



RETAINING RINGS AND WAVE SPRINGS

ABOUT US

STANDARD OR CUSTOM

Smalley is the leading manufacturer of precision retaining rings and wave springs. Our commitment to quality and customer service has made us the preferred supplier to OEMs all over the world.

Whether you need something standard or custom, you will work directly with an engineer to ensure you get exactly what you require. We will provide you the right part, in the right material, with No-Tooling-Charges™.

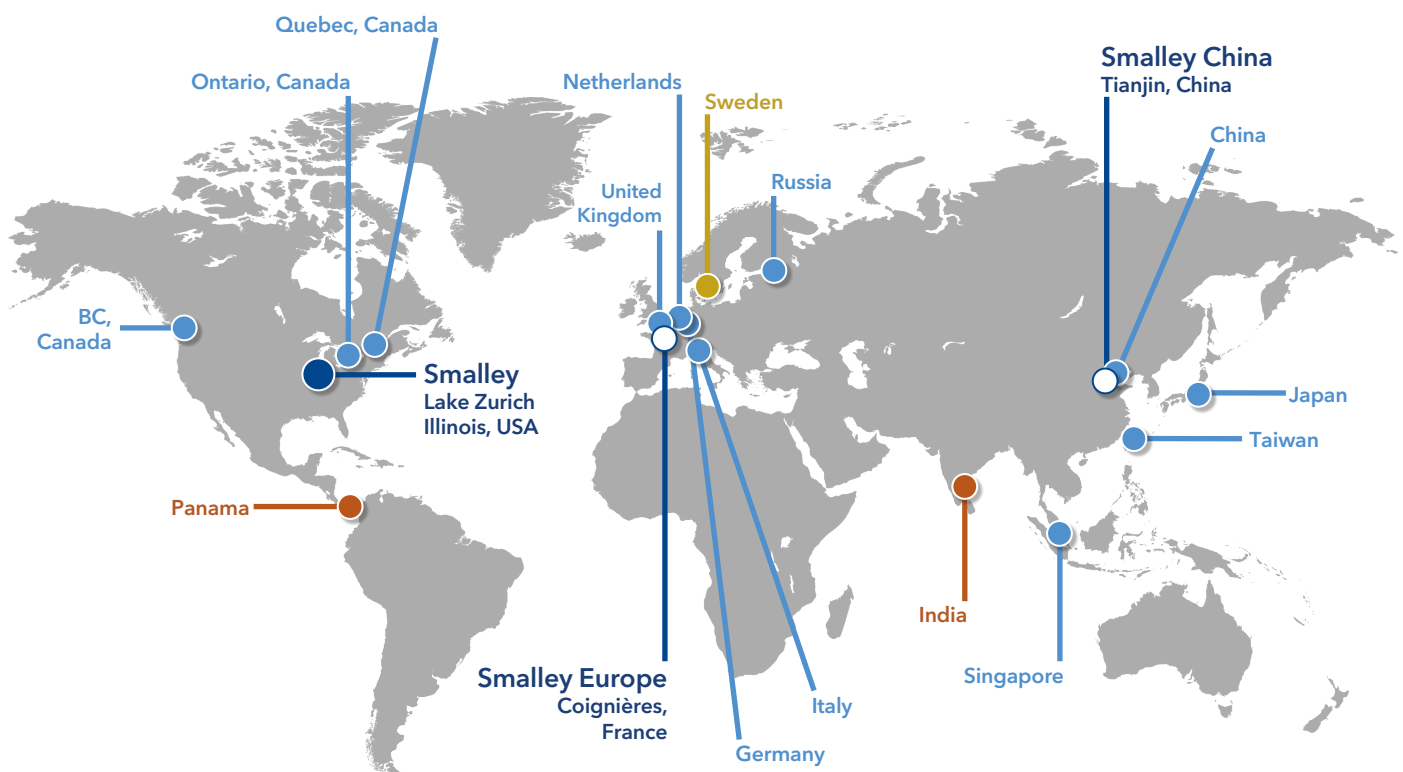


Smalley's 300,000 sq. ft. facility located in Lake Zurich, IL.

LOCATIONS

Smalley's products are manufactured at our Headquarters in Lake Zurich, Illinois, just outside of Chicago.

Smalley's global network of sales offices, engineers, and distribution partners allows us to provide you with the highest quality customer service and cost-effective solutions for your ring and spring needs, no matter where you are.



CORPORATE HEADQUARTERS & MANUFACTURING

MANUFACTURERS' REPRESENTATIVES

REGIONAL HEADQUARTERS & WAREHOUSE

DISTRIBUTION PARTNERS

ENGINEERING SALES OFFICES

For more contact information, please visit smalley.com/our-offices

QUALITY DRIVEN

Being a customer-focused organization means that we contribute to your success by dedicating ourselves to a high level of urgency and customer excellence. Smalley was built from the ground up by providing exceptional quality and service to our customers. This level of service continues to be one of the reasons why we succeed at winning your business. We strive for:



- Complete conformance to drawings, specifications, and contractual requirements
- 100% on-time delivery
- Total customer satisfaction
- Exceptional vendor performance

CERTIFICATIONS AND COMPLIANCES



- ISO 9001 - Quality Management System
- ISO 14001 - Environmental Quality Management System
- ISO 13485 - Medical Device Quality Management System
- IATF 16949 - Automotive Quality Management System
- AS9100 - Aerospace Quality Management System

RoHS and REACH compliant materials and certifications available.
DFARS compliant materials and certifications available.

A TRUSTED SUPPLIER

Smalley's dedication to excellence has earned us the trust of manufacturers worldwide. We have received multiple awards for our service and quality, including Supplier Excellence Awards from both GM and CAT.



ENGINEERING & MANUFACTURING



SMALLEY'S ENGINEERS

When you work with Smalley, you will find an experienced partner who is committed to providing you the exact part you need. We can guide you through the catalog to find a suitable standard part, or help you with your custom design.

Our support goes further than just the design process; we will make sure our parts are working for you and your application from start to finish. Whether you need installation and removal help or have questions about a new design, our engineers are ready for the challenge.

EDGEWINDING AND NO-TOOLING-CHARGES™

Our vertically integrated manufacturing process begins by feeding raw round wire through our rolling mill to flat dimensions. Flat wire is then coiled on edge to form the ring or spring. Because our products are edgewound instead of stamped, no custom dies are required, saving time and costs.

Features and Benefits

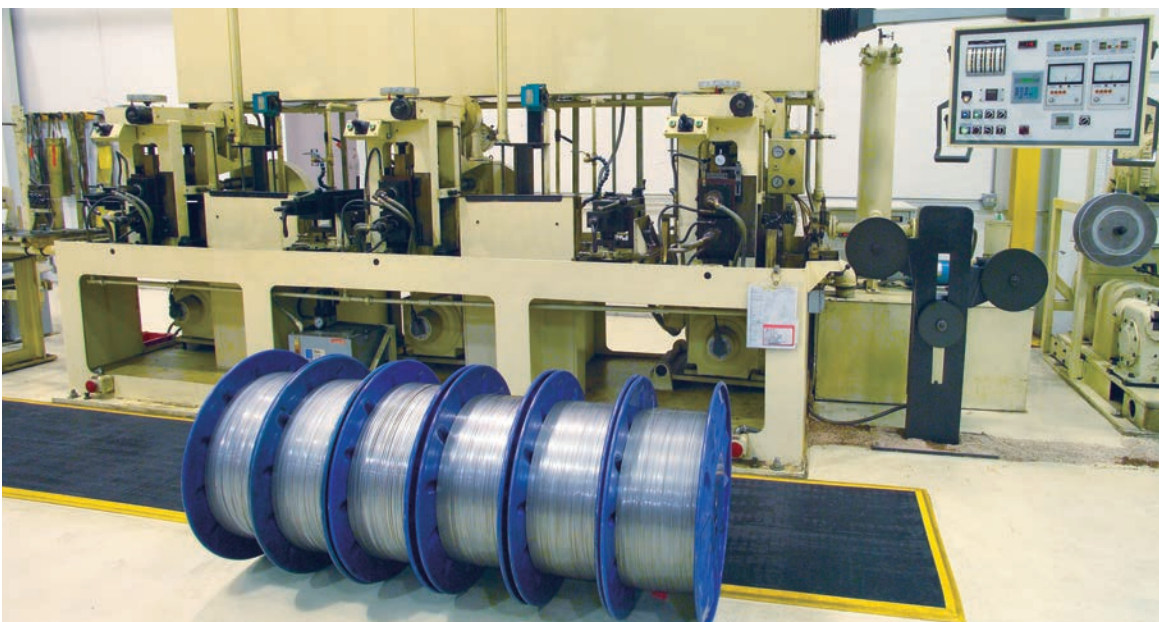
- Increased strength and stability compared to stamped products
- Ability to customize with little to no material waste
- Easily create and modify designs and prototypes
- Quick and economical testing and production procedures
- Large selection of alloys readily available



Edgewound



Stamped



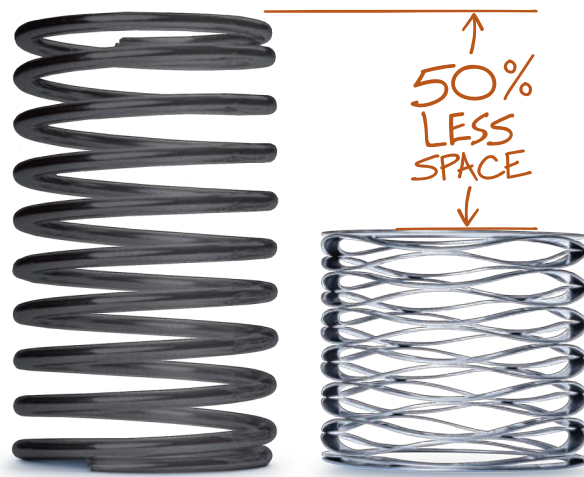
WAVE SPRINGS

Crest-to-Crest®



Crest-to-Crest® Wave Spring

Crest-to-Crest® Wave Spring with Shim Ends



THEIR ORDINARY COIL SPRING

SMALLEY® WAVE SPRING

Crest-to-Crest

Crest-to-Crest Wave Springs are flat wire, multi-turn springs coiled in series. These springs are available with or without Shim Ends, which provide a flat 360° mating surface to distribute forces more evenly for softer assembly materials.

Features and Benefits

- Reduce spring height by up to 50%, saving space and weight
- Same force and deflection as coil/helical compression springs
- Suitable for light-to-medium forces and medium travel
- Custom parts available in diameters from .157 to 120" (4 to 3000 mm) with No-Tooling-Charges™

Crest-to-Crest available from stock in carbon and 17-7 PH stainless steel:

Stock Series	Spring Type	Diameter
C	Light-to-medium forces; medium travel	0.188 - 2"
CM	Light-to-medium forces; medium travel	5 - 60 mm

Crest-to-Crest with Shim Ends available from stock in carbon and 17-7 PH stainless steel:

Stock Series	Spring Type	Diameter
CS	Light-to-medium forces; medium travel	0.312 - 2"
CMS	Light-to-medium forces; medium travel	8 - 60 mm



Application: Push Button

For more information on Crest-to-Crest Wave Springs or how they can be customized, please visit: smalley.com/crest-to-crest
For Free Samples, please visit: smalley.com/samples

WAVE SPRINGS

Single-Turn



Gap-Type Wave Spring



Overlap-Type Wave Spring

Gap-Type and Overlap-Type Single-Turn

Single-turn wave springs are flat wire springs that have either a gap or an overlap.

Features and Benefits

- Ideal for providing a preload or tolerance take-up
- Gap-type is ideal for stacking and reduces height
- Overlap-type is suitable for small diameters and reduces tangling in packaging
- Provide more accurate load than wave washer
- Suitable for light-to-medium forces and short deflections
- Custom parts available from .157 to 120" (4 to 3000 mm) with No-Tooling-Charges™

Gap-Type available from stock in carbon and 17-7 PH stainless steel:

Stock Series	Spring Type	Diameter
SSR	Light-to-medium forces; short deflections	1.750 - 16"
SSR-N	Light-to-medium forces; narrow section	3.250 - 7.750"
SSB	Light-to-medium forces; short deflections	100 - 580 mm

Overlap-Type available from stock in carbon and 17-7 PH stainless steel:

Stock Series	Spring Type	Diameter
SSR	Light-to-medium forces; short deflections	0.500 - 1.625"
SSB	Bearing preload	9 - 95 mm



Application: Bearing Preload

For more information on single-turn wave springs or how they can be customized, please visit: smalley.com/single-turn

For Free Samples, please visit: smalley.com/samples

WAVE SPRINGS

Nested Spirawave®



Nested Spirawave

Nested Spirawave Wave Springs are flat wire, multi-turn wave springs coiled in parallel.

Features and Benefits

- Two-turn and three-turn configurations available from stock
- Can replace stacks of single-turn wave springs
- Eliminates misalignment and loading inconsistencies, reducing cost and assembly time
- Suitable for medium-to-high forces and short deflections
- Custom parts available from .157 to 120" (4 to 3000 mm) with No-Tooling-Charges™

Available from stock in carbon and 17-7 PH stainless steel:

Stock Series	Spring Type	Diameter
NSSR	Medium-to-high forces	0.500 - 4"
NSSB	Medium-to-high forces	16 - 100 mm



Application: Push Seal

For more information on Nested Spirawave Wave Springs or how they can be customized, please visit: smalley.com/nested
For Free Samples, please visit: smalley.com/samples



Wavo

Wavo Wave Springs are single-turn round wire springs.

Features and Benefits

- Suitable for very high forces and used in very tight radial spaces
- Reduce or eliminate vibration in preload. Compensates for thermal expansion
- Can be an acceptable replacement for Belleville disc washers
- Custom parts available from .157 to 120" (4 to 3000 mm) with No-Tooling-Charges™

Available from stock in carbon and 17-7 PH stainless steel:

Stock Series	Spring Type	Diameter
RW	High forces/loads; tight radial spaces	0.500 - 6"



For more information on Wavo Springs or how they can be customized, please visit: smalley.com/wavo
For Free Samples, please visit: smalley.com/samples

WAVE SPRINGS

Linear



Linear

Linear Wave Springs are wave-formed straight lengths of flat wire.

Features and Benefits

- Suitable for low-to-medium loads and deflections
- Applications requiring spring force in linear cavities
- Custom parts available with No-Tooling-Charges™

Available from stock in carbon and 17-7 PH stainless steel:

Stock Series	Spring Type	Lengths
LS	Low-to-medium loads/deflections	1.500 - 12"



Note:

Some applications use these as a Marcel Expander, good for radial positioning.

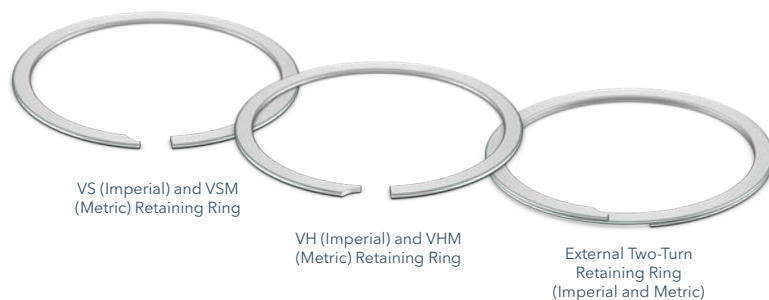


Application: Detent Preload

For more information on Linear Wave Springs or how they can be customized, please visit: smalley.com/linear
For Free Samples, please visit: smalley.com/samples

RETAINING RINGS

Spirolox®



Spirolox

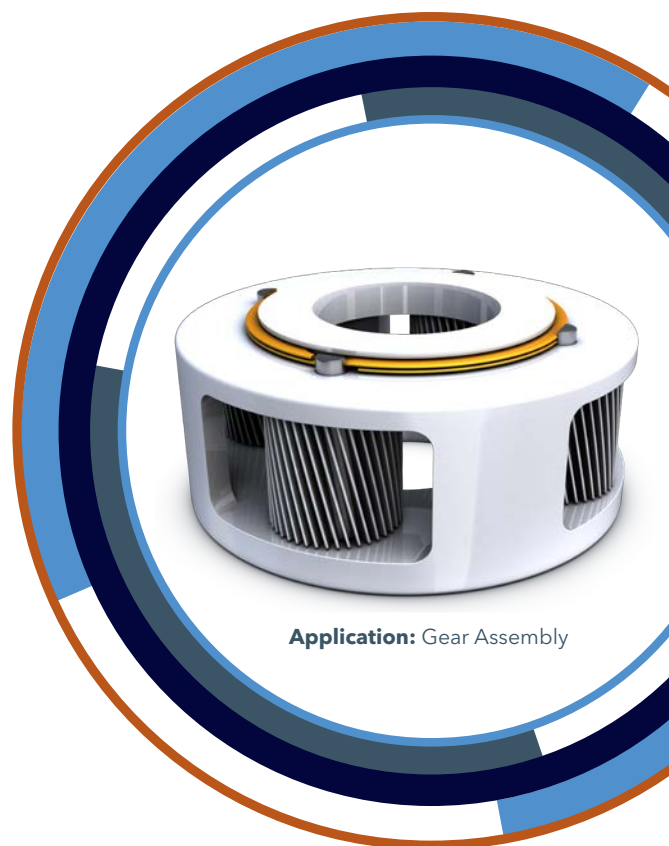
Spirolox Retaining Rings are coiled in single-turn, two-turn, and three-turn configurations.

Features and Benefits

- No Ears to Interfere® with mating components
- No gap - 360° retaining surface
- No lugs - uniform cross-section, improved aesthetic appearance
- No special tooling for installation or removal - simple and safe
- Coiled, not stamped - reduces scrap and costs
- Groove interchangeable with stamped rings
- Custom parts available from .157 to 120" (4 to 3000 mm) with No-Tooling-Charges™

Available from stock in carbon, 302 stainless steel and 316 stainless steel:

Stock Series	Ring Type	Diameter
VH	Light duty, Internal	0.250 - 10"
VHM	Light duty, Internal	6 - 300 mm
VS	Light duty, External	0.250 - 10"
VSM	Light duty, External	6 - 300 mm
WH	Medium duty, Internal	0.500 - 11"
WS	Medium duty, External	0.500 - 11"
EH	Aerospace, Internal	6 - 280 mm
ES	Aerospace, External	6 - 280 mm
WHT	Medium/heavy duty, Internal	0.500 - 11"
WST	Medium/heavy duty, External	0.469 - 10"
WHM	Heavy duty, Internal	0.250 - 15"
WSM	Heavy duty, External	0.250 - 15"
DNH	DIN interchange, Internal	13 - 400 mm
DNS	DIN interchange, External	13 - 400 mm



For more information on Spirolox or how they can be customized, please visit: smalley.com/spirolox

For Free Samples, please visit: smalley.com/samples

RETAINING RINGS

Constant Section



FHE (Imperial) / FH (Metric)



FSE (Imperial) / FS (Metric)

Constant Section

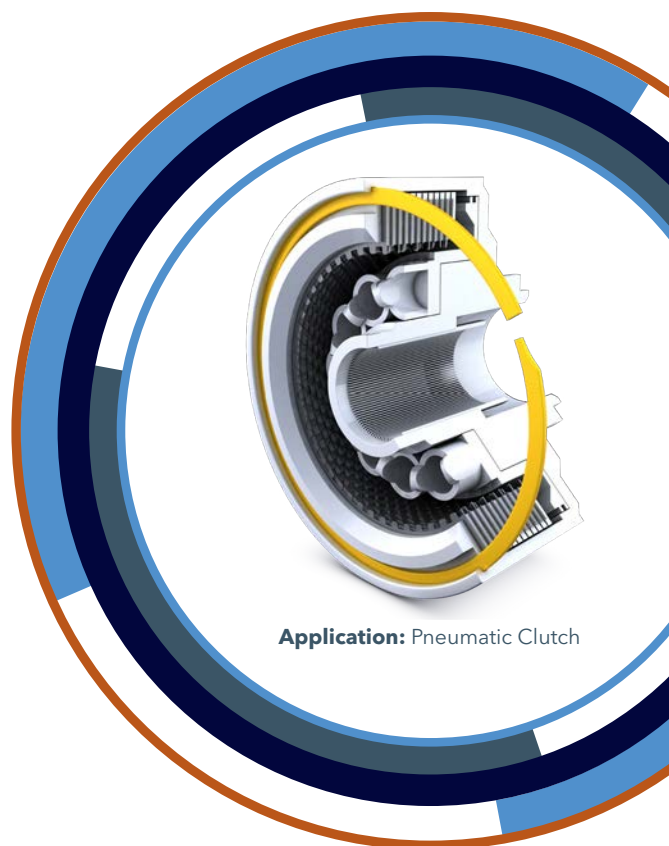
Constant Section Retaining Rings are single-turn, square edge rings with a gap between the two ends.

Features and Benefits

- Available with removal notch dependent on internal or external use
- Groove interchangeable with Eaton style Snap Rings
- Smalley's heaviest-duty rings; suitable for very high forces and impact loading
- Various end types available as a custom
- Custom parts available from .157 to 120" (4 to 3000 mm) with No-Tooling-Charges™

Available from stock in carbon and 302 stainless steel:

Stock Series	Ring Type	Diameter
FHE	Single-Turn, Heavy Duty, Internal	0.500 - 11"
FSE	Single-Turn, Heavy Duty, External	0.500 - 11"
FH	Single-Turn, Heavy Duty, Internal	13 - 300 mm
FS	Single-Turn, Heavy Duty, External	13 - 300 mm
XAH	Single-Turn, Eaton Interchange, Internal	0.375 - 10"
XAS	Single-Turn, Eaton Interchange, External	0.312 - 10"
XDH	Single-Turn, Eaton Interchange, Internal	1.125 - 8"
XDS	Single-Turn, Eaton Interchange, External	0.500 - 8"



Application: Pneumatic Clutch

For more information on Constant Section or how they can be customized, please visit: smalley.com/constant-section
For Free Samples, please visit: smalley.com/samples

RETAINING RINGS

WaveRing®



WHW Series



WSW Series

WaveRing

WaveRing Retaining Rings are two-turn rings with an axial waveform that come in multiple configurations.

Features and Benefits

- Similar function as a traditional retaining ring, but with spring force
- Applies pressure against groove wall and assembly simultaneously
- Alternate number of turns available as customs with No-Tooling-Charges™

Available from stock in carbon and 17-7 PH stainless steel:

Stock Series	Ring Type	Diameter
WHW	Two-Turn, Internal	0.750 - 5"
WSW	Two-Turn, External	0.750 - 5"



For more information on WaveRings or how they can be customized, please visit: smalley.com/wavering
For Free Samples, please visit: smalley.com/samples

RETAINING RINGS

Hoopster®



HHU (Imperial) & HHMU (Metric)



HS (Imperial) & HSM (Metric)



HH (Imperial) & HHM (Metric)
with a removal provision

Hoopster

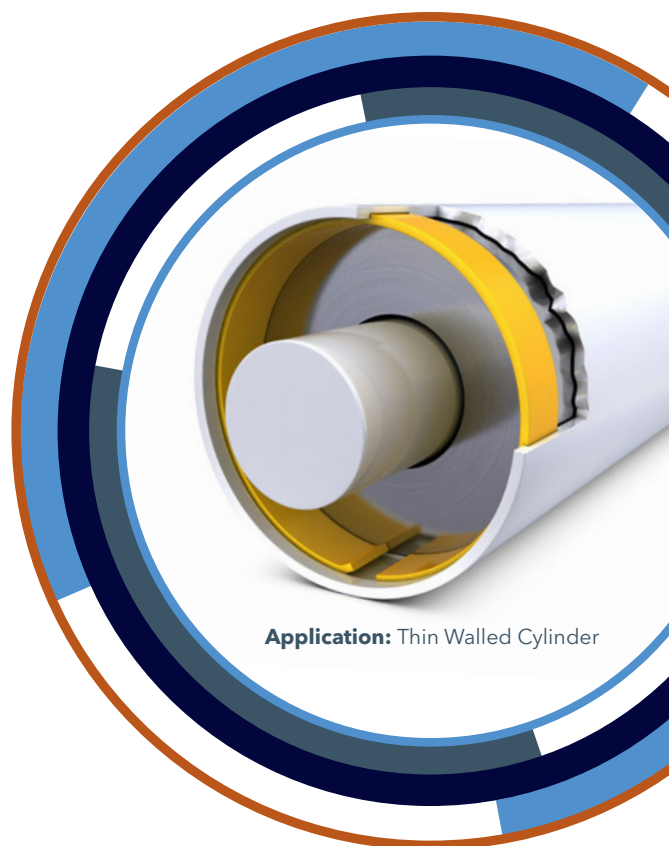
Hoopster Retaining Rings are single-turn, square edge rings that function in a very shallow radial groove.

Features and Benefits

- Minimal radial profile and are suitable for shallow groove depths
- Light-to-medium loads
- Available with or without removal provision
- Custom parts available from .157 to 120" (4 to 3000 mm) with No-Tooling-Charges™

Available from stock in carbon and 302 stainless steel:

Stock Series	Ring Type	Diameter
HH/HHU	Single-Turn, Internal	0.375 - 3"
HHM/HHMU	Single-Turn, Internal	10 - 76 mm
HS	Single-Turn, External	0.375 - 3"
HSM	Single-Turn, External	10 - 76 mm



Application: Thin Walled Cylinder

For more information on Hoopster Retaining Rings or how they can be customized, please visit: smalley.com/hoopster
For Free Samples, please visit: smalley.com/samples

LAMINAR SEALS



Two Ring Set, Two-Turn Rings



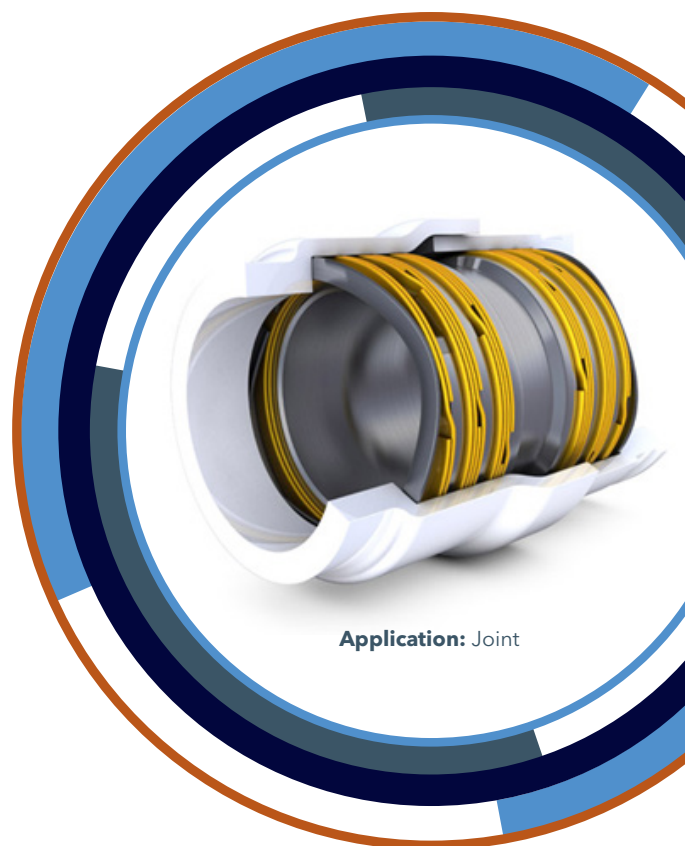
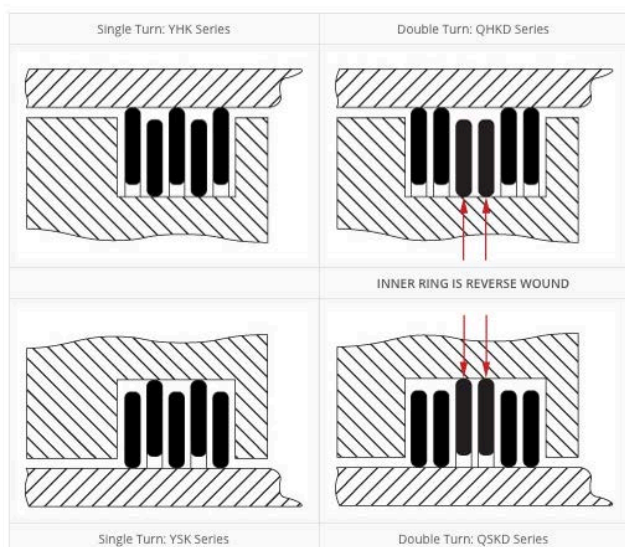
Three Ring Set, Single-Turn Rings

Laminar Seals

A Laminar Seal Ring set is a metallic labyrinth seal consisting of multiple rings in a groove. The arrangement and specific orientation of the rings are dictated by the application and the severity of the environment.

Features and Benefits

- Sets of two, three or five rings
- Configurations (single-turn, two-turn) and materials used dependent on the severity of the environment
- Designed to protect assemblies from solid contaminants



For more information on Laminar Seal Rings or how they can be customized, please visit: smalley.com/laminar
For Free Samples, please visit: smalley.com/samples

CUSTOM RINGS AND SPRINGS

CUSTOM ENGINEERED PRODUCTS

Designing a custom part does not have to be complicated. Our vertically integrated manufacturing process makes it an economical choice. Because we edgewind our products, we can produce your prototypes quickly, and any adjustments throughout the manufacturing process can be made without additional tooling costs. Your custom product can be in your hands in weeks instead of months.

Smalley can design rings and springs with a variety of different ends and configurations. These are just a few examples of what we are able to customize and produce:

Retaining Rings

Can be modified by:

- Diameter
- Number of turns
- Rotational capacity
- Wire thickness
- Material
- Finishes, coatings, and platings
- Radial wall
- End configurations
- Packaging
- Quality Assurance Certifications

Wave Springs

Can be modified by:

- Diameter
- Spring Force
- Work height
- Radial wall
- Wire thickness
- Material
- Finishes, coatings, and platings
- Shim end(s)
- Free height
- End configurations
- Packaging
- Quality Assurance Certifications

Examples of Custom Materials:

- Carbon Steel
- Stainless Steel
- A-286
- INCONEL®
- ELGILOY®
- Beryllium Copper
- MP35N
- Hastelloy
- Monel

Popular custom configurations:



Self-Locking



Flat Wire Bent Ends



Balanced



Round Wire Bent Ends



Special Locking



Removal Handle



Crimp End



Eight-Turn Bent Ends



Marcel Expanders



Heavy Duty



Pitched Coil Spring



Interlaced

For more information please visit: smalley.com/customs
For Free Samples, please visit: smalley.com/samples

CUSTOM CONFIGURATIONS

Common Retaining Rings



Spirolox Two-Turn Retaining
Ring-Locking on I.D.

Spirolox Two-Turn Retaining
Ring-Locking on O.D.

Spirolox Two-Turn Retaining
Ring Centerline lock

Self-Locking Rings

Smalley's Self-Locking Retaining Rings are multiple-turn rings that have a small tab on either the inside, outside, or center of the radial wall, along with an aligned slot on the next turn for it to "lock" into.

- Suitable for applications with high rotational requirements or speeds exceeding recommended rotational capacity
- Prevents interference with mating components



Spirolox Two-Turn Balanced Retaining Ring

Balanced Rings

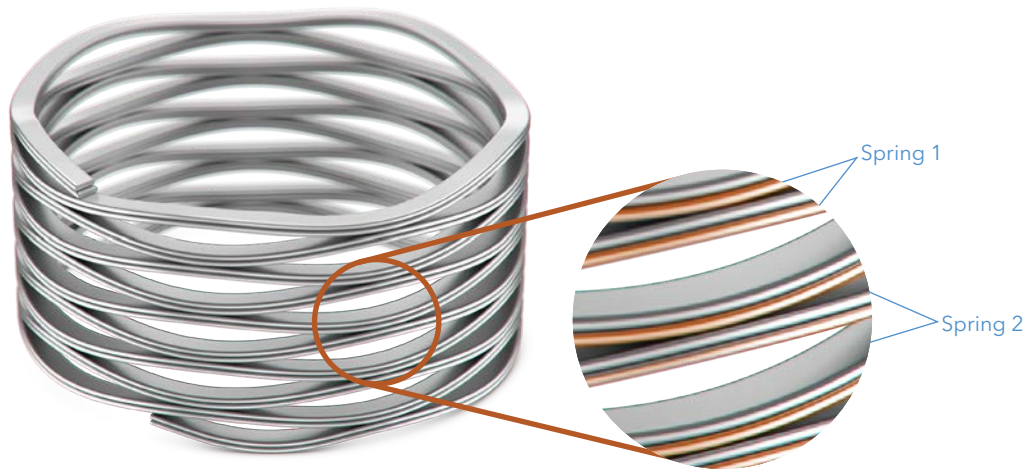
Balanced Retaining Rings are retaining rings with cut-out slots opposite the gap end to centralize the rings' center of gravity.

- Slots made in radial wall/missing material balances the ring
- Suitable for reducing eccentric loading in applications where balance is critical
- Available as a custom option for retaining rings
- Balanced when rotating in an assembly, particularly for higher RPM's

For Free Samples, please visit: smalley.com/samples

CUSTOM CONFIGURATIONS

Common Wave Springs



Interlaced

Interlaced springs are flat wire, multi-turn wave springs wound together in series and parallel.

- Effectively provides increased loading capacity and greater fatigue resistance
- Alternative to Crest-to-Crest when higher loads are needed
- Substitute to a Nested Spirawave when higher free height or deflection is needed
- Available as a custom wave spring



Marcel

Marcel expanders are circular wave springs that provide radial force or outward pressure in an assembly.

- Suitable for tolerance take-up or to self-center an assembly
- Suitable to energize seals when no other pressure is available
- Available as a custom wave spring

For Free Samples, please visit: smalley.com/samples

WAVE SPRINGS

Application Checklist

SMALLEY WAVE SPRINGS

Email to: info@smalley.com

Or fill out online.

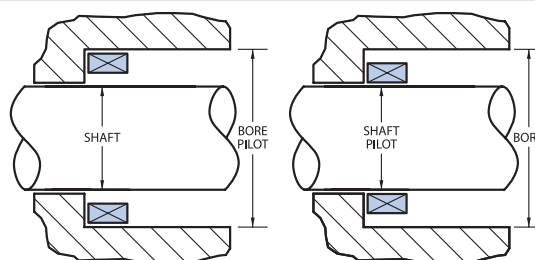
Name _____ Title _____ Date _____
Company _____
Address _____
City/State/Zip Code _____ Country _____
Phone _____ Fax _____
Email _____

DIMENSIONS IN: () Imperial Units () Metric Units

Operates in _____ bore diameter

Inside diameter clears _____ shaft

Specify which diameter the spring should
pilot closest to: () Bore () Shaft



LOAD DEFLECTION (SELECT ONE)

Group A

_____ @ _____ () lb @ in () N @ mm
Min - Max Load Work Height

Free Height _____ Approximate

Group B

_____ @ _____ () lb @ in () N @ mm
Min - Max Load Work Height

_____ @ _____ () lb @ in () N @ mm
Min - Max Load Work Height

Free Height _____ Approximate

Group C

Free Height _____ (min) — _____ (max)

of Waves _____ Material Thickness _____

Radial Wall _____

MATERIAL

Consider the environment:

Temperature _____ °

() F () C

Corrosive Media _____

*Carbon Steel ()

*17-7 PH/CH900 Stainless ()

302 Stainless Steel ()

316 Stainless Steel ()

Inconel X-750 ()

Other _____ ()

FINISH

*Oil dipped ()

(Carbon Steel)

*Vapor degreased ()

and ultrasonic cleaned

(Stainless Steel)

Passivate ()

Black Oxide ()

Phosphate Coat ()

Vibratory Deburr ()

Other _____ ()

SKETCH

FATIGUE: Specify estimated cycle life

() Static Application () 10⁶ Cycle Life

() Under 10⁵ Cycle Life () Over 10⁶ Cycle Life

() 10⁵ Cycle Life

QUANTITY:

Prototype _____

Production _____

APPLICATION: (Description)

* Denotes standard material or finish

RETAINING RINGS

Application Checklist

SMALLEY RETAINING RINGS

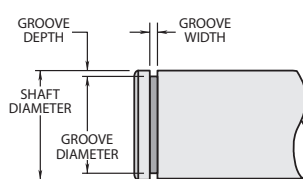
Email to: info@smalley.com

Or fill out online.

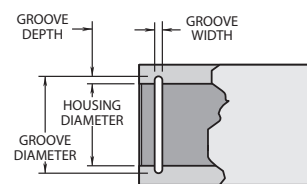
Name _____ Title _____ Date _____
 Company _____
 Address _____
 City/State/Zip Code _____ Country _____
 Phone _____ Fax _____
 Email _____

DIMENSIONS IN: () Imperial Units () Metric Units

Housing Diameter _____
 Shaft Diameter _____
 Groove Diameter _____
 Groove Width _____
 RPM _____



Ring Radial Wall _____



Ring Thickness _____

THRUST CAPACITY

1) Groove Deformation

Occurs when maximum capacity is limited by the groove material (groove material is soft)

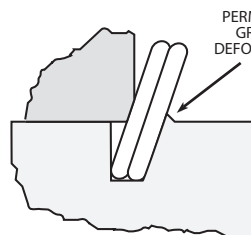
If thrust is a consideration specify:

Groove Material _____

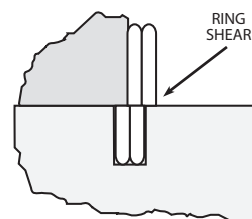
Load Capacity _____ () lb () N

2) Ring Shear

Occurs when maximum capacity is limited by the retaining ring (groove material is hardened)



PERMANENT GROOVE DEFORMATION



RING SHEAR

MATERIAL

Consider the environment:

Temperature _____ °

() F () C

Corrosive Media _____

*Carbon Steel ()

17-7 PH/CH900 Stainless ()

*302 Stainless Steel ()

*316 Stainless Steel ()

Inconel X-750 ()

Other _____ ()

FINISH

*Oil dipped ()
 (Carbon Steel)

*Vapor degreased ()
 and ultrasonic cleaned
 (Stainless Steel)

Passivate ()

Black Oxide ()

Phosphate Coat ()

Vibratory Deburr ()

Other _____ ()

SKETCH

QUANTITY:

Prototype _____

Production _____

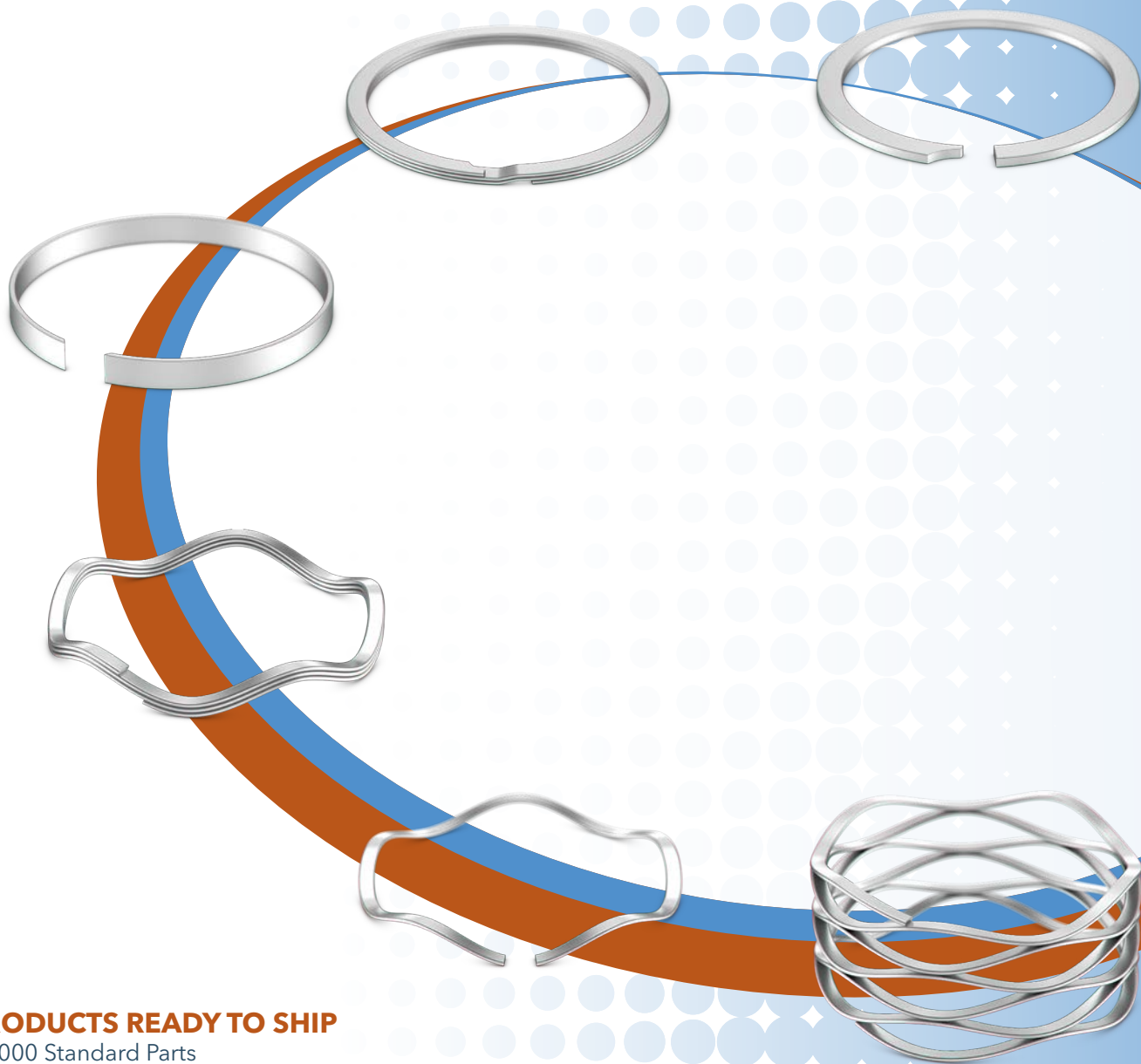
APPLICATION: (Description)

* Denotes standard material or finish

Smalley Steel Ring Co.
555 Oakwood Road
Lake Zurich, IL 60047

STANDARD OR CUSTOM

We'll provide you with the right part,
in the right material, for your application
with No-Tooling-Charges™.



PRODUCTS READY TO SHIP

10,000 Standard Parts
in Carbon and Stainless Steel

CUSTOM ENGINEERED PRODUCTS

Diameters from .157 to 120"
and 4 to 3000 mm
Specialty Alloys Available



SMALLEY

THE ENGINEER'S CHOICE®

CONTACT US FOR:

Free Samples, Engineering Support and more!
Tel: +1.847.719.5900
Email: info@smalley.com