Smalley®
Steel Ring Company

Engineering and Parts Catalog

Spiral Retaining Rings & Wave Springs

www.smalley.com

Metric

All Springs Are Not Equal®

Wave Springs

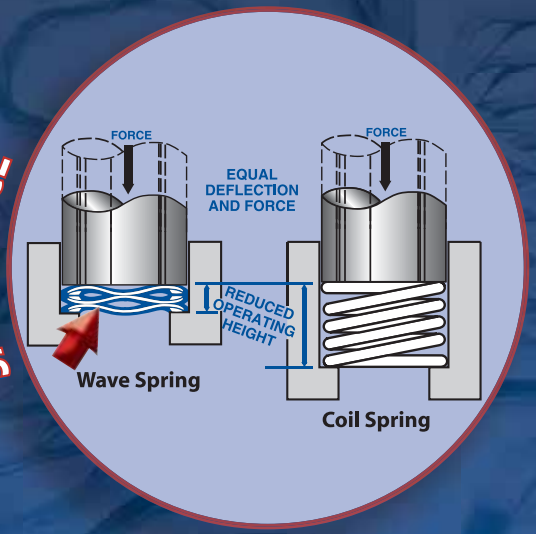
- **1/2 THE HEIGHT OF COIL SPRINGS**
- **EQUAL FORCE AND DEFLECTION**
- **STAINLESS STEEL FROM STOCK**

Smalley wave springs can reduce assembly size by up to 50%. In only half the space used by a coil spring, wave springs produce the same force and deflection.

Over **2 000 standard** wave springs are available from stock in both carbon and stainless steel, from 10 mm – 400 mm, 3/8 in – 16 in.

Special designs can be manufactured quickly and economically with Smalley's No-Tooling-Cost™ manufacturing process. Special designs are available from 5 mm – 2 300 mm, 0,200 in – 90 in diameters.

SAVE SPACE



FREE SAMPLES TO TEST

Smalley®
Steel Ring Company

www.smalley.com • +1 847 719 5900 • info@smalley.com

Smalley® Europe

Smalley® Nordic AB

TABLE OF CONTENTS

Smalley® Steel Ring Company

Smalley®
Steel Ring Company

Founded in 1918 as a supplier of precision automotive piston rings, Smalley Steel Ring Company had many years of successful growth in an expanding marketplace. Having had a variety of products through out the years, it wasn't until 1963, when present ownership began the development of products in the wire forming industry. Spiral Retaining Rings and Wave Springs emerged and Smalley developed into a reputable manufacturer of precision rings, springs & wire forms. But one thing never changed from years back, and that is our commitment to providing ever-higher levels of quality, performance, deliverability, and value to our customers. Today, Smalley Steel Ring Company is a market leader in the industrial retaining ring and wave/compression spring business; a position we work hard to maintain and build upon.

> "One thing has never changed... and that is our **commitment** to providing ever-higher levels of **quality, performance, deliverability,** and **value** to our customers."

Every Smalley ring and spring is engineered and manufactured to the highest quality standards using skills and processes we have honed over three quarters of a century. Our obsession with quality, combined with our near-perfect record of on-time delivery, has earned us an approved supplier status with leading OEM manufacturers around the world. Due to the ceaseless demands we place upon ourselves, Smalley has won the coveted title of Preferred Source in the most demanding applications: automotive, agriculture, aerospace, electronics, appliance, and industrial.

While we are understandably proud of the recognition we have received, ultimately, it is our products that set us apart. Unlike stamped rings and springs, which are die-stamped through the metal grain, our edgewound rings and springs have a circumferential metal grain structure that gives them exceptional strength, dimensional stability, and predictable performance characteristics.

Finally, every Smalley ring and spring is backed by our continued support. We are constantly searching ways to expand and improve our Customer Service and Engineering/Technical Assistance. We welcome your comments and your design challenges. Engineers are available to help assist with any design questions.

With regional offices in Europe, we are prepared to service our European customers. Smalley provides customized global supply chain solutions, to meet your WORLDWIDE manufacturing requirements, in Europe, Asia Pacific and the America's.

Please call us at **+1 847.719.5900** or visit

WWW.SMALLEY.COM

PRODUCTS

All of Smalley's wave springs and retaining rings are manufactured with our unique edgewinding manufacturing process. This eliminates any tooling charges, greatly increases design flexibility and reduces leadtimes as dies do not have to be produced.

RETAINING RINGS

Unlike die-stamped circlips / retaining rings, Smalley Spiral Retaining Rings and Snap Rings are coiled on edge to the exact diameter required. They have a uniform cross-section (or to use our terminology, No Ears To Interfere™ within an assembly) and are free of burrs. Smalley spiral retaining rings meet military and aerospace specifications and are found in thousands of mechanical products around the world.

WAVE SPRINGS

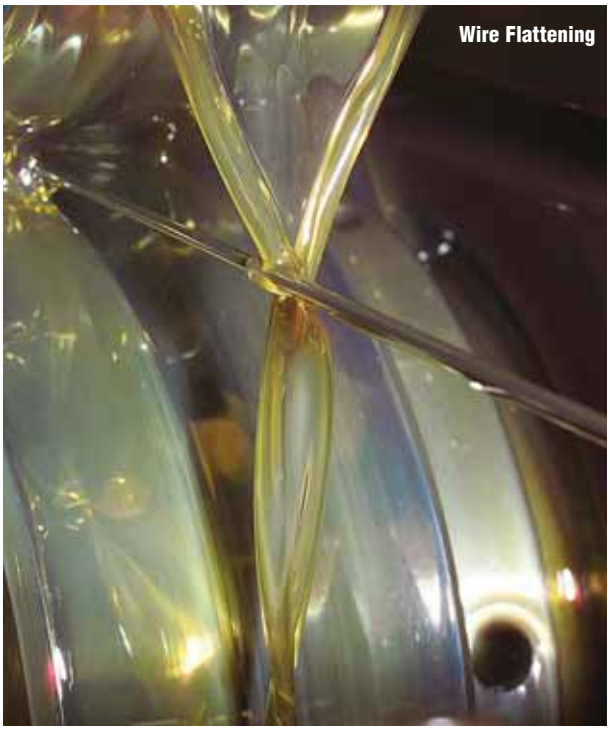
Wave springs are precise flat wire compression springs that fit into assemblies that other springs cannot. Since the overall lengths and operating heights of wave springs are lower than those of conventional round wire springs, they will often reduce the size of an assembly by as much as 50%. Of course, this will also reduce the part weight and raw material cost of every spring produced.

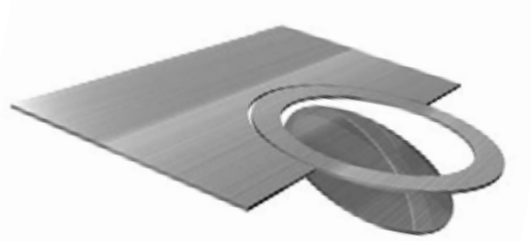
RAW MATERIAL

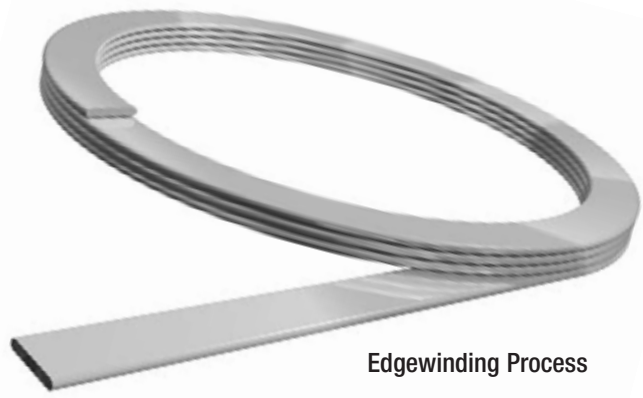
As we meet the increasing demand for more raw material sizes, the flat wire rolling mill operation in our plant continues to grow. Years ago, Smalley began a vertical integration that has evolved into the production of hundreds of material cross-sections in a wide variety of alloys.

MANUFACTURING

Edgewinding, also known as "The No-Tooling-Cost Process", is our precision forming operation that coils pre-tempered flat wire on edge to create a near-perfect circle. (Visualize a Slinky®, the coiled metal toy which has delighted generations of children.) Circular-Grain® metallurgy gives our products strength and stability far superior to that of conventional retaining rings and wave washers which are simply stamped through the metal grain. Smalley edgewound products can be coiled to your exact specification in any diameter and with any number of turns (layers or coils), effectively eliminating material waste.


Wire Flattening


Conventional Stamping Process


Edgewinding Process

As flexible as it is precise, our edgewinding process accommodates your design changes without the need for additional tooling and die modifications. This facilitates your developmental work, allowing us to produce your low-quantity custom orders and your working prototypes quickly and economically. Even after your initial prototype is produced, or in mid-stream production, our edgewinding process allows us to alter your design or dimensions with simple machine adjustments or a change in raw material size. After the revised specifications are approved, we complete and document the final setup. Then, we quickly resume production of your order, whether it consists of one part or one million.

PROTOTYPES

About the easiest way to test a theoretical design is to produce a working prototype – a task at which Smalley excels. A prime example is the development of a custom wave spring. We can adjust dimensions, by changing the number of waves and the number of turns, and trying different combinations of spring variables. Finally, we test for function, before production, so we know we have it right.

Smalley-produced prototypes are also the most economical way to provide results on a trial-and-error basis. From one to a thousand pieces, we can produce, try, modify, and reproduce your design as often as necessary – all without special tooling costs.


Wire Mill

FINISHED PARTS WAREHOUSE

Smalley maintains a substantial parts inventory of every cataloged/standard retaining ring and wave spring – in both carbon and stainless steel. We do this to meet our JIT deliveries as well as any immediate requirement that you may have. In the rare circumstance that our inventory runs low, we can quickly replenish any item overnight.

In addition to our finished parts, we house a vast inventory of raw material sizes, stocked in thousands of pounds of flat wire. We are always ready to meet your needs for a quick turnaround in low to high quantities of existing or new designs.

CUSTOMER SERVICE

Smalley is dedicated to giving you the most positive, efficient, and economical service possible—each and every day. We continually train our staff on every important aspect of our business. We can split shipments to suit your "just-in-time" delivery requirements. We offer you lower prices for your annual higher-usage orders. Please contact us directly for complete details and ideas on how you can purchase economically.

GENERAL SALES INFORMATION

DESCRIPTION: The product descriptions in this catalog are intended to provide the user with practical information for application selection. Since it is not possible to include complete detail on all parts, please contact Smalley for any information not included in the description which may be critical for a specific application.

QUOTATIONS: We will provide written or verbal quotations as requested.

RETURNS: Parts not stocked which must be specially manufactured are not returnable except by special arrangement and will be subject to cancellation charges. Stocked parts may be returned for credit at a standard restocking charge (subject to condition). All returns of stocked parts must be made within 30 days from date of receipt of material.

DELIVERY: Parts carried in stock normally will be shipped within 48 hours after receipt of an order. Special parts are normally delivered in 3 weeks (if no special processes are required) or as previously arranged.

CERTIFICATIONS: Standard Certificate of Conformance will be supplied at no charge. Material and other Certifications for plating, load, etc. will be furnished as quoted.

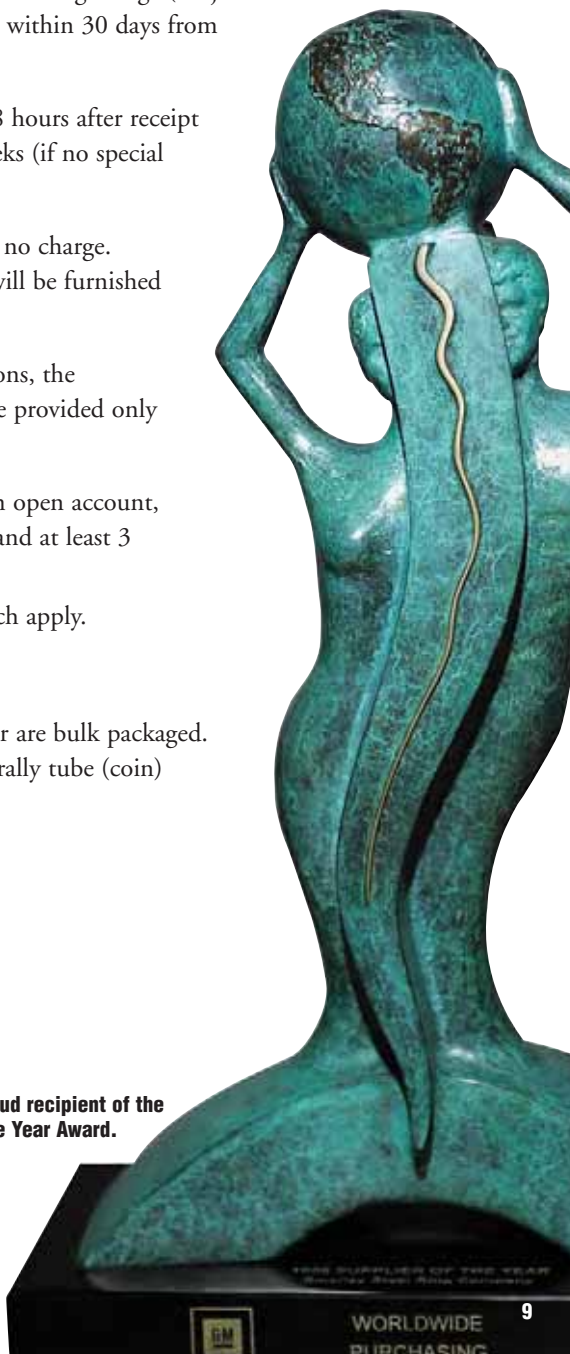
TRANSPORTATION: As specified by the customer. In the absence of instructions, the shipping method will be selected by us. Insurance will be provided only at the customer's request.

TERMS: 1/10/NET 30 on open accounts. For consideration of an open account, customers are requested to supply banking information and at least 3 commercial credit references.

Go to www.smalley.com for Terms and Conditions, which apply.

F.O.B.: Factory, Lake Zurich, Illinois, USA

PACKAGING: Rings and springs roughly 34 mm in diameter and under are bulk packaged. Rings and springs 35 mm and over in diameter are generally tube (coin) packaged in lengths 250 mm to 450 mm.



Smalley is the proud recipient of the GM Supplier of the Year Award.

ENGINEERING & DESIGN ASSISTANCE

Smalley's engineering staff is always ready to address your application requirements. Usually, the sooner we are able to review what you need, the easier the solution will be. Please call us today.

We invite you to draw upon our resources. Over the years, Smalley engineers have built an extensive library of over 5 000 applications while designing rings and springs in mechanical components and assemblies. In addition, we offer computer-aided spring-design alternatives to meet your specifications.

There are many more options that we would be pleased to review with you once your design criteria are established. We are ready to help you with the selection of a standard part from our vast inventory, or to modify a standard part to meet your exact needs.

We are pleased to offer you additional step-by-step resources. The "Designing Specials" section of this catalog will help you determine basic retaining ring and wave spring specifications. We also invite you to try the design section on our website for step-by-step interactive design guidelines and options. As you can see, we are well-equipped to help you develop the best design solution possible, just as we have for thousands of other companies in diverse industries.

NEED A SAMPLE?

We offer free samples of any ring or spring found in our catalog.

SPECIALS

At Smalley, specials are standard. It's easy to get a custom part from Smalley. With No-Tooling-Charges™, die costs, or other fixture charges, we can manufacture a new ring or spring design in just two weeks or to meet your delivery schedules.

Fast, precise, and economical — that's how Smalley produces rings and springs, in short runs or high volumes. If you can't find a standard part to meet your needs from the wide selection in our catalog, please contact our engineering department for immediate assistance with your special design requirements. And please note: Smalley Rings and Springs are available from 5 mm to 2 300 mm in diameter.

CAD DOWNLOADS

Visit our website for CAD downloads in 91 different formats. It's easy to search and select a standard part for a quick upload to your computer.

Inspection Department

QUALITY ASSURANCE

Smalley's Total Quality Management philosophy dictates our commitment to quality and customer satisfaction. While this commitment has earned us official certification (ISO 9001, ISO/TS 16949, AS9100), quality assurance and customer satisfaction mean much more at Smalley. They are tradition, the very foundation upon which we have built our company. From the beginning, we have never lost sight of our goal: "to supply Smalley customers with uncompromising quality and service."

Smalley is committed to a quality policy that requires conformance to specification with controlled lot variation about the target, statistical quality control, defect prevention, and annual improvement in process and product. This is a company-wide commitment involving every Smalley employee. Each person works towards excellence, individually and cooperatively, to provide superior products and services.

"Our goal... to supply Smalley customers with uncompromising quality and service."

A history of quality and strict compliance with military and aerospace standards has earned Smalley an approved supplier status with many leading original equipment manufacturers worldwide. Smalley has worked diligently to become their Preferred Source for spiral retaining rings and wave springs.

In accordance with the requirements of ISO 9001, ISO/TS 16949, AS9100, we have established and are continuously improving our quality systems. Use of the latest technology, including statistical tools, has helped us achieve and maintain the world-class quality associated with the Smalley name for more than 40 years.

Smalley uses statistical quality control tools to assure the capability and stability of our coiling process. To begin with, we identify common dimensions to monitor and special causes of variation in the product. Then, we collect and analyze data on these critical dimensions. We perform disciplined sampling and take measurements during in-line and final inspection, and yet again, during pre-shipping inspection.

We make formal SQC in-house training programs mandatory for many Smalley employees involved with manufacturing. This training has noticeably developed quality awareness and responsibility at all levels. Our employees have a clear understanding of what is expected, a means of regulating their processes and checking their output, and statistical tools to determine when machine adjustments are required.

Smalley's machine capability studies help us identify sources of variation before they become a problem. We analyze the capabilities of all production machinery in primary and secondary operations, heat treating, and finishing. In addition, we follow our own meticulous procedures to determine the reproducibility and repeatability of our gauging systems.

Due to the careful documentation of our quality, many Smalley customers have found that they can reduce or even eliminate their incoming inspections of our product. Many of our accounts have also revised their policy of dual sourcing and confidently rely on Smalley as their single source of retaining rings, wave springs, snap rings, expanders, and other wire forms.

Defect prevention, or near-zero defects, is a key goal at Smalley. We use the latest automated inspection techniques to monitor production. As a result, we are constantly studying the causes of variation, improving upon and developing processes with capability indexes (Cpk) exceeding 1,33.

Continuous improvement is an integral part of Smalley's quality plan. We require each of our departments to design and implement projects to improve their respective systems.

QUALITY POLICY

Smalley has established and is continuously improving upon a program that is designed to meet the following objectives:

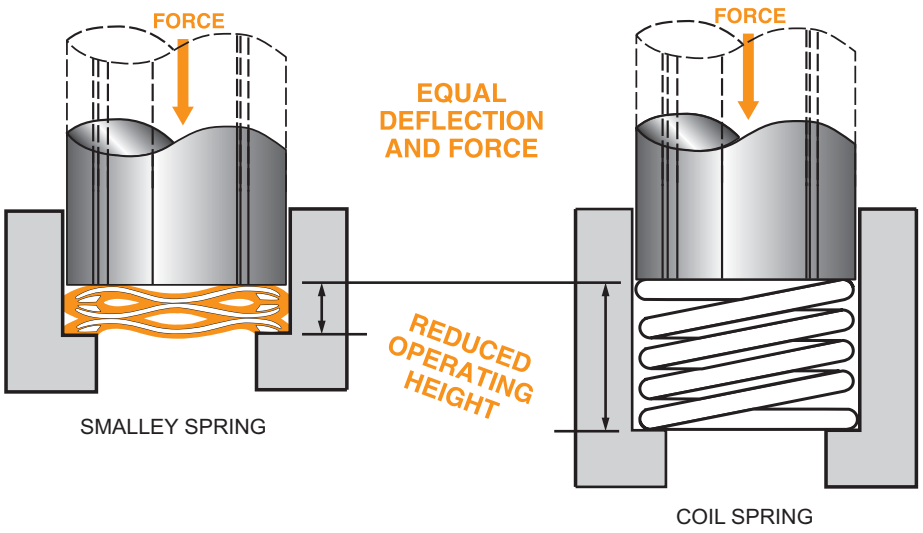
- Total product conformance in terms of drawings, specifications and contractual requirements.
- 100% on-time delivery performance.
- Superior products with exceptional value.
- Prompt, professional and courteous response in every facet of design, manufacturing, sales, and customer service.
- Continued development and use of the latest technology.

ALL SPRINGS ARE NOT EQUAL®

Smalley Wave Springs offer the unique advantage of space savings when used to replace coil springs. By reducing spring operating height, wave springs also produce a decrease in the spring cavity. With a smaller assembly size and less material used in the manufacturing process, a cost savings is realized.

Wave springs operate as load bearing devices. They take up play and compensate for dimensional variations within assemblies. A virtually unlimited range of forces can be produced whereby loads build either gradually or abruptly to reach a predetermined working height. This establishes a precise spring rate in which load is proportional to deflection.

Functional requirements are necessary for both dynamic and static spring applications. Special performance characteristics are individually built into each spring to satisfy a variety of precise operating conditions. Typically, a wave spring will occupy an extremely small area for the amount of work it performs. The use of this product is demanded, but not limited to tight axial and radial space constraints.



PRODUCT PERFORMANCE

With their smooth, circular coiled sinusoidal wave form, and rolled round edges of pre-tempered raw material, Smalley's edgewound Wave Springs offer many advantages over die stamped products.

Loads and spring rates are more accurate, more predictable, and may be toleranced better than 50 percent tighter than stampings. The force of a Smalley Wave Spring will increase at a uniform rate throughout most of its available deflection.

By any criteria, Smalley Wave Springs offer their users higher dependability and better performance. Since they are produced from full hard, pre-tempered raw material, there is no risk of distorting the spring during a hardening heat treatment. By contrast, subsequent manufacturing procedures for stamped wavy washers can lead to problems such as fatigue cracking and inaccurate or inconsistent loading between springs. All told, the metallurgy, the mechanical properties and the uniform dimensional stability of the Smalley edgewound Wave Spring provide a component for precision quality applications.

WAVE SPRING TYPES

GAP & OVERLAP TYPE

Conventional Gap and Overlap Type Wave Springs are used in a wide variety of applications. For short deflections and low-medium forces, they function with precision and dependability.

These two types of Smalley Wave Springs permit radial expansion or growth in diameter within a cavity, without the binding or hang-up normally associated with die stamped wave washers. Just as their terms imply, the gap type is split to retain a gap between the ends; while the overlap type has overlapping ends. Thus, the ends are free to move circumferentially as the spring outside diameter grows during compression.

For example, the O.D. of a Gap Type Wave Spring would fit 0,50 mm loose per side in a bore. Its I.D. clears a shaft by 0,25 mm per side. As the spring is deflected, the O.D. and I.D. grow larger until the O.D. contacts the bore. Continued deflection causes the gap ends to move closer together while the O.D. presses against the bore. An Overlap Type Wave Spring permits this type of cycling action in a similar manner.

Gap Type Wave Springs

Overlap Type Wave Springs

CREST-TO-CREST®

Crest-to-Crest Wave Springs are prestacked in series, decreasing the spring rate proportionally to the number of turns. Uses are typically applications requiring low-medium spring rates and large deflections with low-medium forces. Among major advantages, this design eliminates the need to keep the wave crests aligned. The need to use a key locating device, or to insert a shim between individual springs is not necessary. Because the spring is integrally formed, the wave peaks hold their configuration.

As a replacement for helical compression springs, Crest-to-Crest springs can develop similar forces, yet occupy one-half (½) or less the axial space. This allows for strict space constraints. Crest-to-Crest Wave Springs will maintain the same force and load specifications of a conventional round wire spring, but with the advantages of resultant lowered and compacted operating heights, free heights, and solid heights.

WAVE SPRING TYPES (cont'd)

CREST-TO-CREST® WITH OPTIONAL SHIM ENDS

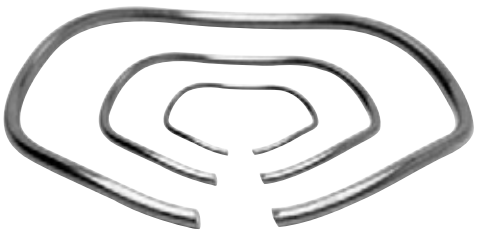
Crest-to-Crest Wave Springs are also available with squared-shim ends. Shim ends provide a 360° contact surface when compared to the wave point contact of plain ends. The shim-ends under load, more evenly distribute the springs force upon adjacent components. This feature is similar to the concept of double-disc grinding springs for a flat surface. Shim ends have also been used to affix springs to mating components, as a flat locating surface that may be attached by various methods in the assembly.

NESTED

Nested Wave Springs are pre-stacked in parallel from one continuous filament of flat wire. The need to stack individual springs for higher loads is no longer necessary. Nested springs result in a spring rate that increases proportionately to the number of turns. They can exert tremendous forces, yet maintain the precision of a circular-grain wave spring. In many applications, Nested Wave Springs replace Belleville Springs, particularly in cases where a high but accurate force is needed.

WAVO®

Wavo Springs are produced from round-section wire to provide higher loads while maintaining the accurate loading found in wave springs. As an alternative to Belleville Springs, the Wavo provides similar loads but with an accurate, predictable spring rate.



LINEAR EXPANDERS

Linear expanders are a continuous wave formed (marcelled) wire length produce from spring tempered materials. They act as a load bearing device having approximately the same load/deflection characteristics as a wave spring.

Forces act axially or radially depending on the installed position. Axial pressure is obtained by lying the expander flat in a straight line. Circular wrapping the expander produces a radial force or outward pressure. Linear expanders are available cut to length or as a continuous coil, for the user to cut as needed.

PRESSURE RELIEF VALVE

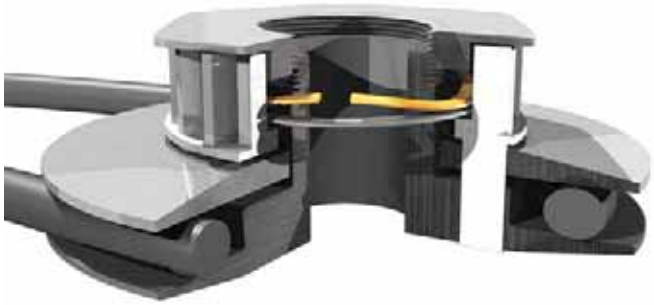
An exact load applied to the top sealing plate was accomplished using a flat wire wave spring. Air pressure entering the top slots forces the plate away from the sealing surface providing the pressure relief mechanism.

FACE SEAL

Wave spring applies pressure, to precisely load the carbon face against a mating surface, to properly seal fluids. The spring operates over a fixed working range and provides an exact force, unlike the stamped wavy washer it replaced which could not maintain the necessary spring rate.

CLUTCH DRIVE

Pressure on the round belt is produced by compressing the Wavo® Spring thru the sheave halves. The top threaded cap rotates to adjust the Wavo compression.



BAYONET CONNECTOR

Overlap Type Wave Spring installed in an electronic connector assembly. As male and female components are rotated together into final assembly, the wave spring is compressed to its working height. In this position it exerts a constant force that locks both components together.

MULTI-TOOTH CUTTER

A custom designed wave spring with locating tabs is contained in the housing. The spring applies a precise force to the two cutter halves, allowing them to oscillate but not rattle.

Wave Spring Applications

SLIP CLUTCH

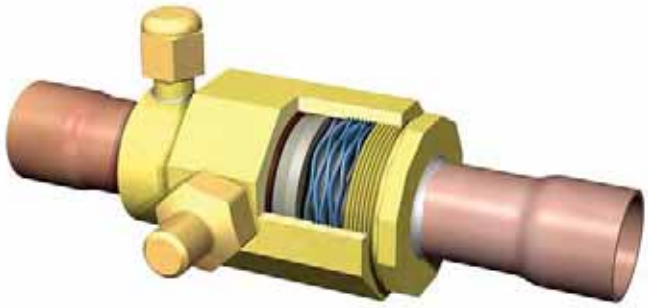
Clutch drives when the "V"-detents are in the "V"-slots. A Smalley Wave Spring maintains pressure to hold this position. As torque is increased, the "V"-detents will ride up and out the "V"-slots, depressing the wave spring and developing the slip mechanism. When torque is decreased, the wave spring forces the "V"-detents firmly into the "V"-slots to drive again.

BEARING PRE-LOAD

One of the most common wave spring applications world-wide is a bearing preload arrangement as illustrated. Having the proper load will often extend bearing life by lowering operating temperatures, reducing vibration, minimizing wear and providing for quieter & smoother performance.

FLOW VALVE

As fluid pressure increases the Crest-to-Crest® Wave Spring precisely controls the linear displacement of the piston, which positions the orifice for proper fluid flow.

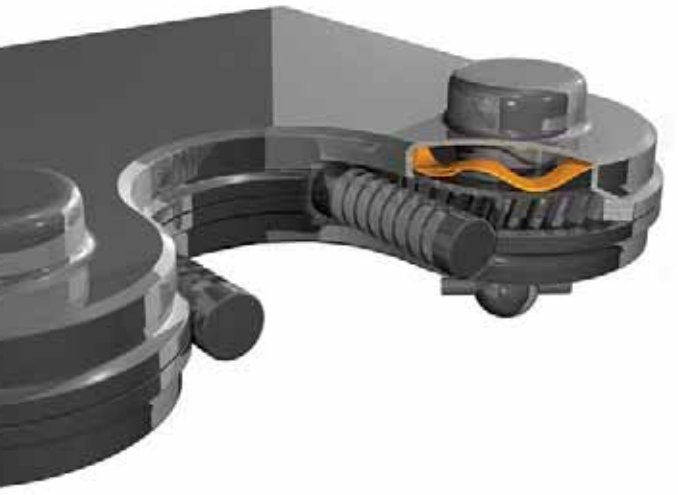


LOW VOLTAGE CONNECTOR

A Bayonet Connector couples as the male end rotates and follows the groove contour in the female end. A 2-Turn Nested Spirawave Wave Spring provides the pre-load between the two halves. A 2-Turn Nested Spring was necessary, to develop a higher load in very tight radial and axial space.

SPRINKLER VALVE

With height restrictions accounted for, the Smalley Crest-to-Crest® Wave Spring maintains constant pressure on the pop-up head, holding it firmly closed. In operation, water pressure releases the head by over-coming the spring's force.

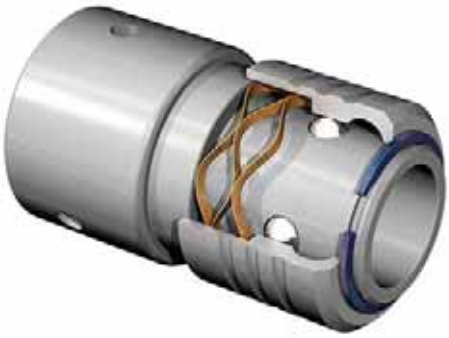


GEAR BOX DRIVE

Designed in a plastic housing, this Smalley Wave Spring keeps constant pressure on a pinion gear, which is driven by a worm gear. The presence of vibration is greatly reduced by the spring. Also, the spring takes up tolerances that accumulate in the plastic non-critical components used in the box.

HIGH SPEED PUMP

A Smalley Wavo® Spring was specified to provide a higher preload (the force needed was greater than offered with a stock Wave Spring) to the tapered roller bearings. Also, the entire bearing/spindle arrangement is held in its housing by a spiral retaining ring.

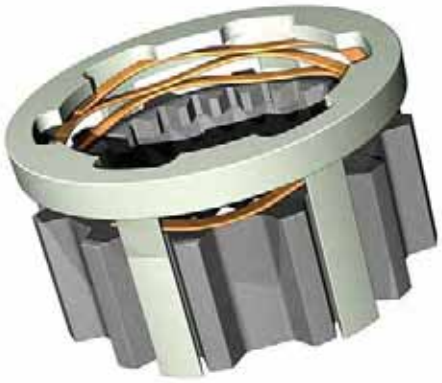


QUICK DISCONNECT

The sliding member of the disconnect is held in its forward / locked position against the retaining ring, by the Crest-to-Crest® Spring. As the user slides the member in the opposite direction compressing the spring, the detent balls align with a groove and release.

VIBRATION ISOLATOR

Wavo Springs provide high force and a relatively large axial displacement, in limited space. The springs are arranged in series for additional travel.



FLOATING GEAR

Functioning in a contained bracket, a Crest-to-Crest Wave Spring loads a gear with light force allowing axial movement. The gear shown self-aligns with its mating gear during operation.

Stock Items in carbon steel and 17-7 PH/C stainless steel. Springs listed below are 3 wave, **Overlap Type.**

Smalley Part Number [1, 4]	Operates in Bore Diameter (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height [2] (mm)	Number of Waves	Wire Thickness	Radial Wall	Spring Rate [2, 3] (N/mm)
SSR-0050	12,70	10,16	31,2	1,27	2,16	3	0,20	1,02	35
SSR-0062	15,75	12,19	44,5	1,27	2,41	3	0,25	1,47	39
SSR-0075	19,05	12,70	62,3	1,57	4,06	3	0,25	1,98	25
SSR-0087	22,10	15,75	71,2	1,57	3,30	3	0,30	2,39	41
SSR-0100	25,40	19,81	80,1	1,57	4,06	3	0,30	2,39	32
SSR-0112	28,45	21,34	89,0	1,98	3,30	3	0,41	3,38	67
SSR-0125	31,75	24,38	97,9	1,98	3,81	3	0,41	3,38	54
SSR-0137	34,80	27,69	106,8	1,98	4,83	3	0,41	3,38	37
SSR-0150	38,10	29,72	115,7	1,98	4,32	3	0,46	3,63	50
SSR-0162	41,15	33,27	124,6	1,98	5,08	3	0,46	3,63	40

[1] Add suffix "-S17" for 17-7 stainless steel.
[2] Reference dimension.
[3] Spring rate is measured in N/mm.
[4] See pages 106-107 for How to Order.

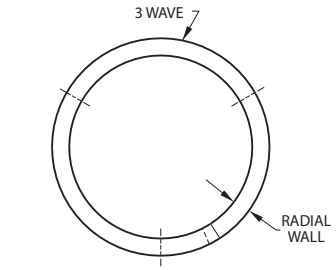
SPRINGS

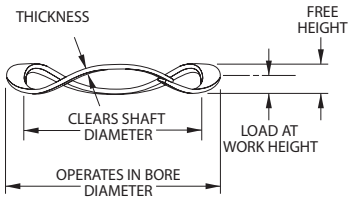
OVERLAP TYPE

SSR-0050 to SSR-0162

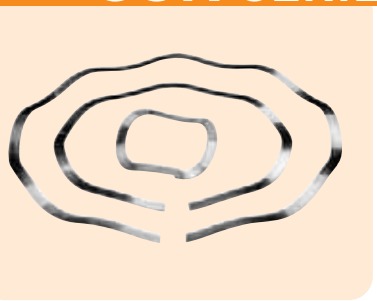
Product Dimensions

All dimensions in millimeters unless otherwise specified.





Stock Items in carbon steel and 17-7 PH/C stainless steel. Springs listed below are 4 waves and up, **Gap Type.**



Smalley Part Number [1, 4]	Operates in Bore Diameter (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height [2] (mm)	Number of Waves	Wire Thickness	Radial Wall	Spring Rate [2,3] (N/mm)
SSR-0175	44,45	36,58	133,5	1,98	3,56	4	0,46	3,63	85
SSR-0187	47,50	39,62	142,4	1,98	3,81	4	0,46	3,63	78
SSR-0200	50,80	42,67	151,3	2,36	3,56	4	0,61	3,81	127
SSR-0212	53,85	45,72	160,2	2,36	3,81	4	0,61	3,81	111
SSR-0225	57,15	49,02	169,1	2,36	4,32	4	0,61	3,81	87
SSR-0237	60,20	50,55	178,0	2,36	4,06	4	0,61	4,52	105
SSR-0250	63,50	53,85	186,9	2,36	4,32	4	0,61	4,52	95
SSR-0262	66,55	56,90	195,8	2,36	4,83	4	0,61	4,52	80
SSR-0275	69,85	59,44	204,7	2,77	4,32	4	0,76	4,78	132
SSR-0287	72,90	62,74	213,6	2,77	4,57	4	0,76	4,78	118
SSR-0300	76,20	65,79	222,5	2,77	4,83	4	0,76	4,78	108
SSR-0312	79,25	68,83	231,4	2,77	5,33	4	0,76	4,78	90
SSR-0325	82,55	69,85	240,3	2,77	5,08	4	0,76	5,92	104
SSR-0337	85,60	72,14	249,2	2,77	5,59	4	0,76	5,92	88
SSR-0350	88,90	76,20	258,1	2,77	5,84	4	0,76	5,92	84
SSR-0362	91,95	79,25	267,0	2,77	6,10	4	0,76	5,92	80
SSR-0375	95,25	82,55	275,9	2,77	6,60	4	0,76	5,92	72
SSR-0387	98,30	85,60	284,8	2,77	7,62	4	0,76	5,92	59
SSR-0400	101,60	88,90	293,7	2,77	4,83	5	0,76	5,92	143
SSR-0412	104,65	91,95	298,2	2,77	5,08	5	0,76	5,92	129
SSR-0425	107,95	95,00	307,1	2,77	5,33	5	0,76	5,92	120
SSR-0437	111,00	98,04	311,5	2,77	5,33	5	0,76	5,92	121
SSR-0450	114,30	101,35	320,4	2,77	5,84	5	0,76	5,92	104
SSR-0462	117,35	104,39	324,9	3,18	6,86	5	0,76	5,92	88
SSR-0475	120,65	107,70	333,8	3,18	7,87	5	0,76	5,92	71
SSR-0487	123,70	111,00	338,2	3,18	7,37	5	0,76	5,92	81
SSR-0500	127,00	114,05	347,1	3,18	7,87	5	0,76	5,92	74
SSR-0512	130,05	117,09	356,0	3,18	8,64	5	0,76	5,92	65
SSR-0525	133,35	120,40	364,9	3,18	9,40	5	0,76	5,92	59
SSR-0537	136,40	123,44	373,8	3,18	9,65	5	0,76	5,92	58
SSR-0550	139,70	126,75	382,7	3,18	6,35	6	0,76	5,92	121
SSR-0562	142,75	129,79	391,6	3,18	6,86	6	0,76	5,92	106
SSR-0575	146,05	133,10	400,5	3,18	7,11	6	0,76	5,92	102
SSR-0587	149,10	136,14	409,4	3,18	7,62	6	0,76	5,92	92
SSR-0600	152,40	139,45	418,3	3,18	7,62	6	0,76	5,92	94
SSR-0612	155,45	142,49	427,2	3,18	7,87	6	0,76	5,92	91
SSR-0625	158,75	145,54	436,1	3,18	8,64	6	0,76	5,92	80
SSR-0637	161,80	148,84	445,0	3,18	8,89	6	0,76	5,92	78
SSR-0650	165,10	151,89	453,9	3,18	9,91	6	0,76	5,92	67
SSR-0675	171,45	158,24	462,8	3,18	10,67	6	0,76	5,92	62
SSR-0700	177,80	156,46	471,7	3,96	8,13	6	0,81	9,53	113
SSR-0725	184,15	163,58	480,6	3,96	8,89	6	0,81	9,53	98
SSR-0750	190,50	169,93	489,5	3,96	9,14	6	0,81	9,53	94
SSR-0775	196,85	176,28	507,3	3,96	9,65	6	0,81	9,53	89
SSR-0800	203,20	182,63	525,1	3,96	9,91	6	0,81	9,53	88
SSR-0825	209,55	188,98	542,9	3,96	10,92	6	0,81	9,53	78
SSR-0850	215,90	195,07	560,7	3,96	8,64	7	0,81	9,53	120
SSR-0875	222,25	201,42	578,5	3,96	8,64	7	0,81	9,53	124
SSR-0900	228,60	207,77	596,3	3,96	7,37	8	0,81	9,53	175
SSR-0950	241,30	220,47	631,9	3,96	6,10	9	0,81	9,53	296
SSR-1000	254,00	232,92	667,5	3,96	7,37	9	0,81	9,53	196
SSR-1050	266,70	245,62	703,1	3,96	7,87	9	0,81	9,53	180
SSR-1100	279,40	258,32	738,7	3,96	8,89	9	0,81	9,53	150
SSR-1150	292,10	270,76	774,3	3,96	9,14	9	0,81	9,53	149
SSR-1200	304,80	283,46	809,9	3,96	11,18	9	0,81	9,53	112
SSR-1250	317,50	296,16	845,5	3,96	8,89	10	0,81	9,53	172
SSR-1300	330,20	308,86	881,1	3,96	10,41	10	0,81	9,53	137
SSR-1350	342,90	321,31	916,7	3,96	10,92	10	0,81	9,53	132
SSR-1400	355,60	334,01	952,3	3,96	7,62	12	0,81	9,53	260
SSR-1450	368,30	346,71	983,5	3,96	8,13	12	0,81	9,53	236
SSR-1500	381,00	358,90	1 023,5	3,96	8,89	12	0,81	9,53	208
SSR-1550	393,70	371,86	1 063,6	3,96	7,87	13	0,81	9,53	272
SSR-1600	406,40	384,56	1 103,6	3,96	8,64	13	0,81	9,53	236

[1] Add suffix "-S17" for 17-7 stainless steel.
[2] Reference dimension.
[3] Spring rate is measured in N/mm.
[4] See pages 106-107 for How to Order.

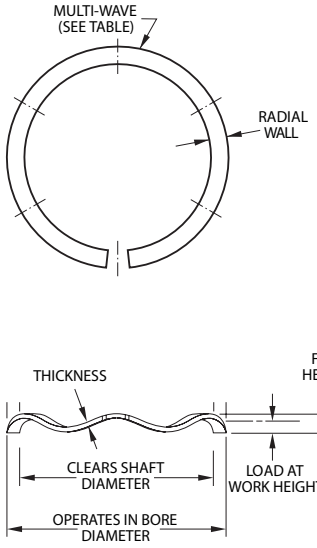
SPRINGS

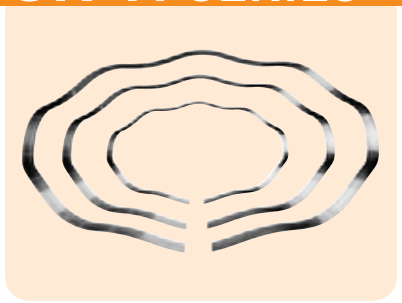
GAP TYPE

SSR-0175 to SSR-1600

Product Dimensions

All dimensions in millimeters unless otherwise specified.





Smalley narrow section wave springs were originally designed to pre-load packings in telescoping hydraulic cylinders. They have also found other applications where working space is highly limited. This Smalley Wave Spring series is designed to fit into a bore with a light snap to assure perfect concentricity between the wave spring and assembly. When these narrow section wave springs are compressed, radial expansion is taken up by the gap in the spring to eliminate binding.

Stock Items in carbon steel and 17-7 PH/C stainless steel. Springs listed below are 4 waves and up, **Gap Type**.

Smalley Part Number[1, 4]	Operates in Bore Diameter (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height[2] (mm)	Number of Waves	Wire Thickness	Radial Wall	Spring Rate[2,3] (N/mm)
SSR-0325-N	82,55	71,63	240,3	2.77	5,08	4	0,76	4,78	104
SSR-0337-N	85,60	74,68	249,2	2,77	5,59	4	0,76	4,78	88
SSR-0350-N	88,90	77,98	258,1	2,77	6,60	4	0,76	4,78	67
SSR-0362-N	91,95	81,03	267,0	2,77	6,86	4	0,76	4,78	65
SSR-0375-N	95,25	84,33	275,9	2,77	7,11	4	0,76	4,78	64
SSR-0387-N	98,30	87,38	284,8	2,77	7,87	4	0,76	4,78	56
SSR-0400-N	101,60	90,68	293,7	2,77	5,08	5	0,76	4,78	127
SSR-0412-N	104,65	93,73	298,2	2,77	5,08	5	0,76	4,78	129
SSR-0425-N	107,95	97,03	307,1	2,77	6,10	5	0,76	4,78	92
SSR-0437-N	111,00	100,08	311,5	2,77	5,33	5	0,76	4,78	121
SSR-0450-N	114,30	103,38	320,4	2,77	7,11	5	0,76	4,78	74
SSR-0462-N	117,35	106,43	324,9	3,18	6,86	5	0,76	4,78	88
SSR-0475-N	120,65	109,73	333,8	3,18	8,13	5	0,76	4,78	67
SSR-0487-N	123,70	112,78	338,2	3,18	8,13	5	0,76	4,78	68
SSR-0500-N	127,00	116,08	347,1	3,18	8,89	5	0,76	4,78	61
SSR-0512-N	130,05	119,13	356,0	3,18	8,89	5	0,76	4,78	62
SSR-0525-N	133,35	122,43	364,9	3,18	9,14	5	0,76	4,78	61
SSR-0537-N	136,40	125,48	373,8	3,18	11,18	5	0,76	4,78	47
SSR-0550-N	139,70	128,78	382,7	3,18	7,11	6	0,76	4,78	97
SSR-0562-N	142,75	131,83	391,6	3,18	7,37	6	0,76	4,78	93
SSR-0575-N	146,05	135,13	400,5	3,18	8,64	6	0,76	4,78	73
SSR-0587-N	149,10	138,18	409,4	3,18	8,64	6	0,76	4,78	75
SSR-0600-N	152,40	141,48	418,3	3,18	8,64	6	0,76	4,78	77
SSR-0612-N	155,45	144,53	427,2	3,18	7,11	7	0,76	4,78	108
SSR-0625-N	158,75	147,83	436,1	3,18	7,11	7	0,76	4,78	111
SSR-0637-N	161,80	150,88	445,0	3,18	7,62	7	0,76	4,78	100
SSR-0650-N	165,10	154,18	453,9	3,18	7,62	7	0,76	4,78	102
SSR-0675-N	171,45	160,53	462,8	3,18	7,62	7	0,76	4,78	104
SSR-0700-N	177,80	164,59	471,7	3,96	8,13	7	0,76	5,92	113
SSR-0725-N	184,15	170,94	480,6	3,96	8,38	7	0,76	5,92	109
SSR-0750-N	190,50	177,29	489,5	3,96	9,14	7	0,76	5,92	94
SSR-0775-N	196,85	183,64	507,3	3,96	9,65	7	0,76	5,92	89

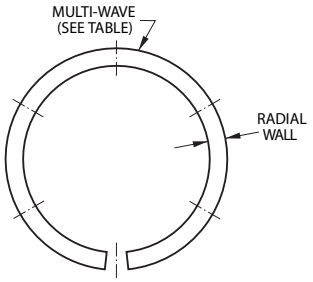
[1] Add suffix "-S17" for 17-7 stainless steel.
[2] Reference dimension.
[3] Spring rate is measured in N/mm.
[4] See pages 106-107 for How to Order.

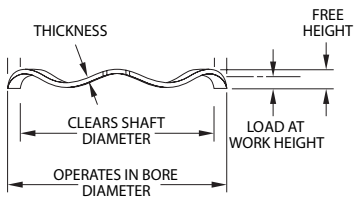
GAP TYPE

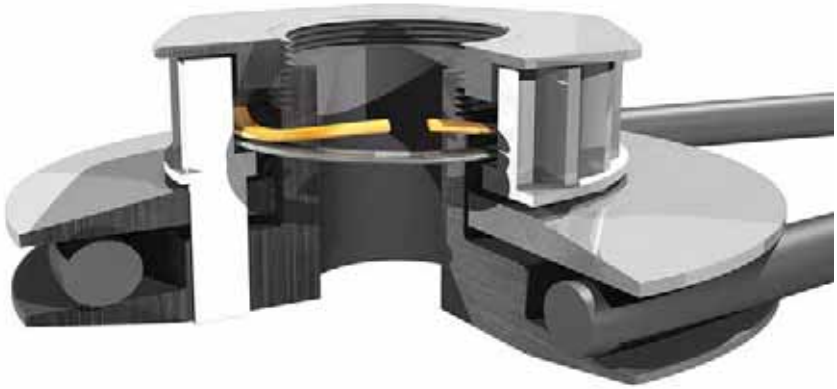
SSR-0325-N to SSR-0775-N

Product Dimensions

All dimensions in millimeters unless otherwise specified.



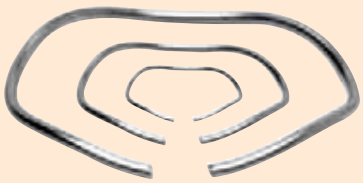


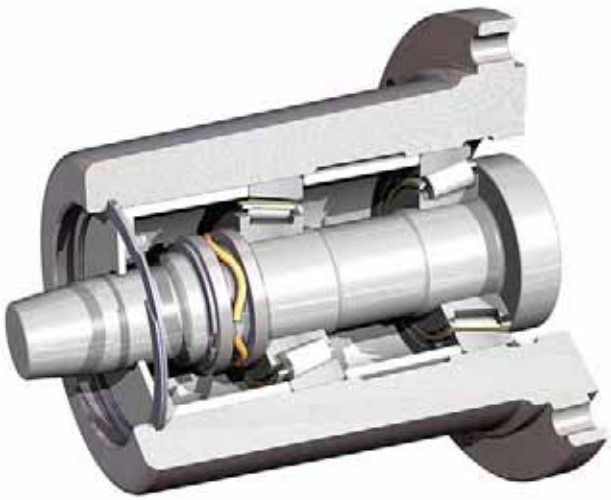


Stock Items in carbon and stainless steel.

Smalley Part Number [1, 4]	Operates in Bore Diameter (mm)	Clears Shaft Diameter (mm)	Load (N)	Work Height (mm)	Free Height [2] (mm)	Number of Waves	Wire Diameter (mm)	Spring Rate [2,3]
RW-0050	12,70	10,36	155,8	1,32	1,57	3	0,79	613
RW-0062	15,88	13,13	222,5	1,63	1,96	3	0,97	674
RW-0075	19,05	15,95	311,5	1,93	2,34	3	1,14	766
RW-0087	22,23	18,80	356,0	2,18	2,64	3	1,30	779
RW-0100	25,40	21,72	400,5	2,41	2,95	3	1,42	751
RW-0112	28,58	24,56	445,0	2,59	3,23	3	1,52	701
RW-0125	31,75	27,46	489,5	2,79	3,51	3	1,65	688
RW-0137	34,93	31,06	534,0	2,41	3,07	4	1,42	809
RW-0150	38,10	34,01	578,5	2,59	3,25	4	1,52	876
RW-0162	41,28	36,68	623,0	2,79	3,48	4	1,65	908
RW-0175	44,45	39,73	667,5	2,87	3,66	4	1,70	848
RW-0187	47,63	42,72	712,0	3,02	3,94	4	1,78	779
RW-0200	50,80	45,80	756,5	3,15	4,19	4	1,83	726
RW-0212	53,98	48,41	801,0	3,28	4,11	4	1,93	956
RW-0225	57,15	51,38	845,5	3,45	4,27	4	2,03	1040
RW-0237	60,33	54,38	890,0	3,58	4,52	4	2,11	947
RW-0250	63,50	57,43	934,5	3,66	4,70	4	2,16	897
RW-0262	66,68	60,30	979,0	3,89	5,16	4	2,29	771
RW-0275	69,85	63,42	1 023,5	3,91	5,38	4	2,31	695
RW-0287	73,03	66,50	1 068,0	4,01	5,33	4	2,36	809
RW-0300	76,20	70,28	1 112,5	3,58	4,55	5	2,11	1 153
RW-0312	79,38	73,10	1 157,0	3,66	4,67	5	2,16	1 139
RW-0325	82,55	76,00	1 201,5	3,89	4,83	5	2,29	1 278
RW-0337	85,73	79,12	1 246,0	3,91	4,95	5	2,31	1 196
RW-0350	88,90	82,19	1 290,5	4,01	5,11	5	2,36	1 182
RW-0362	92,08	85,24	1 335,0	4,09	5,23	5	2,41	1 168
RW-0375	95,25	88,27	1 379,5	4,22	5,38	5	2,49	1 181
RW-0387	98,43	91,31	1 424,0	4,32	5,28	5	2,54	1 475
RW-0400	101,60	94,44	1 468,5	4,32	5,72	5	2,54	1 051
RW-0412	104,78	97,21	1 490,8	4,45	5,61	5	2,67	1 276
RW-0425	107,95	100,28	1 535,3	4,52	5,72	5	2,67	1 286
RW-0437	111,13	103,20	1 557,5	4,75	6,10	5	2,79	1 157
RW-0450	114,30	106,30	1 602,0	4,75	6,27	5	2,79	1 051
RW-0462	117,48	109,47	1 624,3	4,75	6,43	5	2,79	969
RW-0475	120,65	112,55	1 668,8	4,83	6,53	5	2,84	981
RW-0487	123,83	115,70	1 691,0	4,83	6,71	5	2,84	900
RW-0500	127,00	118,67	1 735,5	4,95	6,73	5	2,95	976
RW-0512	130,18	121,21	1 780,0	5,08	6,96	5	3,00	947
RW-0525	133,35	124,28	1 824,5	5,18	7,09	5	3,05	958
RW-0537	136,53	127,94	1 869,0	4,75	6,22	6	2,79	1 269
RW-0550	139,70	131,11	1 913,5	4,75	6,38	6	2,79	1 177
RW-0562	142,88	134,19	1 958,0	4,83	6,22	6	2,84	1 402
RW-0575	146,05	137,31	2 002,5	4,83	6,38	6	2,84	1 292
RW-0587	149,23	140,31	2 047,0	5,00	6,65	6	2,95	1 240
RW-0600	152,40	143,36	2 091,5	5,08	6,81	6	3,00	1 211

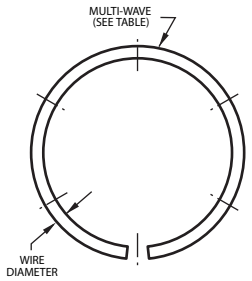
[1] Add suffix "-S17" for 17-7 stainless steel.
[2] Reference dimension.
[3] Spring rate is measured in N/mm.
[4] See pages 106-107 for How to Order.

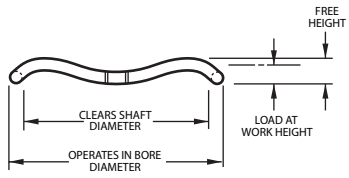




Product Dimensions

All dimensions in millimeters unless otherwise specified.





SPRINGS

Smalley Circular-Grain® bearing preload Wave Springs eliminate play and minimize bearing noise. The constant light/medium pressure they apply removes play between the ball bearings and the bearings' inner and outer races. Preloading can reduce the possibility of bearing damage due to vibration (vibratory loading) and wear due to repetitive and non-repetitive runout.

Stock Items in carbon steel and 17-7 PH/C stainless steel. Springs listed below are 3 and 4 waves **Overlap Type**.

Smalley Part Number[1, 5]	Bearing O.D.[2] (mm)	Clears Shaft Diameter	Load (N)	Work Height	Free Height[3]	Number of Waves	Thickness	Radial Wall	Spring Rate[3,4]
SSB-0063	16,00	11,28	44,5	1,57	2,29	3	0,25	1,98	65
SSB-0075	19,00	14,28	53,4	1,57	3,05	3	0,25	1,98	35
SSB-0087	22,00	16,46	62,3	1,57	2,79	3	0,30	2,39	48
SSB-0095	24,00	18,46	66,7	1,57	3,56	3	0,30	2,39	35
SSB-0102	26,00	18,22	71,2	1,98	2,54	3	0,41	3,38	111
SSB-0110	28,00	20,22	75,6	1,98	2,79	3	0,41	3,38	85
SSB-0118	30,00	22,22	84,5	1,98	3,30	3	0,41	3,38	66
SSB-0126	32,00	24,22	89,0	1,98	3,81	3	0,41	3,38	52
SSB-0138	35,00	27,22	97,9	1,98	4,57	3	0,41	3,38	38
SSB-0146	37,00	28,72	102,3	1,98	3,81	3	0,46	3,63	58
SSB-0158	40,00	31,72	111,2	1,98	5,08	3	0,46	3,63	37
SSB-0165	42,00	33,72	115,7	1,98	3,05	4	0,46	3,63	99
SSB-0185	47,00	38,72	129,0	1,98	3,81	4	0,46	3,63	68
SSB-0205	52,00	43,11	142,4	2,36	3,56	4	0,61	3,81	121
SSB-0217	55,00	46,11	151,3	2,36	3,81	4	0,61	3,81	100
SSB-0244	62,00	51,69	169,1	2,36	4,32	4	0,61	4,52	85
SSB-0268	68,00	57,17	186,9	2,77	4,32	4	0,76	4,78	131
SSB-0276	70,00	59,17	191,3	2,77	4,32	4	0,76	4,78	119
SSB-0284	72,00	61,17	195,8	2,77	4,57	4	0,76	4,78	108
SSB-0295	75,00	64,17	204,7	2,77	5,08	4	0,76	4,78	94
SSB-0315	80,00	68,66	218,0	2,77	5,59	4	0,76	4,78	76
SSB-0335	85,00	71,38	231,4	2,77	5,59	4	0,76	5,92	83
SSB-0354	90,00	76,38	249,2	2,77	6,35	4	0,76	5,92	68
SSB-0374	95,00	81,38	262,5	2,77	7,37	4	0,76	5,92	57

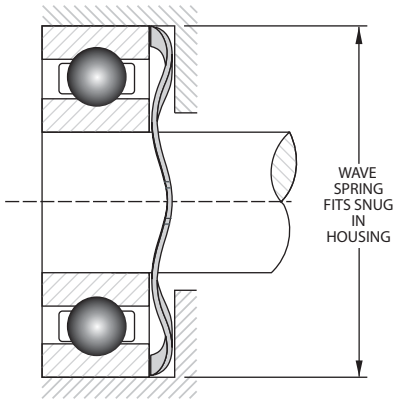
[1] Add suffix "-S17" for 17-7 stainless steel.
[2] Wave springs fit snug in housing.
[3] Reference dimension.
[4] Spring rate is measured in N/mm.
[5] See pages 106-107 for How to Order.

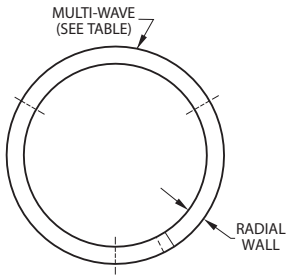
OVERLAP TYPE

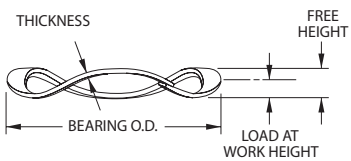
SSB-0063 to SSB-0374

Product Dimensions

All dimensions in millimeters unless otherwise specified.







Stock Items in carbon steel and 17-7 PH/C stainless steel. Springs listed below are 5 waves and up, **Gap Type.**

Smalley Part Number [1, 5]	Bearing O.D. [2] (mm)	Clears Shaft Diameter	Load (N)	Work Height	Free Height [3]	Number of Waves	Thickness	Radial Wall	Spring Rate [3, 4]
SSB-0394	100,00	86,38	275,9	2,77	4,57	5	0,76	5,92	157
SSB-0413	105,00	91,38	289,2	2,77	5,08	5	0,76	5,92	134
SSB-0433	110,00	96,38	302,6	2,77	5,33	5	0,76	5,92	115
SSB-0453	115,00	101,38	315,9	3,18	6,35	5	0,76	5,92	99
SSB-0472	120,00	106,38	329,3	3,18	7,11	5	0,76	5,92	86
SSB-0492	125,00	111,38	342,6	3,18	7,62	5	0,76	5,92	76
SSB-0512	130,00	116,38	356,0	3,18	8,64	5	0,76	5,92	67
SSB-0532	135,00	121,38	369,3	3,18	9,40	5	0,76	5,92	59
SSB-0551	140,00	126,38	382,7	3,18	6,86	6	0,76	5,92	108
SSB-0571	145,00	131,38	396,0	3,18	7,37	6	0,76	5,92	97
SSB-0591	150,00	136,38	404,9	3,18	7,87	6	0,76	5,92	87
SSB-0630	160,00	146,38	440,5	3,18	9,40	6	0,76	5,92	71
SSB-0650	165,00	151,38	453,9	3,18	10,41	6	0,76	5,92	64
SSB-0669	170,00	156,38	467,2	3,18	11,18	6	0,76	5,92	58
SSB-0689	175,00	154,16	480,6	3,96	8,13	6	0,81	9,53	116
SSB-0709	180,00	159,16	493,9	3,96	8,64	6	0,81	9,53	105
SSB-0728	185,00	164,16	507,3	3,96	9,14	6	0,81	9,53	97
SSB-0748	190,00	169,16	520,6	3,96	9,91	6	0,81	9,53	88
SSB-0787	200,00	179,16	547,3	3,96	7,11	7	0,81	9,53	174
SSB-0807	205,00	184,16	560,7	3,96	7,37	7	0,81	9,53	161
SSB-0827	210,00	189,16	578,5	3,96	7,87	7	0,81	9,53	149
SSB-0847	215,00	194,16	591,8	3,96	8,38	7	0,81	9,53	138
SSB-0866	220,00	199,16	605,2	3,96	8,64	7	0,81	9,53	128
SSB-0886	225,00	204,16	618,5	3,96	7,11	8	0,81	9,53	203
SSB-0906	230,00	209,16	631,9	3,96	6,10	9	0,81	9,53	303
SSB-0925	235,00	214,16	645,2	3,96	6,35	9	0,81	9,53	283
SSB-0945	240,00	219,16	658,6	3,96	6,35	9	0,81	9,53	265
SSB-0984	250,00	229,16	685,3	3,96	6,86	9	0,81	9,53	232
SSB-1024	260,00	239,16	712,0	3,96	7,37	9	0,81	9,53	205
SSB-1043	265,00	244,16	725,3	3,96	7,62	9	0,81	9,53	193
SSB-1063	270,00	249,16	743,1	3,96	8,13	9	0,81	9,53	182
SSB-1102	280,00	259,16	769,8	3,96	8,64	9	0,81	9,53	162
SSB-1142	290,00	269,16	796,5	3,96	9,40	9	0,81	9,53	144
SSB-1181	300,00	279,16	823,2	3,96	10,41	9	0,81	9,53	129
SSB-1221	310,00	289,16	849,9	3,96	7,11	9	1,07	9,53	264
SSB-1260	320,00	299,16	876,6	3,96	7,62	9	1,07	9,53	239
SSB-1339	340,00	319,16	934,5	3,96	8,64	9	1,07	9,53	198
SSB-1378	350,00	329,16	961,1	3,96	9,40	9	1,07	9,53	180
SSB-1417	360,00	339,16	987,9	3,96	7,62	10	1,07	9,53	271
SSB-1457	370,00	349,16	1 014,6	3,96	8,13	10	1,07	9,53	249
SSB-1496	380,00	359,16	1 041,3	3,96	8,64	10	1,07	9,53	229
SSB-1535	390,00	369,16	1 072,4	3,96	9,14	10	1,07	9,53	211
SSB-1575	400,00	379,16	1 099,1	3,96	9,65	10	1,07	9,53	196
SSB-1614	410,00	382,82	1 125,8	3,96	8,38	10	1,07	12,70	251
SSB-1654	420,00	392,82	1 152,5	3,96	8,89	10	1,07	12,70	233
SSB-1693	430,00	402,82	1 179,2	3,96	7,62	11	1,07	12,70	317
SSB-1732	440,00	412,82	1 205,9	3,96	8,13	11	1,07	12,70	295
SSB-1811	460,00	432,82	1 263,7	3,96	8,89	11	1,07	12,70	256
SSB-1890	480,00	452,82	1 317,1	3,96	8,13	12	1,07	12,70	318
SSB-1969	500,00	472,82	1 370,5	3,96	8,89	12	1,07	12,70	280
SSB-2126	540,00	512,82	1 481,8	3,96	8,89	13	1,07	12,70	303
SSB-2284	580,00	552,82	1 593,0	3,96	8,89	14	1,07	12,70	327

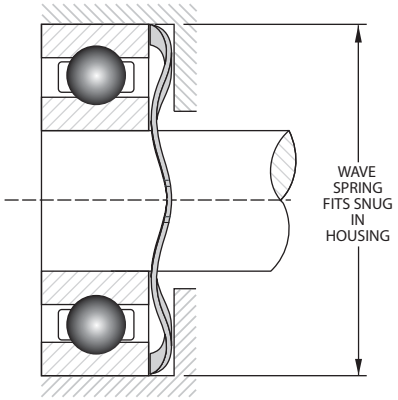
[1] Add suffix "-S17" for 17-7 stainless steel.
[2] Wave springs fit snug in housing.
[3] Reference dimension.
[4] Spring rate is measured in N/mm.
[5] See pages 106-107 for How to Order.

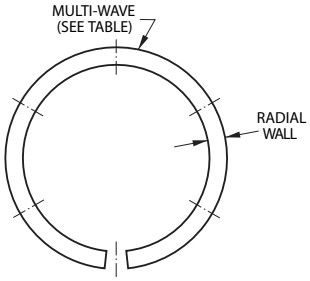
GAP TYPE

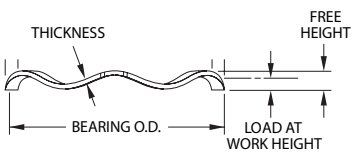
SSB-0394 to SSB-2284

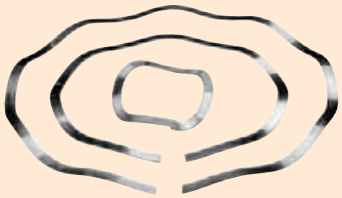
Product Dimensions

All dimensions in millimeters unless otherwise specified.









Use this cross-reference guide to select the appropriate Wave Spring for your bearing size. The numbers represent typical standard bearing part numbers and/or the suffix of a standard bearing size.

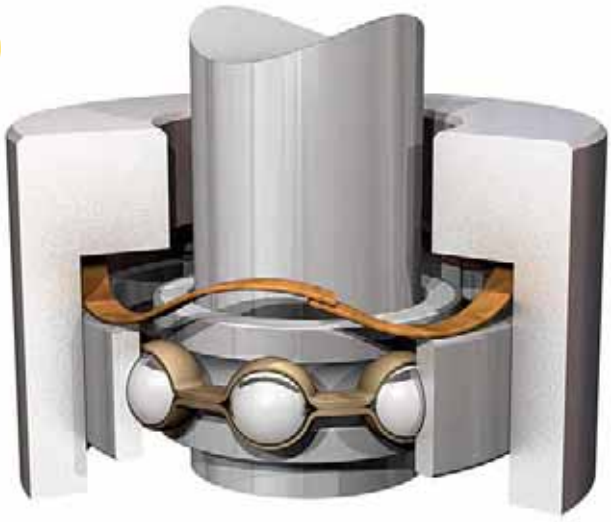
Smalley Part Number[1]	Bearing O.D.[2] (mm)	BEARING PART NUMBERS						
		Extra Small	Extremely Light	Extra Light	Narrow	Light	Medium	Heavy
SSB-0063	16,00	34	—	—	—	—	—	—
SSB-0075	19,00	35, 36	—	—	—	—	—	—
SSB-0087	22,00	37, 38	00	—	—	—	—	—
SSB-0095	24,00	38KV	01	—	—	—	—	—
SSB-0102	26,00	39	—	100	—	—	—	—
SSB-0110	28,00	—	02	101	—	—	—	—
SSB-0118	30,00	—	03	—	—	200	—	—
SSB-0126	32,00	—	—	102	02	201	—	—
SSB-0138	35,00	—	—	103	—	202	300	—
SSB-0146	37,00	—	04	—	03	—	301	—
SSB-0158	40,00	—	—	—	—	203	—	—
SSB-0165	42,00	—	05	104	04	—	302	—
SSB-0185	47,00	—	06	105	—	204	303	—
SSB-0205	52,00	—	—	—	05	205	304	—
SSB-0217	55,00	—	07	106	—	—	—	—
SSB-0244	62,00	—	08	107	06	206	305	403
SSB-0268	68,00	—	09	108	—	—	—	—
SSB-0276	70,00	—	—	—	07	—	—	—
SSB-0284	72,00	—	10	—	—	207	306	404
SSB-0295	75,00	—	—	109	—	—	—	—
SSB-0315	80,00	—	11	110	08	208	307	405
SSB-0335	85,00	—	12	—	09	209	—	—
SSB-0354	90,00	—	13	111	10	210	308	406
SSB-0374	95,00	—	—	112	—	—	—	—
SSB-0394	100,00	—	14	113	11	211	309	407
SSB-0413	105,00	—	15	—	12	—	—	—
SSB-0433	110,00	—	16	114	—	212	310	408
SSB-0453	115,00	—	—	115	13	—	—	—
SSB-0472	120,00	—	17	—	14	213	311	409
SSB-0492	125,00	—	18	116	—	214	—	—
SSB-0512	130,00	—	19	117	15	215	312	410
SSB-0532	135,00	—	—	—	16	—	—	—
SSB-0551	140,00	—	20	118	—	216	313	411
SSB-0571	145,00	—	21	119	17	—	—	—
SSB-0591	150,00	—	22	120	18	217	314	412
SSB-0630	160,00	—	—	121	19	218	315	413
SSB-0650	165,00	—	24	—	20	—	—	—
SSB-0669	170,00	—	—	122	—	219	316	—
SSB-0689	175,00	—	—	—	22[3]	—	—	—
SSB-0709	180,00	—	26	124	21	220	317	414
SSB-0728	185,00	—	—	—	22[3]	—	—	—
SSB-0748	190,00	—	28	—	24	221	318	415
SSB-0787	200,00	—	—	126	—	222	319	416
SSB-0807	205,00	—	—	—	26	—	—	—
SSB-0827	210,00	—	30	128	—	—	—	417
SSB-0847	215,00	—	—	—	—	224	320	—

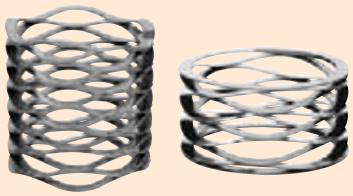
[1] Add suffix "-S17" for 17-7 stainless steel.
[2] Wave springs fit snug in housing.
[3] Check bearing dimensions.

Use this cross-reference guide to select the appropriate Wave Spring for your bearing size. The numbers represent typical standard bearing part numbers and/or the suffix of a standard bearing size.

Smalley Part Number [1]	Bearing O.D. [2] (mm)	BEARING PART NUMBERS						
		Extra Small	Extremely Light	Extra Light	Narrow	Light	Medium	Heavy
SSB-0866	220,00	—	32	—	28	—	—	—
SSB-0886	225,00	—	—	130	—	—	321	418
SSB-0906	230,00	—	34	—	—	226	—	—
SSB-0925	235,00	—	—	—	30	—	—	—
SSB-0945	240,00	—	—	132	—	—	322	—
SSB-0984	250,00	—	36	—	32	228	—	419
SSB-1024	260,00	—	38	134	—	—	324	—
SSB-1043	265,00	—	—	—	34	—	—	420
SSB-1063	270,00	—	—	—	—	230	—	—
SSB-1102	280,00	—	40	136	36	—	326	—
SSB-1142	290,00	—	—	138	—	232	—	421
SSB-1181	300,00	—	—	—	38	—	328	—
SSB-1221	310,00	—	—	140	—	234	—	—
SSB-1260	320,00	—	—	—	40	236	330	422
SSB-1339	340,00	—	—	144	42	238	332	—
SSB-1378	350,00	—	—	—	44	—	—	—
SSB-1417	360,00	—	—	148	—	240	334	—
SSB-1457	370,00	—	—	—	46	—	—	—
SSB-1496	380,00	—	—	—	—	—	336	—
SSB-1535	390,00	—	—	—	48	—	—	—
SSB-1575	400,00	—	—	152	—	244	338	—
SSB-1614	410,00	—	—	—	50	—	—	—
SSB-1654	420,00	—	—	156	—	—	340	—
SSB-1693	430,00	—	—	—	52	—	—	—
SSB-1732	440,00	—	—	—	—	248	342	—
SSB-1811	460,00	—	—	160	56	—	344	—
SSB-1890	480,00	—	—	164	—	252	—	—
SSB-1969	500,00	—	—	—	64	256	348	—
SSB-2126	540,00	—	—	—	—	260	352	—
SSB-2284	580,00	—	—	—	—	264	356	—

[1] Add suffix "-S17" for 17-7 stainless steel.
[2] Wave springs fit snug in housing.
[3] Check bearing dimensions.





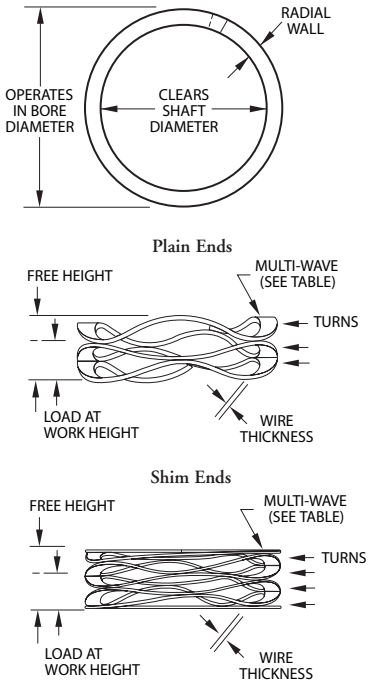
Stock Items in carbon steel and 17-7 PH/C stainless steel.

Smalley Part Number [1,2,5]	Operates in Bore Diameter	Clears Shaft Diameter	Load (N)	Work Height	Free Height [3]	Number of Turns	Number of Waves	Thickness	Radial Wall	Spring Rate [3,4]
C037-L1	9,53	6,35	17,80	1,57	3,81	3	2,5	0,20	0,81	8
C037-L2	9,53	6,35	17,80	2,49	5,08	4	2,5	0,20	0,81	7
C037-L3	9,53	6,35	17,80	2,74	6,35	5	2,5	0,20	0,81	5
C037-L4	9,53	6,35	17,80	3,43	7,62	6	2,5	0,20	0,81	4
C037-L5	9,53	6,35	17,80	3,81	8,89	7	2,5	0,20	0,81	4
C037-L6	9,53	6,35	17,80	4,67	10,16	8	2,5	0,20	0,81	3
C037-L7	9,53	6,35	17,80	4,95	11,43	9	2,5	0,20	0,81	3
C037-L8	9,53	6,35	17,80	5,79	12,70	10	2,5	0,20	0,81	3
C037-L9	9,53	6,35	17,80	6,10	13,97	11	2,5	0,20	0,81	2
C037-M1	9,53	6,35	31,15	2,06	3,81	3	2,5	0,28	0,81	18
C037-M2	9,53	6,35	31,15	3,02	5,08	4	2,5	0,28	0,81	15
C037-M3	9,53	6,35	31,15	3,68	6,35	5	2,5	0,28	0,81	12
C037-M4	9,53	6,35	31,15	4,57	7,62	6	2,5	0,28	0,81	10
C037-M5	9,53	6,35	31,15	5,13	8,89	7	2,5	0,28	0,81	8
C037-M6	9,53	6,35	31,15	6,10	10,16	8	2,5	0,28	0,81	8
C037-M7	9,53	6,35	31,15	6,65	11,43	9	2,5	0,28	0,81	6
C037-M8	9,53	6,35	31,15	7,57	12,70	10	2,5	0,28	0,81	6
C037-M9	9,53	6,35	31,15	8,31	13,97	11	2,5	0,28	0,81	5
C043-L1	11,10	7,14	17,80	1,60	4,19	3	2,5	0,20	1,02	7
C043-L2	11,10	7,14	17,80	2,36	5,59	4	2,5	0,20	1,02	5
C043-L3	11,10	7,14	17,80	2,77	6,99	5	2,5	0,20	1,02	4
C043-L4	11,10	7,14	17,80	3,63	8,38	6	2,5	0,20	1,02	4
C043-L5	11,10	7,14	17,80	4,06	9,78	7	2,5	0,20	1,02	3
C043-L6	11,10	7,14	17,80	4,95	11,18	8	2,5	0,20	1,02	3
C043-L7	11,10	7,14	17,80	5,33	12,57	9	2,5	0,20	1,02	2
C043-L8	11,10	7,14	17,80	6,10	13,97	10	2,5	0,20	1,02	2
C043-L9	11,10	7,14	17,80	6,60	15,37	11	2,5	0,20	1,02	2
C043-M1	11,10	7,14	35,60	2,08	4,19	3	2,5	0,28	1,17	17
C043-M2	11,10	7,14	35,60	2,92	5,59	4	2,5	0,28	1,17	13
C043-M3	11,10	7,14	35,60	3,61	6,99	5	2,5	0,28	1,17	11
C043-M4	11,10	7,14	35,60	4,55	8,38	6	2,5	0,28	1,17	9
C043-M5	11,10	7,14	35,60	5,03	9,78	7	2,5	0,28	1,17	8
C043-M6	11,10	7,14	35,60	5,87	11,18	8	2,5	0,28	1,17	7
C043-M7	11,10	7,14	35,60	6,48	12,57	9	2,5	0,28	1,17	6
C043-M8	11,10	7,14	35,60	7,37	13,97	10	2,5	0,28	1,17	5
C043-M9	11,10	7,14	35,60	8,10	15,37	11	2,5	0,28	1,17	5
C050-L1	12,70	7,92	22,25	1,57	4,57	3	2,5	0,20	1,42	7
C050-L2	12,70	7,92	22,25	2,29	6,10	4	2,5	0,20	1,42	6
C050-L3	12,70	7,92	22,25	2,72	7,62	5	2,5	0,20	1,42	5
C050-L4	12,70	7,92	22,25	3,45	9,14	6	2,5	0,20	1,42	4
C050-L5	12,70	7,92	22,25	3,81	10,67	7	2,5	0,20	1,42	3
C050-L6	12,70	7,92	22,25	4,57	12,19	8	2,5	0,20	1,42	3
C050-L7	12,70	7,92	22,25	4,95	13,72	9	2,5	0,20	1,42	2
C050-L8	12,70	7,92	22,25	5,59	15,24	10	2,5	0,20	1,42	2
C050-L9	12,70	7,92	22,25	6,10	16,76	11	2,5	0,20	1,42	2
C050-M1	12,70	7,92	44,50	1,65	4,57	3	2,5	0,25	1,47	15
C050-M2	12,70	7,92	44,50	2,34	6,10	4	2,5	0,25	1,47	12
C050-M3	12,70	7,92	44,50	2,90	7,62	5	2,5	0,25	1,47	9
C050-M4	12,70	7,92	44,50	3,73	9,14	6	2,5	0,25	1,47	8
C050-M5	12,70	7,92	44,50	4,11	10,67	7	2,5	0,25	1,47	7
C050-M6	12,70	7,92	44,50	4,98	12,19	8	2,5	0,25	1,47	6
C050-M7	12,70	7,92	44,50	5,26	13,72	9	2,5	0,25	1,47	5
C050-M8	12,70	7,92	44,50	6,25	15,24	10	2,5	0,25	1,47	5
C050-M9	12,70	7,92	44,50	6,71	16,76	11	2,5	0,25	1,47	4
C056-L1	14,27	9,53	22,25	2,03	4,95	3	2,5	0,23	1,47	8
C056-L2	14,27	9,53	22,25	3,18	6,60	4	2,5	0,23	1,47	6
C056-L3	14,27	9,53	22,25	3,43	8,26	5	2,5	0,23	1,47	5
C056-L4	14,27	9,53	22,25	4,57	9,91	6	2,5	0,23	1,47	4
C056-L5	14,27	9,53	22,25	4,83	11,56	7	2,5	0,23	1,47	3
C056-L6	14,27	9,53	22,25	5,84	13,21	8	2,5	0,23	1,47	3

[1] Use "C" prefix for plain ends. Use "CS" prefix for squared-shim ends.
[2] Add suffix "-S17" for 17-7 stainless steel.
[3] Theoretical dimension.
[4] Spring rate is measured in N/mm.
[5] See pages 106-107 for How to Order.

Product Dimensions

All dimensions in millimeters unless otherwise specified.



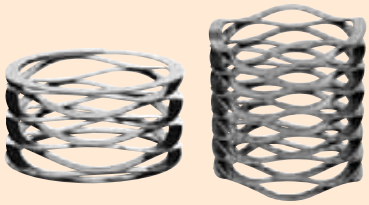
Order Options

C 037-L1

End options:
Plain ends. C
Squared-shim ends . . CS

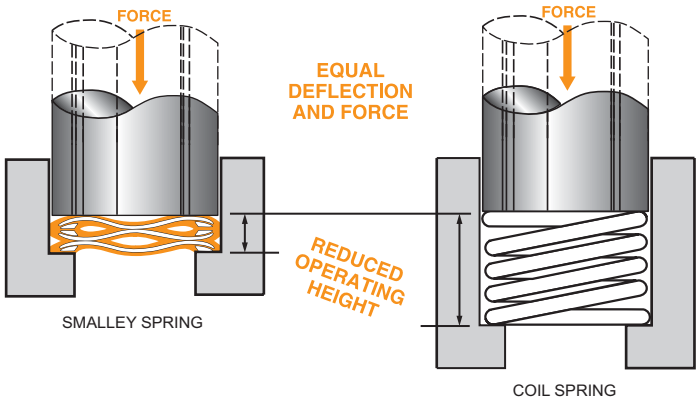
Material option:
Carbon Steel. . . . (blank)
Stainless Steel. . . . . -S17

Stock Items in carbon steel and 17-7 PH/C stainless steel.



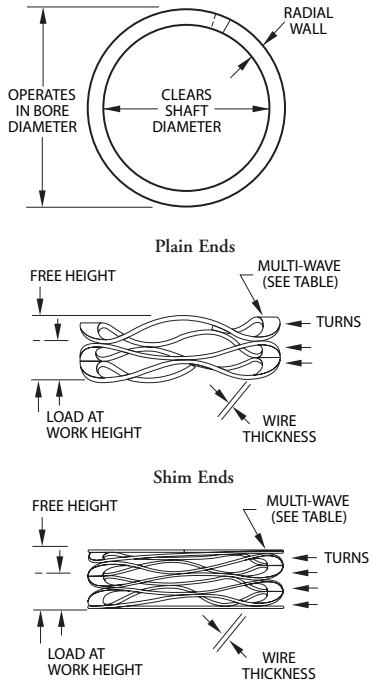
Smalley Part Number [1,2,5]	Operates in Bore Diameter	Clears Shaft Diameter	Load (N)	Work Height	Free Height [3]	Number of Turns	Number of Waves	Thickness	Radial Wall	Spring Rate [3,4]
C056-L7	14,27	9,53	22,25	6,60	14,86	9	2,5	0,23	1,47	3
C056-L8	14,27	9,53	22,25	7,24	16,51	10	2,5	0,23	1,47	2
C056-L9	14,27	9,53	22,25	8,00	18,16	11	2,5	0,23	1,47	2
C056-M1	14,27	9,53	48,95	2,18	4,95	3	2,5	0,30	1,52	18
C056-M2	14,27	9,53	48,95	3,12	6,60	4	2,5	0,30	1,52	14
C056-M3	14,27	9,53	48,95	3,68	8,26	5	2,5	0,30	1,52	11
C056-M4	14,27	9,53	48,95	4,75	9,91	6	2,5	0,30	1,52	9
C056-M5	14,27	9,53	48,95	5,31	11,56	7	2,5	0,30	1,52	8
C056-M6	14,27	9,53	48,95	6,43	13,21	8	2,5	0,30	1,52	7
C056-M7	14,27	9,53	48,95	6,93	14,86	9	2,5	0,30	1,52	6
C056-M8	14,27	9,53	48,95	8,08	16,51	10	2,5	0,30	1,52	6
C056-M9	14,27	9,53	48,95	8,71	18,16	11	2,5	0,30	1,52	5
C062-L1	15,88	11,43	26,70	1,40	4,57	3	2,5	0,25	1,47	8
C062-L2	15,88	11,43	26,70	1,73	6,10	4	2,5	0,25	1,47	6
C062-L3	15,88	11,43	26,70	2,16	7,62	5	2,5	0,25	1,47	5
C062-L4	15,88	11,43	26,70	2,69	9,14	6	2,5	0,25	1,47	4
C062-L5	15,88	11,43	26,70	3,25	10,67	7	2,5	0,25	1,47	4
C062-L6	15,88	11,43	26,70	4,19	13,72	9	2,5	0,25	1,47	3
C062-L7	15,88	11,43	26,70	5,13	16,76	11	2,5	0,25	1,47	2
C062-L8	15,88	11,43	26,70	6,05	19,81	13	2,5	0,25	1,47	2
C062-M1	15,88	11,43	53,40	2,64	4,57	3	3,5	0,25	1,48	28
C062-M2	15,88	11,43	53,40	3,30	6,10	4	3,5	0,25	1,48	19
C062-M3	15,88	11,43	53,40	4,45	7,62	5	3,5	0,25	1,48	17
C062-M4	15,88	11,43	53,40	5,23	9,14	6	3,5	0,25	1,48	14
C062-M5	15,88	11,43	53,40	6,25	10,67	7	3,5	0,25	1,48	12
C062-M6	15,88	11,43	53,40	8,05	13,72	9	3,5	0,25	1,48	9
C062-M7	15,88	11,43	53,40	9,80	16,76	11	3,5	0,25	1,48	8
C062-M8	15,88	11,43	53,40	11,53	19,81	13	3,5	0,25	1,48	6
C075-L1	19,05	13,97	31,15	3,61	6,35	3	3,5	0,20	1,80	11
C075-L2	19,05	13,97	31,15	4,75	8,46	4	3,5	0,20	1,80	8
C075-L3	19,05	13,97	31,15	6,25	10,59	5	3,5	0,20	1,80	7
C075-L4	19,05	13,97	31,15	7,24	12,70	6	3,5	0,20	1,80	6
C075-L5	19,05	13,97	31,15	8,84	14,81	7	3,5	0,20	1,80	5
C075-L6	19,05	13,97	31,15	11,33	19,05	9	3,5	0,20	1,80	4
C075-L7	19,05	13,97	31,15	14,73	25,40	12	3,5	0,20	1,80	3
C075-M1	19,05	13,97	57,85	4,04	6,35	3	3,5	0,25	1,98	25
C075-M2	19,05	13,97	57,85	5,16	8,46	4	3,5	0,25	1,98	18
C075-M3	19,05	13,97	57,85	6,86	10,59	5	3,5	0,25	1,98	15
C075-M4	19,05	13,97	57,85	7,98	12,70	6	3,5	0,25	1,98	12
C075-M5	19,05	13,97	57,85	9,68	14,81	7	3,5	0,25	1,98	11
C075-M6	19,05	13,97	57,85	12,42	19,05	9	3,5	0,25	1,98	9
C075-M7	19,05	13,97	57,85	16,48	25,40	12	3,5	0,25	1,98	6

[1] Use "C" prefix for plain ends. Use "CS" prefix for squared-shim ends.
[2] Add suffix "-S17" for 17-7 stainless steel.
[3] Theoretical dimension.
[4] Spring rate is measured in N/mm.
[5] See pages 106-107 for How to Order.



Product Dimensions

All dimensions in millimeters unless otherwise specified.



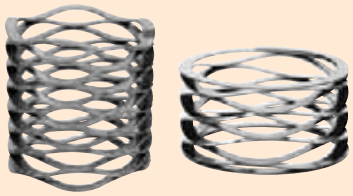
Order Options

C 037-L1

End options:
Plain ends. C
Squared-shim ends . . CS

Material option:
Carbon Steel. . . . (blank)
Stainless Steel. . . . . -S17

SPRINGS



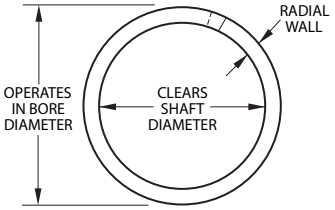
Stock Items in carbon steel and 17-7 PH/C stainless steel.

Smalley Part Number [1,2,5]	Operates in Bore Diameter	Clears Shaft Diameter	Load (N)	Work Height	Free Height [3]	Number of Waves	Number of Turns	Thickness	Radial Wall	Spring Rate [3,4]
C075-H1	19,05	13,97	97,90	4,29	6,35	3,50	3	0,33	2,01	48
C075-H2	19,05	13,97	97,90	5,46	8,46	3,50	4	0,33	2,01	33
C075-H3	19,05	13,97	97,90	7,39	10,59	3,50	5	0,33	2,01	31
C075-H4	19,05	13,97	97,90	8,51	12,70	3,50	6	0,33	2,01	23
C075-H5	19,05	13,97	97,90	10,29	14,81	3,50	7	0,33	2,01	22
C075-H6	19,05	13,97	97,90	13,36	19,05	3,50	9	0,33	2,01	17
C075-H7	19,05	13,97	97,90	17,75	25,40	3,50	12	0,33	2,01	13
C087-L1	22,23	15,24	53,40	2,97	6,35	3,50	3	0,25	2,18	16
C087-L2	22,23	15,24	53,40	4,01	8,46	3,50	4	0,25	2,18	12
C087-L3	22,23	15,24	53,40	5,26	10,59	3,50	5	0,25	2,18	10
C087-L4	22,23	15,24	53,40	6,15	12,70	3,50	6	0,25	2,18	8
C087-L5	22,23	15,24	53,40	7,29	14,81	3,50	7	0,25	2,18	7
C087-L6	22,23	15,24	53,40	9,60	19,05	3,50	9	0,25	2,18	6
C087-L7	22,23	15,24	53,40	12,65	25,40	3,50	12	0,25	2,18	4
C087-M1	22,23	15,24	80,10	3,15	6,35	3,50	3	0,31	2,39	26
C087-M2	22,23	15,24	80,10	4,17	8,46	3,50	4	0,31	2,39	19
C087-M3	22,23	15,24	80,10	5,44	10,59	3,50	5	0,31	2,39	16
C087-M4	22,23	15,24	80,10	6,40	12,70	3,50	6	0,31	2,39	13
C087-M5	22,23	15,24	80,10	7,52	14,81	3,50	7	0,31	2,39	12
C087-M6	22,23	15,24	80,10	9,78	19,05	3,50	9	0,31	2,39	9
C087-M7	22,23	15,24	80,10	12,93	25,40	3,50	12	0,31	2,39	7
C087-H1	22,23	15,24	111,25	4,22	6,35	3,50	3	0,38	2,39	52
C087-H2	22,23	15,24	111,25	5,44	8,46	3,50	4	0,38	2,39	37
C087-H3	22,23	15,24	111,25	7,06	10,59	3,50	5	0,38	2,39	32
C087-H4	22,23	15,24	111,25	8,31	12,70	3,50	6	0,38	2,39	25
C087-H5	22,23	15,24	111,25	10,03	14,81	3,50	7	0,38	2,39	23
C087-H6	22,23	15,24	111,25	12,95	19,05	3,50	9	0,38	2,39	18
C087-H7	22,23	15,24	111,25	17,02	25,40	3,50	12	0,38	2,39	14
C100-L1	25,40	18,54	53,40	2,13	6,35	3,50	3	0,25	2,18	13
C100-L2	25,40	18,54	53,40	2,74	8,46	3,50	4	0,25	2,18	9
C100-L3	25,40	18,54	53,40	3,68	10,59	3,50	5	0,25	2,18	8
C100-L4	25,40	18,54	53,40	4,19	12,70	3,50	6	0,25	2,18	6
C100-L5	25,40	18,54	53,40	5,11	14,81	3,50	7	0,25	2,18	5
C100-L6	25,40	18,54	53,40	6,55	19,05	3,50	9	0,25	2,18	4
C100-L7	25,40	18,54	53,40	8,69	25,40	3,50	12	0,25	2,18	3
C100-L8	25,40	18,54	53,40	11,30	31,75	3,50	15	0,25	2,18	3
C100-L9	25,40	18,54	53,40	13,18	38,10	3,50	18	0,25	2,18	2
C100-L10	25,40	18,54	53,40	16,08	44,45	3,50	21	0,25	2,18	2
C100-L11	25,40	18,54	53,40	18,03	50,80	3,50	24	0,25	2,18	2
C100-M1	25,40	18,54	80,10	2,21	6,35	3,50	3	0,31	2,39	19
C100-M2	25,40	18,54	80,10	2,87	8,46	3,50	4	0,31	2,39	14
C100-M3	25,40	18,54	80,10	3,76	10,59	3,50	5	0,31	2,39	12
C100-M4	25,40	18,54	80,10	4,45	12,70	3,50	6	0,31	2,39	10
C100-M5	25,40	18,54	80,10	5,38	14,81	3,50	7	0,31	2,39	9
C100-M6	25,40	18,54	80,10	7,01	19,05	3,50	9	0,31	2,39	7
C100-M7	25,40	18,54	80,10	9,14	25,40	3,50	12	0,31	2,39	5
C100-M8	25,40	18,54	80,10	11,48	31,75	3,50	15	0,31	2,39	4
C100-M9	25,40	18,54	80,10	13,94	38,10	3,50	18	0,31	2,39	3
C100-M10	25,40	18,54	80,10	16,51	44,45	3,50	21	0,31	2,39	3
C100-M11	25,40	18,54	80,10	18,29	50,80	3,50	24	0,31	2,39	2
C100-H1	25,40	18,54	111,25	3,33	6,35	3,50	3	0,38	2,39	37
C100-H2	25,40	18,54	111,25	4,42	8,46	3,50	4	0,38	2,39	28
C100-H3	25,40	18,54	111,25	5,77	10,59	3,50	5	0,38	2,39	23
C100-H4	25,40	18,54	111,25	6,76	12,70	3,50	6	0,38	2,39	19
C100-H5	25,40	18,54	111,25	8,10	14,81	3,50	7	0,38	2,39	17
C100-H6	25,40	18,54	111,25	10,31	19,05	3,50	9	0,38	2,39	13
C100-H7	25,40	18,54	111,25	13,74	25,40	3,50	12	0,38	2,39	9
C100-H8	25,40	18,54	111,25	17,48	31,75	3,50	15	0,38	2,39	8
C100-H9	25,40	18,54	111,25	20,65	38,10	3,50	18	0,38	2,39	6
C100-H10	25,40	18,54	111,25	24,31	44,45	3,50	21	0,38	2,39	6
C100-H11	25,40	18,54	111,25	27,51	50,80	3,50	24	0,38	2,39	5

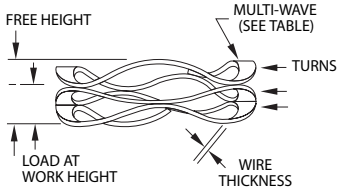
[1] Use "C" prefix for plain ends. Use "CS" prefix for squared-shim ends.
[2] Add suffix "-S17" for 17-7 stainless steel.
[3] Theoretical dimension.
[4] Spring rate is measured in N/mm.
[5] See pages 106-107 for How to Order.

Product Dimensions

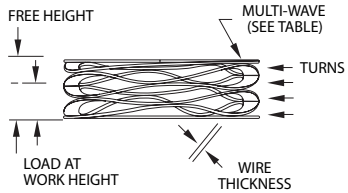
All dimensions in millimeters unless otherwise specified.



Plain Ends



Shim Ends



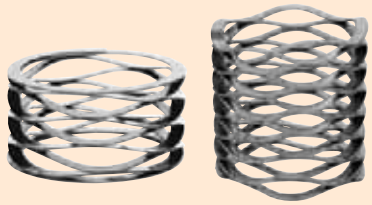
Order Options

C 037-L1

End options:
Plain ends. C
Squared-shim ends . . CS

Material option:
Carbon Steel. . . . (blank)
Stainless Steel. . . . . -S17

Stock Items in carbon steel and 17-7 PH/C stainless steel.

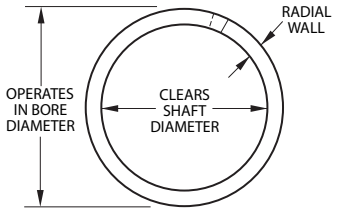


Smalley Part Number [1,2,5]	Operates in Bore Diameter	Clears Shaft Diameter	Load (N)	Work Height	Free Height [3]	Number of Waves	Number of Turns	Thickness	Radial Wall	Spring Rate [3,4]
C112-L1	28,58	21,59	53,40	3,71	7,62	3,50	3	0,31	2,39	14
C112-L2	28,58	21,59	53,40	4,72	10,16	3,50	4	0,31	2,39	10
C112-L3	28,58	21,59	53,40	6,35	12,70	3,50	5	0,31	2,39	8
C112-L4	28,58	21,59	53,40	7,49	15,24	3,50	6	0,31	2,39	7
C112-L5	28,58	21,59	53,40	8,74	17,78	3,50	7	0,31	2,39	6
C112-L6	28,58	21,59	53,40	9,96	20,32	3,50	8	0,31	2,39	5
C112-L7	28,58	21,59	53,40	12,40	25,40	3,50	10	0,31	2,39	4
C112-L8	28,58	21,59	53,40	16,74	33,02	3,50	13	0,31	2,39	3
C112-L9	28,58	21,59	53,40	20,50	40,64	3,50	16	0,31	2,39	3
C112-L10	28,58	21,59	53,40	25,83	50,80	3,50	20	0,31	2,39	2
C112-M1	28,58	21,59	89,00	4,06	7,62	3,50	3	0,38	2,39	25
C112-M2	28,58	21,59	89,00	5,13	10,16	3,50	4	0,38	2,39	18
C112-M3	28,58	21,59	89,00	6,86	12,70	3,50	5	0,38	2,39	15
C112-M4	28,58	21,59	89,00	8,08	15,24	3,50	6	0,38	2,39	12
C112-M5	28,58	21,59	89,00	9,68	17,78	3,50	7	0,38	2,39	11
C112-M6	28,58	21,59	89,00	10,85	20,32	3,50	8	0,38	2,39	9
C112-M7	28,58	21,59	89,00	13,61	25,40	3,50	10	0,38	2,39	8
C112-M8	28,58	21,59	89,00	17,98	33,02	3,50	13	0,38	2,39	6
C112-M9	28,58	21,59	89,00	21,87	40,64	3,50	16	0,38	2,39	5
C112-M10	28,58	21,59	89,00	27,64	50,80	3,50	20	0,38	2,39	4
C112-H1	28,58	21,59	133,50	4,52	7,62	3,50	3	0,46	2,39	43
C112-H2	28,58	21,59	133,50	5,82	10,16	3,50	4	0,46	2,39	31
C112-H3	28,58	21,59	133,50	7,70	12,70	3,50	5	0,46	2,39	27
C112-H4	28,58	21,59	133,50	8,89	15,24	3,50	6	0,46	2,39	21
C112-H5	28,58	21,59	133,50	10,69	17,78	3,50	7	0,46	2,39	19
C112-H6	28,58	21,59	133,50	11,94	20,32	3,50	8	0,46	2,39	16
C112-H7	28,58	21,59	133,50	15,06	25,40	3,50	10	0,46	2,39	13
C112-H8	28,58	21,59	133,50	19,99	33,02	3,50	13	0,46	2,39	10
C112-H9	28,58	21,59	133,50	24,28	40,64	3,50	16	0,46	2,39	8
C112-H10	28,58	21,59	133,50	30,53	50,80	3,50	20	0,46	2,39	7
C125-L1	31,75	25,40	53,40	2,13	7,62	3,50	3	0,31	2,39	10
C125-L2	31,75	25,40	53,40	2,87	10,16	3,50	4	0,31	2,39	7
C125-L3	31,75	25,40	53,40	3,78	12,70	3,50	5	0,31	2,39	6
C125-L4	31,75	25,40	53,40	4,37	15,24	3,50	6	0,31	2,39	5
C125-L5	31,75	25,40	53,40	5,26	17,78	3,50	7	0,31	2,39	4
C125-L6	31,75	25,40	53,40	5,77	20,32	3,50	8	0,31	2,39	4
C125-L7	31,75	25,40	53,40	7,65	25,40	3,50	10	0,31	2,39	3
C125-L8	31,75	25,40	53,40	10,03	33,02	3,50	13	0,31	2,39	2
C125-L9	31,75	25,40	53,40	11,86	40,64	3,50	16	0,31	2,39	2
C125-L10	31,75	25,40	53,40	15,01	50,80	3,50	20	0,31	2,39	2
C125-M1	31,75	25,40	89,00	3,15	7,62	3,50	3	0,38	2,39	20
C125-M2	31,75	25,40	89,00	4,19	10,16	3,50	4	0,38	2,39	15
C125-M3	31,75	25,40	89,00	5,46	12,70	3,50	5	0,38	2,39	12
C125-M4	31,75	25,40	89,00	6,43	15,24	3,50	6	0,38	2,39	10
C125-M5	31,75	25,40	89,00	7,70	17,78	3,50	7	0,38	2,39	9
C125-M6	31,75	25,40	89,00	8,66	20,32	3,50	8	0,38	2,39	8
C125-M7	31,75	25,40	89,00	10,85	25,40	3,50	10	0,38	2,39	6
C125-M8	31,75	25,40	89,00	14,66	33,02	3,50	13	0,38	2,39	5
C125-M9	31,75	25,40	89,00	17,58	40,64	3,50	16	0,38	2,39	4
C125-M10	31,75	25,40	89,00	22,00	50,80	3,50	20	0,38	2,39	3
C125-H1	31,75	25,40	133,50	4,01	7,62	3,50	3	0,48	2,39	37
C125-H2	31,75	25,40	133,50	5,33	10,16	3,50	4	0,48	2,39	28
C125-H3	31,75	25,40	133,50	6,91	12,70	3,50	5	0,48	2,39	23
C125-H4	31,75	25,40	133,50	8,13	15,24	3,50	6	0,48	2,39	19
C125-H5	31,75	25,40	133,50	9,75	17,78	3,50	7	0,48	2,39	17
C125-H6	31,75	25,40	133,50	11,00	20,32	3,50	8	0,48	2,39	14
C125-H7	31,75	25,40	133,50	13,67	25,40	3,50	10	0,48	2,39	11
C125-H8	31,75	25,40	133,50	18,21	33,02	3,50	13	0,48	2,39	9
C125-H9	31,75	25,40	133,50	22,30	40,64	3,50	16	0,48	2,39	7
C125-H10	31,75	25,40	133,50	28,02	50,80	3,50	20	0,48	2,39	6

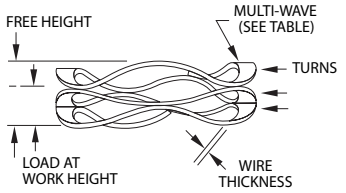
[1] Use "C" prefix for plain ends. Use "CS" prefix for squared-shim ends.
[2] Add suffix "-S17" for 17-7 stainless steel.
[3] Theoretical dimension.
[4] Spring rate is measured in N/mm.
[5] See pages 106-107 for How to Order.

Product Dimensions

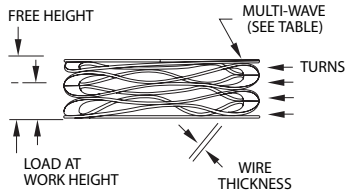
All dimensions in millimeters unless otherwise specified.



Plain Ends



Shim Ends

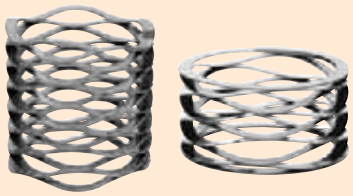


Order Options

C 037-L1

End options:
Plain ends. C
Squared-shim ends . . CS

Material option:
Carbon Steel. . . . (blank)
Stainless Steel. . . . . -S17



Stock Items in carbon steel and 17-7 PH/C stainless steel.

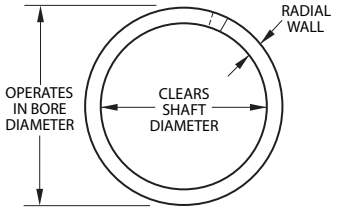
Smalley Part Number [1,2,5]	Operates in Bore Diameter	Clears Shaft Diameter	Load (N)	Work Height	Free Height [3]	Number of Waves	Number of Turns	Thickness	Radial Wall	Spring Rate [3,4]
C137-L1	34,93	26,16	66,75	1,91	7,62	3,50	3	0,31	3,10	12
C137-L2	34,93	26,16	66,75	2,51	10,16	3,50	4	0,31	3,10	9
C137-L3	34,93	26,16	66,75	3,28	12,70	3,50	5	0,31	3,10	7
C137-L4	34,93	26,16	66,75	3,94	15,24	3,50	6	0,31	3,10	6
C137-L5	34,93	26,16	66,75	4,55	17,78	3,50	7	0,31	3,10	5
C137-L6	34,93	26,16	66,75	5,23	20,32	3,50	8	0,31	3,10	4
C137-L7	34,93	26,16	66,75	6,50	25,40	3,50	10	0,31	3,10	4
C137-L8	34,93	26,16	66,75	8,66	33,02	3,50	13	0,31	3,10	3
C137-L9	34,93	26,16	66,75	10,77	40,64	3,50	16	0,31	3,10	2
C137-L10	34,93	26,16	66,75	13,46	50,80	3,50	20	0,31	3,10	2
C137-M1	34,93	26,16	111,25	3,61	7,62	3,50	3	0,41	3,38	28
C137-M2	34,93	26,16	111,25	4,72	10,16	3,50	4	0,41	3,38	20
C137-M3	34,93	26,16	111,25	6,10	12,70	3,50	5	0,41	3,38	17
C137-M4	34,93	26,16	111,25	7,14	15,24	3,50	6	0,41	3,38	14
C137-M5	34,93	26,16	111,25	8,64	17,78	3,50	7	0,41	3,38	12
C137-M6	34,93	26,16	111,25	9,75	20,32	3,50	8	0,41	3,38	11
C137-M7	34,93	26,16	111,25	12,34	25,40	3,50	10	0,41	3,38	9
C137-M8	34,93	26,16	111,25	16,05	33,02	3,50	13	0,41	3,38	6
C137-M9	34,93	26,16	111,25	20,02	40,64	3,50	16	0,41	3,38	5
C137-M10	34,93	26,16	111,25	24,94	50,80	3,50	20	0,41	3,38	4
C137-H1	34,93	26,16	155,75	3,78	7,62	3,50	3	0,46	3,38	41
C137-H2	34,93	26,16	155,75	4,80	10,16	3,50	4	0,46	3,38	29
C137-H3	34,93	26,16	155,75	6,27	12,70	3,50	5	0,46	3,38	24
C137-H4	34,93	26,16	155,75	7,29	15,24	3,50	6	0,46	3,38	20
C137-H5	34,93	26,16	155,75	8,71	17,78	3,50	7	0,46	3,38	17
C137-H6	34,93	26,16	155,75	9,91	20,32	3,50	8	0,46	3,38	15
C137-H7	34,93	26,16	155,75	12,45	25,40	3,50	10	0,46	3,38	12
C137-H8	34,93	26,16	155,75	16,41	33,02	3,50	13	0,46	3,38	9
C137-H9	34,93	26,16	155,75	20,14	40,64	3,50	16	0,46	3,38	8
C137-H10	34,93	26,16	155,75	25,40	50,80	3,50	20	0,46	3,38	6
C150-L1	38,10	28,96	89,00	3,28	7,62	3,50	3	0,41	3,38	20
C150-L2	38,10	28,96	89,00	4,17	10,16	3,50	4	0,41	3,38	15
C150-L3	38,10	28,96	89,00	5,41	12,70	3,50	5	0,41	3,38	12
C150-L4	38,10	28,96	89,00	6,27	15,24	3,50	6	0,41	3,38	10
C150-L5	38,10	28,96	89,00	7,65	17,78	3,50	7	0,41	3,38	9
C150-L6	38,10	28,96	89,00	8,56	20,32	3,50	8	0,41	3,38	8
C150-L7	38,10	28,96	89,00	10,92	25,40	3,50	10	0,41	3,38	6
C150-L8	38,10	28,96	89,00	14,35	33,02	3,50	13	0,41	3,38	5
C150-L9	38,10	28,96	89,00	17,63	40,64	3,50	16	0,41	3,38	4
C150-L10	38,10	28,96	89,00	22,00	50,80	3,50	20	0,41	3,38	3
C150-M1	38,10	28,96	155,75	3,10	7,62	3,50	3	0,46	3,38	35
C150-M2	38,10	28,96	155,75	4,01	10,16	3,50	4	0,46	3,38	25
C150-M3	38,10	28,96	155,75	5,23	12,70	3,50	5	0,46	3,38	21
C150-M4	38,10	28,96	155,75	6,12	15,24	3,50	6	0,46	3,38	17
C150-M5	38,10	28,96	155,75	7,39	17,78	3,50	7	0,46	3,38	15
C150-M6	38,10	28,96	155,75	8,23	20,32	3,50	8	0,46	3,38	13
C150-M7	38,10	28,96	155,75	10,39	25,40	3,50	10	0,46	3,38	10
C150-M8	38,10	28,96	155,75	13,72	33,02	3,50	13	0,46	3,38	8
C150-M9	38,10	28,96	155,75	16,69	40,64	3,50	16	0,46	3,38	6
C150-M10	38,10	28,96	155,75	21,21	50,80	3,50	20	0,46	3,38	5
C150-H1	38,10	28,96	267,00	4,22	7,62	4,50	3	0,46	3,38	78
C150-H2	38,10	28,96	267,00	5,49	10,16	4,50	4	0,46	3,38	57
C150-H3	38,10	28,96	267,00	7,06	12,70	4,50	5	0,46	3,38	47
C150-H4	38,10	28,96	267,00	8,36	15,24	4,50	6	0,46	3,38	39
C150-H5	38,10	28,96	267,00	9,91	17,78	4,50	7	0,46	3,38	34
C150-H6	38,10	28,96	267,00	11,25	20,32	4,50	8	0,46	3,38	29
C150-H7	38,10	28,96	267,00	14,10	25,40	4,50	10	0,46	3,38	24
C150-H8	38,10	28,96	267,00	18,44	33,02	4,50	13	0,46	3,38	18
C150-H9	38,10	28,96	267,00	22,61	40,64	4,50	16	0,46	3,38	15
C150-H10	38,10	28,96	267,00	28,42	50,80	4,50	20	0,46	3,38	12

[1] Use "C" prefix for plain ends. Use "CS" prefix for squared-shim ends.
[2] Add suffix "-S17" for 17-7 stainless steel.
[3] Theoretical dimension.
[4] Spring rate is measured in N/mm.
[5] See pages 106-107 for How to Order.

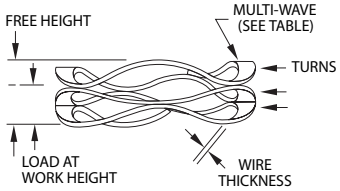
SPRINGS

Product Dimensions

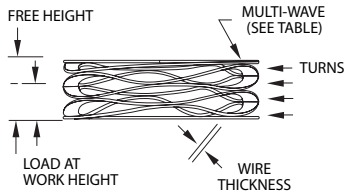
All dimensions in millimeters unless otherwise specified.



Plain Ends



Shim Ends



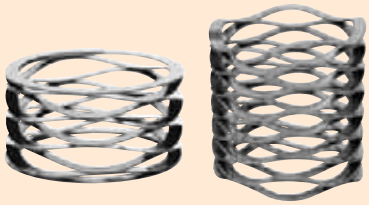
Order Options

C 037-L1

End options:
Plain ends. C
Squared-shim ends . . CS

Material option:
Carbon Steel. . . . (blank)
Stainless Steel. . . . . -S17

Stock Items in carbon steel and 17-7 PH/C stainless steel.

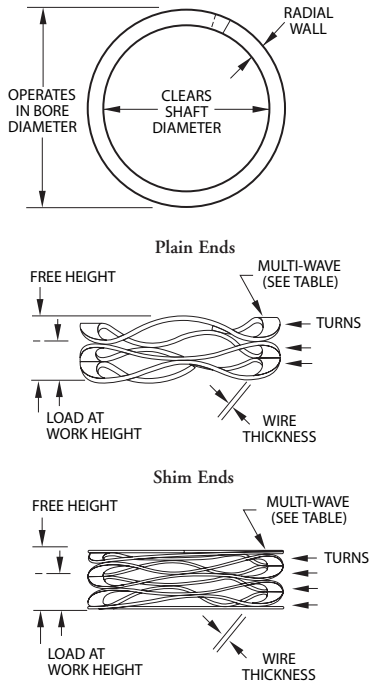


Smalley Part Number [1,2,5]	Operates in Bore Diameter	Clears Shaft Diameter	Load (N)	Work Height	Free Height [3]	Number of Waves	Number of Turns	Thickness	Radial Wall	Spring Rate [3,4]
C175-L1	44,45	34,04	111,25	3,94	9,53	3,50	3	0,46	3,63	20
C175-L2	44,45	34,04	111,25	5,08	12,70	3,50	4	0,46	3,63	15
C175-L3	44,45	34,04	111,25	6,73	15,88	3,50	5	0,46	3,63	12
C175-L4	44,45	34,04	111,25	7,87	19,05	3,50	6	0,46	3,63	10
C175-L5	44,45	34,04	111,25	9,32	22,10	3,50	7	0,46	3,63	9
C175-L6	44,45	34,04	111,25	10,54	25,40	3,50	8	0,46	3,63	8
C175-L7	44,45	34,04	111,25	13,28	31,75	3,50	10	0,46	3,63	6
C175-L8	44,45	34,04	111,25	16,21	38,10	3,50	12	0,46	3,63	5
C175-L9	44,45	34,04	111,25	18,72	44,45	3,50	14	0,46	3,63	4
C175-L10	44,45	34,04	111,25	21,44	50,80	3,50	16	0,46	3,63	4
C175-M1	44,45	34,04	222,50	4,78	9,53	4,50	3	0,46	3,63	47
C175-M2	44,45	34,04	222,50	6,20	12,70	4,50	4	0,46	3,63	34
C175-M3	44,45	34,04	222,50	8,00	15,88	4,50	5	0,46	3,63	28
C175-M4	44,45	34,04	222,50	9,50	19,05	4,50	6	0,46	3,63	23
C175-M5	44,45	34,04	222,50	11,48	22,10	4,50	7	0,46	3,63	21
C175-M6	44,45	34,04	222,50	12,83	25,40	4,50	8	0,46	3,63	18
C175-M7	44,45	34,04	222,50	15,98	31,75	4,50	10	0,46	3,63	14
C175-M8	44,45	34,04	222,50	19,51	38,10	4,50	12	0,46	3,63	12
C175-M9	44,45	34,04	222,50	22,83	44,45	4,50	14	0,46	3,63	10
C175-M10	44,45	34,04	222,50	26,06	50,80	4,50	16	0,46	3,63	9
C175-H1	44,45	34,04	400,50	5,89	9,53	4,50	3	0,61	3,76	110
C175-H2	44,45	34,04	400,50	7,98	12,70	4,50	4	0,61	3,76	85
C175-H3	44,45	34,04	400,50	10,39	15,88	4,50	5	0,61	3,76	73
C175-H4	44,45	34,04	400,50	12,24	19,05	4,50	6	0,61	3,76	59
C175-H5	44,45	34,04	400,50	14,66	22,10	4,50	7	0,61	3,76	54
C175-H6	44,45	34,04	400,50	16,54	25,40	4,50	8	0,61	3,76	45
C175-H7	44,45	34,04	400,50	20,65	31,75	4,50	10	0,61	3,76	36
C175-H8	44,45	34,04	400,50	24,89	38,10	4,50	12	0,61	3,76	30
C175-H9	44,45	34,04	400,50	29,13	44,45	4,50	14	0,61	3,76	26
C175-H10	44,45	34,04	400,50	33,45	50,80	4,50	16	0,61	3,76	23
C200-L1	50,80	40,64	111,25	2,39	9,53	3,50	3	0,46	3,63	16
C200-L2	50,80	40,64	111,25	3,05	12,70	3,50	4	0,46	3,63	12
C200-L3	50,80	40,64	111,25	4,01	15,88	3,50	5	0,46	3,63	9
C200-L4	50,80	40,64	111,25	4,55	19,05	3,50	6	0,46	3,63	8
C200-L5	50,80	40,64	111,25	5,51	22,10	3,50	7	0,46	3,63	7
C200-L6	50,80	40,64	111,25	6,17	25,40	3,50	8	0,46	3,63	6
C200-L7	50,80	40,64	111,25	7,77	31,75	3,50	10	0,46	3,63	5
C200-L8	50,80	40,64	111,25	9,27	38,10	3,50	12	0,46	3,63	4
C200-L9	50,80	40,64	111,25	11,00	44,45	3,50	14	0,46	3,63	3
C200-L10	50,80	40,64	111,25	12,45	50,80	3,50	16	0,46	3,63	3
C200-M1	50,80	40,64	222,50	3,56	9,53	4,50	3	0,46	3,63	37
C200-M2	50,80	40,64	222,50	4,67	12,70	4,50	4	0,46	3,63	28
C200-M3	50,80	40,64	222,50	6,22	15,88	4,50	5	0,46	3,63	23
C200-M4	50,80	40,64	222,50	7,06	19,05	4,50	6	0,46	3,63	19
C200-M5	50,80	40,64	222,50	8,76	22,10	4,50	7	0,46	3,63	17
C200-M6	50,80	40,64	222,50	10,03	25,40	4,50	8	0,46	3,63	15
C200-M7	50,80	40,64	222,50	12,65	31,75	4,50	10	0,46	3,63	12
C200-M8	50,80	40,64	222,50	15,06	38,10	4,50	12	0,46	3,63	10
C200-M9	50,80	40,64	222,50	17,63	44,45	4,50	14	0,46	3,63	8
C200-M10	50,80	40,64	222,50	20,32	50,80	4,50	16	0,46	3,63	7
C200-H1	50,80	40,64	400,50	5,00	9,53	4,50	3	0,61	3,76	89
C200-H2	50,80	40,64	400,50	6,55	12,70	4,50	4	0,61	3,76	65
C200-H3	50,80	40,64	400,50	8,43	15,88	4,50	5	0,61	3,76	54
C200-H4	50,80	40,64	400,50	9,88	19,05	4,50	6	0,61	3,76	44
C200-H5	50,80	40,64	400,50	11,81	22,10	4,50	7	0,61	3,76	39
C200-H6	50,80	40,64	400,50	13,34	25,40	4,50	8	0,61	3,76	33
C200-H7	50,80	40,64	400,50	16,79	31,75	4,50	10	0,61	3,76	27
C200-H8	50,80	40,64	400,50	19,84	38,10	4,50	12	0,61	3,76	22
C200-H9	50,80	40,64	400,50	23,90	44,45	4,50	14	0,61	3,76	19
C200-H10	50,80	40,64	400,50	27,15	50,80	4,50	16	0,61	3,76	17

[1] Use "C" prefix for plain ends. Use "CS" prefix for squared-shim ends.
[2] Add suffix "-S17" for 17-7 stainless steel.
[3] Theoretical dimension.
[4] Spring rate is measured in N/mm.
[5] See pages 106-107 for How to Order.

Product Dimensions

All dimensions in millimeters unless otherwise specified.



Order Options

C 037-L1

End options:
Plain ends. C
Squared-shim ends . . CS

Material option:
Carbon Steel. . . . (blank)
Stainless Steel. . . . . -S17

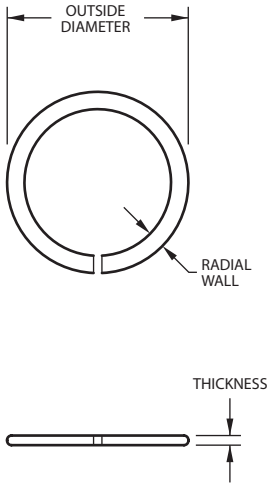
SPRINGS

Smalley Shims are commonly used in conjunction with wave springs where a back-up plate is needed for housings made of softer metals like aluminum or bronze, and for packings made of leather, neoprene or similar materials. Shims can function as spacers to change wave spring operating heights. Adding or subtracting shims is an excellent method of adjusting load on a wave spring. Using a shim spacer can also control tolerance buildups.

Stock Items in carbon steel and 17-7 PH/C stainless steel. However, Smalley can make them to order in nearly any size or material.

Product Dimensions

All dimensions in millimeters unless otherwise specified.



Smalley Part Number [1, 3]	Outside Diameter (mm)		Thickness (mm)	Radial Wall (mm)	Metric Weight [2]
SSRS-0075	19,05	+0,0/-0,38	0,610	2,362	,59
SSRS-0087	22,23		0,610	2,362	,70
SSRS-0100	25,40		0,610	2,616	,90
SSRS-0112	28,58		0,610	3,505	1,32
SSRS-0125	31,75		0,610	3,505	1,49
SSRS-0137	34,93		0,610	3,505	1,65
SSRS-0150	38,10		0,610	3,810	1,96
SSRS-0162	41,28	+0,0/-0,51	0,610	3,810	2,14
SSRS-0175	44,45		0,610	3,810	2,33
SSRS-0187	47,63		0,610	3,810	2,51
SSRS-0200	50,80		0,610	3,810	2,69
SSRS-0212	53,98		0,610	3,810	2,87
SSRS-0225	57,15	+0,0/-0,64	0,610	3,810	3,05
SSRS-0237	60,33		0,610	4,521	3,79
SSRS-0250	63,50		0,610	4,521	4,00
SSRS-0262	66,68		0,610	4,521	4,22
SSRS-0275	69,85		0,762	4,775	5,83
SSRS-0287	73,03		0,762	4,775	6,12
SSRS-0300	76,20		0,762	4,775	6,40
SSRS-0312	79,38		0,762	4,775	6,69
SSRS-0325	82,55	+0,0/-0,76	0,762	5,918	8,51
SSRS-0337	85,73		0,762	5,918	8,87
SSRS-0350	88,90		0,762	5,918	9,22
SSRS-0362	92,08		0,762	5,918	9,57
SSRS-0375	95,25		0,762	5,918	9,92
SSRS-0387	98,43		0,762	5,918	10,28
SSRS-0400	101,60		0,762	5,918	10,63
SSRS-0412	104,78		0,762	5,918	10,98
SSRS-0425	107,95		0,762	5,918	11,34
SSRS-0437	111,13	+0,0/-0,89	0,762	5,918	11,69
SSRS-0450	114,30		0,762	5,918	12,04
SSRS-0462	117,48		0,762	5,918	12,39
SSRS-0475	120,65		0,762	5,918	12,75
SSRS-0487	123,83		0,762	5,918	13,10
SSRS-0500	127,00		0,762	5,918	13,45
SSRS-0512	130,18		0,762	5,918	13,80

Smalley Part Number [1, 3]	Outside Diameter (mm)		Thickness (mm)	Radial Wall (mm)	Metric Weight [2]
SSRS-0525	133,35	+0,0/-0,89	0,762	5,918	14,16
SSRS-0537	136,53		0,762	5,918	14,51
SSRS-0550	139,70	+0,0/-1,14	0,762	5,918	14,86
SSRS-0562	142,88		0,762	5,918	15,22
SSRS-0575	146,05		0,762	5,918	15,57
SSRS-0587	149,23		0,762	5,918	15,92
SSRS-0600	152,40		0,762	5,918	16,27
SSRS-0612	155,58		0,762	5,918	16,63
SSRS-0625	158,75		0,762	5,918	16,98
SSRS-0637	161,93		0,762	5,918	17,33
SSRS-0650	165,10		0,762	5,918	17,68
SSRS-0675	171,45		0,762	5,918	18,39
SSRS-0700	177,80		0,813	9,525	32,09
SSRS-0725	184,15		0,813	9,525	33,31
SSRS-0750	190,50	+0,0/-1,52	0,813	9,525	34,52
SSRS-0775	196,85		0,813	9,525	35,73
SSRS-0800	203,20		0,813	9,525	36,94
SSRS-0825	209,55		0,813	9,525	38,15
SSRS-0850	215,90		0,813	9,525	39,36
SSRS-0875	222,25		0,813	9,525	40,57
SSRS-0900	228,60		0,813	9,525	41,78
SSRS-0950	241,30	+0,0/-1,78	0,813	9,525	44,21
SSRS-1000	254,00		0,813	9,525	46,63
SSRS-1050	266,70		0,813	9,525	49,05
SSRS-1100	279,40		0,813	9,525	51,47
SSRS-1150	292,10		0,813	9,525	53,89
SSRS-1200	304,80	+0,0/-2,03	0,813	9,525	56,32
SSRS-1250	317,50		0,813	9,525	58,74
SSRS-1300	330,20		0,813	9,525	61,16
SSRS-1350	342,90		0,813	9,525	63,58
SSRS-1400	355,60		0,813	9,525	66,01
SSRS-1450	368,30	+0,0/-2,29	0,813	9,525	68,43
SSRS-1500	381,00		0,813	9,525	70,85
SSRS-1550	393,70		0,813	9,525	73,27
SSRS-1600	406,40		0,813	9,525	75,69

[1] Add suffix "-S17" for 17-7 stainless steel.
[2] Kg per 1000.
[3] See pages 106-107 for How to Order.

Spring Tester

SPRING TESTER

Springs are inspected for load, deflection, free height and spring rate with this compression spring tester, designed and built by Smalley. Main components of the tester are described below.

The accuracy in checking spring load/deflection characteristics is dependent on the accuracy and precision of the testing device itself. The concept of accurate compression testing relies greatly on the following tester features:

1. Upper and lower plates must remain parallel throughout the test. Generally, the distance between upper and lower plates must be within 0,05 mm at any point, from zero to full load.
2. Upper and lower plates must be rigid in that they should not misalign with the spring positioned at any point on the lower plate (note that placing a spring off-center induces a moment, which tends to both tip the plates and cause frictional drag.)
3. The load system must be free of friction, which can cause hysteresis in the load values obtained in the test.
4. Testing surfaces of both the lower and upper plates must be smooth and free of scratches, cracks or other physical imperfections.

FATIGUE TESTER

Fatigue cycling is often a consideration when designing compression springs. Testing provides a more accurate prediction of actual cycle life and is recommended whenever cycle life is critical or when calculations show little margin over the cycle requirement.

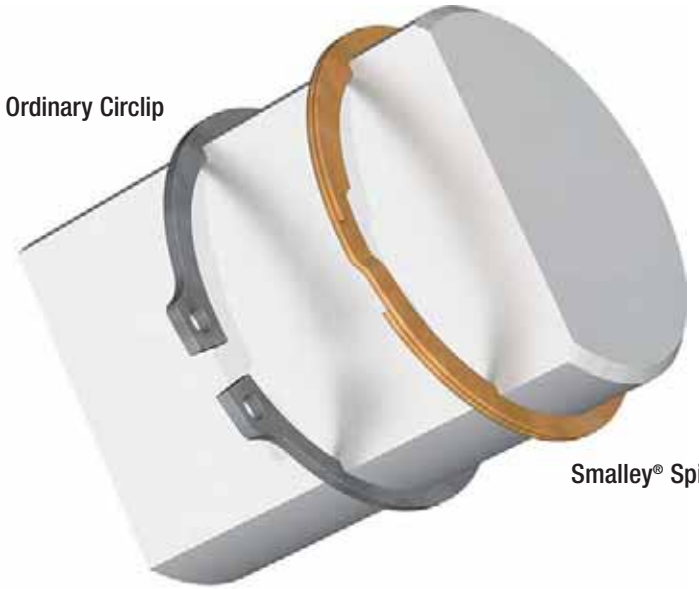
Ideally, springs should be cycle tested in the actual assembly. Where this is not feasible, Smalley offers testing on high speed cycle machinery. The cycle test machinery can be adjusted to various work heights and stroke lengths to simulate the actual application.


Fatigue Tester

ADVANTAGES OF SMALLEY® RETAINING RINGS

Smalley Spiral Retaining Rings have no ears to interfere in your assembly! Spirals are manufactured by coiling the ring from flat wire. This unique process produces a retaining ring that has no protruding ears or burrs that would interfere in your assembly. Because coiling produces a retaining ring with no scrap, the Smalley Ring can be economically produced in carbon steel, stainless steel, coppers, and many other alloys.

Smalley offers over 5 000 standard parts, which are readily available in both carbon and stainless steel. If you require special designs, take advantage of Smalley's No-Tooling-Cost process; a process perfect for large runs, prototypes and midstream design changes. Whatever your application, Smalley has the cost-effective and innovative design solution.



Smalley Spiral Retaining Rings offer many advantages over stamped retaining rings

- No gap - 360° retaining surface
- No protruding ears to interfere with mating components (uniform cross-section)
- Economically produced in stainless steel because the coiling process produces no scrap
- **No-Tooling-Charge** on special designs
- Easy installation and removal

OTHER RING TYPES & SPECIAL DESIGNS

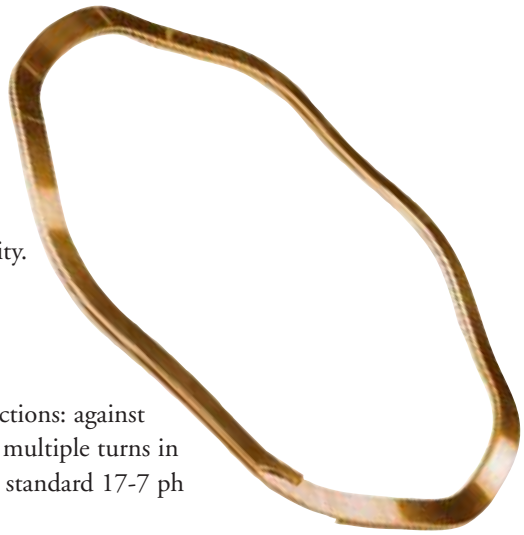
SNAP RINGS

Another popular choice of retaining ring configurations is the well known Snap Ring. Produced by edgewinding with no special tooling charges, Snap Rings have been specified for many years in the automotive and heavy equipment industries as a standard choice of engineers.

Smalley has hundreds of standard Snap Rings in stock, in carbon steel & stainless steel and in both inch & metric sizes. Special or custom designs can be produced fast and economical utilizing Smalley's precision No-Tooling-Cost manufacturing process.

Snap Rings can withstand high forces & impact loads and are easily installed & removed from their internal or external groove for field servicing your product.

WAVERING®



The WaveRing is a spiral retaining ring with an axial wave form. It acts like a standard retaining ring with the additional feature of compressibility. It compensates for the overall length tolerance of stacked components, while still acting as a retaining ring. Once assembled the WaveRing will reduce looseness and vibration in the assembly.

Designed to fit into a groove, the WaveRing applies pressure in two directions: against the groove wall and against the assembly components. Single, double or multiple turns in the WaveRing are possible as well as a choice of materials, including our standard 17-7 ph stainless and carbon steel.

SPECIAL RINGS

A major segment of Smalley manufacturing is in "special" or prototype retaining rings. Common Smalley specials include balanced, multi-turn (4,5,6 turns and more) and special ends in diameters from 5 mm – 2 300 mm (0,200 in – 90 in) and larger. Smalley engineers are on hand to help you design a ring specific for your application. Because there are no tooling costs, no job is too big or too little. Prototypes can be quickly and economically produced to test a design, in days, not weeks.

RETAINING RING SELECTION GUIDE

STEP 1: Do you need to meet any specifications?

YES

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

NO

STEP 2: Do you need to match a circlip or snap ring groove?

YES

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

NO

STEP 3A: Choose by the Thrust Capacity needed OR see step 3B

Standard Units (inches)

Series	Load [1]	Housing	Shaft
Light Duty	4100	VH	VS
Medium Duty	4950	WH	WS
Medium Heavy Duty	7070	WHT	WST
Heavy Duty	8340	WHM	WSM
Snap Rings	8341	FHE	FSE
WaveRing	—	WHW	WSW

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

Metric Units (mm)

Series	Load [1]	Housing	Shaft
Light Duty	18,03	VHM	VSM
DIN Series [2]	36,55	DNH	DNS
Aerospace Series	38,96	EH	ES
Snap Rings	36,53	FH	FS

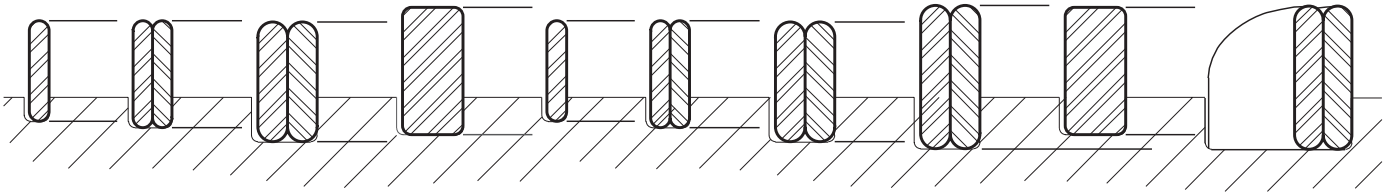
[1] Representative example shows the load capacity (kN) for a 50 mm ring.
[2] Manufactured to DIN groove specifications.

Step 3B: Still not sure? Use Smalley's most popular series, Medium Duty WH (internal) or WS (external). Ask for a free sample.

RELATIVE PROPORTIONS OF RINGS IN GROOVES

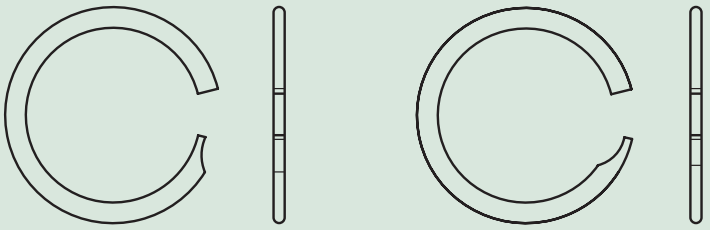
A cross-section of each Smalley Retaining Ring configuration is illustrated, comparing groove and ring sections in the same diameter bore or shaft. The heavier retaining ring cross-sections are in deeper and wider grooves, to provide significantly greater thrust capacity.

VHM & VSM Light Duty Metric Series | **EH & ES** Metric Aerospace Series | **DNH & DNS** DIN Metric Series | **FH & FS** Heavy Duty Metric Series | **VH & VS** Light Duty Series | **WH & WS** Medium Duty Series | **WHT & WST** Medium Heavy Duty Series | **WHM & WSM** Heavy Duty Series | **FHE & FSE** Heavy Duty Series | **WHW & WSW** WaveRing Series

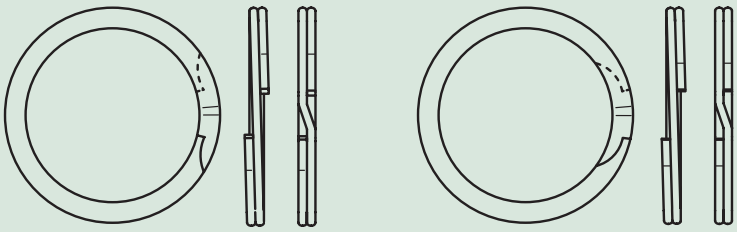


RING TYPES

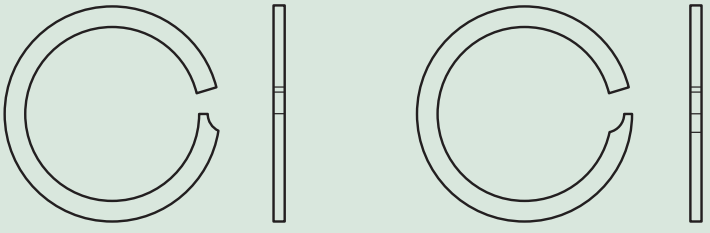
SPIRAL RETAINING RINGS
SINGLE TURN (1-TURN)
VHM & VSM – Light Duty, metric
VH & VS – Light Duty, inch



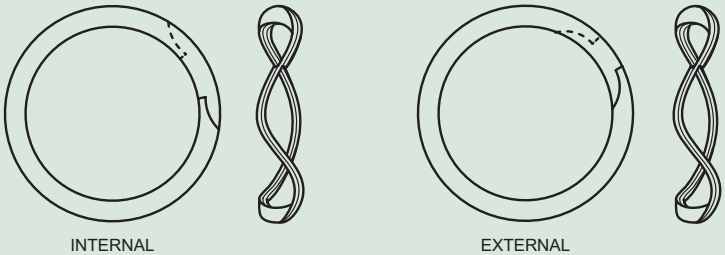
SPIRAL RETAINING RINGS
2-TURN
EH & ES – Medium Duty, Metric Aerospace
DNH & DNS – Heavy Duty DIN, metric
WH & WS – Medium Duty, inch
WHT & WST – Medium Heavy Duty, inch
WHM & WSM – Heavy Duty, inch



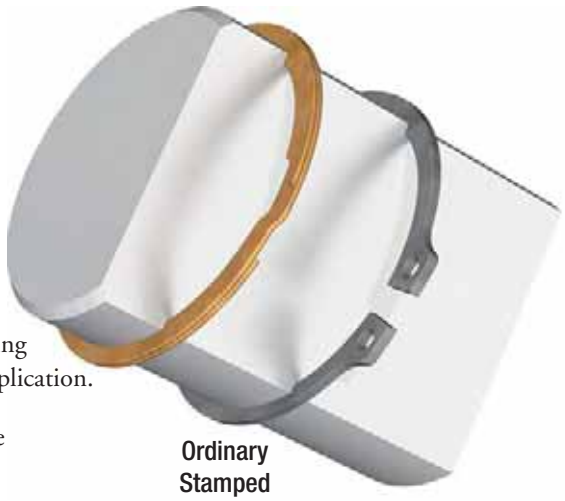
SNAP RINGS
FH & FS – Heavy Duty, metric
FHE & FSE – Heavy Duty, inch



WAVERINGS
WHW & WSW – inch



Smalley® Spiral Retaining Ring



Ordinary Stamped Circlip

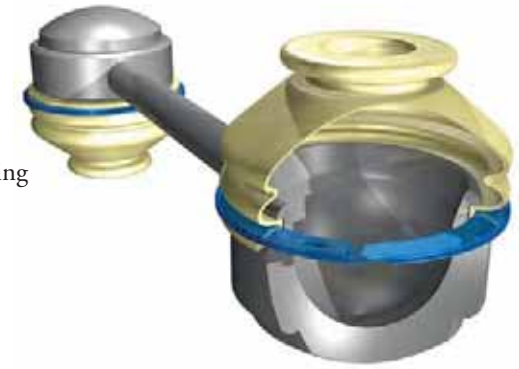
INTERCHANGE LISTING

Smalley Retaining Rings are interchangeable with both inch and metric retaining ring grooves. Smalley offers FREE SAMPLES of all stock retaining rings to test in your application.

Cross reference a standard circlip, stamped ring or snap ring to find the appropriate Smalley Retaining Ring to fit your application.

SMALLEY®	SPIRAL EQUIVALENT	MILITARY MIL-DTL-27426	AEROSPACE AS 3219	METRIC AEROSPACE MA 4035	EUROPEAN SPECIFICATION DIN	WALDES TRUARC	EATON	INDUSTRIAL RETAINING RING	ANDERTON
VH	UR	---	---	---					
VS	US	---	---	---					
WH	RR	/3	AS4299 AS3217	---					
WS	RS	/1	AS4299 AS3218	---					
WHT	RRT	---	---	---	---	---	NAN	---	---
WST	RST	---	---	---	---	---	XAN	---	---
WHM	RRN	/4	AS4299 AS3215	---	---	N5000 5008	IN	3000 4000	N1300
WSM	RSN	/2	AS4299 AS3216	---	---	5100 5108	EN	3100 4100	N1400
DNH	---	---	---	---	DIN 472	---	---	---	D1300
DNS	---	---	---	---	DIN 471	---	---	---	D1400
EH	---	---	---	MA 4017	---	---	---	---	---
ES	---	---	---	MA 4016	---	---	---	---	---
FH	---	---	---	---	DIN 472	---	---	---	D1300
FS	---	---	---	---	DIN 471	---	---	---	D1400

GROOVE INTERCHANGE ONLY
Use a Smalley retaining ring to fit into the same groove of these stamped retaining rings.



RUBBER BOOT

A 2-Turn Spiral Retaining Ring clamps the rubber boot onto the groove making for a nearly perfect seal when the boot is filled with grease. The ring has been deburred so it will not tear into the rubber.

PNEUMATIC FITTING

An economical (without removal notches or offset) 2-Turn Spiral Retaining Ring creates an ID/OD lock, permitting the 360° rotation of the nut. This permanent assembly is commonly used to hold two components together.

RATCHET WRENCH

This Single-Turn (it is actually 1½ turns) External Retaining Ring retains the internal mechanical components of the ratchet wrench. The additional ½ turn provides that little extra strength needed to prevent the ring from dislodging when the wrench is dropped.

GEAR BRACKET

The worm gear shaft is held in place and pre-loaded using a 2-Turn Smalley WaveRing. The WaveRing fits an internal groove and the waveform in the ring allows the gear/shaft to float axially as the gear rotates.

CONDUIT CONNECTOR

In this unique application, a Dished Retaining Ring was designed with sharp edges, to bite into the conduit it holds in place. The clamping force of the ring to the conduit (not shown) is achieved by screwing the nut. This decreases the ring's diameter as it advances in a tapered bore.

Ring Applications

BIKE LOCK

Tamper-proof ring holds the lock assembly within its housing. The ring is considered tamper-proof because of reversed removal notches. Also, having a heavy cross-section makes the ring nearly impossible to remove.

PRESSURE GAUGE

A retaining ring designed in a shallow groove exerts very light pressure on the glass lens in this pressure gauge. This single-turn retaining ring design provides the optimum load without breaking the glass.

GEAR ASSEMBLY

External 2-Turn, retaining ring prevents the pinion shafts from spinning when the gears are rotating. The Smalley ring snaps securely on the groove and the rings radial wall is designed to extend radially outward, clearing the four flat pinion shaft pins by 0,50 mm.

ACTUATOR VALVE

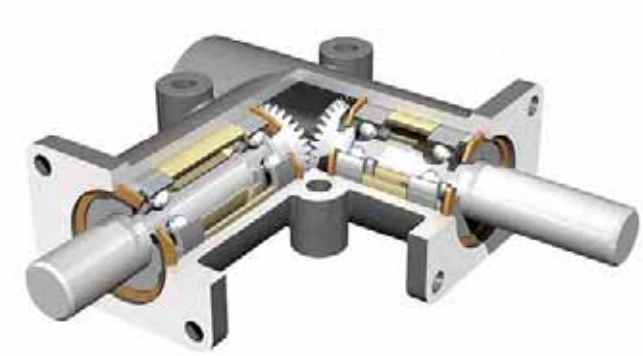
High thrust capacity was needed and a snap ring was selected to absorb the occasional shock loading of the pistons.

PNEUMATIC CLUTCH

The internal components of this clutch are held in the housing using a heavy-duty snap ring. Field servicing was often necessary and the snap ring was the ideal solution to the design requirement.

HOSE FITTING

To keep the cap on the fitting, a single-turn retaining ring is located in a shallow internal groove. The wall thickness of the cap is small so the ring was designed with square corners to operate in a very shallow groove.



RIGHT ANGLE DRIVE

Snap rings secure the bearing assembly by providing removable shoulders in the bore. This simplifies the design of the gear box and replaces costly flanged end-plates.

AIR VENT

Single-turn, light-duty retaining ring fits tightly in the internal groove of a plastic air vent. Ring ends are dimensioned close together, providing nearly complete 360° ring support.

PULLEY

2-Turn retaining rings provide 360° side walls as sides of the timing belt pulley. Design eliminates costly pressed-on stamped side walls. For belt replacement one ring can be easily removed.

ID/OD LOCK

Single-turn retaining ring operates in an internal and external groove at the same time, commonly referred to as an ID/OD Lock. In this application, the ring fits tight on the body (shaft) groove and extends radially into the nut (housing). This allows the nut to spin freely but not come off the body.

BELT PULLEY

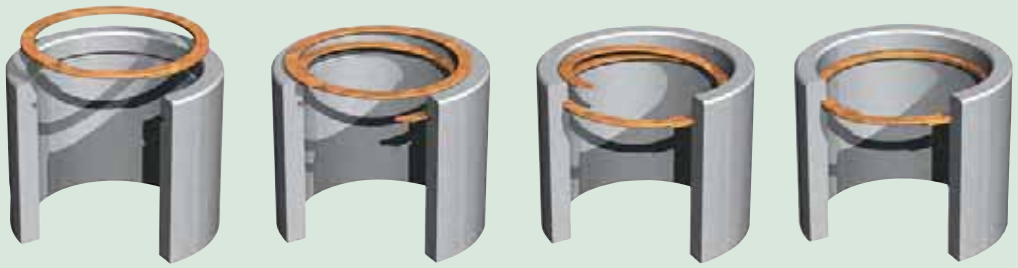
Three hold down screws and a 2-Turn Smalley Ring form a bi-directional shoulder. The shaft is inserted through the pulley and the retaining ring rests on the pulley face securing the shaft in one direction. Movement is prevented in the other direction with the three screws clamping down on the ring.

MANUAL INSTALLATION

Manual installation on an individual or low production basis is accomplished as follows:

- Separate the ring coils and insert one end of the ring into the groove.
- Wind the ring by pressing down around the circumference until the entire ring is inserted into the groove.

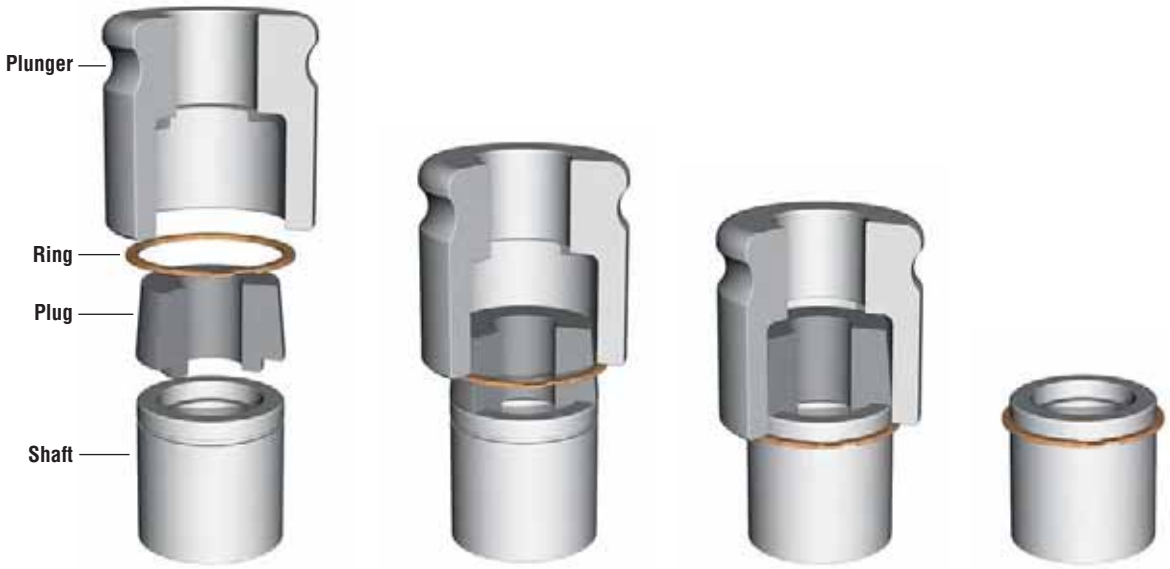
HOUSING:



SHAFT:

SEMI–AUTOMATED and AUTOMATED INSTALLATION

For higher speed and automated assembly operations, simple tooling or assembly fixtures can be designed. External installation on a shaft can be accomplished with a plunger and tapered plug. The plug, angled at approximately 6 degrees, is centered over the shaft end. A loose fitting plunger pushes the ring into position over the tapered plug. An arbor press or air cylinder is commonly used to automate this assembly operation.



Internal retaining ring installation is accomplished in a similar manner. A tapered bore which acts as a ring contracting guide, and a plunger pushes the retaining ring into position. Tooling for ring installation should have hardened working surfaces to minimize wear.

Using Screwdriver

Using Dental Pick

REMOVAL

Smalley Retaining Rings are supplied standard with removal notches to enable easy extraction from a groove. The notch is provided to form a small gap between the ring end and the shaft or housing, permitting a blunt object to be inserted at the end of the ring to pry the free end out radially and up.

- Insert a screwdriver or dental pick behind the removal notch.
- Use the tool to pry out the first end of the ring.
- Manually spiral the ring around until it is free from the groove.

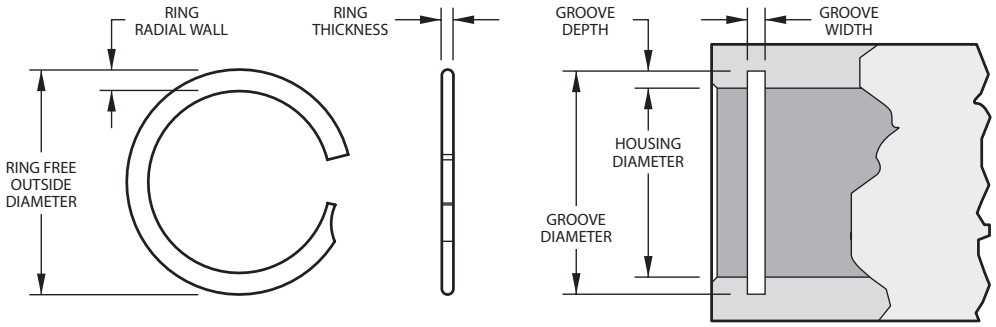
SMALLEY TOOLING

Smalley's Spiral Retaining Ring Removal Tool, part number RT-107, fits between the layers of a multiple turn retaining ring in order to access the removal notch. The end of the tool bit is slotted for the tip of the notch end to pass through. Once inserted, the ring end may be pulled out radially and up.

Visit http://www.smalley.com/retaining_rings/installation_and_removal.asp for more information about installation and removal.

Product Dimensions

All dimensions are in millimeters unless otherwise specified.



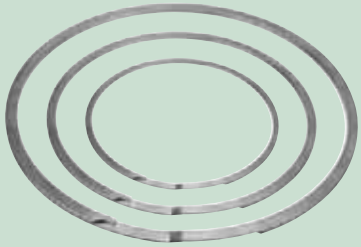
Smalley Part Number [1, 4]	Housing Diameter	RING					GROOVE			THRUST CAPACITY	
		Outside Diameter		Radial Wall		Thickness	Diameter		Width	Groove Yield (kN) [2]	Ring Shear (kN) [3]
VHM-6*	6,00	6,35	+0,25/-0,0	0,51	±0,10	0,30	6,30	±0,05	0,38	0,44	1,99
VHM-7*	7,00	7,38		0,51		0,30	7,32		0,38	0,55	2,32
VHM-8*	8,00	8,44		0,64		0,38	8,36		0,46	0,70	3,18
VHM-9*	9,00	9,54		0,76		0,38	9,46		0,46	1,00	3,58
VHM-10*	10,00	10,58	+0,30/-0,0	0,76		0,38	10,50		0,46	1,24	3,98
VHM-11	11,00	11,68		0,89		0,38	11,60		0,46	1,63	4,39
VHM-12	12,00	12,74		0,89		0,38	12,66		0,46	1,93	4,77
VHM-13	13,00	13,80	+0,33/-0,0	1,14		0,46	13,72		0,56	2,28	6,26
VHM-14	14,00	14,80		1,14		0,46	14,72		0,56	2,46	6,74
VHM-15	15,00	15,80		1,14		0,46	15,72		0,56	2,63	7,22
VHM-16	16,00	16,80		1,14		0,46	16,72		0,56	2,81	7,71
VHM-17	17,00	17,82		1,14		0,46	17,72		0,56	2,98	8,19
VHM-18	18,00	18,82		1,14		0,46	18,72		0,56	3,16	8,67
VHM-19	19,00	19,86		1,14		0,46	19,76		0,56	3,52	9,15
VHM-20	20,00	21,26		1,65		0,53	21,06	±0,08	0,66	5,17	11,10
VHM-21	21,00	22,27		1,65		0,53	22,06		0,66	5,42	11,65
VHM-22	22,00	23,28		1,65		0,53	23,06		0,66	5,68	12,21
VHM-24	24,00	25,29		1,65		0,53	25,06		0,66	6,20	13,32
VHM-25	25,00	26,30		1,65		0,53	26,06		0,66	6,46	13,87
VHM-26	26,00	27,31		1,65		0,53	27,06		0,66	6,72	14,43
VHM-28	28,00	29,40	+0,38/-0,0	2,24		0,64	29,12	±0,10	0,79	7,64	16,30
VHM-29	29,00	30,41		2,24		0,64	30,12		0,79	7,91	16,88
VHM-30	30,00	31,42		2,24		0,64	31,12		0,79	8,19	17,47
VHM-31	31,00	32,43		2,24		0,64	32,12		0,79	8,46	18,05
VHM-32	32,00	33,44		2,24		0,64	33,12		0,79	8,73	18,63
VHM-34	34,00	35,45		2,24		0,64	35,12		0,79	9,28	19,80
VHM-35	35,00	36,47		2,24		0,64	36,12		0,79	9,55	20,38
VHM-36	36,00	37,48		2,24		0,64	37,12		0,79	9,83	20,96
VHM-37	37,00	38,49		2,24		0,64	38,12		0,79	10,10	21,54
VHM-38	38,00	39,50		2,24		0,64	39,12		0,79	10,37	22,12
VHM-40	40,00	41,94	+0,51/-0,0	3,00		0,79	41,48	±0,13	0,99	14,43	28,75
VHM-42	42,00	43,96		3,00		0,79	43,48		0,99	15,15	30,19
VHM-45	45,00	46,99		3,00		0,79	46,48		0,99	16,23	32,34
VHM-47	47,00	49,00		3,00		0,79	48,48		0,99	16,95	33,78
VHM-48	48,00	50,01		3,00		0,79	49,48		0,99	17,31	34,50
VHM-50	50,00	52,04		3,00		0,79	51,48		0,99	18,03	35,93
VHM-52	52,00	54,55	+0,64/-0,0	4,01		0,79	53,94	±0,15	0,99	24,58	37,37
VHM-55	55,00	57,57		4,01		0,79	56,94		0,99	26,00	39,53
VHM-56	56,00	58,58		4,01		0,79	57,94		0,99	26,47	40,25
VHM-58	58,00	60,60		4,01		0,79	59,94		0,99	27,42	41,68
VHM-60	60,00	62,64		4,01		0,79	61,94		0,99	28,36	43,12
VHM-62	62,00	64,67		4,01		0,79	63,94		0,99	29,31	44,56
VHM-63	63,00	65,69		4,01		0,79	64,94		0,99	29,78	45,28
VHM-65	65,00	67,70		4,01		0,79	66,94		0,99	30,73	46,72
VHM-68	68,00	70,72		4,01		0,79	69,94		0,99	32,15	48,87
VHM-70	70,00	72,74		4,01		0,79	71,94		0,99	33,09	50,31
VHM-72	72,00	74,77		4,01		0,79	73,94		0,99	34,04	51,75
VHM-75	75,00	77,80		4,01		0,79	76,94		0,99	35,46	53,90

[1] Add suffix "-S02" for 302 stainless steel. Add suffix "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number [1, 4]	Housing Diameter	RING			GROOVE		THRUST CAPACITY	
		Outside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (kN) [2]	Ring Shear (kN) [3]
VHM-78	78,00	81,20	4,78	0,99	80,34	1,12	44,48	70,25
VHM-80	80,00	83,23	4,78	0,99	82,34	1,12	45,62	72,05
VHM-82	82,00	85,25	4,78	0,99	84,34	1,12	46,76	73,85
VHM-85	85,00	88,29	4,78	0,99	87,34	1,12	48,47	76,55
VHM-88	88,00	91,32	4,78	0,99	90,34	1,12	50,18	79,26
VHM-90	90,00	93,36	4,78	0,99	92,34	1,12	51,32	81,06
VHM-92	92,00	95,37	4,78	0,99	94,34	1,12	52,46	82,86
VHM-95	95,00	98,39	4,78	0,99	97,34	1,12	54,17	85,56
VHM-98	98,00	101,41	4,78	0,99	100,34	1,12	55,88	88,26
VHM-100	100,00	103,43	4,78	0,99	102,34	1,12	57,02	90,06
VHM-102	102,00	105,44	4,78	0,99	104,34	1,12	58,16	91,87
VHM-105	105,00	108,92	5,72	1,17	107,80	1,32	71,64	106,44
VHM-110	110,00	113,98	5,72	1,17	112,80	1,32	75,05	111,51
VHM-112	112,00	116,01	5,72	1,17	114,80	1,32	76,42	113,54
VHM-115	115,00	119,12	5,72	1,17	117,88	1,32	80,71	116,58
VHM-120	120,00	124,30	5,72	1,17	123,00	1,32	87,73	121,65
VHM-125	125,00	129,47	5,72	1,17	128,12	1,32	95,04	126,71
VHM-130	130,00	134,66	5,72	1,17	133,26	1,32	103,27	131,78
VHM-135	135,00	139,83	5,72	1,55	138,38	1,70	111,19	181,30
VHM-140	140,00	145,00	5,72	1,55	143,50	1,70	119,40	188,01
VHM-150	150,00	155,30	6,73	1,55	153,76	1,70	137,44	201,44
VHM-155	155,00	160,46	6,73	1,55	158,88	1,70	146,36	208,16
VHM-160	160,00	165,64	6,73	1,55	164,00	1,70	155,96	214,87
VHM-165	165,00	170,82	6,73	1,55	169,13	1,70	165,86	221,59
VHM-170	170,00	175,99	6,73	1,55	174,25	1,70	176,06	228,30
VHM-175	175,00	181,17	6,73	1,55	179,38	1,70	186,57	235,02
VHM-180	180,00	186,35	6,73	1,55	184,50	1,70	197,38	241,73
VHM-185	185,00	191,52	6,73	1,55	189,63	1,70	208,50	248,45
VHM-190	190,00	196,70	6,73	1,55	194,75	1,70	219,92	255,16
VHM-195	195,00	201,87	7,62	1,55	199,88	1,70	231,65	261,88
VHM-200	200,00	207,05	7,62	1,55	205,00	1,70	243,68	268,59
VHM-210	210,00	217,40	7,62	1,55	215,25	1,70	268,66	282,02
VHM-220	220,00	227,76	8,76	1,93	225,50	2,08	294,85	367,88
VHM-230	230,00	238,11	8,76	1,93	235,75	2,08	322,27	384,60
VHM-240	240,00	248,46	8,76	1,93	246,00	2,08	350,90	401,33
VHM-250	250,00	258,81	8,76	1,93	256,25	2,08	380,75	418,05
VHM-260	260,00	269,17	9,65	1,93	266,50	2,08	411,82	434,77
VHM-270	270,00	279,52	9,65	1,93	276,75	2,08	444,11	451,49
VHM-280	280,00	289,87	9,65	1,93	287,00	2,08	477,61	468,21
VHM-290	290,00	300,22	9,65	1,93	297,25	2,08	512,34	484,94
VHM-300	300,00	310,58	9,65	1,93	307,50	2,08	548,28	501,66

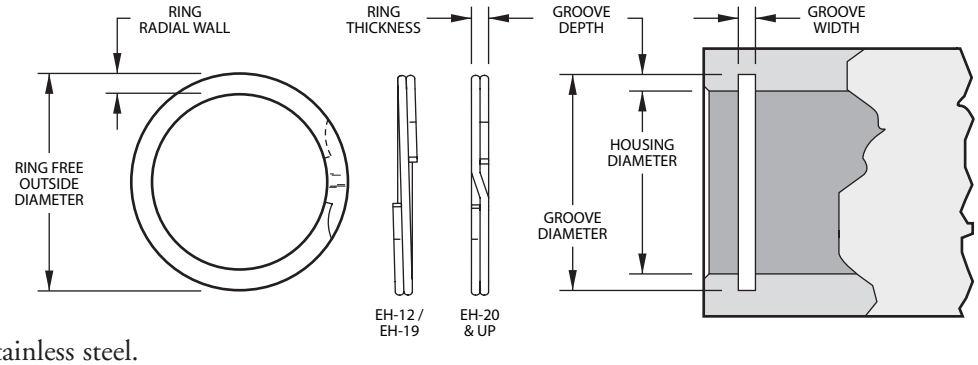
+0,76/-0,0 (Outside Diameter, VHM-78 to VHM-102)
+0,89/-0,0 (Outside Diameter, VHM-105 to VHM-130)
+1,14/-0,0 (Outside Diameter, VHM-135 to VHM-175)
+1,52/-0,0 (Outside Diameter, VHM-180 to VHM-210)
+1,78/-0,0 (Outside Diameter, VHM-220 to VHM-300)
+0,0/-0,13 (Radial Wall, VHM-78 to VHM-190)
+0,0/-0,15 (Radial Wall, VHM-195 to VHM-300)
+0,0/-0,05 (Thickness, VHM-135 to VHM-300)
±0,15 (Groove Diameter, VHM-78 to VHM-102)
±0,18 (Groove Diameter, VHM-125 to VHM-155)
±0,20 (Groove Diameter, VHM-150 to VHM-300)
+0,08/-0,0 (Groove Width, VHM-78 to VHM-102)
+0,10/-0,0 (Groove Width, VHM-105 to VHM-210)
+0,13/-0,0 (Groove Width, VHM-220 to VHM-300)

[1] Add suffix "-S02" for 302 stainless steel. Add suffix "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.



MA 4017

Product Dimensions
All dimensions are in millimeters unless otherwise specified.



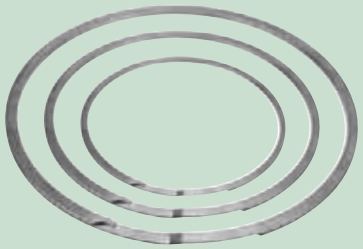
Stock Items available in carbon and stainless steel.

Smalley Part Number [1, 4]	Housing Diameter	RING						GROOVE				THRUST CAPACITY	
		Outside Diameter		Radial Wall		Thickness		Diameter		Width		Groove Yield (kN) [2]	Ring Shear (kN) [3]
EH-12	12,00	12,89		1,14		0,60		12,70		0,70		2,05	7,95
EH-13	13,00	13,95		1,14		0,89		13,75		1,00		2,41	12,11
EH-14	14,00	15,07		1,40		0,89		14,85		1,00		2,93	13,04
EH-15	15,00	16,14		1,40		0,89		15,90	±0,05	1,00		3,29	13,97
EH-16	16,00	17,15		1,40		0,89		16,95		1,00		3,74	14,90
EH-17	17,00	18,32		1,65		0,89		18,05		1,00		4,39	15,83
EH-18	18,00	19,39		1,65		0,89		19,10		1,00		4,82	16,76
EH-19	19,00	20,48		1,65		0,89		20,17		1,00		5,46	17,69
EH-20	20,00	21,51		1,91		0,89		21,22		1,00	+0,08/-0,0	5,94	18,62
EH-21	21,00	22,56		1,91		0,89		22,27		1,00		6,55	19,55
EH-22	22,00	23,65		1,91		1,07		23,37		1,20		7,39	24,63
EH-23	23,00	24,69		2,16		1,07		24,42		1,20		7,95	25,75
EH-24	24,00	25,73		2,16		1,07		25,47	±0,075	1,20		8,65	26,87
EH-25	25,00	27,03		2,16		1,07		26,67		1,20		10,23	27,99
EH-26	26,00	28,07		2,16		1,07		27,77		1,20		11,27	29,11
EH-27	27,00	29,11		2,64		1,27		28,87		1,40		12,36	31,17
EH-28	28,00	30,10		2,64		1,27		29,87		1,40		12,82	32,33
EH-29	29,00	31,21		2,64		1,27		30,95		1,40		13,84	33,48
EH-30	30,00	32,28		2,64		1,27		32,00		1,40		14,61	34,64
EH-31	31,00	33,32		2,64		1,27		33,05		1,40		15,55	35,79
EH-32	32,00	34,23		2,64		1,27		34,00		1,40		15,88	36,95
EH-34	34,00	36,46		3,00		1,27		36,20		1,40		18,21	39,26
EH-35	35,00	37,55		3,00		1,27		37,30		1,40		19,60	40,41
EH-36	36,00	38,68		3,00		1,27		38,40		1,40		21,04	41,56
EH-37	37,00	39,60		3,00		1,27		39,40	±0,10	1,40		21,62	42,72
EH-38	38,00	40,77		3,00		1,27		40,50		1,40		23,13	43,87
EH-40	40,00	42,91		3,25		1,57		42,50		1,75		24,35	57,09
EH-42	42,00	45,01		3,25		1,57		44,60		1,75		26,59	59,95
EH-45	45,00	48,13		3,25		1,57		47,70		1,75		29,59	64,23
EH-46	46,00	49,28		3,25		1,57		48,80		1,75		31,37	65,66
EH-47	47,00	50,32		4,01		1,57		49,90		1,75		33,19	67,08
EH-48	48,00	51,46		4,01		1,57		51,00		1,75		35,07	68,51
EH-50	50,00	53,66		4,01		1,57		53,20		1,75		38,96	71,37
EH-52	52,00	54,30	+0,50/-0,0	3,25		1,25		53,79	±0,125	1,42		22,79	59,09
EH-53	53,00	55,32		3,25		1,25		54,79		1,42		23,23	60,23
EH-55	55,00	57,38		3,51		1,25		56,85		1,42		24,91	62,50
EH-56	56,00	58,40		3,51		1,25		57,85		1,42		25,36	63,64
EH-58	58,00	60,43		3,51		1,25		59,85		1,42		26,27	65,91
EH-59	59,00	61,54		3,51		1,25		60,93		1,42		27,87	67,05
EH-60	60,00	62,57		3,51		1,25		61,99		1,42		29,22	68,18
EH-61	61,00	63,65		3,81		1,25		63,09		1,42		31,19	69,32
EH-62	62,00	64,70		3,81		1,25		64,09		1,42		31,70	70,46
EH-63	63,00	65,70		3,81		1,25		65,09		1,42		32,22	71,59
EH-64	64,00	66,77		3,81		1,25		66,19		1,42		34,29	72,73
EH-65	65,00	67,82		3,81		1,25		67,19		1,42		34,82	73,87
EH-66	66,00	68,80		3,81		1,25		68,19		1,42		35,36	75,00
EH-67	67,00	69,90		3,81		1,25		69,25		1,42		36,87	76,14

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

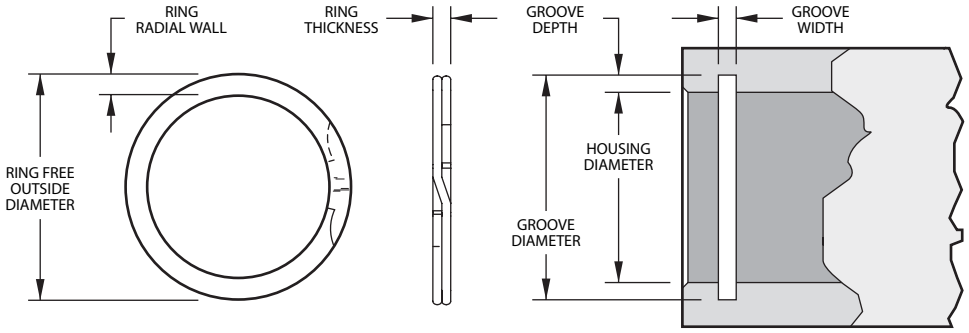
Smalley Part Number [1, 4]	Housing Diameter	RING						GROOVE				THRUST CAPACITY	
		Outside Diameter		Radial Wall		Thickness		Diameter		Width		Groove Yield (kN) [2]	Ring Shear (kN) [3]
EH-68	68,00	70,94	+0,63/-0,0	4,01	±0,10	1,25	±0,08	70,29	±0,15	1,42	+0,10/-0,0	38,09	77,27
EH-69	69,00	71,94		4,01		1,25		71,29		1,42		38,65	78,41
EH-70	70,00	72,94		4,01		1,25		72,29		1,42		39,21	79,55
EH-71	71,00	73,99		4,01		1,25		73,29		1,42		39,77	80,68
EH-72	72,00	75,04		4,27	±0,13	1,25		74,39		1,42		40,91	81,51
EH-75	75,00	78,07		4,27		1,25		77,39		1,42		43,83	85,23
EH-78	78,00	81,21	+0,76/-0,0	4,27		1,55		80,45		1,73	+0,13/-0,0	46,73	109,91
EH-80	80,00	83,22		4,52		1,55		82,49		1,73		48,70	112,73
EH-82	82,00	85,28		4,52		1,55		84,55		1,73		51,12	115,55
EH-85	85,00	88,38		4,78		1,55		87,65		1,73		55,06	119,78
EH-88	88,00	91,45		4,78		1,55		90,69		1,73		57,86	124,00
EH-90	90,00	93,58		5,03		1,55		92,79		1,73		61,37	126,82
EH-92	92,00	95,66		5,03		1,55		94,85		1,73		64,07	129,64
EH-95	95,00	98,69		5,03		1,55		97,85		1,73		66,16	133,87
EH-98	98,00	101,83		5,28		1,55		100,99		1,73		71,59	138,09
EH-100	100,00	103,83		5,28		1,55		102,99		1,73		73,05	140,91
EH-102	102,00	106,00		5,54		1,55		105,15		1,73		78,49	143,73
EH-105	105,00	109,00	+0,90/-0,0	5,54		1,55		108,15		1,73		80,80	147,96
EH-108	108,00	112,22		5,79		1,55		111,31		1,73		87,31	152,19
EH-110	110,00	114,25		5,79		1,55		113,31		1,73		62,14	155,00
EH-112	112,00	116,44		6,05		1,55		115,45		1,73		94,37	157,82
EH-115	115,00	119,44		6,05		1,55		118,45		1,73		96,89	162,05
EH-120	120,00	124,54		6,35		1,83	±0,10	123,55		2,00		104,03	199,64
EH-125	125,00	129,59		6,35		1,83		128,55		2,00		108,36	207,96
EH-130	130,00	134,71		6,35		1,83		133,65		2,00		115,86	216,28
EH-135	135,00	139,74	+1,14/-0,0	6,35		1,83		138,62	±0,18	2,00		119,00	224,60
EH-140	140,00	144,87		6,35		1,83		143,72		2,00		126,82	232,92
EH-145	145,00	150,04		6,35		1,83		148,82		2,00		134,88	241,23
EH-150	150,00	155,07		6,35		1,83		153,82		2,00		139,53	249,55
EH-155	155,00	160,72	+1,40/-0,0	7,92	±0,15	2,18		159,40	±0,20	2,40	+0,15/-0,0	166,08	307,19
EH-160	160,00	165,74		7,92		2,18		164,40		2,40		171,43	317,10
EH-165	165,00	170,77		7,92		2,18		169,40		2,40		176,79	327,01
EH-170	170,00	176,05		7,92		2,18		174,60		2,40		190,43	336,92
EH-175	175,00	181,05		7,92		2,18		179,60		2,40		196,03	346,83
EH-180	180,00	186,38		7,92		2,18		184,88		2,40		213,90	356,74
EH-185	185,00	191,10	+1,65/-0,0	7,92		2,18		189,88		2,40		219,84	366,65
EH-190	190,00	196,45		7,92		2,18		194,88		2,40		225,79	376,56
EH-195	195,00	201,74		7,92		2,18		200,14		2,40		244,07	386,46
EH-200	200,00	206,76		7,92		2,18		205,14		2,40		250,33	396,37
EH-210	210,00	217,10		9,53		2,18		215,40		2,40		276,14	416,49
EH-220	220,00	227,40		9,53		2,18		225,64		2,40		257,15	436,01
EH-230	230,00	237,73		9,53		2,18		235,90		2,40		330,45	455,83
EH-240	240,00	247,80		9,53		2,18		245,90		2,40		344,81	475,65
EH-250	250,00	258,10		9,53		2,18		256,16		2,40		375,01	495,47
EH-260	260,00	268,43		9,53		2,18		266,40		2,40		405,21	515,29
EH-270	270,00	278,50		9,53		2,18		276,40		2,40		420,79	535,10
EH-280	280,00	288,82		9,53		2,18		286,66		2,40		454,10	554,92

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.



European Specification
Incorporating DIN 472

Product Dimensions
All dimensions are in millimeters unless otherwise specified.



Stock Items available in carbon and stainless steel.

Smalley Part Number [1, 4]	Housing Diameter	RING						GROOVE				THRUST CAPACITY	
		Outside Diameter		Radial Wall		Thickness		Diameter		Width		Groove Yield (kN) [2]	Ring Shear (kN) [3]
DNH-13	13,00	13,72	+0,33/-0,0	1,40	±0,10	0,99	±0,05	13,60	+0,11/-0,0	1,10	+0,14/-0,0	1,90	13,47
DNH-14	14,00	14,75		1,40		0,99		14,60		1,10		2,05	14,51
DNH-15	15,00	15,85		1,40		0,99		15,70		1,10		2,56	15,55
DNH-16	16,00	16,97		1,65		0,99		16,80		1,10		3,12	16,58
DNH-17	17,00	17,98		1,65		0,99		17,80		1,10		3,31	17,62
DNH-18	18,00	19,18		1,91		0,99		19,00	+0,13/-0,0	1,10		4,39	18,66
DNH-19	19,00	20,19		1,91		0,99		20,00		1,10		4,63	19,69
DNH-20	20,00	21,21		1,91		0,99		21,00		1,10		4,87	20,73
DNH-21	21,00	22,23		1,91		0,99		22,00		1,10		5,12	21,77
DNH-22	22,00	23,23		1,91		0,99		23,00		1,10		5,36	22,80
DNH-23	23,00	24,33	+0,38/-0,0	2,18		1,14		24,10	+0,21/-0,0	1,30		6,17	23,85
DNH-24	24,00	25,45		2,18		1,14		25,20		1,30		7,02	24,89
DNH-25	25,00	26,45		2,18		1,14		26,20		1,30		7,31	25,93
DNH-26	26,00	27,48		2,18		1,14		27,20		1,30		7,60	26,97
DNH-27	27,00	28,68		2,41		1,14		28,40		1,30		9,21	28,00
DNH-28	28,00	29,69		2,41		1,14		29,40		1,30		9,55	29,04
DNH-29	29,00	30,71		2,41		1,14		30,40	+0,25/-0,0	1,30		9,89	30,08
DNH-30	30,00	31,71		2,41		1,14		31,40		1,30		10,24	31,11
DNH-31	31,00	33,02		2,41		1,14		32,70		1,30		12,84	32,15
DNH-32	32,00	34,04		2,41		1,14		33,70		1,30		13,26	33,19
DNH-33	33,00	35,05		2,41		1,14		34,70		1,30		13,67	34,22
DNH-34	34,00	36,07		3,25		1,44		35,70		1,60		14,09	44,54
DNH-35	35,00	37,38		3,25		1,44		37,00		1,60		17,06	45,85
DNH-36	36,00	38,39		3,25		1,44		38,00		1,60		17,55	47,16
DNH-37	37,00	39,40		3,25		1,44		39,00		1,60		18,03	48,47
DNH-38	38,00	40,41		3,25		1,44		40,00		1,60		18,52	49,78
DNH-40	40,00	42,93	+0,51/-0,0	4,01		1,69		42,50		1,85		24,37	61,50
DNH-41	41,00	43,94		4,01		1,69		43,50		1,85		24,98	63,04
DNH-42	42,00	44,96		4,01		1,69		44,50		1,85		25,59	64,57
DNH-45	45,00	47,98		4,01		1,69		47,50		1,85		27,41	69,19
DNH-47	47,00	49,99		4,01		1,69		49,50		1,85		28,63	72,26
DNH-48	48,00	51,00		4,01		1,69		50,50		1,85		29,24	73,80
DNH-50	50,00	53,54	+0,63/-0,0	5,08	±0,12	1,93	±0,08	53,00	+0,30/-0,0	2,15		36,55	87,79
DNH-51	51,00	54,54		5,08		1,93		54,00		2,15		37,28	89,55
DNH-52	52,00	55,55		5,08		1,93		55,00		2,15		38,01	91,30
DNH-55	55,00	58,57		5,08		1,93		58,00		2,15		40,21	96,57
DNH-56	56,00	59,59		5,08		1,93		59,00		2,15		40,94	98,33
DNH-57	57,00	60,60		5,08		1,93		60,00		2,15		41,67	100,08
DNH-58	58,00	61,62		5,08		1,93		61,00		2,15		42,40	101,84
DNH-60	60,00	63,63		5,08		1,93		63,00		2,15		43,86	105,35
DNH-62	62,00	65,66		5,08		1,93		65,00		2,15		45,33	108,86
DNH-63	63,00	66,67		5,08		1,93		66,00		2,15		46,06	110,62
DNH-64	64,00	67,67		5,08		1,93		67,00		2,15		46,79	112,37
DNH-65	65,00	68,67	+0,76/-0,0	5,08		2,41		68,00		2,65		47,52	135,73
DNH-67	67,00	70,67		5,08		2,41		70,00		2,65		48,98	139,90
DNH-68	68,00	71,67		5,08		2,41		71,00		2,65		49,71	141,99
DNH-70	70,00	73,67		5,08		2,41		73,00		2,65		51,17	146,17

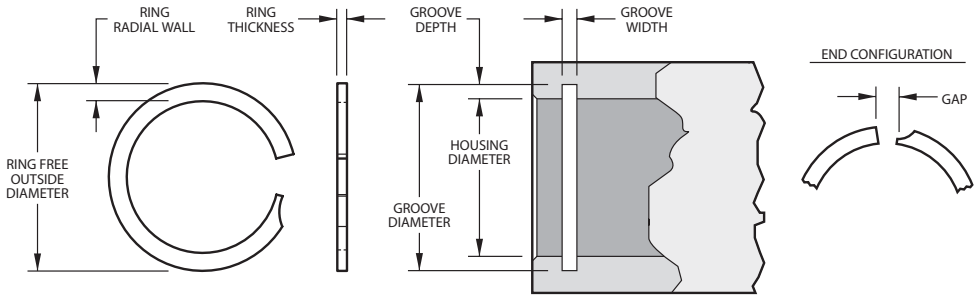
[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number [1, 4]	Housing Diameter	RING			GROOVE		THRUST CAPACITY	
		Outside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (kN) [2]	Ring Shear (kN) [3]
DNH-72	72,00	75,67 +0,76/-0,0	5,08 ±0,12	2,41 ±0,08	75,00 +0,30/-0,0	2,65 +0,14/-0,0	52,64	150,34
DNH-75	75,00	78,68	5,08	2,41	78,00	2,65	54,83	156,61
DNH-76	76,00	79,68	5,08	2,41	79,00	2,65	55,56	158,69
DNH-78	78,00	81,69	5,08	2,41	81,00	2,65	57,02	162,87
DNH-80	80,00	84,19	6,05	2,41	83,50	2,65	68,23	167,05
DNH-82	82,00	86,20	6,05	2,41	85,50	2,65	69,94	171,22
DNH-85	85,00	89,20 +0,89/-0,0	6,05	2,91	88,50 +0,35/-0,0	3,15	72,50	214,31
DNH-88	88,00	92,21	6,05	2,91	91,50	3,15	75,05	221,87
DNH-90	90,00	94,21	6,05	2,91	93,50	3,15	76,76	226,92
DNH-92	92,00	96,22	6,05	2,91	95,50	3,15	78,47	231,96
DNH-95	95,00	99,24	6,05	2,91	98,50	3,15	81,02	239,52
DNH-98	98,00	102,26	6,05	2,91	101,50	3,15	83,58	247,09
DNH-100	100,00	104,29	6,05	2,91	103,50	3,15	85,29	252,13
DNH-102	102,00	106,79	6,73 ±0,13	3,89	106,00	4,15	99,42	343,78
DNH-105	105,00	109,79	6,73	3,89	109,00	4,15	102,35	353,89
DNH-108	108,00	112,80	6,73	3,89	112,00	4,15	105,27	364,00
DNH-110	110,00	114,83	6,73	3,89	114,00	4,15	107,22	370,74
DNH-112	112,00	116,84	6,73	3,89	116,00	4,15	109,17	377,48
DNH-115	115,00	119,86 +1,30/-0,0	6,73	3,89	119,00 +0,54/-0,0	4,15	112,09	387,59
DNH-120	120,00	124,92	6,73	3,89	124,00	4,15	116,97	404,45
DNH-125	125,00	129,97	6,73	3,89	129,00	4,15	121,84	421,30
DNH-127	127,00	131,97	6,73	3,89	131,00	4,15	123,79	428,04
DNH-130	130,00	135,00	6,73	3,89	134,00	4,15	126,71	438,15
DNH-135	135,00	140,03	6,73	3,89	139,00	4,15	131,59	455,00
DNH-140	140,00	145,11	6,73	3,89 ±0,10	144,00	4,15	136,46	471,85
DNH-145	145,00	150,11	6,73	3,89	149,00	4,15	141,34	488,70
DNH-150	150,00	156,13	7,92	3,89	155,00 +0,63/-0,0	4,15 +0,18/-0,0	182,76	505,56
DNH-155	155,00	161,19	7,92	3,89	160,00	4,15	188,85	522,41
DNH-160	160,00	166,22	7,92	3,89	165,00	4,15	194,95	539,26
DNH-165	165,00	171,27	7,92	3,89	170,00	4,15	201,04	556,11
DNH-170	170,00	176,33 +1,40/-0,0	7,92	3,89	175,00	4,15	207,13	572,96
DNH-175	175,00	181,36	7,92	3,89	180,00	4,15	213,22	589,82
DNH-180	180,00	186,39	7,92	3,89	185,00	4,15	219,31	606,67
DNH-185	185,00	191,44	7,92 ±0,15	3,89	190,00	4,15	225,41	623,52
DNH-190	190,00	196,47	7,92	3,89	195,00	4,15	231,50	640,37
DNH-195	195,00	201,52	7,92	3,89	200,00 +0,720/-0,0	4,15	237,59	657,22
DNH-200	200,00	206,58	7,92	3,89	205,00	4,15	243,68	674,08
DNH-210	210,00	217,58 +1,78/-0,0	9,53	4,86	216,00	5,15	307,04	884,27
DNH-220	220,00	227,66	9,53	4,86	226,00	5,15	321,66	926,38
DNH-230	230,00	237,72	9,53	4,86	236,00	5,15	336,28	968,48
DNH-240	240,00	247,80	9,53	4,86	246,00	5,15	350,90	1 010,59
DNH-250	250,00	257,89	9,53	4,86	256,00	5,15	365,52	1 052,70
DNH-260	260,00	269,93	11,18	4,86	268,00 +0,81/-0,0	5,15	506,86	1 094,81
DNH-270	270,00	280,01	11,18	4,86	278,00	5,15	526,35	1 136,92
DNH-280	280,00	290,09	11,18	4,86	288,00	5,15	545,85	1 179,02
DNH-290	290,00	300,15 +3,05/-0,0	11,18	4,86 ±0,13	298,00	5,15	565,34	1 221,13
DNH-300	300,00	310,24	11,18	4,86	308,00	5,15	584,83	1 263,24
DNH-310	310,00	322,25	12,70	5,87	320,00	6,20	755,41	1 576,63
DNH-320	320,00	332,33	12,70	5,87	330,00	6,20	779,78	1 627,48
DNH-330	330,00	342,42	12,70	5,87	340,00	6,20	804,15	1 678,34
DNH-340	340,00	352,50	12,70	5,87	350,00 +0,89/-0,0	6,20 +0,22/-0,0	828,52	1 729,20
DNH-350	350,00	362,56	12,70	5,87	360,00	6,20	852,88	1 780,06
DNH-360	360,00	372,64 +3,56/-0,0	12,70 ±0,19	5,87	370,00	6,20	877,25	1 830,92
DNH-370	370,00	382,73	12,70	5,87	380,00	6,20	901,62	1 881,78
DNH-380	380,00	392,79	12,70	5,87	390,00	6,20	925,99	1 932,64
DNH-390	390,00	402,84	12,70	5,87	400,00	6,20	950,36	1 983,50
DNH-400	400,00	412,93	12,70	5,87	410,00	6,20	974,72	2 034,35

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Groove Compatible with DIN 472

Product Dimensions
All dimensions are in millimeters unless otherwise specified.



Stock Items available in carbon and stainless steel.

Smalley Part Number [1, 4]	Housing Diameter	RING			GROOVE		THRUST CAPACITY (N)	
		Outside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (kN) [2]	Ring Shear (kN) [3]
FH-013	13,00	13,73	1,40	0,94	13,60	1,10	1,93	10,59
FH-014	14,00	14,74	1,40	0,94	14,60	1,10	2,08	11,40
FH-015	15,00	15,85	1,40	0,94	15,70	1,10	2,60	12,22
FH-016	16,00	16,90	1,65	0,94	16,80	1,10	3,17	13,03
FH-017	17,00	17,97	1,65	0,94	17,80	1,10	3,37	13,84
FH-018	18,00	19,18	1,90	0,94	19,00	1,10	4,46	14,67
FH-019	19,00	20,25	1,90	0,94	20,00	1,10	4,70	15,47
FH-020	20,00	21,20	1,90	0,94	21,00	1,10	4,95	16,28
FH-021	21,00	22,21	1,90	0,94	22,00	1,10	5,20	17,10
FH-022	22,00	23,22	1,90	0,94	23,00	1,10	5,45	17,91
FH-023	23,00	24,23	1,90	0,94	24,00	1,10	5,70	18,74
FH-024	24,00	25,40	2,15	1,15	25,20	1,30	6,54	23,93
FH-025	25,00	26,45	2,15	1,15	26,20	1,30	6,81	24,91
FH-026	26,00	27,46	2,15	1,15	27,20	1,30	7,08	25,93
FH-027	27,00	28,47	2,38	1,15	28,20	1,30	7,35	26,92
FH-028	28,00	29,68	2,38	1,15	29,40	1,30	9,70	27,90
FH-029	29,00	30,69	2,38	1,15	30,40	1,30	10,05	28,92
FH-030	30,00	31,79	2,38	1,15	31,40	1,30	10,40	29,91
FH-031	31,00	33,01	2,38	1,15	32,70	1,30	12,66	30,89
FH-032	32,00	33,93	2,38	1,15	33,70	1,30	13,07	31,91
FH-033	33,00	35,03	2,38	1,15	34,70	1,30	13,48	32,90
FH-034	34,00	36,04	3,25	1,44	35,70	1,60	13,89	40,32
FH-035	35,00	37,35	3,25	1,44	37,00	1,60	16,90	41,49
FH-036	36,00	38,36	3,25	1,44	38,00	1,60	17,38	42,66
FH-037	37,00	39,37	3,25	1,44	39,00	1,60	17,87	43,87
FH-038	38,00	40,44	3,25	1,44	40,00	1,60	18,34	45,04
FH-040	40,00	42,86	4,01	1,69	42,50	1,85	24,27	55,62
FH-041	41,00	43,91	4,01	1,69	43,50	1,85	24,87	57,00
FH-042	42,00	44,92	4,01	1,69	44,50	1,85	25,48	58,41
FH-045	45,00	47,88	4,01	1,69	47,50	1,85	27,30	62,58
FH-047	47,00	49,97	4,01	1,69	49,50	1,85	28,50	65,33
FH-048	48,00	50,98	4,01	1,69	50,50	1,85	29,12	66,74
FH-050	50,00	53,50	5,08	1,93	53,00	2,15	36,53	75,28
FH-051	51,00	54,43	5,08	1,93	54,00	2,15	37,25	76,78
FH-052	52,00	55,52	5,08	1,93	55,00	2,15	37,97	78,27
FH-055	55,00	58,55	5,08	1,93	58,00	2,15	40,16	82,78
FH-056	56,00	59,56	5,08	1,93	59,00	2,15	40,91	84,31
FH-057	57,00	60,68	5,08	1,93	60,00	2,15	41,63	85,80
FH-058	58,00	61,58	5,08	1,93	61,00	2,15	42,35	87,29
FH-060	60,00	63,60	5,08	1,93	63,00	2,15	43,82	90,31
FH-062	62,00	65,58	5,08	1,93	65,00	2,15	45,28	93,33
FH-063	63,00	66,63	5,08	1,93	66,00	2,15	46,01	94,82
FH-064	64,00	67,64	5,08	2,41	67,00	2,65	46,75	114,74
FH-065	65,00	68,70	5,08	2,41	68,00	2,65	47,47	116,52
FH-067	67,00	70,54	5,08	2,41	70,00	2,65	48,94	120,12
FH-068	68,00	71,84	5,08	2,41	71,00	2,65	49,66	121,89
FH-070	70,00	73,64	5,08	2,41	73,00	2,65	51,13	125,49

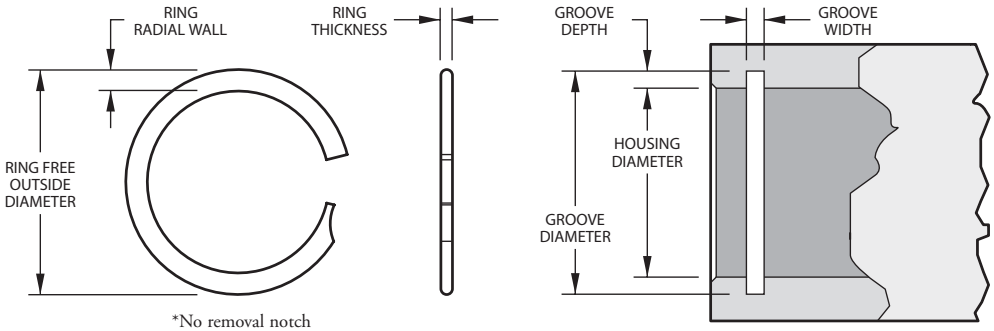
+0,33/-0,0 (Outside Diameter, FH-013 to FH-017)
+0,38/-0,0 (Outside Diameter, FH-018 to FH-038)
+0,51/-0,0 (Outside Diameter, FH-040 to FH-048)
+0,63/-0,0 (Outside Diameter, FH-050 to FH-063)
+0,76/-0,0 (Outside Diameter, FH-064 to FH-070)
±0,10 (Radial Wall, FH-013 to FH-048)
±0,13 (Radial Wall, FH-050 to FH-070)
±0,05 (Thickness, FH-013 to FH-048)
±0,08 (Thickness, FH-050 to FH-070)
+0,11/-0,0 (Diameter, FH-013 to FH-017)
+0,13/-0,0 (Diameter, FH-018 to FH-022)
+0,21/-0,0 (Diameter, FH-023 to FH-027)
+0,25/-0,0 (Diameter, FH-028 to FH-048)
+0,30/-0,0 (Diameter, FH-050 to FH-070)
+0,14/-0,0 (Width, FH-013 to FH-048)

[1] Add suffix "-S02" for 302 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number [1, 4]	Housing Diameter	RING						GROOVE				THRUST CAPACITY (N)	
		Outside Diameter		Radial Wall		Thickness		Diameter		Width		Groove Yield (kN) [2]	Ring Shear (kN) [3]
FH-072	72,00	75,72	+0,76/-0,0	5,08	±0,13	2,41	±0,08	75,00	+0,30/-0,0	2,65	+0,14/-0,0	52,59	129,08
FH-075	75,00	78,75		5,08		2,41		78,00		2,65		54,78	134,46
FH-076	76,00	79,88		5,08		2,41		79,00		2,65		55,51	136,23
FH-078	78,00	81,73		5,08		2,41		81,00	+0,35/-0,0	2,65		56,97	139,83
FH-080	80,00	84,30		6,02		2,41		83,50		2,65		68,34	143,43
FH-082	82,00	86,32		6,02		2,41		85,50		2,65		70,03	146,98
FH-085	85,00	89,35	+0,89/-0,0	6,30		2,91		88,50		3,15		72,60	175,05
FH-088	88,00	92,38		6,30		2,91		91,50		3,15		75,18	181,27
FH-090	90,00	94,70		6,30		2,91		93,50		3,15		76,87	185,35
FH-092	92,00	96,50		6,30		2,91		95,50		3,15		78,58	189,49
FH-095	95,00	99,62		6,30		2,91		98,50		3,15		81,14	195,66
FH-098	98,00	102,71		6,30		2,91		101,50		3,15		83,70	201,83
FH-100	100,00	104,50		6,30		2,91		103,50		3,15		85,42	205,96
FH-102	102,00	107,27	+1,30/-0,0	6,73		3,89	±0,10	106,00	+0,54/-0,0	4,15		87,13	269,22
FH-105	105,00	109,96		6,73		3,89		109,00		4,15		102,69	277,13
FH-108	108,00	113,09		6,73		3,89		112,00		4,15		105,62	285,04
FH-110	110,00	115,10		6,73		3,89		114,00		4,15		107,58	290,34
FH-112	112,00	117,12		6,73		3,89		116,00		4,15		109,52	295,57
FH-115	115,00	120,15		6,73		3,89		119,00		4,15		112,47	303,55
FH-120	120,00	125,60		6,73		3,89		124,00		4,15		117,34	316,69
FH-125	125,00	130,25		6,73		3,89		129,00		4,15		122,24	329,89
FH-127	127,00	132,27		6,73		3,89		131,00		4,15		124,20	335,19
FH-130	130,00	135,30		6,73		3,89		134,00		4,15		127,13	343,10
FH-135	135,00	140,35		6,73		3,89		139,00		4,15		132,02	356,30
FH-140	140,00	145,26		6,73		3,89		144,00		4,15		136,92	369,51
FH-145	145,00	150,45		6,73		3,89		149,00		4,15		141,81	382,72
FH-150	150,00	156,50	+1,40/-0,0	8,03	±0,15	3,89		155,00	+0,63/-0,0	4,15	+0,18/-0,0	181,99	395,92
FH-155	155,00	161,55		8,03		3,89		160,00		4,15		188,03	409,06
FH-160	160,00	166,60		8,03		3,89		165,00		4,15		194,09	422,27
FH-165	165,00	171,70		8,03		3,89		170,00		4,15		200,17	435,48
FH-170	170,00	176,70		8,03		3,89		175,00		4,15		206,24	448,68
FH-175	175,00	181,75		8,03		3,89		180,00		4,15		212,31	461,89
FH-180	180,00	186,80		8,03		3,89		185,00		4,15		218,38	475,10
FH-185	185,00	191,85	+1,78/-0,0	8,03		3,89		190,00	+0,72/-0,0	4,15		224,42	488,23
FH-190	190,00	197,15		8,03		3,89		195,00		4,15		230,49	501,44
FH-195	195,00	201,95		8,03		3,89		200,00		4,15		236,56	514,65
FH-200	200,00	207,00		8,03		3,89		205,00		4,15		242,63	527,85
FH-210	210,00	217,93		9,48		4,87	±0,13	216,00		5,15		306,76	657,10
FH-220	220,00	228,20		9,48		4,87		226,00		5,15		321,34	688,33
FH-230	230,00	238,30		9,48		4,87		236,00		5,15		335,96	719,64
FH-240	240,00	248,40		9,48		4,87		246,00		5,15		350,58	750,95
FH-250	250,00	258,50		9,48		4,87		256,00		5,15		365,20	782,26
FH-260	260,00	270,77		11,05	±0,18	4,87		268,00	+0,81/-0,0	5,15		505,30	813,50
FH-270	270,00	280,70		11,05		4,87		278,00		5,15		524,75	844,81
FH-280	280,00	290,57	+3,05/-0,0	11,05		4,87		288,00		5,15		544,20	876,13
FH-290	290,00	300,90		11,05		4,87		298,00		5,15		563,60	907,36
FH-300	300,00	311,00		11,05		4,87		308,00		5,15		583,05	938,67

[1] Add suffix "-S02" for 302 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Product Dimensions
All dimensions are in inches unless otherwise specified.



*No removal notch

Stock Items available in carbon and stainless steel.

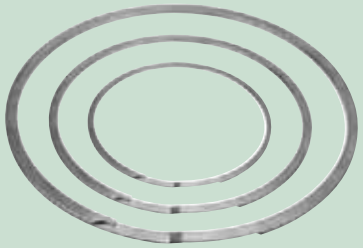
Smalley Part Number[1,4]	Housing Diameter	RING						GROOVE				THRUST CAPACITY	
		Outside Diameter		Radial Wall		Thickness		Diameter		Width		Groove Yield (lb)[2]	Ring Shear (lb)[3]
VH-25*	0,250	0,264	+0,010/-0,0	0,020	±0,004	0,012	±0,0015	0,262	±0,002	0,015	+0,002/-0,0	106	481
VH-31*	0,312	0,329		0,025		0,015		0,326		0,018		154	750
VH-37*	0,375	0,398		0,030		0,015		0,395		0,018		265	901
VH-43	0,437	0,466	+0,012/-0,0	0,030		0,015		0,463		0,018		402	1 050
VH-50	0,500	0,531	+0,013/-0,0	0,045		0,018		0,528		0,022		500	1 300
VH-56	0,562	0,593		0,045		0,018		0,590		0,022		560	1 460
VH-62	0,625	0,656		0,045		0,018		0,653		0,022		620	1 630
VH-68	0,687	0,719		0,045		0,018		0,715		0,022		680	1 790
VH-75	0,750	0,783		0,045		0,018		0,779		0,022		800	1 950
VH-81	0,812	0,862		0,065		0,021		0,854	±0,003	0,026		1 210	2 460
VH-87	0,875	0,926		0,065		0,021		0,917		0,026		1 300	2 660
VH-93	0,937	0,989		0,065		0,021		0,979		0,026		1 390	2 840
VH-100	1,000	1,052		0,065		0,021		1,042		0,026		1 480	3 040
VH-106	1,062	1,117	+0,015/-0,0	0,088		0,025		1,106	±0,004	0,031		1 650	3 500
VH-112	1,125	1,180		0,088		0,025		1,169		0,031		1 750	3 710
VH-118	1,187	1,242		0,088		0,025		1,231		0,031		1 850	3 920
VH-125	1,250	1,307		0,088		0,025		1,294		0,031		1 940	4 120
VH-131	1,312	1,369		0,088		0,025		1,356		0,031		2 040	4 330
VH-137	1,375	1,433		0,088		0,025		1,419		0,031		2 140	4 540
VH-143	1,437	1,496		0,088		0,025		1,481		0,031		2 240	4 740
VH-150	1,500	1,559		0,088		0,025		1,544		0,031		2 330	4 950
VH-156	1,562	1,637	+0,020/-0,0	0,118		0,031	± 0,002	1,619	±0,005	0,039	+0,003/-0,0	3 200	6 390
VH-162	1,625	1,701		0,118		0,031		1,682		0,039		3 330	6 650
VH-168	1,687	1,763		0,118		0,031		1,744		0,039		3 460	6 900
VH-175	1,750	1,827		0,118		0,031		1,807		0,039		3 590	7 160
VH-181	1,812	1,890		0,118		0,031		1,869		0,039		3 710	7 410
VH-187	1,875	1,953		0,118		0,031		1,932		0,039		3 840	7 670
VH-193	1,937	2,016		0,118		0,031		1,994		0,039		3 970	7 920
VH-200	2,000	2,079		0,118		0,031		2,057		0,039		4 100	8 180
VH-206	2,062	2,162	+0,025/-0,0	0,158		0,031		2,138	±0,006	0,039		5 540	8 430
VH-212	2,125	2,226		0,158		0,031		2,201		0,039		5 710	8 690
VH-218	2,187	2,289		0,158		0,031		2,263		0,039		5 870	8 950
VH-225	2,250	2,352		0,158		0,031		2,326		0,039		6 040	9 200
VH-231	2,312	2,415		0,158		0,031		2,388		0,039		6 210	9 460
VH-237	2,375	2,478		0,158		0,031		2,451		0,039		6 380	9 720
VH-243	2,437	2,541		0,158		0,031		2,513		0,039		6 550	9 970
VH-250	2,500	2,605		0,158		0,031		2,576		0,039		6 720	10 230
VH-256	2,562	2,667		0,158		0,031		2,638		0,039		6 880	10 480
VH-262	2,625	2,731		0,158		0,031		2,701		0,039		7 050	10 740
VH-268	2,687	2,794		0,158		0,031		2,763		0,039		7 220	10 990
VH-275	2,750	2,857		0,158		0,031		2,826		0,039		7 390	11 250
VH-281	2,812	2,920		0,158		0,031		2,888		0,039		7 550	11 500
VH-287	2,875	2,983		0,158		0,031		2,951		0,039		7 720	11 760
VH-293	2,937	3,046		0,158		0,031		3,013		0,039		7 890	12 010
VH-300	3,000	3,110		0,158		0,031		3,076		0,039		8 060	12 270
VH-306	3,062	3,188	+0,030/-0,0	0,188	±0,005	0,039		3,154		0,044		9 960	15 760
VH-312	3,125	3,251		0,188		0,039		3,217		0,044		10 160	16 080

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number [1, 4]	Housing Diameter	RING			GROOVE		THRUST CAPACITY	
		Outside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (lb) [2]	Ring Shear (lb) [3]
VH-318	3,187	3,314	0,188	0,039	3,279	0,044	10 360	16 400
VH-325	3,250	3,377	0,188	0,039	3,342	0,044	10 570	16 720
VH-331	3,312	3,440	0,188	0,039	3,404	0,044	10 770	17 040
VH-337	3,375	3,504	0,188	0,039	3,467	0,044	10 970	17 370
VH-343	3,437	3,566	0,188	0,039	3,529	0,044	11 180	17 690
VH-350	3,500	3,630	0,188	0,039	3,592	0,044	11 380	18 010
VH-356	3,562	3,692	0,188	0,039	3,654	0,044	11 580	18 330
VH-362	3,625	3,756	0,188	0,039	3,717	0,044	11 790	18 650
VH-368	3,687	3,819	0,188	0,039	3,779	0,044	11 990	18 970
VH-375	3,750	3,882	0,188	0,039	3,842	0,044	12 190	19 300
VH-381	3,812	3,945	0,188	0,039	3,904	0,044	12 400	19 620
VH-387	3,875	4,009	0,188	0,039	3,967	0,044	12 600	19 940
VH-393	3,937	4,071	0,188	0,039	4,029	0,044	12 800	20 260
VH-400	4,000	4,135	0,188	0,039	4,092	0,044	13 010	20 580
VH-412	4,125	4,279	0,225	0,046	4,235	0,052	16 040	23 850
VH-425	4,250	4,405	0,225	0,046	4,360	0,052	16 520	24 570
VH-437	4,375	4,531	0,225	0,046	4,485	0,052	17 010	25 290
VH-450	4,500	4,658	0,225	0,046	4,610	0,052	17 500	26 010
VH-462	4,625	4,784	0,225	0,046	4,735	0,052	17 980	26 740
VH-475	4,750	4,910	0,225	0,046	4,860	0,052	18 470	27 460
VH-487	4,875	5,036	0,225	0,046	4,985	0,052	18 950	28 180
VH-500	5,000	5,163	0,225	0,046	5,110	0,052	19 440	28 900
VH-525	5,250	5,435	0,225	0,061	5,381	0,067	24 490	40 240
VH-550	5,500	5,694	0,225	0,061	5,638	0,067	26 830	42 160
VH-575	5,750	5,953	0,225	0,061	5,894	0,067	29 260	44 080
VH-600	6,000	6,212	0,265	0,061	6,150	0,067	31 810	45 990
VH-625	6,250	6,470	0,265	0,061	6,406	0,067	34 460	47 910
VH-650	6,500	6,730	0,265	0,061	6,663	0,067	37 680	49 830
VH-675	6,750	6,988	0,265	0,061	6,919	0,067	40 560	51 740
VH-700	7,000	7,247	0,265	0,061	7,175	0,067	43 540	53 660
VH-725	7,250	7,505	0,265	0,061	7,431	0,067	46 640	55 580
VH-750	7,500	7,765	0,265	0,061	7,688	0,067	49 830	57 490
VH-775	7,750	8,023	0,300	0,061	7,944	0,067	53 140	59 410
VH-800	8,000	8,282	0,300	0,061	8,200	0,067	56 550	61 320
VH-825	8,250	8,541	0,300	0,061	8,456	0,067	60 070	63 240
VH-850	8,500	8,800	0,300	0,061	8,713	0,067	64 290	65 160
VH-875	8,750	9,059	0,345	0,076	8,969	0,082	68 040	83 570
VH-900	9,000	9,317	0,345	0,076	9,225	0,082	71 890	85 950
VH-925	9,250	9,576	0,345	0,076	9,481	0,082	75 850	88 340
VH-950	9,500	9,835	0,345	0,076	9,738	0,082	79 910	90 730
VH-975	9,750	10,094	0,345	0,076	9,994	0,082	84 080	93 120
VH-1000	10,000	10,353	0,345	0,076	10,250	0,082	88 360	95 500

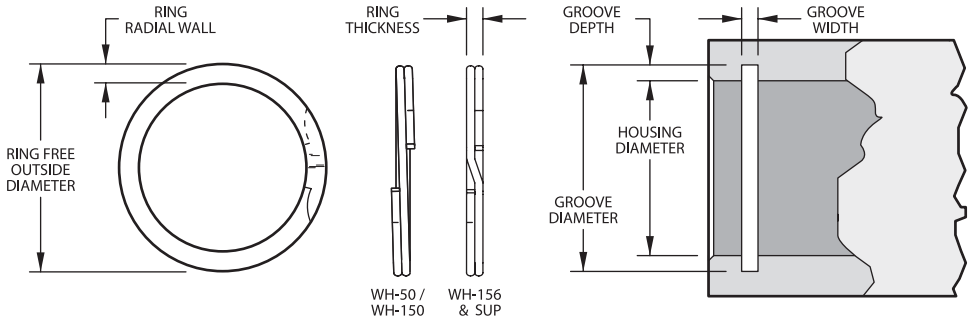
+0,030/-0,0 (Outside Diameter: VH-318 to VH-400)
+0,035/-0,0 (Outside Diameter: VH-412 to VH-487)
+0,045/-0,0 (Outside Diameter: VH-525 to VH-700)
+0,060/-0,0 (Outside Diameter: VH-725 to VH-825)
+0,070/-0,0 (Outside Diameter: VH-850 to VH-1000)
±0,005 (Radial Wall: VH-412 to VH-700)
+0,004/-0,008 (Radial Wall: VH-725 to VH-1000)
±0,002 (Thickness: VH-318 to VH-487)
±0,006 (Diameter: VH-318 to VH-487)
±0,007 (Diameter: VH-525 to VH-700)
±0,008 (Diameter: VH-725 to VH-1000)
+0,003/-0,0 (Width: VH-318 to VH-400)
+0,004/-0,0 (Width: VH-412 to VH-825)
+0,005/-0,0 (Width: VH-850 to VH-1000)

[1] Add suffix "S02" for 302 stainless steel, "S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² psi and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.



AS3217, AS4299
MIL-DTL-27426/3

Product Dimensions
All dimensions are in inches unless otherwise specified.



Stock Items available in carbon and stainless steel.

Smalley Part Number[1,4]	Housing Diameter	RING			GROOVE		THRUST CAPACITY	
		Outside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (lb)[2]	Ring Shear (lb)[3]
WH-50	0,500	0,532	0,045	0,025	0,526	0,030	460	2 000
WH-51	0,512	0,544	0,045	0,025	0,538	0,030	470	2 050
WH-53	0,531	0,564	0,045	0,025	0,557	0,030	490	2 130
WH-56	0,562	0,594	0,045	0,025	0,588	0,030	520	2 250
WH-59	0,594	0,626	0,045	0,025	0,619	0,030	550	2 380
WH-62	0,625	0,658	0,045	0,025	0,651	0,030	570	2 500
WH-65	0,656	0,689	0,045	0,025	0,682	0,030	600	2 630
WH-68	0,687	0,720	0,045	0,025	0,713	0,030	630	2 750
WH-71	0,718	0,751	0,045	0,025	0,744	0,030	660	2 870
WH-75	0,750	0,790	0,065	0,031	0,782	0,036	850	3 360
WH-77	0,777	0,817	0,065	0,031	0,808	0,036	880	3 480
WH-78	0,781	0,821	0,065	0,031	0,812	0,036	880	3 500
WH-81	0,812	0,853	0,065	0,031	0,843	0,036	920	3 640
WH-84	0,843	0,889	0,065	0,031	0,880	0,036	1 130	3 780
WH-86	0,866	0,913	0,065	0,031	0,903	0,036	1 160	3 880
WH-87	0,875	0,922	0,065	0,031	0,912	0,036	1 180	3 920
WH-90	0,906	0,953	0,065	0,031	0,943	0,036	1 220	4 060
WH-93	0,938	0,986	0,065	0,031	0,975	0,036	1 260	4 200
WH-96	0,968	1,022	0,075	0,037	1,011	0,042	1 440	5 180
WH-98	0,987	1,041	0,075	0,037	1,030	0,042	1 470	5 280
WH-100	1,000	1,054	0,075	0,037	1,043	0,042	1 480	5 350
WH-102	1,023	1,078	0,075	0,037	1,066	0,042	1 520	5 470
WH-103	1,031	1,084	0,075	0,037	1,074	0,042	1 530	5 510
WH-106	1,062	1,117	0,075	0,037	1,104	0,042	1 580	5 680
WH-109	1,093	1,147	0,075	0,037	1,135	0,042	1 620	5 840
WH-112	1,125	1,180	0,075	0,037	1,167	0,042	1 670	6 020
WH-115	1,156	1,210	0,075	0,037	1,198	0,042	1 720	6 180
WH-118	1,188	1,249	0,085	0,043	1,236	0,048	2 020	7 380
WH-121	1,218	1,278	0,085	0,043	1,266	0,048	2 070	7 570
WH-125	1,250	1,312	0,085	0,043	1,298	0,048	2 120	7 770
WH-128	1,281	1,342	0,085	0,043	1,329	0,048	2 170	7 960
WH-131	1,312	1,374	0,085	0,043	1,360	0,048	2 230	8 150
WH-134	1,343	1,408	0,085	0,043	1,395	0,048	2 470	8 350
WH-137	1,375	1,442	0,095	0,043	1,427	0,048	2 530	8 540
WH-140	1,406	1,472	0,095	0,043	1,458	0,048	2 580	8 740
WH-143	1,437	1,504	0,095	0,043	1,489	0,048	2 640	8 930
WH-145	1,456	1,523	0,095	0,043	1,508	0,048	2 680	9 050
WH-146	1,468	1,535	0,095	0,043	1,520	0,048	2 700	9 120
WH-150	1,500	1,567	0,095	0,043	1,552	0,048	2 760	9 320
WH-156	1,562	1,634	0,108	0,049	1,617	0,056	3 090	10 100
WH-157	1,574	1,649	0,108	0,049	1,633	0,056	3 340	10 180
WH-162	1,625	1,701	0,108	0,049	1,684	0,056	3 350	10 510
WH-165	1,653	1,730	0,108	0,049	1,712	0,056	3 510	10 690
WH-168	1,687	1,768	0,118	0,049	1,750	0,056	3 700	10 910
WH-175	1,750	1,834	0,118	0,049	1,813	0,056	3 840	11 310
WH-181	1,813	1,894	0,118	0,049	1,875	0,056	3 970	11 720
WH-185	1,850	1,937	0,118	0,049	1,917	0,056	4 450	11 960

±0,013/-0,0 (Outside Diameter, WH-50 to WH-75)
±0,015/-0,0 (Outside Diameter, WH-106 to WH-150)
±0,020/-0,0 (Outside Diameter, WH-156 to WH-185)
±0,004 (Radial Wall)
±0,002 (Thickness, WH-50 to WH-96)
±0,003 (Thickness, WH-98 to WH-185)
±0,002 (Diameter, WH-50 to WH-75)
±0,003 (Diameter, WH-77 to WH-103)
±0,004 (Diameter, WH-106 to WH-150)
±0,005 (Diameter, WH-156 to WH-185)
+0,003/-0,0 (Width, WH-50 to WH-103)
+0,004/-0,0 (Width, WH-106 to WH-185)

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number [1, 4]	Housing Diameter	RING			GROOVE		THRUST CAPACITY	
		Outside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (lb) [2]	Ring Shear (lb) [3]
WH-187	1,875	1,960 +0,020/-0,0	0,118 ±0,004	0,049 ±0,003	1,942 ±0,005	0,056 +0,004/-0,0	4 510	12 120
WH-193	1,938	2,025	0,118	0,049	2,005	0,056	4 660	12 530
WH-200	2,000	2,091	0,128	0,049	2,071	0,056	4 950	12 930
WH-204	2,047	2,138	0,128	0,049	2,118	0,056	5 060	13 240
WH-206	2,062	2,154 +0,025/-0,0	0,128	0,049	2,132	0,056	5 100	13 330
WH-212	2,125	2,217	0,128	0,049	2,195	0,056	5 260	13 740
WH-216	2,165	2,260	0,138	0,049	2,239	0,056	5 660	14 000
WH-218	2,188	2,284	0,138	0,049	2,262	0,056	5 720	14 150
WH-225	2,250	2,347	0,138	0,049	2,324	0,056	5 890	14 550
WH-231	2,312	2,413	0,138	0,049	2,390	0,056	6 370	14 950
WH-237	2,375	2,476	0,138	0,049	2,453	0,056	6 550	15 360
WH-243	2,437	2,543	0,148	0,049	2,519	0,056	7 060	15 760
WH-244	2,440	2,546	0,148	0,049	2,522	0,056	7 070	15 780
WH-250	2,500	2,606	0,148	0,049	2,582	0,056	7 250	16 160
WH-253	2,531	2,641	0,148	0,049	2,617	0,056	7 690	16 360
WH-256	2,562	2,673	0,148	0,049	2,648	0,056	7 790	16 560
WH-262	2,625	2,736	0,148	0,049	2,711	0,056	7 980	16 970
WH-267	2,677	2,789	0,158	0,049	2,767	0,056	8 520	17 310
WH-268	2,688	2,803	0,158	0,049	2,778	0,056	8 550	17 380
WH-275	2,750	2,865	0,158	0,049	2,841	0,056	8 750	17 780
WH-281	2,813	2,929	0,158	0,049	2,903	0,056	8 950	18 190
WH-283	2,834	2,954	0,168	0,049	2,928	0,056	9 520	18 320
WH-287	2,875	2,995	0,168	0,049	2,969	0,056	9 550	18 590
WH-293	2,937	3,058	0,168	0,049	3,031	0,056	9 760	18 990
WH-295	2,952	3,073	0,168	0,049	3,046	0,056	9 810	19 090
WH-300	3,000	3,122	0,168	0,061	3,096	0,068	10 180	24 150
WH-306	3,062	3,186	0,168	0,061	3,158	0,068	10 390	24 650
WH-312	3,125	3,251	0,178	0,061	3,223	0,068	10 600	25 150
WH-314	3,149	3,276	0,178	0,061	3,247	0,068	10 680	25 350
WH-318	3,187	3,311	0,178	0,061	3,283	0,068	10 810	25 650
WH-325	3,250	3,379	0,178	0,061	3,350	0,068	11 490	26 160
WH-331	3,312	3,446	0,188	0,061	3,416	0,068	12 170	26 660
WH-334	3,346	3,479	0,188	0,061	3,450	0,068	12 300	26 930
WH-337	3,375	3,509	0,188	0,061	3,479	0,068	12 410	27 170
WH-343	3,437	3,574 +0,030/-0,0	0,188	0,061	3,543 ±0,006	0,068	12 880	27 660
WH-350	3,500	3,636	0,188	0,061	3,606	0,068	13 110	28 170
WH-354	3,543	3,684	0,198	0,061	3,653	0,068	13 770	28 520
WH-356	3,562	3,703	0,198	0,061	3,672	0,068	13 850	28 670
WH-362	3,625	3,769	0,198	0,061	3,737	0,068	14 350	29 180
WH-368	3,687	3,832	0,198 ±0,005	0,061	3,799	0,068	14 600	29 680
WH-374	3,740	3,885	0,198	0,061	3,852	0,068	14 800	30 100
WH-375	3,750	3,894	0,198	0,061	3,862	0,068	14 840	30 180
WH-381	3,812	3,963	0,208	0,061	3,930	0,068	15 900	30 680
WH-387	3,875	4,025	0,208	0,061	3,993	0,068	16 160	31 190
WH-393	3,938	4,089	0,208	0,061	4,056	0,068	16 420	31 700
WH-400	4,000	4,157	0,218	0,061	4,124	0,068	17 530	32 200
WH-406	4,063	4,222	0,218	0,061	4,187	0,068	17 810	32 700
WH-412	4,125	4,284	0,218	0,061	4,249	0,068	18 080	33 200
WH-418	4,188	4,347	0,218	0,061	4,311	0,068	18 350	33 710
WH-425	4,250	4,416	0,228	0,061	4,380	0,068	19 530	34 210
WH-431	4,312	4,479	0,228	0,061	4,442	0,068	19 810	34 710
WH-433	4,330	4,497	0,228	0,061	4,460	0,068	19 900	34 850
WH-437	4,375	4,543	0,228	0,061	4,505	0,068	20 100	35 210
WH-443	4,437	4,611 +0,035/-0,0	0,238	0,061	4,573	0,068	21 330	35 710
WH-450	4,500	4,674	0,238	0,061	4,636	0,068	21 630	36 220
WH-452	4,527	4,701	0,238	0,061	4,663	0,068	21 760	36 440
WH-456	4,562	4,737	0,238	0,061	4,698	0,068	21 930	36 720
WH-462	4,625	4,803	0,250	0,072	4,765	0,079	22 890	43 940
WH-468	4,687	4,867	0,250	0,072	4,827	0,079	23 190	44 530
WH-472	4,724	4,903	0,250	0,072 ±0,004	4,864	0,079	23 370	44 880
WH-475	4,750	4,930	0,250	0,072	4,890	0,079	23 500	45 130
WH-481	4,812	4,993	0,250	0,072	4,952	0,079	23 810	45 720
WH-487	4,875	5,055	0,250	0,072	5,015	0,079	24 120	46 310
WH-492	4,921	5,102	0,250	0,072	5,061	0,079	24 350	46 750

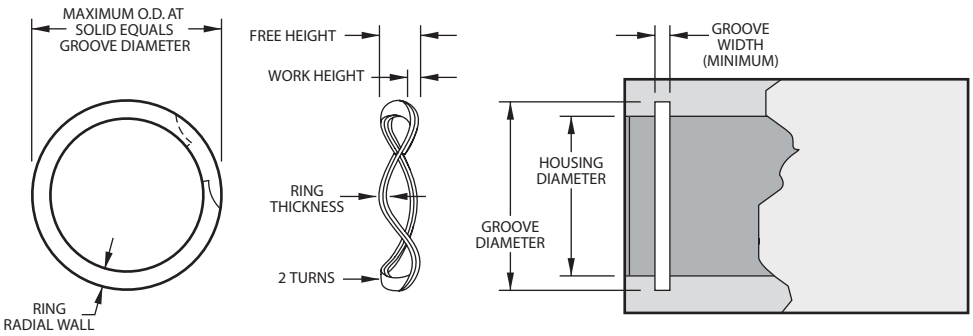
[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Stock Items available in carbon and stainless steel.

Smalley Part Number [1, 4]	Housing Diameter	RING			GROOVE		THRUST CAPACITY	
		Outside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (lb) [2]	Ring Shear (lb) [3]
WH-493	4,937	5,122 +0,035/-0,0	0,250 ±0,005	0,072 ±0,004	5,081 ±0,006	0,079 +0,005/-0,0	25 130	46 900
WH-500	5,000	5,185	0,250	0,072	5,144	0,079	25 450	47 500
WH-511	5,118	5,304	0,250	0,072	5,262	0,079	26 050	48 620
WH-512	5,125	5,311	0,250	0,072	5,269	0,079	26 100	48 690
WH-525	5,250	5,436 +0,045/-0,0	0,250	0,072	5,393 ±0,007	0,079	26 720	49 880
WH-537	5,375	5,566	0,250	0,072	5,522	0,079	28 120	51 060
WH-550	5,500	5,693	0,250	0,072	5,647	0,079	28 770	52 250
WH-551	5,511	5,703	0,250	0,072	5,658	0,079	28 830	52 360
WH-562	5,625	5,818	0,250	0,072	5,772	0,079	29 400	53 440
WH-570	5,708	5,909	0,250	0,072	5,861	0,079	31 070	54 230
WH-575	5,750	5,950	0,250	0,072	5,903	0,079	31 300	54 630
WH-587	5,875	6,077	0,250	0,072	6,028	0,079	31 980	55 810
WH-590	5,905	6,106	0,250	0,072	6,058	0,079	32 140	56 100
WH-600	6,000	6,202	0,250	0,072	6,153	0,079	32 660	57 000
WH-612	6,125	6,349 +0,055/-0,0	0,312 ±0,006	0,086	6,297 ±0,008	0,094 +0,006/-0,0	37 200	69 500
WH-625	6,250	6,474	0,312	0,086	6,422	0,094	37 990	70 920
WH-629	6,299	6,524	0,312	0,086	6,471	0,094	38 290	71 480
WH-637	6,375	6,601	0,312	0,086	6,547	0,094	38 750	72 340
WH-650	6,500	6,726	0,312	0,086	6,672	0,094	39 510	73 760
WH-662	6,625	6,863	0,312	0,086	6,807	0,094	42 620	75 180
WH-669	6,692	6,931	0,312	0,086	6,874	0,094	43 050	75 940
WH-675	6,750	6,987	0,312	0,086	6,932	0,094	43 420	76 600
WH-687	6,875	7,114	0,312	0,086	7,057	0,094	44 220	78 010
WH-700	7,000	7,239	0,312	0,086	7,182	0,094	45 030	79 430
WH-708	7,086	7,337	0,312	0,086	7,278	0,094	48 080	80 410
WH-712	7,125	7,376	0,312	0,086	7,317	0,094	48 350	80 850
WH-725	7,250	7,501 +0,065/-0,0	0,312	0,086	7,442	0,094	49 200	82 270
WH-737	7,375	7,628	0,312	0,086	7,567	0,094	50 050	83 690
WH-748	7,480	7,734	0,312	0,086	7,672	0,094	50 760	84 880
WH-750	7,500	7,754	0,312	0,086	7,692	0,094	50 890	85 110
WH-762	7,625	7,890	0,312	0,086	7,827	0,094	54 440	86 520
WH-775	7,750	8,014	0,312	0,086	7,952	0,094	55 330	87 940
WH-787	7,875	8,141	0,312	0,086	8,077	0,094	63 360	89 360
WH-800	8,000	8,266	0,312	0,086	8,202	0,094	57 110	90 780
WH-825	8,250	8,528	0,375	0,086	8,462	0,094	61 820	93 620
WH-826	8,267	8,546	0,375	0,086	8,479	0,094	61 940	93 810
WH-846	8,464	8,744	0,375	0,086	8,676	0,094	63 420	96 050
WH-850	8,500	8,780	0,375	0,086	8,712	0,094	63 690	96 450
WH-875	8,750	9,041	0,375	0,086	8,972	0,094	68 650	99 290
WH-885	8,858	9,151	0,375	0,086	9,080	0,094	69 500	100 520
WH-900	9,000	9,293	0,375	0,086	9,222	0,094	70 620	102 130
WH-905	9,055	9,359	0,375	0,086	9,287	0,094	74 250	102 750
WH-925	9,250	9,555	0,375	0,086	9,482	0,094	75 850	104 960
WH-944	9,448	9,755	0,375	0,086	9,680	0,094	77 470	107 210
WH-950	9,500	9,806	0,375	0,086	9,732	0,094	77 900	107 800
WH-975	9,750	10,068	0,375	0,086	9,992	0,094	83 390	110 640
WH-1000	10,000	10,320	0,375	0,086	10,242	0,094	85 530	113 470
WH-1025	10,250	10,582	0,375	0,086	10,502	0,094	91 290	116 310
WH-1050	10,500	10,834	0,375	0,086	10,752	0,094	93 520	119 150
WH-1075	10,750	11,095	0,375	0,086	11,012	0,094	99 540	121 990
WH-1100	11,000	11,347	0,375	0,086	11,262	0,094	101 860	124 820

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

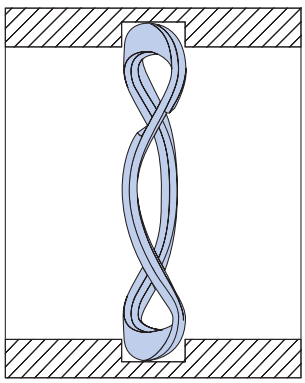
Product Dimensions
All dimensions are in inches unless otherwise specified.

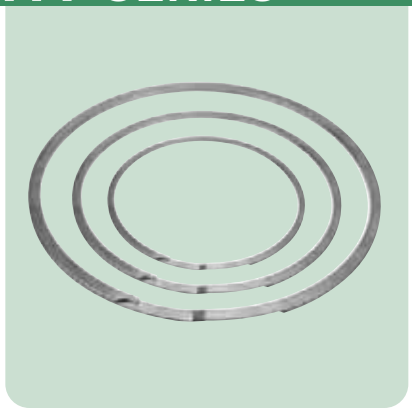


Stock Items available in carbon and stainless steel.

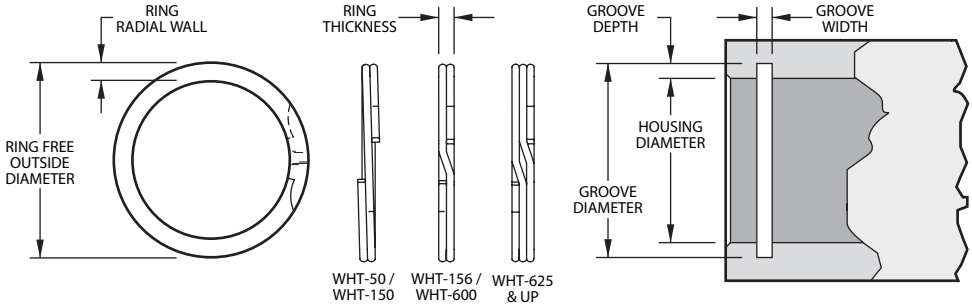
Smalley Part Number [1, 2]	Housing Diameter	Load (lb) @ Work Height	Max. Free Height	Number of Waves	RING			GROOVE	
					Thickness	Radial Wall	Crimp	Diameter	Width Min.
WHW-75	0,750	25 @ 0,080	0,114	3	0,035	0,065	N	0,796	0,119
WHW-87	0,875	30 @ 0,085	0,110	3	0,042	0,085	N	0,931	0,115
WHW-100	1,000	34 @ 0,085	0,120	3	0,042	0,085	N	1,066	0,125
WHW-112	1,125	38 @ 0,100	0,125	3	0,050	0,128	N	1,197	0,130
WHW-125	1,250	40 @ 0,100	0,135	3	0,050	0,128	N	1,330	0,140
WHW-137	1,375	45 @ 0,100	0,125	4	0,050	0,128	N	1,461	0,130
WHW-150	1,500	50 @ 0,100	0,135	4	0,050	0,128	N	1,594	0,140
WHW-162	1,625	55 @ 0,110	0,135	4	0,062	0,158	N	1,725	0,140
WHW-175	1,750	60 @ 0,110	0,140	4	0,062	0,158	N	1,858	0,145
WHW-187	1,875	63 @ 0,110	0,141	4	0,062	0,158	N	1,989	0,146
WHW-200	2,000	65 @ 0,110	0,150	4	0,062	0,158	N	2,122	0,155
WHW-212	2,125	70 @ 0,130	0,170	4	0,078	0,188	N	2,251	0,175
WHW-225	2,250	75 @ 0,130	0,175	4	0,078	0,188	N	2,382	0,180
WHW-237	2,375	80 @ 0,130	0,180	4	0,078	0,188	N	2,517	0,185
WHW-250	2,500	84 @ 0,130	0,183	4	0,078	0,188	N	2,648	0,188
WHW-262	2,625	88 @ 0,170	0,220	4	0,093	0,225	N	2,781	0,225
WHW-275	2,750	94 @ 0,170	0,229	4	0,093	0,225	N	2,914	0,234
WHW-287	2,875	97 @ 0,170	0,225	4	0,093	0,225	N	3,051	0,230
WHW-300	3,000	100 @ 0,170	0,230	4	0,093	0,225	N	3,182	0,235
WHW-312	3,125	103 @ 0,185	0,250	4	0,111	0,281	Y	3,315	0,255
WHW-325	3,250	106 @ 0,185	0,250	4	0,111	0,281	Y	3,446	0,255
WHW-358	3,500	115 @ 0,185	0,245	4	0,111	0,281	Y	3,710	0,250
WHW-362	3,625	117 @ 0,185	0,250	4	0,111	0,281	Y	3,841	0,250
WHW-375	3,750	121 @ 0,185	0,255	4	0,111	0,312	Y	3,974	0,260
WHW-387	3,875	126 @ 0,185	0,260	4	0,111	0,312	Y	4,107	0,265
WHW-400	4,000	130 @ 0,185	0,255	4	0,111	0,312	Y	4,240	0,260
WHW-412	4,125	134 @ 0,185	0,258	4	0,111	0,312	Y	4,365	0,263
WHW-425	4,250	140 @ 0,185	0,264	4	0,111	0,312	Y	4,490	0,269
WHW-450	4,500	150 @ 0,185	0,250	5	0,111	0,312	Y	4,740	0,255
WHW-475	4,750	160 @ 0,185	0,252	5	0,111	0,312	Y	4,995	0,257
WHW-500	5,000	170 @ 0,185	0,247	5	0,111	0,312	Y	5,260	0,252

[1] Add suffix "-S17" for stainless steel.
[2] See pages 106-107 for How to Order.





Product Dimensions
All dimensions are in inches unless otherwise specified.



Stock Items available in carbon and stainless steel.

Smalley Part Number[1,4]	Housing Diameter	RING					GROOVE				THRUST CAPACITY	
		Outside Diameter		Radial Wall		Thickness	Diameter		Width		Groove Yield (lb)[2]	Ring Shear (lb)[3]
WHT-50	0,500	0,529	+0,0/-0,013	0,045	±0,004	0,035	0,524	±0,002	0,039	+0,003/-0,0	420	2 530
WHT-51	0,512	0,541		0,045		0,035	0,536	±0,003	0,039		430	2 590
WHT-56	0,562	0,597		0,045		0,035	0,592		0,039		600	2 840
WHT-62	0,625	0,665		0,045		0,035	0,659		0,039		750	3 160
WHT-68	0,688	0,730		0,055		0,035	0,724		0,039		880	3 480
WHT-75	0,750	0,796		0,055		0,035	0,790		0,039		1 060	3 790
WHT-77	0,777	0,825		0,065		0,042	0,819		0,046		1 150	4 720
WHT-81	0,812	0,864		0,065		0,042	0,857		0,046		1 320	4 930
WHT-86	0,866	0,919		0,065		0,042	0,912		0,046		1 410	5 260
WHT-87	0,875	0,929		0,065		0,042	0,922		0,046		1 480	5 310
WHT-90	0,901	0,957		0,065		0,042	0,950		0,046		1 590	5 470
WHT-93	0,938	0,997		0,075		0,042	0,989		0,046		1 720	5 690
WHT-100	1,000	1,063		0,075		0,042	1,055		0,046		1 980	6 070
WHT-102	1,023	1,087		0,075		0,042	1,079		0,046		2 030	6 210
WHT-106	1,062	1,129	+0,0/-0,015	0,078		0,050	1,120	±0,004	0,056	+0,004/-0,0	2 180	7 010
WHT-112	1,125	1,195		0,078		0,050	1,185		0,056		2 390	7 420
WHT-118	1,188	1,260		0,088		0,050	1,250		0,056		2 600	7 840
WHT-125	1,250	1,330		0,093		0,050	1,320		0,056		3 090	8 250
WHT-131	1,312	1,395		0,093		0,050	1,385		0,056		3 430	8 660
WHT-137	1,375	1,461		0,098		0,050	1,450		0,056		3 690	9 070
WHT-143	1,438	1,526		0,103		0,050	1,515		0,056		3 960	9 490
WHT-145	1,456	1,546		0,108		0,050	1,535		0,056		4 120	9 610
WHT-150	1,500	1,591		0,108		0,050	1,580		0,056		4 240	9 900
WHT-156	1,562	1,659	+0,0/-0,020	0,113		0,062	1,647	±0,005	0,068		4 750	12 780
WHT-162	1,625	1,727		0,113		0,062	1,715		0,068		5 170	13 290
WHT-165	1,653	1,757		0,118		0,062	1,745		0,068		5 380	13 520
WHT-168	1,688	1,793		0,118		0,062	1,780		0,068		5 490	13 810
WHT-175	1,750	1,858		0,118		0,062	1,845		0,068		5 940	14 320
WHT-181	1,812	1,923		0,123		0,062	1,910		0,068		6 280	14 820
WHT-185	1,850	1,963		0,123		0,062	1,949		0,068		6 540	15 130
WHT-187	1,875	1,989		0,128		0,062	1,975		0,068		6 630	15 340
WHT-193	1,938	2,054		0,128		0,062	2,040		0,068		6 990	15 850
WHT-200	2,000	2,125		0,138		0,062	2,110		0,068		7 780	16 360
WHT-206	2,062	2,190	+0,0/-0,025	0,141	±0,005	0,078	2,175	±0,006	0,086	+0,005/-0,0	8 310	21 220
WHT-212	2,125	2,255		0,141		0,078	2,240		0,086		8 710	21 870
WHT-218	2,188	2,321		0,141		0,078	2,305		0,086		9 130	22 520
WHT-225	2,250	2,386		0,141		0,078	2,370		0,086		9 540	23 160
WHT-231	2,312	2,457		0,188		0,078	2,440		0,086		10 460	23 800
WHT-237	2,375	2,522		0,188		0,078	2,505		0,086		10 910	24 440
WHT-244	2,440	2,588		0,188		0,078	2,570		0,086		11 210	25 110
WHT-250	2,500	2,653		0,188		0,078	2,635		0,086		12 020	25 730
WHT-253	2,531	2,687		0,188		0,078	2,668		0,086		12 350	26 050
WHT-256	2,562	2,720		0,188		0,093	2,700		0,103		12 500	29 940
WHT-262	2,625	2,785		0,188		0,093	2,765		0,103		12 990	30 680
WHT-268	2,688	2,855		0,188		0,093	2,834		0,103		13 870	31 410
WHT-275	2,750	2,921		0,188		0,093	2,900		0,103		14 580	32 140
WHT-281	2,813	2,987		0,188		0,093	2,965		0,103		15 110	32 880

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

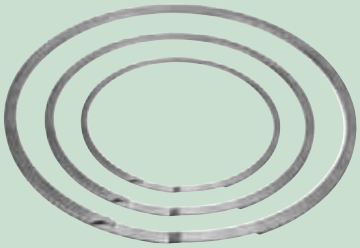
Smalley Part Number [1, 4]	Housing Diameter	RING					GROOVE			THRUST CAPACITY	
		Outside Diameter		Radial Wall		Thickness	Diameter		Width	Groove Yield (lb) [2]	Ring Shear (lb) [3]
WHT-283	2,834	3,009	+0,025/-0,0	0,188	±0,005	0,093	2,987	±0,006	0,103	15 430	33 120
WHT-287	2,875	3,053		0,188		0,093	3,030		0,103	15 850	33 600
WHT-300	3,000	3,188		0,188		0,093	3,165		0,103	17 600	35 060
WHT-306	3,062	3,253	+0,030/-0,0	0,250		0,111	3,230		0,120	18 180	42 710
WHT-312	3,125	3,318		0,250		0,111	3,295		0,120	18 780	43 590
WHT-315	3,156	3,354		0,250		0,111	3,328		0,120	19 190	44 040
WHT-325	3,250	3,450		0,250		0,111	3,426		0,120	20 220	45 330
WHT-334	3,346	3,550		0,250		0,111	3,525		0,120	21 290	46 670
WHT-346	3,464	3,675		0,250		0,111	3,650		0,120	22 770	48 320
WHT-350	3,500	3,716		0,250		0,111	3,690		0,120	23 500	48 820
WHT-354	3,543	3,761		0,250		0,111	3,735		0,120	24 040	49 420
WHT-356	3,562	3,783		0,250		0,111	3,756		0,120	24 420	49 690
WHT-362	3,625	3,849		0,250		0,111	3,822		0,120	25 370	50 560
WHT-375	3,750	3,982		0,250		0,111	3,955		0,120	27 300	52 310
WHT-387	3,875	4,115		0,250		0,111	4,087		0,120	29 030	54 050
WHT-393	3,938	4,178		0,250		0,111	4,150		0,120	29 510	54 930
WHT-400	4,000	4,248		0,250		0,111	4,220		0,120	31 100	55 800
WHT-412	4,125	4,373	+0,035/-0,0	0,312	±0,006	0,111	4,345	±0,007	0,120	32 070	57 540
WHT-425	4,250	4,500		0,312		0,111	4,470		0,120	33 050	59 280
WHT-433	4,330	4,586		0,312		0,111	4,556		0,120	34 590	60 400
WHT-450	4,500	4,768		0,312		0,111	4,735		0,120	37 530	62 770
WHT-462	4,625	4,897		0,312		0,111	4,865		0,120	39 230	64 510
WHT-475	4,750	5,028		0,312		0,111	4,995		0,120	41 300	66 260
WHT-500	5,000	5,295		0,312		0,111	5,260		0,120	45 950	69 740
WHT-525	5,250	5,559	+0,045/-0,0	0,375		0,127	5,520		0,139	50 100	83 790
WHT-537	5,375	5,685		0,375		0,127	5,645		0,139	51 290	85 780
WHT-550	5,500	5,810		0,375		0,127	5,770		0,139	52 480	87 780
WHT-575	5,750	6,062		0,375		0,127	6,020		0,139	54 870	91 770
WHT-600	6,000	6,314		0,375		0,127	6,270		0,139	57 260	95 760

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 45 000 psi and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Stock Items available in carbon and stainless steel. Rings listed below are three-turn construction.

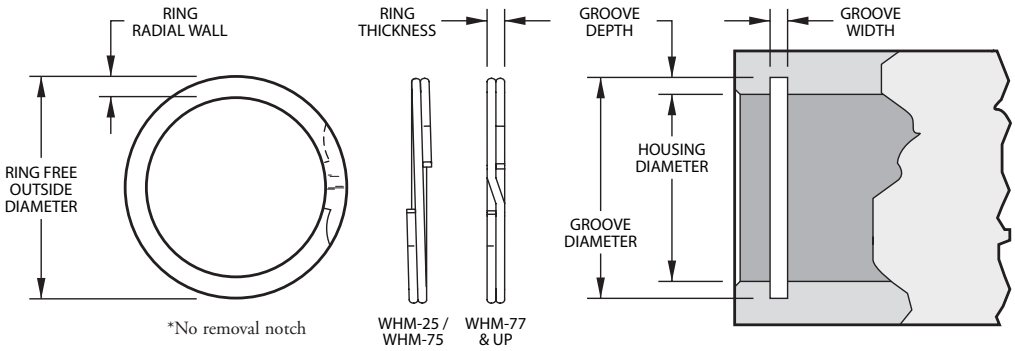
Smalley Part Number [1, 4]	Housing Diameter	RING					GROOVE			THRUST CAPACITY	
		Outside Diameter		Radial Wall		Thickness	Diameter		Width	Groove Yield (lb) [2]	Ring Shear (lb) [3]
WHT-625	6,250	6,576	+0,055/-0,0	0,312	±0,006	0,165	6,530	±0,008	0,174	61 850	129 590
WHT-650	6,500	6,837		0,312		0,165	6,790		0,174	66 620	134 780
WHT-662	6,625	6,973		0,312		0,165	6,925		0,174	70 240	137 370
WHT-675	6,750	7,104		0,312		0,165	7,055		0,174	73 000	139 960
WHT-700	7,000	7,366		0,312		0,165	7,315		0,174	78 180	145 140
WHT-725	7,250	7,628	+0,070/-0,0	0,375		0,189	7,575		0,209	83 530	172 190
WHT-750	7,500	7,895		0,375		0,189	7,840		0,209	90 120	178 130
WHT-775	7,750	8,156		0,375		0,189	8,100		0,209	95 870	184 070
WHT-800	8,000	8,418		0,375		0,189	8,360		0,209	101 790	190 000
WHT-825	8,250	8,680		0,375		0,189	8,620		0,209	107 880	195 940
WHT-850	8,500	8,942		0,375		0,189	8,880		0,209	114 160	201 880
WHT-875	8,750	9,209		0,375		0,189	9,145		0,209	122 460	207 820
WHT-900	9,000	9,471		0,375		0,189	9,405		0,209	129 140	213 750
WHT-925	9,250	9,736		0,375		0,189	9,669		0,209	137 310	219 690
WHT-950	9,500	9,999		0,375		0,189	9,930		0,209	144 380	225 630
WHT-975	9,750	10,260		0,375		0,189	10,189		0,209	151 620	231 570
WHT-1000	10,000	10,552		0,375		0,189	10,450		0,209	159 040	237 500
WHT-1050	10,500	11,072		0,375		0,189	10,970		0,209	174 420	249 380

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.



AS3215, AS4299
MIL-DTL-27426/4

Product Dimensions
All dimensions are in inches unless otherwise specified.



Stock Items available in carbon and stainless steel.

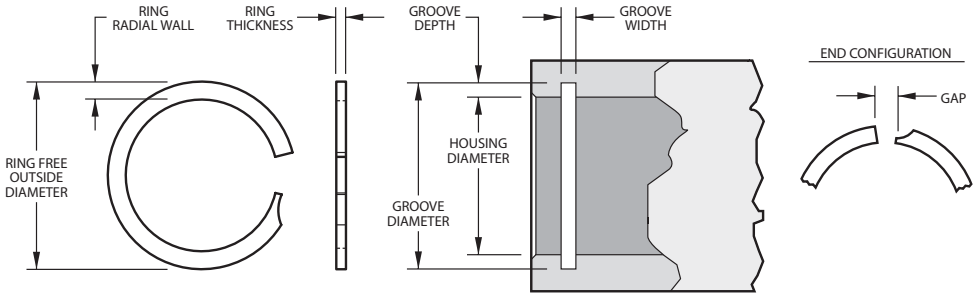
Smalley Part Number[1,4]	Housing Diameter	RING					GROOVE				THRUST CAPACITY	
		Outside Diameter		Radial Wall		Thickness		Diameter		Width		Groove Yield (lb)[2]	Ring Shear (lb)[3]
WHM-25*	0,250	0,270	+0,010/-0,0	0,020	±0,004	0,015	±0,002	0,268	±0,002	0,020	+0,003/-0,0	159	561
WHM-31*	0,312	0,333		0,025		0,015		0,330		0,020		198	700
WHM-37*	0,375	0,400		0,030		0,025		0,397		0,029		292	1 442
WHM-43	0,437	0,464	+0,012/-0,0	0,035		0,025		0,461		0,029		371	1 680
WHM-50	0,500	0,538	+0,013/-0,0	0,045		0,035		0,530		0,039		530	2 530
WHM-51	0,512	0,550		0,045		0,035		0,542		0,039		540	2 590
WHM-56	0,562	0,605		0,055		0,035		0,596		0,039		680	2 840
WHM-62	0,625	0,675		0,055		0,035		0,665		0,039		880	3 160
WHM-68	0,688	0,743		0,065		0,035		0,732		0,039		1 070	3 480
WHM-75	0,750	0,807		0,065		0,035		0,796		0,039		1 220	3 790
WHM-77	0,777	0,836		0,075		0,042		0,825	±0,003	0,046		1 320	4 720
WHM-81	0,812	0,873		0,075		0,042		0,862		0,046		1 440	4 930
WHM-86	0,866	0,931		0,075		0,042		0,920		0,046		1 650	5 260
WHM-87	0,875	0,943		0,085		0,042		0,931		0,046		1 730	5 310
WHM-90	0,901	0,972		0,085		0,042		0,959		0,046		1 850	5 470
WHM-93	0,938	1,013		0,085		0,042		1,000		0,046		2 060	5 690
WHM-100	1,000	1,080		0,085		0,042		1,066		0,046		2 330	6 070
WHM-102	1,023	1,105		0,085		0,042		1,091		0,046		2 460	6 210
WHM-106	1,062	1,138		0,103		0,050		1,130	±0,004	0,056		2 550	7 010
WHM-112	1,125	1,205		0,103		0,050		1,197		0,056		2 860	7 420
WHM-118	1,188	1,271		0,103		0,050		1,262		0,056		3 110	7 840
WHM-125	1,250	1,339		0,103		0,050		1,330		0,056		3 530	8 250
WHM-131	1,312	1,406		0,118		0,050		1,396		0,056		3 900	8 660
WHM-137	1,375	1,471		0,118		0,050		1,461		0,056		4 180	9 070
WHM-143	1,439	1,539		0,118		0,050		1,528		0,056		4 580	9 490
WHM-145	1,456	1,559		0,118		0,050		1,548		0,056		4 730	9 610
WHM-150	1,500	1,605		0,118		0,050		1,594		0,056		4 980	9 900
WHM-156	1,562	1,675	+0,020/-0,0	0,128		0,062		1,658	±0,005	0,068	+0,004/-0,0	5 300	12 780
WHM-162	1,625	1,742		0,128		0,062		1,725		0,068		5 740	13 290
WHM-165	1,653	1,772		0,128		0,062		1,755		0,068		5 960	13 520
WHM-168	1,688	1,810		0,128		0,062		1,792		0,068		6 210	13 810
WHM-175	1,750	1,876		0,128		0,062		1,858		0,068		6 680	14 320
WHM-181	1,812	1,940		0,128		0,062		1,922		0,068		7 050	14 820
WHM-185	1,850	1,981		0,158		0,062		1,962		0,068		7 320	15 130
WHM-187	1,875	2,008		0,158		0,062		1,989		0,068		7 560	15 340
WHM-193	1,938	2,075		0,158		0,062		2,056		0,068		8 080	15 850
WHM-200	2,000	2,142		0,158		0,062		2,122		0,068		8 620	16 360
WHM-206	2,062	2,201	+0,025/-0,0	0,168	±0,005	0,078	±0,003	2,186	±0,006	0,086	+0,005/-0,0	9 040	21 220
WHM-212	2,125	2,267		0,168		0,078		2,251		0,086		9 460	21 870
WHM-218	2,188	2,334		0,168		0,078		2,318		0,086		10 050	22 520
WHM-225	2,250	2,399		0,168		0,078		2,382		0,086		10 500	23 160
WHM-231	2,312	2,467		0,200		0,078		2,450		0,086		11 280	23 800
WHM-237	2,375	2,535		0,200		0,078		2,517		0,086		11 920	24 440
WHM-244	2,440	2,602		0,200		0,078		2,584		0,086		12 420	25 110
WHM-250	2,500	2,667		0,200		0,078		2,648		0,086		13 080	25 730
WHM-253	2,531	2,700		0,200		0,078		2,681		0,086		13 420	26 050
WHM-256	2,562	2,733	+0,030/-0,0	0,225		0,093		2,714		0,103		13 760	29 940
WHM-262	2,625	2,801		0,225		0,093		2,781		0,103		14 470	30 680
WHM-268	2,688	2,868		0,225		0,093		2,848		0,103		15 200	31 410
WHM-275	2,750	2,934		0,225		0,093		2,914		0,103		15 940	32 140

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number [1, 4]	Housing Diameter	RING						GROOVE				THRUST CAPACITY	
		Outside Diameter		Radial Wall		Thickness		Diameter		Width		Groove Yield (lb) [2]	Ring Shear (lb) [3]
WHM-281	2,813	3,001	+0,030/-0,0	0,225	±0,005	0,093	±0,003	2,980	±0,006	0,103	+0,005/-0,0	16 700	32 880
WHM-283	2,834	3,027		0,225		0,093		3,006		0,103		17 230	33 120
WHM-287	2,875	3,072		0,225		0,093		3,051		0,103		17 880	33 600
WHM-300	3,000	3,204		0,225		0,093		3,182		0,103		18 300	35 060
WHM-306	3,062	3,271	+0,035/-0,0	0,281		0,111		3,248		0,120		20 130	42 710
WHM-312	3,125	3,338		0,281		0,111		3,315		0,120		20 990	43 590
WHM-315	3,157	3,371		0,281		0,111		3,348		0,120		21 420	44 040
WHM-325	3,250	3,470		0,281		0,111		3,446		0,120		22 510	45 330
WHM-334	3,346	3,571		0,281		0,111		3,546		0,120		23 650	46 670
WHM-347	3,464	3,701		0,281		0,111		3,675		0,120		25 710	48 320
WHM-350	3,500	3,736		0,281		0,111		3,710		0,120		25 980	48 820
WHM-354	3,543	3,781		0,281		0,111		3,755		0,120		26 550	49 420
WHM-356	3,562	3,802		0,281		0,111		3,776		0,120		26 940	49 690
WHM-362	3,625	3,868		0,281		0,111		3,841		0,120		27 670	50 560
WHM-375	3,750	4,002		0,312	±0,006	0,111		3,974		0,120		29 690	52 310
WHM-387	3,875	4,136		0,312		0,111		4,107		0,120		31 770	54 050
WHM-393	3,938	4,203		0,312		0,111		4,174		0,120		32 850	54 930
WHM-400	4,000	4,270		0,312		0,111		4,240		0,120		33 930	55 800
WHM-412	4,125	4,395		0,312		0,111		4,365		0,120		34 990	57 540
WHM-425	4,250	4,520		0,312		0,111		4,490		0,120		36 050	59 280
WHM-433	4,330	4,600		0,312		0,111		4,570		0,120		36 730	60 400
WHM-450	4,500	4,770		0,312		0,111		4,740		0,120		38 170	62 770
WHM-462	4,625	4,899		0,312		0,111		4,865		0,120		39 230	64 510
WHM-475	4,750	5,030		0,312		0,111		4,995		0,120		41 300	66 260
WHM-500	5,000	5,297		0,312		0,111		5,260		0,120		45 950	69 740
WHM-525	5,250	5,559	+0,050/-0,0	0,350		0,127	±0,004	5,520	±0,007	0,139	+0,006/-0,0	50 100	83 790
WHM-537	5,375	5,685		0,350		0,127		5,645		0,139		51 290	85 780
WHM-550	5,500	5,810		0,350		0,127		5,770		0,139		52 480	87 780
WHM-575	5,750	6,062		0,350		0,127		6,020		0,139		54 870	91 770
WHM-600	6,000	6,314		0,350		0,127		6,270		0,139		57 260	95 760
WHM-625	6,250	6,576	+0,055/-0,0	0,380		0,156	±0,005	6,530	±0,008	0,174	+0,008/-0,0	61 850	122 520
WHM-650	6,500	6,838		0,380		0,156		6,790		0,174		66 620	127 420
WHM-662	6,625	6,974		0,380		0,156		6,925		0,174		70 240	129 870
WHM-675	6,750	7,105		0,380		0,156		7,055		0,174		73 000	132 320
WHM-700	7,000	7,366		0,380		0,156		7,315		0,174		78 180	137 230
WHM-725	7,250	7,628	+0,070/-0,0	0,418	±0,007	0,187		7,575		0,209		83 530	170 370
WHM-750	7,500	7,895		0,418		0,187		7,840		0,209		90 120	176 240
WHM-775	7,750	8,157		0,418		0,187		8,100		0,209		95 870	182 120
WHM-800	8,000	8,419		0,418		0,187		8,360		0,209		101 790	187 990
WHM-825	8,250	8,680		0,437		0,187		8,620		0,209		107 880	193 870
WHM-850	8,500	8,942		0,437		0,187		8,880		0,209		114 160	199 740
WHM-875	8,750	9,209		0,437		0,187		9,145		0,209		122 460	205 620
WHM-900	9,000	9,471		0,437		0,187		9,405		0,209		129 140	211 490
WHM-925	9,250	9,737		0,437		0,187		9,669		0,209		137 310	217 370
WHM-950	9,500	10,000		0,500		0,187		9,930		0,209		144 380	223 240
WHM-975	9,750	10,260		0,500		0,187		10,189		0,209		150 620	229 120
WHM-1000	10,000	10,523		0,500		0,187		10,450		0,209		159 040	234 990
WHM-1025	10,250	10,786		0,500		0,187		10,711		0,209		167 370	240 870
WHM-1050	10,500	11,047		0,500		0,187		10,970		0,209		174 420	246 740
WHM-1075	10,750	11,313	+0,120/-0,0	0,500		0,187		11,234	±0,010	0,209		183 890	252 620
WHM-1100	11,000	11,575		0,500		0,187		11,495		0,209		192 830	258 490
WHM-1125	11,250	11,838		0,500		0,187		11,756		0,209		201 190	264 370
WHM-1150	11,500	12,102		0,562	±0,015	0,187		12,018		0,209		210 540	270 240
WHM-1175	11,750	12,365		0,562		0,187		12,279		0,209		220 100	276 120
WHM-1200	12,000	12,628		0,562		0,187		12,540		0,209		229 020	281 990
WHM-1225	12,250	12,891		0,562		0,187		12,801		0,209		238 990	287 860
WHM-1250	12,500	13,154		0,562		0,187		13,063		0,209		249 170	293 740
WHM-1275	12,750	13,417		0,562		0,187		13,324	±0,012	0,209		258 660	299 610
WHM-1300	13,000	13,680	+0,140/-0,0	0,662		0,187		13,585		0,209		269 240	305 490
WHM-1325	13,250	13,943		0,662		0,187		13,846		0,209		279 100	311 360
WHM-1350	13,500	14,207		0,662		0,187		14,108		0,209		290 100	317 240
WHM-1375	13,750	14,470		0,662		0,187		14,369		0,209		301 300	323 110
WHM-1400	14,000	14,732		0,662		0,187		14,630		0,209		311 730	328 990
WHM-1425	14,250	14,995		0,662		0,187		14,891		0,209		323 340	334 860
WHM-1450	14,500	15,259		0,750		0,187		15,153		0,209		335 160	340 740
WHM-1475	14,750	15,522		0,750		0,187		15,414		0,209		346 150	346 610
WHM-1500	15,000	15,785		0,750		0,187		15,675		0,209		358 380	352 490

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Product Dimensions
All dimensions are in inches unless otherwise specified.



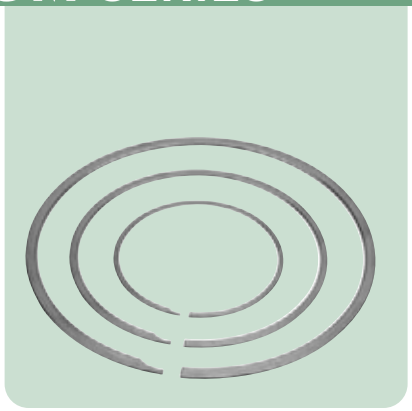
Stock Items available in carbon and stainless steel.

Smalley Part Number[1,4]	Housing Diameter	RING						GROOVE				THRUST CAPACITY	
		Outside Diameter		Radial Wall		Thickness		Diameter		Width		Groove Yield (lb)[2]	Ring Shear (lb)[3]
FHE-0050	0,500	0,529	+0,013/-0,0	0,055	±0,004	0,037	±0,002	0,524	+0,004/-0,0	0,043	+0,006/-0,0	424	2 325
FHE-0056	0,562	0,591		0,055		0,037		0,586		0,043		477	2 613
FHE-0062	0,625	0,665		0,065		0,037		0,657		0,043		707	2 906
FHE-0068	0,687	0,726		0,065		0,037		0,719		0,043		777	3 194
FHE-0075	0,750	0,797		0,075		0,037		0,790	+0,005/-0,0	0,043		1 060	3 487
FHE-0081	0,812	0,860		0,075		0,037		0,852		0,043		1 148	3 775
FHE-0087	0,875	0,924		0,075		0,037		0,915		0,043		1 237	4 068
FHE-0093	0,937	1,000	+0,015/-0,0	0,085		0,045		0,985	+0,008/-0,0	0,051		1 590	5 334
FHE-0100	1,000	1,058		0,085		0,045		1,048		0,051		1 696	5 693
FHE-0106	1,062	1,121		0,094		0,045		1,110		0,051		1 802	6 045
FHE-0112	1,125	1,192		0,094		0,045		1,181		0,051		2 227	6 404
FHE-0118	1,187	1,252		0,094		0,045		1,243	+0,010/-0,0	0,051		2 349	6 757
FHE-0125	1,250	1,336		0,094		0,045		1,316		0,051		2 916	7 116
FHE-0131	1,312	1,391		0,094		0,045		1,378		0,051		3 060	7 469
FHE-0137	1,375	1,470		0,128		0,057		1,453		0,063		3 791	9 307
FHE-0143	1,437	1,529		0,128		0,057		1,515		0,063		3 961	9 727
FHE-0150	1,500	1,592		0,128		0,057		1,578		0,063		4 135	10 153
FHE-0156	1,562	1,687	+0,020/-0,0	0,158		0,067		1,666		0,073		5 741	12 400
FHE-0162	1,625	1,746		0,158		0,067		1,729		0,073		5 973	12 901
FHE-0168	1,687	1,808		0,158		0,067		1,791		0,073		6 201	13 393
FHE-0175	1,750	1,885		0,158		0,067		1,862		0,073		6 927	13 893
FHE-0181	1,812	1,942		0,158		0,067		1,924		0,073		7 173	14 385
FHE-0187	1,875	2,007		0,158		0,067		1,987		0,073		7 422	14 885
FHE-0193	1,937	2,074	+0,025/-0,0	0,200	±0,005	0,076	±0,003	2,055	+0,012/-0,0	0,085		8 078	16 649
FHE-0200	2,000	2,143		0,200		0,076		2,118		0,085		8 341	17 191
FHE-0206	2,062	2,200		0,200		0,076		2,180		0,085		8 599	17 724
FHE-0212	2,125	2,264		0,200		0,076		2,243		0,085		8 862	18 265
FHE-0218	2,187	2,327		0,200		0,076		2,305		0,085		9 121	18 798
FHE-0225	2,250	2,389		0,200		0,076		2,368		0,085		9 384	19 340
FHE-0231	2,312	2,453		0,200		0,076		2,430		0,085		9 642	19 873
FHE-0237	2,375	2,517		0,200		0,076		2,493		0,085		9 905	20 414
FHE-0243	2,437	2,582		0,200		0,076		2,555		0,085		10 163	20 947
FHE-0250	2,500	2,643		0,200		0,076		2,618		0,085		10 426	21 488
FHE-0256	2,562	2,705	+0,030/-0,0	0,200		0,095		2,680		0,104		10 685	26 225
FHE-0262	2,625	2,777		0,200		0,095		2,743		0,104		10 947	26 870
FHE-0268	2,687	2,828		0,200		0,095		2,805		0,104		11 206	27 504
FHE-0275	2,750	2,899		0,200		0,095		2,868		0,104		11 469	28 149
FHE-0281	2,812	2,958		0,200		0,095		2,930		0,104		11 727	28 784
FHE-0287	2,875	3,022		0,200		0,095		2,993		0,104		11 990	29 429
FHE-0293	2,937	3,084		0,200		0,095		3,055		0,104		12 249	30 063
FHE-0300	3,000	3,145		0,200		0,095		3,118		0,104		12 511	30 708
FHE-0306	3,062	3,218		0,200		0,095		3,184		0,104		13 203	31 343
FHE-0312	3,125	3,294		0,237		0,095		3,263	+0,013/-0,0	0,104		15 242	31 988
FHE-0318	3,187	3,357		0,237		0,095		3,325		0,104		15 544	32 622
FHE-0325	3,250	3,420		0,237		0,095		3,388		0,104		15 851	33 267
FHE-0331	3,312	3,483	+0,035/-0,0	0,248		0,115		3,450		0,124	+0,007/-0,0	16 154	38 952
FHE-0337	3,375	3,547		0,248		0,115		3,513		0,124		16 461	39 693

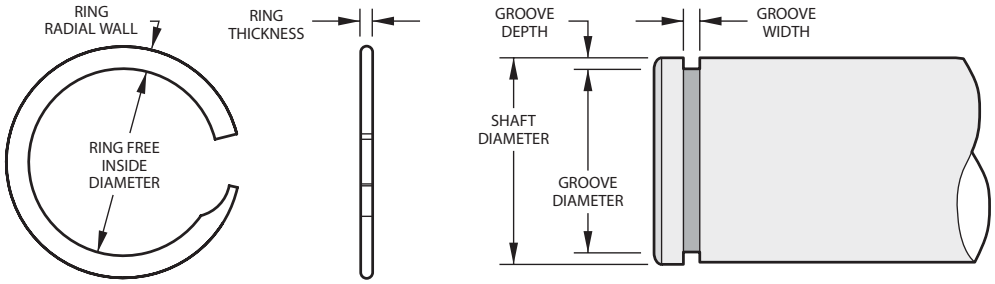
[1] Add suffix "-S02" for 302 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number [1, 4]	Housing Diameter	RING			GROOVE		THRUST CAPACITY	
		Outside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (lb) [2]	Ring Shear (lb) [3]
FHE-0343	3,437	3,609 +0,035/-0,0	0,248 ±0,005	0,115 ±0,003	3,575 +0,013/-0,0	0,124 +0,007/-0,0	16 763	40 422
FHE-0350	3,500	3,673	0,248	0,115	3,638	0,124	17 071	41 163
FHE-0356	3,562	3,728	0,248	0,115	3,700	0,124	17 373	41 892
FHE-0362	3,625	3,799	0,248	0,115	3,763	0,124	17 680	42 633
FHE-0368	3,687	3,862	0,248	0,115	3,825	0,124	17 983	43 362
FHE-0375	3,750	3,922	0,248	0,115	3,888	0,124	18 290	44 103
FHE-0381	3,812	3,988	0,248	0,115	3,950	0,124	18 592	44 832
FHE-0387	3,875	4,044	0,248	0,115	4,013	0,124	18 900	45 573
FHE-0393	3,937	4,114	0,248	0,115	4,075	0,124	19 202	46 302
FHE-0400	4,000	4,223	0,265	0,153	4,158	0,163	22 337	60 283
FHE-0412	4,125	4,329	0,265	0,153	4,283 +0,021/-0,0	0,163	23 035	62 166
FHE-0425	4,250	4,452	0,265	0,153	4,408	0,163	23 733	64 050
FHE-0437	4,375	4,576	0,265	0,153	4,533	0,163	24 431	65 934
FHE-0450	4,500	4,703 +0,050/-0,0	0,265	0,153	4,658	0,163	25 129	67 818
FHE-0462	4,625	4,829	0,265	0,153	4,783	0,163	25 827	69 702
FHE-0475	4,750	4,945	0,265	0,153	4,908	0,163	26 525	71 585
FHE-0487	4,875	5,082	0,265	0,153	5,033	0,163	27 223	73 469
FHE-0500	5,000	5,207	0,265	0,153	5,158	0,163	27 921	75 353
FHE-0525	5,250	5,460	0,265	0,153	5,408 +0,024/-0,0	0,163	29 317	79 121
FHE-0550	5,500	5,719	0,265	0,153 ±0,004	5,658	0,163	30 713	82 888
FHE-0575	5,750	5,965	0,265	0,153	5,908	0,163	32 109	86 656
FHE-0600	6,000	6,256 +0,055/-0,0	0,316 ±0,006	0,153	6,196	0,163	41 563	90 424
FHE-0625	6,250	6,508	0,316	0,153	6,446	0,163	43 295	94 191
FHE-0650	6,500	6,760	0,316	0,153	6,696	0,163	45 027	97 959
FHE-0675	6,750	7,013	0,316	0,153	6,946	0,163	46 759	101 727
FHE-0700	7,000	7,266	0,316	0,153	7,196	0,163	48 490	105 494
FHE-0725	7,250	7,541	0,316	0,153	7,446	0,163	50 222	109 262
FHE-0750	7,500	7,762	0,316	0,153	7,696	0,163	51 954	113 030
FHE-0775	7,750	8,023	0,316	0,153	7,946	0,163	53 686	116 797
FHE-0800	8,000	8,276	0,316	0,153	8,196 +0,028/-0,0	0,163	55 418	120 565
FHE-0825	8,250	8,580	0,373	0,192	8,486	0,203	68 813	147 399
FHE-0850	8,500	8,821	0,373	0,192	8,736	0,203	70 898	151 866
FHE-0875	8,750	9,073	0,373	0,192	8,986	0,203	72 983	156 332
FHE-0900	9,000	9,326 +0,070/-0,0	0,373	0,192	9,236	0,203	75 068	160 799
FHE-0925	9,250	9,580	0,373	0,192	9,486	0,203	77 154	165 265
FHE-0950	9,500	9,831	0,373	0,192 ±0,005	9,736	0,203	79 239	169 732
FHE-0975	9,750	10,083	0,373	0,192	9,986	0,203	81 324	174 199
FHE-1000	10,000	10,414	0,435	0,192	10,314 +0,031/-0,0	0,203	110 977	178 665
FHE-1025	10,250	10,660	0,435 ±0,007	0,192	10,564	0,203	113 751	183 132
FHE-1050	10,500	10,919	0,435	0,192	10,814	0,203	116 526	187 599
FHE-1075	10,750	11,171	0,435	0,192	11,064	0,203	119 300	192 065
FHE-1100	11,000	11,440 +0,120/-0,0	0,435	0,192	11,314	0,203	122 074	196 532

[1] Add suffix "-S02" for 302 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.



Product Dimensions
All dimensions are in millimeters unless otherwise specified.



*No removal notch

Stock Items available in carbon and stainless steel.

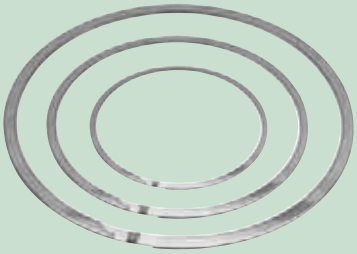
Smalley Part Number[1, 4]	Shaft Diameter	RING						GROOVE				THRUST CAPACITY	
		Inside Diameter		Radial Wall		Thickness		Diameter		Width		Groove Yield (kN)[2]	Ring Shear (kN)[3]
VSM-6*	6,00	5,65	+0,0/-0,25	0,51	+/-0,10	0,30	+/-0,04	5,70	±0,05	0,38	+0,05/-0,0	0,44	1,99
VSM-7*	7,00	6,58		0,51		0,30		6,64		0,38		0,61	2,23
VSM-8*	8,00	7,52		0,64		0,38		7,60		0,46		0,78	3,18
VSM-9*	9,00	8,42		0,76		0,38		8,50		0,46		1,11	3,58
VSM-10*	10,00	9,32	+0,0/-0,30	0,89		0,38		9,40		0,46		1,46	3,98
VSM-11	11,00	10,32		0,89		0,38		10,40		0,46		1,61	4,38
VSM-12	12,00	11,22	+0,0/-0,33	1,14		0,46		11,34		0,56		1,93	5,78
VSM-13	13,00	12,15		1,14		0,46		12,28		0,56		2,28	6,26
VSM-14	14,00	13,15		1,14		0,46		13,28		0,56		2,46	6,74
VSM-15	15,00	14,14		1,14		0,46		14,28		0,56		2,63	7,22
VSM-16	16,00	15,13		1,14		0,46		15,28		0,56		2,81	7,71
VSM-17	17,00	16,13		1,14		0,46		16,28		0,56		2,98	8,19
VSM-18	18,00	17,12		1,14		0,46		17,28		0,56		3,16	8,67
VSM-19	19,00	18,11		1,14		0,46		18,28		0,56		3,33	9,15
VSM-20	20,00	19,10		1,14		0,46		19,28	±0,08	0,56		3,51	9,63
VSM-21	21,00	19,74		1,65		0,53		19,94		0,66		5,42	11,65
VSM-22	22,00	20,73		1,65		0,53		20,94		0,66		5,68	12,21
VSM-24	24,00	22,72		1,65		0,53		22,94		0,66		6,20	13,32
VSM-25	25,00	23,71		1,65		0,53		23,94		0,66		6,46	13,87
VSM-26	26,00	24,63	+0,0/-0,38	2,24		0,64		24,88		0,79		7,10	15,14
VSM-28	28,00	26,62		2,24		0,64		26,88		0,79		7,64	16,30
VSM-29	29,00	27,61		2,24		0,64		27,88		0,79		7,91	16,88
VSM-30	30,00	28,59		2,24		0,64		28,88		0,79		8,19	17,47
VSM-32	32,00	30,57		2,24		0,64		30,88	±0,10	0,79		8,73	18,63
VSM-34	34,00	32,56		2,24		0,64		32,88		0,79		9,28	19,80
VSM-35	35,00	33,55		2,24		0,64		33,88		0,79		9,55	20,38
VSM-36	36,00	34,54		2,24		0,64		34,88		0,79		9,83	20,96
VSM-38	38,00	36,52		2,24		0,64		36,88		0,79		10,37	22,12
VSM-40	40,00	38,09	+0,0/-0,51	3,00		0,79	+/-0,05	38,52	±0,13	0,99	+0,08/-0,0	14,43	28,75
VSM-42	42,00	40,07		3,00		0,79		40,52		0,99		15,15	30,19
VSM-45	45,00	43,04		3,00		0,79		43,52		0,99		16,23	32,34
VSM-48	48,00	46,01		3,00		0,79		46,52		0,99		17,31	34,50
VSM-50	50,00	47,99		3,00		0,79		48,52		0,99		18,03	35,93
VSM-52	52,00	49,48	+0,0/-0,64	4,01		0,79		50,06	±0,15	0,99		24,58	37,37
VSM-55	55,00	52,46		4,01		0,79		53,06		0,99		26,00	39,53
VSM-56	56,00	53,44		4,01		0,79		54,06		0,99		26,47	40,25
VSM-58	58,00	55,42		4,01		0,79		56,06		0,99		27,42	41,68
VSM-60	60,00	57,40		4,01		0,79		58,06		0,99		28,36	43,12
VSM-62	62,00	59,37		4,01		0,79		60,06		0,99		29,31	44,56
VSM-63	63,00	60,35		4,01		0,79		61,06		0,99		29,78	45,28
VSM-65	65,00	62,33		4,01		0,79		63,06		0,99		30,73	46,72
VSM-68	68,00	65,31		4,01		0,79		66,06		0,99		32,15	48,87
VSM-70	70,00	67,29		4,01		0,79		68,06		0,99		33,09	50,31
VSM-72	72,00	69,27		4,01		0,79		70,06		0,99		34,04	51,75
VSM-75	75,00	72,25		4,01		0,79		73,06		0,99		35,45	53,90

[1] Add suffix "-S02" for 302 stainless steel. Add suffix "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number [1, 4]	Shaft Diameter	RING			GROOVE		THRUST CAPACITY	
		Inside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (kN)[2]	Ring Shear (kN)[3]
VSM-78	78,00	74,85	4,78	0,99	75,66	1,12	44,48	70,25
VSM-80	80,00	76,82	4,78	0,99	77,66	1,12	45,62	72,05
VSM-82	82,00	78,79	4,78	0,99	79,66	1,12	46,76	73,85
VSM-85	85,00	81,76	4,78	0,99	82,66	1,12	48,47	76,55
VSM-88	88,00	84,73	4,78	0,99	85,66	1,12	50,18	79,26
VSM-90	90,00	86,69	4,78	0,99	87,66	1,12	51,32	81,06
VSM-95	95,00	91,66	4,78	0,99	92,66	1,12	54,17	85,56
VSM-100	100,00	96,62	4,78	0,99	97,66	1,12	57,02	90,06
VSM-105	105,00	101,13	5,72	1,17	102,20	1,32	71,64	106,44
VSM-110	110,00	106,08	5,72	1,17	107,20	1,32	75,05	111,51
VSM-115	115,00	111,03	5,72	1,17	112,20	1,32	78,47	116,58
VSM-120	120,00	115,98	5,72	1,17	117,20	1,32	81,88	121,65
VSM-125	125,00	120,93	5,72	1,17	122,20	1,32	85,29	126,71
VSM-130	130,00	125,88	5,72	1,17	127,20	1,32	88,70	131,78
VSM-135	135,00	130,31	5,72	1,55	131,63	1,70	111,03	181,30
VSM-140	140,00	135,13	5,72	1,55	136,50	1,70	119,40	188,01
VSM-150	150,00	144,83	5,72	1,55	146,25	1,70	137,07	201,44
VSM-155	155,00	149,66	5,72	1,55	151,13	1,70	146,36	208,16
VSM-160	160,00	154,44	6,73	1,55	156,00	1,70	155,96	214,87
VSM-165	165,00	159,27	6,73	1,55	160,88	1,70	165,86	221,59
VSM-170	170,00	164,09	6,73	1,55	165,75	1,70	176,06	228,30
VSM-175	175,00	168,92	6,73	1,55	170,63	1,70	186,57	235,02
VSM-180	180,00	173,75	6,73	1,55	175,50	1,70	197,38	241,73
VSM-185	185,00	178,57	7,62	1,55	180,38	1,70	208,50	248,45
VSM-190	190,00	183,40	7,62	1,55	185,25	1,70	219,92	255,16
VSM-195	195,00	188,22	7,62	1,55	190,13	1,70	231,65	261,88
VSM-200	200,00	193,05	7,62	1,55	195,00	1,70	243,68	268,59
VSM-210	210,00	202,70	8,76	1,93	204,75	2,08	268,66	351,16
VSM-220	220,00	212,36	8,76	1,93	214,50	2,08	294,85	367,88
VSM-230	230,00	222,01	8,76	1,93	224,25	2,08	322,27	384,60
VSM-240	240,00	231,66	8,76	1,93	234,00	2,08	350,90	401,33
VSM-250	250,00	241,31	8,76	1,93	243,75	2,08	380,75	418,05
VSM-260	260,00	250,97	9,65	1,93	253,50	2,08	411,82	434,77
VSM-270	270,00	260,62	9,65	1,93	263,25	2,08	444,11	451,49
VSM-280	280,00	270,27	9,65	1,93	273,00	2,08	477,61	468,21
VSM-290	290,00	279,92	9,65	1,93	282,75	2,08	512,34	484,94
VSM-300	300,00	289,58	9,65	1,93	292,50	2,08	548,28	501,66

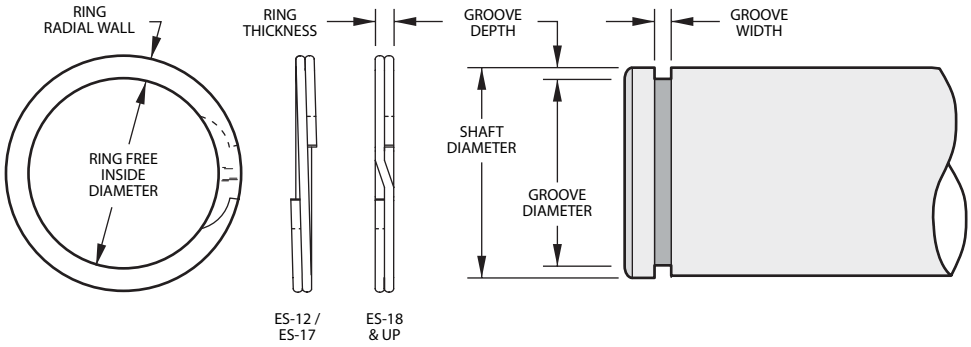
Inside Diameter	Radial Wall	Thickness	Diameter	Width
+0,0/-0,76	+/-0,13	+/-0,05	±0,05	+0,08/-0,0
+0,0/-0,89			±0,18	+0,10/-0,0
+0,0/-1,14				
+0,0/-1,52	+/-0,15		±0,20	+0,13/-0,0
+0,0/-1,78				

[1] Add suffix "S02" for 302 stainless steel. Add suffix "S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.



MA 4016

Product Dimensions
All dimensions are in millimeters unless otherwise specified.



Stock Items in carbon and stainless steel.

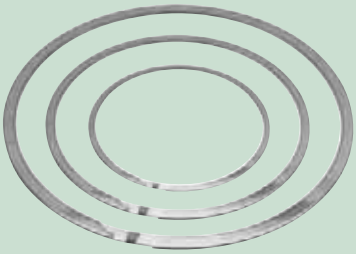
Smalley Part Number[1,4]	Shaft Diameter	RING			GROOVE		THRUST CAPACITY	
		Inside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (kN)[2]	Ring Shear (kN)[3]
ES-12	12,00	11,18	1,14	0,60	11,29	0,70	2,10	7,95
ES-13	13,00	12,13	1,27	0,89	12,24	1,00	2,41	12,10
ES-14	14,00	13,06	1,27	0,89	13,19	1,00	2,80	13,04
ES-15	15,00	13,98	1,27	0,89	14,09	1,00	3,36	13,97
ES-16	16,00	14,90	1,40	0,89	15,02	1,00	3,82	14,90
ES-17	17,00	15,82	1,40	0,89	16,02	1,00	4,06	15,83
ES-18	18,00	16,80	1,65	1,07	16,92	1,20	4,73	20,15
ES-19	19,00	17,73	1,65	1,07	17,87	1,20	5,27	21,27
ES-20	20,00	18,62	1,65	1,07	18,77	1,20	6,04	22,39
ES-21	21,00	19,57	1,65	1,07	19,72	1,20	6,55	23,51
ES-22	22,00	20,45	1,91	1,07	20,62	1,20	7,39	24,63
ES-23	23,00	21,39	1,91	1,07	21,57	1,20	8,07	25,75
ES-24	24,00	22,35	1,91	1,07	22,52	1,20	8,65	26,87
ES-25	25,00	23,25	2,16	1,07	23,42	1,20	9,62	27,99
ES-26	26,00	24,21	2,16	1,07	24,42	1,20	10,00	29,11
ES-27	27,00	25,04	2,64	1,27	25,35	1,40	10,91	31,17
ES-28	28,00	26,00	2,64	1,27	26,30	1,40	11,59	32,33
ES-29	29,00	26,95	2,64	1,27	27,27	1,40	12,29	33,48
ES-30	30,00	27,92	2,64	1,27	28,25	1,40	12,86	34,64
ES-31	31,00	28,84	2,64	1,27	29,17	1,40	13,89	35,79
ES-32	32,00	29,77	2,64	1,27	30,09	1,40	14,96	36,95
ES-34	34,00	31,54	3,00	1,27	31,90	1,40	17,39	39,26
ES-35	35,00	32,44	3,00	1,27	32,80	1,40	18,75	40,41
ES-36	36,00	33,40	3,00	1,27	33,75	1,40	19,81	41,56
ES-37	37,00	34,24	3,00	1,27	34,67	1,40	21,08	42,72
ES-38	38,00	35,18	3,00	1,27	35,66	1,40	21,65	43,87
ES-40	40,00	37,15	3,25	1,57	37,55	1,75	23,96	57,09
ES-42	42,00	39,02	3,25	1,57	39,45	1,75	26,18	59,99
ES-45	45,00	41,77	3,25	1,57	42,25	1,75	30,24	64,23
ES-46	46,00	42,67	3,25	1,57	43,15	1,75	32,04	65,66
ES-47	47,00	43,81	4,01	1,57	44,31	1,75	30,90	67,08
ES-48	48,00	44,48	4,01	1,57	45,05	1,75	34,60	68,51
ES-50	50,00	46,69	4,01	1,57	47,05	1,75	36,04	71,37
ES-52	52,00	49,62	3,25	1,25	50,15	1,42	23,55	59,09
ES-53	53,00	50,62	3,25	1,25	51,15	1,42	24,00	60,23
ES-54	54,00	51,62	3,25	1,25	52,15	1,42	24,46	61,37
ES-55	55,00	52,62	3,51	1,25	53,15	1,42	24,91	62,50
ES-56	56,00	53,62	3,51	1,25	54,15	1,42	25,37	63,64
ES-58	58,00	55,43	3,51	1,25	56,01	1,42	28,25	65,91
ES-59	59,00	56,43	3,51	1,25	57,01	1,42	28,73	67,05
ES-60	60,00	57,43	3,51	1,25	58,01	1,42	29,22	68,18
ES-61	61,00	58,36	3,51	1,25	58,91	1,42	31,19	69,32
ES-62	62,00	59,30	3,76	1,25	59,91	1,42	31,71	70,46
ES-63	63,00	60,30	3,76	1,25	60,91	1,42	32,22	71,59
ES-64	64,00	61,25	3,76	1,25	61,91	1,42	32,73	72,73
ES-65	65,00	62,20	3,76	1,25	62,81	1,42	34,82	73,87
ES-66	66,00	63,16	3,76	1,25	63,79	1,42	35,68	75,00

Inside Diameter: +0,0/-0,33 (ES-12 to ES-31); +0,0/-0,51 (ES-32 to ES-50); +0,0/-0,63 (ES-52 to ES-66)
Radial Wall: ±0,10
Thickness: ±0,05 (ES-12 to ES-31); ±0,075 (ES-32 to ES-50); ±0,08 (ES-52 to ES-66)
Diameter: ±0,06 (ES-12 to ES-15); ±0,075 (ES-16 to ES-25); ±0,10 (ES-26 to ES-36); ±0,15 (ES-37 to ES-66)
Width: +0,08/-0,0 (ES-12 to ES-25); +0,10/-0,0 (ES-26 to ES-66)

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

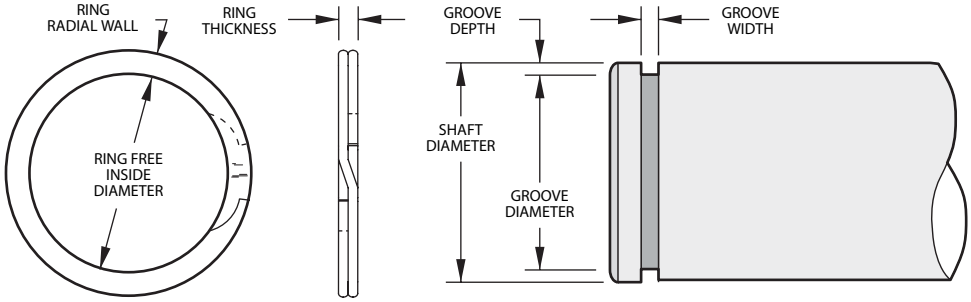
Smalley Part Number [1, 4]	Shaft Diameter	RING			GROOVE		THRUST CAPACITY	
		Inside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (kN) [2]	Ring Shear (kN) [3]
ES-67	67,00	64,16 +0,0/-0,63	3,76 ±0,10	1,25 ±0,08	64,71 ±0,15	1,42 +0,10/-0,0	37,53	76,14
ES-68	68,00	65,08	4,01	1,25	65,71	1,42	38,09	77,27
ES-69	69,00	66,06 +0,0/-0,76	4,01	1,25	66,71	1,42	38,65	78,41
ES-70	70,00	67,08	4,01	1,25	67,71	1,42	39,21	79,55
ES-71	71,00	68,04	4,01	1,25	68,71	1,42	39,77	80,68
ES-72	72,00	69,00	4,27 ±0,13	1,25	69,65	1,42	41,38	81,82
ES-75	75,00	71,93	4,27	1,25	72,61	1,42	43,83	85,23
ES-78	78,00	74,84	4,27	1,55	75,55	1,73	46,73	109,91
ES-80	80,00	76,80	4,52	1,55	77,51	1,73	48,70	112,73
ES-82	82,00	78,72	4,52	1,55	79,45	1,73	51,12	115,55
ES-85	85,00	81,62	4,78	1,55	82,35	1,73	55,06	119,78
ES-88	88,00	84,53	4,78	1,55	85,31	1,73	57,86	124,00
ES-90	90,00	86,43	5,03	1,55	87,21	1,73	61,37	126,82
ES-95	95,00	91,37	5,03	1,55	92,15	1,73	66,16	133,87
ES-100	100,00	96,10	5,28	1,55	97,01	1,73	73,05	140,91
ES-105	105,00	100,94 +0,0/-1,0	5,54	1,55	101,85	1,73 +0,13/-0,0	80,78	147,96
ES-110	110,00	105,75	5,79	1,55	106,69	1,73	88,93	155,00
ES-115	115,00	110,59	6,05	1,55	111,55	1,73	96,89	162,05
ES-120	120,00	115,49	6,35	1,83	116,45	2,00	104,03	199,64
ES-125	125,00	120,44	6,35	1,83	121,45	2,00	108,36	207,96
ES-130	130,00	125,34	6,35	1,83	126,35	2,00	115,86	216,28
ES-135	135,00	130,20 +0,0/-1,30	6,35	1,83	131,27	2,00	122,95	224,60
ES-140	140,00	135,14	6,35	1,83	136,25	2,00	128,19	232,92
ES-145	145,00	140,00	6,35	1,83	141,17	2,00	135,59	241,23
ES-150	150,00	145,00	6,35	1,83	146,17	2,00	140,26	249,55
ES-155	155,00	149,33	7,92 ±0,15	2,18 ±0,10	150,60 ±0,175	2,40 +0,15/-0,0	166,08	307,19
ES-160	160,00	154,31	7,92	2,18	155,60	2,40	171,43	317,10
ES-165	165,00	159,23	7,92	2,18	160,60	2,40	176,79	327,01
ES-170	170,00	164,00	7,92	2,18	165,40	2,40	190,43	336,92
ES-175	175,00	169,00	7,92	2,18	170,40	2,40	196,03	346,83
ES-180	180,00	173,78 +0,0/-1,52	7,92	2,18	175,20	2,40	210,40	356,74
ES-185	185,00	178,70	7,92	2,18	180,20	2,40	216,24	366,65
ES-190	190,00	183,70	7,92	2,18	185,20	2,40	220,08	376,56
ES-195	195,00	188,43	7,92	2,18	190,00	2,40	237,42	386,46
ES-200	200,00	193,43	7,92	2,18	195,00	2,40	243,51	396,37
ES-210	210,00	202,93	9,53	2,18	204,60	2,40	276,14	416,19
ES-220	220,00	212,65	9,53	2,18	214,40	2,40	300,01	436,01
ES-230	230,00	222,60	9,53	2,18	224,40	2,40	313,64	455,83
ES-240	240,00	232,32 +0,0/-1,78	9,53	2,18	234,20	2,40	328,97	475,65
ES-250	250,00	241,83	9,53	2,18	243,80	2,40	377,44	495,47
ES-260	260,00	251,57	9,53	2,18	253,60	2,40	405,21	515,29
ES-270	270,00	261,30	9,53	2,18	263,40	2,40	433,94	535,10
ES-280	280,00	271,04	9,53	2,18	273,20	2,40	463,65	554,92

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.



European Specification
Incorporating DIN 471

Product Dimensions
All dimensions are in millimeters unless otherwise specified.



Stock Items in carbon and stainless steel.

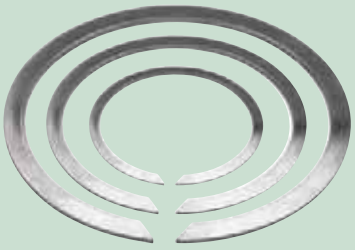
Smalley Part Number[1,4]	Shaft Diameter	RING			GROOVE		THRUST CAPACITY	
		Inside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (kN)[2]	Ring Shear (kN)[3]
DNS-13	13,00	12,27	1,40	0,99	12,40	1,10	1,90	13,47
DNS-14	14,00	13,26	1,40	0,99	13,40	1,10	2,05	14,51
DNS-15	15,00	14,15	1,40	0,99	14,30	1,10	2,56	15,55
DNS-16	16,00	15,04	1,65	0,99	15,20	1,10	3,12	16,58
DNS-17	17,00	16,04	1,65	0,99	16,20	1,10	3,31	17,62
DNS-18	18,00	16,83	1,91	1,14	17,00	1,30	4,39	18,67
DNS-19	19,00	17,83	1,91	1,14	18,00	1,30	4,63	19,71
DNS-20	20,00	18,82	1,91	1,14	19,00	1,30	4,87	20,74
DNS-21	21,00	19,79	1,91	1,14	20,00	1,30	5,12	21,78
DNS-22	22,00	20,78	1,91	1,14	21,00	1,30	5,36	22,82
DNS-23	23,00	21,77	1,91	1,14	22,00	1,30	5,61	23,85
DNS-24	24,00	22,66	2,18	1,14	22,90	1,30	6,43	24,89
DNS-25	25,00	23,65	2,18	1,14	23,90	1,30	6,70	25,93
DNS-26	26,00	24,64	2,18	1,14	24,90	1,30	6,97	26,97
DNS-27	27,00	25,34	2,18	1,14	25,60	1,30	9,21	28,00
DNS-28	28,00	26,34	2,39	1,44	26,60	1,60	9,55	36,68
DNS-29	29,00	27,33	2,39	1,44	27,60	1,60	9,89	37,99
DNS-30	30,00	28,32	2,39	1,44	28,60	1,60	10,24	39,30
DNS-32	32,00	30,00	3,25	1,44	30,30	1,60	13,26	41,92
DNS-33	33,00	30,99	3,25	1,44	31,30	1,60	13,67	43,23
DNS-34	34,00	31,98	3,25	1,44	32,30	1,60	14,09	44,54
DNS-35	35,00	32,66	3,25	1,44	33,00	1,60	17,06	45,85
DNS-36	36,00	33,65	4,01	1,69	34,00	1,85	17,55	55,35
DNS-38	38,00	35,64	4,01	1,69	36,00	1,85	18,52	58,42
DNS-40	40,00	37,11	4,01	1,69	37,50	1,85	24,37	61,50
DNS-42	42,00	39,09	4,01	1,69	39,50	1,85	25,59	64,57
DNS-45	45,00	42,06	4,01	1,69	42,50	1,85	27,41	69,19
DNS-46	46,00	43,05	4,01	1,69	43,50	1,85	28,02	70,72
DNS-47	47,00	44,04	4,01	1,69	44,50	1,85	28,63	72,26
DNS-48	48,00	45,03	4,01	1,69	45,50	1,85	29,24	73,80
DNS-50	50,00	46,53	5,08	1,93	47,00	2,15	36,55	87,79
DNS-52	52,00	48,51	5,08	1,93	49,00	2,15	38,01	91,30
DNS-54	54,00	50,50	5,08	1,93	51,00	2,15	39,48	94,81
DNS-55	55,00	51,49	5,08	1,93	52,00	2,15	40,21	96,57
DNS-56	56,00	52,48	5,08	1,93	53,00	2,15	40,94	98,33
DNS-58	58,00	54,43	5,08	1,93	55,00	2,15	42,40	101,84
DNS-60	60,00	56,42	5,08	1,93	57,00	2,15	43,86	105,35
DNS-62	62,00	58,42	5,08	1,93	59,00	2,15	45,33	108,86
DNS-63	63,00	59,39	5,08	1,93	60,00	2,15	46,06	110,62
DNS-65	65,00	61,39	5,08	2,41	62,00	2,65	47,52	135,73
DNS-67	67,00	63,37	5,08	2,41	64,00	2,65	48,98	139,90
DNS-68	68,00	64,34	5,08	2,41	65,00	2,65	49,71	141,99
DNS-70	70,00	66,34	5,08	2,41	67,00	2,65	51,17	146,17
DNS-72	72,00	68,33	5,08	2,41	69,00	2,65	52,64	150,34
DNS-75	75,00	71,33	5,08	2,41	72,00	2,65	54,83	156,61
DNS-77	77,00	73,33	5,08	2,41	74,00	2,65	56,29	160,78
DNS-78	78,00	74,33	5,08	2,41	75,00	2,65	57,02	162,87

Inside Diameter: +0,0/-0,33 (DNS-13 through DNS-38); +0,0/-0,51 (DNS-40 through DNS-78)
Radial Wall: ±0,10 (DNS-13 through DNS-48); ±0,12 (DNS-50 through DNS-78)
Thickness: ±0,05 (DNS-13 through DNS-48); ±0,08 (DNS-50 through DNS-78)
Diameter: +0,0/-0,11 (DNS-13 through DNS-19); +0,0/-0,25 (DNS-20 through DNS-78)
Width: +0,14/-0,0 (DNS-13 through DNS-78)

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

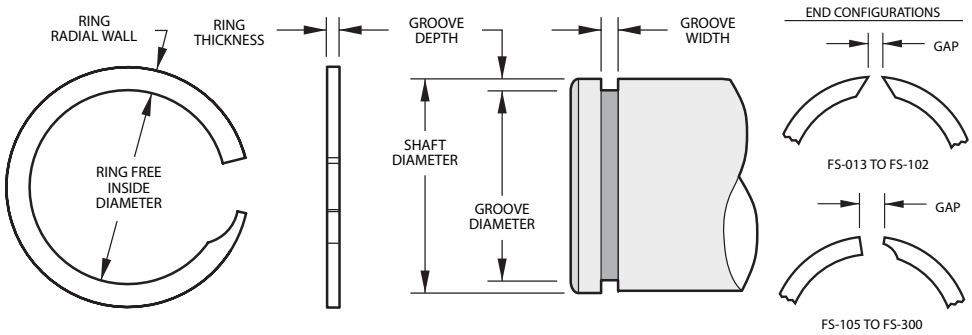
Smalley Part Number [1, 4]	Shaft Diameter	RING					GROOVE				THRUST CAPACITY	
		Inside Diameter		Radial Wall		Thickness	Diameter		Width		Groove Yield (kN) [2]	Ring Shear (kN) [3]
DNS-80	80,00	75,81	+0,0/-0,76	6,05	±0,13	2,41	76,50	+0,0/-0,30	2,65	+0,14/-0,0	68,23	167,05
DNS-82	82,00	77,81		6,05		2,41	78,50		2,65		69,94	171,22
DNS-85	85,00	80,80		6,35		2,91	81,50		3,15		72,50	214,31
DNS-88	88,00	83,80	+0,0/-0,89	6,35		2,91	84,50	+0,0/-0,35	3,15		75,05	221,87
DNS-90	90,00	85,80		6,35		2,91	86,50		3,15		76,76	226,92
DNS-95	95,00	90,80		6,35		2,91	91,50		3,15		81,02	239,52
DNS-98	98,00	93,79		6,35		2,91	94,50		3,15		83,58	247,09
DNS-100	100,00	95,79		6,35		2,91	96,50		3,15		85,29	252,13
DNS-102	102,00	97,29	+0,0/-1,30	6,73		3,89	98,00	+0,0/-0,54	4,15		99,42	343,78
DNS-105	105,00	100,28		6,73		3,89	101,00		4,15		102,35	353,89
DNS-108	108,00	103,25		6,73		3,89	104,00		4,15		105,27	364,00
DNS-110	110,00	105,23		6,73		3,89	106,00		4,15		107,22	370,74
DNS-115	115,00	110,19		6,73		3,89	111,00		4,15		112,09	387,59
DNS-120	120,00	115,16		6,73		3,89	116,00		4,15		116,97	404,45
DNS-125	125,00	120,12		6,73		3,89	121,00		4,15		121,84	421,30
DNS-130	130,00	125,07		6,73		3,89	126,00		4,15		126,71	438,15
DNS-135	135,00	130,02		6,73		3,89	131,00		4,15		131,59	455,00
DNS-140	140,00	134,98		6,73		3,89	136,00		4,15		136,46	471,85
DNS-145	145,00	139,93		6,73		3,89	141,00		4,15		141,34	488,70
DNS-150	150,00	143,91	+0,0/-1,52	7,92	±0,15	3,89	145,00	+0,0/-0,63	4,15	+0,18/-0,0	182,76	505,56
DNS-155	155,00	148,89		7,92		3,89	150,00		4,15		188,85	522,41
DNS-160	160,00	153,85		7,92		3,89	155,00		4,15		194,95	539,26
DNS-165	165,00	158,80		7,92		3,89	160,00		4,15		201,04	556,11
DNS-170	170,00	163,75		7,92		3,89	165,00		4,15		207,13	572,96
DNS-175	175,00	168,73		7,92		3,89	170,00		4,15		213,22	589,82
DNS-180	180,00	173,69		7,92		3,89	175,00		4,15		219,31	606,67
DNS-185	185,00	178,66	+0,0/-1,78	7,92		3,89	180,00		4,15		225,41	623,52
DNS-190	190,00	183,59		7,92		3,89	185,00	+0,0/-0,72	4,15		231,50	640,37
DNS-195	195,00	188,54		7,92		3,89	190,00		4,15		237,59	657,22
DNS-200	200,00	193,54		7,92		3,89	195,00		4,15		243,68	674,08
DNS-205	205,00	197,54		11,18		4,86	199,00		5,15		299,73	863,21
DNS-210	210,00	202,54		11,18		4,86	204,00		5,15		307,04	884,27
DNS-220	220,00	212,47		11,18		4,86	214,00		5,15		321,66	926,38
DNS-230	230,00	222,40		11,18		4,86	224,00		5,15		336,28	968,48
DNS-240	240,00	232,33		11,18		4,86	234,00		5,15		350,90	1 010,59
DNS-250	250,00	242,24	+0,0/-2,30	11,18		4,86	244,00		5,15		365,52	1 052,70
DNS-260	260,00	250,19		12,70	±0,19	4,86	252,00	+0,0/-0,81	5,15		506,86	1 094,81
DNS-270	270,00	260,15		12,70		4,86	262,00		5,15		526,35	1 136,92
DNS-280	280,00	270,08		12,70		4,86	272,00		5,15		545,85	1 179,02
DNS-290	290,00	279,98		12,70		4,86	282,00		5,15		565,34	1 221,13
DNS-300	300,00	289,92		12,70		4,86	292,00		5,15		584,83	1 263,24
DNS-310	310,00	297,84	+0,0/-2,80	15,88		5,87	300,00		6,20		755,41	1 576,63
DNS-320	320,00	307,84		15,88		5,87	310,00		6,20		779,78	1 627,48
DNS-330	330,00	317,75		15,88		5,87	320,00		6,20		804,15	1 678,34
DNS-340	340,00	327,69		15,88		5,87	330,00		6,20		828,52	1 729,20
DNS-350	350,00	337,64		15,88		5,87	340,00	+0,0/-0,89	6,20	+0,22/-0,0	852,88	1,780,06
DNS-360	360,00	347,57		15,88		5,87	350,00		6,20		877,25	1 830,92
DNS-370	370,00	357,48		15,88		5,87	360,00		6,20		901,62	1 881,78
DNS-380	380,00	367,41		15,88		5,87	370,00		6,20		925,99	1 932,64
DNS-390	390,00	377,34		15,88		5,87	380,00		6,20		950,36	1 983,50
DNS-400	400,00	387,25		15,88		5,87	390,00		6,20		974,72	2 034,35

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.



Groove Compatible with DIN 471

Product Dimensions
All dimensions are in millimeters unless otherwise specified.



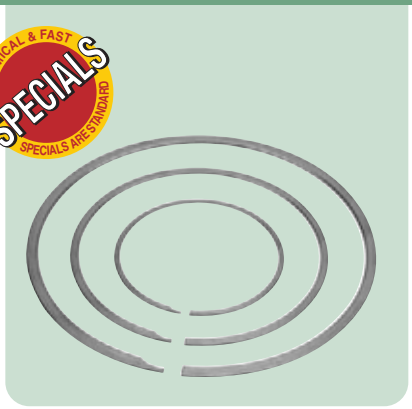
Stock Items in carbon and stainless steel.

Smalley Part Number[1,4]	Shaft Diameter	RING			GROOVE		THRUST CAPACITY	
		Inside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (kN)[2]	Ring Shear (kN)[3]
FS-013	13,00	12,27	1,40	0,94	12,40	1,10	1,93	10,59
FS-014	14,00	13,31	1,40	0,94	13,40	1,10	2,08	11,40
FS-015	15,00	14,15	1,40	0,94	14,30	1,10	2,60	12,22
FS-016	16,00	14,98	1,65	0,94	15,20	1,10	3,17	13,03
FS-017	17,00	16,06	1,65	0,94	16,20	1,10	3,37	13,84
FS-018	18,00	16,82	1,90	1,15	17,00	1,30	4,46	17,95
FS-019	19,00	17,81	1,90	1,15	18,00	1,30	4,70	18,94
FS-020	20,00	18,80	1,90	1,15	19,00	1,30	4,95	19,93
FS-021	21,00	19,79	1,90	1,15	20,00	1,30	5,20	20,94
FS-022	22,00	20,83	1,90	1,15	21,00	1,30	5,45	21,93
FS-023	23,00	21,77	1,90	1,15	22,00	1,30	5,70	22,94
FS-024	24,00	22,50	2,15	1,15	22,90	1,30	6,54	23,93
FS-025	25,00	23,70	2,15	1,15	23,90	1,30	6,81	24,91
FS-026	26,00	24,64	2,15	1,15	24,90	1,30	7,08	25,93
FS-027	27,00	25,50	2,15	1,15	25,90	1,30	7,35	26,92
FS-028	28,00	26,32	3,25	1,44	26,60	1,60	9,70	33,18
FS-029	29,00	27,15	3,25	1,44	27,60	1,60	10,05	34,39
FS-030	30,00	28,35	3,25	1,44	28,60	1,60	10,40	35,56
FS-032	32,00	29,87	3,25	1,44	30,30	1,60	13,07	37,94
FS-033	33,00	31,07	3,25	1,44	31,30	1,60	13,48	39,11
FS-034	34,00	31,96	3,25	1,44	32,30	1,60	13,89	40,32
FS-035	35,00	32,57	3,25	1,44	33,00	1,60	16,90	41,49
FS-036	36,00	33,64	4,01	1,69	34,00	1,85	17,38	50,04
FS-038	38,00	35,62	4,01	1,69	36,00	1,85	18,34	52,83
FS-040	40,00	37,02	4,01	1,69	37,50	1,85	24,27	55,62
FS-042	42,00	39,08	4,01	1,69	39,50	1,85	25,48	58,41
FS-045	45,00	42,05	4,01	1,69	42,50	1,85	27,30	62,58
FS-046	46,00	43,10	4,01	1,69	43,50	1,85	27,90	63,95
FS-047	47,00	44,03	4,01	1,69	44,50	1,85	28,50	65,33
FS-048	48,00	44,89	4,01	1,69	45,50	1,85	29,12	66,74
FS-050	50,00	46,50	5,08	1,93	47,00	2,15	36,53	75,28
FS-052	52,00	48,48	5,08	1,93	49,00	2,15	37,97	78,27
FS-054	54,00	50,46	5,08	1,93	51,00	2,15	39,44	81,29
FS-055	55,00	51,45	5,08	1,93	52,00	2,15	40,16	82,78
FS-056	56,00	52,44	5,08	1,93	53,00	2,15	40,91	84,31
FS-058	58,00	54,42	5,08	1,93	55,00	2,15	42,35	87,29
FS-060	60,00	56,55	5,08	1,93	57,00	2,15	43,82	90,31
FS-062	62,00	58,32	5,08	1,93	59,00	2,15	45,28	93,33
FS-063	63,00	59,37	5,08	1,93	60,00	2,15	46,01	94,82
FS-065	65,00	61,35	5,08	2,41	62,00	2,65	47,47	116,64
FS-067	67,00	63,35	5,08	2,41	64,00	2,65	48,94	120,24
FS-068	68,00	64,45	5,08	2,41	65,00	2,65	49,66	122,02
FS-070	70,00	66,22	5,08	2,41	67,00	2,65	51,13	125,62
FS-072	72,00	68,28	5,08	2,41	69,00	2,65	52,59	129,22
FS-075	75,00	71,25	5,08	2,41	72,00	2,65	54,78	134,60
FS-077	77,00	73,23	5,08	2,41	74,00	2,65	56,23	138,15
FS-078	78,00	74,06	5,08	2,41	75,00	2,65	56,97	139,98

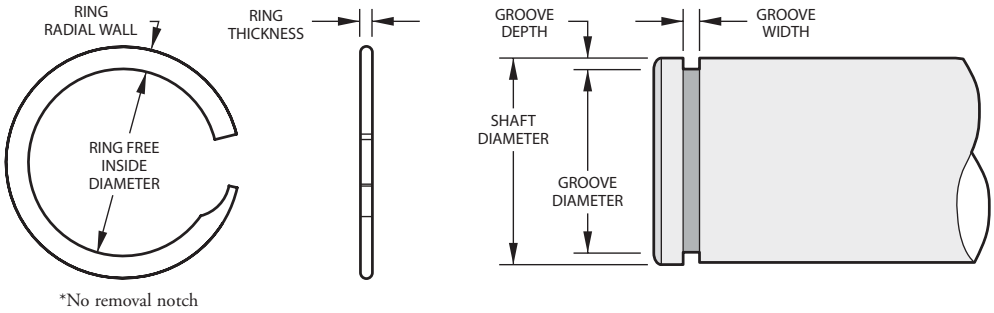
[1] Add suffix "-S02" for 302 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number [1, 4]	Shaft Diameter	RING						GROOVE				THRUST CAPACITY	
		Inside Diameter		Radial Wall		Thickness		Diameter		Width		Groove Yield (kN) [2]	Ring Shear (kN) [3]
FS-080	80,00	75,70	+0,0/-0,76	6,02	±0,13	2,41	±0,08	76,50	+0,0/-0,30	2,65	+0,14/-0,0	68,34	143,58
FS-082	82,00	77,68		6,02		2,41		78,50		2,65		70,03	147,13
FS-085	85,00	80,65		6,30		2,91		81,50	+0,0/-0,35	3,15		72,56	175,66
FS-088	88,00	83,60	+0,0/-0,89	6,30		2,91		84,50		3,15		75,18	181,91
FS-090	90,00	85,80		6,30		2,91		86,50		3,15		76,87	186,00
FS-095	95,00	90,68		6,30		2,91		91,50		3,15		81,14	196,34
FS-098	98,00	93,70		6,30		2,91		94,50		3,15		83,70	202,54
FS-100	100,00	95,50		6,30		2,91		96,50		3,15		85,42	206,68
FS-102	102,00	97,23	+0,0/-1,30	6,30		2,91		98,50	+0,0/-0,54	3,15		87,13	210,83
FS-105	105,00	99,83		6,73		3,89	±0,10	101,00		4,15		102,69	276,95
FS-108	108,00	102,87		6,73		3,89		104,00		4,15		105,62	284,86
FS-110	110,00	104,90		6,73		3,89		106,00		4,15		107,58	290,15
FS-115	115,00	109,85		6,73		3,89		111,00		4,15		112,47	303,35
FS-120	120,00	115,06		6,73		3,89		116,00		4,15		117,34	316,48
FS-125	125,00	119,75		6,73		3,89		121,00	+0,0/-0,63	4,15	+0,18/-0,0	122,24	329,68
FS-130	130,00	124,70		6,73		3,89		126,00		4,15		127,13	342,87
FS-135	135,00	129,65		6,73		3,89		131,00		4,15		132,02	356,07
FS-140	140,00	134,42		6,73		3,89		136,00		4,15		136,92	369,27
FS-145	145,00	139,55		6,73		3,89		141,00		4,15		141,81	382,47
FS-150	150,00	143,50	+0,0/-1,52	8,03	±0,15	3,89		145,00		4,15		181,99	395,67
FS-155	155,00	148,45		8,03		3,89		150,00		4,15		188,03	408,80
FS-160	160,00	153,40		8,03		3,89		155,00		4,15		194,09	421,99
FS-165	165,00	158,40		8,03		3,89		160,00		4,15		200,17	435,19
FS-170	170,00	163,30		8,03		3,89		165,00		4,15		206,24	448,68
FS-175	175,00	168,25		8,03		3,89		170,00		4,15		212,31	461,89
FS-180	180,00	173,20		8,03		3,89		175,00		4,15		218,38	475,10
FS-185	185,00	177,62	+0,0/-1,78	8,03		3,89		180,00		4,15		224,42	488,23
FS-190	190,00	183,35		8,03		3,89		185,00	+0,0/-0,72	4,15		230,49	501,44
FS-195	195,00	188,05		8,03		3,89		190,00		4,15		236,56	514,65
FS-200	200,00	193,00		8,03		3,89		195,00		4,15		242,63	527,85
FS-205	205,00	196,95		11,05	±0,18	4,87	±0,13	199,00		5,15		299,45	641,44
FS-210	210,00	201,67		11,05		4,87		204,00		5,15		306,76	657,10
FS-220	220,00	211,80		11,05		4,87		214,00		5,15		321,34	688,33
FS-230	230,00	221,70		11,05		4,87		224,00		5,15		335,96	719,64
FS-240	240,00	231,89		11,05		4,87		234,00		5,15		350,58	750,95
FS-250	250,00	241,50	+0,0/-2,30	11,05		4,87		244,00	+0,0/-0,81	5,15		365,20	782,26
FS-260	260,00	249,59		12,70		4,87		252,00		5,15		505,30	813,50
FS-270	270,00	259,30		12,70		4,87		262,00		5,15		524,75	844,81
FS-280	280,00	268,83		12,70		4,87		272,00		5,15		544,20	876,13
FS-290	290,00	279,10		12,70		4,87		282,00		5,15		563,60	907,36
FS-300	300,00	289,00		12,70		4,87		292,00		5,15		583,05	938,67

[1] Add suffix "-S02" for 302 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.



Product Dimensions
All dimensions are in inches unless otherwise specified.



*No removal notch

Stock Items available in carbon and stainless steel.

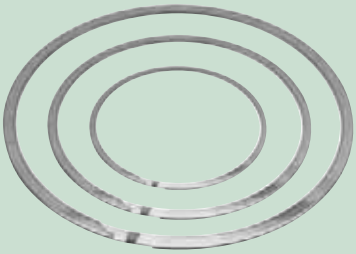
Smalley Part Number[1, 4]	Shaft Diameter	RING					GROOVE				THRUST CAPACITY	
		Inside Diameter		Radial Wall		Thickness	Diameter		Width		Groove Yield (lb)[2]	Ring Shear (lb)[3]
VS-25*	0,250	0,236	+0,0/-0,010	0,020	±0,004	0,012	0,238	±0,002	0,015	+0,002/-0,0	106	481
VS-31*	0,312	0,294		0,025		0,015	0,297		0,018		165	750
VS-37*	0,375	0,348		0,025		0,015	0,351		0,018		318	901
VS-43	0,437	0,410	+0,000/-0,012	0,035		0,015	0,413		0,018		371	1 050
VS-50	0,500	0,467	+0,0/-0,013	0,045		0,018	0,472		0,022		500	1 300
VS-56	0,562	0,529		0,045		0,018	0,534		0,022		560	1 460
VS-62	0,625	0,591		0,045		0,018	0,597		0,022		620	1 630
VS-68	0,687	0,652		0,045		0,018	0,659		0,022		680	1 790
VS-75	0,750	0,715		0,045		0,018	0,722		0,022		740	1 950
VS-81	0,812	0,762		0,065		0,021	0,770	±0,003	0,026		1 210	2 460
VS-87	0,875	0,825		0,065		0,021	0,833		0,026		1 300	2 660
VS-93	0,937	0,886		0,065		0,021	0,895		0,026		1 390	2 840
VS-100	1,000	0,949		0,065		0,021	0,958		0,026		1 480	3 040
VS-106	1,062	1,008	+0,0/-0,015	0,088		0,025	1,018	±0,004	0,031		1 650	3 500
VS-112	1,125	1,071		0,088		0,025	1,081		0,031		1 750	3 710
VS-118	1,187	1,132		0,088		0,025	1,143		0,031		1 850	3 920
VS-125	1,250	1,194		0,088		0,025	1,206		0,031		1 940	4 120
VS-131	1,312	1,255		0,088		0,025	1,268		0,031		2 040	4 330
VS-137	1,375	1,318		0,088		0,025	1,331		0,031		2 140	4 540
VS-143	1,437	1,379		0,088		0,025	1,393		0,031		2 240	4 740
VS-150	1,500	1,442		0,088		0,025	1,456		0,031		2 330	4 950
VS-156	1,562	1,488	+0,0/-0,020	0,118		0,031	1,505	±0,005	0,039		3 200	6 390
VS-162	1,625	1,550		0,118		0,031	1,568		0,039		3 330	6 650
VS-168	1,687	1,612		0,118		0,031	1,630		0,039		3 460	6 900
VS-175	1,750	1,674		0,118		0,031	1,693		0,039		3 590	7 160
VS-181	1,812	1,736		0,118		0,031	1,755		0,039		3 710	7 410
VS-187	1,875	1,798		0,118		0,031	1,818		0,039		3 840	7 670
VS-193	1,937	1,859		0,118		0,031	1,880		0,039		3 970	7 920
VS-200	2,000	1,922		0,118		0,031	1,943		0,039		4 100	8 180
VS-206	2,062	1,963	+0,0/-0,025	0,158		0,031	1,986	±0,006	0,039	+0,003/-0,0	5 540	8 430
VS-212	2,125	2,026		0,158		0,031	2,049		0,039		5 710	8 690
VS-218	2,187	2,087		0,158		0,031	2,111		0,039		5 870	8 950
VS-225	2,250	2,149		0,158		0,031	2,174		0,039		6 040	9 200
VS-231	2,312	2,211		0,158		0,031	2,236		0,039		6 210	9 460
VS-237	2,375	2,273		0,158		0,031	2,299		0,039		6 380	9 720
VS-243	2,437	2,335		0,158		0,031	2,361		0,039		6 550	9 970
VS-250	2,500	2,397		0,158		0,031	2,424		0,039		6 720	10 230
VS-256	2,562	2,458		0,158		0,031	2,486		0,039		6 880	10 480
VS-262	2,625	2,521		0,158		0,031	2,549		0,039		7 050	10 740
VS-268	2,687	2,582		0,158		0,031	2,611		0,039		7 220	10 990
VS-275	2,750	2,644		0,158		0,031	2,674		0,039		7 390	11 250
VS-281	2,812	2,706		0,158		0,031	2,736		0,039		7 550	11 500
VS-287	2,875	2,768		0,158		0,031	2,799		0,039		7 720	11 760
VS-293	2,937	2,830		0,158		0,031	2,861		0,039		7 890	12 010
VS-300	3,000	2,892		0,158		0,031	2,924		0,039		8 060	12 270
VS-306	3,062	2,938	+0,0/-0,030	0,188	±0,005	0,039	2,970		0,044		9 960	15 760
VS-312	3,125	3,001		0,188		0,039	3,033		0,044		10 160	16 080

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number [1, 4]	Shaft Diameter	RING			GROOVE		THRUST CAPACITY	
		Inside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (lb) [2]	Ring Shear (lb) [3]
VS-318	3,187	3,062	0,188	0,039	3,095	0,044	10 360	16 400
VS-325	3,250	3,125	0,188	0,039	3,158	0,044	10 570	16 720
VS-331	3,312	3,186	0,188	0,039	3,220	0,044	10 770	17 040
VS-337	3,375	3,248	0,188	0,039	3,283	0,044	10 970	17 370
VS-343	3,437	3,310	0,188	0,039	3,345	0,044	11 180	17 690
VS-350	3,500	3,372	0,188	0,039	3,408	0,044	11 380	18 010
VS-356	3,562	3,433	0,188	0,039	3,470	0,044	11 580	18 330
VS-362	3,625	3,496	0,188	0,039	3,533	0,044	11 790	18 650
VS-368	3,687	3,557	0,188	0,039	3,595	0,044	11 990	18 970
VS-375	3,750	3,620	0,188	0,039	3,658	0,044	12 190	19 300
VS-381	3,812	3,681	0,188	0,039	3,720	0,044	12 400	19 620
VS-387	3,875	3,743	0,188	0,039	3,783	0,044	12 600	19 940
VS-393	3,937	3,805	0,188	0,039	3,845	0,044	12 800	20 260
VS-400	4,000	3,867	0,188	0,039	3,908	0,044	13 010	20 580
VS-412	4,125	3,973	0,225	0,046	4,015	0,052	16 040	23 850
VS-425	4,250	4,097	0,225	0,046	4,140	0,052	16 520	24 570
VS-437	4,375	4,221	0,225	0,046	4,265	0,052	17 010	25 290
VS-450	4,500	4,345	0,225	0,046	4,390	0,052	17 500	26 010
VS-462	4,625	4,468	0,225	0,046	4,515	0,052	17 980	26 740
VS-475	4,750	4,592	0,225	0,046	4,640	0,052	18 470	27 460
VS-487	4,875	4,715	0,225	0,046	4,765	0,052	18 950	28 180
VS-500	5,000	4,839	0,225	0,046	4,890	0,052	19 440	28 900
VS-525	5,250	5,067	0,225	0,061	5,119	0,067	24 490	40 240
VS-550	5,500	5,309	0,225	0,061	5,363	0,067	26 830	42 160
VS-575	5,750	5,550	0,225	0,061	5,606	0,067	29 260	44 080
VS-600	6,000	5,792	0,225	0,061	5,850	0,067	31 810	45 990
VS-625	6,250	6,033	0,265	0,061	6,094	0,067	34 460	47 910
VS-650	6,500	6,275	0,265	0,061	6,338	0,067	37 220	49 830
VS-675	6,750	6,515	0,265	0,061	6,581	0,067	40 560	51 740
VS-700	7,000	6,757	0,265	0,061	6,825	0,067	43 540	53 660
VS-725	7,250	6,998	0,300	0,061	7,069	0,067	46 640	55 580
VS-750	7,500	7,240	0,300	0,061	7,313	0,067	49 830	57 490
VS-775	7,750	7,480	0,300	0,061	7,556	0,067	53 140	59 410
VS-800	8,000	7,722	0,300	0,061	7,800	0,067	56 550	61 320
VS-825	8,250	7,964	0,345	0,076	8,044	0,082	60 070	78 790
VS-850	8,500	8,205	0,345	0,076	8,288	0,082	63 690	81 180
VS-875	8,750	8,446	0,345	0,076	8,531	0,082	68 040	83 570
VS-900	9,000	8,687	0,345	0,076	8,775	0,082	71 890	85 950
VS-925	9,250	8,929	0,345	0,076	9,019	0,082	75 850	88 340
VS-950	9,500	9,170	0,345	0,076	9,263	0,082	79 910	90 730
VS-975	9,750	9,411	0,345	0,076	9,506	0,082	84 080	93 120
VS-1000	10,000	9,653	0,345	0,076	9,750	0,082	88 360	95 500

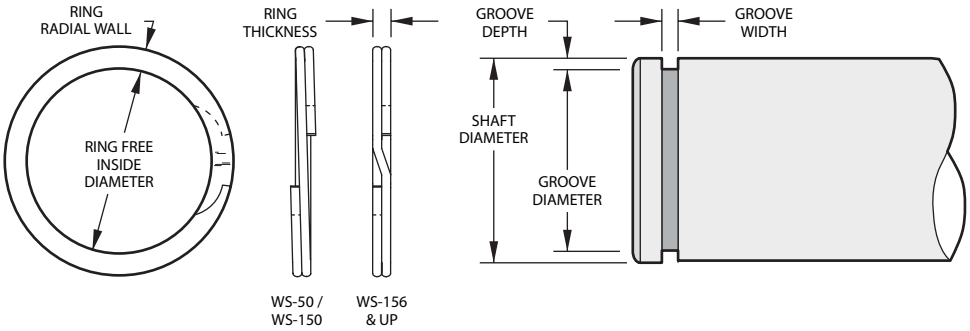
+0,0/-0,030 | +0,0/-0,035 | +0,0/-0,045 | +0,0/-0,060 | +0,0/-0,070 | ±0,005 | +0,004/-0,008 | ±0,002 | ±0,006 | ±0,007 | ±0,008 | +0,003/-0,0 | +0,004/-0,0 | +0,005/-0,0

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.



AS3218, AS4299
MIL-DTL-27426/1

Product Dimensions
All dimensions are in inches unless otherwise specified.



Stock Items in carbon and stainless steel.

Smalley Part Number[1,4]	Shaft Diameter	RING			GROOVE		THRUST CAPACITY	
		Inside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (lb)[2]	Ring Shear (lb)[3]
WS-50	0,500	0,467	0,045	0,025	0,474	0,030	460	2 000
WS-53	0,531	0,498	0,045	0,025	0,505	0,030	490	2 130
WS-55	0,551	0,518	0,045	0,025	0,525	0,030	510	2 210
WS-56	0,562	0,529	0,045	0,025	0,536	0,030	520	2 250
WS-59	0,594	0,561	0,045	0,025	0,569	0,030	550	2 380
WS-62	0,625	0,585	0,055	0,025	0,594	0,030	710	2 500
WS-65	0,656	0,617	0,055	0,025	0,625	0,030	740	2 630
WS-66	0,669	0,629	0,055	0,025	0,638	0,030	760	2 680
WS-68	0,687	0,647	0,055	0,025	0,656	0,030	780	2 750
WS-71	0,718	0,679	0,055	0,025	0,687	0,030	810	2 880
WS-75	0,750	0,710	0,065	0,031	0,719	0,036	850	3 360
WS-78	0,781	0,741	0,065	0,031	0,750	0,036	880	3 500
WS-81	0,812	0,771	0,065	0,031	0,781	0,036	920	3 640
WS-84	0,843	0,803	0,065	0,031	0,812	0,036	950	3 780
WS-87	0,875	0,828	0,065	0,031	0,838	0,036	1 180	3 920
WS-90	0,906	0,860	0,065	0,031	0,869	0,036	1 220	4 060
WS-93	0,937	0,889	0,065	0,031	0,900	0,036	1 260	4 200
WS-96	0,968	0,916	0,075	0,037	0,925	0,042	1 440	5 180
WS-98	0,984	0,930	0,075	0,037	0,941	0,042	1 460	5 260
WS-100	1,000	0,946	0,075	0,037	0,957	0,042	1 480	5 350
WS-102	1,023	0,968	0,075	0,037	0,980	0,042	1 520	5 470
WS-103	1,031	0,978	0,075	0,037	0,988	0,042	1 530	5 510
WS-106	1,062	1,007	0,075	0,037	1,020	0,042	1 580	5 680
WS-109	1,093	1,040	0,075	0,037	1,051	0,042	1 620	5 840
WS-112	1,125	1,070	0,075	0,037	1,083	0,042	1 670	6 020
WS-115	1,156	1,102	0,075	0,037	1,114	0,042	1 720	6 180
WS-118	1,188	1,127	0,085	0,043	1,140	0,048	2 020	7 380
WS-121	1,218	1,159	0,085	0,043	1,170	0,048	2 070	7 570
WS-125	1,250	1,188	0,085	0,043	1,202	0,048	2 120	7 770
WS-128	1,281	1,221	0,085	0,043	1,233	0,048	2 170	7 960
WS-131	1,312	1,251	0,095	0,043	1,264	0,048	2 230	8 150
WS-134	1,343	1,282	0,095	0,043	1,295	0,048	2 280	8 350
WS-137	1,375	1,308	0,095	0,043	1,323	0,048	2 530	8 540
WS-140	1,406	1,340	0,095	0,043	1,354	0,048	2 580	8 740
WS-143	1,437	1,370	0,095	0,043	1,385	0,048	2 640	8 930
WS-146	1,468	1,402	0,095	0,043	1,416	0,048	2 700	9 120
WS-150	1,500	1,433	0,095	0,043	1,448	0,048	2 760	9 320
WS-156	1,562	1,490	0,108	0,049	1,507	0,056	3 090	10 100
WS-157	1,575	1,503	0,108	0,049	1,520	0,056	3 120	10 190
WS-162	1,625	1,549	0,108	0,049	1,566	0,056	3 450	10 510
WS-168	1,687	1,610	0,118	0,049	1,628	0,056	3 580	10 910
WS-175	1,750	1,673	0,118	0,049	1,691	0,056	3 710	11 310
WS-177	1,771	1,690	0,118	0,049	1,708	0,056	4 010	11 450
WS-181	1,813	1,730	0,118	0,049	1,749	0,056	4 100	11 720
WS-187	1,875	1,789	0,128	0,049	1,808	0,056	4 510	12 120
WS-193	1,938	1,851	0,128	0,049	1,871	0,056	4 660	12 530
WS-196	1,969	1,882	0,128	0,049	1,902	0,056	4 730	12 730

±0,0/-0,013 (Inside Diameter)
±0,004 (Radial Wall)
±0,002 (Thickness)
±0,002 (Diameter)
±0,003 (Diameter)
±0,004 (Diameter)
±0,005 (Diameter)
±0,003/-0,0 (Width)
±0,004/-0,0 (Width)
±0,0/-0,015 (Inside Diameter)
±0,0/-0,020 (Inside Diameter)
±0,003 (Thickness)

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number [1, 4]	Shaft Diameter	RING			GROOVE		THRUST CAPACITY	
		Inside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (lb) [2]	Ring Shear (lb) [3]
WS-200	2,000	1,909 +0,0/-0,020	0,128 ±0,004	0,049 ±0,003	1,929 ±,005	0,056 +0,004/-0,0	4 950	12 930
WS-206	2,062	1,971	0,128	0,049	1,992	0,056	5 100	13 330
WS-212	2,125	2,029	0,128	0,049	2,051	0,056	5 560	13 740
WS-215	2,156	2,060 +0,0/-0,025	0,138	0,049	2,082	0,056	5 640	13 940
WS-216	2,165	2,070	0,138	0,049	2,091	0,056	5 660	14 000
WS-218	2,188	2,092	0,138	0,049	2,113	0,056	5 720	14 150
WS-225	2,250	2,153	0,138	0,049	2,176	0,056	5 890	14 550
WS-231	2,312	2,211	0,138	0,049	2,234	0,056	6 370	14 950
WS-236	2,362	2,261	0,138	0,049	2,284	0,056	6 510	15 270
WS-237	2,375	2,273	0,138	0,049	2,297	0,056	6 550	15 360
WS-243	2,437	2,331	0,148	0,049	2,355	0,056	7 060	15 760
WS-250	2,500	2,394	0,148	0,049	2,418	0,056	7 250	16 160
WS-255	2,559	2,449	0,148	0,049	2,473	0,056	7 780	16 550
WS-256	2,562	2,452	0,148	0,049	2,476	0,056	7 790	16 560
WS-262	2,625	2,514	0,148	0,049	2,539	0,056	7 980	16 970
WS-268	2,688	2,572	0,158	0,049	2,597	0,056	8 550	17 380
WS-275	2,750	2,635	0,158	0,049	2,660	0,056	8 750	17 780
WS-281	2,813	2,696	0,168	0,049	2,722	0,056	8 950	18 190
WS-287	2,875	2,755	0,168	0,049	2,781	0,056	9 550	18 590
WS-293	2,937	2,817	0,168	0,049	2,843	0,056	9 760	18 990
WS-295	2,952	2,831	0,168	0,049	2,858	0,056	9 810	19 090
WS-300	3,000	2,877	0,168	0,061	2,904	0,068	10 180	24 150
WS-306	3,062	2,938	0,168	0,061	2,966	0,068	10 390	24 650
WS-312	3,125	3,000	0,178	0,061	3,027	0,068	10 820	25 150
WS-314	3,149	3,023	0,178	0,061	3,051	0,068	10 910	25 350
WS-318	3,187	3,061	0,178	0,061	3,089	0,068	11 040	25 650
WS-325	3,250	3,121	0,178	0,061	3,150	0,068	11 490	26 160
WS-331	3,312	3,180	0,188	0,061	3,208	0,068	12 170	26 660
WS-334	3,343	3,210	0,188	0,061	3,239	0,068	12 290	26 910
WS-337	3,375	3,242	0,188	0,061	3,271	0,068	12 410	27 170
WS-343	3,437	3,301	0,188	0,061	3,331	0,068	12 880	27 660
WS-350	3,500	3,363	0,188	0,061	3,394	0,068	13 110	28 170
WS-354	3,543	3,402	0,198	0,061	3,433	0,068	13 770	28 520
WS-356	3,562	3,422	0,198	0,061	3,452	0,068	13 850	28 670
WS-362	3,625	3,483	0,198	0,061	3,515	0,068	14 090	29 180
WS-368	3,687	3,543	0,198	0,061	3,575	0,068	14 600	29 680
WS-374	3,740	3,597	0,198	0,061	3,628	0,068	14 800	30 100
WS-375	3,750	3,606	0,198	0,061	3,638	0,068	14 840	30 180
WS-381	3,812	3,668	0,198	0,061	3,700	0,068	15 090	30 680
WS-387	3,875	3,724	0,208	0,061	3,757	0,068	16 160	31 190
WS-393	3,938	3,784	0,208	0,061	3,820	0,068	16 420	31 700
WS-400	4,000	3,842	0,218	0,061	3,876	0,068	17 530	32 200
WS-406	4,063	3,906	0,218	0,061	3,939	0,068	17 810	32 700
WS-412	4,125	3,967	0,218	0,061	4,000	0,068	18 080	33 200
WS-413	4,134	3,975	0,218	0,061	4,010	0,068	18 120	33 270
WS-418	4,188	4,022	0,218	0,061	4,058	0,068	19 240	33 710
WS-425	4,250	4,084	0,228	0,061	4,120	0,068	19 530	34 210
WS-431	4,312	4,147	0,228	0,061	4,182	0,068	19 810	34 710
WS-433	4,331	4,164	0,228	0,061	4,200	0,068	19 900	34 860
WS-437	4,375	4,208	0,228	0,061	4,245	0,068	20 100	35 210
WS-443	4,437	4,271	0,228	0,061	4,307	0,068	20 390	35 710
WS-450	4,500	4,326	0,238	0,061	4,364	0,068	21 630	36 220
WS-456	4,562	4,384	0,250	0,072	4,422	0,079	22 570	43 340
WS-462	4,625	4,447	0,250	0,072	4,485	0,079	22 890	43 940
WS-468	4,687	4,508	0,250	0,072	4,547	0,079	23 190	44 530
WS-472	4,724	4,546	0,250	0,072	4,584	0,079	23 370	44 880
WS-475	4,750	4,571	0,250	0,072	4,610	0,079	23 500	45 130
WS-481	4,812	4,633	0,250	0,072	4,672	0,079	23 810	45 720
WS-487	4,875	4,695	0,250	0,072	4,735	0,079	24 120	46 310
WS-493	4,937	4,757	0,250	0,072	4,797	0,079	24 430	46 900
WS-500	5,000	4,816	0,250	0,072	4,856	0,079	25 450	47 500
WS-511	5,118	4,934	0,250	0,072	4,974	0,079	26 050	48 620
WS-512	5,125	4,939	0,250	0,072	4,981	0,079	26 080	48 690
WS-525	5,250	5,064 +0,0/-0,050	0,250	0,072	5,107 ±0,007	0,079	26 720	49 880

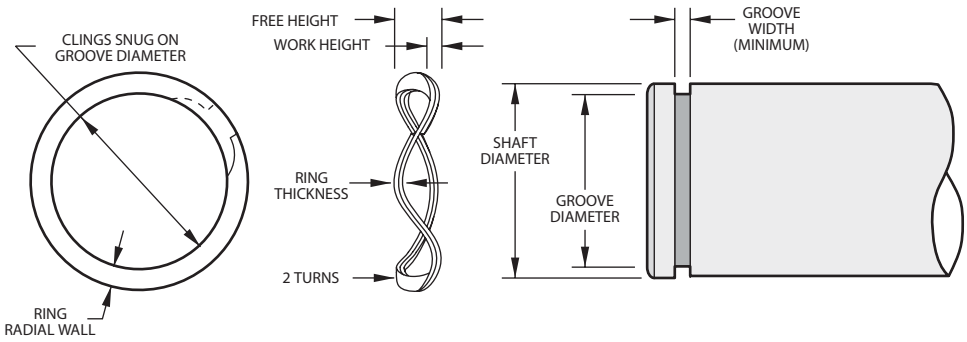
[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number[1, 4]	Shaft Diameter	RING			GROOVE		THRUST CAPACITY	
		Inside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (lb)[2]	Ring Shear (lb)[3]
WS-537	5,375	5,187	0,250	0,072	5,228	0,079	28 120	51 060
WS-550	5,500	5,308	0,250	0,072	5,353	0,079	28 770	52 250
WS-551	5,511	5,320	0,250	0,072	5,364	0,079	28 830	52 360
WS-562	5,625	5,433	0,250	0,072	5,478	0,079	29 420	53 440
WS-575	5,750	5,550	0,250	0,072	5,597	0,079	31 300	54 630
WS-587	5,875	5,674	0,250	0,072	5,722	0,079	31 980	55 810
WS-590	5,905	5,705	0,250	0,072	5,752	0,079	32 140	56 100
WS-600	6,000	5,798	0,250	0,072	5,847	0,079	32 660	57 000
WS-612	6,125	5,903	0,312	0,086	5,953	0,094	37 230	69 500
WS-625	6,250	6,026	0,312	0,086	6,078	0,094	37 990	70 920
WS-629	6,299	6,076	0,312	0,086	6,127	0,094	38 290	71 480
WS-637	6,375	6,152	0,312	0,086	6,203	0,094	38 750	72 340
WS-650	6,500	6,274	0,312	0,086	6,328	0,094	39 510	73 760
WS-662	6,625	6,390	0,312	0,086	6,443	0,094	42 620	75 180
WS-675	6,750	6,513	0,312	0,086	6,568	0,094	43 420	76 600
WS-687	6,875	6,638	0,312	0,086	6,693	0,094	44 220	78 010
WS-700	7,000	6,761	0,312	0,086	6,818	0,094	45 030	79 430
WS-712	7,125	6,877	0,312	0,086	6,933	0,094	48 350	80 850
WS-725	7,250	6,999	0,312	0,086	7,058	0,094	49 200	82 270
WS-737	7,375	7,125	0,312	0,086	7,183	0,094	50 050	83 690
WS-750	7,500	7,250	0,312	0,086	7,308	0,094	50 890	85 110
WS-762	7,625	7,363	0,312	0,086	7,423	0,094	54 440	86 520
WS-775	7,750	7,486	0,312	0,086	7,548	0,094	55 330	87 940
WS-787	7,875	7,611	0,312	0,086	7,673	0,094	56 220	89 360
WS-800	8,000	7,734	0,312	0,086	7,798	0,094	57 110	90 780
WS-825	8,250	7,972	0,375	0,086	8,038	0,094	61 820	93 620
WS-850	8,500	8,220	0,375	0,086	8,288	0,094	63 690	96 450
WS-875	8,750	8,459	0,375	0,086	8,528	0,094	68 650	99 290
WS-900	9,000	8,707	0,375	0,086	8,778	0,094	70 620	102 130
WS-925	9,250	8,945	0,375	0,086	9,018	0,094	75 850	104 960
WS-950	9,500	9,194	0,375	0,086	9,268	0,094	77 900	107 800
WS-975	9,750	9,432	0,375	0,086	9,508	0,094	83 390	110 640
WS-1000	10,000	9,680	0,375	0,086	9,758	0,094	85 530	113 470
WS-1025	10,250	9,918	0,375	0,086	9,998	0,094	91 290	116 310
WS-1050	10,500	10,166	0,375	0,086	10,248	0,094	93 520	119 150
WS-1075	10,750	10,405	0,375	0,086	10,488	0,094	99 540	121 990
WS-1100	11,000	10,653	0,375	0,086	10,738	0,094	101 860	124 820

Inside Diameter: +0,0/-0,050 (WS-537 through WS-600); +0,0/-0,060 (WS-612 through WS-737); +0,0/-0,070 (WS-750 through WS-1100)
Radial Wall: ±0,005 (WS-537 through WS-600); ±0,006 (WS-612 through WS-1100)
Thickness: ±0,004 (WS-537 through WS-737); ±0,006 (WS-750 through WS-1100)
Diameter: ±0,007 (WS-537 through WS-737); ±0,008 (WS-750 through WS-1100)
Width: +0,005/-0,0 (WS-537 through WS-737); +0,006/-0,0 (WS-750 through WS-1100)

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

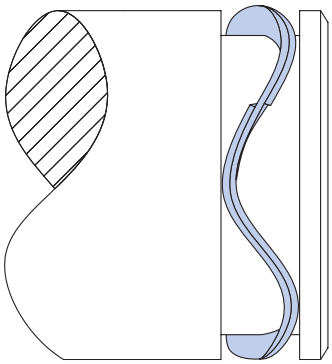
Product Dimensions
All dimensions are in inches unless otherwise specified.

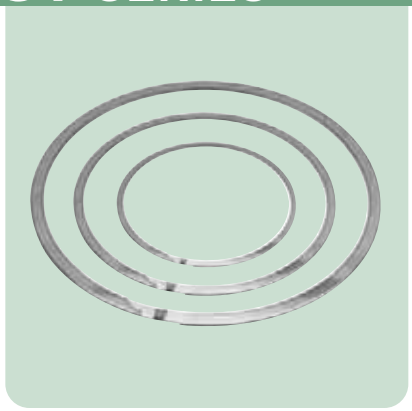


Stock Items available in carbon and stainless steel.

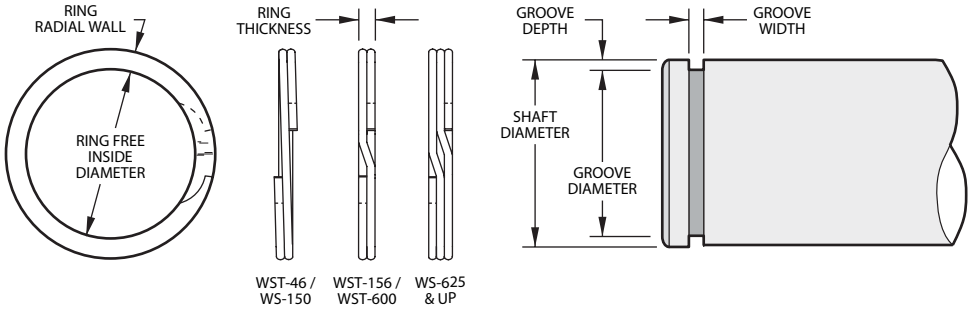
Smalley Part Number [1, 2]	Shaft Diameter	Load (lb) @ Work Height	Max. Free Height	Number of Waves	RING			GROOVE	
					Thickness	Radial Wall	Crimp	Diameter	Width Min.
WSW-75	0,750	25 @ 0,085	0,115	3	0,042	0,065	N	0,704	0,120
WSW-87	0,875	30 @ 0,085	0,131	3	0,042	0,075	N	0,821	0,136
WSW-100	1,000	34 @ 0,085	0,129	3	0,042	0,085	N	0,940	0,134
WSW-112	1,125	38 @ 0,100	0,137	3	0,050	0,128	N	1,059	0,142
WSW-125	1,250	40 @ 0,100	0,145	3	0,050	0,128	N	1,176	0,150
WSW-137	1,375	45 @ 0,100	0,130	4	0,050	0,128	N	1,291	0,135
WSW-150	1,500	50 @ 0,100	0,126	4	0,050	0,128	N	1,406	0,131
WSW-162	1,625	55 @ 0,110	0,138	4	0,062	0,158	N	1,529	0,143
WSW-175	1,750	60 @ 0,110	0,137	4	0,062	0,158	N	1,650	0,142
WSW-187	1,875	63 @ 0,110	0,140	4	0,062	0,158	N	1,769	0,145
WSW-200	2,000	65 @ 0,110	0,145	4	0,062	0,158	N	1,886	0,150
WSW-212	2,125	70 @ 0,130	0,170	4	0,078	0,188	N	2,003	0,175
WSW-225	2,250	75 @ 0,130	0,175	4	0,078	0,188	N	2,120	0,180
WSW-237	2,375	80 @ 0,130	0,175	4	0,078	0,188	N	2,239	0,180
WSW-250	2,500	84 @ 0,130	0,171	4	0,078	0,188	N	2,360	0,176
WSW-262	2,625	88 @ 0,130	0,181	4	0,078	0,188	N	2,481	0,190
WSW-275	2,750	94 @ 0,170	0,217	4	0,093	0,225	Y	2,602	0,222
WSW-287	2,875	97 @ 0,170	0,217	4	0,093	0,225	Y	2,721	0,222
WSW-300	3,000	100 @ 0,170	0,225	4	0,093	0,225	Y	2,838	0,230
WSW-312	3,125	103 @ 0,170	0,230	4	0,093	0,225	Y	2,957	0,235
WSW-325	3,250	106 @ 0,170	0,225	4	0,093	0,225	Y	3,076	0,230
WSW-350	3,500	115 @ 0,185	0,245	4	0,111	0,281	Y	3,316	0,250
WSW-362	3,625	117 @ 0,185	0,250	4	0,111	0,281	Y	3,435	0,255
WSW-375	3,750	121 @ 0,185	0,258	4	0,111	0,281	Y	3,552	0,263
WSW-387	3,875	126 @ 0,185	0,255	4	0,111	0,281	Y	3,673	0,260
WSW-400	4,000	130 @ 0,185	0,268	4	0,111	0,281	Y	3,792	0,273
WSW-412	4,125	134 @ 0,185	0,263	4	0,111	0,281	Y	3,919	0,268
WSW-425	4,250	140 @ 0,185	0,248	5	0,111	0,281	Y	4,065	0,253
WSW-450	4,500	150 @ 0,185	0,256	5	0,111	0,281	Y	4,310	0,261
WSW-475	4,750	160 @ 0,185	0,253	5	0,111	0,281	Y	4,550	0,258
WSW-500	5,000	170 @ 0,185	0,259	5	0,111	0,281	Y	4,790	0,264

[1] Add suffix "-S17" for stainless steel.
[2] See pages 106-107 for How to Order.





Product Dimensions
All dimensions are in inches unless otherwise specified.



Stock Items in carbon and stainless steel.

Smalley Part Number [1, 4]	Shaft Diameter	RING			GROOVE		THRUST CAPACITY	
		Inside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (lb) [2]	Ring Shear (lb) [3]
WST-46	0,469	0,436	0,045	0,025	0,443 ±0,002	0,029	430	1 800
WST-50	0,500	0,469	0,045	0,035	0,474	0,039	460	2 530
WST-55	0,551	0,518	0,045	0,035	0,524	0,039	550	2 790
WST-56	0,562	0,529	0,045	0,035	0,535	0,039	560	2 840
WST-59	0,594	0,559	0,045	0,035	0,565	0,039	630	3 000
WST-62	0,625	0,590	0,055	0,035	0,596	0,039	660	3 160
WST-66	0,669	0,630	0,055	0,035	0,638	0,039	760	3 380
WST-68	0,688	0,648	0,065	0,042	0,655	0,046	830	4 180
WST-75	0,750	0,708	0,065	0,042	0,715	0,046	950	4 550
WST-78	0,781	0,738	0,065	0,042	0,745	0,046	990	4 740
WST-81	0,812	0,768	0,065	0,042	0,776	0,046	1 030	4 930
WST-87	0,875	0,827	0,075	0,042	0,835	0,046	1 240	5 310
WST-93	0,938	0,886	0,075	0,042	0,894	0,046	1 460	5 690
WST-98	0,984	0,934	0,075	0,042	0,940	0,046	1 530	5 970
WST-100	1,000	0,947	0,075	0,042	0,955	0,046	1 630	6 070
WST-102	1,023	0,969	0,075	0,042	0,977	0,046	1 660	6 210
WST-106	1,062	1,005	0,088	0,050	1,015	0,056	1 800	7 010
WST-112	1,125	1,064	0,088	0,050	1,075	0,056	1 990	7 420
WST-118	1,188	1,126	0,088	0,050	1,135	0,056	2 270	7 370
WST-125	1,250	1,184	0,093	0,050	1,195	0,056	2 470	8 250
WST-131	1,312	1,240	0,098	0,050	1,250	0,056	2 880	8 660
WST-137	1,375	1,298	0,103	0,050	1,310	0,056	3 210	9 070
WST-143	1,438	1,359	0,103	0,050	1,370	0,056	3 460	9 490
WST-150	1,500	1,419	0,103	0,050	1,430	0,056	3 710	9 900
WST-156	1,562	1,476	0,108	0,062	1,490	0,068	3 980	12 780
WST-162	1,625	1,537	0,118	0,062	1,550	0,068	4 370	13 290
WST-168	1,687	1,598	0,118	0,062	1,610	0,068	4 650	13 800
WST-175	1,750	1,657	0,118	0,062	1,670	0,068	4 950	14 320
WST-177	1,771	1,676	0,123	0,062	1,689	0,068	5 130	14 490
WST-181	1,812	1,714	0,123	0,062	1,730	0,068	5 250	14 820
WST-187	1,875	1,774	0,123	0,062	1,790	0,068	5 700	15 340
WST-196	1,969	1,864	0,123	0,062	1,879	0,068	6 260	16 110
WST-200	2,000	1,894	0,128	0,062	1,910	0,068	6 360	16 360
WST-206	2,062	1,955	0,141	0,078	1,970	0,086	6 710	21 220
WST-212	2,125	2,012	0,141	0,078	2,027	0,086	7 360	21 870
WST-215	2,156	2,041	0,141	0,078	2,057	0,086	7 620	22 190
WST-225	2,250	2,129	0,141	0,078	2,145	0,086	8 430	23 160
WST-231	2,312	2,188	0,141	0,078	2,205	0,086	8 830	23 800
WST-237	2,375	2,248	0,141	0,078	2,265	0,086	9 230	24 440
WST-243	2,437	2,307	0,141	0,078	2,325	0,086	9 650	25 080
WST-250	2,500	2,366	0,188	0,078	2,385	0,086	10 250	25 730
WST-255	2,559	2,424	0,188	0,078	2,443	0,086	10 490	26 340
WST-262	2,625	2,485	0,188	0,078	2,505	0,086	11 130	27 020
WST-268	2,687	2,545	0,188	0,078	2,565	0,086	11 590	27 660
WST-275	2,750	2,604	0,188	0,093	2,625	0,103	12 250	32 140
WST-287	2,875	2,722	0,188	0,093	2,742	0,103	13 620	33 600
WST-293	2,937	2,780	0,188	0,093	2,801	0,103	14 120	34 320

Inside Diameter: +0,0/-0,013 (WST-46 through WST-102); +0,0/-0,015 (WST-106 through WST-150); +0,0/-0,020 (WST-156 through WST-200); +0,0/-0,025 (WST-206 through WST-243); +0,0/-0,030 (WST-250 through WST-293)

Radial Wall: ±0,004 (WST-46 through WST-243); ±0,005 (WST-250 through WST-293)

Thickness: ±0,002 (WST-46 through WST-150); ±0,003 (WST-156 through WST-243); ±0,005 (WST-250 through WST-293)

Diameter: ±0,002 (WST-46); ±0,003 (WST-50 through WST-102); ±0,004 (WST-106 through WST-150); ±0,005 (WST-156 through WST-200); ±0,006 (WST-206 through WST-293)

Width: +0,003/-0,0 (WST-46 through WST-102); +0,004/-0,0 (WST-106 through WST-200); +0,005/-0,0 (WST-206 through WST-293)

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² psi and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

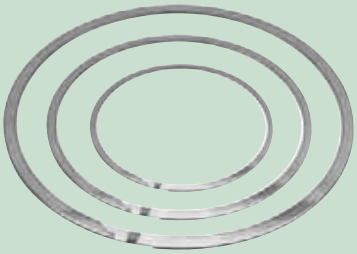
Smalley Part Number [1, 4]	Shaft Diameter	RING						GROOVE				THRUST CAPACITY	
		Inside Diameter		Radial Wall		Thickness		Diameter		Width		Groove Yield (lb) [2]	Ring Shear (lb) [3]
WST-300	3,000	2,838	+0,0/-0,030	0,188	±0,005	0,093	±0,003	2,860	±0,006	0,103	±0,005	14 840	35 060
WST-306	3,062	2,897		0,188		0,093		2,920		0,103		15 370	35 790
WST-312	3,125	2,957		0,188		0,093		2,980		0,103		16 130	36 520
WST-315	3,156	2,986		0,188		0,093		3,010		0,103		16 290	36 880
WST-325	3,250	3,075		0,188		0,093		3,100		0,103		17 230	37 980
WST-334	3,344	3,164		0,188		0,093		3,190		0,103		18 200	39 080
WST-343	3,437	3,254		0,188		0,093		3,280		0,103		19 190	40 170
WST-350	3,500	3,153	+0,0/-0,040	0,250		0,111		3,340		0,120		19 790	48 820
WST-354	3,543	3,356		0,250		0,111		3,381		0,120		20 290	49 420
WST-362	3,625	3,433		0,250		0,111		3,458		0,120		21 520	50 560
WST-368	3,687	3,490		0,250		0,111		3,517		0,120		22 150	51 430
WST-375	3,750	3,550		0,250		0,111		3,577		0,120		23 060	52 310
WST-387	3,875	3,670		0,250		0,111		3,696		0,120		24 650	54 050
WST-393	3,938	3,730		0,250		0,111		3,756		0,120		25 330	54 930
WST-400	4,000	3,787		0,250		0,111		3,815		0,120		26 300	55 800
WST-425	4,250	4,032		0,250		0,111		4,065		0,120		27 940	59 280
WST-437	4,375	4,162		0,250		0,111		4,190		0,120		28 760	61 030
WST-450	4,500	4,280		0,250		0,111		4,310		0,120		30 220	62 770
WST-475	4,750	4,515		0,250		0,111		4,550		0,120		33 580	66 260
WST-500	5,000	4,755		0,250		0,111		4,790		0,120		37 110	69 740
WST-525	5,250	4,995	+0,0/-0,050	0,375	±0,006	0,127	±0,004	5,030	±0,007	0,139	±0,006	40 820	83 790
WST-550	5,500	5,229		0,375		0,127		5,265		0,139		45 880	87 780
WST-575	5,750	5,466		0,375		0,127		5,505		0,139		49 990	91 770
WST-600	6,000	5,705		0,375		0,127		5,745		0,139		54 290	95 760

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 45 000 psi and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Stock Items in carbon and stainless steel. Rings listed below are three-turn construction.

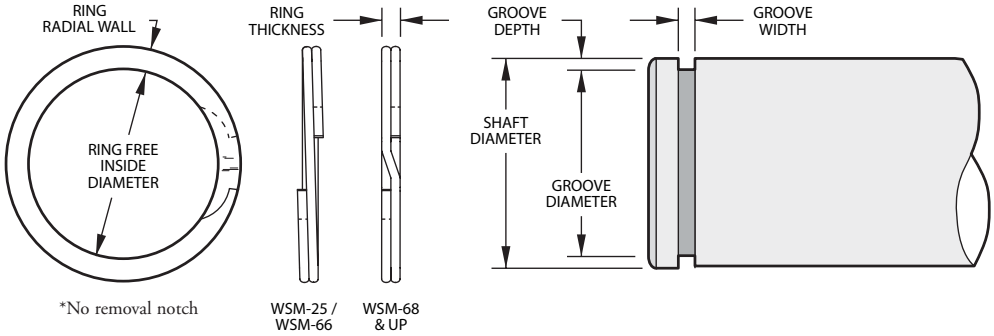
Smalley Part Number [1, 4]	Shaft Diameter	RING						GROOVE				THRUST CAPACITY	
		Inside Diameter		Radial Wall		Thickness		Diameter		Width		Groove Yield (lb) [2]	Ring Shear (lb) [3]
WST-625	6,250	5,942	+0,0/-0,060	0,312	±0,006	0,165	±0,005	5,985	±0,008	0,174	+0,008/-0,0	58 760	129 590
WST-650	6,500	6,182		0,312		0,165		6,225		0,174		63 410	134 780
WST-675	6,750	6,420		0,312		0,165		6,465		0,174		68 230	139 960
WST-700	7,000	6,658		0,312		0,165		6,705		0,174		73 230	145 140
WST-725	7,250	6,894	+0,0/-0,070	0,312		0,165		6,942		0,174		78 290	172 190
WST-750	7,500	7,130		0,375		0,189		7,180		0,209		84 820	178 130
WST-775	7,750	7,368		0,375		0,189		7,420		0,209		90 390	184 070
WST-800	8,000	7,607		0,375		0,189		7,660		0,209		96 130	190 000
WST-825	8,250	7,845		0,375		0,189		7,900		0,209		102 050	195 940
WST-850	8,500	8,083		0,375		0,189		8,140		0,209		108 150	201 880
WST-875	8,750	8,321		0,375		0,189		8,383		0,209		113 800	207 820
WST-900	9,000	8,560		0,375		0,189		8,620		0,209		120 870	213 750
WST-925	9,250	8,798		0,375		0,189		8,860		0,209		127 500	219 690
WST-950	9,500	9,036		0,375		0,189		9,100		0,209		134 300	225 630
WST-975	9,750	9,273		0,375		0,189		9,338		0,209		141 970	231 570
WST-1000	10,000	9,508		0,375		0,189		9,575		0,209		150 560	237 500

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.



AS3216, AS4299
MIL-DTL-27426/2

Product Dimensions
All dimensions are in inches unless otherwise specified.



Stock Items in carbon and stainless steel.

Smalley Part Number[1,4]	Shaft Diameter	RING						GROOVE				THRUST CAPACITY	
		Inside Diameter		Radial Wall		Thickness		Diameter		Width		Groove Yield (lb)[2]	Ring Shear (lb)[3]
WSM-25*	0,250	0,228	+0,0/-0,010	0,020	±0,004	0,025	±0,002	0,230	±0,002	0,029	+0,003/-0,0	177	961
WSM-31*	0,312	0,287		0,025		0,025		0,290		0,029		243	1 200
WSM-37*	0,375	0,349		0,030		0,025		0,352		0,029		305	1 442
WSM-43	0,437	0,409	+0,0/-0,012	0,035		0,025		0,412		0,029		386	1 680
WSM-46	0,469	0,439		0,045		0,025		0,443		0,029		430	1 880
WSM-50	0,500	0,464	+0,0/-0,013	0,049		0,035		0,468		0,039		570	2 530
WSM-55	0,551	0,514		0,049		0,035		0,519		0,039		620	2 790
WSM-56	0,562	0,525		0,049		0,035		0,530		0,039		640	2 840
WSM-59	0,594	0,554		0,049		0,035		0,559	±0,003	0,039		760	3 000
WSM-62	0,625	0,583		0,054		0,035		0,588		0,039		840	3 160
WSM-66	0,669	0,623		0,054		0,035		0,629		0,039		950	3 380
WSM-68	0,688	0,641		0,065		0,042		0,646		0,046		1 020	4 180
WSM-75	0,750	0,698		0,065		0,042		0,704		0,046		1 220	4 550
WSM-78	0,781	0,727		0,065		0,042		0,733		0,046		1 330	4 740
WSM-81	0,812	0,756		0,065		0,042		0,762		0,046		1 440	4 930
WSM-87	0,875	0,814		0,075		0,042		0,821		0,046		1 670	5 310
WSM-93	0,938	0,875		0,075		0,042		0,882		0,046		1 860	5 690
WSM-98	0,984	0,919		0,085		0,042		0,926		0,046		2 020	5 970
WSM-100	1,000	0,932		0,085		0,042		0,940		0,046		2 120	6 070
WSM-102	1,023	0,953		0,085		0,042		0,961		0,046		2 240	6 210
WSM-106	1,062	0,986		0,103		0,050		0,998	±0,004	0,056		2 400	7 010
WSM-112	1,125	1,047		0,103		0,050		1,059		0,056		2 620	7 420
WSM-118	1,188	1,105		0,103		0,050		1,118		0,056		2 940	7 840
WSM-125	1,250	1,163		0,103		0,050		1,176		0,056		3 270	8 250
WSM-131	1,312	1,218		0,118		0,050		1,232		0,056		3 710	8 660
WSM-137	1,375	1,277		0,118		0,050		1,291		0,056		4 080	9 070
WSM-143	1,438	1,336		0,118		0,050		1,350		0,056		4 470	9 490
WSM-150	1,500	1,390		0,118		0,050		1,406		0,056		4 980	9 900
WSM-156	1,562	1,453	+0,0/-0,020	0,128		0,062		1,468	±0,005	0,068	+0,004/-0,0	5 190	12 780
WSM-162	1,625	1,513		0,128		0,062		1,529		0,068		5 510	13 290
WSM-168	1,687	1,573		0,128		0,062		1,589		0,068		5 840	13 800
WSM-175	1,750	1,633		0,128		0,062		1,650		0,068		6 190	14 320
WSM-177	1,771	1,651		0,128		0,062		1,669		0,068		6 380	14 490
WSM-181	1,812	1,690		0,128		0,062		1,708		0,068		6 660	14 820
WSM-187	1,875	1,751		0,158		0,062		1,769		0,068		7 020	15 340
WSM-196	1,969	1,838		0,158		0,062		1,857		0,068		7 790	16 110
WSM-200	2,000	1,867		0,158		0,062		1,886		0,068		8 060	16 360
WSM-206	2,062	1,932	+0,0/-0,025	0,168	±0,005	0,078	±0,003	1,946	±0,006	0,086	+0,005/-0,0	8 450	21 220
WSM-212	2,125	1,989		0,168		0,078		2,003		0,086		9 160	21 870
WSM-215	2,156	2,018		0,168		0,078		2,032		0,086		9 450	22 190
WSM-225	2,250	2,105		0,168		0,078		2,120		0,086		10 340	23 160
WSM-231	2,312	2,163		0,168		0,078		2,178		0,086		10 950	23 800
WSM-237	2,375	2,223		0,200		0,078		2,239		0,086		11 420	24 440
WSM-243	2,437	2,283		0,200		0,078		2,299		0,086		11 890	25 080
WSM-250	2,500	2,343		0,200		0,078		2,360		0,086		12 370	25 730
WSM-255	2,559	2,402		0,200		0,078		2,419		0,086		12 660	26 340
WSM-262	2,625	2,464		0,200		0,078		2,481		0,086		13 360	27 020

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² psi and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number [1, 4]	Shaft Diameter	RING			GROOVE		THRUST CAPACITY	
		Inside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (lb) [2]	Ring Shear (lb) [3]
WSM-268	2,687	2,523 +0,0/-0,025	0,200	0,078	2,541	0,086	13 870	27 660
WSM-275	2,750	2,584	0,225	0,093	2,602	0,103	14 390	32 140
WSM-287	2,875	2,702	0,225	0,093	2,721	0,103	15 650	33 600
WSM-293	2,937	2,760	0,225	0,093	2,779	0,103	16 400	34 320
WSM-300	3,000	2,818	0,225	0,093	2,838	0,103	17 180	35 060
WSM-306	3,062	2,878	0,225	0,093	2,898	0,103	17 750	35 790
WSM-312	3,125	2,936	0,225	0,093	2,957	0,103	18 560	36 520
WSM-315	3,156	2,965	0,225	0,093	2,986	0,103	18 960	36 880
WSM-325	3,250	3,054	0,225	0,093	3,076	0,103	19 990	37 980
WSM-334	3,344	3,144	0,225	0,093	3,166	0,103	21 040	39 080
WSM-343	3,437	3,234	0,225	0,093	3,257	0,103	21 870	40 170
WSM-350	3,500	3,293	0,270	0,111	3,316	0,120	22 760	48 820
WSM-354	3,543	3,333	0,270	0,111	3,357	0,120	23 290	49 420
WSM-362	3,625	3,411	0,270	0,111	3,435	0,120	24 340	50 560
WSM-368	3,687	3,469	0,270	0,111	3,493	0,120	25 280	51 430
WSM-375	3,750	3,527	0,270	0,111	3,552	0,120	26 240	52 310
WSM-387	3,875	3,647	0,270	0,111	3,673	0,120	27 670	54 050
WSM-393	3,938	3,708	0,270	0,111	3,734	0,120	28 390	54 930
WSM-400	4,000	3,765	0,270	0,111	3,792	0,120	29 410	55 800
WSM-425	4,250	4,037	0,270	0,111	4,065	0,120	27 940	59 280
WSM-437	4,375	4,161	0,270	0,111	4,190	0,120	28 760	61 030
WSM-450	4,500	4,280	0,270	0,111	4,310	0,120	30 220	62 770
WSM-475	4,750	4,518	0,270	0,111	4,550	0,120	36 930	66 260
WSM-500	5,000	4,756	0,270	0,111	4,790	0,120	37 110	69 740
WSM-525	5,250	4,995	0,350	0,127	5,030	0,139	40 820	83 790
WSM-550	5,500	5,228	0,350	0,127	5,265	0,139	45 880	87 780
WSM-575	5,750	5,466	0,350	0,127	5,505	0,139	49 990	91 770
WSM-600	6,000	5,705	0,350	0,127	5,745	0,139	54 290	95 760
WSM-625	6,250	5,938	0,418	0,156	5,985	0,174	58 760	122 520
WSM-650	6,500	6,181	0,418	0,156	6,225	0,174	63 410	127 420
WSM-675	6,750	6,410	0,418	0,156	6,465	0,174	68 230	132 330
WSM-700	7,000	6,648	0,418	0,156	6,705	0,174	73 230	137 230
WSM-725	7,250	6,891	0,418	0,156	6,942	0,174	78 920	142 130
WSM-750	7,500	7,130	0,437	0,187	7,180	0,209	84 820	176 240
WSM-775	7,750	7,368	0,437	0,187	7,420	0,209	90 390	182 120
WSM-800	8,000	7,606	0,437	0,187	7,660	0,209	96 130	187 990
WSM-825	8,250	7,845	0,437	0,187	7,900	0,209	102 050	193 870
WSM-850	8,500	8,083	0,437	0,187	8,140	0,209	108 150	199 740
WSM-875	8,750	8,324	0,437	0,187	8,383	0,209	113 800	205 620
WSM-900	9,000	8,560	0,500	0,187	8,620	0,209	120 870	211 490
WSM-925	9,250	8,798	0,500	0,187	8,860	0,209	127 500	217 370
WSM-950	9,500	9,036	0,500	0,187	9,100	0,209	134 300	223 240
WSM-975	9,750	9,275	0,500	0,187	9,338	0,209	141 970	229 120
WSM-1000	10,000	9,508	0,500	0,187	9,575	0,209	150 560	234 990
WSM-1025	10,250	9,745	0,500	0,187	9,814	0,209	157 950	240 870
WSM-1050	10,500	9,984	0,500	0,187	10,054	0,209	165 510	246 740
WSM-1075	10,750	10,221	0,500	0,187	10,293	0,209	174 010	252 620
WSM-1100	11,000	10,459	0,500	0,187	10,533	0,209	181 950	258 490
WSM-1125	11,250	10,692	0,500	0,187	10,772	0,209	190 060	264 360
WSM-1150	11,500	10,934	0,562	0,187	11,011	0,209	199 160	270 240
WSM-1175	11,750	11,171	0,562	0,187	11,250	0,209	207 640	276 120
WSM-1200	12,000	11,410	0,562	0,187	11,490	0,209	216 300	281 990
WSM-1225	12,250	11,647	0,562	0,187	11,729	0,209	226 000	287 860
WSM-1250	12,500	11,885	0,562	0,187	11,969	0,209	235 030	293 740
WSM-1275	12,750	12,124	0,562	0,187	12,208	0,209	244 240	299 610
WSM-1300	13,000	12,361	0,662	0,187	12,448	0,209	253 620	305 490
WSM-1325	13,250	12,598	0,662	0,187	12,687	0,209	264 120	311 360
WSM-1350	13,500	12,837	0,662	0,187	12,927	0,209	273 870	317 240
WSM-1375	13,750	13,074	0,662	0,187	13,166	0,209	283 800	323 110
WSM-1400	14,000	13,311	0,662	0,187	13,405	0,209	294 900	328 990
WSM-1425	14,250	13,548	0,662	0,187	13,644	0,209	305 200	334 860
WSM-1450	14,500	13,787	0,750	0,187	13,884	0,209	315 680	340 740
WSM-1475	14,750	14,024	0,750	0,187	14,123	0,209	327 380	346 610
WSM-1500	15,000	14,262	0,750	0,187	14,363	0,209	338 230	352 490

Inside Diameter: +0,0/-0,030 (2,687–3,344); +0,0/-0,035 (3,437–4,500); +0,0/-0,050 (4,750–5,500); +0,0/-0,060 (5,750–6,500); +0,0/-0,070 (6,750–8,500); +0,0/-0,090 (8,750–10,500); +0,0/-0,110 (10,750–13,500); +0,015/-0,010 (13,750–15,000)

Radial Wall: ±0,005 (2,687–4,500); ±0,006 (4,750–5,500); ±0,007 (5,750–8,500); ±0,005 (8,750–15,000)

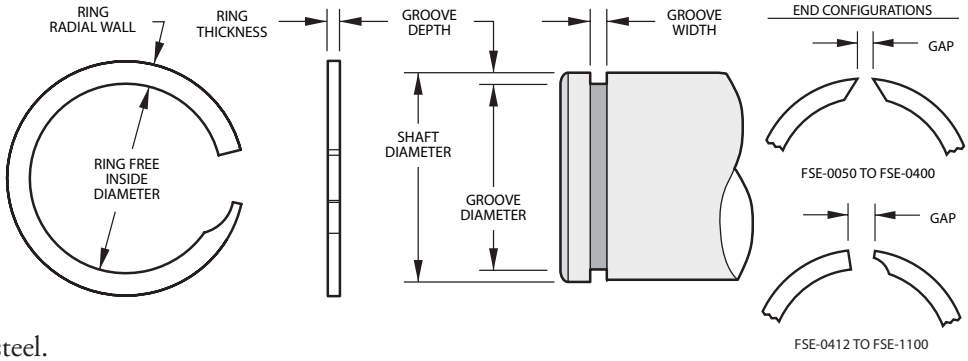
Thickness: ±0,003 (2,687–4,500); ±0,004 (4,750–5,500); ±0,005 (5,750–15,000)

Diameter: ±0,006 (2,687–4,500); ±0,007 (4,750–5,500); ±0,008 (5,750–8,500); ±0,010 (8,750–10,500); ±0,012 (10,750–15,000)

Width: +0,005/-0,0 (2,687–4,500); +0,006/-0,0 (4,750–5,500); +0,008/-0,0 (5,750–15,000)

[1] Add suffix "-S02" for 302 stainless steel, "-S16" for 316 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Product Dimensions
All dimensions are in inches unless otherwise specified.



Stock Items in carbon and stainless steel.

Smalley Part Number[1,4]	Shaft Diameter	RING					GROOVE				THRUST CAPACITY	
		Inside Diameter		Radial Wall		Thickness	Diameter		Width		Groove Yield (lb)[2]	Ring Shear (lb)[3]
FSE-0050	0,500	0,471	+0,0/-0,013	0,055	+0,003/-0,005	0,037 ±0,002	0,476	+0,0/-0,004	0,043	+0,006/-0,0	424	2 325
FSE-0056	0,562	0,524		0,055		0,037	0,532		0,043		596	2 613
FSE-0062	0,625	0,590		0,065		0,037	0,595		0,043		663	2 906
FSE-0068	0,687	0,649		0,065		0,037	0,655		0,043		777	3 194
FSE-0075	0,750	0,701		0,075		0,045	0,710		0,051		1 060	4 241
FSE-0081	0,812	0,764		0,075		0,045	0,772	+0,000/-0,005	0,051		1 148	4 592
FSE-0087	0,875	0,820		0,075		0,045	0,831		0,051		1 361	4 948
FSE-0093	0,937	0,886		0,085		0,045	0,893	+0,0/-0,008	0,051		1 457	5 334
FSE-0100	1,000	0,933		0,085		0,045	0,952		0,051		1 696	5 693
FSE-0106	1,062	1,004		0,085		0,045	1,014		0,051		1 802	6 045
FSE-0112	1,125	1,069	+0,0/-0,015	0,128		0,057	1,077		0,063		1 909	7 615
FSE-0118	1,187	1,116		0,128		0,057	1,131		0,063		2 349	8 035
FSE-0125	1,250	1,176		0,128		0,057	1,188		0,063		2 739	8 461
FSE-0131	1,312	1,223		0,128		0,057	1,242		0,063		3 246	8 881
FSE-0137	1,375	1,282		0,128		0,057	1,297		0,063		3 791	9 307
FSE-0143	1,437	1,344		0,158		0,067	1,359		0,073		3 961	11 408
FSE-0150	1,500	1,402		0,158		0,067	1,422		0,073		4 135	11 908
FSE-0156	1,562	1,457	+0,0/-0,020	0,158		0,067	1,470	+0,0/-0,010	0,073		5 079	12 400
FSE-0162	1,625	1,517		0,158		0,067	1,533		0,073		5 284	12 901
FSE-0168	1,687	1,578		0,158		0,067	1,595		0,073		5 485	13 393
FSE-0175	1,750	1,640		0,158		0,067	1,658		0,073		5 690	13 893
FSE-0181	1,812	1,697		0,158		0,067	1,720		0,073		5 892	14 385
FSE-0187	1,875	1,767		0,158		0,067	1,783		0,073		6 097	14 885
FSE-0193	1,937	1,800	+0,0/-0,025	0,200	+0,004/-0,006	0,076 ±0,003	1,819	+0,0/-0,012	0,085		8 078	16 649
FSE-0200	2,000	1,862		0,200		0,076	1,882		0,085		8 341	17 191
FSE-0206	2,062	1,924		0,200		0,076	1,944		0,085		8 599	17 724
FSE-0212	2,125	1,987		0,200		0,076	2,007		0,085		8 862	18 265
FSE-0218	2,187	2,048		0,200		0,076	2,069		0,085		9 121	18 798
FSE-0225	2,250	2,110		0,200		0,076	2,132		0,085		9 384	19 340
FSE-0231	2,312	2,171		0,200		0,076	2,194		0,085		9 642	19 873
FSE-0237	2,375	2,226		0,200		0,076	2,257		0,085		9 905	20 414
FSE-0243	2,437	2,296		0,200		0,076	2,319		0,085		10 163	20 947
FSE-0250	2,500	2,357		0,200		0,076	2,382		0,085		10 426	21 488
FSE-0256	2,562	2,415		0,200		0,095	2,444		0,104		10 685	26 252
FSE-0262	2,625	2,486		0,200		0,095	2,507		0,104		10 947	26 898
FSE-0268	2,687	2,537	+0,0/-0,030	0,200		0,095 ±0,003	2,569	+0,0/-0,012	0,104		11 206	27 533
FSE-0275	2,750	2,607		0,200		0,095	2,632		0,104		11 469	28 179
FSE-0281	2,812	2,665		0,200		0,095	2,694		0,104		11 727	28 814
FSE-0287	2,875	2,727		0,200		0,095	2,757		0,104		11 990	29 460
FSE-0293	2,937	2,789		0,200		0,095	2,819		0,104		12 249	30 095
FSE-0300	3,000	2,852		0,200		0,095	2,882		0,104		12 511	30 740
FSE-0306	3,062	2,916		0,200		0,095	2,944		0,104		12 770	31 376
FSE-0312	3,125	2,955		0,237		0,095	2,987		0,104		15 242	32 021
FSE-0318	3,187	3,016		0,237	±0,005	0,095	3,049		0,104		15 544	32 657
FSE-0325	3,250	3,079		0,237		0,095	3,112		0,104		15 851	33 302
FSE-0331	3,312	3,140		0,248		0,115	3,174	+0,0/-0,014	0,124	+0,007/-0,0	16 154	39 088
FSE-0337	3,375	3,203	+0,0/-0,035	0,248		0,115	3,237		0,124		16 461	39 831

[1] Add suffix "-S02" for 302 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² psi and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

Smalley Part Number [1, 4]	Shaft Diameter	RING			GROOVE		THRUST CAPACITY	
		Inside Diameter	Radial Wall	Thickness	Diameter	Width	Groove Yield (lb) [2]	Ring Shear (lb) [3]
FSE-0343	3,437	3,264	0,248	0,115	3,299	0,124	16 763	40 563
FSE-0350	3,500	3,326	0,248	0,115	3,362	0,124	17 071	41 307
FSE-0356	3,562	3,378	0,248	0,115	3,424	0,124	17 373	42 038
FSE-0362	3,625	3,451	0,248	0,115	3,487	0,124	17 680	42 782
FSE-0368	3,687	3,512	0,248	0,115	3,549	0,124	17 983	43 514
FSE-0375	3,750	3,570	0,248	0,115	3,612	0,124	18 290	44 257
FSE-0381	3,812	3,636	0,248	0,115	3,674	0,124	18 592	44 989
FSE-0387	3,875	3,689	0,248	0,115	3,737	0,124	18 900	45 732
FSE-0393	3,937	3,760	0,248	0,115	3,799	0,124	19 202	46 464
FSE-0400	4,000	3,828	0,248	0,115	3,862	0,124	19 509	47 208
FSE-0412	4,125	3,930	0,265	0,153	3,967	0,163	23 035	62 126
FSE-0425	4,250	4,050	0,265	0,153	4,092	0,163	23 733	64 008
FSE-0437	4,375	4,174	0,265	0,153	4,217	0,163	24 431	65 891
FSE-0450	4,500	4,297	0,265	0,153	4,342	0,163	25 129	67 774
FSE-0462	4,625	4,421	0,265	0,153	4,467	0,163	25 827	69 656
FSE-0475	4,750	4,530	0,265	0,153	4,592	0,163	26 525	71 539
FSE-0487	4,875	4,668	0,265	0,153	4,717	0,163	27 223	73 421
FSE-0500	5,000	4,792	0,265	0,153	4,842	0,163	27 921	75 304
FSE-0525	5,250	5,039	0,265	0,153	5,092	0,163	29 317	79 069
FSE-0550	5,500	5,292	0,265	0,153	5,342	0,163	30 713	82 834
FSE-0575	5,750	5,535	0,265	0,153	5,592	0,163	32 109	86 599
FSE-0600	6,000	5,744	0,316	0,153	5,804	0,163	41 563	90 365
FSE-0625	6,250	5,992	0,316	0,153	6,054	0,163	43 295	94 130
FSE-0650	6,500	6,236	0,316	0,153	6,304	0,163	45 027	97 895
FSE-0675	6,750	6,486	0,316	0,153	6,554	0,163	46 759	101 727
FSE-0700	7,000	6,734	0,316	0,153	6,804	0,163	48 490	105 494
FSE-0725	7,250	6,993	0,316	0,153	7,054	0,163	50 222	109 262
FSE-0750	7,500	7,219	0,316	0,153	7,304	0,163	51 954	113 030
FSE-0775	7,750	7,477	0,316	0,153	7,554	0,163	53 686	116 797
FSE-0800	8,000	7,683	0,435	0,192	7,764	0,203	66 727	142 932
FSE-0825	8,250	7,940	0,435	0,192	8,014	0,203	68 813	147 399
FSE-0850	8,500	8,179	0,435	0,192	8,264	0,203	70 898	151 866
FSE-0875	8,750	8,427	0,435	0,192	8,514	0,203	72 983	156 332
FSE-0900	9,000	8,673	0,435	0,192	8,764	0,203	75 068	160 799
FSE-0925	9,250	8,922	0,435	0,192	9,014	0,203	77 154	165 265
FSE-0950	9,500	9,130	0,435	0,192	9,240	0,203	87 297	169 732
FSE-0975	9,750	9,393	0,435	0,192	9,490	0,203	89 594	174 199
FSE-1000	10,000	9,586	0,500	0,192	9,686	0,203	110 977	178 665
FSE-1025	10,250	9,826	0,500	0,192	9,936	0,203	113 751	183 132
FSE-1050	10,500	10,081	0,500	0,192	10,186	0,203	116 526	187 599
FSE-1075	10,750	10,329	0,500	0,192	10,436	0,203	119 300	192 065
FSE-1100	11,000	10,584	0,500	0,192	10,686	0,203	122 074	196 532

+0,0/-0,035 | ±0,005 | ±0,003 | +0,0/-0,014 | +0,007/-0,0
+0,0/-0,051 | ±0,004 | +0,0/-0,021
+0,0/-0,060 | ±0,006 | +0,0/-0,024
+0,0/-0,070 | ±0,007 | ±0,005 | +0,0/-0,028
+0,0/-0,091 | +0,0/-0,031

[1] Add suffix "-S02" for 302 stainless steel.
[2] Based on a groove material yield strength of 310 N/mm² and a safety factor of 2.
[3] Based on a safety factor of 3.
[4] See pages 106-107 for How to Order.

CUSTOM FOR YOUR APPLICATION

While Smalley has a large selection of stock retaining rings and wave springs to choose from, the uniqueness of applications often demands a ring or spring to conform to application specific requirements. Our No-Tooling-Cost™ process provides an economical alternative, to produce a custom ring or spring to meet your exact specifications. Think of it as modifying a standard; change the diameter, material size, alloy or nearly any product characteristic to fit within your assembly. It's really a simple solution to get exactly what works best. At Smalley, specials are standard, as many of our accounts take advantage of getting exactly what works best. Retaining rings and wave springs are often the last design consideration in an assembly and commonly have to fit in restrictive spaces and need to provide critical operating characteristics. Having the ability to easily specify non-standard sizes, offers a preferred option designers will often follow.

ECONOMICAL

A common misconception of special designs is the cost. Because of Smalley's unique manufacturing process, application specific retaining rings or wave springs can be an economical solution for your unique needs. With Smalley's No-Tooling-Cost™ process we have the flexibility to quickly manufacture products of different diameter, thickness, material and finish at a minimal cost. This means that during the prototype stage we can produce alternative designs with no tooling modifications. It's not uncommon to produce one prototype for evaluation and subsequently make dimensional adjustments for a second single prototype. That's two setups, NO-TOOLING-CHARGES and a final product produced fast and economical.

AVAILABILITY

Smalley is vertically integrated with onsite material manufacturing and large warehouse. We are able to produce custom rings or springs using a wide variety of readily available materials or can produce custom raw material sizes to meet delivery requirements. For customers who use just-in-time inventory control, Smalley will offer to stock parts for immediate shipment, ready for the next purchase order or blanket order release.

LEAD TIME

Whether you are looking for prototypes, short-runs or high volumes, Smalley's unique No-Tooling-Cost™ manufacturing process allows for special designs to be manufactured in a timely fashion. Since no special dies or forming tools are necessary for custom rings or springs, prototypes can be designed and produced in days, not weeks.

ENGINEERING SUPPORT

Smalley specializes in the design, development and production of custom retaining rings and wave/compression springs. Our design engineers will tailor a design to meet the exact characteristics necessary for individual function, where certain criteria must be considered. For decades we've been doing exactly this at Smalley.

Smalley brings along the combined experience of our engineering staff in designing retaining rings and wave springs for the most demanding of applications. Our capabilities extend well beyond the ordinary manufacturer as we not only design the rings and springs, we design the machinery they run on. We have in depth knowledge of mechanical assemblies, machining operations, fitting components, dynamics and a host of other elements in the diverse universe of mechanical components. Product Application Engineers have designed and solved thousands of tough applications for OEMs in nearly every industry.

Whether it's exposure to high temperature or a cryogenic environment, a dynamic / fatigue problem or simply a static load, we've been involved and resolved complex design issues.

Smalley engineers establish the manufacturing processes needed. This includes primary coiling operations, secondary operations for special product features such as slots, tabs, holes, bends, hooks, joints, etc…, plating & finishing, marking and other characteristics for most any feature required.

To develop a packaging solution, Smalley engineering has created standards with which solutions are offered for consideration. Whether the part is coin-wrapped, bulk packaged, wire tied, on a tube or individually bagged a Smalley engineer is involved with all aspects of handling and shipment.

OPTIMIZED DESIGN

Smalley has developed sophisticated software that optimizes the variables in a given design. It considers both the dimensions of the product and the cost to produce the ring or spring. The typical analysis provides a product that performs to specification but does not over-design dimensions and/or materials that can raise costs. Because our No-Tooling-Cost™ process enables an almost infinite selection of dimensions, the software considers the relationships between maximum stress levels, product configurations & dimensions and pushes the limits in the choices available for the best design. Based upon the criteria selected, Smalley engineers work with you to best determine what design alternatives will work best for a particular application. By making simple design changes; such as material thickness, radial wall, number of waves or selecting a different alloy we can quickly determine the design impact. This time saving technology allows for correct parts to be manufactured and ready to test.

TESTING

In-house testing is performed on our products to ensure that they satisfy our stringent quality standards prior to shipment. Statistical Process Control, SPC, is performed on a sampling of parts to verify that critical dimensions are in control. Smalley has the ability to test various application specific performance characteristics. An example would be cycle life.

CROSS-FUNCTIONAL TEAMS

Housing both the manufacturing and office activities under one roof allows Smalley engineers to be involved in all aspects of support in the manufacturing process. From concept to production our engineers work with quality control, manufacturing, shipping and purchasing to ensure that the design and production process move efficiently and effectively.

RE-ENGINEERING

If you are currently considering using Smalley Spiral Retaining Rings or Wave Springs to replace an existing product, our engineering department will work with you to choose the best new design for your application. Send Smalley a sample of an existing ring or spring, drawings of the assembly or your design requirements and we will engineer and provide new solutions for your consideration.. Once an alternative design is presented, engineering will work with you to obtain exact prototypes or samples of similar products for evaluation and testing.

Mid-Stream design changes can also be accomplished with relative ease. It is not uncommon that dimensions need modification right in the middle of production. Once again, Smalley products can usually be changed at any point in the process by making a machine adjustment, without any tooling changes.

You can count on the flexibility Smalley products offer for all your applications.

Materials Table

The table below presents the more common alloys used by Smalley Steel Ring Company.

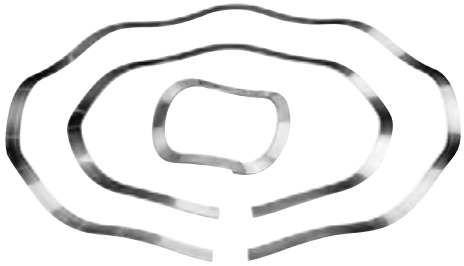
Material	Material Thickness (mm)	Minimum Tensile Strength (N/mm²)	Shear Strength (N/mm²)	Maximum Recommended Operating Temp.[4] (°C)	Modulus of Elasticity (N/mm²)
CARBON STEEL					
OIL TEMPERED	0,152 - 0,356	1 855	1 055	121	206 843
SAE 1070 - 1090	0,357 - 0,533	1 758	1 000		
	0,534 - 1,092	1 524	869		
	1,093 & larger	1 455	827		
HARD DRAWN	0,152 to 0,762	1 586	896		
SAE 1060 - 1075	0,763 - 2,794	1 248	710		
	2,795 - 5,588	1 076	614		
AISI 302	0,051 - 0,559	1 448	820	204	193 053
AMS-5866	0,560 - 1,194	1 379	786		
	1,195 - 1,575	1 276	724		
	1,576 - 1,880	1 207	689		
	1,881 - 2,261	1 138	648		
	2,262 - 2,413	1 069	607		
AISI 316	0,051 - 0,584	1 344	765	204	193 053
ASTM A313 [1]	0,585 - 1,219	1 310	745		
	1,220 - 1,549	1 207	683		
	1,550 & larger	1 172	669		
17-7 PH/C					
CONDITION CH900		1 655	945	343	203 395
AMS-5529					
A-286		1 241	724	538	213 737
AMS-5810					
INCONEL[5] Alloy X-750					
SPRING TEMPER		1 517	862	371	213 737
AMS-5699 [3]					
No. 1 TEMPER		938	531	371	
"Rc 35 MAXIMUM"					
AMS-5699 [1,3]					
No. 1 TEMPER		1 069	607	538	
AMS-5698					
INCONEL[5] Alloy 718		1 241	703	704	204 085
AMS-5596 [1]					
ELGILOY[5]	0,109 - 0,635	1 931	1 103	427	206 843
AMS-5876 [1,3]	0,636 - 1,194	1 758	1 000		
	1,195 - 1,905	1 413	807		
	1,906 - 2,540	1 103	627		
BERYLLIUM COPPER					
TEMPER TH02		1 276	883	204	127 553
ASTM B197 [1]					

NOTE: Additional materials available include Phosphor Bronze, C-276, 410 Stainless Steel, MONEL[5] K-500, MONEL[5] 400, Waspaloy 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 MR-01-75.
[4] Exceeding these temperatures will cause increased relaxation. Consult Smalley Engineering for High Temperature applications.
[5] 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.

MATERIAL TYPES

Selecting the proper material for an application requires a general knowledge of what is commonly available for use in Smalley flat wire products. Specifying the correct material can prevent additional cost and failure in operation. Carbon steel is the most commonly specified material. Stainless steels, although more costly than carbon steel, provide far superior corrosion resistance and have higher temperature operating limits.



CARBON STEEL

OIL TEMPERED

SAE 1070-1090 high carbon tempered spring steel is a standard material for spiral retaining rings and wave springs. Tensile strength and yield strength are maximized as a result of the oil tempered martensitic structure.

HARD DRAWN

SAE 1060-1075 high carbon cold drawn spring steel is a standard material for snap rings. Hard drawn carbon steel has no scale as it receives its strength from the drawing process.

In either temper, carbon steel is best suited in applications having a protected environment as it corrodes if not lubricated or atmospherically sealed. Additional corrosion protection can be added with special finishes. Rings and springs are normally supplied with an oil dip finish providing protection during shipment and for shelf storage.

- Carbon steel is highly magnetic and can be a variety of different colors including blue, black and gray.

STAINLESS STEEL

302 STAINLESS STEEL

302 is the standard stainless steel for spiral retaining rings. This widely used material is specified because of its combination of corrosion resistance and physical properties. 302 obtains its spring temper condition by cold working. Though it is categorized as being a nonmagnetic stainless, 302 becomes slightly magnetic as a result of cold working. It is not hardenable by heat treatment.

- 302 has a silver-gray color.

316 STAINLESS STEEL

Nearly identical in physical properties and heat resistance to 302, 316 provides additional corrosion resistance, particularly against pitting, due to its molybdenum chemical content. 316 is generally used in food, chemical and sea water applications.

316 shows less magnetism than 302. However, as with 302, magnetism increases as the wire is cold reduced. This stainless grade is also not hardenable by heat treatment.

- 316 has a silver-gray color.

17-7 PH/C STAINLESS STEEL

Similar in corrosion resistance to type 302, this alloy is used almost exclusively for wave springs, yet offers both high tensile and yield strengths for special ring applications. In fatigue and high stress applications, 17-7 out performs even the finest grade of carbon steel.

Spring properties are achieved by precipitation hardening Condition C to Condition CH-900. As a result, the material may be subjected to a temperature of 343°C without a loss of spring properties. 17-7 PH C/CH-900 exhibits magnetism similar to high carbon steel.

- After precipitation hardening, 17-7 has a blue, brown or silver color as a result of open-air heat treatment, although atmosphere controlled heat treatment provides a bright color.

SUPER ALLOYS

INCONEL X-750*

This nickel-chromium alloy is used most commonly in high temperature and corrosive environments. Two commonly specified tempers of Inconel are described below.

Most commonly, Inconel X-750 is precipitation heat treated to a spring temper condition. In this state, it has temperature resistance to 371°C. The National Association of Corrosion Engineers (NACE) approves this hard temper to specification MR-01-75 (R_C50 maximum) for spiral retaining rings and wave/compression springs.

#1 temper, which requires a longer heat treatment than spring temper, has a lower tensile strength but provides temperature protection to 538°C.

Both spring temper and #1 temper may be heat treated in either an open air or atmosphere controlled furnace. Open air heat treatment may produce oxidation, which often results in a slight black residue. An atmosphere controlled environment eliminates oxidation and produces a component with no residue.

- Rings and springs manufactured from this grade of Inconel have a blue/silver-gray color and exhibit no magnetism.

A286 ALLOY

In applications up to 538°C, this alloy exhibits similar properties to Inconel X-750. Its spring temper condition is obtained by precipitation hardening. A286 may be heat treated similar to spring temper and #1 temper Inconel.

- This material exhibits no magnetism and has a blue/silver-gray color.

ELGILOY*

Known for its excellent resistance to corrosive environments and use at elevated temperatures, this relatively new spring material is now readily available from Smalley. Commonly used in oil industry applications, Elgiloy shows improved reliability over other NACE approved materials by resisting sulfide stress cracking. Additionally, Elgiloy is said to out perform "over 600% better than 17-7 PH in load retention at 343°C and provide over 100% more cycles (in fatigue resistance) than carbon steel, without breakage."

- Elgiloy exhibits no magnetism and is blue-brown in color as a result of heat treatment.

COPPERS

BERYLLIUM COPPER ALLOY #25

Normally specified in a hard temper, this alloy produces excellent spring properties due to 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 offers remarkable resistance to loss of physical properties at elevated temperatures.

- Beryllium copper is nonmagnetic. Its electrical conductivity is about 2-4 times as great as phosphor bronze

PHOSPHOR BRONZE, GRADE A

Phosphor bronze offers fair spring properties, fair electrical conductivity and is rated a step below beryllium copper in performance. It is purchased in a spring temper condition to maximize spring characteristics.

- Phosphor bronze is hardenable only by cold working. This material is also nonmagnetic.

* ELGILOY is a registered trademark of Combined Metals of Chicago. INCONEL X-750 is a registered trademark of Special Metals Corporation.

MATERIAL FINISHES

BLACK OXIDE

MIL-DTL-13924, Class 1

This finish provides a flat black finish. Black oxide is intended more for cosmetic appearance than for corrosion resistance.

CADMIUM PLATING

Cadmium Plate, AMS-QQ-P-416, Class 2, Type I

Cadmium Plate w/Chromate Dip, AMS-QQ-P-416, Class 2, Type II

Cadmium plating is used on carbon steel to increase the corrosion resistance of the product. The process of cadmium plating spiral retaining rings is costly and subjects the ring to the possibility of hydrogen embrittlement. Smalley offers stainless steel as the preferable option to cadmium.

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, which have become imbedded in the surface of stainless steel during production. If not dissolved, these foreign particles could promote rusting, discoloration or even pitting.

In theory, the corrosion resistance of stainless steel is due to the thin, invisible oxide film that completely covers the surface of the ring and prevents further oxidation. Removing the contaminates prevents breaks in the oxide film for optimum corrosion resistance.

ZINC PHOSPHATE

MIL-DTL-16232, Type Z, Class 2

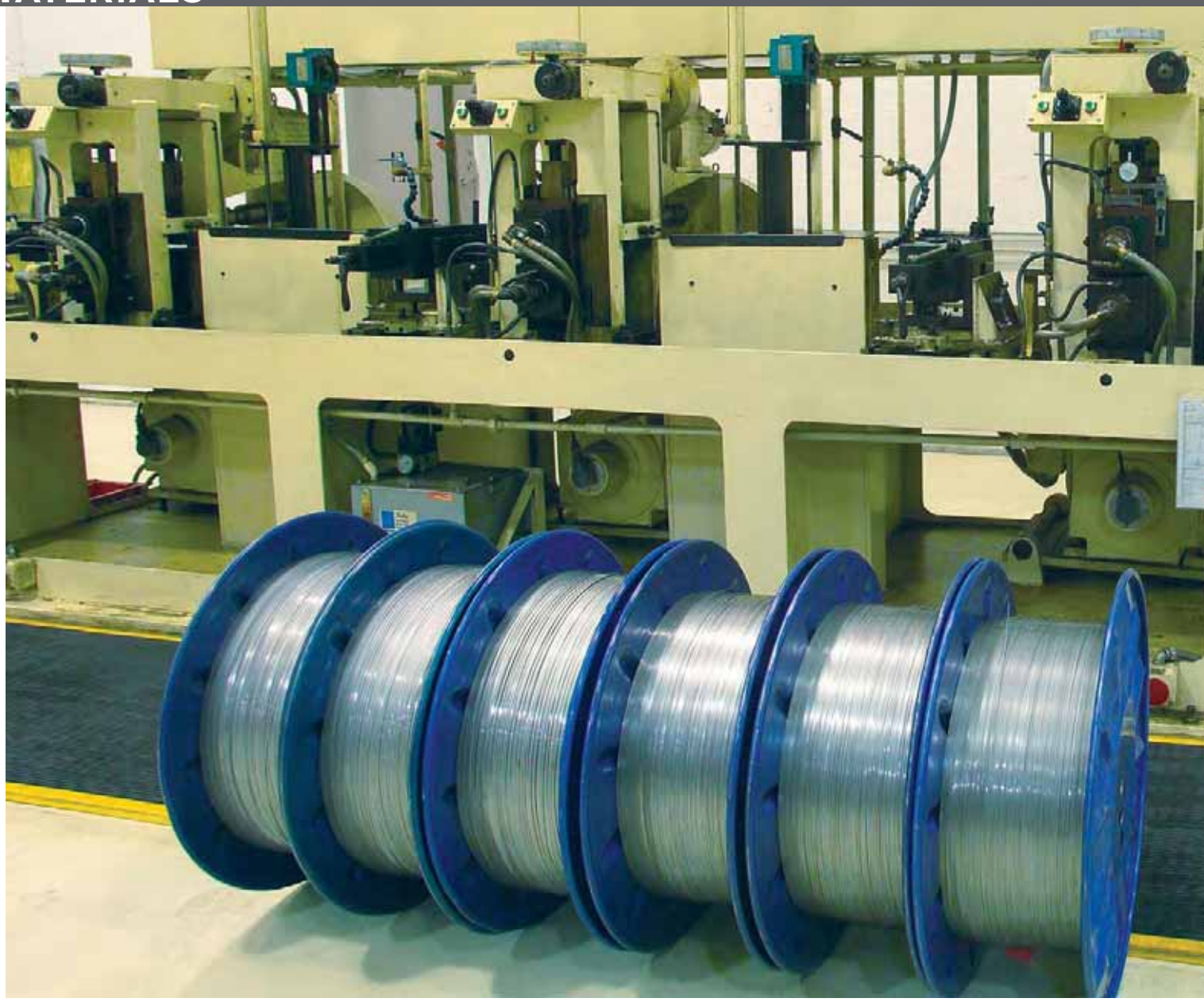
This finish is sometimes referred to as “Parkerizing” and appears gray-black in color. The corrosion resistance of phosphate is superior to black oxide but inferior to cadmium plating or stainless steel. Phosphate can not be applied to stainless steel.

VAPOR DEGREASE/ULTRASONIC CLEAN

This is the standard cleaning and finish for all stainless steels. The process removes oil and other organic compounds from the material surface by use of a chlorinated solvent. The solvent effectively removes oil and grease from the exposed surfaces of the ring or spring. Ultrasonics are used in forcing the solvent to act between the turns of the ring.

VIBRATORY DEBURR/HAND DEBURR

Though all circumferential surfaces and edges of Smalley Rings are smooth, sharp corners are always present on the gap ends due to the cut-off operation. To break the sharp corners, achieving a blended/smooth surface finish, rings may either be vibratory or hand deburred to meet your specifications.

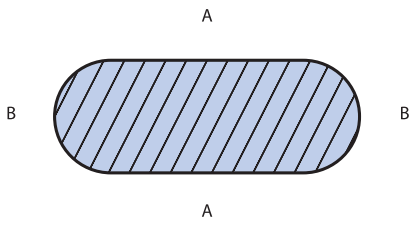


SPECIFICATIONS

Federal, aerospace and other regulating agencies have prepared several specifications for sheet and strip materials, but few have been published for flat wire. Smalley procures its material to internally generated specifications. In addition to controlling tensile strength, rigid inspection procedures have been established to check for edge contour, physical imperfections, camber, cross-section and chemical composition.

ULTIMATE TENSILE STRENGTH

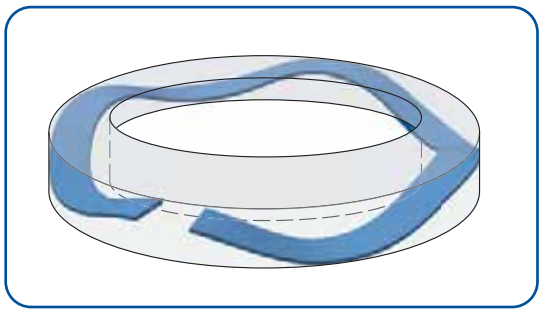
To check the spring properties of wire Ultimate Tensile Strength is the preferred test method over hardness because spring temper flat wire develops different hardnesses at various indentation points. As a result of cold rolling, the top and bottom surfaces ("A") become harder as they are more severely worked than the round edge areas ("B"). Tensile tests are more consistent as they evaluate the entire cross-section, not a single point as in a hardness test.



SPRING DESIGN

DEFINING THE SPRING REQUIREMENTS

Although wave spring applications are extremely diverse, there is a consistently basic set of rules for defining spring requirements. Those requirements are used to select a stock/standard spring or design a special spring to meet the specifications.

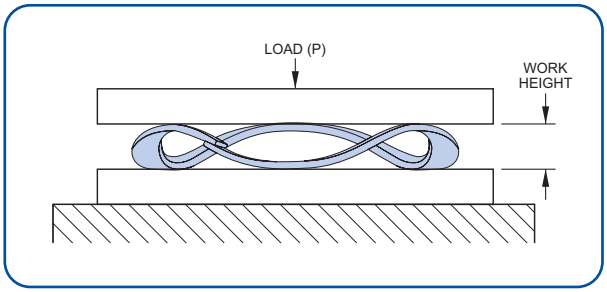


WORKING CAVITY

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

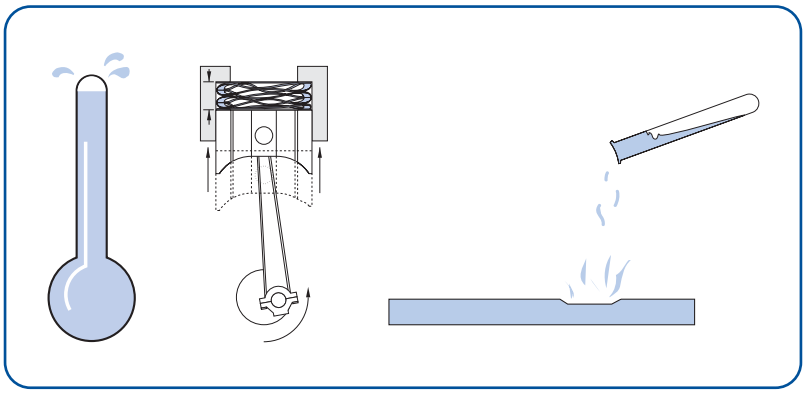
LOAD REQUIREMENT

The load requirement is defined by the amount of axial force the spring must produce when installed at its work height. Some applications require multiple working heights, where loads at 2 or more operating heights are critical and must be considered in the design. Often minimum and/or maximum loads are satisfactory solutions, particularly where tolerance stack-ups are inherent in the application.



OPERATING ENVIRONMENT

High temperature, dynamic loading (fatigue), a corrosive media or other unusual operating conditions must be considered in spring applications. Solutions to various environmental conditions typically require selection of the optimal raw material and operating stress.



STANDARD SPRINGS vs. SPECIAL SPRINGS

Finding the right spring can be as easy as selecting a standard catalog item. A Smalley engineer can help you choose from over 2 000 standard parts available from stock in carbon and stainless steel. Smalley's "no-tooling" method of manufacturing provides the utmost in flexibility and quality. Whether the requirement is for 1 spring or 1 000 000 consider Smalley for your special spring requirements.

LET SMALLEY DESIGN YOUR SPRING

Over 50% of Smalley's business is in the design and manufacturing of special springs to suit individual applications. Whether it's a technical question, or the most complex spring design, Smalley engineers are always available and welcome the opportunity to assist you. Utilize the Application Checklist found in this catalog. Or at www.smalley.com we provide a simple procedure to e-mail us your known design parameters. An engineer will recommend a standard catalog item or provide you with design options for a special spring.

NOMENCLATURE

b	Radial Width of Material, mm [(O.D. - I.D.)÷2]
D_m	Mean Diameter, mm [(O.D. + I.D.)÷2]
E	Modulus of Elasticity, N/mm²
f	Deflection, mm
H	Free height, mm
I.D.	Inside Diameter, mm
K	Multiple Wave Factor, see Table 1
L	Length, Overall Linear, mm
N	Number of Waves (per turn)
O.D.	Outside Diameter, mm
P	Load, N
S	Operating Stress, N/mm²
t	Thickness of Material, mm
W.H.	Work Height, mm (H-f)
Z	Number of Turns

Table 1

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

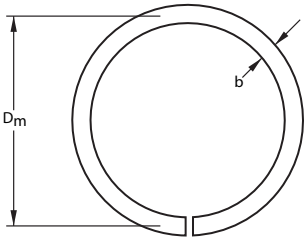
SINGLE TURN GAP OR OVERLAP TYPE

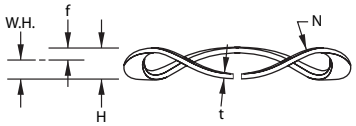
APPLICATIONS

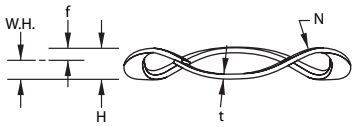
1. Low-Medium Force
2. Low-Medium Spring Rate
3. Short Deflection
4. Precise Load/Deflection Characteristics

Single turn wave springs are the basic and most common wave spring product. They are used in the widest variety of spring applications due to their lower cost and simplified design configuration.

Single turn wave springs provide the most flexibility to designers. There are few restrictions in their design. They are specified in the majority of small axial and radial space constraint applications.







FORMULAS:

$$\text{Deflection} = f = \frac{P\ K\ D_m^3}{E\ b\ t^3\ N^4} * \frac{\text{I.D.}}{\text{O.D.}}$$

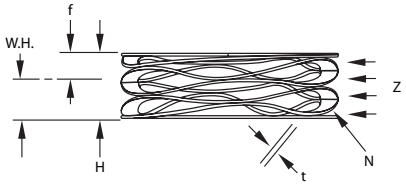
$$\text{Operating Stress} = S = \frac{3\ \pi\ P\ D_m}{4\ b\ t^2\ N^2}$$

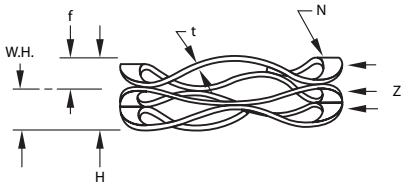
CREST–TO–CREST® SPIRAWAVE (SERIES STACKED)

APPLICATIONS

1. Low-Medium Force
2. Low-Medium Spring Rate
3. Long Deflection
4. Precise Load/Deflection Characteristics

Crest-to-Crest Spirawave flat wire compression springs are pre-stacked in series, decreasing the spring rate by a factor related to the number of turns.





FORMULAS:

$$\text{Deflection} = f = \frac{P\ K\ D_m^3\ Z}{E\ b\ t^3\ N^4} * \frac{\text{I.D.}}{\text{O.D.}}$$

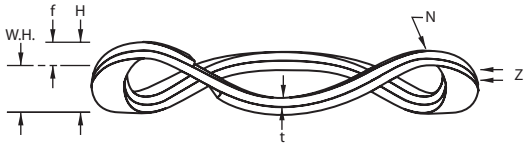
$$\text{Operating Stress} = S = \frac{3\ \pi\ P\ D_m}{4\ b\ t^2\ N^2}$$

Note: N must be in ½ wave increments
Z = Number of active turns

NESTED SPIRAWAVE® (PARALLEL STACKED)

1. Higher Force
2. Higher Spring Rate
3. Short Deflection
4. Precise Load/Deflection Characteristics

Nested Spirawave Wave Springs are pre-stacked in parallel, increasing the spring rate by a factor related to the number of turns.



FORMULAS:

$$\text{Deflection} = f = \frac{P\,K\,D_m^3}{E\,b\,t^3\,N^4\,Z} * \frac{\text{I.D.}}{\text{O.D.}} \qquad \text{Operating Stress} = S = \frac{3\,\pi\,P\,D_m}{4\,b\,t^2\,N^2\,Z}$$

EXAMPLE: Smalley Part Number SSB-0158

Calculate free height and operating stress for Smalley part number SSB-0158 (Gap Type, Single Turn, Carbon Spring Temper Steel).

Where:

P = 111,2 N
t = 0,46 mm
b = 3,63 mm
O.D = 40,00 mm
I.D. = 32,74 mm
D_m = 36,37 mm
N = 3
E = 206 843 N/mm²
K = 3,88
W.H. = 1,98 mm

$$\text{Deflection} = f = \frac{(111{,}2)(3{,}88)(36{,}37)^3}{(206\,843)(3{,}63)(0{,}46)^3(3)^4} * \frac{32{,}74}{40{,}00} = 2{,}87 \text{ mm}$$

*Free Height = H = (W.H. + f) = 1,98 + 2,87 = 4,85 mm

$$\text{Operating Stress} = S = \frac{(3)(\pi)(111{,}2)(36{,}37)}{(4)(3{,}63)(0{,}46)^2(3)^2} = 1\,378 \text{ N/mm}^2$$

*Calculated free height may not be the same as the actual springs measure due to variations in raw material and manufacturing process.

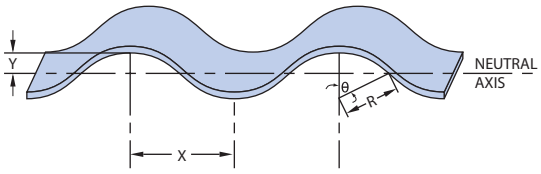
DIAMETER EXPANSION

Nested & Crest-to-Crest Spirawaves Only: Multiple turn Spirawaves expand in diameter when compressed. The formula shown below is used to predict the maximum fully compressed diameter.

FORMULA: Maximum outside diameter at 100% deflection (solid height) = 0,02222 * R * N * θ + b

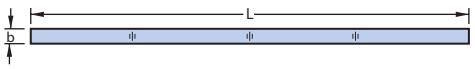
Where:

R = Wave Radius = $(4Y^2 + X^2) \div 8Y$
N = Number of Waves
θ = Angle, degrees = ArcSin (X÷2R)
b = Radial Wall
X = ½ Wave Frequency = $\pi D_m \div 2N$
Y = ½ Mean Free Height = (H-t)÷2
Where H = Per Turn Free Height

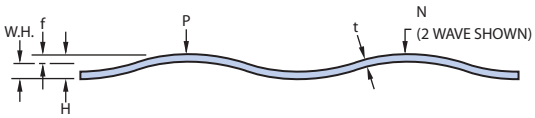


LINEAR EXPANDERS

Linear Expanders are a continuous wave formed (marcelled) wire length produced from spring temper materials. They act as a load bearing device having approximately the same load/deflection characteristics as a wave spring.



Forces act axially or radially depending on the installed position. Axial pressure is obtained by lying the expander flat in a straight line. Circular wrapping the expander (around a piston for example) produces a radial force or outward pressure.



FORMULA: *Single* wave expander where N=1

$$\text{Deflection} = f = \frac{P\,L^3}{4\,E\,b\,t^3} \qquad \text{Operating Stress} = S = \frac{3\,P\,L}{2\,b\,t^2}$$

FORMULA: *2 or more* wave expander where N>1

$$\text{Deflection} = f = \frac{P\,L^3}{16\,E\,b\,t^3\,N^4} \qquad \text{Operating Stress} = S = \frac{3\,P\,L}{4\,b\,t^2\,N^2}$$

ENGINEERING

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

Static Applications Smalley utilizes the Minimum Tensile Strength found in this catalog's "Materials" section to approximate yield strength due to the minimal elongation of the hardened flat wire used in Smalley products. When designing springs for static applications we recommend the calculated operating stress be no greater than 100% of the minimum tensile strength. However, depending on certain applications, operating stress can exceed the minimum tensile strength with allowances for yield strength. Typical factors to consider are permanent set, relaxation, loss of load and/or loss of free height.

Dynamic Applications When designing wave springs for dynamic applications, Smalley recommends that the calculation of operating stress not exceed 80% of the minimum tensile strength. Refer to the "Fatigue Stress Ratio" 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 or "presetting". Preset springs are manufactured to a higher than needed free height and load and then compressed solid. Both the free height and load are reduced and the material surfaces now exhibit residual stresses, which enhance spring performance.

FATIGUE

Fatigue cycling is an important consideration in wave spring design and determining precisely how much the spring will deflect can greatly impact the price of the spring. An analysis should include whether the spring deflects full stroke or only a few thousandths each cycle or possibly a combination of both as parts wear or temperature changes.

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

FORMULA:

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

(refer to Table 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
< 0,40	Under 30 000
0,40 - 0,49	30 000 – 50 000
0,50 - 0,55	50 000 – 75 000
0,56 - 0,60	75 000 – 100 000
0,61 - 0,67	100 000 – 200 000
0,68 - 0,70	200 000 – 1 000 000
> 0,70	Over 1 000 000

Table 2

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 (ΔForce/ΔWorking Height) can be calculated by manipulating the deflection equations. See formulas in the spring design section.

Figure 1 shows a graph of theoretical and tested spring rate. Typically, theoretical rate is accurate until the spring starts to bottom out or reach its "solid height".

As a general rule, the calculated spring rate is linear through the first 80% of available deflection and for work heights down to 2 times the solid height. Although the spring can operate beyond this "linear" range, measured loads will be much higher than calculated.

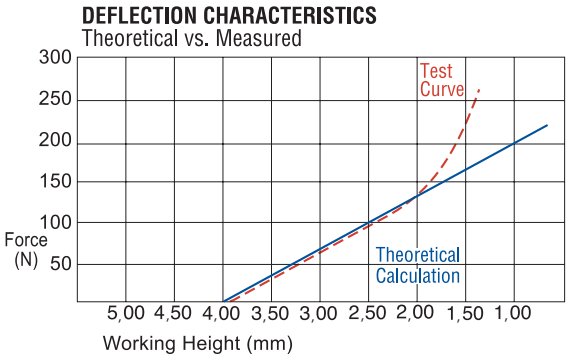


Figure 1

HYSTERESIS

Wave springs exert a greater force upon loading and lower force upon unloading. This effect is known as hysteresis. The shaded area shows a graphic representation between the curves in Figure 2.

In a single turn spring, friction due to circumferential and radial movements are the prime causes. Crest-to-Crest and Nested Springs also contribute to the frictional loss as adjacent layers rub against each other. Sufficient lubrication will minimize this effect.

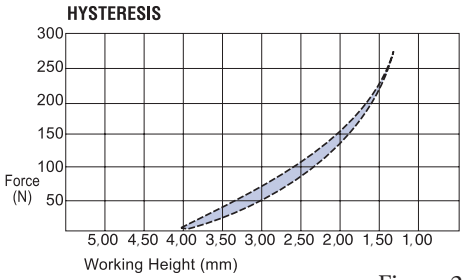


Figure 2

DESIGN GUIDELINES

MATERIAL CROSS-SECTION

Material cross-section plays an important role in wave spring design. The most economical materials are those used in manufacturing Smalley standard springs and retaining rings. In addition, many other material cross sections are commonly used in special spring manufacture designs. Smalley engineering can provide assistance in selecting an economical alloy and cross section.

As a basic guideline, use our standard 'SSR'-Wave Spring series for cross-section/diameter relationships. Lighter material sections are usually acceptable. Heavier 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

For Overlap Type Wave Springs and multiple turn Spirawaves, the radial wall must be sufficient to prevent misalignment between adjacent layers. For springs with a narrow radial wall, radial misalignment can occur during handling or during operation if the spring is not contained or closely piloted.

Solutions to this problem include dimensioning the spring to pilot closely on the I.D. and/or O.D. or designing the spring as a single turn Gap Type.

DIAMETERS

Figure 3 illustrates two methods of specifying diameters. In either case, the spring diameter is developed to provide proper operation between the bore and the shaft.

Note: Smalley's manufacturing process of edgewinding controls either the O.D. or the I.D. The material radial wall is also tightly controlled. Therefore whenever possible, tolerance only one diameter and the radial wall instead of tolerancing both the O.D. and I.D.

BORE PILOT

For springs that pilot in the bore as shown in figure 3a, 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.

For Gap Type and Overlap Type Springs, the outside diameter can be specified because binding is not a concern. The outside diameter can be toleranced to provide a minimum clearance in the bore or provide cling in the bore, as do the Smalley Bearing Preload Springs.

SHAFT PILOT

For springs that pilot on a shaft as shown in Figure 3b, 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 insure 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."

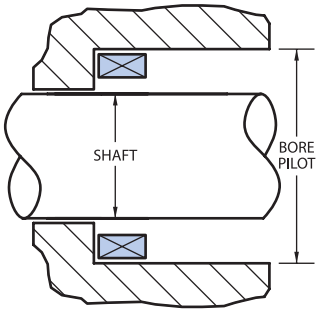


Figure 3a

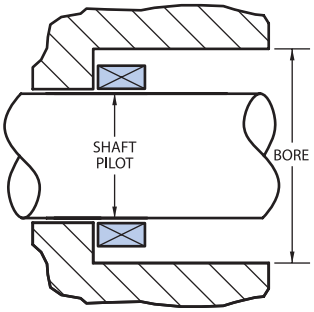


Figure 3b

ENGINEERING DESIGN

Smalley Spiral Retaining Ring and Snap 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 Application Engineers are available to provide immediate technical assistance.

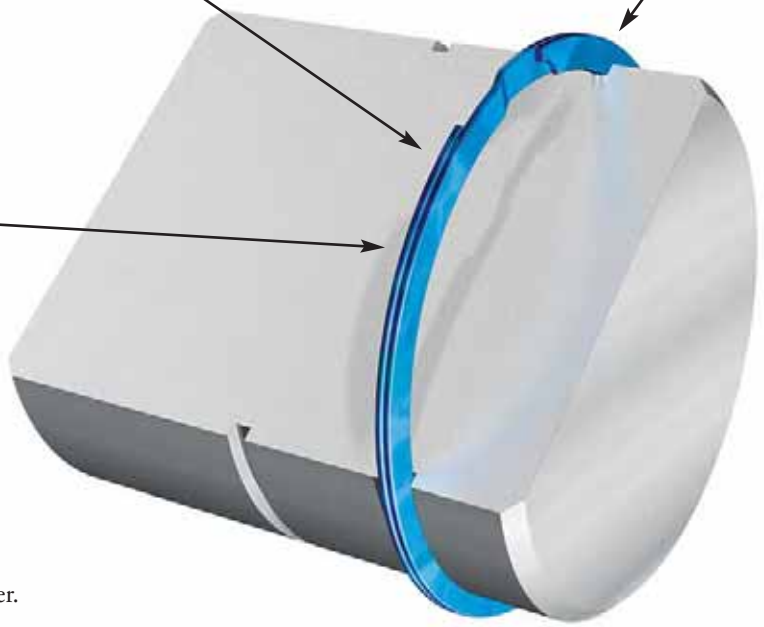
The following pages of Spiral Retaining Ring and Snap Ring engineering design have been developed from over 40 years of extensive testing and research into the various applications of retaining rings. The formulas are provided for the preliminary analysis of a ring application and the design of a Smalley® 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. Smalley Spiral Retaining Rings offer a distinct alternative and in many instances an advantage over the more common retaining rings available on the market today. Some of the major distinctions are:

360° RETAINING SURFACE
No gap – no protruding ears.

SPIRAL WOUND IN MULTIPLE TURNS
Increases load capacity yet allows easy assembly by hand or as an automated process.

Diameters from 5 mm to 2 300 mm



UNIFORM RADIAL SECTION
Provides a pleasant appearance on the assembled product. Beneficial when radial clearance is limited.

SIMPLIFIED ASSEMBLY
Wind into groove. No special pliers/tools needed to install or remove. Removal notch provided for easy removal using a screwdriver.

DESIGN FLEXIBILITY
Ring thickness can be changed to accommodate most any application by either varying material thickness and/or number of turns. Standard rings meet military and aerospace specifications. Special designs are produced quick and economical in many alloys.

LOAD CAPACITY

Understanding the load capacity of a Smalley Retaining Ring assembly requires calculations for both ring shear and groove deformation, with the design limitation being the lesser of the two.

The load capacity formulas do not take into account any dynamic or eccentric loading. If this type of loading exists, the proper safety factor should be applied and product testing conducted. In addition, the groove geometry and edge margin (i.e., the distance of the groove from the end of the shaft or housing) should be considered.

When abusive operating conditions exist, true ring performance is best determined thorough actual testing.

RING SHEAR

Although not commonly associated as a typical failure of Smalley 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 within this catalog's tables of standard rings. These values are based on a shear strength of carbon steel with the recommended safety factor of 3.

FORMULA:

$$P_R = \frac{D\ T\ S_S\ \pi}{K}$$

Where:

P_R = Allowable thrust load based on ring shear (N)

D = Shaft or housing diameter (mm)

T = Ring thickness (mm)

S_S = Shear strength of ring material (N/mm²)

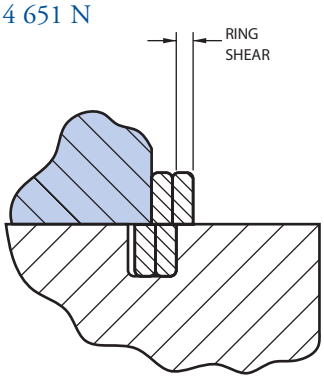
K = Safety factor (3 recommended)

EXAMPLE:

1. EH-20-S02
2. Safety factor = 3

$$P_R = \frac{20{,}00\ (0{,}89)\ 786\ (\pi)}{3}$$

$$P_R = 14\ 651\ N$$



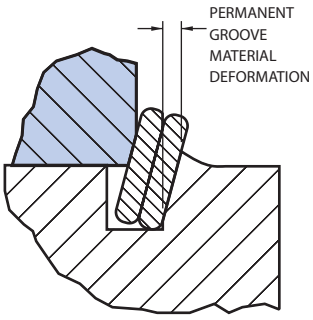
The thrust load based on ring shear above, must be compared to the thrust load based on groove deformation to determine which is the limiting factor in the design.

GROOVE DEFORMATION (YIELD)

Groove deformation is by far the most common design limitation of retaining rings. As permanent groove deformation occurs, the ring begins to twist. As the angle of twist increases, the ring begins to enlarge in diameter. Ultimately, the ring becomes dished and extrudes (rolls) out of the groove. As a conservative interpretation, the following equation calculates the point of initial groove deformation. This does not constitute failure which occurs at a much higher value. A safety factor of 2 is suggested. Ring thrust load capabilities based on groove deformation are provided within this catalog's tables of standard rings.

FORMULA:

$$P_G = \frac{D\ d\ S_y\ \pi}{K}$$



Where:

P_G = Allowable thrust load based on groove deformation (N)

D = Shaft or housing diameter (mm)

d = Groove depth (mm)

S_y = Yield strength of groove material (N/mm²), see Table 1

K = Safety factor (2 recommended)

EXAMPLE:

1. EH-20-S02
2. Groove material yield strength = 310 N/mm²
3. Safety factor = 2

$$P_G = \frac{20{,}00\ (0{,}61)\ 310\ (\pi)}{2}$$

$$P_G = 5\ 941\ N$$

TYPICAL GROOVE MATERIAL YIELD STRENGTHS

Hardened Steel 8620	750 N/mm²
Cold Drawn Steel 1018	500 N/mm²
Hot Rolled Steel 1018	310 N/mm²
Aluminum 2017	275 N/mm²
Cast Iron	70-275 N/mm²

Table 1

Since ring shear was calculated at 14 651 N, the groove yields before the ring shears. Therefore 5 941 N is the load capacity of the retaining ring.

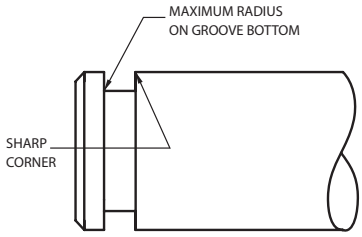
GROOVE GEOMETRY

GROOVE RADIUS

To assure maximum load capacity it is essential to have square corners on the groove and retained components. Additionally, retained components must always be square to the ring groove in order to maintain a uniform concentric load against the retained part. The radius at the bottom of the groove should be no larger than table 2 states.

SHAFT OR HOUSING DIAMETER	MAXIMUM RADIUS ON GROOVE BOTTOM
25 mm and under	0,10 Max.
Over 25 mm	0,25 Max.

Table 2



RETAINED COMPONENT

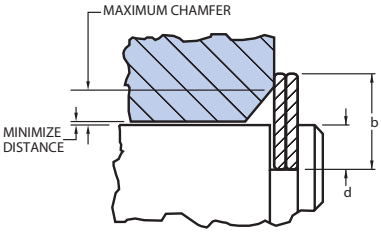
The retained part ideally has a square corner and contacts the ring as close as possible to the housing or shaft. The maximum recommended radius or chamfer allowable on the retained part can be calculated with the following formulas.

Where:
- b = Radial wall (mm)
- d = Groove depth (mm)

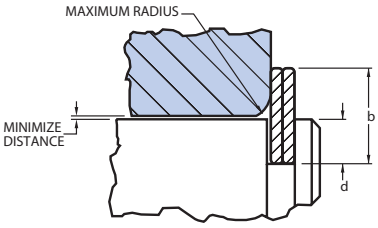
EXAMPLE:
1. DNH-100

Maximum Chamfer = 0,375(6,05-1,61) = 1,61 mm
Maximum Radius = 0,5(6,05-1,75) = 2,15 mm

FORMULA:
Maximum Chamfer = 0,375(b - d)
(on retained component)



FORMULA:
Maximum Radius = 0,5(b - d)
(on retained component)



EDGE MARGIN

Ring grooves which are located near the end of a shaft or housing should have an adequate edge margin to maximize strength. Both shear and bending should be checked and the larger value selected for the edge margin. As a general rule, the minimum edge margin may be approximated by a value of 3 times the groove depth.

FORMULA:

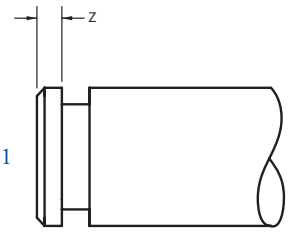
Shear

$$z = \frac{K\ 3\ P}{S_Y\ D_G\ \pi}$$

Bending

$$z = \left[\frac{K\ 6\ d\ P}{S_Y\ D_G\ \pi}\right]^{\frac{1}{2}}$$

Where:
- z = Edge margin (mm)
- P = Load (N)
- D_G = Groove diameter (mm)
- S_Y = Yield strength of groove material (N/mm²), Table 1
- d = Groove depth (mm)
- K = Safety factor (3 recommended)



EXAMPLE:
1. FS-040
2. Groove material yield strength = 310 N/mm²
3. Safety factor = 3
4. Load = 5 000 N

Shear

$$z = \frac{3\ (3)\ 5\ 000}{310\ (37{,}50)\ \pi}$$

$z = 1{,}23$ mm

Bending

$$z = \left[\frac{3\ (6)\ 1{,}25\ (5\ 000)}{310\ (37{,}50)\ \pi}\right]^{\frac{1}{2}}$$

$z = 1{,}76$ mm

Therefore the minimum edge margin that should be used is 1,76 mm

ROTATIONAL CAPACITY

The maximum recommended RPM for all standard external Smalley Retaining Rings are listed in the ring tables of this manual.

A Smalley Retaining Ring, operating on a rotating shaft, can be limited by centrifugal forces. Failure may occur when these centrifugal forces are great enough to lift the ring from the groove. The formula below calculates the RPM at which the force holding the ring tight on the groove (cling) becomes zero.

Rapid acceleration of the assembly may cause failure of the retaining ring. If this is a potential problem, contact Smalley engineering for design assistance.

MAXIMUM RPM

FORMULA:

$$N = \left[\frac{3\,600\ V\ E\ I\ g}{(4\pi^2)\ Y\ \gamma\ A\ R_M^{\,5}} \right]^{\frac{1}{2}}$$

n	1	2	3	4
Y	1,909	3,407	4,958	6,520

Table 3

Where: N = Maximum allowable rpm (rpm)
E = Modulus of elasticity (N/mm^2)
I = Moment of inertia = $(t \times b^3) \div 12$ (mm^4)
g = Gravitational acceleration (mm/sec^2), 9 810 mm/sec^2
V = Cling÷2 = $(D_G - D_I) \div 2$ (mm)
D_G = Groove diameter (mm)
D_I = Free inside diameter (mm)
Y = Multiple turn factor, Table 3
n = Number of turns
γ = Material density (N/mm^3), (assume $7{,}68 \times 10^{-5}$ N/mm^3)
A = Cross sectional area = $(t \times b) - (0{,}12)t^2$ (mm^2)
t = Material thickness (mm)
b = Radial wall (mm)
R_M = Mean free radius = $(D_I + b) \div 2$ (mm)

EXAMPLE:

1. DNS-60

V = $(D_G - D_I) \div 2 = (57{,}00 - 56{,}41) \div 2 = 0{,}30$ mm
I = $(t \times b^3) \div 12 = (0{,}91 \times 5{,}08^3) \div 12 = 9{,}94\ mm^4$
A = $(t \times b) - (0{,}12)t^2 = (0{,}91 \times 5{,}08) - 0{,}12(0{,}91)^2 = 4{,}52\ mm^2$
$R_M = (D_I + b) \div 2 = (56{,}41 + 5{,}08) \div 2 = 30{,}75$ mm

$$N = \left[\frac{3\,600\ (0{,}30)\ 206\,843\ (9{,}94)\ 9\,810}{(4\pi^2)\ 3{,}407\ (7{,}68 \times 10^{-5})\ 4{,}52\ (30{,}75)^5} \right]^{\frac{1}{2}}$$

N = 4 119 rpm

SELF-LOCKING

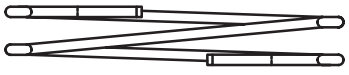
This feature allows the ring to function properly at speeds that exceed the recommended rotational capacity. The self-locking option can be incorporated for both external and internal rings. The self-locking feature utilizes a small tab on the inside turn "locking" into a slot on the outside turn. Self-locking allows the ring to operate at high speeds, withstand vibration, function under rapid acceleration and absorb a degree of impact loading.

BALANCED

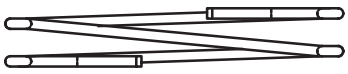
Smalley's balanced feature statically balances the retaining ring. A series of slots, opposite the gap end, account for the missing material in the gap. This characteristic is very useful when the balance of the assembly is critical and it is necessary to reduce eccentric loading.

LEFT HAND WOUND

Smalley retaining rings are wound standard in a clockwise direction. In special applications it is sometimes favorable to have the retaining ring reverse, left hand wound.



Right Hand (Standard Wound)



Left Hand (Reverse Wound)

MAXIMUM ALLOWABLE RPM FOR SMALLEY® RETAINING RINGS — METRIC

PART NUMBER	VSM	ES	DNS	FS
6	51 561	-	-	-
7	39 742	-	-	-
8	40 518	-	-	-
9	35 627	-	-	-
10	31 833	-	-	-
11	25 202	-	-	-
12	30 875	22 153	-	-
13	26 805	20 094	22 915	31 185
14	22 359	18 471	19 967	21 602
15	19 625	14 543	17 836	24 273
16	17 364	14 149	18 132	29 110
17	14 958	15 923	15 677	19 841
18	13 439	12 233	16 195	22 605
19	12 140	11 685	14 221	20 417
20	11 066	10 810	12 948	18 532
21	15 326	9 641	12 475	16 896
22	13 341	10 397	11 421	13 523
23	-	9 652	10 495	14 213
24	11 035	8 479	10 825	19 083
25	10 214	8 524	10 020	11 982
26	12 483	8 642	9 301	12 494
27	-	11 357	8 721	14 320
28	10 648	10 259	8 609	15 229
29	9 973	9 765	8 060	18 016
30	9 534	9 149	7 562	12 189
31	-	8 495	-	-
32	8 437	7 778	8 686	14 215
33	-	-	8 205	9 511
34	7 398	7 982	7 763	10 847
35	7 004	7 485	7 628	11 685
36	6 641	6 903	8 474	11 640
37	-	7 227	-	-
38	5 994	7 174	7 556	10 520
40	7 573	6 172	7 181	10 841
42	6 888	5 715	6 546	8 972
45	6 021	5 158	5 740	7 861
46	-	4 909	5 505	7 006
47	-	5 570	5 283	7 232
48	5 309	5 744	5 075	7 881
50	4 901	4 084	5 651	7 885
52	6 057	3 616	5 251	7 318
53	-	3 450	-	-
54	-	3 295	4 842	6 811
55	5 380	3 360	4 680	6 576
56	5 238	3 215	4 525	6 354
58	4 890	3 111	4 359	5 942
59	-	2 982	-	-
60	4 575	2 862	4 050	4 793
61	-	2 683	-	-
62	4 323	2 884	3 738	5 490
63	4 220	2 773	3 691	5 071
64	-	2 780	-	-
65	3 967	2 577	3 430	4 806
66	-	2 526	-	-
67	-	2 275	3 239	4 463
68	3 602	2 486	3 201	3 945
69	-	2 438	-	-
70	3 402	2 315	2 982	4 411
71	-	2 309	-	-
72	3 218	2 321	2 805	3 947
75	2 949	2 152	2 537	3 648
77	-	-	2 379	3 467
78	3 158	2 007	2 304	3 731
80	3 025	1 981	2 576	3 747
82	2 900	1 895	2 425	3 574
85	2 703	1 825	2 333	3 476
88	2 526	1 737	2 143	3 252
90	2 443	1 721	2 029	2 731
92	-	-	-	-
95	2 174	1 509	1 777	2 598
98	-	-	1 659	2 377
100	1 955	1 508	1 579	2 542
102			1 530	2 746
105	2 082	1 399	1 435	2 640
108			1 368	2 418
110	1 902	1 323	1 391	2 279
115	1 745	1 248	1 280	2 090
120	1 606	1 176	1 175	1 694
125	1 483	1 092	1 088	1 778
130	1 374	993	1 017	1 647
135	1 270	934	952	1 530
140	1 186	870	888	1 519
145		821	835	1 331
150	1 022	755	788	1 470
155	961	891	733	1 379
160	1 060	831	690	1 296
165	1 000	795	753	1 201
170	945	749	715	1 151
175	894	697	671	1 088
180	848	657	636	1 030
185	898	631	601	1 115
190	854	591	577	860
195	813	569	551	880
200	775	534	518	837
205			495	1 068
210	802	579	466	1 077
220	734	530	425	932
230	674	482	527	854
240	622	444	486	735
250	575	413	451	726
260	582	381	424	743
270	541	354	390	718
280	505	328	363	714
290	472	-	382	624
300	443	-	357	584
310	-	-	342	-
320	-	-	316	-
330	-	-	299	-
340	-	-	343	-
350	-	-	322	-
360	-	-	305	-
370	-	-	291	-
380	-	-	276	-
390	-	-	262	-
400	-	-	251	-

MAXIMUM ALLOWABLE RPM FOR SMALLEY® RETAINING RINGS — SAE

PART NUMBER	VS	WS	WST	WSM	FSE
25	45 227	–	–	36 651	–
31	39 946	–	–	31 364	–
37	31 161	–	–	23 025	–
43	24 067	–	–	18 019	–
46	–	–	28 820	21 450	–
50	28 030	24 650	20 780	20 600	32 573
53	–	21 280	–	–	–
55	–	19 440	18 130	18 260	–
56	21 060	18 520	17 270	17 400	32 410
59	–	17 290	15 200	15 390	–
62	17 850	19 500	15 700	14 730	22 107
65	–	16 270	–	–	–
66	–	16 510	15 600	13 860	–
68	15 340	15 470	15 600	13 510	19 520
71	–	13 050	–	–	–
75	12 350	14 290	12 750	12 190	22 451
78	–	12 960	11 590	11 110	–
81	15 380	12 470	11 300	10 150	17 414
84	–	10 770	–	–	–
87	12 800	10 570	10 660	10 340	17 374
90	–	9 180	–	–	–
93	11 500	9 400	9 100	8 760	12 757
96	–	8 920	–	–	–
98	–	9 530	6 980	8 640	–
100	9 800	9 160	7 800	8 940	18 675
102	–	9 070	7 400	8 500	–
103	–	8 080	–	–	–
106	11 490	8 610	8 660	11 260	11 446
109	–	7 350	–	–	–
112	9 990	7 470	7 960	9 820	12 107
115	–	6 700	–	–	–
118	9 220	7 350	6 320	9 040	15 056
121	–	6 340	–	–	–
125	8 500	6 750	6 500	8 042	11 970
128	–	5 860	–	–	–
131	7 880	6 310	5 800	8 280	13 786
134	–	5 960	–	–	–
137	7 030	6 110	6 000	7 430	11 008
140	–	5 580	–	–	–
143	6 560	5 490	5 160	6 700	11 594
146	–	5 020	–	–	–
150	5 900	4 940	4 670	6 540	12 178
156	7 720	5 343	5 160	6 110	9 004
157	–	5 240	–	–	–
162	7 220	4 880	4 690	5 750	9 118
168	6 590	4 930	4 110	5 260	8 595
175	6 200	4 510	3 930	4 970	8 101
177	–	4 410	3 960	4 990	–
181	5 700	4 290	4 170	4 720	8 470
187	5 380	4 240	3 850	4 540	6 440
193	5 100	4 020	–	–	8 047
196	–	3 860	3 320	4 730	–
200	4 720	3 740	3 410	4 560	7 650
206	5 970	3 550	3 340	3 810	7 103
212	5 550	3 400	3 120	3 560	6 603
215	–	3 490	3 120	3 450	–
216	–	3 370	–	–	–
218	5 290	3 290	–	–	6 316
225	5 050	3 220	2 820	3 240	6 040
231	4 720	3 020	2 730	3 040	5 786
236	–	2 870	–	–	–
237	4 520	2 890	2 560	3 380	6 343
243	4 240	2 920	2 480	3 180	5 089
250	4 063	2 750	3 040	3 090	4 994
255	–	2 600	3 430	2 920	–
256	3 900	2 600	–	–	5 118
262	3 680	2 500	2 780	2 750	4 073
268	3 540	2 470	2 630	2 680	4 797
275	3 400	2 340	2 560	2 790	3 981
281	3 220	2 380	–	–	4 074
287	3 100	2 260	2 260	2 590	3 927
293	2 940	2 140	2 200	2 460	3 727
295	–	2 160	–	–	–
300	2 840	2 080	2 150	2 410	3 537
306	3 670	2 020	2 090	2 290	3 245
312	3 030	1 980	1 990	2 240	3 853
314	–	1 980	–	–	–
315	–	–	1 990	2 190	–
318	2 930	1 930	–	–	3 731
325	2 790	1 870	1 900	2 100	3 557
331	2 700	1 840	–	–	3 595
334	–	1 840	1 810	1 960	–
337	2 630	1 790	–	–	3 433
343	3 500	1 750	1 690	1 880	3 334
350	2 440	1 700	2 020	2 090	3 236
354	–	1 730	1 960	2 080	–
356	2 370	1 680	–	1 970	3 528
362	2 270	1 660	1 860	1 890	2 970
368	2 210	1 600	1 860	1 890	2 890
374	–	1 520	–	–	–
375	2 120	1 530	1 790	1 860	2 964
381	2 060	1 470	–	–	2 701
387	2 010	1 500	1 620	1 750	2 934
393	1 930	1 510	1 560	1 690	2 529
400	1 880	1 470	1 560	1 660	2 264
406	–	1 400	–	–	–
412	2 090	1 350	–	–	2 367
413	–	1 380	–	–	–
418	–	1 360	–	–	–
425	1 960	1 360	1 350	1 440	2 350
431	–	1 300	–	–	–
433	–	1 300	–	–	–
437	1 850	1 290	1 250	1 360	2 215
443	–	1 230	–	–	–
450	1 750	1 270	1 210	1 300	2 116
456	–	1 280	–	–	–
462	1 670	1 240	–	–	2 001
468	–	1 220	–	–	–
472	–	1 180	–	–	–
475	1 580	1 180	1 160	1 180	2 193
481	–	1 140	–	–	–
487	1 520	1 120	–	–	1 816
493	–	1 090	–	–	–
500	1 440	1 050	1 020	1 080	1 724
511	–	1 000	–	–	–
512	–	1 020	–	–	–
525	1 310	970	1 280	1 210	
537	–	900	–	–	–
550	1 190	890	1 170	1 120	
551	–	870	–	–	–
562	–	840	–	–	–
575	1 090	820	1 100	1 030	–

INSTALLATION STRESS ANALYSIS

The equations provided are used to check that the elastic stress limit of the ring material is not exceeded by stress due to installation. Standard parts that are assembled manually in the recommended shaft/bore and groove diameters do not require stress analysis. Special rings, or rings being assembled with special tooling, require stress 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 of the catalog, can be used as a suitable estimate. As with any theoretical calculation, 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 centrifugal capacity.

After forming, the ring's natural tendency is to return to its original state. 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; see table 4.

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

INSTALLATION STRESS

FORMULA:

For external rings

$$S_E = \frac{E\ b\ (D_S - D_I)}{(D_I + b)(D_S + b)}$$

For internal rings

$$S_C = \frac{E\ b\ (D_O - D_H)}{(D_O - b)(D_H - b)}$$

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

Table 4

Where:

S_E = Stress due to expansion (N/mm²)
S_C = Stress due to compression (N/mm²)
E = Modulus of elasticity (N/mm²)
b = Radial wall (mm)
D_S = Shaft diameter (mm)
D_H = Housing diameter (mm)
D_I = Free inside diameter, minimum (mm)
D_O = Free outside diameter, maximum (mm)

EXAMPLE: Compare theoretical installation stress to percent of minimum tensile strength.

1. ES-20-S02

$$S_E = \frac{193\ 053\ (1{,}65)\ (20{,}00 - 18{,}62)}{(18{,}62 + 1{,}65)(20{,}00 + 1{,}65)}$$

$$S_E = 1\ 002\ \text{N/mm}^2$$

Minimum tensile strength of the ring material: 1 448 N/mm².
Using 80%, (Table 4), of 1 448 N/mm² = 1 158 N/mm².

$$1\ 002\ \text{N/mm}^2 < 1\ 158\ \text{N/mm}^2$$

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

www.Smalley.com

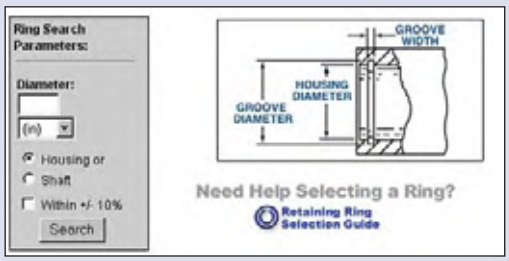
Smalley's website is an interactive useful tool designed to help engineers and buyers find the product information needed. Here is a small sample of the resources available:

PRODUCT SEARCH

With numerous different product lines, it can be difficult to find the standard part that is best for an application. To simplify the selection of stock items, utilize Smalley's search tools.

RETAINING RING SEARCH:

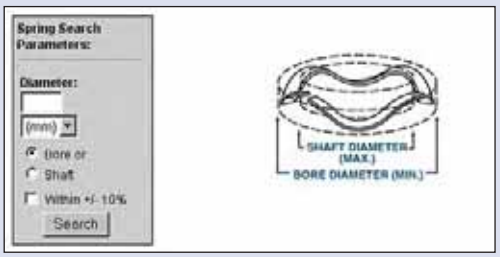
www.smalley.com/retaining_rings/search_for_a_ring.asp



Smalley has over 5 000 retaining rings to select from. Searching for the right ring is easy. Simply enter the application parameters and a list of corresponding rings will be presented to select from. A ring search allows the user to view the dimensions of all the rings for comparison.

WAVE SPRING SEARCH:

www.smalley.com/wave_springs/search_for_a_spring.asp



Selecting the appropriate wave spring for an application can be a challenge. To simplify the process and differentiate between 2 000 stock springs is easy. By searching online, only the springs that fit a particular application will be presented. This makes it easy to see the variety of spring configurations available.

ONLINE DESIGN

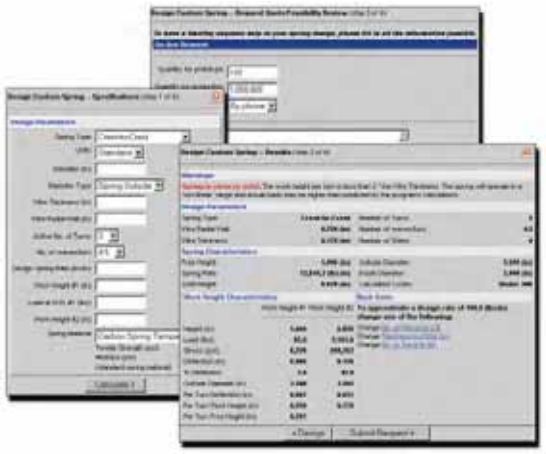
To simplify the design process and assist with the selection and design of spiral retaining rings and wave springs, a number of tools are available to assist with part selection, designing a special and receiving design assistance.

ENGINEERING SPECS

With the complete dimensions of all standard parts available online, it is simple to view the specifications of the stock items applied to your application.

Retaining Ring Example: Modify the groove material to match your assembly and calculate the new thrust capacity.

Wave Spring Example: Substitute your actual work heights and generate the new loads and cycle life for a standard spring.



DESIGN YOUR OWN RING OR SPRING

Smalley's website offers users the ability to configure their own retaining ring or wave spring. Enter the application requirements to design a custom part that can be manufactured to your specifications. Change the material, the operating cavity and the wire properties to see how your design is affected. Print or submit your design directly to Smalley to verify that your design will work. This useful tool can be found at:

Retaining Ring Design:
www.smalley.com/retaining_rings/design_a_special.asp

Wave Spring Design:
www.smalley.com/wave_springs/design_a_special.asp

DESIGN ASSISTANCE

If you would like Smalley's assistance in specifying a retaining ring or wave spring for your application, simply fill out an application checklist and specify the known parameters. Smalley will work with you to determine if a stock item can be provided or if a special design is required. Requests can be submitted online or print the application checklist and fax it back to us.

CAD DOWNLOADS

Standard retaining rings and wave springs are available for download in all major CAD systems. Once a part number has been selected an option to download a CAD model is presented. After a few simple steps, the model is e-mailed to you. This powerful CAD tool simplifies the design process by allowing engineers to drop Smalley parts right into any application.

With recently expanded capabilities, it is simple to adjust the operating heights of a wave spring model. Download a spring at either its posted work height, free height or enter a height where the spring is expected to operate at.

REQUEST FREE SAMPLES

Requesting samples to test in an application could not be easier. At www.smalley.com/get_samples/get_samples.asp free samples of any standard catalog item can be requested at any time. Sample requests can be submitted and processed in 24 hours.

ADDITIONAL INFORMATION

Assembly Information: **www.smalley.com/retaining_rings/installation_and_removal.asp**
Detailed information on the various methods of assembling spiral retaining rings for high volume and low volume production is provided; includes both automated and manual assembly methods and an 18 page assembly brochure (www.smalley.com/pdfs/spiral_retaining_ring_install_and_removal.pdf).

Smalley News: **www.smalley.com/whats_new/whats_new.asp**
As new products and applications are developed, Smalley's website is regularly updated with the latest information. Stay up to date with Smalley and find out What's New and how Smalley products are continuously evolving to meet new manufacturing standards.

Ask the Expert: **www.smalley.com/ask_the_expert/ask_the_expert.asp**
Do you have a question that you would like to ask our staff? Questions submitted through "Ask the Expert" are routed directly to the appropriate department and will be promptly answered within 1 business day.

Smalley's engineering department provides free design consultation. Engineers are available to assist with part selection, custom designs, application requirements, materials, and more.

Get Catalog: **www.smalley.com/information_center/information_center.asp**
Need a new catalog or want to make sure you have the latest information? Smalley will promptly send out a copy of our latest catalog. Additionally, a PDF copy of Smalley's latest catalog is always available for download.

APPLICATION CHECKLIST

CUSTOM ORDERS...OUR SPECIALTY

SMALLEY WAVE SPRINGS

FAX TO: +1 847 719 5999

Quick Delivery on Custom Orders • No-Tooling-Cost™ • Precise Specifications • Engineering/Design Assistance
Complete this application checklist and challenge Smalley's Engineering staff.

Name _____ Title _____ Date _____

Company _____ Tel _____ Fax _____

Address _____

City _____ State _____ Postal Code _____ Country _____

Email _____

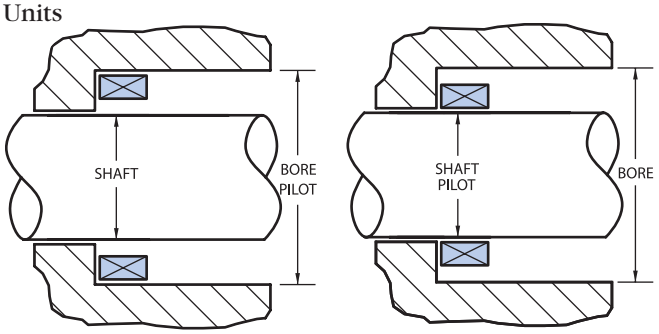
DIMENSIONS IN: ( ) Metric Units ( ) Imperial Units

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

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

Free Height _____ Approximate

Group B

_____ (Minimum Load) @ _____ (Work Height 1) ( ) N @ mm ( ) lb @ in

_____ (Maximum Load) @ _____ (Work Height 2) ( ) N @ mm ( ) lb @ in

Free Height _____ Approximate

Group C

Free Height _____ (min) — _____ (max)

# of Waves _____ Material Thickness _____

Radial Wall _____

SKETCH

MATERIAL

Consider the environment:
Temperature _____°
( ) C ( ) F

Corrosive Media _____

*Carbon Steel	( )
*17-7 PH/C Stainless	( )
302 Stainless Steel	( )
316 Stainless Steel	( )
Inconel X-750	( )
Other _____	( )

*Standards

FINISH

*Oil dipped (Carbon Steel)	( )
*Vapor degreased and ultrasonic cleaned (Stainless Steel)	( )
Passivate	( )
Black Oxide	( )
Phosphate Coat	( )
Vibratory Deburr	( )
Other _____	( )

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)

_____

_____

_____

_____

_____

APPLICATION CHECKLIST

CUSTOM ORDERS...OUR SPECIALTY

SMALLEY RETAINING RINGS

FAX TO: +1 847 719 5999

Quick Delivery on Custom Orders • No-Tooling-Cost™ • Precise Specifications • Engineering/Design Assistance
Complete this application checklist and challenge Smalley's Engineering staff.

Name _____ Title _____ Date _____

Company _____ Tel _____ Fax _____

Address _____

City _____ State _____ Postal Code _____ Country _____

Email _____

DIMENSIONS IN: ( ) Metric Units ( ) Imperial Units

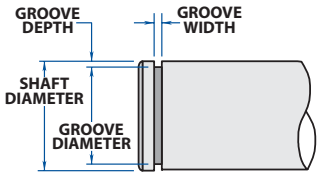
Housing Diameter _____

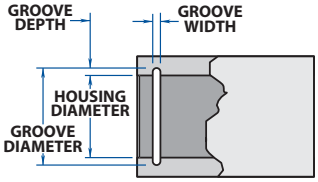
Shaft Diameter _____

Groove Diameter _____

Groove Width _____

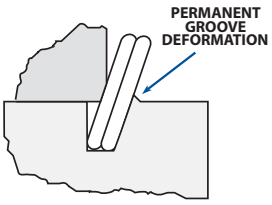
RPM _____



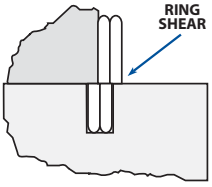


Ring Radial Wall _____ Ring Thickness _____

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 _____ ( ) N ( ) lb

SKETCH

MATERIAL

Consider the environment:
Temperature _____°
( ) C ( ) F

Corrosive Media _____

*Carbon Steel ( )
*302 Stainless Steel ( )
*316 Stainless Steel ( )
Inconel X-750 ( )
A-286 ( )

Other _____ ( )

*Standards

FINISH

*Oil dipped (Carbon Steel) ( )
*Vapor degreased and ultrasonic cleaned (Stainless Steel) ( )
Passivate ( )
Black Oxide ( )
Phosphate Coat ( )
Vibratory Deburr ( )

Other _____ ( )

QUANTITY: Prototype _____

Production _____

APPLICATION: (Description)

_____

_____

_____

_____

_____

_____

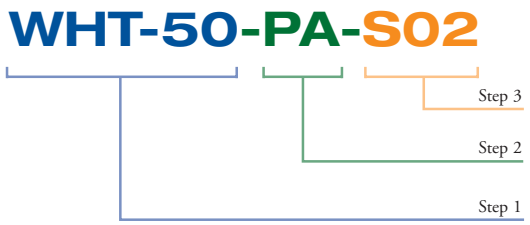
_____

_____

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:



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 & 1b)

STEP 1: BASE PART NUMBERS

SELECT SERIES...

TABLE 1a: Retaining Ring Series

SERIES	# TURNS	INTERNAL	EXTERNAL
Light Duty*	1	VHM	VSM
Aerospace*	2	EH	ES
DIN Series*	2	DNH	DNS
Snap Ring*	1	FH	FS
Light Duty	1	VH	VS
Medium Duty	2	WH	WS
WaveRing	2	WHW	WSW
Medium Heavy Duty	2 or 3	WHT	WST
Heavy Duty	2	WHM	WSM
Snap Ring	1	FHE	FSE

* Metric Series

TABLE 1b: Wave Spring Series

SERIES	PREFIX
Standard Single-Turn	SSR
Narrow Section Single-Turn	SSR-N
Wavo	RW
Bearing Preload*	SSB
Crest-to-Crest	C
Crest-to-Crest with Shim End	CS
Shim	SSRS

* Metric Series

THEN SPECIFY PART DIAMETER

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

DNH-20	20 mm DIN Internal Ring
WSM-150	1,500" Heavy Duty External Ring
C150	1,500" Crest-to-Crest Wave Spring
CS125	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 C/CH900 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 C/CH900 stainless steel upon request.

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:

- 34 mm and under diameters are bulk packaged.
- 35 mm and over diameters are generally tube (coin) packaged in lengths 250 mm to 450 mm.

PLACING AN ORDER

Smalley customer service representatives are available to assist you and guide you though the ordering process. For standard catalog rings and springs, Smalley's customer service department can assist with pricing, ordering and delivery information. Contact Smalley customer service at:

P: +1 847.719.5900 F: +1 847.719.5999 E: sales@smalley.com

EXPORT COMPLIANCE

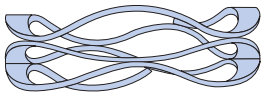
Smalley produces products that are shipped domestically and/or exported from the United States of America in accordance with the Export Administration Regulations (EAR) and International Traffic in Arms Regulations (ITAR). Use and routing of these products contrary to U.S.A. laws is prohibited.

Bore Diameter: (See housing diameter)

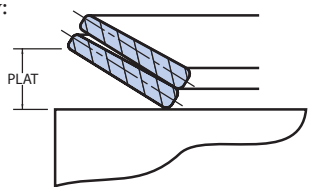
Centrifugal Capacity (N): A mathematical expression for determining the speed (in revolutions per minute, rpm) at which a retaining ring will loose cling on the groove.

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

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.

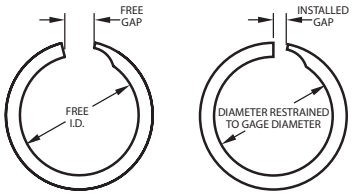


Dish: This ring dimension is the height difference in the ring cross section's axis of symmetry between O.D. and I.D. as illustrated below:



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

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



Gap Type: Defines the physical split between the ends in a wave spring.

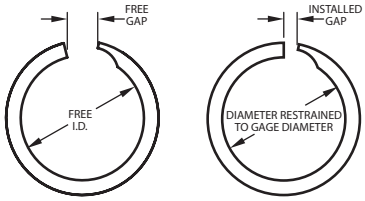
Hardness: The resistance of a material to plastic deformation, usually by indention.

Helix: (see pitch)

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

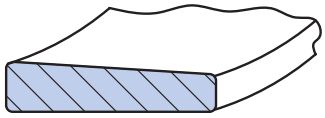
Hydrogen Embrittlement: A condition where hydrogen is absorbed within the internal grain structure of metal tending to make it susceptible to cracking and failure, particularly under sustained loads. Environments such as hydrogen sulfide (H_2S) or processes such as electroplating or pickling can induce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

Installed Gap: (see Free Gap) 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.



Installation Stress (S_C) or (S_E): Mathematical expression based on a radial strain. Useful in determining how far a Smalley retaining ring can be expanded or contracted during installation.

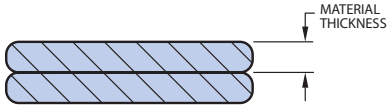
Keystone: Derived from the definition of a "wedge" shaped stone. This term, illustrated below, refers to the "wedge" shaped cross section as a result of edgewinding flat wire.



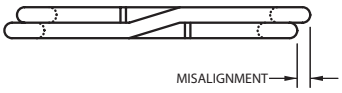
Left Hand Wound: Also referred to as "reverse wound", design term signifying the counter-clockwise winding direction of a pitched coil.

Linear Expander: 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.

Material Thickness (t): Also referred to as "wire" thickness. This dimension, as illustrated below, is useful in determining the overall ring thickness.

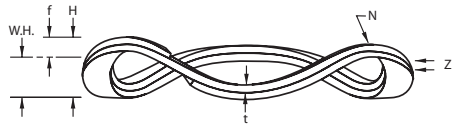


Misalignment: Also referred to as "skew", this ring dimension is the radial variance of a multiple turn retaining.



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.



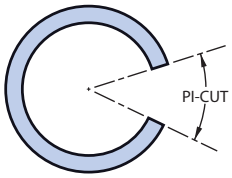
Number of Turns (n): The number of 360° turns of flat wire formed in a retaining ring or wave spring.

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.

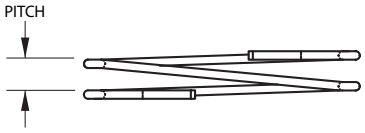
Overlap Type: Defines the physical overlap of the ends in a wave spring.

Permanent Set: A ring that has been expanded or contracted to a point where its elastic properties have been exceeded and does not return to its original diameter is said to have taken "permanent set".

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.



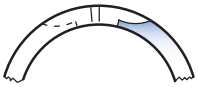
Pitch: Also referred to as helix, this ring dimension is the distance between two adjacent layers of the retaining ring.



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

Radius Notch: (see Removal Notch)

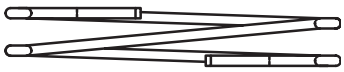
Removal Notch: Also referred to as a "radius notch" or "scallop", this standard Smalley Retaining Ring design feature is used to facilitate removal of the ring from its groove by means of a screwdriver or similar type tool.



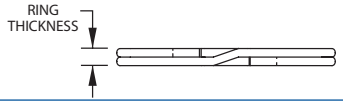
Residual Stress: Stress induced by a cold working process such as edgewinding. It may or may not be beneficial, depending upon the application.

Reverse Wound: (see left hand wound)

Right Hand Wound: Design term signifying the clockwise direction that a Smalley Retaining Ring is normally wound. (also see Left Hand Wound)



Ring Thickness (T): Total thickness of an edgewound retaining ring. It may be determined by multiplying the material thickness by the number of turns and adding in the keystone value.



Rod Diameter: (see shaft diameter)

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

Scallop: (see Removal Notch)

Shaft Diameter (D_S): This dimension represents the outside diameter of the assembly where an external retaining ring is installed.

Shear Strength (S_S): 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.

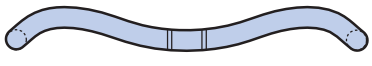
Stress Relieve: Low temperature heat treatment for removing any residual stresses induced by edgewinding and/or forming.

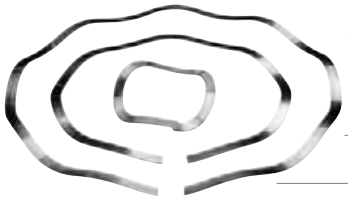
Tensile Strength: An index of the quality of a material through a mathematical expression which divides the material's load capacity in tension by its original cross-sectional area. Particularly accurate for spring steels, as there is only a small difference between ultimate tensile strength and yield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

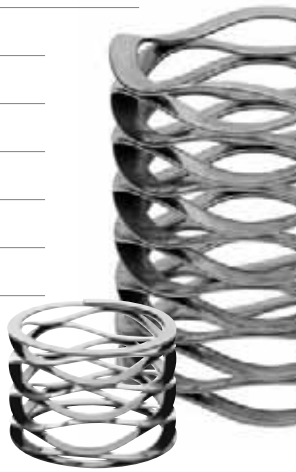
Thrust Load Capacity (P_G) or (P_R): Overall capacity of an assembly to withstand a given value of thrust load in pounds. The limitation being the lesser of two mathematical calculations: ring thrust load capacity (P_R) or groove thrust load capacity (P_G).

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

WAVO®: Single turn round wire wave spring.







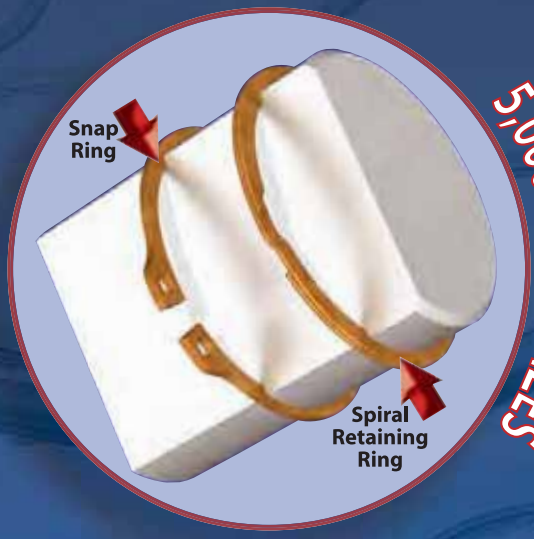
No Ears To Interfere™
Spiral Retaining Rings

- **COMPATIBLE WITH CIRCLIP GROOVES**
- **NO GAP: 360° RETAINING SURFACE**
- **STAINLESS STEEL FROM STOCK**

Smalley spiral retaining rings have No Ears to Interfere™ with the mating components in an assembly, allowing for tight radial applications. Spiral retaining rings are interchangeable with standard circlip grooves.

Over **5 000 standard** spiral retaining rings are stocked in both carbon and stainless steel, from 6 mm – 400 mm, 1/4 in – 16 in diameters.

Special designs can be manufactured quickly and economically with Smalley's No-Tooling-Cost™ manufacturing process. Special designs are available from 5 mm – 2 300 mm, 0,200 in – 90 in diameters.



5,000 STOCK SIZES

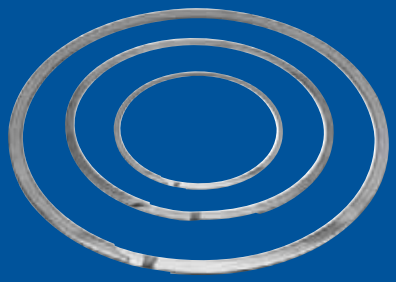
FREE SAMPLES TO TEST

Smalley® Steel Ring Company

www.smalley.com • +1 847 719 5900 • info@smalley.com

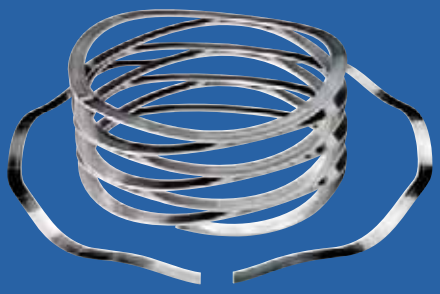
Smalley® Europe Smalley® Nordic AB

RETAINING RINGS



- No protruding ears to interfere with assembly
- No gap allows for 360° retaining surface
- No special tools required for removal
- 5 000 stock sizes in carbon & stainless steel, 6 mm – 400 mm
- No Tooling Charges™ on special designs

WAVE SPRINGS



- Reduces spring operating height by 50%
- Wave Springs save space
- Fits tight radial and axial spaces
- 2 000 stock sizes in carbon & stainless steel, 10 mm – 400 mm
- No Tooling Charges™ on special designs

Smalley Offices

Smalley Steel Ring Company
(Corporate Headquarters)
555 Oakwood Road
Lake Zurich, IL 60047
USA

Phone: +1 847 719 5900
Fax: +1 847 719 5999
Email: info@smalley.com

Smalley Europe
46, avenue des Frères Lumière
78190 Trappes
France

Phone: +33 130 131 575
Fax: +33 130 131 576
Email: europe@smalley.com

Smalley Nordic AB
Afzeliivägen 51
SE - 441 41 Alingsås
Sweden

Phone: +46 322 611 770
Fax: +46 322 611 777
Email: nordic@smalley.com

Smalley also has representatives that can provide Spanish and Portuguese language support: americas@smalley.com

Smalley WORLDWIDE

Smalley provides customized global supply chain solutions, to meet your WORLDWIDE manufacturing requirements, in Europe, Asia Pacific and the America's.

Catalog #CM2007