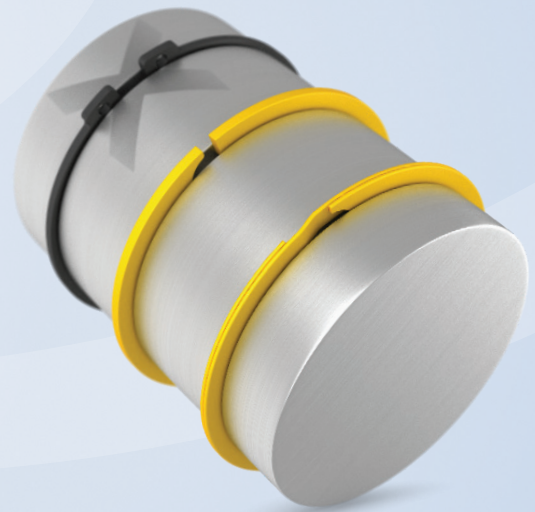


# Retaining Ring Selection Guide

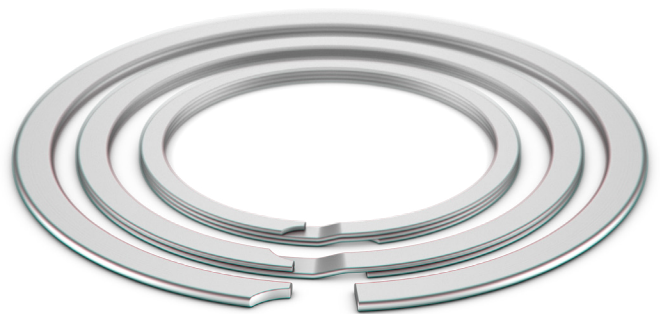
Smalley Engineers have seen and heard it all when it comes to retaining rings, so who better to ask about the best ring for your application than the experts themselves. From materials, to size, function and more, learn about what separates our rings from the rest.

**SMALLEY**

THE ENGINEER'S CHOICE™

## Table of Contents

- 4 Types of Retaining Rings
  - 4 Spirolox® Retaining Rings
  - 4 Constant Section Rings
  - 5 WaveRings
  - 5 Hoopster Retaining Rings
  - 5 Custom Rings
  
- 6 Material
  - 6 Carbon Steel
  - 6 Stainless Steel
  - 7 Special Materials



## Retaining Ring Selection Guide

From aerospace to automotive, medical, off-highway, oil & gas to industrial, Smalley retaining rings can be found in millions of mechanical products all around the world. Smalley retaining rings are manufactured by coiling the ring from flat wire. Since coiling produces a retaining ring with minimal scrap, the Smalley Ring can be economically produced in carbon steel, stainless steel, and many other alloys.

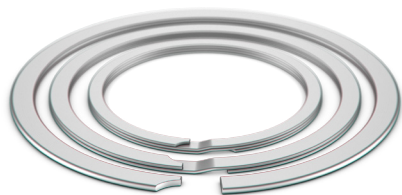
Engineers prefer using Smalley retaining rings because of the unique configuration, offering many advantages over typical die stamped rings. Smalley rings have No Ears to Interfere® with the assembly, require no special tools for installation or removal and can be manufactured in nearly any alloy.

When specing a retaining ring in your design, it is important to know which type of ring to use. If your specifications don't match one of our 6,000 retaining rings in stock, our engineers are ready to collaborate with you to design a unique ring for your application. The four main dynamics to take into account when considering a ring for an application are:

- **Material**
- **Load Capacity**
- **Rotational Capacity**
- **Installation Stress**

## Types of Retaining Rings

Smalley offers an assortment of ring types and configurations, the style of ring used will be based on application requirements. The types of rings offered are:



### Spirolox® Retaining Rings

Smalley's signature Spirolox® Retaining Rings are specified for their unique configuration. Spirolox® rings are interchangeable with existing stamped retaining ring grooves and their main features include:

- 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 minimal scrap
- No-Tooling-Charges™ on custom designs
- Easy to assemble and remove
- No gap or lugs provide for a functional and aesthetically pleasing ring
- Can operate in an internal and external groove at the same time



### Constant Section Rings

A retaining ring designed for heavy duty and impact-loading applications, constant section retaining rings have been the standard choice in automotive and heavy equipment industries for years.

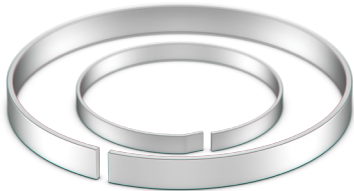
- Over 1,000 stock sizes
- Inch and Metric series rings available
- Stocked from .375" to 10" diameters, 13 mm to 300 mm
- Customs available from .200" to 120"
- New series, interchangeable with Eaton® rings

*continue* ►



## WaveRings

The Smalley WaveRings offer a spiral look in an axial form. With similar properties to standard retaining rings, WaveRings also add compression spring properties. WaveRings compensate for overall length tolerances in stacked assemblies while reducing looseness and vibration.



## Hoopster Retaining Rings

Recommended for when space concerns arise, the Hoopster retaining rings have minimal radial projection and operate in a shallow groove depth. Ideal for applications with thin wall cylinders, the low profile ring also features bent ends for simplified connection and removal.

- Standard in Carbon and 302 Stainless Steel
- Coiled From Flat Wire - Not Stamped
- Suitable for Medium or Light Loads
- Stock sizes in both Imperial and Metric; .375" to 3" and 10 mm to 76 mm
- No Tooling Charges™ for Customs; .200" to 120" and 5 mm to 3000 mm



## Custom Rings

The manufacturing process of Smalley Retaining Rings allows for the production of various ring end types and configurations. A sampling of custom rings that have been fabricated before include:

- Crimped
- Dimpled
- Holes
- Locking with holes
- Rounded
- Straight
- Square with radial pinch
- Round wire with axial bent locks
- Self-locking
- Balanced

## Material

Choosing the right material is crucial in order to ensure the assembly has optimum performance and cost-effectiveness. Not only is failure in operation not an option, but high manufacturing costs can derail a project. Material selection is dictated by the operating environment of the ring.

### Carbon Steel

Carbon steel is the most commonly specified material for Smalley flat wire products mainly due to lower cost. Spirolox® Retaining Rings are available in stock in carbon steel and can ship immediately. Some of the different finishing methods include:

- **Oil-tempered** – to create an even harder material the carbon steel is quenched and tempered in oil maximizing both tensile strength and yield strength.
- **Hard-drawn** – the drawing process is a way of cold-working metal to increase it's strength.

While these processes strengthen the carbon steel it does nothing to prevent corrosion and oxidation, thus carbon steel retaining rings should always be used in a protective environment. Finishes and lubrication do help, but for persistent exposure stainless steel should be used.

### Stainless Steel

For higher corrosion resistance and higher temperature operation ranges, stainless steel rings should be specified. The stainless steel properties include:

- **302 Stainless** – a standard material for spiral retaining rings which is an effective combination of corrosion resistance and workable physical properties.
- **316 Stainless** – very similar in heat-resistance and other physical properties as 302 steel, 316 does have increased corrosion resistance due to molybdenum chemical content. Often specified in the medical and food service industries or areas of intense exposure such as chemical or sea water applications.

*continue ►*

## Special Materials

Because material selection is such an important part of a project's integrity, there are also retaining rings can be manufactured in a variety of miscellaneous materials. Some of those materials in stock consist of:

- **17-7 PH Condition CH900 Stainless** – used almost exclusively in wave springs but offers high tensile and yield strengths (comparable or above carbon steel) for special ring applications. 17-7 rings can operate in environments up to 650°F.
- **Inconel X-750** – nickel-chromium alloy for use in high-temp and corrosive environments. Temperature resistance can range up to 700°F to 1000°F with special tempering.
- **A286 Alloy** – a precipitation hardened alloy that is also corrosion resistant and performs in temperatures up to 1000°F.
- **Elgiloy** – a relatively new material commonly used in oil industry applications because of its unmatched resistance to sulfide stress cracking. It is said to perform "over 600% better than 17-7 PH in load retention at 650°F and provide over 100% more cycles (in fatigue resistance) than carbon steel, without breakage."
- **BERYLLIUM COPPER ALLOY # 25** – a copper alloy that combines low elasticity with high tensile strength.
- **PHOSPHOR BRONZE, GRADE A** – a copper alloy with high electrical conductivity.

It should be noted that the Edgewinding manufacturing technique that Smalley employs allows special materials to be coiled into retaining rings and springs. Hastelloy, Wastelloy, and Titanium are just a few of the products that can be manufactured for custom purposes. As with all inquiries, please contact Smalley Engineering for more detailed information.

The Smalley Engineering team is also beneficial for specific recommendations of rings needed based on calculations for load capacity, rotational capacity, and stress analysis. While the material stock that is offered is static, the load, stress, and tension requirements will vary on a customer by customer basis.

From prototypes to production, Smalley is able to meet the volume requirements of any size order. What we want to stress at Smalley is our engineering expertise, we are focused on designing solutions that meet your target application performance. In addition to a team of specialized engineers available to help with unique project specifics, Smalley also features a No-Cost-Tooling production advantage. Many times the biggest downfall to custom manufacturing is the high costs incurred during the concept and prototyping phases. Smalley helps to both limit those early overheads and to fine-tune a design that both parties can back with confidence thanks to No-Tooling-Cost. Smalley, The Engineer's Choice™.

Want to learn more? We would love to hear from you.

|                |                                                      |
|----------------|------------------------------------------------------|
| <b>ADDRESS</b> | Smalley<br>555 Oakwood Road<br>Lake Zurich, IL 60047 |
| <b>PHONE</b>   | (847) 719-5900                                       |
| <b>FAX</b>     | (847) 719-5999                                       |
| <b>EMAIL</b>   | info@smalley.com                                     |

# Retaining Ring Selection Guide

1

**STEP 1:** Do you need to meet any specifications?

**YES**

**NO**

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



2

**STEP 2:** Do you need to match an alternative ring groove?

**YES**

**NO**

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



3

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

| Standard Units (inches) |                   |            |            |
|-------------------------|-------------------|------------|------------|
| Series                  | Load <sup>1</sup> | Housing    | Shaft      |
| Light Duty              | 4100              | <b>VH</b>  | <b>VS</b>  |
| Medium Duty             | 4950              | <b>WH</b>  | <b>WS</b>  |
| Medium Heavy Duty       | 7070              | <b>WHT</b> | <b>WST</b> |
| Heavy Duty              | 8340              | <b>WHM</b> | <b>WSM</b> |
| Constant Section Rings  | 8341              | <b>FHE</b> | <b>FSE</b> |
| WaveRing                | —                 | <b>WHW</b> | <b>WSW</b> |

| Metric Units (mm)       |                   |            |            |
|-------------------------|-------------------|------------|------------|
| Series                  | Load <sup>1</sup> | Housing    | Shaft      |
| Light Duty              | 18.03             | <b>VHM</b> | <b>VSM</b> |
| DIN Series <sup>2</sup> | 36.55             | <b>DNH</b> | <b>DNS</b> |
| Aerospace Series        | 38.96             | <b>EH</b>  | <b>ES</b>  |
| Constant Section Rings  | 36.53             | <b>FH</b>  | <b>FS</b>  |

<sup>1</sup> Representative example shows the load capacity (lb) for a 2" ring.

<sup>1</sup> Representative example shows the load capacity (kN) for a 50 mm ring.

<sup>2</sup> Manufactured to DIN groove specifications.

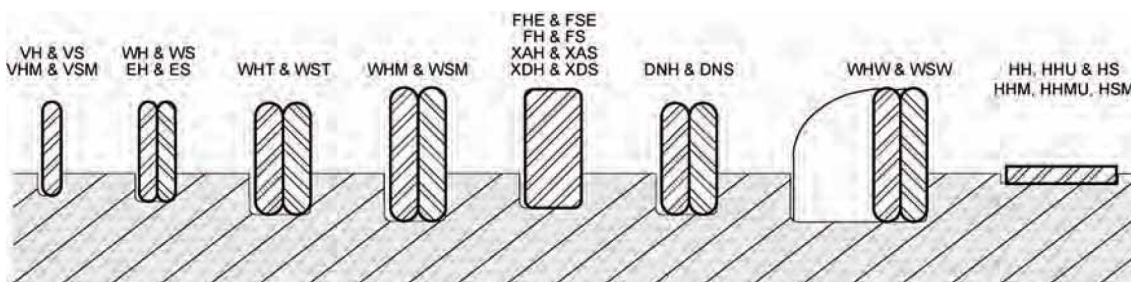
**STEP 3B:** Still not sure?

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 Spirolox 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.

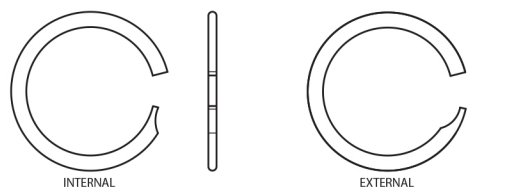


## Ring Types

### Spirolox Retaining Rings—Single Turn (1-Turn)

VH & VS — Light Duty, inch

VHM & VSM — Light Duty, metric



### Spirolox Retaining Rings—2-Turn

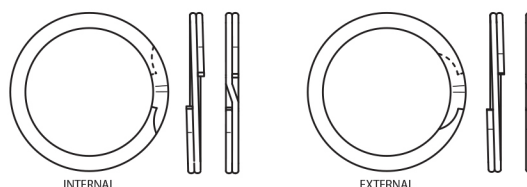
WH & WS — Medium Duty, inch

WHT & WST — Medium Heavy Duty, inch

WHM & WSM — Heavy Duty, inch

EH & ES — Medium Duty, Metric Aerospace

DNH & DNS — Heavy Duty DIN, metric



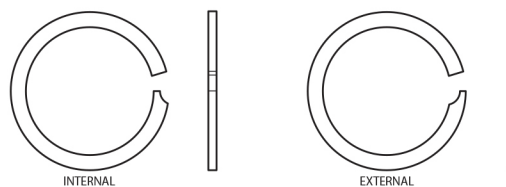
### Constant Section Rings

FHE & FSE — Heavy Duty, inch

FH & FS — Heavy Duty, metric

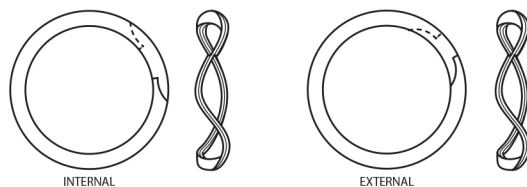
\*XAH & XAS — Eaton Style, inch

\*XDH & XDS — Eaton Style, inch



### WaveRings

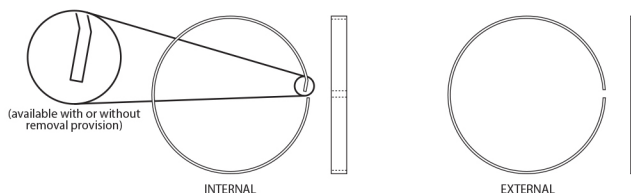
WHW & WSW — inch



### Hoopster Rings

HH, HHU & HS — inch

HHM, HHMU & HSM — metric



\*End configurations vary by size; see page 128 for Constant Section Ring end configurations.

## 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 stamped ring or snap ring to find the appropriate Smalley Retaining Ring to fit your application.

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