VULCAN SPRING

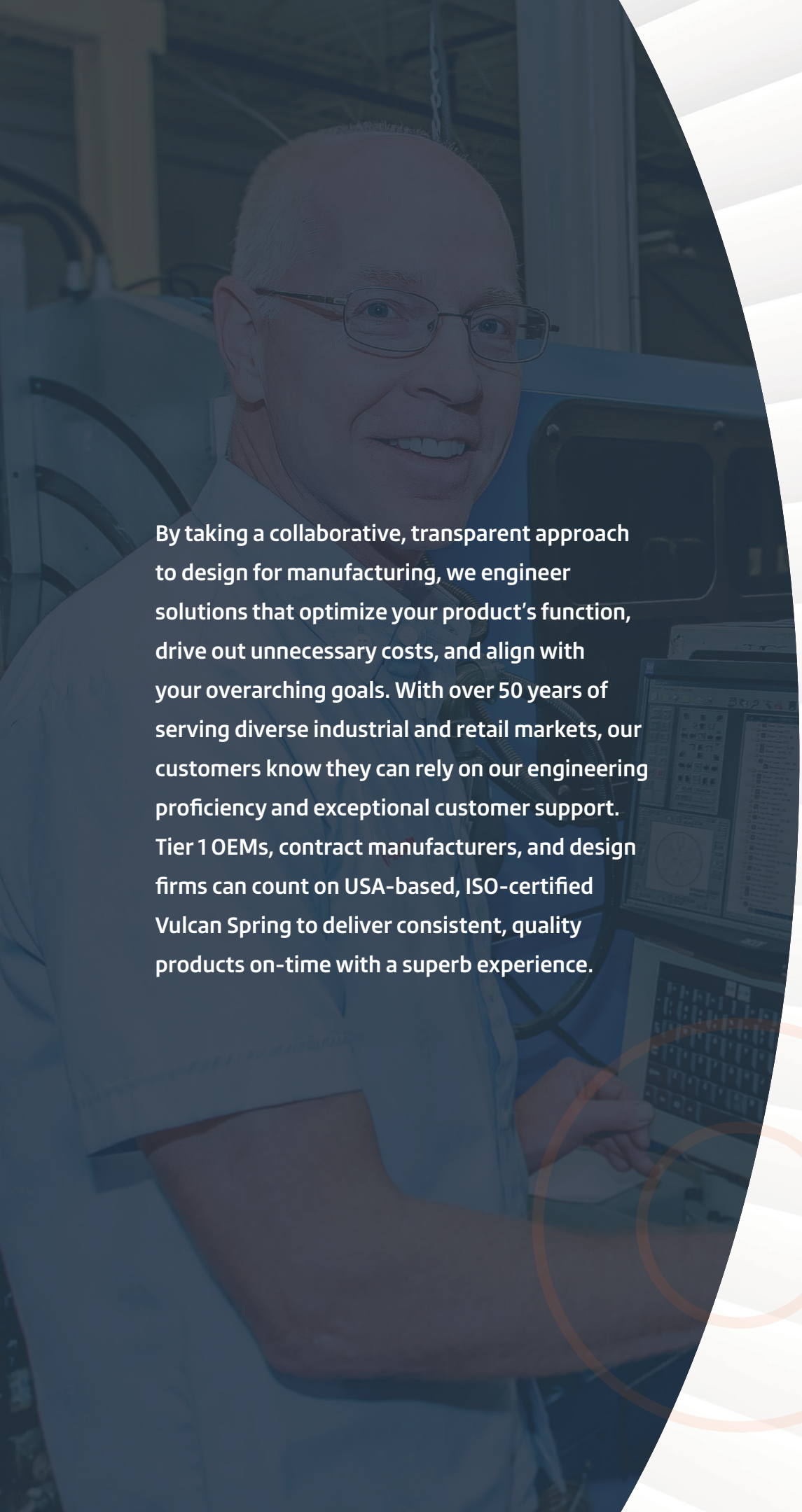
Beyond the Spring™

Design Guide

Your Preferred Supplier of Custom Springs from Design to Production

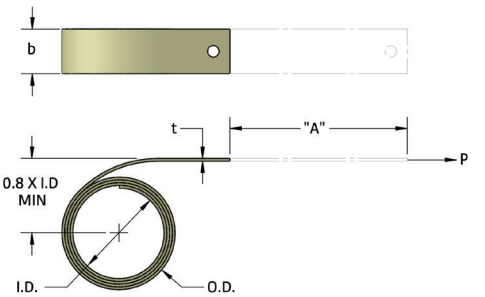
MADE IN THE USA

VulcanSpring.com



By taking a collaborative, transparent approach to design for manufacturing, we engineer solutions that optimize your product's function, drive out unnecessary costs, and align with your overarching goals. With over 50 years of serving diverse industrial and retail markets, our customers know they can rely on our engineering proficiency and exceptional customer support. Tier 1 OEMs, contract manufacturers, and design firms can count on USA-based, ISO-certified Vulcan Spring to deliver consistent, quality products on-time with a superb experience.

Contents



Conforce® Springs

Conforce Springs offer high force output with small space requirements, provide long linear reach with minimal force buildup, and store energy indefinitely when extended. These springs are ideal for a wide variety of uses where constant force is needed, including applications requiring smooth extension and retraction, counterbalancing, and tensioning.

Materials

Several materials are used to make constant force springs, including stainless steel, high carbon steel, Inconel, and Elgiloy. Type 301 stainless steel is a proven choice for consistent quality, life, availability, stress retention, and low product cost. Type 301 stainless steel, in its cold-worked condition, is magnetic and passivation is not recommended.

Testing & Inspection

Inspection expertise is a critical part of our success. Our modern metrology tools accurately and consistently measure the force and many other characteristics of our products. Our tools are routinely calibrated to National Institute of Standards and Technology (NIST) requirements.

Our quality control team, sales team, and customers work closely to clearly define the inspection criteria. We have experience working with quality programs from many industries including aerospace, automotive, and defense.

Design Considerations

The below criteria will impact the design and performance of a Conforce® Spring.

1. **Raw material** – Most of the flat steel springs we produce are made from Type 301 Stainless Steel. This material is readily available and offers predictable performance. Other materials include high carbon steel, Inconel, and Elgiloy.

2. **Life requirements** – The requirement must be realistic, since estimating a high life cycle can lead to a larger, more expensive part, and underestimating the life requirement can lead to premature failure. The Design Guide has charts that range from 3,000 to 100,000 life cycles. These values are estimates of the actual performance, not guaranteed minimums. If a high life cycle is needed, considerations must be made for increased tolerances of the spring's diameter and force due to the low stress level and slight variations in raw material.

3. **Force requirements** – The force of a constant force spring should be determined by the requirement of the application. The standard tolerance for the force of a constant force spring is ± 10%.

4. **Available space** – When reviewing the charts in our Design Guide, it will become obvious that there are several thickness and width combinations that result in the same force. The inside diameter (I.D.) of the spring is dependent on the thickness, life cycle requirement, and force required. The outside diameter (O.D.) is dependent on the above variables and the overall length. Note that a constant force spring does not extend tangent to the body of the spring. To allow for proper operation, a minimum distance of .8" X I.D. is required and should be considered during initial design (see diagram on page 4). The standard tolerance for the I.D. and O.D. is ± 10%.

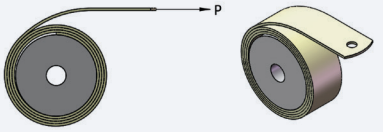
5. **Mounting details** – We have many standard end details available. Special end designs may be obtained for an additional charge. The pre-load length (dimension "A" in the diagram on page 4) is the minimum required extension to reach the rated force. It is typically equal to the O.D. of the spring.

6. **Environment** – Corrosive atmospheres or extreme temperatures will affect spring performance. Our engineers can assist in these situations which can often be addressed with alternate material choices.

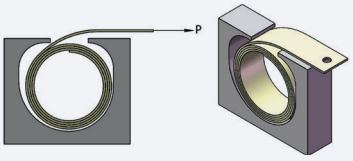
Mounting Methods

Single Mounting

For ideal operation, the diameter of the spool should be 12–20% greater than nominal spring I.D.



Spool Mounting



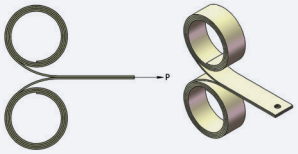
Cavity

Mounting Features

Common spring end features include punched and formed features. Please contact our sales department for stock options suitable for your application.

Multiple Mounting

Force is the sum of two or more springs.



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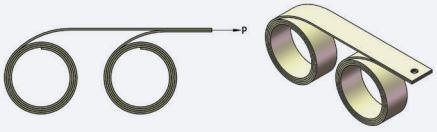
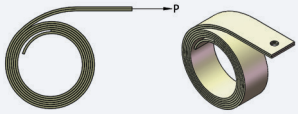


Tandem



Laminar

Note For All Constant Force Springs

Idler drums may damage Conforce Springs. Contact our sales department for more information.

Conforce® Spring Design Chart

TYPE 301 STAINLESS STEEL

CHART H
SPRING LIFE
4,000 CYCLES

b →		D 1/4	E 5/16	F 3/8	G 1/2	J 5/8	K 3/4	P 1	R 1 1/4	S 1 1/2	U 2	V 3	W 4
t	ID	P (Force)											
.002	.13	.39	.49	.58	.77								
.003	.20	.58	.72	.86	1.15	1.44							
.004	.27	.77	.96	1.15	1.54	1.92	2.30						
.005	.34	.96	1.20	1.44	1.92	2.40	2.88	3.84					
.006	.41	1.15	1.44	1.73	2.30	2.88	3.45	4.61	5.76				
.008	.54	1.54	1.92	2.31	3.07	3.84	4.61	6.14	7.68	9.22			
.010	.68	1.92	2.40	2.88	3.84	4.80	5.76	7.68	9.59	11.5	15.4		
.012	.81		2.88	3.45	4.61	5.76	6.91	9.21	11.5	13.8	18.4	26.2	
.014	.95			4.03	5.37	6.72	8.06	10.8	13.4	16.1	21.5	30.6	38.7
.016	1.08				6.14	7.68	9.21	12.3	15.4	18.4	24.6	35.0	44.2
.018	1.22					8.63	10.4	13.8	17.3	20.7	27.6	39.4	49.7
.020	1.35						11.5	15.4	19.2	23.0	30.7	43.8	55.3
.022	1.49							16.9	21.1	25.3	33.8	48.1	60.8
.025	1.69								24.0	28.8	38.4	54.7	69.1
.031	2.09									35.7	47.6	67.8	85.7

CHART J
SPRING LIFE
8,000 CYCLES

b ›		D 1/4	E 5/16	F 3/8	G 1/2	J 5/8	K 3/4	P 1	R 1 1/4	S 1 1/2	U 2	V 3	W 4
t	ID	FORCE P											
.002	.18	.29	.36	.43	.57	.71							
.003	.26	.43	.53	.64	.86	1.07							
.004	.35	.57	.71	.86	1.14	1.43	1.71						
.005	.44	.72	.89	1.07	1.43	1.79	2.15	2.86					
.006	.53	.86	1.07	1.28	1.71	2.14	2.57	3.42	4.28				
.008	.70	1.14	1.43	1.71	2.28	2.85	3.42	4.56	5.70	6.84			
.010	.88	1.42	1.78	2.14	2.85	3.56	4.28	5.70	7.13	8.55	11.4		
.012	1.05	1.71	2.14	2.57	3.42	4.28	5.13	6.84	8.55	10.3	13.7	20.5	
.014	1.23			2.99	3.99	4.99	5.99	7.98	9.98	12.0	16.0	23.9	30.3
.016	1.40				4.56	5.70	6.84	9.12	11.4	13.7	18.2	27.4	34.7
.018	1.58					6.41	7.70	10.3	12.8	15.4	20.6	30.8	39.0
.020	1.75						8.55	11.4	14.3	17.1	22.8	34.2	43.3
.022	1.93							12.5	15.7	18.8	25.1	37.6	47.7
.025	2.19								17.8	21.4	28.5	42.8	54.2
.031	2.71									26.5	35.3	53.0	67.1

CHART K
SPRING LIFE
12,000 CYCLES

b ›		D 1/4	E 5/16	F 3/8	G 1/2	J 5/8	K 3/4	P 1	R 1 1/4	S 1 1/2	U 2	V 3	W 4
t	ID	FORCE P											
.002	.21	.22	.27	.32	.43	.54							
.003	.31	.32	.40	.48	.65	.81							
.004	.41	.43	.54	.65	.86	1.08	1.29						
.005	.51	.54	.68	.81	1.08	1.35	1.62	2.15					
.006	.62	.65	.81	.97	1.29	1.61	1.94	2.58	3.23				
.008	.82	.86	1.08	1.29	1.72	2.15	2.58	3.44	4.30	5.16			
.010	1.03	1.08	1.34	1.61	2.15	2.69	3.23	4.30	5.38	6.45	8.60		
.012	1.23	1.29	1.61	1.94	2.58	3.23	3.87	5.16	6.45	7.74	10.3	15.5	
.014	1.44			2.26	3.01	3.76	4.52	6.02	7.53	9.03	12.0	18.1	24.1
.016	1.64				3.44	4.30	5.16	6.88	8.60	10.3	13.8	20.6	27.5
.018	1.85					4.84	5.81	7.74	9.68	11.6	15.5	23.2	31.0
.020	2.05						6.45	8.60	10.8	12.9	17.2	25.8	34.4
.022	2.26							9.46	11.8	14.2	18.9	28.4	37.8
.025	2.56								13.4	16.1	21.5	32.3	43.0
.031	3.18									20.0	26.7	40.0	53.3

Variables:
t = material thickness (inches)
b = material width (inches)

P = force (pounds)
ID = inside coil diameter (inches)

For Metric Design Charts, please download the ***Metric Unit Supplement***

CHART L
SPRING LIFE
25,000 CYCLES

b ›		D 1/4	E 5/16	F 3/8	G 1/2	J 5/8	K 3/4	P 1	R 1 1/4	S 1 1/2	U 2	V 3	W 4
t	ID	FORCE P											
.002	.28	.13	.16	.19	.26	.32							
.003	.41	.19	.24	.29	.38	.48							
.004	.55	.26	.32	.38	.51	.64	.77						
.005	.69	.32	.40	.48	.64	.80	.96	1.28					
.006	.83	.38	.48	.57	.77	.96	1.15	1.53	1.91				
.008	1.10	.51	.64	.77	1.02	1.28	1.53	2.04	2.55	3.06			
.010	1.38	.64	.80	.96	1.28	1.60	1.92	2.56	3.20	3.84	5.12		
.012	1.65	.77	.96	1.15	1.53	1.91	2.30	3.06	3.83	4.59	6.12	9.18	
.014	1.93			1.34	1.79	2.24	2.69	3.58	4.48	5.37	7.16	10.7	14.3
.016	2.20				2.04	2.55	3.06	4.08	5.10	6.12	8.16	12.2	16.3
.018	2.48					2.87	3.44	4.59	5.74	6.89	9.18	13.8	18.4
.020	2.75						3.83	5.10	6.38	7.65	10.2	15.3	20.4
.022	3.03							5.60	7.01	8.42	11.2	16.8	22.4
.025	3.44								7.97	9.56	12.8	19.1	25.5
.031	4.26									11.9	15.8	23.7	31.6

CHART M
SPRING LIFE
50,000 CYCLES

b ›		D 1/4	E 5/16	F 3/8	G 1/2	J 5/8	K 3/4	P 1	R 1 1/4	S 1 1/2	U 2	V 3	W 4
t	ID	FORCE P											
.002	.37	.07	.09	.11	.15	.18							
.003	.56	.11	.14	.16	.22	.27							
.004	.75	.15	.18	.22	.29	.36	.44						
.005	.93	.18	.23	.27	.36	.45	.56	.73					
.006	1.12	.22	.27	.33	.44	.54	.65	.87	1.09				
.008	1.49	.29	.36	.44	.58	.72	.87	1.16	1.45	1.74			
.010	1.86	.36	.45	.54	.73	.91	1.09	1.45	1.81	2.18	2.90		
.012	2.24	.44	.54	.65	.87	1.09	1.31	1.74	2.18	2.61	3.48	5.22	
.014	2.61			.77	1.02	1.28	1.53	2.04	2.55	3.06	4.08	6.12	8.16
.016	2.98				1.16	1.45	1.74	2.32	2.90	3.48	4.64	6.96	9.28
.018	3.35					1.63	1.96	2.61	3.26	3.92	5.22	7.83	10.4
.020	3.73						2.18	2.90	3.63	4.35	5.80	8.70	11.6
.022	4.10							3.19	3.99	4.79	6.38	9.57	12.8
.025	4.66								4.53	5.44	7.25	10.9	14.5
.031	5.77									6.75	8.99	13.5	18.0

CHART N
SPRING LIFE
100,000 CYCLES

b ›		D 1/4	E 5/16	F 3/8	G 1/2	J 5/8	K 3/4	P 1	R 1 1/4	S 1 1/2	U 2	V 3	W 4
t	ID	FORCE P											
.002	.44	.05	.07	.08	.11	.13							
.003	.66	.08	.10	.12	.16	.20							
.004	.89	.11	.13	.16	.21	.26	.32						
.005	1.11	.13	.16	.20	.26	.33	.40	.53					
.006	1.33	.16	.20	.24	.32	.39	.47	.63	.79				
.008	1.77	.21	.26	.32	.42	.53	.63	.84	1.10	1.26			
.010	2.21	.26	.33	.39	.53	.66	.79	1.05	1.31	1.58	2.10		
.012	2.66	.32	.39	.47	.63	.79	.95	1.26	1.58	1.89	2.52	3.78	
.014	3.10			.55	.74	.92	1.10	1.47	1.84	2.20	2.94	4.41	5.88
.016	3.54				.84	1.05	1.26	1.68	2.10	2.52	3.36	5.04	6.72
.018	3.98					1.18	1.42	1.89	2.36	2.84	3.78	5.68	7.56
.020	4.43						1.58	2.10	2.63	3.16	4.20	6.32	8.40
.022	4.87							2.31	2.89	3.47	4.62	6.94	9.24
.025	5.53								3.28	3.94	5.25	7.88	10.5
.031	6.86									4.89	6.51	9.77	13.0

Variables:
t = material thickness (inches)
b = material width (inches)

P = force (pounds)
ID = inside coil diameter (inches)

For Metric Design Charts, please download the ***Metric Unit Supplement***

Stock Constant Force Springs

The below stock Conforce Springs are available on our website. Specifications are subject to change.

SERIES H
SPRING LIFE
4,000 CYCLES

Part #	Thickness	Width	Length	Load +/- 10%	I.D. +/- 10%	O.D. +/- 10%	End Holes
SH3C12	.003"	.187"	12"	.37 lbs	.21"	.30"	1X.096
SH4C15	.004"	.187"	15"	.49 lbs	.29"	.40"	1X.096
SH4D15	.004"	.250"	15"	.66 lbs	.25"	.40"	1X.130
SH4E15	.004"	.312"	15"	.83 lbs	.28"	.40"	1X.130
SH5E17	.005"	.312"	17"	1.03 lbs	.37"	.50"	1X.130
SH6F24	.006"	.375"	24"	1.48 lbs	.45"	.62"	1X.196
SH6G25	.006"	.500"	25"	1.97 lbs	.45"	.65"	1X.196
SH8G30	.008"	.500"	30"	2.63 lbs	.59"	.82"	1X.196
SH8J30	.008"	.625"	30"	3.29 lbs	.61"	.83"	1X.196
SH8K24	.009"	.750"	24"	4.00 lbs	.62"	.82"	1X.196
SH10J33	.010"	.625"	33"	4.12 lbs	.73"	.99"	1X.196
SH10K33	.010"	.750"	33"	4.95 lbs	.71"	.97"	1X.196
SH12K39	.012"	.750"	39"	5.94 lbs	.88"	1.19"	1X.196
SH12P39	.012"	1.00"	39"	7.92 lbs	.88"	1.20"	1X.196
SH16P40	016"	1.00"	40"	10.60 lbs	1.20"	1.52"	1X.196
SH20R50	.020"	1.25"	50"	16.50 lbs	1.47"	1.89"	1X.196
SH25S52	.025"	1.50"	52"	24.80 lbs	1.77"	2.23"	2X.265
SH25U52	.025"	2.00"	52"	33.00 lbs	1.78"	2.22"	2X.265
SH31U60	.031"	2.00"	60"	40.90 lbs	2.50"	3.03"	2X.265

SERIES L
SPRING LIFE
25,000 CYCLES

Part #	Thickness	Width	Length	Load +/- 10%	I.D. +/- 10%	O.D. +/- 10%	End Holes
SL4D18	.004"	.250"	18"	.23 lbs	.53"	.62"	1X.130
SL5E18	.005"	.312"	18"	.36 lbs	.69"	.78"	1X.130
SL5F25	.005"	.375"	25"	.43 lbs	.65"	.78"	1X.130
SL6F25	.006"	.375"	25"	.52 lbs	.70"	.90"	1X.196
SL6G25	.006"	.500"	25"	.70 lbs	.80"	.92"	1X.196
SL8G33	.008"	.500"	33"	.93 lbs	1.07"	1.23"	1X.196
SL10J35	.010"	.625"	35"	1.46 lbs	1.36"	1.53"	1X.196
SL12K45	.012"	.750"	45"	2.09 lbs	1.60"	1.82"	1X.196
SL12P45	.012"	1.00"	45"	2.80 lbs	1.60"	1.84"	1X.196
SL15P48	.015"	1.00"	48"	3.50 lbs	1.96"	2.20"	1X.196
SL15R48	.015"	1.25"	48"	4.37 lbs	2.03"	2.29"	1X.196
SL16P46	.016"	1.00"	46"	4.10 lbs	1.96"	2.21"	1X.196
SL20R55	.020"	1.25"	55"	5.83 lbs	2.53"	2.82"	1X.196
SL25S60	.025"	1.50"	60"	8.40 lbs	3.35"	3.70"	2X.265
SL25U60	025"	2.00"	60"	11.70 lbs	3.37"	3.68"	2X.265
SL31U70	.031"	2.00"	70"	14.40 lbs	4.35"	4.74"	2X.265

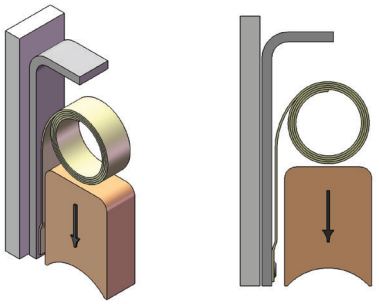
*For Metric Design Charts, please download the **Metric Unit Supplement***

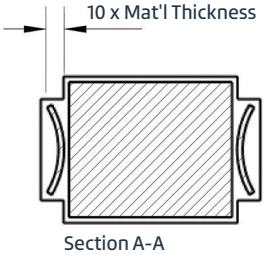
Conforce Twin Springs

Electric motor and medical device manufacturers rely on Conforce Twin Springs for constant force in a small package.

Design Considerations

1. **Raw material** – Type 301 stainless steel is preferred.
2. **Force requirements** – The force of the spring should be determined by the requirements of the application. Normal force tolerance is ± 10%.
3. **Available space** – For any given force there are several combinations of spring thickness and width that can be used. Select the one that best fits the space.
4. **Allow clearance for spring cross-curvature** – See section A–A below for the required clearance of the extended portion of a conforce spring.





Section A-A

CONFORCE CHART B

3,000 CYCLES | SINGLE COIL

b →		B 1/8	C 3/16	D 1/4	E 5/16	F 3/8	G 1/2	J 5/8	K 3/4
t	ID	P (Force)							
.001	.06	.11	.16	.21	Reference Only				
.0015	.09	.16	.24	.32					
.002	.12	.21	.32	.43	.53	.64			
.0025	.16	.27	.40	.53	.67	.80			
.003	.19	.32	.48	.64	.80	.96	1.28		
.0035	.22	.37	.56	.75	.93	1.12	1.49		
.004	.25	.43	.64	.86	1.07	1.28	1.71	2.14	2.56
.0045	.28	.48	.72	.96	1.20	1.44	1.92	2.40	2.88
.005	.32	.54	.80	1.07	1.33	1.60	2.13	2.66	3.20
.0055	.35		.88	1.17	1.47	1.76	2.34	2.93	3.51
.006	.38			1.28	1.60	1.92	2.56	3.20	3.84
.008	.51			1.71	2.13	2.56	3.41	4.26	5.12
.010	.64			2.13	2.66	3.20	4.26	5.33	6.39
.012	.77			2.56	3.20	3.84	5.12	6.39	7.67

CONFORCE CHART T

3,000 CYCLES | TWIN COIL

b →		A 1/16	B 1/8	C 3/16	D 1/4	E 5/16	F 3/8	G 1/2
t	ID	P (Force)						
.001	.06	.11	.21	.32	.43	Reference Only		
.0015	.09	.16	.32	.48	.64			
.002	.12	.21	.43	.64	.85	1.07	1.28	1.71
.0025	.16	.27	.53	.80	1.07	1.33	1.60	2.13
.003	.19		.64	.96	1.28	1.60	1.92	2.56
.0035	.22		.75	1.12	1.49	1.86	2.24	2.98
.004	.25			1.28	1.71	2.13	2.56	3.41
.0045	.28			1.44	1.92	2.40	2.88	3.84
.005	.32				2.13	2.66	3.20	4.26
.0055	.35				2.34	2.93	3.52	4.69
.006	.38				2.56	3.20	3.84	5.12
.008	.51				3.41	4.26	5.12	6.82

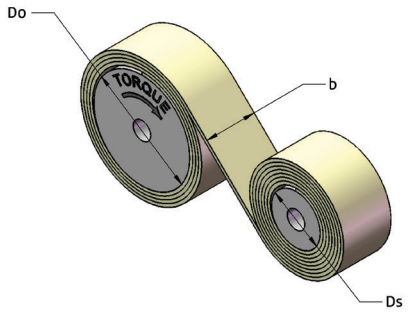
Variables:
t = material thickness (inches)
b = material width (inches)

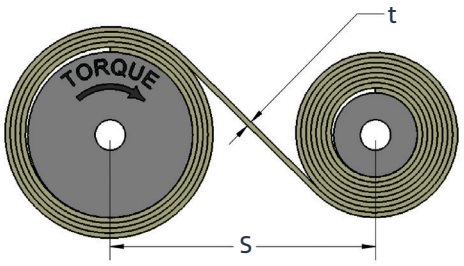
P = force (pounds)
ID = inside coil diameter (inches)

For Metric Design Charts, please download the ***Metric Unit Supplement***

Contorque® Springs

Contorque Springs offer high amounts of torque with small space requirements and can be designed to produce a constant torque or a positive or negative gradient output. These springs are ideal for a wide variety of uses where constant torque is needed.





Stock Constant Torque Springs

The below stock constant torque springs are available on our website. Specifications are subject to change.

Part #	Torque +/- 10%	Thickness (t)	Width (b)	Length	Output Turns	ID +/- 10%	Storage Drum (Ds)	Output Drum (Do)	Center to Center (s)	Inner End Detail*
SV3D48	0.18 in-lbs	0.003"	0.250"	48"	20	0.30"	0.35"	0.61"	0.65"	4
SV4D64	0.33 in-lbs	0.004"	0.250"	64"	20	0.41"	0.47"	0.81"	0.90"	4
SV6D96	0.75 in-lbs	0.006"	0.250"	96"	20	0.61"	0.70"	1.22"	1.30"	4
SV4G64	0.67 in-lbs	0.004"	0.500"	64"	20	0.41"	0.47"	0.81"	0.90"	5
SV6G96	1.50 in-lbs	0.006"	0.500"	96"	20	0.61"	0.70"	1.22"	1.30"	5
SV10G160	4.17 in-lbs	0.010"	0.500"	160"	20	1.01"	1.17"	2.02"	2.25"	5
SV12J192	7.50 in-lbs	0.012"	0.625"	192"	20	1.22"	1.40"	2.43"	2.60"	5

* See pages 14-15 for end detail dimensions

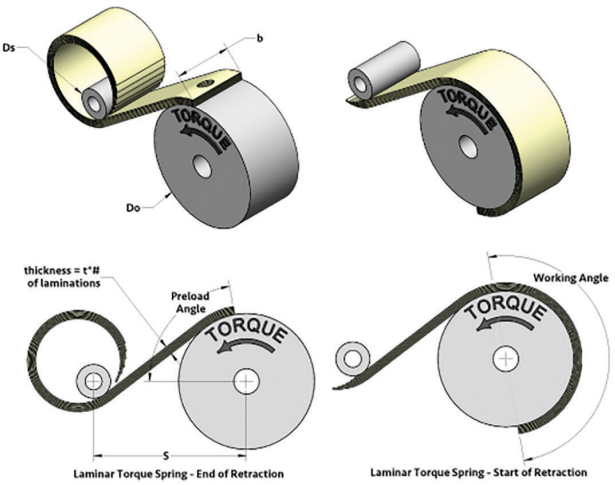
*For Metric Design Charts, please download the **Metric Unit Supplement***

Design Considerations

The below criteria will impact the design and performance of a contorque spring.

1. **Raw material** – Most of the flat steel springs we produce are made from Type 301 Stainless Steel. This material is readily available and offers predictable performance. Other materials include high carbon steel, Inconel, and Elgiloy.

2. **Life requirements** – The requirement must be realistic, since estimating a high life cycle can lead to a larger, more expensive part and underestimating the life requirement can lead to premature failure. The Design Guide has charts that range from 4,000 to 50,000 life cycles—these values are estimates of the actual performance, not guaranteed minimums. If a high life cycle is needed, considerations must be made for increased tolerances of the spring's diameter and torque due to the low stress level and slight variations in raw material.



Laminar Torque Spring - End of Retraction

Laminar Torque Spring - Start of Retraction

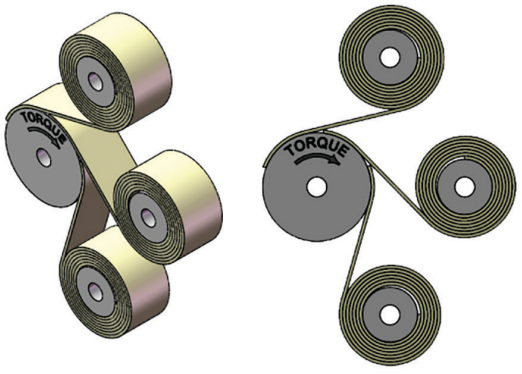
3. **Torque requirements** – The torque of the spring should be determined by the requirement of the application. Standard tolerance for the torque of constant torque spring is ± 10%.

4. **Available Space** – When reviewing the charts in the Design Guide, it will become obvious that there are several thickness and width combinations that can be used to create the same torque. The inside diameter (I.D.) of the spring is dependent on the thickness, life, and torque required. The outside diameter (O.D.) is dependent on the above variables and overall length.

5. **Mounting features** – The end detail will connect the spring to the output spool. Special end designs may be obtained for an additional charge.

6. **Environment** – Corrosive atmospheres or extreme temperatures will affect a spring's performance. Our engineers can assist in these situations which can often be addressed with alternate material choices.

Sample Application of a Contorque® Spring



Multiple Contorque® Motor Assembly

Contorque® Spring Design Chart

TYPE 301 STAINLESS STEEL

CHART V
SPRING LIFE
4,000 CYCLES

b →				C 3/16	D 1/4	E 5/16	F 3/8	G 1/2	J 5/8	K 3/4	P 1	R 1 1/4	S 1 1/2	U 2
t	ID	Ds	Do	T (Torque)										
.002	.20	.23	.41	.06	.08	.10	.13	.17						
.003	.30	.35	.61	.14	.19	.23	.28	.38	.47					
.004	.41	.47	.81	.25	.33	.42	.50	.67	.83	1.00				
.005	.51	.58	1.01	.39	.52	.65	.78	1.04	1.30	1.56	2.08			
.006	.61	.70	1.22		.75	.94	1.13	1.50	1.88	2.25	2.99	3.75		
.008	.81	.93	1.62			1.66	2.00	2.66	3.33	4.00	5.33	6.66	8.00	
.010	1.01	1.17	2.02				3.13	4.17	5.21	6.25	8.33	10.4	12.5	16.7
.012	1.22	1.40	2.43					6.00	7.50	9.00	12.0	15.0	18.0	24.0
.014	1.42	1.63	2.84						10.2	12.3	16.3	20.4	24.5	32.7
.016	1.62	1.86	3.24							16.0	21.3	26.7	32.0	42.7
.018	1.82	2.10	3.65								27.0	33.8	40.5	54.0
.020	2.03	2.33	4.05								33.3	41.7	50.0	66.7
.022	2.23	2.56	4.46									50.4	60.5	80.7
.025	2.53	2.91	5.07									65.1	78.1	104
.031	3.14	3.61	6.28										120	160

CHART W
SPRING LIFE
8,000 CYCLES

b →				C 3/16	D 1/4	E 5/16	F 3/8	G 1/2	J 5/8	K 3/4	P 1	R 1 1/4	S 1 1/2	U 2
t	ID	Ds	Do	T (Torque)										
.002	.26	.30	.52	.05	.07	.09	.11	.14						
.003	.39	.45	.79	.12	.16	.20	.24	.32	.40					
.004	.52	.60	1.05	.21	.28	.35	.42	.57	.71	.85				
.005	.66	.75	1.31	.33	.44	.55	.66	.88	1.10	1.33	1.77			
.006	.79	.90	1.57		.64	.79	.95	1.27	1.59	1.91	2.54	3.18		
.008	1.05	1.21	2.10			1.41	1.70	2.26	2.82	3.39	4.52	5.65	6.78	
.010	1.31	1.51	2.62				2.65	3.53	4.42	5.30	7.07	8.83	10.6	14.1
.012	1.57	1.81	3.14					5.09	6.36	7.63	10.2	12.7	15.3	20.4
.014	1.83	2.11	3.67						8.65	10.4	13.8	17.3	20.8	27.7
.016	2.10	2.41	4.19							13.6	18.1	22.6	27.1	36.2
.018	2.36	2.71	4.72								22.9	28.6	34.3	45.8
.020	2.62	3.01	5.24								28.3	35.3	42.4	56.5
.022	2.88	3.31	5.76									42.7	51.3	68.4
.025	3.28	3.77	6.55									55.2	66.3	88.3
.031	4.06	4.67	8.12										102	136

CHART X
SPRING LIFE
12,000 CYCLES

b →				C 3/16	D 1/4	E 5/16	F 3/8	G 1/2	J 5/8	K 3/4	P 1	R 1 1/4	S 1 1/2	U 2
t	ID	Ds	Do	T (Torque)										
.002	.31	.35	.62	.05	.06	.08	.09	.13						
.003	.46	.53	.92	.11	.14	.18	.21	.28	.36					
.004	.62	.71	1.23	.19	.25	.32	.38	.51	.63	.76				
.005	.77	.88	1.54	.30	.40	.49	.59	.79	.99	1.19	1.58			
.006	.92	1.06	1.85		.57	.71	.85	1.14	1.42	1.70	2.28	2.84		
.008	1.23	1.42	2.46			1.26	1.52	2.02	2.53	3.03	4.04	5.06	6.06	
.010	1.54	1.77	3.08				2.37	3.16	3.95	4.74	6.32	7.90	9.48	12.6
.012	1.85	2.12	3.69					4.55	5.69	6.82	9.10	11.4	13.7	18.2
.014	2.15	2.48	4.31						7.74	9.29	12.4	15.5	18.6	24.8
.016	2.46	2.83	4.92							12.1	16.2	20.2	24.3	32.4
.018	2.77	3.18	5.54								20.5	25.6	30.7	41.0
.020	3.08	3.54	6.15								25.3	31.6	37.9	50.6
.022	3.38	3.89	6.77									38.2	45.9	61.2
.025	3.85	4.42	7.69									49.4	59.3	79.0
.031	4.77	5.48	9.54										91.1	121

Variables:
t = material thickness (inches)
b = material width (inches)
T = torque (inch - pounds)

Do = output drum diameter (inches)
Ds = storage drum diameter (inches)
ID = inside coil diameter (inches)

For Metric Design Charts, please download the ***Metric Unit Supplement***

CHART Y
SPRING LIFE
25,000 CYCLES

b →				C 3/16	D 1/4	E 5/16	F 3/8	G 1/2	J 5/8	K 3/4	P 1	R 1 1/4	S 1 1/2	U 2
t	ID	Ds	Do	T (Torque)										
.002	.41	.47	.82	.04	.05	.06	.07	.10						
.003	.62	.71	1.23	.08	.11	.13	.16	.22	.27					
.004	.82	.95	1.64	.14	.19	.24	.29	.38	.48	.57				
.005	1.03	1.18	2.05	.22	.30	.37	.45	.60	.75	.90	1.20			
.006	1.23	1.42	2.47		.43	.54	.65	.86	1.08	1.29	1.72	2.15		
.008	1.64	1.89	3.29			.96	1.15	1.53	1.91	2.29	3.06	3.82	4.60	
.010	2.05	2.36	4.11				1.80	2.39	2.99	3.59	4.78	5.98	7.18	9.57
.012	2.47	2.84	4.93					3.44	4.30	5.17	6.88	8.61	10.3	13.8
.014	2.88	3.31	5.75						5.86	7.03	9.37	11.7	14.1	18.8
.016	3.29	3.78	6.58							9.19	12.2	15.3	18.4	24.5
.018	3.70	4.25	7.40								15.5	19.4	23.3	31.0
.020	4.11	4.73	8.22								19.1	23.9	28.7	38.3
.022	4.52	5.20	9.04									28.9	34.8	46.3
.025	5.14	5.91	10.3									37.4	44.9	59.8
.031	6.37	7.33	12.7										69.0	92.0

CHART Z
SPRING LIFE
50,000 CYCLES

b →				C 3/16	D 1/4	E 5/16	F 3/8	G 1/2	J 5/8	K 3/4	P 1	R 1 1/4	S 1 1/2	U 2
t	ID	Ds	Do	T (Torque)										
.002	.56	.64	1.12	.03	.04	.05	.06	.07						
.003	.84	.97	1.68	.06	.08	.10	.13	.17	.21					
.004	1.12	1.29	2.24	.11	.15	.19	.22	.30	.37	.45				
.005	1.40	1.61	2.80	.17	.23	.29	.35	.47	.58	.70	.93			
.006	1.68	1.93	3.36		.33	.42	.50	.67	.84	1.00	1.34	1.67		
.008	2.24	2.58	4.49			.74	.89	1.19	1.49	1.78	2.38	2.98	3.57	
.010	2.80	3.22	5.61				1.40	1.86	2.33	2.79	3.72	4.65	5.58	7.44
.012	3.36	3.87	6.73					2.67	3.35	4.02	5.35	6.70	8.04	10.7
.014	3.93	4.51	7.85						4.56	5.47	7.29	9.11	10.9	14.6
.016	4.49	5.16	8.97							7.14	9.52	11.9	14.3	19.0
.018	5.05	5.80	10.1								12.1	15.1	18.1	24.1
.020	5.61	6.45	11.2								14.9	18.6	22.3	29.8
.022	6.17	7.09	12.3									22.5	27.0	36.0
.025	7.01	8.06	14.0									29.1	34.9	46.5
.031	8.69	10.0	17.4										53.6	71.5

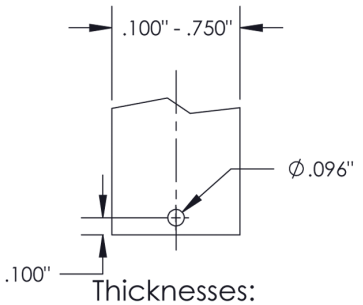
Variables:
t = material thickness (inches)
b = material width (inches)
T = torque (inch - pounds)

Do = output drum diameter (inches)
Ds = storage drum diameter (inches)
ID = inside coil diameter (inches)

For Metric Design Charts, please download the ***Metric Unit Supplement***

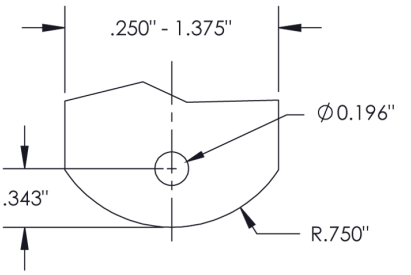
Commonly Used End Details

We have many standard dies to create spring end details. Commonly used end details are shown below. Special end designs can be made upon request.



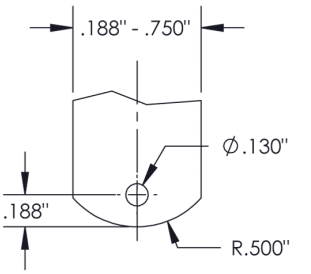
Thicknesses:
0.003" - 0.016"

1



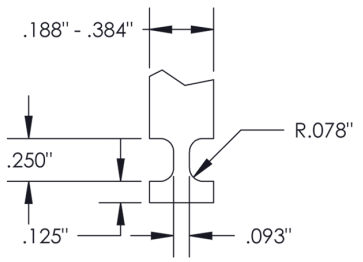
Thicknesses:
0.003" - 0.025"

2



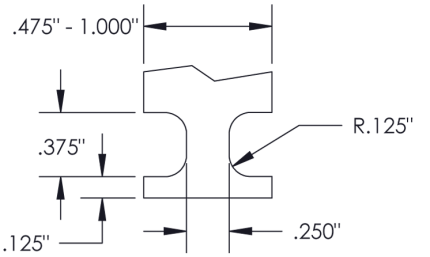
Thicknesses:
0.003" - 0.012"

3



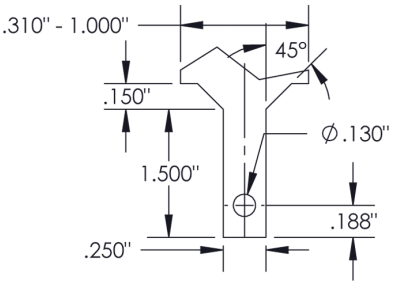
Thicknesses:
0.0025" - 0.010"

4



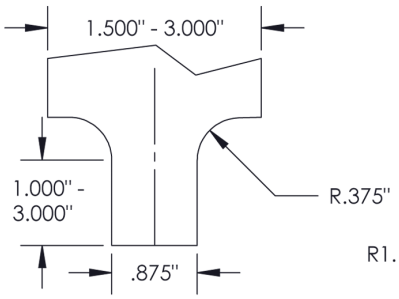
Thicknesses:
0.0025" - 0.014"

5



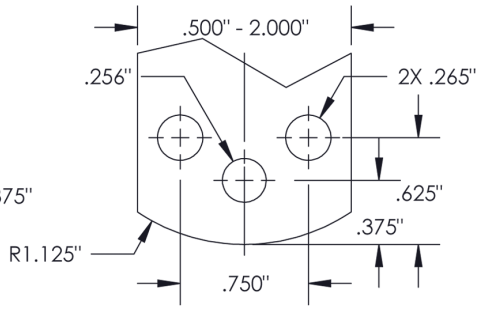
Thicknesses:
0.006" - 0.010"

6



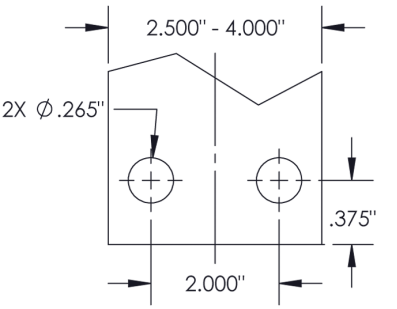
Thicknesses:
0.016" - 0.020"

7



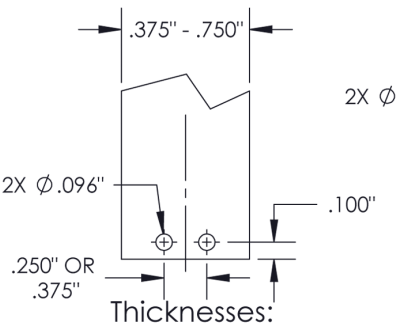
Thicknesses:
0.012" - 0.031"

8



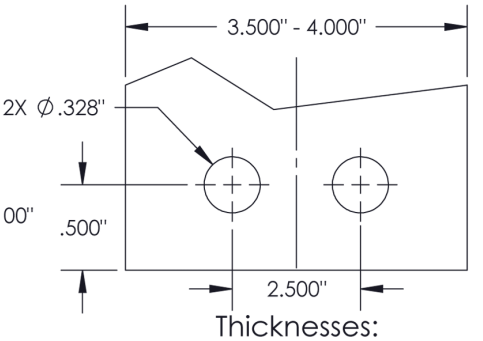
Thicknesses:
0.025" - 0.031"

9



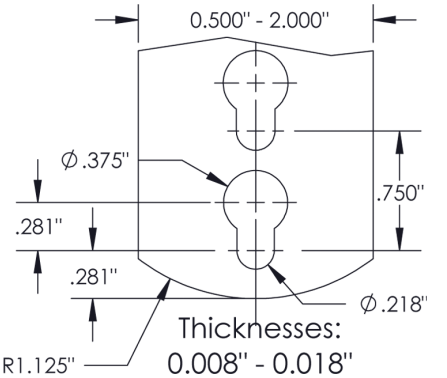
Thicknesses:
0.003" - 0.014"

10



Thicknesses:
0.025" - 0.031"

11



Thicknesses:
0.008" - 0.018"

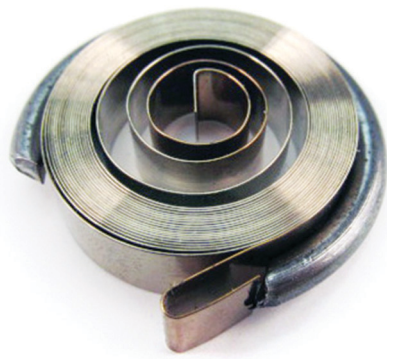
12

For Metric Design Charts, please download the ***Metric Unit Supplement***

Education is Empowerment

At Vulcan Spring, we do more than design and manufacture high-quality spring solutions. We take the time to make sure each client understands how our springs are intended to work so optimal performance can lead them to greater success.

We also recognize the importance of supporting young innovators to create a brighter future. The "For Inspiration and Recognition of Science and Technology" (FIRST) Robotics Competition is a world-leading nonprofit that advances STEM education for our youth. We support FIRST by working with tomorrow's engineers and entrepreneurs by encouraging careers in STEM. At the FIRST Robotics Competition, many awards are for how your team works together. At Vulcan, we share the same values, and we act as an extension of our clients' teams, all working towards the same goals.


Conpower® & Power Springs

Conpower and conventional power springs are used to create a compact power source. Torque is generated from either rotation of the center arbor or the spring housing. This torque increases throughout the working range. Their compact size makes power springs a desired solution for manufactures. Unlike conventional power springs, Conpower springs are pre-stressed to produce a flatter torque gradient.

Design Considerations

Design criteria for both types of power springs are the same. The decision to use a conventional power spring or Conpower spring is based on the application. Important considerations for designing and manufacturing power springs include:

1. **Arbor size**
2. **Inside diameter (I.D.) of case**
3. **Available case width**
4. **Turns required**
5. **Peak torque required**
6. **Life requirements**
7. **Environment**
8. **Mounting requirements for case and arbor**

Applications & Uses

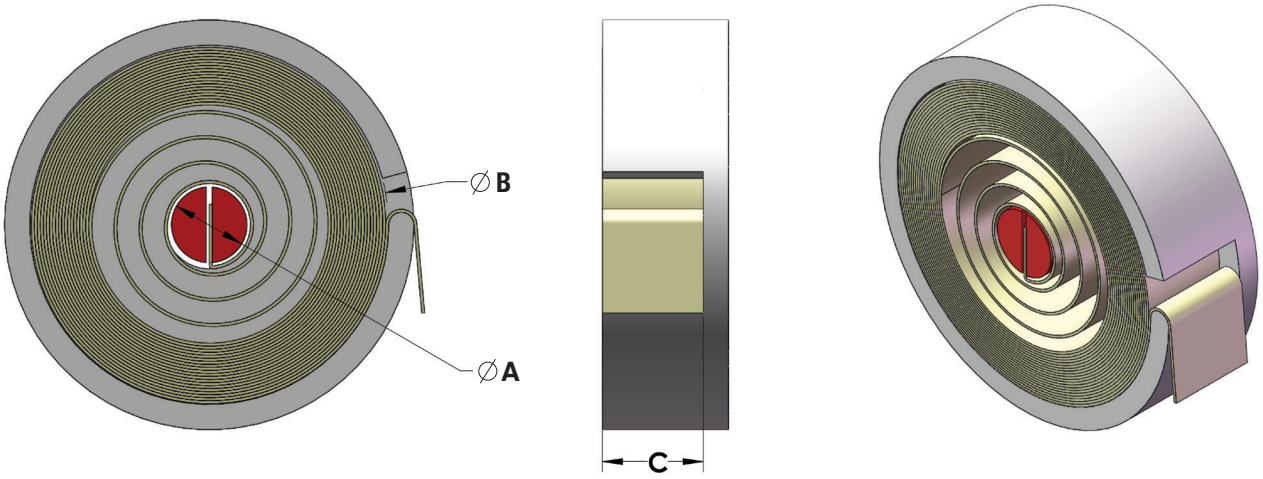
Conpower and power springs are ideal for a wide variety of uses where smooth returning and retrieving, counterbalancing, and tensioning are required. Products that use power springs may include cord retractors, counterbalances, wind-up toys and games, timers, and cable reels.

Stock Conpower & Power Springs

The below stock conpower and power springs are available on our website. Specifications are subject to change.

Part #	Type	Peak Torque (in-lbs)	Arbor Size (inches)	Number of Turns	Case I.D. (inches)	Width (inches)
SCP4G202VS	Conpower®	0.41	0.250	44.00	1.50	0.500
SCP7.5D50VS	Conpower®	0.73	0.250	11.50	1.00	0.250
SCP6G135VS	Conpower®	0.93	0.250	30.00	1.50	0.500
SCP8G108VS	Conpower®	1.65	0.250	22.00	1.50	0.500
SCP10G81VS	Conpower®	2.58	0.250	17.00	1.50	0.500
SCP18D162VS	Conpower®	4.20	0.625	14.00	2.80	0.250
SCP13G59VS	Conpower®	4.32	0.250	11.50	1.50	0.500
SPS16F77VS	Power	4.50	0.250	12.00	1.80	0.375
SPS20F65VS	Power	7.00	0.250	9.00	1.80	0.375
SCP18G198VS	Conpower®	8.30	0.625	16.50	3.00	0.500

*For Metric Design Charts, please download the **Metric Unit Supplement***



A = Arbor Diameter
B = Inside Diameter (I.D.) of case
C = Available Case Width

Other Products—Industrial Applications

Spiral Torsion Springs

Spiral torsion springs are produced from flat strip and are characterized by the symmetric spacing between coils. A spiral torsion spring will exert a torque on the arbor or housing, usually through 360° rotation or less. The torque curve of a spiral torsion spring scales linearly to the degree of rotation.

Truck Door Counterbalances

This specialty product counterbalances the weight of overhead truck doors, providing an easy-open and smooth closing of the door. Our counterbalances range in size from 29" to 85" and can serve doors weighing up to 85lbs. Counterbalances are available in standard sizes for most OEM or retrofit applications. Counterbalances feature zinc-plated tubes, rustproof bearings, integrated mounting points, and optional included cable.

PULLBOX Pro®

The Pullbox Pro works with motorized skylight shades in top-down, bottom-up, and horizontal applications. Made from 304 stainless steel and Kevlar cable, the Pullbox Pro was designed to provide a constant force profile through the extension and retraction of the shade.

Other Products—Retail Applications

PULLBOX®

The versatile and dependable PULLBOX® line of retractable tethers sets the standard for proven performance and customizable options. The retractable tethers are used most often for POP security, product positioning, product feeding, and signage support.

VS-1

An equally effective yet smaller solution for product positioning, the VS-1 can be mounted on the inside or outside of a display as a functional and aesthetic component of an effective POP presentation tool. The VS-1 is available in multiple colors to blend in with any display and can be mounted using double-sided tape or a screw for a 360° swivel.

MiniVS

The MiniVS is slightly larger than a quarter yet contains up to 36'' of nylon-coated steel cable. The wide cable slot allows for maximum design flexibility and easy recoil. The cable's ball end-fitting accommodates a wide range of available fasteners, increasing the tether's versatility and simplifying installation.

Variable Force Spring

Variable force springs deliver dependable force profiles to precisely match variable force requirements. Commonly used on POP shelf displays, the variable force spring can be customized to the specific product in question. These springs are engineered to push light products as well as very heavy packaged products, such as frozen foods, beverages, and personal hygiene items.

Plastic Scrolls

Plastic scrolls are printed with numbers, letters, or words to quickly communicate product information and messages to consumers. Plastic scrolls can be created in a variety of widths and lengths for attractive and informative display.

Our Certifications

ISO 9001:2015 Certification

Vulcan Spring is proud to be ISO 9001:2015 certified. Our certified processes ensure the precision design and manufacture of springs, spring assemblies, related parts, and miscellaneous commercial printing.

ISO 13485:2016 Certification

Vulcan Spring is proud to be a manufacturer of high-precision springs for active non-implantable and non-active medical devices.

Industries We Serve

Aerospace & Defense

Automotive & Transportation

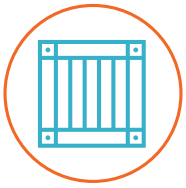
Industrial Applications

Medical Device & Healthcare

Firearms

Window & Window Shades

Point-of-Purchase & Retail Displays



Fire Dampers

Services

We utilize highly customized production equipment, lean manufacturing techniques, and ISO 9001 certified procedures to provide our customers with reliable, high quality products. Benefits of working with Vulcan Spring include reduced lead times, robust quality control, and competitive costs.

Production Capabilities

- Laminating
- Assembly onto spools
- Riveting
- Spot welding
- Coiling pre-printed material
- Stampings
- Automatic production controls and equipment
- Complete tooling manufacturing facilities
- Prototyping

Part Identification

- Color coding
- Die stamping
- Laser etching
- Special packaging

Surface Coatings

- Vinyl adhesives
- Food-grade silicone coating
- Dry film lubricant
- Oil coating

Reasons to Work With Us

We're Your Preferred Supplier of Custom Springs from Design to Production

We're the preferred global supplier of custom springs, recognized for our superior capabilities from design through mass production. With innovative machinery, tooling, and engineers, we can deliver a spring solution for even the most challenging applications. For industrial or POP displays and beyond, we're equipped for the timely production of millions of high-quality springs, all while promising to make your experience from concept to production as easy as possible.

We Provide a Better & Faster Way to Mass Produce Consistent, Quality Springs

We empower you to succeed by finding innovative solutions to your industrial or POP display spring challenges. We use a better and faster way to mass produce custom quality springs, recognizing that quality is the combination of precision and consistency. By bringing all the necessary tools and expertise in-house and advancing that expertise every day, we are confident that every order you place will meet or exceed your expectations.

Our Responsive & Helpful Customer Support Goes Beyond the Spring

We take customer support seriously with extreme responsiveness with fast and honest feedback, recognizing that it's our job to keep your team and project moving forward. Each member of our staff is an expert of our craft, seeing beyond the spring to its end application to provide insight and advice that ensures your order will be produced accurately and optimally. With us, you'll never have to question our commitment to you and your project's success.

About Vulcan Spring

Vulcan Spring is the preferred global supplier of mass-produced spring solutions, headquartered in Telford, Pennsylvania. With innovative machinery, tooling, and engineers, we can deliver a spring solution for even the most challenging applications. For industrial or POP displays and beyond, we're equipped for the timely production of millions of high-quality springs, all while promising to make your experience from concept to production as easy as possible.

Contact us with questions or for help with a custom need.
Our responsive and helpful team is standing by.

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