



NITINOL

FOR YOUR SHAPE MEMORY APPLICATIONS

This nickel-titanium alloy “remembers” its original, cold-forged shape: returning the pre-deformed shape by heating. Shape-memory alloys have applications in industries ranging from medical to aerospace. Ulbrich specializes in tailoring high-performance Nitinol to your desired needs with the tightest tolerances and absolute precision. With our stringent specifications, state-of-the-art machinery, and commitment to buy only from the highest quality suppliers further enhances our material quality for all the critical markets we proudly serve. With our expertise in material selection and production of your Nitinol wire or strip, we can aid you in your application requirements.



We Deliver Precision®

**CAPABILITY
WHITEPAPER**



We Deliver Precision®

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CAPABILITY SHEET

Nitinol Solutions

For Shape Memory Challenges

- 
- Width: 0.0015" to 1.00"
 - Diameters: 0.0007" up to 0.025"
 - Thickness: Dependent on Aspect Ratio
 - Conditions: As-Drawn Superelastic or Straight Anneal
 - Finish: Oxide Free, Light Oxide or Standard Black Oxide

STREAMLINED WIRE ALLOY SOLUTIONS ARE AVAILABLE ANYWHERE

Ulbrich's global support structure guarantees streamlined solutions for all our customers, no matter how big or small they might be. With our widespread physical presence throughout the world – which includes twelve locations in five countries across North America, Asia, and Europe – it's easy for us to provide industry-leading services for most manufacturers. From vendor managed stock programs and excellent lead times, to industry expertise and rapid deliveries, we ensure precision in our process from start to finish.

Definitive Guide to Super-Elastic Nitinol

HISTORY OF NITINOL

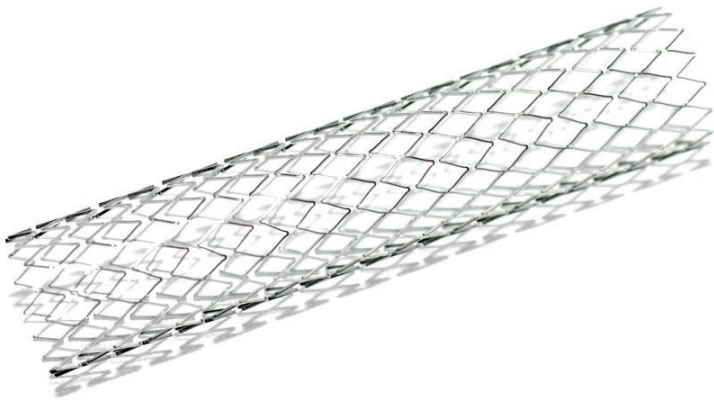
Nitinol, an alloy of nickel and titanium with approximately fifty percent nickel, is a relatively recently formulated metal that takes its name both from its composition and the place where it was produced (Nickel Titanium – Naval Ordnance Laboratory).

Although it was discovered in the early 1960s it took decades for Nitinol to become useful in the marketplace due to the difficulties encountered in its processing and manufacturing. In fact, Nitinol's many uses have mostly all been realized since the mid-1990s when its usefulness in a broad range of applications results derived from its shape memory characteristic and super-elastic properties. Shape memory means Nitinol can change to a new form at one temperature – lower than at normal body temperature for instance – and then recover its original shape upon being heated beyond its transformation temperature.

CHARACTERISTICS AND PROPERTIES

Since Nitinol also has a unique ability to adapt to extraordinary strains and is compatible with the human body, it is finding use in numerous applications in the medical field. At higher temperatures, Nitinol assumes a cubic crystal structure referred to as austenite (or the parent phase). At lower temperatures, it spontaneously transforms to a more complicated 'monoclinic' crystal structure known as martensite. The temperature at which austenite transforms to martensite is generally referred to as the transformation temperature – more specifically, martensite begins to form at the so-called M_s temperature, and the temperature at which it is complete is called the M_f temperature. Those two facets of its structure – shape memory and superelastic properties – allow Nitinol to exhibit a reversible response to an applied stress which itself is caused by a phase transformation between the austenitic and martensitic phases of a crystal.





Crucial to Nitinol's properties are two key aspects of this phase transformation. First is that the transformation is 'reversible', meaning that heating above the transformation temperature will revert the crystal structure to the simpler austenite phase. The second key point is that the transformation in both directions is instantaneous.

Martensite's crystal structure has the unique ability to undergo limited deformation substantially without breaking atomic bonds. This type of deformation is known as twinning, which consists of the rearrangement of atomic planes without causing any permanent deformation. It is able to undergo about 6–8% strain in this manner.

When martensite is reverted to austenite by heating, the original austenitic structure is returned, regardless of whether the martensite phase was deformed. Thus, the name 'shape memory' refers to the fact that the shape of the high-temperature austenite phase is 'remembered', even though the alloy is severely deformed at a lower temperature.

Thus, Nitinol medical devices – such as stents – can be fabricated at body temperature, deformed or folded smaller at another temperature, then inserted into an artery where it will return to its normal temperature and regain its original size. Phase transformation also allows a device to fully recover after it has been bent to a high rate of strain (up to 7%).

SUPER-ELASTIC EFFECT OF NITINOL WIRE

This 'super-elastic' effect allows use of nitinol wire devices that have been bent or shaped to allow introduction or use inside the body. Tools such as small grasping and biopsy devices can extend from a tube and expand to a much larger area than devices made from standard alloys. Nitinol's reduced weight and unique properties make it especially attractive for biomedical applications including heart valve tools, stents, staples, bone anchors, sophisticated septal defect devices and a variety of implants.

However, heat treating Nitinol is delicate – and critical – in fine tuning the transformation temperature. Aging time & temperature control the precipitation of various nickel-rich phases, and thus control how much nickel resides on the nickel –and titanium– lattice; by depleting the matrix of nickel, aging then increases the transformation temperature. The combination of heat treatment and cold working is essential in controlling the properties of Nitinol.

Nitinol's medical uses include devices for reconnecting intestines after surgery; as stitching; in implants; and wiring to locate breast tumors. Given its recent emergence in the manufacturing world, it is clear that the surface of Nitinol's future uses has barely been scratched.





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Nitinol Wire

**SHAPED, FLAT, SQUARE, ROUND, FINE WIRE,
BLACK OXIDE, LIGHT OXIDES AND OXIDE FREE
NITINOL WIRE ASTM F2063 (CHEMISTRY)**

NITINOL DESCRIPTION

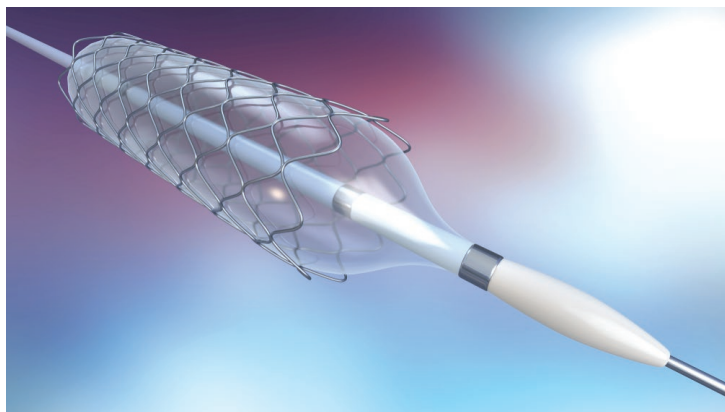
Nitinol is a nickel-titanium alloy with super elasticity and shape memory properties. Shape memory refers to the ability of Nitinol to undergo deformation at one temperature, then recover its original, under formed shape upon heating above its transformation temperature. Super elasticity occurs at a narrow temperature range just above its transformation temperature; in this case, no heating is necessary to cause the under formed shape to recover, and the material exhibits enormous elasticity, some 10-30 times that of ordinary metal.

APPLICATIONS

- Medical Devices: Stents, Catheters, Heart Valve Tools, Staples, Bone Anchors
- Aerospace Heat Engine Components
- Temperature Control System and High Reliability Couplings
- Resilient Glass Frames
- Orthodontic Arc Wires
- Actuators

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Exploring Medical Applications of Ultra-Fine Nitinol Wire



As the name alludes to, Nitinol is a nickel-titanium alloy known for its shape memory and super elastic characteristics. Shape memory refers to Nitinol's ability to undergo deformation at one temperature, then recover its original, under formed shape upon heating above its transformation temperature. Super elasticity occurs at a narrow temperature range just above its transformation temperature; in this case, no heating is necessary to cause the under formed shape to recover. The material exhibits enormous elasticity, some 10-30 times that of ordinary metal.

It was initially discovered in 1968 in a search for mining materials. Still, it took decades for Nitinol to become useful in the marketplace due to the difficulties encountered in its processing and manufacturing. In fact, Nitinol's many uses have mostly all been realized since the mid-1990s when its usefulness in a broad range of applications results derived from it being a shape memory alloys and its super-elastic properties. It is now widely used for many medical components, including re-enforcement braiding and coiling for catheter tubing and shafts, braided and formed stents, formed retrieval baskets, and many other applications. The shape memory makes it an excellent candidate for many in-body applications such as catheter re-enforcement and braided stents.

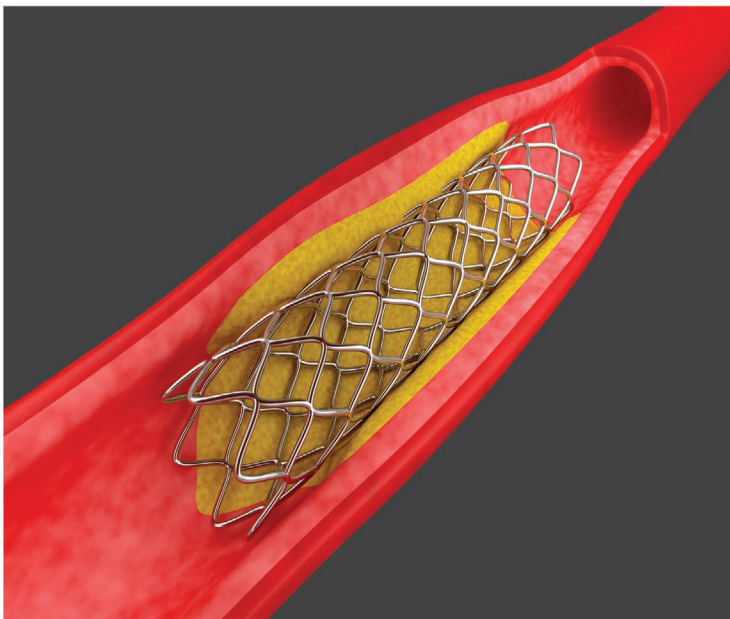
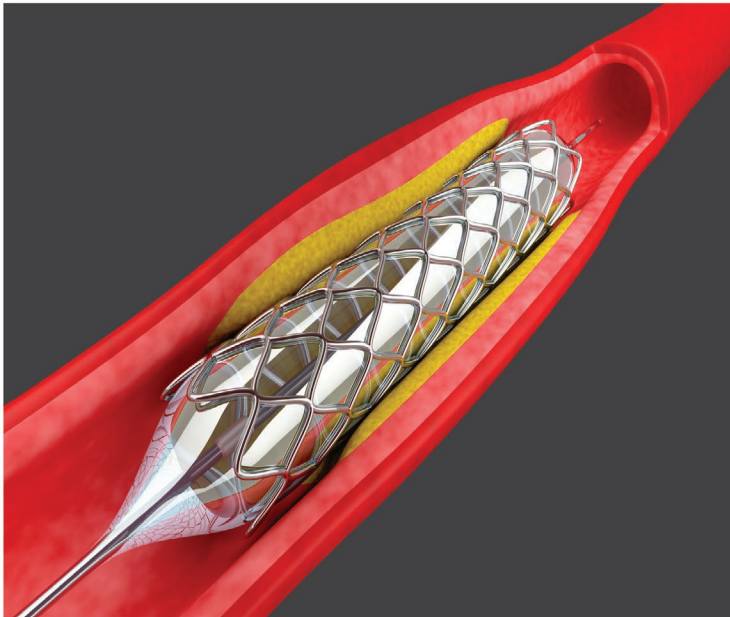
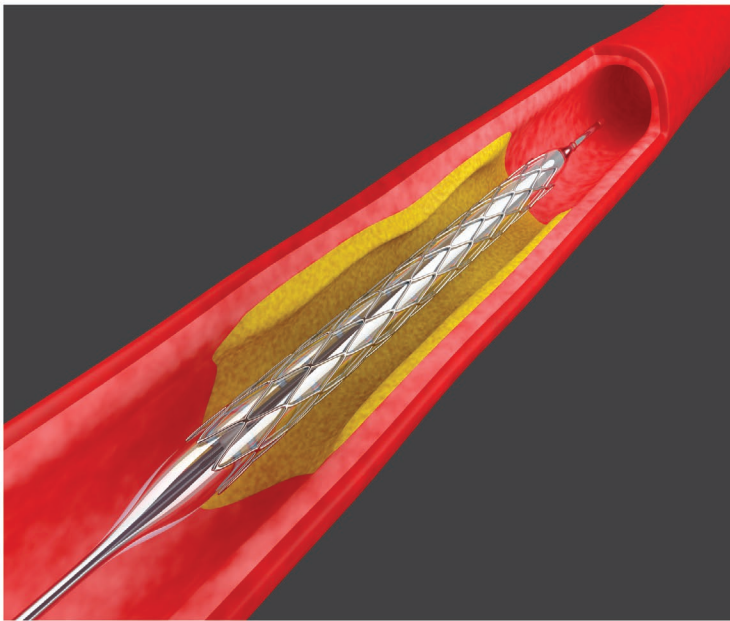
Nitinol is also used for these medical devices because it is bio-compatible, meaning it is compatible with the human body and will, therefore, not be harmful to human tissue. Other materials that are not bio-compatible can result in issues such as blood clotting when used for similar applications.

Nitinol is generally produced in large cast ingots and can be subsequently processed all the way down to ultra-fine wires that are only a fraction of the size of a human hair. The final stages of the entire process are called wire drawing and require precision control in order to maintain physical and mechanical properties.

Ultra-fine wire is very small diameter (thickness) wire that is held to incredibly tight tolerances. Fine wire products are engineered with cutting edge on-line gauging to deliver outstanding dimensional precision and reliability. Nitinol is produced at Ulbrich in fine and flat wire forms with micro-scale diameter and widths and is then meticulously wound to guarantee tolerance consistency and ensure downstream performance.

Nitinol wire in this form is a great choice for medical devices that may be introduced into the body to perform surgical procedures or treat diseases, and their mechanical properties play a significant role in the selection of metal for their manufacture.





MOST COMMON MEDICAL APPLICATIONS FOR NITINOL WIRE

Nitinol, also known as niti wire, has mechanical properties that include excellent corrosion resistance, fatigue performance, and enormous elasticity. Nitinol is a shape memory alloy with unique fatigue properties. This shape memory effect allows it to return back to its original form even after deformation when it is exposed to a specific transformation temperature. Because of these characteristics, Ulbrich's super-elastic Nitinol round wire is a suitable alloy product for many medical applications including braid products, orthodontic wire, and implantable devices such as surgical implants.

Medical device customers should also decide whether braid-enforced or coiled-enforced catheters are the best choice for their application. Many customers are now choosing to use Nitinol for coiled catheters in especially sensitive surgeries or other applications where accuracy is of utmost importance, such as cardiovascular or neural surgeries.

The advantage of this is the superelasticity of Nitinol. It will act almost like a spring in that it can be stretched significantly and then return to its original shape. This is extremely beneficial in the medical field as the use often involves bending and twisting through arteries.

Another application for Nitinol wire in the medical industry is Braided Stents. Nitinol Stents are becoming more and more widely used in surgeries, especially to treat stenosis issues and issues below the knee. Nitinol stents would more so be used for the latter and is often a suitable choice for peripheral vascular disease, known as PAD. This is due to the force the nickel-titanium alloy can provide when it comes to holding open vessels, while still having enough elasticity to breathe.

CHARACTERISTICS THAT AFFECT THE PERFORMANCE OF NITINOL

There are multiple characteristics when it comes to producing and manufacturing this wire that will affect the final application: Physical characteristics, such as size and tolerance, and mechanical properties including tensile strength, elongation, and surface condition.

PHYSICAL CHARACTERISTICS – SIZE AND TOLERANCE

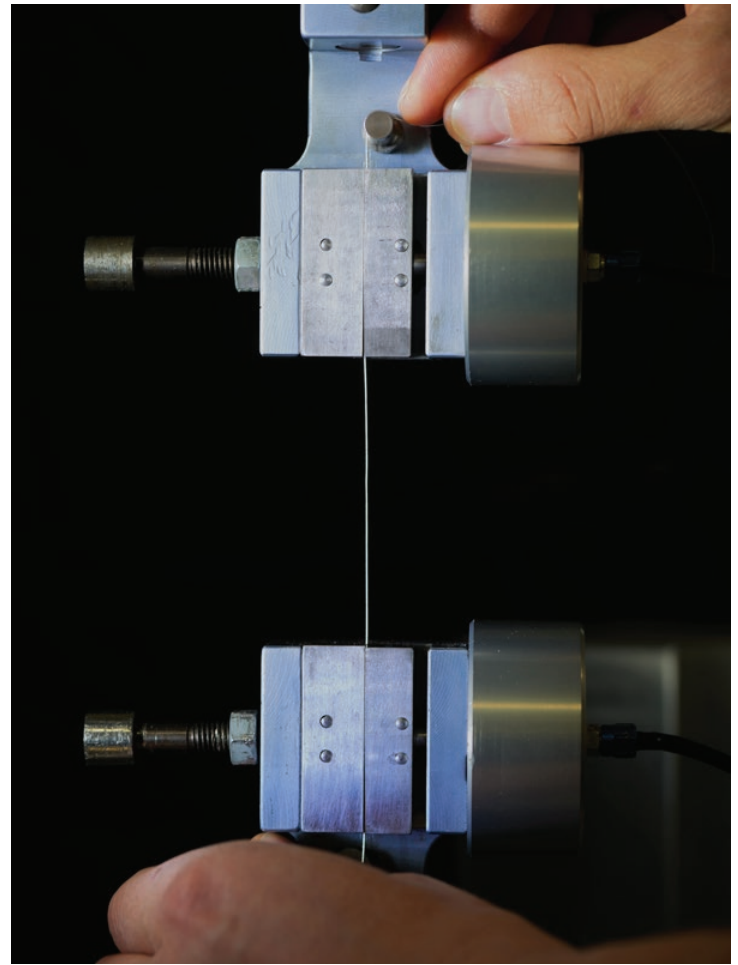
Nitinol is very abrasive on wire drawing dies and has to go through these dies multiple times to achieve the small diameters required in the medical industry.

Tight tolerances need to be held when it comes to the diameter but just as important, need to be consistent throughout the entire length of the wire. This is beneficial not only to the end use but wear and tear on the drawing die.

MECHANICAL PROPERTIES – TENSILE STRENGTH, ELONGATION, AND SURFACE CONDITION

The typical two conditions for Nitinol Ultra-Fine Wire are cold worked and straight annealed. The preference all depends on the processes of the customer and their manufacturing operations. Most of the wires will be heat set into super-elastic condition at the next manufacturing tier.

Controlling all of these characteristics throughout the wire and ensuring uniform dimensions will be essential to producing a good product and saving money in production. Precision equipment is required to keep these properties in check because even small inconsistencies will result in issues at the next manufacturing step in coil reinforcement, such as unusable parts or excess scrap.



FINAL CONSIDERATIONS

Since Nitinol also has a unique ability to adapt to extraordinary strains and is compatible with the human body, it is a great choice for numerous applications in the medical field. What starts as ultra-fine metal wire ends up being used for braid products such as stents, orthodontic wire, catheters, and other surgical implant devices. With end uses like these, it is essential for medical device manufacturers to select an alloy and a supplier that provides materials with undeviating, consistent mechanical properties, ensuring that those properties are appropriate for processing medical wire. Both production methods and manufacturing sources are equally important in supply chains within the high-tech medical device industry. For any further questions on Nitinol Fine Wire, please contact a specialist at Ulbrich, and we'll be happy to answer!



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ULBRICH SPECIALTY WIRE PRODUCTS

692 Plant Road
Westminster, SC 29693

(864) 647-6087
info@ulbrich.com

CAPABILITY SHEET

Fine Nitinol: Flat & Round Wire

BASE MATERIAL

Standard Binary per ASTM F2063 (NiTi 1)	Chrome Doped	Minimum	Maximum
		2:1	40:1

ASPECT RATIO

Dimensions & Size Tolerances (Standard tolerances - please ask for your custom requirement)

FLAT WIRE

THICKNESS WIDTH	NOMINAL VALUE		TOLERANCE	
	Minimum	Maximum	Minimum	Maximum
	0.0003" [inch]	0.015" [inch]	+/- 0.0001" [inch]	+/- 0.001" [inch]
	0.0015" [inch]	0.150" [inch]	+/- 0.0002" [inch]	+/- 0.005" [inch]

ROUND WIRE

DIAMETER	NOMINAL VALUE		TOLERANCE	
	Minimum	Maximum	0.0020" and under	+/- 0.00010" [inch]
	0.0007" [inch]	0.025" [inch]	0.0021" to 0.0050"	+/- 0.00015" [inch]
			0.0051" and above	+/- 0.00020" [inch]

Typical Mechanical Properties of Nitinol (Size dependent)

NITI 1 CHROME DOPED	TYPICAL AS DRAWN (AD)		TYPICAL STRAIGHT ANNEALED (SE)	
	UTS (ksi)	Elongation (%)	UTS (ksi)	Elongation (%)
	200 Min	4% Min	180 Min	10% Min
	210 Min	4% Min	180 Min	10% Min

Packaging (Our machinery can adapt to most custom spools upon request)

SPOOL TYPE	DIMENSIONS
30mm Steeger	1.57" flange x 1.40" width x 1.18" barrel x 0.42" bore
26mm Steeger	1.69" flange x 1.40" width x 1.02" barrel x 0.42" bore
15mm Steeger	1.57" flange x 1.40" width x 0.59" barrel x 0.42" bore
Wardwell	2.60" flange x 3.25" width x 0.74" barrel x 0.657" bore
DIN 100	3.94" flange x 2.52" width x 2.48" barrel x 0.63" bore
DIN 125	4.92" flange x 4.92" width x 3.15" barrel x 0.63" bore
Bulk Spools	Various

All information provided is based on our current standard knowledge and does not claim to be exhaustive. This information may not be passed on to third parties without approval by Ulbrich Specialty Wire Products.



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DEVELOPMENT PARTNERSHIP

Braid Wire **Accelerator®** PROGRAM



At Ulbrich, we understand medical device development timelines continue to be reduced. The need for device designers to iterate quickly is accelerating and rarely supported by the supply chain. To better serve our customers' ever increasing requirements, we have developed our fine wire stocking program.

- » We provide you the ability to obtain a variety of round and flat wire quickly
- » This program can have wire in your hands in 72 hours or less
- » Product ships within 24 hours of order acknowledgement
- » Your project teams are now able to meet their timelines while incorporating all the design performance characteristics your devices require
- » Need minor modifications? Ask about our semi-finished-materials program!

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ULBRICH SPECIALTY WIRE PRODUCTS

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Material	Size	Tensile Range	Winding Tension	Bobbin Type	Feet/Bobbin	Part Number
304V	.0005" x .0025"	300-355 ksi	50 grams	Steeger 30mm	5,000	7894-7012
304V	.0005" x .003"	300 ksi min	60 grams	Steeger 30mm	5,000	7894-7011
304V	.0007" x .003"	300 ksi min	50 grams	Steeger 30mm	5,000	7894-7014
304V	.001" x .003"	150-180 ksi	50 grams	Steeger 30mm	5,000	7894-7000
304V	.001" x .003"	200-250 ksi	50 grams	Steeger 30mm	5,000	7894-7002
304V	.001" x .003"	300-355 ksi	50 grams	Steeger 30mm	5,000	7894-7001
304V	.001" x .003"	High Tensile 400 ksi min	75 grams	Steeger 30mm	5,000	7894-7024
304V	.001" x .005"	150-200 ksi	75 grams	Steeger 30mm	5,000	7894-7003
304V	.001" x .005"	200-250 ksi	50 grams	Steeger 30mm	5,000	7894-7004
304V	.001" x .005"	300 ksi min	75 grams	Steeger 30mm	5,000	7894-7005
304V	.002" x .005"	300 ksi min	85 grams	Steeger 30mm	2,500	7894-7016
304V	.002" x .006"	300 ksi min	100 grams	Steeger 30mm	2,500	7894-7015
304V	.0015" x .005"	300 ksi min	75 grams	Steeger 30mm	5,000	7894-7023
304V	.0005" x .0015"	300 ksi min	60 grams	Steeger 30mm	5,000	7894-7041
304V	.0015" Rd	300 ksi min	75 grams	Steeger 30mm	5,000	7894-7038
304V	.00075" Rd	300 ksi min	25 grams	Steeger 30mm	5,000	7894-7022
304V	.001" Rd	235-265 ksi	25 grams	Steeger 30mm	5,000	7894-7006
304V	.001" Rd	300 ksi min	40 grams	Steeger 30mm	5,000	7894-7007
304V	.001" Rd	High Tensile 425 ksi min	25 grams	Steeger 30mm	5,000	7894-7026
304V	.0015" Rd	235-265 ksi	50 grams	Steeger 30mm	5,000	7894-7013
304V	.002" Rd	151-200 ksi	50 grams	Steeger 30mm	5,000	7894-7008
304V	.002" Rd	235-265 ksi	50 grams	Steeger 30mm	5,000	7894-7009
304V	.0005" Rd	300 ksi min	15 grams	Steeger 30mm	5,000	7894-7025
304V	.002" Rd	300 ksi min	50 grams	Steeger 30mm	5,000	7894-7010
304V	.002" Rd	High Tensile 425 ksi min	75 grams	Steeger 30mm	5,000	7894-7027
304V	.002" Dual-lead	300 ksi min	50 grams	Steeger 30mm	5,000	7894-7021
304V	.002" 3 ends	300 ksi min	50 grams	Steeger 30mm	4,200	7894-7028
304V	.002" 4 ends	300 ksi min	50 grams	Steeger 30mm	4,000	7894-7029
304V	.003" Rd	300 ksi min	100 grams	Steeger 30mm	4,000	7894-7017
Nitinol	.001" Rd	As Drawn, Oxide Finish	30 grams	DIN 100	2,500	7990-7100
Nitinol	.001" Rd	As Drawn, Oxide Finish	35 grams	Steeger 30mm	1,000	7990-7101
Nitinol	.002" Rd	As Drawn, Oxide Finish	60 grams	DIN 100	2,500	7990-7102
Nitinol	.002" Rd	As Drawn, Oxide Finish	60 grams	Steeger 30mm	1,000	7990-7103
Nitinol	.003" Rd	As Drawn, Oxide Finish	60 grams	DIN 100	2,500	7990-7104
Nitinol	.003" Rd	As Drawn, Oxide Finish	85 grams	Steeger 30mm	1,000	7990-7105
Tungsten	.001" x .003"	400 ksi min	75 grams	Steeger 30mm	500	7894-7042
Tungsten	.0005" x .0015"	400 ksi min	75 grams	Steeger 30mm	500	7894-7043
Tungsten	.0005" x .003"	400 ksi min	75 grams	Steeger 30mm	500	7894-7044
Tungsten	.0005" Rd	450 ksi min	40 grams	Steeger 30mm	1,000	7894-7039
Tungsten	.0007" Rd	450 ksi min	75 grams	Steeger 30mm	1,000	7894-7040
Tungsten	.001" Rd	400 ksi min	75 grams	Steeger 30mm	2,500	7894-7030
Tungsten	.002" Rd	400 ksi min	75 grams	Steeger 30mm	2,500	7894-7031
L605	.002" Rd	300 ksi min	75 grams	Steeger 30mm	2,500	7894-7032
L605	.001" x .003"	300 ksi min	75 grams	Steeger 30mm	2,500	7894-7033
CuBe 172	.002" Rd	185-245 ksi	75 grams	Steeger 30mm	2,500	7894-7034
CuBe 172	.001" x .003"	185-245 ksi	75 grams	Steeger 30mm	2,500	7894-7035
MP35N	.002" Rd	300 ksi min	75 grams	Steeger 30mm	2,500	7894-7036
MP35N	.001" x .003"	300 ksi min	75 grams	Steeger 30mm	2,500	7894-7037



We Deliver Precision®

ULBRICH.COM

Our Industry Leading Capabilities

DESIGNED WITH YOUR SUCCESS IN MIND



OVERVIEW OF MANUFACTURING

Our state-of-the-art equipment, technology, and staff make us the go-to stainless steel and special metals producer for numerous manufacturing markets, including the medical, aerospace and automotive industries.

ROLLING TOLERANCES

Our largest H-mill can handle incoming strip material up to .125" thick, while our smallest Z-mill can roll foil as light as .00039": an order of magnitude thinner than a human hair.

SLITTING & EDGING

From Round to Square edge, our slitters have the ability to separate a wide strip into "mults" or narrower strips to achieve your desired width with as much minimized burr as possible.

ANNEALING

Utilizing hydrogen, nitrogen, and argon controlled atmospheres, we properly anneal all the alloys we offer to satisfy the most demanding specifications of the aerospace, medical, and nuclear industries.

MATERIAL PROPERTIES

From Bright to Dull or Quarter Hard to Extra Full Hard, Ulbrich has the ability to control your desired surface finish and mechanical properties of your Precision Strip & Wire products.

COATING & PLATING

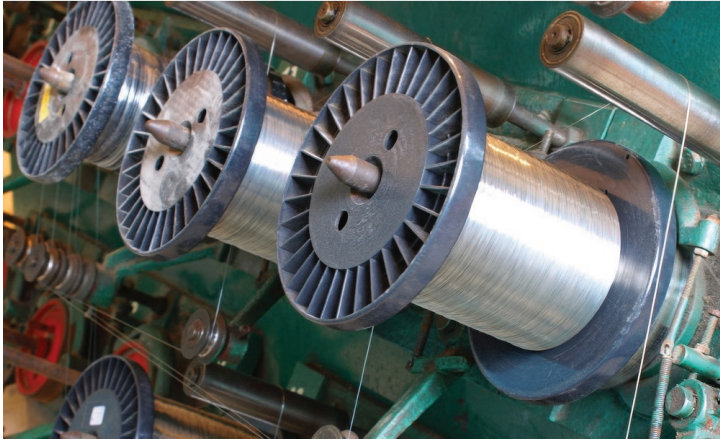
Based on your exact requirements, we expertly apply protective coatings with various thicknesses, adhesion properties, colors, and opacity to ensure your product is successfully brought to completion. Additionally, our multiple plating lines, first-rate production capabilities, and expert metallurgists can handle any plating needs you have.

PACKAGING

With production and shipping capabilities spanning the entire globe, we are able to accommodate steel and metal product packaging and transit to almost any international destination.

Experience Consistency & Increased Performance

WITH ULBRICH SPECIALTY WIRE PRODUCTS



METHODS TO ENSURE MATERIAL QUALITY

Quality Control Coordinators, Engineers and Machine Operators at Ulbrich are continuously inspecting each work order with vigorous attention to detail. Collaboration is paramount to ensuring quality throughout the supply chain. When selecting a materials partner, you should work to understand if they have the same level of commitment to quality as you would expect. Compliance with the latest ISO certifications is just the start. To meet the material needs of customers, special precautions and utmost care should not only be standardized in the process, but engrained in the culture.

Focusing on SPC (continuous dimensional data collection) as the metal runs through Ulbrich's mill improves consistency in the performance for your manufacturing process as well as the final device. This type of quality control ensures that defects are less likely and therefore, time and energy savings are benefitting your device component and streamlining your production while reducing scrap, waste and failure. Most of all, SPC data assures that materials are within your specifications and meet all the regulatory and manufacturing requirements.

Furthermore, Ulbrich understands that tedious spooling methods to avoid tangles during production are also of high importance. When customers go to use bulk, Steeger or Wardwell bobbins, they do not want any breakages due to tangling wires. With round Nitinol wire as thin as 0.0007", tangling can cause massive strain on your device production. Ulbrich puts emphasis on not only ensuring accuracy in the dimensions of the bobbins and winding device with precise concentricity and alignment, but also matching the winding parameters with the parameters that will be used in the next operation, resulting in an optimized braiding performance.

PRECISION WINDING & SHAPING OF WIRE

At Ulbrich Specialty Wire Products in Westminster, SC, we offer precision winding of a variety of round, flat, fine and shaped Nitinol wire products. Our "focus factory" (factory within a factory) dedicates our managers, rolling mill operators, and metallurgists along with state-of-the-art equipment to produce and manage industry specific requirements. Ulbrich's engineers and technical support staff also assists customers select and procure the right material with the right properties based on their specific application demands, with the most common mechanical properties being high strength, dimensional control, surface smoothness and elongation.

The expansion of Ulbrich's in-house drawing and plating capabilities has led to industry expertise in bare and plated mandrels for critical applications. Our metallurgical prowess allows us to offer multiple custom tempers and finishes in quantities ranging from small R&D lots up to full production runs prepared to your specifications.



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SHAPED WIRE CAPABILITIES

Precision Rolled, Coated & Shaped Wires for Medical

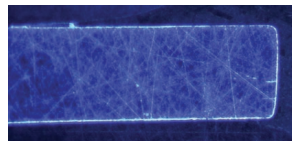
Ulbrich Specialty Wire Products is expanding shaping capabilities to include ultra-fine cross sections and additional alloys to complement Ulbrich Shaped Wire's already extensive offering.

SPECIALTY EDGING:

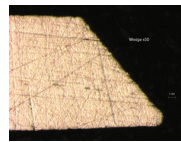
TYPES OF EDGES

Exact dimensions achieved with specialized tooling to create accurate edges.

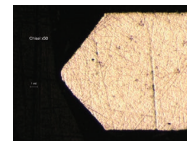
Square



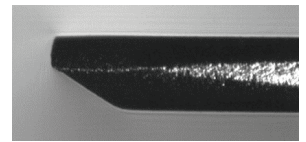
Chisel



Wedge



Tapered



SPECIALTY SHAPES:

MATERIALS

- Stainless Steel
- Titanium Alloys
- Nickel Alloys
- Cobalt Alloys
- Nitinol
- Copper
- Special Metals

COATING

- In-House Capacity:
- Gold
 - Silver
 - Nickel

SIZING

Various radii and angles are achieved consistently and replicated over multiple batches and thousands of feet by using specific shaping rolls and edging tools.

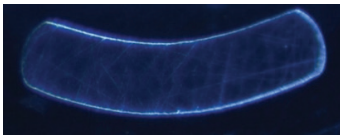
GENERAL SIZE RANGES

- Thickness: .001" – .080" (0,025 – 2 mm)
- Width: .010" – .200" (0,25 – 5 mm)
- Diameter: .010" up to .080" (0,25 up to 2 mm)

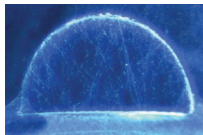
TYPES OF SHAPES

Existing shapes shown below. Custom Shapes developed on request.

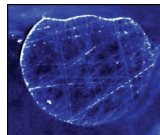
U-Shaped



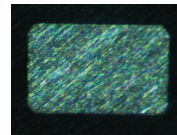
D-Shaped



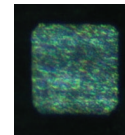
Wave



Rectangle



Square



Rhombus



Actual examples of possible shapes that can be manufactured. Images obtained using a scanning electron microscope.

Ulbrich Wires are precision rolled or drawn to size. Products have a clean superior finish and are free of burrs. Ulbrich offers custom shapes made of a wide variety of alloys and coatings. Ulbrich produces complex shape profiles while maintaining exacting dimensional standards. The physical properties can be closely controlled, making Ulbrich's precision wire products the ideal choice for any application.

Knowledgeable Leadership in Precision Alloys

WE'RE ALWAYS LOOKING FOR WAYS TO INNOVATE AND IMPROVE YOUR METAL DEVICES



In addition to our state-of-the-art capabilities in rolling, slitting, and annealing, Ulbrich is continuously testing, researching, and analyzing alloys and their chemical and mechanical properties to maximize performance potential. What does this mean for you? It means when you partner with Ulbrich, you not only get the best of the best in personnel, process, and product—you also get a promise of a team that truly cares about making your application as consistently successful and effective as possible.

GLOBAL REPRESENTATION WITH SERVICE & DISTRIBUTION CENTERS LOCATED WORLDWIDE

Ulbrich Stainless Steels & Special Metals, Inc., is a family owned company in its fourth generation of leadership. Established in 1924, Ulbrich has become a critical supplier of stainless steel & special metals to various industries throughout the globe. During this time, we have participated in the development and manufacturing of hundreds of innovative applications. With industry leading Dimensional Control, real time gauging and Statistical Process Control (SPC), a large variety of specialty alloys, and the best customer service available, we strive to produce and distribute the highest quality materials to you. Ulbrich is comprised of a series of manufacturing divisions that supply specialty strip and foil, as well as precision flat, fine, round, and shaped wire, all with local management and all designed to provide custom metal products to satisfy the needs of original equipment manufacturers around the world.

YOU HAVE IDEAS. WE HAVE RESOURCES. PARTNER WITH LEADING EXPERTS.

With Ulbrich's world-class Development Innovation Team, you can gain access to product specialists and quality metallurgists, each with expertise that is best-suited for your unique raw material needs. Our team can deliver custom material solutions to maximize the performance of your application. Talk to a specialist today to learn about what finishes, edge capabilities, mechanical properties, packaging and lengths we can offer for your application! Learn more about our Development Partnership online at www.ulbrich.com/company/development-partnership

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info@ulbrich.com | 800-243-1676

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