

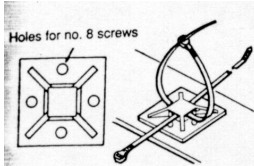
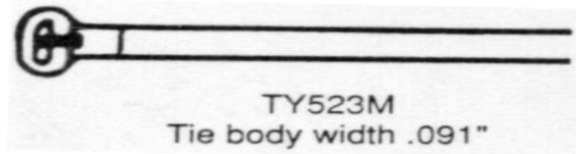
# THE 2001 FIRST ROBOTICS COMPETITION MANUAL

## Thomas&Betts

### *Standard nylon 6/6 cable ties*

Cat. No.	Bulk Pkg. Cat. No.	Body Width (in.)	Length (in.)	Max. Wire Bundle Dia. (in.)	Tensile Strength (lbs.)
TY52315M	TYB2315M	0.091	7.00	1.500	18

Cable ties made from natural nylon 6/6 are excellent performers in most applications. Nylon 6/6 is recommended for use in temperatures ranging from 185°F to -40°F.



Accepting cable ties in either of two directions at 90°, this nylon, adhesive-backed base has two advantages: It eliminates errors in pre-mounting the base with respect to its orientation to wire bundle direction. It also is a convenient way to mount wire bundles at cross-over points. Four optional mounting holes are included.

### Two-way adhesive mounting base

Bulk Pkg. Cat. No.	Mounting Method	Maximum Tie Width Accom.	Width (in.)	Length (in.)	Material	Bulk Pkg. Quan.
TC345AFR	Adhesive	.190	.125	.125	Flame retardant	1000
TC345AX	Adhesive	.190	.125	.125	Weatherable nylon	



WT111M

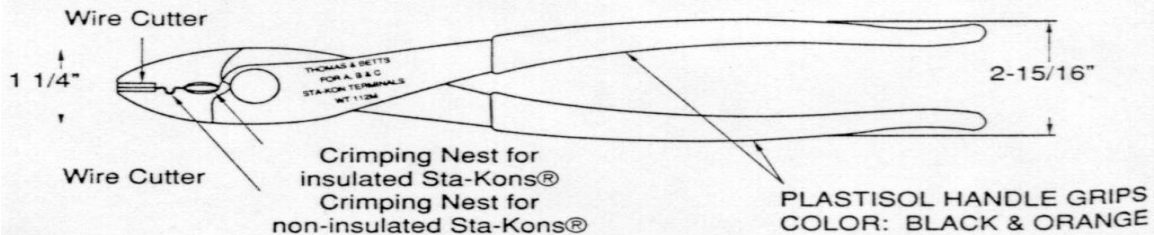


WT112M

*These tools are designed in a variety of styles—some with wire cutters and strippers—for installation of the various STA-KON terminal series. #22-10 AWG wire range.*

## Plier Type Tools

Cat. No.	Description	Std. Pkg.	Wt. Each
WT110M	A, B, C non-insulated terminal and splices and A, B non-insulated terminals with insulation grip	1	1
WT111M	A, B, C, PT non-insulated terminal and splices	1	1
WT112M	RA, RB, A, B, C, non-insulated and RC insulated nylon and vinyl terminal and splices	1	1



WT112M

***Installs insulated and non-insulated Sta-Kon terminals, splices, disconnects, and wire joints 22-10 AWG.***

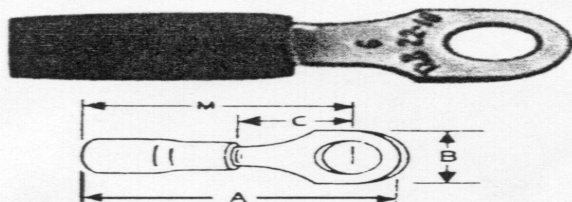
# THE 2001 FIRST ROBOTICS COMPETITION MANUAL

## Nylon Insulated Ring - Insulation Grip

Cat. No.	Bulk Pkg. Cat. No.	Wire Range	Max. Ins.	Bolt Hole	Wt./Lbs. Per 1000	Dimensions			
						A	B	C	M
	RAX63*	26-24	0.125	#6	3	0.57	0.25	0.22	0.72
RA18-6	RA853	22-16	0.136	#6	2	0.83	0.26	0.25	0.71
RC10-6	RC333	12-10	0.210	#6	3	1.00	0.37	0.27	0.81
RE6-14	RE267	6-5	0.420	#10	16	1.65	0.49	0.28	1.40

Not Listed By U.L. CSA

Installing tools: WT200, WT112M, WT145C, WT1455, ERG-2001, ERG-2003, WT145A, WT2130A (RC, RBC)

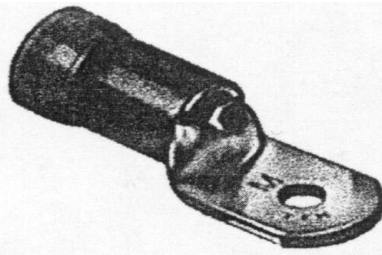
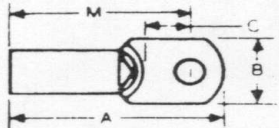


*Self-insulated with high dielectric-strength nylon sleeves, these ring terminals are recommended for temperatures up to 105°C. An inner bronze insulation grip sleeve lengthens the flexing radius of the conductor and eliminates conductor creep. The nylon jacket is color-coded:*

Color Code	Wire Range
yellow	26-22
red	22-16
blue	18-14
yellow	12-10

Most standard bulk catalog numbers can be put on Mylar Tape for reel fed applications (i.e. 12050 tool and application dies). See page O1149.

Please put the suffix M for Mylar Tape RA2573M.

**Stock Thickness:**

RH = .05	RE = .04
RJ = .06	RF = .04
RK = .06	RG = .05
RL = .07	
RM = .07	

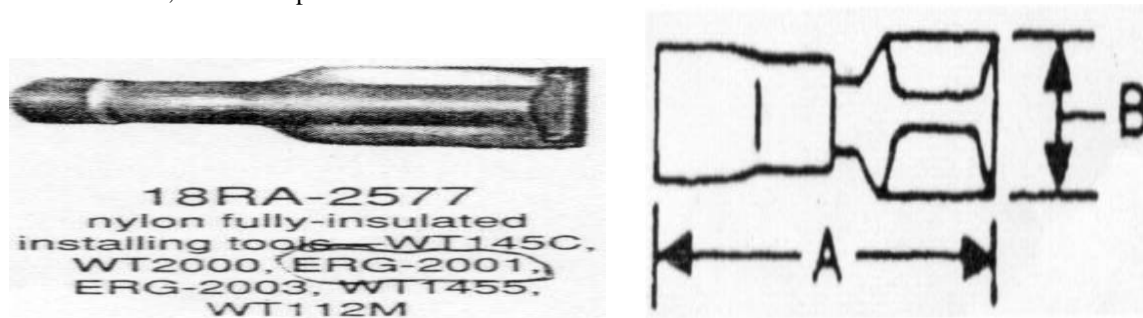
## THE 2001 FIRST ROBOTICS COMPETITION MANUAL

Disconnect terminals provide a quick, reliable method of connection to terminal blocks and boards without the use of tools. They are supplied in a variety of styles to meet virtually all quick-disconnect requirements. Female disconnect terminals and matching male tabs accommodate a range of 22-10 AWG, and are available in non-insulated, partially insulated, and fully insulated styles, in both nylon and vinyl. They are available in various tab widths including 0.250", 0.187" and 0.110", and a combination size. A unique construction of the female disconnect offers long term dependability. The brazed seam serrated barrel provides maximum tensile strength.

### 250 Series - Female Disconnects

Cat. No.	Bulk Pkg. Cat. No.	Wire Range	Max. Ins.	Tab Size	Wt./Lbs. Per 1000	Dimensions	
						A	B
18RA-2577	RA2573	22-18	0.165	0.250 x 0.032	3	0.97	0.38
14RB-2577	RB2573	16-14	0.185	0.250 x 0.032	4	0.97	0.38
10RC-2577	RC2573	12-10	0.225	0.250 x 0.032	5	1.04	0.38

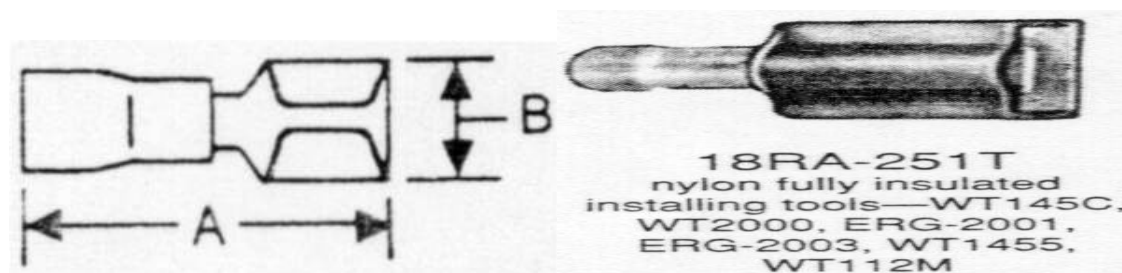
Material: brass, Finish: tin plated



### 250 Series - Male Tabs

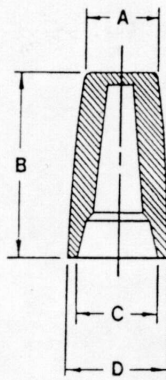
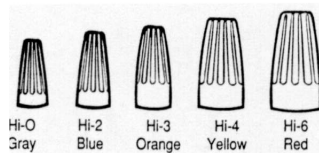
Cat. No.	Bulk Pkg. Cat. No.	Wire Range	Max. Ins.	Tab Size	Wt./Lbs. Per 1000	Dimensions	
						A	B
18RA-251T	RA25177	22-18	0.150	0.250 x 0.032	5	1.13	0.45
14RB-251T	RB25177	16-14	0.170	0.250 x 0.032	5	1.13	0.45
10RC-251T	RC25177	12-10	0.210	0.250 x 0.032	5	1.17	0.45

Material: brass, Finish: tin plated





# THE 2001 FIRST ROBOTICS COMPETITION MANUAL



## Easy Installation

Wire connectors are easy to use. They give you a mechanical advantage over conventional wire connectors.

1. Simply strip wires and push them firmly into our wire connector.

2. Twist the specially designed, comfortable feeling serrated cap tightly.

3. The internal wire spring produces a pressure that forms the wires into a tight, dependable joint.

## Fixed Spring



Cat. No.	Color Code	Wire Range (AWG)	Min.	Max.	Voltage Rating	Dimensions				Unit Qty.	Std. Pkg.
						A	B	C	D		
10-100	Gray	22 to 16 Solid or Stranded	1#20 w/1#22	2#16		.203	.562	.328	.250	1	1000
10-102-H	Blue	22 to 14 Solid or Stranded	3#22	3#16	300 Volt Max.	.250	.687	.375	.312	1	1000
10-103-H	Orange	22 to 14 Solid or Stranded	3#22	2#14 1#18	600 Volt Max.	.312	.843	.437	.375	1	1000
10-104	Yellow	18 to 10 Solid or Stranded	1#14 w/1#18	1#10 w/1#14	Building Wire 1000 V.	.406	.937	.546	.468	1	1000
10-106-H	Red	18 to 10 Solid or Stranded	2#14	3#12	Max. in Signs & Fixtures	.468	1.04	.656	.531	1	1000



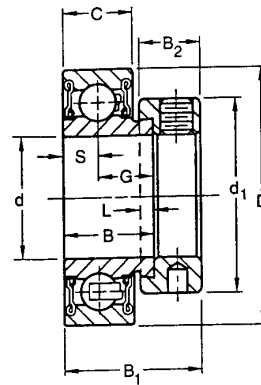
## WIDE INNER RING BEARINGS

### RA-RR, RA-RRB Series Non-Relubricatable Types

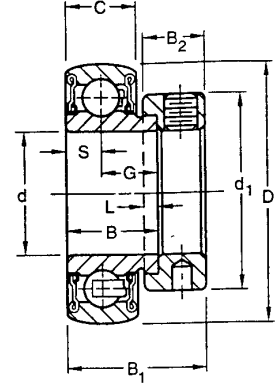
The RA-RR Series bearings are extended inner ring type with self-locking collar. A positive contact, land riding R-seal provides improved protection against harmful contaminants and effectively retains the lubricant under severe operating conditions. A 6/6 molded nylon retainer has proven extremely effective under conditions of misalignment. 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:  $\frac{1}{8}$ "- $1\frac{1}{4}$ " $\phi$ , nominal to  $-.0005$ ",  $-.013$ mm;  
 $2$ "- $2\frac{3}{4}$ " $\phi$ , nominal to  $-.0010$ ",  $-.025$ mm.

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

Bearing Number Cylindrical O.D.	Spherical O.D.	Collar Number	Basic Outer Size	Bore <sup>(1)</sup> d	O.D. D	Ring Widths		S	G	L	d <sub>1</sub>	B <sub>2</sub>	B <sub>1</sub>	Brg. & Collar Wt.		Static Load C <sub>0</sub>	Extended Dynamic Rating C <sub>e</sub>
						B Inner	C Outer							lbs	kg		
				in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	in. mm	lbs	kg	lbs N	lbs N
RA008RR	RA008RRB	S1008K	203	$\frac{1}{8}$	1.5748	0.750	0.512 <sup>(2)</sup>	0.256	0.494	$\frac{1}{32}$	$1\frac{1}{4}$	$\frac{1}{32}$	$1\frac{1}{4}$	0.34	0.154	1000	2360
RA009RR	RA009RRB	S1009K		$\frac{9}{64}$	40	19.05	13	6.5	12.55	4.0	28.6	13.5	28.6	0.32	0.145	4400	10600
RA010RR	RA010RRB	S1010K		$\frac{3}{8}$										0.28	0.127		
RAE17RR	RAE17RRB	SE17K		17										0.28	0.127		
RA012RR	RA012RRB	S1012K	204	$\frac{3}{4}$	1.8504	0.844	0.591 <sup>(3)</sup>	0.295	0.548	$\frac{1}{16}$	$1\frac{1}{4}$	$\frac{1}{16}$	$1\frac{1}{2}$	0.29	0.132	1400	3200
RAE20RR	RAE20RRB	SE20K		20	47	21.44	15	7.49	13.92	4.0	33.3	13.5	31	0.29	0.132	6200	14300
RA013RR	RA013RRB	S1013K		$\frac{13}{16}$										0.51	0.231		
RA014RR	RA014RRB	S1014K		$\frac{1}{2}$	2.0472	0.844	0.591	0.295	0.548	$\frac{1}{16}$	$1\frac{1}{4}$	$\frac{1}{16}$	$1\frac{1}{2}$	0.47	0.213	1560	3450
RA015RR	RA015RRB	S1015K	205	$\frac{11}{16}$	52	21.44	15	7.49	13.92	4.0	38.1	13.5	31	0.44	0.2	6950	15600
RA100RR	RA100RRB	S1100K		1										0.41	0.186		
RAE25RR	RAE25RRB	SE25K		25										0.41	0.186		
RA101RR	RA101RRB	S1101K	206	$1\frac{1}{8}$	2.4409	0.938	0.709	0.354	0.583	$\frac{1}{8}$	$1\frac{1}{4}$	5/8	$1\frac{1}{2}$	0.77	0.349	2280	4800
RA102RR	RA102RRB	S1102K		$1\frac{1}{4}$	62	23.82	18	8.99	14.81	4.0	44.1	15.9	35.7	0.72	0.327	10000	21600
RA103RR	RA103RRB	S1103K		$1\frac{3}{8}$										0.7	0.318		
RA103RR2	RA103RRB2	S1103K3		$1\frac{1}{4}$										0.65	0.295		
RAE30RR	RAE30RRB	SE30K		30										0.7	0.318		
RA104RR	RA104RRB	S1104K	207	$1\frac{1}{2}$	2.8346	1.000	0.748	0.374	0.626	$\frac{1}{8}$	$2\frac{1}{4}$	$\frac{3}{4}$	$1\frac{1}{2}$	1.24	0.562	3050	6400
RA105RR	RA105RRB	S1105K		$1\frac{3}{8}$	72	25.4	19	9.5	15.9	4.0	54.40	17.1	38.9	1.19	0.54	13700	28500
RA106RR	RA106RRB	S1106K		$1\frac{1}{2}$										1.13	0.513		
RA107RR	RA107RRB	S1107K		$1\frac{5}{8}$										1.05	0.476		
RAE35RR	RAE35RRB	SE35K		35										1.13	0.513		
RA108RR	RA108RRB	S1108KT	208	$1\frac{1}{2}$	3.1496	1.188	0.866 <sup>(4)</sup>	0.433	0.755	$\frac{1}{8}$	$2\frac{1}{4}$	$\frac{3}{16}$	$1\frac{3}{4}$	1.53	0.694	4000	8150
RA109RR	RA109RRB	S1109KT		$1\frac{3}{4}$	80	30.18	22	11	19.18	4.8	60.3	18.3	43.7	1.43	0.649	17600	36000
RAE40RR	RAE40RRB	SE40K		40										1.43	0.649		
RA110RR	RA110RRB	S1110K	209	$1\frac{3}{8}$										1.72	0.78		
RA111RR	RA111RRB	S1111K		$1\frac{1}{2}$	3.3465	1.188	0.866	0.433	0.755	$\frac{1}{8}$	$2\frac{1}{4}$	$\frac{3}{16}$	$1\frac{3}{4}$	1.62	0.735	4000	8150
RA112RR	RA112RRB	S1112K		$1\frac{1}{4}$	85	30.18	22	11	19.18	4.8	63.5	18.3	43.7	1.5	0.68	17600	36000
RAE45RR	RAE45RRB	SE45K		45										1.5	0.68		
RA113RR	RA113RRB	S1113K	210	$1\frac{13}{16}$										1.94	0.88		
RA114RR	RA114RRB	S1114K		$1\frac{3}{4}$	3.5433	1.188	0.866	0.433	0.755	$\frac{1}{8}$	$2\frac{1}{4}$	$\frac{3}{16}$	$1\frac{3}{4}$	1.83	0.83	4500	8800
RA115RR	RA115RRB	S1115K		$1\frac{11}{16}$	90	30.18	22	11	19.18	4.8	69.9	18.3	43.7	1.70	0.771	19600	3900
RA115RR2	RA115RRB2	S1115K2		2										1.58	0.717		
RAE50RR	RAE50RRB	SE50K		50										1.79	0.771		
RA200RR	RA200RRB	S1200K	211	2										2.12	0.962		
RA201RR	RA201RRB	S1201K		$2\frac{1}{8}$	3.9370	1.281	0.945	0.472	0.809	$\frac{1}{8}$	3	$\frac{1}{16}$	$1\frac{3}{4}$	1.98	0.898	5630	10800
RA202RR	RA202RRB	S1202K		$2\frac{1}{4}$	100	32.54	24	11.99	20.55	4.8	76.2	20.6	48.4	1.89	0.857	25000	48000
RA203RR	RA203RRB	S1203K		$2\frac{1}{8}$										1.78	0.807		
RAE55RR	RAE55RRB	SE55K		55										1.78	0.807		

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

<sup>(2)</sup> Spherical O.D. outer ring width is .472", 12mm

<sup>(3)</sup> Spherical O.D. outer ring width is .551", 14mm

<sup>(4)</sup> Spherical O.D. outer ring width is .827", 21mm

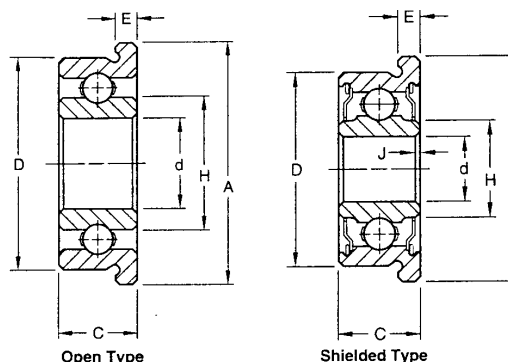


### Flanged Series

#### 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 A		Shielded Type Overall Width		Wt		Static Load Rating C <sub>0</sub>		Extended Dynamic Load Rating C <sub>E</sub>							
open	shielded*	+0.0000 -0.0003 +0.000 mm -0.008 mm		chamfer J x 45° +0.010° -0.000° +0.25 mm -0.00 mm		+0.000° -0.0004 +0.000 mm -0.010 mm		+0.000° -0.005° +0.00 mm -0.13 mm		H min		A +0.005° -0.002° +0.13 mm -0.05 mm		E ±0.002° ±0.05 mm		+0.000° -0.005° +0.00 mm -0.13 mm		H min							
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kg.	lbs.	N	lbs.	N		
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
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	FS1KDD <sup>(1)</sup>	0.2500	6.350	0.012	0.30	0.6250	15.875	0.196	4.98	0.349	8.86	0.690	17.53	0.042	1.07	0.196	4.98	0.332	8.43	0.01	0.005	125	560	365	1630
FS3K	FS3KDD <sup>(1)</sup>	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

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

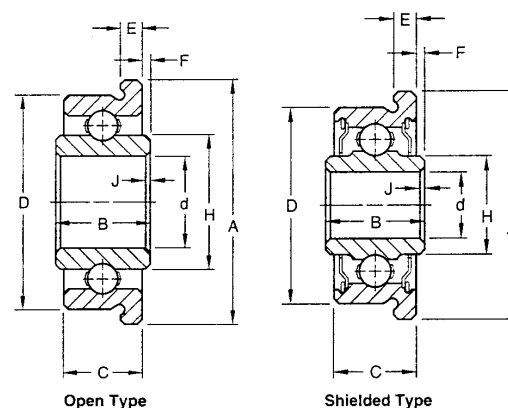
\* Also available with two contact seals. To specify, replace "KDD" in part number with "PP".

#### 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		Ring Widths				Flange				Wt		Static Load Rating C <sub>0</sub>		Extended Dynamic Load C <sub>E</sub>						
	chamfer J x 45°						Inner Width B		Project F		H <sup>(3)</sup>		Outer Width C		A												
	+0.0003° -0.0000° +0.008 mm -0.000 mm				+0.010° -0.0004° +0.025 mm -0.00 mm		±0.010° ±0.03 mm		+0.005° ±13 mm		min		+0.000° -0.004° +0.00 mm -0.10 mm		taper per foot		+0.005° -0.002° +0.13 mm -0.05 mm		E ±0.002° ±0.05 mm								
	open shielded																										
		in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kg.	lbs.	N	lbs.	N		
F2 <sup>(1)</sup>	—	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	0.226	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	F5DD	0.3125	7.938	0.010	0.25	0.6882	17.480	0.250	6.35	0.015	0.38	0.410 <sup>(2)</sup>	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

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

<sup>(2)</sup> H dimension is .381" (9.68 mm) for F5DD.

<sup>(3)</sup> Land dimension of the inner ring.



## PILLOW BLOCKS/CAST IRON

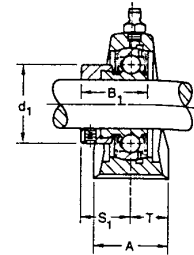
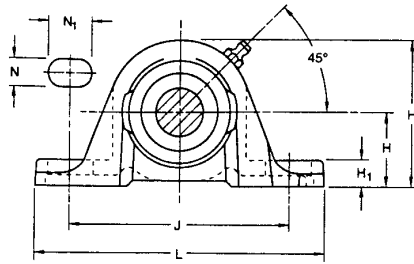
### VAK Standard Series

This streamlined, rugged one-piece VAK pillow block unit combines Fafnir's proven RAK housing and unique RA-RR extended inner ring bearing. The RA-RR bearing employs a positive contact land-riding seal and a Fafnir originated self-locking collar to assure positive shaft retention. The VAK pillow block can be mounted and will operate in any position. Bearing housed units are factory prelubricated but a grease fitting is provided to allow for relubrication if required.

Recommended shaft tolerances:  $\frac{1}{8}$ "-1  $\frac{1}{4}$ ", nominal to  $-.0005$ ",  $-.013$ mm;  
2"-2  $\frac{3}{4}$ ", nominal to  $-.0010$ ",  $-.025$ mm.

#### Bearing Data

Unit	Bearing Number	Dimensions and Load Ratings
VAK	GRA-KRRB	Page 163



TO ORDER, SPECIFY UNIT AND SHAFT DIAMETER. EXAMPLE: VAK 1"

Unit	Shaft Diam.	H	H <sub>2</sub>	B <sub>1</sub>	J	L	A	H <sub>1</sub>	N	N <sub>1</sub>	d <sub>1</sub>	S <sub>1</sub>	T	Bolt Size	Bearing Number	Collar Number	Housing Number	Unit Wt.
in.	mm	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	mm			new (old)	lbs kg
VAK $\frac{1}{2}$															GRA008RRB	S1008K		
VAK $\frac{3}{8}$		1 $\frac{1}{4}$	2 $\frac{3}{32}$	1 $\frac{1}{4}$	3 $\frac{3}{8}$	4 $\frac{1}{8}$	1 $\frac{3}{16}$	$\frac{1}{32}$	$\frac{1}{16}$	$\frac{1}{8}$	1 $\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{32}$	$\frac{3}{4}$	GRA009RRB	S1009K	T-40238	1
VAK $\frac{1}{2}$	17	26.99	53.2	28.6	92.1	123.8	30.2	8.7	11.1	22.2	28.6	22.2	15.1	10	GRA010RRB	S1010K	(T-30595)	0.454
VAK															GRAE17RRB	SE17K		
VAK $\frac{3}{4}$		1 $\frac{1}{4}$	2 $\frac{1}{32}$	1 $\frac{1}{32}$	3 $\frac{3}{32}$	5	1 $\frac{1}{4}$	$\frac{1}{32}$	$\frac{1}{16}$	$\frac{3}{32}$	1 $\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{3}{4}$	GRA012RRB	S1012K	T-40239	1.24
VAK	20	31.75	62.7	31	96	127	31.8	11.9	11.1	19.8	33.3	23.4	15.9	10	GRAE20RRB	SE20K	(T-30555)	0.563
VAK $1\frac{1}{8}$		1 $\frac{3}{16}$	2 $\frac{1}{16}$	1 $\frac{1}{32}$	4 $\frac{1}{4}$	5 $\frac{1}{2}$	1 $\frac{1}{32}$	$\frac{1}{32}$	$\frac{1}{16}$	$\frac{1}{16}$	1 $\frac{1}{2}$	$\frac{5}{16}$	$\frac{4}{16}$	$\frac{3}{4}$	GRA013RRB	S1013K		
VAK $\frac{3}{4}$		33.34	68.3	31	104.8	139.7	35.7	11.9	11.1	20.6	38.1	23.4	17.9	10	GRA014RRB	S1014K		
VAK $1\frac{1}{16}$															GRA015RRB	S1015K	T-30365	1.67
VAK 1	25														GRA100RRB	S1100K		0.758
VAK															GRAE25RRB	SE25K		
VAK $1\frac{1}{8}$		1 $\frac{3}{16}$	3 $\frac{3}{32}$	1 $\frac{1}{32}$	4 $\frac{1}{4}$	6 $\frac{3}{16}$	1 $\frac{3}{16}$	$\frac{1}{32}$	$\frac{1}{16}$	$\frac{1}{16}$	1 $\frac{1}{4}$	1 $\frac{1}{8}$	$\frac{3}{32}$	$\frac{1}{2}$	GRA101RRB	S1101K		
VAK $1\frac{1}{16}$		39.69	80.2	35.7	117.5	157.2	39.7	13.5	14.3	23.8	44.1	27	19.9	12	GRA102RRB	S1102K	T-40241	2.72
VAK $1\frac{3}{16}$															GRA103RRB	S1103K	(T-30300)	1.235
VAK $1\frac{1}{4}$ S	30														GRA103RRB2	S1103K3		
VAK															GRAE30RRB	SE30K		
VAK $1\frac{1}{4}$		1 $\frac{3}{16}$	3 $\frac{3}{8}$	1 $\frac{1}{32}$	5 $\frac{1}{4}$	6 $\frac{3}{16}$	1 $\frac{3}{32}$	$\frac{1}{32}$	$\frac{1}{16}$	$\frac{1}{32}$	2 $\frac{1}{4}$	1 $\frac{3}{32}$	$\frac{5}{16}$	$\frac{1}{2}$	GRA104RRB	S1104K		
VAK $1\frac{3}{16}$		46.04	92.1	38.9	130.2	166.7	45.2	16.7	14.3	24.6	54	29.4	22.7	12	GRA105RRB	S1105K	T-40242	3.51
VAK $1\frac{1}{2}$															GRA106RRB	S1106K	(T-30410)	1.594
VAK $1\frac{1}{8}$	35														GRA107RRB	S1107K		
VAK															GRAE35RRB	SE35K		
VAK $1\frac{1}{2}$		1 $\frac{3}{16}$	3 $\frac{3}{16}$	1 $\frac{1}{32}$	5 $\frac{3}{4}$	7 $\frac{1}{4}$	1 $\frac{1}{4}$	$\frac{3}{4}$	$\frac{1}{16}$	1 $\frac{1}{2}$	2 $\frac{1}{4}$	1 $\frac{1}{2}$	$\frac{1}{16}$	$\frac{1}{2}$	GRA108RRB	S1108KT	T-40243	4.48
VAK $1\frac{3}{8}$	40	49.21	100	43.7	136.5	179.4	47.6	19	14.3	26.2	60.3	32.5	23.8	12	GRA109RRB	S1109KT	(T-30484)	2.034
VAK															GRAE40RRB	SE40K		



## DRAWN CUP ROLLER CLUTCHES

### Type DC Roller Clutches

Nominal dimensions with rounded conversions are shown below. Shaft raceway and housing bore diameters necessary for proper mounting and operation are listed on the opposite page.

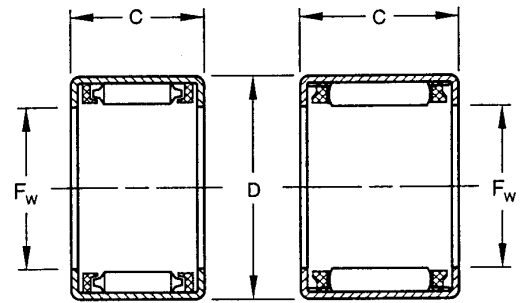
Types FC, FCS, FCL-K and RC-FS clutches have stainless steel springs inserted in the molded cage to position the rollers for instantaneous lockup.

Type RC clutches have springs integrally molded with the cage to position the rollers for instantaneous lockup.

Before ordering any clutch check for availability.



The mounted clutch engages when the housing is rotated relative to the shaft in the direction of the arrow marking (←LOCK) stamped on the cup.



Type FC

Types FCS, FCL-K  
RC and RC-FS

### DIMENSIONS AND RATINGS

F <sub>w</sub> Bore		D O.D.		C Width		Clutch Designation		Torque Rating †	Z Minimum O.D. of Steel Housing for Rated Torque		Overrun Limiting Speed
(nominal)		(nominal)		+0.000 -0.010	+0.00 -0.25	with Stainless Steel Springs	with Integral Springs				
inch	mm	inch	mm	inch	mm			lbf • in.	inch	mm	rpm
⅛	3.18	½	7.14	0.250	6.35	—	RC-02	2.86	0.44	11	50000
0.16	4	0.31	8	0.236	6	FC-4-K	—	2.78	0.44	11	50000
0.24	6	0.39	10	0.472	12	FCS-6	—	18.60	0.55	14	39300
¼	6.35	⅞	11.11	0.500	12.70	—	RC-040708	17.20	0.62	16	38000
0.31	8	0.47	12	0.472	12	FCL-8-K	—	28.70	0.67	17	28700
0.31	8	0.55	14	0.472	12	FC-8	—	35.80	0.79	20	30500
⅜	9.52	⅝	15.88	0.500	12.70	RC-061008-FS*	RC-061008	45.40	0.88	22	25300
0.39	10	0.55	14	0.472	12	FCL-10-K	—	39.10	0.77	20	22700
0.39	10	0.63	16	0.472	12	FC-10	—	50.40	0.98	25	23700
0.47	12	0.71	18	0.630	16	FC-12	—	118	1.10	27	19300
⅜	12.70	⅝	19.05	0.500	12.70	RC-081208-FS*	RC-081208	73.60	1.10	28	18700
⅝	15.88	⅞	22.22	0.625	15.88	RC-101410-FS*	RC-101410	143	1.20	30	14700
0.63	16	0.87	22	0.630	16	FC-16	—	182	1.20	31	14000
¾	19.05	1	25.40	0.625	15.88	RC-121610-FS*	RC-121610	196	1.40	36	11300
0.79	20	1.02	26	0.630	16	FC-20	—	274	1.50	38	10700
0.98	25	1.26	32	0.787	20	FC-25	—	605	1.80	46	8670
1	25.40	1 ¼	33.34	0.625	15.88	RC-162110-FS*	RC-162110	412	1.90	48	8670
1.18	30	1.46	37	0.787	20	FC-30	—	845	2.0	51	7330

\* Suffix "-FS" is not always stamped on the clutch cup. Type RC-FS with stainless steel springs is always readily identified by RED clutch cage.

† Torque ratings are given in pound force inches: 1 lbf • in = 0.113 N • m = 0.0115 kgf • m

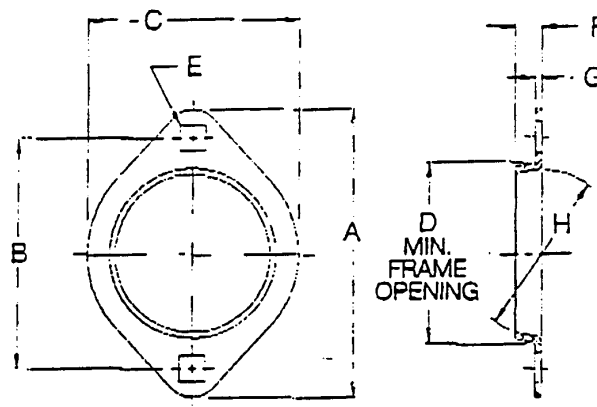
## General Flangette Information

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 <sup>7</sup> / <sub>8</sub> 73.0	2 <sup>1</sup> / <sub>2</sub> 63.50	2 <sup>5</sup> / <sub>16</sub> 58.74	1 <sup>5</sup> / <sub>8</sub> 41.28	<sup>9</sup> / <sub>32</sub> 7.14	<sup>7</sup> / <sub>32</sub> 5.54	0.054 1.37	35	350 1556	0.06
40MST	3 <sup>3</sup> / <sub>16</sub> 80.96	2 <sup>1</sup> / <sub>2</sub> 63.50	2 <sup>5</sup> / <sub>16</sub> 58.74	1 <sup>7</sup> / <sub>8</sub> 47.63	<sup>9</sup> / <sub>32</sub> 7.14	<sup>9</sup> / <sub>32</sub> 7.14	0.075 1.905	40	750 3100	0.08
47MST	3 <sup>5</sup> / <sub>16</sub> 90.49	2 <sup>13</sup> / <sub>16</sub> 71.44	2 <sup>5</sup> / <sub>8</sub> 66.68	2 <sup>3</sup> / <sub>16</sub> 55.55	<sup>11</sup> / <sub>32</sub> 8.73	<sup>5</sup> / <sub>16</sub> 7.94	0.083 2.11	47	900 3900	0.10
52MST	3 <sup>3</sup> / <sub>4</sub> 95.25	3 76.20	2 <sup>5</sup> / <sub>16</sub> 71.04	2 <sup>3</sup> / <sub>8</sub> 60.33	<sup>11</sup> / <sub>32</sub> 8.73	<sup>11</sup> / <sub>32</sub> 8.73	0.083 2.11	52	1000 4450	0.11
62MST	4 <sup>7</sup> / <sub>8</sub> 112.71	3 <sup>5</sup> / <sub>8</sub> 90.49	3 <sup>5</sup> / <sub>8</sub> 84.14	2 <sup>13</sup> / <sub>16</sub> 71.44	<sup>13</sup> / <sub>32</sub> 10.31	<sup>3</sup> / <sub>8</sub> 9.53	0.104 2.64	62	1400 6200	0.33
72MST	4 <sup>15</sup> / <sub>16</sub> 125.41	3 <sup>15</sup> / <sub>16</sub> 100.01	3 <sup>11</sup> / <sub>16</sub> 93.66	3 <sup>7</sup> / <sub>16</sub> 80.96	<sup>13</sup> / <sub>32</sub> 10.31	<sup>13</sup> / <sub>32</sub> 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.

## CABLE MANAGEMENT ACCESSORIES

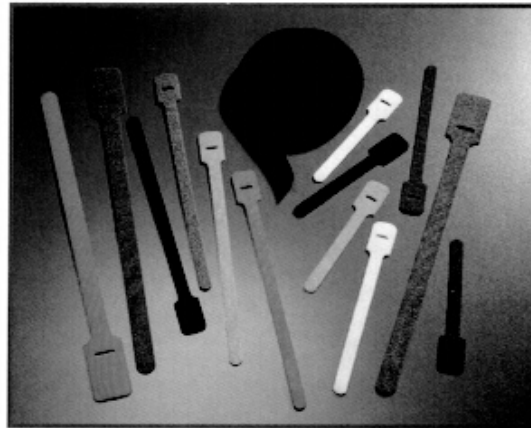
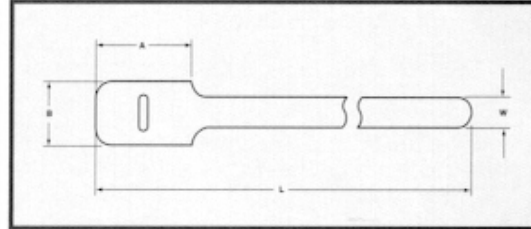
### GRIP TIES



The Grip Tie is a low profile, one-piece fastening device. Constructed of VELCRO®\* brand polyethylene hook and nylon loop, laminated back to back, the Grip Tie features quick release for repetitive access to cable and wire. It can be opened and closed numerous times without failure. The Grip Tie is reusable, adjustable, releasable, and easy to install. Its design provides ease of installation in tight areas such as telecommunications closets and will not get caught on other cables. The tie also will not cause damage to Category 5 cable or fiber optic cable since it cannot be overcinched.

Available in a large color variety as well as different sizes including 6", 8", 11", and 15", the Grip Tie is versatile enough for applications ranging from network installations to bundling power cords. An assortment pack containing the four different sizes and six different colors is also available. For custom-cut lengths, the VELCRO® brand strap also comes on a five yard roll.

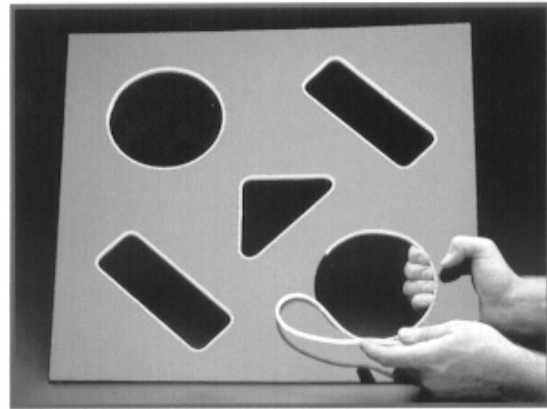
\* VELCRO® is registered trademark for fasteners of the Velcro companies.



Tyton Hellermann Part No.	Color	Bundle Diameter	Tensile Strength	Length (L)	Width (W)	Head Length (A)	Head Width (B)	Pkg. Qty.
<b>6" Straps</b>								
GT.375X60C2	Black	1"	42 lbs.	6"	.375"	1.5"	.75"	100
GT.50X60P2	Black	1"	45 lbs.	6"	0.5"	1.5"	1"	10
GT.50X60C2	Black	1"	45 lbs.	6"	0.5"	1.5"	1"	100
GT.50X62P2	Red	1"	45 lbs.	6"	0.5"	1.5"	1"	10
GT.50X62C2	Red	1"	45 lbs.	6"	0.5"	1.5"	1"	100
GT.50X63P2	Orange	1"	45 lbs.	6"	0.5"	1.5"	1"	10
GT.50X63C2	Orange	1"	45 lbs.	6"	0.5"	1.5"	1"	100
GT.50X64P2	Yellow	1"	45 lbs.	6"	0.5"	1.5"	1"	10
GT.50X64C2	Yellow	1"	45 lbs.	6"	0.5"	1.5"	1"	100
GT.50X65P2	Green	1"	45 lbs.	6"	0.5"	1.5"	1"	10
GT.50X65C2	Green	1"	45 lbs.	6"	0.5"	1.5"	1"	100
GT.50X66P2	Blue	1"	45 lbs.	6"	0.5"	1.5"	1"	10
GT.50X66C2	Blue	1"	45 lbs.	6"	0.5"	1.5"	1"	100
<b>8" Straps</b>								
GT.50X80P2	Black	1.75"	50 lbs.	8"	0.5"	1.5"	1"	10
GT.50X80C2	Black	1.75"	50 lbs.	8"	0.5"	1.5"	1"	100
GT.50X82P2	Red	1.75"	50 lbs.	8"	0.5"	1.5"	1"	10
GT.50X82C2	Red	1.75"	50 lbs.	8"	0.5"	1.5"	1"	100
GT.50X83P2	Orange	1.75"	50 lbs.	8"	0.5"	1.5"	1"	10
GT.50X83C2	Orange	1.75"	50 lbs.	8"	0.5"	1.5"	1"	100
GT.50X84P2	Yellow	1.75"	50 lbs.	8"	0.5"	1.5"	1"	10
GT.50X84C2	Yellow	1.75"	50 lbs.	8"	0.5"	1.5"	1"	100

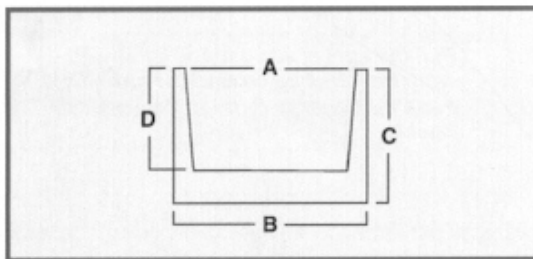
## GROMMET

Tyton Hellermann's Flexiform grommet is a unique, continuous wire protection product which fits easily in all shapes and sizes of holes without the aid of tools or adhesives. Since Flexiform can be cut to the right length with scissors, it eliminates waste, helping keep grommet stock to a minimum. Tyton Hellermann's Flexiform flexible panel grommet can be used on any type of material including wood, steel, aluminum, plexiglass, and glass. It is available in 9 sizes for thicknesses from .016" to .512". The standard color is natural. Materials: polyethylene, nylon, and P.T.F.E. (Teflon®).



Material	Reference	Maximum Operating Temperature	Pkg. Qty.
Polyethylene	FP	176°F (80°C)	One 82 foot (25 meters) reel
Nylon	FH	275°F (135°C)	One 82 foot (25 meters) reel
P.T.F.E. (Teflon®)	FT	500°F (260°C)	One 82 foot (25 meters) reel

*The maximum operating temperatures shown above are dependent upon the environmental application.*



Standard Dimensions (in inches)					
Size	A	B	C	D	For Thickness
AA	.037	.087	.094	.063	.016-.040
A	.055	.150	.157	.099	.016-.052
B	.091	.177	.157	.099	.052-.083
C	.130	.220	.157	.099	.083-.130
D	.197	.327	.228	.157	.130-.189
E	.260	.386	.241	.170	.189-.256
F	.319	.445	.256	.181	.256-.319
G	.394	.512	.256	.181	.319-.382
H	.512	.638	.256	.181	.382-.512

*Note: Size AA is available in polyethylene only.*

*Note: Nylon is available in sizes A through E only.*

### Example Part Number

FP AA  
MATERIAL TYPE SIZE

When ordering, add size to the material reference. For example, FPAA equals size AA in polyethylene material.

## SPIRALWRAP

Spiralwrap protective sheathing allows flexible routing and lead-out of cables. The inner edges are beveled to prevent damage to cables. U.L. recognized Spiralwrap is reusable and resistant to most chemicals. Natural and black are standard colors (see material descriptions). Colors may be available dependent upon volume requirements. Contact Tyton Hellermann for more information.

### Installation

Spiralwrap can be installed in two basic ways:

In a gapped installation, Spiralwrap is wrapped with space between the sheathing. This accommodates wire breakouts and also keeps the wire bundle flexible.

In a butted installation, Spiralwrap is wrapped so the sheathing completely insulates the wire bundle. This provides superior abrasion resistance and additional rigidity.

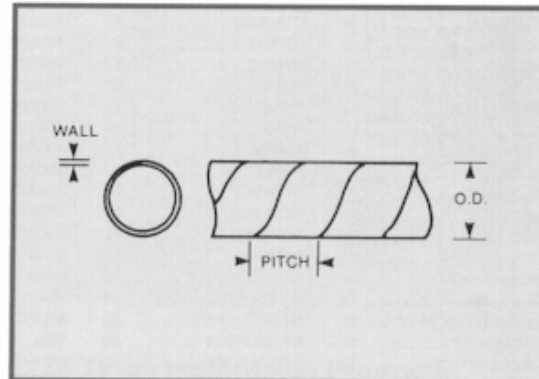
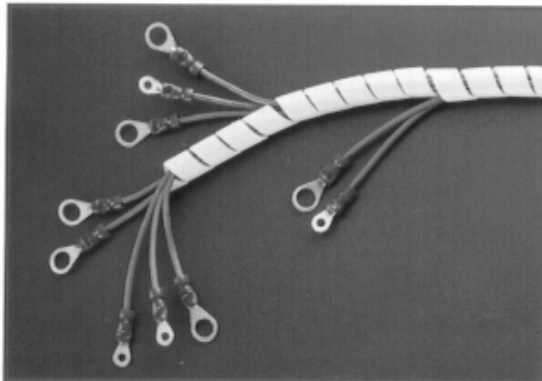


# THE 2001 FIRST ROBOTICS COMPETITION MANUAL

## Spiralwrap Material Specifications

Materials	Max. Oper. Temp.	Min. Oper. Temp.	Abrasion Resist. Lower No.s Better mg.loss per M Cycles	Dielectric Constant	Standard Dimensions (in inches)		Specific Gravity D792 -50	Water Absorption %D-570	Flammability	Effect of Solvents	Effect of Acids	Effect of Alkalies	MIL Spec. & Approvals
					D-638 -52Tpsi	D-412 -51Tpsi							
<b>Clear Non-Flame Retardant Polyethylene</b> Ideal for general applications. Not affected by ordinary solvents and extremely resistant to abrasion. (Ref.NFP)	215°F 101°C	-105°F -76°C	22	2.50	-	1800	0.92	.014	Flammable	None below 122°F 50°C	None	None	Fed. Spec. LP390 MIL I-631D MIL P-21922A
<b>Black Non-Flame Retardant Polyethylene</b> Ultraviolet resistant for outdoor use. Has the same qualities as clear polyethylene but also contains an ultraviolet absorber which permits it to be used in direct sunlight for long periods of time. (Ref. NFPO)	215°F 101°C	-105°F -76°C	20	2.60	-	2000	0.93	.030	Flammable	None below 122°F 50°C	None	None	Fed. Spec. LP390 MIL I-631D MIL P-21922A

Spiralwrap is also available in flame retardant polyethylene, nylon and P.T.F.E Teflon® (Teflon is a DuPont Trademark).



Tyton Hellermann Part No.	Materials	Outside Diameter		Nominal Dimensions Wall		Pitch		Maximum Bundle		Weight Lb./M ft	Pkg. Qty.
		Inches	Millimeters	Inches	Millimeters	Inches	Millimeters	Inches	Millimeters		
1NFP9C	Non-Flame	.125	(3.18)	.032	(.81)	.187	(4.75)	1/16 to 1/2	(1.60 to 12.7)	4	One 100' Reel
2NFP9C	Retardant	.250	(6.35)	.045	(1.14)	.375	(9.53)	3/16 to 2	(4.75 to 50.8)	12	
2.5NFP9C	Polyethylene	.375	(9.53)	.052	(1.32)	.438	(11.13)	5/16 to 3	(7.92 to 76.2)	22	
3NFP9C	(Ref. NFP)	.500	(12.70)	.062	(1.57)	.563	(14.30)	3/8 to 4	(9.52 to 102)	35	
4NFP9C		.750	(19.05)	.065	(1.65)	.750	(19.05)	3/4 to 5	(19.10 to 127)	58	
5NFP9C		1.000	(25.40)	.095	(2.41)	1.000	(25.40)	1 to 7	(25.40 to 178)	105	
1NFP0C	Black	.125	(3.18)	.032	(.81)	.187	(4.75)	1/16 to 1/2	(1.60 to 12.7)	4	One 100' Reel
2NFP0C	Non-Flame	.250	(6.35)	.045	(1.14)	.375	(9.53)	3/16 to 2	(4.75 to 50.8)	12	
2.5NFP0C	Retardant	.375	(9.53)	.052	(1.32)	.438	(11.13)	5/16 to 3	(7.92 to 76.2)	22	
3NFP0C	Polyethylene	.500	(12.70)	.062	(1.57)	.500	(12.70)	3/8 to 4	(9.52 to 102)	35	
4NFP0C	(Ref. NFPO)	.750	(19.05)	.065	(1.65)	.750	(19.05)	3/4 to 5	(19.10 to 127)	58	
5NFP0C		1.000	(25.40)	.095	(2.41)	1.000	(25.40)	1 to 7	(25.40 to 178)	105	

For other materials, contact Tyton Hellermann.



**HPX-30/60**

**HPX-10**

**HPX-150**

**Low Voltage  
Cut-Off's**

**Multi-  
Position**

**Lead  
Acid**

**Standard  
Products**

**Request A  
Quotation**

The HPX-30 and HPX-60 lead-acid battery chargers were designed with an emphasis on optimizing recharge time while extracting the maximum battery life possible even in the most demanding applications. This, along with semiconductor and passive device selection based on military standards, assure outstanding reliability. Constant attention to manufacturing engineering and our high quality standards set these chargers apart from other designs presently available.

## ADDITIONAL FEATURES:

■ IEC Power Inlet with 6' Grounded Detachable Power Cord

■ CSA/UL (NRTL) Approved 

■ Temperature Compensated

■ Single Tri Color LED indicator (Green="float", Yellow = "fast charge", Red= "fault")

■ Private Labeling Available



HPX-30



HPX-60

Technical Specifications @ 25° C	HPX-30	HPX-60
Input Voltage and Frequency	115 or 230 VAC switchable +/- 10%, 47- 63 Hz	
Current Limit (Imax) (+/- 5%)	2A at 12VDC 1A at 24VDC	4A at 12VDC 2A at 24VDC
High Rate Voltage	14.70 +/- 0.30 VDC at 12V or 29.40 +/- 0.24 +/- 0.60 VDC at 24VDC	
High Rate Current (+/- 10%)	Imax through Imax/7.5	Imax through Imax/7.5
Float Rate Voltage	13.68 +/- 0.12 VDC at 12VDC or 27.36 +/- 0.24 VDC at 24VDC	
Float Rate Current (+/- 10%)	0 Imax through Imax/7.5	0 Imax through Imax/7.5
Dimensions	5.55" W x 2.90" x 3.6"D	6.65" W x 3.40" H x 5.30" D
Weight	3.8 lbs	7.4 lbs
Temperature Tolerances	Operating 0° to 40° C or 32° to 104° F Storage -40° to 80°C or -40° to 176°	

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