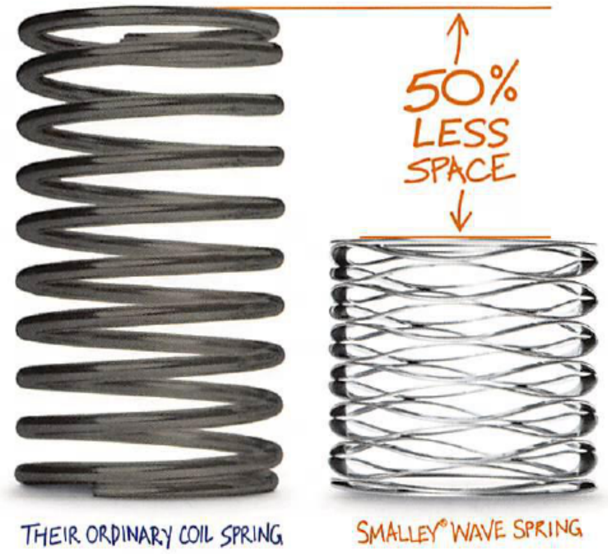
Wave Spring Introduction

All Springs Are Not Equal®

Standard Smalley wave springs are available in a wide range of configurations in carbon and stainless steel from .188 to 16" (5 to 400 mm). Our wave springs can be found across nearly all industries because of their space and weight saving ability.



Standard Smalley wave springs include:

- Crest-to-Crest®
- Crest-to-Crest® with Shim Ends
- Overlap-Type Single-Turn
- Gap-Type Single-Turn
- Nested Spirawave®
- Wavo®

Custom Wave Springs

If one of our standard springs does not fit your application, our engineers are here to help you design a wave spring that does. Application-specific features are customizable to ensure the desired spring size, force, and cycle life are met. It is often thought that designing a custom part is costly and time-consuming, but Smalley's No-Tooling-Charges™ manufacturing process makes custom parts a cost-effective solution. This process allows us to create and adjust your prototype quickly to meet your exact needs. At Smalley, customs are a practical and economical choice.

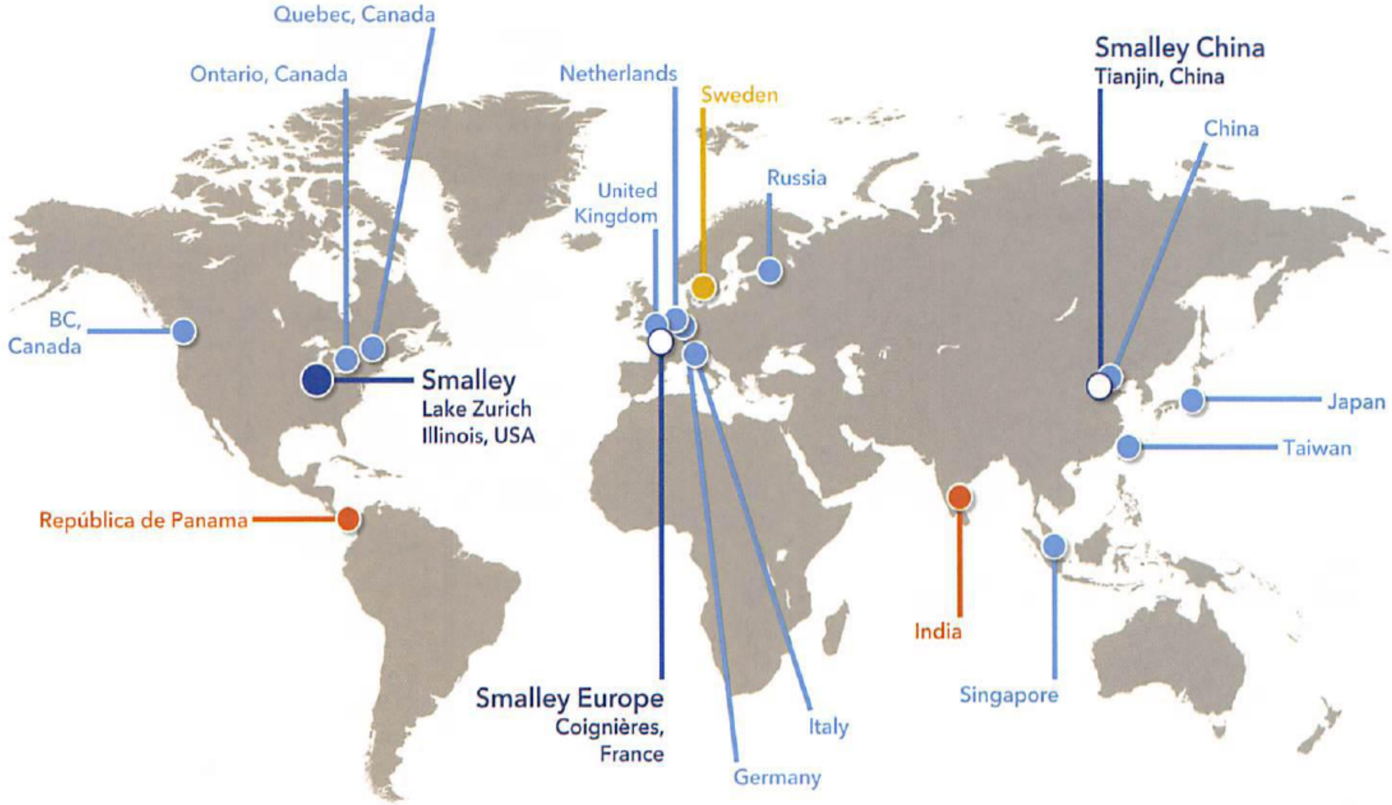
Customizable features include:

- Deburring
- Diameter (.157 - 120"; 4 - 3000 mm)
- End configurations
- Finishes, plating, coating
- Free height
- Markings
- Material
- Number of turns
- Number of waves
- Packaging/labeling
- Quality Assurance certifications
- Radial wall
- Shim ends
- Tolerances
- Wire thickness
- Work height

You can find more information about these terms in the glossary on page 151.

SMALLEY
THE ENGINEER'S CHOICE®

LOCATIONS



CORPORATE OFFICE & MANUFACTURING

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+33 182 886 913 • europe@smalley.com

Tianjin, China
+86 22 8895 6811 • china@smalley.com

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Germany
Italy
Japan
Netherlands
Russia
Singapore
Taiwan
United Kingdom

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+507 6930 4744 • latinamerica@smalley.com

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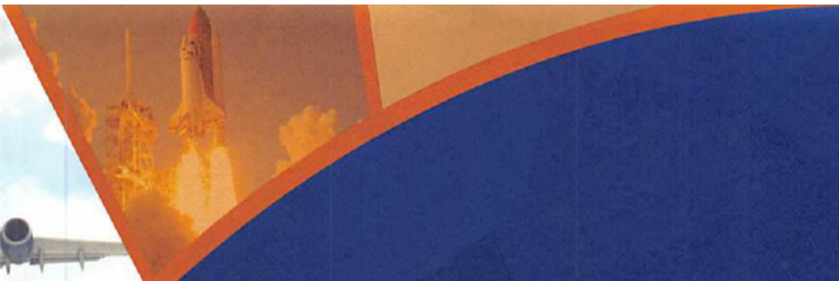
CONNECT WITH US

INDUSTRIES



Aerospace

Smalley parts meet quality and performance standards to AS9100. Their compact design reduces assembly size and weight while maintaining precision.

Automotive

Smalley's IATF 16949 certified rings and springs have been specified for applications in cars and trucks from bumper-to-bumper. Our ability to produce durable, space-saving products quickly and economically has continuously earned us multiple GM Quality Awards.

Consumer

Our variety of sizes, configurations, and finishes allow us to serve the diverse requirements of the consumer industry with standard and custom parts that are both functional and durable. Our unique No Ears to Interfere® retaining ring feature allows for an aesthetically pleasing assembly when parts are visible.

Industrial

Our 10,000 stock parts and No-Tooling-Charges™ on customs allows us to create products that meet exact application requirements for a vast range of demands.

Medical

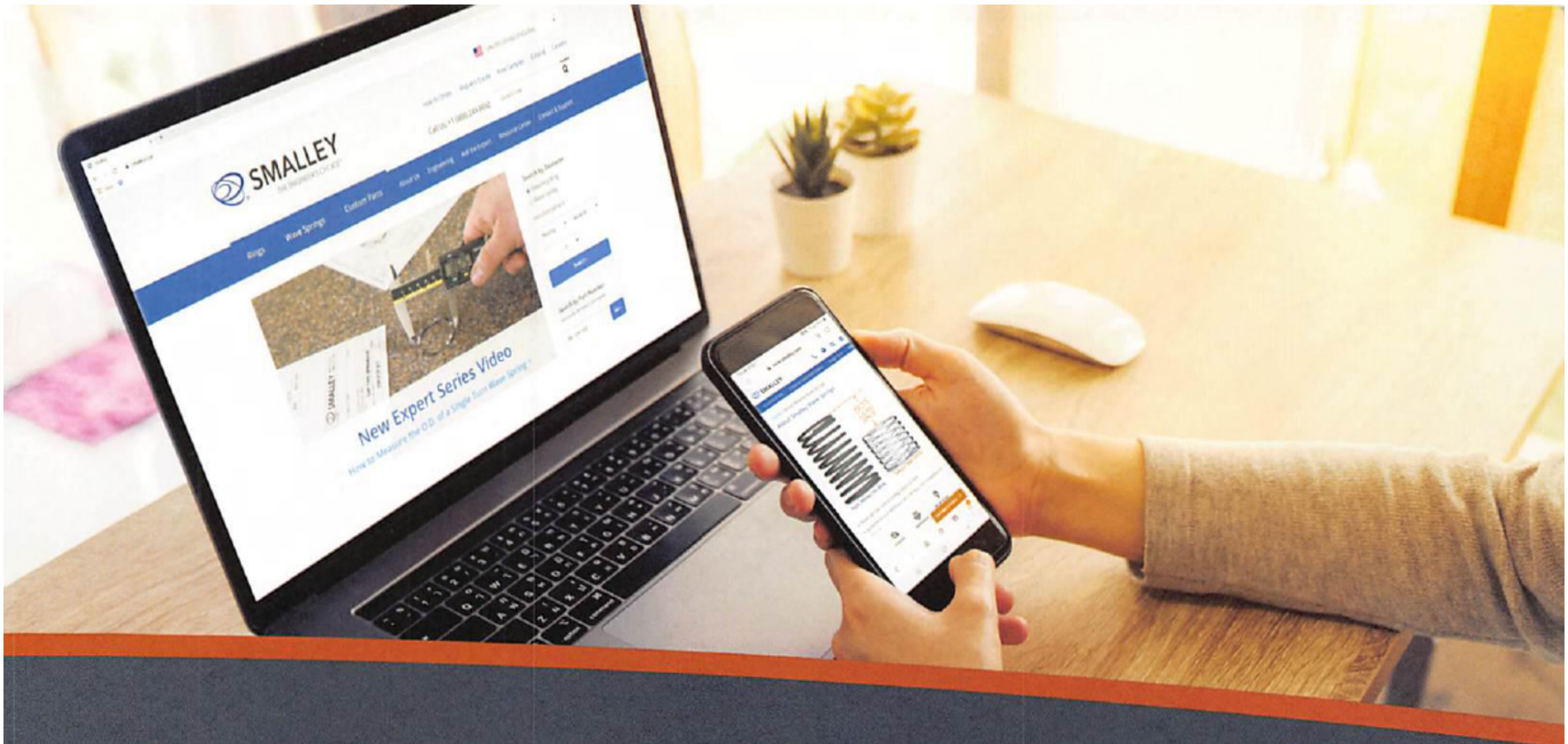
Our products have been used in medical industry applications from imaging equipment to implantable devices. We can manufacture rings and springs in diameters as small as .157" (4 mm), with stainless steel and other medically approved materials readily available. Our products are certified to ISO 13485.

Off-Highway

Smalley offers products that are safe and reliable for an industry that often requires heavy-duty and/or large diameter parts for high impact loading or large machinery.

Oil and Gas

Smalley Engineers can design parts with NACE compliant materials. Select a standard material from stainless and carbon steel, or design your ring and spring to withstand the harshest of environments from over 40 material options, including Inconel®, Elgiloy®, and MP35N® stocked and available.



Free Samples

We are happy to offer free samples of any of our standard rings or springs for you to try and test in your application.

smalley.com/samples

Quotes

Smalley responds quickly to all quote requests for standard and custom products.

sales@smalley.com
smalley.com/rfq

E-commerce

Easily purchase standard parts online using our web store. The web store offers product pricing, quick re-order from past online orders and a fast, secure check-out process.

smalley.com

CAD Models

Download CAD models of standard parts to application-specific requirements. Adjustments for material or spring height can be made to help you determine the best part for your needs. Custom CAD models available upon request.

smalley.com/CAD

Online Resource Library

Our digital library contains videos, e-books, white papers, and guides that cover everything from product design to installation and removal processes.

smalley.com/resource-center

Social Media

We update our blog and social media regularly so you are the first to hear about product launches, quality certifications, new applications, and advancements in ring and spring technology.

smalley.com/blog

SUPPORT

Customer Service

Smalley's Customer Service department is ready to provide pricing, ordering, and delivery information.

For Customer Service inquires
847.719.5920
info@smalley.com

Engineering

Smalley's Engineering department is ready to provide personalized application-support and expertise to determine the best solution for your needs.

For Engineering inquires
847.719.5960
engineering@smalley.com

Quality

All Smalley products are manufactured and certified to the highest quality standards across all industries.

For Quality inquiries
847.719.5950
info@smalley.com

Global Supply Chain

Our international network of offices, engineers, warehouses, and distributors allows us to provide real-time customer support and quick shipping options for businesses worldwide.

smalley.com/our-offices

Packaging

Smalley is committed to getting products to you in the manner you require. We offer standard and custom packaging solutions designed to fit your needs.

smalley.com/packaging

Ordering

Smalley is available to assist and guide you through the ordering process. You can find more information on page 150.

Talk to a representative
847.719.5920
sales@smalley.com

Environmental Regulatory Compliances

The raw materials and processes used to manufacture our standard products are in compliance with environmental regulations. We are committed to helping our customers choose products made from compliant materials that will limit their adverse effect on the environment. We offer materials that comply with:

- RoHS - Hazardous Substance Regulation
- REACH - Chemical Regulation

Defense Regulatory Compliances

Smalley sources and acquires materials from qualified suppliers that meet your Defense needs, and we are able to provide necessary material certifications. Contact us for more information.
We offer materials that comply with:

- DFARS - Defense Federal Acquisition Regulation

A Trusted Supplier

Smalley's dedication to excellence has earned the trust of manufacturers worldwide. We have received multiple awards for our service and quality from both GM and Caterpillar.

Quality Certifications

Smalley meets strict guidelines and requirements for aerospace, automotive, and medical industries to ensure that you get the highest quality parts. We hold the following certifications:

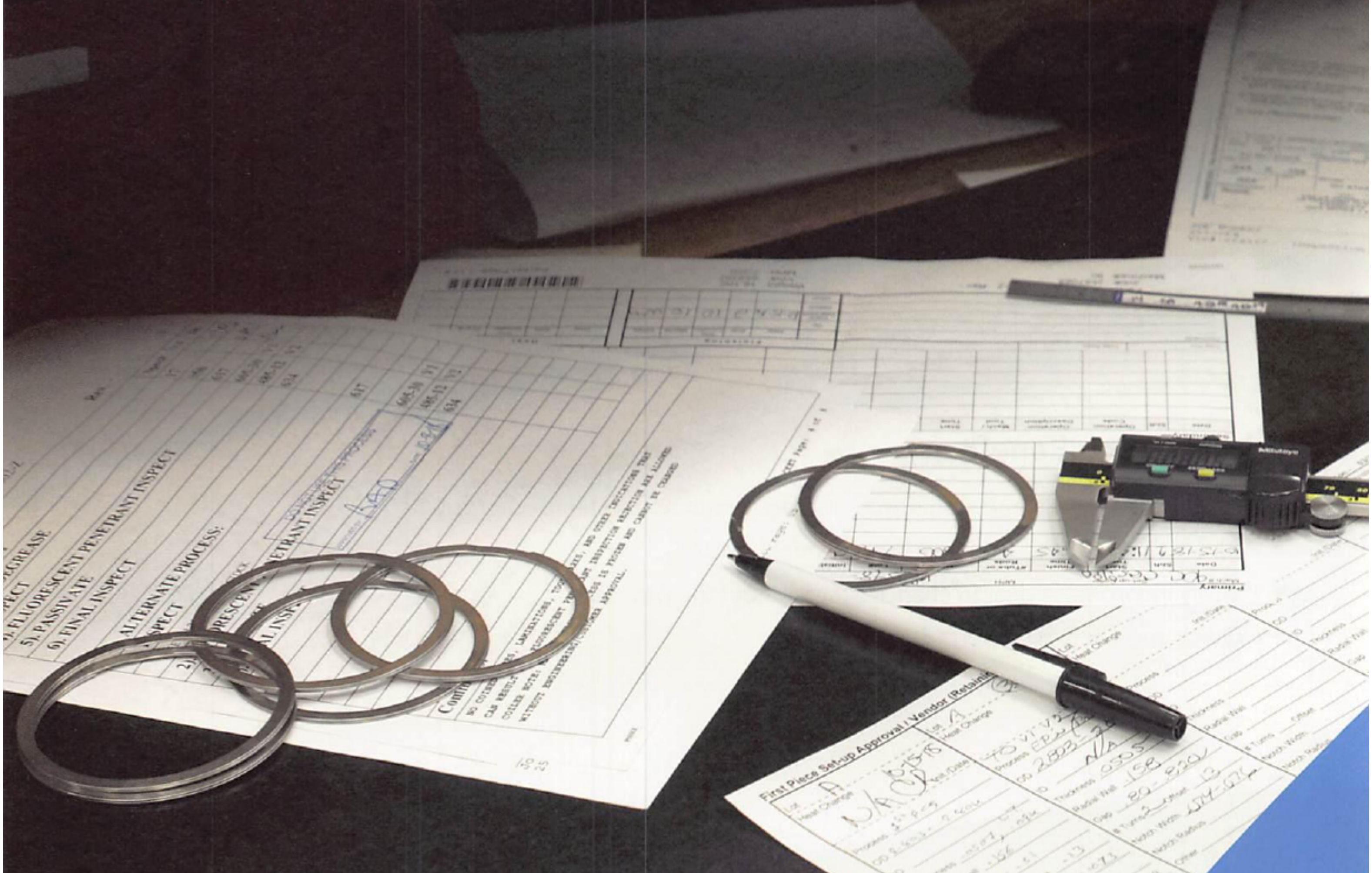
- ISO 9001 - Quality Management System
- ISO 14001 - Environmental Quality Management System
- ISO 13485 - Medical Quality Management System
- IATF 16949 - Automotive Quality Management System
- AS9100 - Aerospace Quality Management System

QUALITY

Commitment to Quality

Our Total Quality Management Philosophy dictates our commitment to excellence and customer satisfaction. This philosophy has led to our numerous manufacturers' supplier quality awards. We have also established and continue to improve upon an in-house program that is built on the following principles:

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



Quality Engineering Department

Our Quality Engineering Department is an essential part of the Smalley manufacturing process. This team's engineers work closely with our Inspection personnel to guarantee quality in our processes and products.

- In-house Statistical Quality Control (SQC) training programs
- Quick inspection processes within our manufacturing flow
- Processes with capability indexes (Cpk) exceeding 1.33

Edgewinding Benefits:

- Increased strength and stability compared to traditional stamped products
- Ability to customize with nearly no material waste
- Easily incorporate design changes throughout the process
- Quick and economical production

No-Tooling-Charges™

Because we coil our products instead of stamping them, no custom dies are required to create a custom ring or spring. Set-up procedures are simple and allow us to generate production-level prototypes for testing and make adjustments throughout production, allowing for an efficient process from design to final production.

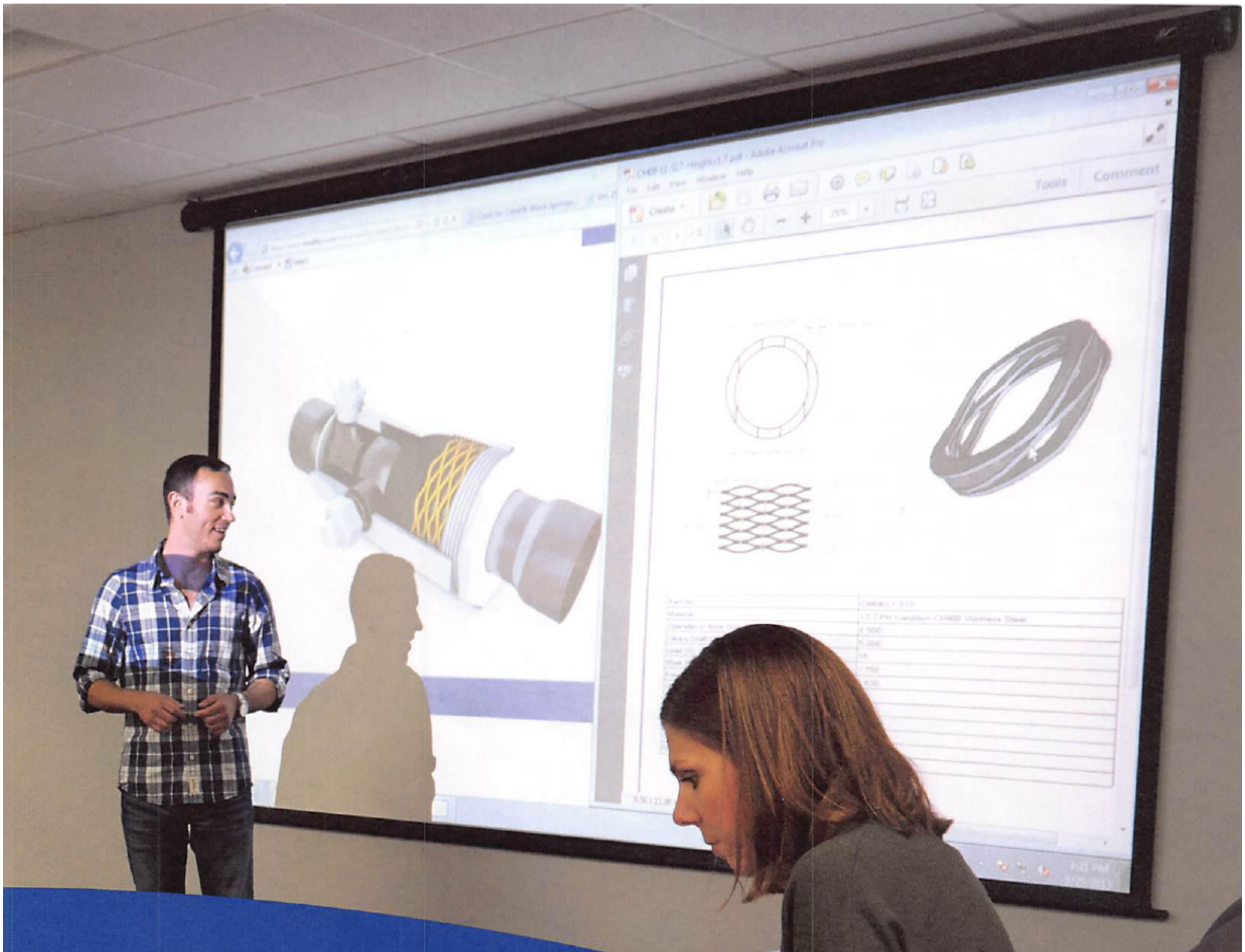
MANUFACTURING

Edgewinding Process

Edgewinding is a flexible and economical process that allows us to produce parts with No-Tooling-Costs™ and nearly no material waste. The process begins by feeding raw round wire through our rolling mills, and then coiling flat wire on edge to form the ring or spring.

Inventory and Delivery

To meet tight deadlines, we stock over 10,000 standard parts, as well as raw materials ready to be processed to ensure that your rings and springs are delivered in a timely manner. We have stock in the US, France, and China for quick deliveries worldwide.



Custom Products

At Smalley, we make custom products easy for you.
Work with our innovative team of over 30 industry-specialized engineers to quickly create an economical custom solution in the material of your choice, all with no new tooling required. Prototype or production volume, our No-Tooling-Charges™ manufacturing process meets the design flexibility your application, budget, and timeline requires.

Please see page 1 for customizable options for wave springs, and page 45 for customizable options for retaining rings.

Popular custom configurations:

ENGINEERING

Ask Smalley

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 perfect standard part or help you with your custom design.

Our support goes further than just collaborating on your design; we will make sure our parts are working for you and your application from start to finish. Our engineers can guide you to helpful resources, provide samples, or assist you in selecting the right material for your application. We're just a phone call, email, live chat, virtual or in-person visit away from finding a solution to your design challenge.

Rings

Spirolox®

Single-turn or multi-turn rings which are interchangeable with traditional retaining rings and available in many different configurations for light-to-heavy load requirements.

smalley.com/spirolox

Hoopster®

Single-turn rings that fit into a very shallow groove depth, optimal for thin-walled applications with low-to-medium load requirements.

smalley.com/hoopster

Constant Section

Single-turn rings with a square edge cross-section, ideal for heavy loads or impact loading applications.

smalley.com/constant-section-rings

WaveRing®

Multi-turn ring with an axial waveform, which operates as a retaining ring while also providing preload.

smalley.com/wavering

Laminar Seals

Labyrinth seals made of multiple rings in configurations dependent on the application, used to prevent contamination in harsh environments.

smalley.com/laminar

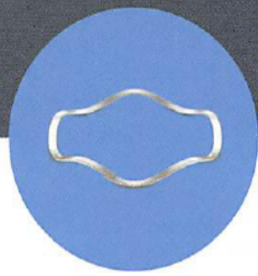
PRODUCTS

Springs

Crest-to-Crest®

Multi-turn wave springs coiled in series and designed to save space and weight for applications requiring low-to-medium forces.

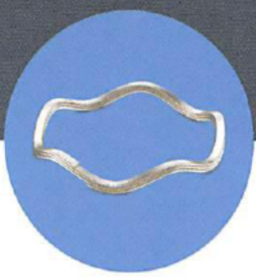
smalley.com/crest-to-crest



Overlap-Type & Gap-Type Single-Turn

Single-turn wave springs specified for applications requiring short deflections and low-to-medium forces.

smalley.com/single-turn



Nested Spirawave®

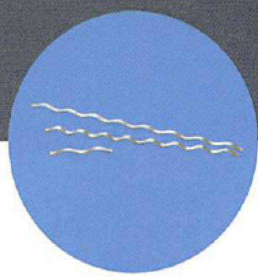
Multi-turn wave springs coiled in parallel to produce high forces and short deflections.

smalley.com/nested

Wavo®

Round wire wave springs produce high forces and operate in confined or tight radial spaces.

smalley.com/wavo



Linear

Continuous wave formed wire length with the same load/deflection characteristics as a traditional wave spring.

smalley.com/linear-springs

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Wave Springs

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Laminar Seal Rings

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SMALLEY

THE ENGINEER'S CHOICE®

NO ORDINARY RING OR SPRING

As the inventor of the edgewound wave spring and with over 100 years of manufacturing excellence, Smalley is the Engineer's Choice® in providing wave springs and retaining rings for all of your application needs.

Quick Delivery

Large stock of over 10,000 part numbers in 12 product types and 400 sizes.

U.S. Manufacturing with Global Support

Global network of offices, engineers, and distribution partners, no matter where you are.

Application Assistance & Expertise

Over 30 engineers ready to provide industry specialized application and product support.

Product Design Flexibility

Custom parts in over 40 material options made quickly and economically with no new tooling required.

Trusted & Proven Quality

Reliable and customer award winning inspection processes, backed by industry specific certifications.

Personalized Support

On-demand and responsive customer service customized

SMALLEY

THE ENGINEER'S CHOICE®

RING AND SPRING
CATALOG AND DESIGN GUIDE

Wave Spring Types

Crest-to-Crest®

Crest-to-Crest Wave Springs are flat wire, multi-turn springs coiled in series. These wave springs provide a similar force with up to 50% less axial height compared to a traditional coil spring. Standard Crest-to-Crest springs are suitable for light-to-medium loads and medium travel, making them an ideal replacement for coil springs.

Series	Page	Material	Diameter
C	25	Carbon and 17-7 PH SS	0.188 - 2"
CM	33	Carbon and 17-7 PH SS	5 - 60 mm

Crest-to-Crest® with Shim Ends

Crest-to-Crest Wave Springs with shim ends provide a secure 360° contact surface for even load distribution. They are used in applications requiring a larger mating surface area for softer materials such as plastic or aluminum.

Series	Page	Material	Diameter
CS	25	Carbon and 17-7 PH SS	0.312 - 2"
CMS	33	Carbon and 17-7 PH SS	8 - 60 mm

Wave Spring Types

Overlap-Type Single-Turn

Overlap-Type Single-Turn Wave Springs are flat wire springs that have ends that sit with a slight overlap. Overlap-type springs are ideal for smaller diameters to lessen tangling during packaging and when over-compression is not a concern. They function best with light-to-medium loads and short deflections.

Series	Page	Material	Diameter
SSR	15	Carbon and 17-7 PH SS	0.5 - 1.625"
SSB	19	Carbon and 17-7 PH SS	9 - 95 mm

Gap-Type Single-Turn

Gap-Type Single-Turn Wave Springs are flat wire springs that have ends that sit with a slight gap. Gap-type springs are ideal for situations in which the overlap would cause height or over-compression issues, especially while stacking. They function best with light-to-medium loads and short deflections.

Series	Page	Material	Diameter
SSR	15	Carbon and 17-7 PH SS	1.75 - 16"
SSR-N	17	Carbon and 17-7 PH SS	3.25 - 7.75"
SSB	19	Carbon and 17-7 PH SS	100 - 580 mm

Wave Spring Types

Nested Spirawave®

Smalley's Nested Spirawave Wave Springs are multi-turn, flat wire wave springs coiled in parallel, available in two-turn or three-turn configurations. They can replace stacks of single-turn wave springs, which eliminates errors stacking individual springs and reduces assembly time. Nested wave springs are specified for applications requiring medium-to-high loads and short deflection.

Series	Page	Material	Diameter
NSSR	23	Carbon and 17-7 PH SS	0.5 - 4"
NSSB	24	Carbon and 17-7 PH SS	16 - 100 mm

Wavo®

Wavo Wave Springs are round-wire, single-turn springs which produce extremely high loads with an accurate, predictable spring rate. They are specified to reduce or eliminate vibration in preload, to compensate for looseness due to thermal expansion in assemblies, or perform in extremely tight radial spaces that demand very high force.

Series	Page	Material	Diameter
RW	18	Carbon and 17-7 PH SS	0.5 - 6"

Wave Spring Types

Linear

Linear Springs are straight lengths of flat wire with an added wave-form. They are specified for applications requiring low-to-medium loads and deflections in a linear cavity, such as mechanical seals or rotary vane pumps.

Series	Page	Material	Length
LS	41	Carbon and 17-7 PH SS	1.5 - 12"

Popular Custom Springs

In addition to customizing our stock spring types by changing diameter, turns, waves, or other characteristics, Smalley Engineers can help design the following alternative spring types:

Interlaced

Interlaced Springs are multiple Crest-to-Crest Wave Springs woven together in series. This increases the functional thickness of the turns in the spring to provide increased loading. Interlaced springs are a good alternative for applications in which a Crest-to-Crest Wave Spring cannot support required loads and a Nested Spirawave cannot produce the desired free height or deflection.

Marcel

Marcel Expanders are single-turn, flat wire wave springs coiled to provide radial forces. They are specified to self-center an assembly or to energize a seal when no pressure is available from another source within the application.

Pitched Coils

Pitched Coils are multi-turn flat wire coil springs, available with or without shims. They produce extremely low loads with extremely high travel.

Wave Spring Applications

Crest-to-Crest®

Pressure Relief Valve

Air pressure under the assembly causes the spring load to increase, forcing the plate away from the surface, providing pressure relief.

Flow Valve

As fluid pressure increases, the wave spring precisely controls the linear displacement of the piston, which positions the orifice for proper fluid flow.

Sprinkler Valve

The wave spring maintains constant pressure on the pop-up head so it remains closed. In operation, water pressure releases the head by overcoming the spring's force.

Oil Valve

The force provided by the wave spring precisely regulates the amount of oil that is released, providing accurate resistance in a small space, reducing valve size.

Wave Spring Applications

Crest-to-Crest®

Ball Valve

The wave spring allows the seat to oscillate on the ball and keep a tight seal in the operating position. The smaller spring cavity reduces the weight and size of the valve.

Quick Disconnect

The sliding piece of the disconnect is held in its locked position against the retaining ring by the wave spring. The user slides the piece in the opposite direction to compress the spring, aligning the detent balls with a groove, and releases.

Floating Gear

The wave spring functions in a contained bracket, preloading a gear with a light load while allowing axial movement.

Water Valve

The wave spring prevents the valve handle from rotating by maintaining a constant load. As the handle rotates counter-clockwise, the spring's resistance increases, preventing rotation.

Wave Spring Applications

Crest-to-Crest®

Shoe

Wave springs positioned in the heel and ball of the sole are used to absorb shock when the foot hits the ground while walking or running.

Motherboard Heatsink Fan

Small diameter wave springs were designed to lighten the weight of the fan installed in an electronics application.

Push Button

Small diameter wave springs are used to minimize assembly size, allowing for a lighter weight assembly for compact wearable electronics.

Auto Mirror

The wave springs allows for the mirror to adjust while remaining lightweight and small to reduce assembly size.

Wave Spring Applications

Overlap-Type Single-Turn

Slip Clutch

As torque is increased, the "V" detents ride up and out of the slots, depressing the wave spring and developing the slip mechanism. When torque is decreased, the wave spring forces the detents back into the slots to drive again.

Bearing Preload

Properly loading a bearing with a wave spring extends the lifecycle by reducing vibration, which reduces operating temperature and minimizes wear.

Aerospace Electrical Connector

Two wave springs are compressed, exerting a constant force on the connector, providing continuous connection.

Rotary Union

The wave spring preloads a bearing, taking up play and reducing vibration and noise.

Wave Spring Applications

Gap-Type Single-Turn

Face Seal

The wave spring applies an exact force to precisely load the carbon face against a mating surface and properly seal fluids.

Multi-Tooth Cutter

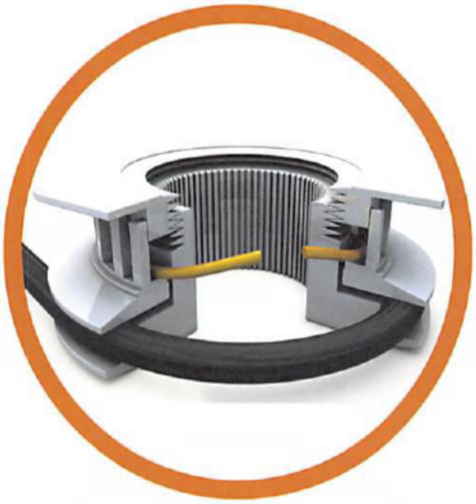
The wave spring, custom designed with locating tabs, applies precise force to the two cutter halves, holding them together while allowing them to oscillate.

Wave Spring Applications

Wavo®

Clutch Drive

Compressing the Wavo Spring through sheave halves produces pressure on the round belt while the top threaded cap rotates to adjust compression.



Vibration Isolator

Wavo Springs are used to provide precise and predictable load and deflection curves in the isolator, dampening vibration from equipment operation.

Axial Piston Pump

A Wavo Spring can provide a high preload and large compressive force to tapered roller bearings.

Wave Spring Applications

Nested Spirawave®

Low Voltage Connector

A bayonet connector couples as male and female components rotate, while the two-turn nested spring provides preload between two halves, developing a high load in a very tight radial and axial space.

Push Seal

A two-turn nested spring provides a higher force than a single-turn spring to maintain a proper seal. This exact pressure is essential to avoid excessive wear.

Bearing Preload

A three-turn nested spring can provide bearing preload for heavy duty applications with high preload requirements, prolonging bearing life.

Valve

A two-turn nested spring is used to provide a high spring force with a low profile for space savings.

Wave Spring Applications

Linear

Detent Preload

The springs are used to load pins positioned inside grooves so a rotating element can detent to specific positions. They exert a precise load to give the rotation a specific resistance.

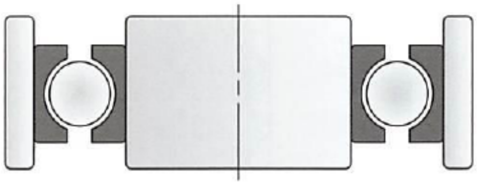
Rotary Vane Pump

The springs energize the vanes against the bore for better sealing by loading the bottom of the vanes in the pump.

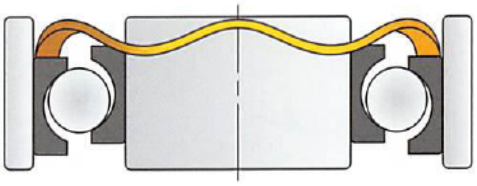
Wave Spring Application Spotlight
Single-Turn Bearing Preload

What is Bearing Preload?

There are two main methods to preload a bearing. The first is solid preload, which is achieved by holding inner and outer races in place with a locking mechanism. The more common, simpler, and less expensive method is spring preload, which is achieved by using a spring to apply a constant axial load on one side. A Smalley Single-Turn Wave Spring provides necessary preload force between the inner or outer races while also compensating for any tolerance stack-ups or thermal misalignments. Play is reduced both axially and radially, as depicted in the image below.



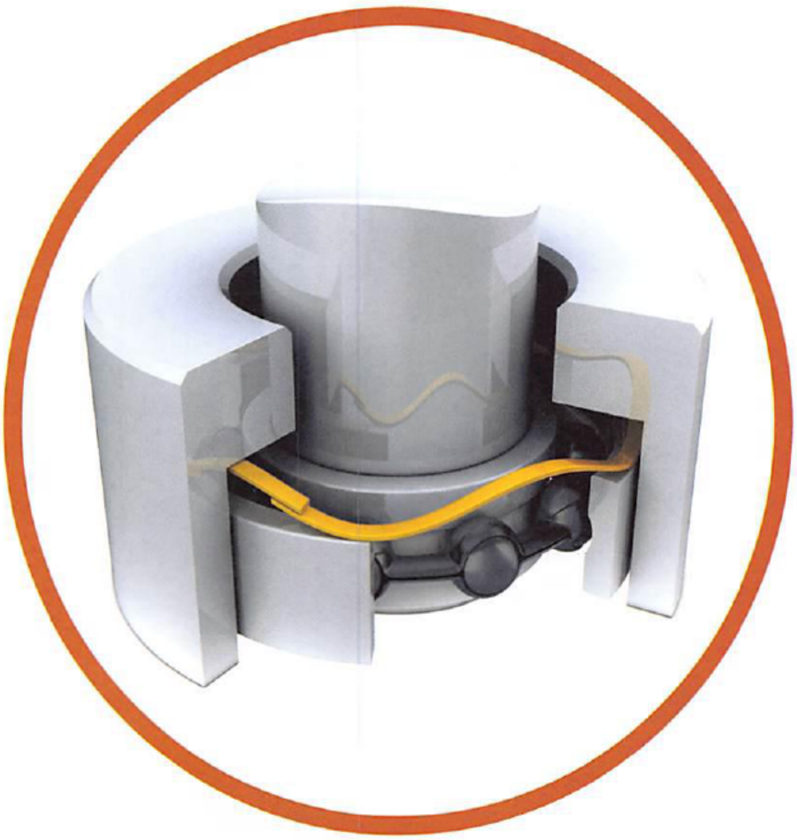
Bearing without a preload: Clearance between components can cause vibration and wear.



Bearing with a preload: The ball complement and bearing races mate reliably reducing or eliminating vibration and wear.

Controlling play is necessary to maintain bearing functionality and longevity. Preloading a bearing provides constant contact between the bearing type (ball, needle, etc.) and bearing races. The sustained load provided by the spring controls axial and radial play, reducing bearing damage, wear, noise, and vibration.

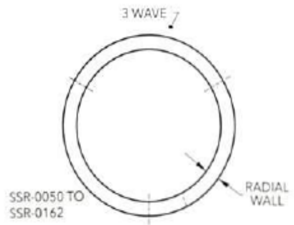
The overall goal of preloading is to prolong bearing life, and therefore, your application product life. Using a Single-Turn Wave Spring for preload is critical for high-precision or high-speed applications, as it essentially eliminates the need for holding tighter tolerances and helps withstand high operating speeds.

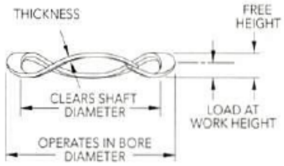


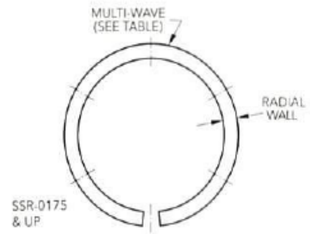
Wave Springs

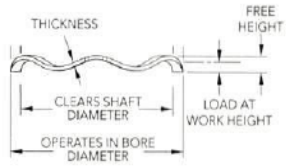
SSR Series

Single-Turn Overlap-Type and Gap-Type Springs









Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number		Operates in Bore Diameter (in)	Clears Shaft Diameter (in)	Load (lb)	Work Height (in)	Free Height[1] (in)	Number of Waves	Number of Turns	Thickness (in)	Radial Wall (in)	Spring Rate[2] (lb/in)
Carbon Steel	Add Suffix 17-7 SS										
Single-Turn Overlap-Type Springs											
SSR-0050	**-S17**	.500	.390	7	.050	.085	3	1	.008	.040	200
SSR-0062	**-S17**	.625	.480	10	.050	.095	3	1	.010	.058	222
SSR-0075	**-S17**	.750	.500	14	.062	.160	3	1	.010	.078	143
SSR-0087	**-S17**	.875	.620	16	.062	.130	3	1	.012	.094	235
SSR-0100	**-S17**	1.000	.780	18	.062	.190	3	1	.012	.094	184
SSR-0112	**-S17**	1.125	.835	20	.078	.130	3	1	.016	.133	385
SSR-0125	**-S17**	1.250	.960	22	.078	.150	3	1	.016	.133	306
SSR-0137	**-S17**	1.375	1.090	24	.078	.210	3	1	.016	.133	214
SSR-0150	**-S17**	1.500	1.170	26	.078	.170	3	1	.018	.143	283
SSR-0162	**-S17**	1.625	1.310	28	.078	.200	3	1	.018	.143	230
Single-Turn Gap-Type Springs											
SSR-0175	**-S17**	1.750	1.440	30	.078	.140	4	1	.018	.143	484
SSR-0187	**-S17**	1.875	1.560	32	.078	.150	4	1	.018	.143	444
SSR-0200	**-S17**	2.000	1.680	34	.093	.140	4	1	.024	.148	723
SSR-0212	**-S17**	2.125	1.800	36	.093	.150	4	1	.024	.148	632
SSR-0225	**-S17**	2.250	1.930	38	.093	.170	4	1	.024	.148	494
SSR-0237	**-S17**	2.375	1.990	40	.093	.160	4	1	.024	.178	597
SSR-0250	**-S17**	2.500	2.120	42	.093	.170	4	1	.024	.178	545
SSR-0262	**-S17**	2.625	2.240	44	.093	.190	4	1	.024	.178	454
SSR-0275	**-S17**	2.750	2.340	46	.109	.170	4	1	.030	.188	754
SSR-0287	**-S17**	2.875	2.470	48	.109	.180	4	1	.030	.188	676
SSR-0300	**-S17**	3.000	2.590	50	.109	.190	4	1	.030	.188	617
SSR-0312	**-S17**	3.125	2.710	52	.109	.210	4	1	.030	.188	515
SSR-0325	**-S17**	3.250	2.750	54	.109	.200	4	1	.030	.233	593
SSR-0337	**-S17**	3.375	2.845	56	.109	.220	4	1	.030	.233	505
SSR-0350	**-S17**	3.500	3.000	58	.109	.230	4	1	.030	.233	479
SSR-0362	**-S17**	3.625	3.120	60	.109	.240	4	1	.030	.233	458
SSR-0375	**-S17**	3.750	3.250	62	.109	.260	4	1	.030	.233	411
SSR-0387	**-S17**	3.875	3.370	64	.109	.300	4	1	.030	.233	335
SSR-0400	**-S17**	4.000	3.500	66	.109	.190	5	1	.030	.233	815
SSR-0412	**-S17**	4.125	3.620	67	.109	.200	5	1	.030	.233	736
SSR-0425	**-S17**	4.250	3.740	69	.109	.210	5	1	.030	.233	683
SSR-0437	**-S17**	4.375	3.860	70	.109	.210	5	1	.030	.233	693
SSR-0450	**-S17**	4.500	3.990	72	.109	.230	5	1	.030	.233	595
SSR-0462	**-S17**	4.625	4.110	73	.125	.270	5	1	.030	.233	503
SSR-0475	**-S17**	4.750	4.240	75	.125	.285	5	1	.030	.233	405
SSR-0487	**-S17**	4.875	4.370	76	.125	.310	5	1	.030	.233	461
SSR-0500	**-S17**	5.000	4.490	78	.125	.310	5	1	.030	.233	422
SSR-0512	**-S17**	5.125	4.610	80	.125	.340	5	1	.030	.233	372

[1] Reference dimension.
[2] Theoretical dimension.

SSR Series

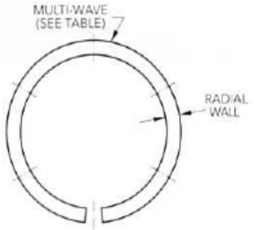
Single-Turn Overlap-Type and Gap-Type Springs Continued

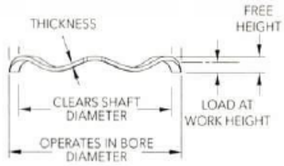
Smalley Part Number		Operates in Bore Diameter (in)	Clears Shaft Diameter (in)	Load (lb)	Work Height (in)	Free Height[1] (in)	Number of Waves	Number of Turns	Thickness (in)	Radial Wall (in)	Spring Rate[2] (lb/in)
Carbon Steel	Add Suffix 17-7 SS										
Single-Turn Gap-Type Springs											
SSR-0525	**-S17**	5.250	4.740	82	.125	.370	5	1	.030	.233	335
SSR-0537	**-S17**	5.375	4.860	84	.125	.380	5	1	.030	.233	329
SSR-0550	**-S17**	5.500	4.990	86	.125	.250	6	1	.030	.233	688
SSR-0562	**-S17**	5.625	5.110	88	.125	.270	6	1	.030	.233	607
SSR-0575	**-S17**	5.750	5.240	90	.125	.280	6	1	.030	.233	581
SSR-0587	**-S17**	5.875	5.360	92	.125	.310	6	1	.030	.233	526
SSR-0600	**-S17**	6.000	5.490	94	.125	.310	6	1	.030	.233	537
SSR-0612	**-S17**	6.125	5.610	96	.125	.340	6	1	.030	.233	519
SSR-0625	**-S17**	6.250	5.730	98	.125	.340	6	1	.030	.233	456
SSR-0637	**-S17**	6.375	5.860	100	.125	.350	6	1	.030	.233	444
SSR-0650	**-S17**	6.500	5.980	102	.125	.390	6	1	.030	.233	385
SSR-0675	**-S17**	6.750	6.230	104	.125	.420	6	1	.030	.233	353
SSR-0700	**-S17**	7.000	6.160	106	.156	.320	6	1	.032	.375	646
SSR-0725	**-S17**	7.250	6.440	108	.156	.350	6	1	.032	.375	557
SSR-0750	**-S17**	7.500	6.690	110	.156	.380	6	1	.032	.375	539
SSR-0775	**-S17**	7.750	6.940	114	.156	.380	6	1	.032	.375	509
SSR-0800	**-S17**	8.000	7.190	118	.156	.390	6	1	.032	.375	504
SSR-0825	**-S17**	8.250	7.440	122	.156	.430	6	1	.032	.375	445
SSR-0850	**-S17**	8.500	7.680	126	.156	.340	7	1	.032	.375	685
SSR-0875	**-S17**	8.750	7.930	130	.156	.340	7	1	.032	.375	707
SSR-0900	**-S17**	9.000	8.180	134	.156	.290	8	1	.032	.375	1,000
SSR-0950	**-S17**	9.500	8.680	142	.156	.240	9	1	.032	.375	1,690
SSR-1000	**-S17**	10.000	9.170	150	.156	.290	9	1	.032	.375	1,119
SSR-1050	**-S17**	10.500	9.670	158	.156	.310	9	1	.032	.375	1,026
SSR-1100	**-S17**	11.000	10.170	166	.156	.350	9	1	.032	.375	856
SSR-1150	**-S17**	11.500	10.660	174	.156	.360	9	1	.032	.375	853
SSR-1200	**-S17**	12.000	11.160	182	.156	.440	9	1	.032	.375	641
SSR-1250	**-S17**	12.500	11.660	190	.156	.350	10	1	.032	.375	979
SSR-1300	**-S17**	13.000	12.160	198	.156	.380	10	1	.032	.375	780
SSR-1350	**-S17**	13.500	12.650	206	.156	.430	10	1	.032	.375	752
SSR-1400	**-S17**	14.000	13.150	214	.156	.300	12	1	.032	.375	1,486
SSR-1450	**-S17**	14.500	13.650	221	.156	.320	12	1	.032	.375	1,348
SSR-1500	**-S17**	15.000	14.130	230	.156	.350	12	1	.032	.375	1,186
SSR-1550	**-S17**	15.500	14.640	239	.156	.310	13	1	.032	.375	1,552
SSR-1600	**-S17**	16.000	15.140	248	.156	.310	13	1	.032	.375	1,348

[1] Reference dimension.
[2] Theoretical dimension.

SSR-N Series

Narrow Section Gap-Type Springs



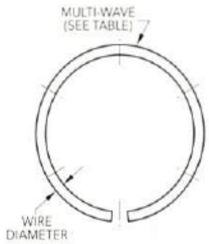


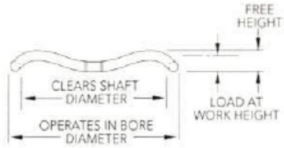
Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number		Operates in Bore Diameter (in)	Clears Shaft Diameter (in)	Load (lb)	Work Height (in)	Free Height[1] (in)	Number of Waves	Number of Turns	Thickness (in)	Radial Wall (in)	Spring Rate[2] (lb/in)
Carbon Steel	Add Suffix 17-7 SS										
SSR-0325-N	**-S17**	3.250	2.820	54	.109	.230	4	1	.030	.188	593
SSR-0337-N	**-S17**	3.375	2.940	56	.109	.220	4	1	.030	.188	505
SSR-0350-N	**-S17**	3.500	3.070	58	.109	.260	4	1	.030	.188	384
SSR-0362-N	**-S17**	3.625	3.190	60	.109	.270	4	1	.030	.188	373
SSR-0375-N	**-S17**	3.750	3.320	62	.109	.330	4	1	.030	.188	363
SSR-0387-N	**-S17**	3.875	3.440	64	.109	.310	4	1	.030	.188	318
SSR-0400-N	**-S17**	4.000	3.570	66	.109	.200	5	1	.030	.188	725
SSR-0412-N	**-S17**	4.125	3.690	67	.109	.200	5	1	.030	.188	736
SSR-0425-N	**-S17**	4.250	3.820	69	.109	.240	5	1	.030	.188	527
SSR-0437-N	**-S17**	4.375	3.940	70	.109	.210	5	1	.030	.188	693
SSR-0450-N	**-S17**	4.500	4.070	72	.109	.280	5	1	.030	.188	421
SSR-0462-N	**-S17**	4.625	4.190	73	.125	.270	5	1	.030	.188	503
SSR-0475-N	**-S17**	4.750	4.320	75	.125	.320	5	1	.030	.188	385
SSR-0487-N	**-S17**	4.875	4.440	76	.125	.320	5	1	.030	.188	390
SSR-0500-N	**-S17**	5.000	4.570	78	.125	.350	5	1	.030	.188	347
SSR-0512-N	**-S17**	5.125	4.690	80	.125	.350	5	1	.030	.188	356
SSR-0525-N	**-S17**	5.250	4.820	82	.125	.360	5	1	.030	.188	349
SSR-0537-N	**-S17**	5.375	4.940	84	.125	.440	5	1	.030	.188	267
SSR-0550-N	**-S17**	5.500	5.070	86	.125	.280	6	1	.030	.188	555
SSR-0562-N	**-S17**	5.625	5.190	88	.125	.290	6	1	.030	.188	533
SSR-0575-N	**-S17**	5.750	5.320	90	.125	.340	6	1	.030	.188	419
SSR-0587-N	**-S17**	5.875	5.440	92	.125	.340	6	1	.030	.188	428
SSR-0600-N	**-S17**	6.000	5.570	94	.125	.340	6	1	.030	.188	437
SSR-0612-N	**-S17**	6.125	5.690	96	.125	.280	7	1	.030	.188	619
SSR-0625-N	**-S17**	6.250	5.820	98	.125	.280	7	1	.030	.188	632
SSR-0637-N	**-S17**	6.375	5.940	100	.125	.300	7	1	.030	.188	571
SSR-0650-N	**-S17**	6.500	6.070	102	.125	.300	7	1	.030	.188	583
SSR-0675-N	**-S17**	6.750	6.320	104	.125	.300	7	1	.030	.188	594
SSR-0700-N	**-S17**	7.000	6.480	106	.156	.320	7	1	.030	.233	646
SSR-0725-N	**-S17**	7.250	6.730	108	.156	.330	7	1	.030	.233	621
SSR-0750-N	**-S17**	7.500	6.980	110	.156	.360	7	1	.030	.233	539
SSR-0775-N	**-S17**	7.750	7.230	114	.156	.380	7	1	.030	.233	509

[1] Reference dimension.
[2] Theoretical dimension.

RW Series
Wavo® Springs





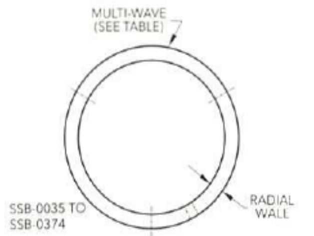
Product Dimensions: All dimensions in inches unless otherwise specified.

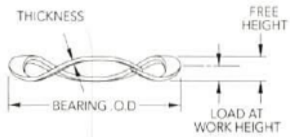
Smalley Part Number		Operates in Bore Diameter (in)	Clears Shaft Diameter (in)	Load (lb)	Work Height (in)	Free Height[1] (in)	Number of Waves	Number of Turns	Thickness (in)	Wire Diameter (in)	Spring Rate[2] (lb/in)
Carbon Steel	Add Suffix 17-7 SS										
RW-0050	-S17	.500	.408	35	.052	.062	3	1	.031	.031	3,500
RW-0062	-S17	.625	.517	50	.064	.077	3	1	.038	.038	3,846
RW-0075	-S17	.750	.628	70	.076	.092	3	1	.045	.045	4,375
RW-0087	-S17	.875	.740	80	.086	.104	3	1	.051	.051	4,444
RW-0100	-S17	1.000	.855	90	.095	.116	3	1	.056	.056	4,286
RW-0112	-S17	1.125	.967	100	.102	.127	3	1	.060	.060	4,000
RW-0125	-S17	1.250	1.081	110	.110	.138	3	1	.065	.065	3,929
RW-0137	-S17	1.375	1.223	120	.095	.121	4	1	.056	.056	4,615
RW-0150	-S17	1.500	1.339	130	.102	.128	4	1	.060	.060	5,000
RW-0162	-S17	1.625	1.444	140	.110	.137	4	1	.065	.065	5,185
RW-0175	-S17	1.750	1.564	150	.113	.144	4	1	.067	.067	4,839
RW-0187	-S17	1.875	1.682	160	.119	.155	4	1	.070	.070	4,444
RW-0200	-S17	2.000	1.803	170	.124	.165	4	1	.072	.072	4,146
RW-0212	-S17	2.125	1.906	180	.129	.162	4	1	.076	.076	5,455
RW-0225	-S17	2.250	2.023	190	.136	.168	4	1	.080	.080	5,938
RW-0237	-S17	2.375	2.141	200	.141	.178	4	1	.083	.083	5,405
RW-0250	-S17	2.500	2.261	210	.144	.185	4	1	.085	.085	5,122
RW-0262	-S17	2.625	2.374	220	.153	.203	4	1	.090	.090	4,400
RW-0275	-S17	2.750	2.497	230	.154	.212	4	1	.091	.091	3,966
RW-0287	-S17	2.875	2.618	240	.158	.210	4	1	.093	.093	4,615
RW-0300	-S17	3.000	2.767	250	.141	.179	5	1	.083	.083	6,579
RW-0312	-S17	3.125	2.878	260	.144	.184	5	1	.085	.085	6,500
RW-0325	-S17	3.250	2.992	270	.153	.190	5	1	.090	.090	7,297
RW-0337	-S17	3.375	3.115	280	.154	.195	5	1	.091	.091	6,829
RW-0350	-S17	3.500	3.236	290	.158	.201	5	1	.093	.093	6,744
RW-0362	-S17	3.625	3.356	300	.161	.206	5	1	.095	.095	6,667
RW-0375	-S17	3.750	3.475	310	.166	.212	5	1	.098	.098	6,739
RW-0387	-S17	3.875	3.595	320	.170	.208	5	1	.100	.100	8,421
RW-0400	-S17	4.000	3.718	330	.170	.225	5	1	.100	.100	6,000
RW-0412	-S17	4.125	3.827	335	.175	.221	5	1	.105	.105	7,283
RW-0425	-S17	4.250	3.948	345	.178	.225	5	1	.105	.105	7,340
RW-0437	-S17	4.375	4.063	350	.187	.240	5	1	.110	.110	6,604
RW-0450	-S17	4.500	4.185	360	.187	.247	5	1	.110	.110	6,000
RW-0462	-S17	4.625	4.310	365	.187	.253	5	1	.110	.110	5,530
RW-0475	-S17	4.750	4.431	375	.190	.257	5	1	.112	.112	5,597
RW-0487	-S17	4.875	4.555	380	.190	.264	5	1	.112	.112	5,135
RW-0500	-S17	5.000	4.672	390	.195	.265	5	1	.116	.116	5,571
RW-0512	-S17	5.125	4.772	400	.200	.274	5	1	.118	.118	5,405
RW-0525	-S17	5.250	4.893	410	.204	.279	5	1	.120	.120	5,467
RW-0537	-S17	5.375	5.037	420	.187	.245	6	1	.110	.110	7,241
RW-0550	-S17	5.500	5.162	430	.187	.251	6	1	.110	.110	6,719
RW-0562	-S17	5.625	5.283	440	.190	.245	6	1	.112	.112	8,000
RW-0575	-S17	5.750	5.406	450	.190	.251	6	1	.112	.112	7,377
RW-0587	-S17	5.875	5.524	460	.197	.262	6	1	.116	.116	7,077
RW-0600	-S17	6.000	5.644	470	.200	.268	6	1	.118	.118	6,912

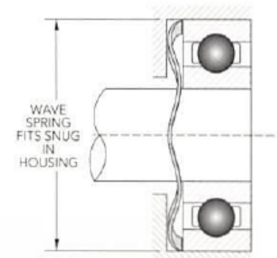
[1] Reference dimension.
[2] Theoretical dimension.

SSB Series

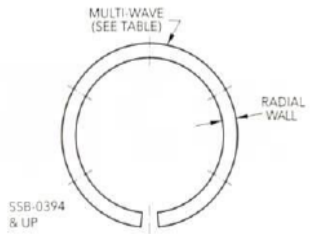
Metric Bearing Preload Springs

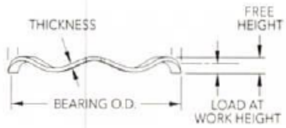






Gap-Type Wave Spring shown in a housing.





Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number		Bearing O.D.[1] (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height[2] (mm)	Number of Waves	Number of Turns	Thickness (mm)	Radial Wall (mm)	Spring Rate[3] (N/mm)
Carbon Steel	Add Suffix 17-7 SS										
		Single-Turn Overlap-Type Springs									
SSB-0035	**-S17**	9.00	6.86	25.80	1.00	1.50	3	1	.20	.81	52
SSB-0039	**-S17**	10.00	7.49	27.60	1.00	1.57	3	1	.20	1.02	48
SSB-0043	**-S17**	11.00	8.46	29.40	1.00	1.83	3	1	.20	1.02	35
SSB-0047	**-S17**	12.00	9.17	33.40	1.00	1.57	3	1	.25	1.17	59
SSB-0051	**-S17**	13.00	9.53	37.80	1.00	1.57	3	1	.25	1.47	66
SSB-0063	**-S17**	16.00	11.28	44.50	1.57	2.29	3	1	.25	1.98	65
SSB-0075	**-S17**	19.00	14.28	53.40	1.57	3.05	3	1	.25	1.98	35
SSB-0087	**-S17**	22.00	16.46	62.30	1.57	3.05	3	1	.30	2.39	48
SSB-0095	**-S17**	24.00	18.46	66.70	1.57	3.56	3	1	.30	2.39	35
SSB-0102	**-S17**	26.00	18.22	71.20	1.98	2.54	3	1	.41	3.38	111
SSB-0110	**-S17**	28.00	20.22	75.60	1.98	2.79	3	1	.41	3.38	85
SSB-0118	**-S17**	30.00	22.22	84.50	1.98	3.30	3	1	.41	3.38	66
SSB-0126	**-S17**	32.00	24.22	89.00	1.98	3.81	3	1	.41	3.38	52
SSB-0138	**-S17**	35.00	27.22	97.90	1.98	4.57	3	1	.41	3.38	38
SSB-0146	**-S17**	37.00	28.72	102.30	1.98	3.81	3	1	.46	3.63	58
SSB-0158	**-S17**	40.00	31.72	111.20	1.98	5.08	3	1	.46	3.63	37
SSB-0165	**-S17**	42.00	33.72	115.70	1.98	3.05	4	1	.46	3.63	99
SSB-0185	**-S17**	47.00	38.72	129.00	1.98	3.81	4	1	.46	3.63	68
SSB-0205	**-S17**	52.00	43.11	142.40	2.36	3.56	4	1	.61	3.76	121
SSB-0217	**-S17**	55.00	46.11	151.30	2.36	3.81	4	1	.61	3.76	100
SSB-0244	**-S17**	62.00	51.69	169.10	2.36	4.32	4	1	.61	4.52	85
SSB-0268	**-S17**	68.00	57.17	186.90	2.77	4.32	4	1	.76	4.78	131
SSB-0276	**-S17**	70.00	59.17	191.30	2.77	4.32	4	1	.76	4.78	119
SSB-0284	**-S17**	72.00	61.17	195.80	2.77	4.57	4	1	.76	4.78	108
SSB-0295	**-S17**	75.00	64.17	204.70	2.77	5.08	4	1	.76	4.78	94
SSB-0315	**-S17**	80.00	68.66	218.00	2.77	5.59	4	1	.76	4.78	76
SSB-0335	**-S17**	85.00	71.38	231.40	2.77	5.59	4	1	.76	5.92	83
SSB-0354	**-S17**	90.00	76.38	249.20	2.77	6.35	4	1	.76	5.92	68
SSB-0374	**-S17**	95.00	81.38	262.50	2.77	7.37	4	1	.76	5.92	57
		Single-Turn Gap-Type Springs									
SSB-0394	**-S17**	100.00	86.38	275.90	2.77	4.57	5	1	.76	5.92	157
SSB-0413	**-S17**	105.00	91.38	289.20	2.77	5.08	5	1	.76	5.92	134
SSB-0433	**-S17**	110.00	96.38	302.60	2.77	5.33	5	1	.76	5.92	115
SSB-0453	**-S17**	115.00	101.38	315.90	3.18	6.35	5	1	.76	5.92	99
SSB-0472	**-S17**	120.00	106.38	329.30	3.18	7.11	5	1	.76	5.92	86
SSB-0492	**-S17**	125.00	111.38	342.60	3.18	7.62	5	1	.76	5.92	76
SSB-0512	**-S17**	130.00	116.38	356.00	3.18	8.64	5	1	.76	5.92	67
SSB-0532	**-S17**	135.00	121.38	369.30	3.18	9.40	5	1	.76	5.92	59
SSB-0551	**-S17**	140.00	126.38	382.70	3.18	6.86	6	1	.76	5.92	108

[1] Wave Springs fit snug in housing.
[2] Reference dimension.
[3] Theoretical dimension.

SSB Series

Metric Bearing Preload Springs Continued

Smalley Part Number		Bearing O.D.[1] (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height[2] (mm)	Number of Waves	Number of Turns	Thickness (mm)	Radial Wall (mm)	Spring Rate[3] (N/mm)
Carbon Steel	Add Suffix 17-7 SS										
Single-Turn Gap-Type Springs											
SSB-0571	**-S17**	145.00	131.38	396.00	3.18	7.37	6	1	.76	5.92	97
SSB-0591	**-S17**	150.00	136.38	404.90	3.18	7.87	6	1	.76	5.92	87
SSB-0630	**-S17**	160.00	146.38	440.50	3.18	9.40	6	1	.76	5.92	71
SSB-0650	**-S17**	165.00	151.38	453.90	3.18	10.41	6	1	.76	5.92	64
SSB-0669	**-S17**	170.00	156.38	467.20	3.18	11.18	6	1	.76	5.92	58
SSB-0689	**-S17**	175.00	154.16	480.60	3.96	8.13	6	1	.81	9.53	116
SSB-0709	**-S17**	180.00	159.16	493.90	3.96	8.64	6	1	.81	9.53	105
SSB-0728	**-S17**	185.00	164.16	507.30	3.96	9.14	6	1	.81	9.53	97
SSB-0748	**-S17**	190.00	169.16	520.60	3.96	9.91	6	1	.81	9.53	88
SSB-0787	**-S17**	200.00	179.16	547.30	3.96	7.11	7	1	.81	9.53	174
SSB-0807	**-S17**	205.00	184.16	560.70	3.96	7.37	7	1	.81	9.53	161
SSB-0827	**-S17**	210.00	189.16	578.50	3.96	7.87	7	1	.81	9.53	149
SSB-0847	**-S17**	215.00	194.16	591.80	3.96	8.38	7	1	.81	9.53	138
SSB-0866	**-S17**	220.00	199.16	605.20	3.96	8.64	7	1	.81	9.53	128
SSB-0886	**-S17**	225.00	204.16	618.50	3.96	7.11	8	1	.81	9.53	203
SSB-0906	**-S17**	230.00	209.16	631.90	3.96	6.10	9	1	.81	9.53	303
SSB-0925	**-S17**	235.00	214.16	645.20	3.96	6.35	9	1	.81	9.53	283
SSB-0945	**-S17**	240.00	219.16	658.60	3.96	6.35	9	1	.81	9.53	265
SSB-0984	**-S17**	250.00	229.16	685.30	3.96	6.86	9	1	.81	9.53	232
SSB-1024	**-S17**	260.00	239.16	712.00	3.96	7.37	9	1	.81	9.53	205
SSB-1043	**-S17**	265.00	244.16	725.30	3.96	7.62	9	1	.81	9.53	193
SSB-1063	**-S17**	270.00	249.16	743.10	3.96	8.13	9	1	.81	9.53	182
SSB-1102	**-S17**	280.00	259.16	769.80	3.96	8.64	9	1	.81	9.53	162
SSB-1142	**-S17**	290.00	269.16	796.50	3.96	9.40	9	1	.81	9.53	144
SSB-1181	**-S17**	300.00	279.16	823.20	3.96	10.41	9	1	.81	9.53	129
SSB-1221	**-S17**	310.00	289.16	849.90	3.96	7.11	9	1	1.07	9.53	264
SSB-1260	**-S17**	320.00	299.16	876.60	3.96	7.62	9	1	1.07	9.53	239
SSB-1339	**-S17**	340.00	319.16	934.50	3.96	8.64	9	1	1.07	9.53	198
SSB-1378	**-S17**	350.00	329.16	961.10	3.96	9.40	9	1	1.07	9.53	180
SSB-1417	**-S17**	360.00	339.16	987.90	3.96	7.62	10	1	1.07	9.53	271
SSB-1457	**-S17**	370.00	349.16	1,014.60	3.96	8.13	10	1	1.07	9.53	249
SSB-1496	**-S17**	380.00	359.16	1,041.30	3.96	8.64	10	1	1.07	9.53	229
SSB-1535	**-S17**	390.00	369.16	1,072.40	3.96	9.14	10	1	1.07	9.53	211
SSB-1575	**-S17**	400.00	379.16	1,099.10	3.96	9.65	10	1	1.07	9.53	196
SSB-1614	**-S17**	410.00	382.82	1,125.80	3.96	8.38	10	1	1.07	12.70	251
SSB-1654	**-S17**	420.00	392.82	1,152.50	3.96	8.89	10	1	1.07	12.70	233
SSB-1693	**-S17**	430.00	402.82	1,179.20	3.96	7.62	11	1	1.07	12.70	317
SSB-1732	**-S17**	440.00	412.82	1,205.90	3.96	8.13	11	1	1.07	12.70	295
SSB-1811	**-S17**	460.00	432.82	1,263.70	3.96	8.89	11	1	1.07	12.70	256
SSB-1890	**-S17**	480.00	452.82	1,317.10	3.96	8.13	12	1	1.07	12.70	318
SSB-1969	**-S17**	500.00	472.82	1,370.50	3.96	8.89	12	1	1.07	12.70	280
SSB-2126	**-S17**	540.00	512.82	1,481.80	3.96	8.89	13	1	1.07	12.70	303
SSB-2284	**-S17**	580.00	552.82	1,593.00	3.96	8.89	14	1	1.07	12.70	327

[1] Wave Springs fit snug in housing.
[2] Reference dimension.
[3] Theoretical dimension.

SSB Series

Cross Reference Guide for Bearing Preload

Smalley Part Number		Bearing O.D.[1] (mm)	Bearing Part Numbers						
Carbon Steel	Add Suffix 17-7 SS		Extra Small	Extremely Light	Extra Light	Narrow	Light	Medium	Heavy
			Single-Turn Overlap-Type Springs						
SSB-0035	**-S17**	9.00	603, 684	–	–	–	–	–	–
SSB-0039	**-S17**	10.00	623	–	–	–	–	–	–
SSB-0043	**-S17**	11.00	694, 685	–	–	–	–	–	–
SSB-0047	**-S17**	12.00	604	–	–	–	–	–	–
SSB-0051	**-S17**	13.00	633,624,695,686	–	–	–	–	–	–
SSB-0063	**-S17**	16.00	625, 634, 688	–	–	–	–	–	–
SSB-0075	**-S17**	19.00	607,626,635,698	–	–	–	–	–	–
SSB-0087	**-S17**	22.00	608, 627, 636	6900	–	–	–	–	–
SSB-0095	**-S17**	24.00	609, 628	6901	–	–	–	–	–
SSB-0102	**-S17**	26.00	637, 629	–	6000	–	–	–	–
SSB-0110	**-S17**	28.00	638	6902	6001	–	–	–	–
SSB-0118	**-S17**	30.00	639	6903	–	–	6200	–	–
SSB-0126	**-S17**	32.00	–	–	6002	16002	6201	–	–
SSB-0138	**-S17**	35.00	–	–	6003	16003	6202	6300	–
SSB-0146	**-S17**	37.00	–	6904	–	–	–	6301	–
SSB-0158	**-S17**	40.00	–	–	–	–	6203	–	–
SSB-0165	**-S17**	42.00	–	6905	6004	16004	–	6302	–
SSB-0185	**-S17**	47.00	–	6906	6005	16005	6204	6303	–
SSB-0205	**-S17**	52.00	–	–	–	–	6205	6304	–
SSB-0217	**-S17**	55.00	–	6907	6006	16006	–	–	–
SSB-0244	**-S17**	62.00	–	6908	6007	16007	6206	6305	6403
SSB-0268	**-S17**	68.00	–	6909	6008	16008	–	–	–
SSB-0276	**-S17**	70.00	–	–	–	–	–	–	–
SSB-0284	**-S17**	72.00	–	6910	–	–	6207	6306	6404
SSB-0295	**-S17**	75.00	–	–	6009	16009	–	–	–
SSB-0315	**-S17**	80.00	–	6911	6010	16010	6208	6307	6405
SSB-0335	**-S17**	85.00	–	6912	–	–	6209	–	–
SSB-0354	**-S17**	90.00	–	6913	6011	16011	6210	6308	6406
SSB-0374	**-S17**	95.00	–	–	6012	16012	–	–	–

[1] Wave Spring fits snug in housing.

SSB Series

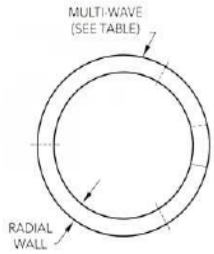
Cross Reference Guide for Bearing Preload Continued

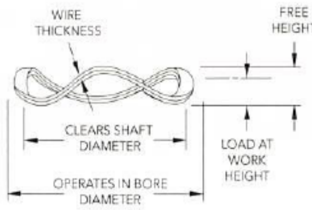
Smalley Part Number		Bearing O.D.[1] (mm)	Bearing Part Numbers						
Carbon Steel	Add Suffix 17-7 SS		Extra Small	Extremely Light	Extra Light	Narrow	Light	Medium	Heavy
Single-Turn Gap-Type Springs									
SSB-0394	-S17	100.00	–	6914	6013	16013	6211	6309	6407
SSB-0413	-S17	105.00	–	6915	–	–	–	–	–
SSB-0433	-S17	110.00	–	6916	6014	16014	6212	6310	6408
SSB-0453	-S17	115.00	–	–	6015	16015	–	–	–
SSB-0472	-S17	120.00	–	6917	–	–	6213	6311	6409
SSB-0492	-S17	125.00	–	6918	6016	16016	6214	–	–
SSB-0512	-S17	130.00	–	6919	6017	16017	6215	6312	6410
SSB-0532	-S17	135.00	–	–	–	–	–	–	–
SSB-0551	-S17	140.00	–	6920	6018	16018	6216	6313	6411
SSB-0571	-S17	145.00	–	6921	6019	16019	–	–	–
SSB-0591	-S17	150.00	–	6922	6020	16020	6217	6314	6412
SSB-0630	-S17	160.00	–	–	6021	16021	6218	6315	6413
SSB-0650	-S17	165.00	–	6924	–	–	–	–	–
SSB-0669	-S17	170.00	–	–	6022	16022[2]	6219	6316	–
SSB-0689	-S17	175.00	–	–	–	–	–	–	–
SSB-0709	-S17	180.00	–	6926	6024	16024	6220	6317	6414
SSB-0728	-S17	185.00	–	–	–	–	–	–	–
SSB-0748	-S17	190.00	–	6928	–	–	6221	6318	6415
SSB-0787	-S17	200.00	–	–	6026	16026	6222	6319	6416
SSB-0807	-S17	205.00	–	–	–	–	–	–	–
SSB-0827	-S17	210.00	–	6930	6028	16028	–	–	6417
SSB-0847	-S17	215.00	–	–	–	–	6224	6320	–
SSB-0866	-S17	220.00	–	6932	–	–	–	–	–
SSB-0886	-S17	225.00	–	–	6030	16030	–	6321	6418
SSB-0906	-S17	230.00	–	6934	–	–	6226	–	–
SSB-0925	-S17	235.00	–	–	–	–	–	–	–
SSB-0945	-S17	240.00	–	–	6032	16032	–	6322	6419
SSB-0984	-S17	250.00	–	6936	–	–	6228	–	6420
SSB-1024	-S17	260.00	–	6938	6034	16034	–	6324	6421
SSB-1043	-S17	265.00	–	–	–	–	–	–	–
SSB-1063	-S17	270.00	–	–	–	–	6230	–	–
SSB-1102	-S17	280.00	–	6940	6036	16036	–	6326	6422
SSB-1142	-S17	290.00	–	–	6038	16038	6232	–	–
SSB-1181	-S17	300.00	–	–	–	–	–	6328	–
SSB-1221	-S17	310.00	–	–	6040	16040	6234	–	–
SSB-1260	-S17	320.00	–	–	–	–	6236	6330	–
SSB-1339	-S17	340.00	–	–	6044	16044	6238	6332	–
SSB-1378	-S17	350.00	–	–	–	–	–	–	–
SSB-1417	-S17	360.00	–	–	6048	16048	6240	6334	–
SSB-1457	-S17	370.00	–	–	–	–	–	–	–
SSB-1496	-S17	380.00	–	–	–	–	–	6336	–
SSB-1535	-S17	390.00	–	–	–	–	–	–	–
SSB-1575	-S17	400.00	–	–	6052	16052	6244	6338	–
SSB-1614	-S17	410.00	–	–	–	–	–	–	–
SSB-1654	-S17	420.00	–	–	6056	16056	–	6340	–
SSB-1693	-S17	430.00	–	–	–	–	–	–	–
SSB-1732	-S17	440.00	–	–	–	–	6248	6342	–
SSB-1811	-S17	460.00	–	–	6060	–	–	6344	–
SSB-1890	-S17	480.00	–	–	6064	16064	6252	–	–
SSB-1969	-S17	500.00	–	–	–	–	6256	6348	–
SSB-2126	-S17	540.00	–	–	–	–	6260	6352	–
SSB-2284	-S17	580.00	–	–	–	–	6264	6356	–

[1] Wave Spring fits snug in housing.

NSSR Series

Nested Spirawave® Springs





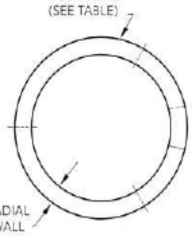
Product Dimensions: All dimensions in inches unless otherwise specified.

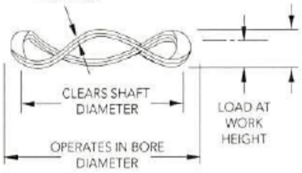
Smalley Part Number		Operates in Bore Diameter (in)	Clears Shaft Diameter (in)	Load at Work Height (lb)	Work Height (in)	Load at Free Height (lb)	Free Height[1] (in)	Number of Waves	Number of Turns	Wire Thickness (in)	Radial Wall (in)	Spring Rate[2] (lb/in)
Carbon Steel	Add Suffix for 17-7 PH SS											
NSSR-0050-L2	-S17	0.500	0.355	14	0.058	1.0	0.079	3	2	0.009	0.046	667
NSSR-0050-L3	-S17	0.500	0.355	22	0.066	1.0	0.087	3	3	0.009	0.046	1,024
NSSR-0062-L2	-S17	0.625	0.445	20	0.059	1.0	0.093	3	2	0.010	0.058	571
NSSR-0062-L3	-S17	0.625	0.445	30	0.068	1.0	0.110	3	3	0.010	0.058	714
NSSR-0075-L2	-S17	0.750	0.523	28	0.072	1.0	0.115	3	2	0.012	0.072	651
NSSR-0075-L3	-S17	0.750	0.523	42	0.082	1.0	0.126	3	3	0.012	0.072	955
NSSR-0087-L2	-S17	0.875	0.625	32	0.074	1.0	0.133	3	2	0.012	0.094	542
NSSR-0087-L3	-S17	0.875	0.625	48	0.086	1.0	0.140	3	3	0.012	0.094	889
NSSR-0100-L2	-S17	1.000	0.741	36	0.074	1.0	0.190	3	2	0.012	0.089	310
NSSR-0100-L3	-S17	1.000	0.741	54	0.086	1.0	0.202	3	3	0.012	0.089	466
NSSR-0112-L2	-S17	1.125	0.807	40	0.092	1.0	0.164	3	2	0.014	0.125	556
NSSR-0112-L3	-S17	1.125	0.807	60	0.106	1.0	0.178	3	3	0.014	0.125	833
NSSR-0125-L2	-S17	1.250	0.921	44	0.094	1.0	0.165	3	2	0.016	0.133	620
NSSR-0125-L3	-S17	1.250	0.921	66	0.110	1.0	0.181	3	3	0.016	0.133	930
NSSR-0137-L2	-S17	1.375	1.033	48	0.094	1.0	0.203	3	2	0.016	0.133	440
NSSR-0137-L3	-S17	1.375	1.033	72	0.110	1.0	0.219	3	3	0.016	0.133	661
NSSR-0150-L2	-S17	1.500	1.136	52	0.096	1.0	0.197	3	2	0.018	0.143	515
NSSR-0150-L3	-S17	1.500	1.136	78	0.114	1.0	0.215	3	3	0.018	0.143	772
NSSR-0162-L2	-S17	1.625	1.249	56	0.096	1.0	0.240	3	2	0.018	0.143	389
NSSR-0162-L3	-S17	1.625	1.249	84	0.114	1.0	0.258	3	3	0.018	0.143	583
NSSR-0175-L2	-S17	1.750	1.390	60	0.096	1.0	0.159	4	2	0.018	0.143	952
NSSR-0175-L3	-S17	1.750	1.390	90	0.114	1.0	0.177	4	3	0.018	0.143	1,429
NSSR-0187-L2	-S17	1.875	1.507	64	0.096	1.0	0.181	4	2	0.018	0.143	753
NSSR-0187-L3	-S17	1.875	1.507	96	0.114	1.0	0.199	4	3	0.018	0.143	1,129
NSSR-0200-L2	-S17	2.000	1.626	68	0.117	1.0	0.162	4	2	0.024	0.148	1,511
NSSR-0200-L3	-S17	2.000	1.626	102	0.141	1.0	0.186	4	3	0.024	0.148	2,267
NSSR-0212-L2	-S17	2.125	1.743	72	0.117	1.0	0.176	4	2	0.024	0.148	1,220
NSSR-0212-L3	-S17	2.125	1.743	108	0.141	1.0	0.200	4	3	0.024	0.148	1,831
NSSR-0225-L2	-S17	2.250	1.863	76	0.117	1.0	0.193	4	2	0.024	0.148	1,000
NSSR-0225-L3	-S17	2.250	1.863	114	0.141	1.0	0.217	4	3	0.024	0.148	1,500
NSSR-0237-L2	-S17	2.375	1.964	80	0.117	1.0	0.204	4	2	0.024	0.158	920
NSSR-0237-L3	-S17	2.375	1.964	120	0.141	1.0	0.228	4	3	0.024	0.158	1,379
NSSR-0250-L2	-S17	2.500	2.044	84	0.117	1.0	0.210	4	2	0.024	0.178	903
NSSR-0250-L3	-S17	2.500	2.044	126	0.141	1.0	0.234	4	3	0.024	0.178	1,355
NSSR-0262-L2	-S17	2.625	2.159	88	0.117	1.0	0.231	4	2	0.024	0.178	772
NSSR-0262-L3	-S17	2.625	2.159	132	0.141	1.0	0.255	4	3	0.024	0.178	1,158
NSSR-0275-L2	-S17	2.750	2.281	92	0.139	1.0	0.205	4	2	0.030	0.188	1,394
NSSR-0275-L3	-S17	2.750	2.281	138	0.169	1.0	0.235	4	3	0.030	0.188	2,091
NSSR-0287-L2	-S17	2.875	2.402	96	0.139	1.0	0.220	4	2	0.030	0.188	1,185
NSSR-0287-L3	-S17	2.875	2.402	144	0.169	1.0	0.250	4	3	0.030	0.188	1,778
NSSR-0300-L2	-S17	3.000	2.519	100	0.139	1.0	0.236	4	2	0.030	0.188	1,031
NSSR-0300-L3	-S17	3.000	2.519	150	0.169	1.0	0.266	4	3	0.030	0.188	1,546
NSSR-0312-L2	-S17	3.125	2.630	104	0.139	1.0	0.254	4	2	0.030	0.188	904
NSSR-0312-L3	-S17	3.125	2.630	156	0.169	1.0	0.284	4	3	0.030	0.188	1,357
NSSR-0325-L2	-S17	3.250	2.672	108	0.139	1.0	0.241	4	2	0.030	0.233	1,059
NSSR-0325-L3	-S17	3.250	2.672	162	0.169	1.0	0.271	4	3	0.030	0.233	1,588
NSSR-0337-L2	-S17	3.375	2.791	112	0.139	1.0	0.259	4	2	0.030	0.233	933
NSSR-0337-L3	-S17	3.375	2.791	168	0.169	1.0	0.289	4	3	0.030	0.233	1,400
NSSR-0350-L2	-S17	3.500	2.908	116	0.139	1.0	0.280	4	2	0.030	0.233	823
NSSR-0350-L3	-S17	3.500	2.908	174	0.169	1.0	0.310	4	3	0.030	0.233	1,234
NSSR-0362-L2	-S17	3.625	3.026	120	0.139	1.0	0.303	4	2	0.030	0.233	732
NSSR-0362-L3	-S17	3.625	3.026	180.0	0.169	1.0	0.333	4	3	0.030	0.233	1,098
NSSR-0375-L2	-S17	3.750	3.141	124.0	0.139	1.0	0.329	4	2	0.030	0.233	653
NSSR-0375-L3	-S17	3.750	3.141	186.0	0.169	1.0	0.359	4	3	0.030	0.233	979
NSSR-0387-L2	-S17	3.875	3.255	128.0	0.139	1.0	0.357	4	2	0.030	0.233	587
NSSR-0387-L3	-S17	3.875	3.255	192.0	0.169	1.0	0.387	4	3	0.030	0.233	881
NSSR-0400-L2	-S17	4.000	3.423	132.0	0.139	5.0	0.216	5	2	0.030	0.233	1,714
NSSR-0400-L3	-S17	4.000	3.423	198.0	0.169	5.0	0.246	5	3	0.030	0.233	2,571

[1] Reference dimension.
[2] Theoretical dimension.

NSSB Series

Metric Nested Spirawave® Springs





Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number		Operates in Bore Diameter (mm)	Clears Shaft Diameter (mm)	Load at Work Height (N)	Work Height (mm)	Load at Free Height (N)	Free Height[1] (mm)	Number of Waves	Number of Turns	Wire Thickness (mm)	Radial Wall (mm)	Spring Rate[2] (N/mm)
Carbon Steel	Add Suffix for 17-7 PH SS											
NSSB-0063-L2	-S17	16.00	11.46	89.0	1.83	4.5	2.46	3	2	0.28	1.52	140
NSSB-0063-L3	-S17	16.00	11.46	133.5	2.08	4.5	3.15	3	3	0.28	1.52	125
NSSB-0075-L2	-S17	19.00	13.36	106.8	1.83	4.5	2.77	3	2	0.28	1.98	114
NSSB-0075-L3	-S17	19.00	13.36	160.2	2.08	4.5	3.18	3	3	0.28	1.98	146
NSSB-0087-L2	-S17	22.00	15.75	124.6	1.88	4.5	3.14	3	2	0.30	2.39	99
NSSB-0087-L3	-S17	22.00	15.75	186.9	2.18	4.5	3.56	3	3	0.30	2.39	136
NSSB-0095-L2	-S17	24.00	17.02	133.5	1.88	4.5	3.56	3	2	0.30	2.39	80
NSSB-0095-L3	-S17	24.00	17.02	200.3	2.18	4.5	3.86	3	3	0.30	2.39	119
NSSB-0102-L2	-S17	26.00	18.14	142.4	2.34	4.5	3.37	3	2	0.36	3.18	138
NSSB-0102-L3	-S17	26.00	18.14	213.6	2.69	4.5	3.73	3	3	0.36	3.18	205
NSSB-0110-L2	-S17	28.00	20.07	151.3	2.34	4.5	3.68	3	2	0.36	3.18	113
NSSB-0110-L3	-S17	28.00	20.07	227.0	2.69	4.5	4.04	3	3	0.36	3.18	168
NSSB-0118-L2	-S17	30.00	21.87	169.1	2.34	4.5	4.24	3	2	0.36	3.18	89
NSSB-0118-L3	-S17	30.00	21.87	253.7	2.69	4.5	4.78	3	3	0.36	3.18	121
NSSB-0126-L2	-S17	32.00	23.67	178.0	2.39	4.5	4.07	3	2	0.41	3.38	106
NSSB-0126-L3	-S17	32.00	23.67	267.0	2.79	4.5	4.48	3	3	0.41	3.38	158
NSSB-0138-L2	-S17	35.00	26.42	195.8	2.39	4.5	4.94	3	2	0.41	3.38	77
NSSB-0138-L3	-S17	35.00	26.42	293.7	2.79	4.5	5.35	3	3	0.41	3.38	115
NSSB-0146-L2	-S17	37.00	28.65	204.7	2.44	4.5	4.72	3	2	0.46	3.38	90
NSSB-0146-L3	-S17	37.00	28.65	307.1	2.90	4.5	5.18	3	3	0.46	3.38	135
NSSB-0158-L2	-S17	40.00	31.01	222.5	2.44	4.5	5.70	3	2	0.46	3.38	68
NSSB-0158-L3	-S17	40.00	31.01	333.8	2.90	4.5	6.15	3	3	0.46	3.38	103
NSSB-0165-L2	-S17	42.00	33.50	231.4	2.44	4.5	3.71	4	2	0.46	3.38	182
NSSB-0165-L3	-S17	42.00	33.50	347.1	2.90	4.5	4.17	4	3	0.46	3.38	273
NSSB-0185-L2	-S17	47.00	38.18	258.1	2.44	4.5	4.52	4	2	0.46	3.38	124
NSSB-0185-L3	-S17	47.00	38.18	387.2	2.90	4.5	4.98	4	3	0.46	3.38	186
NSSB-0205-L2	-S17	52.00	42.37	284.8	2.97	4.5	4.15	4	2	0.61	3.76	241
NSSB-0205-L3	-S17	52.00	42.37	427.2	3.58	4.5	4.76	4	3	0.61	3.76	362
NSSB-0217-L2	-S17	55.00	45.31	302.6	2.97	4.5	4.48	4	2	0.61	3.76	200
NSSB-0217-L3	-S17	55.00	45.31	453.9	3.58	4.5	5.09	4	3	0.61	3.76	301
NSSB-0244-L2	-S17	62.00	50.65	338.2	2.97	4.5	4.93	4	2	0.61	4.52	173
NSSB-0244-L3	-S17	62.00	50.65	507.3	3.58	4.5	5.54	4	3	0.61	4.52	259
NSSB-0268-L2	-S17	68.00	56.16	373.8	3.53	4.5	4.94	4	2	0.76	4.78	265
NSSB-0268-L3	-S17	68.00	56.16	560.7	4.29	4.5	5.70	4	3	0.76	4.78	398
NSSB-0276-L2	-S17	70.00	58.14	382.7	3.53	4.5	5.12	4	2	0.76	4.78	241
NSSB-0276-L3	-S17	70.00	58.14	574.1	4.29	4.5	5.88	4	3	0.76	4.78	361
NSSB-0284-L2	-S17	72.00	60.07	391.6	3.53	4.5	5.32	4	2	0.76	4.78	219
NSSB-0284-L3	-S17	72.00	60.07	587.4	4.29	4.5	6.08	4	3	0.76	4.78	328
NSSB-0295-L2	-S17	75.00	62.97	409.4	3.53	4.5	5.68	4	2	0.76	4.78	190
NSSB-0295-L3	-S17	75.00	62.97	614.1	4.29	4.5	6.44	4	3	0.76	4.78	286
NSSB-0315-L2	-S17	80.00	67.49	436.1	3.53	4.5	6.37	4	2	0.76	4.78	154
NSSB-0315-L3	-S17	80.00	67.49	654.2	4.29	4.5	7.13	4	3	0.76	4.78	230
NSSB-0335-L2	-S17	85.00	70.26	462.8	3.53	4.5	6.29	4	2	0.76	5.92	168
NSSB-0335-L3	-S17	85.00	70.26	694.2	4.29	4.5	7.05	4	3	0.76	5.92	252
NSSB-0354-L2	-S17	90.00	74.98	498.4	3.53	4.5	7.13	4	2	0.76	5.92	138
NSSB-0354-L3	-S17	90.00	74.98	747.6	4.29	4.5	7.89	4	3	0.76	5.92	208
NSSB-0374-L2	-S17	95.00	79.65	525.1	3.53	4.5	8.08	4	2	0.76	5.92	115
NSSB-0374-L3	-S17	95.00	79.65	787.7	4.29	4.5	8.84	4	3	0.76	5.92	173
NSSB-0394-L2	-S17	100.00	85.42	551.8	3.53	23.0	5.27	5	2	0.76	5.92	317
NSSB-0394-L3	-S17	100.00	85.42	827.7	4.29	23.0	6.03	5	3	0.76	5.92	476

[1] Reference dimension.
[2] Theoretical dimension.

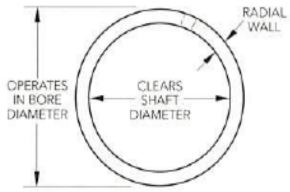
Wave Springs

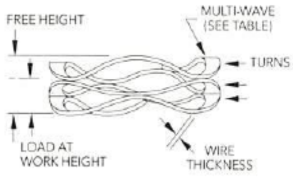
C/CS Series

Crest-To-Crest® Springs

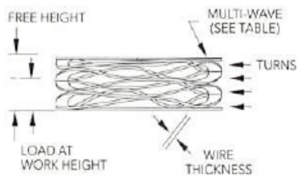
C-Plain Ends

CS-Shim Ends





C-Plain Ends



CS-Shim Ends

Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number [1]		Operates in Bore Diameter (in)	Clears Shaft Diameter (in)	Load (lb)	Work Height (in)	Free Height[2] (in)	Number of Waves	Number of Turns	Thickness (in)	Radial Wall (in)	Spring Rate[3] (lb/in)
Carbon Steel	Add Suffix 17-7 SS										
N/A	**C018-L1-S17**	.188	.125	1.0	.035	.075	2.5	3	.004	.015	25.0
N/A	**C018-L2-S17**	.188	.125	1.0	.046	.100	2.5	4	.004	.015	18.5
N/A	**C018-L3-S17**	.188	.125	1.0	.057	.125	2.5	5	.004	.015	14.7
N/A	**C018-L4-S17**	.188	.125	1.0	.068	.150	2.5	6	.004	.015	12.2
N/A	**C018-L5-S17**	.188	.125	1.0	.079	.175	2.5	7	.004	.015	10.4
N/A	**C018-L6-S17**	.188	.125	1.0	.090	.200	2.5	8	.004	.015	9.1
N/A	**C018-L7-S17**	.188	.125	1.0	.101	.226	2.5	9	.004	.015	8.0
N/A	**C018-L8-S17**	.188	.125	1.0	.123	.276	2.5	11	.004	.015	6.5
N/A	**C018-L9-S17**	.188	.125	1.0	.145	.326	2.5	13	.004	.015	5.5
N/A	**C018-M1-S17**	.188	.125	2.2	.047	.089	2.5	3	.005	.020	52.4
N/A	**C018-M2-S17**	.188	.125	2.2	.063	.119	2.5	4	.005	.020	39.3
N/A	**C018-M3-S17**	.188	.125	2.2	.079	.149	2.5	5	.005	.020	31.4
N/A	**C018-M4-S17**	.188	.125	2.2	.095	.179	2.5	6	.005	.020	26.2
N/A	**C018-M5-S17**	.188	.125	2.2	.111	.209	2.5	7	.005	.020	22.4
N/A	**C018-M6-S17**	.188	.125	2.2	.127	.239	2.5	8	.005	.020	19.6
N/A	**C018-M7-S17**	.188	.125	2.2	.143	.268	2.5	9	.005	.020	17.6
N/A	**C018-M8-S17**	.188	.125	2.2	.174	.328	2.5	11	.005	.020	14.3
N/A	**C018-M9-S17**	.188	.125	2.2	.203	.388	2.5	13	.005	.020	11.9
N/A	**C021-L1-S17**	.219	.140	1.5	.040	.079	2.5	3	.005	.020	38.5
N/A	**C021-L2-S17**	.219	.140	1.5	.053	.105	2.5	4	.005	.020	28.8
N/A	**C021-L3-S17**	.219	.140	1.5	.066	.131	2.5	5	.005	.020	23.1
N/A	**C021-L4-S17**	.219	.140	1.5	.080	.157	2.5	6	.005	.020	19.5
N/A	**C021-L5-S17**	.219	.140	1.5	.092	.183	2.5	7	.005	.020	16.5
N/A	**C021-L6-S17**	.219	.140	1.5	.106	.209	2.5	8	.005	.020	14.6
N/A	**C021-L7-S17**	.219	.140	1.5	.120	.236	2.5	9	.005	.020	12.9
N/A	**C021-L8-S17**	.219	.140	1.5	.146	.288	2.5	11	.005	.020	10.6
N/A	**C021-L9-S17**	.219	.140	1.5	.171	.340	2.5	13	.005	.020	8.9
N/A	**C021-M1-S17**	.219	.140	4.5	.051	.080	2.5	3	.008	.020	155.2
N/A	**C021-M2-S17**	.219	.140	4.5	.068	.107	2.5	4	.008	.020	115.4
N/A	**C021-M3-S17**	.219	.140	4.5	.085	.133	2.5	5	.008	.020	93.8
N/A	**C021-M4-S17**	.219	.140	4.5	.101	.160	2.5	6	.008	.020	76.3
N/A	**C021-M5-S17**	.219	.140	4.5	.118	.187	2.5	7	.008	.020	65.2
N/A	**C021-M6-S17**	.219	.140	4.5	.135	.214	2.5	8	.008	.020	57.0
N/A	**C021-M7-S17**	.219	.140	4.5	.152	.240	2.5	9	.008	.020	51.1
N/A	**C021-M8-S17**	.219	.140	4.5	.187	.294	2.5	11	.008	.020	42.1
N/A	**CO21-M9-S17**	.219	.140	4.5	.217	.347	2.5	13	.008	.020	34.6

[1] Not available with shim ends.
[2] Reference dimension.
[3] Theoretical dimension.

C/CS Series
Crest-To-Crest® Springs Continued

Smalley Part Number[3] Carbon Steel	Add Suffix 17-7 SS	Operates in Bore Diameter (in)	Clears Shaft Diameter (in)	Load (lb)	Work Height (in)	Free Height[2] (in)	Number of Waves	Number of Turns	Thickness (in)	Radial Wall (in)	Spring Rate[4] (lb/in)
C025-L1[1]	-S17	.250	.150	2	.033	.075	2.5	3	.006	.024	48
C025-L2[1]	-S17	.250	.150	2	.050	.100	2.5	4	.006	.024	40
C025-L3[1]	-S17	.250	.150	2	.060	.125	2.5	5	.006	.024	31
C025-L4[1]	-S17	.250	.150	2	.075	.150	2.5	6	.006	.024	27
C025-L5[1]	-S17	.250	.150	2	.085	.175	2.5	7	.006	.024	22
C025-L6[1]	-S17	.250	.150	2	.095	.200	2.5	8	.006	.024	19
C025-L7[1]	-S17	.250	.150	2	.120	.225	2.5	9	.006	.024	19
C025-L8[1]	-S17	.250	.150	2	.140	.275	2.5	11	.006	.024	15
C025-L9[1]	-S17	.250	.150	2	.170	.325	2.5	13	.006	.024	13
C025-M1[1]	-S17	.250	.150	5	.037	.075	2.5	3	.008	.024	132
C025-M2[1]	-S17	.250	.150	5	.048	.100	2.5	4	.008	.024	96
C025-M3[1]	-S17	.250	.150	5	.065	.125	2.5	5	.008	.024	83
C025-M4[1]	-S17	.250	.150	5	.075	.150	2.5	6	.008	.024	67
C025-M5[1]	-S17	.250	.150	5	.090	.175	2.5	7	.008	.024	59
C025-M6[1]	-S17	.250	.150	5	.100	.200	2.5	8	.008	.024	50
C025-M7[1]	-S17	.250	.150	5	.120	.225	2.5	9	.008	.024	48
C025-M8[1]	-S17	.250	.150	5	.148	.275	2.5	11	.008	.024	39
C025-M9[1]	-S17	.250	.150	5	.175	.325	2.5	13	.008	.024	33
C031-L1	-S17	.312	.200	3	.070	.114	2.5	3	.008	.032	68
C031-L2	-S17	.312	.200	3	.096	.152	2.5	4	.008	.032	54
C031-L3	-S17	.312	.200	3	.118	.190	2.5	5	.008	.032	42
C031-L4	-S17	.312	.200	3	.145	.228	2.5	6	.008	.032	36
C031-L5	-S17	.312	.200	3	.165	.266	2.5	7	.008	.032	30
C031-L6	-S17	.312	.200	3	.195	.304	2.5	8	.008	.032	28
C031-L7	-S17	.312	.200	3	.215	.342	2.5	9	.008	.032	24
C031-L8	-S17	.312	.200	3	.262	.418	2.5	11	.008	.032	19
C031-L9	-S17	.312	.200	3	.309	.494	2.5	13	.008	.032	16
C031-M1	-S17	.312	.200	6	.072	.114	2.5	3	.010	.032	143
C031-M2	-S17	.312	.200	6	.096	.152	2.5	4	.010	.032	107
C031-M3	-S17	.312	.200	6	.123	.190	2.5	5	.010	.032	90
C031-M4	-S17	.312	.200	6	.144	.228	2.5	6	.010	.032	71
C031-M5	-S17	.312	.200	6	.176	.266	2.5	7	.010	.032	67
C031-M6	-S17	.312	.200	6	.197	.304	2.5	8	.010	.032	56
C031-M7	-S17	.312	.200	6	.227	.342	2.5	9	.010	.032	52
C031-M8	-S17	.312	.200	6	.278	.418	2.5	11	.010	.032	43
C031-M9	-S17	.312	.200	6	.336	.494	2.5	13	.010	.032	38
C037-L1	-S17	.375	.250	4	.062	.150	2.5	3	.008	.032	45
C037-L2	-S17	.375	.250	4	.098	.200	2.5	4	.008	.032	39
C037-L3	-S17	.375	.250	4	.108	.250	2.5	5	.008	.032	28
C037-L4	-S17	.375	.250	4	.135	.300	2.5	6	.008	.032	24
C037-L5	-S17	.375	.250	4	.150	.350	2.5	7	.008	.032	20
C037-L6	-S17	.375	.250	4	.184	.400	2.5	8	.008	.032	19
C037-L7	-S17	.375	.250	4	.195	.450	2.5	9	.008	.032	16
C037-L8	-S17	.375	.250	4	.228	.500	2.5	10	.008	.032	15
C037-L9	-S17	.375	.250	4	.240	.550	2.5	11	.008	.032	13
C037-M1	-S17	.375	.250	7	.081	.150	2.5	3	.011	.032	101
C037-M2	-S17	.375	.250	7	.119	.200	2.5	4	.011	.032	86
C037-M3	-S17	.375	.250	7	.145	.250	2.5	5	.011	.032	67
C037-M4	-S17	.375	.250	7	.180	.300	2.5	6	.011	.032	58
C037-M5	-S17	.375	.250	7	.202	.350	2.5	7	.011	.032	47
C037-M6	-S17	.375	.250	7	.240	.400	2.5	8	.011	.032	44
C037-M7	-S17	.375	.250	7	.262	.450	2.5	9	.011	.032	37
C037-M8	-S17	.375	.250	7	.298	.500	2.5	10	.011	.032	35
C037-M9	-S17	.375	.250	7	.327	.550	2.5	11	.011	.032	31
C043-L1	-S17	.437	.281	4	.063	.165	2.5	3	.008	.040	39
C043-L2	-S17	.437	.281	4	.093	.220	2.5	4	.008	.040	31
C043-L3	-S17	.437	.281	4	.109	.275	2.5	5	.008	.040	24
C043-L4	-S17	.437	.281	4	.143	.330	2.5	6	.008	.040	21
C043-L5	-S17	.437	.281	4	.160	.385	2.5	7	.008	.040	18
C043-L6	-S17	.437	.281	4	.195	.440	2.5	8	.008	.040	16
C043-L7	-S17	.437	.281	4	.210	.495	2.5	9	.008	.040	14
C043-L8	-S17	.437	.281	4	.240	.550	2.5	10	.008	.040	13
C043-L9	-S17	.437	.281	4	.260	.605	2.5	11	.008	.040	12
C043-M1	-S17	.437	.281	8	.082	.165	2.5	3	.011	.046	96
C043-M2	-S17	.437	.281	8	.115	.220	2.5	4	.011	.046	76
C043-M3	-S17	.437	.281	8	.142	.275	2.5	5	.011	.046	60
C043-M4	-S17	.437	.281	8	.179	.330	2.5	6	.011	.046	53

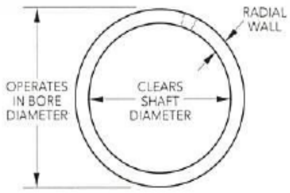
[1] Not available with shim ends.
[2] Reference dimension.
[3] Use "C" prefix for plain ends. Use "CS" prefix for squared-shim ends.
[4] Theoretical dimension.

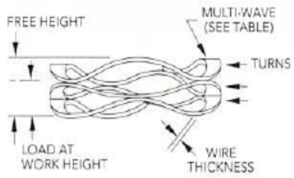
C/CS Series

Crest-To-Crest® Springs

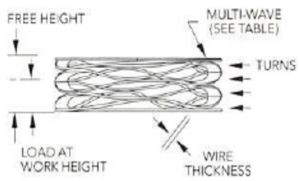
C-Plain Ends

CS-Shim Ends





C-Plain Ends



CS-Shim Ends

Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number [3]		Operates in Bore Diameter (in)	Clears Shaft Diameter (in)	Load (lb)	Work Height (in)	Free Height[2] (in)	Number of Waves	Number of Turns	Thickness (in)	Radial Wall (in)	Spring Rate[4] (lb/in)
Carbon Steel	Add Suffix 17-7 SS										
C043-M5	-S17	.437	.281	8	.198	.385	2.5	7	.011	.046	43
C043-M6	-S17	.437	.281	8	.231	.440	2.5	8	.011	.046	38
C043-M7	-S17	.437	.281	8	.255	.495	2.5	9	.011	.046	33
C043-M8	-S17	.437	.281	8	.290	.550	2.5	10	.011	.046	31
C043-M9	-S17	.437	.281	8	.319	.605	2.5	11	.011	.046	28
C050-L1	-S17	.500	.312	5	.062	.180	2.5	3	.008	.056	42
C050-L2	-S17	.500	.312	5	.090	.240	2.5	4	.008	.056	33
C050-L3	-S17	.500	.312	5	.107	.300	2.5	5	.008	.056	26
C050-L4	-S17	.500	.312	5	.136	.360	2.5	6	.008	.056	22
C050-L5	-S17	.500	.312	5	.150	.420	2.5	7	.008	.056	19
C050-L6	-S17	.500	.312	5	.180	.480	2.5	8	.008	.056	17
C050-L7	-S17	.500	.312	5	.195	.540	2.5	9	.008	.056	14
C050-L8	-S17	.500	.312	5	.220	.600	2.5	10	.008	.056	13
C050-L9	-S17	.500	.312	5	.240	.660	2.5	11	.008	.056	12
C050-M1	-S17	.500	.312	10	.065	.180	2.5	3	.010	.058	87
C050-M2	-S17	.500	.312	10	.092	.240	2.5	4	.010	.058	68
C050-M3	-S17	.500	.312	10	.114	.300	2.5	5	.010	.058	54
C050-M4	-S17	.500	.312	10	.147	.360	2.5	6	.010	.058	47
C050-M5	-S17	.500	.312	10	.162	.420	2.5	7	.010	.058	39
C050-M6	-S17	.500	.312	10	.196	.480	2.5	8	.010	.058	35
C050-M7	-S17	.500	.312	10	.207	.540	2.5	9	.010	.058	30
C050-M8	-S17	.500	.312	10	.246	.600	2.5	10	.010	.058	28
C050-M9	-S17	.500	.312	10	.264	.660	2.5	11	.010	.058	25
C050-H1	-S17	.500	.312	15	.075	.180	2.5	3	.012	.060	143
C050-H2	-S17	.500	.312	15	.110	.240	2.5	4	.012	.060	115
C050-H3	-S17	.500	.312	15	.136	.300	2.5	5	.012	.060	91
C050-H4	-S17	.500	.312	15	.167	.360	2.5	6	.012	.060	78
C050-H5	-S17	.500	.312	15	.182	.420	2.5	7	.012	.060	63
C050-H6	-S17	.500	.312	15	.216	.480	2.5	8	.012	.060	57
C050-H7	-S17	.500	.312	15	.240	.540	2.5	9	.012	.060	50
C050-H8	-S17	.500	.312	15	.280	.600	2.5	10	.012	.060	47
C050-H9	-S17	.500	.312	15	.312	.660	2.5	11	.012	.060	43
C056-L1	-S17	.562	.375	5	.080	.195	2.5	3	.009	.058	43
C056-L2	-S17	.562	.375	5	.125	.260	2.5	4	.009	.058	37
C056-L3	-S17	.562	.375	5	.135	.325	2.5	5	.009	.058	26
C056-L4	-S17	.562	.375	5	.180	.390	2.5	6	.009	.058	24
C056-L5	-S17	.562	.375	5	.190	.455	2.5	7	.009	.058	19
C056-L6	-S17	.562	.375	5	.230	.520	2.5	8	.009	.058	17
C056-L7	-S17	.562	.375	5	.260	.585	2.5	9	.009	.058	15
C056-L8	-S17	.562	.375	5	.285	.650	2.5	10	.009	.058	14
C056-L9	-S17	.562	.375	5	.315	.715	2.5	11	.009	.058	13
C056-M1	-S17	.562	.375	11	.086	.195	2.5	3	.012	.060	101
C056-M2	-S17	.562	.375	11	.123	.260	2.5	4	.012	.060	80
C056-M3	-S17	.562	.375	11	.145	.325	2.5	5	.012	.060	61
C056-M4	-S17	.562	.375	11	.187	.390	2.5	6	.012	.060	54
C056-M5	-S17	.562	.375	11	.209	.455	2.5	7	.012	.060	45
C056-M6	-S17	.562	.375	11	.253	.520	2.5	8	.012	.060	41
C056-M7	-S17	.562	.375	11	.273	.585	2.5	9	.012	.060	35
C056-M8	-S17	.562	.375	11	.318	.650	2.5	10	.012	.060	33
C056-M9	-S17	.562	.375	11	.343	.715	2.5	11	.012	.060	30
C056-H1	-S17	.562	.375	18	.093	.195	2.5	3	.015	.060	176

[1] Not available with shim ends.
[2] Reference dimension.
[3] Use "C" prefix for plain ends. Use "CS" prefix for squared-shim ends.
[4] Theoretical dimension.

C/CS Series
Crest-To-Crest® Springs Continued

Smalley Part Number[3] Carbon Steel	Add Suffix 17-7 SS	Operates in Bore Diameter (in)	Clears Shaft Diameter (in)	Load (lb)	Work Height (in)	Free Height[2] (in)	Number of Waves	Number of Turns	Thickness (in)	Radial Wall (in)	Spring Rate[4] (lb/in)
C056-H2	-S17	.562	.375	18	.136	.260	2.5	4	.015	.060	145
C056-H3	-S17	.562	.375	18	.165	.325	2.5	5	.015	.060	113
C056-H4	-S17	.562	.375	18	.212	.390	2.5	6	.015	.060	101
C056-H5	-S17	.562	.375	18	.245	.455	2.5	7	.015	.060	86
C056-H6	-S17	.562	.375	18	.282	.520	2.5	8	.015	.060	76
C056-H7	-S17	.562	.375	18	.323	.585	2.5	9	.015	.060	69
C056-H8	-S17	.562	.375	18	.360	.650	2.5	10	.015	.060	62
C056-H9	-S17	.562	.375	18	.408	.715	2.5	11	.015	.060	59
C062-L1	-S17	.625	.450	6	.055	.180	2.5	3	.010	.058	48
C062-L2	-S17	.625	.450	6	.068	.240	2.5	4	.010	.058	35
C062-L3	-S17	.625	.450	6	.085	.300	2.5	5	.010	.058	28
C062-L4	-S17	.625	.450	6	.106	.360	2.5	6	.010	.058	24
C062-L5	-S17	.625	.450	6	.128	.420	2.5	7	.010	.058	21
C062-L6	-S17	.625	.450	6	.165	.540	2.5	9	.010	.058	16
C062-L7	-S17	.625	.450	6	.202	.660	2.5	11	.010	.058	13
C062-L8	-S17	.625	.450	6	.238	.780	2.5	13	.010	.058	11
C062-M1	-S17	.625	.450	12	.104	.180	3.5	3	.010	.058	158
C062-M2	-S17	.625	.450	12	.130	.240	3.5	4	.010	.058	109
C062-M3	-S17	.625	.450	12	.175	.300	3.5	5	.010	.058	96
C062-M4	-S17	.625	.450	12	.206	.360	3.5	6	.010	.058	78
C062-M5	-S17	.625	.450	12	.246	.420	3.5	7	.010	.058	69
C062-M6	-S17	.625	.450	12	.317	.540	3.5	9	.010	.058	54
C062-M7	-S17	.625	.450	12	.386	.660	3.5	11	.010	.058	44
C062-M8	-S17	.625	.450	12	.454	.780	3.5	13	.010	.058	37
C062-H1	-S17	.625	.450	20	.102	.180	3.5	3	.012	.060	256
C062-H2	-S17	.625	.450	20	.135	.240	3.5	4	.012	.060	190
C062-H3	-S17	.625	.450	20	.175	.300	3.5	5	.012	.060	160
C062-H4	-S17	.625	.450	20	.205	.360	3.5	6	.012	.060	129
C062-H5	-S17	.625	.450	20	.245	.420	3.5	7	.012	.060	114
C062-H6	-S17	.625	.450	20	.315	.540	3.5	9	.012	.060	89
C062-H7	-S17	.625	.450	20	.390	.660	3.5	11	.012	.060	74
C062-H8	-S17	.625	.450	20	.465	.780	3.5	13	.012	.060	63
C075-L1	-S17	.750	.550	7	.142	.250	3.5	3	.008	.071	65
C075-L2	-S17	.750	.550	7	.187	.333	3.5	4	.008	.071	48
C075-L3	-S17	.750	.550	7	.246	.417	3.5	5	.008	.071	41
C075-L4	-S17	.750	.550	7	.285	.500	3.5	6	.008	.071	33
C075-L5	-S17	.750	.550	7	.348	.583	3.5	7	.008	.071	30
C075-L6	-S17	.750	.550	7	.446	.750	3.5	9	.008	.071	23
C075-L7	-S17	.750	.550	7	.580	1.000	3.5	12	.008	.071	17
C075-M1	-S17	.750	.550	13	.159	.250	3.5	3	.010	.078	143
C075-M2	-S17	.750	.550	13	.203	.333	3.5	4	.010	.078	100
C075-M3	-S17	.750	.550	13	.270	.417	3.5	5	.010	.078	88
C075-M4	-S17	.750	.550	13	.314	.500	3.5	6	.010	.078	70
C075-M5	-S17	.750	.550	13	.381	.583	3.5	7	.010	.078	64
C075-M6	-S17	.750	.550	13	.489	.750	3.5	9	.010	.078	50
C075-M7	-S17	.750	.550	13	.649	1.000	3.5	12	.010	.078	37
C075-H1	-S17	.750	.550	22	.169	.250	3.5	3	.013	.079	272
C075-H2	-S17	.750	.550	22	.215	.333	3.5	4	.013	.079	186
C075-H3	-S17	.750	.550	22	.291	.417	3.5	5	.013	.079	175
C075-H4	-S17	.750	.550	22	.335	.500	3.5	6	.013	.079	133
C075-H5	-S17	.750	.550	22	.405	.583	3.5	7	.013	.079	124
C075-H6	-S17	.750	.550	22	.526	.750	3.5	9	.013	.079	98
C075-H7	-S17	.750	.550	22	.699	1.000	3.5	12	.013	.079	73
C087-L1	-S17	.875	.600	12	.117	.250	3.5	3	.010	.086	90
C087-L2	-S17	.875	.600	12	.158	.333	3.5	4	.010	.086	69
C087-L3	-S17	.875	.600	12	.207	.417	3.5	5	.010	.086	57
C087-L4	-S17	.875	.600	12	.242	.500	3.5	6	.010	.086	47
C087-L5	-S17	.875	.600	12	.287	.583	3.5	7	.010	.086	41
C087-L6	-S17	.875	.600	12	.378	.750	3.5	9	.010	.086	32
C087-L7	-S17	.875	.600	12	.498	1.000	3.5	12	.010	.086	24
C087-M1	-S17	.875	.600	18	.124	.250	3.5	3	.012	.094	143
C087-M2	-S17	.875	.600	18	.164	.333	3.5	4	.012	.094	107
C087-M3	-S17	.875	.600	18	.214	.417	3.5	5	.012	.094	89
C087-M4	-S17	.875	.600	18	.252	.500	3.5	6	.012	.094	73
C087-M5	-S17	.875	.600	18	.296	.583	3.5	7	.012	.094	63
C087-M6	-S17	.875	.600	18	.385	.750	3.5	9	.012	.094	50
C087-M7	-S17	.875	.600	18	.509	1.000	3.5	12	.012	.094	37

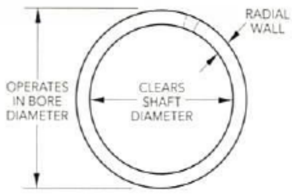
[1] Not available with shim ends.
[2] Reference dimension.
[3] Use "C" prefix for plain ends. Use "CS" prefix for squared-shim ends.
[4] Theoretical dimension.

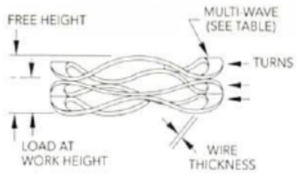
C/CS Series

Crest-To-Crest® Springs

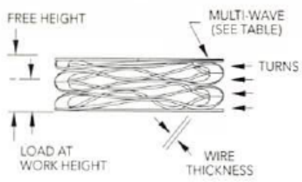
C-Plain Ends

CS-Shim Ends





C-Plain Ends



CS-Shim Ends

Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number [3]		Operates in Bore Diameter (in)	Clears Shaft Diameter (in)	Load (lb)	Work Height (in)	Free Height[2] (in)	Number of Waves	Number of Turns	Thickness (in)	Radial Wall (in)	Spring Rate[4] (lb/in)
Carbon Steel	Add Suffix 17-7 SS										
C087-H1	-S17	.875	.600	25	.166	.250	3.5	3	.015	.094	298
C087-H2	-S17	.875	.600	25	.214	.333	3.5	4	.015	.094	210
C087-H3	-S17	.875	.600	25	.278	.417	3.5	5	.015	.094	180
C087-H4	-S17	.875	.600	25	.327	.500	3.5	6	.015	.094	145
C087-H5	-S17	.875	.600	25	.395	.583	3.5	7	.015	.094	133
C087-H6	-S17	.875	.600	25	.510	.750	3.5	9	.015	.094	104
C087-H7	-S17	.875	.600	25	.670	1.000	3.5	12	.015	.094	76
C100-L1	-S17	1.000	.730	12	.084	.250	3.5	3	.010	.086	72
C100-L2	-S17	1.000	.730	12	.108	.333	3.5	4	.010	.086	53
C100-L3	-S17	1.000	.730	12	.145	.417	3.5	5	.010	.086	44
C100-L4	-S17	1.000	.730	12	.165	.500	3.5	6	.010	.086	36
C100-L5	-S17	1.000	.730	12	.201	.583	3.5	7	.010	.086	31
C100-L6	-S17	1.000	.730	12	.258	.750	3.5	9	.010	.086	24
C100-L7	-S17	1.000	.730	12	.342	1.000	3.5	12	.010	.086	18
C100-L8	-S17	1.000	.730	12	.445	1.250	3.5	15	.010	.086	15
C100-L9	-S17	1.000	.730	12	.519	1.500	3.5	18	.010	.086	12
C100-L10	-S17	1.000	.730	12	.633	1.750	3.5	21	.010	.086	11
C100-L11	-S17	1.000	.730	12	.710	2.000	3.5	24	.010	.086	9
C100-M1	-S17	1.000	.730	18	.087	.250	3.5	3	.012	.094	110
C100-M2	-S17	1.000	.730	18	.113	.333	3.5	4	.012	.094	82
C100-M3	-S17	1.000	.730	18	.148	.417	3.5	5	.012	.094	67
C100-M4	-S17	1.000	.730	18	.175	.500	3.5	6	.012	.094	55
C100-M5	-S17	1.000	.730	18	.212	.583	3.5	7	.012	.094	49
C100-M6	-S17	1.000	.730	18	.276	.750	3.5	9	.012	.094	38
C100-M7	-S17	1.000	.730	18	.360	1.000	3.5	12	.012	.094	28
C100-M8	-S17	1.000	.730	18	.452	1.250	3.5	15	.012	.094	23
C100-M9	-S17	1.000	.730	18	.549	1.500	3.5	18	.012	.094	19
C100-M10	-S17	1.000	.730	18	.650	1.750	3.5	21	.012	.094	16
C100-M11	-S17	1.000	.730	18	.720	2.000	3.5	24	.012	.094	14
C100-H1	-S17	1.000	.730	25	.131	.250	3.5	3	.015	.094	210
C100-H2	-S17	1.000	.730	25	.174	.333	3.5	4	.015	.094	157
C100-H3	-S17	1.000	.730	25	.227	.417	3.5	5	.015	.094	132
C100-H4	-S17	1.000	.730	25	.266	.500	3.5	6	.015	.094	107
C100-H5	-S17	1.000	.730	25	.319	.583	3.5	7	.015	.094	95
C100-H6	-S17	1.000	.730	25	.406	.750	3.5	9	.015	.094	73
C100-H7	-S17	1.000	.730	25	.541	1.000	3.5	12	.015	.094	54
C100-H8	-S17	1.000	.730	25	.688	1.250	3.5	15	.015	.094	45
C100-H9	-S17	1.000	.730	25	.813	1.500	3.5	18	.015	.094	36
C100-H10	-S17	1.000	.730	25	.957	1.750	3.5	21	.015	.094	32
C100-H11	-S17	1.000	.730	25	1.083	2.000	3.5	24	.015	.094	27
C112-L1	-S17	1.125	.850	12	.146	.300	3.5	3	.012	.094	78
C112-L2	-S17	1.125	.850	12	.186	.400	3.5	4	.012	.094	56
C112-L3	-S17	1.125	.850	12	.250	.500	3.5	5	.012	.094	48
C112-L4	-S17	1.125	.850	12	.295	.600	3.5	6	.012	.094	39
C112-L5	-S17	1.125	.850	12	.344	.700	3.5	7	.012	.094	34
C112-L6	-S17	1.125	.850	12	.392	.800	3.5	8	.012	.094	29
C112-L7	-S17	1.125	.850	12	.488	1.000	3.5	10	.012	.094	23
C112-L8	-S17	1.125	.850	12	.659	1.300	3.5	13	.012	.094	19
C112-L9	-S17	1.125	.850	12	.807	1.600	3.5	16	.012	.094	15
C112-L10	-S17	1.125	.850	12	.983	2.000	3.5	20	.012	.094	12
C112-M1	-S17	1.125	.850	20	.160	.300	3.5	3	.015	.094	143

[1] Not available with shim ends.
[2] Reference dimension.

[3] Use "C" prefix for plain ends. Use "CS" prefix for squared-shim ends.
[4] Theoretical dimension.

C/CS Series

Crest-To-Crest® Springs Continued

Smalley Part Number[3] Carbon Steel	Add Suffix 17-7 SS	Operates in Bore Diameter (in)	Clears Shaft Diameter (in)	Load (lb)	Work Height (in)	Free Height[2] (in)	Number of Waves	Number of Turns	Thickness (in)	Radial Wall (in)	Spring Rate[4] (lb/in)
C112-M2	-S17	1.125	.850	20	.202	.400	3.5	4	.015	.094	101
C112-M3	-S17	1.125	.850	20	.270	.500	3.5	5	.015	.094	87
C112-M4	-S17	1.125	.850	20	.318	.600	3.5	6	.015	.094	71
C112-M5	-S17	1.125	.850	20	.381	.700	3.5	7	.015	.094	63
C112-M6	-S17	1.125	.850	20	.427	.800	3.5	8	.015	.094	54
C112-M7	-S17	1.125	.850	20	.536	1.000	3.5	10	.015	.094	43
C112-M8	-S17	1.125	.850	20	.708	1.300	3.5	13	.015	.094	34
C112-M9	-S17	1.125	.850	20	.861	1.600	3.5	16	.015	.094	27
C112-M10	-S17	1.125	.850	20	1.088	2.000	3.5	20	.015	.094	22
C112-H1	-S17	1.125	.850	30	.178	.300	3.5	3	.018	.094	246
C112-H2	-S17	1.125	.850	30	.229	.400	3.5	4	.018	.094	175
C112-H3	-S17	1.125	.850	30	.303	.500	3.5	5	.018	.094	152
C112-H4	-S17	1.125	.850	30	.350	.600	3.5	6	.018	.094	120
C112-H5	-S17	1.125	.850	30	.421	.700	3.5	7	.018	.094	108
C112-H6	-S17	1.125	.850	30	.470	.800	3.5	8	.018	.094	91
C112-H7	-S17	1.125	.850	30	.593	1.000	3.5	10	.018	.094	74
C112-H8	-S17	1.125	.850	30	.787	1.300	3.5	13	.018	.094	58
C112-H9	-S17	1.125	.850	30	.956	1.600	3.5	16	.018	.094	47
C112-H10	-S17	1.125	.850	30	1.202	2.000	3.5	20	.018	.094	38
C125-L1	-S17	1.250	1.000	12	.084	.300	3.5	3	.012	.094	56
C125-L2	-S17	1.250	1.000	12	.113	.400	3.5	4	.012	.094	42
C125-L3	-S17	1.250	1.000	12	.149	.500	3.5	5	.012	.094	34
C125-L4	-S17	1.250	1.000	12	.172	.600	3.5	6	.012	.094	28
C125-L5	-S17	1.250	1.000	12	.207	.700	3.5	7	.012	.094	24
C125-L6	-S17	1.250	1.000	12	.227	.800	3.5	8	.012	.094	21
C125-L7	-S17	1.250	1.000	12	.301	1.000	3.5	10	.012	.094	17
C125-L8	-S17	1.250	1.000	12	.395	1.300	3.5	13	.012	.094	13
C125-L9	-S17	1.250	1.000	12	.467	1.600	3.5	16	.012	.094	11
C125-L10	-S17	1.250	1.000	12	.591	2.000	3.5	20	.012	.094	9
C125-M1	-S17	1.250	1.000	20	.124	.300	3.5	3	.015	.094	114
C125-M2	-S17	1.250	1.000	20	.165	.400	3.5	4	.015	.094	85
C125-M3	-S17	1.250	1.000	20	.215	.500	3.5	5	.015	.094	70
C125-M4	-S17	1.250	1.000	20	.253	.600	3.5	6	.015	.094	58
C125-M5	-S17	1.250	1.000	20	.303	.700	3.5	7	.015	.094	50
C125-M6	-S17	1.250	1.000	20	.341	.800	3.5	8	.015	.094	44
C125-M7	-S17	1.250	1.000	20	.427	1.000	3.5	10	.015	.094	35
C125-M8	-S17	1.250	1.000	20	.577	1.300	3.5	13	.015	.094	28
C125-M9	-S17	1.250	1.000	20	.692	1.600	3.5	16	.015	.094	22
C125-M10	-S17	1.250	1.000	20	.866	2.000	3.5	20	.015	.094	18
C125-H1	-S17	1.250	1.000	30	.158	.300	3.5	3	.019	.094	210
C125-H2	-S17	1.250	1.000	30	.210	.400	3.5	4	.019	.094	158
C125-H3	-S17	1.250	1.000	30	.272	.500	3.5	5	.019	.094	132
C125-H4	-S17	1.250	1.000	30	.320	.600	3.5	6	.019	.094	107
C125-H5	-S17	1.250	1.000	30	.384	.700	3.5	7	.019	.094	95
C125-H6	-S17	1.250	1.000	30	.433	.800	3.5	8	.019	.094	82
C125-H7	-S17	1.250	1.000	30	.538	1.000	3.5	10	.019	.094	65
C125-H8	-S17	1.250	1.000	30	.717	1.300	3.5	13	.019	.094	51
C125-H9	-S17	1.250	1.000	30	.878	1.600	3.5	16	.019	.094	42
C125-H10	-S17	1.250	1.000	30	1.103	2.000	3.5	20	.019	.094	33
C137-L1	-S17	1.375	1.030	15	.075	.300	3.5	3	.012	.122	67
C137-L2	-S17	1.375	1.030	15	.099	.400	3.5	4	.012	.122	50
C137-L3	-S17	1.375	1.030	15	.129	.500	3.5	5	.012	.122	40
C137-L4	-S17	1.375	1.030	15	.155	.600	3.5	6	.012	.122	34
C137-L5	-S17	1.375	1.030	15	.179	.700	3.5	7	.012	.122	29
C137-L6	-S17	1.375	1.030	15	.206	.800	3.5	8	.012	.122	25
C137-L7	-S17	1.375	1.030	15	.256	1.000	3.5	10	.012	.122	20
C137-L8	-S17	1.375	1.030	15	.341	1.300	3.5	13	.012	.122	16
C137-L9	-S17	1.375	1.030	15	.424	1.600	3.5	16	.012	.122	13
C137-L10	-S17	1.375	1.030	15	.530	2.000	3.5	20	.012	.122	10
C137-M1	-S17	1.375	1.030	25	.142	.300	3.5	3	.016	.133	158
C137-M2	-S17	1.375	1.030	25	.186	.400	3.5	4	.016	.133	117
C137-M3	-S17	1.375	1.030	25	.240	.500	3.5	5	.016	.133	96
C137-M4	-S17	1.375	1.030	25	.281	.600	3.5	6	.016	.133	78
C137-M5	-S17	1.375	1.030	25	.340	.700	3.5	7	.016	.133	69
C137-M6	-S17	1.375	1.030	25	.384	.800	3.5	8	.016	.133	60
C137-M7	-S17	1.375	1.030	25	.486	1.000	3.5	10	.016	.133	49

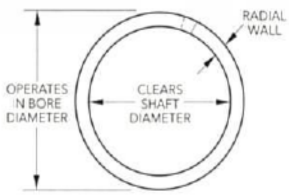
[1] Not available with shim ends.
[2] Reference dimension.
[3] Use "C" prefix for plain ends. Use "CS" prefix for squared-shim ends.
[4] Theoretical dimension.

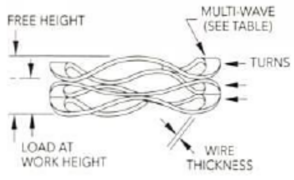
C/CS Series

Crest-To-Crest® Springs

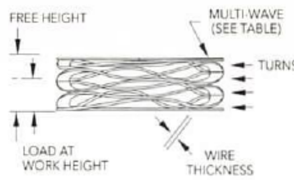
C-Plain Ends

CS-Shim Ends





C-Plain Ends



CS-Shim Ends

Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number [3]		Operates in Bore Diameter (in)	Clears Shaft Diameter (in)	Load (lb)	Work Height (in)	Free Height[2] (in)	Number of Waves	Number of Turns	Thickness (in)	Radial Wall (in)	Spring Rate[4] (lb/in)
Carbon Steel	Add Suffix 17-7 SS										
C137-M8	-S17	1.375	1.030	25	.632	1.300	3.5	13	.016	.133	37
C137-M9	-S17	1.375	1.030	25	.788	1.600	3.5	16	.016	.133	31
C137-M10	-S17	1.375	1.030	25	.982	2.000	3.5	20	.016	.133	25
C137-H1	-S17	1.375	1.030	35	.149	.300	3.5	3	.018	.133	232
C137-H2	-S17	1.375	1.030	35	.189	.400	3.5	4	.018	.133	166
C137-H3	-S17	1.375	1.030	35	.247	.500	3.5	5	.018	.133	138
C137-H4	-S17	1.375	1.030	35	.287	.600	3.5	6	.018	.133	112
C137-H5	-S17	1.375	1.030	35	.343	.700	3.5	7	.018	.133	98
C137-H6	-S17	1.375	1.030	35	.390	.800	3.5	8	.018	.133	85
C137-H7	-S17	1.375	1.030	35	.490	1.000	3.5	10	.018	.133	69
C137-H8	-S17	1.375	1.030	35	.646	1.300	3.5	13	.018	.133	54
C137-H9	-S17	1.375	1.030	35	.793	1.600	3.5	16	.018	.133	43
C137-H10	-S17	1.375	1.030	35	1.000	2.000	3.5	20	.018	.133	35
C150-L1	-S17	1.500	1.140	20	.129	.300	3.5	3	.016	.133	117
C150-L2	-S17	1.500	1.140	20	.164	.400	3.5	4	.016	.133	85
C150-L3	-S17	1.500	1.140	20	.213	.500	3.5	5	.016	.133	70
C150-L4	-S17	1.500	1.140	20	.247	.600	3.5	6	.016	.133	57
C150-L5	-S17	1.500	1.140	20	.301	.700	3.5	7	.016	.133	50
C150-L6	-S17	1.500	1.140	20	.337	.800	3.5	8	.016	.133	43
C150-L7	-S17	1.500	1.140	20	.430	1.000	3.5	10	.016	.133	35
C150-L8	-S17	1.500	1.140	20	.565	1.300	3.5	13	.016	.133	27
C150-L9	-S17	1.500	1.140	20	.694	1.600	3.5	16	.016	.133	22
C150-L10	-S17	1.500	1.140	20	.866	2.000	3.5	20	.016	.133	18
C150-M1	-S17	1.500	1.140	35	.122	.300	3.5	3	.018	.133	197
C150-M2	-S17	1.500	1.140	35	.158	.400	3.5	4	.018	.133	145
C150-M3	-S17	1.500	1.140	35	.206	.500	3.5	5	.018	.133	119
C150-M4	-S17	1.500	1.140	35	.241	.600	3.5	6	.018	.133	97
C150-M5	-S17	1.500	1.140	35	.291	.700	3.5	7	.018	.133	86
C150-M6	-S17	1.500	1.140	35	.324	.800	3.5	8	.018	.133	74
C150-M7	-S17	1.500	1.140	35	.409	1.000	3.5	10	.018	.133	59
C150-M8	-S17	1.500	1.140	35	.540	1.300	3.5	13	.018	.133	46
C150-M9	-S17	1.500	1.140	35	.657	1.600	3.5	16	.018	.133	37
C150-M10	-S17	1.500	1.140	35	.835	2.000	3.5	20	.018	.133	30
C150-H1	-S17	1.500	1.140	60	.166	.300	4.5	3	.018	.133	448
C150-H2	-S17	1.500	1.140	60	.216	.400	4.5	4	.018	.133	326
C150-H3	-S17	1.500	1.140	60	.278	.500	4.5	5	.018	.133	270
C150-H4	-S17	1.500	1.140	60	.329	.600	4.5	6	.018	.133	221
C150-H5	-S17	1.500	1.140	60	.390	.700	4.5	7	.018	.133	194
C150-H6	-S17	1.500	1.140	60	.443	.800	4.5	8	.018	.133	168
C150-H7	-S17	1.500	1.140	60	.555	1.000	4.5	10	.018	.133	135
C150-H8	-S17	1.500	1.140	60	.726	1.300	4.5	13	.018	.133	105
C150-H9	-S17	1.500	1.140	60	.890	1.600	4.5	16	.018	.133	85
C150-H10	-S17	1.500	1.140	60	1.119	2.000	4.5	20	.018	.133	68
C175-L1	-S17	1.750	1.340	25	.155	.375	3.5	3	.018	.143	114
C175-L2	-S17	1.750	1.340	25	.200	.500	3.5	4	.018	.143	83
C175-L3	-S17	1.750	1.340	25	.265	.625	3.5	5	.018	.143	69
C175-L4	-S17	1.750	1.340	25	.310	.750	3.5	6	.018	.143	57
C175-L5	-S17	1.750	1.340	25	.367	.870	3.5	7	.018	.143	50
C175-L6	-S17	1.750	1.340	25	.415	1.000	3.5	8	.018	.143	43
C175-L7	-S17	1.750	1.340	25	.523	1.250	3.5	10	.018	.143	34
C175-L8	-S17	1.750	1.340	25	.638	1.500	3.5	12	.018	.143	29

[1] Not available with shim ends.
[2] Reference dimension.
[3] Use "C" prefix for plain ends. Use "CS" prefix for squared-shim ends.
[4] Theoretical dimension.

C/CS Series
Crest-To-Crest® Springs Continued

Smalley Part Number[3] Carbon Steel	Add Suffix 17-7 SS	Operates in Bore Diameter (in)	Clears Shaft Diameter (in)	Load (lb)	Work Height (in)	Free Height[2] (in)	Number of Waves	Number of Turns	Thickness (in)	Radial Wall (in)	Spring Rate[4] (lb/in)
C175-L9	-S17	1.750	1.340	25	.737	1.750	3.5	14	.018	.143	25
C175-L10	-S17	1.750	1.340	25	.844	2.000	3.5	16	.018	.143	22
C175-M1	-S17	1.750	1.340	50	.188	.375	4.5	3	.018	.143	267
C175-M2	-S17	1.750	1.340	50	.244	.500	4.5	4	.018	.143	195
C175-M3	-S17	1.750	1.340	50	.315	.625	4.5	5	.018	.143	161
C175-M4	-S17	1.750	1.340	50	.374	.750	4.5	6	.018	.143	133
C175-M5	-S17	1.750	1.340	50	.452	.870	4.5	7	.018	.143	120
C175-M6	-S17	1.750	1.340	50	.505	1.000	4.5	8	.018	.143	101
C175-M7	-S17	1.750	1.340	50	.629	1.250	4.5	10	.018	.143	81
C175-M8	-S17	1.750	1.340	50	.768	1.500	4.5	12	.018	.143	68
C175-M9	-S17	1.750	1.340	50	.899	1.750	4.5	14	.018	.143	59
C175-M10	-S17	1.750	1.340	50	1.026	2.000	4.5	16	.018	.143	51
C175-H1	-S17	1.750	1.340	90	.232	.375	4.5	3	.024	.148	629
C175-H2	-S17	1.750	1.340	90	.314	.500	4.5	4	.024	.148	484
C175-H3	-S17	1.750	1.340	90	.409	.625	4.5	5	.024	.148	417
C175-H4	-S17	1.750	1.340	90	.482	.750	4.5	6	.024	.148	336
C175-H5	-S17	1.750	1.340	90	.577	.870	4.5	7	.024	.148	307
C175-H6	-S17	1.750	1.340	90	.651	1.000	4.5	8	.024	.148	258
C175-H7	-S17	1.750	1.340	90	.813	1.250	4.5	10	.024	.148	206
C175-H8	-S17	1.750	1.340	90	.980	1.500	4.5	12	.024	.148	173
C175-H9	-S17	1.750	1.340	90	1.147	1.750	4.5	14	.024	.148	149
C175-H10	-S17	1.750	1.340	90	1.317	2.000	4.5	16	.024	.148	132
C200-L1	-S17	2.000	1.600	25	.094	.375	3.5	3	.018	.143	89
C200-L2	-S17	2.000	1.600	25	.120	.500	3.5	4	.018	.143	66
C200-L3	-S17	2.000	1.600	25	.158	.625	3.5	5	.018	.143	54
C200-L4	-S17	2.000	1.600	25	.179	.750	3.5	6	.018	.143	44
C200-L5	-S17	2.000	1.600	25	.217	.870	3.5	7	.018	.143	38
C200-L6	-S17	2.000	1.600	25	.243	1.000	3.5	8	.018	.143	33
C200-L7	-S17	2.000	1.600	25	.306	1.250	3.5	10	.018	.143	26
C200-L8	-S17	2.000	1.600	25	.365	1.500	3.5	12	.018	.143	22
C200-L9	-S17	2.000	1.600	25	.433	1.750	3.5	14	.018	.143	19
C200-L10	-S17	2.000	1.600	25	.490	2.000	3.5	16	.018	.143	17
C200-M1	-S17	2.000	1.600	50	.140	.375	4.5	3	.018	.143	213
C200-M2	-S17	2.000	1.600	50	.184	.500	4.5	4	.018	.143	158
C200-M3	-S17	2.000	1.600	50	.245	.625	4.5	5	.018	.143	132
C200-M4	-S17	2.000	1.600	50	.278	.750	4.5	6	.018	.143	106
C200-M5	-S17	2.000	1.600	50	.345	.870	4.5	7	.018	.143	95
C200-M6	-S17	2.000	1.600	50	.395	1.000	4.5	8	.018	.143	83
C200-M7	-S17	2.000	1.600	50	.498	1.250	4.5	10	.018	.143	66
C200-M8	-S17	2.000	1.600	50	.593	1.500	4.5	12	.018	.143	55
C200-M9	-S17	2.000	1.600	50	.694	1.750	4.5	14	.018	.143	47
C200-M10	-S17	2.000	1.600	50	.800	2.000	4.5	16	.018	.143	42
C200-H1	-S17	2.000	1.600	90	.197	.375	4.5	3	.024	.148	506
C200-H2	-S17	2.000	1.600	90	.258	.500	4.5	4	.024	.148	372
C200-H3	-S17	2.000	1.600	90	.332	.625	4.5	5	.024	.148	307
C200-H4	-S17	2.000	1.600	90	.389	.750	4.5	6	.024	.148	249
C200-H5	-S17	2.000	1.600	90	.465	.870	4.5	7	.024	.148	222
C200-H6	-S17	2.000	1.600	90	.525	1.000	4.5	8	.024	.148	189
C200-H7	-S17	2.000	1.600	90	.661	1.250	4.5	10	.024	.148	153
C200-H8	-S17	2.000	1.600	90	.781	1.500	4.5	12	.024	.148	125
C200-H9	-S17	2.000	1.600	90	.941	1.750	4.5	14	.024	.148	111
C200-H10	-S17	2.000	1.600	90	1.069	2.000	4.5	16	.024	.148	97

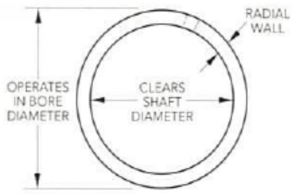
[1] Not available with shim ends.
[2] Reference dimension.
[3] Use "C" prefix for plain ends. Use "CS" prefix for squared-shim ends.
[4] Theoretical dimension.

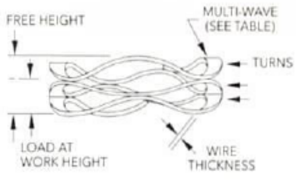
CM/CMS Series

Metric Crest-To-Crest® Springs

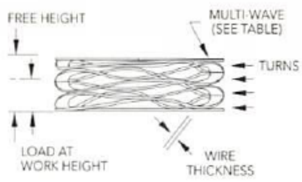
CM-Plain Ends

CMS-Shim Ends*





CM-Plain Ends



CMS-Shim Ends*

Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number [1] Carbon Steel	Add Suffix 17-7 SS	Operates in Bore Diameter (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height[2] (mm)	Number of Waves	Number of Turns	Thickness (mm)	Radial Wall (mm)	Spring Rate[3] (N/mm)
NA	CM05-L1-S17[4]	5	3.5	5	1.14	1.84	2.5	3	.13	.46	7.14
NA	CM05-L2-S17[4]	5	3.5	5	1.52	2.45	2.5	4	.13	.46	5.38
NA	CM05-L3-S17[4]	5	3.5	5	1.91	3.06	2.5	5	.13	.46	4.35
NA	CM05-L4-S17[4]	5	3.5	5	2.26	3.68	2.5	6	.13	.46	3.52
NA	CM05-L5-S17[4]	5	3.5	5	2.67	4.29	2.5	7	.13	.46	3.09
NA	CM05-L6-S17[4]	5	3.5	5	3.02	4.90	2.5	8	.13	.46	2.66
NA	CM05-L7-S17[4]	5	3.5	5	3.43	5.52	2.5	9	.13	.46	2.39
NA	CM05-L8-S17[4]	5	3.5	5	4.14	6.74	2.5	11	.13	.46	1.92
NA	CM05-L9-S17[4]	5	3.5	5	4.90	7.97	2.5	13	.13	.46	1.63
NA	CM05-M1-S17[4]	5	3.5	10	1.14	1.89	2.5	3	.15	.46	13.33
NA	CM05-M2-S17[4]	5	3.5	10	1.52	2.52	2.5	4	.15	.46	10.00
NA	CM05-M3-S17[4]	5	3.5	10	1.91	3.15	2.5	5	.15	.46	8.06
NA	CM05-M4-S17[4]	5	3.5	10	2.26	3.78	2.5	6	.15	.46	6.58
NA	CM05-M5-S17[4]	5	3.5	10	2.67	4.41	2.5	7	.15	.46	5.75
NA	CM05-M6-S17[4]	5	3.5	10	3.02	5.04	2.5	8	.15	.46	4.95
NA	CM05-M7-S17[4]	5	3.5	10	3.43	5.67	2.5	9	.15	.46	4.46
NA	CM05-M8-S17[4]	5	3.5	10	4.14	6.93	2.5	11	.15	.46	3.58
NA	CM05-M9-S17[4]	5	3.5	10	4.90	8.19	2.5	13	.15	.46	3.04
NA	CM06-L1-S17[4]	6	4	6	.61	1.52	2.5	3	.13	.51	6.59
NA	CM06-L2-S17[4]	6	4	6	.81	2.03	2.5	4	.13	.51	4.92
NA	CM06-L3-S17[4]	6	4	6	1.02	2.54	2.5	5	.13	.51	3.95
NA	CM06-L4-S17[4]	6	4	6	1.22	3.05	2.5	6	.13	.51	3.28
NA	CM06-L5-S17[4]	6	4	6	1.42	3.56	2.5	7	.13	.51	2.80
NA	CM06-L6-S17[4]	6	4	6	1.63	4.06	2.5	8	.13	.51	2.47
NA	CM06-L7-S17[4]	6	4	6	1.83	4.57	2.5	9	.13	.51	2.19
NA	CM06-L8-S17[4]	6	4	6	2.24	5.59	2.5	11	.13	.51	1.79
NA	CM06-L9-S17[4]	6	4	6	2.64	6.60	2.5	13	.13	.51	1.52
NA	CM06-M1-S17[4]	6	4	12	.74	1.52	2.5	3	.15	.61	15.38
NA	CM06-M2-S17[4]	6	4	12	.97	2.03	2.5	4	.15	.61	11.32
NA	CM06-M3-S17[4]	6	4	12	1.22	2.54	2.5	5	.15	.61	9.09
NA	CM06-M4-S17[4]	6	4	12	1.47	3.05	2.5	6	.15	.61	7.59
NA	CM06-M5-S17[4]	6	4	12	1.70	3.56	2.5	7	.15	.61	6.45
NA	CM06-M6-S17[4]	6	4	12	1.96	4.06	2.5	8	.15	.61	5.71
NA	CM06-M7-S17[4]	6	4	12	2.18	4.57	2.5	9	.15	.61	5.02
NA	CM06-M8-S17[4]	6	4	12	2.69	5.59	2.5	11	.15	.61	4.14
NA	CM06-M9-S17[4]	6	4	12	3.18	6.60	2.5	13	.15	.61	3.51
CM08-L1	-S17	8	5	15	1.70	2.82	2.5	3	.20	.81	13.39
CM08-L2	-S17	8	5	15	2.39	3.76	2.5	4	.20	.81	10.95
CM08-L3	-S17	8	5	15	2.74	4.70	2.5	5	.20	.81	7.65
CM08-L4	-S17	8	5	15	3.56	5.64	2.5	6	.20	.81	7.21
CM08-L5	-S17	8	5	15	4.01	6.58	2.5	7	.20	.81	5.84
CM08-L6	-S17	8	5	15	4.57	7.52	2.5	8	.20	.81	5.08
CM08-L7	-S17	8	5	15	5.26	8.46	2.5	9	.20	.81	4.69
CM08-L8	-S17	8	5	15	6.35	10.34	2.5	11	.20	.81	3.76
CM08-L9	-S17	8	5	15	7.37	12.22	2.5	13	.20	.81	3.09
CM08-M1	-S17	8	5	30	1.78	3.05	2.5	3	.25	.81	23.62
CM08-M2	-S17	8	5	30	2.54	4.06	2.5	4	.25	.81	19.74
CM08-M3	-S17	8	5	30	3.05	5.08	2.5	5	.25	.81	14.78
CM08-M4	-S17	8	5	30	3.81	6.10	2.5	6	.25	.81	13.10
CM08-M5	-S17	8	5	30	4.32	7.11	2.5	7	.25	.81	10.75
CM08-M6	-S17	8	5	30	4.95	8.13	2.5	8	.25	.81	9.43

[1] Use "CM" prefix for plain ends. Use "CMS" prefix for squared-shim ends.
[2] Reference dimension.
[3] Theoretical dimension.
[4] Not available with shim ends
*For parts with Shim ends in sizes less than 8 mm, please contact a Smalley Engineer

CM/CMS Series

Metric Crest-To-Crest® Springs Continued

Smalley Part Number[1] Carbon Steel	Add Suffix 17-7 SS	Operates in Bore Diameter (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height[2] (mm)	Number of Waves	Number of Turns	Thickness (mm)	Radial Wall (mm)	Spring Rate[3] (N/mm)
CM08-M7	-S17	8	5	30	5.59	9.14	2.5	9	.25	.81	8.45
CM08-M8	-S17	8	5	30	6.86	10.34	2.5	11	.25	.81	8.62
CM08-M9	-S17	8	5	30	7.87	12.22	2.5	13	.25	.81	6.90
CM10-L1	-S17	10	7	18	1.91	3.96	2.5	3	.20	.81	8.78
CM10-L2	-S17	10	7	18	2.54	5.28	2.5	4	.20	.81	6.57
CM10-L3	-S17	10	7	18	3.15	6.60	2.5	5	.20	.81	5.22
CM10-L4	-S17	10	7	18	3.78	7.92	2.5	6	.20	.81	4.35
CM10-L5	-S17	10	7	18	4.42	9.25	2.5	7	.20	.81	3.73
CM10-L6	-S17	10	7	18	5.05	10.57	2.5	8	.20	.81	3.26
CM10-L7	-S17	10	7	18	5.69	11.89	2.5	9	.20	.81	2.90
CM10-L8	-S17	10	7	18	6.32	13.21	2.5	10	.20	.81	2.61
CM10-L9	-S17	10	7	18	6.96	14.53	2.5	11	.20	.81	2.38
CM10-M1	-S17	10	7	35	2.03	3.96	2.5	3	.28	.81	18.13
CM10-M2	-S17	10	7	35	2.79	5.28	2.5	4	.28	.81	14.06
CM10-M3	-S17	10	7	35	3.56	6.60	2.5	5	.28	.81	11.51
CM10-M4	-S17	10	7	35	4.32	7.92	2.5	6	.28	.81	9.72
CM10-M5	-S17	10	7	35	5.08	9.25	2.5	7	.28	.81	8.39
CM10-M6	-S17	10	7	35	5.84	10.57	2.5	8	.28	.81	7.40
CM10-M7	-S17	10	7	35	6.60	11.89	2.5	9	.28	.81	6.62
CM10-M8	-S17	10	7	35	7.37	13.21	2.5	10	.28	.81	5.99
CM10-M9	-S17	10	7	35	8.13	14.53	2.5	11	.28	.81	5.47
CM12-L1	-S17	12	9	20	1.47	4.34	2.5	3	.20	1.02	6.97
CM12-L2	-S17	12	9	20	1.98	5.79	2.5	4	.20	1.02	5.25
CM12-L3	-S17	12	9	20	2.46	7.24	2.5	5	.20	1.02	4.18
CM12-L4	-S17	12	9	20	2.95	8.69	2.5	6	.20	1.02	3.48
CM12-L5	-S17	12	9	20	3.45	10.13	2.5	7	.20	1.02	2.99
CM12-L6	-S17	12	9	20	3.94	11.58	2.5	8	.20	1.02	2.62
CM12-L7	-S17	12	9	20	4.45	13.03	2.5	9	.20	1.02	2.33
CM12-L8	-S17	12	9	20	4.93	14.48	2.5	10	.20	1.02	2.09
CM12-L9	-S17	12	9	20	5.44	15.93	2.5	11	.20	1.02	1.91
CM12-M1	-S17	12	8.5	40	2.36	4.34	2.5	3	.28	1.17	20.20
CM12-M2	-S17	12	8.5	40	3.18	5.79	2.5	4	.28	1.17	15.33
CM12-M3	-S17	12	8.5	40	3.96	7.24	2.5	5	.28	1.17	12.20
CM12-M4	-S17	12	8.5	40	4.75	8.69	2.5	6	.28	1.17	10.15
CM12-M5	-S17	12	8.5	40	5.54	10.13	2.5	7	.28	1.17	8.71
CM12-M6	-S17	12	8.5	40	6.32	11.58	2.5	8	.28	1.17	7.60
CM12-M7	-S17	12	8.5	40	7.11	13.03	2.5	9	.28	1.17	6.76
CM12-M8	-S17	12	8.5	40	7.92	14.48	2.5	10	.28	1.17	6.10
CM12-M9	-S17	12	8.5	40	8.71	15.93	2.5	11	.28	1.17	5.54
CM12-H1	-S17	12	8.5	60	1.98	4.34	2.5	3	.30	1.14	25.42
CM12-H2	-S17	12	8.5	60	2.64	5.79	2.5	4	.30	1.14	19.05
CM12-H3	-S17	12	8.5	60	3.30	7.24	2.5	5	.30	1.14	15.23
CM12-H4	-S17	12	8.5	60	3.99	8.69	2.5	6	.30	1.14	12.77
CM12-H5	-S17	12	8.5	60	4.65	10.13	2.5	7	.30	1.14	10.95
CM12-H6	-S17	12	8.5	60	5.31	11.58	2.5	8	.30	1.14	9.57
CM12-H7	-S17	12	8.5	60	5.97	13.03	2.5	9	.30	1.14	8.50
CM12-H8	-S17	12	8.5	60	6.63	14.48	2.5	10	.30	1.14	7.64
CM12-H9	-S17	12	8.5	60	7.29	15.93	2.5	11	.30	1.14	6.94
CM14-L1	-S17	14	10	22	2.18	4.95	2.5	3	.23	1.47	7.94
CM14-L2	-S17	14	10	22	2.92	6.60	2.5	4	.23	1.47	5.98
CM14-L3	-S17	14	10	22	3.66	8.26	2.5	5	.23	1.47	4.78
CM14-L4	-S17	14	10	22	4.37	9.91	2.5	6	.23	1.47	3.97
CM14-L5	-S17	14	10	22	5.10	11.56	2.5	7	.23	1.47	3.40
CM14-L6	-S17	14	10	22	5.84	13.21	2.5	8	.23	1.47	2.99
CM14-L7	-S17	14	10	22	6.58	14.86	2.5	9	.23	1.47	2.66
CM14-L8	-S17	14	10	22	7.29	16.51	2.5	10	.23	1.47	2.39
CM14-L9	-S17	14	10	22	8.03	18.16	2.5	11	.23	1.47	2.17
CM14-M1	-S17	14	10	50	2.18	4.95	2.5	3	.30	1.52	18.05
CM14-M2	-S17	14	10	50	2.95	6.60	2.5	4	.30	1.52	13.70
CM14-M3	-S17	14	10	50	3.71	8.26	2.5	5	.30	1.52	10.99
CM14-M4	-S17	14	10	50	4.52	9.91	2.5	6	.30	1.52	9.28
CM14-M5	-S17	14	10	50	5.33	11.56	2.5	7	.30	1.52	8.03
CM14-M6	-S17	14	10	50	6.17	13.21	2.5	8	.30	1.52	7.10
CM14-M7	-S17	14	10	50	7.01	14.86	2.5	9	.30	1.52	6.37
CM14-M8	-S17	14	10	50	7.85	16.51	2.5	10	.30	1.52	5.77
CM14-M9	-S17	14	10	50	8.71	18.16	2.5	11	.30	1.52	5.29
CM14-H1	-S17	14	9	80	3.15	4.95	2.5	3	.38	1.52	44.44

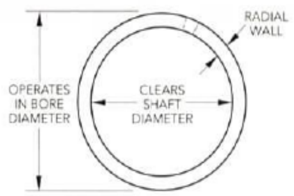
[1] Use "CM" prefix for plain ends. Use "CMS" prefix for squared-shim ends.
[2] Reference dimension.
[3] Theoretical dimension.

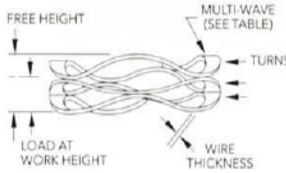
CM/CMS Series

Metric Crest-To-Crest® Springs

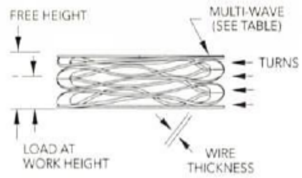
CM-Plain Ends

CMS-Shim Ends





CM-Plain Ends



CMS-Shim Ends

Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number [1] Carbon Steel	Add Suffix 17-7 SS	Operates in Bore Diameter (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height[2] (mm)	Number of Waves	Number of Turns	Thickness (mm)	Radial Wall (mm)	Spring Rate[3] (N/mm)
CM14-H2	-S17	14	9	80	4.19	6.60	2.5	4	.38	1.52	33.20
CM14-H3	-S17	14	9	80	5.26	8.26	2.5	5	.38	1.52	26.67
CM14-H4	-S17	14	9	80	6.30	9.91	2.5	6	.38	1.52	22.16
CM14-H5	-S17	14	9	80	7.34	11.56	2.5	7	.38	1.52	18.96
CM14-H6	-S17	14	9	80	8.41	13.21	2.5	8	.38	1.52	16.67
CM14-H7	-S17	14	9	80	9.45	14.86	2.5	9	.38	1.52	14.79
CM14-H8	-S17	14	9	80	10.49	16.51	2.5	10	.38	1.52	13.29
CM14-H9	-S17	14	9	80	11.56	18.16	2.5	11	.38	1.52	12.12
CM15-L1	-S17	15	11	25	2.57	5.18	2.5	3	.25	1.47	9.58
CM15-L2	-S17	15	11	25	3.43	6.91	2.5	4	.25	1.47	7.18
CM15-L3	-S17	15	11	25	4.27	8.64	2.5	5	.25	1.47	5.72
CM15-L4	-S17	15	11	25	5.13	10.36	2.5	6	.25	1.47	4.78
CM15-L5	-S17	15	11	25	5.99	12.09	2.5	7	.25	1.47	4.10
CM15-L6	-S17	15	11	25	6.83	13.82	2.5	8	.25	1.47	3.58
CM15-L7	-S17	15	11	25	7.70	15.54	2.5	9	.25	1.47	3.19
CM15-L8	-S17	15	11	25	8.53	17.27	2.5	10	.25	1.47	2.86
CM15-L9	-S17	15	11	25	9.40	19.00	2.5	11	.25	1.47	2.60
CM15-M1	-S17	15	10	50	3.43	5.18	3.5	3	.23	1.47	28.57
CM15-M2	-S17	15	10	50	4.57	6.91	3.5	4	.23	1.47	21.37
CM15-M3	-S17	15	10	50	5.72	8.64	3.5	5	.23	1.47	17.12
CM15-M4	-S17	15	10	50	6.86	10.36	3.5	6	.23	1.47	14.29
CM15-M5	-S17	15	10	50	8.00	12.09	3.5	7	.23	1.47	12.22
CM15-M6	-S17	15	10	50	9.14	13.82	3.5	8	.23	1.47	10.68
CM15-M7	-S17	15	10	50	10.29	15.54	3.5	9	.23	1.47	9.52
CM15-M8	-S17	15	10	50	11.43	17.27	3.5	10	.23	1.47	8.56
CM15-M9	-S17	15	10	50	12.57	19.00	3.5	11	.23	1.47	7.78
CM15-H1	-S17	15	10	80	3.20	5.18	3.5	3	.25	1.47	40.40
CM15-H2	-S17	15	10	80	4.19	6.91	3.5	4	.25	1.47	29.41
CM15-H3	-S17	15	10	80	5.23	8.64	3.5	5	.25	1.47	23.46
CM15-H4	-S17	15	10	80	6.27	10.36	3.5	6	.25	1.47	19.56
CM15-H5	-S17	15	10	80	7.32	12.09	3.5	7	.25	1.47	16.77
CM15-H6	-S17	15	10	80	8.36	13.82	3.5	8	.25	1.47	14.65
CM15-H7	-S17	15	10	80	9.40	15.54	3.5	9	.25	1.47	13.03
CM15-H8	-S17	15	10	80	10.46	17.27	3.5	10	.25	1.47	11.75
CM15-H9	-S17	15	10	80	11.51	19.00	3.5	11	.25	1.47	10.68
CM16-L1	-S17	16	11	25	2.11	5.41	2.5	3	.25	1.47	7.58
CM16-L2	-S17	16	11	25	2.79	7.21	2.5	4	.25	1.47	5.66
CM16-L3	-S17	16	11	25	3.51	9.02	2.5	5	.25	1.47	4.54
CM16-L4	-S17	16	11	25	4.19	10.82	2.5	6	.25	1.47	3.77
CM16-L5	-S17	16	11	25	4.90	12.62	2.5	7	.25	1.47	3.24
CM16-L6	-S17	16	11	25	6.30	16.23	2.5	9	.25	1.47	2.52
CM16-L7	-S17	16	11	25	7.70	19.84	2.5	11	.25	1.47	2.06
CM16-L8	-S17	16	11	25	9.09	23.44	2.5	13	.25	1.47	1.74
CM16-M1	-S17	16	11	55	3.63	5.41	3.5	3	.25	1.47	30.90
CM16-M2	-S17	16	11	55	4.83	7.21	3.5	4	.25	1.47	23.11
CM16-M3	-S17	16	11	55	6.05	9.02	3.5	5	.25	1.47	18.52
CM16-M4	-S17	16	11	55	7.24	10.82	3.5	6	.25	1.47	15.36
CM16-M5	-S17	16	11	55	8.46	12.62	3.5	7	.25	1.47	13.22
CM16-M6	-S17	16	11	55	10.87	16.23	3.5	9	.25	1.47	10.26
CM16-M7	-S17	16	11	55	13.28	19.84	3.5	11	.25	1.47	8.38
CM16-M8	-S17	16	11	55	15.70	23.44	3.5	13	.25	1.47	7.11

[1] Use "CM" prefix for plain ends. Use "CMS" prefix for squared-shim ends.
[2] Reference dimension.
[3] Theoretical dimension.

CM/CMS Series

Metric Crest-To-Crest® Springs Continued

Smalley Part Number[1]											
Carbon Steel	Add Suffix 17-7 SS	Operates in Bore Diameter (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height[2] (mm)	Number of Waves	Number of Turns	Thickness (mm)	Radial Wall (mm)	Spring Rate[3] (N/mm)
CM16-H1	-S17	16	11	90	3.30	5.41	3.5	3	.30	1.52	42.65
CM16-H2	-S17	16	11	90	4.57	7.21	3.5	4	.30	1.52	34.09
CM16-H3	-S17	16	11	90	5.59	9.02	3.5	5	.30	1.52	26.24
CM16-H4	-S17	16	11	90	6.86	10.82	3.5	6	.30	1.52	22.73
CM16-H5	-S17	16	11	90	7.87	12.62	3.5	7	.30	1.52	18.95
CM16-H6	-S17	16	11	90	10.16	16.23	3.5	9	.30	1.52	14.83
CM16-H7	-S17	16	11	90	12.45	19.84	3.5	11	.30	1.52	12.18
CM16-H8	-S17	16	11	90	14.73	23.44	3.5	13	.30	1.52	10.33
CM18-L1	-S17	18	13	30	3.63	5.72	3.5	3	.20	1.80	14.35
CM18-L2	-S17	18	13	30	4.75	7.62	3.5	4	.20	1.80	10.45
CM18-L3	-S17	18	13	30	5.94	9.53	3.5	5	.20	1.80	8.36
CM18-L4	-S17	18	13	30	7.14	11.43	3.5	6	.20	1.80	6.99
CM18-L5	-S17	18	13	30	8.31	13.34	3.5	7	.20	1.80	5.96
CM18-L6	-S17	18	13	30	10.69	17.15	3.5	9	.20	1.80	4.64
CM18-L7	-S17	18	13	30	14.25	22.86	3.5	12	.20	1.80	3.48
CM18-M1	-S17	18	13	55	3.68	5.72	3.5	3	.25	1.83	26.96
CM18-M2	-S17	18	13	55	4.98	7.62	3.5	4	.25	1.83	20.83
CM18-M3	-S17	18	13	55	6.22	9.53	3.5	5	.25	1.83	16.62
CM18-M4	-S17	18	13	55	7.47	11.43	3.5	6	.25	1.83	13.89
CM18-M5	-S17	18	13	55	8.74	13.34	3.5	7	.25	1.83	11.96
CM18-M6	-S17	18	13	55	11.23	17.15	3.5	9	.25	1.83	9.29
CM18-M7	-S17	18	13	55	14.96	22.86	3.5	12	.25	1.83	6.96
CM18-H1	-S17	18	13	90	3.84	5.72	3.5	3	.30	1.83	47.87
CM18-H2	-S17	18	13	90	5.13	7.62	3.5	4	.30	1.83	36.14
CM18-H3	-S17	18	13	90	6.40	9.53	3.5	5	.30	1.83	28.75
CM18-H4	-S17	18	13	90	7.70	11.43	3.5	6	.30	1.83	24.13
CM18-H5	-S17	18	13	90	8.97	13.34	3.5	7	.30	1.83	20.59
CM18-H6	-S17	18	13	90	11.53	17.15	3.5	9	.30	1.83	16.01
CM18-H7	-S17	18	13	90	15.37	22.86	3.5	12	.30	1.83	12.02
CM20-L1	-S17	20	15	35	2.72	6.32	3.5	3	.20	1.80	9.72
CM20-L2	-S17	20	15	35	3.61	8.43	3.5	4	.20	1.80	7.26
CM20-L3	-S17	20	15	35	4.52	10.54	3.5	5	.20	1.80	5.81
CM20-L4	-S17	20	15	35	5.41	12.65	3.5	6	.20	1.80	4.83
CM20-L5	-S17	20	15	35	6.32	14.76	3.5	7	.20	1.80	4.15
CM20-L6	-S17	20	15	35	8.13	18.97	3.5	9	.20	1.80	3.23
CM20-L7	-S17	20	15	35	10.82	25.30	3.5	12	.20	1.80	2.42
CM20-M1	-S17	20	14	70	3.05	6.32	3.5	3	.25	1.98	21.41
CM20-M2	-S17	20	14	70	4.06	8.43	3.5	4	.25	1.98	16.02
CM20-M3	-S17	20	14	70	5.08	10.54	3.5	5	.25	1.98	12.82
CM20-M4	-S17	20	14	70	6.27	12.65	3.5	6	.25	1.98	10.97
CM20-M5	-S17	20	14	70	7.32	14.76	3.5	7	.25	1.98	9.41
CM20-M6	-S17	20	14	70	9.17	18.97	3.5	9	.25	1.98	7.14
CM20-M7	-S17	20	14	70	12.22	25.30	3.5	12	.25	1.98	5.35
CM20-H1	-S17	20	14	100	4.24	6.32	3.5	3	.33	2.01	48.08
CM20-H2	-S17	20	14	100	5.66	8.43	3.5	4	.33	2.01	36.10
CM20-H3	-S17	20	14	100	7.06	10.54	3.5	5	.33	2.01	28.74
CM20-H4	-S17	20	14	100	8.48	12.65	3.5	6	.33	2.01	23.98
CM20-H5	-S17	20	14	100	9.91	14.76	3.5	7	.33	2.01	20.62
CM20-H6	-S17	20	14	100	12.73	18.97	3.5	9	.33	2.01	16.03
CM20-H7	-S17	20	14	100	16.97	25.30	3.5	12	.33	2.01	12.00
CM25-L1	-S17	25	19	50	2.06	6.63	3.5	3	.25	2.18	10.94
CM25-L2	-S17	25	19	50	2.74	8.84	3.5	4	.25	2.18	8.20
CM25-L3	-S17	25	19	50	3.43	11.05	3.5	5	.25	2.18	6.56
CM25-L4	-S17	25	19	50	4.11	13.26	3.5	6	.25	2.18	5.46
CM25-L5	-S17	25	19	50	4.80	15.47	3.5	7	.25	2.18	4.69
CM25-L6	-S17	25	19	50	6.20	19.89	3.5	9	.25	2.18	3.65
CM25-L7	-S17	25	19	50	8.26	26.52	3.5	12	.25	2.18	2.74
CM25-M1	-S17	25	19	80	2.95	6.63	3.5	3	.30	2.39	21.74
CM25-M2	-S17	25	19	80	3.94	8.84	3.5	4	.30	2.39	16.33
CM25-M3	-S17	25	19	80	4.90	11.05	3.5	5	.30	2.39	13.01
CM25-M4	-S17	25	19	80	5.89	13.26	3.5	6	.30	2.39	10.85
CM25-M5	-S17	25	19	80	6.88	15.47	3.5	7	.30	2.39	9.31
CM25-M6	-S17	25	19	80	8.84	19.89	3.5	9	.30	2.39	7.24
CM25-M7	-S17	25	19	80	11.79	26.52	3.5	12	.30	2.39	5.43
CM25-H1	-S17	25	19	110	4.04	6.63	3.5	3	.38	2.39	42.47
CM25-H2	-S17	25	19	110	5.38	8.84	3.5	4	.38	2.39	31.79
CM25-H3	-S17	25	19	110	6.73	11.05	3.5	5	.38	2.39	25.46

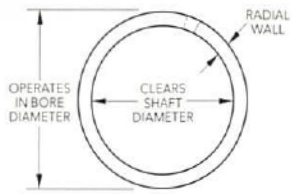
[1] Use "CM" prefix for plain ends. Use "CMS" prefix for squared-shim ends.
[2] Reference dimension.
[3] Theoretical dimension.

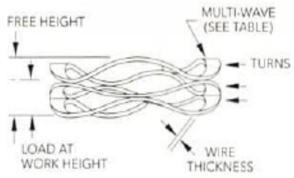
CM/CMS Series

Metric Crest-To-Crest® Springs

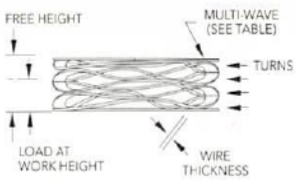
CM-Plain Ends

CMS-Shim Ends





CM-Plain Ends



CMS-Shim Ends

Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number [1]		Operates in Bore Diameter (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height[2] (mm)	Number of Waves	Number of Turns	Thickness (mm)	Radial Wall (mm)	Spring Rate[3] (N/mm)
Carbon Steel	Add Suffix 17-7 SS										
CM25-H4	-S17	25	19	110	8.08	13.26	3.5	6	.38	2.39	21.24
CM25-H5	-S17	25	19	110	9.40	15.47	3.5	7	.38	2.39	18.12
CM25-H6	-S17	25	19	110	12.12	19.89	3.5	9	.38	2.39	14.16
CM25-H7	-S17	25	19	110	16.15	26.52	3.5	12	.38	2.39	10.61
CM28-L1	-S17	28	22	50	3.76	7.24	3.5	3	.30	2.39	14.37
CM28-L2	-S17	28	22	50	5.00	9.65	3.5	4	.30	2.39	10.75
CM28-L3	-S17	28	22	50	6.27	12.07	3.5	5	.30	2.39	8.62
CM28-L4	-S17	28	22	50	7.52	14.48	3.5	6	.30	2.39	7.18
CM28-L5	-S17	28	22	50	8.79	16.89	3.5	7	.30	2.39	6.17
CM28-L6	-S17	28	22	50	10.03	19.30	3.5	8	.30	2.39	5.39
CM28-L7	-S17	28	22	50	11.28	21.72	3.5	9	.30	2.39	4.79
CM28-L8	-S17	28	22	50	13.79	26.54	3.5	11	.30	2.39	3.92
CM28-L9	-S17	28	22	50	16.31	31.37	3.5	13	.30	2.39	3.32
CM28-M1	-S17	28	22	80	4.39	7.24	3.5	3	.38	2.39	28.07
CM28-M2	-S17	28	22	80	5.84	9.65	3.5	4	.38	2.39	21.00
CM28-M3	-S17	28	22	80	7.32	12.07	3.5	5	.38	2.39	16.84
CM28-M4	-S17	28	22	80	8.79	14.48	3.5	6	.38	2.39	14.06
CM28-M5	-S17	28	22	80	10.24	16.89	3.5	7	.38	2.39	12.03
CM28-M6	-S17	28	22	80	11.71	19.30	3.5	8	.38	2.39	10.54
CM28-M7	-S17	28	22	80	13.18	21.72	3.5	9	.38	2.39	9.37
CM28-M8	-S17	28	22	80	16.10	26.54	3.5	11	.38	2.39	7.66
CM28-M9	-S17	28	22	80	19.02	31.37	3.5	13	.38	2.39	6.48
CM28-H1	-S17	28	22	130	4.57	7.24	3.5	3	.46	2.39	48.69
CM28-H2	-S17	28	22	130	6.07	9.65	3.5	4	.46	2.39	36.31
CM28-H3	-S17	28	22	130	7.59	12.07	3.5	5	.46	2.39	29.02
CM28-H4	-S17	28	22	130	9.12	14.48	3.5	6	.46	2.39	24.25
CM28-H5	-S17	28	22	130	10.64	16.89	3.5	7	.46	2.39	20.80
CM28-H6	-S17	28	22	130	12.17	19.30	3.5	8	.46	2.39	18.23
CM28-H7	-S17	28	22	130	13.69	21.72	3.5	9	.46	2.39	16.19
CM28-H8	-S17	28	22	130	16.71	26.54	3.5	11	.46	2.39	13.22
CM28-H9	-S17	28	22	130	19.76	31.37	3.5	13	.46	2.39	11.20
CM30-L1	-S17	30	24	50	3.18	7.62	3.5	3	.30	2.39	11.26
CM30-L2	-S17	30	24	50	4.22	10.16	3.5	4	.30	2.39	8.42
CM30-L3	-S17	30	24	50	5.28	12.70	3.5	5	.30	2.39	6.74
CM30-L4	-S17	30	24	50	6.32	15.24	3.5	6	.30	2.39	5.61
CM30-L5	-S17	30	24	50	7.39	17.78	3.5	7	.30	2.39	4.81
CM30-L6	-S17	30	24	50	8.43	20.32	3.5	8	.30	2.39	4.21
CM30-L7	-S17	30	24	50	9.50	22.86	3.5	9	.30	2.39	3.74
CM30-L8	-S17	30	24	50	11.61	27.94	3.5	11	.30	2.39	3.06
CM30-L9	-S17	30	24	50	13.72	33.02	3.5	13	.30	2.39	2.59
CM30-M1	-S17	30	24	90	3.51	7.62	3.5	3	.38	2.39	21.90
CM30-M2	-S17	30	24	90	4.70	10.16	3.5	4	.38	2.39	16.48
CM30-M3	-S17	30	24	90	5.87	12.70	3.5	5	.38	2.39	13.18
CM30-M4	-S17	30	24	90	7.04	15.24	3.5	6	.38	2.39	10.98
CM30-M5	-S17	30	24	90	8.20	17.78	3.5	7	.38	2.39	9.39
CM30-M6	-S17	30	24	90	9.37	20.32	3.5	8	.38	2.39	8.22
CM30-M7	-S17	30	24	90	10.54	22.86	3.5	9	.38	2.39	7.31
CM30-M8	-S17	30	24	90	12.90	27.94	3.5	11	.38	2.39	5.98
CM30-M9	-S17	30	24	90	15.24	33.02	3.5	13	.38	2.39	5.06
CM30-H1	-S17	30	24	130	4.19	7.62	3.5	3	.46	2.39	37.90
CM30-H2	-S17	30	24	130	5.59	10.16	3.5	4	.46	2.39	28.45

[1] Use "CM" prefix for plain ends. Use "CMS" prefix for squared-shim ends.
[2] Reference dimension.
[3] Theoretical dimension.

CM/CMS Series

Metric Crest-To-Crest® Springs Continued

Smalley Part Number[1] Carbon Steel	Add Suffix 17-7 SS	Operates in Bore Diameter (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height[2] (mm)	Number of Waves	Number of Turns	Thickness (mm)	Radial Wall (mm)	Spring Rate[3] (N/mm)
CM30-H3	-S17	30	24	130	6.99	12.70	3.5	5	.46	2.39	22.77
CM30-H4	-S17	30	24	130	8.38	15.24	3.5	6	.46	2.39	18.95
CM30-H5	-S17	30	24	130	9.78	17.78	3.5	7	.46	2.39	16.25
CM30-H6	-S17	30	24	130	11.18	20.32	3.5	8	.46	2.39	14.22
CM30-H7	-S17	30	24	130	12.57	22.86	3.5	9	.46	2.39	12.63
CM30-H8	-S17	30	24	130	15.37	27.94	3.5	11	.46	2.39	10.34
CM30-H9	-S17	30	24	130	18.16	33.02	3.5	13	.46	2.39	8.75
CM35-L1	-S17	35	27	70	3.94	8.38	3.5	3	.36	3.18	15.77
CM35-L2	-S17	35	27	70	5.23	11.18	3.5	4	.36	3.18	11.76
CM35-L3	-S17	35	27	70	6.55	13.97	3.5	5	.36	3.18	9.43
CM35-L4	-S17	35	27	70	7.87	16.76	3.5	6	.36	3.18	7.87
CM35-L5	-S17	35	27	70	9.17	19.56	3.5	7	.36	3.18	6.74
CM35-L6	-S17	35	27	70	10.49	22.35	3.5	8	.36	3.18	5.90
CM35-L7	-S17	35	27	70	11.81	25.15	3.5	9	.36	3.18	5.25
CM35-L8	-S17	35	27	70	14.43	30.73	3.5	11	.36	3.18	4.29
CM35-L9	-S17	35	27	70	17.04	36.32	3.5	13	.36	3.18	3.63
CM35-M1	-S17	35	27	110	4.14	8.38	3.5	3	.41	3.38	25.94
CM35-M2	-S17	35	27	110	5.51	11.18	3.5	4	.41	3.38	19.40
CM35-M3	-S17	35	27	110	6.88	13.97	3.5	5	.41	3.38	15.51
CM35-M4	-S17	35	27	110	8.26	16.76	3.5	6	.41	3.38	12.94
CM35-M5	-S17	35	27	110	9.63	19.56	3.5	7	.41	3.38	11.08
CM35-M6	-S17	35	27	110	11.02	22.35	3.5	8	.41	3.38	9.71
CM35-M7	-S17	35	27	110	12.40	25.15	3.5	9	.41	3.38	8.63
CM35-M8	-S17	35	27	110	15.14	30.73	3.5	11	.41	3.38	7.06
CM35-M9	-S17	35	27	110	17.91	36.32	3.5	13	.41	3.38	5.98
CM35-H1	-S17	35	27	160	4.04	8.38	3.5	3	.46	3.38	36.87
CM35-H2	-S17	35	27	160	5.38	11.18	3.5	4	.46	3.38	27.59
CM35-H3	-S17	35	27	160	6.73	13.97	3.5	5	.46	3.38	22.10
CM35-H4	-S17	35	27	160	8.08	16.76	3.5	6	.46	3.38	18.43
CM35-H5	-S17	35	27	160	9.42	19.56	3.5	7	.46	3.38	15.78
CM35-H6	-S17	35	27	160	10.77	22.35	3.5	8	.46	3.38	13.82
CM35-H7	-S17	35	27	160	12.12	25.15	3.5	9	.46	3.38	12.28
CM35-H8	-S17	35	27	160	14.81	30.73	3.5	11	.46	3.38	10.05
CM35-H9	-S17	35	27	160	17.50	36.32	3.5	13	.46	3.38	8.50
CM40-L1	-S17	40	30	100	2.90	9.14	3.5	3	.41	3.38	16.03
CM40-L2	-S17	40	30	100	3.86	12.19	3.5	4	.41	3.38	12.00
CM40-L3	-S17	40	30	100	4.80	15.24	3.5	5	.41	3.38	9.58
CM40-L4	-S17	40	30	100	5.77	18.29	3.5	6	.41	3.38	7.99
CM40-L5	-S17	40	30	100	6.73	21.34	3.5	7	.41	3.38	6.84
CM40-L6	-S17	40	30	100	7.70	24.38	3.5	8	.41	3.38	6.00
CM40-L7	-S17	40	30	100	8.66	27.43	3.5	9	.41	3.38	5.33
CM40-L8	-S17	40	30	100	10.59	33.53	3.5	11	.41	3.38	4.36
CM40-L9	-S17	40	30	100	12.52	39.62	3.5	13	.41	3.38	3.69
CM40-M1	-S17	40	30	150	5.44	9.14	3.5	3	.53	3.63	40.54
CM40-M2	-S17	40	30	150	7.24	12.19	3.5	4	.53	3.63	30.30
CM40-M3	-S17	40	30	150	9.04	15.24	3.5	5	.53	3.63	24.19
CM40-M4	-S17	40	30	150	10.85	18.29	3.5	6	.53	3.63	20.16
CM40-M5	-S17	40	30	150	12.65	21.34	3.5	7	.53	3.63	17.26
CM40-M6	-S17	40	30	150	14.48	24.38	3.5	8	.53	3.63	15.15
CM40-M7	-S17	40	30	150	16.28	27.43	3.5	9	.53	3.63	13.45
CM40-M8	-S17	40	30	150	19.89	33.53	3.5	11	.53	3.63	11.00
CM40-M9	-S17	40	30	150	23.50	39.62	3.5	13	.53	3.63	9.31
CM40-H1	-S17	40	30	300	5.66	9.14	4.5	3	.46	3.38	86.21
CM40-H2	-S17	40	30	300	7.54	12.19	4.5	4	.46	3.38	64.52
CM40-H3	-S17	40	30	300	9.42	15.24	4.5	5	.46	3.38	51.55
CM40-H4	-S17	40	30	300	11.33	18.29	4.5	6	.46	3.38	43.10
CM40-H5	-S17	40	30	300	13.21	21.34	4.5	7	.46	3.38	36.90
CM40-H6	-S17	40	30	300	15.09	24.38	4.5	8	.46	3.38	32.29
CM40-H7	-S17	40	30	300	16.97	27.43	4.5	9	.46	3.38	28.68
CM40-H8	-S17	40	30	300	20.75	33.53	4.5	11	.46	3.38	23.47
CM40-H9	-S17	40	30	300	24.54	39.62	4.5	13	.46	3.38	19.89
CM45-L1	-S17	45	35	110	3.38	9.91	3.5	3	.46	3.63	16.85
CM45-L2	-S17	45	35	110	4.52	13.21	3.5	4	.46	3.63	12.66
CM45-L3	-S17	45	35	110	5.64	16.51	3.5	5	.46	3.63	10.12
CM45-L4	-S17	45	35	110	6.76	19.81	3.5	6	.46	3.63	8.43
CM45-L5	-S17	45	35	110	7.90	23.11	3.5	7	.46	3.63	7.23
CM45-L6	-S17	45	35	110	9.02	26.42	3.5	8	.46	3.63	6.32

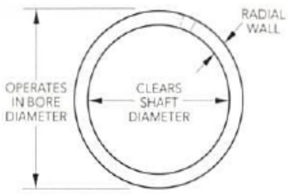
[1] Use "CM" prefix for plain ends. Use "CMS" prefix for squared-shim ends.
[2] Reference dimension.
[3] Theoretical dimension.

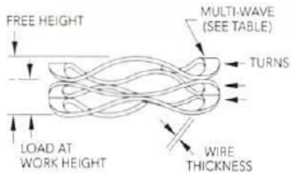
CM/CMS Series

Metric Crest-To-Crest® Springs

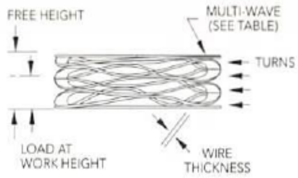
CM-Plain Ends

CMS-Shim Ends





CM-Plain Ends



CMS-Shim Ends

Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number [1] Carbon Steel	Add Suffix 17-7 SS	Operates in Bore Diameter (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height[2] (mm)	Number of Waves	Number of Turns	Thickness (mm)	Radial Wall (mm)	Spring Rate[3] (N/mm)
CM45-L7	-S17	45	35	110	10.16	29.72	3.5	9	.46	3.63	5.62
CM45-L8	-S17	45	35	110	12.40	36.32	3.5	11	.46	3.63	4.60
CM45-L9	-S17	45	35	110	14.66	42.93	3.5	13	.46	3.63	3.89
CM45-M1	-S17	45	35	225	5.33	9.91	4.5	3	.46	3.63	49.13
CM45-M2	-S17	45	35	225	6.99	13.21	4.5	4	.46	3.63	36.17
CM45-M3	-S17	45	35	225	9.14	16.51	4.5	5	.46	3.63	30.53
CM45-M4	-S17	45	35	225	10.80	19.81	4.5	6	.46	3.63	24.97
CM45-M5	-S17	45	35	225	12.70	23.11	4.5	7	.46	3.63	21.61
CM45-M6	-S17	45	35	225	14.48	26.42	4.5	8	.46	3.63	18.84
CM45-M7	-S17	45	35	225	16.26	29.72	4.5	9	.46	3.63	16.72
CM45-M8	-S17	45	35	225	19.81	36.32	4.5	11	.46	3.63	13.63
CM45-M9	-S17	45	35	225	23.37	42.93	4.5	13	.46	3.63	11.50
CM45-H1	-S17	45	35	400	6.43	9.91	4.5	3	.61	3.76	114.94
CM45-H2	-S17	45	35	400	8.38	13.21	4.5	4	.61	3.76	82.82
CM45-H3	-S17	45	35	400	11.20	16.51	4.5	5	.61	3.76	75.33
CM45-H4	-S17	45	35	400	12.95	19.81	4.5	6	.61	3.76	58.31
CM45-H5	-S17	45	35	400	15.37	23.11	4.5	7	.61	3.76	51.68
CM45-H6	-S17	45	35	400	17.27	26.42	4.5	8	.61	3.76	43.72
CM45-H7	-S17	45	35	400	19.68	29.72	4.5	9	.61	3.76	39.88
CM45-H8	-S17	45	35	400	24.26	36.32	4.5	11	.61	3.76	33.17
CM45-H9	-S17	45	35	400	28.45	42.93	4.5	13	.61	3.76	27.62
CM50-L1	-S17	50	40	110	4.83	10.29	3.5	3	.53	3.63	20.15
CM50-L2	-S17	50	40	110	6.10	13.72	3.5	4	.53	3.63	14.44
CM50-L3	-S17	50	40	110	7.87	17.15	3.5	5	.53	3.63	11.85
CM50-L4	-S17	50	40	110	9.40	20.57	3.5	6	.53	3.63	9.85
CM50-L5	-S17	50	40	110	11.30	24.00	3.5	7	.53	3.63	8.66
CM50-L6	-S17	50	40	110	12.70	27.43	3.5	8	.53	3.63	7.47
CM50-L7	-S17	50	40	110	14.99	30.86	3.5	9	.53	3.63	6.93
CM50-L8	-S17	50	40	110	18.16	37.72	3.5	11	.53	3.63	5.62
CM50-L9	-S17	50	40	110	21.34	44.58	3.5	13	.53	3.63	4.73
CM50-L10	-S17	50	40	110	24.64	51.44	3.5	15	.53	3.63	4.10
CM50-M1	-S17	50	40	225	4.62	10.29	4.5	3	.46	3.63	39.68
CM50-M2	-S17	50	40	225	5.84	13.72	4.5	4	.46	3.63	30.53
CM50-M3	-S17	50	40	225	7.49	17.15	4.5	5	.46	3.63	23.29
CM50-M4	-S17	50	40	225	8.89	20.57	4.5	6	.46	3.63	19.26
CM50-M5	-S17	50	40	225	10.54	24.00	4.5	7	.46	3.63	16.72
CM50-M6	-S17	50	40	225	11.89	27.43	4.5	8	.46	3.63	14.48
CM50-M7	-S17	50	40	225	13.59	30.86	4.5	9	.46	3.63	13.03
CM50-M8	-S17	50	40	225	16.71	37.72	4.5	11	.46	3.63	10.71
CM50-M9	-S17	50	40	225	19.61	44.58	4.5	13	.46	3.63	9.01
CM50-M10	-S17	50	40	225	22.48	51.44	4.5	15	.46	3.63	7.77
CM50-H1	-S17	50	40	400	5.92	10.29	4.5	3	.61	3.76	91.53
CM50-H2	-S17	50	40	400	7.80	13.72	4.5	4	.61	3.76	67.57
CM50-H3	-S17	50	40	400	10.16	17.15	4.5	5	.61	3.76	57.22
CM50-H4	-S17	50	40	400	11.79	20.57	4.5	6	.61	3.76	45.56
CM50-H5	-S17	50	40	400	14.15	24.00	4.5	7	.61	3.76	40.61
CM50-H6	-S17	50	40	400	15.62	27.43	4.5	8	.61	3.76	33.87
CM50-H7	-S17	50	40	400	17.91	30.86	4.5	9	.61	3.76	30.89
CM50-H8	-S17	50	40	400	21.54	37.72	4.5	11	.61	3.76	24.72
CM50-H9	-S17	50	40	400	25.65	44.58	4.5	13	.61	3.76	21.13
CM50-H10	-S17	50	40	400	29.21	51.44	4.5	15	.61	3.76	17.99

[1] Use "CM" prefix for plain ends. Use "CMS" prefix for squared-shim ends.
[2] Reference dimension.
[3] Theoretical dimension.

CM/CMS Series

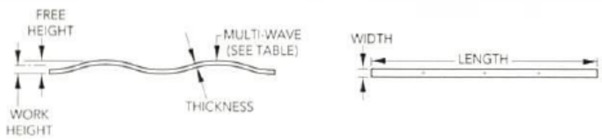
Metric Crest-To-Crest® Springs Continued

Smalley Part Number [1] Carbon Steel	Add Suffix 17-7 SS	Operates in Bore Diameter (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height[2] (mm)	Number of Waves	Number of Turns	Thickness (mm)	Radial Wall (mm)	Spring Rate[3] (N/mm)
CM55-L1	-S17	55	45	125	5.59	11.05	3.5	3	.61	3.76	22.89
CM55-L2	-S17	55	45	125	7.72	14.73	3.5	4	.61	3.76	17.83
CM55-L3	-S17	55	45	125	9.68	18.41	3.5	5	.61	3.76	14.32
CM55-L4	-S17	55	45	125	11.48	22.10	3.5	6	.61	3.76	11.77
CM55-L5	-S17	55	45	125	13.92	25.78	3.5	7	.61	3.76	10.54
CM55-L6	-S17	55	45	125	15.52	29.46	3.5	8	.61	3.76	8.97
CM55-L7	-S17	55	45	125	18.42	33.15	3.5	9	.61	3.76	8.49
CM55-L8	-S17	55	45	125	21.67	40.51	3.5	11	.61	3.76	6.63
CM55-L9	-S17	55	45	125	25.65	47.88	3.5	13	.61	3.76	5.62
CM55-L10	-S17	55	45	125	29.77	55.25	3.5	15	.61	3.76	4.91
CM55-M1	-S17	55	45	250	3.10	11.05	4.5	3	.46	3.63	31.45
CM55-M2	-S17	55	45	250	4.11	14.73	4.5	4	.46	3.63	23.54
CM55-M3	-S17	55	45	250	5.16	18.41	4.5	5	.46	3.63	18.85
CM55-M4	-S17	55	45	250	6.20	22.10	4.5	6	.46	3.63	15.72
CM55-M5	-S17	55	45	250	7.21	25.78	4.5	7	.46	3.63	13.46
CM55-M6	-S17	55	45	250	8.26	29.46	4.5	8	.46	3.63	11.79
CM55-M7	-S17	55	45	250	9.27	33.15	4.5	9	.46	3.63	10.47
CM55-M8	-S17	55	45	250	11.33	40.51	4.5	11	.46	3.63	8.57
CM55-M9	-S17	55	45	250	13.41	47.88	4.5	13	.46	3.63	7.25
CM55-M10	-S17	55	45	250	15.47	55.25	4.5	15	.46	3.63	6.28
CM55-H1	-S17	55	45	400	5.31	11.05	4.5	3	.61	3.76	69.69
CM55-H2	-S17	55	45	400	7.24	14.73	4.5	4	.61	3.76	53.40
CM55-H3	-S17	55	45	400	9.09	18.41	4.5	5	.61	3.76	42.87
CM55-H4	-S17	55	45	400	10.64	22.10	4.5	6	.61	3.76	34.90
CM55-H5	-S17	55	45	400	12.24	25.78	4.5	7	.61	3.76	29.54
CM55-H6	-S17	55	45	400	14.10	29.46	4.5	8	.61	3.76	26.04
CM55-H7	-S17	55	45	400	15.82	33.15	4.5	9	.61	3.76	23.08
CM55-H8	-S17	55	45	400	19.30	40.51	4.5	11	.61	3.76	18.86
CM55-H9	-S17	55	45	400	23.11	47.88	4.5	13	.61	3.76	16.15
CM55-H10	-S17	55	45	400	26.54	55.25	4.5	15	.61	3.76	13.93
CM60-L1	-S17	60	50	135	5.59	11.43	4.5	3	.46	3.63	23.12
CM60-L2	-S17	60	50	135	7.47	15.24	4.5	4	.46	3.63	17.37
CM60-L3	-S17	60	50	135	9.32	19.05	4.5	5	.46	3.63	13.87
CM60-L4	-S17	60	50	135	11.20	22.86	4.5	6	.46	3.63	11.58
CM60-L5	-S17	60	50	135	13.06	26.67	4.5	7	.46	3.63	9.92
CM60-L6	-S17	60	50	135	14.94	30.48	4.5	8	.46	3.63	8.69
CM60-L7	-S17	60	50	135	16.79	34.29	4.5	9	.46	3.63	7.71
CM60-L8	-S17	60	50	135	20.52	41.91	4.5	11	.46	3.63	6.31
CM60-L9	-S17	60	50	135	24.26	49.53	4.5	13	.46	3.63	5.34
CM60-L10	-S17	60	50	135	27.99	57.15	4.5	15	.46	3.63	4.63
CM60-M1	-S17	60	50	275	6.65	11.43	4.5	3	.61	3.76	57.53
CM60-M2	-S17	60	50	275	8.86	15.24	4.5	4	.61	3.76	43.10
CM60-M3	-S17	60	50	275	11.07	19.05	4.5	5	.61	3.76	34.46
CM60-M4	-S17	60	50	275	13.28	22.86	4.5	6	.61	3.76	28.71
CM60-M5	-S17	60	50	275	15.49	26.67	4.5	7	.61	3.76	24.60
CM60-M6	-S17	60	50	275	17.70	30.48	4.5	8	.61	3.76	21.52
CM60-M7	-S17	60	50	275	19.94	34.29	4.5	9	.61	3.76	19.16
CM60-M8	-S17	60	50	275	24.36	41.91	4.5	11	.61	3.76	15.67
CM60-M9	-S17	60	50	275	28.78	49.53	4.5	13	.61	3.76	13.25
CM60-M10	-S17	60	50	275	33.22	57.15	4.5	15	.61	3.76	11.49
CM60-H1	-S17	60	50	450	7.75	11.43	4.5	3	.76	4.01	122.28
CM60-H2	-S17	60	50	450	10.31	15.24	4.5	4	.76	4.01	91.28
CM60-H3	-S17	60	50	450	12.90	19.05	4.5	5	.76	4.01	73.17
CM60-H4	-S17	60	50	450	15.47	22.86	4.5	6	.76	4.01	60.89
CM60-H5	-S17	60	50	450	18.06	26.67	4.5	7	.76	4.01	52.26
CM60-H6	-S17	60	50	450	20.62	30.48	4.5	8	.76	4.01	45.64
CM60-H7	-S17	60	50	450	23.22	34.29	4.5	9	.76	4.01	40.65
CM60-H8	-S17	60	50	450	28.37	41.91	4.5	11	.76	4.01	33.23
CM60-H9	-S17	60	50	450	33.53	49.53	4.5	13	.76	4.01	28.13
CM60-H10	-S17	60	50	450	38.68	57.15	4.5	15	.76	4.01	24.36

[1] Use "CM" prefix for plain ends. Use "CMS" prefix for squared-shim ends.
[2] Reference dimension.
[3] Theoretical dimension.

LS Series

Linear Springs



Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number		Width (in)	Length (in)	Load (lb)	Work Height (in)	Free Height[1] (in)	Number of Waves	Thickness (in)	Spring Rate[2] (lb/in)
Carbon Steel	Add Suffix 17-7 SS								
LS12188-1	-S17	.188	1.500	1.5	.125	.225	1	.012	11
LS12188-2	-S17	.188	3.000	5.6	.125	.225	2	.012	91
LS12188-3	-S17	.188	4.500	10.4	.125	.225	3	.012	136
LS12188-4	-S17	.188	6.000	14.8	.125	.225	4	.012	182
LS12250-1	-S17	.250	1.500	2.2	.125	.225	1	.012	15
LS12250-2	-S17	.250	3.000	7.8	.125	.225	2	.012	121
LS12250-3	-S17	.250	4.500	13.9	.125	.225	3	.012	181
LS12250-4	-S17	.250	6.000	19.8	.125	.225	4	.012	242
LS12312-1	-S17	.312	1.500	2.9	.125	.225	1	.012	19
LS12312-2	-S17	.312	3.000	10.2	.125	.225	2	.012	151
LS12312-3	-S17	.312	4.500	17.6	.125	.225	3	.012	226
LS12312-4	-S17	.312	6.000	26.0	.125	.225	4	.012	302
LS12375-1	-S17	.375	1.500	3.5	.125	.225	1	.012	23
LS12375-2	-S17	.375	3.000	11.3	.125	.225	2	.012	181
LS12375-3	-S17	.375	4.500	20.1	.125	.225	3	.012	272
LS12375-4	-S17	.375	6.000	25.2	.125	.225	4	.012	362
LS20188-1	-S17	.188	1.875	3.0	.150	.250	1	.020	27
LS20188-2	-S17	.188	3.750	11.4	.150	.250	2	.020	215
LS20188-3	-S17	.188	5.625	23.5	.150	.250	3	.020	323
LS20188-4	-S17	.188	7.500	32.5	.150	.250	4	.020	431
LS20250-1	-S17	.250	1.875	5.6	.150	.250	1	.020	36
LS20250-2	-S17	.250	3.750	17.6	.150	.250	2	.020	286
LS20250-3	-S17	.250	5.625	31.7	.150	.250	3	.020	430
LS20250-4	-S17	.250	7.500	44.9	.150	.250	4	.020	573
LS20312-1	-S17	.312	1.875	6.0	.150	.250	1	.020	45
LS20312-2	-S17	.312	3.750	20.5	.150	.250	2	.020	357
LS20312-3	-S17	.312	5.625	34.9	.150	.250	3	.020	536
LS20312-4	-S17	.312	7.500	50.8	.150	.250	4	.020	715
LS20375-1	-S17	.375	1.875	6.4	.150	.250	1	.020	54
LS20375-2	-S17	.375	3.750	23.3	.150	.250	2	.020	430
LS20375-3	-S17	.375	5.625	52.0	.150	.250	3	.020	644
LS20375-4	-S17	.375	7.500	74.5	.150	.250	4	.020	859
LS25188-1	-S17	.188	2.250	3.5	.175	.275	1	.025	30
LS25188-2	-S17	.188	4.500	15.4	.175	.275	2	.025	243
LS25188-3	-S17	.188	6.750	27.9	.175	.275	3	.025	365
LS25188-4	-S17	.188	9.000	42.5	.175	.275	4	.025	487
LS25250-1	-S17	.250	2.250	6.5	.175	.275	1	.025	40
LS25250-2	-S17	.250	4.500	21.7	.175	.275	2	.025	324
LS25250-3	-S17	.250	6.750	34.7	.175	.275	3	.025	486
LS25250-4	-S17	.250	9.000	50.5	.175	.275	4	.025	647
LS25312-1	-S17	.312	2.250	6.6	.175	.275	1	.025	51
LS25312-2	-S17	.312	4.500	24.0	.175	.275	2	.025	404
LS25312-3	-S17	.312	6.750	43.2	.175	.275	3	.025	606
LS25312-4	-S17	.312	9.000	62.0	.175	.275	4	.025	808
LS25375-1	-S17	.375	2.250	7.7	.175	.275	1	.025	61
LS25375-2	-S17	.375	4.500	29.4	.175	.275	2	.025	486
LS25375-3	-S17	.375	6.750	53.8	.175	.275	3	.025	728
LS25375-4	-S17	.375	9.000	76.9	.175	.275	4	.025	971
LS38188-1	-S17	.188	2.625	7.5	.200	.300	1	.038	67
LS38188-2	-S17	.188	5.250	25.0	.200	.300	2	.038	538
LS38188-3	-S17	.188	7.875	58.5	.200	.300	3	.038	808

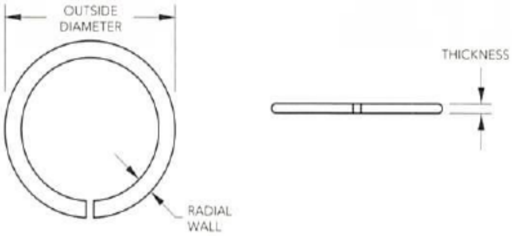
[1] Reference dimension.
[2] Theoretical dimension.

LS Series
Linear Springs Continued

Smalley Part Number		Width (in)	Length (in)	Load (lb)	Work Height (in)	Free Height[1] (in)	Number of Waves	Thickness (in)	Spring Rate[2] (lb/in)
Carbon Steel	Add Suffix 17-7 SS								
LS38188-4	-S17	.188	10.500	90.0	.200	.300	4	.038	1,077
LS38250-1	-S17	.250	2.625	11.9	.200	.300	1	.038	89
LS38250-2	-S17	.250	5.250	45.7	.200	.300	2	.038	716
LS38250-3	-S17	.250	7.875	74.3	.200	.300	3	.038	1,074
LS38250-4	-S17	.250	10.500	111.5	.200	.300	4	.038	1,432
LS38312-1	-S17	.312	2.625	9.9	.200	.300	1	.038	112
LS38312-2	-S17	.312	5.250	49.3	.200	.300	2	.038	893
LS38312-3	-S17	.312	7.875	92.8	.200	.300	3	.038	1,340
LS38312-4	-S17	.312	10.500	131.0	.200	.300	4	.038	1,787
LS38375-1	-S17	.375	2.625	16.9	.200	.300	1	.038	134
LS38375-2	-S17	.375	5.250	61.7	.200	.300	2	.038	1,074
LS38375-3	-S17	.375	7.875	105.0	.200	.300	3	.038	1,611
LS38375-4	-S17	.375	10.500	153.0	.200	.300	4	.038	2,148
LS45188-1	-S17	.188	3.000	9.3	.225	.325	1	.045	75
LS45188-2	-S17	.188	6.000	36.0	.225	.325	2	.045	599
LS45188-3	-S17	.188	9.000	65.0	.225	.325	3	.045	898
LS45188-4	-S17	.188	12.000	89.0	.225	.325	4	.045	1,198
LS45250-1	-S17	.250	3.000	12.5	.225	.325	1	.045	100
LS45250-2	-S17	.250	6.000	42.5	.225	.325	2	.045	797
LS45250-3	-S17	.250	9.000	83.0	.225	.325	3	.045	1,195
LS45250-4	-S17	.250	12.000	120.5	.225	.325	4	.045	1,593
LS45312-1	-S17	.312	3.000	14.7	.225	.325	1	.045	124
LS45312-2	-S17	.312	6.000	60.3	.225	.325	2	.045	994
LS45312-3	-S17	.312	9.000	108.9	.225	.325	3	.045	1,491
LS45312-4	-S17	.312	12.000	160.7	.225	.325	4	.045	1,988
LS45375-1	-S17	.375	3.000	20.4	.225	.325	1	.045	149
LS45375-2	-S17	.375	6.000	73.1	.225	.325	2	.045	1,195
LS45375-3	-S17	.375	9.000	133.5	.225	.325	3	.045	1,792
LS45375-4	-S17	.375	12.000	190.0	.225	.325	4	.045	2,390
LS62188-1	-S17	.188	3.375	14.3	.250	.350	1	.062	138
LS62188-2	-S17	.188	6.750	67.5	.250	.350	2	.062	1,100
LS62188-3	-S17	.188	10.125	105.5	.250	.350	3	.062	1,650
LS62188-4	-S17	.188	13.500	159.5	.250	.350	4	.062	2,200
LS62250-1	-S17	.250	3.375	22.5	.250	.350	1	.062	183
LS62250-2	-S17	.250	6.750	104.0	.250	.350	2	.062	1,463
LS62250-3	-S17	.250	10.125	161.0	.250	.350	3	.062	2,195
LS62250-4	-S17	.250	13.500	234.0	.250	.350	4	.062	2,926
LS62312-1	-S17	.312	3.375	27.8	.250	.350	1	.062	228
LS62312-2	-S17	.312	6.750	104.0	.250	.350	2	.062	1,826
LS62312-3	-S17	.312	10.125	174.5	.250	.350	3	.062	2,739
LS62312-4	-S17	.312	13.500	262.5	.250	.350	4	.062	3,652
LS62375-1	-S17	.375	3.375	42.0	.250	.350	1	.062	274
LS62375-2	-S17	.375	6.750	139.5	.250	.350	2	.062	2,195
LS62375-3	-S17	.375	10.125	240.0	.250	.350	3	.062	3,292
LS62375-4	-S17	.375	13.500	333.6	.250	.350	4	.062	4,389

[1] Reference dimension.
[2] Theoretical dimension.

SSRS Series
Circular-Grain® Shims



Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number Carbon Steel	Add Suffix 17-7 SS	Outside Diameter (in)	Tolerance	Thickness (in)	Radial Wall (in)	Part Weight[1] (lb)
SSRS-0075	-S17	.750	+.000/-.015	.024	.093	1.31
SSRS-0087	-S17	.875		.024	.093	1.55
SSRS-0100	-S17	1.000		.024	.103	1.97
SSRS-0112	-S17	1.125		.024	.138	2.91
SSRS-0125	-S17	1.250		.024	.138	3.28
SSRS-0137	-S17	1.375		.024	.138	3.65
SSRS-0150	-S17	1.500		.024	.150	4.33
SSRS-0162	-S17	1.625	+.000/-.020	.024	.150	4.73
SSRS-0175	-S17	1.750		.024	.150	5.13
SSRS-0187	-S17	1.875		.024	.150	5.53
SSRS-0200	-S17	2.000		.024	.150	5.93
SSRS-0212	-S17	2.125		.024	.150	6.33
SSRS-0225	-S17	2.250	+.000/-.025	.024	.150	6.73
SSRS-0237	-S17	2.375		.024	.178	8.35
SSRS-0250	-S17	2.500		.024	.178	8.83
SSRS-0262	-S17	2.625		.024	.178	9.30
SSRS-0275	-S17	2.750		.030	.188	12.86
SSRS-0287	-S17	2.875		.030	.188	13.49
SSRS-0300	-S17	3.000		.030	.188	14.12
SSRS-0312	-S17	3.125		.030	.188	14.74
SSRS-0325	-S17	3.250	+.000/-.030	.030	.233	18.77
SSRS-0337	-S17	3.375		.030	.233	19.55
SSRS-0350	-S17	3.500		.030	.233	20.32
SSRS-0362	-S17	3.625		.030	.233	21.10
SSRS-0375	-S17	3.750		.030	.233	21.88
SSRS-0387	-S17	3.875		.030	.233	22.66
SSRS-0400	-S17	4.000		.030	.233	23.44
SSRS-0412	-S17	4.125		.030	.233	24.21
SSRS-0425	-S17	4.250		.030	.233	24.99
SSRS-0437	-S17	4.375	+.000/-.035	.030	.233	25.77
SSRS-0450	-S17	4.500		.030	.233	26.55
SSRS-0462	-S17	4.625		.030	.233	27.32
SSRS-0475	-S17	4.750		.030	.233	28.10
SSRS-0487	-S17	4.875		.030	.233	28.88
SSRS-0500	-S17	5.000		.030	.233	29.66
SSRS-0512	-S17	5.125		.030	.233	30.43
SSRS-0525	-S17	5.250		.030	.233	31.21
SSRS-0537	-S17	5.375		.030	.233	31.99
SSRS-0550	-S17	5.500	+.000/-.045	.030	.233	32.77
SSRS-0562	-S17	5.625		.030	.233	33.54
SSRS-0575	-S17	5.750		.030	.233	34.32
SSRS-0587	-S17	5.875		.030	.233	35.10
SSRS-0600	-S17	6.000		.030	.233	35.88
SSRS-0612	-S17	6.125		.030	.233	36.66
SSRS-0625	-S17	6.250		.030	.233	37.43
SSRS-0637	-S17	6.375		.030	.233	38.21
SSRS-0650	-S17	6.500		.030	.233	38.99
SSRS-0675	-S17	6.750		.030	.233	40.54
SSRS-0700	-S17	7.000		.032	.375	70.76
SSRS-0725	-S17	7.250		.032	.375	73.43

[1] Lbs. per 1000.

SSRS Series
Circular-Grain® Shims Continued

Smalley Part Number: Carbon Steel	Add Suffix: 17-7 SS	Outside Diameter (in)	OD Tolerance	Thickness (in)	Radial Wall (in)	Part Weight[1] (lb)
SSRS-0750	-S17	7.500	+.000/-.060	.032	.375	76.10
SSRS-0775	-S17	7.750		.032	.375	78.77
SSRS-0800	-S17	8.000		.032	.375	81.44
SSRS-0825	-S17	8.250		.032	.375	84.11
SSRS-0850	-S17	8.500		.032	.375	86.78
SSRS-0875	-S17	8.750		.032	.375	89.45
SSRS-0900	-S17	9.000		.032	.375	92.12
SSRS-0950	-S17	9.500	+.000/-.070	.032	.375	97.46
SSRS-1000	-S17	10.000		.032	.375	102.80
SSRS-1050	-S17	10.500		.032	.375	108.14
SSRS-1100	-S17	11.000		.032	.375	113.48
SSRS-1150	-S17	11.500		.032	.375	118.82
SSRS-1200	-S17	12.000	+.000/-.080	.032	.375	124.16
SSRS-1250	-S17	12.500		.032	.375	129.50
SSRS-1300	-S17	13.000		.032	.375	134.84
SSRS-1350	-S17	13.500		.032	.375	140.18
SSRS-1400	-S17	14.000		.032	.375	145.52
SSRS-1450	-S17	14.500	+.000/-.090	.032	.375	150.86
SSRS-1500	-S17	15.000		.032	.375	156.20
SSRS-1550	-S17	15.500		.032	.375	161.54
SSRS-1600	-S17	16.000		.032	.375	166.88

[1] Lbs. per 1000.

Retaining Ring Introduction

No Ordinary Ring®

Smalley stocks thousands of standard retaining rings to meet your applications requirements in carbon, 302 and 316 stainless steel. Our retaining rings are manufactured using our edgewinding process, also known as coiling on edge. This puts Smalley's rings at an advantage for many reasons, including No Ears to Interfere® with undesired components and ease of installation and removal.

Standard Smalley Retaining Rings include:

- Spirolox®
- Constant Section
- WaveRing®
- Hoopster®

Custom Retaining Rings

If one of our standard retaining rings does not fit your exact needs, Smalley Engineers are happy to assist you in designing one that does. Because all of our products are edgewound (coiled, not stamped), there is no new tooling required for custom configurations. This means that we can produce prototypes quickly and economically for high or low volume orders, and easily make adjustments to designs throughout the No-Tooling-Charges™ production process.

Customizable features include:

- Coil direction
- Crimp
- Deburring
- Diameter (.157 to 120", 4 to 3000 mm)
- Dished
- End configurations
- Finishes, platings, coatings
- Laser-etching/marking
- Material
- Number of turns
- Packaging/labeling
- Pitch
- Quality Assurance certifications
- Radial wall
- Round/square edge
- Tolerance
- Wire size
- Work height (for WaveRing)

You can find more information about these terms in the glossary on page 151.

Retaining Ring Types

Spirolox®

Standard Spirolox Retaining Rings are available in single-turn, two-turn, and three-turn configurations. They are easier to install and remove than traditional stamped rings as they can be wound in and out of grooves with no special tools. This leads to safer installation because there is no risk of a ring flying off a set of pliers. Multiple-turn Spirolox rings provide a secure 360° retaining surface.

There are many Spirolox ring series, ranging from light duty to heavy duty.

Series	Page	Material	Diameter	Internal or External
VH - light duty	63	Carbon, 302 or 316 SS	0.25 - 10"	Internal
VHM - light duty	65	Carbon, 302 or 316 SS	6 - 300 mm	Internal
VS - light duty	91	Carbon, 302 or 316 SS	0.25 - 10"	External
VSM - light duty	93	Carbon, 302 or 316 SS	6 - 300 mm	External
WH - medium duty	67	Carbon, 302 or 316 SS	0.5 - 11"	Internal
WS - medium duty	95	Carbon, 302 or 316 SS	0.5 - 11"	External
EH - aerospace	75	Carbon, 302 or 316 SS	6 - 280 mm	Internal
ES - aerospace	103	Carbon, 302 or 316 SS	6 - 280 mm	External
WHT - medium/heavy duty	71	Carbon, 302 or 316 SS	0.5 - 11"	Internal
WST - medium/heavy duty	99	Carbon, 302 or 316 SS	0.469 - 10"	External
WHM - heavy duty	73	Carbon, 302 or 316 SS	0.25 - 15"	Internal
WSM - heavy duty	101	Carbon, 302 or 316 SS	0.25 - 15"	External
DNH - DIN interchange	77	Carbon, 302 or 316 SS	13 - 400 mm	Internal
DNS - DIN interchange	105	Carbon, 302 or 316 SS	13 - 400 mm	External

Retaining Ring Types

Constant Section

Smalley's Constant Section Retaining Rings are single-turn, square edge rings that have a gap. They are available with a removal provision dependent on internal or external usage. Many of our constant section rings are groove interchangeable with Eaton rings. These retaining rings are heavy duty rings capable of withstanding very high forces and thrust loads.

Series	Page	Material	Diameter	Internal or External
FHE	83	Carbon or 302 SS	0.5 - 11"	Internal
FSE	111	Carbon or 302 SS	0.5 - 11"	External
FH	85	Carbon or 302 SS	13 - 300 mm	Internal
FS	113	Carbon or 302 SS	13 - 300 mm	External
XAH	87	Carbon or 302 SS	0.375 - 10"	Internal
XAS	115	Carbon or 302 SS	0.312 - 10"	External
XDH	89	Carbon or 302 SS	1.125 - 8"	Internal
XDS	117	Carbon or 302 SS	0.5 - 8"	External

WaveRing®

WaveRings are two-turn Spirolox® Retaining Rings with an axial wave form. These rings function similarly to a traditional retaining ring (providing a removable shoulder), but when installed offer a spring force that applies pressure against both the groove wall and the assembly components. This spring force compensates for tolerance stack-up or play.

Series	Page	Material	Diameter	Internal or External
WHW	70	Carbon or 17-7 PH SS	0.75 - 5"	Internal
WSW	98	Carbon or 17-7 PH SS	0.75 - 5"	External

Retaining Ring Types

Hoopster®

Hoopster Retaining Rings are single-turn, square edge rings. They are specified for applications that have shallow groove depths due to tight space constraints. These rings have a minimal radial projection and provide a removable shoulder in assemblies with thin walls, such as cylinders. Hoopsters are suitable for light-to-medium loads and have optional removal provisions.

Series	Page	Material	Diameter	Internal or External
HH*/HHU	79	Carbon or 302 SS	0.375 - 3"	Internal
HHM*/HHMU	81	Carbon or 302 SS	10 - 76 mm	Internal
HS	107	Carbon or 302 SS	0.375 - 3"	External
HSM	109	Carbon or 302 SS	10 - 76 mm	External

* With removal provision

Popular Custom Rings

In addition to customizing our stock ring types by changing diameter, turns, materials, or other characteristics, Smalley Engineers can help design the following alternative ring types:

Self-Locking

Smalley's Self-Locking Retaining Rings are multiple-turn rings that have a small tab on either the inside, outside, or middle of the radial wall, along with an aligned slot on the next turn for the tab to "lock" into. These locks allow a retaining ring to function properly at speeds which normally exceed the recommended rotational capacity of a standard retaining ring. They are ideal for applications that operate at very high RPM, like in transmissions or clutch assemblies.

Balanced

Balanced Retaining Rings are retaining rings with cut-out notches opposite the gap end to centralize the rings' center of gravity. The size, placement, and number of notches are dependent on the weight distribution required and on the amount of material absent in the gap. Balanced rings are ideal in applications where weight distribution is critical and it is necessary to reduce eccentric loading. They are used often in the aerospace industry.

Retaining Ring Selection Guide

STEP 1: Do you need to meet any specifications?

Yes: See table below.

No: Move to step 2.

Specification	Smalley Series	Page
Military MIL- DTL-27426/3	WH	67
Military MIL- DTL-27426/1	WS	95
Military MIL- DTL-27426/4	WHM	73
Military MIL- DTL-27426/2	WSM	101
Aerospace AS4299, AS3217, AS3219	WH	67
Aerospace AS4299, AS3218, AS3219	WS	95
Aerospace AS4299, AS3215, AS3219	WHM	73
Aerospace AS4299, AS3216, AS3219	WSM	101
Metric Aerospace MA 4017	EH	75
Metric Aerospace MA 4016	ES	103

** If you need a part to include added inspections or other quality requirements, please contact one of our engineers.*

STEP 2: Do you need an interchangeable ring based on a groove?

Yes: See table below.

No: Move to step 3.

Manufacturer	Smalley Series	Page
Truarc N5000 & 5008	WHM	73
Truarc 5100 & 5108	WSM	101
Eaton NAN	WHT	71
Eaton XAN	WST	99
Eaton I-N	WHM	73
Eaton E-N	WSM	101
Industrial RR 3000 & 4000	WHM	73
Industrial RR 3100 & 4100	WSM	101
Anderton N1300	WHM	73
Anderton N1400	WSM	101
Anderton D1300	DNH	77
Anderton D1400	DNS	105
European Specification DIN 472	DNH	77
European Specification DIN 471	DNS	105

STEP 3: Choose by the thrust capacity needed OR see step 4.

Standard Units (inches)					
Series	**Load[1]**	**Housing**	**Page**	**Shaft**	**Page**
Light Duty	4,100	VH	65	VS	91
Medium Duty	4,950	WH	67	WS	95
Medium/Heavy Duty	7,070	WHT	71	WST	99
Heavy Duty	8,340	WHM	73	WSM	101
Constant Section Rings	8,341	FHE	83	FSE	111
WaveRing	–	WHW	70	WSW	98

[1] Representative examples shows the load capacity (lb.) for a 2" ring.

Metric Units (mm)					
Series	**Load[1]**	**Housing**	**Page**	**Shaft**	**Page**
Light Duty	18.03	VHM	65	VSM	93
DIN Series[2]	36.55	DNH	77	DNS	105
Aerospace Series	38.96	EH	75	ES	103
Constant Section Rings	36.53	FH	85	FS	113

[1] Representative examples shows the load capacity (kN) for a 50 mm ring.
[2] Manufactured to DIN groove specifications.

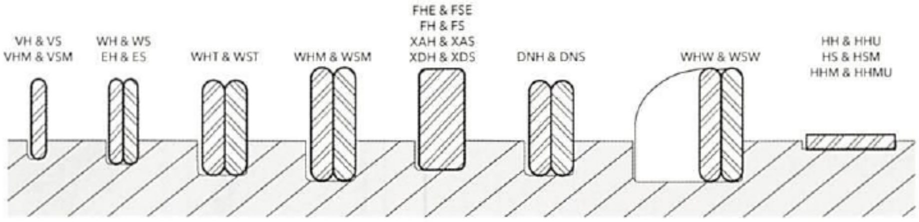
STEP 4: Still not sure?

Call our Engineering team at 847.719.5960.

Retaining Ring Selection Guide

Relative proportions of rings in grooves

A cross-section of each Spirolox Retaining Ring configuration is illustrated below, comparing groove and ring sections in the same diameter bore or shaft. The heavier retaining ring cross-sections are in deeper and wider grooves, to provide significantly greater thrust capacity.



Interchange Listing

Smalley retaining rings are interchangeable with both imperial and metric retaining ring grooves. Smalley offers free samples of all stock retaining rings to test in your application. Cross reference a standard stamped or snap ring to find the appropriate Smalley retaining ring to fit your application.

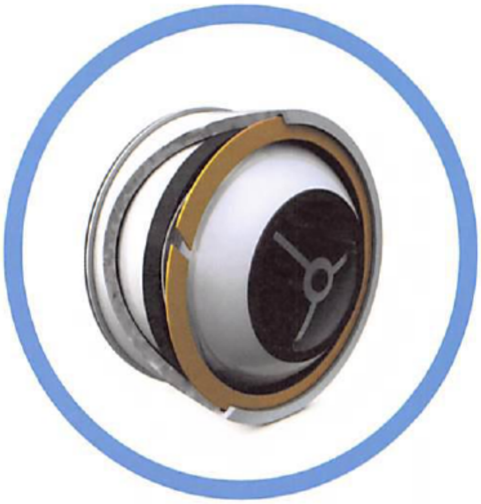
SMALLEY®	SPIROLOX® SERIES	MILITARY MIL-DTL-27426	AEROSPACE AS3219	METRIC AEROSPACE MA 4035	EUROPEAN SPECIFICATION DIN	WALDES TRUARC	EATON	INDUSTRIAL RETAINING RING	OTHER RINGS	ANDERTON
VH	UR	---	---	---	**Groove Interchange Only** Use a Smalley Retaining Ring to fit into the same groove of these stamped Retaining Rings (circlips).					
VS	US	---	---	---						
WH	RR	/3	AS4299 AS3217	---						
WS	RS	/1	AS4299 AS3218	---						
WHT	RRT	---	---	---	---	---	NAN	---	UHB	---
WST	RST	---	---	---	---	---	XAN	---	USC	---
WHM	RRN	/4	AS4299 AS3215	---	---	N5000 5008	IN	3000 4000	HO HOI UHO	N1300
WSM	RSN	/2	AS4299 AS3216	---	---	5100 5108	EN	3100 4100	SH SHI USH	N1400
DNH	---	---	---	---	DIN 472	---	---	---	DHO	D1300
DNS	---	---	---	---	DIN 471	---	---	---	DSH	D1400
EH	---	---	---	MA 4017	---	---	---	---	---	---
ES	---	---	---	MA 4016	---	---	---	---	---	---
FH	---	---	---	---	DIN 472	---	---	---	DHO	D1300
FS	---	---	---	---	DIN 471	---	---	---	DSH	D1400
XAH	---	---	---	---	---	---	NAN	---	UHB	---
XAS	---	---	---	---	---	---	XAN	---	USC	---
XDH	---	---	---	---	---	---	ND	---	HN	---
XDS	---	---	---	---	---	---	XD	---	SNL	---
XNH	---	---	---	---	---	---	IN	---	UHO	---
XNS	---	---	---	---	---	---	EN	---	USH	---

Retaining Ring Applications

Spirolox® Single-Turn

Hose Fitting

The single-turn ring was made to fit in the shallow groove and keep the cap on the fitting.



Air Vent

A light-duty, single-turn ring fits tightly into the groove of the plastic air vent housing. It has a very small gap to provide nearly 360° support.

Hip Replacement

This titanium ring secures the shell and liner together to form the socket of the new hip.

Ratchet Wrench

This one and a half-turn external ring retains the internal mechanical components of the wrench, with the extra half-turn giving the strength to retain if dropped.

Retaining Ring Applications

Spirolox® Two-Turn

Electrical Coupler

A wave spring is coupled with a retaining ring to allow the components to rotate independently.

Rubber Boot

The retaining ring clamps the rubber boot onto the groove, making a nearly perfect seal when the boot fills with grease.

Bolt Replacement

Instead of utilizing multiple bolts, a two-turn ring is installed to retain the two components of the gear assembly together, allowing for simple assembly and leading to weight savings.

Retaining Ring Applications

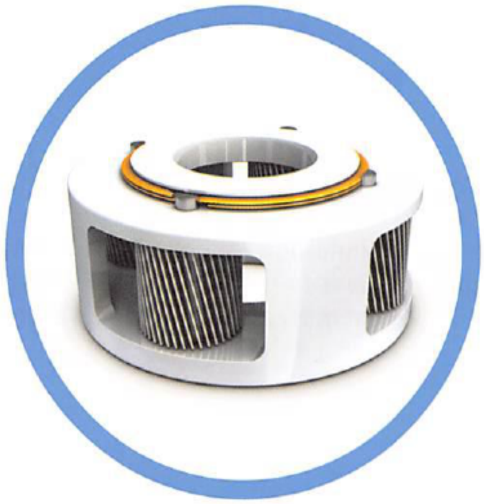
Spirolox® Two-Turn

Pneumatic Fitting

This ring creates an ID/OD lock (see more on page 58) permitting 360° rotation of the nut while staying in place on the shaft.

Bike Lock

A tamper-proof ring with reverse removal notches and a heavy cross-section holds the lock within the assembly.



Gear Assembly

A ring is wound into the groove and extends outward radially, clearing the four flat pinion shaft pins and preventing the pins from spinning when the gears rotate.

Pulley

Retaining rings provide 360° side walls, eliminating the need for pressed-on stamped side walls.

Retaining Ring Applications

Spirolox® Two-Turn

Belt Pulley

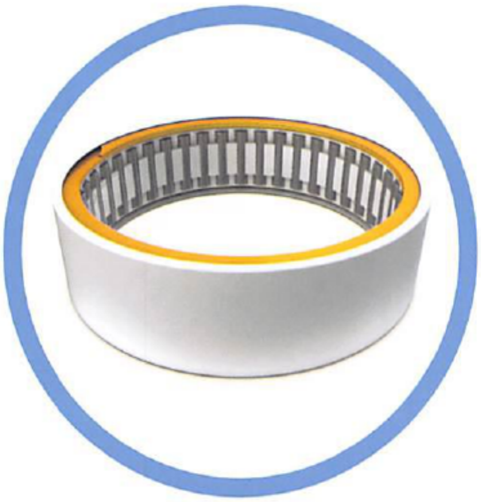
Three hold-down screws are used with this ring to form a bi-directional shoulder. The ring rests on the pulley securing the inserted shaft in one direction, with the screws clamping the ring to prevent movement in the other direction.

Slip Clutch

The retaining ring provides a surface for the wave spring to be mounted against, allowing the two main components to rotate independently, developing the slip mechanism.

Axial Piston Pump

The bearing and spindle are held in the housing by the ring. The removal notch allows for easy installation and removal for modifications or repairs.



Needle Bearing

The ring secures the bearing cage assembly within the housing, replacing the formerly unreliable operation of roll-forming the housing.

Retaining Ring Applications

WaveRing®

Gear Bracket

The worm gear shaft is preloaded and held in place by a two-turn WaveRing, which fits in an internal groove and allows the gear/shaft to float axially as the gear rotates.

Bearing Preload

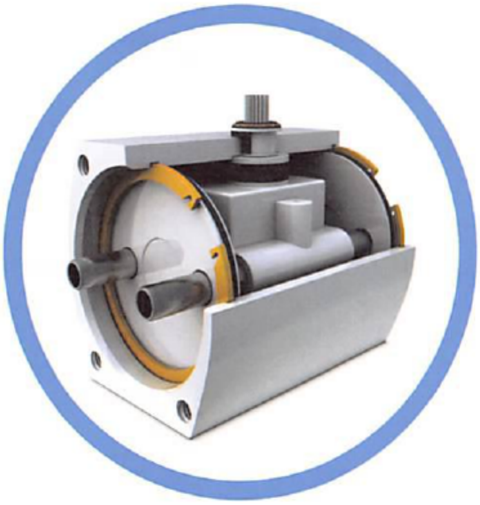
This WaveRing keeps the assembly together and also preloads the bearing cage, eliminating vibration caused by high radial speeds.

Retaining Ring Applications

Constant Section

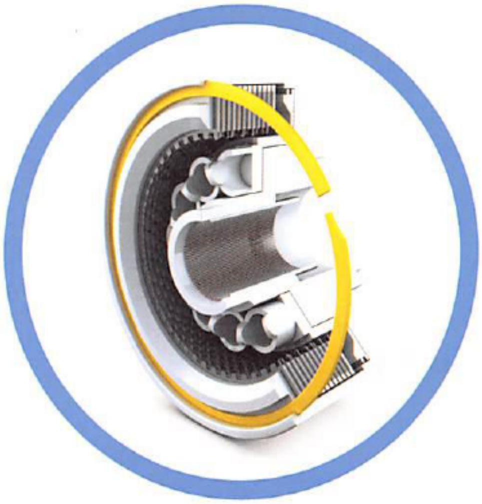
Right Angle Drive

Multiple retaining rings secure the assembly by providing removable shoulders in the bore, simplifying the design of the gear box and replacing flanged end plates.



Valve Actuator

A heavy duty ring with removal notches absorbs the occasional shock loading of the pistons.



Pneumatic Clutch

Internal clutch components are held in the housing by a heavy duty ring. The removal notch allows for quick removal for frequent field repairs.

Pressure Gauge

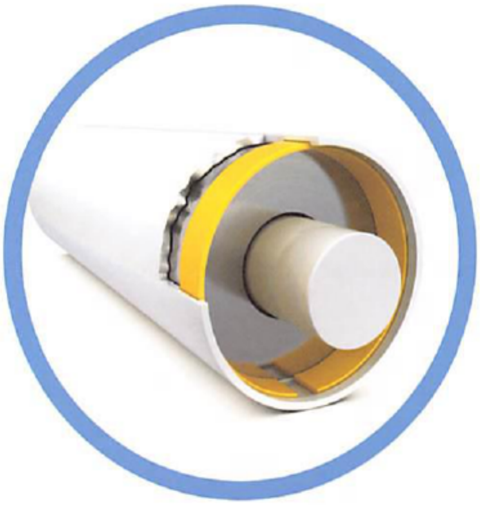
In this assembly, the ring exerts a light pressure on the glass lens, providing optimum load at all points along the circumference without breaking the glass.

Retaining Ring Applications

Hoopster®

Pin Retainer

The Hoopster is retaining the pin, not the component, in a very shallow groove that a traditional retaining ring would not fit in.



Cylinder Housing

The cylinder is very thin walled, but the Hoopster still allows for forces to be applied even though there is a shallow groove.

Custom

Conduit Connector

A dished retaining ring was custom designed with sharp edges, and when the nut is screwed in, clamping force is achieved, holding the conduit in place.

Retaining Ring Application Spotlight
ID/OD Lock

What is an ID/OD Lock?

An ID/OD lock is when a retaining ring is used to hold two mating components together in an assembly. There is a groove in both components that traps the ring, locking the ring on both the ID and OD (hence, the term ID/OD lock). The ring cannot be removed, and the two components cannot be disassembled without damaging the assembly.

Typically, the groove diameter in the housing is oversized to accommodate the ring diameter as it expands over the shaft. The ring is installed loosely into the housing groove, then the housing is pushed onto the mating component (shaft). The ring ID expands to the shaft diameter, then snaps into the shaft groove. The ring will then cling tightly to the shaft groove. The oversized groove in the housing allows the two components to rotate relative to each other, while the ring keeps both components locked together. The ring is hidden from view, keeping two pieces connected in an easy and inexpensive manner that is aesthetically pleasing.

Retaining Ring Assembly Methods

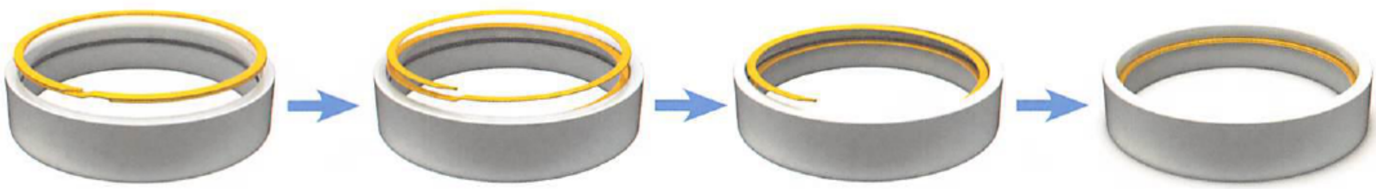
Installation Methods

Smalley's retaining rings require no special tools to install or remove. For large volumes or assemblies with tight space constraints, there are a number of installation methods to consider.

Manual Installation

Separate the end of the ring and insert into the groove. Wind the ring into the groove by pressing down around the circumference until the entire ring is inside of the groove. This operation is the same for internal or external installation. Watch how at smalley.com/videos.

Internal:



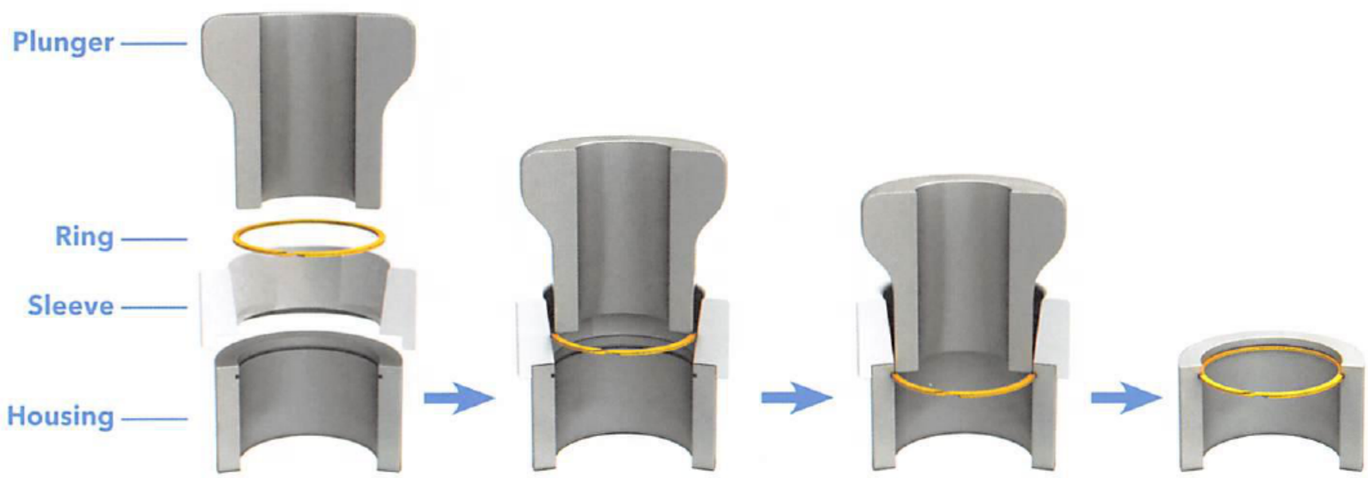
External:

Semi-Automated and Automated Installation

For higher speed or large quantity assemblies, simple tooling can be used to aid in installation.

For internal installation, a tapered sleeve angled at 5° contacts the ring and acts as a plunger, pushing the retaining ring into the groove. Hardened work surfaces work best for this type of tooling to prevent wear. Watch how at smalley.com/videos.

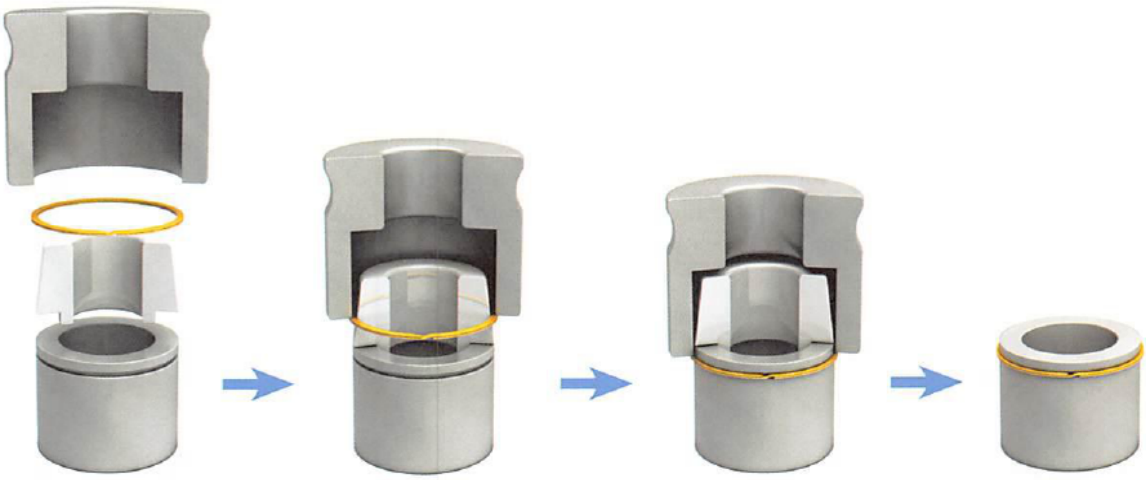
Internal:



Retaining Ring Assembly Methods

For external installation, a tapered plunger is centered over the shaft, and the ring is placed over the plug. A loose-fitting plug is centered at the recommended 5° angle over the shaft and the plunger pushes the ring down over the plug and into the groove. An arbor press or air cylinder is commonly used to automate this process. Watch how at smalley.com/videos.

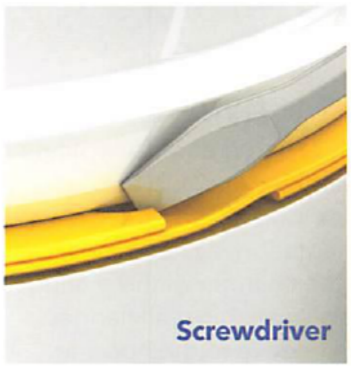
External:

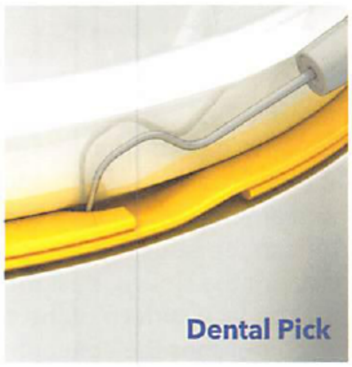


Removal Methods

Our standard rings are manufactured with removal notches so they are easily extracted from a groove with simple tools such as a flat head screwdriver or a dental pick.

The notch on the end of the ring creates a small gap between the groove and the ring, so that the screwdriver or pick can be inserted behind it to pry the visible end out of the groove. Then simply manually wind the ring out of the groove. This method is the same for internal and external removal.


Screwdriver


Dental Pick


RT-108

Removal Tooling

Smalley offers a Retaining Ring Removal Tool, part number RT-108, which fits between the individual layers of a Spirolox Retaining Ring. The end of the tool is slotted, fitting over the notch so that it can be pried from the groove and wound out. This tool is available with a variety of different end options.

Assembly Tooling

Optional Tooling for High Volumes

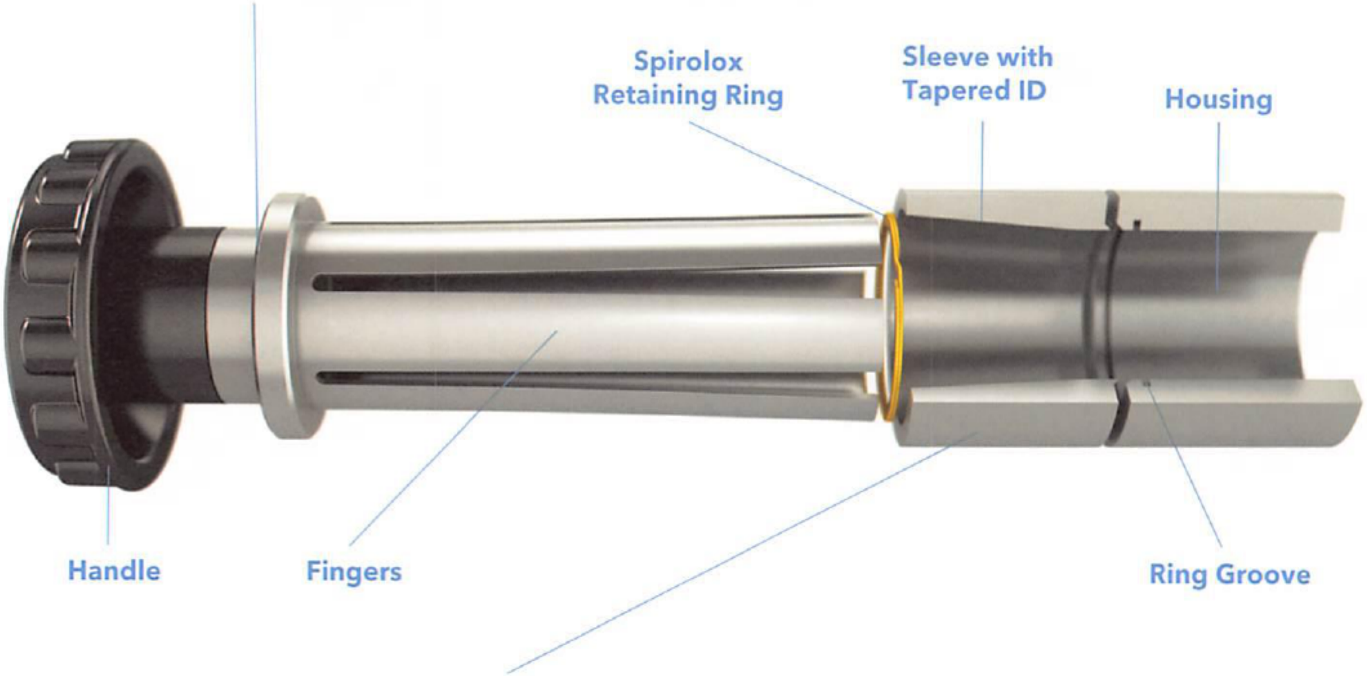
Installation of an Internal Spirolox® Retaining Ring

The internal assembly tool consists of a flexible plunger that pushes a retaining ring through a tapered sleeve and into a housing groove. Each assembly tool is designed to install a specific size ring. Tool sizing is available in incremental sizes for rings up to 2", or 49 mm in diameter.

Internal Retaining Ring Tooling

Plunger

Spring Fingers fit into and hug the tapered ID of the sleeve to remain in contact with the ring as it advances through the taper during installation. The fingers are designed with stiffness for durability, yet are sufficiently flexible for ease of assembly.



Sleeve

Made from hardened steel, the inside diameter is tapered at 5° to facilitate installation by gradually contracting the ring's diameter down to the housing diameter. Installation will be successful as long as the sleeve stays concentric to the housing. To accomplish this orientation, a chamfer exists on the face of the sleeve, designed to locate on the chamfer of the mating housing. The face surface of the sleeve provides a small thin-wall flange, which accomplishes the concentric location of the sleeve to the housing.

Assembly Tooling

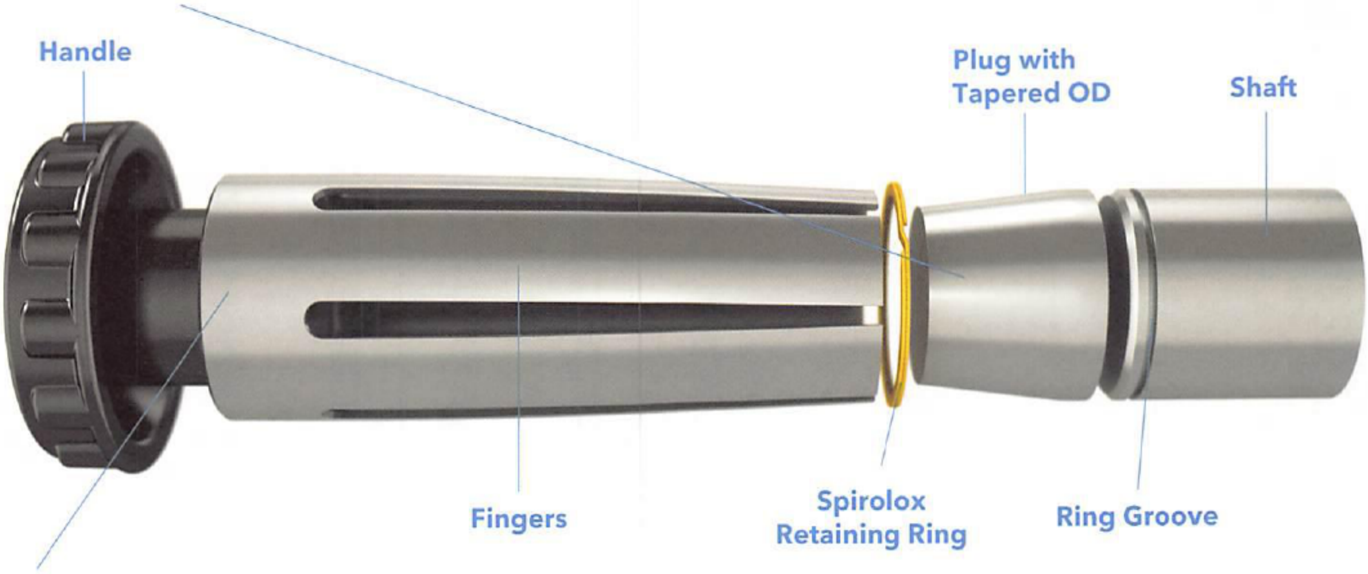
Optional Tooling for High Volumes

Installation of an External Spirolox® Retaining Ring

The external assembly tool consists of a flexible plunger that pushes a retaining over a plug and into a shaft groove. Each assembly tool is designed to install a specific size ring. Tool sizing is available in incremental sizes for rings up to 2", or 49 mm in diameter.

External Retaining Ring Tooling

Plug
Made from hardened steel, the outside diameter is tapered at 5° to facilitate installation by gradually increasing the ring's diameter up to the shaft diameter. Installation will be successful as long as the plug stays concentric to the shaft. To accomplish this orientation, a chamfer exists on the face of the plug, designed to locate on the chamfer of the mating shaft. The face surface of the plug provides a small thin wall flange, which accomplishes the concentric location of the plug to the shaft.

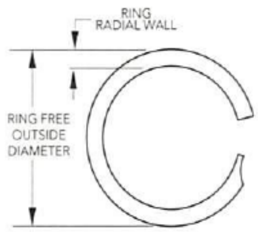


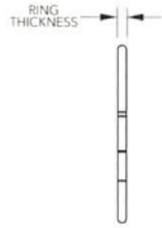
Plunger
Spring Fingers fit onto and hug the tapered OD of the sleeve to remain in contact with the ring as it advances over the taper during installation. The fingers are designed with stiffness for durability, yet are sufficiently flexible for ease of assembly.

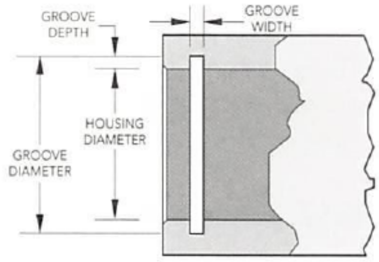
Custom Engineering and Design Assistance

In addition to our standard installation tooling, Smalley engineers can develop custom tooling for your Smalley custom ring to assist with your manual or semi-automated assembly.

VH Series
Spirolox® Light Duty Internal







Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number			Housing Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	Add Suffix 316 SS	in	mm	Outside Diameter (in)		Radial Wall (in)		Thickness (in)		Diameter (in)		Width (in)		Groove Yield [1] (lb)	Ring Shear [2] (lb)
VH-25 [3,4]	-S02	-S16	.250	6.35	.264	+.010/-.000	.020	±.004	.012	±.015	.262	±.002	.015	+.002/-.000	106	481
VH-31 [3,4]	-S02	-S16	.312	7.92	.329		.025		.015		.326		.018		154	750
VH-37 [3,4]	-S02	-S16	.375	9.53	.398		.030		.015		.395		.018		265	901
VH-43 [4]	-S02	-S16	.437	11.10	.466	+.013/-.000	.030		.015		.463		.018		402	1,050
VH-50	-S02	-S16	.500	12.70	.531	+.013/-.000	.045		.018		.528		.022		500	1,300
VH-56	-S02	-S16	.562	14.27	.593		.045		.018		.590		.022		560	1,460
VH-62	-S02	-S16	.625	15.88	.656		.045		.018		.653		.022		620	1,630
VH-68	-S02	-S16	.687	17.45	.719		.045		.018		.715		.022		680	1,790
VH-75	-S02	-S16	.750	19.05	.783		.045		.018		.779		.022		800	1,950
VH-81	-S02	-S16	.812	20.62	.862		.065		.021		.854	±.003	.026		1,210	2,460
VH-87	-S02	-S16	.875	22.23	.926		.065		.021		.917		.026		1,300	2,660
VH-93	-S02	-S16	.937	23.80	.989		.065		.021		.979		.026		1,390	2,840
VH-100	-S02	-S16	1.000	25.40	1.052		.065		.021		1.042		.026		1,480	3,040
VH-106	-S02	-S16	1.062	26.97	1.117	+.015/-.000	.088		.025		1.106	±.004	.031		1,650	3,500
VH-112	-S02	-S16	1.125	28.58	1.180		.088		.025		1.169		.031		1,750	3,710
VH-118	-S02	-S16	1.187	30.15	1.242		.088		.025		1.231		.031		1,850	3,920
VH-125	-S02	-S16	1.250	31.75	1.307		.088		.025		1.294		.031		1,940	4,120
VH-131	-S02	-S16	1.312	33.32	1.369		.088		.025		1.356		.031		2,040	4,330
VH-137	-S02	-S16	1.375	34.93	1.433		.088		.025		1.419		.031		2,140	4,540
VH-143	-S02	-S16	1.437	36.50	1.496		.088		.025		1.481		.031		2,240	4,740
VH-150	-S02	-S16	1.500	38.10	1.559		.088		.025		1.544		.031		2,330	4,950
VH-156	-S02	-S16	1.562	39.67	1.637	+.020/-.000	.118		.031		1.619	±.005	.039	+.003/-.000	3,200	6,390
VH-162	-S02	-S16	1.625	41.28	1.701		.118		.031		1.682		.039		3,330	6,650
VH-168	-S02	-S16	1.687	42.85	1.763		.118		.031		1.744		.039		3,460	6,900
VH-175	-S02	-S16	1.750	44.45	1.827		.118		.031		1.807		.039		3,590	7,160
VH-181	-S02	-S16	1.812	46.02	1.890		.118		.031		1.869		.039		3,710	7,410
VH-187	-S02	-S16	1.875	47.63	1.953		.118		.031		1.932		.039		3,840	7,670
VH-193	-S02	-S16	1.937	49.20	2.016		.118		.031		1.994		.039		3,970	7,920
VH-200	-S02	-S16	2.000	50.80	2.079		.118		.031		2.057		.039		4,100	8,180
VH-206	-S02	-S16	2.062	52.37	2.162	+.025/-.000	.158		.031	±.002	2.138	±.006	.039		5,540	8,430
VH-212	-S02	-S16	2.125	53.98	2.226		.158		.031		2.201		.039		5,710	8,690
VH-218	-S02	-S16	2.187	55.55	2.289		.158		.031		2.263		.039		5,870	8,950
VH-225	-S02	-S16	2.250	57.15	2.352		.158		.031		2.326		.039		6,040	9,200
VH-231	-S02	-S16	2.312	58.72	2.415		.158		.031		2.388		.039		6,210	9,460
VH-237	-S02	-S16	2.375	60.33	2.478		.158		.031		2.451		.039		6,380	9,720
VH-243	-S02	-S16	2.437	61.90	2.541		.158		.031		2.513		.039		6,550	9,970
VH-250	-S02	-S16	2.500	63.50	2.605		.158		.031		2.576		.039		6,720	10,230
VH-256	-S02	-S16	2.562	65.07	2.667		.158		.031		2.638		.039		6,880	10,480
VH-262	-S02	-S16	2.625	66.68	2.731		.158		.031		2.701		.039		7,050	10,740
VH-268	-S02	-S16	2.687	68.25	2.794		.158		.031		2.763		.039		7,220	10,990
VH-275	-S02	-S16	2.750	69.85	2.857		.158		.031		2.826		.039		7,390	11,250
VH-281	-S02	-S16	2.812	71.42	2.920		.158		.031		2.888		.039		7,550	11,500
VH-287	-S02	-S16	2.875	73.03	2.983		.158		.031		2.951		.039		7,720	11,760
VH-293	-S02	-S16	2.937	74.60	3.046		.158		.031		3.013		.039		7,890	12,010
VH-300	-S02	-S16	3.000	76.20	3.110		.158		.031		3.076		.039		8,060	12,270
VH-306	-S02	-S16	3.062	77.77	3.188	+.030/-.000	.188	±.005	.039		3.154		.044		9,960	15,760
VH-312	-S02	-S16	3.125	79.38	3.251		.188		.039		3.217		.044		10,160	16,080
VH-318	-S02	-S16	3.187	80.95	3.314		.188		.039		3.279		.044		10,360	16,400
VH-325	-S02	-S16	3.250	82.55	3.377		.188		.039		3.342		.044		10,570	16,720
VH-331	-S02	-S16	3.312	84.12	3.440		.188		.039		3.404		.044		10,770	17,040

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] No removal notch.
[4] Square edge wire.

VH Series

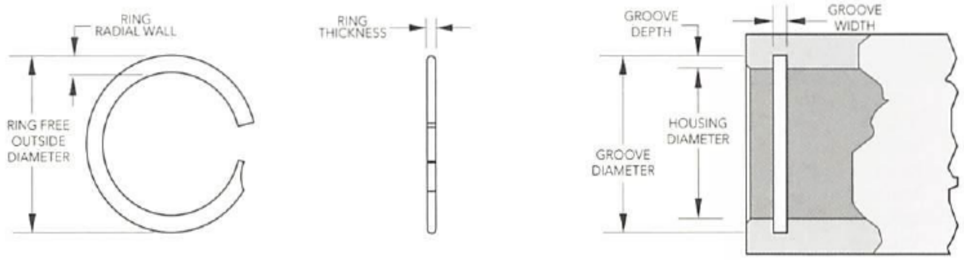
Spirolox® Light Duty Internal Continued

Smalley Part Number			Housing Diameter		Ring					Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Outside Diameter (in)		Radial Wall (in)		Thickness (in)	Diameter (in)		Width (in)		Groove Yield [1] (lb)	Ring Shear [2] (lb)
	302 SS	316 SS	in	mm		Tol.		Tol.			Tol.		Tol.		
VH-337	-S02	-S16	3.375	85.73	3.504	+.030/-.000	.188	±.005	.039 ±.002	3.467	±.006	.044	+.003/-.000	10,970	17,370
VH-343	-S02	-S16	3.437	87.30	3.566		.188		.039	3.529		.044		11,180	17,690
VH-350	-S02	-S16	3.500	88.90	3.630		.188		.039	3.592		.044		11,380	18,010
VH-356	-S02	-S16	3.562	90.47	3.692		.188		.039	3.654		.044		11,580	18,330
VH-362	-S02	-S16	3.625	92.08	3.756		.188		.039	3.717		.044		11,790	18,650
VH-368	-S02	-S16	3.687	93.65	3.819		.188		.039	3.779		.044		11,990	18,970
VH-375	-S02	-S16	3.750	95.25	3.882		.188		.039	3.842		.044		12,190	19,300
VH-381	-S02	-S16	3.812	96.82	3.945		.188		.039	3.904		.044		12,400	19,620
VH-387	-S02	-S16	3.875	98.43	4.009		.188		.039	3.967		.044		12,600	19,940
VH-393	-S02	-S16	3.937	100.00	4.071		.188		.039	4.029		.044		12,800	20,260
VH-400	-S02	-S16	4.000	101.60	4.135		.188		.039	4.092		.044		13,010	20,580
VH-412	-S02	-S16	4.125	104.78	4.279	+.035/-.000	.225		.046	4.235		.052	+.004/-.000	16,040	23,850
VH-425	-S02	-S16	4.250	107.95	4.405		.225		.046	4.360		.052		16,520	24,570
VH-437	-S02	-S16	4.375	111.13	4.531		.225		.046	4.485		.052		17,010	25,290
VH-450	-S02	-S16	4.500	114.30	4.658		.225		.046	4.610		.052		17,500	26,010
VH-462	-S02	-S16	4.625	117.48	4.784		.225		.046	4.735		.052		17,980	26,740
VH-475	-S02	-S16	4.750	120.65	4.910		.225		.046	4.860		.052		18,470	27,460
VH-487	-S02	-S16	4.875	123.83	5.036		.225		.046	4.985		.052		18,950	28,180
VH-500	-S02	-S16	5.000	127.00	5.163		.225		.046	5.110	±.007	.052		19,440	28,900
VH-525	-S02	-S16	5.250	133.35	5.435	+.045/-.000	.225		.061	5.381		.067		24,490	40,240
VH-550	-S02	-S16	5.500	139.70	5.694		.225		.061	5.638		.067		26,830	42,160
VH-575	-S02	-S16	5.750	146.05	5.953		.225		.061	5.894		.067		29,260	44,080
VH-600	-S02	-S16	6.000	152.40	6.212		.265		.061	6.150		.067		31,810	45,990
VH-625	-S02	-S16	6.250	158.75	6.470		.265		.061	6.406	±.008	.067		34,460	47,910
VH-650	-S02	-S16	6.500	165.10	6.730		.265		.061	6.663		.067		37,680	49,830
VH-675	-S02	-S16	6.750	171.45	6.988		.265		.061	6.919		.067		40,560	51,740
VH-700	-S02	-S16	7.000	177.80	7.247		.265		.061	7.175		.067		43,540	53,660
VH-725	-S02	-S16	7.250	184.15	7.505	+.060/-.000	.265		.061	7.431		.067		46,640	55,580
VH-750	-S02	-S16	7.500	190.50	7.765		.265		.061	7.688		.067		49,830	57,490
VH-775	-S02	-S16	7.750	196.85	8.023		.300	+.004/-.008	.061	7.944		.067		53,140	59,410
VH-800	-S02	-S16	8.000	203.20	8.282		.300		.061	8.200		.067		56,550	61,320
VH-825	-S02	-S16	8.250	209.55	8.541		.300		.061	8.456		.067		60,070	63,240
VH-850	-S02	-S16	8.500	215.90	8.800		.300		.061	8.713		.067		64,290	65,160
VH-875	-S02	-S16	8.750	222.25	9.059	+.070/-.000	.345		.076	8.969		.082	+.005/-.000	68,040	83,570
VH-900	-S02	-S16	9.000	228.60	9.317		.345		.076	9.225		.082		71,890	85,950
VH-925	-S02	-S16	9.250	234.95	9.576		.345		.076	9.481		.082		75,850	88,340
VH-950	-S02	-S16	9.500	241.30	9.835		.345		.076	9.738		.082		79,910	90,730
VH-975	-S02	-S16	9.750	247.65	10.094		.345		.076	9.994		.082		84,080	93,120
VH-1000	-S02	-S16	10.000	254.00	10.353		.345		.076	10.250		.082		88,360	95,500

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] No removal notch.
[4] Square edge wire.

VHM Series

Metric Light Duty Rings Internal



Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number			Housing Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Outside Diameter (mm)	Tol.	Radial Wall (mm)	Tol.	Thickness (mm)	Tol.	Diameter (mm)	Tol.	Width (mm)	Tol.	Groove Yield[1] (N)	Ring Shear[2] (N)
	302 SS	316 SS	mm	in												
VHM-6[3,4]	-S02	-S16	6.00	.24	6.35	+.25/-.00	.51	±.10	.30	±.04	6.30	±.05	.38	+.05/-.00	439	1,988
VHM-7[3,4]	-S02	-S16	7.00	.28	7.38	+.25/-.00	.51	±.10	.30	±.04	7.32	±.05	.38	+.05/-.00	546	2,320
VHM-8[3,4]	-S02	-S16	8.00	.31	8.44	+.25/-.00	.64	±.10	.38	±.04	8.36	±.05	.46	+.05/-.00	702	3,183
VHM-9[3,4]	-S02	-S16	9.00	.35	9.54	+.25/-.00	.76	±.10	.38	±.04	9.46	±.05	.46	+.05/-.00	1,003	3,580
VHM-10[3,4]	-S02	-S16	10.00	.39	10.58	+.30/-.00	.76	±.10	.38	±.04	10.50	±.05	.46	+.05/-.00	1,238	3,978
VHM-11[3,4]	-S02	-S16	11.00	.43	11.68	+.30/-.00	.89	±.10	.38	±.04	11.60	±.05	.46	+.05/-.00	1,634	4,388
VHM-12[4]	-S02	-S16	12.00	.47	12.74	+.30/-.00	.89	±.10	.38	±.04	12.66	±.05	.46	+.05/-.00	1,930	4,774
VHM-13	-S02	-S16	13.00	.51	13.80	+.33/-.00	1.14	±.10	.46	±.04	13.72	±.05	.56	+.05/-.00	2,281	6,261
VHM-14	-S02	-S16	14.00	.55	14.80	+.33/-.00	1.14	±.10	.46	±.04	14.72	±.05	.56	+.05/-.00	2,456	6,742
VHM-15	-S02	-S16	15.00	.59	15.80	+.33/-.00	1.14	±.10	.46	±.04	15.72	±.05	.56	+.05/-.00	2,632	7,224
VHM-16	-S02	-S16	16.00	.63	16.80	+.33/-.00	1.14	±.10	.46	±.04	16.72	±.05	.56	+.05/-.00	2,807	7,705
VHM-17	-S02	-S16	17.00	.67	17.82	+.33/-.00	1.14	±.10	.46	±.04	17.72	±.05	.56	+.05/-.00	2,983	8,187
VHM-18	-S02	-S16	18.00	.71	18.82	+.33/-.00	1.14	±.10	.46	±.04	18.72	±.05	.56	+.05/-.00	3,158	8,669
VHM-19	-S02	-S16	19.00	.75	19.86	+.33/-.00	1.14	±.10	.46	±.04	19.76	±.05	.56	+.05/-.00	3,519	9,150
VHM-20	-S02	-S16	20.00	.79	21.26	+.33/-.00	1.65	±.10	.53	±.04	21.06	±.08	.66	+.05/-.00	5,166	11,097
VHM-21	-S02	-S16	21.00	.83	22.27	+.33/-.00	1.65	±.10	.53	±.04	22.06	±.08	.66	+.05/-.00	5,424	11,652
VHM-22	-S02	-S16	22.00	.87	23.28	+.33/-.00	1.65	±.10	.53	±.04	23.06	±.08	.66	+.05/-.00	5,683	12,207
VHM-24	-S02	-S16	24.00	.94	25.29	+.33/-.00	1.65	±.10	.53	±.04	25.06	±.08	.66	+.05/-.00	6,199	13,317
VHM-25	-S02	-S16	25.00	.98	26.30	+.33/-.00	1.65	±.10	.53	±.04	26.06	±.08	.66	+.05/-.00	6,458	13,872
VHM-26	-S02	-S16	26.00	1.02	27.31	+.33/-.00	1.65	±.10	.53	±.04	27.06	±.08	.66	+.05/-.00	6,716	14,427
VHM-28	-S02	-S16	28.00	1.10	29.40	+.38/-.00	2.24	±.10	.64	±.04	29.12	±.10	.79	+.05/-.00	7,642	16,303
VHM-29	-S02	-S16	29.00	1.14	30.41	+.38/-.00	2.24	±.10	.64	±.04	30.12	±.10	.79	+.05/-.00	7,915	16,885
VHM-30	-S02	-S16	30.00	1.18	31.42	+.38/-.00	2.24	±.10	.64	±.04	31.12	±.10	.79	+.05/-.00	8,188	17,467
VHM-31	-S02	-S16	31.00	1.22	32.43	+.38/-.00	2.24	±.10	.64	±.04	32.12	±.10	.79	+.05/-.00	8,461	18,049
VHM-32	-S02	-S16	32.00	1.26	33.44	+.38/-.00	2.24	±.10	.64	±.04	33.12	±.10	.79	+.05/-.00	8,734	18,632
VHM-34	-S02	-S16	34.00	1.34	35.45	+.38/-.00	2.24	±.10	.64	±.04	35.12	±.10	.79	+.05/-.00	9,279	19,796
VHM-35	-S02	-S16	35.00	1.38	36.47	+.38/-.00	2.24	±.10	.64	±.04	36.12	±.10	.79	+.05/-.00	9,552	20,378
VHM-36	-S02	-S16	36.00	1.42	37.48	+.38/-.00	2.24	±.10	.64	±.04	37.12	±.10	.79	+.05/-.00	9,825	20,960
VHM-37	-S02	-S16	37.00	1.46	38.49	+.38/-.00	2.24	±.10	.64	±.04	38.12	±.10	.79	+.05/-.00	10,098	21,543
VHM-38	-S02	-S16	38.00	1.50	39.50	+.38/-.00	2.24	±.10	.64	±.04	39.12	±.10	.79	+.05/-.00	10,371	22,125
VHM-40	-S02	-S16	40.00	1.57	41.94	+.51/-.00	3.00	±.10	.79	±.05	41.48	±.13	.99	+.08/-.00	14,426	28,748
VHM-42	-S02	-S16	42.00	1.65	43.96	+.51/-.00	3.00	±.10	.79	±.05	43.48	±.13	.99	+.08/-.00	15,147	30,185
VHM-45	-S02	-S16	45.00	1.77	46.99	+.51/-.00	3.00	±.10	.79	±.05	46.48	±.13	.99	+.08/-.00	16,229	32,341
VHM-47	-S02	-S16	47.00	1.85	49.00	+.51/-.00	3.00	±.10	.79	±.05	48.48	±.13	.99	+.08/-.00	16,950	33,779
VHM-48	-S02	-S16	48.00	1.89	50.01	+.51/-.00	3.00	±.10	.79	±.05	49.48	±.13	.99	+.08/-.00	17,311	34,497
VHM-50	-S02	-S16	50.00	1.97	52.04	+.51/-.00	3.00	±.10	.79	±.05	51.48	±.13	.99	+.08/-.00	18,032	35,935
VHM-52	-S02	-S16	52.00	2.05	54.55	+.64/-.00	4.01	±.10	.79	±.05	53.94	±.13	.99	+.08/-.00	24,583	37,372
VHM-55	-S02	-S16	55.00	2.17	57.57	+.64/-.00	4.01	±.10	.79	±.05	56.94	±.15	.99	+.08/-.00	26,001	39,528
VHM-56	-S02	-S16	56.00	2.20	58.58	+.64/-.00	4.01	±.10	.79	±.05	57.94	±.15	.99	+.08/-.00	26,473	40,247
VHM-58	-S02	-S16	58.00	2.28	60.60	+.64/-.00	4.01	±.10	.79	±.05	59.94	±.15	.99	+.08/-.00	27,419	41,684
VHM-60	-S02	-S16	60.00	2.36	62.64	+.64/-.00	4.01	±.10	.79	±.05	61.94	±.15	.99	+.08/-.00	28,364	43,122
VHM-62	-S02	-S16	62.00	2.44	64.67	+.64/-.00	4.01	±.10	.79	±.05	63.94	±.15	.99	+.08/-.00	29,310	44,559
VHM-63	-S02	-S16	63.00	2.48	65.69	+.64/-.00	4.01	±.10	.79	±.05	64.94	±.15	.99	+.08/-.00	29,783	45,278
VHM-65	-S02	-S16	65.00	2.56	67.70	+.64/-.00	4.01	±.10	.79	±.05	66.94	±.15	.99	+.08/-.00	30,728	46,715
VHM-68	-S02	-S16	68.00	2.68	70.72	+.64/-.00	4.01	±.10	.79	±.05	69.94	±.15	.99	+.08/-.00	32,146	48,871
VHM-70	-S02	-S16	70.00	2.76	72.74	+.64/-.00	4.01	±.10	.79	±.05	71.94	±.15	.99	+.08/-.00	33,092	50,309
VHM-72	-S02	-S16	72.00	2.83	74.77	+.64/-.00	4.01	±.10	.79	±.05	73.94	±.15	.99	+.08/-.00	34,037	51,746
VHM-75	-S02	-S16	75.00	2.95	77.80	+.64/-.00	4.01	±.10	.79	±.05	76.94	±.15	.99	+.08/-.00	35,456	53,902
VHM-78	-S02	-S16	78.00	3.07	81.20	+.76/-.00	4.78	±.13	.99	±.05	80.34	±.15	1.12	+.08/-.00	44,477	70,250
VHM-80	-S02	-S16	80.00	3.15	83.23	+.76/-.00	4.78	±.13	.99	±.05	82.34	±.15	1.12	+.08/-.00	45,617	72,052

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] No removal notch.
[4] Square edge wire.

VHM Series

Metric Light Duty Rings Internal Continued

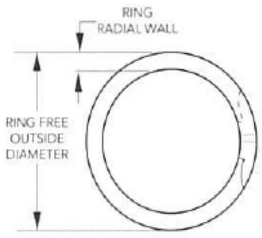
Smalley Part Number			Housing Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Outside Diameter (mm)		Radial Wall (mm)		Thickness (mm)		Diameter (mm)		Width (mm)		Groove Yield[1] (N)	Ring Shear[2] (N)
	302 SS	316 SS	mm	in												
VHM-82	-S02	-S16	82.00	3.23	85.25	+.76/-.00	4.78	±.13	.99	±.05	84.34	±.15	1.12	+.08/-.00	46,757	73,853
VHM-85	-S02	-S16	85.00	3.35	88.29		4.78		.99		87.34		1.12		48,468	76,555
VHM-88	-S02	-S16	88.00	3.46	91.32		4.78		.99		90.34		1.12		50,179	79,257
VHM-90	-S02	-S16	90.00	3.54	93.36		4.78		.99		92.34		1.12		51,319	81,058
VHM-92	-S02	-S16	92.00	3.62	95.37		4.78		.99		94.34		1.12		52,460	82,859
VHM-95	-S02	-S16	95.00	3.74	98.39		4.78		.99		97.34		1.12		54,170	85,561
VHM-98	-S02	-S16	98.00	3.86	101.41		4.78		.99		100.34		1.12		55,881	88,263
VHM-100	-S02	-S16	100.00	3.94	103.43		4.78		.99		102.34		1.12		57,021	90,064
VHM-102	-S02	-S16	102.00	4.02	105.44		4.78		.99		104.34		1.12		58,162	91,866
VHM-105	-S02	-S16	105.00	4.13	108.92	+.89/-.00	5.72		1.17		107.80		1.32	+.10/-.00	71,642	106,440
VHM-110	-S02	-S16	110.00	4.33	113.98		5.72		1.17		112.80		1.32		75,054	111,508
VHM-112	-S02	-S16	112.00	4.41	116.01		5.72		1.17		114.80		1.32		76,418	113,536
VHM-115	-S02	-S16	115.00	4.53	119.12		5.72		1.17		117.88		1.32		80,707	116,577
VHM-120	-S02	-S16	120.00	4.72	124.30		5.72		1.17		123.00		1.32		87,725	121,645
VHM-125	-S02	-S16	125.00	4.92	129.47		5.72		1.17		128.12		1.32		95,036	126,714
VHM-130	-S02	-S16	130.00	5.12	134.66		5.72		1.17		133.26	±.18	1.32		103,272	131,783
VHM-135	-S02	-S16	135.00	5.31	139.83	+1.14/-.00	5.72		1.55		138.38		1.70		111,192	181,299
VHM-140	-S02	-S16	140.00	5.51	145.00		5.72		1.55		143.50		1.70		119,404	188,013
VHM-145	-S02	-S16	145.00	5.71	150.17		5.72		1.55		148.62		1.70		127,974	194,907
VHM-150	-S02	-S16	150.00	5.91	155.30		6.73		1.55		153.76		1.70		137,436	201,443
VHM-155	-S02	-S16	155.00	6.10	160.46		6.73		1.55		158.88		1.70		146,361	208,158
VHM-160	-S02	-S16	160.00	6.30	165.64		6.73		1.55		164.00	±.20	1.70		155,956	214,872
VHM-165	-S02	-S16	165.00	6.50	170.82		6.73		1.55		169.11		1.70		165,855	221,587
VHM-170	-S02	-S16	170.00	6.69	175.99		6.73		1.55		174.25		1.70		176,059	228,302
VHM-175	-S02	-S16	175.00	6.89	181.17		6.73		1.55		179.38		1.70		186,568	235,017
VHM-180	-S02	-S16	180.00	7.09	186.35	+1.52/-.00	6.73		1.55		184.50		1.70		197,381	241,731
VHM-185	-S02	-S16	185.00	7.28	191.52		6.73		1.55		189.63		1.70		208,499	248,446
VHM-190	-S02	-S16	190.00	7.48	196.70		6.73		1.55		194.75		1.70		219,922	255,161
VHM-195	-S02	-S16	195.00	7.68	201.87		7.62	±.15	1.55		199.88		1.70		231,649	261,876
VHM-200	-S02	-S16	200.00	7.87	207.05		7.62		1.55		205.00		1.70		243,681	268,590
VHM-210	-S02	-S16	210.00	8.27	217.40		7.62		1.55		215.25		1.70		268,658	282,020
VHM-220	-S02	-S16	220.00	8.66	227.76	+1.78/-.00	8.76		1.93		225.50		2.08	+.13/-.00	294,854	367,882
VHM-230	-S02	-S16	230.00	9.06	238.11		8.76		1.93		235.75		2.08		322,268	384,604
VHM-240	-S02	-S16	240.00	9.45	248.46		8.76		1.93		246.00		2.08		350,900	401,326
VHM-250	-S02	-S16	250.00	9.84	258.81		8.76		1.93		256.25		2.08		380,751	418,048
VHM-260	-S02	-S16	260.00	10.24	269.17		9.65		1.93		266.50		2.08		411,821	434,770
VHM-270	-S02	-S16	270.00	10.63	279.52		9.65		1.93		276.75		2.08		444,108	451,492
VHM-280	-S02	-S16	280.00	11.02	289.87		9.65		1.93		287.00		2.08		477,614	468,214
VHM-290	-S02	-S16	290.00	11.42	300.22		9.65		1.93		297.25		2.08		512,339	484,936
VHM-300	-S02	-S16	300.00	11.81	310.58		9.65		1.93		307.50		2.08		548,282	501,658

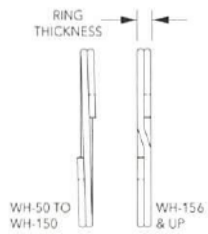
[1] Based on a groove material yield strength of 310 N/mm^2 and a safety factor of 2.
[2] Based on a safety factor of 3.

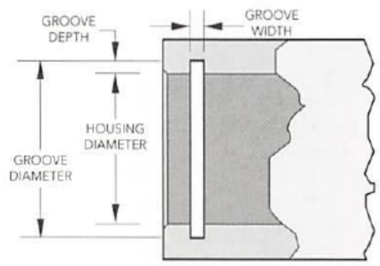
WH Series

Spirolox® Medium Duty Internal

**Compliance with AS3217, AS4299, MIL-DTL-27426/3*







Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number			Housing Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	Add Suffix 316 SS	in	mm	Outside Diameter (in)	Tol.	Radial Wall (in)	Tol.	Thickness (in)	Tol.	Diameter (in)	Tol.	Width (in)	Tol.	Groove Yield[1] (lb)	Ring Shear[2] (lb)
WH-50	-S02	-S16	.500	12.70	.532	+.013/-.000	.045	+.003/-.005	.025	±.002	.526	±.002	.030	+.003/-.000	460	2,000
WH-51	-S02	-S16	.512	13.00	.544		.045		.025		.538		.030		470	2,050
WH-53	-S02	-S16	.531	13.49	.564		.045		.025		.557		.030		490	2,130
WH-56	-S02	-S16	.562	14.27	.594		.045		.025		.588		.030		520	2,250
WH-59	-S02	-S16	.594	15.09	.626		.045		.025		.619		.030		550	2,380
WH-62	-S02	-S16	.625	15.88	.658		.045		.025		.651		.030		570	2,500
WH-65	-S02	-S16	.656	16.66	.689		.045		.025		.682		.030		600	2,630
WH-68	-S02	-S16	.687	17.45	.720		.045		.025		.713		.030		630	2,750
WH-71	-S02	-S16	.718	18.24	.751		.045		.025		.744		.030		660	2,870
WH-75	-S02	-S16	.750	19.05	.790		.065		.031		.782	±.003	.036		850	3,360
WH-77	-S02	-S16	.777	19.74	.817		.065		.031		.808		.036		880	3,480
WH-78	-S02	-S16	.781	19.84	.821		.065		.031		.812		.036		880	3,500
WH-81	-S02	-S16	.812	20.62	.853		.065		.031		.843		.036		920	3,640
WH-84	-S02	-S16	.843	21.41	.889		.065		.031		.880		.036		1,130	3,780
WH-86	-S02	-S16	.866	22.00	.913		.065		.031		.903		.036		1,160	3,880
WH-87	-S02	-S16	.875	22.23	.922		.065		.031		.912		.036		1,180	3,920
WH-90	-S02	-S16	.906	23.01	.949		.065		.031		.939		.036		1,220	4,060
WH-93	-S02	-S16	.938	23.83	.986		.065		.031		.975		.036		1,260	4,200
WH-96	-S02	-S16	.968	24.59	1.025		.075		.037		1.015		.042		1,440	5,180
WH-98	-S02	-S16	.987	25.07	1.041		.075		.037		1.030		.042		1,470	5,280
WH-100	-S02	-S16	1.000	25.40	1.054		.075		.037		1.043		.042		1,480	5,350
WH-102	-S02	-S16	1.023	25.98	1.078		.075		.037		1.066		.042		1,520	5,470
WH-103	-S02	-S16	1.031	26.19	1.084		.075		.037		1.074		.042		1,530	5,510
WH-106	-S02	-S16	1.062	26.97	1.117	+.015/-.000	.075		.037		1.104	±.004	.042		1,580	5,680
WH-109	-S02	-S16	1.093	27.76	1.147		.075		.037		1.135		.042		1,620	5,840
WH-112	-S02	-S16	1.125	28.58	1.180		.075		.037		1.167		.042		1,670	6,020
WH-115	-S02	-S16	1.156	29.36	1.210		.075		.037		1.198		.042		1,720	6,180
WH-118	-S02	-S16	1.188	30.18	1.249		.085		.043		1.236		.048	+.004/-.000	2,020	7,380
WH-121	-S02	-S16	1.218	30.94	1.278		.085		.043		1.266		.048		2,070	7,570
WH-125	-S02	-S16	1.250	31.75	1.312		.085		.043		1.298		.048		2,120	7,770
WH-128	-S02	-S16	1.281	32.54	1.342		.085		.043		1.329		.048		2,170	7,960
WH-131	-S02	-S16	1.312	33.32	1.374		.085		.043		1.360		.048		2,230	8,150
WH-134	-S02	-S16	1.343	34.11	1.408		.085		.043		1.395		.048		2,470	8,350
WH-137	-S02	-S16	1.375	34.93	1.442		.095		.043		1.427		.048		2,530	8,540
WH-140	-S02	-S16	1.406	35.71	1.472		.095		.043		1.458		.048		2,580	8,740
WH-143	-S02	-S16	1.437	36.50	1.504		.095		.043		1.489		.048		2,640	8,930
WH-145	-S02	-S16	1.456	36.98	1.523		.095		.043		1.508		.048		2,680	9,050
WH-146	-S02	-S16	1.468	37.29	1.535		.095		.043		1.520		.048		2,700	9,120
WH-150	-S02	-S16	1.500	38.10	1.567		.095		.043		1.552		.048		2,760	9,320
WH-156	-S02	-S16	1.562	39.67	1.634	+.020/-.000	.108		.049	±.003	1.617	±.005	.056		3,090	10,100
WH-157	-S02	-S16	1.574	39.98	1.649		.108		.049		1.633		.056		3,340	10,180
WH-162	-S02	-S16	1.625	41.28	1.701		.108		.049		1.684		.056		3,350	10,510
WH-165	-S02	-S16	1.653	41.99	1.730		.108		.049		1.712		.056		3,510	10,690
WH-168	-S02	-S16	1.687	42.85	1.768		.118		.049		1.750		.056		3,700	10,910
WH-175	-S02	-S16	1.750	44.45	1.834		.118		.049		1.813		.056		3,840	11,310
WH-181	-S02	-S16	1.813	46.05	1.894		.118		.049		1.875		.056		3,970	11,720
WH-185	-S02	-S16	1.850	46.99	1.937		.118		.049		1.917		.056		4,450	11,960
WH-187	-S02	-S16	1.875	47.63	1.960		.118		.049		1.942		.056		4,510	12,120
WH-193	-S02	-S16	1.938	49.23	2.025		.118		.049		2.005		.056		4,660	12,530
WH-200	-S02	-S16	2.000	50.80	2.091		.128		.049		2.071		.056		4,950	12,930

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

WH Series

Spirolox® Medium Duty Internal Continued

Smalley Part Number			Housing Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	Add Suffix 316 SS	in	mm	Outside Diameter (in)	Tol.	Radial Wall (in)	Tol.	Thickness (in)	Tol.	Diameter (in)	Tol.	Width (in)	Tol.	Groove Yield[1] (lb)	Ring Shear[2] (lb)
WH-204	-S02	-S16	2.047	51.99	2.138	+.020/-.000	.128	+.003/-.005	.049	±.003	2.118	±.005	.056	+.004/-.000	5,060	13,240
WH-206	-S02	-S16	2.062	52.37	2.154	+.025/-.000	.128		.049		2.132	±.006	.056		5,100	13,330
WH-212	-S02	-S16	2.125	53.98	2.217		.128		.049		2.195		.056		5,260	13,740
WH-216	-S02	-S16	2.165	54.99	2.260		.138		.049		2.239		.056		5,660	14,000
WH-218	-S02	-S16	2.188	55.58	2.284		.138		.049		2.262		.056		5,720	14,150
WH-225	-S02	-S16	2.250	57.15	2.347		.138		.049		2.324		.056		5,890	14,550
WH-231	-S02	-S16	2.312	58.72	2.413		.138		.049		2.390		.056		6,370	14,950
WH-237	-S02	-S16	2.375	60.33	2.476		.138		.049		2.453		.056		6,550	15,360
WH-243	-S02	-S16	2.437	61.90	2.543		.148		.049		2.519		.056		7,060	15,760
WH-244	-S02	-S16	2.440	61.98	2.546		.148		.049		2.522		.056		7,070	15,780
WH-250	-S02	-S16	2.500	63.50	2.606		.148		.049		2.582		.056		7,250	16,160
WH-253	-S02	-S16	2.531	64.29	2.641		.148		.049		2.617		.056		7,690	16,360
WH-256	-S02	-S16	2.562	65.07	2.673		.148		.049		2.648		.056		7,790	16,560
WH-262	-S02	-S16	2.625	66.68	2.736		.148		.049		2.711		.056		7,980	16,970
WH-267	-S02	-S16	2.677	68.00	2.789		.158		.049		2.767		.056		8,520	17,310
WH-268	-S02	-S16	2.688	68.28	2.803		.158		.049		2.778		.056		8,550	17,380
WH-275	-S02	-S16	2.750	69.85	2.865		.158		.049		2.841		.056		8,750	17,780
WH-281	-S02	-S16	2.813	71.45	2.929		.158		.049		2.903		.056		8,950	18,190
WH-283	-S02	-S16	2.834	71.98	2.954		.168	+.004/-.006	.049		2.928		.056		9,520	18,320
WH-287	-S02	-S16	2.875	73.03	2.995		.168		.049		2.969		.056		9,550	18,590
WH-293	-S02	-S16	2.937	74.60	3.058		.168		.049		3.031		.056		9,760	18,990
WH-295	-S02	-S16	2.952	74.98	3.073		.168		.049		3.046		.056		9,810	19,090
WH-300	-S02	-S16	3.000	76.20	3.122	+.030/-.000	.168		.061		3.096		.068	+.005/-.000	10,180	24,150
WH-306	-S02	-S16	3.062	77.77	3.186		.168		.061		3.158		.068		10,390	24,650
WH-312	-S02	-S16	3.125	79.38	3.251		.178		.061		3.223		.068		10,600	25,150
WH-314	-S02	-S16	3.149	79.98	3.276		.178		.061		3.247		.068		10,680	25,350
WH-318	-S02	-S16	3.187	80.95	3.311		.178		.061		3.283		.068		10,810	25,650
WH-325	-S02	-S16	3.250	82.55	3.379		.178		.061		3.350		.068		11,490	26,160
WH-331	-S02	-S16	3.312	84.12	3.446		.188		.061		3.416		.068		12,170	26,660
WH-334	-S02	-S16	3.346	84.99	3.479		.188		.061		3.450		.068		12,300	26,930
WH-337	-S02	-S16	3.375	85.73	3.509		.188		.061		3.479		.068		12,410	27,170
WH-343	-S02	-S16	3.437	87.30	3.574		.188		.061		3.543		.068		12,880	27,660
WH-350	-S02	-S16	3.500	88.90	3.636		.188		.061		3.606		.068		13,110	28,170
WH-354	-S02	-S16	3.543	89.99	3.684		.198		.061		3.653		.068		13,770	28,520
WH-356	-S02	-S16	3.562	90.47	3.703		.198		.061		3.672		.068		13,850	28,670
WH-362	-S02	-S16	3.625	92.08	3.769		.198		.061		3.737		.068		14,350	29,180
WH-368	-S02	-S16	3.687	93.65	3.832		.198		.061		3.799		.068		14,600	29,680
WH-374	-S02	-S16	3.740	95.00	3.885		.198		.061		3.852		.068		14,800	30,100
WH-375	-S02	-S16	3.750	95.25	3.894		.198		.061		3.862		.068		14,840	30,180
WH-381	-S02	-S16	3.812	96.82	3.963		.208		.061		3.930		.068		15,900	30,680
WH-387	-S02	-S16	3.875	98.43	4.025		.208		.061		3.993		.068		16,160	31,190
WH-393	-S02	-S16	3.938	100.03	4.089		.208		.061		4.056		.068		16,420	31,700
WH-400	-S02	-S16	4.000	101.60	4.157		.218		.061		4.124		.068		17,530	32,200
WH-406	-S02	-S16	4.063	103.20	4.222		.218		.061		4.187		.068		17,810	32,700
WH-412	-S02	-S16	4.125	104.78	4.284		.218		.061		4.249		.068		18,080	33,200
WH-418	-S02	-S16	4.188	106.38	4.347	+.035/-.000	.218		.061		4.311		.068		18,350	33,710
WH-425	-S02	-S16	4.250	107.95	4.416		.228		.061		4.380		.068		19,530	34,210
WH-431	-S02	-S16	4.312	109.52	4.479		.228		.061		4.442		.068		19,810	34,710
WH-433	-S02	-S16	4.330	109.98	4.497		.228		.061		4.460		.068		19,900	34,850
WH-437	-S02	-S16	4.375	111.13	4.543		.228		.061		4.505		.068		20,100	35,210
WH-443	-S02	-S16	4.437	112.70	4.611		.238		.061		4.573		.068		21,330	35,710
WH-450	-S02	-S16	4.500	114.30	4.674		.238		.061		4.636		.068		21,630	36,220
WH-452	-S02	-S16	4.527	114.99	4.701		.238		.061		4.663		.068		21,760	36,440
WH-456	-S02	-S16	4.562	115.87	4.737		.238		.061		4.698		.068		21,930	36,720
WH-462	-S02	-S16	4.625	117.48	4.803		.250		.072	±.004	4.765		.079		22,890	43,940
WH-468	-S02	-S16	4.687	119.05	4.867		.250		.072		4.827		.079		23,190	44,530
WH-472	-S02	-S16	4.724	119.99	4.903		.250		.072		4.864		.079		23,370	44,880
WH-475	-S02	-S16	4.750	120.65	4.930		.250		.072		4.890		.079		23,500	45,130
WH-481	-S02	-S16	4.812	122.22	4.993		.250		.072		4.952		.079		23,810	45,720
WH-487	-S02	-S16	4.875	123.83	5.055		.250		.072		5.015		.079		24,120	46,310
WH-492	-S02	-S16	4.921	124.99	5.102		.250		.072		5.061		.079		24,350	46,750
WH-493	-S02	-S16	4.937	125.40	5.122		.250		.072		5.081		.079		25,130	46,900
WH-500	-S02	-S16	5.000	127.00	5.185		.250		.072		5.144		.079		25,450	47,500
WH-511	-S02	-S16	5.118	130.00	5.304		.250		.072		5.262		.079		26,050	48,620
WH-512	-S02	-S16	5.125	130.18	5.311		.250		.072		5.269		.079		26,100	48,690
WH-525	-S02	-S16	5.250	133.35	5.436	+.045/-.000	.250		.072		5.393	±.007	.079		26,720	49,880

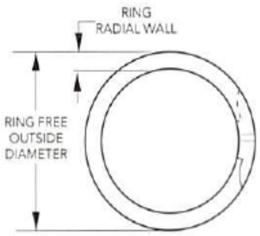
[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

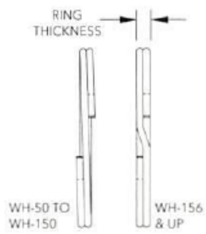
* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

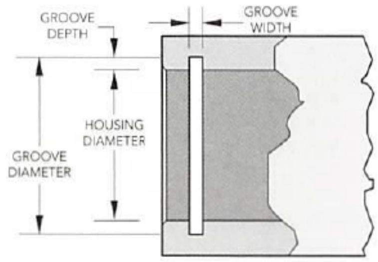
WH Series

Spirolox® Medium Duty Internal

**Compliance with AS3217, AS4299, MIL-DTL-27426/3*







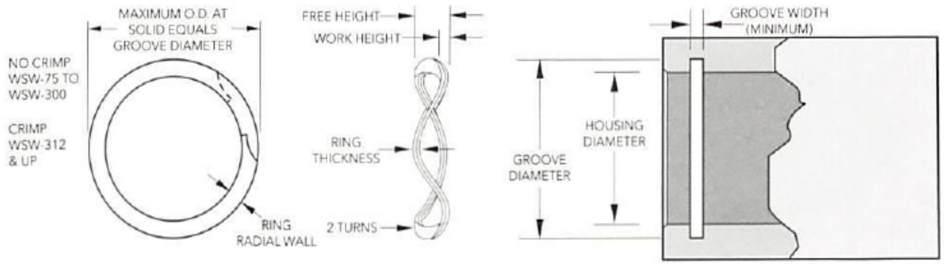
Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number			Housing Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Outside Diameter (in)		Radial Wall (in)		Thickness (in)		Diameter (in)		Width (in)		Groove Yield[1] (lb)	Ring Shear[2] (lb)
	302 SS	316 SS	in	mm												
WH-537	-S02	-S16	5.375	136.53	5.566	+.045/-.000	.250	+.004/-.006	.072	±.004	5.522	±.007	.079	+.005/-.000	28,120	51,060
WH-550	-S02	-S16	5.500	139.70	5.693		.250		.072		5.647		.079		28,770	52,250
WH-551	-S02	-S16	5.511	139.98	5.703		.250		.072		5.658		.079		28,830	52,360
WH-562	-S02	-S16	5.625	142.88	5.818		.250		.072		5.772		.079		29,400	53,440
WH-570	-S02	-S16	5.708	144.98	5.909		.250		.072		5.861		.079		31,070	54,230
WH-575	-S02	-S16	5.750	146.05	5.950		.250		.072		5.903		.079		31,300	54,630
WH-587	-S02	-S16	5.875	149.23	6.077		.250		.072		6.028		.079		31,980	55,810
WH-590	-S02	-S16	5.905	149.99	6.106		.250		.072		6.058		.079		32,140	56,100
WH-600	-S02	-S16	6.000	152.40	6.202		.250		.072		6.153		.079		32,660	57,000
WH-612	-S02	-S16	6.125	155.58	6.349	+.055/-.000	.312	+.004/-.008	.086		6.297	±.008	.094	+.006/-.000	37,200	69,500
WH-625	-S02	-S16	6.250	158.75	6.474		.312		.086		6.422		.094		37,990	70,920
WH-629	-S02	-S16	6.299	159.99	6.524		.312		.086		6.471		.094		38,290	71,480
WH-637	-S02	-S16	6.375	161.93	6.601		.312		.086		6.547		.094		38,750	72,340
WH-650	-S02	-S16	6.500	165.10	6.726		.312		.086		6.672		.094		39,510	73,760
WH-662	-S02	-S16	6.625	168.28	6.863		.312		.086		6.807		.094		42,620	75,180
WH-669	-S02	-S16	6.692	169.98	6.931		.312		.086		6.874		.094		43,050	75,940
WH-675	-S02	-S16	6.750	171.45	6.987		.312		.086		6.932		.094		43,420	76,600
WH-687	-S02	-S16	6.875	174.63	7.114		.312		.086		7.057		.094		44,220	78,010
WH-700	-S02	-S16	7.000	177.80	7.239		.312		.086		7.182		.094		45,030	79,430
WH-708	-S02	-S16	7.086	179.98	7.337		.312		.086		7.278		.094		48,080	80,410
WH-712	-S02	-S16	7.125	180.98	7.376		.312		.086		7.317		.094		48,350	80,850
WH-725	-S02	-S16	7.250	184.15	7.501	+.065/-.000	.312		.086		7.442		.094		49,200	82,270
WH-737	-S02	-S16	7.375	187.33	7.628		.312		.086		7.567		.094		50,050	83,690
WH-748	-S02	-S16	7.480	189.99	7.734		.312		.086		7.672		.094		50,760	84,880
WH-750	-S02	-S16	7.500	190.50	7.754		.312		.086		7.692		.094		50,890	85,110
WH-762	-S02	-S16	7.625	193.68	7.890		.312		.086		7.827		.094		54,440	86,520
WH-775	-S02	-S16	7.750	196.85	8.014		.312		.086		7.952		.094		55,330	87,940
WH-787	-S02	-S16	7.875	200.03	8.131		.312		.086		8.077		.094		63,360	89,360
WH-800	-S02	-S16	8.000	203.20	8.266		.312		.086		8.202		.094		57,110	90,780
WH-825	-S02	-S16	8.250	209.55	8.528		.375		.086		8.462		.094		61,820	93,620
WH-826	-S02	-S16	8.267	209.98	8.546		.375		.086		8.479		.094		61,940	93,810
WH-846	-S02	-S16	8.464	214.99	8.744		.375		.086		8.676		.094		63,420	96,050
WH-850	-S02	-S16	8.500	215.90	8.780		.375		.086		8.712		.094		63,690	96,450
WH-875	-S02	-S16	8.750	222.25	9.041		.375		.086		8.972		.094		68,650	99,290
WH-885	-S02	-S16	8.858	224.99	9.151		.375		.086		9.080		.094		69,500	100,520
WH-900	-S02	-S16	9.000	228.60	9.293		.375		.086		9.222		.094		70,620	102,130
WH-905	-S02	-S16	9.055	230.00	9.359		.375		.086		9.287		.094		74,250	102,750
WH-925	-S02	-S16	9.250	234.95	9.555		.375		.086		9.482		.094		75,850	104,960
WH-944	-S02	-S16	9.448	239.98	9.755		.375		.086		9.680		.094		77,470	107,210
WH-950	-S02	-S16	9.500	241.30	9.806		.375		.086		9.732		.094		77,900	107,800
WH-975	-S02	-S16	9.750	247.65	10.068		.375		.086		9.992		.094		83,390	110,640
WH-1000	-S02	-S16	10.000	254.00	10.320		.375		.086		10.242		.094		85,530	113,470
WH-1025	-S02	-S16	10.250	260.35	10.582		.375		.086		10.502		.094		91,290	116,310
WH-1050	-S02	-S16	10.500	266.70	10.834		.375		.086		10.752		.094		93,520	119,150
WH-1075	-S02	-S16	10.750	273.05	11.095		.375		.086		11.012		.094		99,540	121,990
WH-1100	-S02	-S16	11.000	279.40	11.347		.375		.086		11.262		.094		101,860	124,820

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

WHW Series
WaveRing® Internal

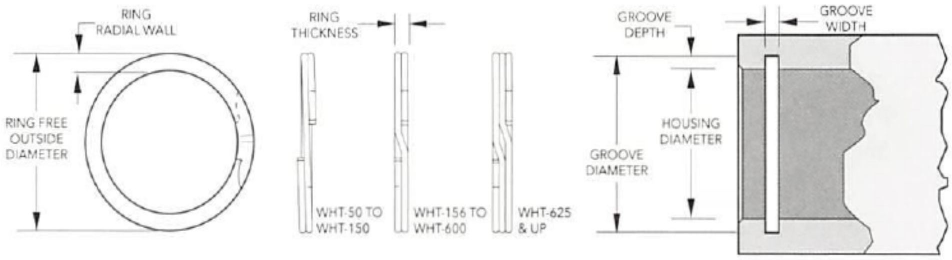


Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number: Carbon Steel	Smalley Part Number: Add Suffix 17-7	Housing Diameter in	Housing Diameter mm	Ring Thickness (in)	Ring Radial Wall (in)	Groove Diameter (in)	Groove Width Minimum (in)	Load (lb) @ Work Height	Max Free Height (in)	Number of Waves
WHW-75	-S17	.750	19.050	.035	.065	.796	.119	25 @ .080	.114	3
WHW-87	-S17	.875	22.225	.042	.085	.931	.115	30 @ .085	.110	3
WHW-100	-S17	1.000	25.400	.042	.085	1.066	.125	34 @ .085	.120	3
WHW-112	-S17	1.125	28.575	.050	.128	1.197	.130	38 @ .100	.125	3
WHW-125	-S17	1.250	31.750	.050	.128	1.330	.140	40 @ .100	.135	3
WHW-137	-S17	1.375	34.925	.050	.128	1.461	.130	45 @ .100	.125	4
WHW-150	-S17	1.500	38.100	.050	.128	1.594	.140	50 @ .100	.135	4
WHW-162	-S17	1.625	41.275	.062	.158	1.725	.140	55 @ .110	.135	4
WHW-175	-S17	1.750	44.450	.062	.158	1.858	.145	60 @ .110	.140	4
WHW-187	-S17	1.875	47.625	.062	.158	1.989	.146	63 @ .110	.141	4
WHW-200	-S17	2.000	50.800	.062	.158	2.122	.155	65 @ .110	.150	4
WHW-212	-S17	2.125	53.975	.078	.188	2.251	.175	70 @ .130	.170	4
WHW-225	-S17	2.250	57.150	.078	.188	2.382	.180	75 @ .130	.175	4
WHW-237	-S17	2.375	60.325	.078	.188	2.517	.185	80 @ .130	.180	4
WHW-250	-S17	2.500	63.500	.078	.188	2.648	.188	84 @ .130	.183	4
WHW-262	-S17	2.625	66.675	.093	.225	2.781	.225	88 @ .170	.220	4
WHW-275	-S17	2.750	69.850	.093	.225	2.914	.234	94 @ .170	.229	4
WHW-287	-S17	2.875	73.025	.093	.225	3.051	.230	97 @ .170	.225	4
WHW-300	-S17	3.000	76.200	.093	.225	3.182	.235	100 @ .170	.230	4
WHW-312	-S17	3.125	79.375	.111	.281	3.315	.255	103 @ .185	.250	4
WHW-325	-S17	3.250	82.550	.111	.281	3.446	.255	106 @ .185	.250	4
WHW-350	-S17	3.500	88.900	.111	.281	3.710	.250	115 @ .185	.245	4
WHW-362	-S17	3.625	92.075	.111	.281	3.841	.250	117 @ .185	.250	4
WHW-375	-S17	3.750	95.250	.111	.312	3.974	.260	121 @ .185	.255	4
WHW-387	-S17	3.875	98.425	.111	.312	4.107	.265	126 @ .185	.260	4
WHW-400	-S17	4.000	101.600	.111	.312	4.240	.260	130 @ .185	.255	4
WHW-412	-S17	4.125	104.775	.111	.312	4.365	.263	134 @ .185	.258	4
WHW-425	-S17	4.250	107.950	.111	.312	4.490	.269	140 @ .185	.264	4
WHW-450	-S17	4.500	114.300	.111	.312	4.740	.255	150 @ .185	.250	5
WHW-475	-S17	4.750	120.650	.111	.312	4.995	.257	160 @ .185	.252	5
WHW-500	-S17	5.000	127.000	.111	.312	5.260	.252	170 @ .185	.247	5

WHT Series

Spirolox® Medium/Heavy Duty Internal



Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number: Carbon Steel	Add Suffix: 302 SS	Add Suffix: 316 SS	Housing Diameter in	Housing Diameter mm	Ring Outside Diameter (in)	OD Tol.	Ring Radial Wall (in)	Wall Tol.	Ring Thickness (in)	Thickness Tol.	Groove Diameter (in)	Diameter Tol.	Groove Width (in)	Width Tol.	Thrust Capacity: Groove Yield[1] (lb)	Thrust Capacity: Ring Shear[2] (lb)
					Two-Turn											
WHT-50	-S02	-S16	.500	12.70	.529		.045		.035		.524	±.002	.039		420	2,530
WHT-51	-S02	-S16	.512	13.00	.541		.045		.035		.536		.039		430	2,590
WHT-56	-S02	-S16	.562	14.27	.597		.045		.035		.592		.039		600	2,840
WHT-62	-S02	-S16	.625	15.88	.665		.045		.035		.659		.039		750	3,160
WHT-68	-S02	-S16	.688	17.48	.730		.055		.035		.724		.039		880	3,480
WHT-75	-S02	-S16	.750	19.05	.796		.055		.035		.790		.039		1,060	3,790
WHT-77	-S02	-S16	.777	19.74	.825	+.013/-.000	.065		.042		.819	±.003	.046	+.003/-.000	1,150	4,720
WHT-81	-S02	-S16	.812	20.62	.864		.065		.042		.857		.046		1,320	4,930
WHT-86	-S02	-S16	.866	22.00	.919		.065		.042		.912		.046		1,410	5,260
WHT-87	-S02	-S16	.875	22.23	.929		.065		.042		.922		.046		1,480	5,310
WHT-90	-S02	-S16	.901	22.89	.957		.065		.042		.950		.046		1,590	5,470
WHT-93	-S02	-S16	.938	23.83	.997		.075		.042	±.002	.989		.046		1,720	5,690
WHT-100	-S02	-S16	1.000	25.40	1.063		.075		.042		1.055		.046		1,980	6,070
WHT-102	-S02	-S16	1.023	25.98	1.087		.075		.042		1.079		.046		2,030	6,210
WHT-106	-S02	-S16	1.062	26.97	1.129		.078		.050		1.120		.056		2,180	7,010
WHT-112	-S02	-S16	1.125	28.58	1.195		.078		.050		1.185		.056		2,390	7,420
WHT-118	-S02	-S16	1.188	30.18	1.260		.088		.050		1.250		.056		2,600	7,840
WHT-125	-S02	-S16	1.250	31.75	1.330		.093		.050		1.320	±.004	.056		3,090	8,250
WHT-131	-S02	-S16	1.312	33.32	1.395	+.015/-.000	.093	±.004	.050		1.385		.056		3,430	8,660
WHT-137	-S02	-S16	1.375	34.93	1.461		.098		.050		1.450		.056		3,690	9,070
WHT-143	-S02	-S16	1.438	36.53	1.526		.103		.050		1.515		.056		3,960	9,490
WHT-145	-S02	-S16	1.456	36.98	1.546		.108		.050		1.535		.056		4,120	9,610
WHT-150	-S02	-S16	1.500	38.10	1.591		.108		.050		1.580		.056	+.004/-.000	4,240	9,900
WHT-156	-S02	-S16	1.562	39.67	1.659		.113		.062		1.647		.068		4,750	12,780
WHT-162	-S02	-S16	1.625	41.28	1.727		.113		.062		1.715		.068		5,170	13,290
WHT-165	-S02	-S16	1.653	41.99	1.757		.118		.062		1.745		.068		5,380	13,520
WHT-168	-S02	-S16	1.688	42.88	1.793		.118		.062		1.780		.068		5,490	13,810
WHT-175	-S02	-S16	1.750	44.45	1.858	+.020/-.000	.118		.062		1.845		.068		5,940	14,320
WHT-181	-S02	-S16	1.812	46.02	1.923		.123		.062		1.910	±.005	.068		6,280	14,820
WHT-185	-S02	-S16	1.850	46.99	1.963		.123		.062		1.949		.068		6,540	15,130
WHT-187	-S02	-S16	1.875	47.63	1.989		.128		.062		1.975		.068		6,630	15,340
WHT-193	-S02	-S16	1.938	49.23	2.054		.128		.062		2.040		.068		6,990	15,850
WHT-200	-S02	-S16	2.000	50.80	2.125		.138		.062		2.110		.068		7,780	16,360
WHT-206	-S02	-S16	2.062	52.37	2.190		.141		.078		2.175		.086		8,310	21,220
WHT-212	-S02	-S16	2.125	53.98	2.255		.141		.078		2.240		.086		8,710	21,870
WHT-218	-S02	-S16	2.188	55.58	2.321		.141		.078	±.003	2.305		.086		9,130	22,520
WHT-225	-S02	-S16	2.250	57.15	2.386		.141		.078		2.370		.086		9,540	23,160
WHT-231	-S02	-S16	2.312	58.72	2.457		.188		.078		2.440		.086		10,460	23,800
WHT-237	-S02	-S16	2.375	60.33	2.522		.188		.078		2.505		.086		10,910	24,440
WHT-244	-S02	-S16	2.440	61.98	2.588		.188		.078		2.570		.086		11,210	25,110
WHT-250	-S02	-S16	2.500	63.50	2.653	+.025/-.000	.188		.078		2.635	±.006	.086	+.005/-.000	12,020	25,730
WHT-253	-S02	-S16	2.531	64.29	2.687		.188		.078		2.668		.086		12,350	26,050
WHT-256	-S02	-S16	2.562	65.07	2.720		.188	±.005	.093		2.700		.103		12,500	29,940
WHT-262	-S02	-S16	2.625	66.68	2.785		.188		.093		2.765		.103		12,990	30,680
WHT-268	-S02	-S16	2.688	68.28	2.855		.188		.093		2.834		.103		13,870	31,410
WHT-275	-S02	-S16	2.750	69.85	2.921		.188		.093		2.900		.103		14,580	32,140
WHT-281	-S02	-S16	2.813	71.45	2.987		.188		.093		2.965		.103		15,110	32,880
WHT-283	-S02	-S16	2.834	71.98	3.009		.188		.093		2.987		.103		15,430	33,120
WHT-287	-S02	-S16	2.875	73.03	3.053		.188		.093		3.030		.103		15,850	33,600

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

WHT Series

Spirolox® Medium/Heavy Duty Internal Continued

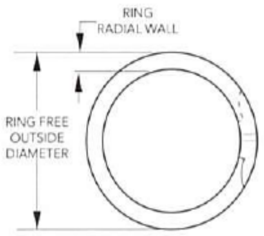
Smalley Part Number: Carbon Steel	Add Suffix: 302 SS	Add Suffix: 316 SS	Housing Diameter: in	Housing Diameter: mm	Ring: Outside Diameter (in)	OD Tol.	Ring: Radial Wall (in)	Radial Wall Tol.	Ring: Thickness (in)	Thickness Tol.	Groove: Diameter (in)	Diameter Tol.	Groove: Width (in)	Width Tol.	Thrust Capacity: Groove Yield[1] (lb)	Thrust Capacity: Ring Shear[2] (lb)
WHT-300	**-S02**	**-S16**	3.000	76.20	3.188	+.025/-.000	.188	±.005	.093	±.003	3.165	±.006	.103	+.005/-.000	17,600	35,060
WHT-306	**-S02**	**-S16**	3.062	77.77	3.253	+.030/-.000	.250		.111		3.230		.120		18,180	42,710
WHT-312	**-S02**	**-S16**	3.125	79.38	3.318		.250		.111		3.295		.120		18,780	43,590
WHT-315	**-S02**	**-S16**	3.156	80.16	3.354		.250		.111		3.328		.120		19,190	44,040
WHT-325	**-S02**	**-S16**	3.250	82.55	3.450		.250		.111		3.426		.120		20,220	45,330
WHT-334	**-S02**	**-S16**	3.346	84.99	3.550		.250		.111		3.525		.120		21,290	46,670
WHT-346	**-S02**	**-S16**	3.464	87.99	3.675		.250		.111		3.650		.120		22,770	48,320
WHT-350	**-S02**	**-S16**	3.500	88.90	3.716		.250		.111		3.690		.120		23,500	48,820
WHT-354	**-S02**	**-S16**	3.543	89.99	3.761		.250		.111		3.735		.120		24,040	49,420
WHT-356	**-S02**	**-S16**	3.562	90.47	3.783		.250		.111		3.756		.120		24,420	49,690
WHT-362	**-S02**	**-S16**	3.625	92.08	3.849		.250		.111		3.822		.120		25,370	50,560
WHT-375	**-S02**	**-S16**	3.750	95.25	3.982		.250		.111		3.955		.120		27,300	52,310
WHT-387	**-S02**	**-S16**	3.875	98.43	4.115		.250		.111		4.087		.120		29,030	54,050
WHT-393	**-S02**	**-S16**	3.938	100.03	4.178		.250		.111		4.150		.120		29,510	54,930
WHT-400	**-S02**	**-S16**	4.000	101.60	4.248		.250		.111		4.220		.120		31,100	55,800
WHT-412	**-S02**	**-S16**	4.125	104.78	4.373	+.035/-.000	.312	±.006	.111		4.345		.120		32,070	57,540
WHT-425	**-S02**	**-S16**	4.250	107.95	4.500		.312		.111		4.470		.120		33,050	59,280
WHT-433	**-S02**	**-S16**	4.330	109.98	4.586		.312		.111		4.556		.120		34,590	60,400
WHT-450	**-S02**	**-S16**	4.500	114.30	4.768		.312		.111		4.735		.120		37,530	62,770
WHT-462	**-S02**	**-S16**	4.625	117.48	4.897		.312		.111		4.865		.120		39,230	64,510
WHT-475	**-S02**	**-S16**	4.750	120.65	5.028		.312		.111		4.995		.120		41,300	66,260
WHT-500	**-S02**	**-S16**	5.000	127.00	5.295		.312		.111		5.260		.120		45,950	69,740
WHT-525	**-S02**	**-S16**	5.250	133.35	5.559	+.045/-.000	.375		.127	±.004	5.520	±.007	.139	+.006/-.000	50,100	83,790
WHT-537	**-S02**	**-S16**	5.375	136.53	5.685		.375		.127		5.645		.139		51,290	85,780
WHT-550	**-S02**	**-S16**	5.500	139.70	5.810		.375		.127		5.770		.139		52,480	87,780
WHT-575	**-S02**	**-S16**	5.750	146.05	6.062		.375		.127		6.020		.139		54,870	91,770
WHT-600	**-S02**	**-S16**	6.000	152.40	6.314		.375		.127		6.270		.139		57,260	95,760
						Three-Turn										
WHT-625	**-S02**	**-S16**	6.250	158.75	6.576	+.055/-.000	.312	±.006	.165	±.005	6.530	±.008	.174	+.008/-.000	61,850	129,590
WHT-650	**-S02**	**-S16**	6.500	165.10	6.837		.312		.165		6.790		.174		66,620	134,780
WHT-662	**-S02**	**-S16**	6.625	168.28	6.973		.312		.165		6.925		.174		70,240	137,370
WHT-675	**-S02**	**-S16**	6.750	171.45	7.104		.312		.165		7.055		.174		73,000	139,960
WHT-700	**-S02**	**-S16**	7.000	177.80	7.366		.312		.165		7.315		.174		78,180	145,140
WHT-725	**-S02**	**-S16**	7.250	184.15	7.628	+.070/-.000	.375		.189		7.575		.209		83,530	172,190
WHT-750	**-S02**	**-S16**	7.500	190.50	7.895		.375		.189		7.840		.209		90,120	178,130
WHT-775	**-S02**	**-S16**	7.750	196.85	8.156		.375		.189		8.100		.209		95,870	184,070
WHT-800	**-S02**	**-S16**	8.000	203.20	8.418		.375		.189		8.360		.209		101,790	190,000
WHT-825	**-S02**	**-S16**	8.250	209.55	8.680		.375		.189		8.620		.209		107,880	195,940
WHT-850	**-S02**	**-S16**	8.500	215.90	8.942		.375		.189		8.880		.209		114,160	201,880
WHT-875	**-S02**	**-S16**	8.750	222.25	9.209		.375		.189		9.145		.209		122,460	207,820
WHT-900	**-S02**	**-S16**	9.000	228.60	9.471		.375		.189		9.405		.209		129,140	213,750
WHT-925	**-S02**	**-S16**	9.250	234.95	9.736		.375		.189		9.669		.209		137,310	219,690
WHT-950	**-S02**	**-S16**	9.500	241.30	9.999		.375		.189		9.930		.209		144,380	225,630
WHT-975	**-S02**	**-S16**	9.750	247.65	10.260		.375		.189		10.189		.209		151,620	231,570
WHT-1000	**-S02**	**-S16**	10.000	254.00	10.552		.375		.189		10.450		.209		159,040	237,500
WHT-1050	**-S02**	**-S16**	10.500	266.70	11.072		.375		.189		10.970		.209		174,420	249,380

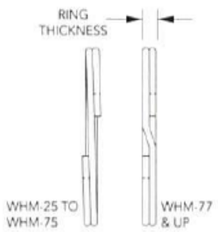
[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

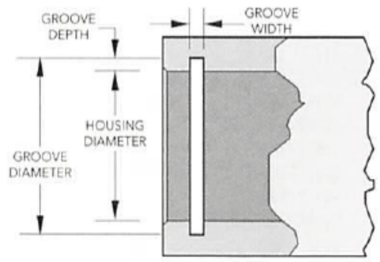
WHM Series

Spirolox® Heavy Duty Internal

**Compliance with AS3215, AS4299, MIL-DTL-27426/4*







Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number			Housing Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Outside Diameter (in)		Radial Wall (in)		Thickness (in)		Diameter (in)		Width (in)		Groove Yield[1] (lb)	Ring Shear[2] (lb)
	302 SS	316 SS	in	mm												
WHM-25[3,4]	-S02	-S16	.250	6.350	.270	+.010/-.000	.020	+.003/-.005	.015	±.002	.268	±.002	.020	+.003/-.000	159	561
WHM-31[3,4]	-S02	-S16	.312	7.925	.333		.025		.015		.330		.020		198	700
WHM-37[3,4]	-S02	-S16	.375	9.525	.400		.030		.025		.397		.029		292	1,442
WHM-43[4]	-S02	-S16	.437	11.100	.464	+.012/-.000	.035		.025		.461		.029		371	1,680
WHM-50	-S02	-S16	.500	12.700	.538	+.013/-.000	.045		.035		.530		.039		530	2,530
WHM-51	-S02	-S16	.512	13.005	.550		.045		.035		.542		.039		540	2,590
WHM-56	-S02	-S16	.562	14.275	.605		.055		.035		.596		.039		680	2,840
WHM-62	-S02	-S16	.625	15.875	.675		.055		.035		.665		.039		880	3,160
WHM-68	-S02	-S16	.688	17.475	.743		.065		.035		.732		.039		1,070	3,480
WHM-75	-S02	-S16	.750	19.050	.807		.065		.035		.796		.039		1,220	3,790
WHM-77	-S02	-S16	.777	19.736	.836		.075		.042		.825	±.003	.046		1,320	4,720
WHM-81	-S02	-S16	.812	20.625	.873		.075		.042		.862		.046		1,440	4,930
WHM-86	-S02	-S16	.866	21.996	.931		.075		.042		.920		.046		1,650	5,260
WHM-87	-S02	-S16	.875	22.225	.943		.085		.042		.931		.046		1,730	5,310
WHM-90	-S02	-S16	.901	22.885	.972		.085		.042		.959		.046		1,850	5,470
WHM-93	-S02	-S16	.938	23.825	1.013		.085		.042		1.000		.046		2,060	5,690
WHM-100	-S02	-S16	1.000	25.400	1.080		.085		.042		1.066		.046		2,330	6,070
WHM-102	-S02	-S16	1.023	25.984	1.105		.085		.042		1.091		.046		2,460	6,210
WHM-106	-S02	-S16	1.062	26.975	1.138		.103		.050		1.130	±.004	.056	+.004/-.000	2,550	7,010
WHM-112	-S02	-S16	1.125	28.575	1.205		.103		.050		1.197		.056		2,860	7,420
WHM-118	-S02	-S16	1.188	30.175	1.271		.103		.050		1.262		.056		3,110	7,840
WHM-125	-S02	-S16	1.250	31.750	1.339		.103		.050		1.330		.056		3,530	8,250
WHM-131	-S02	-S16	1.312	33.325	1.406		.118		.050		1.396		.056		3,900	8,660
WHM-137	-S02	-S16	1.375	34.925	1.471		.118		.050		1.461		.056		4,180	9,070
WHM-143	-S02	-S16	1.439	36.551	1.539		.118		.050		1.528		.056		4,580	9,490
WHM-145	-S02	-S16	1.456	36.982	1.559		.118		.050		1.548		.056		4,730	9,610
WHM-150	-S02	-S16	1.500	38.100	1.605		.118		.050		1.594		.056		4,980	9,900
WHM-156	-S02	-S16	1.562	39.675	1.675	+.020/-.000	.128		.062	±.003	1.658	±.005	.068		5,300	12,780
WHM-162	-S02	-S16	1.625	41.275	1.742		.128		.062		1.725		.068		5,740	13,290
WHM-165	-S02	-S16	1.653	41.986	1.772		.128		.062		1.755		.068		5,960	13,520
WHM-168	-S02	-S16	1.688	42.875	1.810		.128		.062		1.792		.068		6,210	13,810
WHM-175	-S02	-S16	1.750	44.450	1.876		.128		.062		1.858		.068		6,680	14,320
WHM-181	-S02	-S16	1.812	46.025	1.940		.128		.062		1.922		.068		7,050	14,820
WHM-185	-S02	-S16	1.850	46.990	1.981		.158		.062		1.962		.068		7,320	15,130
WHM-187	-S02	-S16	1.875	47.625	2.008		.158		.062		1.989		.068		7,560	15,340
WHM-193	-S02	-S16	1.938	49.225	2.075		.158		.062		2.056		.068		8,080	15,850
WHM-200	-S02	-S16	2.000	50.800	2.142		.158		.062		2.122		.068		8,620	16,360
WHM-206	-S02	-S16	2.062	52.375	2.201	+.025/-.000	.168	+.004/-.006	.078		2.186	±.006	.086	+.005/-.000	9,040	21,220
WHM-212	-S02	-S16	2.125	53.975	2.267		.168		.078		2.251		.086		9,460	21,870
WHM-218	-S02	-S16	2.188	55.575	2.334		.168		.078		2.318		.086		10,050	22,520
WHM-225	-S02	-S16	2.250	57.150	2.399		.168		.078		2.382		.086		10,500	23,160
WHM-231	-S02	-S16	2.312	58.725	2.467		.200		.078		2.450		.086		11,280	23,800
WHM-237	-S02	-S16	2.375	60.325	2.535		.200		.078		2.517		.086		11,920	24,440
WHM-244	-S02	-S16	2.440	61.976	2.602		.200		.078		2.584		.086		12,420	25,110
WHM-250	-S02	-S16	2.500	63.500	2.667		.200		.078		2.648		.086		13,080	25,730
WHM-253	-S02	-S16	2.531	64.287	2.700		.200		.078		2.681		.086		13,420	26,050
WHM-256	-S02	-S16	2.562	65.075	2.733	+.030/-.000	.225		.093		2.714		.103		13,760	29,940
WHM-262	-S02	-S16	2.625	66.675	2.801		.225		.093		2.781		.103		14,470	30,680
WHM-268	-S02	-S16	2.688	68.275	2.868		.225		.093		2.848		.103		15,200	31,410
WHM-275	-S02	-S16	2.750	69.850	2.934		.225		.093		2.914		.103		15,940	32,140

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] No removal notch.
[4] Square edge wire.
* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

WHM Series

Spirolox® Heavy Duty Internal Continued

Smalley Part Number			Housing Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	Add Suffix 316 SS	in	mm	Outside Diameter (in)		Radial Wall (in)		Thickness (in)		Diameter (in)		Width (in)		Groove Yield[1] (lb)	Ring Shear[2] (lb)
WHM-281	-S02	-S16	2.813	71.450	3.001	+.030/-.000	.225	+.004/-.006	.093	±.003	2.980	±.006	.103	+.005/-.000	16,700	32,880
WHM-283	-S02	-S16	2.834	71.984	3.027		.225		.093		3.006		.103		17,230	33,120
WHM-287	-S02	-S16	2.875	73.025	3.072		.225		.093		3.051		.103		17,880	33,600
WHM-300	-S02	-S16	3.000	76.200	3.204		.225		.093		3.182		.103		18,300	35,060
WHM-306	-S02	-S16	3.062	77.775	3.271	+.035/-.000	.281		.111		3.248		.120		20,130	42,710
WHM-312	-S02	-S16	3.125	79.375	3.338		.281		.111		3.315		.120		20,990	43,590
WHM-315	-S02	-S16	3.157	80.188	3.371		.281		.111		3.348		.120		21,420	44,040
WHM-325	-S02	-S16	3.250	82.550	3.470		.281		.111		3.446		.120		22,510	45,330
WHM-334	-S02	-S16	3.346	84.988	3.571		.281		.111		3.546		.120		23,650	46,670
WHM-347	-S02	-S16	3.464	87.986	3.701		.281		.111		3.675		.120		25,710	48,320
WHM-350	-S02	-S16	3.500	88.900	3.736		.281		.111		3.710		.120		25,980	48,820
WHM-354	-S02	-S16	3.543	89.992	3.781		.281		.111		3.755		.120		26,550	49,420
WHM-356	-S02	-S16	3.562	90.475	3.802		.281		.111		3.776		.120		26,940	49,690
WHM-362	-S02	-S16	3.625	92.075	3.868		.281		.111		3.841		.120		27,670	50,560
WHM-375	-S02	-S16	3.750	95.250	4.002		.312	+.004/-.008	.111		3.974		.120		29,690	52,310
WHM-387	-S02	-S16	3.875	98.425	4.136		.312		.111		4.107		.120		31,770	54,050
WHM-393	-S02	-S16	3.938	100.025	4.203		.312		.111		4.174		.120		32,850	54,930
WHM-400	-S02	-S16	4.000	101.600	4.270		.312		.111		4.240		.120		33,930	55,800
WHM-412	-S02	-S16	4.125	104.775	4.369		.312		.111		4.339		.120		34,990	57,540
WHM-425	-S02	-S16	4.250	107.950	4.501		.312		.111		4.470		.120		36,050	59,280
WHM-433	-S02	-S16	4.330	109.982	4.588		.312		.111		4.556		.120		36,730	60,400
WHM-450	-S02	-S16	4.500	114.300	4.768		.312		.111		4.735		.120		38,170	62,770
WHM-462	-S02	-S16	4.625	117.475	4.899		.312		.111		4.865		.120		39,230	64,510
WHM-475	-S02	-S16	4.750	120.650	5.030		.312		.111		4.995		.120		41,300	66,260
WHM-500	-S02	-S16	5.000	127.000	5.297		.312		.111		5.260		.120		45,950	69,740
WHM-525	-S02	-S16	5.250	133.350	5.559	+.050/-.000	.350		.127	±.004	5.520	±.007	.139	+.006/-.000	50,100	83,790
WHM-537	-S02	-S16	5.375	136.525	5.690		.350		.127		5.650		.139		51,290	85,780
WHM-550	-S02	-S16	5.500	139.700	5.810		.350		.127		5.770		.139		52,480	87,780
WHM-575	-S02	-S16	5.750	146.050	6.062		.350		.127		6.020		.139		54,870	91,770
WHM-600	-S02	-S16	6.000	152.400	6.314		.350		.127		6.270		.139		57,260	95,760
WHM-625	-S02	-S16	6.250	158.750	6.576	+.055/-.000	.380		.156	±.005	6.530	±.008	.174	+.008/-.000	61,850	122,520
WHM-650	-S02	-S16	6.500	165.100	6.838		.380		.156		6.790		.174		66,620	127,420
WHM-662	-S02	-S16	6.625	168.275	6.974		.380		.156		6.925		.174		70,240	129,870
WHM-675	-S02	-S16	6.750	171.450	7.105		.380		.156		7.055		.174		73,000	132,320
WHM-700	-S02	-S16	7.000	177.800	7.366		.380		.156		7.315		.174		78,180	137,230
WHM-725	-S02	-S16	7.250	184.150	7.628	+.070/-.000	.418		.187		7.575		.209		83,530	170,370
WHM-750	-S02	-S16	7.500	190.500	7.895		.418		.187		7.840		.209		90,120	176,240
WHM-775	-S02	-S16	7.750	196.850	8.157		.418		.187		8.100		.209		95,870	182,120
WHM-800	-S02	-S16	8.000	203.200	8.419		.418		.187		8.360		.209		101,790	187,990
WHM-825	-S02	-S16	8.250	209.550	8.680		.437		.187		8.620		.209		107,880	193,870
WHM-850	-S02	-S16	8.500	215.900	8.942		.437		.187		8.880		.209		114,160	199,740
WHM-875	-S02	-S16	8.750	222.250	9.209		.437		.187		9.145		.209		122,460	205,620
WHM-900	-S02	-S16	9.000	228.600	9.471		.437		.187		9.405		.209		129,140	211,490
WHM-925	-S02	-S16	9.250	234.950	9.737		.437		.187		9.669		.209		137,310	217,370
WHM-950	-S02	-S16	9.500	241.300	10.000		.500	+.005/-.010	.187		9.930		.209		144,380	223,240
WHM-975	-S02	-S16	9.750	247.650	10.260		.500		.187		10.189		.209		150,620	229,120
WHM-1000	-S02	-S16	10.000	254.000	10.523		.500		.187		10.450		.209		159,040	234,990
WHM-1025	-S02	-S16	10.250	260.350	10.786		.500		.187		10.711		.209		167,370	240,870
WHM-1050	-S02	-S16	10.500	266.700	11.047		.500		.187		10.970		.209		174,420	246,740
WHM-1075	-S02	-S16	10.750	273.050	11.313	+.120/-.000	.500		.187		11.234	±.010	.209		183,890	252,620
WHM-1100	-S02	-S16	11.000	279.400	11.575		.500		.187		11.495		.209		192,830	258,490
WHM-1125	-S02	-S16	11.250	285.750	11.838		.500		.187		11.756		.209		201,190	264,370
WHM-1150	-S02	-S16	11.500	292.100	12.102		.562		.187		12.018		.209		210,540	270,240
WHM-1175	-S02	-S16	11.750	298.450	12.365		.562		.187		12.279		.209		220,100	276,120
WHM-1200	-S02	-S16	12.000	304.800	12.628		.562		.187		12.540		.209		229,020	281,990
WHM-1225	-S02	-S16	12.250	311.150	12.891		.562		.187		12.801		.209		238,990	287,860
WHM-1250	-S02	-S16	12.500	317.500	13.154		.562		.187		13.063		.209		249,170	293,740
WHM-1275	-S02	-S16	12.750	323.850	13.417		.562		.187		13.324	±.012	.209		258,660	299,610
WHM-1300	-S02	-S16	13.000	330.200	13.680	+.140/-.000	.662		.187		13.585		.209		269,240	305,490
WHM-1325	-S02	-S16	13.250	336.550	13.943		.662		.187		13.846		.209		279,100	311,360
WHM-1350	-S02	-S16	13.500	342.900	14.207		.662		.187		14.108		.209		290,100	317,240
WHM-1375	-S02	-S16	13.750	349.250	14.470		.662		.187		14.369		.209		301,300	323,110
WHM-1400	-S02	-S16	14.000	355.600	14.732		.662		.187		14.630		.209		311,730	328,990
WHM-1425	-S02	-S16	14.250	361.950	14.995		.662		.187		14.891		.209		323,340	334,860
WHM-1450	-S02	-S16	14.500	368.300	15.259		.750		.187		15.153		.209		335,160	340,740
WHM-1475	-S02	-S16	14.750	374.650	15.522		.750		.187		15.414		.209		346,150	346,610
WHM-1500	-S02	-S16	15.000	381.000	15.785		.750		.187		15.675		.209		358,380	352,490

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

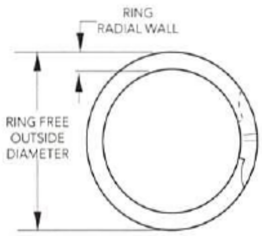
* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

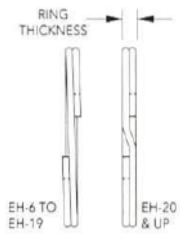
Retaining Rings

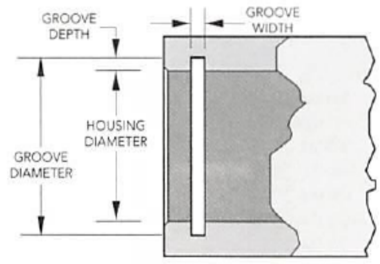
EH Series

Metric Aerospace Rings Internal

**Compliance with MA 4017 specification*







Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number			Housing Diameter		Ring					Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Outside Diameter (mm)		Radial Wall (mm)	Thickness (mm)		Diameter (mm)		Width (mm)		Groove Yield[1] (N)	Ring Shear[2] (N)
	302 SS	316 SS	mm	in											
EH-6[3,4]	-S02	-S16	6.00	.24	6.35	+.25/-.00	.33 - .53	.38	±.05	6.30	±.05	.51	+.08/-.00	440	1,880
EH-7[3,4]	-S02	-S16	7.00	.28	7.37		.33 - .53	.38		7:32		.51		550	2,190
EH-8[3,4]	-S02	-S16	8.00	.32	8.51		.51 - .71	.38		8.43		.51		840	2,500
EH-9[3,4]	-S02	-S16	9.00	.35	9.60		.64 - .84	.64		9.50		.74		1,100	4,740
EH-10[3,4]	-S02	-S16	10.00	.39	10.62		.64 - .84	.64		10.52		.74		1,270	5,270
EH-11[4]	-S02	-S16	11.00	.43	11.79	+.30/-.00	.76 - .96	.64		11.71		.74		1,900	5,790
EH-12	-S02	-S16	12.00	.47	12.89	+.35/-.00	1.02 - 1.22	.60		12.70		.70		2,050	7,950
EH-13	-S02	-S16	13.00	.51	13.95		1.02 - 1.22	.89		13.75		1.00		2,410	12,110
EH-14	-S02	-S16	14.00	.55	15.07		1.27 - 1.47	.89		14.85		1.00		2,930	13,040
EH-15	-S02	-S16	15.00	.59	16.14		1.27 - 1.47	.89		15.90		1.00		3,290	13,970
EH-16	-S02	-S16	16.00	.63	17.15		1.27 - 1.47	.89		16.95		1.00		3,740	14,900
EH-17	-S02	-S16	17.00	.67	18.32		1.52 - 1.73	.89		18.05		1.00		4,390	15,830
EH-18	-S02	-S16	18.00	.71	19.39		1.52 - 1.73	.89		19.10		1.00		4,820	16,760
EH-19	-S02	-S16	19.00	.75	20.48		1.52 - 1.73	.89		20.17	±.075	1.00		5,460	17,690
EH-20	-S02	-S16	20.00	.79	21.51		1.78 - 1.98	.89		21.22		1.00		5,940	18,620
EH-21	-S02	-S16	21.00	.83	22.56		1.78 - 1.98	.89		22.27		1.00		6,550	19,550
EH-22	-S02	-S16	22.00	.87	23.65		1.78 - 1.98	1.07		23.37		1.20		7,390	24,630
EH-23	-S02	-S16	23.00	.91	24.69		2.03 - 2.24	1.07		24.42		1.20		7,950	25,750
EH-24	-S02	-S16	24.00	.95	25.73		2.03 - 2.24	1.07		25.47		1.20		8,650	26,870
EH-25	-S02	-S16	25.00	.98	27.03		2.03 - 2.24	1.07		26.67		1.20		10,230	27,990
EH-26	-S02	-S16	26.00	1.02	28.07		2.03 - 2.24	1.07		27.77		1.20		11,270	29,110
EH-27	-S02	-S16	27.00	1.06	29.11		2.49 - 2.69	1.27		28.87		1.40	+.10/-.00	12,360	31,170
EH-28	-S02	-S16	28.00	1.10	30.10		2.49 - 2.69	1.27		29.87		1.40		12,820	32,330
EH-29	-S02	-S16	29.00	1.14	31.21		2.49 - 2.69	1.27		30.95	±.10	1.40		13,840	33,480
EH-30	-S02	-S16	30.00	1.18	32.28		2.49 - 2.69	1.27		32.00		1.40		14,610	34,640
EH-31	-S02	-S16	31.00	1.22	33.32		2.49 - 2.69	1.27		33.05		1.40		15,550	35,790
EH-32	-S02	-S16	32.00	1.26	34.23		2.49 - 2.69	1.27		34.00		1.40		15,880	36,950
EH-34	-S02	-S16	34.00	1.34	36.46		2.87 - 3.07	1.27		36.20		1.40		18,210	39,260
EH-35	-S02	-S16	35.00	1.38	37.55		2.87 - 3.07	1.27		37.30		1.40		19,600	40,410
EH-36	-S02	-S16	36.00	1.42	38.68		2.87 - 3.07	1.27		38.40		1.40		21,040	41,560
EH-37	-S02	-S16	37.00	1.46	39.60		2.87 - 3.07	1.27		39.40		1.40		21,620	42,720
EH-38	-S02	-S16	38.00	1.50	40.77		2.87 - 3.07	1.27		40.50		1.40		23,130	43,870
EH-40	-S02	-S16	40.00	1.58	42.91	+.51/-.00	3.12 - 3.33	1.57	±.75	42.50		1.75		24,350	57,090
EH-42	-S02	-S16	42.00	1.65	45.01		3.12 - 3.33	1.57		44.60		1.75		26,590	59,950
EH-45	-S02	-S16	45.00	1.77	48.13		3.12 - 3.33	1.57		47.70		1.75		29,590	64,230
EH-46	-S02	-S16	46.00	1.81	49.28		3.12 - 3.33	1.57		48.80		1.75		31,370	65,660
EH-47	-S02	-S16	47.00	1.85	50.32		3.89 - 4.09	1.57		49.90		1.75		33,190	67,080
EH-48	-S02	-S16	48.00	1.89	51.46		3.89 - 4.09	1.57		51.00		1.75		35,070	68,510
EH-50	-S02	-S16	50.00	1.97	53.66		3.89 - 4.09	1.57		53.20		1.75		38,960	71,370
EH-52	-S02	-S16	52.00	2.05	54.30	+.50/-.00	3.12 - 3.33	1.25	±.08	53.79	±.125	1.42		22,790	59,090
EH-53	-S02	-S16	53.00	2.09	55.32		3.12 - 3.33	1.25		54.79		1.42		23,230	60,230
EH-55	-S02	-S16	55.00	2.17	57.38	+.63/-.00	3.38 - 3.58	1.25		56.85	±.15	1.42		24,910	62,500
EH-56	-S02	-S16	56.00	2.21	58.40		3.38 - 3.58	1.25		57.85		1.42		25,360	63,640
EH-58	-S02	-S16	58.00	2.28	60.43		3.38 - 3.58	1.25		59.85		1.42		26,270	65,910
EH-59	-S02	-S16	59.00	2.32	61.54		3.38 - 3.58	1.25		60.93		1.42		27,870	67,050
EH-60	-S02	-S16	60.00	2.36	62.57		3.38 - 3.58	1.25		61.99		1.42		29,220	68,180
EH-61	-S02	-S16	61.00	2.40	63.65		3.63 - 3.84	1.25		63.09		1.42		31,190	69,320
EH-62	-S02	-S16	62.00	2.44	64.70		3.63 - 3.84	1.25		64.09		1.42		31,700	70,460
EH-63	-S02	-S16	63.00	2.48	65.70		3.63 - 3.84	1.25		65.09		1.42		32,220	71,590
EH-64	-S02	-S16	64.00	2.52	66.77		3.63 - 3.84	1.25		66.19		1.42		34,290	72,730

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] No removal notch.
[4] Square edge wire.
* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

EH Series

Metric Aerospace Rings Internal Continued

Smalley Part Number			Housing Diameter		Ring					Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	Add Suffix 316 SS	mm	in	Outside Diameter (mm)		Radial Wall (mm)	Thickness (mm)		Diameter (mm)		Width (mm)		Groove Yield[1] (N)	Ring Shear[2] (N)
EH-65	-S02	-S16	65.00	2.56	67.82	+.63/-.00	3.63 - 3.84	1.25	±.08	67.19	±.15	1.42	+.10/-.00	34,820	73,870
EH-66	-S02	-S16	66.00	2.60	68.80		3.63 - 3.84	1.25		68.19		1.42		35,360	75,000
EH-67	-S02	-S16	67.00	2.64	69.90		3.63 - 3.84	1.25		69.25		1.42		36,870	76,140
EH-68	-S02	-S16	68.00	2.68	70.94		3.89 - 4.09	1.25		70.29		1.42		38,090	77,270
EH-69	-S02	-S16	69.00	2.72	71.94		3.89 - 4.09	1.25		71.29		1.42		38,650	78,410
EH-70	-S02	-S16	70.00	2.76	72.94		3.89 - 4.09	1.25		72.29		1.42		39,210	79,550
EH-71	-S02	-S16	71.00	2.80	73.99		3.89 - 4.09	1.25		73.29		1.42		39,770	80,680
EH-72	-S02	-S16	72.00	2.83	75.04		4.11 - 4.39	1.25		74.39		1.42		40,910	81,510
EH-75	-S02	-S16	75.00	2.95	78.07		4.11 - 4.39	1.25		77.39		1.42		43,830	85,230
EH-78	-S02	-S16	78.00	3.07	81.21	+.76/-.00	4.11 - 4.39	1.55		80.45		1.73	+.13/-.00	46,730	109,910
EH-80	-S02	-S16	80.00	3.15	83.22		4.37 - 4.62	1.55		82.49		1.73		48,700	112,730
EH-82	-S02	-S16	82.00	3.23	85.28		4.37 - 4.62	1.55		84.55		1.73		51,120	115,550
EH-85	-S02	-S16	85.00	3.35	88.38		4.62 - 4.88	1.55		87.65		1.73		55,060	119,780
EH-88	-S02	-S16	88.00	3.46	91.45		4.62 - 4.88	1.55		90.69		1.73		57,860	124,000
EH-90	-S02	-S16	90.00	3.54	93.58		4.88 - 5.13	1.55		92.79		1.73		61,370	126,820
EH-92	-S02	-S16	92.00	3.62	95.66		4.88 - 5.13	1.55		94.85		1.73		64,070	129,640
EH-95	-S02	-S16	95.00	3.74	98.69		4.88 - 5.13	1.55		97.85		1.73		66,160	133,870
EH-98	-S02	-S16	98.00	3.86	101.83		5.13 - 5.38	1.55		100.99		1.73		71,590	138,090
EH-100	-S02	-S16	100.00	3.94	103.83		5.13 - 5.38	1.55		102.99		1.73		73,050	140,910
EH-102	-S02	-S16	102.00	4.02	106.00		5.38 - 5.64	1.55		105.15		1.73		78,490	143,730
EH-105	-S02	-S16	105.00	4.13	109.00	+.90/-.00	5.38 - 5.64	1.55		108.15		1.73		80,800	147,960
EH-108	-S02	-S16	108.00	4.25	112.22		5.64 - 5.89	1.55		111.31		1.73		87,310	152,190
EH-110	-S02	-S16	110.00	4.33	114.25		5.64 - 5.89	1.55		113.31		1.73		88,510	155,000
EH-112	-S02	-S16	112.00	4.41	116.44		5.89 - 6.15	1.55		115.45		1.73		94,370	157,820
EH-115	-S02	-S16	115.00	4.53	119.44		5.89 - 6.15	1.55		118.45		1.73		96,890	162,050
EH-120	-S02	-S16	120.00	4.72	124.54	+1.14/-.00	6.20 - 6.45	1.83		123.55	±.18	2.00		104,030	199,640
EH-125	-S02	-S16	125.00	4.92	129.59		6.20 - 6.45	1.83		128.55		2.00		108,360	207,960
EH-130	-S02	-S16	130.00	5.12	134.71		6.20 - 6.45	1.83		133.65		2.00		115,860	216,280
EH-135	-S02	-S16	135.00	5.31	139.74		6.20 - 6.45	1.83		138.62		2.00		119,000	224,600
EH-140	-S02	-S16	140.00	5.51	144.87		6.20 - 6.45	1.83		143.72		2.00		126,820	232,920
EH-145	-S02	-S16	145.00	5.71	150.04		6.20 - 6.45	1.83		148.82		2.00		134,880	241,230
EH-150	-S02	-S16	150.00	5.91	155.07		6.20 - 6.45	1.83		153.82		2.00		139,530	249,550
EH-155	-S02	-S16	155.00	6.10	160.72	+1.40/-.00	7.72 - 8.03	2.18	±.10	159.40	±.20	2.40	+.15/-.00	166,080	307,190
EH-160	-S02	-S16	160.00	6.30	165.74		7.72 - 8.03	2.18		164.40		2.40		171,433	317,100
EH-165	-S02	-S16	165.00	6.50	170.77		7.72 - 8.03	2.18		169.40		2.40		176,790	327,010
EH-170	-S02	-S16	170.00	6.69	176.05		7.72 - 8.03	2.18		174.60		2.40		190,430	336,920
EH-175	-S02	-S16	175.00	6.89	181.05		7.72 - 8.03	2.18		179.60		2.40		196,030	346,830
EH-180	-S02	-S16	180.00	7.09	186.38		7.72 - 8.03	2.18		184.88		2.40		213,900	356,740
EH-185	-S02	-S16	185.00	7.28	191.10	+1.65/-.00	7.72 - 8.03	2.18		189.88		2.40		219,840	366,650
EH-190	-S02	-S16	190.00	7.48	196.45		7.72 - 8.03	2.18		194.88		2.40		225,790	376,560
EH-195	-S02	-S16	195.00	7.68	201.74		7.72 - 8.03	2.18		200.14		2.40		244,070	386,460
EH-200	-S02	-S16	200.00	7.87	206.76		7.72 - 8.03	2.18		205.14		2.40		250,330	396,370
EH-210	-S02	-S16	210.00	8.27	217.10		9.32 - 9.63	2.18		215.40		2.40		276,140	416,490
EH-220	-S02	-S16	220.00	8.66	227.40		9.32 - 9.63	2.18		225.64		2.40		257,150	436,010
EH-230	-S02	-S16	230.00	9.06	237.73		9.32 - 9.63	2.18		235.90		2.40		330,450	455,830
EH-240	-S02	-S16	240.00	9.45	247.80		9.32 - 9.63	2.18		245.90		2.40		344,810	475,650
EH-250	-S02	-S16	250.00	9.84	258.10		9.32 - 9.63	2.18		256.16		2.40		375,010	495,470
EH-260	-S02	-S16	260.00	10.24	268.43		9.32 - 9.63	2.18		266.40		2.40		405,210	515,290
EH-270	-S02	-S16	270.00	10.63	278.50		9.32 - 9.63	2.18		276.40		2.40		420,790	535,100
EH-280	-S02	-S16	280.00	11.02	288.82		9.32 - 9.63	2.18		286.66		2.40		454,100	554,920

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.

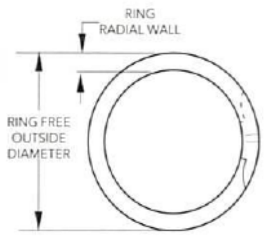
* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

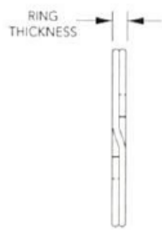
Retaining Rings

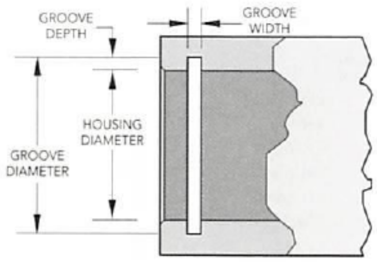
DNH Series

Metric DIN Rings Internal

**Groove compliance with DIN 472*







Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number			Housing Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	Add Suffix 316 SS	mm	in	Outside Diameter (mm)		Radial Wall (mm)		Thickness (mm)		Diameter (mm)		Width (mm)		Groove Yield[1] (N)	Ring Shear[2] (N)
DNH-13	-S02	-S16	13.00	.51	13.72	+.33/-.00	1.40	±.10	.99	±.05	13.60	+.11/-.00	1.10	+.14/-.00	1,901	13,474
DNH-14	-S02	-S16	14.00	.55	14.75		1.40		.99		14.60		1.10		2,047	14,510
DNH-15	-S02	-S16	15.00	.59	15.85		1.40		.99		15.70		1.10		2,559	15,547
DNH-16	-S02	-S16	16.00	.63	16.97		1.65		.99		16.80		1.10		3,119	16,583
DNH-17	-S02	-S16	17.00	.67	17.98		1.65		.99		17.80		1.10		3,314	17,620
DNH-18	-S02	-S16	18.00	.71	19.18		1.91		.99		19.00	+.13/-.00	1.10		4,386	18,656
DNH-19	-S02	-S16	19.00	.75	20.19		1.91		.99		20.00		1.10		4,630	19,693
DNH-20	-S02	-S16	20.00	.79	21.21		1.91		.99		21.00		1.10		4,874	20,729
DNH-21	-S02	-S16	21.00	.83	22.23		1.91		.99		22.00		1.10		5,117	21,766
DNH-22	-S02	-S16	22.00	.87	23.23		1.91		.99		23.00		1.10		5,361	22,802
DNH-23	-S02	-S16	23.00	.91	24.33	+.38/-.00	2.18		1.14		24.10	+.21/-.00	1.30		6,165	23,853
DNH-24	-S02	-S16	24.00	.94	25.45		2.18		1.14		25.20		1.30		7,018	24,891
DNH-25	-S02	-S16	25.00	.98	26.45		2.18		1.14		26.20		1.30		7,310	25,928
DNH-26	-S02	-S16	26.00	1.02	27.48		2.18		1.14		27.20		1.30		7,603	26,965
DNH-27	-S02	-S16	27.00	1.06	28.68		2.41		1.14		28.40		1.30		9,211	28,002
DNH-28	-S02	-S16	28.00	1.10	29.69		2.41		1.14		29.40		1.30		9,552	29,039
DNH-29	-S02	-S16	29.00	1.14	30.71		2.41		1.14		30.40	+.25/-.00	1.30		9,893	30,076
DNH-30	-S02	-S16	30.00	1.18	31.71		2.41		1.14		31.40		1.30		10,235	31,113
DNH-31	-S02	-S16	31.00	1.22	33.02		2.41		1.14		32.70		1.30		12,842	32,150
DNH-32	-S02	-S16	32.00	1.26	34.04		2.41		1.14		33.70		1.30		13,256	33,187
DNH-33	-S02	-S16	33.00	1.30	35.05		2.41		1.14		34.70		1.30		13,670	34,224
DNH-34	-S02	-S16	34.00	1.34	36.07		3.25		1.44		35.70		1.60		14,085	44,541
DNH-35	-S02	-S16	35.00	1.38	37.38		3.25		1.44		37.00		1.60		17,058	45,851
DNH-36	-S02	-S16	36.00	1.42	38.39		3.25		1.44		38.00		1.60		17,545	47,161
DNH-37	-S02	-S16	37.00	1.46	39.40		3.25		1.44		39.00		1.60		18,032	48,471
DNH-38	-S02	-S16	38.00	1.50	40.41		3.25		1.44		40.00		1.60		18,520	49,781
DNH-40	-S02	-S16	40.00	1.57	42.93	+.51/-.00	4.01		1.69		42.50		1.85		24,368	61,498
DNH-41	-S02	-S16	41.00	1.61	43.94		4.01		1.69		43.50		1.85		24,977	63,036
DNH-42	-S02	-S16	42.00	1.65	44.96		4.01		1.69		44.50		1.85		25,586	64,573
DNH-45	-S02	-S16	45.00	1.77	47.98		4.01		1.69		47.50		1.85		27,414	69,186
DNH-47	-S02	-S16	47.00	1.85	49.99		4.01		1.69		49.50		1.85		28,633	72,261
DNH-48	-S02	-S16	48.00	1.89	51.00		4.01		1.69		50.50		1.85		29,242	73,798
DNH-50	-S02	-S16	50.00	1.97	53.54	+.63/-.00	5.08	±.12	1.93	±.08	53.00	+.30/-.00	2.15		36,552	87,790
DNH-51	-S02	-S16	51.00	2.01	54.54		5.08		1.93		54.00		2.15		37,283	89,546
DNH-52	-S02	-S16	52.00	2.05	55.55		5.08		1.93		55.00		2.15		38,014	91,302
DNH-55	-S02	-S16	55.00	2.17	58.57		5.08		1.93		58.00		2.15		40,207	96,569
DNH-56	-S02	-S16	56.00	2.20	59.59		5.08		1.93		59.00		2.15		40,938	98,325
DNH-57	-S02	-S16	57.00	2.24	60.60		5.08		1.93		60.00		2.15		41,669	100,081
DNH-58	-S02	-S16	58.00	2.28	61.62		5.08		1.93		61.00		2.15		42,400	101,836
DNH-60	-S02	-S16	60.00	2.36	63.63		5.08		1.93		63.00		2.15		43,863	105,348
DNH-62	-S02	-S16	62.00	2.44	65.66		5.08		1.93		65.00		2.15		45,325	108,860
DNH-63	-S02	-S16	63.00	2.48	66.67		5.08		1.93		66.00		2.15		46,056	110,615
DNH-64	-S02	-S16	64.00	2.52	67.67	+.76/-.00	5.08		1.93		67.00		2.15		46,787	112,371
DNH-65	-S02	-S16	65.00	2.56	68.67		5.08		2.41		68.00		2.65		47,518	135,725
DNH-67	-S02	-S16	67.00	2.64	70.67		5.08		2.41		70.00		2.65		48,980	139,901
DNH-68	-S02	-S16	68.00	2.68	71.67		5.08		2.41		71.00		2.65		49,711	141,989
DNH-70	-S02	-S16	70.00	2.76	73.67		5.08		2.41		73.00		2.65		51,173	146,165
DNH-72	-S02	-S16	72.00	2.83	75.67		5.08		2.41		75.00		2.65		52,635	150,341
DNH-75	-S02	-S16	75.00	2.95	78.68		5.08		2.41		78.00		2.65		54,828	156,605
DNH-76	-S02	-S16	76.00	2.99	79.68		5.08		2.41		79.00		2.65		55,559	158,694

[1] Based on a groove material yield strength of 310 N/mm^2 and a safety factor of 2.
[2] Based on a safety factor of 3.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

DNH Series

Metric DIN Rings Internal Continued

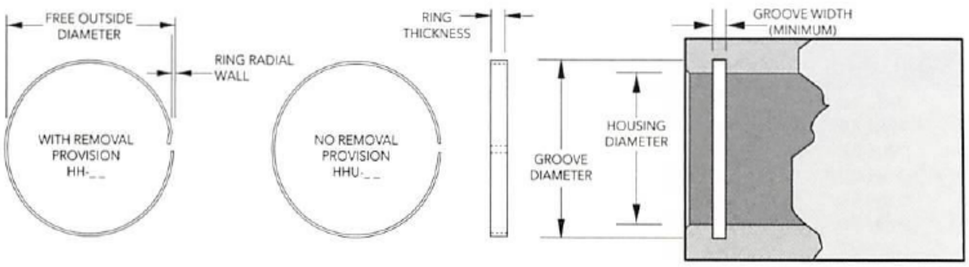
Smalley Part Number			Housing Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	Add Suffix 316 SS	mm	in	Outside Diameter (mm)		Radial Wall (mm)		Thickness (mm)		Diameter (mm)		Width (mm)		Groove Yield[1] (N)	Ring Shear[2] (N)
DNH-78	-S02	-S16	78.00	3.07	81.69		5.08	±.12	2.41		81.00		2.65		57,021	162,870
DNH-80	-S02	-S16	80.00	3.15	84.19	+.76/-.00	6.05		2.41		83.50		2.65	+.14/-.00	68,231	167,046
DNH-82	-S02	-S16	82.00	3.23	86.20		6.05		2.41		85.50		2.65		69,936	171,222
DNH-85	-S02	-S16	85.00	3.35	89.20		6.05		2.91		88.50		3.15		72,495	214,309
DNH-88	-S02	-S16	88.00	3.46	92.21		6.05		2.91	±.08	91.50	+.35/-.00	3.15		75,054	221,873
DNH-90	-S02	-S16	90.00	3.54	94.21		6.05		2.91		93.50		3.15		76,759	226,915
DNH-92	-S02	-S16	92.00	3.62	96.22	+.89/-.00	6.05		2.91		95.50		3.15		78,465	231,958
DNH-95	-S02	-S16	95.00	3.74	99.24		6.05		2.91		98.50		3.15		81,024	239,522
DNH-98	-S02	-S16	98.00	3.86	102.26		6.05		2.91		101.50		3.15		83,583	247,086
DNH-100	-S02	-S16	100.00	3.94	104.29		6.05		2.91		103.50		3.15		85,288	252,128
DNH-102	-S02	-S16	102.00	4.02	106.79		6.73		3.89		106.00		4.15		99,422	343,778
DNH-105	-S02	-S16	105.00	4.13	109.79		6.73	±.13	3.89		109.00		4.15		102,346	353,889
DNH-108	-S02	-S16	108.00	4.25	112.80		6.73		3.89		112.00	+.54/-.00	4.15		105,270	364,000
DNH-110	-S02	-S16	110.00	4.33	114.83		6.73		3.89		114.00		4.15		107,220	370,741
DNH-112	-S02	-S16	112.00	4.41	116.84		6.73		3.89		116.00		4.15		109,169	377,482
DNH-115	-S02	-S16	115.00	4.53	119.86		6.73		3.89		119.00		4.15		112,093	387,593
DNH-120	-S02	-S16	120.00	4.72	124.92	+1.30/-.00	6.73		3.89		124.00		4.15		116,967	404,445
DNH-125	-S02	-S16	125.00	4.92	129.97		6.73		3.89		129.00		4.15		121,840	421,297
DNH-127	-S02	-S16	127.00	5.00	131.97		6.73		3.89		131.00		4.15		123,790	428,038
DNH-130	-S02	-S16	130.00	5.12	135.00		6.73		3.89		134.00		4.15		126,714	438,149
DNH-135	-S02	-S16	135.00	5.31	140.03		6.73		3.89		139.00		4.15		131,588	455,001
DNH-140	-S02	-S16	140.00	5.51	145.11		6.73		3.89	±.10	144.00		4.15		136,461	471,852
DNH-145	-S02	-S16	145.00	5.71	150.11		6.73		3.89		149.00	+.63/-.00	4.15		141,335	488,704
DNH-150	-S02	-S16	150.00	5.91	156.13		7.92		3.89		155.00		4.15	+.18/-.00	182,761	505,556
DNH-155	-S02	-S16	155.00	6.10	161.19		7.92		3.89		160.00		4.15		188,853	522,408
DNH-160	-S02	-S16	160.00	6.30	166.22		7.92		3.89		165.00		4.15		194,945	539,260
DNH-165	-S02	-S16	165.00	6.50	171.27	+1.40/-.00	7.92		3.89		170.00		4.15		201,037	556,112
DNH-170	-S02	-S16	170.00	6.69	176.33		7.92		3.89		175.00		4.15		207,129	572,964
DNH-175	-S02	-S16	175.00	6.89	181.36		7.92		3.89		180.00		4.15		213,221	589,815
DNH-180	-S02	-S16	180.00	7.09	186.39		7.92		3.89		185.00		4.15		219,313	606,667
DNH-185	-S02	-S16	185.00	7.28	191.44		7.92		3.89		190.00		4.15		225,405	623,519
DNH-190	-S02	-S16	190.00	7.48	196.47		7.92		3.89		195.00		4.15		231,497	640,371
DNH-195	-S02	-S16	195.00	7.68	201.52		7.92		3.89		200.00		4.15		237,589	657,223
DNH-200	-S02	-S16	200.00	7.87	206.58		7.92	±.15	3.89		205.00	+.72/-.00	4.15		243,681	674,075
DNH-210	-S02	-S16	210.00	8.27	217.58		9.53		4.86		216.00		5.15		307,038	884,268
DNH-220	-S02	-S16	220.00	8.66	227.66	+1.78/-.00	9.53		4.86		226.00		5.15		321,659	926,376
DNH-230	-S02	-S16	230.00	9.06	237.72		9.53		4.86		236.00		5.15		336,280	968,484
DNH-240	-S02	-S16	240.00	9.45	247.80		9.53		4.86		246.00		5.15		350,900	1,010,592
DNH-250	-S02	-S16	250.00	9.84	257.89		9.53		4.86		256.00		5.15		365,521	1,052,700
DNH-260	-S02	-S16	260.00	10.24	269.93		11.18		4.86		268.00		5.15		506,856	1,094,808
DNH-270	-S02	-S16	270.00	10.63	280.01		11.18		4.86		278.00		5.15		526,351	1,136,916
DNH-280	-S02	-S16	280.00	11.02	290.09		11.18		4.86		288.00	+.81/-.00	5.15		545,845	1,179,024
DNH-290	-S02	-S16	290.00	11.42	300.15		11.18		4.86		298.00		5.15		565,340	1,221,132
DNH-300	-S02	-S16	300.00	11.81	310.24	+3.05/-.00	11.18		4.86	±.13	308.00		5.15		584,834	1,263,241
DNH-310	-S02	-S16	310.00	12.20	322.25		12.70		5.87		320.00		6.20		755,411	1,576,625
DNH-320	-S02	-S16	320.00	12.60	332.33		12.70		5.87		330.00		6.20		779,779	1,627,484
DNH-330	-S02	-S16	330.00	12.99	342.42		12.70		5.87		340.00		6.20		804,147	1,678,342
DNH-340	-S02	-S16	340.00	13.39	352.50		12.70		5.87		350.00		6.20		828,515	1,729,201
DNH-350	-S02	-S16	350.00	13.78	362.56		12.70	±.19	5.87		360.00	+.89/-.00	6.20	+.22/-.00	852,883	1,780,060
DNH-360	-S02	-S16	360.00	14.17	372.64	+3.56/-.00	12.70		5.87		370.00		6.20		877,251	1,830,919
DNH-370	-S02	-S16	370.00	14.57	382.73		12.70		5.87		380.00		6.20		901,619	1,881,778
DNH-380	-S02	-S16	380.00	14.96	392.79		12.70		5.87		390.00		6.20		925,987	1,932,637
DNH-390	-S02	-S16	390.00	15.35	402.84		12.70		5.87		400.00		6.20		950,355	1,983,496
DNH-400	-S02	-S16	400.00	15.75	412.93		12.70		5.87		410.00		6.20		974,723	2,034,354

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

HH/HHU Series

Hoopster® Rings Internal



Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number[3,4] Carbon Steel	Add Suffix 302 SS	Housing Diameter in	Housing Diameter mm	Ring Outside Diameter (in)		Ring Radial Wall (in)		Ring Thickness (in)		Groove Diameter[2] (in)		Groove Width (in)		Thrust Capacity Groove Yield[1] (lb)
HH-37	-S02	.375	9.525	.400	+.012/-.000	.017	±.0015	.045	±.004	.392	±.002	.050	+.003/-.000	225
HH-43	-S02	.437	11.100	.463		.017		.045		.454		.050		263
HH-46	-S02	.469	11.913	.495		.017		.045		.486		.050		282
HH-50	-S02	.500	12.700	.531	+.015/-.000	.021		.065		.521		.070		371
HH-53	-S02	.531	13.487	.563		.021		.065		.552		.070		394
HH-56	-S02	.562	14.275	.594		.021		.065		.583		.070		417
HH-59	-S02	.594	15.088	.627		.021		.065		.615		.070		441
HH-62	-S02	.625	15.875	.659		.021		.065		.646		.070		464
HH-65	-S02	.656	16.662	.690		.021		.065		.677		.070		487
HH-68	-S02	.688	17.475	.723		.021		.065		.709		.070		511
HH-71	-S02	.718	18.237	.756		.024		.088		.742		.093		609
HH-75	-S02	.750	19.050	.789		.024		.088		.774		.093		636
HH-78	-S02	.781	19.837	.821	+.018/-.000	.024		.088		.805	±.003	.093		662
HH-81	-S02	.812	20.625	.852		.024		.088		.836		.093		689
HH-84	-S02	.843	21.412	.884		.024		.088		.867		.093		715
HH-87	-S02	.875	22.225	.917		.024		.088		.899		.093		742
HH-90	-S02	.906	23.012	.948		.024		.088		.930		.093		768
HH-93	-S02	.938	23.825	.981		.024		.088		.962		.093		796
HH-96	-S02	.968	24.587	1.011		.024		.088		.992		.093		821
HH-100	-S02	1.000	25.400	1.044	+.020/-.000	.024		.088		1.024		.093		848
HH-103	-S02	1.031	26.187	1.082		.030	±.002	.118		1.061		.123	+.004/-.000	1,093
HH-106	-S02	1.062	26.975	1.113		.030		.118		1.092	±.004	.123		1,126
HH-109	-S02	1.093	27.762	1.145		.030		.118		1.123		.123		1,159
HH-112	-S02	1.125	28.575	1.178		.030		.118		1.155		.123		1,193
HH-115	-S02	1.156	29.362	1.209		.030		.118		1.186		.123		1,226
HH-118	-S02	1.188	30.175	1.242		.030		.118		1.218		.123		1,260
HH-121	-S02	1.218	30.937	1.272		.030		.118		1.248		.123		1,291
HH-125	-S02	1.250	31.750	1.305		.030		.118		1.280		.123		1,325
HH-128	-S02	1.281	32.537	1.337		.030		.118		1.311		.123		1,358
HH-131	-S02	1.312	33.325	1.372		.034		.150		1.346		.155		1,577
HH-134	-S02	1.343	34.112	1.404		.034		.150		1.377		.155		1,614
HH-137	-S02	1.375	34.925	1.437		.034		.150		1.409		.155		1,652
HH-140	-S02	1.406	35.712	1.468		.034		.150		1.440		.155		1,690
HH-143	-S02	1.437	36.500	1.500		.034		.150		1.471		.155		1,727
HH-146	-S02	1.468	37.287	1.531		.034		.150		1.502		.155		1,765
HH-150	-S02	1.500	38.100	1.564		.034		.150		1.534		.155		1,802
HH-156	-S02	1.562	39.675	1.627		.034		.150		1.596		.155		1,877
HH-162	-S02	1.625	41.275	1.692	+.024/-.000	.034		.150		1.659	±.005	.155		1,953
HH-168	-S02	1.688	42.875	1.755		.034		.150		1.722		.155		2,028
HH-175	-S02	1.750	44.450	1.823		.038		.187	±.005	1.788		.193		2,350
HH-181	-S02	1.812	46.025	1.887		.038		.187		1.850		.193		2,434
HH-187	-S02	1.875	47.625	1.951		.038		.187		1.913		.193		2,518
HH-193	-S02	1.938	49.225	2.015		.038		.187		1.976		.193		2,603
HH-200	-S02	2.000	50.800	2.078		.038		.187		2.038		.193		2,686
HH-206	-S02	2.062	52.375	2.141		.038		.187		2.100		.193		2,769
HH-212	-S02	2.125	53.975	2.206		.038		.187		2.163		.193		2,854
HH-218	-S02	2.188	55.575	2.270		.038		.187		2.226	±.006	.193		2,939
HH-225	-S02	2.250	57.150	2.333		.038		.187		2.288		.193		3,022
HH-231	-S02	2.312	58.725	2.396		.038		.187		2.350		.193		3,105
HH-237	-S02	2.375	60.325	2.461		.038		.187		2.413		.193		3,190

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Sharp corners on the groove required, see page 142 for more information.
[3] Square edge wire.
[4] Use "HH" prefix for removal provision end. Use "HHU" prefix for no removal provision.

HH/HHU Series

Hoopster® Rings Internal Continued

Smalley Part Number[3,4]		Housing Diameter		Ring						Groove				Thrust Capacity
Carbon Steel	Add Suffix 302 SS	in	mm	Outside Diameter (in)		Radial Wall (in)		Thickness (in)		Diameter[2] (in)		Width (in)		Groove Yield[1] (lb)
HH-243	-S02	2.437	61.900	2.531	+.030/-.000	.045	±.002	.225	±.005	2.482	±.006	.232	+.005/-.000	3,876
HH-250	-S02	2.500	63.500	2.595		.045		.225		2.545		.232		3,976
HH-256	-S02	2.562	65.075	2.658		.045		.225		2.607		.232		4,075
HH-262	-S02	2.625	66.675	2.723		.045		.225		2.670		.232		4,175
HH-268	-S02	2.688	68.275	2.787		.045		.225		2.733		.232		4,275
HH-275	-S02	2.750	69.850	2.850		.045		.225		2.795		.232		4,374
HH-281	-S02	2.812	71.425	2.914		.045		.225		2.858		.232		4,472
HH-287	-S02	2.875	73.025	2.978		.045		.225		2.920		.232		4,572
HH-293	-S02	2.938	74.625	3.041		.045		.225		2.982		.232		4,673
HH-300	-S02	3.000	76.200	3.105		.045		.225		3.045		.232		4,771

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Sharp corners on the groove required, see page 142 for more information.
[3] Square edge wire.
[4] Use "HH" prefix for removal provision end. Use "HHU" prefix for no removal provision.

HHM/HHMU Series

Metric Hoopster® Rings Internal

FREE OUTSIDE DIAMETER
RING RADIAL WALL
WITH REMOVAL PROVISION HHM-__
NO REMOVAL PROVISION HHMU-__
RING THICKNESS
GROOVE WIDTH (MINIMUM)
HOUSING DIAMETER
GROOVE DIAMETER

Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number[3,4] Carbon Steel	Add Suffix 302 SS	Housing Diameter mm	Housing Diameter in	Ring Outside Diameter (mm)	Tol.	Ring Radial Wall (mm)	Tol.	Ring Thickness (mm)	Tol.	Groove Diameter[2] (mm)	Tol.	Groove Width (mm)	Tol.	Thrust Capacity Groove Yield[1] (N)
HHM-10	-S02	10.00	.39	10.63	+.30/-.00	.43	±.04	1.14	±.10	10.43	±.05	1.27	+.08/-.00	1,052
HHM-11	-S02	11.00	.43	11.65	+.30/-.00	.43	±.04	1.14	±.10	11.43	±.05	1.27	+.08/-.00	1,157
HHM-12	-S02	12.00	.47	12.67	+.30/-.00	.43	±.04	1.14	±.10	12.43	±.05	1.27	+.08/-.00	1,263
HHM-13	-S02	13.00	.51	13.79	+.38/-.00	.53	±.04	1.65	±.10	13.53	±.05	1.78	+.08/-.00	1,690
HHM-14	-S02	14.00	.55	14.81	+.38/-.00	.53	±.04	1.65	±.10	14.53	±.05	1.78	+.08/-.00	1,820
HHM-15	-S02	15.00	.59	15.83	+.38/-.00	.53	±.04	1.65	±.10	15.53	±.05	1.78	+.08/-.00	1,950
HHM-16	-S02	16.00	.63	16.85	+.38/-.00	.53	±.04	1.65	±.10	16.53	±.05	1.78	+.08/-.00	2,080
HHM-17	-S02	17.00	.67	17.87	+.38/-.00	.53	±.04	1.65	±.10	17.53	±.05	1.78	+.08/-.00	2,210
HHM-18	-S02	18.00	.71	18.97	+.38/-.00	.61	±.04	2.24	±.10	18.61	±.05	2.36	+.08/-.00	2,674
HHM-19	-S02	19.00	.75	19.99	+.38/-.00	.61	±.04	2.24	±.10	19.61	±.05	2.36	+.08/-.00	2,822
HHM-20	-S02	20.00	.79	21.01	+.46/-.00	.61	±.04	2.24	±.10	20.61	±.08	2.36	+.08/-.00	2,971
HHM-21	-S02	21.00	.83	22.03	+.46/-.00	.61	±.04	2.24	±.10	21.61	±.08	2.36	+.08/-.00	3,119
HHM-22	-S02	22.00	.87	23.05	+.46/-.00	.61	±.04	2.24	±.10	22.61	±.08	2.36	+.08/-.00	3,268
HHM-23	-S02	23.00	.91	24.07	+.46/-.00	.61	±.04	2.24	±.10	23.61	±.08	2.36	+.08/-.00	3,417
HHM-24	-S02	24.00	.94	25.09	+.46/-.00	.61	±.04	2.24	±.10	24.61	±.08	2.36	+.08/-.00	3,565
HHM-25	-S02	25.00	.98	26.11	+.46/-.00	.61	±.04	2.24	±.10	25.61	±.08	2.36	+.08/-.00	3,714
HHM-26	-S02	26.00	1.02	27.28	+.51/-.00	.76	±.05	3.00	±.10	26.76	±.08	3.12	+.08/-.00	4,828
HHM-27	-S02	27.00	1.06	28.30	+.51/-.00	.76	±.05	3.00	±.10	27.76	±.10	3.12	+.10/-.00	5,013
HHM-28	-S02	28.00	1.10	29.32	+.51/-.00	.76	±.05	3.00	±.10	28.76	±.10	3.12	+.10/-.00	5,199
HHM-29	-S02	29.00	1.14	30.34	+.51/-.00	.76	±.05	3.00	±.10	29.76	±.10	3.12	+.10/-.00	5,385
HHM-30	-S02	30.00	1.18	31.36	+.51/-.00	.76	±.05	3.00	±.10	30.76	±.10	3.12	+.10/-.00	5,570
HHM-31	-S02	31.00	1.22	32.38	+.51/-.00	.76	±.05	3.00	±.10	31.76	±.10	3.12	+.10/-.00	5,756
HHM-32	-S02	32.00	1.26	33.40	+.51/-.00	.76	±.05	3.00	±.10	32.76	±.10	3.12	+.10/-.00	5,942
HHM-33	-S02	33.00	1.30	34.52	+.51/-.00	.86	±.05	3.81	±.10	33.86	±.10	3.94	+.10/-.00	6,945
HHM-34	-S02	34.00	1.34	35.54	+.51/-.00	.86	±.05	3.81	±.10	34.86	±.10	3.94	+.10/-.00	7,155
HHM-35	-S02	35.00	1.38	36.56	+.51/-.00	.86	±.05	3.81	±.10	35.86	±.10	3.94	+.10/-.00	7,365
HHM-36	-S02	36.00	1.42	37.58	+.51/-.00	.86	±.05	3.81	±.10	36.86	±.10	3.94	+.10/-.00	7,576
HHM-37	-S02	37.00	1.46	38.60	+.51/-.00	.86	±.05	3.81	±.10	37.86	±.10	3.94	+.10/-.00	7,786
HHM-38	-S02	38.00	1.50	39.62	+.51/-.00	.86	±.05	3.81	±.10	38.86	±.10	3.94	+.10/-.00	7,997
HHM-40	-S02	40.00	1.57	41.66	+.51/-.00	.86	±.05	3.81	±.10	40.86	±.10	3.94	+.10/-.00	8,418
HHM-41	-S02	41.00	1.61	42.68	+.61/-.00	.86	±.05	3.81	±.10	41.86	±.10	3.94	+.10/-.00	8,628
HHM-42	-S02	42.00	1.65	43.70	+.61/-.00	.86	±.05	3.81	±.10	42.86	±.10	3.94	+.10/-.00	8,838
HHM-45	-S02	45.00	1.77	46.87	+.61/-.00	.97	±.05	4.75	±.13	45.97	±.13	4.88	+.10/-.00	10,584
HHM-47	-S02	47.00	1.85	48.91	+.61/-.00	.97	±.05	4.75	±.13	47.97	±.13	4.88	+.10/-.00	11,054
HHM-48	-S02	48.00	1.89	49.93	+.61/-.00	.97	±.05	4.75	±.13	48.97	±.13	4.88	+.10/-.00	11,289
HHM-50	-S02	50.00	1.97	51.97	+.61/-.00	.97	±.05	4.75	±.13	50.97	±.13	4.88	+.10/-.00	11,760
HHM-51	-S02	51.00	2.01	52.99	+.61/-.00	.97	±.05	4.75	±.13	51.97	±.13	4.88	+.10/-.00	11,995
HHM-52	-S02	52.00	2.05	54.01	+.61/-.00	.97	±.05	4.75	±.13	52.97	±.13	4.88	+.10/-.00	12,230
HHM-55	-S02	55.00	2.17	57.07	+.61/-.00	.97	±.05	4.75	±.13	55.97	±.15	4.90	+.10/-.00	12,936
HHM-56	-S02	56.00	2.20	58.09	+.61/-.00	.97	±.05	4.75	±.13	56.97	±.15	4.90	+.10/-.00	13,171
HHM-57	-S02	57.00	2.24	59.11	+.61/-.00	.97	±.05	4.75	±.13	57.97	±.15	4.90	+.10/-.00	13,406
HHM-58	-S02	58.00	2.28	60.13	+.61/-.00	.97	±.05	4.75	±.13	58.97	±.15	4.90	+.10/-.00	13,641
HHM-60	-S02	60.00	2.36	62.17	+.61/-.00	.97	±.05	4.75	±.13	60.97	±.15	4.90	+.10/-.00	14,112
HHM-62	-S02	62.00	2.44	64.38	+.76/-.00	1.14	±.05	5.72	±.13	63.14	±.15	5.87	+.10/-.00	17,268
HHM-63	-S02	63.00	2.48	65.40	+.76/-.00	1.14	±.05	5.72	±.13	64.14	±.15	5.87	+.10/-.00	17,547
HHM-64	-S02	64.00	2.52	66.42	+.76/-.00	1.14	±.05	5.72	±.13	65.14	±.15	5.87	+.13/-.00	17,826
HHM-65	-S02	65.00	2.56	67.44	+.76/-.00	1.14	±.05	5.72	±.13	66.14	±.15	5.87	+.13/-.00	18,104
HHM-67	-S02	67.00	2.64	69.48	+.76/-.00	1.14	±.05	5.72	±.13	68.14	±.15	5.87	+.13/-.00	18,661
HHM-68	-S02	68.00	2.68	70.50	+.76/-.00	1.14	±.05	5.72	±.13	69.14	±.15	5.87	+.13/-.00	18,940
HHM-70	-S02	70.00	2.76	72.54	+.76/-.00	1.14	±.05	5.72	±.13	71.14	±.15	5.87	+.13/-.00	19,497

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Sharp corners on the groove required, see page 142 for more information.
[3] Square edge wire.
[4] Use "HHM" prefix for removal provision end. Use "HHMU" prefix for no removal provision.

HHM/HHMU Series

Metric Hoopster® Rings Internal Continued

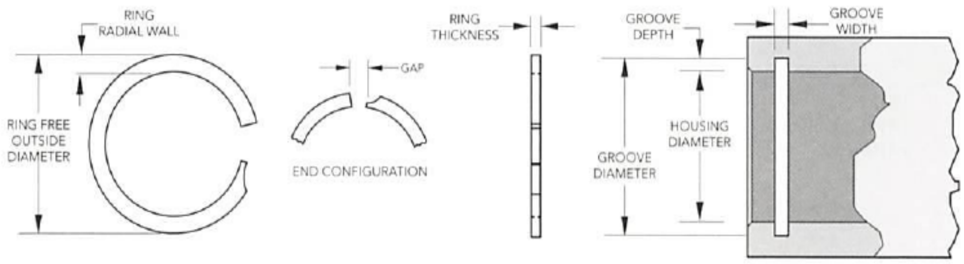
Smalley Part Number[3,4]		Housing Diameter		Ring						Groove				Thrust Capacity
Carbon Steel	Add Suffix 302 SS	mm	in	Outside Diameter (mm)	Tol.	Radial Wall (mm)	Tol.	Thickness (mm)	Tol.	Diameter[2] (mm)	Tol.	Width (mm)	Tol.	Groove Yield[1] (N)
HHM-72	**-S02**	72.00	2.83	74.58	+.76/-.00	1.14	±.05	5.72	±.013	73.14	±.15	5.87	+.13/-.00	20,054
HHM-75	**-S02**	75.00	2.95	77.64		1.14		5.72		76.14		5.87		20,889
HHM-76	**-S02**	76.00	2.99	78.66		1.14		5.72		77.14		5.87		21,168

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Sharp corners on the groove required, see page 142 for more information.
[3] Square edge wire.
[4] Use "HHM" prefix for removal provision end. Use "HHMU" prefix for no removal provision.

FHE Series

Constant Section Rings Internal

*Groove compliance with DIN 472



Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number[3] Carbon Steel	Add Suffix 302 SS	Housing Diameter in	Housing Diameter mm	Ring Outside Diameter (in)	Outside Diameter tolerance	Ring Radial Wall (in)	Radial Wall tolerance	Ring Thickness (in)	Thickness tolerance	Groove Diameter (in)	Groove Diameter tolerance	Groove Width (in)	Groove Width tolerance	Thrust Capacity Groove Yield[1] (lb)	Thrust Capacity Ring Shear[2] (lb)
FHE-0050	-S02	.500	12.700	.529	+.013/-.000	.055	±.004	.037	±.002	.524	+.004/-.000	.043	+.006/-.000	424	2,325
FHE-0056	-S02	.562	14.275	.591		.055		.037		.586		.043		477	2,613
FHE-0062	-S02	.625	15.875	.665		.065		.037		.657		.043		707	2,906
FHE-0068	-S02	.687	17.450	.726		.065		.037		.719		.043		777	3,194
FHE-0075	-S02	.750	19.050	.797		.075		.037		.790	+.005/-.000	.043		1,060	3,487
FHE-0081	-S02	.812	20.625	.860		.075		.037		.852		.043		1,148	3,775
FHE-0087	-S02	.875	22.225	.924		.075		.037		.915		.043		1,237	4,068
FHE-0093	-S02	.937	23.800	1.000	+.015/-.000	.085		.045		.985	+.008/-.000	.051		1,590	5,334
FHE-0100	-S02	1.000	25.400	1.058		.085		.045		1.048		.051		1,696	5,693
FHE-0106	-S02	1.062	26.975	1.121		.094		.045		1.110		.051		1,802	6,045
FHE-0112	-S02	1.125	28.575	1.192		.094		.045		1.181		.051		2,227	6,404
FHE-0118	-S02	1.187	30.150	1.252		.094		.045		1.243	+.010/-.000	.051		2,349	6,757
FHE-0125	-S02	1.250	31.750	1.336		.094		.045		1.316		.051		2,916	7,116
FHE-0131	-S02	1.312	33.325	1.391		.094		.045		1.378		.051		3,060	7,469
FHE-0137	-S02	1.375	34.925	1.470		.128		.057		1.453		.063		3,791	9,307
FHE-0143	-S02	1.437	36.500	1.529		.128		.057		1.515		.063		3,961	9,727
FHE-0150	-S02	1.500	38.100	1.592		.128		.057		1.578		.063		4,135	10,153
FHE-0156	-S02	1.562	39.675	1.687	+.020/-.000	.158		.067		1.666		.073		5,741	12,400
FHE-0162	-S02	1.625	41.275	1.746		.158		.067		1.729		.073		5,973	12,901
FHE-0168	-S02	1.687	42.850	1.808		.158		.067		1.791		.073		6,201	13,393
FHE-0175	-S02	1.750	44.450	1.885		.158		.067		1.862		.073		6,927	13,893
FHE-0181	-S02	1.812	46.025	1.942		.158		.067		1.924		.073		7,173	14,385
FHE-0187	-S02	1.875	47.625	2.007		.158		.067		1.987	+.012/-.000	.073		7,422	14,885
FHE-0193	-S02	1.937	49.200	2.074	+.025/-.000	.200	±.005	.076	±.003	2.055		.085		8,078	16,649
FHE-0200	-S02	2.000	50.800	2.143		.200		.076		2.118		.085		8,341	17,191
FHE-0206	-S02	2.062	52.375	2.200		.200		.076		2.180		.085		8,599	17,724
FHE-0212	-S02	2.125	53.975	2.264		.200		.076		2.243		.085		8,862	18,265
FHE-0218	-S02	2.187	55.550	2.327		.200		.076		2.305		.085		9,121	18,798
FHE-0225	-S02	2.250	57.150	2.389		.200		.076		2.368		.085		9,384	19,340
FHE-0231	-S02	2.312	58.725	2.453		.200		.076		2.430		.085		9,642	19,873
FHE-0237	-S02	2.375	60.325	2.517		.200		.076		2.493		.085		9,905	20,414
FHE-0243	-S02	2.437	61.900	2.582		.200		.076		2.555		.085		10,163	20,947
FHE-0250	-S02	2.500	63.500	2.643		.200		.076		2.618		.085		10,426	21,488
FHE-0256	-S02	2.562	65.075	2.705	+.030/-.000	.200		.095		2.680		.104		10,685	26,225
FHE-0262	-S02	2.625	66.675	2.777		.200		.095		2.743		.104		10,947	26,870
FHE-0268	-S02	2.687	68.250	2.828		.200		.095		2.805		.104		11,206	27,504
FHE-0275	-S02	2.750	69.850	2.899		.200		.095		2.868		.104		11,469	28,149
FHE-0281	-S02	2.812	71.425	2.958		.200		.095		2.930		.104		11,727	28,784
FHE-0287	-S02	2.875	73.025	3.022		.200		.095		2.993		.104		11,990	29,429
FHE-0293	-S02	2.937	74.600	3.084		.200		.095		3.055		.104		12,249	30,063
FHE-0300	-S02	3.000	76.200	3.145		.200		.095		3.118		.104		12,511	30,708
FHE-0306	-S02	3.062	77.775	3.218		.200		.095		3.184	+.013/-.000	.104		13,203	31,343
FHE-0312	-S02	3.125	79.375	3.294		.237		.095		3.263		.104		15,242	31,988
FHE-0318	-S02	3.187	80.950	3.357		.237		.095		3.325		.104		15,544	32,622
FHE-0325	-S02	3.250	82.550	3.420		.237		.095		3.388		.104		15,851	33,267
FHE-0331	-S02	3.312	84.125	3.483	+.035/-.000	.248		.115		3.450		.124		16,154	38,952
FHE-0337	-S02	3.375	85.725	3.547		.248		.115		3.513		.124		16,461	39,693
FHE-0343	-S02	3.437	87.300	3.609		.248		.115		3.575		.124		16,763	40,422
FHE-0350	-S02	3.500	88.900	3.673		.248		.115		3.638		.124		17,071	41,163
FHE-0356	-S02	3.562	90.475	3.728		.248		.115		3.700		.124		17,373	41,892

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] Square edge wire.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

FHE Series

Constant Section Rings Internal Continued

Smalley Part Number[3] Carbon Steel	Add Suffix 302 SS	Housing Diameter in	Housing Diameter mm	Ring Outside Diameter (in)	Tol.	Ring Radial Wall (in)	Tol.	Ring Thickness (in)	Tol.	Groove Diameter (in)	Tol.	Groove Width (in)	Tol.	Thrust Capacity Groove Yield[1] (lb)	Thrust Capacity Ring Shear[2] (lb)
FHE-0362	-S02	3.625	92.075	3.799	+.035/-.000	.248	±.005	.115	±.003	3.763	+.013/-.000	.124	+.007/-.000	17,680	42,633
FHE-0368	-S02	3.687	93.650	3.862		.248		.115		3.825		.124		17,983	43,362
FHE-0375	-S02	3.750	95.250	3.922		.248		.115		3.888		.124		18,290	44,103
FHE-0381	-S02	3.812	96.825	3.988		.248		.115		3.950		.124		18,592	44,832
FHE-0387	-S02	3.875	98.425	4.044		.248		.115		4.013		.124		18,900	45,573
FHE-0393	-S02	3.937	100.000	4.114		.248		.115		4.075		.124		19,202	46,302
FHE-0400	-S02	4.000	101.600	4.223	+.050/-.000	.265		.153	±.004	4.158	+.021/-.000	.163		22,337	60,283
FHE-0412	-S02	4.125	104.775	4.329		.265		.153		4.283		.163		23,035	62,166
FHE-0425	-S02	4.250	107.950	4.452		.265		.153		4.408		.163		23,733	64,050
FHE-0437	-S02	4.375	111.125	4.576		.265		.153		4.533		.163		24,431	65,934
FHE-0450	-S02	4.500	114.300	4.703		.265		.153		4.658		.163		25,129	67,818
FHE-0462	-S02	4.625	117.475	4.829		.265		.153		4.783		.163		25,827	69,702
FHE-0475	-S02	4.750	120.650	4.945		.265		.153		4.908	+.024/-.000	.163		26,525	71,585
FHE-0487	-S02	4.875	123.825	5.082		.265		.153		5.033		.163		27,223	73,469
FHE-0500	-S02	5.000	127.000	5.207		.265		.153		5.158		.163		27,921	75,353
FHE-0525	-S02	5.250	133.350	5.460		.265		.153		5.408		.163		29,317	79,121
FHE-0550	-S02	5.500	139.700	5.719		.265		.153		5.658		.163		30,713	82,888
FHE-0575	-S02	5.750	146.050	5.965		.265		.153		5.908		.163		32,109	86,656
FHE-0600	-S02	6.000	152.400	6.256	+.055/-.000	.316	±.006	.153		6.196		.163		41,563	90,424
FHE-0625	-S02	6.250	158.750	6.508		.316		.153		6.446		.163		43,295	94,191
FHE-0650	-S02	6.500	165.100	6.760		.316		.153		6.696		.163		45,027	97,959
FHE-0675	-S02	6.750	171.450	7.013		.316		.153		6.946		.163		46,759	101,727
FHE-0700	-S02	7.000	177.800	7.266		.316		.153		7.196		.163		48,490	105,494
FHE-0725	-S02	7.250	184.150	7.541	+.070/-.000	.316		.153		7.446	+.028/-.000	.163		50,222	109,262
FHE-0750	-S02	7.500	190.500	7.762		.316		.153		7.696		.163		51,954	113,030
FHE-0775	-S02	7.750	196.850	8.023		.316		.153		7.946		.163		53,686	116,797
FHE-0800	-S02	8.000	203.200	8.276		.316		.153		8.196		.163		55,418	120,565
FHE-0825	-S02	8.250	209.550	8.580		.373		.192	±.005	8.486		.203		68,813	147,399
FHE-0850	-S02	8.500	215.900	8.821		.373		.192		8.736		.203		70,898	151,866
FHE-0875	-S02	8.750	222.250	9.073		.373		.192		8.986		.203		72,983	156,332
FHE-0900	-S02	9.000	228.600	9.326		.373		.192		9.236		.203		75,068	160,799
FHE-0925	-S02	9.250	234.950	9.580		.373		.192		9.486		.203		77,154	165,265
FHE-0950	-S02	9.500	241.300	9.831		.373		.192		9.736		.203		79,239	169,732
FHE-0975	-S02	9.750	247.650	10.083		.373		.192		9.986		.203		81,324	174,199
FHE-1000	-S02	10.000	254.000	10.414		.435	±.007	.192		10.314	+.031/-.000	.203		110,977	178,665
FHE-1025	-S02	10.250	260.350	10.660		.435		.192		10.564		.203		113,751	183,132
FHE-1050	-S02	10.500	266.700	10.919		.435		.192		10.814		.203		116,526	187,599
FHE-1075	-S02	10.750	273.050	11.171		.435		.192		11.064		.203		119,300	192,065
FHE-1100	-S02	11.000	279.400	11.440	+.012/-.005	.435		.192		11.314		.203		122,074	196,532

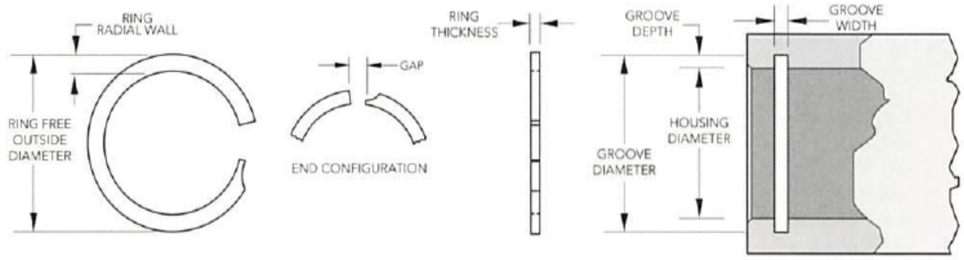
[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] Square edge wire.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

FH Series

Metric Constant Section Rings Internal

**Groove compatible with DIN 472*



Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number[3] Carbon Steel	Add Suffix 302 SS	Housing Diameter mm	Housing Diameter in	Ring Outside Diameter (mm)	Tol.	Ring Radial Wall (mm)	Tol.	Ring Thickness (mm)	Tol.	Groove Diameter (mm)	Tol.	Groove Width (mm)	Tol.	Thrust Capacity Groove Yield[1] (N)	Thrust Capacity Ring Shear[2] (N)
FH-013	-S02	13.00	.51	13.73	+.33/-.00	1.40	±.10	.94	±.05	13.60	+.11/-.00	1.10	+.14/-.00	1,931	10,591
FH-014	-S02	14.00	.55	14.74		1.40		.94		14.60		1.10		2,077	11,396
FH-015	-S02	15.00	.59	15.85		1.40		.94		15.70		1.10		2,602	12,224
FH-016	-S02	16.00	.63	16.90		1.65		.94		16.80		1.10		3,172	13,029
FH-017	-S02	17.00	.67	17.97		1.65		.94		17.80		1.10		3,367	13,838
FH-018	-S02	18.00	.71	19.18		1.90		.94		19.00	+.13/-.00	1.10		4,457	14,666
FH-019	-S02	19.00	.75	20.25		1.90		.94		20.00		1.10		4,702	15,471
FH-020	-S02	20.00	.79	21.20		1.90		.94		21.00		1.10		4,951	16,276
FH-021	-S02	21.00	.83	22.21		1.90		.94		22.00		1.10		5,200	17,103
FH-022	-S02	22.00	.87	23.22		1.90		.94		23.00		1.10		5,445	17,913
FH-023	-S02	23.00	.91	24.23	+.38/-.00	1.90		.94		24.00	+.21/-.00	1.10		5,698	18,736
FH-024	-S02	24.00	.94	25.40		2.15		1.15		25.20		1.30		6,539	23,927
FH-025	-S02	25.00	.98	26.45		2.15		1.15		26.20		1.30		6,806	24,914
FH-026	-S02	26.00	1.02	27.46		2.15		1.15		27.20		1.30		7,082	25,929
FH-027	-S02	27.00	1.06	28.47		2.38		1.15		28.20		1.30		7,353	26,916
FH-028	-S02	28.00	1.10	29.68		2.38		1.15		29.40		1.30		9,702	27,904
FH-029	-S02	29.00	1.14	30.69		2.38		1.15		30.40		1.30		10,053	28,918
FH-030	-S02	30.00	1.18	31.79		2.38		1.15		31.40		1.30		10,395	29,905
FH-031	-S02	31.00	1.22	33.01		2.38		1.15		32.70		1.30		12,660	30,893
FH-032	-S02	32.00	1.26	33.93		2.38		1.15		33.70		1.30		13,073	31,907
FH-033	-S02	33.00	1.30	35.03		2.38		1.15		34.70	+.25/-.00	1.30		13,478	32,895
FH-034	-S02	34.00	1.34	36.04		3.25		1.44		35.70		1.60		13,892	40,319
FH-035	-S02	35.00	1.38	37.35		3.25		1.44		37.00		1.60		16,899	41,493
FH-036	-S02	36.00	1.42	38.36		3.25		1.44		38.00		1.60		17,375	42,663
FH-037	-S02	37.00	1.46	39.37		3.25		1.44		39.00		1.60		17,869	43,868
FH-038	-S02	38.00	1.50	40.44		3.25		1.44		40.00		1.60		18,344	45,043
FH-040	-S02	40.00	1.57	42.86	+.51/-.00	4.01		1.69		42.50		1.85		24,265	55,621
FH-041	-S02	41.00	1.61	43.91		4.01		1.69		43.50		1.85		24,866	56,995
FH-042	-S02	42.00	1.65	44.92		4.01		1.69		44.50		1.85		25,484	58,410
FH-045	-S02	45.00	1.77	47.88		4.01		1.69		47.50		1.85		27,303	62,578
FH-047	-S02	47.00	1.85	49.97		4.01		1.69		49.50		1.85		28,504	65,331
FH-048	-S02	48.00	1.89	50.98		4.01		1.69		50.50		1.85		29,118	66,741
FH-050	-S02	50.00	1.97	53.50	+.63/-.00	5.08	±.13	1.93	±.08	53.00	+.30/-.00	2.15		36,529	75,282
FH-051	-S02	51.00	2.01	54.43		5.08		1.93		54.00		2.15		37,249	76,776
FH-052	-S02	52.00	2.05	55.52		5.08		1.93		55.00		2.15		37,974	78,266
FH-055	-S02	55.00	2.17	58.55		5.08		1.93		58.00		2.15		40,163	82,777
FH-056	-S02	56.00	2.20	59.56		5.08		1.93		59.00		2.15		40,906	84,307
FH-057	-S02	57.00	2.24	60.68		5.08		1.93		60.00		2.15		41,631	85,797
FH-058	-S02	58.00	2.28	61.58		5.08		1.93		61.00		2.15		42,352	87,287
FH-060	-S02	60.00	2.36	63.60		5.08		1.93		63.00		2.15		43,819	90,308
FH-062	-S02	62.00	2.44	65.58		5.08		1.93		65.00		2.15		45,283	93,328
FH-063	-S02	63.00	2.48	66.63		5.08		1.93		66.00		2.15		46,008	94,823
FH-064	-S02	64.00	2.52	67.64	+.76/-.00	5.08		2.41		67.00		2.65		46,751	114,742
FH-065	-S02	65.00	2.56	68.70		5.08		2.41		68.00		2.65		47,471	116,517
FH-067	-S02	67.00	2.64	70.54		5.08		2.41		70.00		2.65		48,939	120,115
FH-068	-S02	68.00	2.68	71.84		5.08		2.41		71.00		2.65		49,660	121,890
FH-070	-S02	70.00	2.76	73.64		5.08		2.41		73.00		2.65		51,128	125,489
FH-072	-S02	72.00	2.83	75.72		5.08		2.41		75.00		2.65		52,591	129,083
FH-075	-S02	75.00	2.95	78.75		5.08		2.41		78.00		2.65		54,780	134,456
FH-076	-S02	76.00	2.99	79.88		5.08		2.41		79.00		2.65		55,505	136,231

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] Square edge wire.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

FH Series

Metric Constant Section Rings Internal Continued

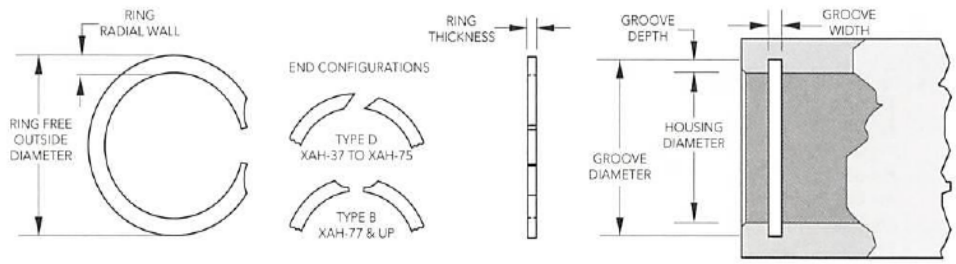
Smalley Part Number[3] Carbon Steel	Add Suffix 302 SS	Housing Diameter mm	Housing Diameter in	Ring Outside Diameter (mm)		Ring Radial Wall (mm)		Ring Thickness (mm)		Groove Diameter (mm)		Groove Width (mm)		Thrust Capacity Groove Yield[1] (N)	Thrust Capacity Ring Shear[2] (N)
FH-078	-S02	78.00	3.07	81.73	+.76/-.00	5.08	±.13	2.41	±.08	81.00	+.35/-.00	2.65	+.14/-.00	56,968	139,830
FH-080	-S02	80.00	3.15	84.30		6.02		2.41		83.50		2.65		68,342	143,428
FH-082	-S02	82.00	3.23	86.32		6.02		2.41		85.50		2.65		70,033	146,978
FH-085	-S02	85.00	3.35	89.35	+.89/-.00	6.30		2.91		88.50		3.15	+.18/-.00	72,595	175,046
FH-088	-S02	88.00	3.46	92.38		6.30		2.91		91.50		3.15		75,175	181,269
FH-090	-S02	90.00	3.54	94.70		6.30		2.91		93.50		3.15		76,865	185,353
FH-092	-S02	92.00	3.62	96.50		6.30		2.91		95.50		3.15		78,582	189,485
FH-095	-S02	95.00	3.74	99.62		6.30		2.91		98.50		3.15		81,140	195,659
FH-098	-S02	98.00	3.86	102.71		6.30		2.91		101.50		3.15		83,702	201,829
FH-100	-S02	100.00	3.94	104.50		6.30		2.91		103.50		3.15		85,415	205,962
FH-102	-S02	102.00	4.02	107.27	+1.30/-.00	6.73		3.89	±.10	106.00	+.54/-.00	4.15		87,127	269,224
FH-105	-S02	105.00	4.13	109.96		6.73		3.89		109.00		4.15		102,687	277,133
FH-108	-S02	108.00	4.25	113.09		6.73		3.89		112.00		4.15		105,619	285,042
FH-110	-S02	110.00	4.33	115.10		6.73		3.89		114.00		4.15		107,580	290,340
FH-112	-S02	112.00	4.41	117.12		6.73		3.89		116.00		4.15		109,520	295,567
FH-115	-S02	115.00	4.53	120.15		6.73		3.89		119.00		4.15		112,473	303,547
FH-120	-S02	120.00	4.72	125.60		6.73		3.89		124.00	+.63/-.00	4.15		117,344	316,687
FH-125	-S02	125.00	4.92	130.25		6.73		3.89		129.00		4.15		122,237	329,893
FH-127	-S02	127.00	5.00	132.27		6.73		3.89		131.00		4.15		124,199	335,187
FH-130	-S02	130.00	5.12	135.30		6.73		3.89		134.00		4.15		127,130	343,096
FH-135	-S02	135.00	5.31	140.35		6.73		3.89		139.00		4.15		132,023	356,303
FH-140	-S02	140.00	5.51	145.26		6.73		3.89		144.00		4.15		136,916	369,509
FH-145	-S02	145.00	5.71	150.45		6.73		3.89		149.00		4.15		141,809	382,716
FH-150	-S02	150.00	5.91	156.50	+1.40/-.00	8.03	±.15	3.89		155.00		4.15		181,986	395,923
FH-155	-S02	155.00	6.10	161.55		8.03		3.89		160.00		4.15		188,026	409,063
FH-160	-S02	160.00	6.30	166.60		8.03		3.89		165.00		4.15		194,094	422,270
FH-165	-S02	165.00	6.50	171.70		8.03		3.89		170.00		4.15		200,166	435,476
FH-170	-S02	170.00	6.69	176.70		8.03		3.89		175.00		4.15		206,237	448,683
FH-175	-S02	175.00	6.89	181.75		8.03		3.89		180.00		4.15		212,305	461,890
FH-180	-S02	180.00	7.09	186.80		8.03		3.89		185.00	+.72/-.00	4.15		218,377	475,097
FH-185	-S02	185.00	7.28	191.85	+1.78/-.00	8.03		3.89		190.00		4.15		224,417	488,232
FH-190	-S02	190.00	7.48	197.15		8.03		3.89		195.00		4.15		230,489	501,439
FH-195	-S02	195.00	7.68	201.95		8.03		3.89		200.00		4.15		236,556	514,646
FH-200	-S02	200.00	7.87	207.00		8.03		3.89		205.00		4.15		242,628	527,853
FH-210	-S02	210.00	8.27	217.93		9.48		4.87	±.13	216.00		5.15		306,763	657,096
FH-220	-S02	220.00	8.66	228.20		9.48		4.87		226.00		5.15		321,344	688,327
FH-230	-S02	230.00	9.06	238.30		9.48		4.87		236.00		5.15		335,961	719,638
FH-240	-S02	240.00	9.45	248.40		9.48		4.87		246.00		5.15		350,578	750,953
FH-250	-S02	250.00	9.84	258.50		9.48		4.87		256.00	+.81/-.00	5.15		365,199	782,264
FH-260	-S02	260.00	10.24	270.77	+3.05/-.00	11.05	±.18	4.87		268.00		5.15		505,300	813,500
FH-270	-S02	270.00	10.63	280.70		11.05		4.87		278.00		5.15		524,748	844,811
FH-280	-S02	280.00	11.02	290.57		11.05		4.87		288.00		5.15		544,200	876,126
FH-290	-S02	290.00	11.42	300.90		11.05		4.87		298.00		5.15		563,599	907,357
FH-300	-S02	300.00	11.81	311.00		11.05		4.87		308.00		5.15		583,051	938,673

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] Square edge wire.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

XAH Series

Constant Section Rings Internal



Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number [3]		Housing Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	in	mm	Outside Diameter (in)	Tol.	Radial Wall (in)	Tol.	Thickness (in)	Tol.	Diameter (in)	Tol.	Width (in)	Tol.	Groove Yield[1] (lb)	Ring Shear[2] (lb)
XAH-37	-S02	.375	9.525	.400	+.020/-.000	.035	±.003	.025	±.002	.395	±.003	.028	+.003/-.000	265	1,174
XAH-43	-S02	.438	11.125	.467		.035		.025		.462		.028		372	1,371
XAH-50	-S02	.500	12.700	.530	+.025/-.000	.040		.035		.524		.039		424	2,073
XAH-51	-S02	.512	13.005	.542		.040		.035		.536		.039		434	2,123
XAH-56	-S02	.562	14.275	.600		.048		.035		.590		.039		556	2,331
XAH-62	-S02	.625	15.875	.670		.048		.035		.657		.039		707	2,592
XAH-68	-S02	.688	17.475	.733		.048		.035		.720		.039		778	2,853
XAH-75	-S02	.750	19.050	.799		.048		.035		.786		.039		954	3,110
XAH-77	-S02	.777	19.736	.827		.062		.042		.813		.046		989	3,906
XAH-81	-S02	.812	20.625	.867		.062		.042		.852		.046		1,148	4,082
XAH-87	-S02	.875	22.225	.934	+.031/-.000	.062		.042		.919		.046		1,361	4,398
XAH-90	-S02	.901	22.885	.961		.078		.042		.945		.046		1,401	4,529
XAH-93	-S02	.938	23.825	1.003		.078		.042		.986		.046		1,591	4,715
XAH-100	-S02	1.000	25.400	1.070		.078		.042		1.052		.046		1,696	5,027
XAH-102	-S02	1.023	25.984	1.094		.093		.042		1.075	±.005	.046		1,880	5,142
XAH-106	-S02	1.062	26.975	1.134		.093		.050		1.114		.056		1,952	6,272
XAH-112	-S02	1.125	28.575	1.202		.093		.050		1.181		.056		2,227	6,644
XAH-118	-S02	1.188	30.175	1.270		.093		.050		1.248		.056		2,519	7,017
XAH-125	-S02	1.250	31.750	1.337		.109		.050		1.314		.056		2,827	7,383
XAH-131	-S02	1.312	33.325	1.404		.109		.050		1.380		.056		3,153	7,749
XAH-137	-S02	1.375	34.925	1.472		.109		.050		1.447		.056		3,499	8,121
XAH-143	-S02	1.438	36.525	1.535		.125	±.005	.050		1.510		.056		3,659	8,493
XAH-145	-S02	1.456	36.982	1.557		.125		.050		1.532		.056		3,911	8,599
XAH-150	-S02	1.500	38.100	1.607		.125		.050		1.576		.056		4,029	8,859
XAH-156	-S02	1.562	39.675	1.668	+.046/-.000	.125		.062		1.642		.068	+.004/-.000	4,416	11,002
XAH-162	-S02	1.625	41.275	1.736		.141		.062		1.709		.068		4,824	11,446
XAH-165	-S02	1.653	41.986	1.765		.141		.062		1.737		.068		4,907	11,643
XAH-168	-S02	1.688	42.875	1.804		.156		.062		1.776		.068		5,250	11,889
XAH-175	-S02	1.750	44.450	1.870		.156		.062		1.842		.068		5,690	12,326
XAH-181	-S02	1.812	46.025	1.933		.156		.062		1.904		.068		5,892	12,763
XAH-185	-S02	1.850	46.990	1.975		.156		.062		1.946		.068		6,277	13,030
XAH-187	-S02	1.875	47.625	2.000		.156		.062		1.971		.068		6,362	13,206
XAH-193	-S02	1.938	49.225	2.068		.156		.062		2.038		.068		6,849	13,650
XAH-196	-S02	1.968	49.987	2.098		.156		.062		2.068		.068		6,955	13,862
XAH-200	-S02	2.000	50.800	2.131		.156		.062		2.100		.068		7,069	14,087
XAH-206	-S02	2.062	52.375	2.197		.156		.078		2.166	±.006	.086	+.005/-.000	7,579	17,491
XAH-212	-S02	2.125	53.975	2.260		.156		.078		2.229		.086		7,811	18,025
XAH-218	-S02	2.188	55.575	2.331		.171		.078		2.296		.086		8,352	18,559
XAH-225	-S02	2.250	57.150	2.393		.171		.078		2.358		.086		8,588	19,085
XAH-231	-S02	2.312	58.725	2.459		.171		.078		2.424		.086		9,152	19,611
XAH-237	-S02	2.375	60.325	2.523		.171		.078		2.487		.086		9,401	20,145
XAH-244	-S02	2.440	61.976	2.592		.187		.078		2.556		.086		10,003	20,697
XAH-250	-S02	2.500	63.500	2.653		.187		.078		2.616		.086		10,249	21,206
XAH-253	-S02	2.531	64.287	2.688		.187		.078		2.651		.086		10,734	21,469
XAH-256	-S02	2.562	65.075	2.726		.187		.093		2.686		.103		11,228	26,078
XAH-262	-S02	2.625	66.675	2.790		.187		.093		2.750		.103		11,504	26,719
XAH-268	-S02	2.688	68.275	2.856		.187		.093		2.816		.103		11,780	27,361
XAH-271	-S02	2.717	69.012	2.882		.187		.093		2.842		.103		12,291	27,656
XAH-275	-S02	2.750	69.850	2.918	+.062/-.000	.187		.093		2.878		.103		12,441	27,992
XAH-281	-S02	2.813	71.450	2.985		.187		.093		2.945		.103		13,123	28,633

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

[3] Square edge wire.

XAH Series

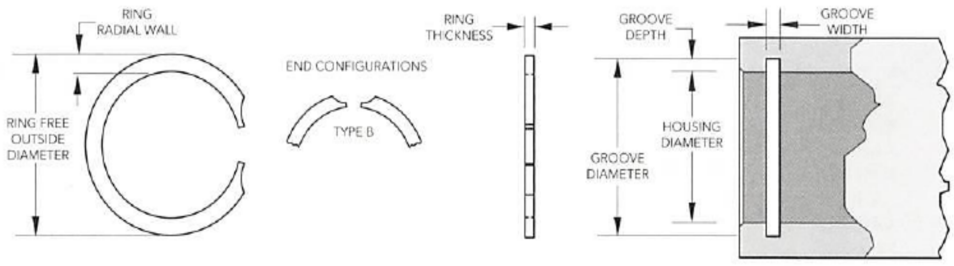
Constant Section Rings Internal Continued

Smalley Part Number[3] Carbon Steel	Add Suffix 302 SS	Housing Diameter in	Housing Diameter mm	Ring Outside Diameter (in)	Tol.	Ring Radial Wall (in)	Tol.	Ring Thickness (in)	Tol.	Groove Diameter (in)	Tol.	Groove Width (in)	Tol.	Thrust Capacity Groove Yield[1] (lb)	Thrust Capacity Ring Shear[2] (lb)
XAH-283	-S02	2.834	71.984	3.006	+.062/-.000	.187	±.005	.093	±.002	2.966	±.006	.103	+.005/-.000	13,221	28,847
XAH-287	-S02	2.875	73.025	3.056		.187		.093		3.011		.103		13,819	29,264
XAH-300	-S02	3.000	76.200	3.181		.187		.093		3.136		.103		14,420	30,536
XAH-306	-S02	3.062	77.775	3.247		.218		.109		3.202		.120		15,151	35,009
XAH-312	-S02	3.125	79.375	3.311		.218		.109		3.265		.120		15,463	35,729
XAH-315	-S02	3.156	80.162	3.342		.218		.109		3.296		.120		15,616	36,084
XAH-325	-S02	3.250	82.550	3.442		.218		.109		3.394		.120		16,540	37,158
XAH-334	-S02	3.346	84.988	3.539		.218		.109		3.490		.120		17,029	38,256
XAH-346	-S02	3.469	88.113	3.663		.218		.109		3.613		.120		17,655	39,662
XAH-350	-S02	3.500	88.900	3.700	+.078/-.000	.250		.109		3.648		.120		18,308	40,017
XAH-354	-S02	3.543	89.992	3.745		.250		.109		3.691		.120		18,533	40,508
XAH-356	-S02	3.562	90.475	3.766		.250		.109		3.710		.120		18,632	40,725
XAH-362	-S02	3.625	92.075	3.831		.250		.109		3.773		.120		18,961	41,446
XAH-375	-S02	3.750	95.250	3.962		.250		.109		3.902		.120		20,145	42,875
XAH-387	-S02	3.875	98.425	4.089		.250		.109		4.027		.120		20,817	44,304
XAH-393	-S02	3.938	100.025	4.156		.250		.109		4.094		.120		21,712	45,024
XAH-400	-S02	4.000	101.600	4.221	+.093/-.000	.250		.109		4.156		.120		22,054	45,733
XAH-412	-S02	4.125	104.775	4.355		.250		.109		4.285		.120		23,326	47,162
XAH-425	-S02	4.250	107.950	4.485		.250		.109		4.410		.120		24,033	48,592
XAH-433	-S02	4.330	109.982	4.565		.250		.109		4.490		.120		24,486	49,506
XAH-443	-S02	4.436	112.674	4.670		.250		.109		4.596		.120		25,085	50,718
XAH-450	-S02	4.500	114.300	4.744		.250		.109		4.664		.120		26,083	51,450
XAH-462	-S02	4.625	117.475	4.875		.250		.109		4.795		.120		27,788	52,879
XAH-475	-S02	4.750	120.650	5.011		.281		.109		4.926		.120		29,547	54,308
XAH-500	-S02	5.000	127.000	5.265		.281		.109		5.180		.120		31,809	57,167
XAH-525	-S02	5.250	133.350	5.530	+.125/-.000	.312		.125		5.435	±.007	.139	+.006/-.000	34,141	65,732
XAH-537	-S02	5.375	136.525	5.660		.312		.125		5.565		.139		36,094	67,297
XAH-550	-S02	5.500	139.700	5.796		.312		.125		5.696		.139		38,100	68,862
XAH-575	-S02	5.750	146.050	6.050		.312		.125		5.950		.139		40,644	71,992
XAH-600	-S02	6.000	152.400	6.309		.312		.125		6.204		.139		43,260	75,122
XAH-625	-S02	6.250	158.750	6.568	+.156/-.000	.343		.156		6.458	±.008	.174		45,946	94,130
XAH-650	-S02	6.500	165.100	6.832		.343		.156		6.712		.174		48,703	97,895
XAH-662	-S02	6.625	168.275	6.975		.343		.156		6.845		.174		51,512	99,778
XAH-675	-S02	6.750	171.450	7.100		.343		.156		6.970		.174		52,484	101,660
XAH-700	-S02	7.000	177.800	7.350		.343		.156		7.220		.174		54,428	105,426
XAH-725	-S02	7.250	184.150	7.630	+.187/-.000	.375		.187		7.500		.209		64,059	123,654
XAH-750	-S02	7.500	190.500	7.890		.375		.187		7.750		.209		66,268	127,918
XAH-800	-S02	8.000	203.200	8.400		.375		.187		8.250		.209		70,686	136,446
XAH-825	-S02	8.250	209.550	8.665		.437		.187		8.540		.209		84,558	141,478
XAH-850	-S02	8.500	215.900	8.915		.437		.187		8.790		.209		87,120	145,766
XAH-875	-S02	8.750	222.250	9.205		.500		.187		9.080		.209		102,053	150,053
XAH-900	-S02	9.000	228.600	9.455		.500		.187		9.330		.209		104,968	154,340
XAH-905	-S02	9.055	229.997	9.509		.500		.187		9.384		.209		105,610	155,283
XAH-950	-S02	9.500	241.300	9.955		.500		.187		9.830		.209		110,800	162,915
XAH-984	-S02	9.840	249.936	10.295		.500		.187		10.170		.209		114,766	168,745
XAH-1000	-S02	10.000	254.000	10.455		.500		.187		10.330		.209		116,632	171,489

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] Square edge wire.

XDH Series

Constant Section Rings Internal



Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number[3] Carbon Steel	Add Suffix 302 SS	Housing Diameter in	Housing Diameter mm	Ring Outside Diameter (in)	Tol.	Ring Radial Wall (in)	Tol.	Ring Thickness (in)	Tol.	Groove Diameter (in)	Tol.	Groove Width (in)	Tol.	Thrust Capacity Groove Yield[1] (lb)	Thrust Capacity Ring Shear[2] (lb)
XDH-112	-S02	1.125	28.575	1.196	+.031/-.000	.093	±.003	.042	±.002	1.181	±.005	.046	+.003/-.000	2,227	5,655
XDH-125	-S02	1.250	31.750	1.330	+.031/-.000	.093	±.003	.042	±.002	1.310	±.005	.046	+.003/-.000	2,651	6,283
XDH-137	-S02	1.375	34.925	1.460	+.031/-.000	.093	±.003	.042	±.002	1.435	±.005	.046	+.003/-.000	2,916	6,912
XDH-150	-S02	1.500	38.100	1.600	+.031/-.000	.125	±.005	.042	±.002	1.580	±.005	.046	+.003/-.000	4,241	7,540
XDH-162	-S02	1.625	41.275	1.725	+.062/-.000	.125	±.005	.042	±.002	1.705	±.005	.046	+.003/-.000	4,595	8,168
XDH-175	-S02	1.750	44.450	1.855	+.062/-.000	.125	±.005	.042	±.002	1.830	±.005	.046	+.003/-.000	4,948	8,796
XDH-187	-S02	1.875	47.625	1.990	+.062/-.000	.156	±.005	.042	±.002	1.965	±.005	.046	+.003/-.000	5,964	9,425
XDH-200	-S02	2.000	50.800	2.115	+.062/-.000	.156	±.005	.042	±.002	2.090	±.005	.046	+.003/-.000	6,362	10,053
XDH-206	-S02	2.062	52.375	2.177	+.062/-.000	.156	±.005	.042	±.002	2.152	±.006	.046	+.003/-.000	6,559	10,365
XDH-218	-S02	2.187	55.550	2.302	+.062/-.000	.156	±.005	.042	±.002	2.277	±.006	.046	+.003/-.000	6,957	10,993
XDH-231	-S02	2.312	58.725	2.432	+.062/-.000	.156	±.005	.042	±.002	2.402	±.006	.046	+.003/-.000	7,354	11,621
XDH-243	-S02	2.437	61.900	2.557	+.062/-.000	.156	±.005	.042	±.002	2.527	±.006	.046	+.003/-.000	7,752	12,250
XDH-256	-S02	2.562	65.075	2.682	+.062/-.000	.156	±.005	.042	±.002	2.652	±.006	.046	+.003/-.000	8,149	12,878
XDH-300	-S02	3.000	76.200	3.154	+.078/-.000	.187	±.005	.062	±.002	3.124	±.006	.068	+.004/-.000	13,148	21,130
XDH-325	-S02	3.250	82.550	3.404	+.078/-.000	.187	±.005	.062	±.002	3.374	±.006	.068	+.004/-.000	14,243	22,891
XDH-350	-S02	3.500	88.900	3.654	+.078/-.000	.187	±.005	.062	±.002	3.624	±.006	.068	+.004/-.000	15,339	24,652
XDH-375	-S02	3.750	95.250	3.904	+.078/-.000	.187	±.005	.062	±.002	3.874	±.006	.068	+.004/-.000	16,434	26,413
XDH-400	-S02	4.000	101.600	4.155	+.078/-.000	.187	±.005	.062	±.002	4.125	±.006	.068	+.004/-.000	17,671	28,174
XDH-425	-S02	4.250	107.950	4.429	+.093/-.000	.218	±.005	.078	±.002	4.394	±.007	.086	+.005/-.000	21,630	36,050
XDH-450	-S02	4.500	114.300	4.679	+.093/-.000	.218	±.005	.078	±.002	4.644	±.007	.086	+.005/-.000	22,902	38,170
XDH-475	-S02	4.750	120.650	4.929	+.093/-.000	.218	±.005	.078	±.002	4.894	±.007	.086	+.005/-.000	24,175	40,291
XDH-500	-S02	5.000	127.000	5.184	+.093/-.000	.218	±.005	.078	±.002	5.144	±.007	.086	+.005/-.000	25,447	42,412
XDH-525	-S02	5.250	133.350	5.434	+.093/-.000	.218	±.005	.078	±.002	5.394	±.007	.086	+.005/-.000	26,719	44,532
XDH-575	-S02	5.750	146.050	5.934	+.093/-.000	.218	±.005	.078	±.002	5.894	±.007	.086	+.005/-.000	29,264	48,773
XDH-600	-S02	6.000	152.400	6.220	+.125/-.000	.250	±.005	.093	±.002	6.160	±.007	.103	+.005/-.000	33,929	61,073
XDH-650	-S02	6.500	165.100	6.730	+.125/-.000	.250	±.005	.093	±.002	6.660	±.007	.103	+.005/-.000	36,757	66,162
XDH-700	-S02	7.000	177.800	7.240	+.187/-.000	.250	±.005	.093	±.002	7.160	±.008	.103	+.005/-.000	39,584	71,251
XDH-725	-S02	7.250	184.150	7.500	+.187/-.000	.250	±.005	.093	±.002	7.410	±.008	.103	+.005/-.000	40,998	73,796
XDH-750	-S02	7.500	190.500	7.760	+.187/-.000	.250	±.005	.093	±.002	7.660	±.008	.103	+.005/-.000	42,412	76,341
XDH-800	-S02	8.000	203.200	8.285	+.187/-.000	.250	±.005	.093	±.002	8.160	±.008	.103	+.005/-.000	45,239	81,430

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] Square edge wire.

Constant Section Rings Series End Configurations

Smalley offers four series of Eaton style snap rings from stock. Additional end types can be manufactured to meet your snap ring requirements. Contact one of our engineers to inquire about the following end types:

U-Notch

Type A-H

Type A-S

Double Scallop

Type B-H

Type B-S

Double Angle

Type C-H

Type C-S

Single Scallop

Type E-H

Type E-S

Single Angle

Type D

Pi-Cut

Type F

Flat Cut

Type G

Holes

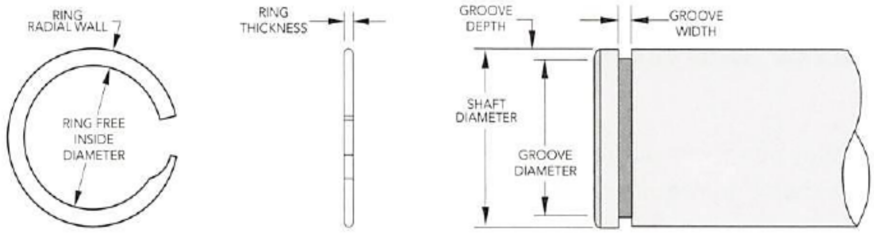
Type H

Material Hardness

Thickness (inch)	Hardness (Rc) Min.
Up to .022	46.0
Over .022 - .050	44.0
Over .050 - .078	42.0
Over .078	40.0

VS Series

Light Duty Rings External



Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number: Carbon Steel	Add Suffix: 302 SS	Add Suffix: 316 SS	Shaft Diameter: in	Shaft Diameter: mm	Ring: Inside Diameter (in)	Tol.	Ring: Radial Wall (in)	Tol.	Ring: Thickness (in)	Tol.	Groove: Diameter (in)	Tol.	Groove: Width (in)	Tol.	Thrust Capacity: Groove Yield[1] (lb)	Thrust Capacity: Ring Shear[2] (lb)
VS-25[3,4]	-S02	-S16	.250	6.35	.236	+.000/-.010	.020	±.004	.012	±.002	.238	±.002	.015	+.002/-.000	106	481
VS-31[3,4]	-S02	-S16	.312	7.92	.294		.025		.015		.297		.018		165	750
VS-37[3,4]	-S02	-S16	.375	9.53	.348		.025		.015		.351		.018		318	901
VS-43[4]	-S02	-S16	.437	11.10	.410	+.000/-.012	.035		.015		.413		.018		371	1,050
VS-50	-S02	-S16	.500	12.70	.467	+.000/-.013	.045		.018		.472		.022		500	1,300
VS-56	-S02	-S16	.562	14.27	.529		.045		.018		.534		.022		560	1,460
VS-62	-S02	-S16	.625	15.88	.591		.045		.018		.597		.022		620	1,630
VS-68	-S02	-S16	.687	17.45	.652		.045		.018		.659		.022		680	1,790
VS-75	-S02	-S16	.750	19.05	.715		.045		.018		.722		.022		740	1,950
VS-81	-S02	-S16	.812	20.62	.762		.065		.021		.770	±.003	.026		1,210	2,460
VS-87	-S02	-S16	.875	22.23	.825		.065		.021		.833		.026		1,300	2,660
VS-93	-S02	-S16	.937	23.80	.886		.065		.021		.895		.026		1,390	2,840
VS-100	-S02	-S16	1.000	25.40	.949		.065		.021		.958		.026		1,480	3,040
VS-106	-S02	-S16	1.062	26.97	1.008	+.000/-.015	.088		.025		1.018	±.004	.031		1,650	3,500
VS-112	-S02	-S16	1.125	28.58	1.071		.088		.025		1.081		.031		1,750	3,710
VS-118	-S02	-S16	1.187	30.15	1.132		.088		.025		1.143		.031		1,850	3,920
VS-125	-S02	-S16	1.250	31.75	1.194		.088		.025		1.206		.031		1,940	4,120
VS-131	-S02	-S16	1.312	33.32	1.255		.088		.025		1.268		.031		2,040	4,330
VS-137	-S02	-S16	1.375	34.93	1.318		.088		.025		1.331		.031		2,140	4,540
VS-143	-S02	-S16	1.437	36.50	1.379		.088		.025		1.393		.031		2,240	4,740
VS-150	-S02	-S16	1.500	38.10	1.442		.088		.025		1.456		.031		2,330	4,950
VS-156	-S02	-S16	1.562	39.67	1.488	+.000/-.020	.118		.031		1.505	±.005	.039	+.003/-.000	3,200	6,390
VS-162	-S02	-S16	1.625	41.28	1.550		.118		.031		1.568		.039		3,330	6,650
VS-168	-S02	-S16	1.687	42.85	1.612		.118		.031		1.630		.039		3,460	6,900
VS-175	-S02	-S16	1.750	44.45	1.674		.118		.031		1.693		.039		3,590	7,160
VS-181	-S02	-S16	1.812	46.02	1.736		.118		.031		1.755		.039		3,710	7,410
VS-187	-S02	-S16	1.875	47.63	1.798		.118		.031		1.818		.039		3,840	7,670
VS-193	-S02	-S16	1.937	49.20	1.859		.118		.031		1.880		.039		3,970	7,920
VS-200	-S02	-S16	2.000	50.80	1.922		.118		.031		1.943		.039		4,100	8,180
VS-206	-S02	-S16	2.062	52.37	1.963	+.000/-.025	.158		.031	±.002	1.986	±.006	.039		5,540	8,430
VS-212	-S02	-S16	2.125	53.98	2.026		.158		.031		2.049		.039		5,710	8,690
VS-218	-S02	-S16	2.187	55.55	2.087		.158		.031		2.111		.039		5,870	8,950
VS-225	-S02	-S16	2.250	57.15	2.149		.158		.031		2.174		.039		6,040	9,200
VS-231	-S02	-S16	2.312	58.72	2.211		.158		.031		2.236		.039		6,210	9,460
VS-237	-S02	-S16	2.375	60.33	2.273		.158		.031		2.299		.039		6,380	9,720
VS-243	-S02	-S16	2.437	61.90	2.335		.158		.031		2.361		.039		6,550	9,970
VS-250	-S02	-S16	2.500	63.50	2.397		.158		.031		2.424		.039		6,720	10,230
VS-256	-S02	-S16	2.562	65.07	2.458		.158		.031		2.486		.039		6,880	10,480
VS-262	-S02	-S16	2.625	66.68	2.521		.158		.031		2.549		.039		7,050	10,740
VS-268	-S02	-S16	2.687	68.25	2.582		.158		.031		2.611		.039		7,220	10,990
VS-275	-S02	-S16	2.750	69.85	2.644		.158		.031		2.674		.039		7,390	11,250
VS-281	-S02	-S16	2.812	71.42	2.706		.158		.031		2.736		.039		7,550	11,500
VS-287	-S02	-S16	2.875	73.03	2.768		.158		.031		2.799		.039		7,720	11,760
VS-293	-S02	-S16	2.937	74.60	2.830		.158		.031		2.861		.039		7,890	12,010
VS-300	-S02	-S16	3.000	76.20	2.892		.158		.031		2.924		.039		8,060	12,270
VS-306	-S02	-S16	3.062	77.77	2.938	+.000/-.030	.188	±.005	.039		2.970		.044		9,960	15,760
VS-312	-S02	-S16	3.125	79.38	3.001		.188		.039		3.033		.044		10,160	16,080
VS-318	-S02	-S16	3.187	80.95	3.062		.188		.039		3.095		.044		10,360	16,400
VS-325	-S02	-S16	3.250	82.55	3.125		.188		.039		3.158		.044		10,570	16,720
VS-331	-S02	-S16	3.312	84.12	3.186		.188		.039		3.220		.044		10,770	17,040

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] No removal notch.
[4] Square edge wire.

VS Series

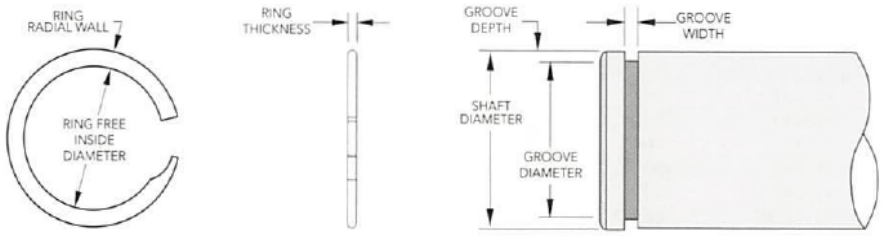
Light Duty Rings External Continued

Smalley Part Number			Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Inside Diameter (in)		Radial Wall (in)		Thickness (in)		Diameter (in)		Width (in)		Groove Yield[1] (lb)	Ring Shear[2] (lb)
	302 SS	316 SS	in	mm		tol.		tol.		tol.		tol.		tol.		
VS-337	-S02	-S16	3.375	85.73	3.248	+.000/-.030	.188	±.005	.039	±.002	3.283	±.006	.044	+.003/-.000	10,970	17,370
VS-343	-S02	-S16	3.437	87.30	3.310		.188		.039		3.345		.044		11,180	17,690
VS-350	-S02	-S16	3.500	88.90	3.372		.188		.039		3.408		.044		11,380	18,010
VS-356	-S02	-S16	3.562	90.47	3.433		.188		.039		3.470		.044		11,580	18,330
VS-362	-S02	-S16	3.625	92.08	3.496		.188		.039		3.533		.044		11,790	18,650
VS-368	-S02	-S16	3.687	93.65	3.557		.188		.039		3.595		.044		11,990	18,970
VS-375	-S02	-S16	3.750	95.25	3.620		.188		.039		3.658		.044		12,190	19,300
VS-381	-S02	-S16	3.812	96.82	3.681		.188		.039		3.720		.044		12,400	19,620
VS-387	-S02	-S16	3.875	98.43	3.743		.188		.039		3.783		.044		12,600	19,940
VS-393	-S02	-S16	3.937	100.00	3.805		.188		.039		3.845		.044		12,800	20,260
VS-400	-S02	-S16	4.000	101.60	3.867		.188		.039		3.908		.044		13,010	20,580
VS-412	-S02	-S16	4.125	104.78	3.973	+.000/-.035	.225		.046		4.015		.052	+.004/-.000	16,040	23,850
VS-425	-S02	-S16	4.250	107.95	4.097		.225		.046		4.140		.052		16,520	24,570
VS-437	-S02	-S16	4.375	111.13	4.221		.225		.046		4.265	±.007	.052		17,010	25,290
VS-450	-S02	-S16	4.500	114.30	4.345		.225		.046		4.390		.052		17,500	26,010
VS-462	-S02	-S16	4.625	117.48	4.468		.225		.046		4.515		.052		17,980	26,740
VS-475	-S02	-S16	4.750	120.65	4.592		.225		.046		4.640		.052		18,470	27,460
VS-487	-S02	-S16	4.875	123.83	4.715		.225		.046		4.765		.052		18,950	28,180
VS-500	-S02	-S16	5.000	127.00	4.839		.225		.046		4.890		.052		19,440	28,900
VS-525	-S02	-S16	5.250	133.35	5.067	+.000/-.045	.225		.061		5.119		.067		24,490	40,240
VS-550	-S02	-S16	5.500	139.70	5.309		.225		.061		5.363		.067		26,830	42,160
VS-575	-S02	-S16	5.750	146.05	5.550		.225		.061		5.606		.067		29,260	44,080
VS-600	-S02	-S16	6.000	152.40	5.792		.225		.061		5.850		.067		31,810	45,990
VS-625	-S02	-S16	6.250	158.75	6.033		.265		.061		6.094	±.008	.067		34,460	47,910
VS-650	-S02	-S16	6.500	165.10	6.275		.265		.061		6.338		.067		37,220	49,830
VS-675	-S02	-S16	6.750	171.45	6.515		.265		.061		6.581		.067		40,560	51,740
VS-700	-S02	-S16	7.000	177.80	6.757		.265		.061		6.825		.067		43,540	53,660
VS-725	-S02	-S16	7.250	184.15	6.998	+.000/-.060	.300	+.004/-.008	.061		7.069		.067		46,640	55,580
VS-750	-S02	-S16	7.500	190.50	7.240		.300		.061		7.313		.067		49,830	57,490
VS-775	-S02	-S16	7.750	196.85	7.480		.300		.061		7.556		.067		53,140	59,410
VS-800	-S02	-S16	8.000	203.20	7.722		.300		.061		7.800		.067		56,550	61,320
VS-825	-S02	-S16	8.250	209.55	7.964		.345		.076		8.044		.082	+.005/-.000	60,070	78,790
VS-850	-S02	-S16	8.500	215.90	8.205		.345		.076		8.288		.082		63,690	81,180
VS-875	-S02	-S16	8.750	222.25	8.446		.345		.076		8.531		.082		68,040	83,570
VS-900	-S02	-S16	9.000	228.60	8.687	+.000/-.070	.345		.076		8.775		.082		71,890	85,950
VS-925	-S02	-S16	9.250	234.95	8.929		.345		.076		9.019		.082		75,850	88,340
VS-950	-S02	-S16	9.500	241.30	9.170		.345		.076		9.263		.082		79,910	90,730
VS-975	-S02	-S16	9.750	247.65	9.411		.345		.076		9.506		.082		84,080	93,120
VS-1000	-S02	-S16	10.000	254.00	9.653		.345		.076		9.750		.082		88,360	95,500

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

VSM Series

Metric Light Duty Rings External



Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number			Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	Add Suffix 316 SS	mm	in	Inside Diameter (mm)		Radial Wall (mm)		Thickness (mm)		Diameter (mm)		Width (mm)		Groove Yield[1] (N)	Ring Shear[2] (N)
VSM-6[3,4]	-S02	-S16	6.00	.24	5.65	+.00/-.25	.51	±.10	.30	±.04	5.70	±.05	.38	+.05/-.00	439	1,988
VSM-7[3,4]	-S02	-S16	7.00	.28	6.58		.51		.30		6.64		.38		614	2,234
VSM-8[3,4]	-S02	-S16	8.00	.31	7.52		.64		.38		7.60		.46		780	3,183
VSM-9[3,4]	-S02	-S16	9.00	.35	8.42		.76		.38		8.50		.46		1,114	3,580
VSM-10[3,4]	-S02	-S16	10.00	.39	9.32	+.00/-.30	.89		.38		9.40		.46		1,462	3,978
VSM-11[4]	-S02	-S16	11.00	.43	10.32		.89		.38		10.40		.46		1,608	4,376
VSM-12	-S02	-S16	12.00	.47	11.22	+.00/-.33	1.14		.46		11.34		.56		1,930	5,779
VSM-13	-S02	-S16	13.00	.51	12.15		1.14		.46		12.28		.56		2,281	6,261
VSM-14	-S02	-S16	14.00	.55	13.15		1.14		.46		13.28		.56		2,456	6,742
VSM-15	-S02	-S16	15.00	.59	14.14		1.14		.46		14.28		.56		2,632	7,224
VSM-16	-S02	-S16	16.00	.63	15.13		1.14		.46		15.28		.56		2,807	7,705
VSM-17	-S02	-S16	17.00	.67	16.13		1.14		.46		16.28		.56		2,983	8,187
VSM-18	-S02	-S16	18.00	.71	17.12		1.14		.46		17.28		.56		3,158	8,669
VSM-19	-S02	-S16	19.00	.75	18.11		1.14		.46		18.28		.56		3,334	9,150
VSM-20	-S02	-S16	20.00	.79	19.10		1.14		.46		19.28	±.08	.56		3,509	9,632
VSM-21	-S02	-S16	21.00	.83	19.74		1.65		.53		19.94		.66		5,424	11,652
VSM-22	-S02	-S16	22.00	.87	20.73		1.65		.53		20.94		.66		5,683	12,207
VSM-24	-S02	-S16	24.00	.94	22.72		1.65		.53		22.94		.66		6,199	13,317
VSM-25	-S02	-S16	25.00	.98	23.71		1.65		.53		23.94		.66		6,458	13,872
VSM-26	-S02	-S16	26.00	1.02	24.63	+.00/-.38	2.24		.64		24.88	±.10	.79	+.08/-.00	7,096	15,138
VSM-28	-S02	-S16	28.00	1.10	26.62		2.24		.64		26.88		.79		7,642	16,303
VSM-29	-S02	-S16	29.00	1.14	27.61		2.24		.64		27.88		.79		7,915	16,885
VSM-30	-S02	-S16	30.00	1.18	28.59		2.24		.64		28.88		.79		8,188	17,467
VSM-32	-S02	-S16	32.00	1.26	30.57		2.24		.64		30.88		.79		8,734	18,632
VSM-34	-S02	-S16	34.00	1.34	32.56		2.24		.64		32.88		.79		9,279	19,796
VSM-35	-S02	-S16	35.00	1.38	33.55		2.24		.64		33.88		.79		9,552	20,378
VSM-36	-S02	-S16	36.00	1.42	34.54		2.24		.64		34.88		.79		9,825	20,960
VSM-38	-S02	-S16	38.00	1.50	36.52		2.24		.64		36.88		.79		10,371	22,125
VSM-40	-S02	-S16	40.00	1.57	38.09	+.00/-.51	3.00		.79	±.05	38.52	±.13	.99		14,426	28,748
VSM-42	-S02	-S16	42.00	1.65	40.07		3.00		.79		40.52		.99		15,147	30,185
VSM-45	-S02	-S16	45.00	1.77	43.04		3.00		.79		43.52		.99		16,229	32,341
VSM-48	-S02	-S16	48.00	1.89	46.01		3.00		.79		46.52		.99		17,311	34,497
VSM-50	-S02	-S16	50.00	1.97	47.99		3.00		.79		48.52		.99		18,032	35,935
VSM-52	-S02	-S16	52.00	2.05	49.48	+.00/-.64	4.01		.79		50.06	±.15	.99		24,583	37,372
VSM-55	-S02	-S16	55.00	2.17	52.46		4.01		.79		53.06		.99		26,001	39,528
VSM-56	-S02	-S16	56.00	2.20	53.44		4.01		.79		54.06		.99		26,473	40,247
VSM-58	-S02	-S16	58.00	2.28	55.42		4.01		.79		56.06		.99		27,419	41,684
VSM-60	-S02	-S16	60.00	2.36	57.40		4.01		.79		58.06		.99		28,364	43,122
VSM-62	-S02	-S16	62.00	2.44	59.37		4.01		.79		60.06		.99		29,310	44,559
VSM-63	-S02	-S16	63.00	2.48	60.35		4.01		.79		61.06		.99		29,783	45,278
VSM-65	-S02	-S16	65.00	2.56	62.33		4.01		.79		63.06		.99		30,728	46,715
VSM-68	-S02	-S16	68.00	2.68	65.31		4.01		.79		66.06		.99		32,146	48,871
VSM-70	-S02	-S16	70.00	2.76	67.29		4.01		.79		68.06		.99		33,092	50,309
VSM-72	-S02	-S16	72.00	2.83	69.27		4.01		.79		70.06		.99		34,037	51,746
VSM-75	-S02	-S16	75.00	2.95	72.25		4.01		.79		73.06		.99		35,456	53,902
VSM-78	-S02	-S16	78.00	3.07	74.85	+.00/-.76	4.78		.99		75.66		1.12		44,477	70,250
VSM-80	-S02	-S16	80.00	3.15	76.82		4.78		.99		77.66		1.12		45,617	72,052
VSM-82	-S02	-S16	82.00	3.23	78.79		4.78		.99		79.66		1.12		46,757	73,853
VSM-85	-S02	-S16	85.00	3.35	81.76		4.78		.99		82.66		1.12		48,468	76,555
VSM-88	-S02	-S16	88.00	3.46	84.73		4.78		.99		85.66		1.12		50,179	79,257

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] No removal notch.
[4] Square edge wire.

VSM Series

Metric Light Duty Rings External Continued

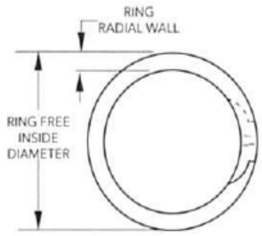
Smalley Part Number			Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Inside Diameter (mm)		Radial Wall (mm)		Thickness (mm)		Diameter (mm)		Width (mm)		Groove Yield[1] (N)	Ring Shear[2] (N)
	302 SS	316 SS	mm	in												
VSM-90	-S02	-S16	90.00	3.54	86.69	+.00/-.76	4.78	±.13	.99	±.05	87.66	±.15	1.12	+.08/-.00	51,319	81,058
VSM-95	-S02	-S16	95.00	3.74	91.66		4.78		.99		92.66		1.12		54,170	85,561
VSM-100	-S02	-S16	100.00	3.94	96.62		4.78		.99		97.66		1.12		57,021	90,064
VSM-105	-S02	-S16	105.00	4.13	101.13	+.00/-.89	5.72		1.17		102.20	±.18	1.32	+.10/-.00	71,642	106,440
VSM-110	-S02	-S16	110.00	4.33	106.08		5.72		1.17		107.20		1.32		75,054	111,508
VSM-115	-S02	-S16	115.00	4.53	111.03		5.72		1.17		112.20		1.32		78,465	116,577
VSM-120	-S02	-S16	120.00	4.72	115.98		5.72		1.17		117.20		1.32		81,877	121,645
VSM-125	-S02	-S16	125.00	4.92	120.93		5.72		1.17		122.20		1.32		85,288	126,714
VSM-130	-S02	-S16	130.00	5.12	125.88		5.72		1.17		127.20		1.32		88,700	131,783
VSM-135	-S02	-S16	135.00	5.31	130.31	+.00/-1.14	5.72		1.55		131.63		1.70		111,027	181,299
VSM-140	-S02	-S16	140.00	5.51	135.13		5.72		1.55		136.50		1.70		119,404	188,013
VSM-145	-S02	-S16	145.00	5.71	139.95		5.72		1.55		141.37		1.70		127,974	194,907
VSM-150	-S02	-S16	150.00	5.91	144.83		5.72		1.55		146.25		1.70		137,070	201,443
VSM-155	-S02	-S16	155.00	6.10	149.66		5.72		1.55		151.13	±.20	1.70		146,361	208,158
VSM-160	-S02	-S16	160.00	6.30	154.44		6.73		1.55		156.00		1.70		155,956	214,872
VSM-165	-S02	-S16	165.00	6.50	159.27		6.73		1.55		160.88		1.70		165,855	221,587
VSM-170	-S02	-S16	170.00	6.69	164.09		6.73		1.55		165.75		1.70		176,059	228,302
VSM-175	-S02	-S16	175.00	6.89	168.92		6.73		1.55		170.63		1.70		186,568	235,017
VSM-180	-S02	-S16	180.00	7.09	173.75		6.73		1.55		175.50		1.70		197,381	241,731
VSM-185	-S02	-S16	185.00	7.28	178.57	+.00/-1.52	7.62	±.15	1.55		180.38		1.70		208,499	248,446
VSM-190	-S02	-S16	190.00	7.48	183.40		7.62		1.55		185.25		1.70		219,922	255,161
VSM-195	-S02	-S16	195.00	7.68	188.22		7.62		1.55		190.13		1.70		231,649	261,876
VSM-200	-S02	-S16	200.00	7.87	193.05		7.62		1.55		195.00		1.70		243,681	268,590
VSM-210	-S02	-S16	210.00	8.27	202.70		8.76		1.93		204.75		2.08	+.13/-.00	268,658	351,160
VSM-220	-S02	-S16	220.00	8.66	212.36		8.76		1.93		214.50		2.08		294,854	367,882
VSM-230	-S02	-S16	230.00	9.06	222.01	+.00/-1.78	8.76		1.93		224.25		2.08		322,268	384,604
VSM-240	-S02	-S16	240.00	9.45	231.66		8.76		1.93		234.00		2.08		350,900	401,326
VSM-250	-S02	-S16	250.00	9.84	241.31		8.76		1.93		243.75		2.08		380,751	418,048
VSM-260	-S02	-S16	260.00	10.24	250.97		9.65		1.93		253.50		2.08		411,821	434,770
VSM-270	-S02	-S16	270.00	10.63	260.62		9.65		1.93		263.25		2.08		444,108	451,492
VSM-280	-S02	-S16	280.00	11.02	270.27		9.65		1.93		273.00		2.08		477,614	468,214
VSM-290	-S02	-S16	290.00	11.42	279.92		9.65		1.93		282.75		2.08		512,339	484,936
VSM-300	-S02	-S16	300.00	11.81	289.58		9.65		1.93		292.50		2.08		548,282	501,658

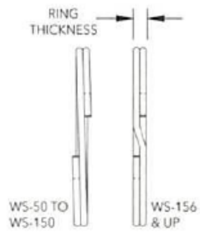
[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.

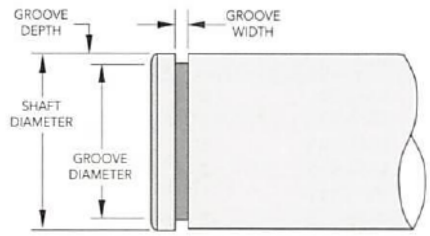
WS Series

Medium Duty Rings External

*Compliance with AS3218, AS4299, MIL-DTL-27426/1







Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number			Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	Add Suffix 316 SS	in	mm	Inside Diameter (in)	Tol.	Radial Wall (in)	Tol.	Thickness (in)	Tol.	Diameter (in)	Tol.	Width (in)	Tol.	Groove Yield[1] (lb)	Ring Shear[2] (lb)
WS-50	-S02	-S16	.500	12.70	.467	+.000/-.013	.045	+.003/-.005	.025	±.002	.474	±.002	.030	+.003/-.000	460	2,000
WS-53	-S02	-S16	.531	13.49	.498		.045		.025		.505		.030		490	2,130
WS-55	-S02	-S16	.551	14.00	.518		.045		.025		.525		.030		510	2,210
WS-56	-S02	-S16	.562	14.27	.529		.045		.025		.536		.030		520	2,250
WS-59	-S02	-S16	.594	15.09	.561		.045		.025		.569	±.003	.030		550	2,380
WS-62	-S02	-S16	.625	15.88	.585		.055		.025		.594		.030		710	2,500
WS-65	-S02	-S16	.656	16.66	.617		.055		.025		.625		.030		740	2,630
WS-66	-S02	-S16	.669	16.99	.629		.055		.025		.638		.030		760	2,680
WS-68	-S02	-S16	.687	17.45	.647		.055		.025		.656		.030		780	2,750
WS-71	-S02	-S16	.718	18.24	.679		.055		.025		.687		.030		810	2,880
WS-75	-S02	-S16	.750	19.05	.710		.065		.031		.719		.036		850	3,360
WS-78	-S02	-S16	.781	19.84	.741		.065		.031		.750		.036		880	3,500
WS-81	-S02	-S16	.812	20.62	.771		.065		.031		.781		.036		920	3,640
WS-84	-S02	-S16	.843	21.41	.803		.065		.031		.812		.036		950	3,780
WS-87	-S02	-S16	.875	22.23	.828		.065		.031		.838		.036		1,180	3,920
WS-90	-S02	-S16	.906	23.01	.860		.065		.031		.869		.036		1,220	4,060
WS-93	-S02	-S16	.937	23.80	.889		.065		.031		.900		.036		1,260	4,200
WS-96	-S02	-S16	.968	24.59	.916		.075		.037		.925		.042		1,440	5,180
WS-98	-S02	-S16	.984	24.99	.930		.075		.037		.941		.042		1,460	5,260
WS-100	-S02	-S16	1.000	25.40	.946		.075		.037		.957		.042		1,480	5,350
WS-102	-S02	-S16	1.023	25.98	.968		.075		.037		.980		.042		1,520	5,470
WS-103	-S02	-S16	1.031	26.19	.978		.075		.037		.988		.042		1,530	5,510
WS-106	-S02	-S16	1.062	26.97	1.007	+.000/-.015	.075		.037		1.020	±.004	.042		1,580	5,680
WS-109	-S02	-S16	1.093	27.76	1.040		.075		.037		1.051		.042		1,620	5,840
WS-112	-S02	-S16	1.125	28.58	1.070		.075		.037		1.083		.042		1,670	6,020
WS-115	-S02	-S16	1.156	29.36	1.102		.075		.037		1.114		.042		1,720	6,180
WS-118	-S02	-S16	1.188	30.18	1.127		.085		.043		1.140		.048	+.004/-.000	2,020	7,380
WS-121	-S02	-S16	1.218	30.94	1.159		.085		.043		1.170		.048		2,070	7,570
WS-125	-S02	-S16	1.250	31.75	1.188		.085		.043		1.202		.048		2,120	7,770
WS-128	-S02	-S16	1.281	32.54	1.221		.085		.043		1.233		.048		2,170	7,960
WS-131	-S02	-S16	1.312	33.32	1.251		.095		.043		1.264		.048		2,230	8,150
WS-134	-S02	-S16	1.343	34.11	1.282		.095		.043		1.295		.048		2,280	8,350
WS-137	-S02	-S16	1.375	34.93	1.308		.095		.043		1.323		.048		2,530	8,540
WS-140	-S02	-S16	1.406	35.71	1.340		.095		.043		1.354		.048		2,580	8,740
WS-143	-S02	-S16	1.437	36.50	1.370		.095		.043		1.385		.048		2,640	8,930
WS-146	-S02	-S16	1.468	37.29	1.402		.095		.043		1.416		.048		2,700	9,120
WS-150	-S02	-S16	1.500	38.10	1.433		.095		.043		1.448		.048		2,760	9,320
WS-156	-S02	-S16	1.562	39.67	1.490	+.000/-.020	.108		.049	±.003	1.507	±.005	.056		3,090	10,100
WS-157	-S02	-S16	1.575	40.01	1.503		.108		.049		1.520		.056		3,120	10,190
WS-162	-S02	-S16	1.625	41.28	1.549		.108		.049		1.566		.056		3,450	10,510
WS-168	-S02	-S16	1.687	42.85	1.610		.118		.049		1.628		.056		3,580	10,910
WS-175	-S02	-S16	1.750	44.45	1.673		.118		.049		1.691		.056		3,710	11,310
WS-177	-S02	-S16	1.771	44.98	1.690		.118		.049		1.708		.056		4,010	11,450
WS-181	-S02	-S16	1.813	46.05	1.730		.118		.049		1.749		.056		4,100	11,720
WS-187	-S02	-S16	1.875	47.63	1.789		.128		.049		1.808		.056		4,510	12,120
WS-193	-S02	-S16	1.938	49.23	1.844		.128		.049		1.861		.056		4,660	12,530
WS-196	-S02	-S16	1.969	50.01	1.882		.128		.049		1.902		.056		4,730	12,730
WS-200	-S02	-S16	2.000	50.80	1.909		.128		.049		1.929		.056		4,950	12,930
WS-206	-S02	-S16	2.062	52.37	1.971		.128		.049		1.992	±.006	.056		5,100	13,330
WS-212	-S02	-S16	2.125	53.98	2.029		.128		.049		2.051		.056		5,560	13,740

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

WS Series

Medium Duty Rings External Continued

Smalley Part Number			Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	Add Suffix 316 SS	in	mm	Inside Diameter (in)	Tol.	Radial Wall (in)	Tol.	Thickness (in)	Tol.	Diameter (in)	Tol.	Width (in)	Tol.	Groove Yield[1] (lb)	Ring Shear[2] (lb)
WS-215	-S02	-S16	2.156	54.76	2.060	+.000/-.025	.138	+.003/-.005	.049	±.003	2.082	±.006	.056	+.004/-.000	5,640	13,940
WS-216	-S02	-S16	2.165	54.99	2.070		.138		.049		2.091		.056		5,660	14,000
WS-218	-S02	-S16	2.188	55.58	2.092		.138		.049		2.113		.056		5,720	14,150
WS-225	-S02	-S16	2.250	57.15	2.153		.138		.049		2.176		.056		5,890	14,550
WS-231	-S02	-S16	2.312	58.72	2.211		.138		.049		2.234		.056		6,370	14,950
WS-236	-S02	-S16	2.362	59.99	2.261		.138		.049		2.284		.056		6,510	15,270
WS-237	-S02	-S16	2.375	60.33	2.273		.138		.049		2.297		.056		6,550	15,360
WS-243	-S02	-S16	2.437	61.90	2.331		.148		.049		2.355		.056		7,060	15,760
WS-250	-S02	-S16	2.500	63.50	2.394		.148		.049		2.418		.056		7,250	16,160
WS-255	-S02	-S16	2.559	65.00	2.449		.148		.049		2.473		.056		7,780	16,550
WS-256	-S02	-S16	2.562	65.07	2.452		.148		.049		2.476		.056		7,790	16,560
WS-262	-S02	-S16	2.625	66.68	2.514		.148		.049		2.539		.056		7,980	16,970
WS-268	-S02	-S16	2.688	68.28	2.572		.158		.049		2.597		.056		8,550	17,380
WS-275	-S02	-S16	2.750	69.85	2.635	+.000/-.030	.158		.049		2.660		.056		8,750	17,780
WS-281	-S02	-S16	2.813	71.45	2.696		.168	+.004/-.006	.049		2.722		.056		8,950	18,190
WS-287	-S02	-S16	2.875	73.03	2.755		.168		.049		2.781		.056		9,550	18,590
WS-293	-S02	-S16	2.937	74.60	2.817		.168		.049		2.843		.056		9,760	18,990
WS-295	-S02	-S16	2.952	74.98	2.831		.168		.049		2.858		.056		9,810	19,090
WS-300	-S02	-S16	3.000	76.20	2.877		.168		.061		2.904		.068	+.005/-.000	10,180	24,150
WS-306	-S02	-S16	3.062	77.77	2.938		.168		.061		2.966		.068		10,390	24,650
WS-312	-S02	-S16	3.125	79.38	3.000		.178		.061		3.027		.068		10,820	25,150
WS-314	-S02	-S16	3.149	79.98	3.023		.178		.061		3.051		.068		10,910	25,350
WS-318	-S02	-S16	3.187	80.95	3.061		.178		.061		3.089		.068		11,040	25,650
WS-325	-S02	-S16	3.250	82.55	3.121		.178		.061		3.150		.068		11,490	26,160
WS-331	-S02	-S16	3.312	84.12	3.180		.188		.061		3.208		.068		12,170	26,660
WS-334	-S02	-S16	3.343	84.91	3.210		.188		.061		3.239		.068		12,290	26,910
WS-337	-S02	-S16	3.375	85.73	3.242		.188		.061		3.271		.068		12,410	27,170
WS-343	-S02	-S16	3.437	87.30	3.301		.188		.061		3.331		.068		12,880	27,660
WS-350	-S02	-S16	3.500	88.90	3.363	+.000/-.040	.188		.061		3.394		.068		13,110	28,170
WS-354	-S02	-S16	3.543	89.99	3.402		.198		.061		3.433		.068		13,770	28,520
WS-356	-S02	-S16	3.562	90.47	3.422		.198		.061		3.452		.068		13,850	28,670
WS-362	-S02	-S16	3.625	92.08	3.483		.198		.061		3.515		.068		14,090	29,180
WS-368	-S02	-S16	3.687	93.65	3.543		.198		.061		3.575		.068		14,600	29,680
WS-374	-S02	-S16	3.740	95.00	3.597		.198		.061		3.628		.068		14,800	30,100
WS-375	-S02	-S16	3.750	95.25	3.606		.198		.061		3.638		.068		14,840	30,180
WS-381	-S02	-S16	3.812	96.82	3.668		.198		.061		3.700		.068		15,090	30,680
WS-387	-S02	-S16	3.875	98.43	3.724		.208		.061		3.757		.068		16,160	31,190
WS-393	-S02	-S16	3.938	100.03	3.784		.208		.061		3.820		.068		16,420	31,700
WS-400	-S02	-S16	4.000	101.60	3.842		.218		.061		3.876		.068		17,530	32,200
WS-406	-S02	-S16	4.063	103.20	3.906		.218		.061		3.939		.068		17,810	32,700
WS-412	-S02	-S16	4.125	104.78	3.967		.218		.061		4.000		.068		18,080	33,200
WS-413	-S02	-S16	4.134	105.00	3.975		.218		.061		4.010		.068		18,120	33,270
WS-418	-S02	-S16	4.188	106.38	4.030		.218		.061		4.058		.068		19,240	33,710
WS-425	-S02	-S16	4.250	107.95	4.084		.228		.061		4.120		.068		19,530	34,210
WS-431	-S02	-S16	4.312	109.52	4.147		.228		.061		4.182		.068		19,810	34,710
WS-433	-S02	-S16	4.331	110.01	4.164		.228		.061		4.200		.068		19,900	34,860
WS-437	-S02	-S16	4.375	111.13	4.208		.228		.061		4.245		.068		20,100	35,210
WS-443	-S02	-S16	4.437	112.70	4.271		.228		.061		4.307		.068		20,390	35,710
WS-450	-S02	-S16	4.500	114.30	4.326		.238		.061		4.364		.068		21,630	36,220
WS-456	-S02	-S16	4.562	115.87	4.384		.250		.072	±.004	4.422		.079		22,570	43,340
WS-462	-S02	-S16	4.625	117.48	4.447		.250		.072		4.485		.079		22,890	43,940
WS-468	-S02	-S16	4.687	119.05	4.508		.250		.072		4.547		.079		23,190	44,530
WS-472	-S02	-S16	4.724	119.99	4.546		.250		.072		4.584		.079		23,370	44,880
WS-475	-S02	-S16	4.750	120.65	4.571		.250		.072		4.610		.079		23,500	45,130
WS-481	-S02	-S16	4.812	122.22	4.633		.250		.072		4.672		.079		23,810	45,720
WS-487	-S02	-S16	4.875	123.83	4.695		.250		.072		4.735		.079		24,120	46,310
WS-493	-S02	-S16	4.937	125.40	4.757		.250		.072		4.797		.079		24,430	46,900
WS-500	-S02	-S16	5.000	127.00	4.820		.250		.072		4.856		.079		25,450	47,500
WS-511	-S02	-S16	5.118	130.00	4.934		.250		.072		4.974		.079		26,050	48,620
WS-512	-S02	-S16	5.125	130.18	4.939		.250		.072		4.981		.079		26,080	48,690
WS-525	-S02	-S16	5.250	133.35	5.064	+.000/-.050	.250		.072		5.107	±.007	.079		26,720	49,880
WS-537	-S02	-S16	5.375	136.53	5.187		.250		.072		5.228		.079		28,120	51,060
WS-550	-S02	-S16	5.500	139.70	5.308		.250		.072		5.353		.079		28,770	52,250
WS-551	-S02	-S16	5.511	139.98	5.320		.250		.072		5.364		.079		28,830	52,360
WS-562	-S02	-S16	5.625	142.88	5.433		.250		.072		5.478		.079		29,420	53,440
WS-575	-S02	-S16	5.750	146.05	5.550		.250		.072		5.597		.079		31,300	54,630

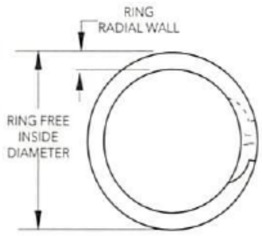
[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

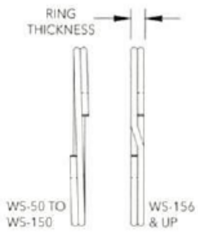
* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

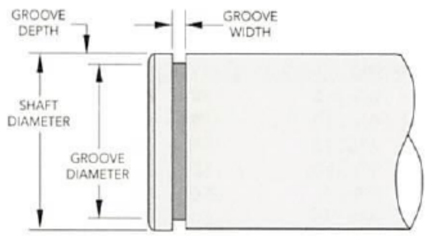
WS Series

Medium Duty Rings External

*Compliance with AS3218, AS4299, MIL-DTL-27426/1







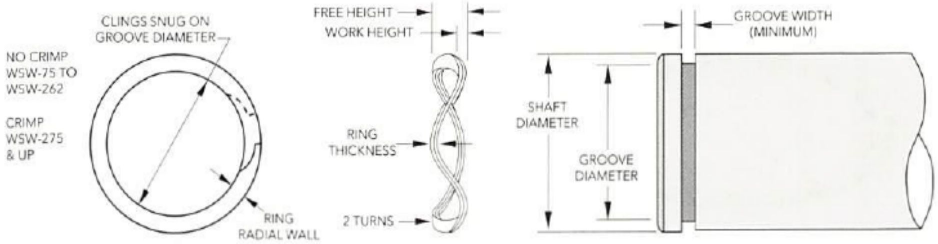
Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number			Shaft Diameter		Ring					Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	Add Suffix 316 SS	in	mm	Inside Diameter (in)	Tol.	Radial Wall (in)	Tol.	Thickness (in)	Tol.	Diameter (in)	Tol.	Width (in)	Tol.	Groove Yield[1] (lb)	Ring Shear[2] (lb)
WS-587	-S02	-S16	5.875	149.23	5.674	+.000/-.050	.250	+.004/-.006	.072	±.004	5.722	±.007	.079	+.005/-.000	31,980	55,810
WS-590	-S02	-S16	5.905	149.99	5.705		.250		.072		5.752		.079		32,140	56,100
WS-600	-S02	-S16	6.000	152.40	5.798		.250		.072		5.847		.079		32,660	57,000
WS-612	-S02	-S16	6.125	155.58	5.903	+.000/-.060	.312	+.004/-.008	.086		5.953	±.008	.094	+.006/-.000	37,230	69,500
WS-625	-S02	-S16	6.250	158.75	6.026		.312		.086		6.078		.094		37,990	70,920
WS-629	-S02	-S16	6.299	159.99	6.076		.312		.086		6.127		.094		38,290	71,480
WS-637	-S02	-S16	6.375	161.93	6.152		.312		.086		6.203		.094		38,750	72,340
WS-650	-S02	-S16	6.500	165.10	6.274		.312		.086		6.328		.094		39,510	73,760
WS-662	-S02	-S16	6.625	168.28	6.390		.312		.086		6.443		.094		42,620	75,180
WS-675	-S02	-S16	6.750	171.45	6.513		.312		.086		6.568		.094		43,420	76,600
WS-687	-S02	-S16	6.875	174.63	6.638		.312		.086		6.693		.094		44,220	78,010
WS-700	-S02	-S16	7.000	177.80	6.761		.312		.086		6.818		.094		45,030	79,430
WS-712	-S02	-S16	7.125	180.98	6.877		.312		.086		6.933		.094		48,350	80,850
WS-725	-S02	-S16	7.250	184.15	6.999		.312		.086		7.058		.094		49,200	82,270
WS-737	-S02	-S16	7.375	187.33	7.125		.312		.086		7.183		.094		50,050	83,690
WS-750	-S02	-S16	7.500	190.50	7.250	+.000/-.070	.312		.086		7.308		.094		50,890	85,110
WS-762	-S02	-S16	7.625	193.68	7.363		.312		.086		7.423		.094		54,440	86,520
WS-775	-S02	-S16	7.750	196.85	7.486		.312		.086		7.548		.094		55,330	87,940
WS-787	-S02	-S16	7.875	200.03	7.611		.312		.086		7.673		.094		56,220	89,360
WS-800	-S02	-S16	8.000	203.20	7.734		.312		.086		7.798		.094		57,110	90,780
WS-825	-S02	-S16	8.250	209.55	7.972		.375		.086		8.038		.094		61,820	93,620
WS-850	-S02	-S16	8.500	215.90	8.220		.375		.086		8.288		.094		63,690	96,450
WS-875	-S02	-S16	8.750	222.25	8.459		.375		.086		8.528		.094		68,650	99,290
WS-900	-S02	-S16	9.000	228.60	8.707		.375		.086		8.778		.094		70,620	102,130
WS-925	-S02	-S16	9.250	234.95	8.945		.375		.086		9.018		.094		75,850	104,960
WS-950	-S02	-S16	9.500	241.30	9.194		.375		.086		9.268		.094		77,900	107,800
WS-975	-S02	-S16	9.750	247.65	9.432		.375		.086		9.508		.094		83,390	110,640
WS-1000	-S02	-S16	10.000	254.00	9.680		.375		.086		9.758		.094		85,530	113,470
WS-1025	-S02	-S16	10.250	260.35	9.918		.375		.086		9.998		.094		91,290	116,310
WS-1050	-S02	-S16	10.500	266.70	10.166		.375		.086		10.248		.094		93,520	119,150
WS-1075	-S02	-S16	10.750	273.05	10.405		.375		.086		10.488		.094		99,540	121,990
WS-1100	-S02	-S16	11.000	279.40	10.653		.375		.086		10.738		.094		101,860	124,820

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

WSW Series
WaveRing® External

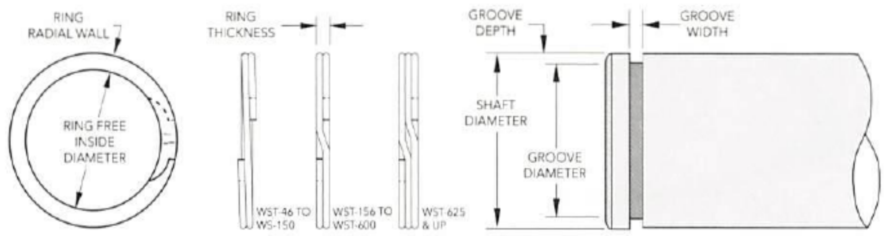


Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number		Housing Diameter		Ring		Groove		Load (lb) @ Work Height	Max Free Height (in)	Number of Waves
Carbon Steel	Add Suffix 17-7	in	mm	Thickness (in)	Radial Wall (in)	Diameter (in)	Width (in)			
WSW-75	**-S17**	.750	19.050	.042	.065	.704	.120	25 @ .085	.115	3
WSW-87	**-S17**	.875	22.225	.042	.075	.821	.136	30 @ .085	.131	3
WSW-100	**-S17**	1.000	25.400	.042	.085	.940	.134	34 @ .085	.129	3
WSW-112	**-S17**	1.125	28.575	.050	.128	1.059	.142	38 @ .100	.137	3
WSW-125	**-S17**	1.250	31.750	.050	.128	1.176	.150	40 @ .100	.145	3
WSW-137	**-S17**	1.375	34.925	.050	.128	1.291	.135	45 @ .100	.130	4
WSW-150	**-S17**	1.500	38.100	.050	.128	1.406	.131	50 @ .100	.126	4
WSW-162	**-S17**	1.625	41.275	.062	.158	1.529	.143	55 @ .110	.138	4
WSW-175	**-S17**	1.750	44.450	.062	.158	1.650	.142	60 @ .110	.137	4
WSW-187	**-S17**	1.875	47.625	.062	.158	1.769	.145	63 @ .110	.140	4
WSW-200	**-S17**	2.000	50.800	.062	.158	1.886	.150	65 @ .110	.145	4
WSW-212	**-S17**	2.125	53.975	.078	.188	2.003	.175	70 @ .130	.170	4
WSW-225	**-S17**	2.250	57.150	.078	.188	2.120	.180	75 @ .130	.175	4
WSW-237	**-S17**	2.375	60.325	.078	.188	2.239	.180	80 @ .130	.175	4
WSW-250	**-S17**	2.500	63.500	.078	.188	2.360	.176	84 @ .130	.171	4
WSW-262	**-S17**	2.625	66.675	.078	.188	2.481	.190	88 @ .130	.181	4
WSW-275	**-S17**	2.750	69.850	.093	.225	2.602	.222	94 @ .170	.217	4
WSW-287	**-S17**	2.875	73.025	.093	.225	2.721	.222	97 @ .170	.217	4
WSW-300	**-S17**	3.000	76.200	.093	.225	2.838	.230	100 @ .170	.225	4
WSW-312	**-S17**	3.125	79.375	.093	.225	2.957	.235	103 @ .170	.230	4
WSW-325	**-S17**	3.250	82.550	.093	.225	3.076	.230	106 @ .170	.225	4
WSW-350	**-S17**	3.500	88.900	.111	.281	3.316	.250	115 @ .185	.245	4
WSW-362	**-S17**	3.625	92.075	.111	.281	3.435	.255	117 @ .185	.250	4
WSW-375	**-S17**	3.750	95.250	.111	.281	3.552	.263	121 @ .185	.258	4
WSW-387	**-S17**	3.875	98.425	.111	.281	3.673	.260	126 @ .185	.255	4
WSW-400	**-S17**	4.000	101.600	.111	.281	3.792	.273	130 @ .185	.268	4
WSW-412	**-S17**	4.125	104.775	.111	.281	3.919	.268	134 @ .185	.263	4
WSW-425	**-S17**	4.250	107.950	.111	.281	4.065	.253	140 @ .185	.248	5
WSW-450	**-S17**	4.500	114.300	.111	.281	4.310	.261	150 @ .185	.256	5
WSW-475	**-S17**	4.750	120.650	.111	.281	4.550	.258	160 @ .185	.253	5
WSW-500	**-S17**	5.000	127.000	.111	.281	4.790	.264	170 @ .185	.259	5

WST Series

Spirolox Medium/Heavy Duty Rings External



Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number			Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Inside Diameter (in)		Radial Wall (in)		Thickness (in)		Diameter (in)		Width (in)		Groove Yield[1] (lb)	Ring Shear[2] (lb)
	302 SS	316 SS	in	mm												
Two-Turn																
WST-46	-S02	-S16	.469	11.91	.436	+.000/-.013	.045	±.004	.025	±.002	.443	±.002	.029	+.003/-.000	430	1,800
WST-50	-S02	-S16	.500	12.70	.469		.045		.035		.474		.039		460	2,530
WST-55	-S02	-S16	.551	14.00	.518		.045		.035		.524	±.003	.039		550	2,790
WST-56	-S02	-S16	.562	14.27	.529		.045		.035		.535		.039		560	2,840
WST-59	-S02	-S16	.594	15.09	.559		.045		.035		.565		.039		630	3,000
WST-62	-S02	-S16	.625	15.88	.590		.055		.035		.596		.039		660	3,160
WST-66	-S02	-S16	.669	16.99	.630		.055		.035		.638		.039		760	3,380
WST-68	-S02	-S16	.688	17.48	.648		.065		.042		.655		.046		830	4,180
WST-75	-S02	-S16	.750	19.05	.708		.065		.042		.715		.046		950	4,550
WST-78	-S02	-S16	.781	19.84	.738		.065		.042		.745		.046		990	4,740
WST-81	-S02	-S16	.812	20.62	.768		.065		.042		.776		.046		1,030	4,930
WST-87	-S02	-S16	.875	22.23	.827		.075		.042		.835		.046		1,240	5,310
WST-93	-S02	-S16	.938	23.83	.886		.075		.042		.894		.046		1,460	5,690
WST-98	-S02	-S16	.984	24.99	.934		.075		.042		.940		.046		1,530	5,970
WST-100	-S02	-S16	1.000	25.40	.947		.075		.042		.955		.046		1,630	6,070
WST-102	-S02	-S16	1.023	25.98	.969		.075		.042		.977	±.004	.046		1,660	6,210
WST-106	-S02	-S16	1.062	26.97	1.005	+.000/-.015	.088		.050		1.015		.056	+.004/-.000	1,800	7,010
WST-112	-S02	-S16	1.125	28.58	1.064		.088		.050		1.075		.056		1,990	7,420
WST-118	-S02	-S16	1.188	30.18	1.126		.088		.050		1.135		.056		2,270	7,370
WST-125	-S02	-S16	1.250	31.75	1.184		.093		.050		1.195		.056		2,470	8,250
WST-131	-S02	-S16	1.312	33.32	1.240		.098		.050		1.250		.056		2,880	8,660
WST-137	-S02	-S16	1.375	34.93	1.298		.103		.050		1.310		.056		3,210	9,070
WST-143	-S02	-S16	1.438	36.53	1.359		.103		.050		1.370		.056		3,460	9,490
WST-150	-S02	-S16	1.500	38.10	1.419		.103		.050		1.430		.056		3,710	9,900
WST-156	-S02	-S16	1.562	39.67	1.476	+.000/-.020	.113		.062	±.003	1.490	±.005	.068		3,980	12,780
WST-162	-S02	-S16	1.625	41.28	1.537		.118		.062		1.550		.068		4,370	13,290
WST-168	-S02	-S16	1.687	42.85	1.598		.118		.062		1.610		.068		4,650	13,800
WST-175	-S02	-S16	1.750	44.45	1.657		.118		.062		1.670		.068		4,950	14,320
WST-177	-S02	-S16	1.771	44.98	1.676		.123		.062		1.689		.068		5,130	14,490
WST-181	-S02	-S16	1.812	46.02	1.714		.123		.062		1.730		.068		5,250	14,820
WST-187	-S02	-S16	1.875	47.63	1.774		.123		.062		1.790		.068		5,700	15,340
WST-196	-S02	-S16	1.969	50.01	1.864		.123		.062		1.879		.068		6,260	16,110
WST-200	-S02	-S16	2.000	50.80	1.894	+.000/-.025	.128		.062		1.910		.068		6,360	16,360
WST-206	-S02	-S16	2.062	52.37	1.955		.141		.078		1.970	±.006	.086	+.005/-.000	6,710	21,220
WST-212	-S02	-S16	2.125	53.98	2.012		.141		.078		2.027		.086		7,360	21,870
WST-215	-S02	-S16	2.156	54.76	2.041		.141		.078		2.057		.086		7,620	22,190
WST-225	-S02	-S16	2.250	57.15	2.129		.141		.078		2.145		.086		8,430	23,160
WST-231	-S02	-S16	2.312	58.72	2.188		.141		.078		2.205		.086		8,830	23,800
WST-237	-S02	-S16	2.375	60.33	2.248		.141		.078		2.265		.086		9,230	24,440
WST-243	-S02	-S16	2.437	61.90	2.307		.141		.078		2.325		.086		9,650	25,080
WST-250	-S02	-S16	2.500	63.50	2.366		.188	±.005	.078		2.385		.086		10,250	25,730
WST-255	-S02	-S16	2.559	65.00	2.424		.188		.078		2.443		.086		10,490	26,340
WST-262	-S02	-S16	2.625	66.68	2.485		.188		.078		2.505		.086		11,130	27,020
WST-268	-S02	-S16	2.687	68.25	2.545	+.000/-.030	.188		.078		2.565		.086		11,590	27,660
WST-275	-S02	-S16	2.750	69.85	2.604		.188		.093		2.625		.103		12,250	32,140
WST-287	-S02	-S16	2.875	73.03	2.722		.188		.093		2.742		.103		13,620	33,600
WST-293	-S02	-S16	2.937	74.60	2.780		.188		.093		2.801		.103		14,120	34,320
WST-300	-S02	-S16	3.000	76.20	2.838		.188		.093		2.860		.103		14,840	35,060
WST-306	-S02	-S16	3.062	77.77	2.897		.188		.093		2.920		.103		15,370	35,790

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

WST Series

Spirolox Medium/Heavy Duty Rings External Continued

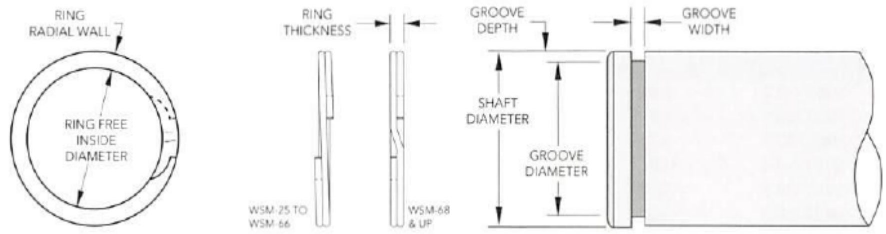
Smalley Part Number			Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Inside Diameter (in)		Radial Wall (in)		Thickness (in)		Diameter (in)		Width (in)		Groove Yield[1] (lb)	Ring Shear[2] (lb)
	302 SS	316 SS	in	mm		Tol.		Tol.		Tol.		Tol.		Tol.		
WST-312	-S02	-S16	3.125	79.38	2.957	+.000/-.030	.188	±.005	.093	±.003	2.980	±.006	.103	+.005/-.000	16,130	36,520
WST-315	-S02	-S16	3.156	80.16	2.986		.188		.093		3.010		.103		16,290	36,880
WST-325	-S02	-S16	3.250	82.55	3.075		.188		.093		3.100		.103		17,230	37,980
WST-334	-S02	-S16	3.344	84.94	3.164		.188		.093		3.190		.103		18,200	39,080
WST-343	-S02	-S16	3.437	87.30	3.254		.188		.093		3.280		.103		19,190	40,170
WST-350	-S02	-S16	3.500	88.90	3.315	+.000/-.040	.250		.111		3.340		.120		19,790	48,820
WST-354	-S02	-S16	3.543	89.99	3.356		.250		.111		3.381		.120		20,290	49,420
WST-362	-S02	-S16	3.625	92.08	3.433		.250		.111		3.458		.120		21,520	50,560
WST-368	-S02	-S16	3.687	93.65	3.490		.250		.111		3.517		.120		22,150	51,430
WST-375	-S02	-S16	3.750	95.25	3.550		.250		.111		3.577		.120		23,060	52,310
WST-387	-S02	-S16	3.875	98.43	3.670		.250		.111		3.696		.120		24,650	54,050
WST-393	-S02	-S16	3.938	100.03	3.730		.250		.111		3.756		.120		25,330	54,930
WST-400	-S02	-S16	4.000	101.60	3.787		.250		.111		3.815		.120		26,300	55,800
WST-425	-S02	-S16	4.250	107.95	4.032		.250		.111		4.065		.120		27,940	59,280
WST-437	-S02	-S16	4.375	111.13	4.162		.250		.111		4.190		.120		28,760	61,030
WST-450	-S02	-S16	4.500	114.30	4.280		.250		.111		4.310		.120		30,220	62,770
WST-475	-S02	-S16	4.750	120.65	4.515		.250		.111		4.550		.120		33,580	66,260
WST-500	-S02	-S16	5.000	127.00	4.755		.250		.111		4.790		.120		37,110	69,740
WST-525	-S02	-S16	5.250	133.35	4.995	+.000/-.050	.375	±.006	.127	±.004	5.030	±.007	.139	+.006/-.000	40,820	83,790
WST-550	-S02	-S16	5.500	139.70	5.229		.375		.127		5.265		.139		45,880	87,780
WST-575	-S02	-S16	5.750	146.05	5.466		.375		.127		5.505		.139		49,990	91,770
WST-600	-S02	-S16	6.000	152.40	5.705		.375		.127		5.745		.139		54,290	95,760
Three-Turn																
WST-625	-S02	-S16	6.250	158.75	5.942	+.000/-.060	.312	±.006	.165	±.005	5.985	±.008	.174	+.008/-.000	58,760	129,590
WST-650	-S02	-S16	6.500	165.10	6.182		.312		.165		6.225		.174		63,410	134,780
WST-675	-S02	-S16	6.750	171.45	6.420		.312		.165		6.465		.174		68,230	139,960
WST-700	-S02	-S16	7.000	177.80	6.658		.312		.165		6.705		.174		73,230	145,140
WST-725	-S02	-S16	7.250	184.15	6.894		.312		.165		6.942		.174		78,290	172,190
WST-750	-S02	-S16	7.500	190.50	7.130	+.000/-.070	.375		.189		7.180		.209		84,820	178,130
WST-775	-S02	-S16	7.750	196.85	7.368		.375		.189		7.420		.209		90,390	184,070
WST-800	-S02	-S16	8.000	203.20	7.607		.375		.189		7.660		.209		96,130	190,000
WST-825	-S02	-S16	8.250	209.55	7.845		.375		.189		7.900		.209		102,050	195,940
WST-850	-S02	-S16	8.500	215.90	8.083		.375		.189		8.140		.209		108,150	201,880
WST-875	-S02	-S16	8.750	222.25	8.321		.375		.189		8.383		.209		113,800	207,820
WST-900	-S02	-S16	9.000	228.60	8.560		.375		.189		8.620		.209		120,870	213,750
WST-925	-S02	-S16	9.250	234.95	8.798		.375		.189		8.860		.209		127,500	219,690
WST-950	-S02	-S16	9.500	241.30	9.036		.375		.189		9.100		.209		134,300	225,630
WST-975	-S02	-S16	9.750	247.65	9.273		.375		.189		9.338		.209		141,970	231,570
WST-1000	-S02	-S16	10.000	254.00	9.508		.375		.189		9.575		.209		150,560	237,500

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

WSM Series

Heavy Duty Rings External

**Compliance with AS3216, AS4299, MIL-DTL-27426/2*



Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number			Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Inside Diameter (in)	Tol.	Radial Wall (in)	Tol.	Thickness (in)	Tol.	Diameter (in)	Tol.	Width (in)	Tol.	Groove Yield[1] (lb)	Ring Shear[2] (lb)
	302 SS	316 SS	in	mm												
WSM-25[3,4]	-S02	-S16	.250	6.35	.228	+.000/-.010	.020	+.003/-.005	.025	±.002	.230	±.002	.029	+.003/-.000	177	961
WSM-31[3,4]	-S02	-S16	.312	7.92	.287		.025		.025		.290		.029		243	1,200
WSM-37[3,4]	-S02	-S16	.375	9.53	.349		.030		.025		.352		.029		305	1,442
WSM-43[4]	-S02	-S16	.437	11.10	.409	+.000/-.012	.035		.025		.412		.029		386	1,680
WSM-46	-S02	-S16	.469	11.91	.439	+.000/-.013	.045		.025		.443		.029		430	1,880
WSM-50	-S02	-S16	.500	12.70	.464		.050		.035		.468		.039		570	2,530
WSM-55	-S02	-S16	.551	14.00	.514		.050		.035		.519		.039		620	2,790
WSM-56	-S02	-S16	.562	14.27	.525		.050		.035		.530		.039		640	2,840
WSM-59	-S02	-S16	.594	15.09	.554		.050		.035		.559	±.003	.039		760	3,000
WSM-62	-S02	-S16	.625	15.88	.583		.055		.035		.588		.039		840	3,160
WSM-66	-S02	-S16	.669	16.99	.623		.055		.035		.629		.039		950	3,380
WSM-68	-S02	-S16	.688	17.48	.641		.065		.042		.646		.046		1,020	4,180
WSM-75	-S02	-S16	.750	19.05	.698		.065		.042		.704		.046		1,220	4,550
WSM-78	-S02	-S16	.781	19.84	.727		.065		.042		.733		.046		1,330	4,740
WSM-81	-S02	-S16	.812	20.62	.756		.065		.042		.762		.046		1,440	4,930
WSM-87	-S02	-S16	.875	22.23	.814		.075		.042		.821		.046		1,670	5,310
WSM-93	-S02	-S16	.938	23.83	.875		.075		.042		.882		.046		1,860	5,690
WSM-98	-S02	-S16	.984	24.99	.919		.085		.042		.926		.046		2,020	5,970
WSM-100	-S02	-S16	1.000	25.40	.932		.085		.042		.940		.046		2,120	6,070
WSM-102	-S02	-S16	1.023	25.98	.953		.085		.042		.961		.046		2,240	6,210
WSM-106	-S02	-S16	1.062	26.97	.986		.103		.050		.998	±.004	.056	+.004/-.000	2,400	7,010
WSM-112	-S02	-S16	1.125	28.58	1.047		.103		.050		1.059		.056		2,620	7,420
WSM-118	-S02	-S16	1.188	30.18	1.105		.103		.050		1.118		.056		2,940	7,840
WSM-125	-S02	-S16	1.250	31.75	1.163		.103		.050		1.176		.056		3,270	8,250
WSM-131	-S02	-S16	1.312	33.32	1.218		.118		.050		1.232		.056		3,710	8,660
WSM-137	-S02	-S16	1.375	34.93	1.277		.118		.050		1.291		.056		4,080	9,070
WSM-143	-S02	-S16	1.438	36.53	1.336		.118		.050		1.350		.056		4,470	9,490
WSM-150	-S02	-S16	1.500	38.10	1.385		.118		.050		1.406		.056		4,980	9,900
WSM-156	-S02	-S16	1.562	39.67	1.453	+.000/-.020	.128		.062	±.003	1.468	±.005	.068		5,190	12,780
WSM-162	-S02	-S16	1.625	41.28	1.513		.128		.062		1.529		.068		5,510	13,290
WSM-168	-S02	-S16	1.687	42.85	1.573		.128		.062		1.589		.068		5,840	13,800
WSM-175	-S02	-S16	1.750	44.45	1.633		.128		.062		1.650		.068		6,190	14,320
WSM-177	-S02	-S16	1.771	44.98	1.651		.128		.062		1.669		.068		6,380	14,490
WSM-181	-S02	-S16	1.812	46.02	1.690		.128		.062		1.708		.068		6,660	14,820
WSM-187	-S02	-S16	1.875	47.63	1.751		.158		.062		1.769		.068		7,020	15,340
WSM-196	-S02	-S16	1.969	50.01	1.838		.158		.062		1.857		.068		7,790	16,110
WSM-200	-S02	-S16	2.000	50.80	1.867		.158		.062		1.886		.068		8,060	16,360
WSM-206	-S02	-S16	2.062	52.37	1.932	+.000/-.025	.168	+.004/-.006	.078		1.946	±.006	.086	+.005/-.000	8,450	21,220
WSM-212	-S02	-S16	2.125	53.98	1.989		.168		.078		2.003		.086		9,160	21,870
WSM-215	-S02	-S16	2.156	54.76	2.018		.168		.078		2.032		.086		9,450	22,190
WSM-225	-S02	-S16	2.250	57.15	2.105		.168		.078		2.120		.086		10,340	23,160
WSM-231	-S02	-S16	2.312	58.72	2.163		.168		.078		2.178		.086		10,950	23,800
WSM-237	-S02	-S16	2.375	60.33	2.223		.200		.078		2.239		.086		11,420	24,440
WSM-243	-S02	-S16	2.437	61.90	2.283		.200		.078		2.299		.086		11,890	25,080
WSM-250	-S02	-S16	2.500	63.50	2.343		.200		.078		2.360		.086		12,370	25,730
WSM-255	-S02	-S16	2.559	65.00	2.402		.200		.078		2.419		.086		12,660	26,340
WSM-262	-S02	-S16	2.625	66.68	2.464		.200		.078		2.481		.086		13,360	27,020
WSM-268	-S02	-S16	2.687	68.25	2.523		.200		.078		2.541		.086		13,870	27,660
WSM-275	-S02	-S16	2.750	69.85	2.584	+.000/-.030	.225		.093		2.602		.103		14,390	32,140
WSM-287	-S02	-S16	2.875	73.03	2.702		.225		.093		2.721		.103		15,650	33,600

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] No removal notch.
[4] Square edge wire.
* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

WSM Series

Heavy Duty Rings External Continued

Smalley Part Number			Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Inside Diameter (in)	Tol.	Radial Wall (in)	Tol.	Thickness (in)	Tol.	Diameter (in)	Tol.	Width (in)	Tol.	Groove Yield[1] (lb)	Ring Shear[2] (lb)
	302 SS	316 SS	in	mm												
WSM-293	-S02	-S16	2.937	74.60	2.760	+.000/-.030	.225	+.004/-.006	.093	±.003	2.779	±.006	.103	+.005/-.000	16,400	34,320
WSM-300	-S02	-S16	3.000	76.20	2.818		.225		.093		2.838		.103		17,180	35,060
WSM-306	-S02	-S16	3.062	77.77	2.878		.225		.093		2.898		.103		17,750	35,790
WSM-312	-S02	-S16	3.125	79.38	2.936		.225		.093		2.957		.103		18,560	36,520
WSM-315	-S02	-S16	3.156	80.16	2.965		.225		.093		2.986		.103		18,960	36,880
WSM-325	-S02	-S16	3.250	82.55	3.054		.225		.093		3.076		.103		19,990	37,980
WSM-334	-S02	-S16	3.344	84.94	3.144		.225		.093		3.166		.103		21,040	39,080
WSM-343	-S02	-S16	3.437	87.30	3.234		.225		.093		3.257		.103		21,870	40,170
WSM-350	-S02	-S16	3.500	88.90	3.293	+.000/-.035	.270		.111		3.316		.120		22,760	48,820
WSM-354	-S02	-S16	3.543	89.99	3.333		.270		.111		3.357		.120		23,290	49,420
WSM-362	-S02	-S16	3.625	92.08	3.411		.270		.111		3.435		.120		24,340	50,560
WSM-368	-S02	-S16	3.687	93.65	3.469		.270		.111		3.493		.120		25,280	51,430
WSM-375	-S02	-S16	3.750	95.25	3.527		.270		.111		3.552		.120		26,240	52,310
WSM-387	-S02	-S16	3.875	98.43	3.647		.270		.111		3.673		.120		27,670	54,050
WSM-393	-S02	-S16	3.938	100.03	3.708		.270		.111		3.734		.120		28,390	54,930
WSM-400	-S02	-S16	4.000	101.60	3.765		.270		.111		3.792		.120		29,410	55,800
WSM-425	-S02	-S16	4.250	107.95	4.037		.270		.111		4.065		.120		27,940	59,280
WSM-437	-S02	-S16	4.375	111.13	4.161		.270		.111		4.190		.120		28,760	61,030
WSM-450	-S02	-S16	4.500	114.30	4.280		.270		.111		4.310		.120		30,220	62,770
WSM-475	-S02	-S16	4.750	120.65	4.518		.270		.111		4.550		.120		36,930	66,260
WSM-500	-S02	-S16	5.000	127.00	4.756		.270		.111		4.790		.120		37,110	69,740
WSM-525	-S02	-S16	5.250	133.35	4.995	+.000/-.050	.350	+.004/-.008	.127	±.004	5.030	±.007	.139	+.006/-.000	40,820	83,790
WSM-550	-S02	-S16	5.500	139.70	5.228		.350		.127		5.265		.139		45,880	87,780
WSM-575	-S02	-S16	5.750	146.05	5.466		.350		.127		5.505		.139		49,990	91,770
WSM-600	-S02	-S16	6.000	152.40	5.705		.350		.127		5.745		.139		54,290	95,760
WSM-625	-S02	-S16	6.250	158.75	5.938	+.000/-.060	.418		.156	±.005	5.985	±.008	.174	+.008/-.000	58,760	122,520
WSM-650	-S02	-S16	6.500	165.10	6.181		.418		.156		6.225		.174		63,410	127,420
WSM-675	-S02	-S16	6.750	171.45	6.410		.418		.156		6.465		.174		68,230	132,330
WSM-700	-S02	-S16	7.000	177.80	6.648		.418		.156		6.705		.174		73,230	137,230
WSM-725	-S02	-S16	7.250	184.15	6.891		.418		.156		6.942		.174		78,920	142,130
WSM-750	-S02	-S16	7.500	190.50	7.130	+.000/-.070	.437		.187		7.180		.209		84,820	176,240
WSM-775	-S02	-S16	7.750	196.85	7.368		.437		.187		7.420		.209		90,390	182,120
WSM-800	-S02	-S16	8.000	203.20	7.606		.437		.187		7.660		.209		96,130	187,990
WSM-825	-S02	-S16	8.250	209.55	7.845		.437		.187		7.900		.209		102,050	193,870
WSM-850	-S02	-S16	8.500	215.90	8.083		.437		.187		8.140		.209		108,150	199,740
WSM-875	-S02	-S16	8.750	222.25	8.324		.437		.187		8.383		.209		113,800	205,620
WSM-900	-S02	-S16	9.000	228.60	8.560		.500	+.005/-.010	.187		8.620		.209		120,870	211,490
WSM-925	-S02	-S16	9.250	234.95	8.798		.500		.187		8.860		.209		127,500	217,370
WSM-950	-S02	-S16	9.500	241.30	9.036		.500		.187		9.100		.209		134,300	223,240
WSM-975	-S02	-S16	9.750	247.65	9.275		.500		.187		9.338		.209		141,970	229,120
WSM-1000	-S02	-S16	10.000	254.00	9.508		.500		.187		9.575		.209		150,560	234,990
WSM-1025	-S02	-S16	10.250	260.35	9.745	+.000/-.090	.500		.187		9.814		.209		157,950	240,870
WSM-1050	-S02	-S16	10.500	266.70	9.984		.500		.187		10.054	±.010	.209		165,510	246,740
WSM-1075	-S02	-S16	10.750	273.05	10.221		.500		.187		10.293		.209		174,010	252,620
WSM-1100	-S02	-S16	11.000	279.40	10.459		.500		.187		10.533		.209		181,950	258,490
WSM-1125	-S02	-S16	11.250	285.75	10.692		.500		.187		10.772		.209		190,060	264,360
WSM-1150	-S02	-S16	11.500	292.10	10.934		.562		.187		11.011		.209		199,160	270,240
WSM-1175	-S02	-S16	11.750	298.45	11.171		.562		.187		11.250		.209		207,640	276,120
WSM-1200	-S02	-S16	12.000	304.80	11.410		.562		.187		11.490		.209		216,300	281,990
WSM-1225	-S02	-S16	12.250	311.15	11.647		.562		.187		11.729		.209		226,000	287,860
WSM-1250	-S02	-S16	12.500	317.50	11.885		.562		.187		11.969		.209		235,030	293,740
WSM-1275	-S02	-S16	12.750	323.85	12.124	+.000/-.110	.562		.187		12.208	±.012	.209		244,240	299,610
WSM-1300	-S02	-S16	13.000	330.20	12.361		.662		.187		12.448		.209		253,620	305,490
WSM-1325	-S02	-S16	13.250	336.55	12.598		.662		.187		12.687		.209		264,120	311,360
WSM-1350	-S02	-S16	13.500	342.90	12.837		.662		.187		12.927		.209		273,870	317,240
WSM-1375	-S02	-S16	13.750	349.25	13.074		.662		.187		13.166		.209		283,800	323,110
WSM-1400	-S02	-S16	14.000	355.60	13.311		.662		.187		13.405		.209		294,900	328,990
WSM-1425	-S02	-S16	14.250	361.95	13.548		.662		.187		13.644		.209		305,200	334,860
WSM-1450	-S02	-S16	14.500	368.30	13.787		.750		.187		13.884		.209		315,680	340,740
WSM-1475	-S02	-S16	14.750	374.65	14.024		.750		.187		14.123		.209		327,380	346,610
WSM-1500	-S02	-S16	15.000	381.00	14.262		.750		.187		14.363		.209		338,230	352,490

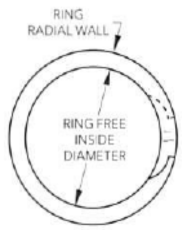
[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

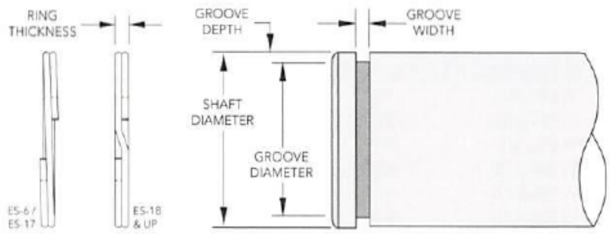
* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

ES Series

Metric Aerospace Rings External

**Compliance with MA 4016*





Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number			Shaft Diameter		Ring					Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Inside Diameter (mm)	Tolerance	Radial Wall (mm)	Thickness (mm)	Tolerance	Diameter (mm)	Tolerance	Width (mm)	Tolerance	Groove Yield[1] (N)	Ring Shear[2] (N)
	302 SS	316 SS	mm	in											
ES-6[3,4]	-S02	-S16	6.00	.24	5.61		.38 - .58	.64		5.66		.74		500	3,160
ES-7[3,4]	-S02	-S16	7.00	.28	6.53	+.00/-.25	.51 - .71	.64		6.58		.74		720	3,690
ES-8[3,4]	-S02	-S16	8.00	.31	7.49		.51 - .71	.64		7.57	±.05	.74		840	4,210
ES-9[3,4]	-S02	-S16	9.00	.35	8.41		.64 - .84	.64		8.48		.74		1,140	4,740
ES-10[3,4]	-S02	-S16	10.00	.39	9.40		.64 - .84	.64		9.50		.74		1,220	5,270
ES-11[4]	-S02	-S16	11.00	.43	10.39	+.00/-.30	.76 - .96	.64		10.46		.74		1,450	5,790
ES-12	-S02	-S16	12.00	.47	11.18		1.02 - 1.22	.60		11.29		.70		2,100	7,950
ES-13	-S02	-S16	13.00	.51	12.13		1.14 - 1.35	.89		12.24	±.06	1.00		2,410	12,100
ES-14	-S02	-S16	14.00	.55	13.06		1.14 - 1.35	.89		13.19		1.00		2,800	13,040
ES-15	-S02	-S16	15.00	.59	13.98		1.14 - 1.35	.89		14.09		1.00		3,360	13,970
ES-16	-S02	-S16	16.00	.63	14.90		1.27 - 1.48	.89		15.02		1.00	+.08/-.00	3,820	14,900
ES-17	-S02	-S16	17.00	.67	15.82		1.27 - 1.48	.89		16.02		1.00		4,060	15,830
ES-18	-S02	-S16	18.00	.71	16.80		1.52 - 1.73	1.07		16.92		1.20		4,730	20,150
ES-19	-S02	-S16	19.00	.75	17.73		1.52 - 1.73	1.07		17.87		1.20		5,270	21,270
ES-20	-S02	-S16	20.00	.79	18.62		1.52 - 1.73	1.07		18.77		1.20		6,040	22,390
ES-21	-S02	-S16	21.00	.83	19.57		1.52 - 1.73	1.07	±.05	19.72	±.075	1.20		6,550	23,510
ES-22	-S02	-S16	22.00	.87	20.45		1.78 - 1.98	1.07		20.62		1.20		7,390	24,630
ES-23	-S02	-S16	23.00	.91	21.39		1.78 - 1.98	1.07		21.57		1.20		8,070	25,750
ES-24	-S02	-S16	24.00	.94	22.35	+.00/-.33	1.78 - 1.98	1.07		22.52		1.20		8,650	26,870
ES-25	-S02	-S16	25.00	.98	23.25		2.03 - 2.24	1.07		23.42		1.20		9,620	27,990
ES-26	-S02	-S16	26.00	1.02	24.21		2.03 - 2.24	1.07		24.42		1.20		10,000	29,110
ES-27	-S02	-S16	27.00	1.06	25.04		2.49 - 2.69	1.27		25.35		1.40		10,910	31,170
ES-28	-S02	-S16	28.00	1.10	26.00		2.49 - 2.69	1.27		26.30		1.40		11,590	32,330
ES-29	-S02	-S16	29.00	1.14	26.95		2.49 - 2.69	1.27		27.27		1.40		12,290	33,480
ES-30	-S02	-S16	30.00	1.18	27.92		2.49 - 2.69	1.27		28.25		1.40		12,860	34,640
ES-31	-S02	-S16	31.00	1.22	28.84		2.49 - 2.69	1.27		29.17	±.10	1.40		13,890	35,790
ES-32	-S02	-S16	32.00	1.26	29.77		2.49 - 2.69	1.27		30.09		1.40		14,960	36,950
ES-34	-S02	-S16	34.00	1.34	31.54		2.87 - 3.07	1.27		31.90		1.40		17,390	39,260
ES-35	-S02	-S16	35.00	1.38	32.44		2.87 - 3.07	1.27		32.80		1.40		18,750	40,410
ES-36	-S02	-S16	36.00	1.42	33.40		2.87 - 3.07	1.27		33.75		1.40		19,810	41,560
ES-37	-S02	-S16	37.00	1.46	34.24		2.87 - 3.07	1.27		34.67		1.40		21,080	42,720
ES-38	-S02	-S16	38.00	1.50	35.18		2.87 - 3.07	1.27		35.66		1.40		21,650	43,870
ES-40	-S02	-S16	40.00	1.57	37.15		3.12 - 3.33	1.57		37.55		1.75		23,960	57,090
ES-42	-S02	-S16	42.00	1.65	39.02		3.12 - 3.33	1.57		39.45		1.75		26,180	59,990
ES-45	-S02	-S16	45.00	1.77	41.77		3.12 - 3.33	1.57	±.075	42.25		1.75		30,240	64,230
ES-46	-S02	-S16	46.00	1.81	42.67	+.00/-.51	3.12 - 3.33	1.57		43.15		1.75	+.10/-.00	32,040	65,660
ES-47	-S02	-S16	47.00	1.85	43.81		3.89 - 4.09	1.57		44.31		1.75		30,900	67,080
ES-48	-S02	-S16	48.00	1.89	44.48		3.89 - 4.09	1.57		45.05		1.75		34,600	68,510
ES-50	-S02	-S16	50.00	1.97	46.69		3.89 - 4.09	1.57		47.05		1.75		36,040	71,370
ES-52	-S02	-S16	52.00	2.05	49.62		3.12 - 3.33	1.25		50.15	±.15	1.42		23,550	59,090
ES-53	-S02	-S16	53.00	2.09	50.62		3.12 - 3.33	1.25		51.15		1.42		24,000	60,230
ES-54	-S02	-S16	54.00	2.13	51.62		3.12 - 3.33	1.25		52.15		1.42		24,460	61,370
ES-55	-S02	-S16	55.00	2.17	52.62		3.38 - 3.58	1.25		53.15		1.42		24,910	62,500
ES-56	-S02	-S16	56.00	2.20	53.62		3.38 - 3.58	1.25		54.15		1.42		25,370	63,640
ES-58	-S02	-S16	58.00	2.28	55.43	+.00/-.63	3.38 - 3.58	1.25	±.08	56.01		1.42		28,250	65,910
ES-59	-S02	-S16	59.00	2.32	56.43		3.38 - 3.58	1.25		57.01		1.42		28,730	67,050
ES-60	-S02	-S16	60.00	2.36	57.43		3.38 - 3.58	1.25		58.01		1.42		29,220	68,180
ES-61	-S02	-S16	61.00	2.40	58.36		3.38 - 3.58	1.25		58.91		1.42		31,190	69,320
ES-62	-S02	-S16	62.00	2.44	59.30		3.63 - 3.84	1.25		59.91		1.42		31,710	70,460
ES-63	-S02	-S16	63.00	2.48	60.30		3.63 - 3.84	1.25		60.91		1.42		32,220	71,590

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] No removal notch.
[4] Square edge wire.
* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

ES Series

Metric Aerospace Rings External Continued

Smalley Part Number			Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	Add Suffix 316 SS	mm	in	Inside Diameter (mm)	Tol.	Radial Wall (mm)	Thickness (mm)	Tol.		Diameter (mm)	Tol.	Width (mm)	Tol.	Groove Yield[1] (N)	Ring Shear[2] (N)
ES-64	-S02	-S16	64.00	2.52	61.25		3.63 - 3.84	1.25			61.91		1.42		32,730	72,730
ES-65	-S02	-S16	65.00	2.56	62.20		3.63 - 3.84	1.25			62.81		1.42		34,820	73,870
ES-66	-S02	-S16	66.00	2.60	63.16	+.00/-.63	3.63 - 3.84	1.25			63.79		1.42		35,680	75,000
ES-67	-S02	-S16	67.00	2.64	64.16		3.63 - 3.84	1.25			64.71		1.42		37,530	76,140
ES-68	-S02	-S16	68.00	2.68	65.08		3.89 - 4.09	1.25			65.71		1.42		38,090	77,270
ES-69	-S02	-S16	69.00	2.72	66.06		3.89 - 4.09	1.25			66.71		1.42	+.10/-.00	38,650	78,410
ES-70	-S02	-S16	70.00	2.76	67.08		3.89 - 4.09	1.25			67.71		1.42		39,210	79,550
ES-71	-S02	-S16	71.00	2.80	68.04		3.89 - 4.09	1.25			68.71		1.42		39,770	80,680
ES-72	-S02	-S16	72.00	2.83	69.00		4.11 - 4.37	1.25			69.65		1.42		41,380	81,820
ES-75	-S02	-S16	75.00	2.95	71.93		4.11 - 4.37	1.25			72.61		1.42		43,830	85,230
ES-78	-S02	-S16	78.00	3.07	74.84		4.11 - 4.37	1.55			75.55		1.73		46,730	109,910
ES-80	-S02	-S16	80.00	3.15	76.80	+.00/-.76	4.37 - 4.62	1.55	±.08		77.51	±.15	1.73		48,700	112,730
ES-82	-S02	-S16	82.00	3.23	78.72		4.37 - 4.62	1.55			79.45		1.73		51,120	115,550
ES-85	-S02	-S16	85.00	3.35	81.62		4.62 - 4.88	1.55			82.35		1.73		55,060	119,780
ES-88	-S02	-S16	88.00	3.46	84.53		4.62 - 4.88	1.55			85.31		1.73		57,860	124,000
ES-90	-S02	-S16	90.00	3.54	86.43		4.88 - 5.13	1.55			87.21		1.73		61,370	126,820
ES-95	-S02	-S16	95.00	3.74	91.37		4.88 - 5.13	1.55			92.15		1.73		66,160	133,870
ES-100	-S02	-S16	100.00	3.94	96.10		5.13 - 5.38	1.55			97.01		1.73		73,050	140,910
ES-105	-S02	-S16	105.00	4.13	100.94		5.38 - 5.64	1.55			101.85		1.73		80,780	147,960
ES-110	-S02	-S16	110.00	4.33	105.75		5.64 - 5.89	1.55			106.69		1.73	+.13/-.00	88,930	155,000
ES-115	-S02	-S16	115.00	4.53	110.59	+.00/-1.00	5.89 - 6.15	1.55			111.55		1.73		96,890	162,050
ES-120	-S02	-S16	120.00	4.72	115.49		6.20 - 6.45	1.83			116.45		2.00		104,030	199,640
ES-125	-S02	-S16	125.00	4.92	120.44		6.20 - 6.45	1.83			121.45		2.00		108,360	207,960
ES-130	-S02	-S16	130.00	5.12	125.34		6.20 - 6.45	1.83			126.35		2.00		115,860	216,280
ES-135	-S02	-S16	135.00	5.31	130.20		6.20 - 6.45	1.83			131.27		2.00		122,950	224,600
ES-140	-S02	-S16	140.00	5.51	135.14		6.20 - 6.45	1.83			136.25	±.175	2.00		128,190	232,920
ES-145	-S02	-S16	145.00	5.71	140.00	+.00/-1.30	6.20 - 6.45	1.83			141.17		2.00		135,590	241,230
ES-150	-S02	-S16	150.00	5.91	145.00		6.20 - 6.45	1.83			146.17		2.00		140,260	249,550
ES-155	-S02	-S16	155.00	6.10	149.33		7.72 - 8.03	2.18			150.60		2.40		166,080	307,190
ES-160	-S02	-S16	160.00	6.30	154.31		7.72 - 8.03	2.18			155.60		2.40		171,430	317,100
ES-165	-S02	-S16	165.00	6.50	159.23		7.72 - 8.03	2.18			160.60		2.40		176,790	327,010
ES-170	-S02	-S16	170.00	6.69	164.00		7.72 - 8.03	2.18			165.40		2.40		190,430	336,920
ES-175	-S02	-S16	175.00	6.89	169.00	+.00/-1.52	7.72 - 8.03	2.18			170.40		2.40		196,030	346,830
ES-180	-S02	-S16	180.00	7.09	173.78		7.72 - 8.03	2.18	±.10		175.20		2.40		210,400	356,740
ES-185	-S02	-S16	185.00	7.28	178.70		7.72 - 8.03	2.18			180.20		2.40		216,240	366,650
ES-190	-S02	-S16	190.00	7.48	183.70		7.72 - 8.03	2.18			185.20		2.40		220,080	376,560
ES-195	-S02	-S16	195.00	7.68	188.43		7.72 - 8.03	2.18			190.00		2.40		237,420	386,460
ES-200	-S02	-S16	200.00	7.87	193.43		7.72 - 8.03	2.18			195.00	±.200	2.40	+.15/-.00	243,510	396,370
ES-210	-S02	-S16	210.00	8.27	202.93		9.32 - 9.63	2.18			204.60		2.40		276,140	416,190
ES-220	-S02	-S16	220.00	8.66	212.65		9.32 - 9.63	2.18			214.40		2.40		300,010	436,010
ES-230	-S02	-S16	230.00	9.06	222.60	+.00/-1.78	9.32 - 9.63	2.18			224.40		2.40		313,640	455,830
ES-240	-S02	-S16	240.00	9.45	232.32		9.32 - 9.63	2.18			234.20		2.40		328,970	475,650
ES-250	-S02	-S16	250.00	9.84	241.83		9.32 - 9.63	2.18			243.80		2.40		377,440	495,470
ES-260	-S02	-S16	260.00	10.24	251.57		9.32 - 9.63	2.18			253.60		2.40		405,210	515,290
ES-270	-S02	-S16	270.00	10.63	261.30		9.32 - 9.63	2.18			263.40		2.40		433,940	535,100
ES-280	-S02	-S16	280.00	11.02	271.04		9.32 - 9.63	2.18			273.20		2.40		463,650	554,920

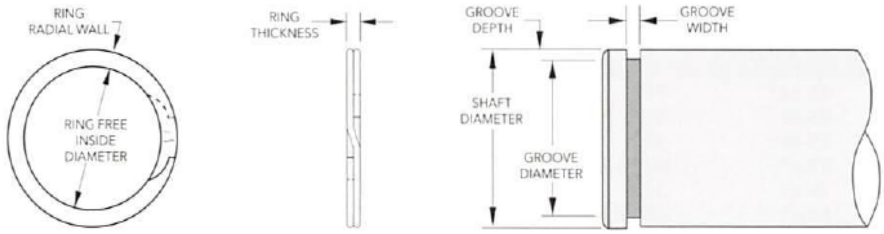
[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

DNS Series

Metric DIN Rings External

**Groove compatible with DIN 471*



Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number			Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	Add Suffix 316 SS	mm	in	Inside Diameter (mm)		Radial Wall (mm)		Thickness (mm)		Diameter (mm)		Width (mm)		Groove Yield[1] (N)	Ring Shear[2] (N)
DNS-13	-S02	-S16	13.00	.51	12.27	+.00/-.33	1.40	±.10	.99	±.05	12.40	+.00/-.11	1.10	+.14/-.00	1,901	13,474
DNS-14	-S02	-S16	14.00	.55	13.26		1.40		.99		13.40		1.10		2,047	14,510
DNS-15	-S02	-S16	15.00	.59	14.15		1.40		.99		14.30		1.10		2,559	15,547
DNS-16	-S02	-S16	16.00	.63	15.04		1.65		.99		15.20		1.10		3,119	16,583
DNS-17	-S02	-S16	17.00	.67	16.04		1.65		.99		16.20		1.10		3,314	17,620
DNS-18	-S02	-S16	18.00	.71	16.83		1.91		1.14		17.00		1.30		4,386	18,668
DNS-19	-S02	-S16	19.00	.75	17.83		1.91		1.14		18.00		1.30		4,630	19,705
DNS-20	-S02	-S16	20.00	.79	18.82		1.91		1.14		19.00	+.00/-.13	1.30		4,874	20,742
DNS-21	-S02	-S16	21.00	.83	19.79		1.91		1.14		20.00		1.30		5,117	21,779
DNS-22	-S02	-S16	22.00	.87	20.78		1.91		1.14		21.00		1.30		5,361	22,816
DNS-23	-S02	-S16	23.00	.91	21.77		1.91		1.14		22.00		1.30		5,605	23,853
DNS-24	-S02	-S16	24.00	.94	22.66		2.18		1.14		22.90	+.00/-.21	1.30		6,433	24,891
DNS-25	-S02	-S16	25.00	.98	23.65		2.18		1.14		23.90		1.30		6,701	25,928
DNS-26	-S02	-S16	26.00	1.02	24.64		2.18		1.14		24.90		1.30		6,969	26,965
DNS-27	-S02	-S16	27.00	1.06	25.34		2.18		1.14		25.60		1.30		9,211	28,002
DNS-28	-S02	-S16	28.00	1.10	26.34	+.00/-.38	2.39		1.44		26.60		1.60		9,552	36,681
DNS-29	-S02	-S16	29.00	1.14	27.33		2.39		1.44		27.60		1.60		9,893	37,991
DNS-30	-S02	-S16	30.00	1.18	28.32		2.39		1.44		28.60		1.60		10,235	39,301
DNS-32	-S02	-S16	32.00	1.26	30.00		3.25		1.44		30.30	+.00/-.25	1.60		13,256	41,921
DNS-33	-S02	-S16	33.00	1.30	30.99		3.25		1.44		31.30		1.60		13,670	43,231
DNS-34	-S02	-S16	34.00	1.34	31.98		3.25		1.44		32.30		1.60		14,085	44,541
DNS-35	-S02	-S16	35.00	1.38	32.66		3.25		1.44		33.00		1.60		17,058	45,851
DNS-36	-S02	-S16	36.00	1.42	33.65		4.01		1.69		34.00		1.85		17,545	55,349
DNS-38	-S02	-S16	38.00	1.50	35.64		4.01		1.69		36.00		1.85		18,520	58,424
DNS-40	-S02	-S16	40.00	1.57	37.11	+.00/-.51	4.01		1.69		37.50		1.85		24,368	61,498
DNS-42	-S02	-S16	42.00	1.65	39.09		4.01		1.69		39.50		1.85		25,586	64,573
DNS-45	-S02	-S16	45.00	1.77	42.06		4.01		1.69		42.50		1.85		27,414	69,186
DNS-46	-S02	-S16	46.00	1.81	43.05		4.01		1.69		43.50		1.85		28,023	70,723
DNS-47	-S02	-S16	47.00	1.85	44.04		4.01		1.69		44.50		1.85		28,633	72,261
DNS-48	-S02	-S16	48.00	1.89	45.03		4.01		1.69		45.50		1.85		29,242	73,798
DNS-50	-S02	-S16	50.00	1.97	46.53	+.00/-.63	5.08	±.12	1.93	±.08	47.00		2.15		36,552	87,790
DNS-52	-S02	-S16	52.00	2.05	48.51		5.08		1.93		49.00		2.15		38,014	91,302
DNS-54	-S02	-S16	54.00	2.13	50.50		5.08		1.93		51.00	+.00/-.30	2.15		39,476	94,813
DNS-55	-S02	-S16	55.00	2.17	51.49		5.08		1.93		52.00		2.15		40,207	96,569
DNS-56	-S02	-S16	56.00	2.20	52.48		5.08		1.93		53.00		2.15		40,938	98,325
DNS-58	-S02	-S16	58.00	2.28	54.43		5.08		1.93		55.00		2.15		42,400	101,836
DNS-60	-S02	-S16	60.00	2.36	56.42		5.08		1.93		57.00		2.15		43,863	105,348
DNS-62	-S02	-S16	62.00	2.44	58.42		5.08		1.93		59.00		2.15		45,325	108,860
DNS-63	-S02	-S16	63.00	2.48	59.39		5.08		1.93		60.00		2.15		46,056	110,615
DNS-65	-S02	-S16	65.00	2.56	61.39		5.08		2.41		62.00		2.65		47,518	135,725
DNS-67	-S02	-S16	67.00	2.64	63.37		5.08		2.41		64.00		2.65		48,980	139,901
DNS-68	-S02	-S16	68.00	2.68	64.34	+.00/-.76	5.08		2.41		65.00		2.65		49,711	141,989
DNS-70	-S02	-S16	70.00	2.76	66.34		5.08		2.41		67.00		2.65		51,173	146,165
DNS-72	-S02	-S16	72.00	2.83	68.33		5.08		2.41		69.00		2.65		52,635	150,341
DNS-75	-S02	-S16	75.00	2.95	71.33		5.08		2.41		72.00		2.65		54,828	156,605
DNS-77	-S02	-S16	77.00	3.03	73.33		5.08		2.41		74.00		2.65		56,290	160,782
DNS-78	-S02	-S16	78.00	3.07	74.33		5.08		2.41		75.00		2.65		57,021	162,870
DNS-80	-S02	-S16	80.00	3.15	75.81		6.02	±.13	2.41		76.50		2.65		68,231	167,046
DNS-82	-S02	-S16	82.00	3.23	77.81		6.02		2.41		78.50		2.65		69,936	171,222
DNS-85	-S02	-S16	85.00	3.35	80.80		6.27		2.91		81.50	+.00/-.35	3.15	+.18/-.00	72,495	214,309

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

DNS Series

Metric DIN Rings External Continued

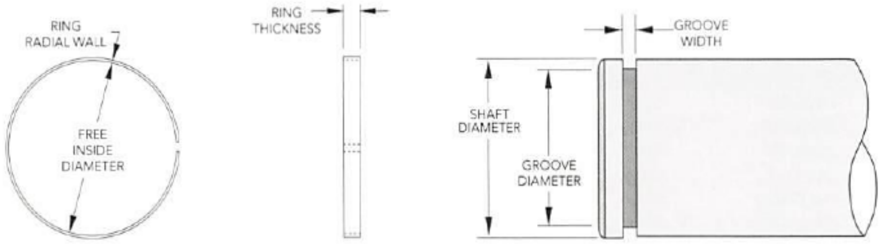
Smalley Part Number			Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix				Inside Diameter (mm)		Radial Wall (mm)		Thickness (mm)		Diameter (mm)		Width (mm)		Groove Yield[1] (N)	Ring Shear[2] (N)
	302 SS	316 SS	mm	in												
DNS-88	-S02	-S16	88.00	3.46	83.80	+.00/-.89	6.27	±.13	2.91	±.08	84.50	+.00/-.35	3.15	+.18/-.00	75,054	221,873
DNS-90	-S02	-S16	90.00	3.54	85.80	+.00/-.89	6.27	±.13	2.91	±.08	86.50	+.00/-.35	3.15	+.18/-.00	76,759	226,915
DNS-95	-S02	-S16	95.00	3.74	90.80	+.00/-.89	6.27	±.13	2.91	±.08	91.50	+.00/-.35	3.15	+.18/-.00	81,024	239,522
DNS-98	-S02	-S16	98.00	3.86	93.79	+.00/-.89	6.27	±.13	2.91	±.08	94.50	+.00/-.35	3.15	+.18/-.00	83,583	247,086
DNS-100	-S02	-S16	100.00	3.94	95.79	+.00/-.89	6.27	±.13	2.91	±.08	96.50	+.00/-.35	3.15	+.18/-.00	85,288	252,128
DNS-102	-S02	-S16	102.00	4.02	97.29	+.00/-1.30	6.73	±.13	3.89	±.10	98.00	+.00/-.54	4.15	+.18/-.00	99,422	343,778
DNS-105	-S02	-S16	105.00	4.13	100.28	+.00/-1.30	6.73	±.13	3.89	±.10	101.00	+.00/-.54	4.15	+.18/-.00	102,346	353,889
DNS-108	-S02	-S16	108.00	4.25	103.25	+.00/-1.30	6.73	±.13	3.89	±.10	104.00	+.00/-.54	4.15	+.18/-.00	105,270	364,000
DNS-110	-S02	-S16	110.00	4.33	105.23	+.00/-1.30	6.73	±.13	3.89	±.10	106.00	+.00/-.54	4.15	+.18/-.00	107,220	370,741
DNS-115	-S02	-S16	115.00	4.53	110.19	+.00/-1.30	6.73	±.13	3.89	±.10	111.00	+.00/-.54	4.15	+.18/-.00	112,093	387,593
DNS-120	-S02	-S16	120.00	4.72	115.16	+.00/-1.30	6.73	±.13	3.89	±.10	116.00	+.00/-.54	4.15	+.18/-.00	116,967	404,445
DNS-125	-S02	-S16	125.00	4.92	120.12	+.00/-1.30	6.73	±.13	3.89	±.10	121.00	+.00/-.63	4.15	+.18/-.00	121,840	421,297
DNS-130	-S02	-S16	130.00	5.12	125.07	+.00/-1.30	6.73	±.13	3.89	±.10	126.00	+.00/-.63	4.15	+.18/-.00	126,714	438,149
DNS-135	-S02	-S16	135.00	5.31	130.02	+.00/-1.30	6.73	±.13	3.89	±.10	131.00	+.00/-.63	4.15	+.18/-.00	131,588	455,001
DNS-140	-S02	-S16	140.00	5.51	134.98	+.00/-1.30	6.73	±.13	3.89	±.10	136.00	+.00/-.63	4.15	+.18/-.00	136,461	471,852
DNS-145	-S02	-S16	145.00	5.71	139.93	+.00/-1.30	6.73	±.13	3.89	±.10	141.00	+.00/-.63	4.15	+.18/-.00	141,335	488,704
DNS-150	-S02	-S16	150.00	5.91	143.91	+.00/-1.52	7.92	±.15	3.89	±.10	145.00	+.00/-.63	4.15	+.18/-.00	182,761	505,556
DNS-155	-S02	-S16	155.00	6.10	148.89	+.00/-1.52	7.92	±.15	3.89	±.10	150.00	+.00/-.63	4.15	+.18/-.00	188,853	522,408
DNS-160	-S02	-S16	160.00	6.30	153.85	+.00/-1.52	7.92	±.15	3.89	±.10	155.00	+.00/-.63	4.15	+.18/-.00	194,945	539,260
DNS-165	-S02	-S16	165.00	6.50	158.80	+.00/-1.52	7.92	±.15	3.89	±.10	160.00	+.00/-.63	4.15	+.18/-.00	201,037	556,112
DNS-170	-S02	-S16	170.00	6.69	163.75	+.00/-1.52	7.92	±.15	3.89	±.10	165.00	+.00/-.63	4.15	+.18/-.00	207,129	572,964
DNS-175	-S02	-S16	175.00	6.89	168.73	+.00/-1.52	7.92	±.15	3.89	±.10	170.00	+.00/-.63	4.15	+.18/-.00	213,221	589,815
DNS-180	-S02	-S16	180.00	7.09	173.69	+.00/-1.52	7.92	±.15	3.89	±.10	175.00	+.00/-.63	4.15	+.18/-.00	219,313	606,667
DNS-185	-S02	-S16	185.00	7.28	178.66	+.00/-1.78	7.92	±.15	3.89	±.10	180.00	+.00/-.72	4.15	+.18/-.00	225,405	623,519
DNS-190	-S02	-S16	190.00	7.48	183.59	+.00/-1.78	7.92	±.15	3.89	±.10	185.00	+.00/-.72	4.15	+.18/-.00	231,497	640,371
DNS-195	-S02	-S16	195.00	7.68	188.54	+.00/-1.78	7.92	±.15	3.89	±.10	190.00	+.00/-.72	4.15	+.18/-.00	237,589	657,223
DNS-200	-S02	-S16	200.00	7.87	193.54	+.00/-1.78	7.92	±.15	3.89	±.10	195.00	+.00/-.72	4.15	+.18/-.00	243,681	674,075
DNS-205	-S02	-S16	205.00	8.07	197.54	+.00/-1.78	11.05	±.15	4.86	±.13	199.00	+.00/-.72	5.15	+.18/-.00	299,727	863,214
DNS-210	-S02	-S16	210.00	8.27	202.54	+.00/-1.78	11.05	±.15	4.86	±.13	204.00	+.00/-.72	5.15	+.18/-.00	307,038	884,268
DNS-220	-S02	-S16	220.00	8.66	212.47	+.00/-1.78	11.05	±.15	4.86	±.13	214.00	+.00/-.72	5.15	+.18/-.00	321,659	926,376
DNS-230	-S02	-S16	230.00	9.06	222.40	+.00/-1.78	11.05	±.15	4.86	±.13	224.00	+.00/-.72	5.15	+.18/-.00	336,280	968,484
DNS-240	-S02	-S16	240.00	9.45	232.33	+.00/-1.78	11.05	±.15	4.86	±.13	234.00	+.00/-.72	5.15	+.18/-.00	350,900	1,010,592
DNS-250	-S02	-S16	250.00	9.84	242.24	+.00/-1.78	11.05	±.15	4.86	±.13	244.00	+.00/-.72	5.15	+.18/-.00	365,521	1,052,700
DNS-260	-S02	-S16	260.00	10.24	250.19	+.00/-2.30	12.70	±.19	4.86	±.13	252.00	+.00/-.81	5.15	+.18/-.00	506,856	1,094,808
DNS-270	-S02	-S16	270.00	10.63	260.15	+.00/-2.30	12.70	±.19	4.86	±.13	262.00	+.00/-.81	5.15	+.18/-.00	526,351	1,136,916
DNS-280	-S02	-S16	280.00	11.02	270.08	+.00/-2.30	12.70	±.19	4.86	±.13	272.00	+.00/-.81	5.15	+.18/-.00	545,845	1,179,024
DNS-290	-S02	-S16	290.00	11.42	279.98	+.00/-2.30	12.70	±.19	4.86	±.13	282.00	+.00/-.81	5.15	+.18/-.00	565,340	1,221,132
DNS-300	-S02	-S16	300.00	11.81	289.92	+.00/-2.30	12.70	±.19	4.86	±.13	292.00	+.00/-.81	5.15	+.18/-.00	584,834	1,263,241
DNS-310	-S02	-S16	310.00	12.20	297.84	+.00/-2.80	15.81	±.19	5.87	±.13	300.00	+.00/-.81	6.20	+.22/-.00	755,411	1,576,625
DNS-320	-S02	-S16	320.00	12.60	307.84	+.00/-2.80	15.81	±.19	5.87	±.13	310.00	+.00/-.81	6.20	+.22/-.00	779,779	1,627,484
DNS-330	-S02	-S16	330.00	12.99	317.75	+.00/-2.80	15.81	±.19	5.87	±.13	320.00	+.00/-.89	6.20	+.22/-.00	804,147	1,678,342
DNS-340	-S02	-S16	340.00	13.39	327.69	+.00/-2.80	15.81	±.19	5.87	±.13	330.00	+.00/-.89	6.20	+.22/-.00	828,515	1,729,201
DNS-350	-S02	-S16	350.00	13.78	337.64	+.00/-2.80	15.81	±.19	5.87	±.13	340.00	+.00/-.89	6.20	+.22/-.00	852,883	1,780,060
DNS-360	-S02	-S16	360.00	14.17	347.57	+.00/-2.80	15.81	±.19	5.87	±.13	350.00	+.00/-.89	6.20	+.22/-.00	877,251	1,830,919
DNS-370	-S02	-S16	370.00	14.57	357.48	+.00/-2.80	15.81	±.19	5.87	±.13	360.00	+.00/-.89	6.20	+.22/-.00	901,619	1,881,778
DNS-380	-S02	-S16	380.00	14.96	367.41	+.00/-2.80	15.81	±.19	5.87	±.13	370.00	+.00/-.89	6.20	+.22/-.00	925,987	1,932,637
DNS-390	-S02	-S16	390.00	15.35	377.34	+.00/-2.80	15.81	±.19	5.87	±.13	380.00	+.00/-.89	6.20	+.22/-.00	950,355	1,983,496
DNS-400	-S02	-S16	400.00	15.75	387.25	+.00/-2.80	15.81	±.19	5.87	±.13	390.00	+.00/-.89	6.20	+.22/-.00	974,723	2,034,354

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

HS Series

Hoopster® Rings External



Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number[3] Carbon Steel	Add Suffix 302 SS	Shaft Diameter in	Shaft Diameter mm	Ring Inside Diameter (in)	Inside Diameter Tol.	Ring Radial Wall (in)	Radial Wall Tol.	Ring Thickness (in)	Thickness Tol.	Groove Diameter[2] (in)	Diameter Tol.	Groove Width (in)	Width Tol.	Thrust Groove Yield[1] (lb)
HS-37	-S02	.375	9.525	.351	+.000/-.012	.017	±.0015	.045	±.004	.358	±.002	.050	+.003/-.000	225
HS-43	-S02	.437	11.100	.411		.017		.045		.420		.050		263
HS-46	-S02	.469	11.913	.443		.017		.045		.452		.050		282
HS-50	-S02	.500	12.700	.469	+.000/-.015	.021		.065		.479		.070		371
HS-53	-S02	.531	13.487	.499		.021		.065		.510		.070		394
HS-56	-S02	.562	14.275	.530		.021		.065		.541		.070		417
HS-59	-S02	.594	15.088	.561		.021		.065		.573		.070		441
HS-62	-S02	.625	15.875	.592		.021		.065		.604		.070		464
HS-65	-S02	.656	16.662	.622		.021		.065		.635		.070		487
HS-68	-S02	.688	17.475	.653		.021		.065		.667		.070		511
HS-71	-S02	.718	18.237	.680		.024		.088		.694		.093		609
HS-75	-S02	.750	19.050	.711		.024		.088		.726		.093		636
HS-78	-S02	.781	19.837	.741	+.000/-.018	.024		.088		.757	±.003	.093		662
HS-81	-S02	.812	20.625	.772		.024		.088		.788		.093		689
HS-84	-S02	.843	21.412	.802		.024		.088		.819		.093		715
HS-87	-S02	.875	22.225	.834		.024		.088		.851		.093		742
HS-90	-S02	.906	23.012	.864		.024		.088		.882		.093		768
HS-93	-S02	.938	23.825	.895		.024		.088		.914		.093		796
HS-96	-S02	.968	24.587	.925		.024		.088		.944		.093		821
HS-100	-S02	1.000	25.400	.956	+.000/-.020	.024		.088		.976		.093		848
HS-103	-S02	1.031	26.187	.980		.030	±.002	.118		1.001	±.004	.123	+.004/-.000	1,093
HS-106	-S02	1.062	26.975	1.011		.030		.118		1.032		.123		1,126
HS-109	-S02	1.093	27.762	1.041		.030		.118		1.063		.123		1,159
HS-112	-S02	1.125	28.575	1.073		.030		.118		1.095		.123		1,193
HS-115	-S02	1.156	29.362	1.103		.030		.118		1.126		.123		1,226
HS-118	-S02	1.188	30.175	1.134		.030		.118		1.158		.123		1,260
HS-121	-S02	1.218	30.937	1.164		.030		.118		1.188		.123		1,291
HS-125	-S02	1.250	31.750	1.195		.030		.118		1.220		.123		1,325
HS-128	-S02	1.281	32.537	1.225		.030		.118		1.251		.123		1,358
HS-131	-S02	1.312	33.325	1.252		.034		.150		1.278		.155		1,577
HS-134	-S02	1.343	34.112	1.282		.034		.150		1.309		.155		1,614
HS-137	-S02	1.375	34.925	1.314		.034		.150		1.341		.155		1,652
HS-140	-S02	1.406	35.712	1.344		.034		.150		1.372		.155		1,690
HS-143	-S02	1.437	36.500	1.374		.034		.150		1.403		.155		1,727
HS-146	-S02	1.468	37.287	1.405		.034		.150		1.434		.155		1,765
HS-150	-S02	1.500	38.100	1.436		.034		.150		1.466		.155		1,802
HS-156	-S02	1.562	39.675	1.497		.034		.150		1.528		.155		1,877
HS-162	-S02	1.625	41.275	1.559	+.000/-.024	.034		.150		1.591	±.005	.155		1,953
HS-168	-S02	1.688	42.875	1.619		.034		.150		1.653		.155		2,028
HS-175	-S02	1.750	44.450	1.677		.038		.187	±.005	1.712		.193		2,350
HS-181	-S02	1.812	46.025	1.739		.038		.187		1.775		.193		2,434
HS-187	-S02	1.875	47.625	1.800		.038		.187		1.837		.193		2,518
HS-193	-S02	1.938	49.225	1.861		.038		.187		1.900		.193		2,603
HS-200	-S02	2.000	50.800	1.922		.038		.187		1.962		.193		2,686
HS-206	-S02	2.062	52.375	1.983		.038		.187		2.024		.193		2,769
HS-212	-S02	2.125	53.975	2.045		.038		.187		2.087		.193		2,854
HS-218	-S02	2.188	55.575	2.106		.038		.187		2.150	±.006	.193		2,939
HS-225	-S02	2.250	57.150	2.167		.038		.187		2.212		.193		3,022
HS-231	-S02	2.312	58.725	2.228		.038		.187		2.274		.193		3,105
HS-237	-S02	2.375	60.325	2.290		.038		.187		2.337		.193		3,190

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Sharp corners on the groove required, see page 141 for more information.
[3] Square edge wire.

HS Series

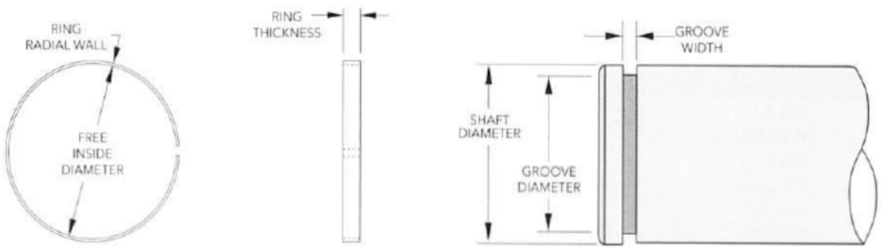
Hoopster® Rings External Continued

Smalley Part Number[3]		Shaft Diameter		Ring			Groove		Thrust
Carbon Steel	Add Suffix 302 SS	in	mm	Inside Diameter (in) +.000/-.030	Radial Wall (in) ±.002	Thickness (in) ±.005	Diameter[2] (in) ±.006	Width (in) +.005/-.000	Groove Yield[1] (lb)
HS-243	-S02	2.437	61.900	2.343	.045	.225	2.392	.232	3,876
HS-250	-S02	2.500	63.500	2.405	.045	.225	2.455	.232	3,976
HS-256	-S02	2.562	65.075	2.466	.045	.225	2.517	.232	4,075
HS-262	-S02	2.625	66.675	2.528	.045	.225	2.580	.232	4,175
HS-268	-S02	2.688	68.275	2.589	.045	.225	2.643	.232	4,275
HS-275	-S02	2.750	69.850	2.650	.045	.225	2.705	.232	4,374
HS-281	-S02	2.812	71.425	2.712	.045	.225	2.768	.232	4,472
HS-287	-S02	2.875	73.025	2.773	.045	.225	2.830	.232	4,572
HS-293	-S02	2.938	74.625	2.833	.045	.225	2.892	.232	4,673
HS-300	-S02	3.000	76.200	2.895	.045	.225	2.955	.232	4,771

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Sharp corners on the groove required, see page 141 for more information.
[3] Square edge wire.

HSM Series

Metric Hoopster® Rings External



Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number[3] Carbon Steel	Add Suffix 302 SS	Shaft Diameter mm	Shaft Diameter in	Ring Inside Diameter (mm)	Inside Diameter Tol.	Ring Radial Wall (mm)	Radial Wall Tol.	Ring Thickness (mm)	Thickness Tol.	Groove Diameter[2] (mm)	Groove Diameter Tol.	Groove Width (mm)	Groove Width Tol.	Thrust Groove Yield[1] (N)
HSM-10	-S02	10.00	.39	9.37	+.00/-.30	.43	±.04	1.14	±.10	9.57	±.05	1.27	+.08/-.00	1,051
HSM-11	-S02	11.00	.43	10.35		.43		1.14		10.57		1.27		1,156
HSM-12	-S02	12.00	.47	11.33		.43		1.14		11.57		1.27		1,262
HSM-13	-S02	13.00	.51	12.21	+.00/-.38	.53		1.65		12.47		1.78		1,688
HSM-14	-S02	14.00	.55	13.19		.53		1.65		13.47		1.78		1,818
HSM-15	-S02	15.00	.59	14.17		.53		1.65		14.47		1.78		1,948
HSM-16	-S02	16.00	.63	15.15		.53		1.65		15.47		1.78		2,078
HSM-17	-S02	17.00	.67	16.13		.53		1.65		16.47		1.78		2,208
HSM-18	-S02	18.00	.71	17.03		.61		2.24		17.39		2.36		2,672
HSM-19	-S02	19.00	.75	18.01		.61		2.24		18.39		2.36		2,820
HSM-20	-S02	20.00	.79	18.99	+.00/-.46	.61		2.24		19.39	±.08	2.36		2,968
HSM-21	-S02	21.00	.83	19.97		.61		2.24		20.39		2.36		3,117
HSM-22	-S02	22.00	.87	20.95		.61		2.24		21.39		2.36		3,265
HSM-23	-S02	23.00	.91	21.93		.61		2.24		22.39		2.36		3,414
HSM-24	-S02	24.00	.94	22.91		.61		2.24		23.39		2.36		3,562
HSM-25	-S02	25.00	.98	23.89		.61		2.24		24.39		2.36		3,711
HSM-26	-S02	26.00	1.02	24.72	+.00/-.51	.76	±.05	3.00		25.24		3.12		4,824
HSM-27	-S02	27.00	1.06	25.70		.76		3.00		26.24	±.10	3.12		5,009
HSM-28	-S02	28.00	1.10	26.68		.76		3.00		27.24		3.12		5,195
HSM-29	-S02	29.00	1.14	27.66		.76		3.00		28.24		3.12		5,380
HSM-30	-S02	30.00	1.18	28.64		.76		3.00		29.24		3.12		5,566
HSM-31	-S02	31.00	1.22	29.62		.76		3.00		30.24		3.12		5,751
HSM-32	-S02	32.00	1.26	30.60		.76		3.00		31.24		3.12		5,937
HSM-33	-S02	33.00	1.30	31.48		.86		3.81		32.14		3.94	+.10/-.00	6,939
HSM-34	-S02	34.00	1.34	32.46		.86		3.81		33.14		3.94		7,149
HSM-35	-S02	35.00	1.38	33.44		.86		3.81		34.14		3.94		7,359
HSM-36	-S02	36.00	1.42	34.42		.86		3.81		35.14		3.94		7,569
HSM-37	-S02	37.00	1.46	35.40		.86		3.81		36.14		3.94		7,780
HSM-38	-S02	38.00	1.50	36.38		.86		3.81		37.14		3.94		7,990
HSM-40	-S02	40.00	1.57	38.34		.86		3.81		39.14		3.94		8,411
HSM-41	-S02	41.00	1.61	39.32	+.00/-.61	.86		3.81		40.14		3.94		8,621
HSM-42	-S02	42.00	1.65	40.30		.86		3.81		41.14		3.94		8,831
HSM-45	-S02	45.00	1.77	43.13		.97		4.75	±.13	44.03	±.13	4.88		10,575
HSM-47	-S02	47.00	1.85	45.09		.97		4.75		46.03		4.88		11,045
HSM-48	-S02	48.00	1.89	46.07		.97		4.75		47.03		4.88		11,280
HSM-50	-S02	50.00	1.97	48.03		.97		4.75		49.03		4.88		11,750
HSM-51	-S02	51.00	2.01	49.01		.97		4.75		50.03		4.88		11,985
HSM-52	-S02	52.00	2.05	49.99		.97		4.75		51.03		4.88		12,220
HSM-55	-S02	55.00	2.17	52.93		.97		4.75		54.03	±.15	4.90		12,925
HSM-56	-S02	56.00	2.20	53.91		.97		4.75		55.03		4.90		13,160
HSM-57	-S02	57.00	2.24	54.89		.97		4.75		56.03		4.90		13,395
HSM-58	-S02	58.00	2.28	55.87		.97		4.75		57.03		4.90		13,630
HSM-60	-S02	60.00	2.36	57.83		.97		4.75		59.03		4.90		14,100
HSM-62	-S02	62.00	2.44	59.62	+.00/-.76	1.14		5.72		60.86		5.87	+.13/-.00	17,254
HSM-63	-S02	63.00	2.48	60.60		1.14		5.72		61.86		5.87		17,532
HSM-64	-S02	64.00	2.52	61.58		1.14		5.72		62.86		5.87		17,811
HSM-65	-S02	65.00	2.56	62.56		1.14		5.72		63.86		5.87		18,089
HSM-67	-S02	67.00	2.64	64.52		1.14		5.72		65.86		5.87		18,645
HSM-68	-S02	68.00	2.68	65.50		1.14		5.72		66.86		5.87		18,924
HSM-70	-S02	70.00	2.76	67.46		1.14		5.72		68.86		5.87		19,480

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Sharp corners on the groove required, see page 141 for more information.
[3] Square edge wire.

HSM Series

Metric Hoopster® Rings External Continued

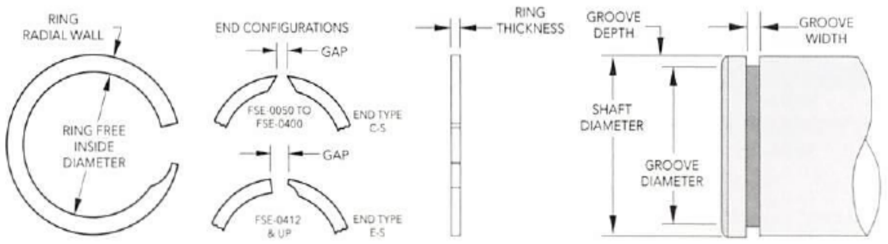
Smalley Part Number[3]		Shaft Diameter		Ring						Groove				Thrust
Carbon Steel	Add Suffix 302 SS	mm	in	Inside Diameter (mm)		Radial Wall (mm)		Thickness (mm)		Diameter[2] (mm)		Width (mm)		Groove Yield[1] (N)
HSM-72	**-S02**	72.00	2.83	69.42	+.00/ -.76	1.14	±.05	5.72	±.13	70.86	±.15	5.87	+.13/ -.00	20,037
HSM-75	**-S02**	75.00	2.95	72.36		1.14		5.72		73.86		5.87		20,872
HSM-76	**-S02**	76.00	2.99	73.34		1.14		5.72		74.86		5.87		21,150

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Sharp corners on the groove required, see page 141 for more information.
[3] Square edge wire.

Retaining Rings

FSE Series

Constant Section Rings External



Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number[3]		Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	in	mm	Inside Diameter (in)	Tol.	Radial Wall (in)	Tol.	Thickness (in)	Tol.	Diameter (in)	Tol.	Width (in)	Tol.	Groove Yield[1] (lb)	Ring Shear[2] (lb)
FSE-0050	-S02	.500	12.700	.471	+.000/-.013	.055	±.004	.037	±.002	.476	+.000/-.004	.043	+.006/-.000	424	2,325
FSE-0056	-S02	.562	14.275	.524		.055		.037		.532		.043		596	2,613
FSE-0062	-S02	.625	15.875	.590		.065		.037		.595		.043		663	2,906
FSE-0068	-S02	.687	17.450	.649		.065		.037		.655		.043		777	3,194
FSE-0075	-S02	.750	19.050	.701		.075		.045		.710		.051		1,060	4,241
FSE-0081	-S02	.812	20.625	.764		.075		.045		.772	+.000/-.005	.051		1,148	4,592
FSE-0087	-S02	.875	22.225	.820		.075		.045		.831	+.000/-.008	.051		1,361	4,948
FSE-0093	-S02	.937	23.800	.886		.085		.045		.893		.051		1,457	5,334
FSE-0100	-S02	1.000	25.400	.933		.085		.045		.952		.051		1,696	5,693
FSE-0106	-S02	1.062	26.975	1.004		.085		.045		1.014		.051		1,802	6,045
FSE-0112	-S02	1.125	28.575	1.069	+.000/-.015	.128		.057		1.077		.063		1,909	7,615
FSE-0118	-S02	1.187	30.150	1.116		.128		.057		1.131		.063		2,349	8,035
FSE-0125	-S02	1.250	31.750	1.176		.128		.057		1.188	+.000/-.010	.063		2,739	8,461
FSE-0131	-S02	1.312	33.325	1.223		.128		.057		1.242		.063		3,246	8,881
FSE-0137	-S02	1.375	34.925	1.282		.128		.057		1.297		.063		3,791	9,307
FSE-0143	-S02	1.437	36.500	1.344		.158		.067		1.359		.073		3,961	11,408
FSE-0150	-S02	1.500	38.100	1.402		.158		.067		1.422		.073		4,135	11,908
FSE-0156	-S02	1.562	39.675	1.457	+.000/-.020	.158		.067		1.470		.073		5,079	12,400
FSE-0162	-S02	1.625	41.275	1.517		.158		.067		1.533		.073		5,284	12,901
FSE-0168	-S02	1.687	42.850	1.578		.158		.067		1.595		.073		5,485	13,393
FSE-0175	-S02	1.750	44.450	1.640		.158		.067		1.658		.073		5,690	13,893
FSE-0181	-S02	1.812	46.025	1.697		.158		.067		1.720		.073		5,892	14,385
FSE-0187	-S02	1.875	47.625	1.767		.158		.067		1.783		.073		6,097	14,885
FSE-0193	-S02	1.937	49.200	1.800	+.000/-.025	.200	±.005	.076	±.003	1.819		.085		8,078	16,649
FSE-0200	-S02	2.000	50.800	1.862		.200		.076		1.882		.085		8,341	17,191
FSE-0206	-S02	2.062	52.375	1.924		.200		.076		1.944		.085		8,599	17,724
FSE-0212	-S02	2.125	53.975	1.987		.200		.076		2.007	+.000/-.012	.085		8,862	18,265
FSE-0218	-S02	2.187	55.550	2.048		.200		.076		2.069		.085		9,121	18,798
FSE-0225	-S02	2.250	57.150	2.110		.200		.076		2.132		.085		9,384	19,340
FSE-0231	-S02	2.312	58.725	2.171		.200		.076		2.194		.085		9,642	19,873
FSE-0237	-S02	2.375	60.325	2.226		.200		.076		2.257		.085		9,905	20,414
FSE-0243	-S02	2.437	61.900	2.296		.200		.076		2.319		.085		10,163	20,947
FSE-0250	-S02	2.500	63.500	2.357		.200		.076		2.382		.085		10,426	21,488
FSE-0256	-S02	2.562	65.075	2.415		.200		.095		2.444		.104		10,685	26,252
FSE-0262	-S02	2.625	66.675	2.486		.200		.095		2.507		.104		10,947	26,898
FSE-0268	-S02	2.687	68.250	2.537	+.000/-.030	.200		.095		2.569		.104		11,206	27,533
FSE-0275	-S02	2.750	69.850	2.607		.200		.095		2.632		.104		11,469	28,179
FSE-0281	-S02	2.812	71.425	2.665		.200		.095		2.694		.104		11,727	28,814
FSE-0287	-S02	2.875	73.025	2.727		.200		.095		2.757		.104		11,990	29,460
FSE-0293	-S02	2.937	74.600	2.789		.200		.095		2.819		.104		12,249	30,095
FSE-0300	-S02	3.000	76.200	2.852		.200		.095		2.882		.104	+.007/-.000	12,511	30,740
FSE-0306	-S02	3.062	77.775	2.916		.200		.095		2.944		.104		12,770	31,376
FSE-0312	-S02	3.125	79.375	2.955		.237		.095		2.987		.104		15,242	32,021
FSE-0318	-S02	3.187	80.950	3.016		.237		.095		3.049		.104		15,544	32,657
FSE-0325	-S02	3.250	82.550	3.079		.237		.095		3.112		.104		15,851	33,302
FSE-0331	-S02	3.312	84.125	3.140	+.000/-.035	.248		.115		3.174	+.000/-.014	.124		16,154	39,088
FSE-0337	-S02	3.375	85.725	3.203		.248		.115		3.237		.124		16,461	39,831
FSE-0343	-S02	3.437	87.300	3.264		.248		.115		3.299		.124		16,763	40,563
FSE-0350	-S02	3.500	88.900	3.326		.248		.115		3.362		.124		17,071	41,307
FSE-0356	-S02	3.562	90.475	3.378		.248		.115		3.424		.124		17,373	42,038

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.

[3] Square edge wire.
* *See page 90 for different End Types.*

FSE Series

Constant Section Rings External Continued

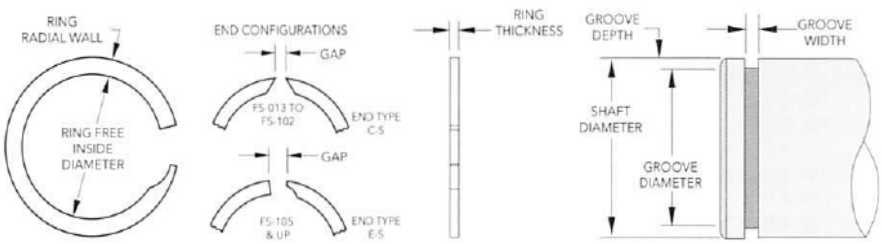
Smalley Part Number[3] Carbon Steel	Add Suffix 302 SS	Shaft Diameter in	Shaft Diameter mm	Ring Inside Diameter (in)	Inside Diameter Tol.	Ring Radial Wall (in)	Radial Wall Tol.	Ring Thickness (in)	Thickness Tol.	Groove Diameter (in)	Groove Diameter Tol.	Groove Width (in)	Groove Width Tol.	Thrust Capacity Groove Yield[1] (lb)	Thrust Capacity Ring Shear[2] (lb)
FSE-0362	-S02	3.625	92.075	3.451	+.000/-.035	.248	±.005	.115	±.003	3.487	+.000/-.014	.124	+.007/-.000	17,680	42,782
FSE-0368	-S02	3.687	93.650	3.512		.248		.115		3.549		.124		17,983	43,514
FSE-0375	-S02	3.750	95.250	3.570		.248		.115		3.612		.124		18,290	44,257
FSE-0381	-S02	3.812	96.825	3.636		.248		.115		3.674		.124		18,592	44,989
FSE-0387	-S02	3.875	98.425	3.689		.248		.115		3.737		.124		18,900	45,732
FSE-0393	-S02	3.937	100.000	3.760		.248		.115		3.799	+.000/-.021	.124		19,202	46,464
FSE-0400	-S02	4.000	101.600	3.828	+.000/-.051	.248		.115		3.862		.124		19,509	47,208
FSE-0412	-S02	4.125	104.775	3.930		.265		.153	±.004	3.967		.163		23,035	62,126
FSE-0425	-S02	4.250	107.950	4.050		.265		.153		4.092		.163		23,733	64,008
FSE-0437	-S02	4.375	111.125	4.174		.265		.153		4.217		.163		24,431	65,891
FSE-0450	-S02	4.500	114.300	4.297		.265		.153		4.342		.163		25,129	67,774
FSE-0462	-S02	4.625	117.475	4.421		.265		.153		4.467		.163		25,827	69,656
FSE-0475	-S02	4.750	120.650	4.530		.265		.153		4.592		.163		26,525	71,539
FSE-0487	-S02	4.875	123.825	4.668		.265		.153		4.717	+.000/-.024	.163		27,223	73,421
FSE-0500	-S02	5.000	127.000	4.792		.265		.153		4.842		.163		27,921	75,304
FSE-0525	-S02	5.250	133.350	5.039		.265		.153		5.092		.163		29,317	79,069
FSE-0550	-S02	5.500	139.700	5.292		.265		.153		5.342		.163		30,713	82,834
FSE-0575	-S02	5.750	146.050	5.535		.265		.153		5.592		.163		32,109	86,599
FSE-0600	-S02	6.000	152.400	5.744	+.000/-.060	.316	±.006	.153		5.804		.163		41,563	90,365
FSE-0625	-S02	6.250	158.750	5.992		.316		.153		6.054		.163		43,295	94,130
FSE-0650	-S02	6.500	165.100	6.236		.316		.153		6.304		.163		45,027	97,895
FSE-0675	-S02	6.750	171.450	6.486		.316		.153		6.554		.163		46,759	101,727
FSE-0700	-S02	7.000	177.800	6.734	+.000/-.070	.316		.153		6.804		.163		48,490	105,494
FSE-0725	-S02	7.250	184.150	6.993		.316		.153		7.054		.163		50,222	109,262
FSE-0750	-S02	7.500	190.500	7.219		.316		.153		7.304	+.000/-.028	.163		51,954	113,030
FSE-0775	-S02	7.750	196.850	7.477		.316		.153		7.554		.163		53,686	116,797
FSE-0800	-S02	8.000	203.200	7.683		.435	±.007	.192	±.005	7.764		.203		66,727	142,932
FSE-0825	-S02	8.250	209.550	7.940		.435		.192		8.014		.203		68,813	147,399
FSE-0850	-S02	8.500	215.900	8.179		.435		.192		8.264		.203		70,898	151,866
FSE-0875	-S02	8.750	222.250	8.427		.435		.192		8.514		.203		72,983	156,332
FSE-0900	-S02	9.000	228.600	8.673		.435		.192		8.764		.203		75,068	160,799
FSE-0925	-S02	9.250	234.950	8.922		.435		.192		9.014		.203		77,154	165,265
FSE-0950	-S02	9.500	241.300	9.130		.435		.192		9.240		.203		87,297	169,732
FSE-0975	-S02	9.750	247.650	9.393	+.000/-.091	.435		.192		9.490		.203		89,594	174,199
FSE-1000	-S02	10.000	254.000	9.586		.500		.192		9.686	+.000/-.031	.203		110,977	178,665
FSE-1025	-S02	10.250	260.350	9.826		.500		.192		9.936		.203		113,751	183,132
FSE-1050	-S02	10.500	266.700	10.081		.500		.192		10.186		.203		116,526	187,599
FSE-1075	-S02	10.750	273.050	10.329		.500		.192		10.436		.203		119,300	192,065
FSE-1100	-S02	11.000	279.400	10.584		.500		.192		10.686		.203		122,074	196,532

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] Square edge wire.
• See page 90 for different End Types.

FS Series

Metric Constant Section Rings External

**Groove compatible with DIN 471*



Product Dimensions: All dimensions in millimeters unless otherwise specified.

Smalley Part Number[3]		Shaft Diameter		Ring						Groove				Thrust Capacity	
Carbon Steel	Add Suffix 302 SS	mm	in	Inside Diameter (mm)	Inside Diameter tolerance	Radial Wall (mm)	Radial Wall tolerance	Thickness (mm)	Thickness tolerance	Diameter (mm)	Diameter tolerance	Width (mm)	Width tolerance	Groove Yield[1] (N)	Ring Shear[2] (N)
FS-013	**-S02**	13.00	.51	12.27	+.00/-.33	1.40	±.10	.94	±.05	12.40	+.00/-.11	1.10	+.14/-.00	1,931	10,591
FS-014	**-S02**	14.00	.55	13.31	+.00/-.33	1.40	±.10	.94	±.05	13.40	+.00/-.11	1.10	+.14/-.00	2,077	11,396
FS-015	**-S02**	15.00	.59	14.15	+.00/-.33	1.40	±.10	.94	±.05	14.30	+.00/-.11	1.10	+.14/-.00	2,602	12,224
FS-016	**-S02**	16.00	.63	14.98	+.00/-.33	1.65	±.10	.94	±.05	15.20	+.00/-.11	1.10	+.14/-.00	3,172	13,029
FS-017	**-S02**	17.00	.67	16.06	+.00/-.33	1.65	±.10	.94	±.05	16.20	+.00/-.11	1.10	+.14/-.00	3,367	13,838
FS-018	**-S02**	18.00	.71	16.82	+.00/-.33	1.90	±.10	1.15	±.05	17.00	+.00/-.11	1.30	+.14/-.00	4,457	17,953
FS-019	**-S02**	19.00	.75	17.81	+.00/-.33	1.90	±.10	1.15	±.05	18.00	+.00/-.11	1.30	+.14/-.00	4,702	18,941
FS-020	**-S02**	20.00	.79	18.80	+.00/-.33	1.90	±.10	1.15	±.05	19.00	+.00/-.13	1.30	+.14/-.00	4,951	19,928
FS-021	**-S02**	21.00	.83	19.79	+.00/-.33	1.90	±.10	1.15	±.05	20.00	+.00/-.13	1.30	+.14/-.00	5,200	20,942
FS-022	**-S02**	22.00	.87	20.83	+.00/-.33	1.90	±.10	1.15	±.05	21.00	+.00/-.13	1.30	+.14/-.00	5,445	21,930
FS-023	**-S02**	23.00	.91	21.77	+.00/-.33	1.90	±.10	1.15	±.05	22.00	+.00/-.13	1.30	+.14/-.00	5,698	22,939
FS-024	**-S02**	24.00	.94	22.50	+.00/-.33	2.15	±.10	1.15	±.05	22.90	+.00/-.21	1.30	+.14/-.00	6,539	23,927
FS-025	**-S02**	25.00	.98	23.70	+.00/-.33	2.15	±.10	1.15	±.05	23.90	+.00/-.21	1.30	+.14/-.00	6,806	24,914
FS-026	**-S02**	26.00	1.02	24.64	+.00/-.33	2.15	±.10	1.15	±.05	24.90	+.00/-.21	1.30	+.14/-.00	7,082	25,929
FS-027	**-S02**	27.00	1.06	25.50	+.00/-.33	2.15	±.10	1.15	±.05	25.90	+.00/-.21	1.30	+.14/-.00	7,353	26,916
FS-028	**-S02**	28.00	1.10	26.32	+.00/-.38	3.25	±.10	1.44	±.05	26.60	+.00/-.21	1.60	+.14/-.00	9,702	33,179
FS-029	**-S02**	29.00	1.14	27.15	+.00/-.38	3.25	±.10	1.44	±.05	27.60	+.00/-.21	1.60	+.14/-.00	10,053	34,385
FS-030	**-S02**	30.00	1.18	28.35	+.00/-.38	3.25	±.10	1.44	±.05	28.60	+.00/-.21	1.60	+.14/-.00	10,395	35,559
FS-032	**-S02**	32.00	1.26	29.87	+.00/-.38	3.25	±.10	1.44	±.05	30.30	+.00/-.25	1.60	+.14/-.00	13,073	37,939
FS-033	**-S02**	33.00	1.30	31.07	+.00/-.38	3.25	±.10	1.44	±.05	31.30	+.00/-.25	1.60	+.14/-.00	13,478	39,113
FS-034	**-S02**	34.00	1.34	31.96	+.00/-.38	3.25	±.10	1.44	±.05	32.30	+.00/-.25	1.60	+.14/-.00	13,892	40,319
FS-035	**-S02**	35.00	1.38	32.57	+.00/-.38	3.25	±.10	1.44	±.05	33.00	+.00/-.25	1.60	+.14/-.00	16,899	41,493
FS-036	**-S02**	36.00	1.42	33.64	+.00/-.38	4.01	±.10	1.69	±.05	34.00	+.00/-.25	1.85	+.14/-.00	17,375	50,038
FS-038	**-S02**	38.00	1.50	35.62	+.00/-.38	4.01	±.10	1.69	±.05	36.00	+.00/-.25	1.85	+.14/-.00	18,344	52,827
FS-040	**-S02**	40.00	1.57	37.02	+.00/-.51	4.01	±.10	1.69	±.05	37.50	+.00/-.25	1.85	+.14/-.00	24,265	55,621
FS-042	**-S02**	42.00	1.65	39.08	+.00/-.51	4.01	±.10	1.69	±.05	39.50	+.00/-.25	1.85	+.14/-.00	25,484	58,410
FS-045	**-S02**	45.00	1.77	42.05	+.00/-.51	4.01	±.10	1.69	±.05	42.50	+.00/-.25	1.85	+.14/-.00	27,303	62,578
FS-046	**-S02**	46.00	1.81	43.10	+.00/-.51	4.01	±.10	1.69	±.05	43.50	+.00/-.25	1.85	+.14/-.00	27,904	63,952
FS-047	**-S02**	47.00	1.85	44.03	+.00/-.51	4.01	±.10	1.69	±.05	44.50	+.00/-.25	1.85	+.14/-.00	28,504	65,331
FS-048	**-S02**	48.00	1.89	44.89	+.00/-.51	4.01	±.10	1.69	±.05	45.50	+.00/-.25	1.85	+.14/-.00	29,118	66,741
FS-050	**-S02**	50.00	1.97	46.50	+.00/-.63	5.08	±.13	1.93	±.08	47.00	+.00/-.25	2.15	+.14/-.00	36,529	75,282
FS-052	**-S02**	52.00	2.05	48.48	+.00/-.63	5.08	±.13	1.93	±.08	49.00	+.00/-.25	2.15	+.14/-.00	37,974	78,266
FS-054	**-S02**	54.00	2.13	50.46	+.00/-.63	5.08	±.13	1.93	±.08	51.00	+.00/-.30	2.15	+.14/-.00	39,438	81,287
FS-055	**-S02**	55.00	2.17	51.45	+.00/-.63	5.08	±.13	1.93	±.08	52.00	+.00/-.30	2.15	+.14/-.00	40,163	82,777
FS-056	**-S02**	56.00	2.20	52.44	+.00/-.63	5.08	±.13	1.93	±.08	53.00	+.00/-.30	2.15	+.14/-.00	40,906	84,307
FS-058	**-S02**	58.00	2.28	54.42	+.00/-.63	5.08	±.13	1.93	±.08	55.00	+.00/-.30	2.15	+.14/-.00	42,352	87,287
FS-060	**-S02**	60.00	2.36	56.55	+.00/-.63	5.08	±.13	1.93	±.08	57.00	+.00/-.30	2.15	+.14/-.00	43,819	90,308
FS-062	**-S02**	62.00	2.44	58.32	+.00/-.63	5.08	±.13	1.93	±.08	59.00	+.00/-.30	2.15	+.14/-.00	45,283	93,328
FS-063	**-S02**	63.00	2.48	59.37	+.00/-.63	5.08	±.13	1.93	±.08	60.00	+.00/-.30	2.15	+.14/-.00	46,008	94,823
FS-065	**-S02**	65.00	2.56	61.35	+.00/-.63	5.08	±.13	2.41	±.08	62.00	+.00/-.30	2.65	+.14/-.00	47,471	116,641
FS-067	**-S02**	67.00	2.64	63.35	+.00/-.63	5.08	±.13	2.41	±.08	64.00	+.00/-.30	2.65	+.14/-.00	48,939	120,240
FS-068	**-S02**	68.00	2.68	64.45	+.00/-.76	5.08	±.13	2.41	±.08	65.00	+.00/-.30	2.65	+.14/-.00	49,660	122,019
FS-070	**-S02**	70.00	2.76	66.22	+.00/-.76	5.08	±.13	2.41	±.08	67.00	+.00/-.30	2.65	+.14/-.00	51,128	125,618
FS-072	**-S02**	72.00	2.83	68.28	+.00/-.76	5.08	±.13	2.41	±.08	69.00	+.00/-.30	2.65	+.14/-.00	52,591	129,221
FS-075	**-S02**	75.00	2.95	71.25	+.00/-.76	5.08	±.13	2.41	±.08	72.00	+.00/-.30	2.65	+.14/-.00	54,780	134,599
FS-077	**-S02**	77.00	3.03	73.23	+.00/-.76	5.08	±.13	2.41	±.08	74.00	+.00/-.30	2.65	+.14/-.00	56,230	138,153
FS-078	**-S02**	78.00	3.07	74.06	+.00/-.76	5.08	±.13	2.41	±.08	75.00	+.00/-.30	2.65	+.14/-.00	56,968	139,977
FS-080	**-S02**	80.00	3.15	75.70	+.00/-.76	6.02	±.13	2.41	±.08	76.50	+.00/-.30	2.65	+.14/-.00	68,342	143,575
FS-082	**-S02**	82.00	3.23	77.68	+.00/-.76	6.02	±.13	2.41	±.08	78.50	+.00/-.30	2.65	+.14/-.00	70,033	147,134
FS-085	**-S02**	85.00	3.35	80.65	+.00/-.76	6.30	±.13	2.91	±.08	81.50	+.00/-.35	3.15	+.18/-.00	72,595	175,656

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] Square edge wire.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.

- *See page 90 for different End Types.*

FS Series

Metric Constant Section Rings External Continued

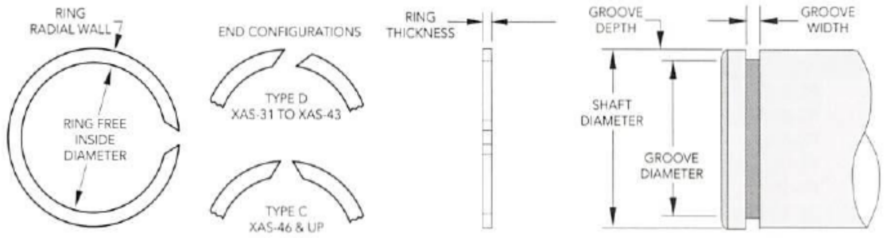
Smalley Part Number[3] Carbon Steel	Add Suffix 302 SS	Shaft Diameter mm	Shaft Diameter in	Ring Inside Diameter (mm)	Tol.	Ring Radial Wall (mm)	Tol.	Ring Thickness (mm)	Tol.	Groove Diameter (mm)	Tol.	Groove Width (mm)	Tol.	Thrust Capacity Groove Yield[1] (N)	Thrust Capacity Ring Shear[2] (N)
FS-088	-S02	88.00	3.46	83.60	+.00/-.89	6.30	±.13	2.91	±.08	84.50	+.00/-.35	3.15	+.18/-.00	75,175	181,906
FS-090	-S02	90.00	3.54	85.80		6.30		2.91		86.50		3.15		76,865	185,998
FS-095	-S02	95.00	3.74	90.68		6.30		2.91		91.50		3.15		81,140	196,340
FS-098	-S02	98.00	3.86	93.70		6.30		2.91		94.50		3.15		83,702	202,536
FS-100	-S02	100.00	3.94	95.50		6.30		2.91		96.50		3.15		85,415	206,682
FS-102	-S02	102.00	4.02	97.23	+.00/-1.30	6.30		2.91		98.50		3.15		87,127	210,828
FS-105	-S02	105.00	4.13	99.83		6.73		3.89	±.10	101.00	+.00/-.54	4.15		102,687	276,951
FS-108	-S02	108.00	4.25	102.87		6.73		3.89		104.00		4.15		105,619	284,855
FS-110	-S02	110.00	4.33	104.90		6.73		3.89		106.00		4.15		107,580	290,149
FS-115	-S02	115.00	4.53	109.85		6.73		3.89		111.00		4.15		112,473	303,346
FS-120	-S02	120.00	4.72	115.06		6.73		3.89		116.00		4.15		117,344	316,478
FS-125	-S02	125.00	4.92	119.75		6.73		3.89		121.00	+.00/-.63	4.15		122,237	329,676
FS-130	-S02	130.00	5.12	124.70		6.73		3.89		126.00		4.15		127,130	342,873
FS-135	-S02	135.00	5.31	129.65		6.73		3.89		131.00		4.15		132,023	356,071
FS-140	-S02	140.00	5.51	134.42		6.73		3.89		136.00		4.15		136,916	369,269
FS-145	-S02	145.00	5.71	139.55		6.73		3.89		141.00		4.15		141,809	382,467
FS-150	-S02	150.00	5.91	143.50	+.00/-1.52	8.03	±.15	3.89		145.00		4.15		181,986	395,665
FS-155	-S02	155.00	6.10	148.45		8.03		3.89		150.00		4.15		188,026	408,796
FS-160	-S02	160.00	6.30	153.40		8.03		3.89		155.00		4.15		194,094	421,994
FS-165	-S02	165.00	6.50	158.40		8.03		3.89		160.00		4.15		200,166	435,192
FS-170	-S02	170.00	6.69	163.30		8.03		3.89		165.00		4.15		206,237	448,683
FS-175	-S02	175.00	6.89	168.25		8.03		3.89		170.00		4.15		212,305	461,890
FS-180	-S02	180.00	7.09	173.20		8.03		3.89		175.00		4.15		218,377	475,097
FS-185	-S02	185.00	7.28	177.62	+.00/-1.78	8.03		3.89		180.00		4.15		224,417	488,232
FS-190	-S02	190.00	7.48	183.35		8.03		3.89		185.00	+.00/-.72	4.15		230,489	501,439
FS-195	-S02	195.00	7.68	188.05		8.03		3.89		190.00		4.15		236,556	514,646
FS-200	-S02	200.00	7.87	193.00		8.03		3.89		195.00		4.15		242,628	527,853
FS-205	-S02	205.00	8.07	196.95		11.05	±.18	4.87	±.13	199.00		5.15		299,454	641,438
FS-210	-S02	210.00	8.27	201.67		11.05		4.87		204.00		5.15		306,763	657,096
FS-220	-S02	220.00	8.66	211.80		11.05		4.87		214.00		5.15		321,344	688,327
FS-230	-S02	230.00	9.06	221.70		11.05		4.87		224.00		5.15		335,961	719,638
FS-240	-S02	240.00	9.45	231.89		11.05		4.87		234.00		5.15		350,578	750,953
FS-250	-S02	250.00	9.84	241.50		11.05		4.87		244.00		5.15		365,199	782,264
FS-260	-S02	260.00	10.24	249.59	+.00/-2.30	12.70		4.87		252.00	+.00/-.81	5.15		505,300	813,500
FS-270	-S02	270.00	10.63	259.30		12.70		4.87		262.00		5.15		524,748	844,811
FS-280	-S02	280.00	11.02	268.83		12.70		4.87		272.00		5.15		544,200	876,126
FS-290	-S02	290.00	11.42	279.10		12.70		4.87		282.00		5.15		563,599	907,357
FS-300	-S02	300.00	11.81	289.00		12.70		4.87		292.00		5.15		583,051	938,673

[1] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] Square edge wire.

* Contact Smalley for details/information on how to order parts to be in compliance with this specification.
- See page 90 for different End Types.

XAS Series

Constant Section Rings External



Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number[3] Carbon Steel	Add Suffix 302 SS	Shaft Diameter in	Shaft Diameter mm	Ring Inside Diameter (in)	Tol.	Ring Radial Wall (in)	Tol.	Ring Thickness (in)	Tol.	Groove Diameter (in)	Tol.	Groove Width (in)	Tol.	Thrust Capacity Groove Yield[1] (lb)	Thrust Capacity Ring Shear[2] (lb)
XAS-31	-S02	.312	7.925	.281		.040		.025		.290		.028		243	977
XAS-34	-S02	.344	8.738	.312	+.000/-.015	.040		.025		.322		.028		267	1,077
XAS-35	-S02	.354	8.992	.320		.040		.025		.330		.028		300	1,108
XAS-37	-S02	.375	9.525	.341		.040		.025		.351		.028		318	1,174
XAS-39	-S02	.393	9.982	.359		.040		.025		.369		.028		333	1,231
XAS-40	-S02	.406	10.312	.372	+.000/-.020	.040		.025		.382		.028		344	1,271
XAS-43	-S02	.438	11.125	.402		.040		.025		.412		.028		402	1,371
XAS-46	-S02	.469	11.913	.433		.040		.025		.443		.028		431	1,468
XAS-50	-S02	.500	12.700	.464		.048		.035		.474		.039		459	2,073
XAS-55	-S02	.551	13.995	.514		.048		.035		.524	±.002	.039		526	2,285
XAS-56	-S02	.562	14.275	.524		.048		.035		.534		.039		556	2,331
XAS-59	-S02	.594	15.088	.555		.048		.035		.566		.039	+.003/-.000	588	2,463
XAS-62	-S02	.625	15.875	.586	+.000/-.025	.062		.035		.597		.039		619	2,592
XAS-66	-S02	.669	16.993	.630		.062		.035		.640		.039		686	2,774
XAS-68	-S02	.688	17.475	.644		.062		.042		.656		.046		778	3,458
XAS-75	-S02	.750	19.050	.703		.062	±.003	.042		.716		.046		901	3,770
XAS-78	-S02	.781	19.837	.733		.062		.042		.745		.046		994	3,926
XAS-81	-S02	.812	20.625	.764		.062		.042		.776		.046		1,033	4,082
XAS-87	-S02	.875	22.225	.820		.078		.042		.835		.046		1,237	4,398
XAS-93	-S02	.938	23.825	.881		.078		.042		.896		.046		1,392	4,715
XAS-98	-S02	.984	24.994	.925		.078		.042		.940		.046		1,530	4,946
XAS-100	-S02	1.000	25.400	.941		.093		.042		.956	±.003	.046		1,555	5,027
XAS-102	-S02	1.023	25.984	.962		.093		.042		.977		.046		1,663	5,142
XAS-106	-S02	1.062	26.975	1.000		.093		.050		1.016		.056		1,727	6,272
XAS-112	-S02	1.125	28.575	1.060	+.000/-.031	.093		.050	±.002	1.075		.056		1,988	6,644
XAS-118	-S02	1.188	30.175	1.121		.093		.050		1.136		.056		2,183	7,017
XAS-125	-S02	1.250	31.750	1.179		.093		.050		1.194		.056		2,474	7,383
XAS-131	-S02	1.312	33.325	1.232		.093		.050		1.250		.056		2,875	7,749
XAS-137	-S02	1.375	34.925	1.291		.109		.050		1.309		.056		3,207	8,121
XAS-143	-S02	1.438	36.525	1.351		.109		.050		1.370		.056		3,456	8,493
XAS-150	-S02	1.500	38.100	1.408		.109		.050		1.430		.056		3,711	8,859
XAS-156	-S02	1.562	39.675	1.467		.125		.062		1.490	±.004	.068	+.004/-.000	3,975	11,002
XAS-162	-S02	1.625	41.275	1.527		.125		.062		1.551		.068		4,250	11,446
XAS-168	-S02	1.687	42.850	1.581		.125		.062		1.611		.068		4,531	11,882
XAS-175	-S02	1.750	44.450	1.640		.125		.062		1.670		.068		4,948	12,326
XAS-177	-S02	1.771	44.983	1.657		.141		.062		1.687		.068		5,258	12,474
XAS-181	-S02	1.812	46.025	1.698		.141		.062		1.728		.068		5,379	12,763
XAS-187	-S02	1.875	47.625	1.759		.156		.062		1.789		.068		5,699	13,206
XAS-196	-S02	1.969	50.013	1.849		.156		.062		1.879		.068		6,263	13,869
XAS-200	-S02	2.000	50.800	1.880		.156		.062		1.910		.068		6,362	14,087
XAS-206	-S02	2.062	52.375	1.936	+.000/-.046	.156	±.005	.078		1.966		.086		6,996	17,491
XAS-212	-S02	2.125	53.975	1.997		.156		.078		2.027		.086		7,360	18,025
XAS-215	-S02	2.156	54.762	2.026		.156		.078		2.056		.086		7,620	18,288
XAS-225	-S02	2.250	57.150	2.116		.156		.078		2.146	±.006	.086		8,270	19,085
XAS-231	-S02	2.312	58.725	2.174		.187		.078		2.204		.086	+.005/-.000	8,825	19,611
XAS-237	-S02	2.375	60.325	2.235		.187		.078		2.265		.086		9,233	20,145
XAS-243	-S02	2.437	61.900	2.295		.187		.078		2.325		.086		9,647	20,671
XAS-250	-S02	2.500	63.500	2.356		.187		.078		2.386		.086		10,073	21,206
XAS-255	-S02	2.559	64.999	2.413		.187		.078		2.443		.086		10,491	21,706
XAS-262	-S02	2.625	66.675	2.475		.187		.078		2.505		.086		11,133	22,266

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] Square edge wire.
* See page 90 for different End Types.

XAS Series

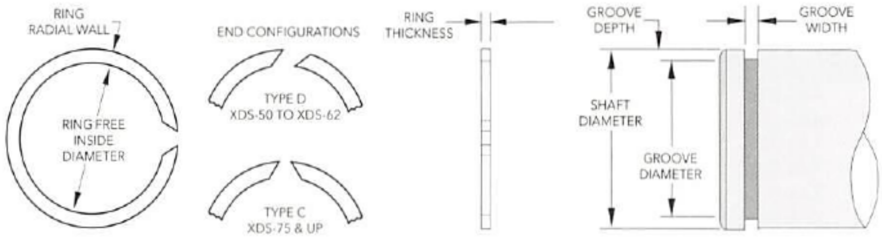
Constant Section Rings External Continued

Smalley Part Number[3] Carbon Steel	Add Suffix 302 SS	Shaft Diameter in	Shaft Diameter mm	Ring Inside Diameter (in)	Inside Diameter Tolerance	Ring Radial Wall (in)	Radial Wall Tolerance	Ring Thickness (in)	Thickness Tolerance	Groove Diameter (in)	Groove Diameter Tolerance	Groove Width (in)	Groove Width Tolerance	Thrust Capacity Groove Yield[1] (lb)	Thrust Capacity Ring Shear[2] (lb)
XAS-268	-S02	2.687	68.250	2.535	.000/-.046	.187	±.005	.078	±.002	2.565	±.006	.086	+.005/-.000	11,586	22,792
XAS-275	-S02	2.750	69.850	2.594	+.000/-.062	.187		.093		2.624		.103		12,246	27,992
XAS-287	-S02	2.875	73.025	2.713		.187		.093		2.743		.103		13,413	29,264
XAS-293	-S02	2.937	74.600	2.771		.187		.093		2.801		.103		14,117	29,895
XAS-300	-S02	3.000	76.200	2.830		.218		.093		2.860		.103		14,844	30,536
XAS-306	-S02	3.062	77.775	2.890		.218		.093		2.920		.103		15,367	31,167
XAS-312	-S02	3.125	79.375	2.951		.218		.093		2.981		.103		15,904	31,809
XAS-315	-S02	3.156	80.162	2.980		.218		.093		3.010		.103		16,285	32,124
XAS-325	-S02	3.250	82.550	3.070		.250		.093		3.100		.103		17,230	33,081
XAS-334	-S02	3.344	84.938	3.160		.250		.093		3.190		.103		18,201	34,038
XAS-343	-S02	3.437	87.300	3.251		.250		.093		3.281		.103		18,950	34,984
XAS-350	-S02	3.500	88.900	3.305	+.000/-.078	.250		.109		3.340		.120		19,792	40,017
XAS-354	-S02	3.543	89.992	3.346		.250		.109		3.381		.120		20,286	40,508
XAS-362	-S02	3.625	92.075	3.423		.250		.109		3.458		.120		21,396	41,446
XAS-368	-S02	3.687	93.650	3.482		.250		.109		3.517		.120		22,153	42,155
XAS-375	-S02	3.750	95.250	3.541		.250		.109		3.576		.120		23,061	42,875
XAS-387	-S02	3.875	98.425	3.657		.281		.109		3.697		.120		24,378	44,304
XAS-393	-S02	3.938	100.025	3.713		.281		.109		3.758		.120		25,052	45,024
XAS-400	-S02	4.000	101.600	3.771	+.000/-.093	.281		.109		3.816		.120		26,012	45,733
XAS-425	-S02	4.250	107.950	4.016		.281		.109		4.066		.120		27,638	48,592
XAS-437	-S02	4.375	111.125	4.141		.281		.109		4.191		.120		28,451	50,021
XAS-450	-S02	4.500	114.300	4.255		.312		.109		4.310		.120		30,218	51,450
XAS-475	-S02	4.750	120.650	4.495		.312		.109		4.550		.120		33,576	54,308
XAS-500	-S02	5.000	127.000	4.730		.312		.109		4.790		.120		37,110	57,167
XAS-525	-S02	5.250	133.350	4.970	+.000/-.125	.375		.125		5.030		.139	+.006/-.000	40,821	65,732
XAS-550	-S02	5.500	139.700	5.206		.375		.125		5.266		.139		45,486	68,862
XAS-575	-S02	5.750	146.050	5.446		.375		.125		5.506		.139		49,586	71,992
XAS-590	-S02	5.900	149.860	5.600		.375		.125		5.656		.139		50,880	73,870
XAS-600	-S02	6.000	152.400	5.687		.375		.125		5.746		.139		53,863	75,122
XAS-625	-S02	6.250	158.750	5.916		.437		.156		5.986	±.008	.174	+.008/-.000	58,316	94,130
XAS-650	-S02	6.500	165.100	6.151		.437		.156		6.226		.174		62,946	97,895
XAS-675	-S02	6.750	171.450	6.386		.437		.156		6.466		.174		67,752	101,660
XAS-700	-S02	7.000	177.800	6.621		.437		.156		6.706		.174		72,736	105,426
XAS-725	-S02	7.250	184.150	6.840	+.000/-.156	.500		.187		6.930		.209		81,996	124,330
XAS-750	-S02	7.500	190.500	7.090		.500		.187		7.180		.209		84,823	128,617
XAS-800	-S02	8.000	203.200	7.560		.500		.187		7.660		.209		96,133	137,191
XAS-850	-S02	8.500	215.900	8.050		.500		.187		8.160		.209		102,141	145,766
XAS-900	-S02	9.000	228.600	8.545		.500		.187		8.660		.209		108,149	154,340
XAS-925	-S02	9.250	234.950	8.800		.500		.187		8.910		.209		111,153	158,627
XAS-950	-S02	9.500	241.300	9.040		.500		.187		9.160		.209		114,158	162,915
XAS-1000	-S02	10.000	254.000	9.535		.500		.187		9.660		.209		120,166	171,489

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] Square edge wire.
* See page 90 for different End Types.

XDS Series

Constant Section Rings External



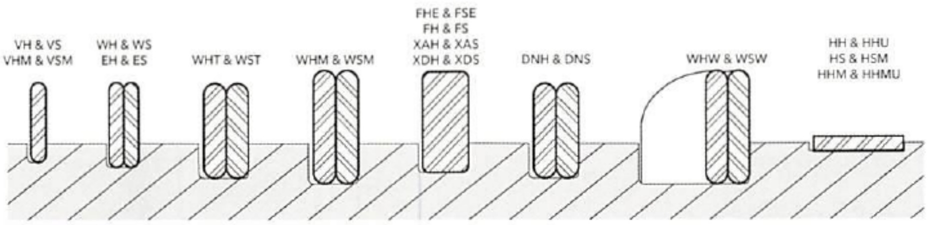
Product Dimensions: All dimensions in inches unless otherwise specified.

Smalley Part Number[3] Carbon Steel	Add Suffix 302 SS	Shaft Diameter in	Shaft Diameter mm	Ring Inside Diameter (in)	Inside Diameter Tol.	Ring Radial Wall (in)	Radial Wall Tol.	Ring Thickness (in)	Thickness Tol.	Groove Diameter (in)	Diameter Tol.	Groove Width (in)	Width Tol.	Thrust Capacity Groove Yield[1] (lb)	Thrust Capacity Ring Shear[2] (lb)
XDS-50	-S02	.500	12.700	.465	+.000/-.025	.048	±.003	.035	±.002	.474	±.002	.039	+.003/-.000	459	2,073
XDS-62	-S02	.625	15.875	.587		.062		.035		.597		.039		619	2,592
XDS-75	-S02	.750	19.050	.704		.078		.042		.716		.046		901	3,770
XDS-87	-S02	.875	22.225	.823	+.000/-.031	.093		.042		.833	±.003	.046		1,299	4,398
XDS-100	-S02	1.000	25.400	.944		.094		.042		.954		.046		1,626	5,027
XDS-112	-S02	1.125	28.575	1.065		.125	±.005	.042		1.077		.046		1,909	5,655
XDS-118	-S02	1.187	30.150	1.120		.125		.042		1.135	±.004	.046		2,182	5,967
XDS-125	-S02	1.250	31.750	1.179		.125		.042		1.194		.046		2,474	6,283
XDS-131	-S02	1.312	33.325	1.232		.125		.042		1.252		.046		2,782	6,595
XDS-137	-S02	1.375	34.925	1.289		.125		.042		1.309		.046		3,207	6,912
XDS-143	-S02	1.437	36.500	1.349		.125		.042		1.369		.046		3,454	7,223
XDS-150	-S02	1.500	38.100	1.410		.125		.042		1.430		.046		3,711	7,540
XDS-162	-S02	1.625	41.275	1.520	+.000/-.062	.156		.042		1.545		.046		4,595	8,168
XDS-168	-S02	1.687	42.850	1.582		.156		.042		1.607		.046		4,770	8,480
XDS-175	-S02	1.750	44.450	1.645		.156		.042		1.670		.046		4,948	8,796
XDS-193	-S02	1.937	49.200	1.832		.156		.042		1.857	±.006	.046		5,477	9,736
XDS-200	-S02	2.000	50.800	1.895		.156		.042		1.920		.046		5,655	10,053
XDS-218	-S02	2.187	55.550	2.082		.156		.042		2.107		.046		6,184	10,993
XDS-225	-S02	2.250	57.150	2.145		.156		.042		2.170		.046		6,362	11,310
XDS-237	-S02	2.375	60.325	2.270		.156		.042		2.295		.046		6,715	11,938
XDS-250	-S02	2.500	63.500	2.390		.156		.042		2.420		.046		7,069	12,566
XDS-275	-S02	2.750	69.850	2.596	+.000/-.093	.187		.062		2.626		.068	+.004/-.000	12,052	19,369
XDS-293	-S02	2.937	74.600	2.783		.187		.062		2.813		.068		12,871	20,687
XDS-300	-S02	3.000	76.200	2.846		.187		.062		2.876		.068		13,148	21,130
XDS-312	-S02	3.125	79.375	2.965		.187		.062		3.000		.068		13,806	22,011
XDS-325	-S02	3.250	82.550	3.090		.187		.062		3.125		.068		14,358	22,891
XDS-337	-S02	3.375	85.725	3.215		.187		.062		3.250		.068		14,910	23,772
XDS-350	-S02	3.500	88.900	3.340		.187		.062		3.375		.068		15,463	24,652
XDS-375	-S02	3.750	95.250	3.570	+.000/-.078	.218		.078		3.610		.086	+.005/-.000	18,555	31,809
XDS-400	-S02	4.000	101.600	3.820		.218		.078		3.860		.086		19,792	33,929
XDS-425	-S02	4.250	107.950	4.070		.218		.078		4.110		.086		21,029	36,050
XDS-450	-S02	4.500	114.300	4.320		.218		.078		4.360		.086		22,266	38,170
XDS-475	-S02	4.750	120.650	4.560		.218		.078		4.610		.086		23,503	40,291
XDS-500	-S02	5.000	127.000	4.800		.218		.078		4.860		.086		24,740	42,412
XDS-550	-S02	5.500	139.700	5.280	+.000/-.125	.250		.093		5.340	±.008	.103		31,102	55,983
XDS-600	-S02	6.000	152.400	5.775		.250		.093		5.840		.103		33,929	61,073
XDS-650	-S02	6.500	165.100	6.270		.250		.093		6.340		.103		36,757	66,162
XDS-700	-S02	7.000	177.800	6.765		.250		.093		6.840		.103		39,584	71,251
XDS-750	-S02	7.500	190.500	7.245	+.000/-.156	.281		.109		7.320		.120		47,713	85,750
XDS-800	-S02	8.000	203.200	7.740		.281		.109		7.820		.120		50,894	91,466

[1] Based on a groove material yield strength of 45,000 psi and a safety factor of 2.
[2] Based on a safety factor of 3.
[3] Square edge wire.
* See page 90 for different End Types.

Relative proportions of rings in grooves

A cross-section of each Spirolox Retaining Ring configuration is illustrated below, comparing groove and ring sections in the same diameter bore or shaft. The heavier retaining ring cross-sections are in deeper and wider grooves, to provide significantly greater thrust capacity.



Interchange Listing

Smalley retaining rings are interchangeable with both imperial and metric retaining ring grooves. Smalley offers free samples of all stock retaining rings to test in your application. Cross reference a standard stamped or snap ring to find the appropriate Smalley retaining ring to fit your application.

SMALLEY®	SPIROLOX® SERIES	MILITARY MIL-DTL-27426	AEROSPACE AS3219	METRIC AEROSPACE MA 4035	EUROPEAN SPECIFICATION DIN	WALDES TRUARC	EATON	INDUSTRIAL RETAINING RING	OTHER RINGS	ANDERTON
VH	UR	---	---	---	**Groove Interchange Only** Use a Smalley retaining ring to fit into the same groove of these stamped retaining rings (circlips).					
VS	US	---	---	---						
WH	RR	/3	AS4299 AS3217	---						
WS	RS	/1	AS4299 AS3218	---						
WHT	RRT	---	---	---	---	---	NAN	---	UHB	---
WST	RST	---	---	---	---	---	XAN	---	USC	---
WHM	RRN	/4	AS4299 AS3215	---	---	N5000 5008	IN	3000 4000	HO HOI UHO	N1300
WSM	RSN	/2	AS4299 AS3216	---	---	5100 5108	EN	3100 4100	SH SHI USH	N1400
DNH	---	---	---	---	DIN 472	---	---	---	DHO	D1300
DNS	---	---	---	---	DIN 471	---	---	---	DSH	D1400
EH	---	---	---	MA 4017	---	---	---	---	---	---
ES	---	---	---	MA 4016	---	---	---	---	---	---
FH	---	---	---	---	DIN 472	---	---	---	DHO	D1300
FS	---	---	---	---	DIN 471	---	---	---	DSH	D1400
XAH	---	---	---	---	---	---	NAN	---	UHB	---
XAS	---	---	---	---	---	---	XAN	---	USC	---
XDH	---	---	---	---	---	---	ND	---	HN	---
XDS	---	---	---	---	---	---	XD	---	SNL	---
XNH	---	---	---	---	---	---	IN	---	UHO	---
XNS	---	---	---	---	---	---	EN	---	USH	---

Laminar Seal Rings Introduction

Laminar Seals

Smalley's laminar seals are flat wire ring sets that, together, form labyrinth seals used to protect an assembly from damaging environments. Their arrangement and orientation is dictated by the application. Standard materials for our laminar seals are carbon and 302 stainless steel, unlike traditional rubber seals. This makes them much more durable in applications that operate at high speeds, at higher temperatures, or in corrosive environments.

Standard Laminar Seal Sets Available:

- Single-Turn, Three Ring Sets
- Single-Turn, Five Ring Sets
- Two-Turn, Two Ring Sets
- Two-Turn, Three Ring Sets

SMALLEY'S LAMINAR SEAL RINGS

Custom Laminar Seals

Smalley Engineers are available to help design custom laminar seals if one of our standard sets do not fit your exact needs. Because all of our products are edgewound (coiled, not stamped), there is no new tooling required for custom configurations. This means that we can produce prototypes quickly and economically for high or low volume orders, and easily make adjustments to designs throughout the No-Tooling- Charge™ production process.

Customizable features include:

- Diameter
- Material
- Tolerance
- Radial walls
- Wire thickness
- Number of turns
- Number of rings in a set

Interchange Listing

Smalley	Fey
QH	AS (FK3)
QHK	ASK (FK3)
QS	IS (FK3)
QSK	ISK (FK3)
QHD	ASD (FK6)
QHKD	ASKD (FK6)
QSD	ISD (FK6)
QSKD	ISKD (FK6)
CONSULT SMALLEY ENGINEERING	FK5

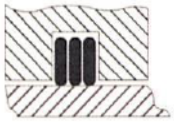
Standard Laminar Ring Sets Available

Laminar Seals Single-Turn Ring Sets

Single-Turn laminar seals consist of three single-turn rings stacked parallel to each other, all clinging to the bore or shaft. This configuration is used to seal applications from light contamination and/or slightly higher temperatures while retaining grease or lubricant. Single-turn, five ring sets will be configured with rings that cling in an alternating pattern to both the bore and shaft. These are used for applications in environments with more contamination and/or high temperatures that would make grease or lubricant less viscous.

YH Series
QH Series
Internal- Light Duty
1 Set= 3 individual rings
(rings rotate with bore only)

YHK Series
QHK Series
Internal- Medium Duty
1 Set= 5 individual rings
(3 rings rotate with bore & 2 rings rotate with shaft)



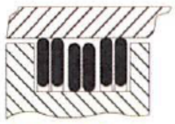
YS Series
QS Series
External- Light Duty
1 Set= 3 individual rings
(rings rotate with shaft only)

YSK Series
QSK Series
External- Medium Duty
1 Set= 5 individual rings
(3 rings rotate with shaft & 2 rings rotate with bore)

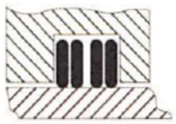
Laminar Seals Two-Turn Ring Sets

Laminar seals are also made in sets of two-turn retaining rings. These seals are ideal for applications set in environments with high contamination risk. Sets of two-turn rings provide the highest level of protection against corrosive contaminants, dirt, extensive water splashing, and high temperatures. Two-turn ring sets with alternate cling provide the most application protection.

YHD Series
QHD Series
Internal- Medium/Heavy Duty
1 Set= 2 individual rings
(rings rotate with bore only)



YHKD Series
QHKD Series
Internal- Heavy Duty
1 Set= 3 individual rings
(2 rings rotate with bore & 1 ring rotates with shaft)



YSD Series
QSD Series
External- Medium/Heavy Duty
1 Set= 2 individual rings
(rings rotate with shaft only)

YSKD Series
QSKD Series
External- Heavy Duty
1 Set= 3 individual rings
(2 rings rotate with shaft & 1 ring rotates with bore)

Laminar Seal Ring Applications

Coupling

The custom seal arrangement was designed for optimum protection against contamination. Gases build up pressure in a center cavity as seals on either side prevent contaminants from entering.

Bearing Protection

A three ring laminar seal set retains grease/lubricant and prevents contaminates such as dirt or water from penetrating into critical assembly components.

Pulley Idler

The custom ring set extends the ball bearing lifespan by limiting contaminants from penetrating precision bearing surfaces. When the shaft rotates, only the groove ring rotates while the housing ring remain stationary.

Laminar Seal Ring
Application Spotlight

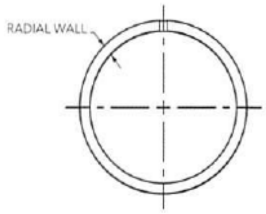
High Speed Spindle

This high-speed spindle consists of two tandem bearings, reducing friction between the moving parts of the assembly which is rotating at high speeds. This particular application is set in a harsh environment exposed to corrosive elements. The ball bearings need to be protected from such elements in order to operate correctly.

A single-turn, three ring seal set was designed into the spindle to protect the bearings from any contaminants. The rings in the set cling to the shaft due to the high rotational speeds of the spindle. The laminar seal is manufactured from steel, making it more durable than a typical rubber seal. While the laminar seal is not the primary seal, it is the final outer seal that protects the bearing.

YH, YHK, YS and YSK Series

Single-Turn Ring Sets

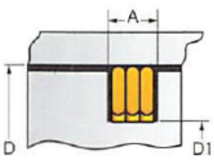


Product Dimensions: All dimensions in inches unless otherwise specified.

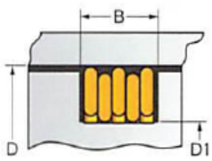
Bore Shaft[1]	Groove[2] Width				Ring Dimensions				Groove Diameter		Groove Diameter	
D	A		B		RW		T		D2		D1	
0.625 - 1.249	0.072	+.004/-.000	0.119	+.004/-.000	0.055	±.004	0.021	±.002	(D) +0.134	+.008/-.000	(D) -0.134	+.000/-.008
1.250 - 1.499	0.072		0.119		0.065		0.021		+0.154		-0.154	
1.500 - 1.749	0.084		0.139		0.078		0.025		+0.180		-0.180	
1.750 - 2.249	0.102		0.170		0.095		0.031		+0.214		-0.214	
2.250 - 2.749	0.102		0.170		0.113		0.031		+0.250		-0.250	
2.750 - 2.999	0.102		0.170		0.123		0.031		+0.270		-0.270	
3.000 - 3.249	0.102		0.170		0.128		0.031		+0.280		-0.280	
3.250 - 3.499	0.102		0.170		0.138		0.031		+0.300		-0.300	
3.500 - 3.999	0.102		0.170		0.158		0.031		+0.340		-0.340	
4.000 - 4.499	0.102		0.170		0.168		0.031		+0.360		-0.360	
4.500 - 4.999	0.131	+.008/-.000	0.215	+.008/-.000	0.188	±.006	0.039	±.003	+0.408	+.012/-.000	-0.408	+.000/-.012
5.000 - 5.499	0.131		0.215		0.200		0.039		+0.432		-0.432	
5.500 - 6.249	0.158		0.254		0.225		0.046		+0.490		-0.490	
6.250 - 7.749	0.187		0.301		0.250		0.055		+0.540		-0.540	
7.750 - 9.999	0.187		0.301		0.312		0.055		+0.702		-0.702	
10.000 - 12.499	0.217	+.010/-.000	0.346	+.010/-.000	0.350	±.007	0.063	±.004	+0.778		-0.778	
12.500 - 14.999	0.217		0.346		0.375		0.063		+0.828		-0.828	
15.000 - 19.999	0.307		0.496		0.437	+.015/-.010	0.093	±.005	+0.952	+.016/-.000	-0.952	+.000/-.016
20.000 - 24.999	0.310		0.504		0.500		0.093		+1.158		-1.158	
25.000 - 29.999	0.310		0.504		0.567		0.093		+1.292		-1.292	
30.000 - 50.000	0.310		0.504		0.750		0.093		+1.658		-1.658	

Contact Smalley Engineering for assistance.

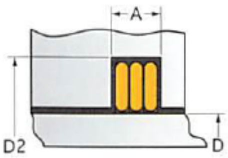
YH



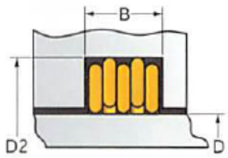
YHK



YS



YSK

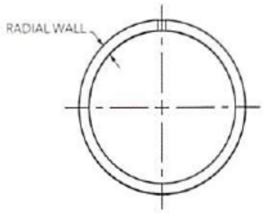


[1] Standard raw materials are carbon steel and 302 stainless steel.

[2] If axial movement occurs during operation, an increase to Groove Width may be necessary to avoid friction between Rings and Groove.

YHD, YHKD, YSD and YSKD Series

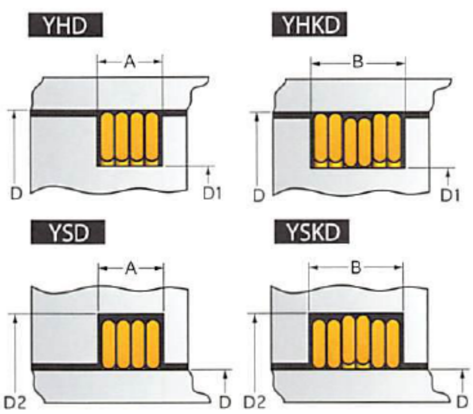
Double-Turn Ring Sets



Product Dimensions: All dimensions in inches unless otherwise specified.

Bore Shaft[1]	Groove[2] Width				Ring Dimensions				Groove Diameter		Groove Diameter	
D	A		B		RW		T		D2		D1	
0.625 - 1.249	0.098	+.004/-.000	0.145	+.004/-.000	0.055	±.004	0.043	±.0025	(D) +0.134	+.008/-.000	(D) -0.134	+.000/-.008
1.250 - 1.499	0.098		0.145		0.065		0.043		+0.154		-0.154	
1.500 - 1.749	0.112		0.166		0.078		0.050		+0.180		-0.180	
1.750 - 2.249	0.136		0.204		0.095		0.062		+0.214		-0.214	
2.250 - 2.749	0.136		0.204		0.113		0.062		+0.250		-0.250	
2.750 - 2.999	0.136		0.204		0.123		0.062		+0.270		-0.270	
3.000 - 3.249	0.136		0.204		0.128		0.062		+0.280		-0.280	
3.250 - 3.499	0.136		0.204		0.138		0.062		+0.300		-0.300	
3.500 - 3.999	0.136		0.204		0.158		0.062		+0.340		-0.340	
4.000 - 4.499	0.136		0.206		0.168		0.062		+0.360		-0.360	
4.500 - 4.999	0.172	+.008/-.000	0.254	+.008/-.000	0.188	±.006	0.078	±.003	+0.408	+.012/-.000	-0.408	+.000/-.012
5.000 - 5.499	0.172		0.254		0.200		0.078		+0.432		-0.432	
5.500 - 6.249	0.202		0.299		0.225		0.093		+0.490		-0.490	
6.250 - 7.749	0.238		0.353		0.250		0.111		+0.540		-0.540	
7.750 - 9.999	0.242		0.357		0.312		0.111		+0.702		-0.702	
10.000 - 12.499	0.274	+.010/-.000	0.405	+.010/-.000	0.350	±.007	0.127	±.004	+0.778		-0.778	
12.500 - 14.999	0.278		0.412		0.375		0.127		+0.828		-0.828	
15.000 - 19.999	0.398		0.592		0.437	+.015/-.010	0.187	±.005	+0.952	+.016/-.000	-0.952	+.000/-.016
20.000 - 24.999	0.398		0.596		0.500		0.187		+1.158		-1.158	
25.000 - 29.999	0.405		0.608		0.567		0.187		+1.292		-1.292	
30.000 - 50.000	0.413		0.620		0.750		0.187		+1.658		-1.658	

Contact Smalley Engineering for assistance.

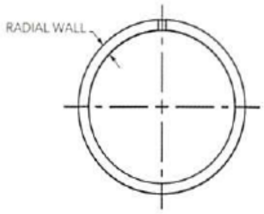


[1] Standard raw materials are carbon steel and 302 stainless steel.

[2] If axial movement occurs during operation, an increase to Groove Width may be necessary to avoid friction between Rings and Groove.

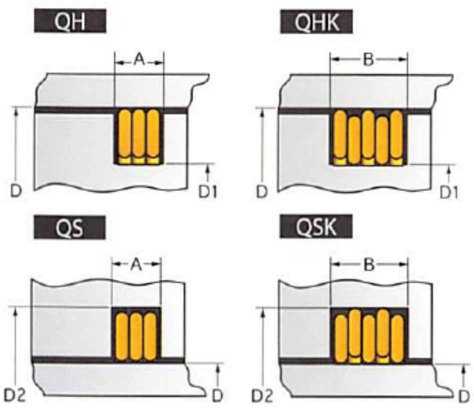
QH, QHK, QS and QSK Series

Metric Single-Turn Ring Sets



Product Dimensions: All dimensions in millimeters unless otherwise specified.

Bore Shaft[1]	Groove[2] Width				Ring Dimensions				Groove Diameter		Groove Diameter	
D	A		B		RW		T		D2		D1	
15 - 24.9	2.2	+.10/-.00	3.6	+.10/-.00	1.0	±.10	0.65	+.04/-.02	(D) + 2.6	+.20/-.00	(D) - 2.6	+.00/-.20
25 - 29.9	2.2		3.6		1.2		0.65		+ 3.0		- 3.0	
30 - 35.9	2.2		3.6		1.5		0.65		+ 3.6		- 3.6	
36 - 42.9	2.2		3.6		1.8		0.65		+ 4.2		- 4.2	
43 - 48.9	2.4		4.0		2.2		0.72		+ 5.0		- 5.0	
49 - 51.9	2.4		4.0		2.4		0.72		+ 5.4		- 5.4	
52 - 59.9	2.4		4.0		2.6		0.72		+ 5.8		- 5.8	
60 - 69.9	2.7		4.5		2.8		0.82		+ 6.2		- 6.2	
70 - 74.9	2.7		4.5		3.1		0.82		+ 6.8		- 6.8	
75 - 79.9	2.7		4.5		3.3		0.82		+ 7.2		- 7.2	
80 - 89.9	2.7		4.5		3.5		0.82		+ 7.6		- 7.6	
90 - 99.9	2.7		4.5		3.8		0.82		+ 8.2		- 8.2	
100 - 104.9	2.7		4.5		4.1		0.82		+ 8.8		- 8.8	
105 - 109.9	3.3	+.15/-.00	5.5	+.15/-.00	4.3	+.10/-.20	0.98	+.05/-.03	+ 9.2	+.25/-.00	- 9.2	+.00/-.25
110 - 119.9	3.3		5.5		4.6		0.98		+ 9.8		- 9.8	
120 - 129.9	3.3		5.5		5.0		0.98		+10.8		-10.8	
130 - 149.9	3.3		5.5		5.5		0.98		+11.8		-11.8	
150 - 170.9	3.4	+.20/-.00	5.6	+.20/-.00	6.0	+.15/-.30	1.00	+.06/-.04	+13.0	+.30/-.00	-13.0	+.00/-.30
150[3] - 170.9	5.1		8.2		6.0		1.50		+13.0		-13.0	
171 - 199.9	3.4		5.6		7.0		1.00		+15.0		-15.0	
171[3] - 199.9	5.1		8.2		7.0		1.50		+15.0		-15.0	
200 - 259.9	4.1		6.6		8.0		1.20		+18.0		-18.0	
200[3] - 259.9	5.1		8.2		8.0		1.50		+18.0		-18.0	
260 - 319.9	5.1		8.2		9.0		1.50		+20.0		-20.0	
320 - 399.9	5.2		8.3		10.0		1.50		+22.0		-22.0	
400 - 439.9	5.2		8.3		11.0		1.50		+24.0		-24.0	
440 - 600.9	5.2	+.25/-.00	8.3	+.25/-.00	12.0	+.20/-.40	1.50	+.07/-.05	+26.0	+.40/-.00	-26.0	+.00/-.40
440[3] - 600.0	8.3		13.5		12.0		2.50		+26.0		-26.0	
601 - 699.9	8.3		13.5		14.0		2.50		+32.0		-32.0	
700 - 799.9	8.3		13.5		16.0		2.50		+36.0		-36.0	
800 - 899.9	8.3		13.5		18.0		2.50		+40.0		-40.0	
900 - 999.9	8.3		13.5		20.0		2.50		+44.0		-44.0	
1000 - 1300.0	8.4		13.6		22.0		2.50		+48.0		-48.0	



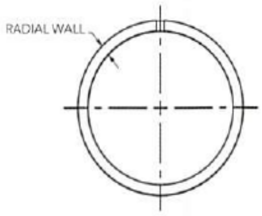
Contact Smalley Engineering for assistance.

[1] Standard raw materials are carbon steel and 302 stainless steel.
[2] If axial movement occurs during operation, an increase to Groove Width may be necessary to avoid friction between Rings and Groove.

[3] Increased cross-section

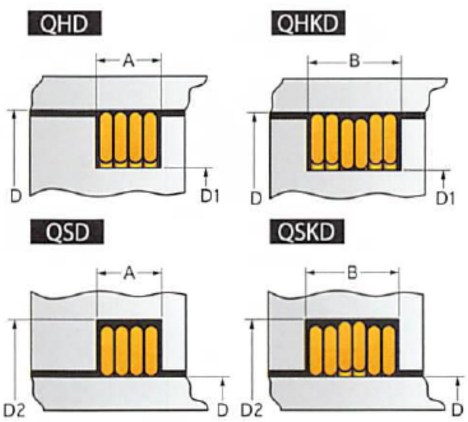
QHD, QHKD, QSD and QSKD Series

Metric Double-Turn Ring Sets



Product Dimensions: All dimensions in millimeters unless otherwise specified.

Bore Shaft[1]	Groove[2] Width				Ring Dimensions				Groove Diameter		Groove Diameter	
D	A		B		RW		T		D2		D1	
15 - 24.9	2.9	+.10/-.00	4.3	+.10/-.00	1.0	±.10	1.30	+.08/-.04	(D) + 2.6	+.20/-.00	(D) - 2.6	+.00/-.20
25 - 29.9	2.9		4.3		1.2		1.30		+ 3.0		- 3.0	
30 - 35.9	2.9		4.3		1.5		1.30		+ 3.6		- 3.6	
36 - 42.9	2.9		4.3		1.8		1.30		+ 4.2		- 4.2	
43 - 48.9	3.2		4.8		2.2		1.45		+ 5.0		- 5.0	
49 - 51.9	3.2		4.8		2.4		1.45		+ 5.4		- 5.4	
52 - 59.9	3.2		4.8		2.6		1.45		+ 5.8		- 5.8	
60 - 69.9	3.6		5.4		2.8		1.65		+ 6.2		- 6.2	
70 - 74.9	3.6		5.4		3.1		1.65		+ 6.8		- 6.8	
75 - 79.9	3.6		5.4		3.3		1.65		+ 7.2		- 7.2	
80 - 89.9	3.6		5.4		3.5		1.65		+ 7.6		- 7.6	
90 - 99.9	3.6		5.4		3.8		1.65		+ 8.2		- 8.2	
100 - 104.9	3.6		5.4		4.1		1.65		+ 8.8		- 8.8	
105 - 109.9	4.3	+.15/-.00	6.4	+.15/-.00	4.3	+.10/-.20	1.96	+.10/-.06	+ 9.2	+.25/-.00	- 9.2	+.00/-.25
110 - 119.9	4.3		6.4		4.6		1.96		+ 9.8		- 9.8	
120 - 129.9	4.3		6.4		5.0		1.96		+10.8		-10.8	
130 - 149.9	4.3		6.4		5.5		1.96		+11.8		-11.8	
150 - 170.9	4.4	+.20/-.00	6.5	+.20/-.00	6.0	+.15/-.30	2.00	+.12/-.08	+13.0	+.30/-.00	-13.0	+.00/-.30
150[3] - 170.9	6.5		9.6		6.0		3.00		+13.0		-13.0	
171 - 199.9	4.4		6.5		7.0		2.00		+15.0		-15.0	
171[3] - 199.9	6.5		9.6		7.0		3.00		+15.0		-15.0	
200 - 259.9	5.3		7.8		8.0		2.40		+18.0		-18.0	
200[3] - 259.9	6.5		9.6		8.0		3.00		+18.0		-18.0	
260 - 319.9	6.5		9.6		9.0		3.00		+20.0		-20.0	
320 - 399.9	6.6		9.8		10.0		3.00		+22.0		-22.0	
400 - 439.9	6.6		9.8		11.0		3.00		+24.0		-24.0	
440 - 600.9	6.6	+.25/-.00	9.8	+.25/-.00	12.0	+.20/-.40	3.00	+.14/-.10	+26.0	+.40/-.00	-26.0	+.00/-.40
440[3] - 600.9	10.6		15.9		12.0		5.00		+26.0		-26.0	
601 - 699.9	10.8		16.2		14.0		5.00		+32.0		-32.0	
700 - 799.9	10.8		16.2		16.0		5.00		+36.0		-36.0	
800 - 899.9	11.0		16.5		18.0		5.00		+40.0		-40.0	
900 - 999.9	11.0		16.5		20.0		5.00		+44.0		-44.0	
1000 - 1300.0	11.0		16.5		22.0		5.00		+48.0		-48.0	



Contact Smalley Engineering for assistance.

[1] Standard raw materials are carbon steel and 302 stainless steel.
[2] If axial movement occurs during operation, an increase to Groove Width may be necessary to avoid friction between Rings and Groove.
[3] Increased cross-section

Spring and Cycle Testers

Spring Tester

A compression spring tester is used to inspect load(s) at work height(s).

Smalley designs and builds its own spring testers.

The accuracy of the spring tester relies on:

1. Parallel Plates and Spring Positioning:
   Upper and lower plates must be parallel and spring must be centered.
2. Surface Cleanliness:
   Plates must be free of cracks, scratches, or other physical imperfections. Our surfaces are polished for a smooth, mirror-like finish.
3. Precision Linear Gauges and Load Cells:
   Linear gauges are used to measure the height of the spring while calibrated load cells precisely output the load at a given spring height.

Spring Tester

Cycle Tester

Cycle testing provides a more accurate prediction of cycle life in comparison to our theoretical cycle life equations.

We recommend cycle testing if cycle life is critical in your application, or when calculations show little margin over the cycle requirement.

Ideally, springs should be cycle tested in the actual assembly. When this is not feasible, Smalley offers testing on high-speed cycle testing machinery. The cycle tester can be adjusted to various work heights and stroke lengths to simulate the application.

Cycle Tester

Materials Table

Material	Material Thickness (in)	Minimum Tensile Strength (psi)	Shear Strength (psi)	Maximum Recommended Operating Temp. (°F)	Modulus of Elasticity (psi)
Carbon Steel					
Oil Tempered SAE 1070 - 1090	.006 - .014	269,000	153,000	250	30×10^6
	.0141 - .021	255,000	145,000		
	.0211 - .043	221,000	126,000		
	.0431 & larger	211,000	120,000		
Hard Drawn SAE 1060 - 1075	.0201 - .030	230,000	130,000		
	.0901 - .110	181,000	103,000		
Stainless Steel					
AISI 302 AMS-5866	.005 - .022	210,000	119,000	400	28×10^6
	.0221 - .047	200,000	114,000		
	.0471 - .062	185,000	105,000		
	.0621 - .074	175,000	100,000		
	.0741 - .089	165,000	94,000		
	.0891 - .095	155,000	88,000		
AISI 316 ASTM A313[1]	.002 - .023	195,000	111,000		
	.0231 - .048	190,000	108,000		
	.0481 - .061	175,000	99,000		
	.0611 & larger	170,000	97,000		
17-7 PH/CH900 Condition CH900 AMS-5529		240,000[2]	137,000[2]	650	29.5×10^6
Exotic Alloys					
A-286 AMS-5810		185,000[2]	105,000[2]	1000	31×10^6
INCONEL® Alloy X-750 Spring Temper AMS-5699[3]		220,000[2]	125,000[2]	700	
INCONEL® Alloy X-750 No. 1 TEMPER "Rc 35 Maximum" AMS-5699[1,3]		136,000 REF	77,000		
INCONEL® Alloy X-750 No. 1 TEMPER AMS-5698		155,000[2]	88,000[2]	1000	
INCONEL® Alloy 718 AMS-5596[1]		180,000[2]	102,000[2]	1300	29.6×10^6
ELGILOY® AMS-5876[1,3]	≤ .004	300,000[2]	171,000[2]	800	30×10^6
	.0041-.019	290,000[2]	165,000[2]		
	.0191-.025	280,000[2]	159,000[2]		
	.0251-.100	270,000[2]	154,000[2]		
BERYLLIUM COPPER TEMPER TH02 ASTM B197[1]		185,000[2]	128,000[2]	400	18.5×10^6
MP35N® AMS 5758[1]		240,000	150,000	600	34.1×10^6
Hastelloy® C-276 ASTM B 74[1]	< .016	230,000	131,000	750	29.8×10^6
	.0161 - .032	210,000	119,000		
	.0321 - .054	200,000	114,000		
	.0541 & Larger	190,000	108,000		
Monel® K-500 QQ-N-2861		170,000	97,000	550	26×10^6

Note: Additional materials available include Phosphor Bronze, 410 Stainless Steel, MONEL® 400, Waspaloy®, Duplex Stainless and others. Please consult Smalley Engineering for further details.

[1] Referenced for chemical composition only.
[2] Values obtained after precipitation hardening.
[3] Conforms to NACE Standard MR0175.
[4] Exceeding these temperatures will cause relaxation. Consult Smalley Engineering for High Temperature Applications.

ELGILOY is a registered trademark of Combined Metals of Chicago. INCONEL and MONEL are registered trademarks of Special Metals Corporation. HASTELLOY is a registered trademark of Haynes International. WASPALOY is a registered trademark of United Technologies Corp. MP35N is a registered trademark of SPS Technologies Inc.

Material Types

Selecting Material Types

Selecting the appropriate material for your ring or spring is essential for avoiding additional cost and failure in operation. Smalley stocks many raw materials for various operating conditions including extreme temperatures and corrosive environments.

Carbon Steel

Smalley offers two standard carbon steel materials for retaining rings and wave springs. Carbon steel is cost effective and durable, but has low corrosion resistance. It is highly magnetic and can be a variety of colors such as blue, gray, or black. Smalley's carbon steel products are oil-dipped for protection during shipment and shelf storage.

SAE 1070-1090

SAE 1070-1090 high carbon spring steels are oil tempered and are Smalley's most commonly used carbon steels. Tensile and yield strength are maximized because of the oil tempered martensitic structure.

SAE 1060-1075

SAE 1060-1075 high carbon cold drawn spring steels receive their strength from cold rolling.

In either temper, carbon steel is suited for use in a protected environment, as it corrodes if not oiled and sealed from the elements. Additional corrosion protection can be achieved with special finishes.

Stainless Steel

Smalley offers three stainless steel materials for retaining rings and wave springs. 302 and 316 are standard materials for retaining rings and 17-7 PH is the standard material for wave springs. Stainless steel, although more costly than carbon steel, is more corrosion resistant and able to withstand higher temperature limits. It is slightly magnetic and can be a variety of colors such as blue, brown, and silver. Smalley's stainless steel products usually undergo ultrasonic cleaning and vapor degrease finishing processes.

302

302 is specified because of its combination of corrosion resistance and physical properties. 302 stainless steel gains spring temper condition by cold working. Although it is categorized as a nonmagnetic stainless, 302 becomes slightly magnetic because of the cold working. It cannot be hardened by heat treatment.

316

316 is nearly identical in physical properties and heat resistance to 302. It provides more corrosion resistance because of the addition of molybdenum, particularly against pitting. As with 302, the magnetism of 316 increases as the wire is cold reduced. It cannot be hardened by heat treatment.

17-7 PH Condition CH900

17-7 PH Condition CH900 is similar in corrosion resistance to 302 and offers both high tensile and yield strength. In fatigue and high stress applications, 17-7 outperforms even the finest grade of carbon steel. Spring properties are achieved by precipitation hardening Condition C to Condition CH900. As a result, the material may be subjected to a temperature of 650° F without a loss of spring properties. Its magnetism is similar to carbon steel. After precipitation hardening, 17-7 has a blue, brown, or silver color; atmosphere-controlled heat treatment provides a brighter color.

Super Alloy

Smalley offers super alloys when carbon and stainless steels do not meet an application's unique requirements. Super alloys maintain material properties in extreme operating conditions. These materials exhibit no magnetism and can be blue, brown, or silver in color.

Materials may be heat treated in open-air or in an atmosphere-controlled furnace. Open-air heat treatment may produce scale, which often results in a dark residue. An atmosphere-controlled environment eliminates scale and produces a part with a brighter finish.

Inconel®[1] X-750

Inconel X-750 is a nickel-chromium alloy and precipitation heat treated to a spring temper condition. In this state, it has temperature resistance up to 700° F. Additional temper methods are available to achieve slightly different physical properties. Smalley also offers NACE (The National Association of Corrosion Engineers) approved materials to meet your requirements.

A286 Alloy

A286 is a nickel-iron-based alloy that exhibits similar properties to Inconel X-750, but with additional heat resistance of up to 1000° F. Its spring temper condition is obtained by precipitation hardening.

Elgiloy®[2]

Elgiloy is a cobalt-based alloy known for its high strength and excellent corrosion resistance. It can be used in environments up to 800° F. Elgiloy shows improved resistance to sulfide stress cracking over other NACE approved materials.

MP35N®[3]

MP35N is a nickel-cobalt-based alloy known for its high strength and corrosion resistance. It can be used in environments up to 600° F. It is often specified for oil and gas applications.

Hastelloy®[4] C-276

Commonly used in chemical processing industries, Hastelloy C-276 is a nickel-based alloy with a proven performance in corrosive applications. Similar to other nickel-based alloys, it is ductile, easy to form, and has excellent resistance to stress corrosion cracking in chloride solutions. It can be used in environments up to 750° F.

Monel®[1] K-500

Monel K-500 is a nickel-copper-based alloy known for its excellent corrosion resistance, strength, and hardness properties. It can be used in environments up to 550° F.

[1]INCONEL X-750 and MONEL are registered trademarks of Special Metals Corporation.
[2]ELGILOY is a registered trademark of Combined Metals of Chicago.
[3]MP35N is a registered trademark of SPS Technologies Inc.
[4]HASTELLOY is a registered trademark of Haynes International.

Material Types

Copper

When magnetism or conductivity are important to your application, Smalley offers a range of copper materials. Smalley offers two major types of copper alloys as custom materials.

Beryllium Copper Alloy #25

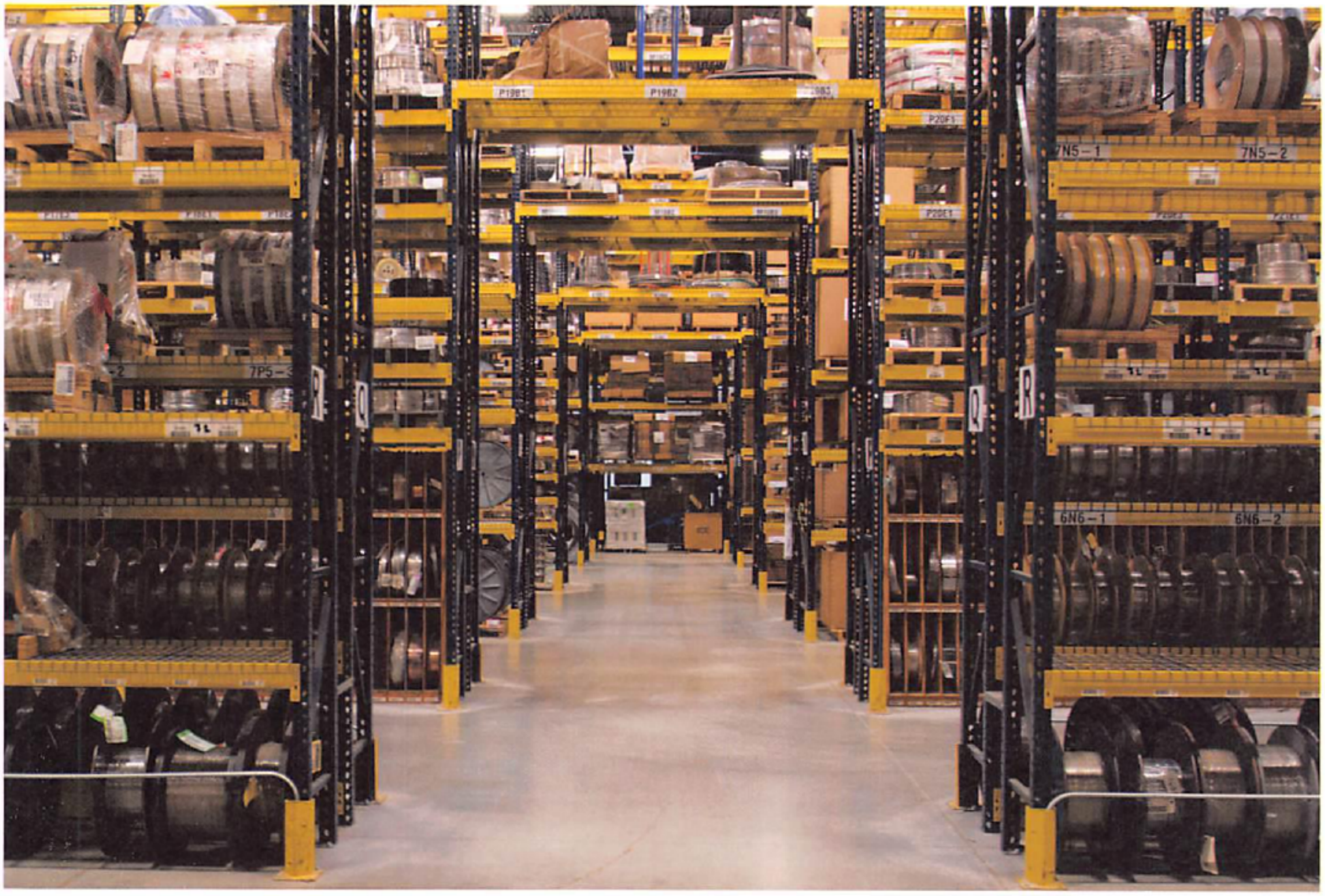
Beryllium copper is nonmagnetic and one of the most electrically conductive materials offered by Smalley. Normally specified in a hard temper, it has a combination of low modulus of elasticity and high ultimate tensile strength. The alloy gains its physical properties by precipitation hardening. In contrast to other copper alloys, beryllium copper has the highest strength and is suitable to use at temperatures up to 400° F.

Phosphor Bronze, Grade A

Phosphor bronze is a nonmagnetic alloy with fair electrical conductivity. It is purchased in a spring temper condition to maximize spring characteristics and can be hardened only by cold working. Phosphor bronze exhibits fair spring properties and is rated a step below beryllium copper in performance.

Additional Materials

In addition to the materials listed above, Smalley offers Hastelloy C-276, 410 Stainless Steel, Waspaloy and others. If you have questions on these materials or do not see your desired material listed, please contact Smalley Engineering for further details.



Finishes, Plating & Coating

After selecting the appropriate material for your application, adding a finish, plating or coating may be necessary to meet your application requirements. These additional processes can improve the function, look, and performance of the part.

Black Oxide

MIL-DTL-13924, Class 1

This finish provides a flat black appearance that is generally used to alter cosmetic appearance instead of an improvement in corrosion resistance.

Oil Dip

This is the standard finish for all Smalley products produced from carbon steel. The oil provides resistance to corrosion in transport and normal storage. The oil dip finish should not be considered a permanent finish.

Passivation

AMS 2700, Method 1, Type 2, Class 3

Passivation is an optional cleaning operation for stainless steel. It provides a bright finish and increased corrosion resistance. Passivation dissolves iron particles and other substances that have become embedded in the surface of the stainless steel during production. If not dissolved, these foreign particles could promote corrosion, discoloration, or pitting.

Vapor Degrease/Ultrasonic Clean

This is the standard cleaning and finish for all products manufactured in stainless steel. The process removes oil and other organic compounds from the material surface by use of a degreasing solvent, which is forced between the turns of the part with ultrasonic waves.

Vibratory Deburr/Hand Deburr

Although all circumferential surfaces and edges of Smalley products are smooth, sharp corners can be present on the gap ends due to the cut-off operation. To break the sharp corners and achieve a smooth surface finish, parts may be either vibratory or hand deburred to meet your specifications.

Zinc Phosphate

MIL-DTL-16232, Type Z, Class 2

Sometimes referred to as "Parkerizing", zinc phosphate appears gray-black in color. The corrosion resistance of phosphate is superior to black oxide but inferior to stainless steel. Zinc phosphate cannot be applied to stainless steel.

Zinc Plating

Zinc Plate, ASTM B633, Type V, Fe/Zn 5, SC1 (Colorless)

Zinc Plate, ASTM B633, Type VI, Fe/Zn 5, SC1 (Colored Chromate)

Zinc plating is used on carbon steel to increase the corrosion resistance of the product. It is sometimes used as a more cost effective alternative to other plating options or stainless steel. Smalley's standard zinc platings, Type V and Type VI, are RoHS compliant. The thickness level of the plating is controlled by the service condition number (SC Number), which should be designated by the customer. Zinc plating does not guarantee coverage between the turns of multiple turn rings and springs. (The process does subject the part to the possibility of hydrogen embrittlement. We offer stainless steel as a preferable alternative.)

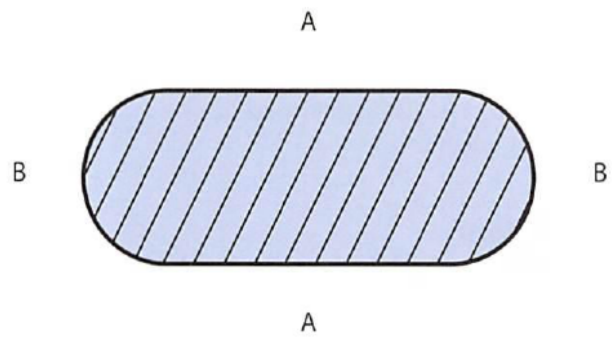
Technical Requirements

Specifications

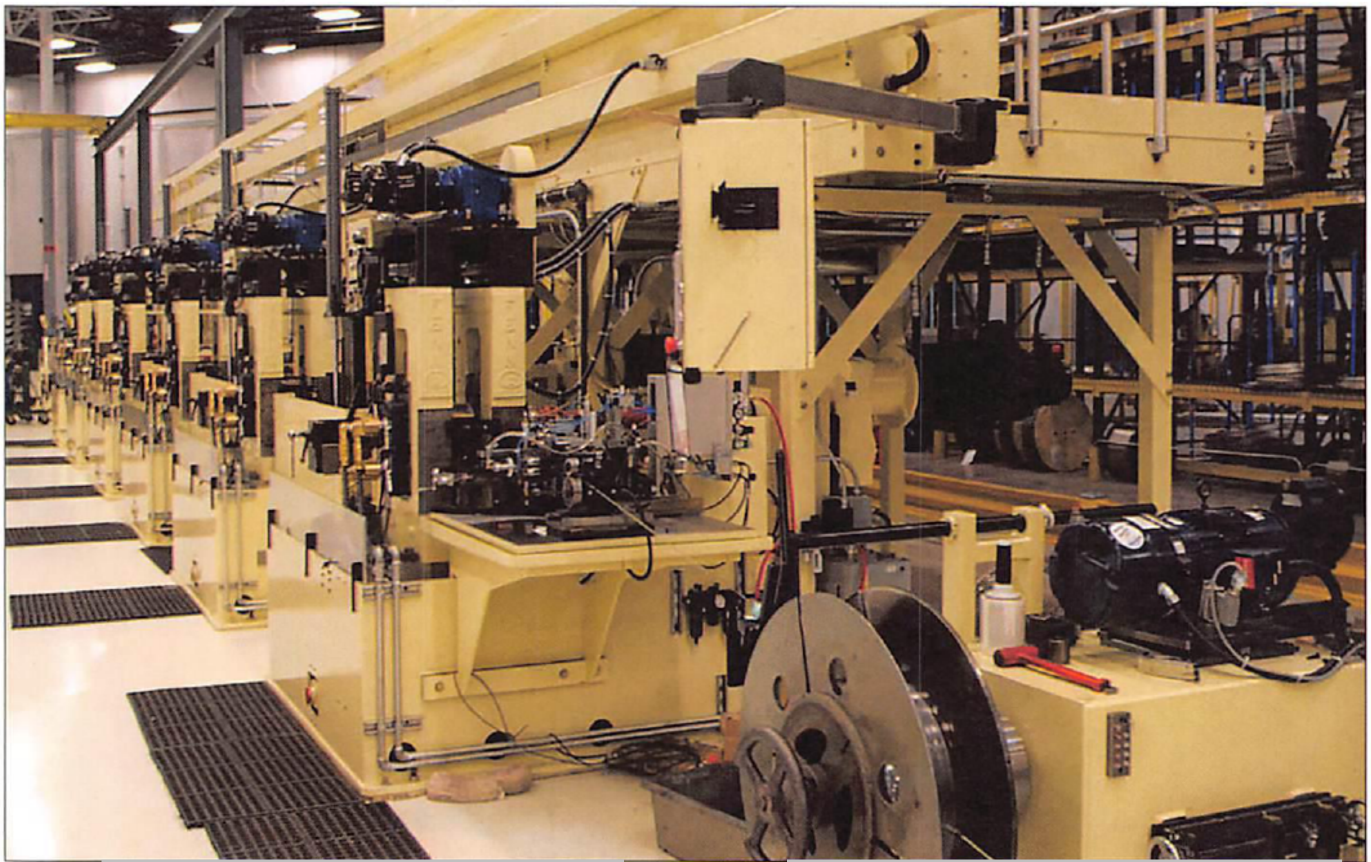
Although there are industry and government specifications that specify properties for flat wire, there are not many. In many cases, Smalley procures and/or rolls its material to internal specifications that are appropriate for the products they are used for. In addition to controlling tensile strength, thickness, and width, strict inspection procedures have been established to check for details such as edge contour, camber, coil set, and other physical imperfections.

Ultimate Tensile Strength

Tensile strength, rather than hardness, is used to measure the strength of our wire. This test method is preferred over hardness testing because flat wire may have different hardness values at various test points. As a result of cold rolling, the top and bottom surfaces ("A") become harder as they are cold worked over multiple passes. The round edge areas ("B") are not compressed in the same manner, resulting in a different hardness. Tensile tests are more consistent as they evaluate the entire cross-section, not just a single point as in a hardness test.



The below photo shows one of Smalley's rolling mills.
For more information on Edgewinding and our manufacturing process, please visit page VI.



Spring Design Considerations

Defining the Spring Requirements

Although wave spring applications are extremely diverse, there is a basic set of rules for defining spring requirements. These guidelines will help determine if a standard spring or a custom design is needed for your application.

Working Cavity

The working cavity usually consists of a bore that a spring operates in and/or a shaft the spring clears. The spring stays positioned by piloting the bore or the shaft. The distance between the loading surfaces defines the axial working cavity or work height of the spring.

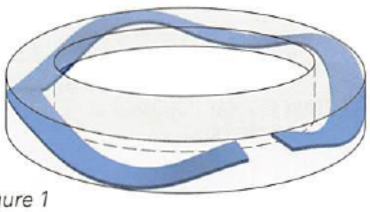


Figure 1

Diameter and Expansion

When wave springs are compressed, the waveform flattens out and the diameter expands. This must be considered in the wave spring design to ensure it performs accurately in the application. The spring diameter is developed to provide proper operation between the bore and the shaft. Two methods of specifying diameters are Bore Pilot and Shaft Pilot.

Bore Pilot

For springs piloting the bore as shown in Figure 2a below, the bore and shaft diameters should be included in the spring specifications. Commonly used requirements would read:

"Spring must pilot and operate in a (minimum bore) bore diameter."

"Spring must clear a (maximum shaft) shaft diameter."

The actual spring diameter is then developed at time of manufacture to provide the best fit and prevent binding due to expansion.

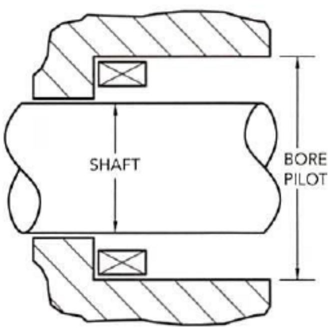


Figure 2a

Shaft Pilot

For springs piloting a shaft as shown in Figure 2b below, the inside diameter can be toleranced to provide a minimum clearance from the shaft. Since wave springs expand during compression, interference with the shaft is generally not a concern.

To ensure proper operation, include shaft and bore diameters in the spring specifications. Commonly used requirements would read:

"Spring pilots over and clears a (maximum shaft) shaft diameter."

"Spring operates in a (minimum bore) bore diameter."

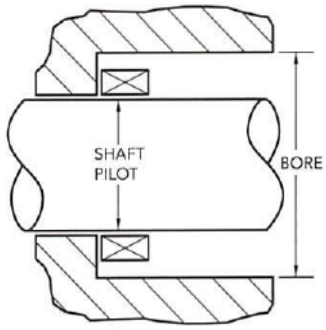


Figure 2b

Material Cross-Section

The material cross-section for flat wire is defined as the thickness by the width. The material cross-section of the spring is an important consideration in preventing misalignment between adjacent layers for multiple turn Crest-to-Crest Wave Springs and Nested Wave Springs. For springs with narrow radial walls, radial misalignment can occur during handling or operation if the spring is not contained or closely piloted.

As a basic guideline, use our standard 'SSR' Wave Spring series for cross-section and diameter relationships. Lighter material cross-sections are usually acceptable, while heavier cross-sections for a given diameter may be incorporated using the following information:

Special wave spring design criteria for selecting material cross-sections:
Maximum material thickness = standard ('SSR-') thickness * 2
Maximum radial wall = material thickness (any value) * 10
Minimum radial wall = material thickness (any value) * 3

Table 1

Spring Design Considerations

Spring Rate

Spring rate is the proportion of how much force it takes to compress a spring a certain distance. It is measured in lb/in or N/mm and can be calculated by manipulating the deflection equations. See formulas in the Spring Calculations section on page 137.

Free Height

Free height is the natural height of the spring with no load applied, denoted as H in Figure 3 below.

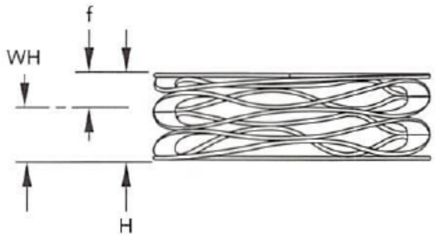


Figure 3

Work Height

Work height is the height that a spring is compressed to in order to achieve a specified load, denoted as WH in Figure 3 above. Compressing a wave spring below the design work height may overstress it.

Deflection

Deflection, also known as travel, is the difference between a spring's free height and its work height. It is denoted as f in Figure 3 above. See formula in the Spring Calculations section on page 137.

Load Requirement

The load requirement is defined as the amount of axial force the spring must output at work height, depicted in Figure 4 below.

Some applications require multiple working heights, where loads at two or more operating heights are critical and must be considered in the design. Often in these applications, minimum and/or maximum loads are satisfactory solutions, particularly where tolerance stack-ups are a concern.

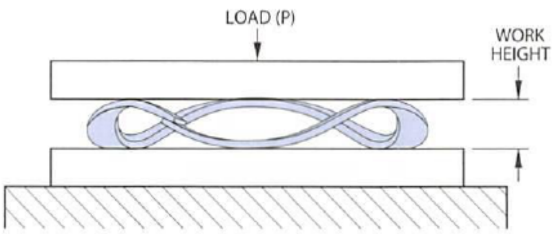


Figure 4

Load/Deflection

A comparison of the actual spring rate to the theoretical (calculated) spring rate provides practical limits for the working range of the spring. Spring rate is defined as the load generated over a distance of deflection. See formulas in the Spring Calculations section on page 137.

Figure 5 below shows a graph of theoretical versus tested spring rate. As a general rule, spring rate is linear through the first 80% of available deflection and for work heights down to two times the solid height. Although the spring can operate beyond this "linear" range, measured loads will be much higher than calculated.

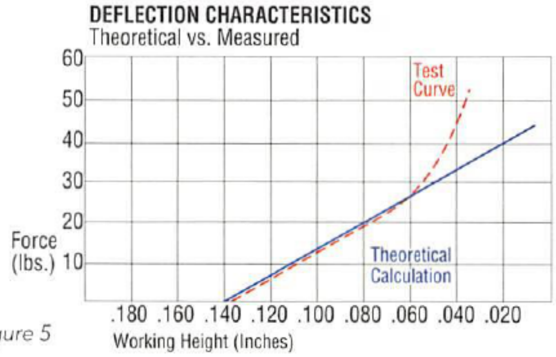


Figure 5

Hysteresis

Wave springs exert a greater force upon loading and a lower force unloading. This effect is known as hysteresis. In Figure 6, the curves show the down-going and upcoming loads. The shaded area represents the difference or the amount of hysteresis.

This difference between the down-going and upcoming loads is a result of friction caused by the circumferential and radial movement of the turns of the spring when it is compressed. Lubricating the wave spring will help to reduce the amount of hysteresis, but the amount of hysteresis will also depend on the type of wave spring, turns, waves, thickness and radial wall.

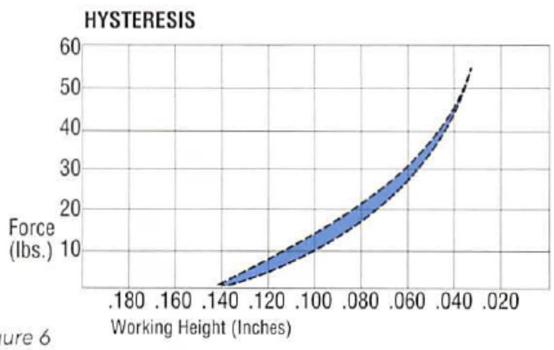


Figure 6

Spring Design Considerations

Operating Environment

There are a several key factors to consider when it comes to choosing the right material for your application. One of the factors is defining the operating environment. Extreme temperatures, corrosive substances, dynamic loading (fatigue), stress, and other operating conditions must be considered for optimal spring performance.

Stress

Operating Stress

Compressing a wave spring creates bending stresses similar to a simple beam in bending. These compressive and tensile stresses limit the amount a spring can be compressed before it yields or "takes a set". Although spring set is sometimes not acceptable, load and deflection requirements will often drive the design to accept some set or "relaxation" over time.

Maximum Design Stress

Smalley utilizes the minimum tensile strength value (found in our Materials Table on page 128) to approximate yield strength due to minimal elongation of hardened flat wire used.

Static Operating Stress

In static applications, the calculated operating stress should be no greater than 100% of minimum tensile strength. This can vary based on the acceptability of permanent set, relaxation, loss of load, and/or loss of free height.

Dynamic Operating Stress

In dynamic applications, the calculated operating stress should not exceed 80% of minimum tensile strength. Refer to the "Cycle Life and Fatigue" section to the right and Table 2 for further fatigue guidelines.

Residual Stress/Pre-Setting

Increasing the load capacity and/or fatigue life can be achieved by compressing a spring beyond its yield point, known as "presetting". Preset springs are manufactured to a higher than needed free height and load, and then compressed beyond the stress limit of the material. Both the free height and load are reduced, and the material surfaces now exhibit residual stresses, which enhances spring performance.

Cycle Life and Fatigue

Cycle life or fatigue cycling is the number of strokes a spring can withstand before permanent deformation or breakage. Fatigue cycling is an important consideration in wave spring design. An analysis should include whether the spring deflects full stroke each cycle, only some fraction of a full stroke, or possibly a combination of both due to part wear and or/temperature changes, for example.

The fatigue guidelines in Table 2 provide a conservative approach to calculate cycle life between two work heights. Although these methods of fatigue analysis have proven to be a good approximation, testing in the application is recommended whenever cycle life is critical.

Formula:

$$\text{Fatigue Stress Ratio} = X = \frac{(\sigma - S_1)}{(\sigma - S_2)}$$

Where: σ = Material tensile strength

S_1 = Calculated operating stress at lower work height (must be less than σ)

S_2 = Calculated operating stress at upper work height

Fatigue Guidelines	
X	Estimated Cycle Life
< .40	Under 30,000
.40 - .49	30,000 - 50,000
.50 - .55	50,000 - 75,000
.56 - .60	75,000 - 100,000
.61 - .67	100,000 - 200,000
.68 - .70	200,000 - 1,000,000
> .70	Over 1,000,000

Table 2

Spring Design Considerations

Nomenclature

b	Radial width of material (in) = (OD - ID) / 2
D_m	Mean diameter (in) = (OD + ID) / 2
E	Modulus of elasticity (psi)
f	Deflection (in)
H	Free height (in) = WH + f
ID	Inside diameter (in)
K	Multiple wave factor, see Table 1
L	Length, overall linear (in)
N	Number of waves (per turn)
OD	Outside diameter (in)
P	Load (lb)
S	Operating stress (psi)
S_1	Operating stress at lower WH (Must be less than σ)
S_2	Operating stress at upper WH
t	Thickness of material (in)
WH	Work Height (in) = H - f
Z	Number of turns
σ	Material tensile strength

Multiple Wave Factor (K)				
N	2.0-4.0	4.5-6.5	7.0-9.5	10.0 & Over
K	3.88	2.90	2.30	2.13

Table 1

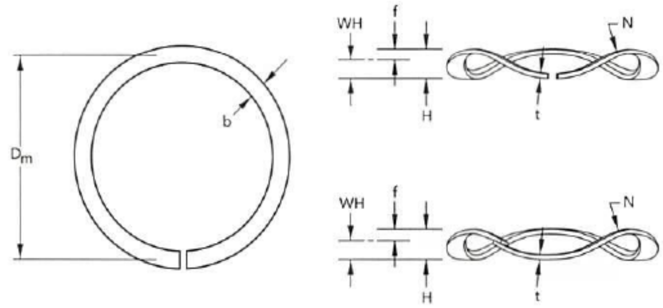
Single-Turn Gap-Type or Overlap-Type

N must be a whole number

Formulas:

$$\text{Deflection} = f = \frac{PKD_m^3}{Ebt^3N^4} * \frac{ID}{OD}$$

$$\text{Operating Stress} = S = \frac{3\pi PD_m}{4bt^2N^2}$$



Example: Smalley Part Number SSR-0200

Calculate free height and operating stress for Smalley part number SSR-0200 (Gap-Type, Single-Turn, Carbon Spring Temper Steel).

Where:

- P = 34 lb
- t = .024 in
- b = .150 in
- OD = 1.985 in
- ID = 1.685 in
- D_m = 1.835 in
- N = 4
- E = 30×10^6 psi
- K = 3.88
- WH = .093 in

$$\text{Deflection} = f = \frac{(34)(3.88)(1.835)^3}{(30\times10^6)(.150)(.024)^3(4)^4} * \frac{1.685}{1.985} = .043 \text{ in}$$

* Free Height = H = (WH + f) = .093 + .043 = .136 in

$$\text{Operating Stress} = S = \frac{(3)(\pi)(34)(1.835)}{(4)(.150)(.024)^2(4)^2} = 106{,}339 \text{ psi}$$

*Calculated free height may vary from manufactured spring height due to variations in raw material and manufacturing process.

Spring Design Considerations

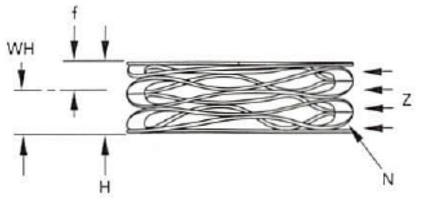
Crest-to-Crest

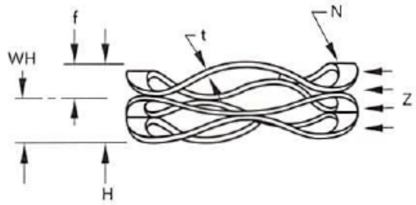
N must be 1/2 wave increments
Z=number of active turns

Formulas:

$$\text{Deflection}= f = \frac{PKD_m^3 Z}{Ebt^3N^4} * \frac{ID}{OD}$$

$$\text{Operating Stress}= S = \frac{3\pi PD_m}{4bt^2N^2}$$





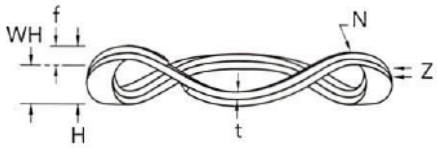
Nested Spirawave

N must be a whole number
Z=number of active turns

Formulas:

$$\text{Deflection}= f = \frac{PKD_m^3}{Ebt^3N^4Z} * \frac{ID}{OD}$$

$$\text{Operating Stress}= S = \frac{3\pi PD_m}{4bt^2N^2Z}$$



Linear

N must be a whole number

Formula 1:
Single wave linear spring where N=1

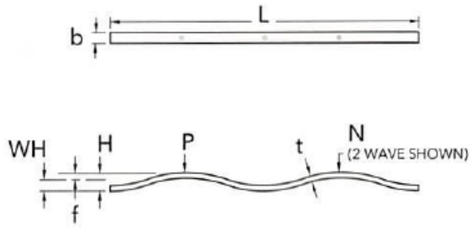
$$\text{Deflection}= f = \frac{PL^3}{4Ebt^3}$$

$$\text{Operating Stress}= S = \frac{3PL}{2bt^2}$$

Formula 2:
2 or more wave linear springs where N>1

$$\text{Deflection}= f = \frac{PL^3}{16Ebt^3N^4}$$

$$\text{Operating Stress}= S = \frac{3PL}{4bt^2N^2}$$

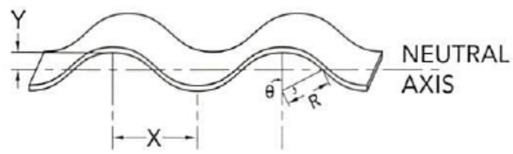


Diameter Expansion

Formula:
Maximum outside diameter at 100% deflection (solid height) = (.02222 * R * N * ϴ) + b

Where:

R	= Wave radius	= $(4Y^2+X^2)/(8Y)$
ϴ	= Angle, degrees	= ArcSin(X / (2R))
X	= 1/2 Wave frequency	= $\pi Dm/(2N)$
Y	= 1/2 Mean free height	= $H_{PT}/2$-t
H_{PT}	= Per-turn free height	= H / Z
N	= Number of Waves	
b	= Radial Wall	



Engineering Design

Retaining Rings

Spirolox® Retaining Ring and Constant Section Ring applications, although diverse, can be analyzed with a straight-forward set of design calculations. There are four main areas that should be considered in most applications.

1. Material Selection
2. Load Capacity
3. Rotational Capacity
4. Installation Stress

Smalley Engineers are available to provide technical and application assistance.

The following pages of Ring Design Considerations for Spirolox and Constant Section Rings have been developed from over 50 years of extensive testing and research into the various applications of retaining rings. The formulas are provided for the preliminary analysis of a ring application and the design of a Spirolox Retaining Ring.

Design engineers commonly associate the word "retaining ring" to a basic style or type of retaining device. In reality, retaining rings are nearly as diverse as their applications. Spirolox Retaining Rings offer a distinct alternative, and in many instances, an advantage over the ordinary stamped circlips. The major distinctions are outlined below.

Spirolox® Retaining Ring Advantages

No Ears to Interfere®
No interference with undesired components

No Lugs
Ideal for tight radial applications

No Gap
Secure 360° retaining surface for even load distribution

Coiled, not Stamped
Economic material options due to reduced scrap costs

Easy Customization
Design around your application with no new tooling required

Improved Aesthetic Appearance
Smoothly blend into your application

Safe and Easy Installation
Requires no special tools

Groove Interchangeable
Easy to replace stamped rings

Defining the Ring Requirements

Although retaining ring applications are extremely diverse, there is a basic set of rules for defining ring requirements. These guidelines will determine if a standard ring or a custom design is needed in your application.

Nomenclature

A	Cross-sectional area (in^2) = t * b - .12 * t^2
b	Radial wall (in) = (OD - ID) / 2
d	Groove depth (in)
D	Shaft or housing diameter (in)
D_G	Groove diameter (in)
D_H	Housing diameter (in)
D_I	Free inside diameter, minimum (in)
D_O	Free outside diameter, maximum (in)
D_S	Shaft diameter (in)
E	Modulus of elasticity (psi)
g	Gravitational acceleration (in/sec^2), = 386.4 in/sec^2 (Assumed)
I	Moment of inertia (in^4)
ID	Inner diameter (in)
K	Safety factor
N	Maximum allowable RPM (rpm)
n	Number of turns
OD	Outer diameter (in)
P	Load (lb)
P_G	Allowable thrust load, groove yield (lb)
P_R	Allowable thrust load, ring shear (lb)
R_M	Mean free radius (in) = (D_I + b) / 2
S_C	Stress due to compression (psi)
S_E	Stress due to expansion (psi)
S_S	Shear strength of ring material (psi)
S_Y	Yield strength of groove material (psi), [See table 1]
t	Material thickness (in)
T	Ring thickness (in)
V	Cling/2 (in)
Y	Multiple turn factor, [See table 2]
z	Edge margin (in)
γ	Material density (lb/in^3), = .283 lb/in^3 (Assumed)

Typical Groove material yield strengths	
Hardened Steel 8620	110,000 psi
Cold Drawn Steel 1018	70,000 psi
Hot Rolled Steel 1018	45,000 psi
Aluminum 2017	40,000 psi
Cast Iron	10,000 - 40,000 psi

Table 1

Multiple turn factor				
n	1	2	3	4
Y	1.909	3.407	4.958	6.520

Table 2

Thrust Capacity

Understanding the thrust (or load) capacity of a retaining ring assembly requires calculations for both groove deformation and ring shear. Assuming the groove geometry meets our recommended standards, the design limitation is the lesser of the two calculations.

The load capacity formulas do not take into account any extreme operating conditions and/or dynamic loading. If the ring is subjected to this type of environment or loading, the proper safety factor should be applied and product testing conducted.

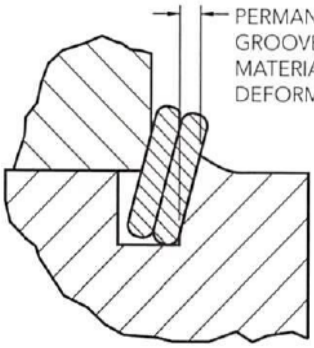
Groove Deformation (Yield)

Groove deformation is by far the most common design limitation of retaining rings. When the groove material yields, it causes the ring to dish and roll out of the groove, potentially leading to failure.

A safety factor of K=2 is recommended

Formula:

$$P_G = \frac{DdS_Y\pi}{K}$$



Example: Smalley Part Number WH-550-S16

Where:

S_Y = 45,000 psi
K = 2
D = 5.500 in
d = .074 in

$$\text{Groove Yield} = P_G = \frac{5.500\,(.074)\,45{,}000\,(\pi)}{2} = 28{,}769 \text{ lb}$$

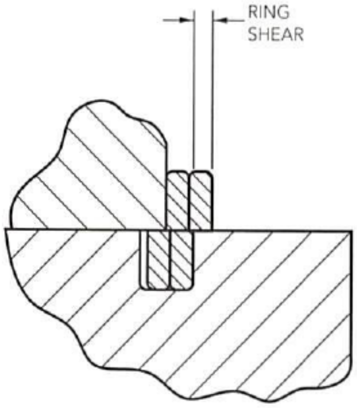
Ring Shear

Although not commonly associated as a typical failure of retaining rings, ring shear can be a design limitation when hardened steel is used as a groove material. Ring thrust load capacities based on ring shear are provided in the product tables for standard rings.

A safety factor of K=3 is recommended

Formula:

$$P_R = \frac{DTS_S\pi}{K}$$



Example: Smalley Part Number WH-550-S16

Where:

D = 5.500 in
T = .072 in
S_S = 108,000 psi
K = 3

$$\text{Ring Shear} = P_R = \frac{5.500\,(.072)\,108{,}000\,(\pi)}{3} = 44{,}787 \text{ lb}$$

Groove Geometry

Groove geometry covers the groove size, shape, and position on both the retained and retaining components. Following all of the associated guidelines below will better ensure optimal ring performance.

Groove Radius

To assure maximum load capacity, it is essential to have square corners on the groove and retained components. Additionally, components must always be square to the ring groove in order to maintain a uniform, concentric load. The radius on the groove bottom should not exceed the values in Table 3.

Shaft or Housing Diameter	Maximum Radius on Groove Bottom
1 inch and under	.005 max
Over 1 inch	.010 max

Table 3

Hoopster Rings

A Hoopster's groove radius has a slightly different recommended groove geometry because it is essential to have sharp corners on every edge of the groove. The maximum radius on the groove bottom of a Hoopster application should be no greater than 10% of the ring's radial wall.

Maximum Radius on Groove Bottom for Hoopster Retaining Rings	
All sizes	.10b

Table 4 b = radial wall

Retained Component

The retained part ideally has a square corner and contacts the ring as close as possible to the housing or shaft. For the maximum recommended radius or chamfer allowable on the retained part, see formula below.

Formulas:

Maximum Chamfer = .375 (b-d)
(on retained component)

Maximum Radius = .5 (b-d)
(on retained component)

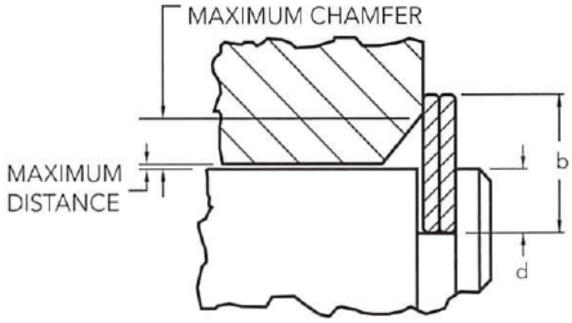
Example: Smalley Part Number WH-100

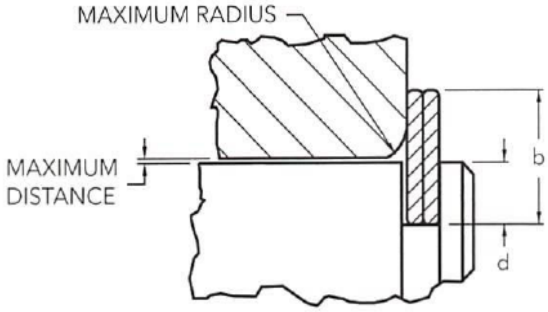
Where:

b = .075 in
d = .021 in

Maximum Chamfer= .375 (.075-.021) = .020 in

Maximum Radius = .5 (.075-.021) = .027 in





Ring Design Considerations

Edge Margin

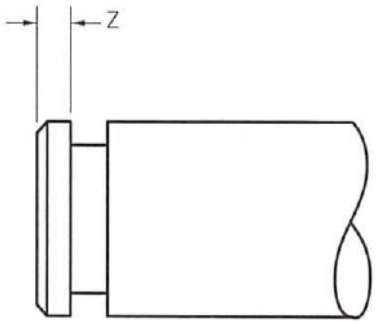
Ring grooves that are located near the end of a shaft or housing should have an adequate edge margin to maximize strength. As a rule, the minimum edge margin may be approximated by a value of 3 times the groove depth. Edge margin for both shear and bending should be calculated and the larger value selected. See formula below.

A safety factor of K=3 is recommended

Formulas:

Shear $$z = \frac{K3P}{S_Y D_G \pi}$$

Bending $$z = \left[\frac{K6dP}{S_Y D_G \pi}\right]^{1/2}$$



Example: Smalley Part Number VS-125

Where:

$P = 1{,}000$

$D_G = 1.206$ in

$S_Y = 40{,}000$ psi

$d = .022$ in

$K = 3$

$$\text{Shear} = z = \frac{3\,(3)\,1{,}000}{40{,}000\,(1.206)\,\pi} = .059 \text{ in}$$

$$\text{Bending} = z = \left[\frac{3\,(6)\,.022\,(1{,}000)}{40{,}000\,(1.206)\,\pi}\right]^{1/2} = .051 \text{ in}$$

Therefore the minimum edge margin that should be used is .059 in.

Rotational Capacity

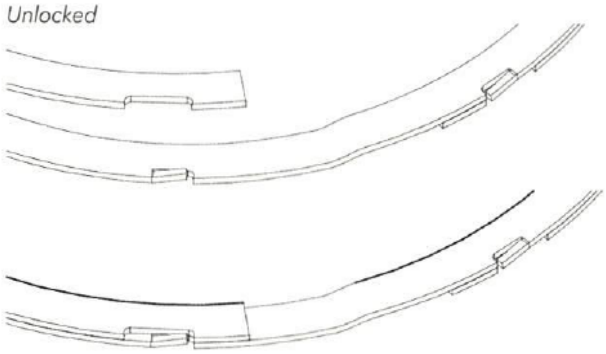
Any retaining ring operating on a rotating shaft is limited by centrifugal forces, including Smalley Retaining Rings. Failure occurs when these centrifugal forces are great enough to expand and shift the retaining ring from the groove. With more applications requiring higher rotational capacities, Smalley is invested in ongoing research and development in this area. If rotational capacity is critical in your application, please contact Smalley engineering for more information. A custom retaining ring, or possibly a self-locking ring, may be an option if your application requirements exceed the recommended rotational capacity of our standard parts.

Self-Locking

The self-locking feature consists of a tab and a slot that interlock to prevent the ring from expanding. The tab lines up with a slot on the mating turn such that when the ring is installed into the groove, the tab seats inside the slot.

This feature allows the ring to function properly at speeds far exceeding the rotational capacity of a standard retaining ring. The self-locking feature makes it possible for the ring to operate at high speeds, withstand vibration, function under rapid acceleration, and absorb a degree of impact loading.

Unlocked



Locked

Ring Design Considerations

Installation Stress Analysis

Installation stress analysis is used to check that the elastic stress limit of the ring material is not exceeded during installation. Standard parts that are assembled manually in the recommended shaft/bore and groove diameters do not require stress analysis. Custom rings assembled with special tooling may require analysis.

To select a safe stress value, it is necessary to estimate the elastic limit of the raw material. The minimum tensile strength, as shown in the Materials Table on page 128, can be used as a suitable estimate. A closer analysis of the actual application may reveal that these stress values can be exceeded. However, particular consideration must be made to functional characteristics such as installation method, the number of times the ring will be installed and removed, thrust load and/or rotational capacity.

After forming, a ring's natural tendency is to return to its original state. For a ring being installed over a shaft, this places the inner edge of the radial wall in residual tension and the outer edge in residual compression. To account for the residual stress in the ring when expansion is taking place, only 80% of the minimum tensile strength should be used to compare to the installation stress, as noted in Table 5 below.

In custom designs where the installation stress exceeds the material's elastic limit, rings can be produced to diameters that will yield a predetermined amount during assembly. Once installed, the ring will have the proper cling (grip) on the groove.

Installation Stress

Formulas:

External Rings $$S_E = \frac{Eb\,(D_S - D_I)}{(D_I + b)(D_S + b)}$$

Internal Rings $$S_C = \frac{Eb\,(D_O - D_H)}{(D_O - b)(D_H - b)}$$

Application	Percent of Minimum Tensile Strength
Shaft	80%
Housing	100%

Table 5

Example: Smalley Part Number WS-100-S02 and WH-100-S02

Where:

- S_E = Stress due to expansion (psi)
- S_C = Stress due to compression (psi)
- E = 28,000,000 psi
- b = .075 in
- D_S = 1.000 in
- D_H = 1.000 in
- D_I = .933 in
- D_O = 1.054 in

$$S_E = \frac{28{,}000{,}000\,(.075)\,(1.000 - .933)}{(.933 + .075)(1.00 + .075)} = 129{,}845 \text{ psi}$$

$$S_C = \frac{28{,}000{,}000\,(.075)\,(1.054 - 1.000)}{(1.054 - .075)\,(1.000 - .075)} = 125{,}224 \text{ psi}$$

WS-100-S02

Minimum tensile strength of the ring material: 210,000 psi
80% (Table 5) of 210,000 psi = 168,000 psi

129,845 psi < 168,000 psi

Since the installation stress is less than 80% of the minimum tensile strength, permanent set is not expected.

WH-100-S02

Minimum tensile strength of the ring material: 210,000 psi
100% (Table 5) of 210,000 psi = 210,000 psi

125,224 psi < 210,000 psi

Since the installation stress is less than 100% of the minimum tensile strength, permanent set is not expected.

Spring Checklist

APPLICATION CHECKLIST

CUSTOM ORDERS...OUR SPECIALTY

SMALLEY WAVE SPRINGS

Email to: info@smalley.com
Or fill out online.

Name ______________________ Title ______________ Date __________

Company ______________________

Address ______________________

City/State/Zip Code ______________________ Country ______________

Phone ______________________ Fax ______________

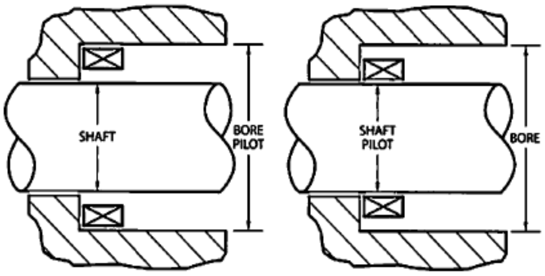
Email ______________________

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

( ) Under 10^5 Cycle Life

( ) 10^5 Cycle Life

( ) 10^6 Cycle Life

( ) Over 10^6 Cycle Life

QUANTITY:

Prototype ____________

Production ____________

APPLICATION: (Description)

____

____

* Denotes standard material or finish

If you need a part to include added inspections or other quality requirements, please contact one of our engineers.

APPLICATION CHECKLIST

CUSTOM ORDERS...OUR SPECIALTY

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

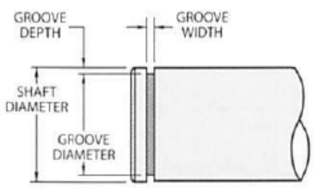
Housing Diameter ______________

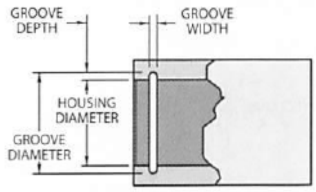
Shaft Diameter ______________

Groove Diameter ______________

Groove Width ______________

RPM ______________





Ring Radial Wall ________ Ring Thickness ________

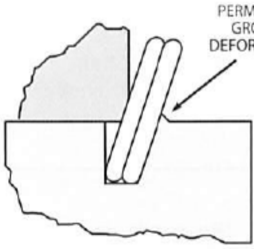
THRUST CAPACITY

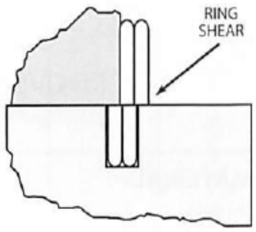
1) Groove Deformation

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

2) Ring Shear

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





If thrust is a consideration specify:

Groove Material ______________________________

Load Capacity ______________________ ( ) lb ( ) N

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

If you need a part to include added inspections or other quality requirements, please contact one of our engineers.

Laminar Ring Checklist

APPLICATION CHECKLIST

CUSTOM ORDERS...OUR SPECIALTY

SMALLEY LAMINAR RINGS

Email to: info@smalley.com
Or fill out online.

Name ____________________ Title ____________________ Date ____________

Company ____

Address ____

City/State/Zip Code ____________________ Country ____________________

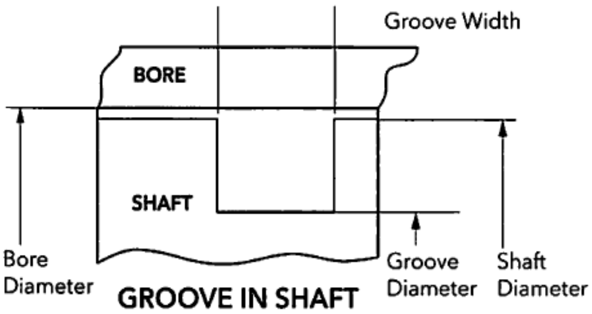
Phone ____________________ Fax ____________________

Email ____

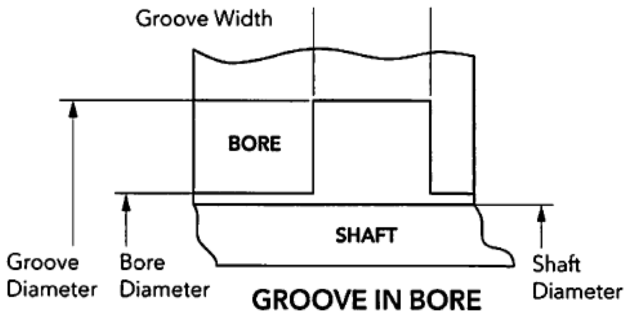
DIMENSIONS IN: ( ) Imperial Units ( ) Metric Units

Bore Diameter ____________________ Shaft Diameter ____________________

Groove Diameter ____________________ Groove Width ____________________



GROOVE IN SHAFT
(Seal Rings fit tight in Bore)



GROOVE IN BORE
(Seal Rings fit tight on Shaft)

MATERIAL

	*Maximum Recommended Operating Temperature °F	°C	
Standard			
Carbon Steel (SAE 1070-1090)	250	120	( )
302 Stainless Steel	400	200	( )
Special			
17-7 PH/CH900 Stainless Steel	650	343	( )
A286 Alloy	1,000	538	( )
316 Stainless Steel	400	204	( )
Inconel X-750	700-1,300	370-700	( )
Elgiloy	800	427	( )
Other			

SKETCH

SERIES

A. Single-Turn Ring Sets

(English - YH, YHK, YS or YSK) ( )

(Metric - QH, QHK, QS or QSK) ( )

B. Double-Turn Ring Sets

(English - YHD, YHKD, YSD or YSKD) ( )

(Metric - QHD, QHKD, QSD or QSKD) ( )

QUANTITY:

Prototype ____________________

Production ____________________

APPLICATION: (Description)

____

____

____

Sample Request Form

SAMPLE REQUEST

Smalley offers free samples to test in your application.

SMALLEY WAVE SPRINGS, RETAINING RINGS AND LAMINAR RINGS

Email to: info@smalley.com
Or fill out online.

Name ______________________ Title ______________ Date __________

Company ____

Address ____

City/State/Zip Code ______________________ Country ______________________

Phone (*REQUIRED*) ______________________ Fax ______________________

Email ____

SHIPPING METHOD:

All samples are sent out by FedEx (Ground). For expedited delivery, please provide a valid UPS or FedEx account number and specify the service to bill.

Please call Smalley at 847.719.5900 to request other delivery methods.

☐ **FedEx Ground:** ***(FREE)***

☐ UPS Account number for charges ***(REQUIRED)*** ______________________

☐ Ground ☐ Overnight ☐ 2nd Day

☐ FedEx Account number for charges ***(REQUIRED)*** ______________________

☐ Overnight ☐ 2nd Day

SPECIFIC SAMPLE:

Please provide us with the part number you would like to test and mark the requested material:

Smalley Part Number: ______________________ ☐ Carbon Steel ☐ Stainless Steel

Smalley Part Number: ______________________ ☐ Carbon Steel ☐ Stainless Steel

ASSORTED SAMPLES:

☐ Please send me a sample bag of assorted Smalley Retaining Rings and Wave Springs.

Smalley reserves the right to authorize all sample requests.

How To Order

Specifying Smalley Part Numbers

Smalley ring and spring part numbers consist of three steps. Please use the following guide to correctly identify your part number:

WHT-50-PA-S02

Material: Specifies type of material (see Table 3)

Finish: Specifies the type of finish to be applied on the material (see Table 2)

Base Part Number: Specifies series and housing/shaft diameter (see Tables 1a and 1b)

Step 1: Base Part Numbers

Select Series from TABLE 1a or 1b

TABLE 1a: Retaining Ring Series

Series	Number of Turns	Internal	External
Light Duty	1	VH	VS
Light Duty Metric	1	VHM	VSM
Medium Duty	2	WH	WS
Medium Heavy Duty	2 or 3	WHT	WST
Heavy Duty	2	WHM	WSM
Constant Section	1	FHE	FSE
Constant Section (Eaton Style)	1	XAH	XAS
Constant Section (Eaton Style)	1	XDH	XDS
Aerospace Metric	2	EH	ES
DIN Series Metric	2	DNH	DNS
DIN Series Constant Section	1	FH	FS
Hoopster	1	HH/HHU	HS
Hoopster Metric	1	HHM/HHMU	HSM
WaveRing	2	WHW	WSW

TABLE 1b: Wave Spring Series

Series	Prefix
Standard Single-Turn	SSR
Bearing Preload Metric	SSB
Narrow Section Single-Turn	SSR-N
Shim	SSRS
Crest-to-Crest	C
Crest-to-Crest with Shim End	CS
Crest-to-Crest Metric	CM
Crest-to-Crest with Shim End Metric	CMS
Wavo	RW
Nested Spirawave	NSSR
Nested Spirawave Metric	NSSB

Then Specify Part Diameter

See the product tables for a complete listing of available diameters in stock. Below are some base part number examples:

Part Number Examples	
WH-100	1.000" Medium Duty Internal Ring
WSM-150	1.500" Heavy Duty External Ring
C150-L1	1.500" Crest-to-Crest Wave Spring
CS125-M2	1.250" Crest-to-Crest Wave Spring w/ Shim Ends
RW-0237	2.375" Wavo Spring

Step 2: Finish
To prevent corrosion, carbon steel has an oil dip finish. Stainless steel parts are vapor degreased and go through an ultrasonic cleaning process. To specify a special finish on retaining rings or wave springs, add the appropriate suffix to the part number preceding the material suffix. For standard materials, there is no designation necessary.

TABLE 2: Finish

Standard	
Finish	**Designation**
Carbon Steel- Oil Dip	None
Stainless Steel-Vapor Degrease & Ultrasonic Clean	None

Special	
Finish	**Designation**
Passivation	PA
Black Oxide	BA
Phosphate Coat	PS
Cadmium Plate	CD
Vibratory Deburr	DV

Example: WH-100-**PA**-S02 1.000" Medium Duty Housing Ring, with **passivation** in 302 stainless steel

Step 3: Material
To specify the material, add the appropriate designation below to the end of the part number.

TABLE 3: Material

Standard	
Material	**Designation**
Carbon Steel SAE 1070-1090	None
302 Stainless Steel (Retaining Rings)	S02
316 Stainless Steel (Retaining Rings)	S16
17/7 PH Stainless Steel (Wave Springs)	S17

Special	
Material	**Designation**
Inconel X-750	INX
A286	A86
Beryllium Copper	BEC
Phosphor Bronze	PHB
Elgiloy	LGY

Examples:		
	VH-50	0.500" Light Duty Housing Ring in **Carbon Steel**
	VS-100-**S02**	1.000" Light Duty Shaft Ring in **302 Stainless Steel**
	C050-M5-**INX**	0.500" Crest-to-Crest Wave Spring in **Inconel X-750**

Note: *Custom wave springs can be manufactured in 302 & 316 stainless steel, retaining rings can be manufactured in 17-7 PH condition CH900 stainless steel upon request. If you need a part to include added inspections or other quality requirements, please contact one of our engineers.*

Packaging
Smalley has the flexibility to package retaining rings and wave springs using a variety of methods to simplify your assembly process. Standard packaging is based on the diameter. As a general rule for both retaining rings and wave springs:

- 15 / 16" and under diameters are bulk packaged
- 13 / 8" and over diameters are generally tube (coin) packaged in lengths from 10 to 18"

Smalley can accommodate custom packaging requests to make your assembly process easier. Contact us for more information.

Placing an Order
Smalley Customer Service representatives are ready to assist you with pricing, ordering, and delivery options.
Contact Smalley Customer Service at:

847.719.5920 **847.719.5999** **sales@smalley.com** **Shop at www.smalley.com**

You may also purchase standard rings and springs online. Our web store offers product pricing, easy re-order, and a quick, secure check-out process.

Glossary

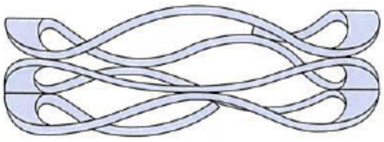
Bore Diameter: (See *Housing Diameter*).

Centrifugal Capacity (N): A mathematical expression for determining the speed (in revolutions per minute, RPM) at which a retaining ring will lose cling on the groove.

Cling: A value that signifies the amount of "interference fit" between a retaining ring and its groove.

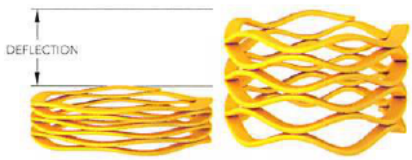
Cold Working: Shaping or forming wire without heating.

Crest-To-Crest: Term used to identify a Smalley Flat Wire Compression spring in a "Series" configuration, having a sinusoidal waveform. The wave contour in each 360° turn provides a peak to valley relationship that decreases spring rate proportionally to the number of turns.

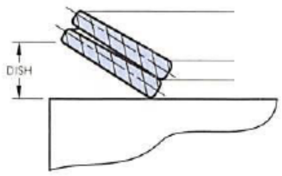


Cycle Life: (See *Fatigue Life*).

Deflection: Also referred to as *Stroke*. The distance a wave spring is displaced under a load. Not to be confused with work height.



Dish: This ring dimension is the height difference in the ring cross section's axis of symmetry between OD and ID as illustrated below:



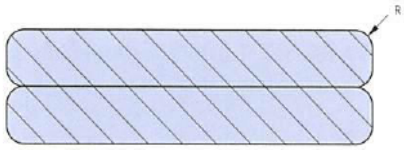
Dynamic Application: An application that moves resulting in repeated spring deflection.

Dynamic Loading: When a spring regularly cycles between different heights.

Eccentric Loading: Loading on a ring or spring that is lateral to or not symmetric with the central axis.

Edge Contour: The shape of the side surfaces of the wire.

Edge Radius: The size of the rounded corner of the wire cross-section.



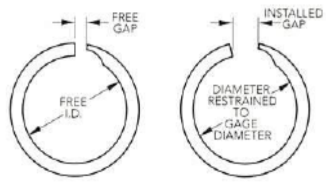
Edgewinding: Smalley's manufacturing method of circle coiling rectangular section flat wire on edge.

Elastic Limit: The maximum stress that can be applied to a material without causing permanent deformation.

External Ring: A type of retaining ring that is installed typically into a groove on a shaft.

Fatigue Life: Also referred to as *Cycle Life*. The number of cycles a spring can withstand before failing.

Free Gap: The distance between the "Free Ends" of a ring or spring as it rests in its free state.



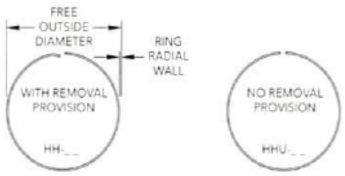
Gap in Gage: (See *Installed Gap*).

Glossary

Hardness: The resistance of a material to plastic deformation, usually by indentation.

Helix: (See *Pitch*).

Hoopster: Term used to identify the style of retaining ring with minimal radial projection and shallow groove depth.



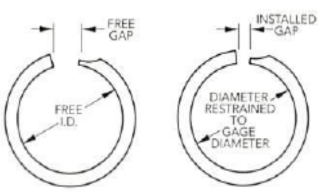
Housing Diameter (DH): Also referred to as *Bore Diameter*. This dimension represents the inside diameter of the assembly where an internal retaining ring is installed.

Hydrogen Embrittlement: A condition where hydrogen is absorbed within the internal grain structure of metal tending to make it susceptible to cracking and failure, particularly under sustained loads. Environments such as hydrogen sulfide (H_2S) or processes such as electroplating or pickling can induce hydrogen embrittlement.

Impact Loading: Sudden force applied to a spring or ring.

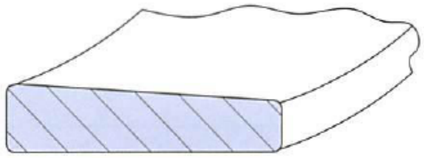
Installation Stress (SC) or (SE): Mathematical expression based on a radial strain. Useful in determining how far a Spirolox Retaining Ring can be expanded or contracted during installation.

Installed Gap: Also referred to as *Gap in Gage*. This ring dimension is the distance between the ring ends while the ring is restrained at a specific gage diameter. Recommended as a more precise method of control over a free gap.



Internal Ring: A type of retaining of ring that is installed typically into a groove in a housing.

Keystone: Derived from the definition of a "wedge" shaped stone. This term, illustrated below, refers to the "wedge" shaped cross section as a result of edgewinding flat wire.



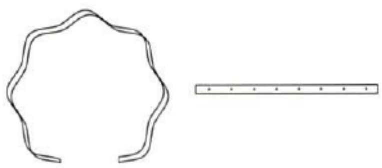
Left Hand Wound: Also referred to as *Reverse Wound*. Design term signifying the counter-clockwise winding direction of a coil.

Linear Spring: Term used to identify a straight length of flat wire having a sinusoidal waveform. Used as a compression spring in both axial and radial applications.

Load/Deflection Curve: Graph of force vs travel of a spring as it is compressed. See page 135.

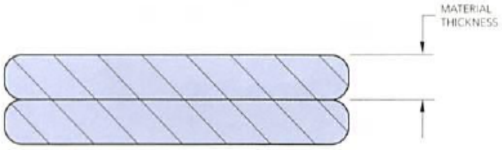
Load Capacity: Also referred to as *Thrust Capacity*. The maximum force that can be applied to a retaining ring without failure.

Marcel Spring: Also known as *Marcel Expander*. A single-turn wave spring used to provide radial force. A Marcel expander is defined by a bore and a shaft. A Marcel expander is coiled in a circular shape such that the ID clings to a shaft and the OD clings in a bore.

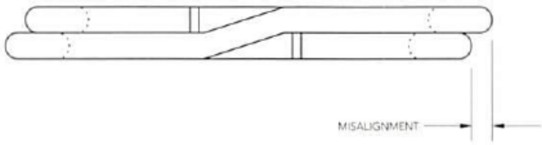


Glossary

Material Thickness (t): Also referred to as *Wire Thickness*. This dimension, illustrated below, is also used in determining the overall ring thickness.

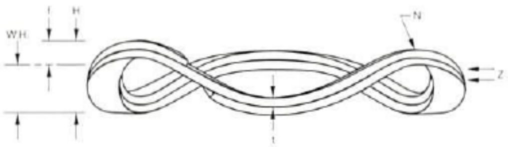


Misalignment: Also referred to as *Skew*. This ring dimension is the radial variance of a multiple turn retaining ring.



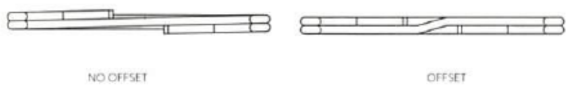
Modulus of elasticity (E): A measure of the rigidity of a material.

Nested: Term used to identify a Smalley Flat Wire Compression Spring in a "Parallel" configuration, having a sinusoidal waveform. The wave contour in each 360° turn matches (nests), increasing the spring rate proportionally to the number of turns.

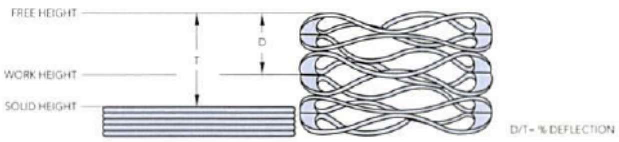


Notch Radius: (See *Removal Notch*).

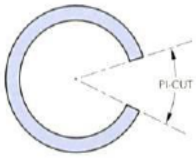
Offset: As illustrated below, this design feature is a bend in the material at the gap. This provides flat and parallel surfaces for ease of installation.



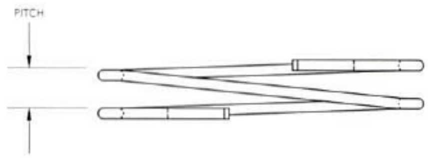
Percent Deflection: Ratio of actual displacement (D) to total available displacement (T) of a spring.



Pi-Cut Ends: Term signifying a particular ring design where the ends have been cut in an angular direction from the center of the ring as illustrated below.



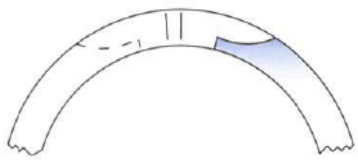
Pitch: Also referred to as *Helix*, this ring dimension is the distance between two adjacent layers of the retaining ring.



Precipitation Hardening: The process of strengthening certain alloys by a heat treatment or aging method.

Radial Wall (b): Width of a retaining ring when measured from inside to outside edge.

Removal Notch: Also referred to as a *Notch Radius* or *Scallop*. This standard Spirolox Retaining Ring design feature is used to facilitate removal of the ring from its groove by means of a screwdriver or similar type tool.

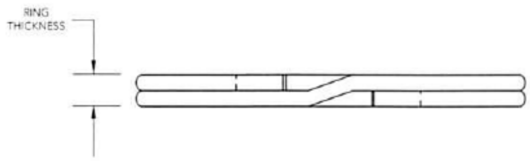


Residual Stress: Internal stresses that are introduced as a result of the cold forming (coiling) process.

Reverse Wound: (See *Left Hand Wound*)

Right Hand Wound: (See also *Left Hand Wound*) Design term signifying the clockwise winding direction of a coil.

Ring Thickness (T): The total thickness of an edgewound retaining ring, which is determined by multiplying material thickness by the number of turns, and accounting for keystone.



Rod Diameter: (See *Shaft Diameter*)

Rotational Capacity: The maximum speed at which a retaining ring can rotate before failing.

Safety Factor (K): Mathematical constant used in many design formulas to account for theoretical inaccuracies.

Scallop: (See *Removal Notch*)

Set (Permanent): The point at which the elastic properties of the material have been exceeded, and the shape of the ring or spring does not return to its original state.

Shaft Diameter (DS): Also referred to as *Rod Diameter*. This dimension represents the outside diameter of the assembly where an external retaining ring is installed.

Shear Strength (SS): An index of the quality of a material through a mathematical expression which divides the force required to shear a material by its cross-sectional area.

Skew: (See *Misalignment*).

Static Application: A spring application that does not have any motion resulting in spring deflection.

Stress Relieve: Low temperature heat treatment for removing any residual stresses induced by edgewinding and/or forming.

Stroke: Also referred to as *Deflection*. The distance a wave spring is displaced under a load.

Tensile Strength: An index of the quality of a material through a mathematical expression which divides the material's load capacity in tension by its original cross-sectional area. Particularly accurate for spring steels, as there is only a small difference between ultimate tensile strength and yield strength.

Thrust Load Capacity (PG) or (PR): Also referred to as *Load Capacity*. Overall capacity of an assembly to withstand a given value of thrust load in pounds. The limitation being the lesser of two mathematical calculations: ring thrust load capacity (PR) or groove thrust load capacity (PG).

Turns (Number of): The number of 360° turns of flat wire formed in a retaining ring or wave spring.

WAVO: Single turn round wire wave spring.

Wire Thickness: (See *Material Thickness*).

Yield Strength (Sy): The stress at which a material exhibits initial plastic deformation.

Terms and Conditions of Sale

All Quotations, Purchase Orders, Order Confirmations, Order Acknowledgements, Invoices or any other form (in any media) for placing orders for goods or services from Smalley Steel Ring Co. ("Order") are expressly subject to the terms and conditions ("Terms and Conditions") set forth herein. Smalley Steel Ring Co. is hereafter referred to as "Seller", and the original purchaser of the products or services of Seller (collectively, "Goods") is hereafter referred to as "Buyer".

1. OFFER AND ACCEPTANCE - THIS ORDER EXPRESSLY LIMITS ACCEPTANCE TO THE TERMS AND CONDITIONS SET FORTH HEREIN, AND ANY ADDITIONAL OR DIFFERENT TERMS ARE REJECTED UNLESS EXPRESSLY AGREED IN WRITING SIGNED BY AN OFFICER OF SELLER, NOTWITHSTANDING ANY PRIOR TRANSACTIONS OR COURSE OF DEALING BETWEEN BUYER AND SELLER. No Order of any kind between Buyer and Seller shall be binding on Seller unless and until it is accepted by Seller. Acceptance of Buyer's Order is upon these Terms and Conditions; provided, however, if Buyer's Order or offer is expressly conditioned upon Seller's acceptance of Buyer's terms and conditions, and the terms of quantity, price and the description of the Goods of Seller in Buyer's offer are the same as set forth in Seller's acceptance, then all other contrary or different terms in Buyer's offer are expressly rejected and Seller's acceptance shall create an agreement between Buyer and Seller to the extent of all consistent terms between Buyer's offer and Seller's acceptance, subject to and conditioned upon Buyer's consent to any of these Terms and Conditions which may constitute terms additional to or different from those terms contained in Buyer's offer. Buyer shall be deemed to have so consented by notifying Seller in writing or electronically, by accepting delivery of the Goods, or by using or selling the Goods. Acceptance by Seller of Buyer's Order shall take place upon acknowledgement either electronically or in writing of Buyer's Order, or by delivery to Buyer or Buyer's carrier of all or any part of the Goods.

2. PRICE - All prices for Goods are quoted and payable in United States currency, unless otherwise agreed by Seller in writing. All prices are F.O.B. Seller's factory in Lake Zurich, Illinois, United States of America ("Seller's Factory"), unless otherwise agreed by Seller in writing. Seller shall have the right to correct any obvious errors in price.

3. TAXES - Prices do not include any taxes. Any taxes which, under any existing or future law, Seller may be required to pay or collect with respect to the sale, purchase, delivery, storage, processing, use, consumption or transportation of any of the Goods shall be paid by Buyer to Seller on Seller's demand.

4. DELIVERY - Delivery dates for any Goods are approximate, are done for the convenience of Buyer, and shall not be binding upon Seller or considered material to the performance of these Terms and Conditions. Shipping schedules and shipping commitments are based upon current production capabilities, material availability and inventory, and may be changed by Seller at Seller's option as conditions may require. The Goods shall be sold and delivered F.O.B. Seller's Factory, and delivery of Goods to Buyer shall be deemed to have taken place upon tender of Goods to Buyer or the shipping carrier. Seller reserves title to the Goods until paid for in full to Seller. Seller reserves the right to ship plus or minus 10% on the quantity ordered, and the Order will be deemed complete when shipped within such 10% range. Shipments in installments shall be permitted.

5. RISK OF LOSS - Buyer agrees to assume all risk for loss of, or damage or injury to, the Goods from the time they are tendered for delivery to the shipping carrier and for all risk of loss arising out of any delay in shipment of the Goods after they are tendered for delivery to the shipping carrier, or if shipment is deferred by an act or omission of Buyer, from the time the Goods are completed and ready for shipment, and Buyer shall be liable for the full purchase price whether or not the Goods are lost, stolen, damaged or destroyed.

6. INSPECTION, ACCEPTANCE AND RETURN OF GOODS - Buyer shall have thirty (30) days from the date of delivery of the Goods to inspect the Goods to determine whether the Goods: (a) conform to this Order, or other shipping document, as applicable, or, (b) are damaged, visibly defective or otherwise nonconforming. Buyer must assert any claim for the foregoing within such thirty-day period by furnishing Seller with detailed written information of such damage, nonconformance, defect or shortage. In the event inspection and notice of rejection are not made within such thirty-day period, Buyer shall be deemed to have accepted the Goods. No returns can be made without the prior authorization of Seller and a pre-assigned return authorization number issued by Seller. All returns are subject to inspection and acceptances by Seller. When returns are accepted, they are subject to a handling and re-inspecting charge to be determined by Seller. All returns shall be in accordance with Seller's specific shipping instructions.

7. PAYMENTS - All invoices shall be due and payable in full, without set-off or reduction, within thirty (30) days from the invoice date, unless payment for the Goods is due in full upon delivery or in advance. Extensions of credit may be changed or withdrawn at any time. Buyer shall pay an interest charge of one and one-half percent (1 ½%) per month or part thereof, or the highest rate permitted by law, whichever is less, on any amount past due and owing by Buyer to Seller on any invoice until paid in full to Seller. Buyer shall bear and promptly pay to Seller any and all costs, expenses and fees, including, without limitation, reasonable attorneys' fees and costs, incurred by Seller in enforcing any of Seller's rights under this Order or to receive or collect any amounts owing from Buyer.

8. LIMITED WARRANTY - Seller warrants that (a) Seller has the right to convey good title to the Goods sold hereunder and, upon Buyer's payment in full therefor, Buyer shall have good title in and to such Goods, and (b) the Goods manufactured by Seller and sold hereunder to original Buyer are free from defects in material and workmanship occurring under normal use and conform, as applicable, to (i) Seller's specifications for stocked Goods, or (ii) Buyer's specifications for the Goods if provided by Buyer to Seller and/or the specifications as indicated on the applicable Smalley drawing. Seller's warranty is limited to a period of one year from the date of shipment from Seller's factory or the expected life of the goods, whichever is shorter. The Goods shall be subject to tolerances and variations consistent with usual industry practices or with Seller's current parts/engineering catalogs where applicable. Smalley assumes no liability for specifications agreed upon, reviewed or provided by Buyer. This limited warranty does not apply to any Goods misused, abused, altered or used other than as approved in writing by Seller, as determined by Seller's inspection of the non-conforming goods. If any defect in material or workmanship occurs during the applicable warranty period in any of the Goods, as determined by Seller's inspection of the non-conforming Goods, Buyer's sole and exclusive remedy shall be as set forth in Section 10 of these Terms and Conditions.

9. WARRANTY DISCLAIMER - OTHER THAN THE LIMITED WARRANTY SET FORTH IN SECTION 8 OF THESE TERMS AND CONDITIONS ABOVE, SELLER MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OF ANY KIND, WITH RESPECT TO THE GOODS, INCLUDING, WITHOUT LIMITATION, ANY WARRANTIES AS TO ACCURACY, FUNCTIONALITY, PERFORMANCE OR MERCHANTABILITY. SELLER EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS, IMPLIED OR STATUTORY WITH RESPECT TO THE GOODS, INCLUDING, WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND ANY WARRANTIES ARISING FROM TRADE USAGE, COURSE OF DEALING OR COURSE OF PERFORMANCE. ANY PERFORMANCE ESTIMATES DESCRIBED IN THIS ORDER, OR IN ANY OF SELLER'S WRITTEN OR ELECTRONIC OR MAGNETIC MEDIA PROPOSALS OR QUOTATIONS, ARE ONLY ESTIMATES AND ARE NOT INTENDED AS AN EXPRESS WARRANTY. ANY SAMPLES SUBMITTED BY SELLER TO BUYER, AND ANY DESCRIPTIONS, ILLUSTRATIONS, OR FORECASTS IN TRADE LITERATURE, BROCHURES, OR OTHER DOCUMENTATION OR ELECTRONIC OR MAGNETIC MEDIA SHALL NOT BE CONSTRUED AS WARRANTIES AS TO SUBSTANCE, PERFORMANCE, QUALITY, WEIGHT OR DIMENSION, AND ANY FAILURE TO CONFORM WITH SUCH SAMPLES, DESCRIPTIONS, FORECASTS OR ILLUSTRATIONS SHALL NOT CONSTITUTE ANY BREACH OF THIS ORDER OR THESE TERMS AND CONDITIONS. NO SALES PERSONNEL, EMPLOYEES, AGENTS OR REPRESENTATIVES OF SELLER OR ANY THIRD PARTY ARE AUTHORIZED TO MAKE ANY REPRESENTATION, WARRANTY OR COVENANT, WHETHER IN WRITING OR ORALLY, ON BEHALF OF SELLER, OTHER THAN THE LIMITED WARRANTY IN SECTION 8 ABOVE.

10. BUYER'S SOLE AND EXCLUSIVE REMEDY; LIMITATIONS ON LIABILITY - Except with respect to infringement of any United States patent or United States copyright by the Goods, Seller's sole obligation and liability to Buyer, and Buyer's sole and exclusive remedy with respect to defective or otherwise nonconforming Goods is limited, in Seller's discretion, to: (a) replacement (not including labor) of the non-conforming Goods and delivery to Buyer free of charge to the same location of original shipment; (b) repair (not including labor) of the non-conforming Goods and delivery to Buyer free of charge to the same location of original shipment; or (c) refund of Buyer's purchase price for the non-conforming Goods (without interest). If requested by Seller and at Seller's expense, Buyer shall return to Seller any Goods which are replaced or for which Buyer receives a refund, provided that in any such event, Buyer has complied with Seller's return policies and procedures. BUYER WAIVES ANY RIGHT TO ANY REMEDIES FOR NONCONFORMING GOODS OTHERWISE AVAILABLE AT LAW OR STATUTE OTHER THAN THOSE EXPRESSLY STATED IN THIS SECTION 10. OTHER THAN AS EXPRESSLY SET FORTH IN THIS SECTION 10 AND SECTION 13, SELLER SHALL NOT BE LIABLE TO BUYER FOR ANY DIRECT, INCIDENTAL, INDIRECT, SPECIAL, PUNITIVE, EXEMPLARY, TORT OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY DAMAGES FOR BUSINESS INTERRUPTION, LOSS OF REVENUES, PROFITS OR SAVINGS, LOSS OF DATA, PROCUREMENT, PRODUCT RECALL, PRODUCT REMOVAL OR REINSTALLATION, INCREASED OVERHEAD, INJURY TO REPUTATION OR LOSS OF CUSTOMERS, INDEMNITY OR REIMBURSEMENT FOR ANY CLAIMS ASSERTED AGAINST BUYER BY A THIRD PARTY ARISING DIRECTLY OR INDIRECTLY FROM THE MANUFACTURE, DELIVERY, SALE, USE, INSTALLATION, ASSEMBLY, DISASSEMBLY OR RECALL OF THE GOODS, REGARDLESS OF CAUSE OR FORM OF ACTION ASSERTED BY BUYER, WHETHER IN CONTRACT, TORT, STRICT LIABILITY, STATUTORY LIABILITY OR OTHERWISE, AND WHETHER OR NOT SUCH DAMAGES WERE FORESEEN, UNFORESEEN OR FORESEEABLE, EVEN IF SELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. NOTWITHSTANDING THE FOREGOING, IN THE EVENT THE TERMS OF THIS SECTION, OR ANY PART THEREOF, SHALL BE HELD INVALID OR UNENFORCEABLE BY A COURT OF COMPETENT JURISDICTION, SELLER'S TOTAL AGGREGATE LIABILITY TO BUYER UNDER THIS ORDER AND THESE TERMS AND CONDITIONS SHALL NOT EXCEED THE PURCHASE PRICE OF THE GOODS GIVING RISE TO THE CLAIM. IF NOT PERMITTED BY APPLICABLE LAW, THIS SECTION SHALL NOT RELIEVE SELLER FROM LIABILITY FOR DAMAGES THAT RESULT FROM ANY GROSS NEGLIGENCE OR WILLFUL OR TORTIOUS ACTS OF SELLER.

11. TECHNOLOGICAL CHANGES OR IMPROVEMENTS - Notwithstanding any other provision hereof, Seller reserves the right, without prior notice, at any time and from time to time, to make changes in: (a) any formula, data, tables, dimensions, materials and/or processes used in the manufacture of the Goods; or (b) to make changes in the design, specifications and capacities of any of the Goods; or (c) to discontinue manufacturing or supplying any of the Goods.

12. SUSPENSION OF PERFORMANCE; SET-OFF - If, in Seller's judgment, reasonable doubt exists as to Buyer's financial responsibility, or if Buyer is past due in payment of any amount owing to Seller, Seller reserves the right, without liability and without prejudice to any other remedies, to suspend performance, decline to ship, or stop any material or the Goods in transit, until Seller receives payment of all amounts owing to Seller, whether or not due or adequate assurance of such payment has been made by Buyer to Seller.

13. INTELLECTUAL PROPERTY INDEMNITY - Notwithstanding anything to the contrary contained in these Terms and Conditions, as Buyer's sole and exclusive remedy with respect to infringement of any United States patent or United States copyright by the Goods, Seller shall indemnify, defend and hold harmless Buyer from and against any and all costs and damages awarded against Buyer in any lawsuit, arbitration or similar proceeding with respect to any actual violation or infringement by the Goods manufactured by Seller of any United States patent or United States copyright of any third party ("Claim"), provided that Buyer provides to Seller prompt written notice and complete support, including, without limitation, documentation and witnesses as requested by Seller, but only if the alleged infringement is solely related to Seller's design, processes or methods and not Buyer's designs, specifications or instructions to Seller, in which event Section 16 shall apply. Seller shall have the right to control the defense of any such Claim, including, without limitation, authority to settle any such Claim and select counsel. As part of Buyer's sole and exclusive remedy with respect to infringement of any United States patent or United States copyright by the Goods, Seller shall, at its option, (a) obtain a license or right for Buyer to continue to use and sell the Goods, (b) redesign the Goods subject to the Claim to make them non-infringing, (c) deliver non-infringing products to Buyer, or (d) refund the purchase price of the infringing Goods upon return of said products to Seller as specified by Seller. This represents Seller's entire and exclusive obligation, and Buyer's sole and exclusive remedy, with respect to any such Claim regarding the Goods.

14. INDEMNIFICATION OF SELLER - Buyer shall indemnify, defend and hold harmless Seller and its officers, directors, employees, agents, shareholders, affiliated companies and their respective successors and assigns from and against any and all claims relating to, in connection with or arising from: (a) any breach by Buyer of any provisions of these Terms and Conditions; (b) any claim or suit for actual or alleged violation or infringement of any United States patent or United States copyright of any third party arising from Buyer's designs, specifications or instructions to Seller; (c) any unauthorized modification, alteration, adaptation or use of the Goods; and (d) any claim or suit for damages arising from acts, representations or omissions of Buyer related to Buyer's sale of the Goods, use of the Goods or incorporation of the Goods into a product or part thereof. Seller shall have the right to control the defense of any such claim, including, without limitation, authority to settle any such claim and seek reimbursement from Buyer and select counsel.

15. TOOLS, DIES, FIXTURES AND TECHNICAL DATA - Unless otherwise required by applicable law, any tools, dies, fixtures or technical data that Seller may develop for use in production of the Goods shall remain the sole property of Seller and shall be subject to the confidentiality provisions set forth herein. Where Seller furnishes Buyer technical data that will be used under a contract with the United States Government, Buyer shall affix the following legend upon such technical data: Technical Data contained herein are proprietary to Smalley Steel Ring Co. and may not be used, disclosed, reproduced, modified or displayed without the prior written approval of Smalley Steel Ring Co. U. S. Government license rights are limited to those mandatory rights identified in DFARS 252.7015(b) and/or to the rights identified in Smalley's commercial license agreement.

16. CONFIDENTIALITY; NO LICENSE - Buyer shall not use, disclose, sell, license, publish, reproduce or otherwise make available Seller's Confidential Information (as defined below), and Buyer shall secure and protect Seller's Confidential Information in a manner at least as robust as the maintenance of Buyer's confidential and proprietary rights, but in no event using less than reasonable efforts. "Confidential Information" means information not generally known by personnel who are not employees of Buyer or Seller, respectively, which is used by either Buyer or Seller, and is proprietary to Seller. Buyer acknowledges and agrees that disclosure of Seller's Confidential Information would be detrimental to Seller. Buyer further agrees that no license, express or implied, under any copyright, patents, trade secrets or know how ("Know How") of Seller is granted to Buyer by this Order or by any disclosure of Confidential Information or proprietary information hereunder. Seller shall retain all of its property rights in any such Know How which it possessed prior to the effective date of this Order and the property rights to any new Know How developed by Seller during the performance of its obligations hereunder shall, subject to any restrictions imposed by the Federal Acquisition Regulation ("FAR") (48 C.F.R. Parts 1-52) or imposed by the applicable terms of any higher tiered prime contract with an executive agency of the United States Government, vest in Seller. Subject to the property rights of the Buyer in respect of pre-existing or developed Know How, if any, Seller shall be entitled to a perpetual, fully paid-up or no-cost license to use, to copy, to modify and to exploit Buyer's Know How disclosed to Seller for the purpose of performing Seller's obligations under this Order. Buyer agrees that in the event of a breach of this confidentiality provision, Seller shall be entitled to obtain injunctive relief against Buyer, without bond but upon due notice, in addition to such other relief as may appertain at law or in equity, and shall be entitled to all costs of suit, including reasonable attorney's fees, related to enforcement of this Section 16.

17. LIMITATION ON ACTION - Any action or suit against Seller arising in any way from or with respect to these Terms and Conditions, this Order or the Goods must be commenced not later than one (1) year after the cause of action has occurred.

18. GOVERNMENT CONTRACTS - Buyer shall notify Seller if Buyer's requirement for Seller's Goods derives from a contract with the United States Government, or a lower-tiered subcontract under a United States Government contract. In that case, Buyer shall provide Seller with a complete listing of all FAR clauses or related agency FAR clause supplements that are deemed "flowed down" from the prime contract to be incorporated by reference into this Order. Such clauses shall apply to Seller in such a manner as necessary to reflect the position of Seller as a subcontractor to Buyer's prime contract, and these clauses shall be deemed to be the obligations of Seller to Buyer to the extent required by applicable law. However, wherever the clauses include a requirement for the settlement of disputes between the parties in accordance with the "Disputes" clause, the dispute shall be handled in accordance with the disputes provisions of this Order and not the prime contract. Unless the specific FAR clause(s) furnished by Buyer is mandatory by law, statue, or regulation, in cases of inconsistency between the provisions of this Order and the referenced clauses, the provisions of this Order shall have precedence.

19. EXPORTS - All sales, shipments, and sharing of technical data, both domestically and internationally, by Seller, its divisions, and subsidiaries, are done so in accordance with all applicable United States laws and regulations, including, but not limited to, the Export Administration Regulations ("EAR"), International Traffic in Arms Regulations ("ITAR"), Iranian Transaction Regulations ("ITR") and the International Emergency Economic Powers Act ("IEEPA") and any controls thereunder, and/or amendments thereof. By entering into this Order and/or accepting the Goods, Buyer confirms that it is not located in (or a national resident of) any country under United States or United Nations embargo or sanction, not identified on any United States Department of Commerce Denied Persons List, Entity List, United States Department of State Debarred Parties List, and/or the United States Department of the Treasury's Specially Designated Nationals list, and not directly or indirectly involved in the financing, commission or support of terrorist activities or in the development or production of nuclear, chemical, biological weapons or in missile technology programs as specified in the EAR. Upon request, Buyer agrees to provide Seller with all information pertaining to the actual routing of Goods to be exported and the intended use thereof. Any routing and/or use of the Goods contrary to the laws and regulations of the United States or country in which they are being used is prohibited.

20. FORCE MAJEURE - Seller shall not be liable for any failure to perform in accordance with this Order, including, without limitation, failure to deliver the Goods, caused for any reason, in whole or in part, beyond Seller's reasonable control, including, but not limited to, production schedules of Seller's suppliers, unavailability of materials, labor disturbances, acts of God, fire, flood, weather, terrorism or transportation difficulties.

21. CANCELLATION - Except as set forth in this Section 21, this Order may be cancelled or modified only by written agreement between Buyer and Seller. Buyer's insistence upon canceling or suspending fabrication or shipment, or Buyer's failure to furnish specifications when required, may be treated by Seller as a breach of contract by Buyer, and Seller may cancel any unshipped balance of Goods without prejudice to any other remedies Seller may have.

22. ENTIRE AGREEMENT - These Terms and Conditions, together with the other documents expressly referred to herein constituting this Order, constitute the entire agreement under which Seller is supplying the Goods for sale to Buyer. No other terms, condition, or understanding, whether oral or written, shall be binding upon Seller, unless concurrently herewith or hereafter made in writing and signed by Seller's authorized representative.

23. NO WAIVER - No waiver of any term, provision, covenant or condition of these Terms and Conditions by Seller, whether by conduct or otherwise, in any one or more instances, shall be deemed or construed as a further or continuing waiver of any such term, provision, covenant or condition or as a waiver of any other term, provision, covenant or condition hereof.

24. SUCCESSORS AND ASSIGNS - The rights, duties, agreements and obligations hereunder, or any portion thereof, shall be binding upon and inure to the benefit of Seller and Buyer and their respective successors and assigns.

25. GOVERNING LAW; U.N. CONVENTION ON THE SALE OF GOODS; JURISDICTION - This Order, which has been made and entered into the State of Illinois, United States of America, and all the rights and duties of the parties arising from or relating in any way to the subject matter of this Order or the transaction(s) contemplated by it, shall be governed by, construed and enforced in accordance with the laws of the State of Illinois and the United States of America without regard to any conflict of laws rules, except to the extent of provisions included herein by virtue of the requirements applicable to Federal Government procurement, which provisions shall be construed and interpreted according to the Federal common law of government contracts as enunciated and applied by Federal judicial bodies, boards of contract appeals and quasi-judicial agencies of the Federal Government. The rights and obligations of Buyer and Seller shall not be governed by the provisions of the United Nations Convention on Contracts for the International Sale of Goods. Any suit or proceeding relating to this Order or the Goods may be brought in the courts, state or federal, located in Chicago, Cook County, Illinois. BUYER HEREBY CONSENTS TO THE PERSONAL JURISDICTION AND VENUE OF THE COURTS, STATE AND FEDERAL, LOCATED IN CHICAGO, COOK COUNTY, ILLINOIS. TCS-06

Please see our website for updated Terms and Conditions: ***smalley.com/terms-and-conditions***

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NO ORDINARY MANUFACTURING COMPANY

Every Smalley retaining ring and wave spring is backed by our legendary customer support.
Don't just take our word for it - see what our customers are saying.

"Great customer service, love how easy it is to get samples for our prototypes. Everyone at Smalley is very courteous and knowledgeable. Love using Smalley on all of our new designs. Thanks so much!"

Christopher
Medical Industry

"I deal with a lot of vendors in our daily business, and Smalley is one of the easiest and most consistent to work with. It's refreshing."

Vanessa
Automotive Industry

"After 45 years, they are still the best supplier!"

Marty
Aerospace Industry

SMALLEY

THE ENGINEER'S CHOICE®

STANDARD OR CUSTOM

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

STANDARD PRODUCTS

SMALLEY WAVE SPRINGS

- CREST-TO-CREST®
- SINGLE-TURN
- WAVO®
- LINEAR
- NESTED SPIRAWAVE®

RETAINING RINGS

- SPIROLOX®
- CONSTANT SECTION
- HOOPSTER®
- WAVERING®

LAMINAR SEAL RINGS

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