

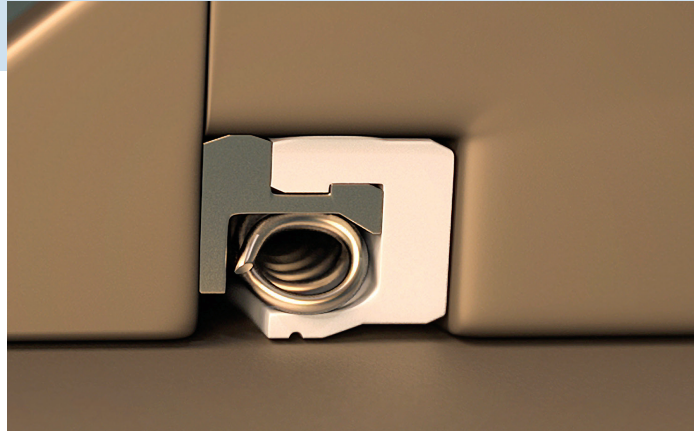


Photo: United States Navy

Sealing, Connecting, Conducting and EMI/RFI Shielding Solutions for Medical Devices

Advancing Medical Device Technology

Bal Seal Engineering, Inc. is a global provider of custom-engineered sealing, connecting, conducting, and EMI/RFI shielding solutions for medical devices. Our core technology, the Bal Spring[®], is a versatile component that functions independently or in combination with precision polymer sealing and metal retaining elements to enhance the performance and reliability of surgical instruments, orthopedic devices, drug infusion, and diagnostic equipment.



We're more than just a component maker - we're your innovation partner. With over 60 years of experience and a vast application knowledge base, we specialize in helping medical device designers develop breakthroughs that shape industry standards, push the technology envelope, and provide a competitive edge.

Whether you're addressing an existing challenge or still in the early stages of development, we can help. Our application engineers can collaborate and contribute during every step in the process, so that you can improve product performance and increase your speed to market.



Commitment to Quality

At Bal Seal Engineering, our goal is to be your #1 component supplier for medical applications. We strive to accomplish this by integrating strict quality standards at every step, from design control to process control, supplier approval to final packaging. These efforts enable us to ensure compliance with the most demanding customer requirements, as well as our own high workmanship standards. We've maintained our ISO 9001 certification since 1999.

The Right Selection for You

We offer a broad range of solutions for medical devices, and by guiding you through design considerations—including seal material, geometry, spring load, etc.—our team of engineering professionals can help you determine which one is ideal for your unique challenge. Our early involvement in the design of hardware can ensure optimal performance to your criteria.

What We Offer

- A design engineering team with the industry's broadest application experience, and the know-how to properly address all of your technical performance, quality, and packaging requirements
- Sealing, connecting, conducting, and EMI/RFI shielding components that are designed to meet the very unique demands of your application, promoting safer, more reliable performance
- A skilled team of customer representatives, serving as your personal connection to the products and services we offer, with the ability to accommodate your manufacturing processes and scheduling needs

OUR PRODUCTS

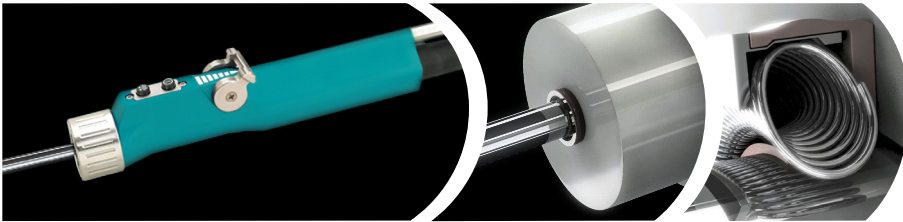
We offer a wide range of sealing, connecting, conducting and EMI/RFI shielding solutions that are easily customized to meet your specific requirements.

- Bal Seal® spring-energized PTFE seals (for rotary, reciprocating, and static service)
- Bal Spring® canted coil springs for mechanical connecting, electrical conducting, EMI shielding/grounding
- Bal Conn® electrical contacts

TYPICAL APPLICATIONS

- Catheters
- Centrifuges
- Dialysis equipment
- Endoscopes
- Hand pieces
- High-speed motors
- Oxygen equipment
- Ophthalmic devices
- Orthopedic applications:
 - Instruments
 - Implantable retention devices
 - Implantable fixation systems
- Pumps
- Ultrasound equipment

Example 1. Surgical Bone Shaver



Operating Parameters

Pressure: Atmospheric to autoclaved 30 psi

Media: Bone, tissue, bearing grease, and sterilization fluids

Speed: 4 ft./min. @ 60 Hz

Temperature: 70°F to 300°F (Autoclave)

Example 2. Carpometacarpal Joint Replacement Implant



Operating Parameters

Diameter: 5-8mm

Degree of freedom (DOF): 90° on X and Y axes

Cycles: >1 million

Mating parts: Biocompatible materials (Housing = Titanium, Spring = Nickel Alloy, Insert/socket lining = UHMWPE)



Bal Seal® spring-energized seal



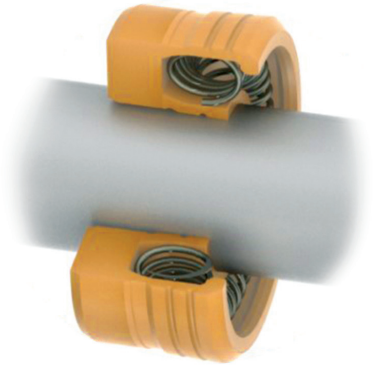
Bal Spring® canted coil spring



Bal Conn® electrical contact

The custom-engineered Bal Seal® spring-energized seal sets new standards for performance and reliability in rotary, reciprocating, oscillating, and static service. Precision-machined from PTFE and other premium polymers, our seal employs innovative geometries and wear-reducing canted coil spring energizer technology to extend the service life of the critical equipment you design.

With nearly limitless combinations of jacket and spring materials to choose from, the Bal Seal gives you the ability to closely control frictional forces and optimize sealing effectiveness in a broad range of chemicals, temperatures, and pressures. Bal Seal locking rings and backup elements can help you push performance levels even higher.

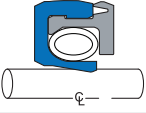
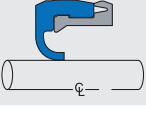
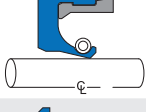

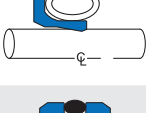

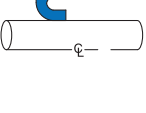


Polymers for seal jackets

The Bal Seal® spring-energized seal's Base jacket materials consist of polytetrafluoroethylene (PTFE), polyethylene (PE), polyetheretherketone (PEEK), and other specialty polymers. We combine these with advanced filler materials to enhance performance properties. Here's a small sampling of the materials we've formulated for specific application requirements, including several that are **USP Class VI and ISO 10993-5 compliant**.

Material Callout	Description	Color	Temperature Range °F (°C)	Chemical Compatibility
T	Virgin PTFE Light duty service. Lowest friction. Low wear resistance. Low cost. FDA compliant.	White	-450 to 450 (-268 to 232)	Excellent
TA	PTFE - Low Permeability Superior mechanical properties with good surface finishes, good sealing ability in gases and vacuum. FDA compliant.	White	-450 to 450 (-268 to 232)	Excellent
GFP 55	Graphite Fiber Reinforced PTFE Moderate service conditions. Excellent performance in high temperature applications with moderate speed and pressure.	Black	-450 to 500 (-268 to 260)	Very good
UPC	UHMW Polyethylene High purity, high wear resistance in water and aqueous solutions. FDA compliant.	Translucent White	-450 to 180 (-268 to 82)	Very good
UPC 15	UHMW polyethylene Suitable for medical implantation. Excellent wear resistance in water and other aqueous applications. Ideal for low-speed, low-pressure service. ISO 10993-5 compliant.	White	-450 to 180 (-268 to 82)	Good
UP30	Polyethylene Blend Suitable for very high pressure low speed reciprocating applications such as HPLC. FDA compatible.	Gold	-450 to 180 (-268 to 82)	Very good
SP23	Polymer-filled PTFE Ideal for gas compressor and oxygen intensifier systems. Low friction and minimal wear in gas. Suitable for stop-start applications. FDA compliant. USP Class VI compliant. ISO 10993-5 compliant.	Brown	-450 to 500 (-268 to 260)	Good
SP 45	Polymer Filled PTFE General service conditions. Good wear resistance in liquid or dry environments. Low abrasion to dynamic mating surfaces. Suitable for high speed low pressure. FDA compatible.	Light Green	-450 to 475 (-268 to 246)	Good
SP 50	Polymer Filled PTFE General service applications. Excellent wear resistance in gases, air and vacuum. Limited wear resistance in water. Low abrasion to dynamic surfaces. Suitable for high speed low pressure. FDA compatible.	Gray Brown	-450 to 475 (-268 to 246)	Good
SP191	Polymer-filled PTFE Ideal for gas compressor and oxygen intensifier systems. Low friction and minimal wear in gas. Suitable for stop-start applications. FDA compliant. USP Class VI compliant. ISO 10993-5 compliant.	Tan	-450 to 500 (-268 to 260)	Good

FOR ROTARY SERVICE

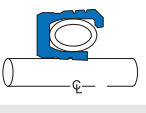

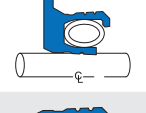
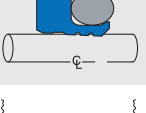
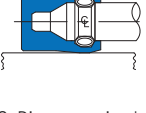
Profile	Series Callout	Features/Benefits	Minimum Size Availability	
			Cross Section in. (mm)	Inside Diameter in. (mm)
	KS	<ul style="list-style-type: none"> • Med. speed, med. pressure • Long life • Excellent sealing • Multiple autoclave reliability 	From 0.044 (1.12)	From 0.125 (3.18)
	KP	<ul style="list-style-type: none"> • High speed, low pressure • To 5,000 ft./min. (25.4 meters/sec) • Multiple autoclave reliability 	From 0.062 (1.57)	From 0.125 (3.18)
	KT	<ul style="list-style-type: none"> • High speed • Multiple autoclave reliability 	From 0.044 (1.12)	From 0.125 (3.18)
	RS3115	<ul style="list-style-type: none"> • Flanged seal • Better sealing • Low cost 	From 0.031 (.79)	From 0.0625" (1.59)
	S3115	<ul style="list-style-type: none"> • Better sealing • Low cost 	From 0.031 (.79)	From 0.0625 (1.59)
	P1	<ul style="list-style-type: none"> • High speed • Low cost 	From 0.062 (1.57)	From 0.0625 (1.59)
	PB1	<ul style="list-style-type: none"> • Very small profile • Lowest cost 	From 0.031 (.79)	From 0.0625 (1.59)

These seals offer unique advantages over conventional lip seals. Their metal locking ring (integral to most profiles) makes them ideal for use in components and subcomponents that require autoclaving. The metal ring supports the seal jacket against the housing on the outer diameter for more effective sealing performance and better retention. It also helps dissipate heat, protecting the PTFE seal jacket from the potentially adverse effects of thermal variation. These seals are available in small diameters and cross-sections.

Typical applications for these seal types include:

- High-speed and low-speed handpieces
- Bone drills, bone shavers
- Surgical saws
- Rotary catheters
- Small motors and pumps
- Centrifuges

FOR RECIPROCATING SERVICE

Profile	Series Callout	Features/Benefits	Minimum Size Availability	
			Cross Section in. (mm)	Inside Diameter in. (mm)
	13	<ul style="list-style-type: none"> • Long life • Excellent wiping • Low friction 	From 0.031 (.788)	From 0.0625 (1.59)
	KS	<ul style="list-style-type: none"> • Self-retaining seal • Excellent sealing • Multiple autoclave reliability 	From 0.044 (1.12)	From 0.125 (3.18)
	R13	<ul style="list-style-type: none"> • Low friction • Flexible lip • Light duty 	From 0.031 (.79)	From 0.0625 (1.59)
	OR15	<ul style="list-style-type: none"> • Low friction • Flexible lip • Medium duty 	From 0.031 (.79)	From 0.094 (2.39)
	35	<ul style="list-style-type: none"> • Cover seal • Minimal dead volume • For very low pressures 	NA	Bore diameters from 0.156 (3.96)

These seals are designed primarily for reciprocating service, but they can also perform well in slow rotary and static applications. Their Bal Spring® energizer provides uniform loading in small diameters and cross-sections, and spring loads can be engineered for optimal performance. The unique cant of the spring's coils provides a nearly constant load from a 10%–35% deflection, which translates to significantly improved service life over standard spring energizers.

Typical applications for these seal types include:

- Respirators
- Oxygen compressors
- Syringes
- Ultrasound equipment
- Dialysis machines
- Blood analysis equipment

*O-Ring energized and silicone-filled spring cavities are also available.

BAL SPRING® CANTED COIL SPRING TECHNOLOGY

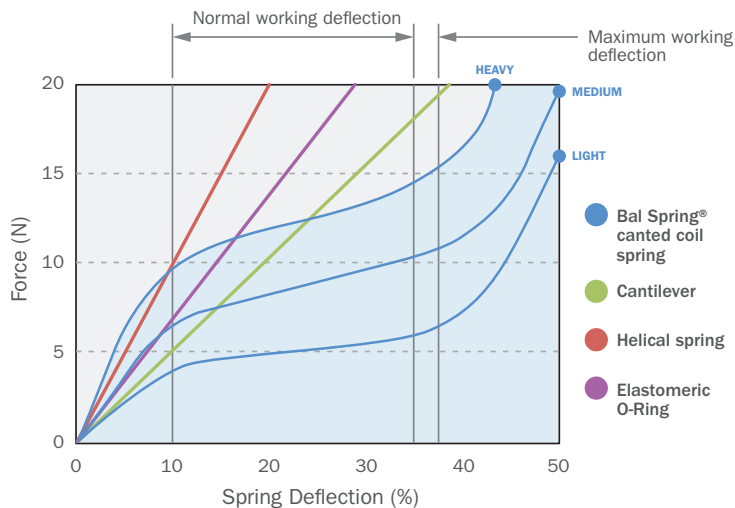
The versatile Bal Spring® canted coil spring is a proven solution for mechanical connecting, electrical conducting, and EMI/RFI shielding challenges. Its size, simplicity, and multifunctional capabilities can help you reduce system complexity and weight while improving functionality.

As a mechanical fastening component, the Bal Spring performs latching, locking, and holding functions with insertion/removal forces that can be precisely controlled to >10,000 lb. In electrical conducting uses, the spring's independent coils compensate for large tolerances, and ensure multi-point contact for improved reliability, lower operating temperatures, and longer equipment life. The spring also provides effective shielding against electromagnetic interference (EMI) and radio-frequency interference (RFI), especially in high-frequency, small package applications.



Material Type	Ultimate Tensile Strength ksi (Mpa)	Features/Benefits
Stainless Steel	230 to 322 (1,590 to 2,220)	<ul style="list-style-type: none"> • Good corrosion resistance • Bright finish
Nickel Alloy	300 to 373 (2,070 to 2,570)	<ul style="list-style-type: none"> • Good corrosion resistance and strength properties • Biocompatibility
Platinum Alloy	155 to 200 (1,070 to 1,380)	<ul style="list-style-type: none"> • Excellent corrosion resistance • Best electrical performance and biocompatibility
Titanium Alloy	167 to 242 (1,150 to 1,670)	<ul style="list-style-type: none"> • High chemical resistance • Implantable-grade material

- Welded ring diameters are available in 0.035 in. (0.90mm) and up
- Standard coil heights are available from 0.025 in. to 0.450 in. (0.64mm to 1.143mm)
- Spring lengths are available from 0.031 in. to 72 in. (0.79mm to 1829 mm)
- A wide variety of standard and custom-designed springs are available to meet specific requirements
- Springs can be coated/plated to improve conductivity and resistance to abrasion and/or corrosion
- Springs can be designed with non-linear compression force



A VERSATILE COMPONENT

Precision connecting

By combining groove and coil configurations, you can use our spring to design unique push-pull, snap-click or permanent mounting and breakaway devices. Insertion and disassembly forces can be precisely engineered to meet your application requirements. Examples of this application include interchangeable drill bits for surgical tools, alignment devices for hip replacement, and dental implant fixation.

Electrical conducting

Combine the mechanical properties of our spring with its inherent electrical conductivity, and you can simplify your device design by eliminating unnecessary components. Whether used as a stand-alone component or inserted into a metal housing, our spring provides exceptionally low electrical resistance and multi-point contact. Examples of this application include drug delivery systems and infusion pumps.

EMI Shielding/grounding

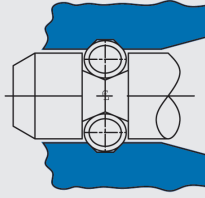
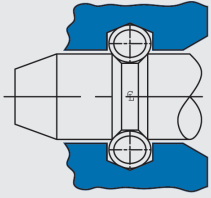
Supplied in welded form or in lengths, the Bal Spring® can be used to protect sensitive electronics from the harmful effects of electromagnetic interference, or EMI. The spring's conductivity, combined with its ability to compensate for surface irregularities, makes it ideal for use in ultrasound and MRI equipment, monitoring devices, and computer workstations.

LATCHING DESIGNS

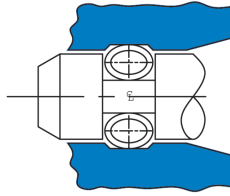
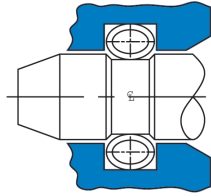
Housing Mounted

Piston Mounted

Features/Benefits



- Latching design with V-bottom groove reduces axial displacement and minimizes variations in conductivity
- Used for latching applications where a specific latch/unlatch force ratio is required
- Can be engineered to meet desired insertion and latch/unlatch force
- Connect/disconnect force ratios range from 1:1 to 1:10



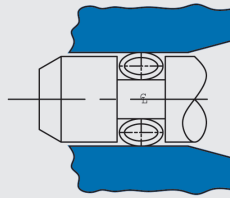
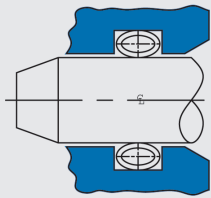
- Latching design with flat-bottom groove
- Used for latching applications where a specific latch/unlatch force is required
- Can be engineered to meet desired insertion and latch/unlatch force
- Connect/disconnect force ratios range from 1:1 to 1:3

HOLDING DESIGNS

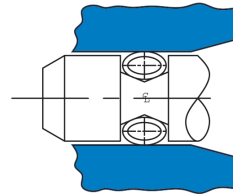
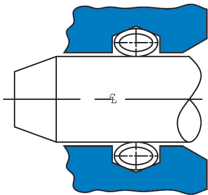
Housing Mounted

Piston Mounted

Features/Benefits



- Typical holding design with flat-bottom groove
- Used for holding, aligning, and electrical contact applications
- Can be engineered to meet desired insertion and sliding force



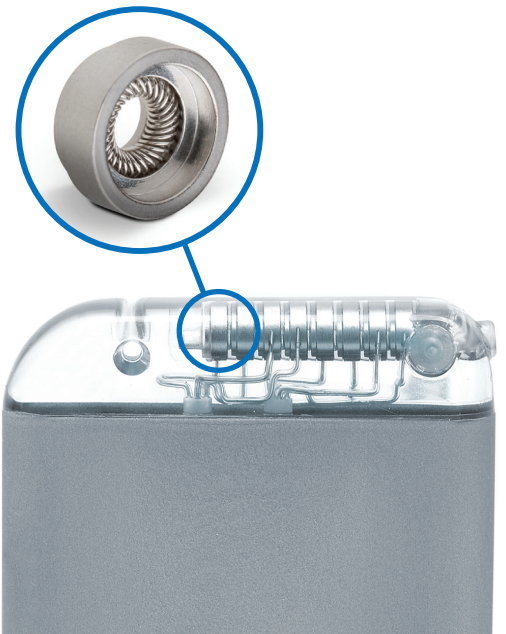
- Holding design with V-bottom groove firmly secures spring, minimizing variations in conductivity
- Used for holding, aligning, and electrical contact applications
- Can be engineered to meet desired insertion and sliding force

Other spring and groove configurations are available. Please contact us for more information.

THE BAL CONN® ELECTRICAL CONTACT

Our Bal Conn electrical contact has earned a reputation as the solution of choice for designers seeking to make consistent, reliable connections in active medical implantables. For more than 20 years, the Bal Conn has been improving device performance and supporting emerging therapies, and it has also dramatically simplified the process of connecting leads during surgery.

Consisting of a housing made from medical-grade MP35N® and a platinum-iridium or MP35N® Bal Spring® canted coil spring, the Bal Conn can accommodate leads down to .9 mm in diameter. The contact provides an ideal combination of low insertion force and low contact resistance, and its spring coils ensure ultra-reliable multipoint electrical contact with superior resistance to fatigue. Its compact footprint paves the way for smaller, more functional devices. The Bal Conn can also be supplied in a system that incorporates silicone seals for dielectric isolation.





We're more than just a component maker. In early development or existing product improvement stages, we combine our proven seals, springs, and electrical contacts with engineering, material science, and precision manufacturing expertise to produce solutions that break down performance barriers.

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*Registered manufacturing facilities in California and Colorado enable us to ensure on-time product delivery, and help you mitigate risk.