600	15.24
T063-270-375			0.600	15.24	3	270			1.000	25.40	0.375	9.53	2.000	50.80	0.835	21.21
T063-180-500			0.767	19.48	2	180			1.000	25.40	0.500	12.70	2.000	50.80	0.475	12.07
T063-270-516			0.784	19.91	3	270			1.000	25.40	0.516	13.11	2.000	50.80	0.645	16.38
T063-360-516			0.798	20.27	4	360			1.000	25.40	0.516	13.11	2.000	50.80	0.820	20.83
T070-090-359	0.070	1.78	0.593	15.06	1	90	7.000	791.	1.000	25.40	0.359	9.12	2.000	50.80	0.400	10.16
T070-180-390			0.625	15.88	2	180			1.000	25.40	0.390	9.91	2.000	50.80	0.665	16.89
T070-270-390			0.639	16.23	3	270			1.000	25.40	0.390	9.91	2.000	50.80	0.930	23.62
T070-180-515			0.810	20.57	2	180			1.000	25.40	0.515	13.08	2.000	50.80	0.525	13.34
T070-270-531			0.826	20.98	3	270			1.000	25.40	0.531	13.49	2.000	50.80	0.717	18.21
T070-360-546			0.843	21.41	4	360			1.000	25.40	0.546	13.87	2.000	50.80	0.910	23.11

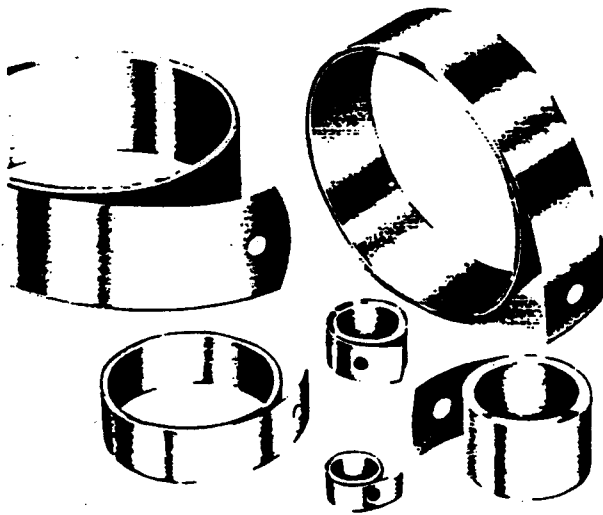
*Indicate direction of helix desired by suffix to catalog number — L for left hand wound, R for right hand wound.

**Space needed on application to allow for operation of the spring. This dimension does not refer to the length of the coils.



Constant-force Springs

Stock sizes in stainless steel



Constant-force springs are a special variety of extension spring. They consist of a spiral of strip material with built-in curvature so that each turn of the strip wraps tightly on its inner neighbor. When the strip is extended (deflected) the inherent stress resists the loading force, just as in a common extension spring, but at a nearly constant (zero) rate. The accompanying load/deflection curves illustrate this.

The constant-force spring is well suited to long extensions with no load build-up. In use, the spring is usually mounted with the ID tightly wrapped on a drum and the free end attached to the loading force, such as in a counterbalance application. This relationship can be reversed, however, with the free end mounted stationary and the spring itself providing the working force, as with carbon brushes in electrical apparatus.

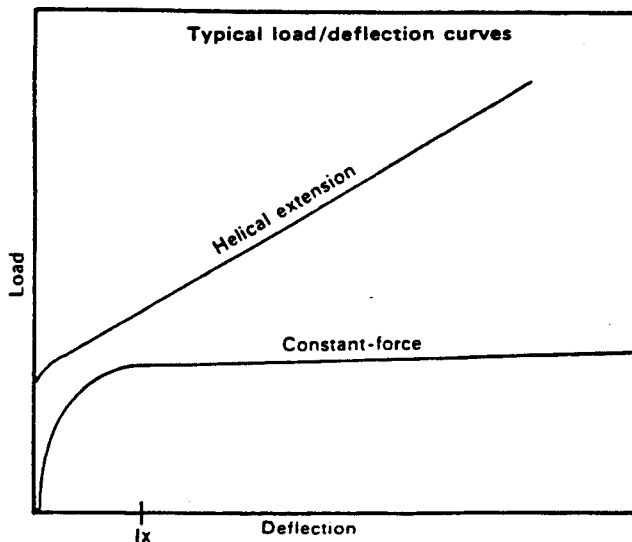
Considerable flexibility is possible with constant-force springs because the load capacity can be multiplied by using two or more strips in tandem, back-to-back, or laminated, as illustrated.

Material

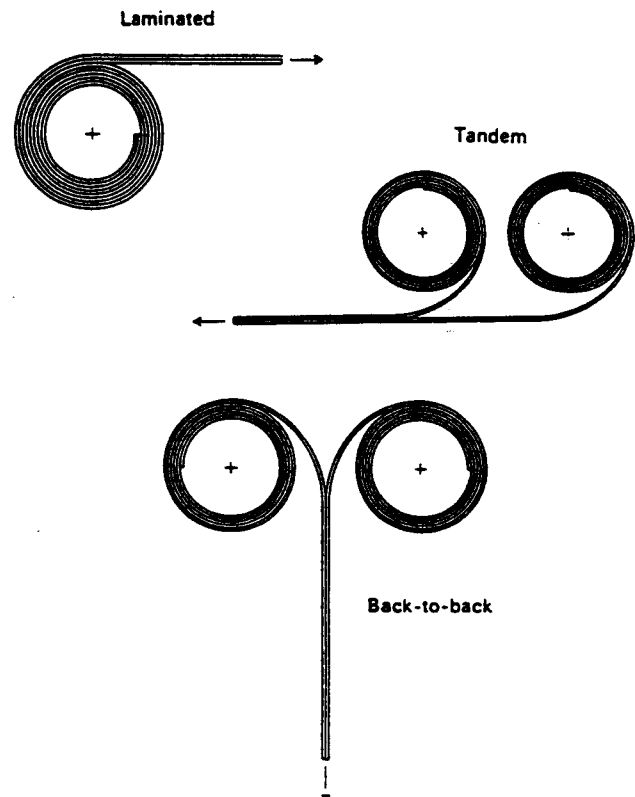
Type 301 stainless steel.

Note

Be sure to allow at least 1½ coils of material on the drum at full extension. The spring ID will wrap tightly on the drum so that in most applications no fastening method on the drum is required.



How to multiply constant-force spring load



STOCK CONSTANT-FORCE SPRINGS

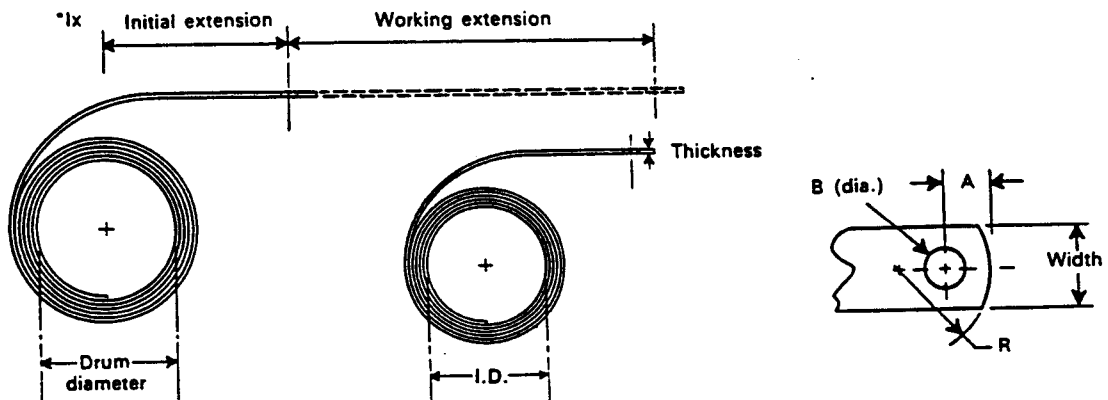
Stainless Steel



Associated Spring
Raymond BARNES

CATALOG NUMBER	Thickness		Width		Length		Initial Extension		Working Ext.		I.D. (Reference)		Drum Diameter		Load ±10%		End Configuration					
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lb	N	A		B		R	
																	in	mm	in	mm	in	mm
Fatigue Life 4,000 Cycles																						
CF015-0050	0.004	0.10	0.25	6.35	15	381	0.61	15.49	12	305	0.34	8.64	0.40	10.16	0.50	2.22	3/8	9.5	0.131	3.3	1/2	12.7
CF018-0075	0.005	0.13	0.31	7.87	18	457	0.75	19.05	15	381	0.42	10.67	0.50	12.70	0.75	3.34	3/8	9.5	0.131	3.3	1/2	12.7
CF022-0112	0.006	0.15	0.37	9.40	22	559	0.92	23.37	18	457	0.51	12.95	0.62	15.75	1.12	4.98	3/8	9.5	0.131	3.3	1/2	12.7
CF026-0162	0.007	0.18	0.50	12.70	26	660	1.06	26.92	21	533	0.59	14.99	0.75	19.05	1.62	7.21	3/8	9.5	0.131	3.3	1/2	12.7
CF030-0237	0.008	0.20	0.59	14.99	30	762	1.22	30.99	24	610	0.68	17.27	0.87	22.10	2.37	10.54	3/8	9.5	0.187	4.7	3/8	22.2
CF034-0350	0.010	0.25	0.68	17.27	34	864	1.53	38.86	27	686	0.85	21.59	1.00	25.40	3.50	15.57	3/8	9.5	0.187	4.7	3/8	22.2
CF038-0500	0.012	0.30	0.81	20.57	38	965	1.84	46.74	30	762	1.02	25.91	1.25	31.75	5.00	22.24	3/8	9.5	0.187	4.7	3/8	22.2
CF043-0700	0.014	0.36	1.00	25.40	43	1092	2.14	54.36	33	838	1.19	30.23	1.50	38.10	7.00	31.14	3/8	9.5	0.187	4.7	3/8	22.2

Fatigue Life 40,000 Cycles																						
CATALOG NUMBER	Thickness		Width		Length		Initial Extension		Working Ext.		I.D. (Reference)		Drum Diameter		Load ±10%		End Configuration					
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	lb	N	A		B		R	
																	in	mm	in	mm	in	mm
CF021-0025	0.006	0.15	0.37	9.40	21	533	2.03	51.56	12	305	1.13	28.70	1.36	34.54	0.25	1.11	3/8	9.5	0.131	3.3	1/2	12.7
CF025-0037	0.007	0.18	0.50	12.70	25	635	2.36	59.94	15	381	1.31	33.27	1.58	40.13	0.37	1.65	3/8	9.5	0.131	3.3	1/2	12.7
CF030-0050	0.008	0.20	0.59	14.99	30	762	2.72	69.09	18	457	1.51	38.35	1.81	45.97	0.50	2.22	3/8	9.5	0.187	4.7	3/8	22.2
CF036-0075	0.010	0.25	0.68	17.27	36	914	3.38	85.85	21	533	1.88	47.75	2.26	57.40	0.75	3.34	3/8	9.5	0.187	4.7	3/8	22.2
CF042-0112	0.012	0.30	0.81	20.57	42	1067	4.07	103.40	24	610	2.26	57.40	2.71	68.83	1.12	4.98	3/8	9.5	0.187	4.7	3/8	22.2
CF048-0162	0.014	0.36	1.00	25.40	48	1219	4.74	120.40	27	686	2.63	66.80	3.16	80.26	1.62	7.21	3/8	9.5	0.187	4.7	3/8	22.2



*Initial extension is the minimum amount of extension needed to operate the spring and achieve a linear rate. (see chart page 77)

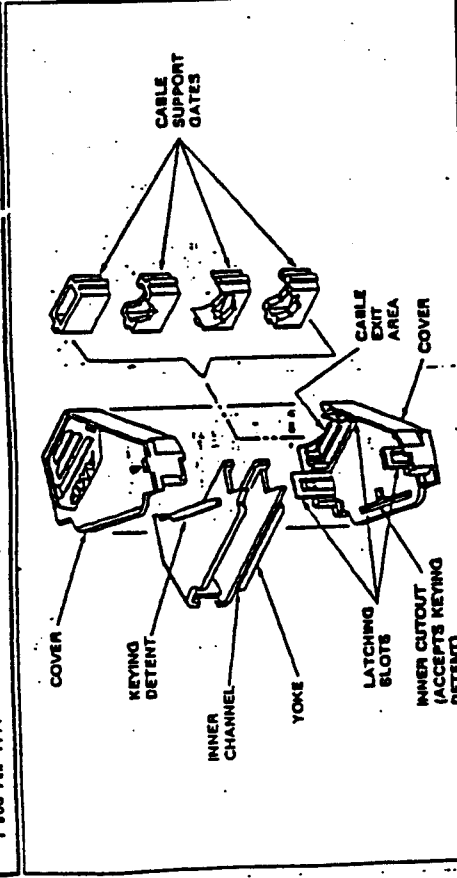
AMPLIMITE CABLE CLAMP KITS

AMP
AMP INCORPORATED
HARRISBURG, PA. 17108
CUSTOMER HOTLINE
1 800 732-1111

AMP® AMPLIMITE®
HDP-20 AND HDE-20 CONNECTORS
THREE-PIECE AND TWO-PIECE
CABLE CLAMP KITS
(STRAIGHT AND RIGHT-ANGLE)

RELEASED
2-4-88

IS 6659



NO. OF CONT POSN	PART NUMBERS				CONN TYPE
	AMPLIMITE HDP-20 (Metal Shell) CONNECTORS	AMPLIMITE HDE-20 (Metal Shell) CONNECTORS	AMPLIMITE HDE-20 (AI-Plastic) CONNECTORS		
25	205206	746486	745211		Plug
	207484				
	205438	746285	745209		Rcpt
	205207				
37	207483	746488	745215		Plug
	205441				
	205310	745497	745213		Rcpt
	205437				
	205208				
	205442				

Fig. 1 Two-piece kits are designed for the AMPLIMITE HDE-20 connectors listed in Figure 4. Read these instructions carefully before assembling any kits.

1. INTRODUCTION This instruction sheet (IS) covers the assembly and specification procedures for AMPLIMITE connector two- and three-piece cable clamp kits. All kits contain parts manufactured from black thermoplastic material. The three-piece kits are designed for the AMPLIMITE HDP-20 and HDE-20 connectors listed in Figure 1. The

NOTE All dimensions presented on this instruction sheet are in inches.

IS 6659

2. DESCRIPTION

Three-piece kits 745308 and 745311 can be used in either 90° (right-angle) or 180° (straight) cable-exit applications. Each three-piece kit features a yoke, two mating covers and cable support gates. The yokes contained in kits 745308 and 745311 feature inner channels which slide onto the connector flange during assembly. The yoke also has two keying detents to accept the inner channels of the covers. Each cover features three latching areas and a cable-exit area. One cover has latching slots which are secured to the latching tabs of the other cover. Each cover also features an inner channel which accepts the detent bars of the yoke. The cable-exit areas will accept one of the four available cable support gates supplied with the kit. Except for kit 745550, each two-piece kit features two mating covers and assorted cable support gates. Kit 745550 consists of two covers with "built-in" cable support gates. Two-piece kits 745547, 745553, and 745560 are designed for 180° cable-exit applications only and kit 745550 is used with 90° cable-exit applications only. Two-piece kits have the same latching features as the three-piece kits; one cover has latching slots which are secured to the latching tabs of the other cover.

The cable support gates are designed to restrict the aperture diameter of the cable exit area depending on the diameter of the cable or wire bundle being used. The cable support gates should provide sufficient clearance of the cable exit area to provide strain relief for the conductor bundle or latched cable being used. The cable-exit areas of kits 745308, 745311, and 745550 will accommodate discrete wires or jacketed other cover.

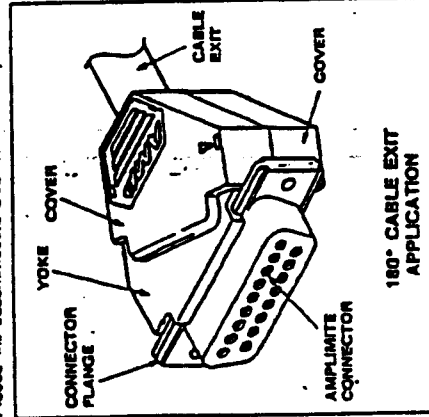


Fig. 2

cable up to .550 in. in diameter. The cable-exit area of kit 745547 and 745550 will accommodate up to .330 in. in diameter and the cable-exit area of kit 745553 will accommodate up to .425 in. in diameter.

NOTE If you are using a three-piece kit, follow the procedures in Sections 3 and 3; if you are using a two-piece kit, proceed to Sections 4 and 3.

3. ASSEMBLY PROCEDURE, THREE-PIECE KITS

Determine that you have the correct cable clamp kit for the connector you are using. Then proceed as follows:

1. Terminate the conductors in the connector you are using according to the instructions packaged with the tooling.

NOTE Ensure that you maintain 1-in. length on individual conductors when using jacketed cable.

2. Slide the yoke onto the connector flange.
3. Lay the cover with the latching slots on a flat surface with the slots in an upright position. See Figure 1.
4. Depending on the cable-exit orientation you desire (straight or right angle), lay the yoke and connector assembly in the cover. See Figures 2 and 3.

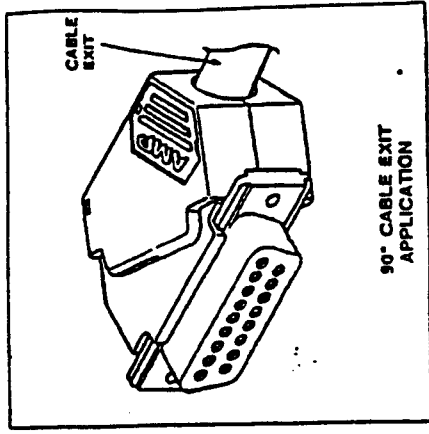
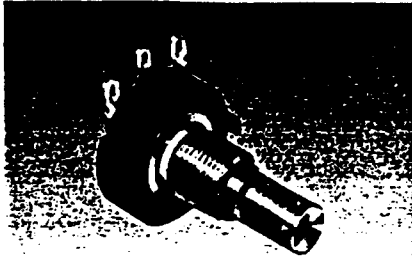


Fig. 3

Amp



BOURNS®

3/4" (19MM) DIAMETER / CERMET OR CONDUCTIVE PLASTIC

- Single-turn (3851 and 3852)
- 3 -3/4-turn (3856)
- Minimal depth package
- Good resolution
- Linear and audio tapers
- Wide resistance range

FOR ORDERING INFORMATION SEE PAGE 258.

Models 3851/3852/3856

Bourns® Panel Controls

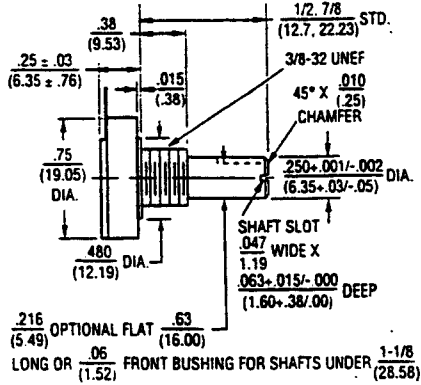
Initial Electrical Characteristics ¹	3851 Conductive Plastic Element	3852/3856 Cermet Element
Standard Resistance Range		
Linear Tapers (A, B, E, and H)	1K to 2.5 megohms	50 ohms to 5 megohms
audio Tapers (C, D, F, and G)	750 ohms to 2.5 megohms	1K ohms to 2.5 megohms
Resistance Tolerance	±20%	±10%
Zero Base Linearity	(B, D, & G tapers) ±20% (E taper) ±10%	(A, C, & F tapers) ±10% (H taper) ±5%
Independent Linearity	±10%	(A & H tapers) ±5%
Absolute Minimum Resistance	2 ohms maximum	2 ohms maximum
Continuity	Maintained for full mechanical angle	Maintained for full mechanical angle
Effective Electrical Angle	250° ±5°	250° ±5°
Contact Resistance Variation	±1%	±3% of total resistance or 3 ohms (whichever is greater)
Dielectric Withstanding Voltage	MIL-STD-202, Method 301	MIL-STD-202, Method 301
Sea Level	900 VAC minimum	900 VAC minimum
70,000 Feet	350 VAC minimum	350 VAC minimum
Insulation Resistance (500 VDC)	1,000 megohms minimum	1,000 megohms minimum
Power Rating (Voltage Limited By Power Dissipation or 316 VAC, Whichever Is Less)		
+70°C	(B & E tapers) 1 watt (D & G tapers) 0.5 watt	(A & H tapers) 2 watts (C & F tapers) 1 watt
+125°C	0 watt	
+150°C		0 watt
Theoretical Resolution	Essentially infinite	Essentially infinite
Environmental Characteristics¹		
Storage Temperature Range	-65°C to +125°C	-65°C to +150°C
Temperature Coefficient		
Over Storage Temperature Range	±1,000PPM/°C	±150PPM/°C
Vibration	20G	20G
Total Resistance Shift	±2% maximum	±2% maximum
Voltage Ratio Shift	±5% maximum	±6% maximum
Shock	100G	100G
Total Resistance Shift	±2% maximum	±2% maximum
Voltage Ratio Shift	±5% maximum	±6% maximum
Load Life	1,000 hours	1,000 hours
Total Resistance Shift	±10% maximum	±3% maximum
Rotational Life (No Load)	100,000 cycles	50,000 cycles
Total Resistance Shift	±15% maximum	±5% or 5 ohms (whichever is greater)
Moisture Resistance	MIL-STD-202, Method 103, Condition B	MIL-STD-202, Method 103, Condition B
Total Resistance Shift	±10% maximum	±2% maximum
Insulation Resistance (500 VDC)	100 megohms minimum	100 megohms minimum
Mechanical Characteristics¹		
Shaft Torque	(A & B bushings) .05 to 6.0 oz.-in. (0.35 to 4.23 Ncm) (C & E bushings) 0.3 to 6.0 oz.-in. (0.21 to 4.23 Ncm)	3852 (A & B bushings) 0.5 to 6.0 oz.-in. (0.35 to 4.23 Ncm) (C & E bushings) 0.3 to 6.0 oz.-in. (0.21 to 4.23 Ncm) 3856 — 0.15 to 3.0 oz.-in. (0.11 to 2.12 Ncm)
Stop Strength	5 in.-lb. (56.5 Ncm)	5 in.-lb. (56.5 Ncm)
Mechanical Angle	280° ±5°	3852 — 280° ±5° 3856 — 1350° ±50°
Weight	30 grams maximum	30 grams maximum
Terminals	Printed circuit terminals or solder lugs	Printed circuit terminals or solder lugs
Marking	Manufacturer's trademark, wiring diagram, date code, resistance, manufacturer's part number manufacturer's part number	Manufacturer's trademark, wiring diagram, date code, resistance, manufacturer's part number resistance, manufacturer's part number

¹At room ambient: +25°C nominal and 50% relative humidity nominal, except as noted.

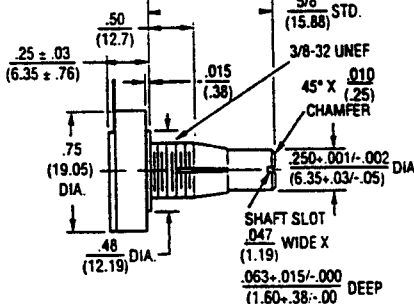
Specifications are subject to change without notice.

DIMENSIONAL DRAWINGS AND TOLERANCES Model 3851/3852/3856

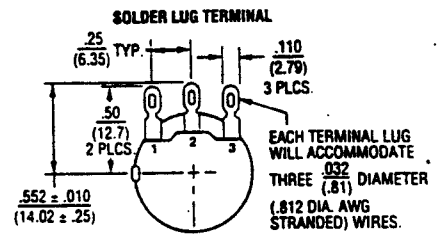
3851A/3852A



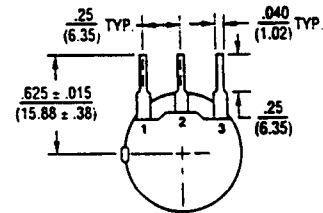
3851B/3852B



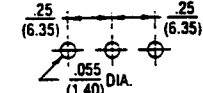
Terminal Configuration



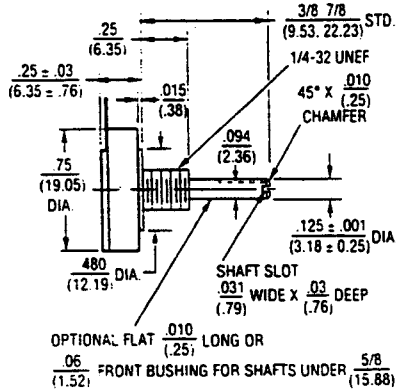
STANDARD PRINTED CIRCUIT TERMINAL



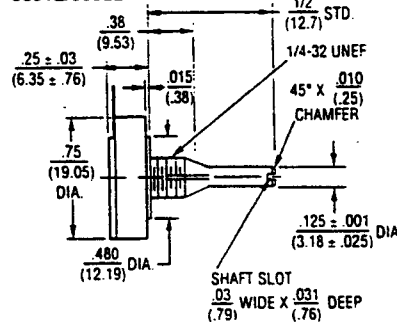
SUGGESTED BOARD LAYOUT



3851C/3852C

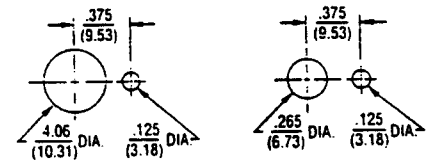


3851E/3852E

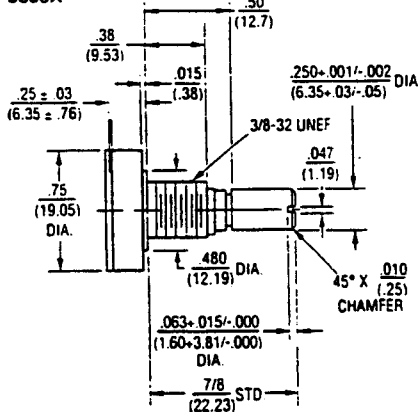


3851/3852/3856

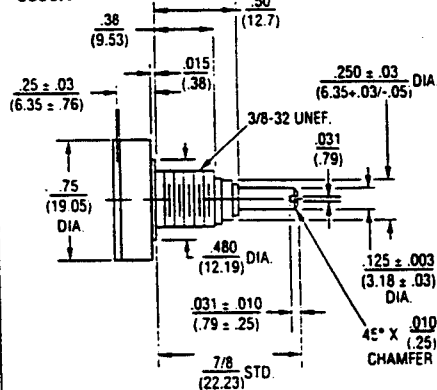
A, B & H BUSHINGS



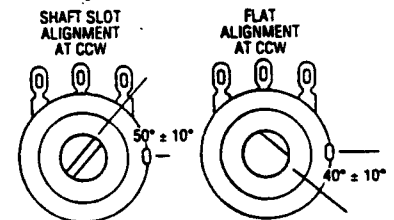
3856A



3856H



Shaft End Detail 3850 Family

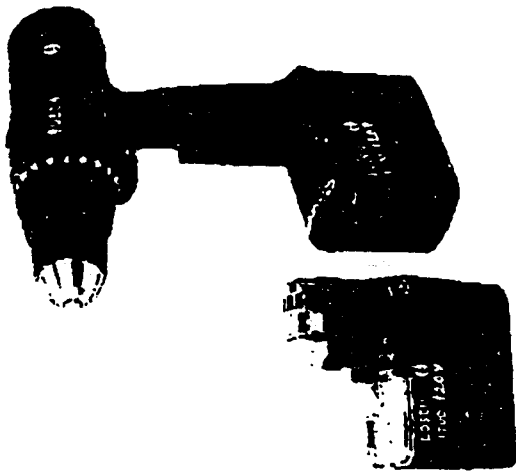


TOLERANCES EXCEPT AS NOTED:
 DECIMALS: .XXX $\pm \frac{.005}{(.127)}$, .XX $\pm \frac{.015}{(.38)}$
 FRACTIONS: $\pm \frac{1}{64}$
 ANGLE: $\pm 3^\circ$

BOSCH

PRODUCT SUMMARY

MODEL: 3310K-10
PRODUCT: 12 Volt Drill Driver
UPC CODE: 000 346 301960

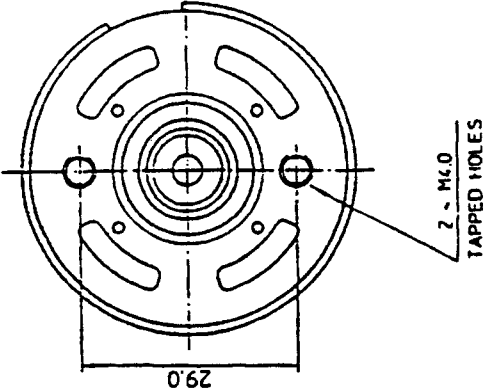


KEY PRODUCT FEATURES:

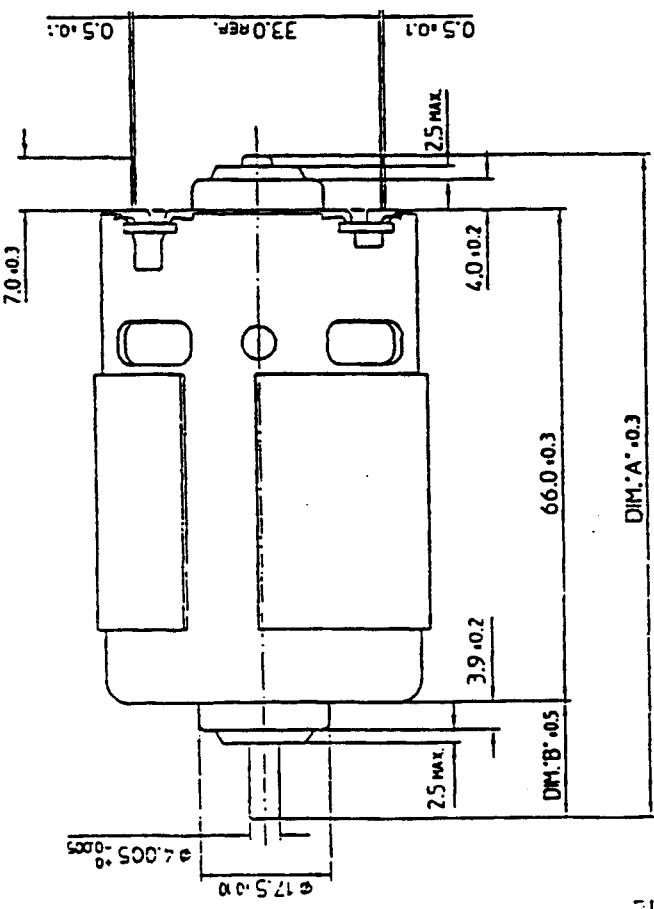
- 12 Volt Power
- 225 Inch Lbs Torque
- T-Handle Styling and Balance
- VSR Switch 0-400 / 0-1200 RPM
- Clutch with 15 Torque Settings

Bosch

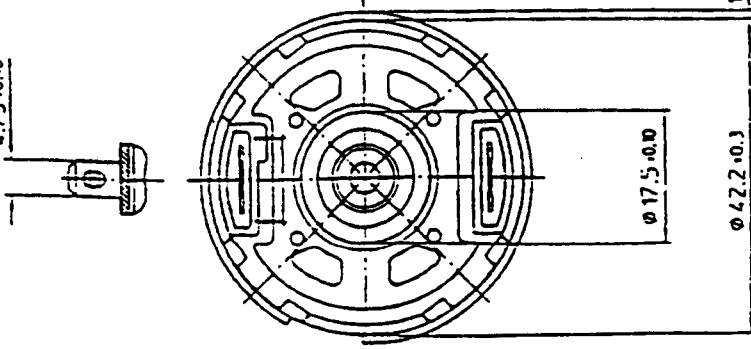
ROTATION



S.E. APPROVED
 BY: *[Signature]*
 DATE: 13-3-82



4.75 ± 0.10



ALT REF	DESCRIPTION	BY	DATE
MATERIAL	FINISH		
TOLERANCES 1 DEC. PLACES ± 0.15 2 DEC. PLACES ± 0.1 ANGULAR ± 2'			
TITLE		SCALE	DATE
(HC 785 LG)		OWN. BY	1/2
MOTOR OUTLINE		CHK. BY	
JOHNSON ELECTRIC IND. MFTY. LTD.		APP. BY	
JOHNSON BUILDING, CHAI WAN, HONGKONG.		DWG. NO.	94J042/05/13

- NOTES:-
1. LENGTH OF SHAFT, DIM 'A' 89.0 mm.
 2. FRONT EXTENSION, DIM 'B' 14.4 mm, MEASURED WITH SHAFT PUSHED AGAINST STEEL END CAP.
 3. DIRECTION OF ROTATION : ANTI-CLOCKWISE WHEN VIEWING MOTOR OUTPUT END WITH POSITIVE VOLTAGE APPLIED TO POSITIVE TERMINAL.
 4. END PLAY : 0.5 mm MAX.
 5. ANY VENTILATION HOLES IN THE MOTOR SHOULD NOT BECOME BLOCKED IN FINAL PRODUCT WITHOUT CONSULTATION WITH JOHNSON.
 6. TAPPED / DRAWN HOLES CAN ACCEPT MAX. USABLE MALE SCREW OR PIN LENGTH OF 3.0 mm.

ALL DIMENSIONS ARE IN MILLIMETRES DO NOT SCALE DRAWING



**JOHNSON
ELECTRIC**

JOHNSON ELECTRIC INDUSTRIAL MANUFACTORY LTD.

35 years of excellence in micromotors

Johnson Building, 14-16 Lee Chung Street, Hong Kong

SOF NO : 28189 94J042/05/13

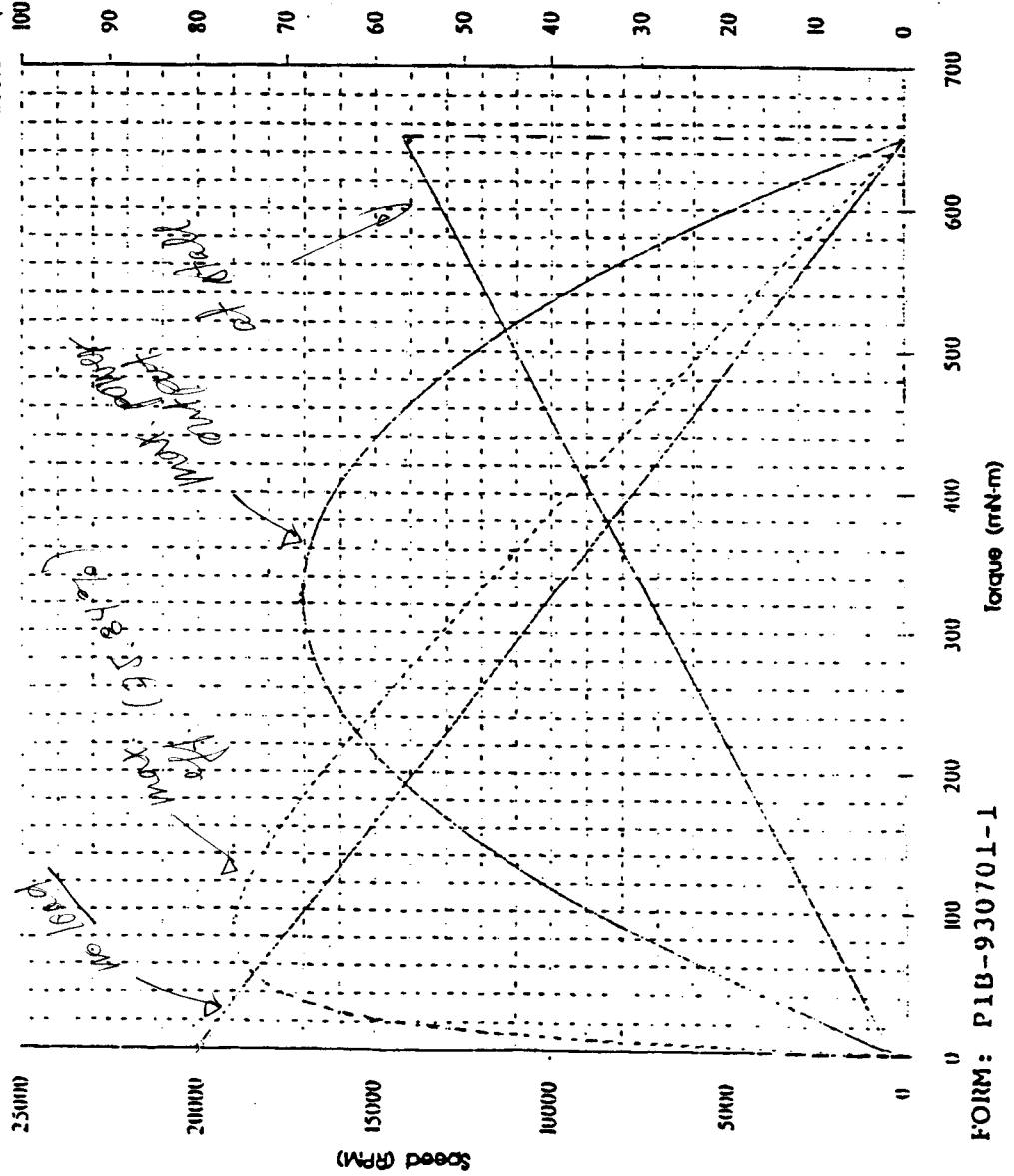
Winding : 80- 10.0

Motor test reference no : HC7851G/ES/35060/3E1/F

Date : 10/09/96

Full scale : ——— 100% eff
500.0 watt
200.0 amp

Performance (In an ambient temperature of 25-30 °C)
Motor tested rapidly to prevent significant temperature rise.
At a constant voltage of : 12.00 Volts
With a circuit resistance of : 0.000 Ohms



AT NO LOAD

Speed : 20023 RPM
Current : 2.450 AMPS

At stall (Extrapolated)

Torque : 650.902 mN-m
Current : 114.002 AMPS

At maximum efficiency

Efficiency : 75.84 %
Torque : 84.628 mN-m
Speed : 17420 RPM
Current : 16.952 AMPS

At maximum Power output

Output : 341.02 Watts
Torque : 325.491 mN-m
Speed : 10012 RPM
Current : 58.226 AMPS

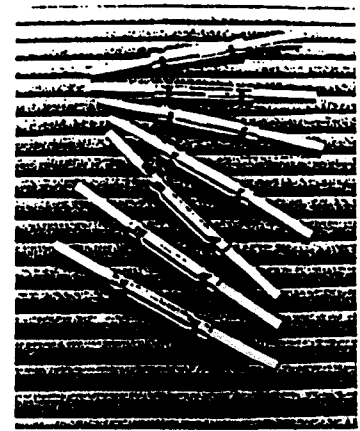
Characteristics

Torque constant : 5.836 mN-m/AMP
E.M.F. constant : 5.836 mV/rad/sec
Dynamic resistance : 0.105 Ohms
Motor regulation : 30.759 PRM/mN-m

FORM: PIB-930701-1

Reed Switch Specification

Clare



SERIES FR2

Clare

Over the past three decades, billions of reed switches have been used in hundreds of applications. Operating in microseconds, they are quiet in operation and need little or no energy for actuation. When driven with an electromagnetic coil, reed switches can accumulate millions of fault-free operations at speeds up to 500 Hz continuously. Reed switches actuated by permanent magnets may lay poised for years, even in hostile environments, and operate perfectly when called upon.

Enhancements made by Clare to reed switch design and manufacturing processes have opened exciting new application possibilities. With more than 30 years experience in reed switch manufacturing, Clare is the world leader in glass-sealed contact technology. Clare DYAD reed switches deliver immediate improvements in end user yields and productivity.

The CLARE FR2 series reed switch is trademarked the DYAD. Unique features of the DYAD include:

- Patented glass to metal seal provides a stronger hermetic seal. Glass breakage is virtually eliminated.
- Sputtered ruthenium contacts provide stable contact resistance throughout life.
- Bifurcated contacts reduce bounce on closure offering faster momentary action and longer life.
- Flat glass dampens the kinetic energy of the blades on opening, virtually eliminating reclosure.
- Flat leads offer more reliable solder, weld, or crimp joints.
- Flat glass and flat leads also lend themselves to surface mount processing capability.

Specifications

Clare

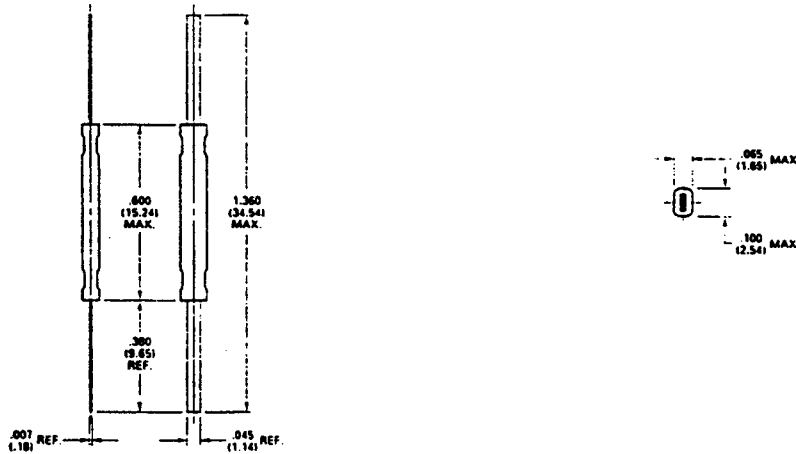
2

PHYSICAL AND MECHANICAL REQUIREMENTS	
■ Contact Form	SPST, Form A (center gap)
■ Contact Material	Ruthenium
■ Standard Overall Length	1.360 inches (34.54mm)
■ Maximum Glass Length	0.600 inches (15.24mm)
■ Terminals*	Nickel iron alloy 52
■ Test Coil	NARM I test coil: See page 3 for details
CONTACT RATING	
■ Maximum Switching Power	10 VA
■ Maximum Switching Voltage	200 VDC, VAC
■ Maximum Switching Current	0.50 A
■ Maximum Continuous Carry Current	1.50 A
ELECTRICAL RATING	
■ Operate Sensitivity Available in Minimum 5 NI Ranges	5-45 NI
■ Maximum Initial Contact Resistance	150 milliohms
■ Minimum Dielectric Voltage	250 VDC
■ Maximum Capacitance	1.0 pF
■ Minimum Insulation Resistance	10 ¹¹ Ohms
OPERATING CHARACTERISTICS	
■ Maximum Operate Time, Including Bounce	0.50 ms
■ Maximum Release Time	0.20 ms
■ Maximum Operating Frequency	500 Hz
■ Operating Temperature Range	-40°C to +125°C
■ Shock	100g, 11 ms, 1/2 sinewave
■ Vibration	20g, or .125" D.A., 10 - 5000 Hz
■ Solderability	As defined by MIL-STD-202 F, Method 208D
■ Resistance to Solvents	The reed switch operating characteristics shall not be affected by water wash, rinse procedures, the use of mild to semi-active fluxes or conformal coating processes.

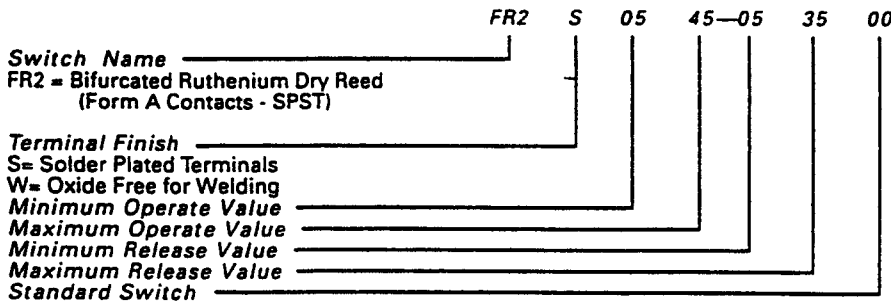
* If the switch is to be soldered in place, a solder plated terminal finish should be specified.

Ordering Information

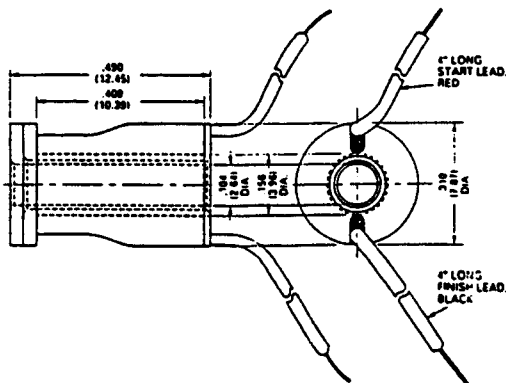
Dimensions



How to Order Clare Reed Switches



Standard Test Coil



Introduction

The magnetic force (expressed in NI, AT, or Ampere Turns) required to cause the reed switch contacts to close is called the pull-in or operate value.

■ Coil Definition	EIA/NARM I Standard
■ Wire size	AWG 46
■ Number of turns	5000 ± 5 turns
■ Coil resistance	1200 Ohms ± 10%
■ Recommended Mounting Conditions	Vertical, with the coil magnetic field opposing the local earth's magnetic field.

The reed switch shall be placed in the test coil with the gap centered in the core of the coil winding.

Test leads and their clips must be non-magnetic.

The longitudinal axis of the test coil and test switch shall be vertical.

Switch Actuation

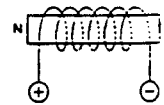
Clare

4

Operation of a Reed Switch Permanent Magnet and Electromagnetic Coil Actuation

The reed switch depends upon an induced magnetic field for its operation. Reed switches are activated by the presence of a magnetic field with sufficient flux to pull the reed blades together.

This can be accomplished by either using a permanent magnet—bringing the magnet close to the switch to turn it on—or by energizing an electromagnetic coil that is mounted around or near the switch. The balance of this page will review the actuating characteristics of a reed switch via these two methods.



Coil Actuation

The operation of a reed switch via an electromagnetic coil provides the designer with a method of actuation from a remote source. This is a very simple method of actuation.

When the reed switch is placed inside or close to a coil of wire and a current is passed through the coil, each lead of the reed switch becomes strongly magnetized. One end of the reed switch will become a north pole and the other a south pole. Because the reed blades overlap in the center of the glass housing, with a few thousandths of an inch separating the overlapping ends, each lead will have a north and south pole. The overlapping reed blades come together (close) when the

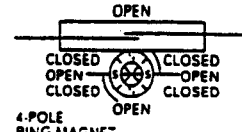
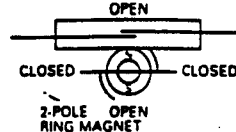
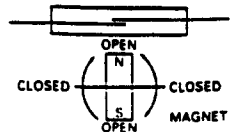
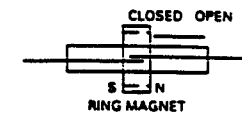
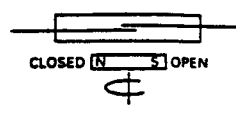
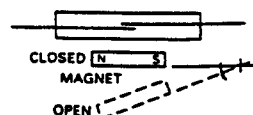
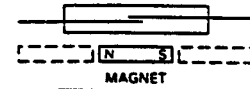
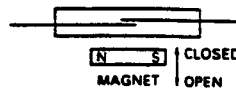
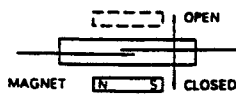
electrical current generates sufficient magnetic flux in the coil. When the current to the coil is turned off, the reed blades return to their open condition.

The efficiency of the reed switch actuation is largely dependent upon the coil. The size, shape, wire type, and the number of turns of wire on the coil determines its efficiency. In addition, the proximity of the switch to the coil determines the efficiency of the coil (ie, if the switch is placed inside or very close to the coil, the coil requires little current to actuate the switch. The farther the switch is from the coil, the more magnetic flux the coil must generate to cause switch closure). Two or more switches can be actuated by a single coil.

Permanent Magnet Actuation

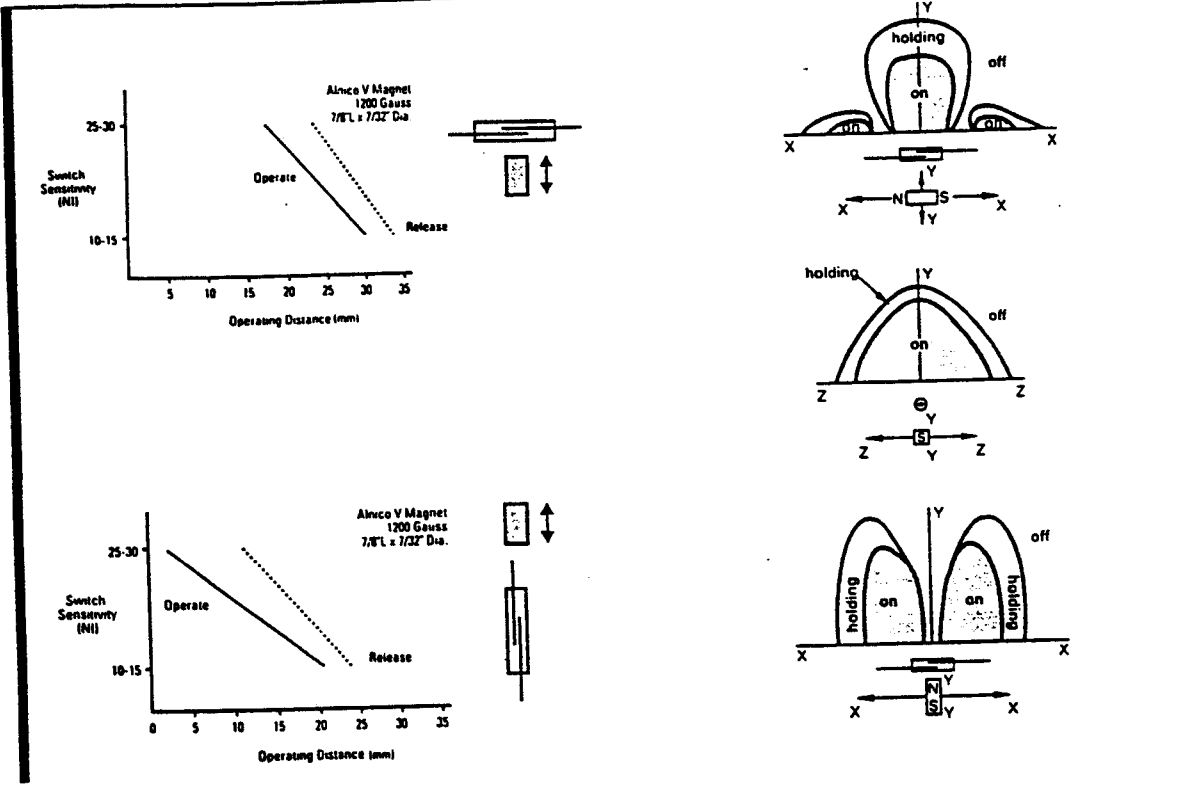
A permanent magnet is the most common means of operating the reed switch. As with a coil, to actuate the reed switch, a magnet and switch must be positioned within a specific proximity of each other. This distance is related to the sensitivity of the switch and the strength of the magnet. For the normally open reed

switch, when the magnetic field is close enough the contacts will close and when the magnetic field is taken away, the contacts will open. There are many ways to use a permanent magnet to actuate the reed switch. Below we have addressed the most popular techniques.



Switch Actuation

Permanent Magnet Actuation Distance (N. O. Contacts)



Form B Reed Switch Actuation

Bias Actuation

Form B, N. C. contact actuation is achieved by Clare through the use of the standard Form A dry reed switch that is biased closed by mounting a permanent magnet to the switch housing. This magnet is located such that it keeps the switch in the on (or closed) condition.

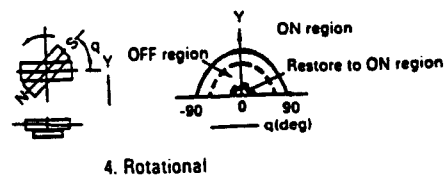
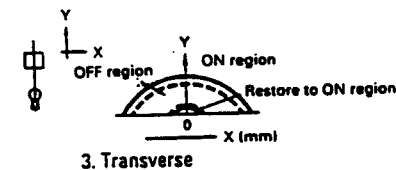
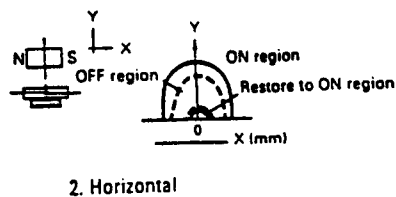
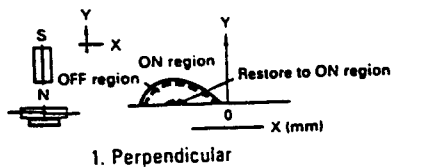
The switch is turned off (or opened) by bringing another magnet in the proximity of the switch/magnet assembly.

Note in the actuation charts shown below, that an on-off-on condition may occur if the proximity of the

actuating magnet is brought very close to the switch/magnet assembly. This condition is, of course, dependent upon the size and strength of the actuating magnet.

Magnets

ALNICO V, ALNICO VIII, Ceramic and Barium ferrite are the most popular magnet materials used. The magnet type is usually chosen based on size, coercivity, cost, and temperature characteristics as defined by the application.

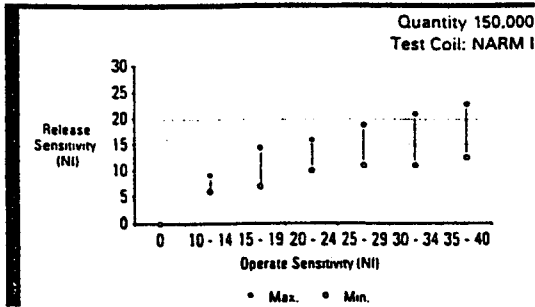


Performance Data

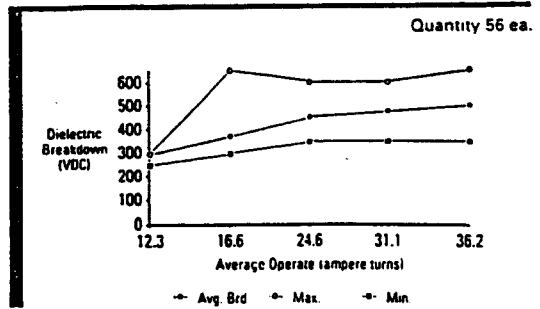
Clare

6

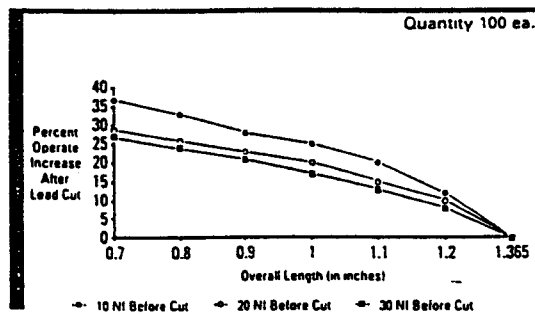
Operate NI vs. Release NI



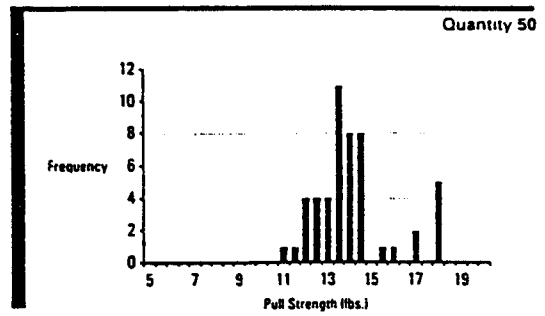
Dielectric Breakdown vs. Operate Sensitivity



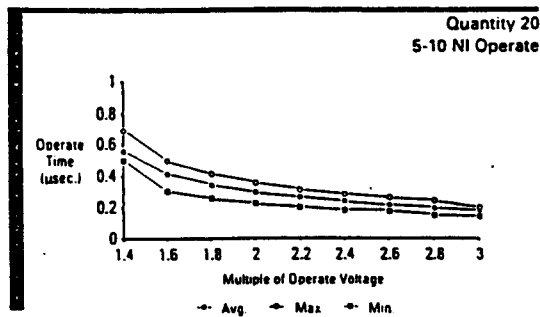
Operate Shift After Lead Trimming



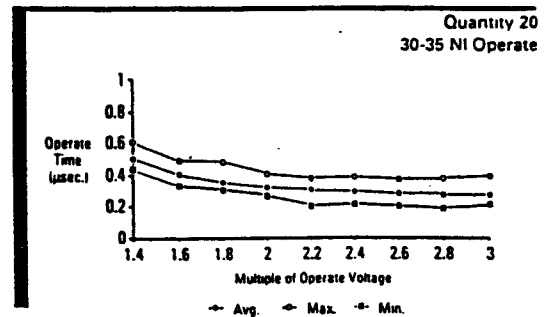
Pull To Fracture Test Distribution



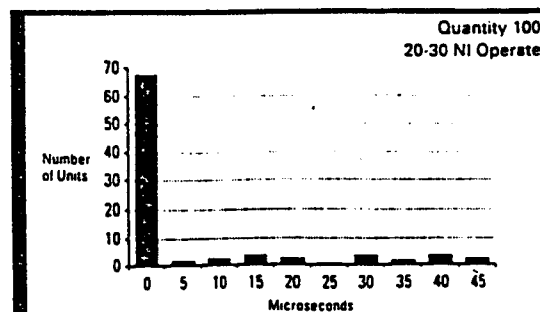
Operate Time vs. Coil Drive



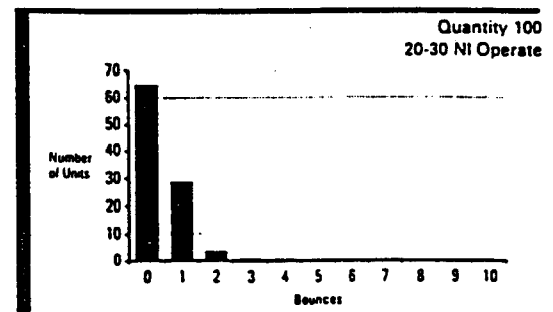
Operate Time vs. Coil Drive



Bounce Time

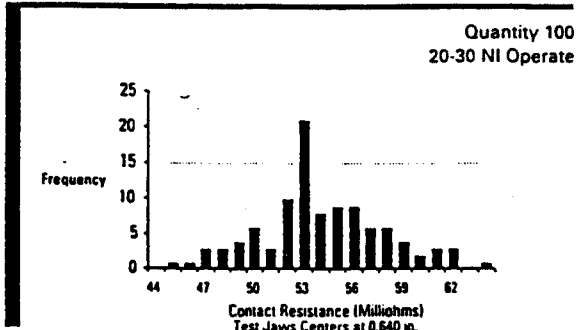


Number of Bounces

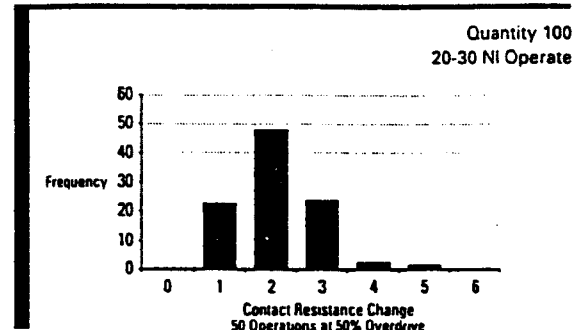


Performance Data

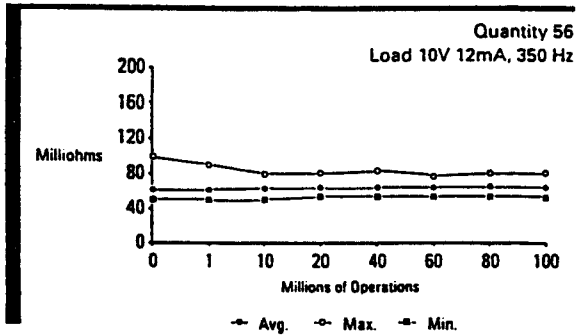
Contact Resistance



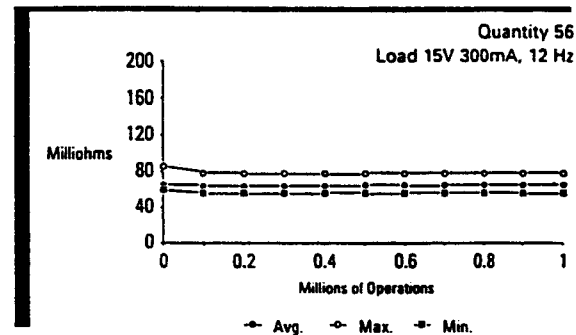
Contact Resistance Stability



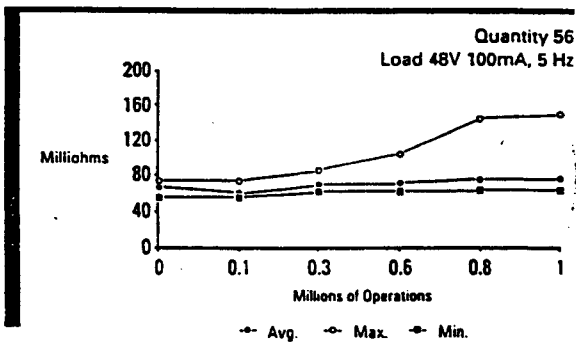
Contact Resistance vs. No. of Operations



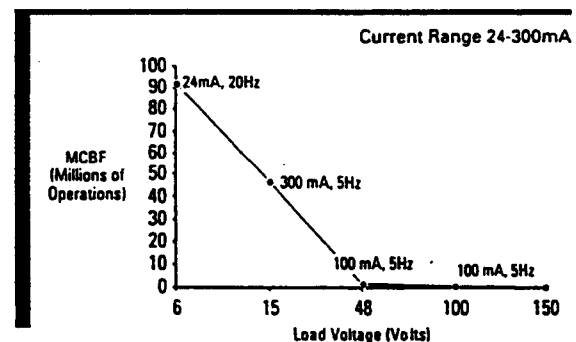
Contact Resistance vs. No. of Operations



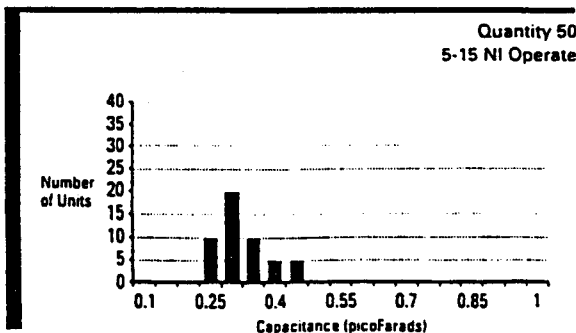
Contact Resistance vs. No. of Operations



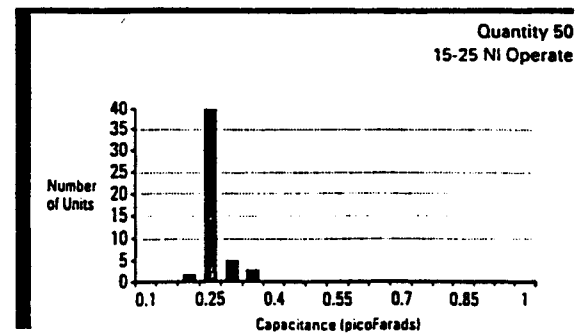
Load Life



Capacitance Across Open Contacts



Capacitance Across Open Contacts



Worldwide Sales Offices

Clare

8

North America

United States
Clare Worldwide Headquarters
3101 West Pratt Boulevard
Chicago, IL 60645
Tel: (312) 262-7700
TELEX: 210076
FAX: 312-262-7819
Technical Hotline: 800-99-CLARE

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87 Wingold Avenue
Toronto, Ontario M6B 1PB (Canada)
Tel: (416) 789-7831
TELEX: 06-969740
FAX: 416-789-5522
Technical Hotline: 800-99-CLARE

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Guadalajara, Jalisco, Mexico
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TELEX: K 27860 WONIL
FAX: (02) 586-7186

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#08-04 Parkway Parade
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TELEX: GISPORE RS 24424
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Overhaamlaan
B-3700 Tongeren (Belgium)
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Room 1104-7, Tower B, Mandarin Plaza
14, Science Museum Road, Tsimshatsui East
Kowloon, Hong Kong
Tel: 3-7226577
TELEX: 54606 GIHK HX
FAX: (852) 3-7239239

Japan

Fukide Building
4-1-13 Toranomon
Minato-Ku, Tokyo, 105, Japan
Tel: (03) 437-0281
TELEX: 2423413 GIC TOKJ
FAX: (81) 3-434-3938



Oilless Diaphragm Pump to 1.3 cfm



Miniature Diaphragm 22D Series

SHADED POLE MOTOR

10 PSI CONTINUOUS PRESSURE (20 PSI INTER.),
22" HG MAX. VACUUM, 0.66 CFM OPEN FLOW

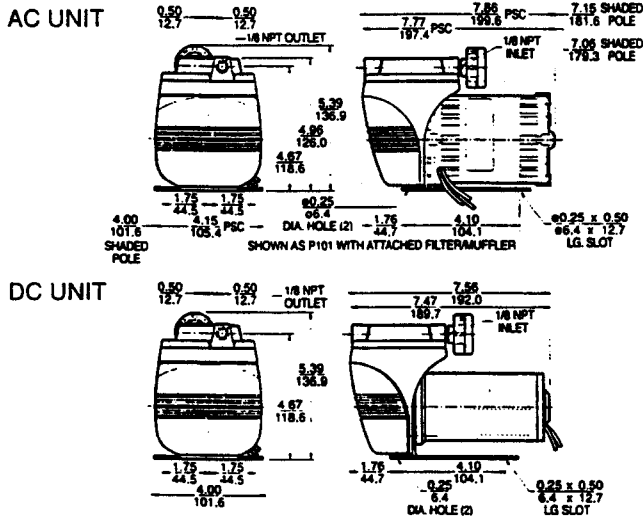
PSC MOTOR

30 PSI MAX. PRESSURE, 24" HG MAX. VACUUM,
0.7 CFM OPEN FLOW

DC MOTOR

30 PSI MAX. PRESSURE, 22.5" HG MAX. VACUUM,
1.3 CFM OPEN FLOW

Product Dimensions Metric (mm) U.S. Imperial (Inches)



PRODUCT FEATURES

- Permanently lubricated ball bearings on rod and motor drive bearing
- Rear sleeve bearing (DC P103 models have ball bearing for higher pressure)
- Field service capability
- PSC models include attached capacitor
- Includes AJ988 filter assembly, unattached

MATERIALS OF CONSTRUCTION

- Head assembly and bracket made of polyphenylene sulfide (PPS) for excellent chemical and heat resistance
- Stainless steel valves
- Neoprene/nylon diaphragm standard
- Other diaphragm materials available

Product Specifications

Note: P101 and P103 models are pressure, V102 model is vacuum.

Model Number	Motor	RPM	Running Amps	HP	kw	Net Wt. lbs.	kg
22D1-P101-AKV	115-60-1*	1725	1.6	1/20	0.04	4.8	2.16
22D1-V102-AKV	115-60-1*	1725	1.6	1/20	0.04	4.8	2.16
22D1-P101-DKV	PSC 115-60-1	1725	0.7	1/20	0.04	5.5	2.48
22D1-P101-DPV	PSC 230-50/60-1	1725**	0.8	1/20	0.04	5.5	2.48
22D1-V102-DKV	PSC 115-60-1	1725	0.5	1/20	0.04	5.5	2.48
22D1-P101-KGV	12V DC	3200	6.2	1/8	0.09	4.8	2.16
22D1-P103-KGB	12V DC	3200	6.2	1/8	0.09	4.9	2.21
22D1-V102-KGV	12V DC	3200	5.1	1/8	0.09	4.8	2.16
22D1-P101-KHV	24V DC	3200	3.5	1/8	0.09	4.8	2.16
22D1-P103-KHB	24V DC	3200	3.5	1/8	0.09	4.9	2.21
22D1-V102-KHV	24V DC	3200	2.7	1/8	0.09	4.8	2.16

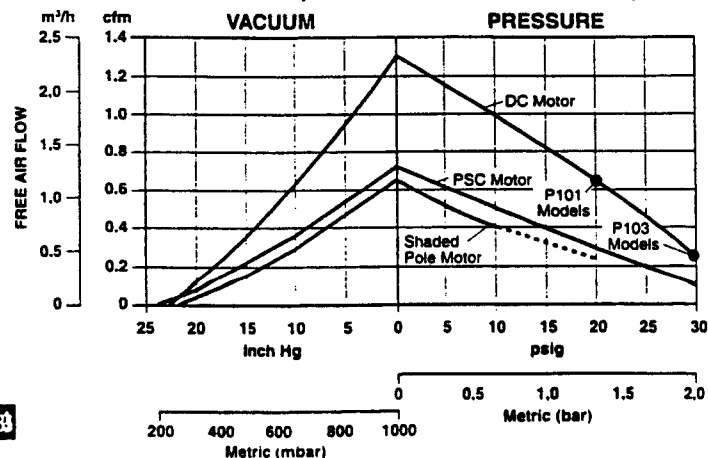
*Shaded Pole **@60 Hz - 50 Hz is 1425 RPM

RECOMMENDED ACCESSORIES

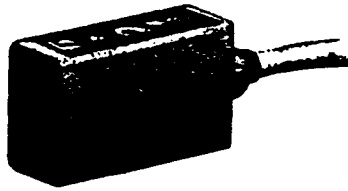
- AA640 Vacuum gauge
- AA204 Vacuum relief valve
- AA644B Pressure gauge
- AA203 Pressure relief valve
- AF584A Rubber feet (3)

Product Performance (Metric, U.S. Imperial)

Solid line indicates continuous duty, dashed line indicates intermittent duty.



Photoelectric Sensors/Controls
Miniature AC and DC Sensors



FEATURES

- 10-foot retroreflective scan range with FE-RR1 reflector
- 1.6 or 3.3 feet diffuse scan range
- 16.4 or 49.2-foot thru scan range
- Miniature and self-contained (AC and DC models)
- Short-circuit protection (DC models only)
- Diagnostic functions (DC models only)
- Self-diagnosis indication (DC models only)
- Remote testing function (DC Through-Scan models only)
- Sensitivity adjustment to detect translucent objects
- Capable of detecting small objects and making highly accurate detections with the proper aperture mask

GENERAL INFORMATION

FE7C retroreflective scan sensors are self-contained and require no separate amplifier for signal conditioning. Each sensor has its own infrared light source, photodiode, amplifier circuitry, signal strength/alignment indicator, and output transistor. FE7C sensors operate on a broad range of 10 to 28 VDC or from 85 to 250 VAC and provide a 100 mA current sinking and current sourcing output. The DC version's output is convertible from dark operated to light operated.

FOR A COMPLETE SENSOR

Required

- AC Retroreflective sensor - FE7C-RT2-M
- DC Retroreflective sensor - FE7C-RC6G-M
- Appropriately rated power supply for DC devices
- Reflector - FE-RR1

ORDER GUIDE RETROREFLECTIVE SCAN - 10 FT. RANGE (3 M)

Description	Catalog Listing
82-250 VAC; dark operated (D.O.); horizontal mount	FE7C-RT2-M
85-250 VAC; dark operated (D.O.); vertical mount	FE7C-RT2V-M
10-28 VDC; convertible L.O./D.O. sinking (NPN) output; horizontal mount*	FE7C-RC6G-M
10-28 VDC; convertible L.O./D.O. sourcing (PNP) output; horizontal mount*	FE7C-RF6G-M

ORDER GUIDE POLARIZED RETROREFLECTIVE SCAN - 10 FT. RANGE (3 M)

Description	Catalog Listing
85-250 VAC; dark operated (D.O.); horizontal mount*	FE7C-RPT2-M
85-250 VAC; dark operated (D.O.); vertical mount*	FE7C-RPT2V-M
85-250 VAC; light operated (L.O.); vertical mount*	FE7C-RPU2V-M
10-28 VDC; convertible L.O./D.O. sinking (NPN) output; horizontal mount*	FE7C-RPC8-M
10-28 VDC; convertible L.O./D.O. sourcing (PNP) output; vertical mount*	FE7C-RPF6V-M

FOR A COMPLETE SENSOR

Required

- Diffuse scan sensor - FE7C-DC6-M
- Appropriately rated power supply for DC devices

ORDER GUIDE DIFFUSE SCAN - 1.6 FT. RANGE (.5 M)

Description	Catalog Listing
85-250 VAC; light operated (L.O.); horizontal mount*	FE7C-DT2-M
85-250 VAC; light operated (L.O.); vertical mount*	FE7C-DT2V-M
10-28 VDC; convertible L.O./D.O. sinking (NPN) output; horizontal mount*	FE7C-DC6-M
10-28 VDC; convertible L.O./D.O. sinking (NPN) output; vertical mount*	FE7C-DC6V-M
10-28 VDC; convertible L.O./D.O. sourcing (PNP) output; horizontal mount*	FE7C-DF6-M
10-28 VDC; convertible L.O./D.O. sourcing (PNP) output; vertical mount*	FE7C-DF6V-M

ORDER GUIDE DIFFUSE SCAN - 3.3 FT. RANGE (1 M)

Description	Catalog Listing
10-28 VDC; convertible L.O./D.O. sinking (NPN) output; horizontal mount*	FE7C-DLC6-M

* Has sensitivity adjustment.

Thru scan next page.

Photoelectric Sensors/Controls

Miniature AC and DC Sensors

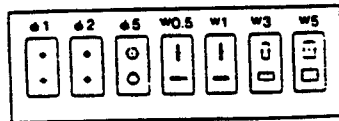
FOR A COMPLETE SENSOR

Required

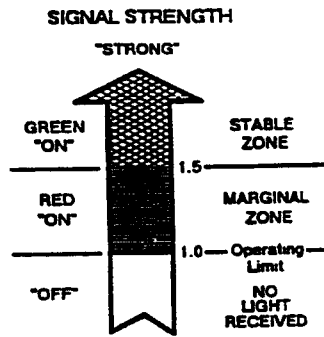
- Thru scan emitter - FE7C-TT2E-M
- Thru scan receiver - FE7C-TT2R-M
- Appropriately rated power supply for DC devices

- Capable of detecting small objects (0.1mm dia.) by use of proper aperture mask

FE-PA7C3-M



For application information, see page C192.



ORDER GUIDE THRU SCAN - 16.4 FT. (5 M)

Description	Catalog Listing
Emitter - 85-250 VAC; horizontal mount	FE7C-TT2E-M
Receiver - 85-250 VAC; dark operated (D.O.); horizontal mount	FE7C-TT2R-M
Receiver - 85-250 VAC; light operated (L.O.); horizontal mount	FE7C-TU2R-M
Emitter - 85-250 VAC; vertical mount	FE7C-TT2VE-M
Receiver - 85-250 VAC; dark operated (D.O.); vertical mount	FE7C-TT2VR-M
Emitter - 10-28 VDC; horizontal mount	FE7C-TC6E-M
Receiver - 10-28 VDC; convertible L.O./D.O. sinking (NPN) output; horizontal mount*	FE7C-TC6GR-M
Receiver - 10-28 VDC; convertible L.O./D.O. sourcing (PNP) output; horizontal mount*	FE7C-TF6GR-M
Emitter - 10-28 VDC; vertical mount	FE7C-TC6VE-M
Receiver - 10-28 VDC; convertible L.O./D.O. sinking (NPN) output; vertical mount*	FE7C-TC6VGR-M
Receiver - 10-28 VDC; convertible L.O./D.O. sourcing (PNP) output; vertical mount*	FE7C-TF6VGR-M

ORDER GUIDE SPECIAL THRU SCAN PRODUCTS - 49.2 FT. (15 M)

Description	Catalog Listing
Receiver - 10-28 VDC; convertible L.O./D.O. sinking (NPN) output; horizontal mount*	FE7C-TLC6GR-M
Emitter - 10-28 VDC; vertical mount; enables 15 meter scan range when used with long range receivers (FE7C-TLC6GR-M or FE7C-TLC6VGR-M)*	FE7C-TLC6VGE-M
Emitter - 10-28 VDC; will work with AC receivers; horizontal mount	FE7C-TC6E-M
Receiver - 10-28 VDC; convertible L.O./D.O. sinking (NPN) output that will work with AC emitters; vertical mount*	FE7C-TC6VGR-M

ORDER GUIDE SELF DIAGNOSTIC OUTPUT (10-28 VDC INPUT)

Description	Catalog Listing
Polarized retroreflective scan; dark operated (D.O.) sourcing (PNP) output; vertical mount*	FE7C-RPD6VP-M
Thru scan emitter; horizontal mount	FE7C-TA6PE-M
Thru scan receiver; dark operated (D.O.) sinking (NPN) output; horizontal mount	FE7C-TA6PR-M

* Has sensitivity adjustment.

BRN +
 BLU GND
 BCK OUT
 WHT DIAG

Photoelectric Sensors/Controls

Miniature AC or DC Sensors

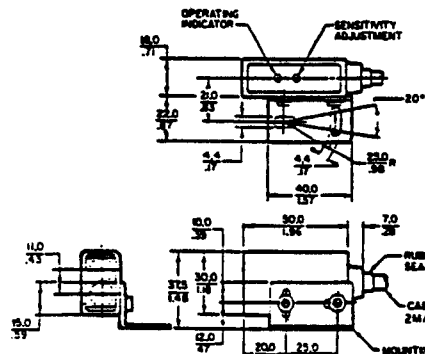
FE7C Series

SPECIFICATIONS

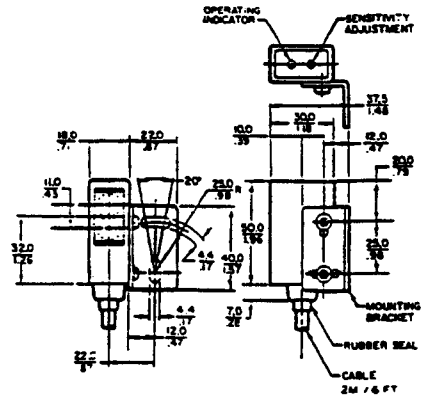
Maximum Scanning Distance (in clean air)	49.2 feet (15 m) thru scan, 3.3 feet (1 m) diffuse scan, 10 feet (3.0 m) with 3 in. reflector (FE-RR1) retro scan	
Supply Voltage	85 to 250 VAC, 50/60 Hz.	10 to 28 VDC: 10% max. power supply ripple
Power Dissipation	Emitter/Receiver Diffuse/Retro	1.25 VA max. 0.375 VA max. (excluding load) 0.42 watts max. (excluding load) 0.56 watts max. (excluding load)
Current Consumption	Emitter/Receiver Diffuse/Retro	10 mA max. (emitter 8.5, receiver 1.5) 1.5 mA max. (excluding load) 30 mA max. (excluding load) 20 mA max. (excluding load)
Output	Load Current	100 mA max.
	Voltage Drop	10 VAC max.
	Leakage Current	1.5 mA max. (100 VAC load 10K Ω)
Maximum Rate of Operation	1000 operations/minute	15000 operations/minute
Typical Response Time	On	30 msec. (50 msec. max.)
	Off	30 msec. (50 msec. max.)
Circuit Protection	False pulsing, Short circuit (DC), Reverse polarity (DC)	
Temperature Range	Operating -4°F to 140°F (-20°C to 60°C) Storage -40°F to 158°F (-40°C to +70°C)	
Sealing	NEMA 12 and IP64	
Housing	Case ABS resin, Lens PMMA acrylic resin, Cable vinyl	
Mounting	Horizontal or vertical side mounting brackets included	
Weight	2.5 oz. (70 g) thru scan pair 5 oz. (150 g)	
Logic	Built-in ON-OFF (immediate response) control; light or dark operated by individual catalog listing	

MOUNTING DIMENSIONS

Horizontal Mount

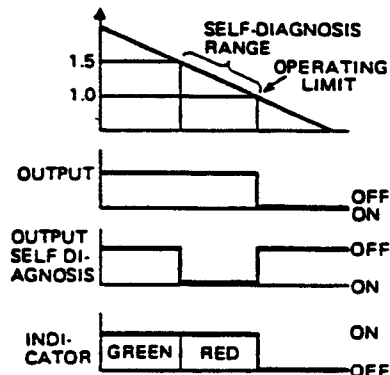


Vertical Mount



FE7C Typical Self-Diagnosis Output Sequence

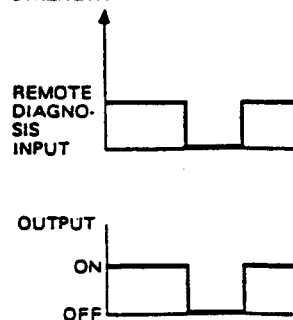
LIGHT STRENGTH



A self diagnostic output function provides early warning of malfunctions due to dust or other lens residue or if the sensor becomes marginally misaligned. Whenever received light drops to 150% of minimum operating level the self diagnostic output switches on. If light intensity continues to drop to minimum operating level, the diagnostic output switches off along with the sensor. The self diagnostic output provides an external communication link of the red alignment LED condition. Current rating is 50 mA max. and is the same as the sensor (NPN or PNP). See circuit diagram for further description.

Remote testing function. The self diagnostic emitter FE7C-TA6PE-M has a remote testing function of the receiver it is used with. A positive voltage applied to the emitters pink wire disables it. Check the receiver for a change in output. If no change is noted, the receiver is not functioning properly.

FE7C Through-Scan Remote Diagnosis EMITTER LIGHT STRENGTH



Photoelectric Sensors/Controls

Miniature AC and DC Sensors

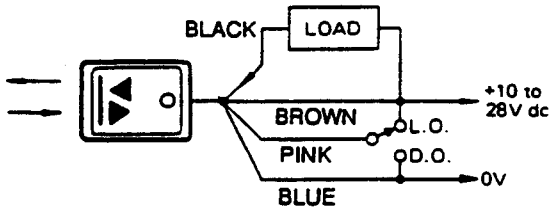
FE7C Series

WIRING

FE7C series Dark Operated/Light Operated Selectable Output types Typical Wiring

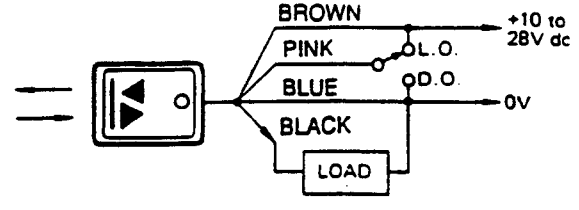
NPN: Dark Operated/Light Operated (Selectable)

Through-scan (Receiver unit) type
Retroreflective-scan type
Polarized Retroreflective-scan type
Diffuse-scan type*



PNP: Dark Operated/Light Operated (Selectable)

Through-scan (Receiver unit) type
Retroreflective-scan type
Polarized Retroreflective-scan type
Diffuse-scan type*

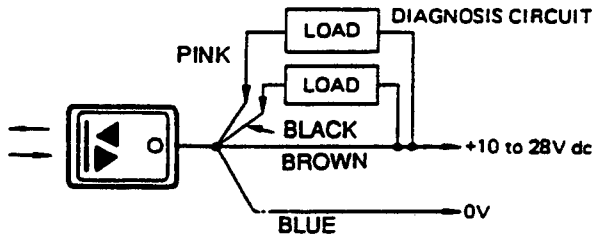


*For Diffuse-Scan, L.O. and D.O. Switch positions are in the reverse.

FE7C series Diagnosis Output types Typical Wiring

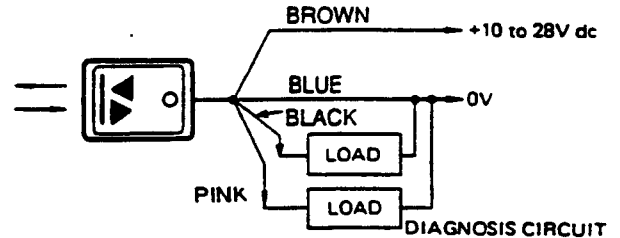
NPN with Diagnosis Outputs:

Through-scan (Receiver unit) type
Retroreflective-scan type
Polarized Retroreflective-scan type
Diffuse-scan type



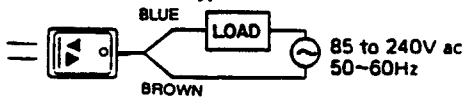
PNP with Diagnosis Outputs:

Through-scan (Receiver unit) type
Retroreflective-scan type
Polarized Retroreflective-scan type
Diffuse-scan type



FE7C series AC types, Light Operated or Dark Operated

Retroreflective-scan type
Polarized Retroreflective-scan type
Diffuse-scan type



NATWELD

**CARBON & LOW ALLOY
BARE STEEL WELDING WIRE**

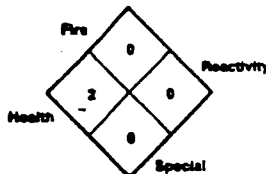
NO: 119

Material Safety Data Sheet

IN COMPLIANCE WITH OSHA'S HAZARD COMMUNICATION STANDARD 29CFR 1910.1200

Manufacturers Name:
National Welding Alloys, Inc.
1600 South Canal Street
Pittsburgh, PA 15215

HAZARD RATING
4 = EXTREME
3 = HIGH
2 = MODERATE
1 = SLIGHT
0 = INSIGNIFICANT



Date Issued: 8/1/90
Date Revised:
Emergency Phone Numbers:
Natweld: (412) 781-4255
Chemtec: 800-424-9300

This Material Safety Data Sheet (MSDS) provides information on a specific group of manufactured metal products.
The following alloys can be found on this MSDS: See Section II and Section VI for important health hazard data.

SECTION I — MATERIAL IDENTIFICATION

TRADE NAME	APPROXIMATE CHEMICAL COMPOSITION - % (Single figures are maximum)									
	Al	C	Cu	Fe	Mn	P	Si	S	Ti	Zr
Bare Wire RG 45	0.02	0.08	0.30	Balance	0.50	.035	0.10	0.04	---	---
Bare Wire RG 60	0.02	---	0.30	Balance	0.90-1.40	.035	0.10-0.35	.035	---	---
Bare Wire RG 65	0.02	---	---	Balance	---	.035	---	.035	---	---
Bare Wire ER70S-2	0.05-0.15	0.07	0.50	Balance	0.90-1.40	.025	0.40-0.70	.035	0.05-0.15	0.02-0.12
Bare Wire ER70S-3	---	0.06-0.15	0.50	Balance	0.90-1.40	.025	0.45-0.70	.035	---	---
Bare Wire ER70S-6	---	0.07-0.15	0.50	Balance	1.40-1.85	.025	0.80-1.15	.035	---	---

TRADE NAME	APPROXIMATE CHEMICAL COMPOSITION - % (Single figures are maximum)									
	C	Cr	Fe	Mn	Mo	Ni	P	Si	S	V
Bare Wire 4130	0.31	0.93	Balance	0.52	0.20	---	.012	0.28	.023	---
Bare Wire 4140	0.40	1.03	Balance	0.87	0.20	0.09	.007	0.26	---	---
Bare Wire 8620	0.20	0.51	Balance	0.81	0.22	0.52	.015	0.25	.023	---

TRADE NAME	APPROXIMATE CHEMICAL COMPOSITION - % (Single figures are maximum)									
	C	Cr	Cu	Fe	Mn	Mo	Ni	P	Si	S
Bare Wire ER80S-B2	0.07-0.12	1.20-1.50	0.35	Balance	0.40-0.70	0.40-0.65	0.20	.025	0.40-0.70	.025
Bare Wire ER80S-B2L	0.05	1.20-1.50	0.35	Balance	0.40-0.70	0.40-0.65	0.20	.025	0.40-0.70	.025
Bare Wire ER90S-B3	0.07-0.12	2.30-2.70	0.35	Balance	0.40-0.70	0.90-1.20	0.20	.025	0.40-0.70	.025
Bare Wire ER90S-B3L	0.05	2.30-2.70	0.35	Balance	0.40-0.70	0.90-1.20	0.20	.025	0.40-0.70	.025
Bare Wire ER80S-D2	0.07-0.12	---	0.50	Balance	1.60-2.10	0.40-0.60	0.15	.025	0.50-0.80	.025
Bare Wire ER100S-1	0.08	0.30	0.25	Balance	1.25-1.80	0.25-0.55	1.40-2.10	0.01	0.20-0.50	0.01
Bare Wire ER110S-1	0.09	0.50	0.25	Balance	1.40-1.80	0.25-0.55	1.95-2.60	0.01	0.20-0.55	0.01
Bare Wire ER120S-1	0.10	0.60	0.25	Balance	1.40-1.80	0.30-0.65	2.00-2.80	0.01	0.25-0.60	0.01

SECTION II — HAZARDOUS CONSTITUENTS

IMPORTANT — Welding electrodes are a non-hazardous solid at ambient temperatures. This section covers the materials from which these products are manufactured. The fumes and gases produced while welding during normal use of these products are covered in Sections V and VI

BARE WIRE

HAZARDOUS COMPONENTS

	CAS NO.	OSHA PEL mg/m ³	ACGIH TLV mg/m ³	STEL mg/m ³
*Chromium (VI)	7440-47-3	1.00	0.50	---
*Nickel	7440-02-0	1.00	1.00	---
Aluminum	7429-80-5	15.0	10.0	---
Carbon	1333-86-4	3.50	3.50	---
Manganese	7439-96-5	5.00 (ceiling)	5.00 (ceiling)	---
Molybdenum (soluble)	7439-98-7	5.00	5.00	---
Iron (oxide fume)	1309-37-1	10.0	5.00	---
Phosphorus	7723-14-0	0.10	0.10	---
Zirconium	7440-67-7	5.00	5.00	10.0
Silicon	7440-21-3	15.0	10.0	---
Sulfur	7446-09-05	13.0	5.00	13.0
Copper (fume)	7440-50-8	1.00	1.00	---
Thallium	7440-28-0	0.10	0.10	---
Vanadium	1314-62-1	0.50 (ceiling)	0.05	---

SUBSTANCES OF VARIABLE COMPOSITION

HAZARDOUS COMPONENTS

	CAS NO.	OSHA PEL mg/m ³	ACGIH TLV mg/m ³	STEL mg/m ³
Welding Fume	NOC	---	5.00	---

* SUBSTANCE IDENTIFIED BY OTHER SOURCES AS A SUSPECTED OR CONFIRMED HUMAN CARCINOGEN

SECTION III — PHYSICAL DATA

Solid wire or rod, grey to copper in color.

SECTION IV — FIRE AND EXPLOSION DATA

FLASH POINT (WITH TEST METHOD): None **FLAMMABLE (EXPLOSIVE) LIMITS V/V%** **LEL:** None **UEL:** None

EXTINGUISHING MEDIA: This alloy is noncombustible. Use extinguishing media appropriate to the surrounding fire.

SPECIAL FIRE FIGHTING PROCEDURES: If this material is reduced to powder form, caution must be used to prevent fire or explosion. To extinguish a metal powder fire use dry sand, dry graphite or other class "D" fire extinguishing powder.

UNUSUAL FIRE AND EXPLOSION HAZARD: No unusual fire or explosion hazards are associated with this material.

INCOMPATIBILITY (MATERIALS TO AVOID): Avoid contact with mineral acids and oxidizing agents which may generate hydrogen gas; the evolution of hydrogen may be an explosion hazard.

HAZARDOUS DECOMPOSITION PRODUCTS: Various elemental metals and metal oxides may be generated from melting or cross handling operations. Refer to Section II for permissible exposure limits.

SECTION V — HEALTH HAZARD DATA — CARBON & LOW ALLOY BARE STEEL WELDING WIRE

Welding generates fumes, gases and electromagnetic radiation with known adverse health effects. The composition of welding emissions varies substantially with the welding process.

Exposure: Section I lists normal composition of aluminum welding wire. Section II lists exposure limits for hazardous decomposition products which might be present in fume generated during welding or brazing. Actual exposure should be determined by monitoring fume in the operator's breathing zone.

Possible Effects of Exposure: Short term exposure to welding fume may result in discomfort, dizziness, nausea and dryness or irritation of the throat. Long term exposure to welding fume, gases or dust may contribute to pulmonary irritation or pneumoconiosis. Long term exposure to iron fume may produce siderosis, which is generally regarded as benign. Nickel and chromium should be considered a possible carcinogen per OSHA 29CFR 1910.1200. Certain nickel compounds have been implicated based on experience in some nickel refining operations. The specific compounds, however, have not been determined and a direct association between nickel in welding fume and cancer has not been demonstrated. Some compounds of hexavalent chromium have been reported to be carcinogenic. No clear association, however, has been established between chromium in welding fume and the development of cancer. Exposure limits should be maintained below the levels listed in Section II.

Routes of Entry: (1) Inhalation of Fume (2) Burns from Electromagnetic Radiation

Pre-existing Medical Condition: Individuals with impaired pulmonary function or illness may have symptoms exacerbated by irritants contained in welding fumes.

SECTION VI — REACTIVITY DATA

Hazardous Decomposition Products

Exposure Limits: Welding fumes and gases cannot be classified simply. The composition and quantity of both are dependent upon the metal being welded, the process, procedure and electrodes used. Other conditions which also influence the composition and quantity of the fumes and gases to which workers may be exposed include: coatings on the metal being welded (such as paint, plating or galvanizing), the number of welders and the volume of work area, the quality and amount of ventilation, the position of the welder's head with respect to the fume plume, as well as the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing activities).

When the electrode is consumed, the fume and gas decomposition products generated are different in percent and form from the ingredients listed in Section II. Fume and gas decomposition products, and not the ingredients in the electrode, are important. The concentration of a given fume or gas component may decrease or increase by many times the original concentration in the electrode. Also, new compounds not in the electrodes may form. Decomposition products of normal operation include those originating from the volatilization, reaction or oxidation of the materials shown in Section II, plus those from the base metal and coating, etc., as noted above.

Most welding, even with primitive ventilation, does not produce exposures inside the welding helmet above 5mg/m³. That which does, should be controlled.

SECTION VII — SPILL OR LEAK PROCEDURES

NOT APPLICABLE

SECTION VIII — SPECIAL PROTECTION INFORMATION

Ventilation: Use enough ventilation, local exhaust at the arc (or flame), or both, to keep the fumes and gases below PEL's, TLV's or STEL's in the worker's breathing zone and the general area. Train the employee to keep his head out of the fumes. See ANSI/ASC Z49.1 Section 5.

Respiratory Protection: Use respirable fume respirator or air supplied respirator when welding, brazing or soldering in confined space or where local exhaust or ventilation does not keep exposure below PEL, TLV or STEL.

Eye Protection: Wear helmet or use face shield with filter lens of appropriate shade number (see ANSI/ASC Z49.1 Section 4.2). Provide protective screens and flash goggles, if necessary, to shield others.

Protective Clothing: Wear head and body protection which help to prevent injury from radiation, sparks, flame and electrical shock. See ANSI Z49.1. At a minimum this includes welder's gloves and a protective face shield, and may include arm protectors, aprons, hats, shoulder protection, as well as dark substantial clothing. Train the employee not to touch live electrical parts and to insulate himself from work and ground. Welders should not wear short sleeve shirts, short pants or cutoffs.

Waste Disposal Method: Prevent waste from contaminating surrounding environment. Discard any product, residue, disposable container or liner in an environmentally acceptable manner, in full compliance with federal, state and local regulations.

Emergency First Aid: Remove from dust or fume exposure. If breathing has stopped perform artificial respiration. Summon medical aid immediately.

Read and understand the manufacturer's instructions and the precautionary label on the product. See American National Standard Z49.1, *Safety in Welding and Cutting* published by the American Welding Society, P.O. Box 351040, Miami, FL 33135 and OSHA publication 2206 (29CFR 1910), U.S. Government Printing Office, Washington D.C. 20402 for more detailed information.

SECTION IX — SPECIAL PRECAUTIONS

Other Precautions: Use exhaust system to clear welding fumes. Make sure that inhaled air does not contain fume constituents above permissible levels.

NOTE: For other precautions or additional safety information on welding and cutting, see American Standard Z49.1-1980, *Safety In Welding and Cutting*, and the *Welding Handbook*, Volume 1, Chapter 9, *Safe Practices In Welding and Cutting*, both available from the American Welding Society, Inc. 550 N.W. LeJeune Road, P.O. Box 351040, Miami, FL 33135, Telephone number (305) 443-9353.

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References:

Air Contaminants — Permissible Exposure Limits
Title 29 Code of Federal Regulations Part 1910.1000

Threshold Limit Values and Biological Exposure Indices for 1989-1990 Second Printing
American Conference of Governmental Industrial Hygienists

Code of Federal Regulation
Parts 1900 to 1910 Revised July 1, 1988

Operator's Manual for Oxyfuel Gas Cutting
ANSI/AWS C4.2-90 An American National Standard

Effects of Welding on Health — VI
Prepared for: Safety and Health Committee of the American Welding Society

OSHA: Employee Workplace Rights
U.S. Dept. of Labor, OSHA 3021 Revised

Respiratory Protection
U.S. Dept. of Labor, OSHA 3079 Revised 1988

Modern Welding
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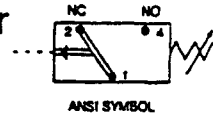
PRESSURE SWITCHES

► APPLICATION

Numatics PS180 is a new line of pressure switches designed for accurate indication that proper system pressure is being achieved. Available in 1/8 or 1/4 threads, it is easily incorporated into an air system using a Flexiblok® diverter plate or other manifold.

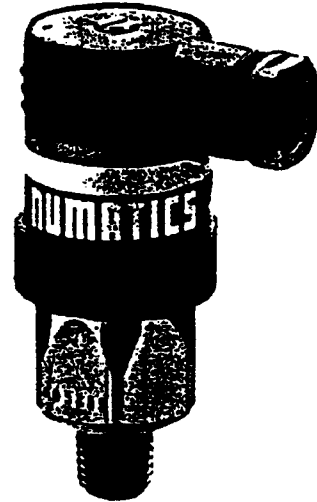
With its rugged housing made from zinc coated steel, the PS180 is designed for industrial multi-million cycle life applications. The four pin connector plug is included and contains a key way preventing accidental misconnection. Pressure adjustment is tamper resistant hindering unauthorized changes. It can be wired in either normally open or normally closed configurations and includes a case ground pin.

normally open or normally closed



► SPECIFICATIONS

- Contact Rating: 4 A @ 250 VAC
- Protection: IP 65, terminals IP00
- Maximum Operation: 200/min.
- Temperature Range: 0°F to 190°F / -15°C to 85°C
- Maximum Pressure: 300 PSI / 20 BAR
- Maximum Voltage: 250 VAC / 200 DC
- Hysteresis Adjustment: 15%
- Connector Material: Polyamid
- Diaphragm Material: Buna N
- Housing Material: Zinc Plated Steel

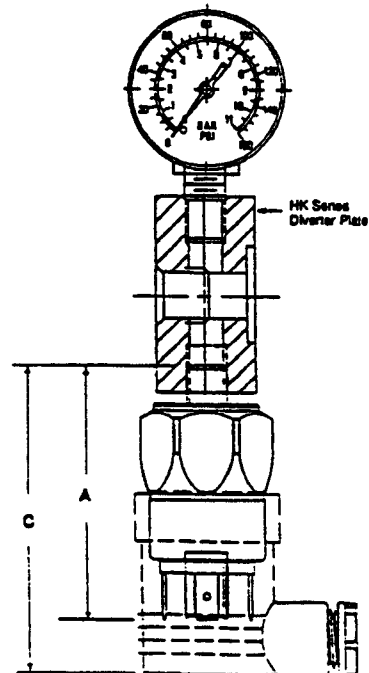


► MODEL SELECTION

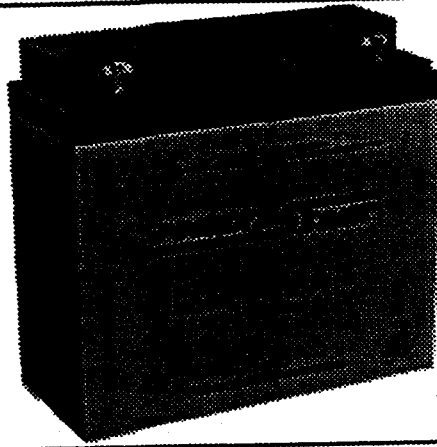
Part number includes connector cap.

thread	model no.	PSIG	dimensions		
			A	B	C
NPT	PS180				
1/8	PS180BAN01	4-20 (0.3-1.5 bar)	2.5 (64)	1.0 (27)	3.1 (79)
★ 1/8	PS180CAN01	14-150 (1-10 bar)	2.5 (64)	1.0 (27)	3.1 (79)
1/4	PS180BAN02	4-20 (0.3-1.5 bar)	2.5 (64)	1.0 (27)	3.1 (79)
1/4	PS180CAN02	14-150 (1-10 bar)	2.5 (64)	1.0 (27)	3.1 (79)
thread	model	PSIG	dimensions		
G	PS180CAG		A	B	C
1/4	PS180BAG02	4-20 (0.3-1.5 bar)	2.3 (58)	1.0 (27)	2.9 (74)
1/4	PS180CAG02	14-150 (1-10 bar)	2.3 (58)	1.0 (27)	2.9 (74)

Replacement Connector Cap: Model No. PSC180



Power Sonic



PS-12180 / 12V-18.0 Amp. Hr. Battery

General Specifications

Dimensions:		
Length	7.13 inches	181 millimeters
Width	2.99 inches	76 millimeters
Height	6.57 inches	167 millimeters
Approximate Weight	13.0 pounds	6.0 kilograms
Terminals:	"NB" type (5mm)	Nut & Bolt
Case:	Polypropylene	

Electrical Specifications

Nominal Voltage:	12 Volts (6 cells in series)	
Nominal Capacity:		
20 hour rate	(875mA to 10.50 volts)	17.5 AH
10 hour rate	(1600mA to 10.50 volts)	16.0 AH
5 hour rate	(2400mA to 10.20 volts)	14.5 AH
1 hour rate	(11500mA to 9.00 volts)	11.5 AH
Energy Density (20 hour rate)	1.50 Watt-hours/cubic inch	91.4 Watt-hours/l
Specific Energy (20 hour rate)	16.2 Watt-hours/pound	35.6 Watt-hours/kg
Internal Resistance (Fully Charged Battery)	15 milliohms (approx.)	

Material Safety Data Sheet (45k gif)

Charging

Cycle Applications: Limit initial current to 3400mA. Charge until battery voltage (under charge) reaches 14.40 to 14.70 volts at 68° F (20° C). Hold at 14.40 to 14.70 volts until current drops to approximately 170mA. Battery is fully charged under these conditions, and charger should either be disconnected or switched to "float" voltage.

"Float" or "Stand-by Service": Hold battery across constant voltage source of 13.50 to 13.80 volts continuously. When held at this voltage, the battery will seek its own current level and maintain itself in a fully charged condition.

POWER *PS* SONIC

SLA BATTERY CHARGERS

E-mail: battery@power-sonic.com

Features | Characteristics | Selection Guide |

SPECIFICATIONS:

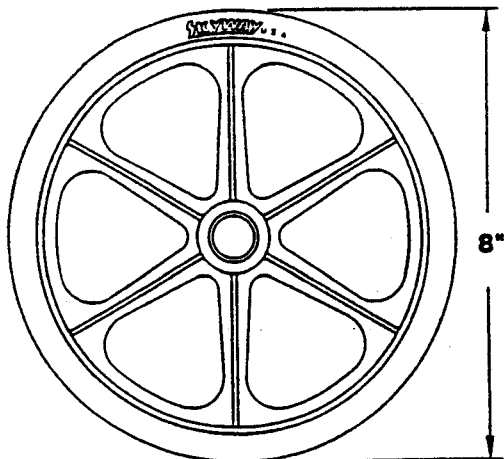
FVF (Fixed Voltage Float).
 DVA (Dual Voltage Automatic).
 CPS (Charger/Power Supply).

Model No.	Output Voltage (V)		Output Current (A)		Type	Dimensions (in.)			Weight (lbs.)
	Nominal	Range	Nominal	Range		Length	Width	Height	
PSC-6250F	6	6.83	.30	.60	FVF	2.20	1.96	1.88	0.5
PSC-6250A	6	6.75/7.35	.30	.60	DVA	2.20	1.96	1.88	0.5
PSC-6300A	6	6.84/7.35	.25	.25	DVA	2.55	2.55	3.65	1.65
PSC-6500A	6	6.75/7.35	.60	.75	DVA	2.55	1.88	2.89	0.8
PSC-61000A	6	6.84/7.35	1.00	1.00	DVA	2.75	2.75	3.75	1.36
PSC-64000A	6	6.75/7.35	3.50	4.00	DVA	5.70	5.80	3.30	6.0
PSC-12250F	12	13.65	.25	.40	FVF	2.20	1.96	1.88	0.5
PSC-12250A	12	13.50/14.75	.25	.40	DVA	2.20	1.96	1.88	0.5
PSC-12300A	12	13.68/14.70	.30	.30	DVA	2.55	2.55	3.65	1.65
PSC-12500F	12	13.65	.50	.60	FVF	2.55	1.88	2.89	0.8
PSC-12500A	12	13.50/14.70	.50	.60	DVA	2.55	1.88	2.89	0.8
PSC-12800A	12	13.68/14.70	.75	.75	DVA	2.55	2.55	3.65	1.65
PSC-122000A	12	13.50/14.70	2.00	2.00	DVA	5.50	3.50	2.75	4.5
PSC-124000A	12	13.50/14.70	4.00	4.75	DVA	5.70	5.80	3.30	6.0
PSC-124000AP	12	13.50/14.70	4.00	3.50/2.50	CPS	5.70	5.80	3.30	6.0
PSC-12-10A	12	13.50/14.70	10.00	10.75	DVA	7.95	6.10	4.50	9.0
PSC-241000A	24	27.00/29.40	1.00	1.00	DVA	5.50	3.50	2.75	4.5

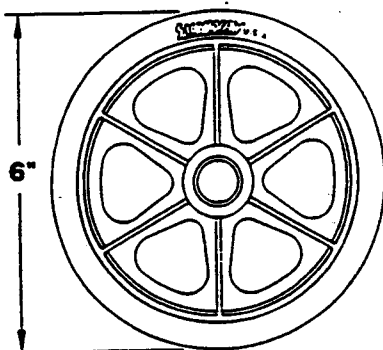


4451 Caterpillar Rd., Redding, CA 96003
916/243-5151 (FAX 916/243-5104)

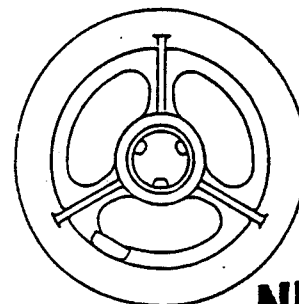
STANDARD UTILITY WHEELS
WHEELCHAIR WHEEL ACCESSORIES
WHEELCHAIR WHEELS
CASTER WHEELS



**8" CASTER
NON-PNEUMATIC**



**6" CASTER
NON-PNEUMATIC**



NEW

**5" CASTER
PNEUMATIC OR
NON-PNEUMATIC**

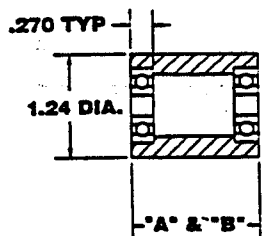
SKYWAY 6" and 8" Non-Pneumatic caster wheels feature a molded DuPont ZYTEL® nylon wheel with a coinjected Monsanto Santoprene® thermoplastic rubber molded-on tire.

Accepts 6" x 1-1/4" Pneumatic Tires. Also Accepts Various 5" & 6" Non-Pneumatic Snap-On Tires. Available Only In Hub #1. 1" Precision Bearing.

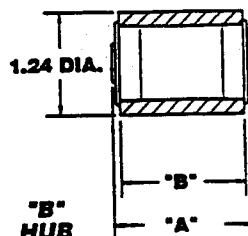
CASTER HUB SPECIFICATIONS

Hub configurations shown are SKYWAY standards, however, if you require a custom design, we stand ready to work with you to create a special hub to suit your needs.

5" Caster Only Available with Standard Hub #1, 1" Overall Width.



HUB #1
Precision Bearing Hub
7/8" O.D. Maximum x 5/16" and 3/8" I.D.'s



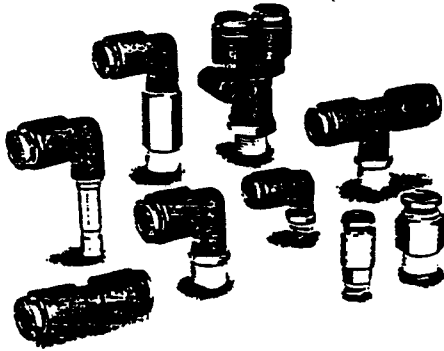
HUB #2
Unground, Flanged Bearing Hub
.906 O.D. Maximum x 1/4", 5/16", 3/8" and 7/16" I.D.'s

	BASIC OVERALL	"A" ACROSS BEARING REFERENCE	"B" HUB WIDTH
PRECISION BEARING			
HUB #1 For 5", 6" & 8" casters only	1"	.99	.98
HUB #1 For 6" & 8" casters only	1-1/2"	1.50	1.48
HUB #1 For 6" & 8" casters only	2-3/16"	2.18	2.17
UNGROUND, FLANGED BEARING			
HUB #2 For 6" & 8" casters only	1"	1.23	.98
HUB #2 For 6" & 8" casters only	2-3/16"	2.43	2.17
HUB #2 For 6" & 8" casters only	1-1/2"	1.73	1.48

SMC Inch-size One-touch Fittings Series KQ

SMC

Applicable tube — Inch-size
Thread — UNF, NPT



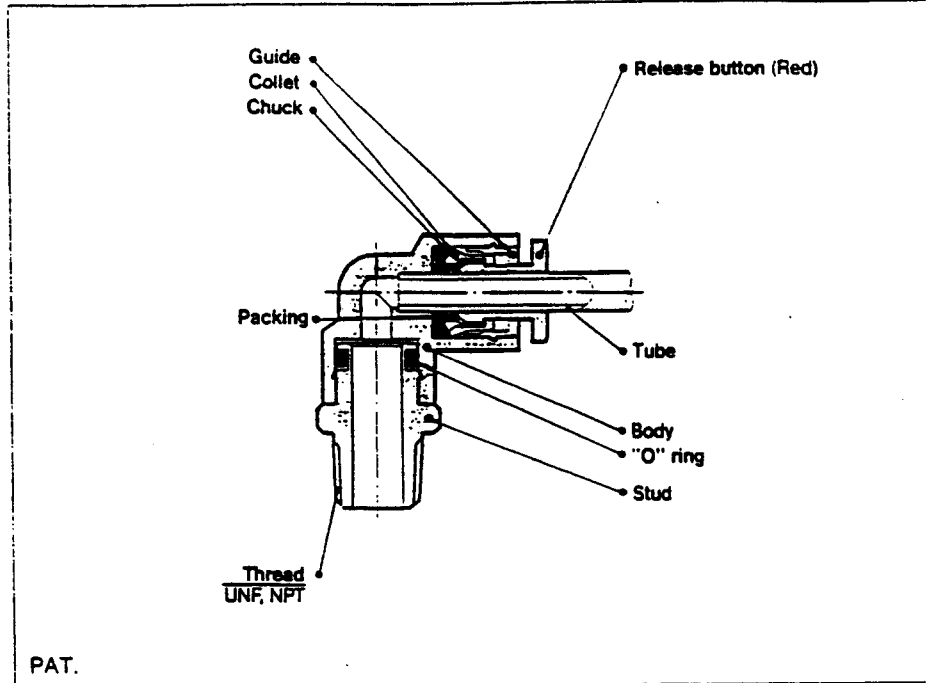
Accepts Many Types of Plastic Tubing
(Polyurethane, Nylon, Soft Nylon, Polyethylene)

**Can Be Used For Low Vacuum (10 Torr)
To A Pressure of 150 psig**

Positive Sealing and Reduced Resistance
when tubing is inserted. This is due to a specially designed packing.

Low Disconnection Force
when releasing tubing. This is because the collet and chuck are released when button is depressed.

Elbows and Tees Rotate At The Stud
for easy piping in confined areas.



PAT.

Applicable Tube

Tube material	Nylon, soft nylon, polyurethane, polyethylene
Tube O.D. (inch)	1/8", 5/32", 3/16", 1/4", 5/16", 3/8", 1/2"

Specifications

Media	Air	
Max. operating pressure	150 psig (9.9kgf/cm ²)	
Proof pressure	430 psig (30kgf/cm ²)	
Ambient and media temperature	32-140°F (0-60°C)	
Thread	Thread portion	NPT
	Nut	SAE

Principle Element Material

Body	Brass alloy or PBT
Stud	Brass alloy
Chuck	Stainless steel
Guide	Brass alloy or Polyacetal
Collet and release button	Polyacetal
Packing and O-ring	NBR
Sealant	Fluoresin

Inch-size/One-touch Fitting: KQ

Model

Inch Size
Series KQ

Male connector: KQH



Extended male elbow: KQW



Plug-in "Y": KQU



Straight union: KQH



Branch tee: KQT



Branch "Y": KQU



Male elbow: KQL



Union tee: KQT



Bulkhead union: KQE



Union elbow: KQL



Male run tee: KQY



Bulkhead connector: KQE



Plug-in elbow: KQL



Plug-in reducer: KQR



Plug: KQP



Reducer elbow: KQL



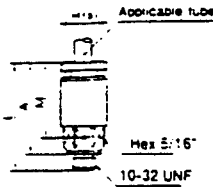
Union "Y": KQU



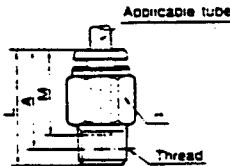
Inch-size/One-touch Fittings: KQ

Male connector: KQH

10-32 UNF



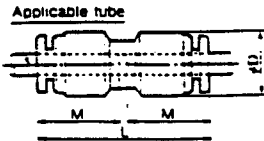
NPT



Applicable tube O.D. (inch)	Thread NPT	Model	H (Hex.)	L	A	M	Orifice Dia.	Weight Oz.
1/8	10-32 UNF	KQH01-32	3/16"	0.97	0.79	0.61	0.09	0.18
	1/8	KQH01-33S	3/16"	0.87	0.71		0.10	0.25
	1/8	KQH01-34S	3/16"	0.87	0.71		0.10	0.32
	1/8	KQH01-35S	3/16"	0.77	0.59		0.10	0.55
3/32	10-32 UNF	KQH03-32	3/16"	0.97	0.79	0.63	0.10	0.13
	3/32	KQH03-33S	3/16"	0.87	0.71		0.12	0.25
	3/32	KQH03-34S	3/16"	0.87	0.71		0.12	0.32
	3/32	KQH03-35S	3/16"	0.77	0.59		0.12	0.55
3/16	1/8	KQH05-34S	1/2"	0.87	0.71	0.65	0.14	0.39
	3/16	KQH05-35S	3/16"	0.83	0.59		0.14	0.42
1/4	10-32 UNF	KQH07-32	1/4"	0.94	0.81	0.67	0.09	0.14
	1/4	KQH07-34S	1/2"	0.89	0.73		0.18	0.35
	1/4	KQH07-35S	3/16"	0.87	0.67		0.18	0.53
	1/4	KQH07-36S	1/16"	0.91	0.65		0.18	0.95
5/16	1/4	KQH09-34S	3/16"	1.12	0.96	0.73	0.24	0.53
	5/16	KQH09-35S	3/16"	1.04	0.81		0.24	0.56
	5/16	KQH09-36S	1/16"	0.93	0.67		0.24	0.85
3/8	1/4	KQH11-34S	1/2"	1.20	1.04	0.83	0.24	0.28
	3/8	KQH11-35S	1/16"	1.32	1.08		0.28	1.09
	3/8	KQH11-36S	1/16"	1.14	0.89		0.28	1.02
	3/8	KQH11-37S	1/8"	1.06	0.75		0.28	1.62
1/2	3/8	KQH13-35S	3/8"	1.36	1.12	0.87	0.35	1.55
	1/2	KQH13-36S	3/8"	1.32	1.06		0.38	1.55
	1/2	KQH13-37S	3/8"	1.18	0.87		0.38	1.55

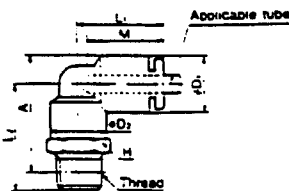
Reference dimensions after thread installation

Straight union: KQH



Applicable tube O.D. (inch)	Model	ø D	L	M	Orifice Dia.	Weight Oz.
1/8	KQH01-00	0.38	1.24	0.61	0.10	0.11
3/32	KQH03-00	0.41	1.28	0.63	0.12	0.11
3/16	KQH05-00	0.45	1.34	0.65	0.14	0.14
1/4	KQH07-00	0.52	1.36	0.67	0.18	0.18
5/16	KQH09-00	0.60	1.52	0.73	0.24	0.25
3/8	KQH11-00	0.70	1.67	0.83	0.28	0.39
1/2	KQH13-00	0.85	1.75	0.87	0.38	0.56

Male elbow: KQL

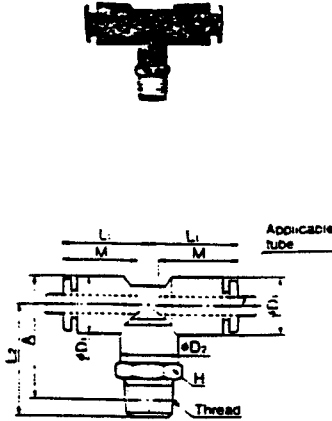


Applicable tube O.D. (inch)	Thread UNF NPT	Model	H (Hex.)	ø D ₁	ø D ₂	L ₁	L ₂	A	M	Orifice Dia.	Weight Oz.			
1/8	10-32 UNF	KQL01-32	3/16"	0.38	0.32	0.69	0.62	0.66	0.61	0.10	0.09	0.20		
	1/8	KQL01-33S	3/16"								0.85	0.89	0.10	0.28
	1/8	KQL01-34S	3/16"								1.00	0.96	0.10	0.63
	1/8	KQL01-35S	3/16"								1.00	0.96	0.10	0.63
3/32	10-32 UNF	KQL03-32	3/16"	0.41	0.32	0.71	0.64	0.70	0.63	0.12	0.09	0.26		
	3/32	KQL03-33S	3/16"								0.87	0.91	0.12	0.32
	3/32	KQL03-34S	3/16"								1.02	0.98	0.12	0.63
	3/32	KQL03-35S	3/16"								1.02	0.98	0.12	0.63
3/16	1/8	KQL05-34S	1/2"	0.45	0.39	0.77	0.89	0.94	0.65	0.14	0.35	0.67		
	3/16	KQL05-35S	3/16"								1.04	1.02	0.14	0.67
1/4	10-32 UNF	KQL07-32	1/4"	0.52	0.39	0.81	0.83	0.95	0.67	0.18	0.09	0.31		
	1/4	KQL07-34S	1/2"								0.93	1.02	0.18	0.35
	1/4	KQL07-35S	3/16"								1.08	1.10	0.18	0.71
	1/4	KQL07-36S	1/16"								1.16	1.16	0.18	1.13
5/16	1/4	KQL09-34S	1/2"	0.60	0.47	0.93	0.96	1.10	0.73	0.24	0.42	0.71		
	5/16	KQL09-35S	3/16"								1.12	1.18	0.24	0.71
	5/16	KQL09-36S	1/16"								1.20	1.24	0.24	0.99
3/8	1/4	KQL11-35S	1/2"	0.70	0.67	1.00	1.15	1.28	0.83	0.28	1.16	2.08		
	3/8	KQL11-36S	1/16"								1.24	1.34	0.28	1.16
	3/8	KQL11-37S	1/8"								1.40	1.44	0.28	2.08
1/2	3/8	KQL13-35S	3/8"	0.85	0.67	1.10	1.24	1.44	0.87	0.38	0.35	0.99		
	1/2	KQL13-36S	1/16"								1.32	1.52	0.38	1.27
	1/2	KQL13-37S	3/8"								1.48	1.57	0.38	2.19

Reference dimensions after thread installation

Inch-size/One-touch Fittings: KQ

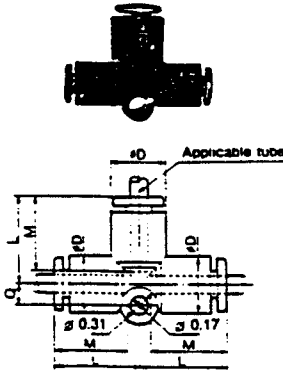
Branch tee: KQT



Applicable tube O.D. (inch)	Thread NPT	Model	H (Hex.)	$\varnothing D_1$	$\varnothing D_2$	L ₁	L ₂	*A	M	Orifice Dia.	Wgt. Oz.
1/8	1/8	KQT01-33S	1/8"	0.38	0.39	0.69	0.85	0.89	0.61	0.10	0.35
	1/8	KQT01-34S	1/8"	0.38			1.00	0.96			0.71
1/2	1/8	KQT03-33S	1/8"	0.41	0.39	0.71	0.87	0.91	0.63	0.12	0.35
	1/8	KQT03-34S	1/8"				1.02	0.98			0.39
3/8	1/8	KQT05-34S	1/8"	0.45	0.39	0.77	0.89	0.94	0.65	0.14	0.42
	1/8	KQT05-35S	1/8"				1.04	1.02			0.74
1/2	1/8	KQT07-34S	1/8"	0.52	0.39	0.81	0.93	1.02	0.67	0.18	0.42
	1/8	KQT07-35S	1/8"				1.08	1.10			0.78
	1/8	KQT07-36S	1/8"				1.16	1.16			1.23
3/4	1/8	KQT09-34S	1/8"	0.60	0.47	0.93	0.96	1.10	0.73	0.24	0.55
	1/8	KQT09-35S	1/8"				1.12	1.18			0.85
	1/8	KQT09-36S	1/8"				1.20	1.24			1.27
1	1/8	KQT11-35S	1/8"	0.70	0.67	1.00	1.16	1.28	0.83	0.28	1.02
	1/8	KQT11-36S	1/8"				1.24	1.34			1.34
	1/8	KQT11-37S	1/8"				1.40	1.44			2.26
1 1/2	1/8	KQT13-35S	1/8"	0.85	0.67	1.10	1.24	1.44	0.87	0.35	1.27
	1/8	KQT13-36S	1/8"				1.32	1.52			1.52
	1/8	KQT13-37S	1/8"				1.48	1.57			2.43

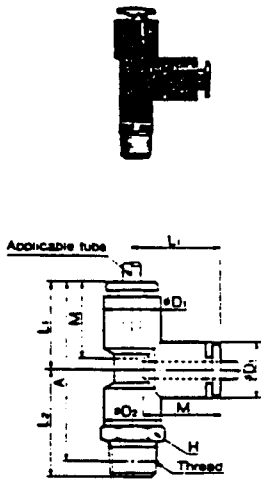
*Reference dimensions after thread installation

Union tee: KQT



Applicable tube O.D. (inch)	Model	$\varnothing D$	L	Q	M	Orifice Dia.	Wgt. Oz.
1/8	KQT01-00	0.38	0.69	0.17	0.61	0.10	0.18
1/2	KQT03-00	0.41	0.71	0.18	0.63	0.12	0.18
3/8	KQT05-00	0.45	0.77	0.19	0.65	0.14	0.25
1/2	KQT07-00	0.52	0.81	0.21	0.67	0.18	0.32
3/4	KQT09-00	0.60	0.91	0.24	0.73	0.24	0.42
1	KQT11-00	0.70	1.02	0.26	0.83	0.28	0.63
1 1/2	KQT13-00	0.85	1.14	0.31	0.87	0.38	0.92

Male run tee: KQY

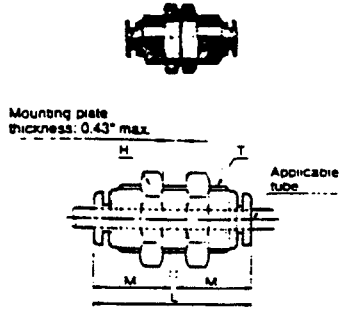


Applicable tube O.D. (inch)	Thread NPT	Model	H (Hex.)	$\varnothing D_1$	$\varnothing D_2$	L ₁	L ₂	*A	M	Orifice Dia.	Wgt. Oz.
1/8	1/8	KQY01-33S	1/8"	0.38	0.39	0.69	0.85	0.89	0.61	0.10	0.35
	1/8	KQY01-34S	1/8"				1.00	0.96			0.71
1/2	1/8	KQY03-33S	1/8"	0.41	0.39	0.71	0.87	0.91	0.63	0.12	0.35
	1/8	KQY03-34S	1/8"				1.02	0.98			0.39
3/8	1/8	KQY05-34S	1/8"	0.45	0.39	0.77	0.89	0.94	0.65	0.14	0.42
	1/8	KQY05-35S	1/8"				1.04	1.02			0.74
1/2	1/8	KQY07-34S	1/8"	0.52	0.39	0.81	0.93	1.02	0.67	0.18	0.42
	1/8	KQY07-35S	1/8"				1.08	1.10			0.78
	1/8	KQY07-36S	1/8"				1.16	1.16			1.23
3/4	1/8	KQY09-34S	1/8"	0.60	0.47	0.93	0.96	1.10	0.73	0.24	0.55
	1/8	KQY09-35S	1/8"				1.12	1.18			0.85
	1/8	KQY09-36S	1/8"				1.20	1.24			1.27
1	1/8	KQY11-35S	1/8"	0.70	0.67	1.00	1.16	1.28	0.83	0.28	1.02
	1/8	KQY11-36S	1/8"				1.24	1.34			1.34
	1/8	KQY11-37S	1/8"				1.40	1.44			2.26
1 1/2	1/8	KQY13-35S	1/8"	0.85	0.67	1.10	1.24	1.44	0.87	0.35	1.27
	1/8	KQY13-36S	1/8"				1.32	1.52			1.52
	1/8	KQY13-37S	1/8"				1.48	1.57			2.43

*Reference dimensions after thread installation

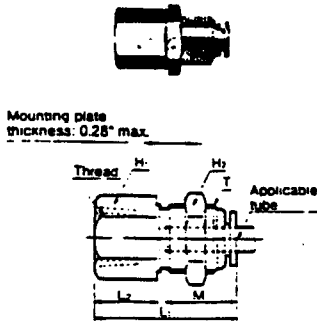
Inch-size/One-touch Fittings : KQ

Bulkhead union : KQE



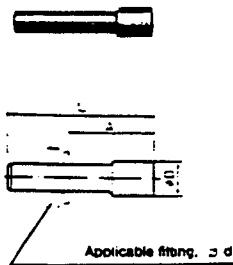
Applicable tube O.D. (inch)	Model	T UNF	H (Hex.)	L	Mounting hole	M	Orifice Dia.	Weight Oz.
1/8	KQE01-00	1/2-20	1 1/8"	1.24	0.53	0.61	0.10	0.92
3/32	KQE03-00	1/2-20	1 1/8"	1.28	0.53	0.63	0.12	0.92
3/16	KQE05-00	3/8-18	1 1/8"	1.34	0.59	0.65	0.14	1.16
1/4	KQE07-00	3/8-18	1 1/8"	1.36	0.59	0.67	0.18	1.16
3/8	KQE09-00	1/2-16	1 1/2"	1.50	0.78	0.73	0.24	1.83
1/2	KQE11-00	3/4-14	1"	1.67	0.91	0.83	0.28	2.47
3/4	KQE13-00	1-12	1 1/2"	1.75	1.03	0.87	0.38	2.42

Bulkhead connector : KQE



Applicable tube O.D. (inch)	Thread NPT	Model	T UNF	H ₁ (Hex.)	H ₂ (Hex.)	L ₁	L ₂	M	Orif. Dia.	Mounting hole	Weight Oz.
1/8	1/8	KQE01-35	1/2-20	1 1/8"	1 1/8"	1.24	0.59	0.61	0.10	0.55	1.27
3/32	1/8	KQE03-35	1/2-20	1 1/8"	1 1/8"	1.24	0.59	0.63	0.12	0.55	1.27
3/16	1/8	KQE05-34	3/8-18	1 1/8"	1 1/8"	1.12	0.51	0.65	0.14	0.59	1.20
1/4	1/8	KQE07-35	3/8-18	1 1/8"	1 1/8"	1.20	0.57	0.67	0.18	0.59	1.20
3/8	1/8	KQE09-36	1/2-16	1 1/2"	1 1/2"	1.40	0.59	0.73	0.24	0.79	1.83
1/2	1/8	KQE11-36	3/4-14	1"	1"	1.40	0.57	0.83	0.28	0.91	3.39
3/4	1/8	KQE13-36	1-12	1 1/2"	1 1/2"	1.44	0.57	0.87	0.38	1.02	4.41
	1/2	KQE13-37	1-12	1 1/2"	1 1/2"	1.59	0.73				4.51

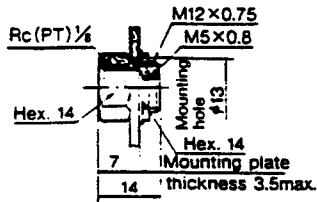
Plug : KQP



ϕd Applicable fitting tube O.D.	Model	ϕD	L	A	Weight Oz.
1/8"	KQP01	0.20	1.24	0.63	0.09
3/32"	KQP03	0.24	1.26	0.63	0.04
3/16"	KQP05	0.27	1.34	0.69	0.04
1/4"	KQP07	0.33	1.38	0.71	0.04
3/8"	KQP09	0.39	1.54	0.81	0.04
1/2"	KQP11	0.45	1.69	0.87	0.08
3/4"	KQP13	0.59	1.81	0.94	0.16

Series: M5

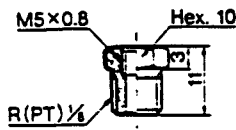
Bulkhead reducer: M-5ER



For the plate thickness 3.5~6mm, give the plate tapping M12×0.75, and then screw-in.

Weight: 12gf

Bushing: M-5B



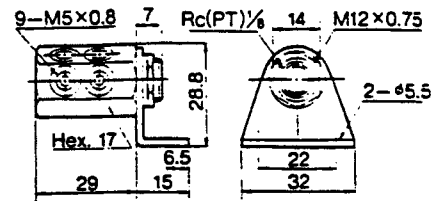
Weight: 5.8gf

Gasket: M-5GI



Weight: 0.01gf

Manifold: M-5M



Panel mounting plate thickness max. 3.5mm
For the plate thickness 3.5~6mm, give the plate tapping M12×0.75, and then screw-in.

Weight: 59gf

Plug: M-5P



Weight: 1.3gf

Gasket: M-5GH



Weight: 0.04gf

Instructions For Use

Tightening of M3 and M5 thread.

- ① Tighten by hand, and give it an additional 1/6 rotation with wrench.
(The additional rotation should be doubled to 1/3 when using the universal elbow, universal tee, etc. which have more than two gasket thicknesses.)

Use of tubing with hose nipples.

- ① Cut the tube perpendicularly to the tube axis to the required length.
(Use tube cutter TKA-1.)

- ② Pass the tubing through the cap nut.

- ③ Push the tube until it comes to the end of the barb portion.

- ④ Tighten the cap nut firmly by hand on the fitting.

Using tubing with barb fittings.

- ① Cut the tube perpendicularly to the tube axis to the required length.

(Use tube cutter TKA-1)

- ② Push the tube in until it comes to the end of the barb portion.

Manifold Mounting of NVJ300 and NVJ3000 Series

NVJ3000 Series is mountable on the manifold base of the NVJ3000, NVV5J3.

① In case of type NVV5J3-20

Insert the plug (VJ3000-33-1) into the B port, which is not used for a 3 way valve.

Applicable Valve : NVJ312, NVJ312M
NVJ322, NVJ322M

② For type NVV5J3-31,S31, NVV5J3-32,S32, and NVV5J3-46,S46

Mount NVJ300 in the usual fashion.

Outlet port of a 3 way valve will be B port of the manifold base

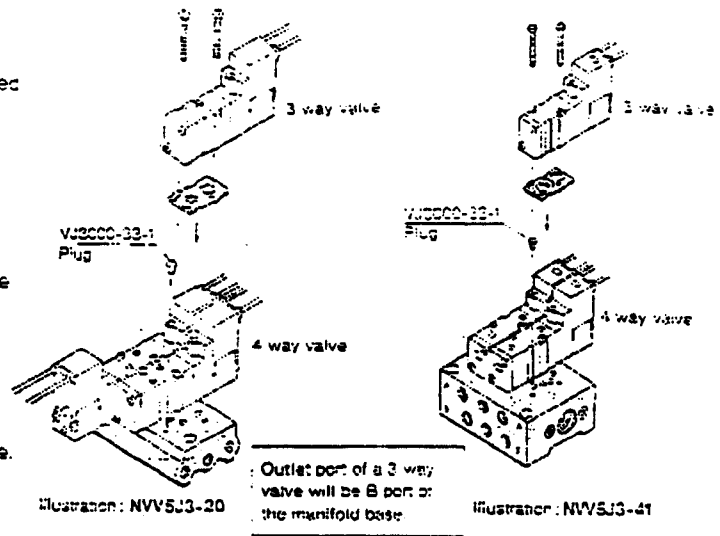
Applicable Valve : NVJ314, NVJ314M
NVJ324, NVJ324M

③ For type NVV5J3-41,S41

Insert the plug (VJ3000-33-1) into the B port, which is not used for a 3 way valve.

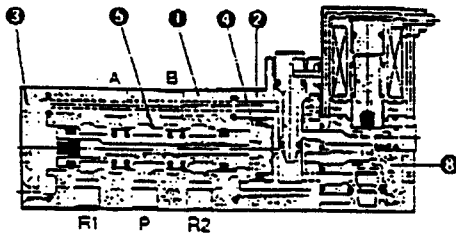
Outlet port of a 3 way valve will be B port of the manifold base.

Applicable Valve : NVJ314, NVJ314M
NVJ324, NVJ324M

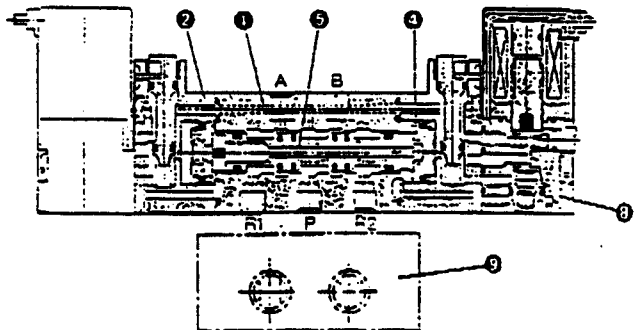


Construction/Parts List

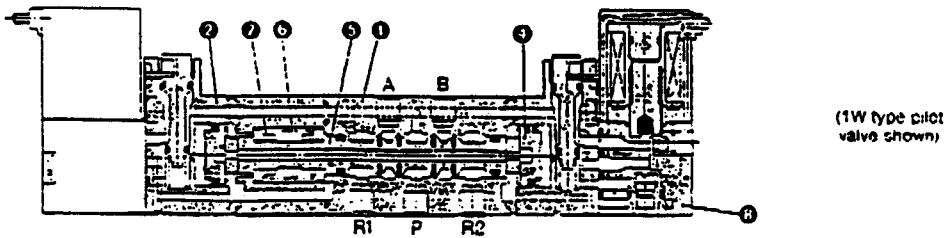
2 Position Single Solenoid



2 Position Double Solenoid



3 Position Closed Center / Exhaust Center / Pressure Center



Main Parts

No.	Part name	Material	Notes
①	Body	Zinc die cast	Platinum silver
②	Piston plate	PBT resin	Black
③	End cover	PBT resin	Black
④	Piston	Polycetal	-
⑤	Spool ass'y	-	-
⑥	Return spring	Stainless steel	-
⑦	Spring washer	Nylon	-

Spare Parts

No.	Part name	Material	Parts No.
⑧	Pilot Valve ass'y	-	NVJ114-○○○○
⑨	Subplate	Zinc die cast	VJ3000-22-1

5 port Base mounted type	NVJ314O	2 position single solenoid	10-32 Nom. (M5)	0.1	0.123 (59)	0.068 (30)	0.120 (59)	0.073 (33)
	NVJ324O	2 position double solenoid			0.147 (67)	0.090 (41)	0.161 (73)	0.103 (47)
	NVJ334O	3 position closed center	10-32 Nom. (M5) One touch fitting for 3/8" tube	[(S) 41:0.08] [(S) 48:0.055]	0.154 (70)	0.097 (44)	0.167 (76)	0.110 (50)
	NVJ344O	3 position exhaust center						
	NVJ354O	3 position pressure center						

[]: In case of manifold. < >: Without substrate

Specifications

Fluid	Air and inert gas	
Operating pressure range	2 position single solenoid	20~100 PSI (1.5~7kgf/cm ²)
	2 position double solenoid	14~100 PSI (1~7kgf/cm ²)
	3 position	28~100 PSI (2~7kgf/cm ²)
Ambient & fluid temperature	Max 120°F (50°C)	
Response time	2 position	15ms
	3 position	30ms
Max operating frequency	2 position	10c/s
	3 position	3c/s
Manual Override	Non-locking push type.	
	Slotted locking type	
Pilot exhaust	Individual pilot exhaust	
	Common exhaust for main & pilot valve	
Lubrication	Not required	
Mounting position	Free	
Impact/vibration resistance	15G/3G (8.3~2000Hz)	
Enclosure	Dust proof	

Solenoid Specifications

Electrical entry	Common (G), (H), Plug connector (L or M)
Voltage τ	24VDC, 12VDC, 5VDC, 5VDC, 3VDC, 110VAC*
Allowable voltage	±10% rated voltage
Coil insulation	Class A or equivalent
Power Consumption	1W (LED: 1.2W) / 0.45W (LED: 0.5W)
Surge voltage suppressor	Diode
Indicator light	LED

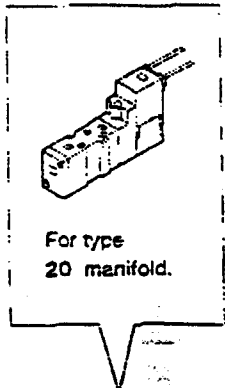
* Rectified. τ 24VAC available as special order.

With Bracket

Applicable type	Valve model number
For single solenoid type	NVJ312C-○○○○-M3-F (Factory installed only)
For double solenoid type	NVJ322O-○○○○-M3-F
	NVJ332O-○○○○-M3-F
	NVJ342O-○○○○-M3-F

(note) Bracket part number (For double solenoid type): VJ3000-13-1
 If a double solenoid type bracket is desired for single solenoid valve, order the double solenoid valve type bracket; and single solenoid valve without a bracket.
 Example) NVJ312C-3M-M3 VJ3000-13-1

How to Order



•Voltage

5	24VDC
6	12VDC
V	6VDC
S	5VDC
R	3VDC
D3	110VAC*

•Type of actuation

1	2 position, single solenoid
2	2 position, double solenoid
3	3 position, closed center
4	3 position, exhaust center
5	3 position, pressure center

* Rectified, 24VAC available also.

•Indicator light and surge voltage suppressor

—	Without indicator light and surge voltage suppressor
S	With surge voltage suppressor
Z	With indicator light & surge voltage suppressor

S and Z not available for grommet, 110VAC type includes S (can not specify).

•Bracket

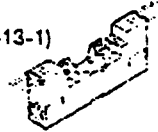
—: Without bracket

F: With bracket:

In case of single solenoid, (factory installed only)



In case of double solenoid, (VJ3000-13-1)

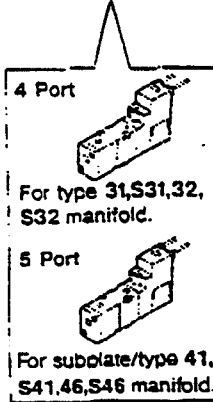


If a double solenoid type bracket is desired for single solenoid valve, please order the double solenoid valve type bracket and a single solenoid valve W/C a bracket. (Ex) NVJ3120-SM-M3 VJ3000-13-1

Body Port Type: NVJ3 1 2 0 5 M M3

Base Mounted Type (4 Port): NVJ3 1 3 0 5 M (Manifold only)

Base Mounted Type (5 Port): NVJ3 1 4 0 5 M



Body option

0: Individual pilot exhaust

3: Common exhaust for main and pilot valve

(The pilot exhaust is connected to the main exhaust via a check valve)

Power consumption

Nil: Standard 1WDC (1.2 w/LED)

Y: 0.45W type (24, 12 VDC only)

Manual

—: Non-locking push type

B: Slotted locking type

Port size

—: Without subplate

M5: With 10-32 Nom. (M5) subplate (VJ3000-22-1)

Electrical entry

G: Grommet :12 inch lead wire	L: L type plug connector with lead wire length :12 inch (300mm)	LO: L type plug connector without connector
H: Grommet Lead wire length :24 inch (600mm)	M: M type plug connector with lead wire length :12 inch (300mm)	MO: M type plug connector without connector

* Special Order Only

How to order

Connector ass'y number

VJ10-20-4A-

(110VAC: VJ10-36-3A-*)

Lead wire length

—	12 inch (300mm)
6	24 inch (600mm)
10	40 inch (1000mm)
15	60 inch (1500mm)
20	80 inch (2000mm)
25	100 inch (2500mm)
30	120 inch (3000mm)

• When ordering both the valve and connector ass'y include both the valve and connector numbers. Example: 90 inch lead wire length NVJ3120-ELC-M3 VJ10-20-4A-20

Series: NVJ3000 Manifold
Specifications

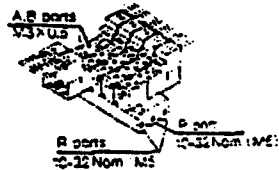
Valve stations | 2 to 20

Type and How to Order

Common Supply, Common Exhaust Type

Note: If there are more than 10 stations supply air from both sides of manifold and exhaust from both sides of manifold.

Type 20 (for 5 port body ported type)



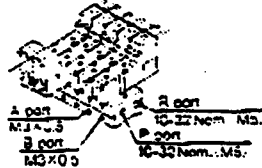
NVV5J3-20-05

Stations
02 2 stations
:
20 20 stations

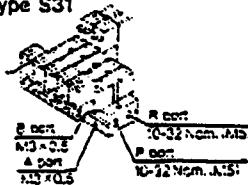
Applicable valves
NVJ3C20C-0000-M3
NVJ3C23C-0000-M3
Applicable blank plate ass'y
VJ3000-21-2A

Type 31 & S31 (for 4 port base mounted type)

Type 31



Type S31



NVV5J3-31-05-M3

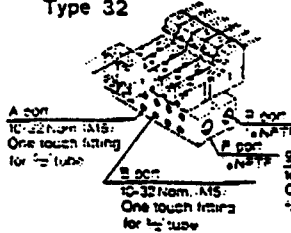
Position of A,B port
— End cover side of single solenoid type
S Solenoid side of single solenoid type

Stations
02 2 stations
:
20 20 stations

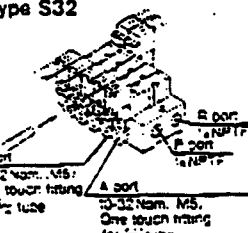
Applicable valves
NVJ3C300-0000
NVJ3C33C-0000
Applicable blank plate ass'y
VJ3000-21-1A

Type 32 & S32 (for 4 port base mounted type)

Type 32



Type S32



NVV5J3-32-05-M5

Position of A,B port
— End cover side of single solenoid type
S Solenoid side of single solenoid type

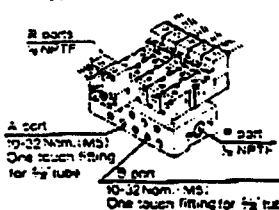
Stations
02 2 stations
:
20 20 stations

A,B port size
M5 | 10-32 Nom. (M5)
B3T | One touch fitting for 1/2" tube

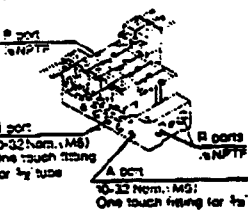
Applicable valves
NVJ3C30C-0000
NVJ3C33C-0000
Applicable blank plate ass'y
VJ3000-21-1A

Type 41 & S41 (for 5 port base mounted type)

Type 41



Type S41



NVV5J3-41-05-B3T

Position of A,B port
— End cover side of single solenoid type
S Solenoid side of single solenoid type

Stations
02 2 stations
:
20 20 stations

A,B port size
M5 | 10-32 Nom. (M5)
B3T | One touch fitting for 1/2" tube

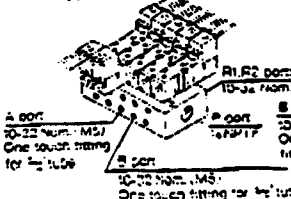
Applicable valves
NVJ3C40C-0000
NVJ3C43C-0000
Applicable blank plate ass'y
VJ3000-21-1A

Common Supply, Individual Exhaust Type

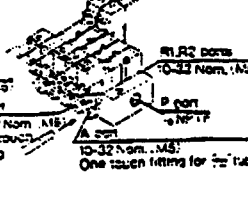
Note: If there are more than 10 stations, supply air from both sides of manifold and exhaust from both sides of manifold.

Type 46 & S46 (for 5 port base mounted type)

Type 46



Type S46



NVV5J3-46-05-B3T

Position of A,B port
— End cover side of single solenoid type
S Solenoid side of single solenoid type

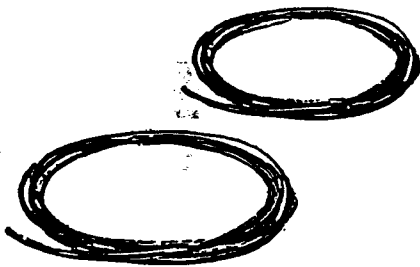
Stations
02 2 stations
:
20 20 stations

A,B port size
M5 | 10-32 Nom. (M5)
B3T | One touch fitting for 1/2" tube

Applicable valves
NVJ3C40C-0000
NVJ3C43C-0000
Applicable blank plate ass'y
VJ3000-21-1A

SMC Polyurethane Tubing Series TU

For general air pressure.
Very pliable.



Series Table

● - 20m Roll □ - 100m roll

Tube type	Tube size				
	Milli-size (Series TU)				
	TU0425	TU0604	TU0805	TU1065	TU1208
Tube O.D. (mm)	4	6	8	10	12
Tube I.D. (mm)	2.5	4	5	6.5	8

Black (B)	●	●	●	●	●
White (W)	●	●	●	●	●
Red (R)	●	●	●	●	●
Blue (BU)	●	●	●	●	●
Yellow (Y)	●	●	●	●	●
Green (G)	●	●	●	●	●
Clear (C)	●	●	●	●	●

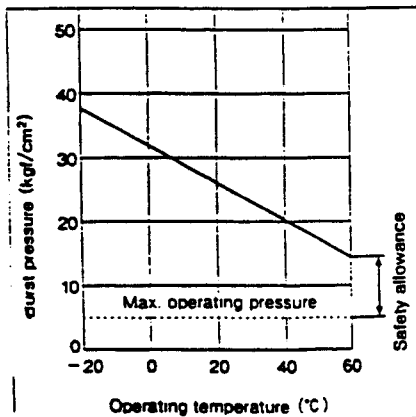
□ 5/8"
□ 5/8"

Specifications

Max. operating pressure	5kgf/cm ² (500kPa)				
Burst pressure	Refer to burst pressure characteristics curve.				
Note 1) Minimum bending radius (mm)	10	15	20	27	35
Operating temperature	-20 ~ +60°C				
Material	Polyurethane				

Note 1) The value for bending radius is at a temperature of 20°C.
(Reference) The inch sizes of 5/8" and 3/4" are equivalent to 16 and 19 millimeter.

Polyurethane Tubing/Burst Pressure Characteristics Curve



• Taking safety allowance into consideration 1/3 or less of burst pressure under temperature 60°C is the max. operating pressure

How To Order

TU0425 BU 20

Indication of tube type

• Length per roll

Symbol	Roll size
20	20m bundle winding
100	100m reel winding

• Color indication

Symbol	Color
B	Black
W	White
R	Red
BU	Blue
Y	Yellow
G	Green
C	Clear

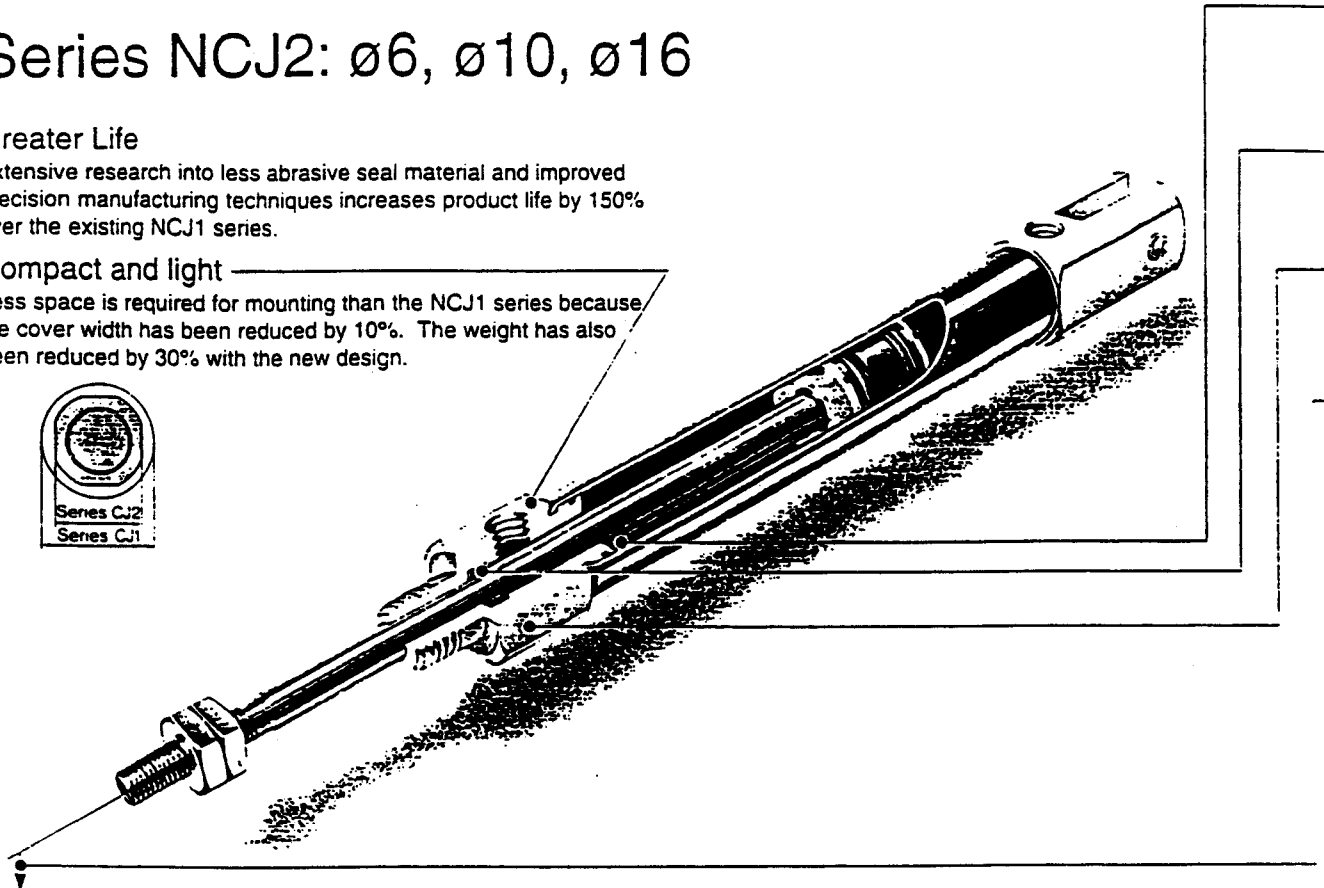
Series NCJ2: ø6, ø10, ø16

Greater Life

Extensive research into less abrasive seal material and improved precision manufacturing techniques increases product life by 150% over the existing NCJ1 series.

Compact and light

Less space is required for mounting than the NCJ1 series because the cover width has been reduced by 10%. The weight has also been reduced by 30% with the new design.



Standard variation

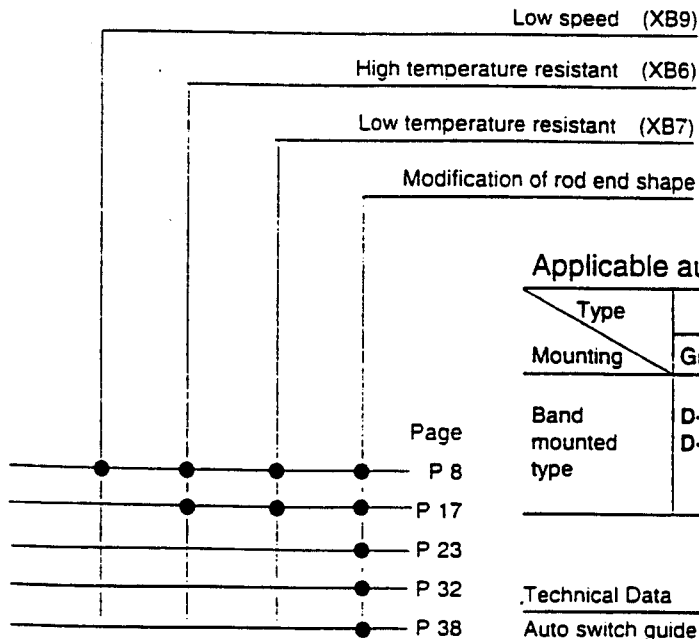
Built-in magnet

Series Variation/INDEX

		Standard type		
Standard type	Double acting	Single rod	●	●
	Double acting	Double rod	●	●
	Single acting	Spring return, Spring extend	●	●
Non-rotating piston rod type	Double acting	Single rod	●	●
	Single acting	Spring return, Spring extend	●	●

- **High speed actuation**
By adding rubber cushions as standard equipment, piston speeds have been increased by 150%.
- **Reduced wear characteristics**
Improved material in the rod bearing and rear clevis reduces wear – greatly prolonging cylinder life.
- **Easy mounting**
Wrench flats on each cover allow easy and precise mounting.
- **Negligible rod shear drop**
Tight machining tolerances and improved materials ensure minimal inclination of the rod at full extension.

Made to order options (see page 55)



Applicable auto switch

Type Mounting	Reed switch		Solid state auto switch	
	Grommet	Connector	Grommet	Connector
Band mounted type	D-C7 type D-C8 type	D-C73C type D-C80C type	3 wire type D-H7A type 2 wire type D-H7B type	2 wire type D-H7C type

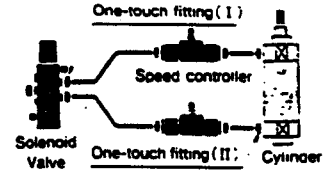
Technical Data	4 - 7
Auto switch guide	P 46

Technical Data

Suggested System Components for use with High Speed Applications

The following table should be used as a guide when selecting system components for use with NCJ2 series cylinders in high speed applications. Allowable kinetic energy must be calculated first to determine applicable cylinder.

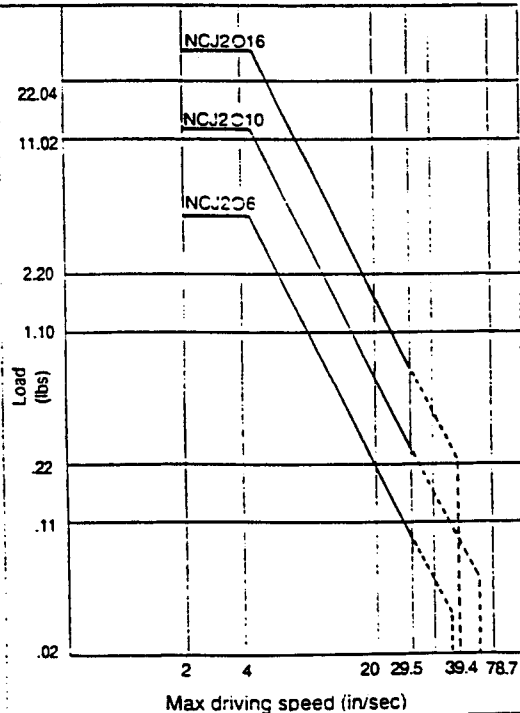
System diagram



System	Bore size	Cylinder port size	Tubing	Solenoid valve (Rubber seal)	Silencer	Speed controller	One -touch fitting		Max. driving speed mm/sec (in/sec) (No load)	
							I	II	OUT	IN
A	NCJ2O6	#10-32	T0425	NVJ3O40-M5	NAN120-M5	NAS1001F-03	KQH03-32	KQH03-32	950 (37.4)	650 (25.6)
	NCJ2O10								1600 (63.0)	650 (25.6)
	NCJ2O16								1050 (41.3)	780 (30.7)
B	NCJ2O6	#10-32	T0425	NVZ3O40-01	NAN101-N01	NAS2001F-03	KQH03-32	KQH03-32	950 (37.4)	700 (27.6)
	NCJ2O10								1600 (63.0)	650 (25.6)
	NCJ2O16								1100 (43.3)	800 (31.5)

Allowable Kinetic Energy

Rubber cushion



With rubber cushion (standard equipment)

Rubber cushions on both ends of the cylinder help to relieve the noise and shock of piston impact at the end of the stroke during high speed operation. Care should be taken to avoid "kickback" of the load at stroke end. Kinetic energy developed by the load during high speed operations can be absorbed by the rubber cushions as indicated by the graph to the left. If the kinetic energy is within the allowable range, the life of the cushion packing can be expected to exceed a million cycles. (all other conditions being ideal).

The load kinetic energy can be obtained by the following equation.

$$Ke = \frac{W}{2g} v^2$$

- Ke: Kinetic energy (lbs/in)
- W: Weight in lbs
- g: Weight acceleration (386 in/sec²)
- v: Piston speed (in/sec)



How to use figure

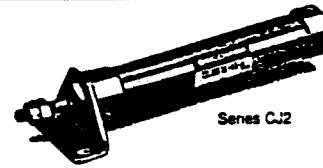
(Example) To obtain the load at the rod tip for a maximum driving speed of 20 in. sec with a cylinder bore size of 16 mm: Extend upward from the abscissa at 20 in/sec. At the intersection point with the line of core size 16mm move leftward and obtain a load of 1.54 lbs.

Technical Data

Selection of bore size

Series and bore size

Series	Action	Bore size (mm)		
		6	10	16
NCJ2	Double acting	●	●	●
	Single acting	●	●	●



Relationship of power generation, bore size, and pressure

Power generation, bore size, and pressure can be expressed by the following equations:

$$Fp_1 = \mu \times Ff_1 \quad (1)$$

$$Fp_2 = \mu \times Ff_2 \quad (2)$$

$$Ff_1 = \frac{\pi}{4} D^2 \times P \quad (3)$$

$$Ff_2 = \frac{\pi}{4} (D^2 - d^2) \times P \quad (4)$$

- Fp_1 : Cylinder power generation in the push side (lbs)
- Fp_2 : Cylinder power generation in the drawing side (lbs)
- Ff_1^* : Theoretical output in the push side (lbs)
- Ff_2^* : Theoretical output in the drawing side (lbs)
- P : Operating pressure (PSI)
- D^{**} : Bore size (in)
- d^{**} : Piston rod diameter (in)
- μ : Load pressure factor

* Theoretical cylinder forces are listed on page 6.
 ** To convert mm to inches divide by 25.4 (25.4mm = 1 in)

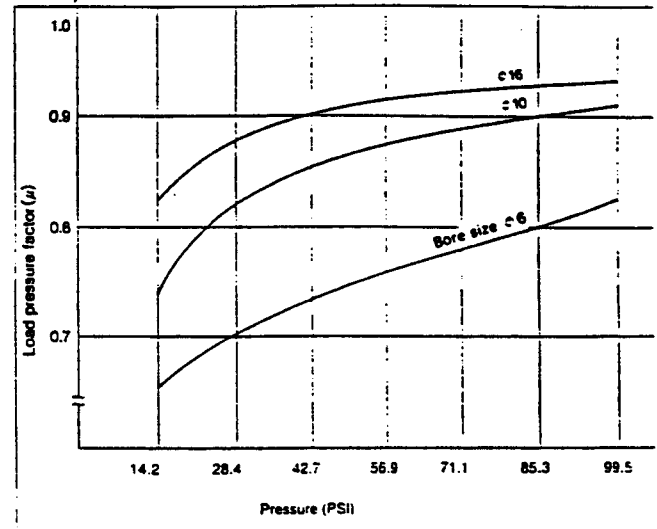
Selection Reference

Theoretical power generation and the pressure load factor of a cylinder from a rest condition to an energized condition is demonstrated from the pressure load factor table and the preceding equations. In selecting an applicable cylinder, a load factor of 0.7 or less should be specified in consideration of lower operating pressures.

Piston speed is influenced by the difference between the pressure supplied to one side of the piston and the air exhausting on the other side, and the weight and inertia of the load.

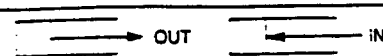
When higher speeds are required, a lower ratio is preferable. Generally in high speed applications, a cylinder should be selected so that the ratio between the theoretical output and the load is 0.5 or less.

Load pressure factor



Technical Data

Theoretical cylinder force



Double acting type cylinder

Unit: kgf / lbf

Series	Bore size (mm)	Rod dia (mm)	Operating direction	Piston area cm ² (in ²)	Operating pressure kgf/cm ² (PSI)						
					2 (28.4)	3 (42.7)	4 (56.9)	5 (71.1)	6 (85.3)	7 (99.5)	
NCJ2	6	3	OUT	0.283 (.043)	0.57 (1.2)	0.85 (1.8)	1.13 (2.5)	1.41 (3.1)	1.70 (3.7)	1.98 (4.3)	
			IN	0.212 (.032)	0.42 (0.9)	0.64 (1.4)	0.85 (1.8)	1.06 (2.3)	1.27 (2.8)	1.48 (3.2)	
	10	4	OUT	0.785 (.121)	1.57 (3.4)	2.36 (5.2)	3.14 (6.9)	3.93 (8.6)	4.71 (10.4)	5.50 (12.1)	
			IN	0.660 (.102)	1.32 (2.9)	1.98 (4.3)	2.64 (5.8)	3.30 (7.3)	3.96 (8.7)	4.62 (10.2)	
	16	5	OUT	2.010 (.311)	4.02 (8.8)	6.03 (13.3)	8.04 (17.7)	10.05 (22.1)	12.06 (26.6)	14.07 (31)	
			IN	1.814 (.281)	3.63 (8.0)	5.44 (12.0)	7.26 (16.0)	9.07 (20.0)	10.89 (24.0)	12.70 (27.9)	

Single acting type cylinder (Spring return)

Unit: kgf / lbf

Series	Bore size (mm)	Rod dia (mm)	Operating direction	Piston area cm ² (in ²)	Operating pressure kgf/cm ² (PSI)						
					2 (28.4)	3 (42.7)	4 (56.9)	5 (71.1)	6 (85.3)	7 (99.5)	
NCJ2	6	3	OUT	0.283 (.043)	0.18 (0.4)	0.46 (1.0)	0.74 (1.6)	1.02 (2.2)	1.31 (2.9)	1.59 (3.5)	
			IN	-	-	0.18 (.39) (Note 2)	-	-	-		
	10	4	OUT	0.785 (.121)	0.87 (1.9)	1.66 (3.6)	2.44 (5.3)	3.23 (7.1)	4.01 (8.8)	4.80 (10.5)	
			IN	-	-	0.36 (.79) (Note 2)	-	-	-		
	16	5	OUT	2.010 (.311)	2.57 (5.6)	4.58 (10)	6.59 (14.5)	8.60 (18.9)	10.61 (23.4)	12.62 (27.8)	
			IN	-	-	0.7 (1.54) (Note 2)	-	-	-		

Note 1) The theoretical output of single acting cylinders for the out stroke is the same as the double acting cylinders minus the compressed spring force when relaxed.
 Note 2) Do not use spring force to move a load.

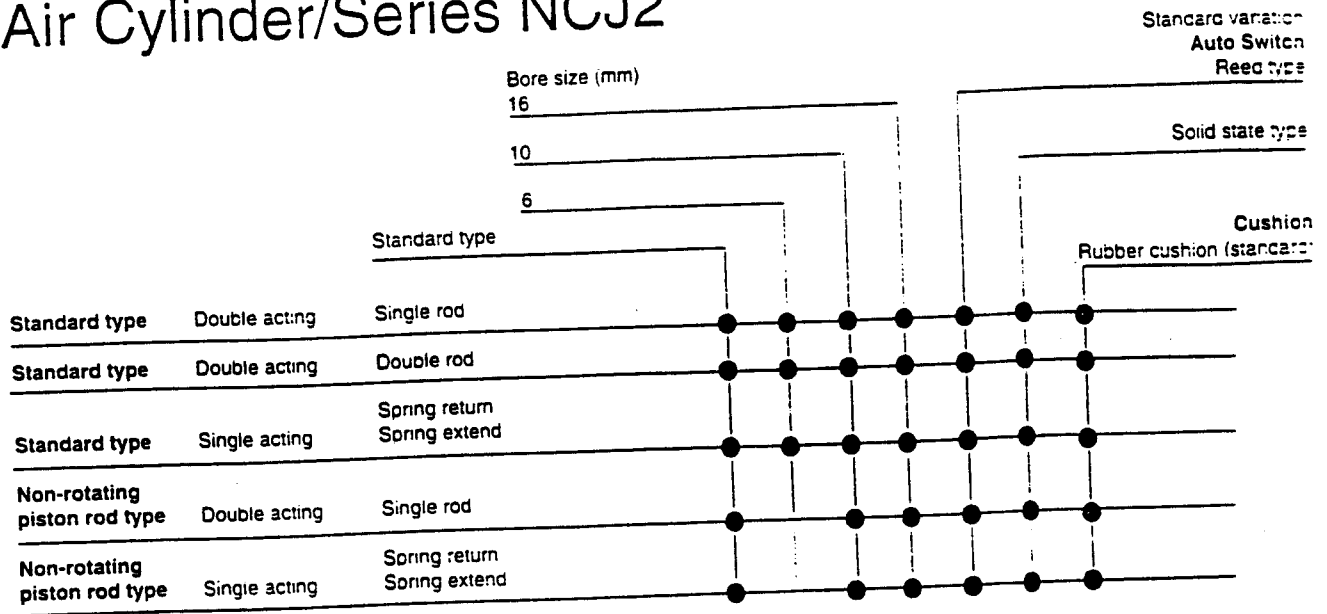
Installation and Maintenance

Precautions

- ① Flush piping thoroughly before connection in order to prevent dust or chips entering the cylinder.
- ② Take care not to mark or damage the piston rod. A damaged piston rod can quickly ruin the rod packing resulting in leakage and shortened cylinder life.
- ③ Always avoid lateral, (side), loads. The load should be applied to the piston rod in an axial direction.
- ④ Do not use the spring force of single acting cylinders to move a load.
- ⑤ Consult your local SMC representative for additional technical information if required.



Air Cylinder/Series NCJ2



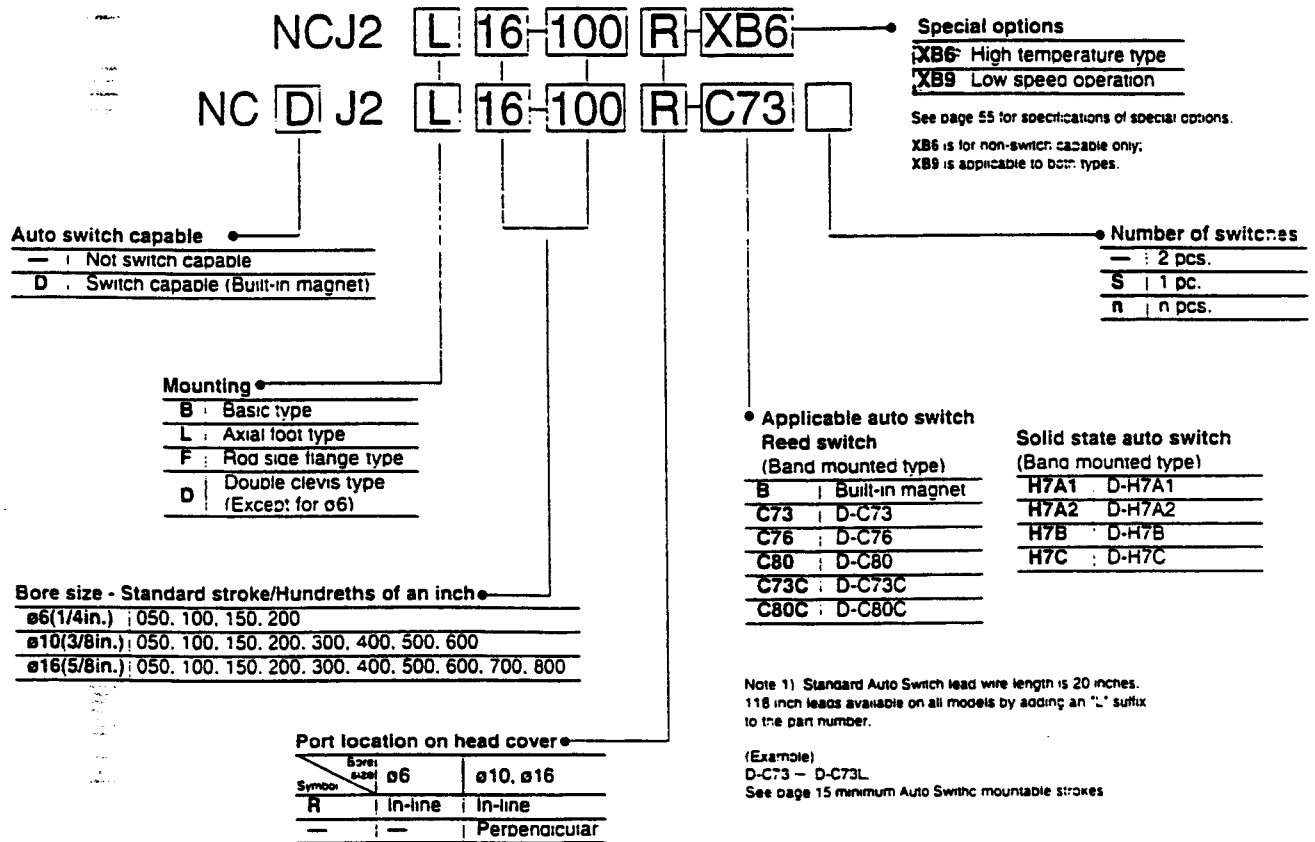
Made to Order

- 1 High temperature resistant cylinder
- 2 Low temperature resistant cylinder
- 3 Low speed cylinder
- 4 Modification of rod end.

Series NCJ2

Bore Size $\phi 6$, $\phi 10$, $\phi 16$

How to Order

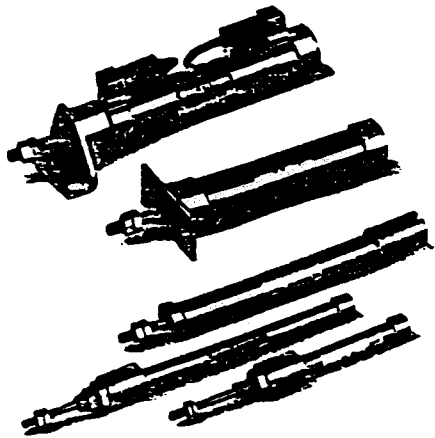


Parts No. of mounting brackets

Mounting Bracket	Bore size (mm)		
	6	10	16
Foot	NCJ-L006B	NCJ-L010B	NCJ-L016B
Flange	NCJ-F006B	NCJ-F010B	NCJ-F016B

Parts No. of auto switch mounting bands

Bore size (mm)	Parts No. of auto switch mounting band	Note
$\phi 6(1/4\text{ in.})$	BJ2-006	Common use to
$\phi 10(3/8\text{ in.})$	BJ2-010	all of D-C7, C8.
$\phi 16(5/8\text{ in.})$	BJ2-016	D-H7 types.

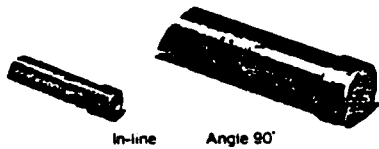
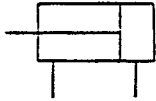


Specifications

Action	Double acting single rod	
Fluid	Air	
Proof pressure	10.5kgf/cm ² (1050kPa), 150 PSI	
Max. operating pressure	7.0kgf/cm ² (700kPa), 100 PSI	
Min. operating pressure	ø6	1.2kgf/cm ² (120kPa), 17 PSI
	ø10, ø16	0.6kgf/cm ² (60kPa), 8.5 PSI
Ambient and fluid temperature	-10° ~ +70° C (14° ~ +158°F)	
Cushion	Rubber cushion (Standard)	
Lubrication	None (Non-lube)	
Stroke tolerance	+1.0 mm (+.04 in) 0 0	
Piston speed	50 - 750mm/s 2 - 29.5 in/s	
	ø6	0.12kgf-cm 0.10lb-in
Allowable kinetic energy	ø10	0.35kgf-cm 0.30lb-in
	ø16	0.9kgf-cm 0.78lb-in

Symbol

Double acting/Single rod



Auto switch specification

Model	Lead wire entry	Applications	Load voltage	Max load current Load current range
D-C73	Grommet	Relay	24VDC	5 - 40mA
		Sequence controller	110VAC	5 - 20mA
D-C76	Grommet	IC Circuit	3 - 8VDC	20mA
D-C80	Grommet	Relay	24V ^{AC} _{DC} or less	50mA
		Sequence controller	48V ^{AC} _{DC}	40mA
		IC Circuit	100V ^{AC} _{DC}	20mA
D-C73C	Connector	Sequence controller	24VDC	5 - 22mA
D-C80C	Connector	Relay	24V ^{AC} _{DC} or less	50mA
		Sequence controller		
D-H7A1	Grommet	IC Circuit, Relay	28VDC	150mA
		Sequence controller		
D-H7A2	Grommet	IC Circuit, Relay	28VDC	150mA
		Sequence controller		
D-H7B	Grommet	24VDC Relay	24VDC	5-150mA
D-H7C	Connector	Sequence Controller	(10-28VDC)	

Mounting and Accessories/Please refer to p14 for details

Mounting		Basic type	Foot type	Rod side flange type	Double clevis
Standard	Mounting nut	●	●	●	—
	Rod end nut	●	●	●	●
	Clevis pin	—	—	—	●
Option	Double knuckle joint (with pin)	●	●	●	●

Weight Table

		gf (oz)		
Bore size(mm)		6	10	16
Basic weight		15 (.52)	24 (.84)	55 (1.94)
Additional weight for each 1/2" of stroke		11.70 (.03)	3.38 (.11)	5.5 (.19)
Mounting bracket weight	Foot type	7 (.24)	7 (.24)	19 (.67)
	Rod side flange type	5 (.17)	5 (.17)	13 (.45)
	Double clevis type(with pin)	—	2 (.07)	8 (.28)

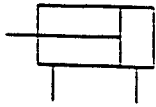
Calculation (Example) NCJ2L10-050

- Basic weight.....84oz (ø10)
- Additional weight.....11 oz
- (Cylinder stroke.....1/2")
- Mounting bracket weight.....24 oz (Foot type)
- .84 - 11 - 24 = 1.19 oz

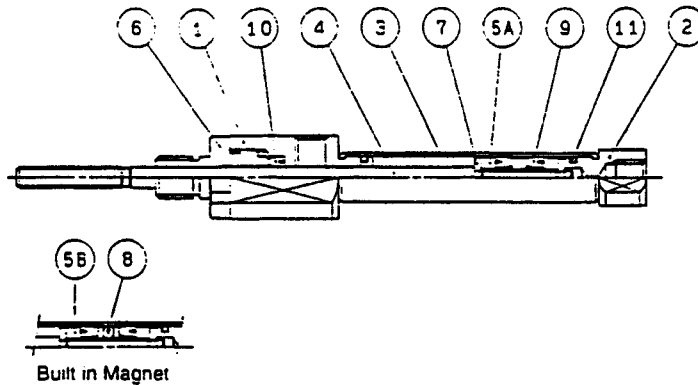
Port location on head cover

Perpendicular to the cylinder axis or in-line with the cylinder axis locations are available for basic type.
(ø6 is not available in perpendicular type.)

Construction/Parts List (Disassembly is not possible)



NCJ206-OR



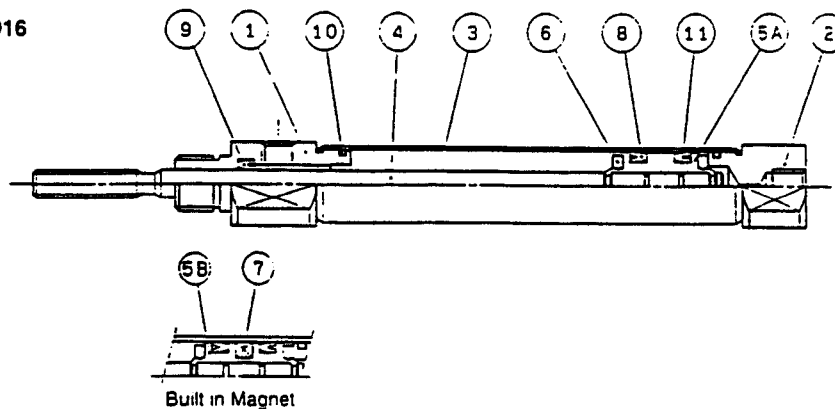
Parts List

Item	Part Name	Material	Qty	Remarks
1	Rod Cover	Aluminum Alloy	1	White Alumite
2	Head Cover	Aluminum Alloy	1	White Alumite
3	Cylinder Tube	Stainless Steel	1	
4	Piston Rod	Stainless Steel	1	
5A	Piston A	Brass	1	
5B	Piston B	Brass	1	(Switch Type Piston)
6	Packing Retainer	Aluminum Alloy	1	White Alumite
7	Bumper	Urethane	2	
8	Magnet	Magnet	1	

Packing List

No.	9	10	11
Name	Piston Packing	Rod Packing	Tube Gasket
Material	NBR	NBR	NBR
Quantity	2	1	2

NCJ2010, NCJ2 O16



Parts List

Item	Part Name	Material	Qty	Remarks
1	Rod Cover	Aluminum Alloy	1	White Alumite
2	Head Cover	Aluminum Alloy	1	White Alumite
3	Cylinder Tube	Stainless Steel	1	
4	Piston Rod	Stainless Steel	1	
5A	Piston A	Brass	1	
5B	Piston B	Brass	2	(Switch Type Piston)
6	Bumper	Urethane	2	
7	Magnet	Magnet	1	

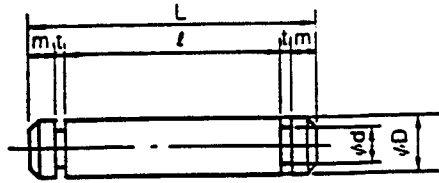
Packing List

No.	8	9	10	11
Name	Piston Packing	Rod Packing	Tube Gasket	Piston Gasket
Material	NBR	NBR	NBR	NBR
Quantity	2	1	2	1

Accessories

(inch)

Rear Clevis Pin

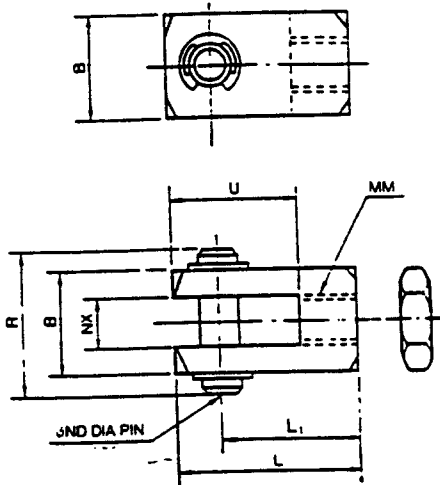


Note: Includes 2 retaining rings.

Part No.	Bore size	B	t	m	L	phi d	phi D
NCD-J010	ø10 (3/8")	0.188	0.59	0.147	0.48	0.03	0.03
NCD-J016	ø16 (5/8")	0.187	0.90	0.147	0.72	0.05	0.03

(inch)

Piston Rod Clevis

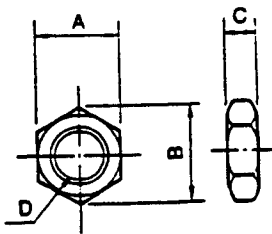


Note: Includes rod jam nut, clevis pin and two retaining rings.

Part No.	Bore size	B	t	NX	JND	U	MM	L1	L
NY-J010B	ø10 (3/8")	0.39	0.54	0.188	0.188	0.56	No.6-40UNF	0.94	0.75
NY-J016	ø16 (5/8")						No.10-32UNF		

(inch)

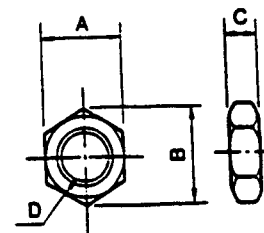
Mounting Nut



Part No.	Bore size	A	B	C	D
JM-025	ø6 (1/4")	0.44	0.50	0.16	1/4-28 UNF
JM-03	ø10 (3/8")	0.50	0.58	0.19	5/16-24 UNF
JM-04	ø16 (5/8")	0.56	0.65	0.23	3/8-24 UNF

(inch)

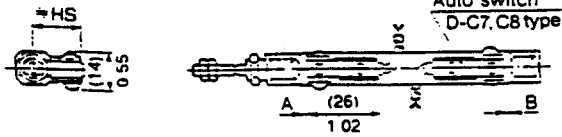
Rod Jam Nut



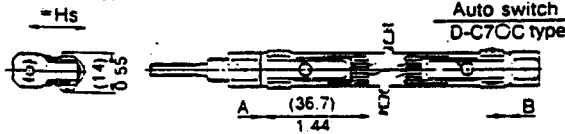
Part No.	Bore size	A	B	C	D
JM-005	ø6 (1/4")	0.31	0.11	0.11	5-40 UNC
JM-006	ø10 (3/8")	0.31	0.36	0.11	6-40 UNF
JM-02	ø16 (5/8")	0.38	0.43	0.13	10-32 UNF

Reed Switch Setting Position (Stroke End)

Band Mounted Type
D-C7/C8 type

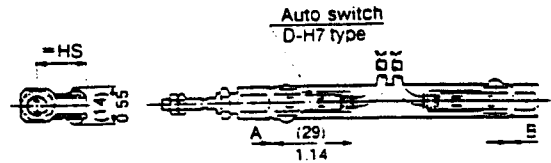


D-C73C/C80C type

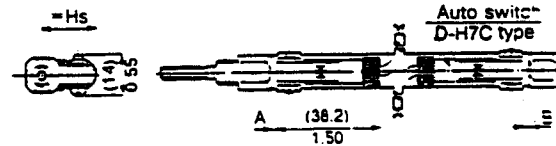


Solid State Switch Setting Position (Stroke End)

Band Mounted Type
D-H7 type



D-H7C type



Auto switch mounting, minimum possible cylinder stroke in(mm)

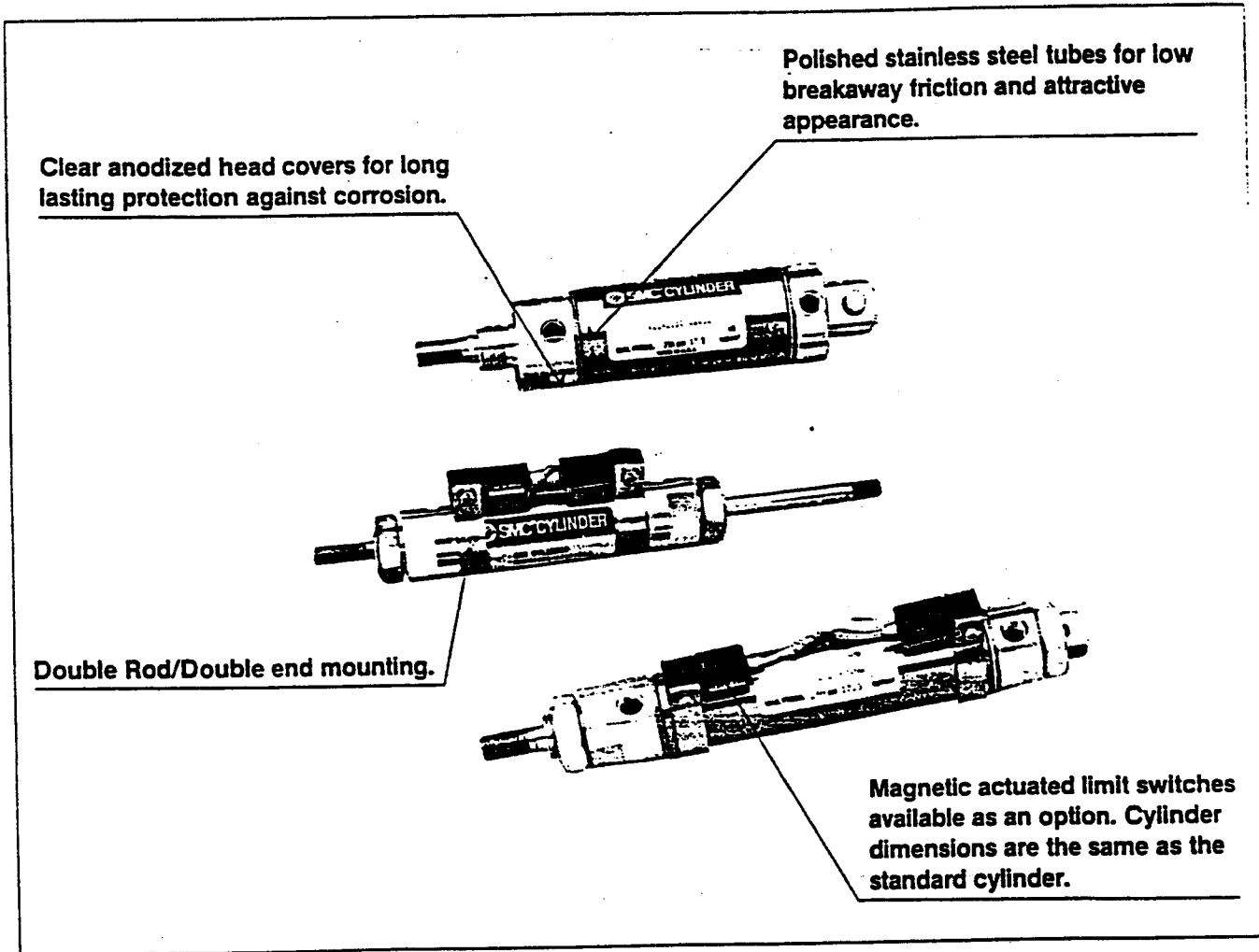
Auto switch mounting method	Auto switch type	No. of auto switch	Min. cylinder stroke
Band Mounted type	D-C7/C8 type	2pcs. (Same orientation)	1.96 (50)
		2pcs. (Different orientation)	0.59 (15)
		1pc.	0.39 (10)
	D-C73C/C80C type	2pcs. (Same orientation)	2.59 (65)
		2pcs. (Different orientation)	0.59 (15)
		1pc.	0.39 (10)

< >: Double Rod (NCJ2W6) inch (mm)

Bore Size	D-C7-C8 type			D-C73C-C80C type			D-H7 type			D-H7C type		
	A	B	Hs	A	B	Hs	A	B	Hs	A	B	Hs
6 (1/4")	.07 (2)	.07 (2)	.59 (15)	.07 (2)	.07 (2)	.68 (17.5)	.04 (1)	.04 (1)	.59 (15)	.04 (1)	.04 (1)	.68 (17.5)
	<.33 (8.5)>	<.02 (0.5)>		<.33 (8.5)>	<.02 (0.5)>		<.29 (7.5)>	(0)		<.29 (7.5)>	(0)	
10 (3/8")	.09 (2.5)	.09 (2.5)	.67 (17)	.09 (2.5)	.09 (2.5)	.76 (19.5)	.06 (1.5)	.06 (1.5)	.67 (17)	.06 (1.5)	.06 (1.5)	.76 (19.5)
16 (5/8")	.11 (3)	.11 (3)	.80 (20.5)	.11 (3)	.11 (3)	.90 (23)	.07 (2)	.07 (2)	.80 (20.5)	.07 (2)	.07 (2)	.90 (23)

Air Cylinder: Standard Type

Series: NCM



INDEX		Series NCM	
How to Order	P①	Single Acting Spring Return	P①
Specifications	P①	Spring Extend	P①
Auto-Switch Specifications	P①	Direct Mount	PP①
Construction/Parts List	P②	Non-rotating Rod	P①
Dimensions	P①	Stainless Steel Rod	P①
Double End Mounting	P①	Low Friction/Low Speed	P①
Front Nose Mounting	P①	High Time/Low Temp	P①
Rear Pivot Mounting	P①	Rod Boots	P①
Double Rod	P①	Accessories	P①

How To Order

NC D MB 075 - 02 00 C S J - B51 - XB6

Auto-Switch

Capable

- Std. Cylinder
- D — With Built-in Magnet
(Not available as std. on single acting models. XB6 & XB7)

Mounting

- B — Front Nose Mount
- C — Rear Pivot
- E — Double End
- K — Non-Rotating Rod
- R — Block Mount
- W — Double Rod

Bore Sizes

- 075 — 3/8"
- 088 — 7/8"
- 106 — 1 1/8"
- 125 — 1 1/4"
- 150 — 1 1/2"

Stroke/Inch

Stroke/Hundredth of an Inch

Options

- XB6 — High Temp.
- XB7 — Low Temp.
- XB9 — Low Friction
- XC6 — Stainless Steel Rod

Number of Auto-Switches

- 2 pcs.
- S — 1 pc.
- n — n pcs.
- L — Long leads

Auto-Switch

- B53 - D-B53 G59 - D-G59
- B54 - D-B54 K59 - D-K59
- B64 - D-B64

Rod Boot

- J — Nylon
- K — Neoprene

Actuation

- Double Acting
- S — Spring Return
- T — Spring Extend

Cushion*

- C — Rubber Bumper

Note: Min. Strokes for Auto Switch Cylinders page 5.

*Rubber Bumpers are no additional cost on 3/8" & 1/4" bore size cylinders. They are options on the other bore sizes. The "C" after the stroke must be included.

***Rubber Bumper Change in overall length**

Model \ Bore	075	088	106	125	150
NCMB-NCME	No Change	Standard	0.125	Standard	0.125
NCMC	No Change	Standard	0.125	Standard	0.125

*Note: If ordered w/o rubber bumper, overall length decreases .25 inches.

Note)

Overall length of Auto Switch Cylinder is the same as standard cylinders except NCMW106 (1 1/8" Bore Double rod)—Add 0.375" to the overall cylinder length.

Model	075	088	106	125	150
NCMW	No Change	Standard	0.125	Standard	0.125
NCDMW	No Change	Standard	0.500	Standard	0.125

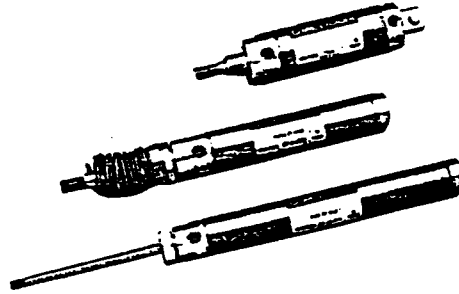
*Note: If ordered w/o rubber bumper, overall length decreases .25 inches.



Air Cylinder

Stainless Steel Cylinder

Series NCM



Specifications

Bore size (inch)	075 (3/4")	088 (7/8")	106 (1 1/8")	125 (1 1/4")	150 (1 1/2")
Fluid	Air				
Max. Operating pressure	250 PSI (17.5 kgf/cm ²)				
Min. Operating pressure	8 PSI (0.5 kgf/cm ²)				
Ambient and fluid temperature	40 ~ 140°F (5 ~ 60°C)				
Piston speed	No Cushion	2 ~ 20 inch/sec (50 ~ 500 mm/sec)			
	Rubber Cushion	2 ~ 30 inch/sec (50 ~ 750 mm/sec)			
Bumper	Optional	Urethane	Optional	Urethane	Optional
Lubrication	Not required (prelubricated at factory)				

Standard Stroke List

Mounting	Standard Stroke (inch)	Max. Stroke (inch)
Front nose mounting	1/2-1-2-3-4-5-6	12
Double end mounting	1/2-1-2-3-4-5-6-7-8-10-12	32
Rear pivot mounting	1/2-1-2-3-4-5-6	12

Note: longer strokes available, up to 39 inches as special request.

Weight

Bore size (inch)	Mounting	(lbs)					
		3/4"	7/8"	1 1/8"	1 1/4"	1 1/2"	
Basic Weight	B-Front Nose Mounting	0.20	0.23	0.33	0.56	0.68	
	E-Double End Mounting	0.28	0.30	0.41	0.71	0.82	
	C-Rear Pivot Mounting	0.20	0.21	0.32	0.61	0.71	
	W-Double Rod	0.30	0.32	0.40	0.81	0.93	
Additional Weight for Stroke		B, E, C	0.034	0.037	0.050	0.079	0.087
Example) NCMB075-0400		W	0.048	0.051	0.071	0.121	0.128

Basic Weight.....0.28 (lbs)
 Additional Weight.....0.034 (lbs)
 Stroke.....4 (inch)
 0.28 + 0.034 × 4 = 0.416 (lbs)

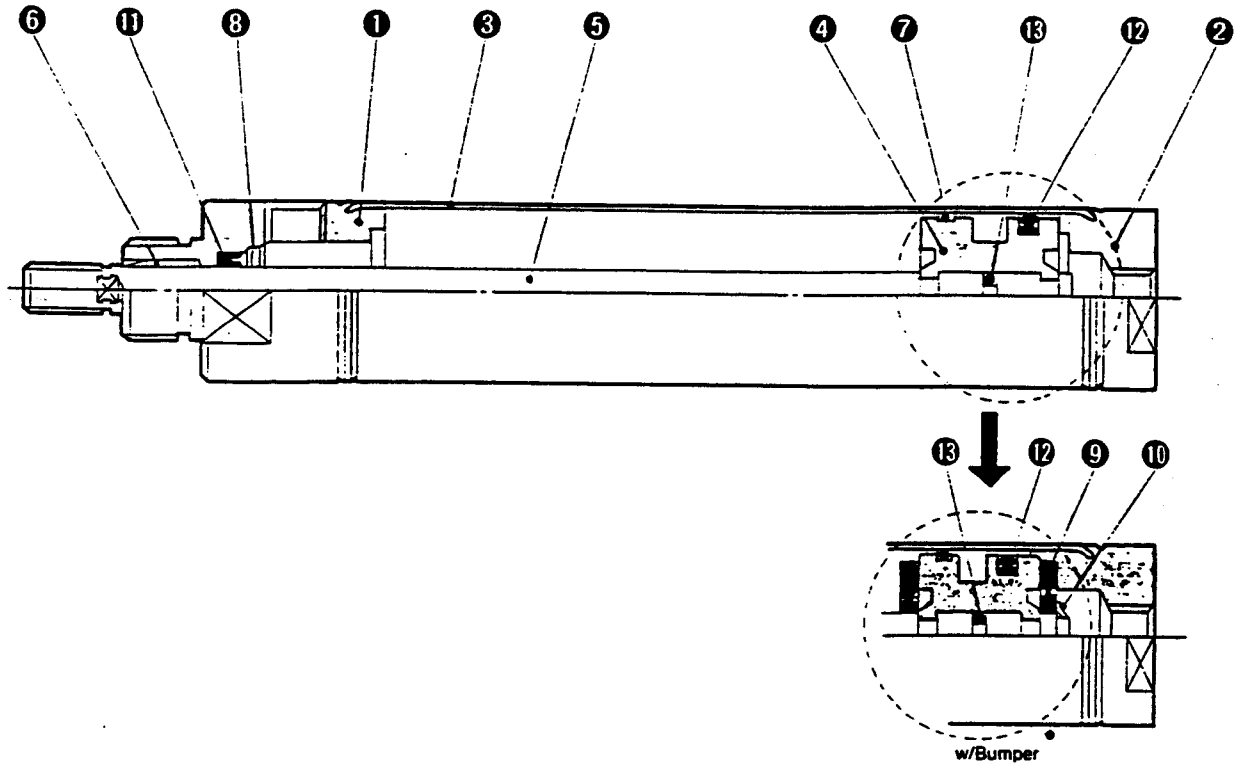
Theoretical Cylinder Force

Bore	Rod Dia.	Action	Effective Area (in ²)	Operating Pressure (PSI)					
				25	50	75	100	125	150
075 (3/4")	.250	OUT	.442	11.1	22.1	33.1	44.2	55.3	66.3
		IN	.393	9.83	19.7	29.5	39.3	49.1	59.0
088 (7/8")	.250	OUT	.601	15.0	30.1	45.1	60.1	75.1	90.2
		IN	.552	13.8	27.6	41.4	55.2	69.0	82.8
106 (1 1/8")	.312	OUT	.887	22.2	44.4	66.5	88.7	111	133
		IN	.811	20.3	40.6	60.8	81.1	101	122
125 (1 1/4")	.437	OUT	1.227	30.7	61.4	92.0	123	153	184
		IN	1.077	26.9	53.9	80.8	108	135	162
150 (1 1/2")	.437	OUT	1.767	44.2	88.4	133	177	221	265
		IN	1.617	40.4	80.9	121	162	202	243

Precautions:

- When mounting, completely flush the piping and be careful that dust and chips do not enter the cylinder.
- Load of piston rod should always be aligned parallel with the cylinder axis.
- Avoid damaging (scratches, nicks) on the piston rod, which would lead to damage of rod seal, resulting in air leakage.

Construction/Parts List



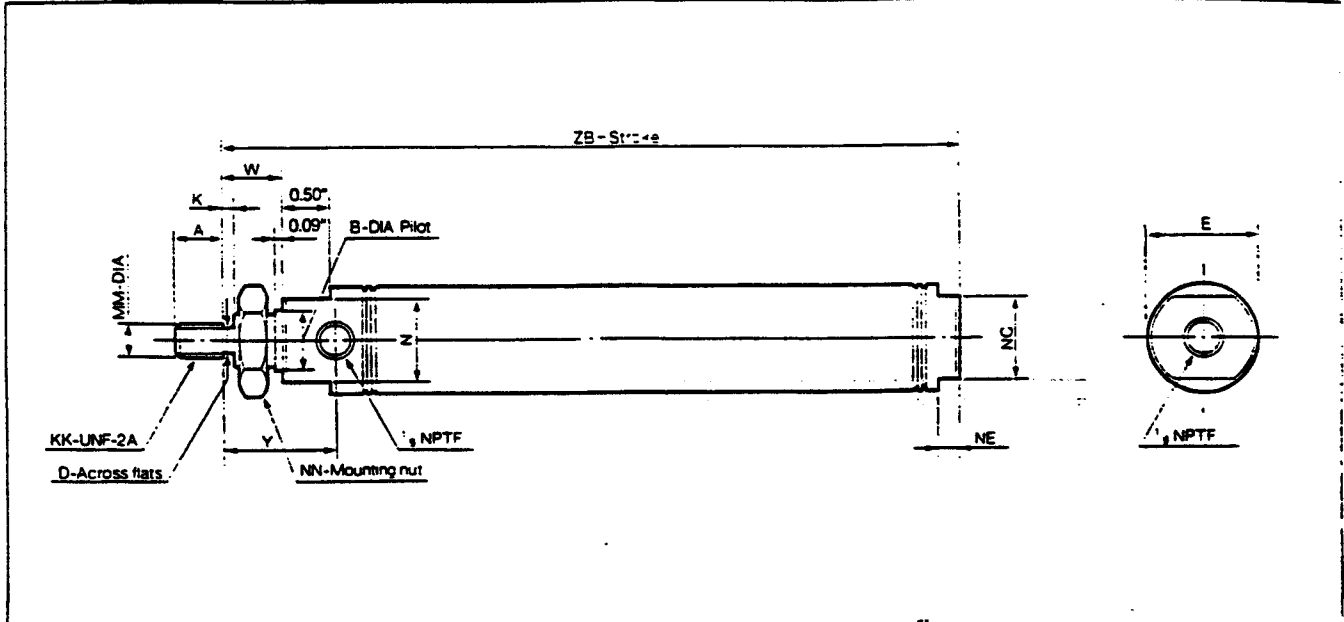
Parts List

No.	Description	Material	Remarks
①	Rod cover	Aluminum alloy	White alumite
②	Head cover	Aluminum alloy	White alumite
③	Cylinder tube	Stainless steel	-
④	Piston	Aluminum alloy	Chromate
⑤	Piston rod	$\frac{3}{8}$ "- $\frac{3}{8}$ "	Stainless steel
		$1\frac{1}{8}$ "- $1\frac{1}{2}$ "- $1\frac{1}{4}$ "	Carbon steel
⑥	Bushing	Sintered BR	-
⑦	Wear ring	Phenolic Resin	-
⑧	Retaining ring	Spring steel	-
⑨	Bumper	Urethane	-
⑩	Retaining ring	Spring steel	-
⑪	Rod seal	NBR	-
⑫	Piston seal	NBR	-
⑬	Piston gasket	NBR	-

Series NCM

Front Nose Mounting: NCMB

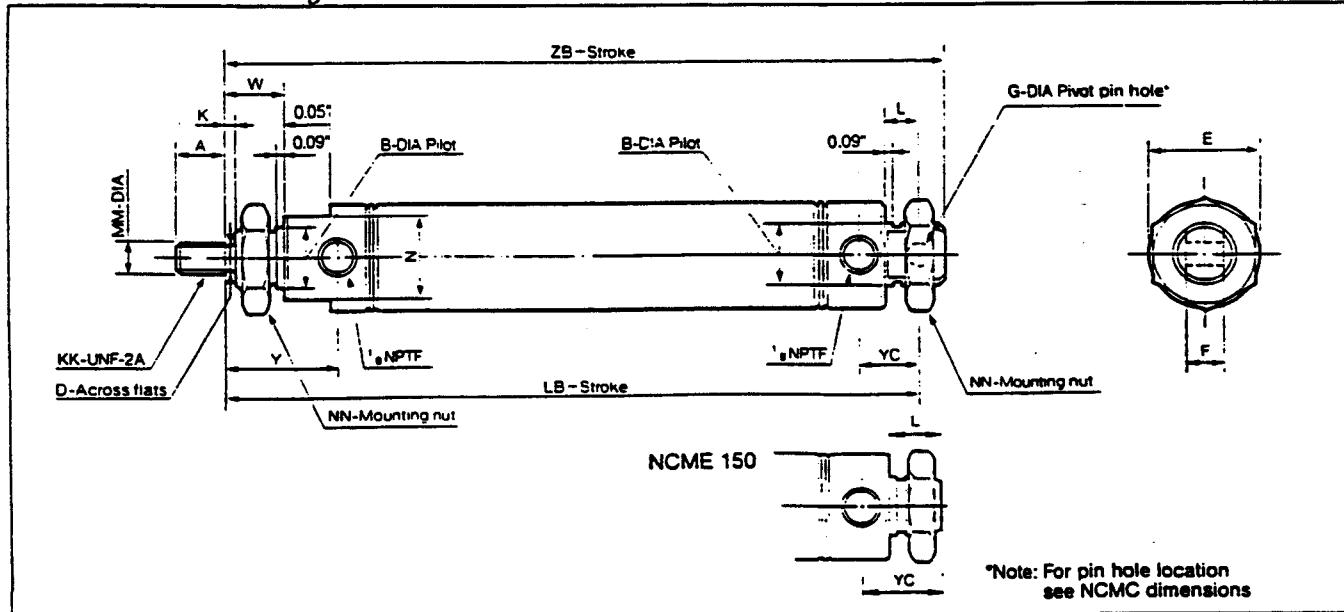
(inch)



Bore (inch)	MM	KK	A	B	D	E	K	N	NC	NE	NN	W	Y	ZB
075 (3/4)	0.250	1/4-28	0.50	0.624	—	0.86	—	0.75	0.62	0.12	3/8-18	0.50	0.95	2.97
088 (7/8)	0.250	1/4-28	0.50	0.624	—	0.93	—	0.75	0.75	0.18	3/8-18	0.50	0.95	2.94
106 (1 1/16)	0.312	5/16-24	0.50	0.624	0.25	1.12	0.12	0.88	0.88	0.24	3/8-18	0.62	1.17	3.25
125 (1 1/4)	0.437	3/4-20	0.75	0.749	0.38	1.32	0.25	1.06	1.06	0.25	3/4-16	0.88	1.62	4.00
150 (1 1/2)	0.437	3/4-20	0.75	0.749	0.38	1.56	0.25	1.25	1.25	0.25	3/4-16	0.88	1.50	3.69

Double End Mounting: NCME

(inch)



Bore (inch)	MM	KK	A	B	D	E	F	G	K	IL	LB	N	NN	W	Y	YC	ZB
075 (3/4)	0.250	1/4-28	0.50	0.624	—	0.86	0.38	0.251	—	0.34	3.75	0.75	3/8-18	0.50	0.95	0.62	4.03
088 (7/8)	0.250	1/4-28	0.50	0.624	—	0.93	0.38	0.251	—	0.34	3.56	0.75	3/8-18	0.50	0.95	0.62	3.84
106 (1 1/16)	0.312	5/16-24	0.50	0.624	0.25	1.12	0.38	0.251	0.12	0.34	3.84	0.88	3/8-18	0.62	1.17	0.62	4.12
125 (1 1/4)	0.437	3/4-20	0.75	0.749	0.38	1.32	0.50	0.251	0.25	0.41	4.72	1.06	3/4-16	0.88	1.62	0.78	5.12
150 (1 1/2)	0.437	3/4-20	0.75	0.749	0.38	1.56	—	—	0.25	0.63	—	1.25	3/4-16	0.88	1.50	0.91	4.50

*Note: For pin hole location see NCMC dimensions



Air Cylinder

Stainless Steel Cylinder

Series NCM

Single Acting — Spring Return/Spring Extend



Specifications

Bore size (inch)	075 (3/4")	088 (7/8")	106 (1 1/4")	125 (1 1/2")	150 (1 1/2")
Fluid	Air				
Max. Operating pressure	250 PSI (17.5 kgf/cm ²)				
Min. Operating pressure	25 PSI (1.75 kgf/cm ²)				
Ambient and fluid temperature	40 ~ 140°F (5 ~ 60°)				
Piston speed	2 ~ 20 inch/sec (50 ~ 500 mm/sec)				
Bumper	Optional	Urethane (Std.)	Optional	Urethane (Std.)	Optional
Lubrication	Not required (prelubricated at factory)				

Standard Stroke List

Mounting	Standard Stroke (inch)	Max. Stroke
Front nose mounting	1/2 · 1 1/2 · 2 · 3 · 4	6

NCM Spring Forces of S & T Type Cylinders (Standard Strokes)

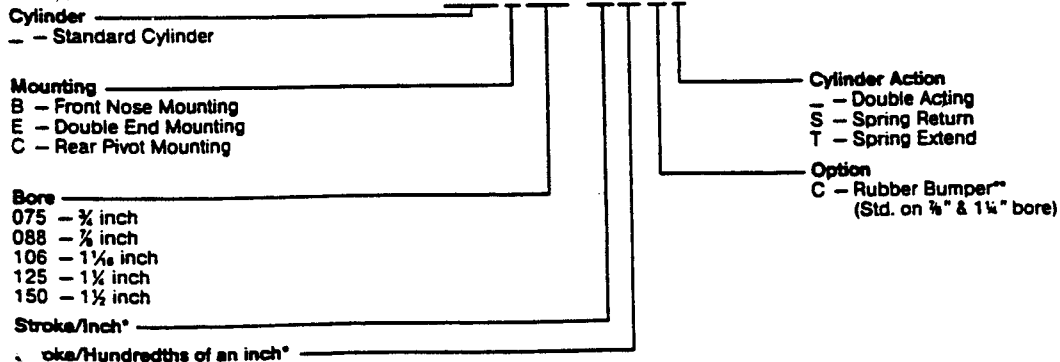
Bore	Resting	Compressed
NCM	Kgf/Lbf	Kgf/Lbf
075	1.36/3	2.72/6
088	1.36/3	2.49/5.45
106	1.36/3	2.74/6
125	3.18/7	5.67/12.4
150	3.18/7	5.67/12.4

Precautions

- When mounting, completely flush the piping and be careful that dust and chips do not enter the cylinder.
- Load of piston rod should always be aligned parallel with the cylinder axis.
- Avoid damaging (scratches, nicks) on the piston rod, which would lead to damage of rod seal, resulting in air leakage.

HOW TO ORDER

NCM B 075 - 0400 C S



*Note) Stroke Length must be indicated as 4 digits
First and Second digit: Stroke/inch
Third and Fourth digit: Stroke/hundredths of an inch
Example) 0400 = 4.00 (4) inch stroke

**Rubber bumpers are standard on 3/4" & 1 1/4" bore.
"C" must be included at the end of this part number.

MODEL VB3: USED WITH THE SAME CONFIDENCE AS A FUSE.

YESTERDAYS TECHNOLOGY

FUSE: Locating a blown plastic incased fuse in the panel is difficult since visual detection can only be made by its removal. Replacement fuses are usually packaged in groups of various ratings which you do not need, or all of the same ratings in anticipation of the need for continuous replacement. The fuse is a very inconvenient, antiquated means of protection.

CIRCUIT BREAKERS: Little improvement has been made in this field in the last 30 to 40 years. In the cycling type the sensing elements lose contact pressure as the current increases, promotes arcing, tacking and may stick causing the breaker to fail. The non-cycling breakers with the same type sensor, use a heater wire to prevent the contacts from closing, generating excessive heat that can effect the calibration of other breakers, which contribute to the extensive use of the fuse.

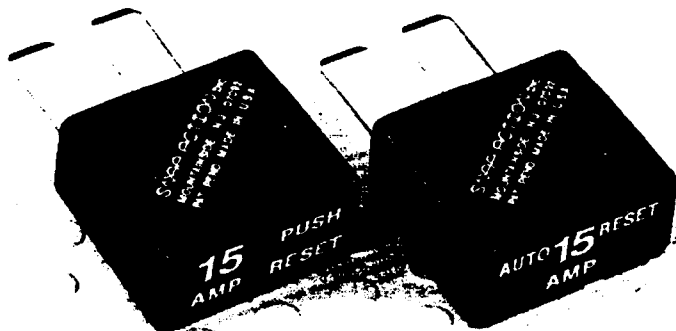
DESIRED OBJECTIVES

PROVIDE:

- Calibrated snap acting sensor which opens with significant amplitude, due to maximum current and contact pressure being reached simultaneously.
- Convenient visible evidence of an over-load condition (VB3-M).
- Mechanical means of holding the open circuit condition (SAE Type II).
- Manual means of resetting.
- SAE Type I cycling unit with a well defined timed open/close cycle.
- A small cross-section area of the sensor for a fail-safe condition.
- A size and configuration for fuse replacement.

ELIMINATE:

- Sensors with decreasing contact pressure that tend to arc, tack and weld.
- Heater wires that generate significant heat to maintain an open circuit condition (SAE Type II).
- The large mass of the sensor that will not provide a fail-safe condition.



TO FUSE OR NOT TO RE-FUSE? NO LONGER THE QUESTION.

Locating the cause of overload can take many blown fuses. **ONE MODEL VB3 IS THE ANSWER.**

CAPABLE OF WITHSTANDING NUMEROUS HIGH OVERLOADS YET SENSITIVE ENOUGH TO ULTIMATELY FAIL SAFE.

Model VB3-M (left) & VB3-A (right), shown above with standard terminal configuration.

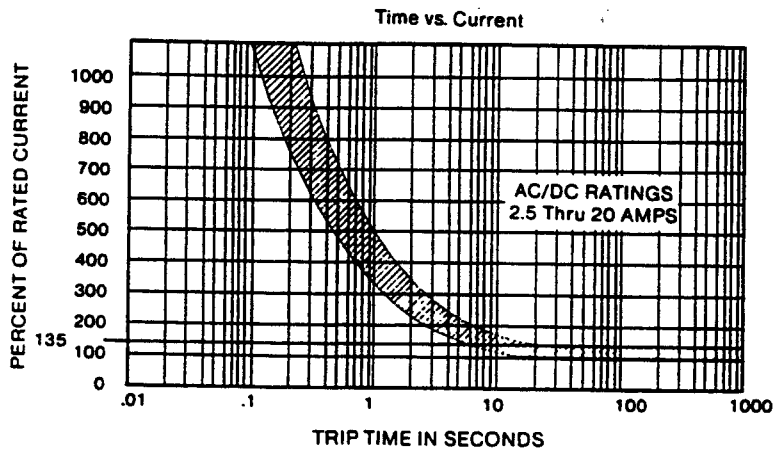
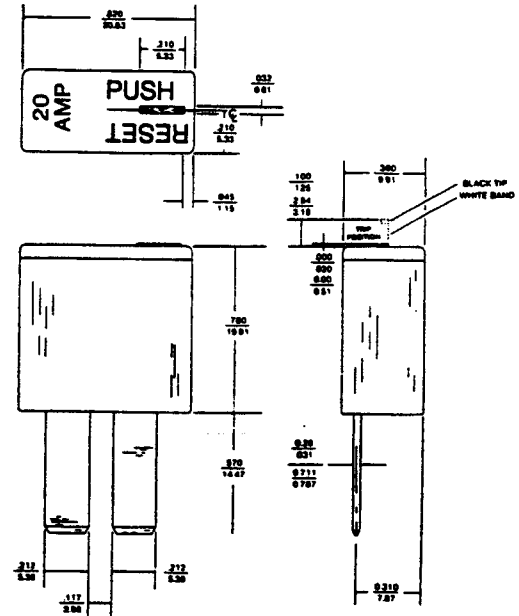
TOMORROWS STANDARD - AVAILABLE TODAY

QUALITY:

- Snap Action sensor provides increasing contact pressure to effect trip, and promotes wiping action of contacts.
- Trip time of 2.6 to 6.5 seconds with 200% overload for all ratings.
- Precise correlation of trip time to rating in any unit.
- Must hold 100% — must trip 135%
- Withstands normal start-up and short duration surges without nuisance tripping.
- Fast response time.
- Unusual tolerance to vibration and shock environment.
- 100% final inspection test before the name goes on.

FEATURES:

- Housed in engineering plastic (non-corrosive - U.L. rated 94VO).
- Visual trip indicator is push to rest (Model VB3-M).
- SAE Type (self-resetting) has well defined open/close cycle on over-load. (Model VB3-A)
- Cannot be held manually closed (trip free).
- Ambient compensated (to 40°C).
- Introduces new convenience and quality to circuit protection.



SPECIFICATIONS

MODELS: VB3-A Cycling (SAE Type I), VB3-M Manual, reset non-cycling new concept (SAE Type II)

VOLTAGE: Up to 50 V.D.C.

RATINGS: 3 thru 20 AMPS

TEMPERATURE COMPENSATION:
To 40°C

CALIBRATION: Must carry rated current at 25°C & 40°C. Must trip 135% of rating within ten minutes.

RESET TIME: Less than 15 seconds.

3, 4, 5, 6, 7.5, 10, 12.5, 15, 20 & 25 & 30 AMPS. NOW AVAILABLE

ORDERING INFORMATION

EXAMPLE: VB3- M20 -F57

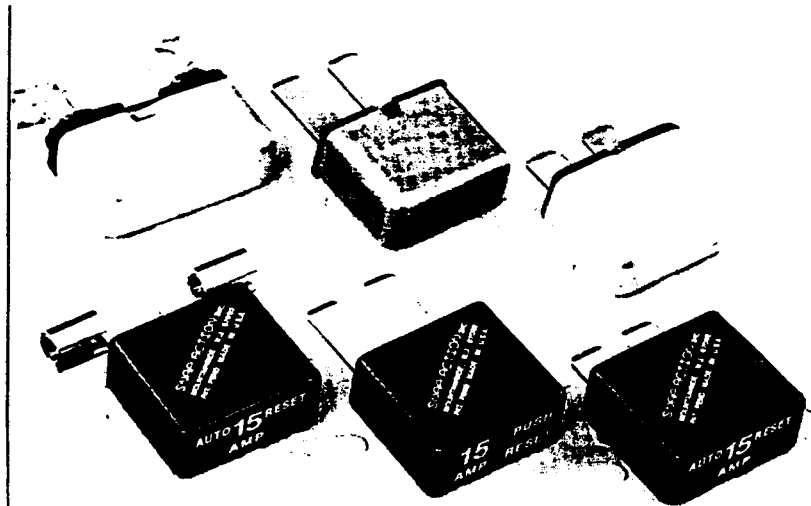
SERIES NUMBER: _____

TYPE RESET: A (automatic),
M (manual) _____

AMP RATING: 3 thru 20 _____

TERMINAL CONFIGURATION: F57 standard (flat .570x.110x.032). Consult factory for other terminal designs and modifications.

**AUTO - TRUCK - RV's
AVIATION - MARINE
GENERATORS - BATTERY CHARGES
AND MANY OTHER
AC OR DC APPLICATIONS**



MODEL VB3 REPLACES SENSORS WHICH LOSE CONTACT PRESSURE.

Terminal configuration can be provided to fit nearly any application.

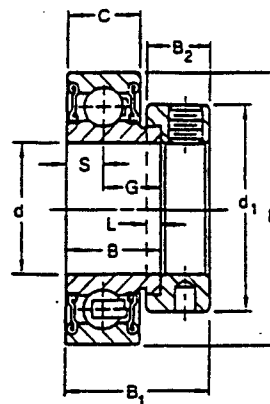
WIDE INNER RING BEARINGS

RA-RR, RA-RRB Series Non-Lubricatable Types

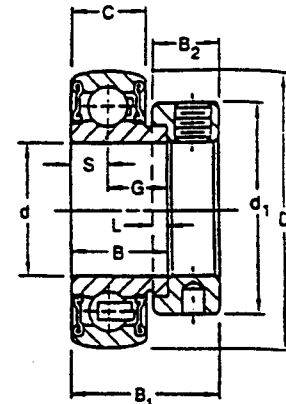
The RA-RR Series bearings are extended inner ring type with self-locking collar. A positive contact, land riding R-seal provides improved protection against harmful contaminants and effectively retains the lubricant under severe operating conditions. A 6/6 molded nylon retainer has proven extremely effective under conditions of misalignment. The RA-RR Series bearings are factory prelubricated.

The RA-RR Series has cylindrical outside diameters.

The RA-RRB Series has spherical outside diameters for use in housings with corresponding spherical inside surfaces to provide unrestricted initial self-alignment.



RA-RR Two Seals Cylindrical O.D.



RA-RRB Two Seals Spherical O.D.

Recommended shaft tolerances: $1/8$ "- $1 1/4$ " nominal to $-.0005$ ", $-.013$ mm;
 2 "- $2 1/4$ " nominal to $-.0010$ ", $-.025$ mm.

TO ORDER, SPECIFY BEARING NUMBER FOLLOWED BY "AND COLLAR". EXAMPLE: RA100RRB AND COLLAR.

Bearing Number	Collar Number	Basic Outer Size	Bore ⁽¹⁾ d	O.D. D	Ring Widths		S	G	L	d ₁	B ₂	B ₁	Brg. & Collar Wt.		Static Load C ₀	Extended Dynamic Rating C _t
					B Inner	C Outer							lbs	kg		
RA00RR RA00RRB RA01RR RAE17RR	RA00RRB RA00RRB RA01RRB RAE17RRB	S1008K S1009K S1010K SE17K	203	17	40	0.750 0.512 ⁽²⁾ 19.05 13	0.256 0.494 6.5 12.55	3/8 1/2 4.0 28.6	1 1/4 1 1/2 13.5 28.6	1 1/2 1 1/2 28.6 28.6	0.34 0.32 0.28 0.28	0.154 0.145 0.127 0.127	1000 4400	2360 10600		
RA012RR RAE20RR	RA012RRB RAE20RRB	S1012K SE20K	204	20	47	0.844 0.591 ⁽²⁾ 21.44 15	0.295 0.548 7.49 13.92	3/8 1/2 4.0 33.3	1 1/4 1 1/2 13.5 31	1 1/2 1 1/2 31 31	0.29 0.29 0.29 0.29	0.132 0.132	1400 6200	3200 14300		
RA013RR RA014RR RA015RR RA100RR RAE25RR	RA013RRB RA014RRB RA015RRB RA100RRB RAE25RRB	S1013K S1014K S1015K S1100K SE25K	205	1	25	0.844 0.591 21.44 15	0.295 0.548 7.49 13.92	3/8 1/2 4.0 38.1	1 1/4 1 1/2 13.5 31	1 1/2 1 1/2 31 31	0.41 0.41 0.41 0.41	0.231 0.213 0.2 0.186 0.186	1560 5950	3450 15600		
RA101RR RA102RR RA103RR RA103RR2 RAE30RR	RA101RRB RA102RRB RA103RRB RA103RRB2 RAE30RRB	S1101K S1102K S1103K S1103K3 SE30K	206	30	62	0.938 0.709 23.82 18	0.354 0.583 8.99 14.81	3/8 1/2 4.0 44.1	1 1/4 1 1/2 15.9 35.7	1 1/2 1 1/2 35.7 35.7	0.77 0.72 0.7 0.65 0.7	0.349 0.327 0.318 0.295 0.318	2280 10000	4800 21600		
RA104RR RA105RR RA106RR RA107RR RAE35RR	RA104RRB RA105RRB RA106RRB RA107RRB RAE35RRB	S1104K S1105K S1106K S1107K SE35K	207	35	72	1.000 0.748 25.4 19	0.374 0.626 9.5 15.9	3/8 1/2 4.0 54.40	1 1/4 1 1/2 17.1 38.9	1 1/2 1 1/2 38.9 38.9	1.24 1.19 1.13 1.05 1.13	0.562 0.54 0.513 0.476 0.513	3050 13700	6400 28500		
RA108RR RA109RR RAE40RR	RA108RRB RA109RRB RAE40RRB	S1108KT S1109KT SE40K	208	40	80	1.188 0.866 ⁽²⁾ 30.18 22	0.433 0.755 11 19.18	3/8 1/2 4.8 60.3	1 1/4 1 1/2 18.3 43.7	1 1/2 1 1/2 43.7 43.7	1.53 1.43 1.43	0.894 0.649 0.649	4000 17600	8150 36000		
RA110RR RA111RR RA112RR RAE45RR	RA110RRB RA111RRB RA112RRB RAE45RRB	S1110K S1111K S1112K SE45K	209	45	85	1.188 0.866 30.18 22	0.433 0.755 11 19.18	3/8 1/2 4.8 63.5	1 1/4 1 1/2 18.3 43.7	1 1/2 1 1/2 43.7 43.7	1.72 1.5 1.5	0.78 0.735 0.68	4000 17600	8150 36000		
RA113RR RA114RR RA115RR RA115RR2 RAE50RR	RA113RRB RA114RRB RA115RRB RA115RRB2 RAE50RRB	S1113K S1114K S1115K S1115K2 SE50K	210	50	90	1.188 0.866 30.18 22	0.433 0.755 11 19.18	3/8 1/2 4.8 69.9	1 1/4 1 1/2 18.3 43.7	1 1/2 1 1/2 43.7 43.7	1.84 1.83 1.70 1.58 1.79	0.88 0.83 0.771 0.717 0.771	4500 19600	8800 3900		
RA200RR RA201RR RA202RR RA203RR RAE55RR	RA200RRB RA201RRB RA202RRB RA203RRB RAE55RRB	S1200K S1201K S1202K S1203K SE55K	211	55	100	1.281 0.945 32.54 24	0.472 0.809 11.99 20.55	3/8 1/2 4.8 76.2	1 1/4 1 1/2 20.6 48.4	1 1/2 1 1/2 48.4 48.4	2.12 1.98 1.89 1.78 1.78	0.962 0.898 0.857 0.807 0.807	5630 25000	10800 48000		

⁽¹⁾ Bore tolerance is nominal to $+.0005$ ", $.013$ mm

⁽²⁾ Spherical O.D. outer ring width is $.472$ ", 12 mm

⁽³⁾ Spherical O.D. outer ring width is $.551$ ", 14 mm

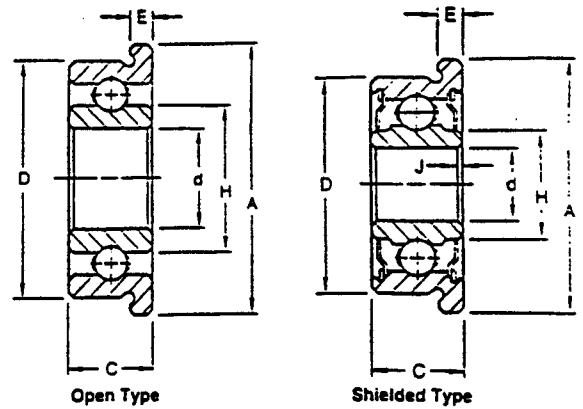
⁽⁴⁾ Spherical O.D. outer ring width is $.827$ ", 21 mm

Flanged Series

CYLINDRICAL O.D.

Four sizes in the cylindrical O.D. series are offered in a flanged construction. Flanged bearings have integral shoulders for mounting in through-bored housings. These flanged bearings have straight outside diameters and are interchangeable with the corresponding unflanged sizes. The flanged group is available with double shields.

These bearings are electric motor quality for applications where extra quietness is a requirement.



DIMENSIONS - TOLERANCES

Bearing Number	Bore d		Outside Diameter D		Width C	Inner Ring Shoulder	Flange				Shielded Type Overall Width		Wt	Static Load Rating C ₀	Extended Dynamic Load Rating C ₂									
	chamfer J x 45°						A	E																
open	+0.0000° -0.0003°		+0.000° -0.0004°		+0.000° -0.005°	N	+0.005° -0.007°	±0.002° ±0.05 mm		+0.000° -0.005°	N													
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kg.	lbs.	N	lbs.	N						
F33K3 F33KDD3	0.1250	3.175	0.012	0.30	0.3750	9.525	0.156	3.96	0.202	5.13	0.440	11.18	0.030	0.76	0.156	3.96	0.183	4.65	0.01	0.005	48	212	160	710
F33K5 F33KDD5	0.1875	4.762	0.012	0.30	0.5000	12.700	0.156	3.96	0.270	6.86	0.565	14.35	0.042	1.07	0.196	4.98	0.248	6.30	0.01	0.005	110	490	325	1430
FS1K7 FS1KDD7 ⁽¹⁾	0.2500	6.350	0.012	0.30	0.6250	15.875	0.196	4.98	0.349	8.86	0.890	17.53	0.042	1.07	0.196	4.98	0.332	8.43	0.01	0.005	125	560	365	1630
F33K F33KDD ⁽¹⁾	0.3750	9.525	0.016	0.41	0.8750	22.225	0.219	5.56	0.517	13.13	0.969	24.61	0.062	1.57	0.281	7.14	0.475	12.06	0.02	0.009	310	1400	830	3650

⁽¹⁾ Also available in stainless steel. To specify, add prefix "A" before bearing number.

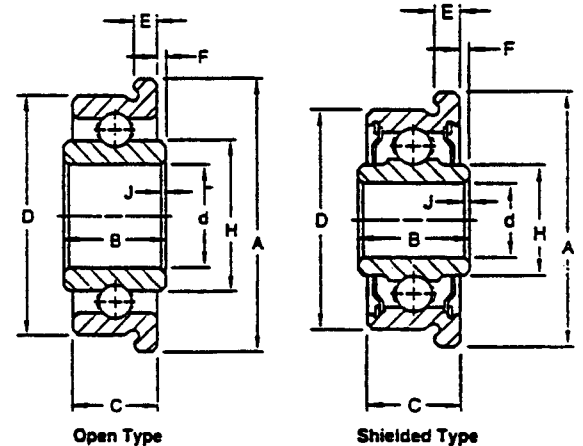
* Also available with two contact seats. To specify, replace "KDD" in part number with "PP".

TAPERED O.D.

The F Flanged Series has shoulders integral with the bearings for mounting in through-bored housings. They are used where compactness is essential or where it is not desirable to machine housing shoulders. All sizes in this series have tapered outside diameters, and all are available with double shields.

These bearings are particularly suitable for such applications as precision instruments, packaging machinery, motion picture projectors and the like. Several sizes in this series are manufactured in both standard bearing quality, chromium-alloy, high carbon steel and stainless steel, as indicated in the tables. To specify stainless steel, use the prefix A before the basic bearing number. Example: AF4.

These bearings are electric motor quality for applications where extra quietness is a requirement.



DIMENSIONS - TOLERANCES

Bearing Number	Bore d		Outside Diameter D		Inner Width B	Inner Ring Widths		Outer Width C		Flange		Wt	Static Load Rating C ₀	Extended Dynamic Load Rating C ₂													
	chamfer J x 45°					Project F	H ⁽²⁾	taper per foot		A	E																
open	+0.0003° -0.0000°		+0.000° -0.0004°		±0.010°	+0.005°	min	+0.000° -0.004°	±0.002° ±0.05 mm		+0.005° -0.002°																
shielded	-0.008 mm -0.00 mm		+0.000 mm -0.010° mm		±0.03 mm	±0.13 mm	min	+0.00 mm -0.10 mm			+0.13 mm -0.05 mm																
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kg.	lbs.	N	lbs.	N							
F2 ⁽¹⁾	—	0.1875	4.762	0.010	0.25	0.4382	11.130	0.189	4.80	0.016	0.41	0.273	6.93	0.163	4.14	0.080	2.03	0.500	12.70	0.042	1.07	0.01	0.005	106	465	260	1160
F2DD-2	—	0.1250	3.175	0.010	0.25	0.3757	9.534	0.188	4.77	0.015	0.38	0.181	4.60	0.163	4.14	0.075	1.90	0.438	11.13	0.037	0.94	0.01	0.005	48	212	160	710
F3	—	0.1875	4.762	0.010	0.25	0.5632	14.305	0.218	5.54	0.015	0.38	0.273	6.93	0.195	4.95	0.080	2.03	0.625	15.88	0.042	1.07	0.01	0.005	110	490	325	1430
F3DD	—	0.1875	4.762	0.010	0.25	0.5632	14.305	0.250	6.35	0.015	0.38	0.245	6.22	0.225	5.74	0.068	1.73	0.625	15.88	0.042	1.07	0.01	0.005	110	490	325	1430
F4	F4DD	0.2500	6.350	0.010	0.25	0.6257	15.893	0.250	6.35	0.015	0.38	0.331	8.41	0.226	5.74	0.068	1.73	0.687	17.45	0.042	1.07	0.01	0.005	125	560	365	1630
F5	FSDD	0.3125	7.938	0.010	0.25	0.6882	17.480	0.250	6.35	0.015	0.38	0.410 ⁽²⁾	10.41	0.226	5.74	0.068	1.73	0.750	19.05	0.042	1.07	0.01	0.005	196	865	540	2400

⁽¹⁾ Full type, no retainer. Not recommended for speeds over 500 RPM.

⁽²⁾ H dimension is .381" (9.68 mm) for FSDD.

⁽³⁾ Land dimension of the inner ring.

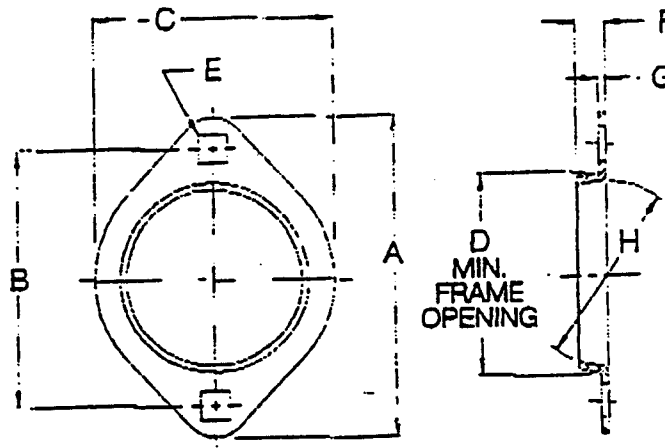
General Flangette Information

LUTCO is the largest manufacturer of precision flangettes in North America. With an extensive tooling inventory, we are able to offer a wide variety of standard and custom units.

Fit and surface contact between the flangettes and the bearing contribute to the life of the assembly. By allowing the bearing to misalign in the housing under a predetermined torque, premature failure can be eliminated. Sophisticated measuring and torque rating equipment are employed to provide statistical process control, through charting and minimum 1.0 CPK values.

For more specific information on the processes utilized, please contact the factory.

2 Bolt Self-Aligning Flangettes



PART NUMBER	A	B	C	D	E	F	G	H	RADIAL LOAD LBS. N	UNIT WT. LBS.
	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	nom. mm		
2 BOLT										
35MST	2 ⁷ / ₁₆ 73.0	2 ¹ / ₂ 63.50	2 ⁵ / ₁₆ 58.74	1 ¹ / ₈ 41.28	³ / ₃₂ 7.14	⁷ / ₃₂ 5.54	0.054 1.37	35	350 1556	0.06
40MST	3 ³ / ₁₆ 80.96	2 ¹ / ₂ 63.50	2 ⁵ / ₁₆ 58.74	1 ¹ / ₈ 47.63	³ / ₃₂ 7.14	⁹ / ₃₂ 7.14	0.075 1.905	40	750 3100	0.08
47MST	3 ⁵ / ₁₆ 90.49	2 ¹³ / ₁₆ 71.44	2 ⁵ / ₈ 66.68	2 ³ / ₁₆ 55.56	¹ / ₃₂ 8.73	⁹ / ₁₆ 7.94	0.083 2.11	47	900 3900	0.10
52MST	3 ³ / ₄ 95.25	3 76.20	2 ⁵ / ₁₆ 71.04	2 ³ / ₈ 60.33	¹ / ₃₂ 8.73	¹ / ₃₂ 8.73	0.083 2.11	52	1000 4450	0.11
62MST	4 ⁷ / ₁₆ 112.71	3 ³ / ₈ 90.49	3 ¹ / ₈ 84.14	2 ¹³ / ₁₆ 71.44	¹³ / ₃₂ 10.31	³ / ₈ 9.53	0.104 2.64	62	1400 6200	0.33
72MST	4 ¹⁵ / ₁₆ 125.41	3 ¹⁵ / ₁₆ 100.01	3 ¹ / ₁₆ 93.66	3 ³ / ₁₆ 80.96	³ / ₃₂ 10.31	¹³ / ₃₂ 10.31	0.104 2.64	72	1750 7500	0.40

For Torque rated flangettes, add the prefix "T".
Add "ZP" for standard zinc plate and "YZP" for yellow chromate finishes.
Special designs available upon request.

