MW® INDUSTRIES inc.
Empowering innovation. Engineering value.™

CARBON COMPOSITE BELLOWS™ SPRING

HELICAL PRODUCTS COMPANY
MW Industries, Inc.

Patent Pending.

THE CARBON COMPOSITE BELLOWS SPRING

The Carbon Composite Bellows Spring (CCBS) is a system of carbon fiber elements that combine to work as a high performance, light weight, and design flexible compression spring.

Meant to replace conventional coil springs or metallic Belleville disc springs by offering value through unique dynamic characteristics and unparalleled in the field design flexibility, the Carbon Composite Bellows Spring offers new solutions to old challenges.

A functional spring is made from several individual elements, paired in sets and joined to make a stack. The spring rate of the stack is determined by the number of elements, the base rate of each element, and their series or parallel orientation in the stack.

ANATOMY OF A CCBS STACK

Elements

F-Type

L-Type

N-Type

Series Stacking

1 F-Type AND 1 L-Type, concave sides facing

Parallel Stacking

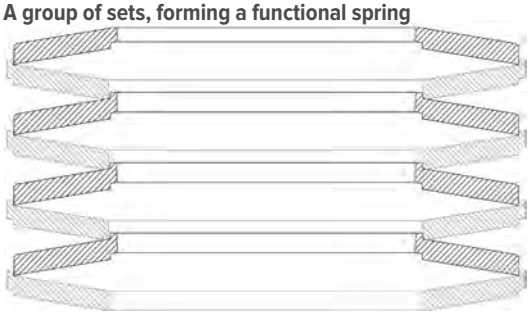
2 F-Type OR 2 L-Type, nested

Set

1 pair of elements in series, with or without parallel elements

Stack

A group of sets, forming a functional spring



Base Rate

Refers to the spring rate of each individual element. It is usually expressed in thousands of pounds per inch.

WHY CARBON FIBER?

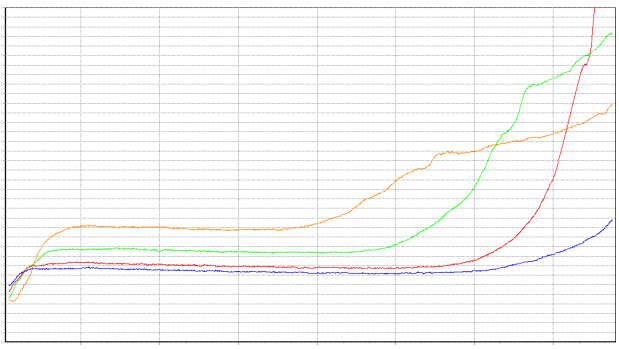
It's Not Only About Weight

Carbon fiber composite material offers significant advantages compared to conventional metallic alloys when used as a spring material.

1. The manufacture of a carbon fiber part is through molding. This allows for complicated and intricate designs to be formed in a single operation and permits design features not possible with a machined or stamped metallic spring.
2. Laminate construction permits steeper pitch angles to allow more deflection per element without overstressing.
3. The base rate of each element is determined by its finished thickness. This means that new or custom rates can be built quickly and do not require the use of different raw material sizes or special tooling.
4. Carbon fiber is non-magnetic and impervious to many liquids and compounds that lead to metallic corrosion.
5. For a given rate and deflection, a CCBS stack weighs significantly less - many times up to 60-70%.

Adaptable

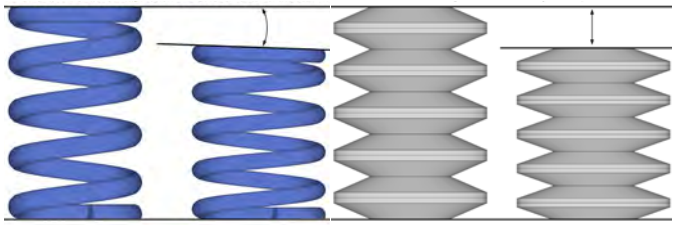
The shape of the rate curve is able to be tuned to meet the needs of the project. This can be done without a costly redesign or even the manufacture of new parts. It is simply a reorientation of the standard elements.



X-axis = deflection and Y-axis = rate.

Centered Load

Side load on the spring carrier is a thing of the past. As the carbon elements work in bending, instead of torsion to store and release energy, the parallel ends of the spring remain parallel throughout the deflection.



Ends tilt under compression to create side load on the carrier.

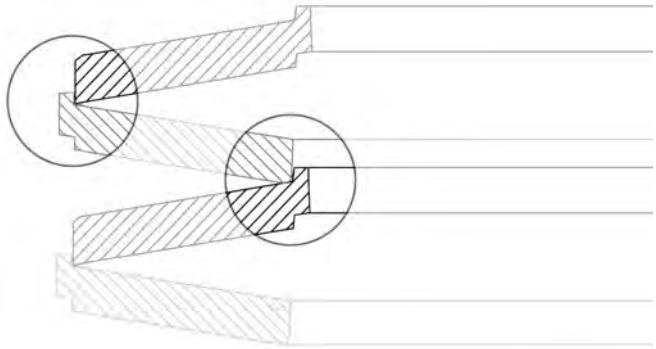
Ends remain parallel under compression, with no side load.

Standard Inventory vs. Custom Needs

Standard elements are available, but one size does not fit all. With low tooling costs for custom sizes and the ability to make multiple base rates from a single mold and one material, production flexibility is at an all time high.

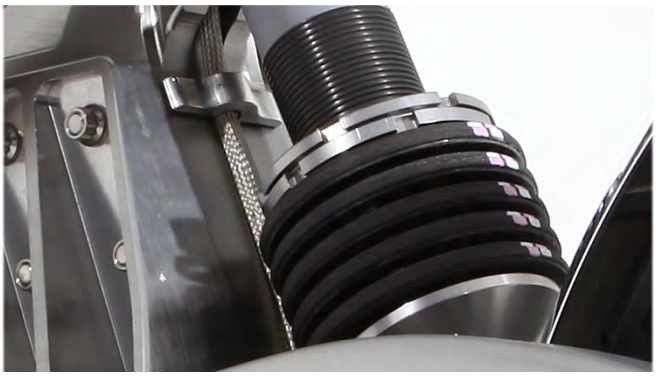
Multi-Function Design

Free up space and weight in your project by utilizing the lip/flange design that keeps all elements in the stack centered on each other. No ID shaft or OD bore is needed.



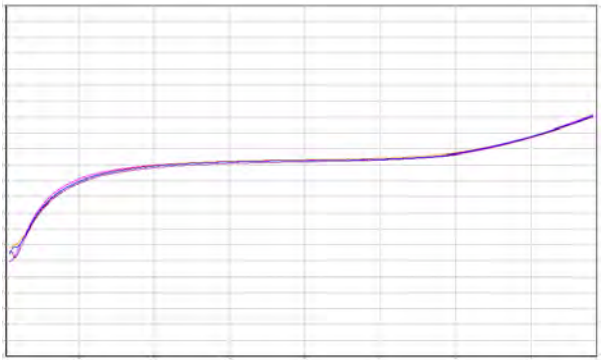
In the Field Design Flexibility

The ability to change the spring rate, length, and deflection of a CCBS stack on the fly, in the field, and without any new manufacturing, means that you have ultimate control over the spring used in your product.



Repeatable

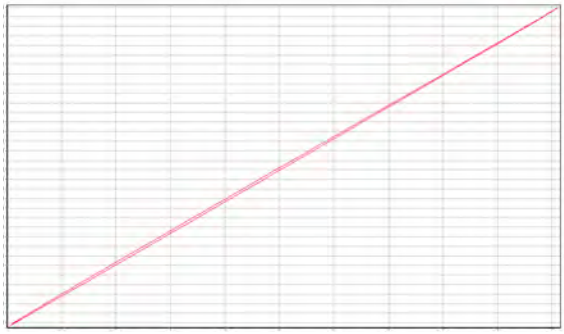
Tolerances are able to be held to 2% of intended rate and free length. Using advanced manufacturing and molding processes, dimensional tolerances are held to +/- 0.001”



X-axis = deflection and Y-axis = rate.

Mechanically Efficient

Low hysteresis due to an optimized interface between the elements and the reduction of friction at the spring-seat surface results in a spring that is as efficient at releasing energy as it is at storing it.



Loading under compression and extension. X-axis = deflection and Y-axis = load.

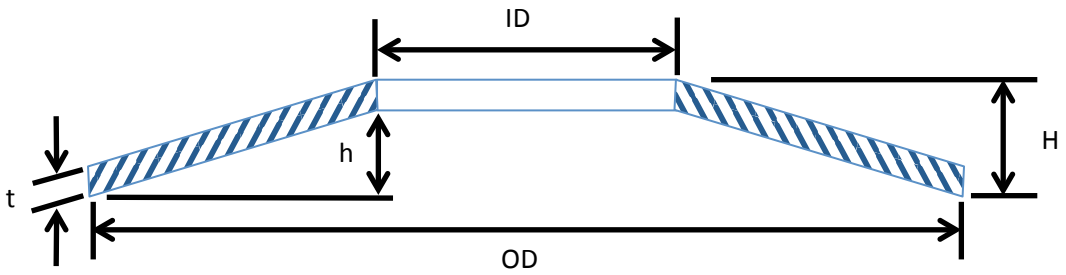
Natural Frequency

The amorphous structure of the composite material and the slight damping created at the contact points eliminates the negative effect of natural frequency on component life.

9501 Technology Boulevard
Suite 401
Rosemont, IL 60018
www.mw-ind.com

General Dimensions of Standard Carbon Composite Elements

Additional sizes possible with custom tooling



Carbon Composite Bellows Spring (CCBS) Interlocking Carbon Spring Elements					
Series	ID^	OD^	h^	t+	H+
A-Series	2.25”	4.00”	.122”	.170”	.292”
C-Series	2.00”	3.60”	.102”	.160”	.262”
J-Series	2.40”	3.83”	.098”	.166”	.271”
K-Series	1.38”	2.35”	.072”	.095”	.167”

Type 2 Carbon Spring Elements					
Part Family	ID^	OD^	h^	t+	H+
120198060	1.20”	1.98”	.055”	.112”	.172”

^ - Listed dimensions are nominal and fixed across all base rates in the series.

+ - Listed dimensions are for approximation only and will vary across all base rates in the series.

For more information visit www.mw-ind.com/ccbs

POSSIBLE APPLICATIONS AND USES FOR CCBS

WEIGHT-CONSCIOUS PROJECTS

MOTORSPORTS

OUTDOOR RECREATION

AEROSPACE

GENERAL INDUSTRY

HIGH PERFORMANCE ACTIVITIES

KEY CONSIDERATIONS FOR CCBS:

- Overall dimensional constraints: ID, OD, and free length
- Deflection vs. free length
- Required rate or range of rates
- Environmental effects: UV exposure, cleanliness, and temperature
- Service life/cycles and frequency of inspection

MW INDUSTRIES, INC.

MW Industries, Inc. (MWI) is one of the world's premier manufacturers of products that make machines, engines, and complex sub-assemblies work harder, better, longer, and faster. Our full line of industrial springs, fasteners, machined parts, and flat-stamped spring-related products are engineered for peak performance and made from the world's best materials. Innovation and value are the linchpins of our company and no one in the industry can match our manufacturing capabilities and reputation for quality. No one.

Across myriad industries and applications, we've created the most diverse product line available. Our innovations become the strength, speed, and durability that you need in your applications. We've earned a reputation for - and built our business on - delivering the most technologically innovative and durable products. **We empower innovation. We engineer value.**

HELICAL PRODUCTS COMPANY
MW Industries, Inc.