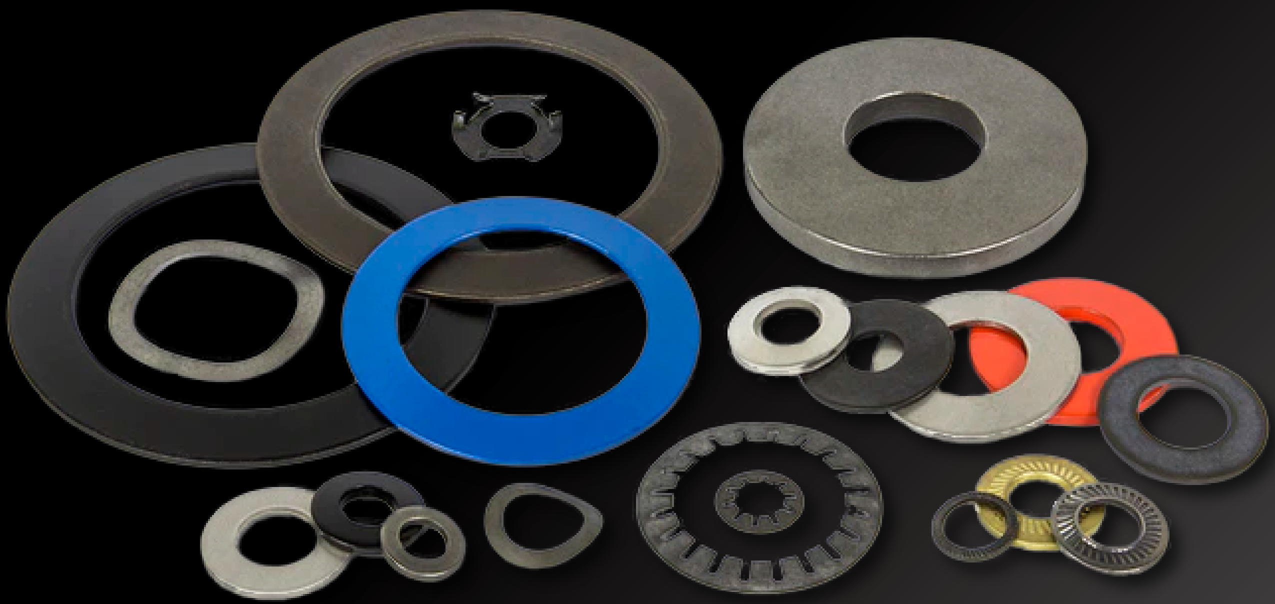
Precision Disc Springs

Maryland Precision Spring



- Hundreds of In-Stock Styles & Sizes
- Custom Sizes, Specialty Materials & Finishes
- Competitive Pricing & Lead Times
- In-House Engineering & Quality Control
- Prototyping, Low-Run & High-Volume Production
- ISO 9001 & AS9100D Certified
- Full Certifications, FAI, PPAP, RoHS & REACH Compliance

marylandprecisionspring.com

Maryland Precision Spring

Maryland Precision Spring is a full-service manufacturer of precision Belleville washers and disc springs, constant force springs, custom coiled springs, and stampings. Our facility is ISO 9001 and AS9100D certified, and offers state-of-the-art manufacturing, superior quality control systems, and experienced on-site engineering support, ensuring you get precisely the part you need. We also proudly offer prototyping, small-run service, and high-volume production capacity.

Table of Contents

MW Components

Corporate Headquarters

3426 Toringdon Way, Suite 100
Charlotte, NC 28277
Sales: 704.280.8875
General: 704.837.0331
sales@mwcomponents.com
mwcomponents.com

Introduction to Disc Springs

Disc Springs, also known as Belleville Washers and Belleville Springs, are washers with a slight cone shape, that deform to a shorter height when subjected to a load along their axis of symmetry. This elastic deformation characterizes the spring action.

Maryland Precision Spring disc spring fabrication is subject to exacting manufacturing and quality control standards. Materials used are generally in the annealed condition and hardened to within a range of HRC 40-52 depending on the material thickness. When required, disc springs are preset so that they will not significantly relax under load over time.

Disc springs can be a good design solution where the load required is high and the space available is limited. They can be tailored to provide loading profiles that are not feasible with coiled springs. Disc springs are used singly or in stacks to achieve a desired load and travel. Our disc springs are commonly used in high temperature/extreme pressure applications, pipe flange applications, bolted joint applications, heavy and light bolting applications, dynamic applications, and bearing preloaded washer applications.

Disc Springs

MW Components offers an extensive listing of catalog parts that have been designed to perform in specific situations. Our disc spring series catalog includes:

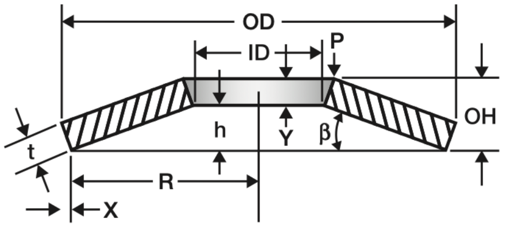
- **AM Disc Springs**
  precision steel Belleville disc springs designed for dynamic loading
- **AI Disc Springs**
  steel Belleville disc springs for light bolted assemblies, sized for standard bolt sizes
- **Serrated Disc Springs**
  serrated element ideal for use with most any screw or bolt
- **Contact Disc Springs**
  for improved bolt connection applications, compensates for developed looseness, loss of bolt tension due to applied surface deterioration, or movement due to thermal changes
- **SP Series Disc Springs**
  for heavy bolted applications with a need to overcome thermal expansion and contraction, and stainless steel options for corrosion resistance
- **FL & MFL Series Flange Disc Springs**
  elastic mechanical elements designed primarily for pipe flange applications
- **NDS Series Flange Disc Springs**
  maintain tension and pressure around a flange especially under thermal variations or mechanical shock
- **Springs for Ball Bearings**
  specially designed to preload radial ball bearings
- **Custom Disc Springs**
  contact us if you need something and do not see it in the catalog

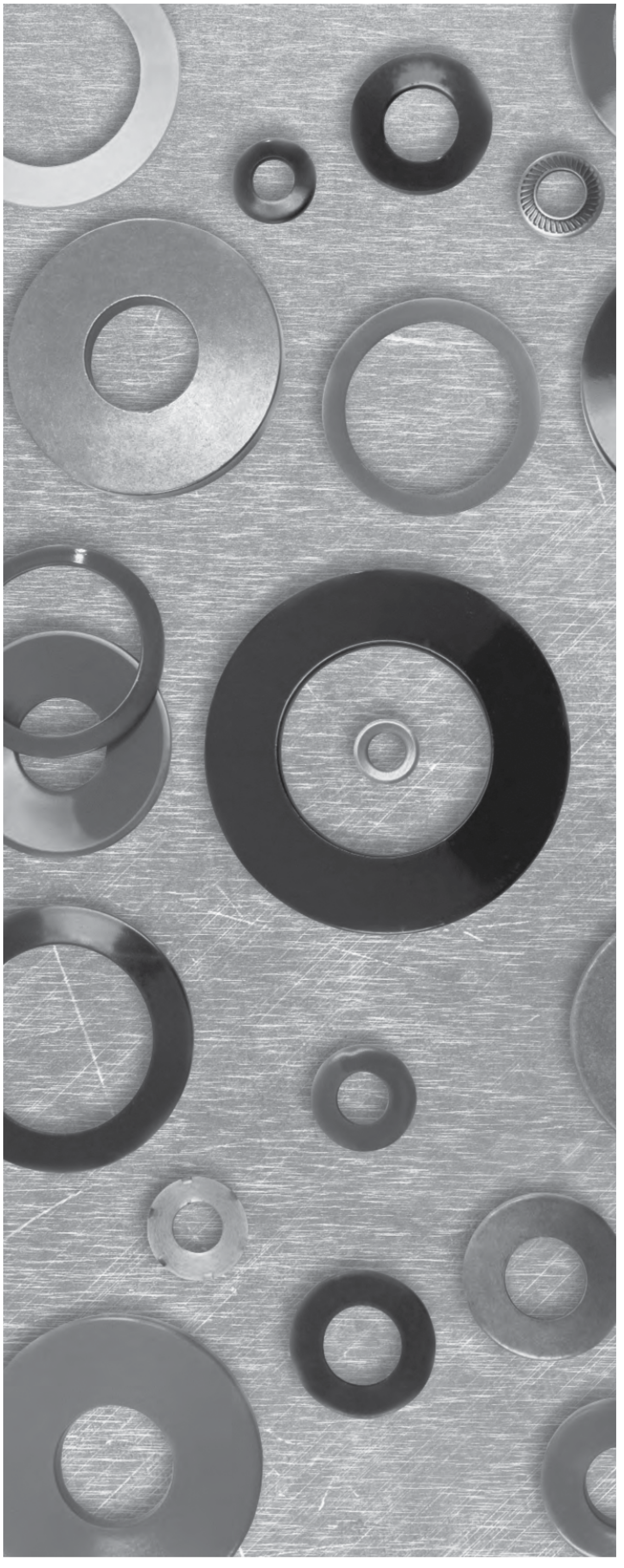
Materials

Maryland Precision Spring stocks Belleville disc springs made from C1075 high carbon steel or C6150 Alloy steel. These disc springs can be finished with a variety of different platings to provide additional corrosion resistance. Stainless steel springs are also available for environments where corrosion resistance is critical. Inconel™ or H13 alloy springs can be provided for high temperature applications. Other materials are available for special applications.

Engineering & Design Information

We use a proprietary design software program that enables our team of engineers to quickly design custom disc spring systems based on our customers' specific applications. Contact our disc spring team for additional information, including design assistance.





Disc Spring Load Calculations

When referring to Belleville disc spring design, certain abbreviations are helpful:

OD	=	Maximum outside diameter (upper surface)
ID	=	Minimum inside diameter (bottom surface)
h	=	Conical disc height (cone height)
OH	=	Overall height = t + h
t	=	Actual thickness of disc
β	=	Cone angle of disc
R	=	Radius from centerline to load bearing circle (bottom surface)
M	=	Ratio factor
μ	=	Poisson's ratio (.3 for steel)
E	=	Young's modulus (30,000,000 for steel)
f	=	Deflection of disc
α	=	Ratio of diameters (OD/ID)
P	=	Load in pounds at a given deflection
P_f	=	Load in pounds at flat
X	=	Sin β • t
Y	=	Cos β • t

Engineering & Design Information

Theoretical vs. Measured Characteristic of a Disc Spring

The shape of Belleville disc springs make accurately predicting their performance a challenge. The design information that follows offers good results for most parts that fit within the following parameters:

Ratio of diameters = OD/ID between 1.75 and 2.5

Ratio of cone height to thickness = h/t between 0.4 and 1.3

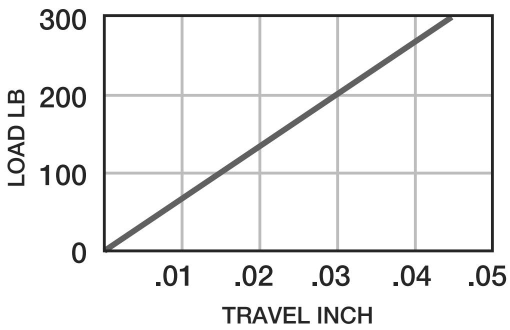
Ratio of diameter to thickness = D/t between 16 and 40

Belleville disc springs should be designed to work within the range of 20% to 80% of their total available deflection to avoid premature fatigue failure. For applications that require springs to operate outside of these parameters, please consult our disc spring design team.

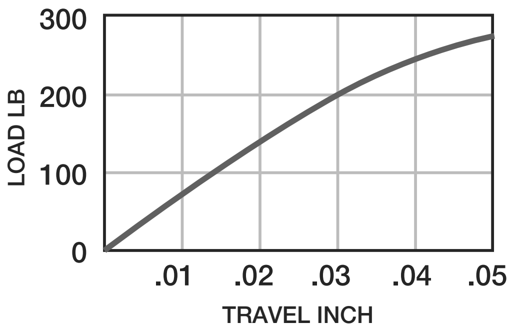
Special Cases of h/t

The shape of the load-deflection diagram for a Belleville disc spring depends on the ratio of the cone height (h) to the material thickness (t). This characteristic of disc springs can be used to optimize a spring system for special applications. When this ratio of h/t is small (up to 0.4) then the shape approximates a straight line. Several examples of shapes for specific values of h/t are shown below.

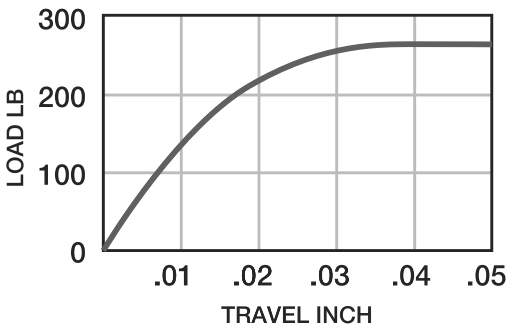
1. Approximate linear h/t ≤ 0.4



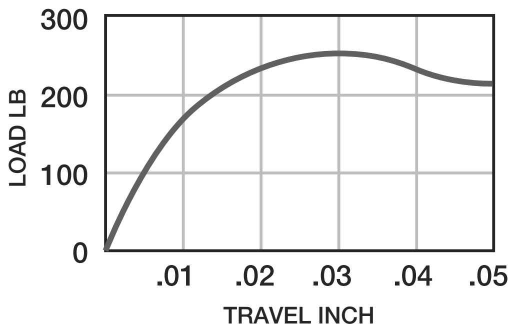
2. Regressive h/t ~ 1



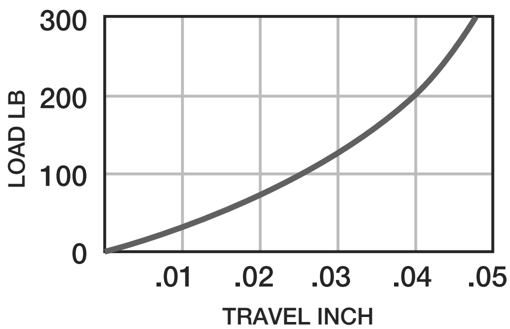
3. Constant load h/t = 1.4



4. Negative type h/t >1.4



5. Progressive



Engineering & Design Information

The load deflection formula was developed by J. Almen and A. Laszlo, and published in the Transactions of the American Society of Mechanical Engineers, May 1936, and is rendered as follows:

Load in pounds at a given deflection:

$$P = \frac{E \bullet f}{(1-\mu^2) \bullet M \bullet R^2} \bullet \left[\left(h-\frac{f}{2}\right) \bullet (h-f) \bullet t + t^3\right]$$

$$\text{WHERE } M = \frac{6}{\pi \bullet \ln \alpha} \bullet \frac{(\alpha-1)^2}{\alpha^2}$$

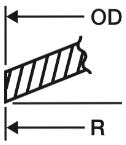
Disc Spring at Flat

In the flattened condition, the deflection (f) is equal to the conical height (h) and the equation becomes:

$$P_f = \frac{E \bullet h \bullet t^3}{(1-\mu^2) \bullet M \bullet R^2}$$

To calculate the load accurately, the following important factors must be considered:

Figure 2a



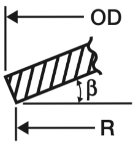


Figure 2b

If the disc spring is made as in Figure 2a, with edges machined to be parallel to the springs central axis, then R = OD/2. Most disc springs are made as in Figure 2b.

Therefore, the load-bearing radius is **not equal** to half of the maximum outside diameter. To calculate R, the angle β first has to be determined.

A well-designed disc spring has radii at all corners to reduce stress concentrations at the edges. A suitable radius is approximately = t/6. This radius further reduces dimension R (see Figure 3).

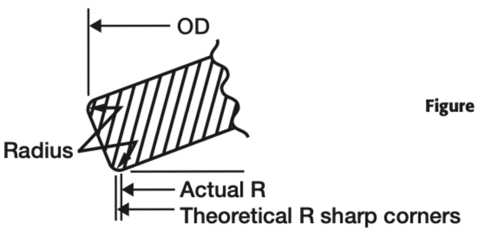


Figure 3

Typically, the overall height of the disc spring is specified because it is easy to measure and control. The cone height (h), on the other hand, is difficult to measure (see Figure 4).

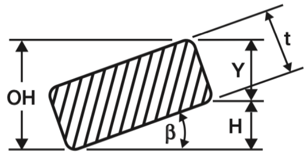


Figure 4

For an approximate calculation, (h = overall height – t) is acceptable. However, this is not accurate. In fact, h = (overall height – Y), where Y = Cos β • t. For small thicknesses (under 2 mm), this is not significant. With thicker disc springs, this becomes a major factor for accurate load and stress calculations. This has not been adequately considered in previous technical literature.

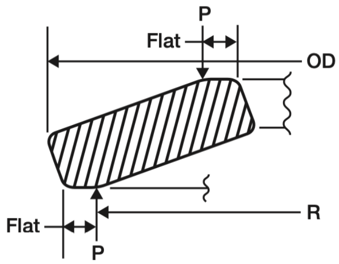


Figure 5

Disc springs that are 8 mm and thicker are made with a bearing flat at upper ID and lower OD as standard (see Figure 5). This bearing flat assures more uniform loading and better alignment of the disc spring stack. The flat is equal to approximately OD/150. For load calculations, R must be calculated to the inner edge of the flat.

Summary

Precise load and stress calculations require the determination of the disc spring angle (β). Since this is not easily determined by physical measurement, we have developed a computer program that calculates the precise angle and arrives at the exact dimension for conical height (h). This exact dimension then determines accurate load and stress calculation. When designing custom disc springs, please consult our disc spring team to accurately evaluate the resultant load and stress.

The load and stress formulas are correct only with the assumption that the spring will be worked within the elastic limit of the material.

Engineering & Design Information

Dynamic Loading & Fatigue Life

Fatigue life for disc springs is defined by the effective number of stress cycles that can be sustained under certain conditions, prior to failure. This depends on the minimum stress, maximum stress, and stress range.

The fatigue life for a particular Belleville disc spring design can be predicted by making the assumption that its load fluctuates smoothly over time from preload to final load (dynamic loading). This however, is not true in cases of impact loading and therefore, it is difficult to predict life and behavior when springs are impact loaded.

Disc spring fatigue life may be differentiated into two categories:

1) **Limited life:** cycles without failure, between 40,000 and 2,000,000 cycles.
2) **Unlimited life**: cycles in excess of 2,000,000 cycles without failure.

The table below can be used to guide design of Belleville disc springs for “unlimited life”.

Preload in % of h	Max. Deflection in % of h Disc Thickness ≤ .039"	Max. Deflection in % of h Disc Thickness ≥ .157"
15	50	44
25	56	49
50	67	64

The diagrams presented here are for forecasting fatigue life of single disc springs or series stacks of no more than six disc springs. There are three groups, based on thickness (see legend with each diagram). The horizontal axis represents “preload stress”. The vertical axis represents “final stress”.

The fatigue life is found at the intersection of these points on the graph. The “zone” in which they fall tells the predicted life. If they fall outside the zones, their life is generally not predictable.

The horizontal borderline enclosing the top portion of the graph zone represents the yield strength of the spring steel material.

Intersection points of minimum/maximum stress limits which fall outside the graph zone boundaries are to be avoided as they indicate spring failure will be likely at an early stage.

The graphs were developed based on empirical test data. How to use the graphs:

1) For standard catalog disc springs:
   a) Determine the preload stress
   b) Determine the final load stress

The intersection of the stress coordinates will indicate the range of fatigue life that may be expected.

2) For non-standard or custom disc springs:
   a) Determine the preload stress from the formula on page 16 for points S2 and S3. Use the HIGHER of the two values for preload and final load.
   b) Repeat above procedure for the “final stress” again, using the higher value found.

Example using AM Series Disc Spring

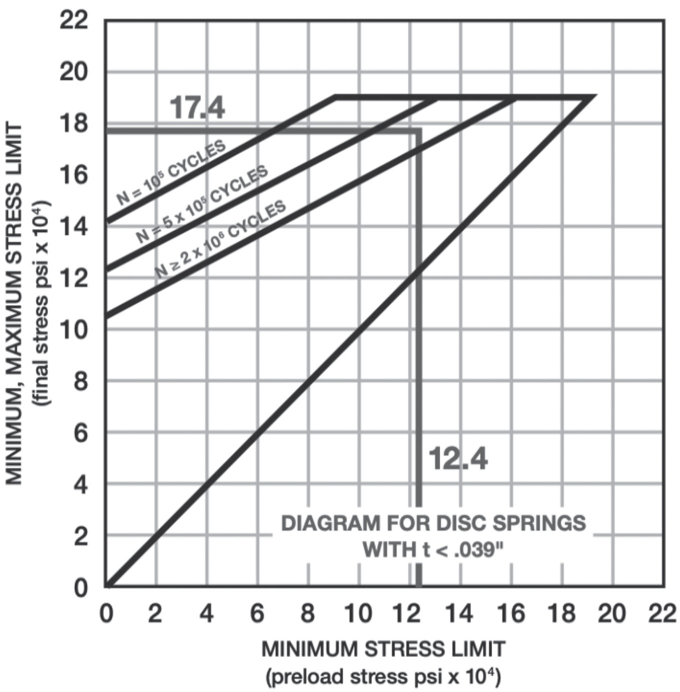
AM-188207: .709 x .323 x .0276 (see page 16)

Preload stress at deflection f = .5h : 124,000 psi

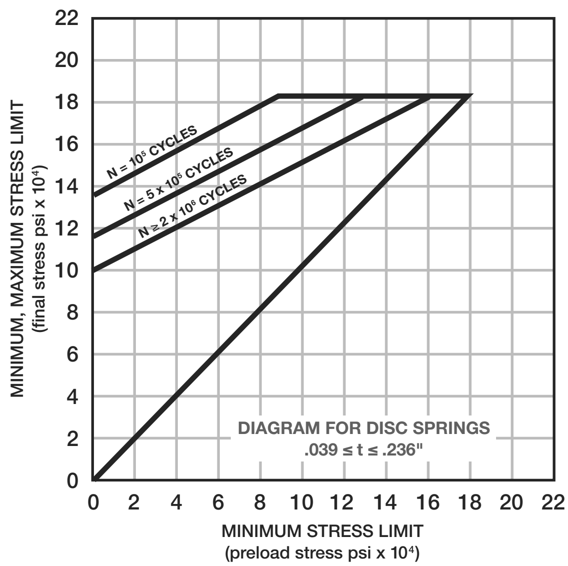
Final load stress at deflection f = .75h : 174,000 psi

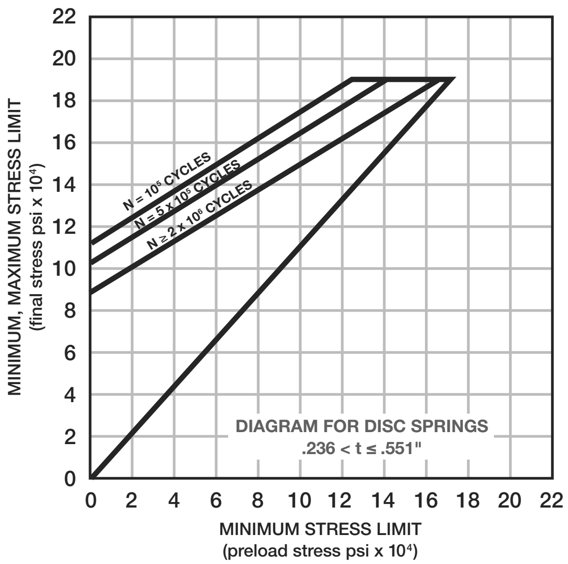
Intersection point between nearby 2 x 104 cycles and 5 x 104 cycles

Predicted cycles: 20,000 cycles



Engineering & Design Information





Disc Spring Stress Calculations

$$S1 = \frac{E \bullet f}{(1-\mu^2) \bullet M \bullet (R)^2} \bullet \left[C_1 \bullet \left(h - \frac{f}{2}\right) + C_2 \bullet t\right]$$

$$S2 = \frac{E \bullet f}{(1-\mu^2) \bullet M \bullet (R)^2} \bullet \left[C_1 \bullet \left(h - \frac{f}{2}\right) - C_2 \bullet t\right]$$

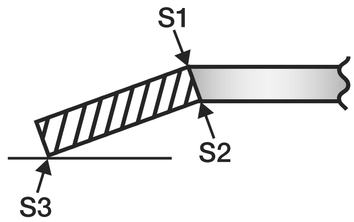
$$S3 = \frac{E \bullet f}{(1-\mu^2) \bullet (R)^2} \bullet \left[T_1 \bullet \left(h - \frac{f}{2}\right) + T_2 \bullet t\right]$$

Where M, C1, C2 are from Table 1. E and μ from material tables.

$$T1 = \frac{(\alpha \bullet L_n(\alpha)) - (\alpha-1)}{L_n(\alpha)} \bullet \frac{\alpha}{(\alpha-1)^2}$$

$$T2 = \frac{(.5) \bullet \alpha}{\alpha-1}$$

α = D/d and Ln = natural logarithm, stress as given is psi

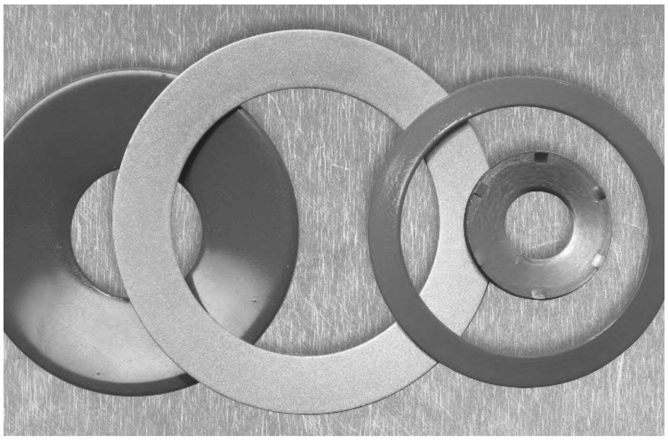


For evaluation of compressive stress, use formula S1. It computes the compressive stress at the upper inner diameter. This compressive stress may be as high as 400,000 psi for certain bolted applications.

For dynamic applications, it is necessary to consider the tensile stresses at the points marked S2 and S3. The stresses at these points depend on the ratio of diameters (α) and the spring characteristic (C) as well as on the deflection (f). This stress should not exceed 200,000 psi at .75h deflection.

OD and ID Guide Clearances

Disc spring diameters change when the springs are loaded. It is necessary to take this into account when specifying clearances between springs and bolts or guide rods operating in the ID of the spring, or between springs and cavity walls when operating in holes. The chart gives recommended minimum guide clearances.



Contact us: marylandprecisionspring.com or email info@marylandprecisionspring.com

Engineering & Design Information

Table 1

Values for M, C_1, C_2

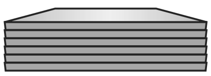
α OD/ID	M	C_1	C2
1.10	.166	.986	1.002
1.15	.232	1.001	1.025
1.20	.291	1.016	1.048
1.25	.342	1.030	1.070
1.30	.388	1.044	1.092
1.35	.428	1.058	1.114
1.40	.463	1.072	1.135
1.45	.495	1.085	1.157
1.50	.523	1.098	1.178
1.60	.571	1.124	1.219
1.70	.610	1.149	1.260
1.80	.642	1.173	1.300
1.90	.668	1.197	1.339
2.00	.680	1.220	1.378
2.10	.706	1.242	1.416
2.20	.721	1.264	1.453
2.30	.733	1.286	1.490
2.40	.742	1.307	1.527
2.50	.750	1.328	1.563
2.60	.757	1.348	1.599
2.80	.767	1.388	1.669
3.00	.773	1.426	1.738
3.20	.776	1.464	1.806
3.40	.778	1.500	1.873
3.60	.778	1.535	1.938
3.80	.777	1.570	2.003
4.00	.775	1.604	2.067

OD or ID (MM)		OD or ID (Inch)		CLEARANCE	
				MM	Inch
Up to 16		0.63		0.18	0.008
Over 16	Up to 20	0.64	0.79	0.27	0.012
Over 20	Up to 26	0.80	1.02	0.36	0.016
Over 26	Up to 31.5	1.03	1.24	0.45	0.020
Over 31.5	Up to 50	1.25	1.97	0.54	0.024
Over 50	Up to 80	1.98	3.14	0.69	0.031
Over 80	Up to 140	3.15	5.52	0.87	0.039
Over 140	Up to 250	5.53	9.85	1.41	0.063

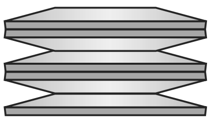
Engineering & Design Information

Disc Spring Stacks

Disc springs may be used singly or in stacks (parallel stack, series stack, or a combination of both parallel and series stacks).

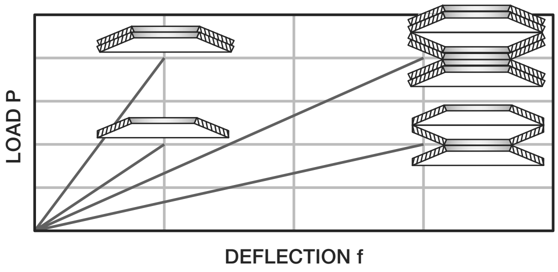


Stacked in Parallel
TOTAL DEFLECTION = deflection of 1 disc
TOTAL LOAD = load on 1 disc x quantity of discs in stack



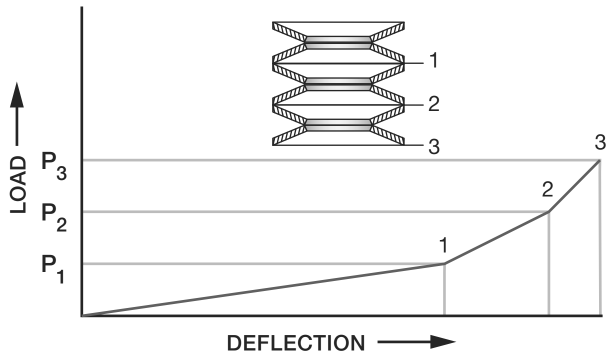
Series
TOTAL DEFLECTION = deflection of 1 disc x quantity of discs in stack
TOTAL LOAD = load on 1 disc

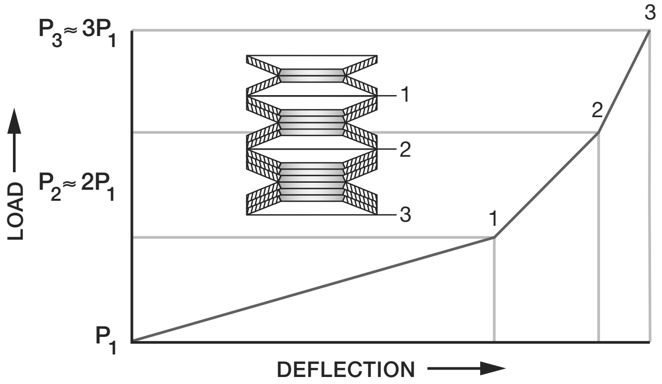
Parallel Series
Combinations of both series stacks and parallel stacks can be designed to accommodate virtually any load or deflection, and to obtain progressive or regressive characteristics.



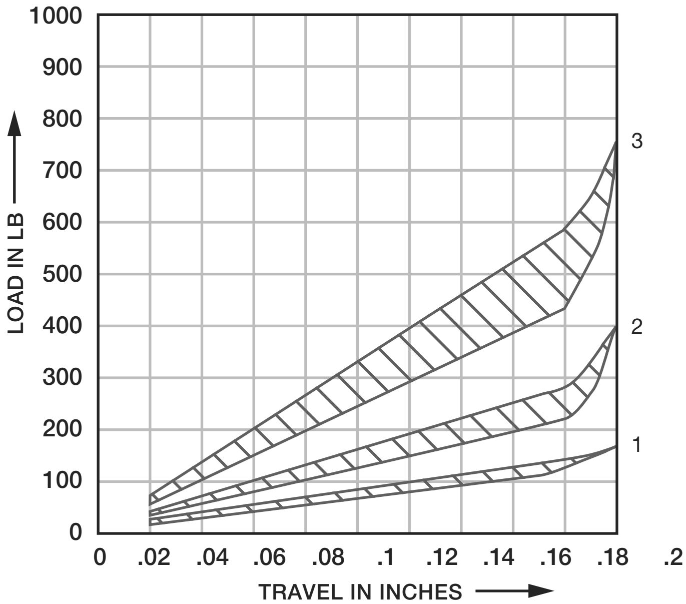
Disc Spring Damping (Hysteresis)

In disc spring stacks, particularly those with parallel units, friction must be considered. Sliding friction occurs at the disc spring's adjoining, moving surfaces (radial walls). As a result, the spring force increases on loading and decreases on unloading, causing a damping effect (hysteresis). This characteristic may be taken advantage of in shock loaded or vibrating systems that need damping. The hysteresis effect is a function of the number of disc springs in parallel.





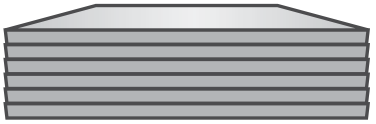
Disc springs of differing thickness can be stacked in series to obtain a progressively rising load. This effect is also obtained using same thickness springs, but incrementally increasing the units in the stack. Care must be taken not to over-stress the spring in the stack.



Note: Friction forces between springs must be considered.

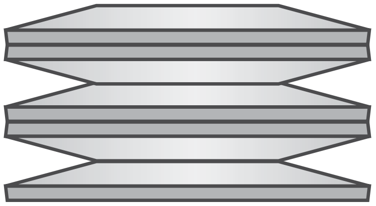
Engineering & Design Information

Recommendations Based on Stack Limitations



Parallel Stack Limitations

- When parallel stacking in dynamic applications, no more than three disc springs should be stacked in succession. This prevents overheating due to excessive friction.
- Use lubrication if possible.



Series Stack Limitations

- In series stacks, the total length should be less than three times the OD and under ten. This can be mitigated by adding flat washers to divide the stack into smaller ones.
- Uneven loading within the stack can cause premature fatigue and subsequent failures.

Design Support

Our team of product and application-focused engineering experts are readily available to support your custom design needs. We offer in-house design tools, 3D modeling, and a variety of testing, including load and performance testing.

Other Services We Offer

Value-Added Services Aid in Installation & Performance

Maryland Precision Spring offers a variety of additional value-added services to ensure quality parts and easy installation. For example, we offer pre-stacked assemblies through automation and manual stacking, which allow for quick installation and efficient production. Assemblies are often shrink wrapped or zip tied together and may be lubricated to minimize friction, marked or wrapped for color identification, or kitted with special packaging to ensure secure transit.

Below is a full list of our most requested value-added services. Contact us with any questions about these or other services that may be needed.

In-House Testing

- Load at deflation
- Load at height
- Load at flat
- Cycle testing
- 100% load testing
- 100% dimensional testing

Specialty Packaging

- Pre-stacking & kitting
- Bulk pack
- Bubble wrap
- Cardboard dividers
- VCI bagging for corrosion resistance
- Custom crating
- Humidity indicators
- Fumigated wood for international shipments
- Other specialty kitting or packaging

Identification Marking

- Color coding
- Ink stamping
- Laser engraving
- Bag and tagging (wire tagging with part number)

Belleville Disc Spring Installation Guide

Materials & Plating

Material Recommendations

Operating Temperature

- Ambient temperatures: spring steel is recommended
- -428/572 °F: 17-7 PH SS or H13
- Up to 1300 °F: Inconel

Environment

- Marine applications: 316 SS
- Chloride or fluoride applications: 17-7 PH SS is NOT recommended
- Sour gas: NACE Inconel 718

Plating Considerations

Carbon steel

- Phosphate extends shelf life and reduces friction.
- Zinc offers 96 hours to red rust.
- Dacromet® offers up to 1000 hours to red rust.

Stainless steels

- Passivation cleans the surface of finished parts so that a pure oxide layer can form.
- Nickel plating reduces wear and increases corrosion resistance.

Ways to reduce friction

- Dry film lubrication
- High-temperature grease

To extend cycle-life, consider shot peening

Belleville Disc Spring Installation Guide

Expected Load Deviations

For applications with <25% deflection

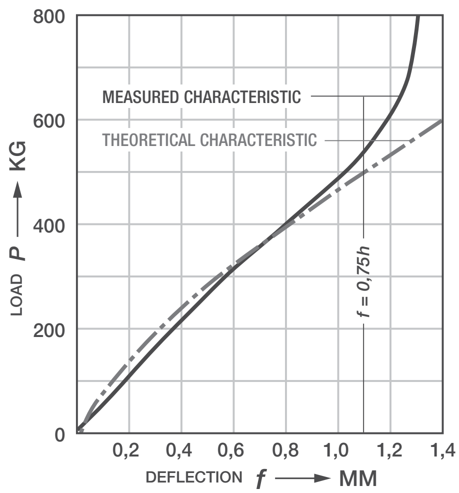
- Spring edges may not remain flat or may roll.
- Expect lower loads than calculated.

For applications with >75% deflection

- The spring may begin to flatten or "bottom out."
- Expect higher loads than calculated.

Graph for AM-502520

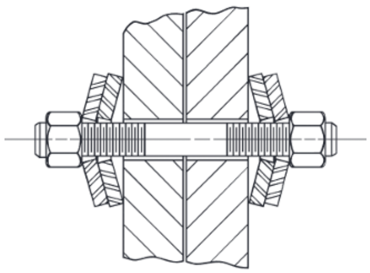
(50 mm x 25.4 x 2.0 x 3.4 OH)



How to Minimize Wear

Guide Elements

- Minimum 55 HRC, .031" case depth, and MoS2 lube necessary.
- Use flat washer(s) to prevent high stress spots and dissipate load.
- Position the Belleville with the OD facing out or mating components to dissipate load.
- Install on opposite ends of the bolt.

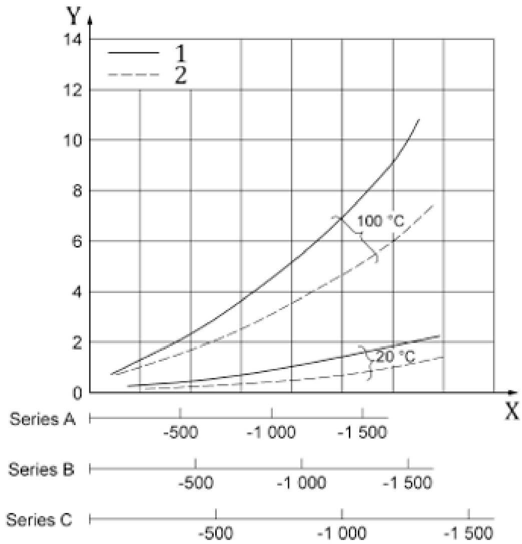


Creep & Relaxation

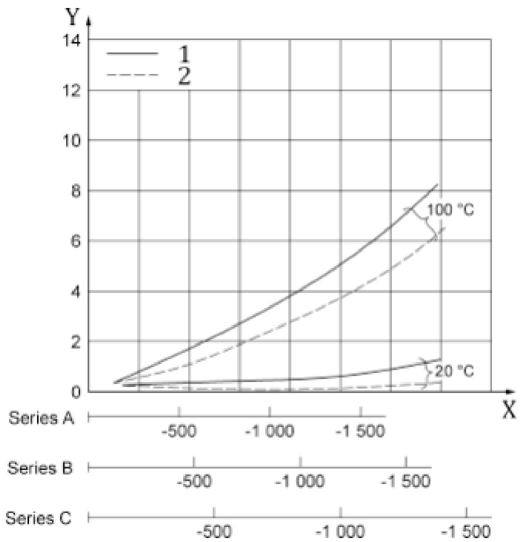
Relaxation or "creep" refers to a loss in load over time. The amount of relaxation is based on spring stresses, operating temperature, material, and the duration of the applied load. For recommendations specific to your application, contact our engineering department.

The graphs below depict creep over time with different materials.

1075 Steel



6150 Steel



Disc Spring Materials: Chemical/Physical Properties

Chemical Content in %

Material	C Carbon	Si Silicon	Mn Manganese	P Phosphorus	S Sulphur	Al Aluminum	Cr Chromium	Ni Nickel	V Vanadium	Fe Iron	Cu Copper	Ti Titanium	Mo Molybdenum	Co Cobalt	Columbium & Tantalum
C1075	.70 - .80	.15 - .30	.40 - .70	.03max	.035max	–	–	–	–	–	–	–	–		–
SAE6150	.48 - .53	.40max	.70 - .90	.035max	.040max	–	.80 - 1.10	–	.15 min	–	–	–	–		–
17/7 PH (ARMCO RG.T.M.)	≤ .09	≤ 1.0	≤ 1.0	–	–	.75 - 1.5	16.0 - 18.0	6.5 - 7.75	–		–	–	–		–
AISI 301	≤ .12	≤ 1.0	≤ 2.0	–	–	–	16.0 - 18.0	7.0 - 9.0	–	–	–	–	–		–
INCONEL X-750	.08	.5	1.0	–	.01	.7	15.5	70.0	–	7.0	.5	2.5	–	1.0	.95
INCONEL 718	.08	.35	.35	.015	.015	.6	19.0	52.5	–	17.0	.3	.9	3.05	1.0	5.125
AISI H-13 ASTM A681	.32 - .45	.8 - 1.2	.2 - .5	.03	.03	–	4.75 - 5.5	–	.8 - 1.2	–	–	–	1.1 - 1.75	–	–

Mechanical Properties Of Disc Springs After Heat Treatment

Material	Tensile Strength KSI	E-Modulus (70° F) PSI	Poisson's Ratio μ	Temperature Range ° F
C1075	200-240.000	30 x 10^6	.30	300
SAE6150	200-240.000	30 x 10^6	.30	400
17/7 PH (ARMCO RG.T.M.)	170-220.000	29 x 10^6	.28	- 428/572
AISI 301	170-220.000	28 x 10^6	.29	- 330/392
INCONEL X-750	Consult our Engineering Dept.	31 x 10^6	.29	to 1200
INCONEL 718	Consult our Engineering Dept.	29.8 x 10^6	.29	to 1300
INCONEL 625	Consult our Engineering Dept.	30 x 10^6	.30	to 1000
MONEL K500	Consult our Engineering Dept.	26 x 10^6	.30	to 1000

Hardness Ranges Of Stainless 301/302 (Not Hardenable — Work Hardened Only)

1/4 Hard TS-125,000 psi min or Rc-25 min	1/2 Hard TS-150,000 psi min or Rc-30 min	3/4 Hard TS-175,000 psi min or Rc-35 min	Full Hard TS-185,000 psi min or Rc-40 min

Load Change (Decrease) (ΔP) vs. Temperature

Material	70°F	400°F		575°F		750°F		850°F	
	E psi•10^6	E psi•10^6	ΔP %	E psi•10^6	ΔP %	E psi•10^6	ΔP %	E psi•10^6	ΔP %
SAE 6150	30	28.5	5	27.5	8.3	–	–	–	–
AISI 301	28	24.9	9.8	–	–	–	–	–	–
17/7 PH	2.9	24.4	6.2	23.2	10.8	–	–	–	–

Temperature Range	70°F	250°F		500°F		1000°F		1200°F	
	E	E	%ΔP	E	%ΔP	E	%ΔP	E	%ΔP
Inconel X-750	psi•10^6	psi•10^6	–	psi•10^6	–	psi•10^6	–	psi•10^6	–
	31	30.8	.6	28.7	7.4	25	19.4	23	25.8

Note: Designation of all stainless disc springs are suffixed with "S". In all cases customer **must specify type of stainless required** by giving identification following the part no. e.g., 17/7 PH or 301, etc.

Suggested Tightening Torque Values to Produce Corresponding Bolt Clamping Loads

Size	Bolt Diam. D (in.)	Tensile Stress Area A (sq. in.)	SAE GRADE 2 BOLTS Tensile Strength (min. psi)	Proof Load (psi)	Clamp[2] Load P (lb.)	Tightening Torque Dry K=0.20	Tightening Torque Lub. K=0.15	SAE GRADE 5 BOLTS Tensile Strength (min. psi)	Proof Load (psi)	Clamp[2] Load P (lb.)	Tightening Torque Dry K=0.20	Tightening Torque Lub. K=0.15	SAE GRADE 7[3] Clamp[2] Load P (lb.)	Tightening Torque Dry K=0.20	Tightening Torque Lub. K=0.15	SAE GRADE 8[4] Clamp[2] Load P (lb.)	Tightening Torque Dry K=0.20	Tightening Torque Lub. K=0.15
						lb. in.	lb. in.				lb. in.	lb. in.		lb. in.	lb. in.		lb. in.	lb. in.
4–40	0.1120	0.00604	74.000	55.000	240	5	4	120.000	85.000	380	8	6	480	11	8	540	12	9
4–48	0.1120	0.00661			280	6	5			420	9	7	520	12	9	600	13	10
6–32	0.1380	0.00909			380	10	8			580	16	12	720	20	15	820	23	17
6–40	0.1380	0.01015			420	12	9			640	18	13	800	22	17	920	25	19
6–32	0.1640	0.01400			580	19	14			900	30	22	1100	36	27	1260	41	31
8–36	0.1640	0.01474			600	20	15			940	31	23	1160	38	29	1320	43	32
10–24	0.1900	0.01750			720	27	21			1120	43	32	1380	52	39	1580	60	45
10–32	0.1900	0.02000			820	31	23			1285	49	36	1580	60	45	1800	68	51
1/4-20	0.2500	0.0318			1320	66	49			2020	96	75	2500	120	96	2860	144	106
1/4-28	0.2500	0.0364			1500	76	56			2320	120	86	2860	144	108	3280	168	120
						lb. ft.	lb. ft.				lb. ft.	lb. ft.		lb. ft.	lb. ft.		lb. ft.	lb. ft.
5/16-18	0.3125	0.0524			2160	11	8			3340	17	13	4120	21	16	4720	25	18
5/16-24	0.3125	0.0580			2400	12	9			3700	19	14	4560	24	18	5220	25	20
3/8-16	0.3750	0.0775			3200	20	15			4940	30	23	6100	40	30	7000	45	35
3/8-24	0.3750	0.0878			3620	23	17			5600	35	25	6900	45	30	7900	50	35
7/16-14	0.4375	0.1063			4380	30	24			6800	50	35	8400	60	45	9550	70	55
7/16-20	0.4375	0.1187			4900	35	25			7550	55	40	9350	70	50	10700	80	60
1/2-13	0.5000	0.1419			5840	50	35			9050	75	55	11200	95	70	12750	110	80
1/2-20	0.5000	0.1599			6600	55	40			10700	90	65	12600	100	80	14400	120	90
9/16-12	0.5625	0.1820			7500	70	55			11600	110	80	14350	135	100	16400	150	110
9/16-18	0.5625	0.2030			8400	80	60			12950	120	90	16000	150	110	18250	170	130
5/8-11	0.6250	0.2260			9300	100	75			14400	150	110	17800	190	140	20350	220	170
5/8-18	0.6250	0.2560			10600	110	85			16300	170	130	20150	210	160	23000	240	180
3/4-10	0.7500	0.3340			13800	175	130			21300	260	200	26300	320	240	30100	380	280
3/4-16	0.7500	0.3730			15400	195	145			23800	300	220	29400	360	280	33600	420	320
7/8-9	0.8750	0.4620	60.000	33.000	11400	165	125			29400	430	320	36400	520	400	41600	600	460
7/8-14	0.8750	0.5090			12600	185	140			32400	470	350	40100	580	440	45800	660	500
1- 8	1.0000	0.6060			15000	250	190			38600	640	480	47700	800	600	54500	900	680
1-12	1.0000	0.6630			16400	270	200			42200	700	530	52200	860	660	59700	1000	740
1 1/8-7	1.1250	0.7630			18900	350	270	105.000	74.000	42300	800	600	60100	1120	840	68700	1280	960
1 1/8-12	1.1250	0.8560			21200	400	300			47500	880	660	67400	1260	940	77000	1440	1080
1 1/4-7	1.2500	0.9690			24000	500	380			53800	1120	840	76300	1580	1100	87200	1820	1360
1 1/4-12	1.2500	1.0730			26600	550	420			59600	1240	920	84500	1760	1320	96600	2000	1500
1 3/8-6	1.3750	1.1550			28600	660	490			64100	1460	1100	91000	2080	1560	104000	2380	1780
1 3/8-12	1.3750	1.3150			32500	740	560			73000	1680	1260	104000	2380	1780	118400	2720	2040
1 1/2-6	1.5000	1.4050			34800	870	650			78000	1940	1460	111000	2780	2060	126500	3160	2360
1 1/2-12	1.5000	1.5800			39100	980	730			87700	2200	1640	124005	3100	2320	142200	3560	2660

Notes:

1. Tightening torque values are calculated from the formula T=KDP T=tightening torque (lb.-in.); K=torque-friction coefficient; D=nominal bolt diameter (in.); P=bolt clamping load developed by tightening (lb.).

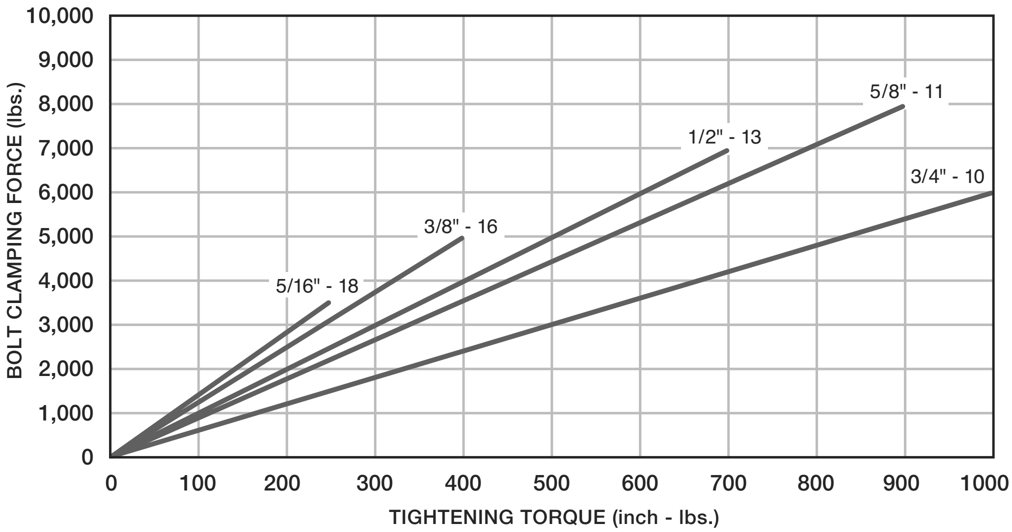
2. Clamp load is also known as preload or initial load in tension on bolt. Clamp load (lb.) is calculated by arbitrarily assuming the usable bolt strength is 75% of the bolt proof load (psi) multiplied by the stress area (sq. in.) of threaded section of each bolt size. Higher or lower values of clamp load can be used depending on the application requirements and the judgment of the designer.

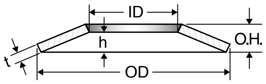
3. Tensile strength (min. psi) of all Grade 7 bolts = 133,000. Proof load = 105,000 psi.

4. Tensile strength (min. psi) of all Grade 8 bolts = 150,000 psi. Proof load = 120,000 psi.

Ref: "Fastening Reference," Machine Design (Nov 1977).

Bolt Clamping Force Vs. Tightening Torque For Unlubricated Steel Bolts





AM Series Disc Springs

AM Series Belleville disc springs are precision springs specifically designed to meet the high performance requirements of dynamic loading applications. They are typically made from High Carbon (C1075) or Alloy (C6150) steel.

AM Series Precision Disc Spring Tolerances

The following tolerances are for the AM series disc springs (AISI 1075 or 6150 carbon steel) and their stainless steel counterparts (17/7 stainless).

Refer to the "SAM" columns for dimensional and/or tolerance differences required for all 17/7 PH stainless steel parts. All stainless steel materials will utilize these SAM specifications with the exception of materials not available in the standard tolerance range. In those cases, the closest material tolerance will be used.

When requesting parts made of stainless steel, add the letter "S" to the beginning of the existing part number. For example, carbon steel part number AM-502520 becomes SAM-502520 for stainless steel.

For availability of other material types and achievable tolerances, please contact the disc spring team for assistance.

Design Note: stainless steel material thickness is different than steel and is subject to commercial availability. The overall height will be used to compensate for the difference in load due to the difference in thickness.

OUTSIDE & INSIDE DIAMETER TOLERANCE

AM Series (MM) Carbon Steel		SAM (MM) Stainless	AM SERIES (Inches) Carbon Steel		SAM (In.) Stainless
Range	Tolerance	Tolerance	Range	Tolerance	Tolerance
< = 3.0	ID + 0.102 OD - 0.102	ID + 0.13 OD - 0.13	< = 0.118	ID + 0.004 OD - 0.004	ID + 0.005 OD - 0.005
> 3.0 < = 6.0	ID + 0.127 OD - 0.127	ID + 0.15 OD - 0.15	> 0.118 < = 0.236	ID + 0.005 OD - 0.005	ID + 0.006 OD - 0.006
> 6.0 < = 10.0	ID + 0.152 OD - 0.152	ID + 0.18 OD - 0.18	> 0.236 < = 0.394	ID + 0.006 OD - 0.006	ID + 0.007 OD - 0.007
> 10.0 < = 18.0	ID + 0.178 OD - 0.178	ID + 0.20 OD - 0.20	> 0.394 < = 0.709	ID + 0.007 OD - 0.007	ID + 0.008 OD - 0.008
> 18.0 < = 30.0	ID + 0.203 OD - 0.203	ID + 0.23 OD - 0.23	> 0.709 < = 1.180	ID + 0.008 OD - 0.008	ID + 0.009 OD - 0.009
> 30.0 < = 50.0	ID + 0.254 OD - 0.254	ID + 0.28 OD - 0.28	> 1.180 < = 1.970	ID + 0.010 OD - 0.010	ID + 0.011 OD - 0.011
> 50.0 < = 80.0	ID + 0.305 OD - 0.305	ID + 0.33 OD - 0.33	> 1.970 < = 3.150	ID + 0.012 OD - 0.012	ID + 0.013 OD - 0.013
> 80.0 < = 120	ID + 0.356 OD - 0.356	ID + 0.38 OD - 0.38	> 3.150 < = 4.720	ID + 0.014 OD - 0.014	ID + 0.015 OD - 0.015
> 120 < = 180	ID + 0.406 OD - 0.406	ID + 0.43 OD - 0.43	> 4.720 < = 7.090	ID + 0.016 OD - 0.016	ID + 0.017 OD - 0.017
> 180	ID + 0.457 OD - 0.457	ID + 0.48 OD - 0.48	> 7.090	ID + 0.018 OD - 0.018	ID + 0.019 OD - 0.019

OVERALL HEIGHT TOLERANCE

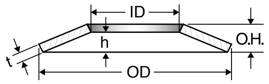
AM Series (MM) by part thickness		SAM (MM) Stainless	AM Series (Inches) by part thickness		SAM (In.) Stainless
t Range	OH Tol.	OH Tol.	t Range	OH Tol.	OH Tol.
< = 1.25	+ 0.10 - 0.05	+ 0.11 - 0.06	< = .049	+ .004 - .002	+ 0.0045 - 0.0025
> 1.25 < = 2.00	+ 0.15 - 0.08	+ 0.17 - 0.09	> .049 < = .078	+ .006 - .003	+ 0.0065 - 0.0035
> 2.00 < = 3.00	+ 0.30 - 0.10	+ 0.32 - 0.11	> .078 < = .118	+ .012 - .004	+ 0.0125 - 0.0045
> 3.00 < = 6.00	+ 0.30 - 0.15	+ 0.32 - 0.17	> .118 < = .236	+ .012 - .006	+ 0.0125 - 0.0065
> 6.00	+ 0.30 - 0.30	+ 0.32 - 0.32	> .236	+ .012 - .012	+ 0.0125 - 0.0125

HARDNESS TOLERANCE

AM Series Tolerance			SAM
Thickness Range		Rockwell	Stainless
MM	Inches	HRC	HRC
< 1.00	< 0.039	46 - 51	Minimum 38
> = 1.00 < 4.25	> = 0.039 < 0.157	44 - 49	Minimum 38
> = 4.25	> = 0.157	42 - 48	Minimum 38

THICKNESS (t) TOLERANCE
Carbon Steel AISI C1075 or AISI 6150

AM Series (MM)		AM Series (Inches)	
Range	Tolerance	Range	Tolerance
< 0.70	± 0.025	< 0.0276	± 0.001
> = 0.70 < 2.25	± 0.051	> = 0.0276 < 0.088	± 0.002
> = 2.25 < 3.00	± 0.076	> = 0.088 < 0.118	± 0.003
> = 3.00 < 4.00	± 0.102	> = 0.118 < 0.157	± 0.004
> = 4.00	± 0.127	> = 0.157	± 0.005



Maryland Precision Spring

AM Series Disc Springs

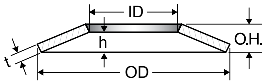
THICKNESS (t) TOLERANCE 17/7 PH Stainless Steel			
SAM Series (MM)		SAM Series (Inches)	
Range	Tolerance	Range	Tolerance
< = 0.51	± 0.05	< = 0.020	± 0.002
> 0.51 < = 1.27	± 0.08	> 0.020 < = 0.050	± 0.003
> 1.27 < = 2.34	± 0.10	> 0.050 < = 0.092	± 0.004
> 2.34 < = 3.18	± 0.13	> 0.092 < = 0.125	± 0.005
> 3.18 < = 4.95	± 0.20	> 0.125 < = 0.195	± 0.008
> 4.95	± 0.25	> 0.195	± 0.010

OPERATION LOAD TOLERANCE			
Thickness Range		AM Series	SAM Series
MM	Inches		
< = 1.25	< = .049	+ 25.0% - 7.5%	± 20%
> 1.25 < = 3.00	> .049 < = .118	+ 15.0% - 7.5%	± 20%
> 3.00 < = 6.00	> .118 < = .236	+ 10.0% - 5.0%	± 20%
> 6.00	> .236	+ 5.0% - 5.0%	± 20%

MPS Part Number	Dimensions (inches)						@ 25%h			@ 50%h			@ 75%h			@ 100%h		
	O.D.	I.D.	t	h	O.H.	h/t	Load (Lbs.)	Deflection (Inches)	Stress x 10^3	Load (Lbs.)	Deflection (Inches)	Stress x 10^3	Load (Lbs.)	Deflection (Inches)	Stress x 10^3	Load (Lbs.)	Deflection (Inches)	Stress x 10^3
AM-63203	.236	.126	.0118	.0060	.0177	.506	11	.0015	69	20	.0030	132	29	.0045	188	37	.0060	269
AM-83202	.315	.126	.0079	.0078	.0157	.991	3	.0020	34	5	.0039	64	6	.0059	89	7	.0078	109
AM-83203	.315	.126	.0118	.0099	.0216	.836	11	.0025	61	19	.0049	114	25	.0074	159	30	.0099	213
AM-83204	.315	.126	.0157	.0080	.0236	.507	17	.0020	55	31	.0040	121	44	.0060	196	56	.0080	280
AM-84202	.315	.165	.0079	.0099	.0177	1.249	5	.0025	61	8	.0049	113	9	.0074	155	10	.0099	188
AM-84203	.315	.165	.0118	.0099	.0216	.840	12	.0025	76	21	.0050	143	28	.0074	199	33	.0099	246
AM-84204	.315	.165	.0157	.0080	.0236	.509	19	.0020	68	35	.0040	129	50	.0060	186	64	.0080	268
AM-103203	.394	.126	.0118	.0139	.0256	1.175	12	.0035	58	19	.0069	106	23	.0104	146	26	.0139	177
AM-103204	.394	.126	.0157	.0120	.0276	.762	18	.0030	54	32	.0060	101	43	.0090	173	52	.0120	260
AM-103205	.394	.126	.0197	.0099	.0295	.500	25	.0025	63	47	.0049	135	66	.0074	218	85	.0099	311
AM-104204	.394	.165	.0157	.0120	.0276	.764	19	.0030	62	33	.0060	117	45	.0090	164	55	.0120	227
AM-104205	.394	.165	.0197	.0099	.0295	.501	26	.0025	55	49	.0049	119	70	.0074	192	90	.0099	275
AM-105225	.394	.205	.0098	.0120	.0217	1.223	7	.0030	58	11	.0060	107	14	.0090	147	15	.0120	178
AM-105204	.394	.205	.0157	.0120	.0276	.767	21	.0030	75	37	.0060	141	50	.0090	198	61	.0120	246
AM-105205	.394	.205	.0197	.0099	.0295	.503	29	.0025	66	54	.0050	127	78	.0074	186	99	.0099	267
AM-124204	.472	.165	.0157	.0159	.0315	1.012	20	.0040	59	34	.0079	109	42	.0119	152	48	.0159	193
AM-124205	.472	.165	.0197	.0139	.0335	.705	28	.0035	55	50	.0069	103	68	.0104	174	84	.0139	259
AM-124206	.472	.165	.0236	.0159	.0394	.674	54	.0040	75	98	.0080	147	135	.0120	248	168	.0159	366
AM-125205	.472	.205	.0197	.0158	.0354	.804	36	.0040	76	63	.0079	142	84	.0119	199	101	.0158	254
AM-125206	.472	.205	.0236	.0139	.0374	.591	47	.0035	71	87	.0070	134	122	.0105	210	154	.0139	306
AM-126205	.472	.244	.0197	.0140	.0335	.708	32	.0035	73	57	.0070	138	78	.0105	195	97	.0140	243
AM-126206	.472	.244	.0236	.0140	.0374	.593	52	.0035	83	95	.0070	157	133	.0105	223	168	.0140	300
AM-135205	.492	.205	.0197	.0139	.0335	.705	27	.0035	56	48	.0069	105	65	.0104	148	80	.0139	220
AM-136235	.492	.244	.0138	.0178	.0315	1.293	20	.0045	77	31	.0089	142	36	.0134	194	38	.0178	235
AM-136205	.492	.244	.0197	.0139	.0335	.707	29	.0035	64	51	.0070	121	70	.0104	171	87	.0139	213
AM-136207	.492	.244	.0276	.0119	.0394	.433	58	.0030	66	110	.0060	133	159	.0090	213	206	.0119	302
AM-147235	.551	.283	.0138	.0178	.0315	1.292	16	.0045	63	25	.0089	116	29	.0134	159	31	.0178	192
AM-147205	.551	.283	.0197	.0158	.0354	.804	28	.0040	63	50	.0079	119	66	.0119	167	80	.0158	207
AM-147208	.551	.283	.0315	.0119	.0433	.379	68	.0030	60	131	.0060	127	191	.0090	201	249	.0119	282
AM-155204	.591	.205	.0157	.0218	.0374	1.389	24	.0055	61	36	.0109	112	41	.0164	152	42	.0218	183
AM-155205	.591	.205	.0197	.0198	.0394	1.005	32	.0050	58	52	.0099	109	66	.0149	150	76	.0198	194
AM-155206	.591	.205	.0236	.0178	.0413	.754	41	.0045	55	72	.0089	103	96	.0134	164	118	.0178	247
AM-155207	.591	.205	.0276	.0158	.0433	.572	51	.0039	54	94	.0079	120	133	.0118	197	168	.0158	286
AM-156205	.591	.244	.0197	.0198	.0394	1.007	33	.0050	64	54	.0099	120	69	.0149	166	79	.0198	203
AM-156206	.591	.244	.0236	.0178	.0413	.756	42	.0045	61	74	.0089	114	100	.0134	161	123	.0178	228
AM-156207	.591	.244	.0276	.0158	.0433	.573	53	.0040	57	98	.0079	111	138	.0119	182	174	.0158	265
AM-158207	.591	.323	.0276	.0159	.0433	.576	61	.0040	73	114	.0080	140	159	.0119	198	202	.0159	257
AM-158208	.591	.323	.0315	.0159	.0472	.506	88	.0040	81	166	.0080	154	236	.0120	220	303	.0159	308
AM-168204	.630	.323	.0157	.0198	.0354	1.263	20	.0050	60	31	.0099	111	36	.0149	152	38	.0198	184
AM-168206	.630	.323	.0236	.0179	.0413	.757	41	.0045	64	72	.0089	120	97	.0134	169	119	.0179	210
AM-168207	.630	.323	.0276	.0179	.0453	.649	61	.0045	71	111	.0089	134	153	.0134	189	191	.0179	242
AM-168208	.630	.323	.0315	.0159	.0472	.504	74	.0040	66	138	.0079	125	197	.0119	186	252	.0159	268
AM-168209	.630	.323	.0354	.0140	.0492	.394	87	.0035	60	167	.0070	126	242	.0105	200	315	.0140	281
AM-186204	.709	.244	.0157	.0238	.0390	1.515	20	.0059	48	30	.0119	88	33	.0178	120	32	.0238	143
AM-186205	.709	.244	.0197	.0237	.0433	1.203	31	.0059	53	49	.0119	98	58	.0178	134	63	.0237	162
AM-186206	.709	.244	.0236	.0237	.0472	1.005	45	.0059	58	75	.0119	108	95	.0178	149	109	.0237	195
AM-186207	.709	.244	.0276	.0217	.0492	.787	56	.0054	55	99	.0109	104	132	.0163	159	160	.0217	241
AM-186208	.709	.244	.0315	.0198	.0512	.629	68	.0050	53	125	.0099	114	173	.0149	189	218	.0198	276
AM-188205	.709	.323	.0197	.0238	.0433	1.206	33	.0059	63	52	.0119	116	62	.0178	160	68	.0238	193
AM-188207	.709	.323	.0276	.0218	.0492	.789	61	.0054	66	106	.0109	124	142	.0163	174	172	.0218	216
AM-188208	.709	.323	.0315	.0199	.0512	.631	74	.0050	63	135	.0099	119	187	.0149	169	234	.0199	248

continued on next page

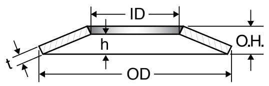
Contact us: marylandprecisionspring.com or email info@marylandprecisionspring.com



AM Series Disc Springs

MPS Part Number	Dimensions (inches)						@ 25%h			@ 50%h			@ 75%h			@ 100%h		
	O.D.	I.D.	t	h	O.H.	h/t	Load (Lbs.)	Deflection (Inches)	Stress x 10^3	Load (Lbs.)	Deflection (Inches)	Stress x 10^3	Load (Lbs.)	Deflection (Inches)	Stress x 10^3	Load (Lbs.)	Deflection (Inches)	Stress x 10^3
AM-188210	.709	.323	.0394	.0158	.0551	.402	101	.0040	59	194	.0079	126	282	.0119	200	366	.0158	282
AM-189245	.709	.362	.0177	.0238	.0413	1.343	28	.0059	66	43	.0119	122	50	.0178	167	52	.0238	201
AM-189207	.709	.362	.0276	.0198	.0472	.717	55	.0049	64	99	.0099	120	134	.0148	169	165	.0198	211
AM-189210	.709	.362	.0394	.0159	.0551	.403	108	.0040	60	207	.0079	124	300	.0119	198	389	.0159	280
AM-208206	.787	.323	.0236	.0278	.0512	1.177	51	.0069	66	81	.0139	122	97	.0208	167	107	.0278	203
AM-208207	.787	.323	.0276	.0257	.0531	.930	62	.0064	63	105	.0128	118	135	.0193	164	159	.0257	201
AM-208208	.787	.323	.0315	.0238	.0551	.755	75	.0059	61	133	.0119	114	179	.0178	161	219	.0238	230
AM-208209	.787	.323	.0354	.0219	.0571	.618	89	.0055	58	164	.0109	110	227	.0164	176	286	.0219	259
AM-208210	.787	.323	.0394	.0218	.0610	.553	118	.0054	62	220	.0109	126	310	.0163	207	394	.0218	299
AM-201005	.787	.402	.0197	.0258	.0453	1.309	34	.0064	64	52	.0129	118	60	.0193	161	63	.0258	195
AM-201008	.787	.402	.0315	.0218	.0531	.693	72	.0055	64	130	.0109	121	178	.0164	171	220	.0218	213
AM-201009	.787	.402	.0354	.0219	.0571	.620	99	.0055	70	181	.0110	132	251	.0165	188	316	.0219	248
AM-201010	.787	.402	.0394	.0219	.0610	.555	131	.0055	75	243	.0109	142	343	.0164	202	436	.0219	287
AM-201011	.787	.402	.0433	.0179	.0610	.413	132	.0045	61	252	.0090	124	364	.0134	198	473	.0179	280
AM-201013	.787	.402	.0492	.0200	.0689	.406	217	.0050	78	415	.0100	160	601	.0150	255	781	.0200	360
AM-201015	.787	.402	.0591	.0119	.0709	.202	207	.0030	66	409	.0060	135	608	.0089	209	805	.0119	285
AM-221106	.886	.441	.0236	.0317	.0551	1.345	57	.0079	74	87	.0159	136	100	.0238	186	104	.0317	224
AM-221108	.886	.441	.0315	.0258	.0571	.820	73	.0065	63	127	.0129	118	167	.0194	165	202	.0258	204
AM-221113	.886	.441	.0492	.0199	.0689	.405	166	.0050	59	318	.0100	125	461	.0149	199	600	.0199	281
AM-238207	.906	.323	.0276	.0317	.0591	1.147	66	.0079	60	107	.0158	112	129	.0238	154	143	.0317	186
AM-238208	.906	.323	.0315	.0297	.0610	.942	79	.0074	58	133	.0148	109	170	.0223	151	199	.0297	204
AM-238209	.906	.323	.0354	.0278	.0630	.784	93	.0069	56	163	.0139	106	208	.0208	157	265	.0278	238
AM-238210	.906	.323	.0394	.0277	.0669	.703	121	.0069	60	217	.0138	113	296	.0208	187	366	.0277	279
AM-231009	.906	.402	.0354	.0299	.0650	.844	111	.0075	72	191	.0149	135	252	.0224	188	302	.0299	232
AM-231010	.906	.402	.0394	.0278	.0669	.704	129	.0069	69	230	.0139	130	314	.0208	183	388	.0278	255
AM-231013	.906	.402	.0492	.0259	.0748	.526	210	.0065	72	391	.0129	142	555	.0194	231	709	.0259	333
AM-231210	.906	.480	.0394	.0239	.0630	.606	113	.0060	65	208	.0119	124	290	.0179	176	365	.0239	228
AM-231213	.906	.480	.0492	.0239	.0728	.487	208	.0060	77	392	.0120	147	560	.0180	216	720	.0239	310
AM-231215	.906	.480	.0591	.0199	.0787	.336	279	.0050	73	542	.0099	153	794	.0149	241	1040	.0199	337
AM-251010	.984	.402	.0394	.0297	.0689	.754	117	.0074	61	207	.0149	114	279	.0233	160	342	.0297	230
AM-251207	.984	.480	.0276	.0357	.0630	1.293	79	.0089	76	122	.0178	140	142	.0268	191	150	.0357	231
AM-251209	.984	.480	.0354	.0278	.0630	.786	87	.0070	59	153	.0139	111	204	.0209	156	248	.0278	193
AM-251210	.984	.480	.0394	.0318	.0709	.808	140	.0080	77	245	.0159	144	325	.0239	202	393	.0318	250
AM-251213	.984	.480	.0492	.0279	.0768	.568	204	.0070	73	378	.0140	140	532	.0209	200	675	.0279	292
AM-251215	.984	.480	.0591	.0218	.0807	.370	250	.0055	65	482	.0109	138	702	.0164	219	917	.0218	307
AM-281008	1.100	.402	.0315	.0376	.0689	1.193	83	.0094	57	131	.0188	106	157	.0282	145	171	.0376	176
AM-281010	1.100	.402	.0394	.0356	.0748	.904	123	.0089	59	209	.0178	110	270	.0267	153	319	.0356	210
AM-281013	1.100	.402	.0492	.0317	.089	.645	177	.0079	57	321	.0159	112	444	.0238	188	556	.0317	276
AM-281015	1.100	.402	.0591	.0277	.0866	.469	242	.0069	65	457	.0138	140	655	.0208	225	845	.0277	320
AM-281210	1.100	.480	.0394	.0377	.0768	.957	142	.0094	72	238	.0189	134	303	.0283	186	354	.0377	228
AM-281213	1.100	.480	.0492	.0338	.0827	.687	203	.0085	70	366	.0169	132	500	.0254	185	621	.0338	268
AM-281215	1.100	.480	.0591	.0298	.0886	.504	278	.0074	66	522	.0149	136	743	.0223	221	952	.0298	317
AM-281408	1.100	.559	.0315	.0398	.0709	1.262	104	.0099	79	163	.0199	146	191	.0298	200	204	.0398	242
AM-281410	1.100	.559	.0394	.0318	.0709	.807	114	.0079	63	199	.0159	119	264	.0238	167	320	.0318	206
AM-281413	1.100	.559	.0492	.0339	.0827	.689	220	.0085	80	395	.0170	151	540	.0254	213	670	.0339	265
AM-281415	1.100	.559	.0591	.0258	.0846	.436	249	.0064	62	473	.0129	122	683	.0193	196	884	.0258	278
AM-321210	1.240	.480	.0394	.0436	.0827	1.106	140	.0109	65	226	.0218	120	277	.0327	166	310	.0436	201
AM-321213	1.240	.480	.0492	.0377	.0866	.765	181	.0094	59	319	.0188	111	429	.0282	155	524	.0377	233
AM-321215	1.240	.480	.0591	.0336	.0925	.569	247	.0084	56	457	.0168	118	642	.0252	194	814	.0336	282
AM-321608	1.240	.642	.0315	.0416	.0728	1.321	91	.0104	68	140	.0208	125	161	.0312	171	169	.0416	206
AM-321613	1.240	.642	.0492	.0358	.0846	.727	188	.0089	68	335	.0179	129	454	.0268	182	559	.0358	226
AM-321615	1.240	.642	.0591	.0359	.0945	.607	304	.0090	77	557	.0179	147	776	.0269	208	979	.0359	276
AM-321618	1.240	.642	.0690	.0278	.0965	.403	335	.0070	61	641	.0139	125	930	.0209	199	1209	.0278	281
AM-321620	1.240	.642	.0787	.0300	.1083	.382	535	.0075	75	1029	.0150	158	1497	.0225	251	1952	.0300	353
AM-341210	1.340	.484	.0394	.0495	.0886	1.256	151	.0124	65	237	.0247	120	278	.0371	164	297	.0495	198
AM-341213	1.340	.484	.0492	.0436	.0925	.885	194	.0109	60	331	.0218	112	431	.0327	156	512	.0436	221
AM-341215	1.340	.484	.0591	.0396	.0984	.669	262	.0099	58	472	.0198	111	649	.0297	187	809	.0396	276
AM-341413	1.340	.563	.0492	.0457	.0945	.928	217	.0114	70	367	.0228	131	473	.0342	182	555	.0457	224
AM-341415	1.340	.563	.0591	.0417	.1004	.705	293	.0104	68	523	.0208	129	713	.0312	181	882	.0417	267
AM-341615	1.340	.642	.0591	.0417	.1004	.706	309	.0104	76	553	.0209	143	753	.0313	202	932	.0417	259
AM-341620	1.340	.642	.0787	.0339	.1122	.431	505	.0085	69	962	.0170	146	1389	.0254	234	1799	.0339	332
AM-361809	1.400	.720	.0354	.0456	.0807	1.289	107	.0114	64	167	.0228	118	194	.0342	162	206	.0456	196
AM-361813	1.400	.720	.0492	.0398	.0886	.808	173	.0099	62	301	.0199	116	400	.0298	163	484	.0398	201
AM-361820	1.400	.720	.0787	.0319	.1102	.405	445	.0080	63	853	.0159	128	1236	.0239	204	1607	.0319	288
AM-401413	1.570	.563	.0492	.0554	.1043	1.126	216	.0139	62	348	.0277	115	424	.0415	159	472	.0554	193
AM-401415	1.570	.563	.0591	.0495	.1083	.837	268	.0124	58	463	.0247	108	610	.0371	151	733	.0495	227
AM-401420	1.570	.563	.0787	.0417	.1201	.530	434	.0104	60	811	.0208	132	1149	.0313	214	1467	.0417	307
AM-401615	1.570	.642	.0591	.0515	.1102	.871	294	.0129	66	504	.0257	124	658	.0386	172	785	.0515	218
AM-401620	1.570	.642	.0787	.0437	.1220	.555	475	.0109	62	882	.0218	127	1244	.0328	208	1582	.0437	301
AM-401820	1.570	.720	.0787	.0458	.1240	.582	528	.0114	72	974	.0229	138	1365	.0343	206	1729	.0458	301
AM-402010	1.570	.803	.0394	.0516	.0906	1.309	135	.0129	64	208	.0258	118	241	.0387	162	254	.0516	196

continued on next page



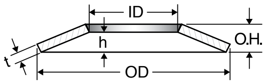
Maryland Precision Spring

AM Series Disc Springs

MPS Part Number	Dimensions (inches)						@ 25%h			@ 50%h			@ 75%h			@ 100%h		
	O.D.	I.D.	t	h	O.H.	h/t	Load (Lbs.)	Deflection (Inches)	Stress x 10^3	Load (Lbs.)	Deflection (Inches)	Stress x 10^3	Load (Lbs.)	Deflection (Inches)	Stress x 10^3	Load (Lbs.)	Deflection (Inches)	Stress x 10^3
AM-402015	1.570	.803	.0591	.0456	.1043	.772	266	.0114	66	468	.0228	125	627	.0342	175	765	.0456	217
AM-402020	1.570	.803	.0787	.0439	.1220	.557	527	.0110	75	978	.0219	144	1377	.0329	204	1751	.0439	289
AM-402023	1.570	.803	.0886	.0358	.1240	.404	565	.0090	63	1083	.0179	129	1570	.0269	205	2042	.0358	290
AM-402025	1.570	.803	.0984	.0379	.1358	.385	817	.0095	73	1573	.0190	155	2286	.0284	246	2979	.0379	346
AM-452213	1.770	.882	.0492	.0635	.1122	1.291	248	.0159	76	385	.0318	139	447	.0476	191	473	.0635	231
AM-452218	1.770	.882	.0689	.0517	.1201	.750	364	.0129	66	644	.0258	125	868	.0388	176	1064	.0517	218
AM-452225	1.770	.882	.0984	.0398	.1378	.405	666	.0100	59	1277	.0199	125	1851	.0299	199	2406	.0398	281
AM-501813	1.970	.724	.0492	.0633	.1122	1.286	178	.0158	49	277	.0316	90	322	.0474	123	342	.0633	148
AM-501815	1.970	.724	.0591	.0712	.1299	1.205	327	.0178	64	517	.0356	118	616	.0534	162	670	.0712	196
AM-501820	1.970	.724	.0787	.0595	.1378	.756	456	.0149	57	806	.0297	107	1085	.0446	159	1328	.0595	240
AM-501825	1.970	.724	.0984	.0635	.1614	.646	891	.0159	72	1618	.0318	141	2235	.0477	235	2798	.0635	346
AM-501830	1.970	.724	.1181	.0556	.1732	.471	1218	.0139	82	2303	.0278	176	3299	.0417	283	4252	.0556	402
AM-502020	1.970	.803	.0787	.0595	.1378	.756	468	.0149	60	826	.0298	114	1111	.0446	160	1360	.0595	230
AM-502025	1.970	.803	.0984	.0536	.1516	.545	720	.0134	60	1339	.0268	125	1891	.0402	204	2409	.0536	295
AM-502220	1.970	.882	.0787	.0636	.1417	.808	535	.0159	71	933	.0318	134	1240	.0477	187	1500	.0636	231
AM-502225	1.970	.882	.0984	.0556	.1535	.566	780	.0139	68	1445	.0278	129	2032	.0417	203	2580	.0556	294
AM-502513	1.970	1.000	.0492	.0634	.1122	1.289	201	.0159	62	312	.0317	114	363	.0476	156	384	.0634	188
AM-502515	1.970	1.000	.0591	.0634	.1220	1.073	293	.0159	67	479	.0317	125	592	.0476	173	668	.0634	211
AM-502520	1.970	1.000	.0787	.0557	.1339	.708	464	.0139	66	829	.0279	124	1129	.0418	175	1396	.0557	217
AM-502525	1.970	1.000	.0984	.0558	.1535	.567	834	.0139	76	1543	.0279	145	2169	.0418	206	2754	.0558	290
AM-502530	1.970	1.000	.1181	.0438	.1614	.371	1021	.0110	65	1970	.0219	138	2871	.0329	218	3747	.0438	306
AM-562915	2.200	1.122	.0591	.0773	.1358	1.308	347	.0193	74	537	.0387	136	622	.0580	186	654	.0773	224
AM-562920	2.200	1.122	.0787	.0636	.1417	.808	456	.0159	63	794	.0318	119	1055	.0477	167	1276	.0636	207
AM-562930	2.200	1.122	.1181	.0518	.1693	.438	999	.0129	63	1903	.0259	122	2742	.0388	196	3549	.0518	279
AM-602120	2.360	.807	.0787	.0832	.1614	1.057	553	.0208	63	906	.0416	116	1125	.0624	160	1278	.0832	199
AM-602125	2.360	.807	.0984	.0713	.1693	.725	723	.0178	56	1287	.0357	106	1745	.0535	178	2150	.0713	266
AM-602130	2.360	.807	.1181	.0674	.1850	.570	1070	.0168	63	1979	.0337	140	2781	.0505	229	3528	.0674	331
AM-602625	2.360	1.004	.0984	.0754	.1732	.767	826	.0189	69	1455	.0377	130	1952	.0566	183	2384	.0754	249
AM-602630	2.360	1.004	.1181	.0656	.1831	.555	1081	.0164	64	2006	.0328	124	2827	.0492	204	3596	.0656	296
AM-603125	2.360	1.201	.0984	.0717	.1693	.729	828	.0179	75	1473	.0358	141	1995	.0538	199	2456	.0717	247
AM-603130	2.360	1.201	.1181	.0678	.1850	.574	1228	.0169	78	2268	.0339	148	3184	.0508	210	4037	.0678	294
AM-603135	2.360	1.201	.1378	.0599	.1969	.435	1599	.0150	74	3047	.0299	145	4393	.0449	232	5690	.0599	329
AM-633118	2.480	1.220	.0709	.0933	.1634	1.316	563	.0233	81	869	.0467	150	1004	.0700	206	1054	.0933	248
AM-633125	2.480	1.220	.0984	.0695	.1673	.707	700	.0174	62	1252	.0348	118	1705	.0521	166	2108	.0695	208
AM-633130	2.480	1.220	.1181	.0717	.1890	.607	1176	.0179	74	2155	.0359	140	3004	.0538	198	3786	.0717	276
AM-633135	2.480	1.220	.1378	.0557	.1929	.404	1293	.0139	58	2479	.0278	125	3594	.0418	199	4672	.0557	281
AM-702620	2.760	1.004	.0787	.0990	.1772	1.258	570	.0248	61	890	.0495	113	1046	.0743	155	1118	.0990	187
AM-703125	2.760	1.201	.0984	.0953	.1929	.968	892	.0238	72	1493	.0476	135	1900	.0714	187	2210	.0953	229
AM-703130	2.760	1.201	.1181	.0834	.2008	.706	1114	.0209	66	1992	.0417	125	2714	.0626	175	3356	.0834	249
AM-703630	2.760	1.398	.1181	.0836	.2008	.708	1201	.0209	75	2148	.0418	142	2924	.0627	201	3615	.0836	250
AM-703640	2.760	1.398	.1575	.0717	.2283	.456	2106	.0179	74	3996	.0359	142	5742	.0538	229	7415	.0717	326
AM-704140	2.760	1.595	.1575	.0641	.2205	.407	2024	.0160	75	3878	.0320	144	5619	.0480	216	7304	.0641	305
AM-704150	2.760	1.595	.1968	.0480	.2441	.244	2786	.0120	70	5481	.0240	146	8117	.0360	227	10723	.0480	313
AM-713620	2.800	1.420	.0787	.1033	.1811	1.313	678	.0258	81	1048	.0517	149	1212	.0775	204	1273	.1033	246
AM-713625	2.800	1.420	.0984	.0795	.1772	.808	685	.0199	61	1193	.0397	114	1585	.0596	160	1917	.0795	198
AM-713640	2.800	1.420	.1575	.0637	.2205	.405	1766	.0159	62	3386	.0319	128	4907	.0478	204	6380	.0637	288
AM-803125	3.150	1.220	.0984	.1110	.2087	1.128	874	.0277	65	1407	.0555	120	1714	.0832	165	1906	.1110	200
AM-803130	3.150	1.220	.1181	.0990	.2165	.839	1078	.0248	60	1864	.0495	112	2456	.0743	157	2950	.0990	217
AM-803140	3.150	1.220	.1575	.0833	.2402	.529	1753	.0208	57	3272	.0417	126	4637	.0625	205	5923	.0833	295
AM-803630	3.150	1.420	.1181	.1072	.2244	.908	1291	.0268	75	2194	.0536	140	2837	.0804	194	3351	.1072	239
AM-803640	3.150	1.420	.1575	.0875	.2441	.555	1960	.0219	67	3637	.0437	152	5125	.0656	201	6520	.875	291
AM-804123	3.150	1.610	.0886	.1172	.2047	1.322	878	.0293	82	1354	.0586	152	1562	.0879	208	1635	.1172	251
AM-804130	3.150	1.610	.1181	.0915	.2087	.775	1058	.0229	66	1860	.0457	124	2491	.0686	174	3036	.0915	216
AM-804140	3.150	1.610	.1575	.0877	.2441	.557	2097	.0219	75	3890	.0438	143	5480	.0658	203	6969	.0877	287
AM-804150	3.150	1.610	.1968	.0678	.2638	.345	2844	.0170	67	5511	.0339	142	8062	.0509	224	10553	.0678	314
AM-904625	3.540	1.810	.0984	.1271	.2244	1.292	1007	.0318	77	1563	.0636	143	1818	.0953	196	1923	.1271	237
AM-904635	3.540	1.810	.1378	.0994	.2362	.721	1392	.0248	64	2480	.0497	121	3366	.0745	171	4151	.0994	213
AM-904650	3.540	1.810	.1968	.0797	.2756	.405	2709	.0199	61	5191	.0399	125	7524	.0598	199	9781	.0797	281
AM-1004140	3.940	1.610	.1575	.1270	.2835	.806	2077	.0317	67	3622	.0635	125	4812	.0952	175	5825	.1270	237
AM-1004150	3.940	1.610	.1968	.1092	.3051	.555	2951	.0273	62	5477	.0546	126	7719	.0819	206	9820	.1092	298
AM-1005127	3.940	2.010	.1063	.1389	.2441	1.307	1132	.0347	74	1751	.0695	137	2028	.1042	187	2134	.1389	226
AM-1005135	3.940	2.010	.1378	.1112	.2480	.807	1331	.0278	60	2321	.0556	114	3084	.0834	159	3732	.1112	197
AM-1005140	3.940	2.010	.1575	.1194	.2756	.758	2071	.0298	73	3657	.0597	137	4918	.0895	193	6017	.1194	239
AM-1005150	3.940	2.010	.1968	.1117	.3071	.568	3351	.0279	77	6200	.0559	146	8715	.0838	207	11063	.1117	291
AM-1005160	3.940	2.010	.2362	.0877	.3228	.371	4099	.0219	65	7907	.0438	138	11520	.0657	218	15037	.0877	306
AM-1125730	4.410	2.240	.1181	.1548	.2717	1.311	1381	.0387	73	2135	.0774	135	2470	.1161	185	2596	.1548	223
AM-1125740	4.410	2.240	.1575	.1271	.2835	.807	1813	.0318	63	3160	.0636	118	4197	.0954	166	5078	.1271	205
AM-1125760	4.410	2.240	.2362	.0995	.3346	.421	3775	.0249	59	7212	.0497	119	10424	.0746	190	13524	.0995	269
AM-1254140	4.920	1.610	.1575	.1661	.3228	1.055	2023	.0415	56	3315	.0831	105	4119	.1246	144	4678	.1661	188
AM-1255140	4.920	2.010	.1575	.1783	.3346	1.132	2404	.0446	70	3866	.0892	131	4701	.1337	180	5222	.1783	219

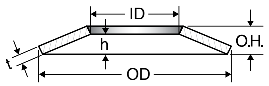
continued on next page

Contact us: marylandprecisionspring.com or email info@marylandprecisionspring.com



AM Series Disc Springs

MPS Part Number	Dimensions (inches)						@ 25%h			@ 50%h			@ 75%h			@ 100%h		
	O.D.	I.D.	t	h	O.H.	h/t	Load (Lbs.)	Deflection (Inches)	Stress x 10^3	Load (Lbs.)	Deflection (Inches)	Stress x 10^3	Load (Lbs.)	Deflection (Inches)	Stress x 10^3	Load (Lbs.)	Deflection (Inches)	Stress x 10^3
AM-1255150	4.920	2.010	.1968	.1548	.3504	.786	3120	.0387	64	5468	.0774	121	7302	.1161	169	8878	.1548	235
AM-1255160	4.920	2.010	.2362	.1350	.3701	.571	4078	.0337	59	7539	.0675	118	10589	.1012	194	13433	.1350	281
AM-1256150	4.920	2.400	.1968	.1592	.3543	.809	3500	.0398	77	6099	.0796	144	8097	.1194	202	9795	.1592	250
AM-1256160	4.920	2.400	.2362	.1434	.3780	.607	4760	.0359	74	8725	.0717	141	12160	.1076	200	15331	.1434	281
AM-1256180	4.920	2.400	.2950	.1361	.4291	.461	8356	.0340	83	15835	.0680	163	22728	.1021	263	29330	.1361	375
AM-1256435	4.920	2.520	.1378	.1788	.3150	1.297	2027	.0447	79	3141	.0894	146	3648	.1341	201	3851	.1788	243
AM-1256450	4.920	2.520	.1968	.1392	.3346	.707	2919	.0348	66	5219	.0696	125	7107	.1044	176	8788	.1392	220
AM-1256480	4.920	2.520	.2950	.1241	.4173	.421	7662	.0310	77	14640	.0621	154	21163	.0931	246	27458	.1241	348
AM-1257160	4.920	2.800	.2362	.1319	.3661	.558	4721	.0330	78	8754	.0659	149	12330	.0989	212	15676	.1319	269
AM-1257180	4.920	2.800	.2913	.1203	.4094	.413	7713	.0301	83	14760	.0602	160	21342	.0902	241	27725	.1203	341
AM-1257110	4.920	2.800	.3622	.1045	.4646	.289	12284	.0261	88	24024	.0522	183	35443	.0784	286	46644	.1045	396
AM-1407238	5.510	2.840	.1496	.1945	.3425	1.300	2256	.0486	75	3495	.0973	138	4055	.1459	190	4277	.1945	229
AM-1407250	5.510	2.840	.1968	.1590	.3543	.808	2853	.0397	64	4972	.0795	120	6603	.1192	168	7990	.1590	208
AM-1407280	5.510	2.840	.2950	.1480	.4409	.502	7588	.0370	77	14254	.0740	147	20306	.1110	219	26051	.1480	315
AM-1506150	5.910	2.400	.1968	.2102	.4055	1.068	3634	.0525	70	5934	.1051	129	7346	.1576	179	8313	.2102	217
AM-1506160	5.910	2.400	.2362	.1905	.4252	.806	4663	.0476	66	8130	.0952	124	10801	.1428	174	13074	.1905	238
AM-1507160	5.910	2.800	.2362	.1909	.4252	.808	4953	.0477	75	8632	.0954	140	11462	.1432	196	13868	.1909	243
AM-1507180	5.910	2.800	.2950	.1796	.4724	.609	8168	.0449	81	14967	.0898	153	20852	.1347	217	26281	.1796	314
AM-1508180	5.910	3.190	.2950	.1682	.4606	.570	8090	.0421	84	14960	.0841	160	21018	.1262	228	26669	.1682	300
AM-1508110	5.910	3.190	.3661	.1482	.5118	.405	12535	.0371	84	24026	.0742	162	34736	.1110	257	45213	.1482	364
AM-1608243	6.300	3.230	.1693	.2223	.3898	1.313	2884	.0556	74	4456	.1112	137	5153	.1668	188	5412	.2223	227
AM-1608260	6.300	3.230	.2362	.1789	.4134	.757	4092	.0447	64	7225	.0894	121	9719	.1342	169	11892	.1789	210
AM-1608210	6.300	3.230	.3700	.1639	.5315	.443	12321	.0410	79	23437	.0820	152	33750	.1229	244	43660	.1639	347
AM-1809248	7.090	3.620	.1890	.2461	.4331	1.302	3464	.0615	72	5365	.1230	133	6223	.1845	182	6560	.2461	220
AM-1809260	7.090	3.620	.2362	.2025	.4370	.857	3915	.0506	60	6738	.1012	112	8834	.1519	157	10565	.2025	194
AM-1809210	7.090	3.620	.3700	.1836	.5512	.496	11120	.0459	72	20914	.0918	137	29824	.1377	206	38293	.1836	296
AM-2008280	7.870	3.230	.2992	.2619	.5591	.875	7957	.0654	70	13641	.1309	131	17800	.1964	183	21196	.2619	228
AM-2008210	7.870	3.230	.3780	.2343	.6102	.620	12024	.0585	69	21991	.1171	130	30571	.1757	208	38457	.2343	305
AM-2008212	7.870	3.230	.4528	.2026	.6535	.447	16216	.0506	72	30847	.1013	154	44373	.1519	246	57386	.2026	349
AM-2009210	7.870	3.620	.3740	.2429	.6142	.649	12836	.0607	78	23287	.1214	148	32148	.1821	209	40226	.2429	298
AM-2009212	7.870	3.620	.4488	.2151	.6614	.479	17772	.0537	75	33577	.1075	152	48048	.1613	246	61850	.2151	351
AM-2009214	7.870	3.620	.5160	.1992	.7126	.386	23996	.0498	83	46160	.0996	177	67103	.1494	280	87434	.1992	394
AM-20010260	7.870	4.020	.2360	.2560	.4920	1.085	4917	.0646	71	7981	.1291	131	9808	.1937	182	11016	.2582	221
AM-20010280	7.870	4.020	.2950	.2430	.5354	.824	7474	.0608	74	12974	.1215	139	17158	.1823	194	20684	.2430	240
AM-20010210	7.870	4.020	.3700	.2477	.6142	.669	13575	.0619	88	24507	.1238	166	33676	.1858	234	41963	.2477	293
AM-20010212	7.870	4.020	.4430	.1972	.6375	.445	16230	.0493	72	30859	.0986	140	44422	.1479	225	57451	.1972	319
AM-20010214	7.870	4.020	.5160	.2039	.7165	.395	26090	.0510	85	50101	.1019	178	72728	.1529	283	94662	.2039	399
AM-20011212	7.870	4.410	.4370	.2043	.6378	.468	17471	.0510	84	33094	.1021	161	47460	.1532	230	61198	.2043	327
AM-20011214	7.870	4.410	.5079	.1845	.6890	.363	23615	.0460	82	45714	.0922	164	66685	.1383	260	87160	.1845	365
AM-20011216	7.870	4.410	.5827	.1604	.7402	.275	30125	.0401	86	59027	.0802	178	87113	.1203	277	114789	.1604	382
AM-22511265	8.860	4.410	.2441	.2936	.5354	1.203	5321	.0734	68	8421	.1468	126	10040	.2202	174	10918	.2936	210
AM-22511280	8.860	4.410	.2950	.2784	.5709	.944	7271	.0696	69	12243	.1392	129	15681	.2088	180	18353	.2784	221
AM-22511212	8.860	4.410	.4430	.2289	.6693	.517	15165	.0572	68	28392	.1145	129	40326	.1717	194	51613	.2289	280
AM-25010210	9.840	4.020	.3780	.3334	.7087	.882	13127	.0833	72	22463	.1667	135	29251	.2500	188	34779	.3334	235
AM-25010212	9.840	4.020	.4528	.2978	.7480	.658	17196	.0744	68	31152	.1489	129	42916	.2233	197	53608	.2978	291
AM-25012770	9.840	5.000	.2638	.3214	.5827	1.218	6101	.0803	67	9627	.1607	124	11427	.2410	171	12368	.3214	207
AM-25012710	9.840	5.000	.3700	.3025	.6693	.818	11651	.0756	73	20257	.1513	138	26833	.2269	193	32393	.3025	238
AM-25012712	9.840	5.000	.4430	.3212	.7598	.725	20008	.0803	89	35617	.1606	168	48293	.2409	237	59503	.3212	295
AM-25012714	9.840	5.000	.5160	.2591	.7717	.502	22121	.0648	73	41550	.1295	140	59185	.1943	210	75924	.2591	302
AM-25012716	9.840	5.000	.5910	.2716	.8583	.460	34298	.0679	86	65017	.1358	165	93351	.2037	263	120456	.2716	374



AI Series Disc Springs Sized for Bolts

AI disc spring series (pre-stressed) are used to maintain load or tension in bolted assemblies. Pressure begins in the outer radius and flattens gradually toward the bolt as deflection progresses. Disc springs exert a uniform pressure that remains constant, despite tension losses caused by thermal expansion and contraction, compression set, or wear of parts. Because pressures are predictable, disc springs provide a simple and effective means of determining bolt tension that is far more accurate than "torque" readings.

AI, AK, SAI, SAK Series and Standard Spring Tolerances

The tolerances on this page are for the AI and AK (AISI 1075 or AISI 6150 carbon steel) and SAI and SAK (17/7 PH stainless steel) series parts.

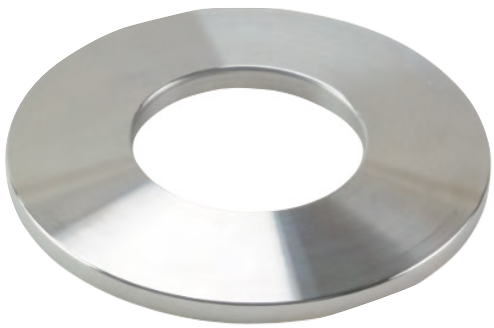
Refer to the "SAI" and/or "SAK" columns for dimensional and/or tolerance differences required for all 17/7 PH stainless steel parts.

All stainless steel materials will utilize these SAI or SAK specifications with the exception of materials not available in the standard tolerance range. In those cases, the closest material tolerance will be used.

When requesting parts made of stainless steel, add the letter "S" in front of the existing part number. For example, carbon steel part number AK-6312 becomes SAK-6312 for stainless steel.

For availability of other material types and achievable tolerances, please call us for assistance.

Design Note: stainless steel material thickness is different than steel and is subject to commercial availability. The overall height will be used to compensate for the difference in load due to the difference in thickness.



OUTSIDE & INSIDE DIAMETER TOLERANCE

AI & AK Series (MM) Carbon Steel		SAI & SAK (MM) Stainless	AI & AK Series (Inches) Carbon Steel		SAI & SAK (Inches) Stainless
Range	Tolerance	Tolerance	Range	Tolerance	Tolerance
< = 3.0	ID + 0.152 OD - 0.152	ID + 0.152 OD - 0.152	< = 0.118	ID + 0.006 OD - 0.006	ID + 0.006 OD - 0.006
> 3.0 < = 6.0	ID + 0.178 OD - 0.178	ID + 0.178 OD - 0.178	> 0.118 < = 0.236	ID + 0.007 OD - 0.007	ID + 0.007 OD - 0.007
> 6.0 < = 10.0	ID + 0.203 OD - 0.203	ID + 0.203 OD - 0.203	> 0.236 < = 0.394	ID + 0.008 OD - 0.008	ID + 0.008 OD - 0.008
> 10.0 < = 18.0	ID + 0.229 OD - 0.229	ID + 0.229 OD - 0.229	> 0.394 < = 0.709	ID + 0.009 OD - 0.009	ID + 0.009 OD - 0.009
> 18.0 < = 30.0	ID + 0.254 OD - 0.254	ID + 0.254 OD - 0.254	> 0.709 < = 1.180	ID + 0.010 OD - 0.010	ID + 0.010 OD - 0.010
> 30.0 < = 50.0	ID + 0.305 OD - 0.305	ID + 0.305 OD - 0.305	> 1.180 < = 1.970	ID + 0.012 OD - 0.012	ID + 0.012 OD - 0.012
> 50.0 < = 80.0	ID + 0.356 OD - 0.356	ID + 0.356 OD - 0.356	> 1.970 < = 3.150	ID + 0.014 OD - 0.014	ID + 0.014 OD - 0.014
> 80.0 <=120.0	ID + 0.406 OD - 0.406	ID + 0.406 OD - 0.406	> 3.150 < = 4.720	ID + 0.016 OD - 0.016	ID + 0.016 OD - 0.016
> 120.0 <=180.0	ID + 0.457 OD - 0.457	ID + 0.457 OD - 0.457	> 4.720 < = 7.090	ID + 0.018 OD - 0.018	ID + 0.018 OD - 0.018
> 180.0	ID + 0.508 OD - 0.508	ID + 0.508 OD - 0.508	> 7.090	ID + 0.020 OD - 0.020	ID + 0.020 OD - 0.020

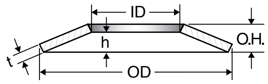
OVERALL HEIGHT TOLERANCE

AI & AK Series (MM) by part thickness		SAI & SAK (MM) Stainless	AI & AK Series (In.) by part thickness		SAI & SAK (In.) Stainless
t Range	OH Tol.	OH Tol.	t Range	OH Tol.	OH Tol.
< = 1.25	+ 0.10 - 0.05	+ 0.11 - 0.06	< = .049	+ .004 - .002	+ 0.0045 - 0.0025
> 1.25 < = 2.00	+ 0.15 - 0.08	+ 0.17 - 0.09	> .049 < = .078	+ .006 - .003	+ 0.0065 - 0.0035
> 2.00 < = 3.00	+ 0.30 - 0.10	+ 0.32 - 0.11	> .078 < = .118	+ .012 - .004	+ 0.0125 - 0.0045
> 3.00 < = 6.00	+ 0.30 - 0.15	+ 0.32 - 0.17	> .118 < = .236	+ .012 - .006	+ 0.0125 - 0.0065
> 6.00	+ 0.30 - 0.30	+ 0.32 - 0.32	> .236	+ .012 - .012	+ 0.0125 - 0.0125

THICKNESS (t) TOLERANCE
Carbon Steel AISI C1075 or AISI 6150

AI & AK Series (MM)		AI & AK Series (Inches)	
Range	Tolerance	Range	Tolerance
< 0.70	± 0.038	< 0.0276	± 0.0015
> = 0.70 < 2.25	± 0.051	> = 0.0276 < 0.088	± 0.0025
> = 2.25 < 3.00	± 0.076	> = 0.088 < 0.118	± 0.0035
> = 3.00 < 4.00	± 0.102	> = 0.118 < 0.157	± 0.0045
> = 4.00	± 0.127	> = 0.157	± 0.0055

Contact us: marylandprecisionspring.com or email info@marylandprecisionspring.com



AI Series Disc Springs Sized for Bolts

THICKNESS (t) TOLERANCE 17/7 PH Stainless Steel			
SAI & SAK Series (MM)		SAI & SAK Series (Inches)	
Range	Tolerance	Range	Tolerance
< = 0.51	± 0.05	< = 0.020	± 0.002
> 0.51 < = 1.27	± 0.08	> 0.020 < = 0.050	± 0.003
> 1.27 < = 2.34	± 0.10	> 0.050 < = 0.092	± 0.004
> 2.34 < = 3.18	± 0.13	> 0.092 < = 0.125	± 0.005
> 3.18 < = 4.95	± 0.20	> 0.125 < = 0.195	± 0.008
> 4.95	± 0.25	> 0.195	± 0.010

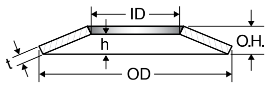
HARDNESS TOLERANCE			
AI Series Tolerance			SAI
Thickness Range		Rockwell	Stainless
MM	Inches	HRC	HRC
< 1.00	< 0.039	46 - 51	Minimum 38
> = 1.00 < 4.25	> = 0.039 < 0.157	44 - 49	Minimum 38
> = 4.25	> = 0.157	42 - 48	Minimum 38

OPERATION LOAD TOLERANCE			
Thickness Range		AI	AK, SAI & SAK
MM	Inches	Series	Series
< = 1.25	< = .049	+ 25.0% - 7.5%	± 20%
> 1.25 < = 3.00	> .049 < = .118	+ 15.0% - 7.5%	± 20%
> 3.00 < = 6.00	> .118 < = .236	+ 10.0% - 5.0%	± 20%
> 6.00	> .236	+ 5.0% - 5.0%	± 20%

HARDNESS TOLERANCE			
AK Series Tolerance			SAK
Thickness Range		Rockwell	Stainless
MM	Inches	HRC	HRC
ALL	ALL	40-52	Minimum 38

MPS Part Number	Nominal Bolt Size	Dimensions (Inches)					@ 100%h	
		O.D.	I.D.	t	h	O.H.	Pmax.	fmax.
AI-180907	#2	.187	.093	.007	.006	.013	12	.006
AI-180910	#2	.187	.093	.010	.005	.015	29	.005
AI-251209	#4	.250	.125	.009	.008	.017	19	.008
AI-251213	#4	.250	.125	.013	.007	.020	50	.007
AI-371219	#4	.375	.125	.019	.010	.028	81	.010
AI-281310	#6	.281	.138	.010	.010	.020	23	.010
AI-281313	#6	.281	.138	.013	.008	.021	43	.008
AI-281315	#6	.281	.138	.015	.008	.023	69	.008
AI-431322	#6	.437	.138	.022	.010	.032	98	.010
AI-311511	#6	.312	.156	.011	.011	.022	30	.011
AI-311517	#6	.312	.156	.017	.008	.025	82	.008
AI-341613	#8	.343	.164	.013	.011	.024	38	.011
AI-341616	#8	.343	.164	.016	.010	.026	65	.010
AI-341619	#8	.343	.164	.019	.009	.028	104	.009
AI-501625	#8	.500	.164	.025	.012	.037	131	.012
AI-561919	3/16	.562	.190	.019	.018	.037	67	.018
AI-561928	3/16	.562	.190	.028	.014	.042	163	.014
AI-371915	3/16	.375	.195	.015	.012	.027	59	.012
AI-371918	3/16	.375	.195	.018	.010	.028	85	.010
AI-371920	3/16	.375	.195	.020	.010	.030	118	.010
AI-371930	3/16	.375	.195	.030	.010	.040	410	.010
AI-432216	#12	.437	.220	.016	.015	.031	60	.015
AI-432220	#12	.437	.220	.020	.012	.032	98	.012
AI-432223	#12	.437	.220	.023	.011	.034	139	.011
AI-682234	#12	.687	.220	.034	.016	.050	229	.016
AI-502522	1/4	.500	.255	.022	.015	.036	115	.015
AI-502525	1/4	.500	.255	.025	.013	.038	165	.013
AI-502538	1/4	.500	.255	.038	.010	.048	454	.010
AI-632532	1/4	.637	.255	.032	.016	.048	222	.016
AI-752525	1/4	.750	.255	.025	.024	.049	114	.024
AI-752536	1/4	.750	.255	.036	.018	.054	261	.018

continued on next page

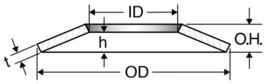


Maryland Precision Spring

AI Series Disc Springs Sized for Bolts

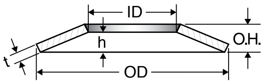
MPS Part Number	Nominal Bolt Size	Dimensions (Inches)					@ 100%h	
		O.D.	I.D.	t	h	O.H.	Pmax.	fmax.
AI-752552	1/4	.750	.255	.052	.013	.065	560	.013
AI-502519	1/4	.500	.258	.019	.016	.035	89	.016
AI-502523	1/4	.500	.258	.023	.016	.039	160	.016
AI-623122	5/16	.625	.317	.022	.020	.042	110	.020
AI-623132	5/16	.625	.317	.032	.016	.048	273	.016
AI-623147	5/16	.625	.317	.047	.012	.059	600	.012
AI-933130	5/16	.937	.317	.030	.030	.060	159	.030
AI-933145	5/16	.937	.317	.045	.022	.067	404	.022
AI-753227	5/16	.750	.320	.028	.024	.052	174	.024
AI-753231	5/16	.750	.320	.032	.024	.056	261	.024
AI-753828	3/8	.750	.380	.028	.023	.051	180	.023
AI-753834	3/8	.750	.380	.034	.021	.055	297	.021
AI-753856	3/8	.750	.380	.056	.014	.070	897	.014
AI-953847	3/8	.950	.380	.047	.023	.070	484	.023
AI-113853	3/8	1.125	.380	.053	.027	.080	535	.027
AI-113878	3/8	1.125	.380	.078	.019	.097	1235	.019
AI-683823	3/8	.688	.382	.024	.020	.044	125	.020
AI-683827	3/8	.688	.382	.028	.020	.048	200	.020
AI-753831	3/8	.750	.382	.032	.020	.052	236	.020
AI-753835	3/8	.750	.382	.035	.022	.057	342	.022
AI-753840	3/8	.750	.382	.040	.019	.059	441	.019
AI-874431	7/16	.875	.442	.031	.028	.059	218	.028
AI-874445	7/16	.875	.442	.045	.022	.067	530	.022
AI-104439	7/16	1.000	.445	.039	.032	.071	359	.032
AI-125060	1/2	1.262	.505	.060	.031	.091	731	.031
AI-155047	1/2	1.500	.505	.047	.046	.093	366	.046
AI-155070	1/2	1.500	.505	.070	.034	.104	896	.034
AI-155002	1/2	1.500	.505	.102	.026	.128	2060	.026
AI-105135	1/2	1.000	.512	.035	.032	.067	277	.032
AI-105139	1/2	1.000	.512	.039	.036	.075	436	.036
AI-105043	1/2	1.000	.512	.043	.028	.071	431	.028
AI-105149	1/2	1.000	.512	.049	.034	.083	825	.034
AI-105050	1/2	1.000	.512	.050	.025	.075	600	.025
AI-105159	1/2	1.000	.512	.059	.028	.087	1190	.028
AI-105173	1/2	1.000	.512	.073	.018	.091	1442	.018
AI-115139	1/2	1.100	.512	.039	.036	.075	339	.036
AI-115149	1/2	1.100	.512	.049	.030	.083	640	.034
AI-115159	1/2	1.100	.512	.059	.028	.087	923	.028
AI-115638	9/16	1.125	.567	.038	.035	.073	303	.035
AI-115656	9/16	1.125	.567	.056	.028	.084	784	.028
AI-126340	5/8	1.250	.630	.040	.042	.082	344	.042
AI-126351	5/8	1.250	.630	.051	.036	.087	582	.036
AI-126362	5/8	1.250	.630	.062	.030	.092	922	.030
AI-126389	5/8	1.250	.630	.089	.022	.111	2019	.022
AI-186357	5/8	1.875	.630	.057	.058	.115	522	.058
AI-186386	5/8	1.875	.630	.086	.043	.129	1319	.043
AI-186327	5/8	1.875	.630	.127	.031	.158	3105	.031
AI-136349	5/8	1.375	.637	.049	.046	.095	549	.046
AI-136359	5/8	1.375	.637	.059	.043	.102	901	.043
AI-136378	5/8	1.375	.637	.078	.032	.110	1556	.032
AI-136944	11/16	1.375	.692	.045	.044	.089	423	.044
AI-136967	11/16	1.375	.692	.067	.034	.101	1089	.034
AI-157545	3/4	1.500	.755	.045	.048	.093	386	.048
AI-157560	3/4	1.500	.755	.060	.042	.102	774	.042
AI-157572	3/4	1.500	.755	.072	.037	.109	1235	.037
AI-1575107	3/4	1.500	.755	.107	.027	.134	2991	.027
AI-227568	3/4	2.250	.755	.068	.069	.137	732	.069
AI-227510	3/4	2.250	.755	.102	.051	.153	1822	.051
AI-227515	3/4	2.250	.755	.150	.038	.188	4295	.038
AI-157659	3/4	1.500	.761	.059	.055	.114	1019	.055
AI-157678	3/4	1.500	.761	.078	.044	.122	1897	.044
AI-157698	3/4	1.500	.761	.098	.036	.134	3097	.036
AI-178857	7/8	1.750	.880	.057	.057	.114	650	.057
AI-178885	7/8	1.750	.880	.085	.043	.128	1735	.043
AI-201084	1	2.000	1.000	.084	.052	.136	1488	.052
AI-201014	1	2.000	1.000	.142	.035	.177	4824	.035
AI-301090	1	3.000	1.000	.090	.090	.180	1244	.090

continued on next page



AI Series Disc Springs Sized for Bolts

MPS Part Number	Nominal Bolt Size	Dimensions (Inches)					@ 100%h	
		O.D.	I.D.	t	h	O.H.	Pmax.	fmax.
AI-301013	1	3.000	1.000	.135	.067	.202	3118	.067
AI-201065	1	2.000	1.016	.065	.065	.130	895	.065
AI-201078	1	2.000	1.016	.078	.060	.138	1436	.060
AI-201098	1	2.000	1.016	.098	.060	.158	2881	.060
AI-201011	1	2.000	1.016	.118	.047	.165	3944	.047
AI-231078	1	2.375	1.016	.078	.079	.157	1231	.079
AI-231098	1	2.375	1.016	.098	.079	.177	2463	.079
AI-231011	1	2.375	1.016	.118	.063	.181	3434	.063
AI-221173	1-1/8	2.250	1.125	.073	.075	.148	1100	.075
AI-221111	1-1/8	2.250	1.125	.111	.054	.165	2780	.054
AI-221115	1-1/8	2.250	1.125	.159	.039	.198	5973	.039
AI-251280	1-1/4	2.500	1.250	.080	.080	.160	1301	.080
AI-251212	1-1/4	2.500	1.250	.120	.060	.180	3322	.060
AI-251217	1-1/4	2.500	1.250	.175	.044	.219	7149	.044
AI-371216	1-1/4	3.750	1.250	.168	.083	.251	4754	.083
AI-271387	1-3/8	2.750	1.375	.087	.086	.173	1440	.086
AI-271313	1-3/8	2.750	1.375	.132	.064	.196	3210	.064
AI-301593	1-1/2	3.000	1.500	.093	.096	.189	1630	.096
AI-301514	1-1/2	3.000	1.500	.143	.070	.213	4380	.070
AI-402012	2	4.000	2.000	.125	.125	.250	2910	.125
AI-402018	2	4.000	2.000	.187	.093	.280	7280	.093



Contact Disc Springs

Contact Belleville Disc Springs combine two important features for improved bolt connections:

1) Their conical shape provides reactive force and a high elasticity of spring return to compensate for developed looseness, loss of bolt tension due to applied surface deterioration, and movement due to the thermal expansion and contraction.

2) The hardened, serrated profile grips the lower surface of the bolt or nut to prevent the loss of tension that normally occurs during extreme vibration or severe shock.

Contact Disc Springs come in sizes that correspond to a wide range of screw head sizes, including hex head socket screws. They can also be used in assemblies. The "Narrow" Contact Disc Springs are designed for use in confined space under a socket head screw. "Wide" Contact Disc Springs are ideal for oversized holes in sheet metal applications, making use of a wide bearing surface. All Contact Disc Springs are made of selected high-quality carbon spring steel.

Contact "Regular"

MPS Part Number	Bolt Diameter	Metric Size	Dimensions (Inches)				Calculate Load Lbs. @ Flat**
			Max. O.D.	Min. I.D.	Ref. t	Ref. O.H.	
C65-03-11	-	3	.315	.122	.024	.039	400
C65-02-52	#6	3.5	.362	.142	.028	.047	590
C65-04-11	#8	4	.402	.161	.039	.059	1480
C65-05-11	#10	5	.481	.201	.050	.073	2420
C65-06-12	-	6	.559	.240	.052	.087	3350
C65-06-15	-	6	.559	.240	.043	.067	1210
C65-06-35	.250	6	.559	.254	.052	.087	3450
C65-08-21	.313	8	.717	.323	.055	.095	2680
C65-08-23	.313	8	.717	.323	.035	.081	760
C65-09-21	-	-	.798	.362	.062	.095	3540
C65-10-22	.375	10	.877	.402	.062	.108	3010
C65-12-01	.438	12	1.074	.489	.078	.120	3510
C65-12-71	.500	12	1.074	.512	.078	.120	3600
C65-14-42	.563	14	1.192	.567	.098	.138	5350
C65-16-42	.625	15	1.273	.646	.098	.156	7460
C65-20-02	.750	20	1.570	.781	.118	.185	9000

For general use

Contact "Narrow"

MPS Part Number	Bolt Diameter	Metric Size	Dimensions (Inches)				Calculate Load Lbs. @ Flat**
			Max. O.D.	Min. I.D.	Ref. t	Ref. O.H.	
C55-03-01	-	3	.224	.122	.024	.037	700
C55-03-51	#6	3	.284	.140	.028	.043	930
C55-04-01	#8	4	.323	.162	.032	.045	900
C55-05-01	#10	5	.402	.201	.039	.059	1700
C55-06-01	-	6	.481	.240	.050	.071	2500
C55-07-21	.281	-	.559	.284	.055	.081	3200
C55-08-01	.313	8	.638	.323	.055	.095	3800
C55-10-21	.375	10	.798	.402	.062	.095	2700
C55-12-41	.438	12	.955	.489	.062	.102	2300

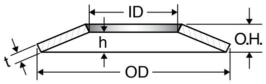
Typical use: In the confined space under a socket head screw

Contact "Wide"

MPS Part Number	Bolt Diameter	Metric Size	Dimensions (Inches)				Calculate Load Lbs. @ Flat**
			Max. O.D.	Min. I.D.	Ref. t	Ref. O.H.	
C75-03-12	-	4	.402	.122	.024	.047	360
C75-04-12	#8	5	.559	.161	.039	.071	1120
C75-05-12	#10	6	.638	.201	.050	.085	1820
C75-06-14	-	6	.717	.240	.055	.100	2780
C75-06-36	.250	8	.717	.254	.055	.100	2810
C75-08-22	.313	10	.877	.323	.055	.095	1610
C75-10-23	.375	12	1.074	.402	.062	.112	1980
C75-12-32	-	12	1.273	.488	.069	.138	2780
C75-12-72	.500	12	1.273	.512	.069	.138	2820

Typical use: For oversized holes in sheet metal applications, making use of a wide bearing surface

** Please note: Loads indicated are computed. Actual loads obtained in practice can vary as much as 25% due to fluctuation in overall height tolerance.



SP Series Disc Springs for Heavy Bolted Sections

SP Series Disc Springs for heavy bolted applications are used wherever there is a need to overcome the effects of thermal expansion and contraction, such as those required for bus bar and transformer applications. SP Series Disc Springs are normally manufactured from high carbon or alloy steel AISI C1075 or 6150 material.

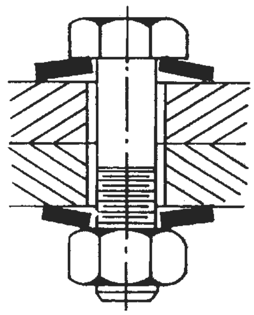
MPS Part Number	Nominal Bolt Size	Metric Size	Dimensions (Inches) O.D.	I.D.	t	1) O.H.	2) O.H.	Load Lbs. @ Flat	Torque to flat (ft-lbs)	Weight Pounds Per M
SP-52203		M2	.197	.087	.012	.020	.016	65	0.1	.1
SP-62704		M2.5	.236	.106	.016	.026	.020	146	0.3	.2
SP-73205	.125, #5	M3	.276	.126	.020	.030	.025	210	0.4	.3
SP-83705	#6	M3.5	.315	.146	.020	.031	.027	176	0.4	.3
SP-94308	.156, #8	M4	.354	.169	.031	.043	.037	590	1.7	.7
SP-115310	.188, #10	M5	.433	.209	.039	.055	.047	1070	3.7	1.3
SP-146412	.125	M6	.551	.252	.050	.067	.056	1390	5.8	2.5
SP-177415		M7	.669	.291	.059	.079	.070	1800	8.7	4.8
SP-188420	.313	M8	.709	.331	.078	.102	.088	4755	26.2	6.9
SP-218425	.313	M8	.827	.331	.098	.118	.108	5345	29.5	12.5
SP-231120	.0375	M10	.906	.413	.078	.106	.094	3200	22.0	11.4
SP-241130	.375	M10	.945	.413	.118	.146	.130	8000	55.1	18.9
SP-291325	.500	M12	1.142	.512	.098	.130	.116	4700	40.1	22.9
SP-321335	.500	M12	1.260	.512	.138	.169	.156	9900	84.5	40.0
SP-351530	.563	M14	1.378	.591	.118	.157	.141	6500	64.0	40.7
SP-391540	.563	M14	1.535	.591	.157	.197	.181	12000	118.2	70.0
SP-391735	.625	M16	1.535	.669	.138	.185	.162	10000	111.5	58.5
SP-421740	.625	M16	1.654	.669	.157	.204	.201	13000	145.0	90.0
SP-471950		M18	1.850	.748	.197	.244	.222	20000	249.3	125.0
SP-522160	.750	M20	2.047	.827	.236	.287	.246	31000	427.3	159.0
SP-562360	.875	M22	2.205	.906	.236	.311	.268	40276	608.2	212.0
SP-622565		M24	2.441	.984	.256	.335	.291	43600	715.0	284.0
SP-702870	1.000	M27	2.756	1.102	.276	.362	.317	46000	844.9	392.0
SP-773175	1.125	M30	3.031	1.220	.295	.386	.343	49000	996.3	508.0

1) When delivered 2) After first loading

A "K" factor of .2 was used for the dry torque calculation. Use .15 if lubricated. The basic metric formula used for foot pounds is **T = K (D/12)P** (T = torque, K = K factor for the coefficient of friction and D = normal bold diameter).

Note: SP Belleville Springs are available in stainless 17/7 PH. Call for availability of stainless.

IMPORTANT NOTICE:
SP Series springs are not pre-stressed. They are designed for static bolted applications only.



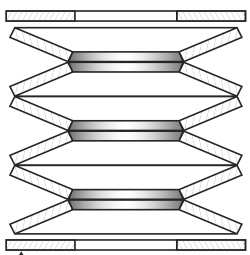
Tolerance

OD:	+ .000 / – 1.5% x OD
ID:	– .000 / + 1.5% ID
Thickness:	thickness is subject to mil-run tolerances
OH:	is a reference and used to control the needed load
Load:	± 20% of nominal shown
Hardness:	RC 43-50

SP Disc Springs

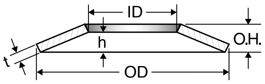
Stainless Steel Flat Washers

National USS high-strength stainless steel flat washers are made of 17-7 precipitation hardened (PH) stainless steel and heat-treated to Rockwell C40-48 hardness. These flat washers provide the strength of heat treatment and the corrosion-resistance of stainless steel and can be used in environments where regular, well-plated steel, cannot survive.



Stainless steel flat washer top and bottom

MPS Part Number	Bolt Diameter Size	I.D.	O.D.	t
SFW-753163S	.250	.500	.750	.063
SFW-873778S	.500	.375	.875	.078
SFW-104378S	.375	.438	1.000	.078
SFW-125078S	.438	.500	1.250	.078
SFW-135678S	.500	.563	1.375	.078
SFW-188290S	.563	.625	1.500	.090
SFW-1768120S	.625	.688	1.750	.120
SFW-2081131S	.750	.813	2.000	.131
SFW-2010131S	1.000	1.113	2.000	.131



Military Specification Series

MIL-DTL-12133/1D

AISI 1075 Spring Steel

(includes magnetic particle inspection and decarb testing)

MPS Part Number	Dash Number	O.D.	I.D.	t	OH
M12133/1-62	62	0.250	0.125	0.009	0.017
M12133/1-1	1	0.250	0.125	0.013	0.020
M12133/1-69	69	0.315	0.125	0.012	0.022
M12133/1-60	60	0.281	0.138	0.015	0.023
M12133/1-2	2	0.312	0.156	0.017	0.025
M12133/1-61	61	0.343	0.164	0.016	0.023
M12133/1-63	63	0.375	0.195	0.020	0.030
M12133/1-3	3	0.375	0.195	0.015	0.027
M12133/1-4	4	0.500	0.258	0.020	0.036
M12133/1-64	64	0.500	0.258	0.018	0.034
M12133/1-5	5	0.625	0.317	0.032	0.051
M12133/1-65	65	0.750	0.382	0.028	0.050
M12133/1-6	6	0.750	0.382	0.032	0.054
M12133/1-66	66	0.750	0.382	0.040	0.059
M12133/1-68	68	0.875	0.442	0.045	0.067
M12133/1-7	7	1.000	0.445	0.035	0.067
M12133/1-67	67	1.000	0.505	0.050	0.075
M12133/1-8	8	1.000	0.512	0.039	0.075
M12133/1-9	9	1.102	0.512	0.049	0.083
M12133/1-10	10	1.375	0.637	0.059	0.102
M12133/1-11	11	1.500	0.761	0.059	0.114
M12133/1-12	12	1.500	0.761	0.078	0.121
M12133/1-13	13	1.750	0.880	0.089	0.128
M12133/1-14	14	2.000	1.016	0.079	0.136
M12133/1-15	15	2.373	1.016	0.098	0.137

MIL-DTL-12133/2C

17/7 PH or 301/302 Stainless Steel

(includes passivation and dye penetrant inspection)

MPS Part Number	Dash Number	O.D.	I.D.	t	OH
M12133/2-93	093	0.187	0.093	0.010	0.015
M12133/2-125	125	0.250	0.125	0.013	0.020
M12133/2-156	156	0.312	0.156	0.017	0.025
M12133/2-190	190	0.375	0.190	0.020	0.030
M12133/2-200	200	0.375	0.190	0.015	0.027
M12133/2-255	255	0.500	0.255	0.025	0.038
M12133/2-400	400	0.625	0.317	0.022	0.042
M12133/2-317	317	0.625	0.317	0.032	0.048
M12133/2-380	380	0.750	0.380	0.040	0.059
M12133/2-505	505	1.000	0.505	0.050	0.075
M12133/2-567	567	1.125	0.567	0.056	0.084
M12133/2-630	630	1.250	0.630	0.062	0.092
M12133/2-755	755	1.500	0.755	0.045	0.093
M12133/2-100	100	2.000	1.000	0.065	0.130
M12133/2-900	900	2.500	1.250	0.125	0.180

Material

Spring steel (i.e. C 1075) MIL-DTL-12133/1

Stainless steel (301/302 or 17-7) MIL-DTL-12133/2

Example

M12133	/	1	-	1	P
MPS PART NUMBER		**MATERIAL** (type 1 for steel; type 2 for stainless)		**DASH NUMBER** size in inches (see chart)	**FINISH** (if any) (see chart for finish codes)

Part Number System

The part number consists of the MPS part number, followed by the material number (1 or 2), then a "Dash Number" and a finish code letter.

For example, **M12133 / 1 - 1 P**, indicates:

C1075 steel .250 OD x .125 ID x .013 thk x .020 OH with electro cadmium plating

Finish Codes

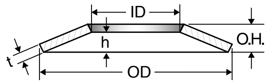
(apply to all MIL spec springs)

P Electro-deposited cadmium (AMS-QQ P-416, Type II, Class 2)

M Mechanically-deposited cadmium (AMS-C-81562, Type II, Class 2)

Z Either mechanical zinc with supplementary chromate (AMS-C-81562, Type II, Class 2) or electro-deposited zinc (ASTM B633, Fe/Zn 12, Type II)

NOTE: If finish spec code is blank, part is supplied as plain.



FL & MFL Series Flange Disc Springs

FL (inch) & MFL (metric) Series Flange Disc Springs are elastic mechanical elements designed primarily for pipe flange applications. When used in bolt joints that are subject to thermal or mechanical shock, they deflect and move with the bolted joint. Hence, they compensate for developed looseness. The reactive power of the flange disc spring serves to keep the bolt joint tight under all conditions. Principal applications include piping construction, compression joints, steam piping joints, valve and pump connections, and others in the petrochemical field.

Abnormally high loads, produced by thermal expansion and contraction of a bolted joint, are a principle cause of flange leakage. Generally, flanges are under static load conditions. However, in large piping systems there may also be mechanical shock from compressor related piping. Thermal and mechanical shock differential can cause variation and yielding in bolt loads. To protect against these conditions, always use flange spring discs under the nut or bolt head.

Pre-stressing or torquing the bolt at factory installation is not sufficient to protect the flange joint under unexpected temperature variations and mechanical shock loads in the field. Flange spring discs absorb peak stresses, therefore preventing damage to the bolt, gasket, and joint.

Material

Stainless	17-7 precipitation hardened
Hardness	Rc 40-45 for ID < 1.250 inches Rc 38-42 for ID ≥ 1.250 inches
Temperature Range	–220°C to +300°C for higher temperatures – to +600°C, Inconel™ 718 can be supplied (Inconel X-750 is non-standard)

MPS Part Number	Nominal Bolt Size (inch)	Metric Size	INCH Dimensions O.D.	I.D.	t	Ref. O.H.	@ Flat Load in Lbs.	Dry Torque to Flat (ft-lbs)
FL-388	.375	M10	.714	.390	.080	.086	1400	8
FL-716	.438		.820	.452	.080	.097	2800	23
FL-889	.500	M12	.900	.515	.089	.100	2100	19
FL-10125	.625	M16	1.145	.656	.125	.143	6500	70
FL-12131	.750	M20	1.365	.781	.131	.150	8500	70
FL-14160	.875	M22	1.585	.906	.160	.180	10200	113
FL-16168	1.000	M26	1.805	1.032	.168	.195	10500	156
FL-18187	1.125	M29	2.020	1.156	.187	.217	16800	217
FL-20190	1.250	M32	2.240	1.281	.190	.225	14000	239
FL-22250	1.375	M35	2.450	1.406	.250	.290	23000	576
FL-24250	1.500	M38	2.680	1.531	.250	.290	21000	520
FL-26262	1.625	M42	2.950	1.687	.262	.307	20000	590
FL-28281	1.750	M45	3.170	1.812	.281	.329	23000	730
FL-30300	1.875	M48	3.380	1.937	.300	.353	28000	960
FL-32318	2.000	M52	3.600	2.062	.318	.375	34000	1120
FL-36356	2.250	M58	4.040	2.312	.356	.418	51000	1600
FL-40394	2.500	M64	4.470	2.562	.394	.464	48000	2200

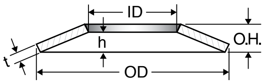
Note: Load calculated for 17-7 PH stainless steel with large radii, R=1/4

Tolerance

O.D.:	+ .000/- 1.5% x O.D.) (+/- .005 min) (Designed for standard flange spot face diameter)
I.D.:	- .000 / + 1.5% I.D. (+/- .005 min)
Thickness:	± 5% x nominal thickness shown
Load:	± 20% of nominal shown

MPS Part Number	Nominal Bolt Size (mm)	Metric Size	METRIC Dimensions Millimeters (mm) O.D.	I.D.	t	Ref. O.H.	Load @ Flat in Newtons	Dry Torque to Flat (N-m)
MFL-8050	8	M8	14.7	8.4	1.27	1.65	6000	9.5
MFL-8078	8	M8	15	8.4	2.00	2.30	17000	30
MFL-10078	10	M10	18.2	10.4	2.00	2.29	11500	24
MFL-12090	12	M12	21.7	12.4	2.30	2.60	14500	34
MFL-14098	14	M14	25.2	14.4	2.50	2.95	19000	56
MFL-20160	20	M20	36.4	20.8	4.06	4.55	51000	190
MFL-24160	24	M24	43	24.8	4.00	4.80	51000	200
MFL-27168	27	M27	48.7	27.8	4.27	5.08	48000	240
MFL-30190	30	M30	53.9	30.8	4.80	5.54	66500	275
MFL-36250	36	M36	68.1	36.8	6.35	7.49	92000	725
MFL-39250	39	M39	70	39.6	6.35	7.49	93000	775

Note: Load calculated for 17-7 PH stainless steel with large radii, R=1/4



NDS Series Flange Disc Springs

NDS (National Disc Spring) Flange Disc Springs maintain bolt tension and gasket pressure around the flange, especially under conditions of thermal variations or mechanical shock, which may disturb the bolted joint. They counteract loosening and assure the integrity of the bolted flange under the most severe conditions. The proper use of NDS series flange disc springs will ensure that the gasketed joints will completely maintain the seal - no leaking, reducing pollution, ensuring safety, and reducing pipeline downtime.

The NDS series flange disc spring is "live loaded", which means it automatically adjusts for thermal variation, vibration, and mechanical shock stress.

Flange disc springs are precision-machined on all surfaces, with well-rounded edges. They are used as a single disc spring or stacked on each end of the bolt, depending on estimated bolt elongation.

Material

H11/H13 steel is used, which can be used at high temperatures. Under most conditions, the NDS disc springs can withstand temperatures in the range of 1100°F (590°C).

MPS Part Number	Nominal Bolt Size	Dimensions (Inches)			Deflection @ Flat	Load @ Flat in Lbs.	Torque in ft-lbs
		I.D.	O.D.	t			
NDS-1-60	.500	.515	1.011	.148	.014	8500	80
NDS-1-45	.500	.515	1.011	.140	.010	6400	45
NDS-1-30	.500	.515	1.011	.130	.010	4200	30
NDS-2-60	.625	.644	1.148	.187	.012	13500	120
NDS-2-45	.625	.644	1.148	.180	.011	9900	90
NDS-2-30	.625	.644	1.148	.152	.012	6500	60
NDS-3-60	.750	.773	1.370	.224	.015	20000	200
NDS-3-45	.750	.773	1.370	.220	.012	15000	150
NDS-3-30	.750	.773	1.370	.190	.013	9700	100
NDS-4-60	.875	.901	1.590	.280	.015	28000	320
NDS-4-45	.875	.901	1.590	.265	.013	20000	240
NDS-4-30	.875	.901	1.590	.220	.015	13000	160
NDS-5-60	1.000	1.030	1.810	.316	.018	36000	490
NDS-5-45	1.000	1.030	1.810	.305	.015	27000	365
NDS-5-30	1.000	1.030	1.810	.260	.016	18000	245
NDS-6-60	1.125	1.155	2.025	.370	.018	47000	700
NDS-6-45	1.125	1.155	2.025	.345	.017	35000	550
NDS-6-30	1.125	1.155	2.025	.285	.020	23000	350
NDS-7-60	1.250	1.281	2.310	.405	.023	60000	1000
NDS-7-45	1.250	1.281	2.310	.395	.019	45000	750
NDS-7-30	1.250	1.281	2.310	.325	.023	30000	500
NDS-8-60	1.375	1.406	2.470	.446	.024	74000	1350
NDS-8-45	1.375	1.406	2.470	.440	.019	55000	1000
NDS-8-30	1.375	1.406	2.470	.358	.023	36000	680
NDS-9-60	1.200	1.531	2.680	.513	.024	89000	1600
NDS-9-45	1.200	1.531	2.680	.503	.025	79000	1500
NDS-9-30	1.200	1.531	2.680	.400	.024	44000	800
NDS-10-60	1.625	1.649	2.950	.542	.028	106000	2200
NDS-10-45	1.625	1.649	2.950	.513	.025	80000	1700
NDS-10-30	1.625	1.649	2.950	.436	.027	53000	1100
NDS-11-60	1.750	1.774	3.170	.593	.029	125000	3000
NDS-11-45	1.750	1.774	3.170	.550	.027	92000	2300
NDS-11-30	1.750	1.774	3.170	.470	.029	60000	1500
NDS-12-60	1.875	1.899	3.389	.618	.030	128000	4000
NDS-12-45	1.875	1.899	3.389	.597	.028	107000	3000
NDS-12-30	1.875	1.899	3.389	.510	.030	70000	2000
NDS-13-60	2.000	2.024	3.600	.636	.032	132000	4400
NDS-13-45	2.000	2.024	3.600	.628	.031	120000	3000
NDS-13-30	2.000	2.024	3.600	.545	.032	83000	2200
NDS-14-60	2.250	2.281	4.040	.725	.036	169000	6000
NDS-14-45	2.250	2.281	4.040	.716	.032	155000	5000
NDS-14-30	2.250	2.281	4.040	.615	.036	105000	4000
NDS-15-60	2.500	2.531	4.483	.810	.038	210000	9000
NDS-15-45	2.500	2.531	4.483	.795	.038	196000	6600
NDS-15-30	2.500	2.531	4.483	.695	.038	130000	4000
NDS-16-60	2.750	2.781	4.920	.880	.045	260000	12000
NDS-16-45	2.750	2.781	4.920	.875	.042	240000	9000
NDS-16-30	2.750	2.781	4.920	.755	.045	164000	6000
NDS-17-60	3.000	3.031	5.360	.984	.046	310000	15000
NDS-17-45	3.000	3.031	5.360	.975	.042	290000	12000
NDS-17-30	3.000	3.031	5.360	.835	.046	190000	8000

Tolerance

O.D.:	+ .000/- 1.5% x O.D. (Designed for standard flange spot face diameter)
I.D.:	- .000 / + 1.5% I.D.
Thickness:	± 5% x nominal thickness shown
OH:	is a reference and used to control the needed load
Load:	± 20% of nominal shown
HRC:	40-45

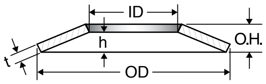
National Disc Spring H11/H13 steel flange disc springs are designed to meet specific bolt stress requirements:

Parts ending in	Bolt stress PSI
-60	60,000
-45	45,000
-30	30,000

All parts are heat treated with a plain finish

Loads for the NDS series have a tolerance of ± 20% of loads indicated

Contact us: marylandprecisionspring.com or email info@marylandprecisionspring.com



AK Series Disc Springs

AK (Ball Bearing Series Disc Springs) are specially designed as preloading springs for use with radial ball bearings. These disc springs help to maintain positioning accuracy of the bearing with no endplay. They also minimize vibration and shaft deflection. Proper preloading will increase bearing rigidity and eliminate excessive running noise.

Refer to pages 20-21 for the standard spring tolerances of the AK/SAK Series Disc Springs.

When requesting parts made of stainless steel, add the letter "S" to the beginning of the existing part number. For example, carbon steel part number AK-6312 becomes SAK-6312.

Material

C1075 Steel

17/7 PH stainless steel

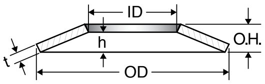
Rockwell hardness HRC 40-52

Tolerance

Load: ± 20% @ .75h

MPS Part Number	Ball Bearing Size	O.D.		I.D.		t		O.H.		Load @ .75h DEFL.			
		Inches	Metric	Inches	Metric	Inches	Metric	Inches	Metric	Lbs	Inches	kg	mm
AK-R-2	R-2	.366	9.300	.228	5.800	.008	.200	.016	.400	5.90	.006	2.7	.15
AK-623	623, EL-3	.386	9.800	.244	6.200	.008	.200	.016	.400	5.40	.006	2.5	.15
AK-R-3	R-3	.492	12.500	.319	8.100	.010	.250	.020	.500	8.30	.008	3.8	.20
AK-624	624, EL-4	.504	12.800	.283	7.200	.010	.250	.020	.500	6.70	.008	3.1	.19
AK-R-4	R-4	.618	15.700	.406	10.300	.010	.250	.022	.560	6.80	.009	3.1	.23
AK-625	625, 634, EL-5	.622	15.800	.323	8.200	.010	.250	.022	.550	5.30	.009	2.4	.23
AK-626	626, 635, EL-6	.740	18.800	.362	9.200	.012	.300	.026	.650	7.20	.010	3.3	.26
AK-607	607, EL-7	.740	18.800	.402	10.200	.014	.350	.028	.700	11.80	.010	5.3	.26
AK-608	608, 627, EL-8	.858	21.800	.484	12.300	.014	.350	.030	.750	10.70	.012	4.8	.30
AK-R-6	R-6	.862	21.900	.539	13.700	.014	.360	.030	.760	11.80	.012	5.3	.30
AK-609	609, EL-9	.933	23.700	.563	14.300	.016	.400	.035	.900	18.50	.015	8.4	.38
AK-6000	6000, 629	1.012	25.700	.563	14.300	.016	.400	.035	.900	14.50	.015	8.3	.38
AK-6001	6001	1.091	27.700	.681	17.300	.016	.400	.039	1.000	18.40	.018	8.3	.45
AK-R-8	R-8	1.110	28.200	.724	18.400	.016	.400	.043	1.100	24.10	.021	10.9	.53
AK-6200	6200	1.169	29.700	.685	17.400	.016	.400	.043	1.100	19.00	.021	8.6	.53
AK-6002	6002, 6201	1.248	31.700	.803	20.400	.016	.400	.043	1.100	18.60	.021	8.4	.53
AK-R-10	R-10	1.358	34.500	1.000	25.400	.020	.500	.047	1.200	34.80	.021	15.8	.53
AK-6300	6300	1.362	34.600	.803	20.400	.016	.400	.043	1.100	14.10	.021	6.4	.53
AK-6003	6003, 6202	1.362	34.600	.882	22.400	.020	.500	.047	1.200	27.30	.021	12.4	.53
AK-6301	6301	1.441	36.600	.803	20.400	.020	.500	.051	1.300	25.50	.024	11.5	.60
AK-6203	6203	1.559	39.600	1.004	25.500	.020	.500	.051	1.300	25.30	.024	11.5	.60
AK-6004	6004, 6302	1.638	41.600	1.004	25.500	.020	.500	.055	1.400	26.10	.027	11.8	.68
AK-6005	6005, 6204, 6303	1.831	46.500	1.201	30.500	.024	.600	.059	1.500	35.30	.027	16.0	.68
AK-6205	6205, 6304	2.028	51.500	1.398	35.300	.024	.600	.059	1.500	31.10	.027	14.1	.68
AK-6006	6006	2.146	54.500	1.594	40.500	.024	.600	.059	1.500	32.50	.027	14.7	.68
AK-6007	6007, 6206, 6305	2.421	61.500	1.594	40.500	.028	.700	.071	1.800	40.30	.033	18.3	.83
AK-6008	6008	2.657	67.500	1.988	50.500	.028	.700	.067	1.700	37.10	.030	16.8	.75
AK-6306	6306	2.815	71.500	1.791	45.500	.028	.700	.083	2.100	42.50	.041	19.3	1.05
AK-6207	6207	2.815	71.500	1.988	50.500	.028	.700	.083	2.100	50.30	.042	22.8	1.05
AK-6009	6009	2.933	74.500	2.185	55.500	.032	.800	.075	1.900	48.50	.033	22.0	.83
AK-6307	6307	3.130	79.500	1.988	50.500	.032	.800	.091	2.300	52.20	.045	23.7	1.13
AK-6010	6010, 6208	3.130	79.500	2.185	55.500	.032	.800	.091	2.300	60.60	.045	27.5	1.13
AK-6209	6209	3.327	84.500	2.382	60.500	.035	.900	.098	2.500	82.40	.048	37.4	1.21
AK-6308	6308	3.524	89.500	2.382	60.500	.035	.900	.098	2.500	65.90	.047	29.9	1.20
AK-6011	6011, 6210	3.524	89.500	2.579	65.500	.035	.900	.098	2.500	76.90	.048	34.9	1.21
AK-6012	6012	3.720	94.500	2.972	75.500	.039	1.000	.087	2.200	74.80	.036	33.9	.91
AK-6309	6309	3.898	99.000	2.579	65.500	.039	1.000	.102	2.600	67.10	.047	30.4	1.20
AK-6013	6013, 6211	3.898	99.000	2.776	70.500	.039	1.000	.102	2.600	76.40	.047	34.6	1.21
AK-6310	6310	4.291	109.000	2.776	70.500	.049	1.250	.106	2.700	81.70	.043	37.1	1.09
AK-6014	6014, 6212	4.291	109.000	2.972	75.500	.049	1.250	.106	2.700	91.10	.043	41.3	1.09
AK-6015	6015	4.488	114.000	3.563	90.500	.049	1.250	.097	2.450	91.40	.036	41.5	.91
AK-6311	6311	4.685	119.000	2.972	75.500	.049	1.250	.110	2.800	73.00	.046	33.1	1.16
AK-6213	6213	4.685	119.000	3.366	85.500	.049	1.250	.110	2.800	89.80	.046	40.7	1.17
AK-6016	6016, 6214	4.882	124.000	3.563	90.500	.049	1.250	.118	3.000	101.90	.052	46.2	1.32
AK-6312	6312	5.079	129.000	3.366	85.500	.049	1.250	.126	3.200	92.70	.058	42.0	1.47
AK-6017	6017, 6215	5.079	129.000	3.760	95.500	.049	1.250	.126	3.200	114.70	.058	52.0	1.47
AK-6313	6313	5.472	139.000	3.563	90.500	.049	1.250	.128	3.250	80.90	.059	36.7	1.50

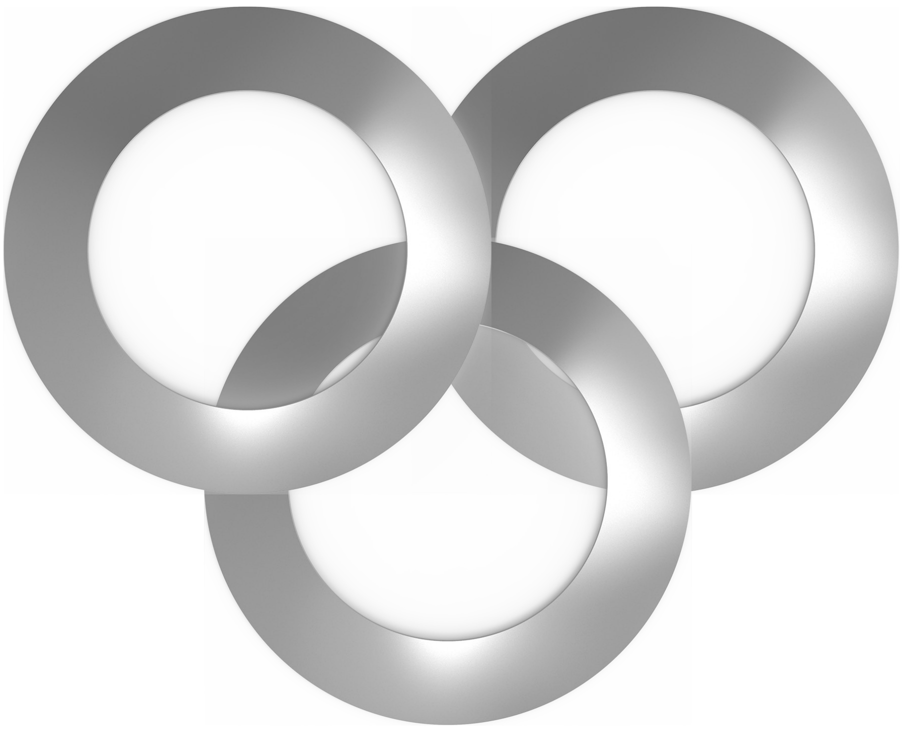
continued on next page



AK Series Disc Springs

continued from previous page

MPS Part Number	Ball Bearing Size	O.D.		I.D.		t		O.H.		Load @ .75h DEFL.			
		Inches	Metric	Inches	Metric	Inches	Metric	Inches	Metric	Lbs	Inches	kg	mm
AK-6018	6018, 6216	5.472	139.000	3.976	101.000	.049	1.250	.128	3.250	98.40	.059	44.6	1.51
AK-6314	6314	5.866	149.000	3.760	95.500	.059	1.500	.126	3.200	86.80	.050	39.4	1.28
AK-6020	6020, 6217	5.866	149.000	4.173	106.000	.059	1.500	.126	3.200	103.00	.050	46.7	1.28
AK-6315	6315	6.260	159.000	3.976	101.000	.059	1.500	.138	3.500	94.30	.059	42.8	1.50
AK-6021	6021, 6218	6.260	159.000	4.370	111.000	.059	1.500	.138	3.500	109.20	.059	49.5	1.50
AK-6316	6316	6.654	169.000	4.370	111.000	.059	1.500	.150	3.800	107.50	.068	48.8	1.73
AK-6022	6022, 6219	6.654	169.000	4.764	121.000	.059	1.500	.150	3.800	125.00	.068	56.7	1.73
AK-6317	6317	7.047	179.000	4.764	121.000	.079	2.000	.165	4.200	197.70	.065	89.7	1.66
AK-6024	6024, 6220	7.047	179.000	4.961	126.000	.079	2.000	.165	4.200	212.50	.065	96.4	1.66
AK-6318	6318	7.441	189.000	4.764	121.000	.079	2.000	.169	4.300	173.30	.068	78.6	1.73
AK-6221	6221	7.441	189.000	5.157	131.000	.079	2.000	.169	4.300	196.10	.068	88.9	1.73
AK-6319	6319	7.795	198.000	5.157	131.000	.079	2.000	.177	4.500	185.50	.074	84.1	1.88
AK-6026	6026, 6222	7.795	198.000	5.551	141.000	.079	2.000	.177	4.500	211.00	.074	95.7	1.88
AK-6224	6224, 6320	8.386	213.000	5.945	151.000	.089	2.250	.177	4.500	215.20	.067	97.6	1.69
AK-6030	6030, 6321	8.780	223.000	6.339	161.000	.089	2.250	.181	4.600	215.30	.070	97.7	1.77
AK-6226	6226	8.976	228.000	6.339	161.000	.089	2.250	.195	4.950	237.00	.080	107.5	2.03
AK-6322	6322	9.370	238.000	6.339	161.000	.089	2.250	.207	5.250	233.40	.089	105.9	2.26
AK-6228	6228	9.764	248.000	6.732	171.000	.098	2.500	.197	5.000	229.30	.074	104.0	1.88
AK-6324	6324	10.157	258.000	6.732	171.000	.098	2.500	.217	5.500	252.50	.089	114.5	2.25
AK-6230	6230	10.551	268.000	7.126	181.000	.098	2.500	.224	5.700	263.60	.095	119.6	2.41
AK-6232	6232	11.339	288.000	7.520	191.000	.108	2.750	.226	5.750	261.50	.089	118.6	2.25
AK-6328	6328	11.732	298.000	7.520	191.000	.108	2.750	.250	6.350	298.60	.107	135.4	2.70
AK-6234	6234	12.126	308.000	7.953	202.000	.118	3.000	.240	6.100	296.70	.092	134.6	2.33
AK-6236	6236, 6330	12.520	318.000	8.346	212.000	.118	3.000	.244	6.200	297.00	.095	134.7	2.40
AK-6238	6238, 6332	13.307	338.000	9.134	232.000	.118	3.000	.260	6.600	322.50	.107	146.3	2.70
AK-6240	6240, 6334	14.094	358.000	9.528	242.000	.118	3.000	.284	7.200	348.90	.124	158.3	3.16



Contact us: marylandprecisionspring.com or email info@marylandprecisionspring.com

Custom Disc Springs

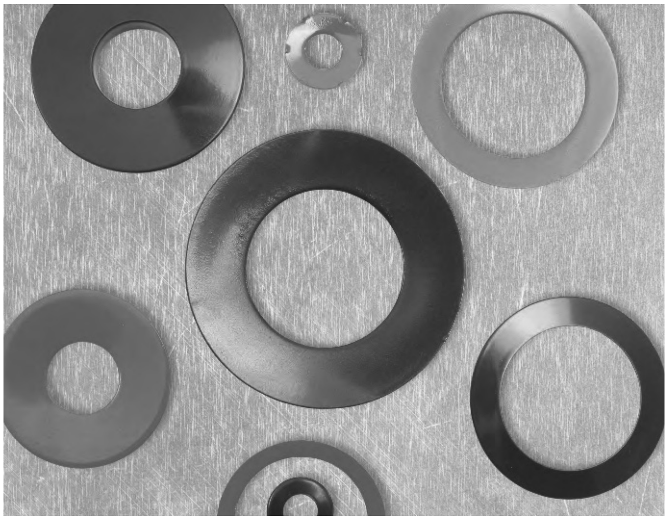
Can't find a stock/catalog disc spring that meets your project requirements? No problem! Our disc spring team will engineer a custom solution for you!

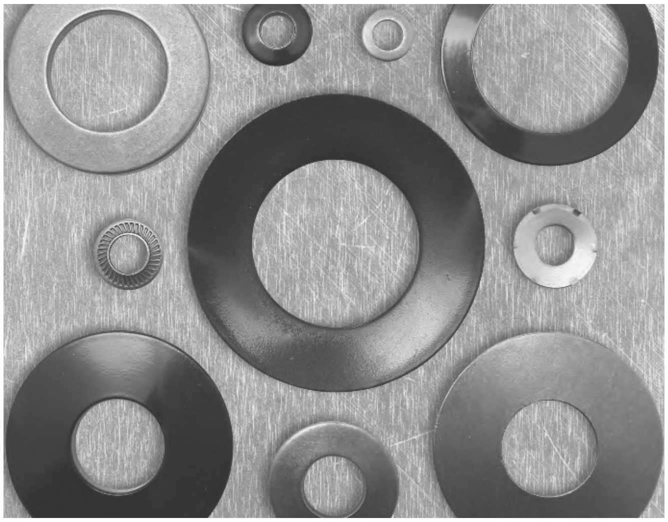
We are the leader in custom, precision disc springs, having designed and manufactured thousands of custom disc springs for a range of customers' unique applications.

If your application needs an engineered solution due to special environmental conditions, tight space constraints, special load requirements, or service life expectations then let us help. Together we will optimize the performance of your system by providing insight into manufacturing methods that minimize your cost.

In addition to custom designs, we offer special packaging of disc springs including stacking, to make your final assembly operation more efficient.

Contact our disc spring team for any information about custom disc spring design and manufacturing.





Material options include

- **Carbon steels**
- **Alloy steels**
- **Stainless steel alloys**
- **Tool steels**
- **Specialty metals**

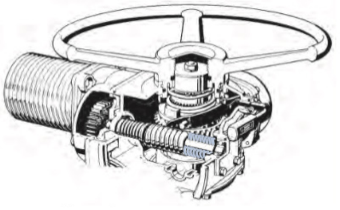
We empower innovation.
We engineer value.

Applications for Disc Springs

Disc springs are used in applications throughout a wide range of industries and markets. A few examples showing the use and importance of our disc springs include:

Valve Actuator Assembly

Normal spring return actuators:

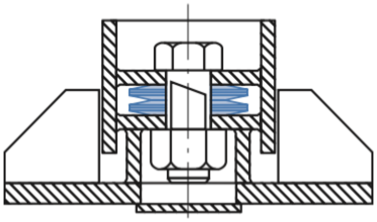


The electrical or pneumatic actuator compresses the springs to actuate the valve. When the controller releases power or pressure, the force stored in the spring returns the actuator to its start position, allowing for simpler and less expensive control/actuator systems.

Fail-safe spring actuators: During powered operation the springs travel with the actuator. The actuator opens and closes the valve, and provides braking. Under loss of power, the spring is released and drives the actuator to the pre-designated fail-safe position.

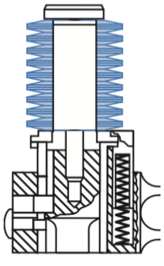
Shock Absorbing Bolted Assembly

Disc springs are largely self-damping, particularly when they are stacked in parallel. This makes the springs useful in dissipating energy in bolted assemblies that are subjected to shock loading and vibration.



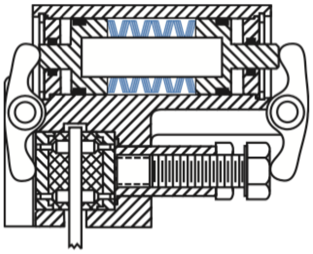
Punch Stripper Assembly

Stacks of disc springs can be used to provide the retraction force (“stripping”) for punches. The compact size of the springs is ideal for punch cassettes that can be used in CNC punch machine tool changers.



Fail-Safe Brake Assembly

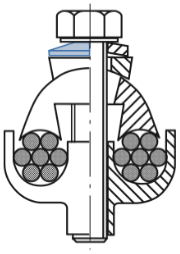
In many machinery applications it is necessary that a brake be applied in case power to the equipment is lost. In these situations disc springs can be installed so that they are compressed when the machine engages to release the brake and then, if power is lost, the springs apply the brake and stop the machinery.



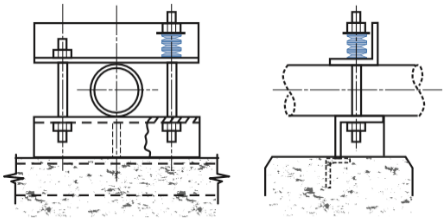
Cable Support Assembly

Often when materials such as wires or cables are clamped using a screw or bolt, the wire or cable will compress over time and the assembly will become loose.

Disc springs can provide for this compression and keep the assembly tight.



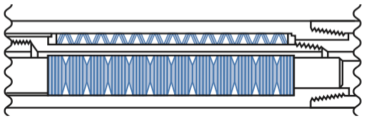
Pipe Hold-Down Assembly



Long pipe runs require structural support, but are also subject to movement due to temperature changes. A structural support that includes disc springs can both support and control the pipe, by allowing some movement when required.

Applications for Disc Springs

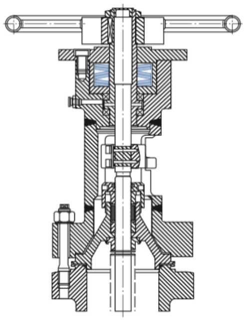
Shock Absorber Assembly for Drill Bit



Deep down-hole drilling for oil and gas exploration creates extreme shock loads on the drill bits. Stacks of disc springs can be used to cushion the drill bit, giving it a longer bit life.

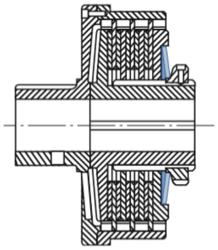
Valve Packing Assembly

Disc springs are used in valves to maintain pressure on the packing so that the seal around the valve stem does not leak. Over time the packing material will compress and the disc springs will take up the slack.



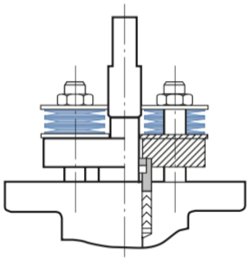
Friction Assembly

Friction assemblies like clutches, traction drives, and brakes use disc springs to provide even pressure as friction materials wear away and actuation deflections change.



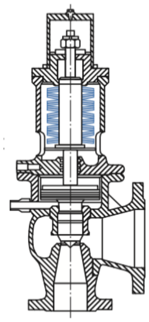
Live Loaded Joints

Many joints, particularly pipe flanges are subject to loosening due to temperature change cycles. This loosening often results in leakage at the joints. Disc springs are part of a "live loading" assembly that help maintain leak-tight joints, greatly reducing maintenance costs.



High Pressure Valve

Disc springs are used to provide control in pressure valves. The disc springs keep the valve closed until the control fluid pressure rises to the point where it overcomes the designed load of the springs, and at that point, the valve opens releasing pressure.



Markets and industries using disc springs

- Agricultural
- Automotive
- Auto Racing
- Aviation/Aerospace
- Chemical Processing
- Computers
- Electrical
- Energy
- Hand and Power Tools
- Heavy Trucks
- Machine Tools
- Material Handling
- Medical
- Mining
- Off-Road Machinery
- Oil Field Equipment
- Outdoor Power Equipment
- Retail Products Display Fixtures
- Telecommunications
- Transportation
- Valves
- And More!

Maryland Precision Spring

About Maryland Precision Spring

Maryland Precision Spring is a leading manufacturer of disc springs with an extensive inventory of standard parts and wide variety of custom manufacturing capabilities. For decades Maryland Precision Spring has been serving a multiple key industries, including aerospace, transportation, machining, construction, and many more.

marylandprecisionspring.com