
With Ulbrich,
your ideas take
flight.
ALLOYS FOR
AEROSPACE
Since the beginning of commercial jet travel and space exploration, Ulbrich has been providing high-quality precision rolled alloys to the aerospace industry. As commercial and defense aviation advances, so does Ulbrich's ability to provide light weight, high strength and heat resistant materials that allow planes to fly more efficiently than ever. Our extensive metallurgical staff will assist you in providing various stainless, nickel, titanium & cobalt alloys in the form of precision rolled strip, foil, flat, round and shaped wire for all of your aerospace needs.
Ulbrich
We Deliver Precision®
CAPABILITY WHITEPAPER

We Deliver Precision®

ULBRICH.COM

CAPABILITY WHITEPAPER

Alloys for Aerospace

MATERIALS THAT WILL WITHSTAND HOTTER TEMPERATURES

To meet these temperature demands, Ulbrich offers heat-resistant super alloys (HRSAs), including niobium, titanium and nickel alloys.

FEATURED NICKEL BASED ALLOYS

- Inconel® 718
- Inconel® X-750
- Hastelloy® C-276
- Haynes® 282
- Haynes® 230
- Waspaloy®

TITANIUM

- Grade 9
- 15-3-3-3
- Beta 21S

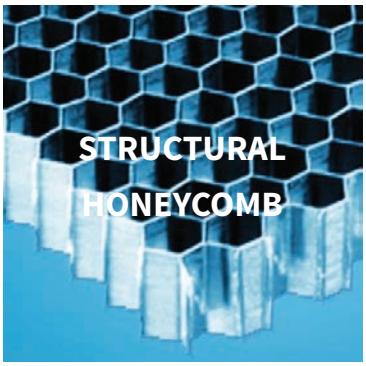
NO MARGIN FOR ERROR

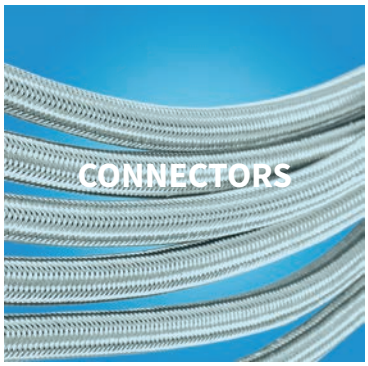
At distances measured in AU, every single detail matters. From material selection to manufacturing and everything in between, we're dedicated to delivering precision.

CONTINUOUS PURSUIT OF INNOVATION

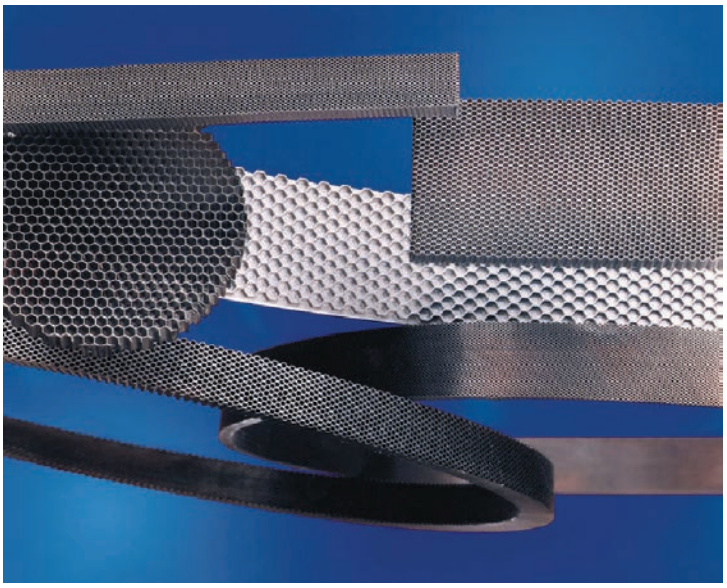
We're on top of the latest trends, processes and industry-specific requirements. Our light weight materials offer increased strength and corrosion resistance.

AEROSPACE APPLICATIONS BENEFITTING FROM ULBRICH PRECISION ROLLED METALS





High-Strength Strip & Foil for Structural Honeycomb



Complete with our broad alloy portfolio and extensive product capability, we're able to provide maximum flexibility for engineering design. With expertise in supporting both small and large production runs, Ulbrich can help you increase your speed to market and provide you with a continuity of supply, ensuring you & your product success for the short- and long-term.

MOST COMMON ULBRICH ALLOYS CHOSEN

With their ease of fabricability and naturally high temperatures, corrosion-resistant properties and immense strength, Nickel-based & Cobalt-based alloys, Commercially Pure Titanium and Titanium alloys in continuous precision strip and foil form are the most common Ulbrich metals used in structural honeycomb cores.

CORE PRODUCTS THAT USE ULBRICH METALS

As a worldwide supplier of precision continuous strip and foil, our metals are critical for today's commercial and military aerospace programs. Used to fabricate precision welded nacelle honeycomb cores, our metals are hugely important components of the following: Engine Cowls, Thrust Reversers, and Exhaust Systems.

WE'RE AEROSPACE DEVELOPMENT PARTNERS

At Ulbrich, we take pride in forming legitimate and reliable partnerships with our customers. To us, that means working closely with you in order to deliver exactly what you need across all of our services. And, with our dedicated team of full-time metallurgists and engineers, our precision products and services allow our customers and aerospace industry OEMs to receive the highest amount of value at the lowest overall cost.

WE WORK WITH YOU TO MEET YOUR SPECIFIC METAL AND AEROSPACE APPLICATION NEEDS

We understand that aerospace applications can present challenging problems for engineers and product development teams to overcome. Ulbrich has a long, rich history of helping our customers identify the right materials with the right characteristics that can withstand and perform in the most challenging of conditions.

SUPERIOR RELIABILITY FOR AEROSPACE BATTERY CAN MANUFACTURING

At Ulbrich, our material knowledge and practical expertise allow us to create special alloys that are guaranteed to perform at optimal levels in all batteries.

METALS USED IN BATTERY CAN PRODUCTION

To manufacture final battery products, Ulbrich typically uses a combination of austenitic and ferritic grades of stainless steels, titaniums, nickels, and nickel alloys. Like all of our metals, we're able to shape these alloys to the exact specifications that you need, allowing you to produce your battery just how you envisioned it.

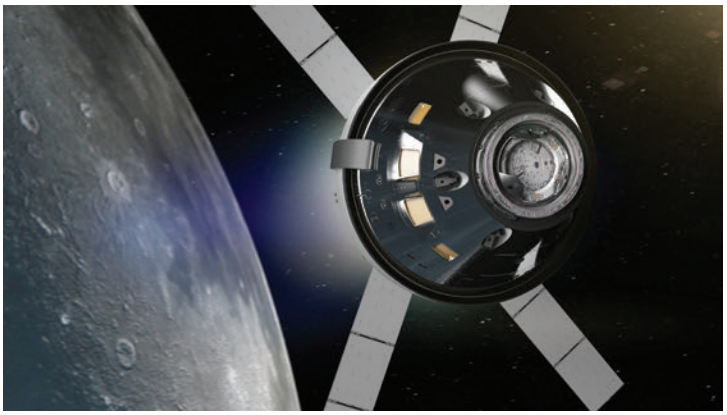
APPLICATIONS MADE WITH ULBRICH ALLOYS

Ulbrich precision-shaped metals and alloys are used in the manufacturing of a variety of energy storing devices. The materials we produce most often act as containers where batteries and circuitry can be stored, and the alloys we utilize depends on a few important factors, most notably what the end-use of the application will be and the environment in which it will be used.

YOUR REQUIRED DIMENSIONS AND SHAPES ARE ALWAYS MADE POSSIBLE WITH ULBRICH

In addition to our ability to control critical tolerances to the tightest specifications in the world, we also apply truly unique manufacturing processes to ensure precise alloy forming, fit to meet the exact shapes and dimensions that your battery products require. Our expert engineers and metallurgists use the latest annealing and shaping technologies to create the aerospace industry's most performant coiled strip and foil. That, combined with our quality accreditations and technical sales support, make us a trusted partner capable of helping OEMs take flight quicker and substantially safer than ever before.

Industry-Leading Supplier for Heat Exchangers

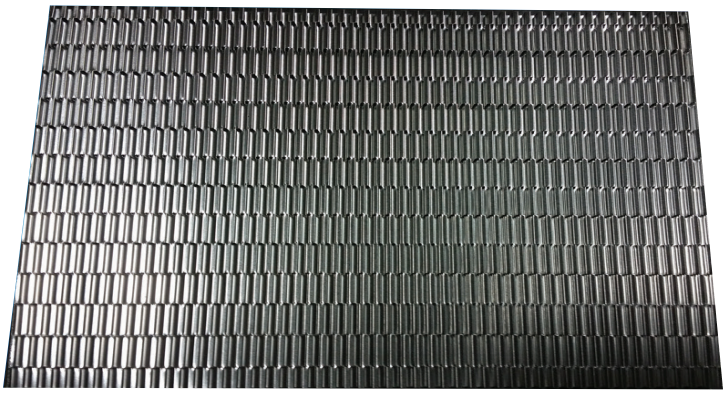


ULBRICH'S METALLURGICAL TEAM CAN GET THE STRIP AND WIRE MATERIALS YOU NEED BUILT TO YOUR EXACTING SPECIFICATIONS

- Nickel Based Alloys (Ni/CR, Ni/Co, Ni/Fe)
- 300 & 400 Series Stainless Steel
- Titanium Alloys (Ti 21s, Ti 15-333, Ti 3/2.5)
- Commercially Pure Titanium (Grade 1-4)
- Titanium 6-4 (rolled from wire only)
- Titanium 6-2-4-2 (rolled from wire only)

HEADER BAR AND FIN STOCK BUILT WITH HIGHER TEMPERATURES & YIELD IN MIND

With industry-leading techniques, Ulbrich is capable of shaping the strongest alloys for heat exchanger components, making header bar and fin stock that are heat- and corrosion-resistant for the world's strongest aerospace engines. Our process involves unparalleled precision, resulting in zero yield loss, which helps you get the most out of raw materials.



ULBRICH'S HEAT EXCHANGER SOLUTION TO AEROSPACE ENGINES: PRECISION TITANIUM

Aerospace engines need Ulbrich-quality alloys in their heat exchangers. Without our custom profile of titanium shaped wire products—provided in both continuous coil and set lengths—world-class engines produce temperatures that can boil fuel out of efficient temperatures. Our unique processing capability for titanium header bar & fin stock gives our customers access to the tightest tolerances in metals and alloys with top-of-the-line precision.

ULBRICH'S UNPARALLELED ROLLING PROCESS AND UNIQUE CAPABILITIES

To ensure quality titanium foil & shaped wire, there needs to be consistency in the material properties and manufacturing process. Tailored especially to your end use, Ulbrich knows your products need repeatable rolling, slitting, annealing, and specific finishing processes. Ulbrich's unique capabilities allow us to engineer surface finishes to minimize the abrasiveness of the oxide, resulting in less tool wear and increasing the die life for our customers.

ULBRICH SHAPED WIRE ADVANTAGES

- Continuous Coils & Traverse/Oscilate Spools
- Cut-to-Length Available as well as Pancakes
- State-of-the-Art, In-House Tooling Center
- Specific Tensile/Yield/Temper Ranges
- Intricate Specialty and Custom Edges
- In-Line Process and Gauge Control
- Close Dimensional Tolerances
- Net or Near Net Shape
- No Burr

High Performance Fastener Alloys for Critical Applications

When an application calls for fasteners that can withstand atmospheric or chemical corrosion, elevated temperatures or a combination of both, fastener makers find themselves dealing with specifications and availability issues that aren't a factor with the more common carbon steels. To make matters worse, the fasteners are often the most critical parts to the final product. Their properties must often exceed those of the materials being joined because the joint areas may be the most vulnerable to failure.

Bolts, nuts, washers, rivets and other fasteners for jet engines, gas turbines, superchargers, afterburners, petrochemical processing parts and other critical aerospace equipment are made from special alloys that can withstand demanding conditions of heat, stress and corrosive environments. Applications like these are becoming more common as designers push the envelope for better performance and greater durability under very demanding conditions.

Fortunately, there are a number of alloys in the commercial mainstream that have proven themselves in these critical applications. At Ulbrich, buyers can obtain just-in-time deliveries when required and select from generous inventories covering more than 165 grades of stainless steel, nickel, cobalt and titanium alloys in a range of thicknesses, shapes, sizes and tempers. The following alloys are in stock at Ulbrich service centers serving the aerospace market. They include foil and strip in a variety of gauges, as well as wire, round bar, centerless ground bar, hex bar, rod, sheet and plate from other Ulbrich divisions.

PRECIPITATION HARDENING ALLOYS

Most of the fastener alloys in demand today are of the precipitation hardening (PH) variety. What makes them different from other grades of stainless and nickel-based alloys is the addition of small amounts of aluminum, phosphorous, copper or titanium to their matrix. With these alloys, cold forming is done in the relatively soft solution annealed condition. After fabrication, the parts are given an age-hardening treatment in which the added elements precipitate as hard intermetallic compounds that significantly increase hardness and strength.

Despite their more complex metallurgy, these alloys are not necessarily more costly than many non-age-hardenable alloys. In fact, performance may be substantially higher in PH alloys without a cost penalty. Although corrosion resistance is decreased (or possibly increased) during the aging cycle, it is only by a slight amount.

Because they are very similar, these alloys can often be used interchangeably depending upon their availability in the tempers, shapes and sizes required. In the case of strip, adjustments in metallurgy can be made through rerolling and heat treatment to arrive at the desired solution annealed condition.

PH STAINLESS STEEL ALLOYS

17-7 PH

Another precipitation-hardening stainless steel, 17-7 PH provides high strength and hardness, excellent fatigue properties, good corrosion resistance and has minimum distortion from heat treatment. Ulbrich stocks 17-7 PH in the forms of strip, wire and bar.

The exceptionally high strength of 17-7 PH offers many advantages where limited ductility and workability are permissible. In the age-hardened condition, it possesses excellent mechanical properties at temperatures up to 900°F and its corrosion resistance is superior to that of most hardenable chromium alloys, approximating that if the austenitic chromium-nickel stainless steels in same environments. Fabrication practices for 17-7 PH are similar to those used for other chromium-nickel stainless steels.

Heat Treatment/Aging

There are three levels of age hardening, each providing a slightly different mix of properties.

In one, the alloy is solution annealed at 1950°F for forming and fabricating, then given a three-part aging process consisting of austenite conditioning at 1400°F, holding for 90 minutes and air cooling.

To create an alloy with higher room temperature and elevated temperature strength, the 1950°F solution annealed material is heated to 1750°F, held for 10 minutes; cooled to -100°F, held for eight hours; heated to 950°F, held for 60 minutes and air cooled.

The third level offers the highest mechanical properties. In this treatment, the solution annealed material is transformed to martensite by cold reduction, heated to 900°F, held for 60 minutes, then air cooled.

A-286® IRON BASE ALLOY

The widest used fastener grade steel among the PH alloys is A-286. This heat and corrosion resistant alloy is found in applications requiring high strength and corrosion resistance up to 1300°F, and for lower stress applications at higher temperatures. It also performs well in extremely low temperatures where a ductile, non-magnetic high strength material must withstand temperatures down to -320°F.

This alloy has a chromium, molybdenum and nickel content similar to many of the austenitic stainless steels, so its aqueous corrosion resistance is very comparable to those alloys. In the elevated temperature service up to 1300°F, its corrosion resistance is excellent. A-286 is available from Ulbrich in the form of strip, sheet, wire and both solution-annealed and aged bars.

Heat Treatment

Formed A-286 alloy parts attain their high strength in a three-step process that includes solution anneal at 1800°F, followed by forming or fabricating to shape, and then an aging heat treatment. The solution anneal provides superior creep and stress rupture properties, better ductility and higher hardness after aging.

Formability

In the solution treated condition, A-286 alloy can be cold formed much like standard austenitic stainless steels. It is somewhat stronger, and may require higher loads to deform the material. During cold working, solution treated A-286 sheet has a work hardening rate about the same as that of Type 310 stainless steel.

Aging

The normal aging cycle consists of heating to 1300/1400°F, holding 12 to 16 hours at heat, followed by air cooling. For an even higher aged strength, solution treated material may be cold worked prior to the aging treatment.

PH SPECIAL METALS

INCONEL® 718

This nickel chromium alloy has high strength & excellent corrosion resistance up to 1300°F with slightly diminished properties as temperatures rise. Inconel 718's strong point is its weldability, especially its resistance to post-weld cracking, in any comparison among PH alloys.

Strength can be maximized by work hardening, and the alloy may be used in the cold worked & aged condition in certain instances. However, aging response is considered minimal when compared to typical age-hardening alloys. A 1900°F - 1950°F anneal followed by aging is preferred to achieve the best transverse ductility in heavy sections, impact strength, and low-temperature notch tensile strength. For this condition, aging is at 1400°F/10 hours, lowering to 1200°F and holding at that temperature for total aging time of 20 hours. Inconel 718 is available in strip, sheet, wire and bar.

WASPALOY®

This precipitation hardening, nickel-based alloy successfully resists intergranular oxidation from combustion products in gas turbines & aircraft jet engines at temperatures up to 1600°F. This is available in strip, wire, sheet and bar at Ulbrich.

Heat Treatment

The best stress rupture and creep properties are obtained through very specific high temperature solution anneals. A typical anneal of 1975°F will result in coarse grain size, low tensile yield strength and low tensile ductility. However, if treated below 1825°F, the as-hot-worked grain size will be retained and high tensile yield and tensile ductility will result, but with some loss in stress-rupture properties. A compromise for adequate rupture properties, acceptable tensile properties and moderate grain growth is to solution anneal just above 1875/1900°F.

Aging

The normal aging treatment for Waspaloy® is to stabilize at 1550°F for four hours, air cool, hold at 1400°F for 16 hours, then air cool. However, if solution treating is done at 1975°F, the 1550°F stabilization aging time is increased to 24 hours.

L-605

This cobalt, nickel, chromium alloy has excellent resistance to hot corrosive atmospheres typical of jet engine operation, qualifying L-605 for the most critical types of fasteners. It resists oxidation for intermittent service up to 1600°F, continuous service up to 2000°F and shows particularly good qualities under extreme oxidizing conditions. It also successfully resists chemical oxidizing agents, hydrochloric and nitric acids at certain concentrations and temperatures, and salt spray corrosion.

This non-magnetic alloy also possesses high strength properties at elevated temperatures, remains non-magnetic in the work-hardened condition, and can be supplied in the cold worked or easier-to-form solution-annealed condition depending on section size and application. Strength can be maximized by work hardening, and the alloy may be used in the cold worked and aged condition in certain instances. However, aging response is considered minimal when compared to typical age-hardening alloys.

TITANIUM ALLOYS

Another popular material for high performance fasteners is titanium bar, particularly Grade 6AL-4V. The most widely used of the titanium alloys, 6AL-4V has a minimum room-temp tensile strength of 130,000 psi, yield at 120,000 psi & it retains 70% of its yield strength at 750°F. It is fully heat treatable in section sizes up to 1". This process increases both hardness & strength by about 20%. After aging, typical yield strength of a 1" bar is 150,000 psi & hardness is 360 Bhn.

LESS POPULAR ALLOYS

What if the fastener specification calls for a less popular or more exotic alloy? Or you need it in a gauge or temper that your suppliers don't carry? There are two solutions, both very doable.

First ask your buyers to be more flexible in their specs Usually there are any number of alloys that might be considered for the job. With more choices you increase your chances of finding the alloy you need. The PH alloys mentioned can often be used interchangeably, depending on availability. The exception to this rule are fasteners that must combat specific conditions, such as ion attack or stress corrosion cracking. Then the specs should be followed to the letter.

But if the first option doesn't work, you have another alternative. If your starting material is strip, then you can use a specialty outsource — a reroller. These operations are a combination of service center and production shop. They use powerful cold rolling mills to reduce strip to the desired thickness and at the same time work harden it to the temper required. Rerollers do more than roll metals to precise thicknesses and temper. With their combination of rolling mills and bright anneal furnaces, they can adjust properties such as yield strength, hardness and elongation to meet a particular specification.

As you might expect, exercising this type of control requires a knowledgeable staff of metallurgists. If your company is regularly in the market for high performance alloys, the most valuable part of dealing with a development partner and reroll source such as Ulbrich may be the technical assistance you can get from these experts. They can assist your engineers in writing the specifications. Factors such as yield or tensile strength, elongation, corrosion resistance, hot tensile properties, grain size, packaging requirements, coil sizes and many others can be addressed in this process.

Rerollers exist throughout the metal industry. But, in the stainless, nickel and cobalt alloy market, they are especially important because these higher priced metals are expected to meet more stringent specifications. Minute changes in metallurgy or surface finish can be key factors in the success of many fastener applications. Whether your needs can be met "off-the-shelf" or with the help of a secondary re-roller like Ulbrich, fastener industry engineers can be assured the answer to their spec can be found readily and within reasonable cost parameters from service centers specializing in these alloys.

YOUR SOURCE FOR FASTENER ALLOYS

Fastener applications involving high temps and corrosive conditions require material specs that can involve stainless, nickel, cobalt & chromium alloy steels. As a major supplier to aircraft and aerospace parts manufacturers, Ulbrich has accumulated a great deal of experience in processing these alloys to meet the industry's high standards. We provide a number of special products and services for fastener producers:

- Bare, copper coated or soap coated rod, bar and wire for cold heading operations
- Centerless ground bar up to ½ inch diameter
- Annealed, percent cold reduced, or other special tempers or PH alloys
- Hex shapes in many alloys

Because of the important jobs they do in maintaining the structural integrity of assembled parts, fasteners are among the more critical applications for alloys supplied by Ulbrich. To meet the demands of this market, our manufacturing operations & service centers follow strict quality control guidelines. We carry large inventories of these and other high-performance alloys, process them to precise gauges or diameters, cut them to size, and package them to accommodate your needs. Contact us today to discuss your next project!

Ulbrich Alloys of Exploration

TITANIUM GRADE 9

(TI 3AL - 2.5V)
UNS R56320
ASTM B265 GR9
MIL-T-9046 AB-5

TITANIUM 15-3-3-3

(TIMETAL® 15-3)
UNS R58153
AMS 4914

TITANIUM BETA 21S

(TIMETAL® 21S)
UNS R58210
ASTM GRADE 21
ASTM B265

AM 350®

STAINLESS STEEL
UNS S35000
AMS 5548
ASTM A693
MILS 8840
(Type 633)

INCONEL® 718

NICKEL ALLOY
UNS N07718
AMS 5596, AMS 5597,
ASTM B670, UNE N07718
WESTINGHOUSE
NFD310021 (NUCLEAR)

INCONEL® X750

NICKEL ALLOY
UNS N07750
AMS 5598
AMS 5542
ASTM B 637
ASME SB 637

HAYNES® 282

NICKEL ALLOY
UNS N07208
AMS 5951
ASTM B 637

HAYNES® 230

NICKEL ALLOY
UNS N06230
ASTM B435
AMS 5878
PWA 1163

HASTELLOY® C-276

NICKEL ALLOY
UNS N10276
ASTM B582

Titanium Meets the Challenges of Military Aerospace Manufacturing

“If stainless, nickel, and cobalt alloys don’t meet your performance requirements, chances are titanium will.” Ron Brucker, a former Ulbrich senior metallurgist once said. The truth is that Titanium can withstand corrosive elements that are no match for the other alloys, and with the strength of steel at half its weight, it can also be used where strength-to-weight ratios are critical.

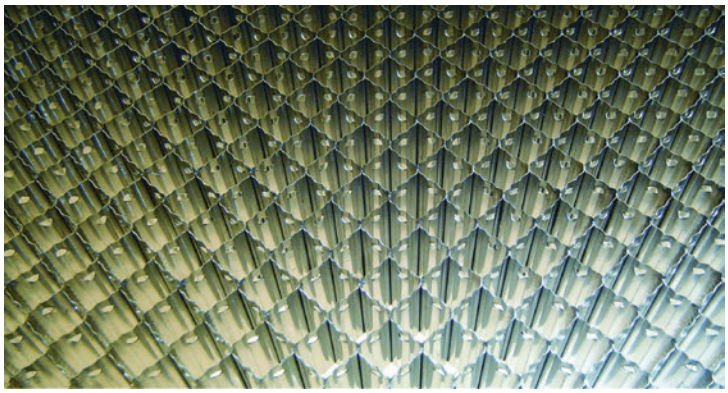
As an aerospace manufacturer, you have specific requirements for your project, so choosing the best alloy for your application is key to having an optimized final product. When it comes to designing parts for the aerospace industry, you need a material that is lighter, yet stronger, and holds up to hotter temperatures, all while allowing planes to fly faster and more efficiently than ever. This is where Titanium shines.

The inception of Titanium dates back to 1791, unknowingly first discovered by geologist Rev. William Gregor. Four years later, it was officially named ‘titanium’ by German scientist Martin Heinrich Klaproth. The name originates from the word 'Titan' which comes from the Greek Mythology beings known as 'Titans', which were extremely strong and resilient. The material’s strength and weight make it preferred for many aerospace and aircraft parts. Still, like other high-performance alloys, processing titanium into metal is a lengthy process and costly, sometimes over 30 times more expensive than stainless and notably unstable.

However, there is one technique that exploits the material’s strength and keeps costs down – honeycomb panels. Made from corrugated, precision width strips, matched up against each other, then brazed or welded where one flat area fits up against the other, the panels provide maximum openness, strength per pound, and lightness. The honeycomb panels provide noise abatement and insulation when used as shrouds around aircraft engines. A mounting case for a military missile is one example.

Titanium is an amazing material which has unique properties that make it highly sought after in the production of many modern and innovative applications such as this. It’s strong and light. The tensile strength of Ti is between 30,000 psi to 200,000 psi depending on the type of titanium. It is also low density; about 60% the density of iron, reducing load and strain of heavier metals while reducing the overall weight of the objects it is used to manufacture.

The military specifies titanium honeycomb panels to meet strength requirements for their missile mounting case. Titanium actually has the highest strength-to-density ratio of any metallic element, making it an excellent choice for this application.



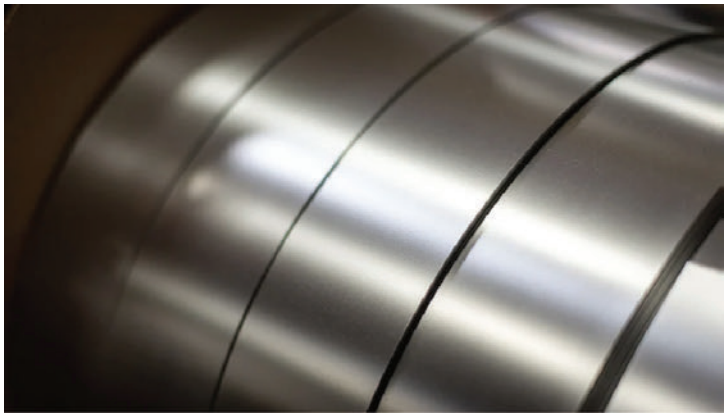
Ulbrich, a precision reroller who supplies Titanium for honeycomb, uses technologically advanced rolling mills to roll the Ti material down in repeated passes to 0.004” (0.10 mm) gauge; we then use our slitting machines to slit the material to .75” (19 mm) widths. The part is further processed with a precision crimp being imparted into the strip, where it is then joined via resistance welding, layer after layer.

Titanium strip users in the military aerospace industry benefit from working with precision rerollers who have deep supply chain partners and expertise in material thickness control, surface finish & formability. Typical thicknesses for honeycomb range from 0.001 (foil) to 0.007” (0.03 – 0.18 mm) with most of the demand on the thinner side of the range ±3 – 5% gauge tolerances in strip less than 1” (25 mm) wide.

Titanium rerollers create a surface area that improves welding and brazing by shot-blasting rolls to a matte or brushed finish. Precision rerollers must perform constant monitoring to ensure this precise, highly consistent finish. To control formability of both chemically pure and titanium alloys, processing or alloying methods are required in concert with cold working of the material. This is partly why Titanium is so difficult for rerollers—requiring deep expertise, experience, and equipment to produce with the precision characteristics demanded by military aerospace manufacturers. When the titanium material has been processed by the reroller, the formed material is then ready for drawing, punching, stamping, and forming on multislide and multiple-die-stamping equipment.

Titanium buyers benefit greatly from working with a precision reroller for their Ti needs. You may not need a 500 lb (225 kg) coil of titanium, but buying from large producing mills usually means accepting a minimum coil of this size. The aerospace market has a growing need for Ti coiled strip & foil for the structural components fabricated to protect these airframes' engine components, but the high minimums required at large mills can be prohibitive.

Working with a reroller who has a cultural commitment, in addition to the financial one required to be able to process this challenging metal can be extremely beneficial to part-makers within the aerospace industry. Ulbrich uses a service-center approach to slitting thin widths off mill-size coils and selling them in pancake or oscillate wound coils weighing under 60 lb (27 kg), putting the material within reach of fabricators. Ulbrich also uses less costly lengths of welded metals to start the coil so the roll gap is perfect by the time the titanium strip gets into mill stands. Slitting is done to precisely measured lengths for the same reason.



Ulbrich Steel is a specialty reroller in metals fabrication quietly helping the titanium industry reduce costs so the work material can compete for nonmilitary applications. If you have a challenging application and wonder if Titanium or one of its alloys may be ideal to meet your requirements, speak to one of our in-house metallurgists today who would be happy to help you in your material evaluation and selection.

Titanium

PRODUCED AS COMMERCIALLY PURE OR ALLOYED, TITANIUM IS LIGHT WEIGHT, CORROSION RESISTANT & ABLE TO WITHSTAND EXTREME TEMPERATURES.

We Deliver Precision®

COMMERCIALLY PURE

CP Titanium has the strength of steel at half the weight and is twice as strong as aluminum at only a little over 50% of the weight. These characteristics along with its superior corrosion-resistance make Commercially Pure Titanium a popular transitional metal for the creation of a countless number of products across many manufacturing industries.

- Grade 1 A35 UNS R50250
- Grade 2 A40 UNS R50400
- Grade 3 A55 UNS R50550
- Grade 4 A70 UNS R50700

TITANIUM ALLOYS

Titanium alloys are known to have two primary phases: alpha and beta. These phases are further broken down into subcategories including Alpha, near-Alpha, Beta, near-Beta. Alpha-Beta phase titanium alloy is a combination of two or more metals and has many attractive properties that make it highly sought after in the manufacturing industry including excellent heat treatability, weldability, corrosion resistance, and much more. These titanium alloys are commonly produced with the addition of vanadium or aluminum for applications within the aerospace market.

- Grade 5 6Al-4V UNS R56400
- Grade 9 3Al-2.5V UNS R56320
- Titanium 15-3-3-3 UNS R58153
- Grade 21 Titanium Beta 21S UNS R58210
- Titanium 6-2-4-2 UNS R54620 UNS R54621

PRODUCT FORMS

- Strip Coil
- Foil
- Ribbon
- Shaped Wire
- Round Wire
- Flat Wire

ULBRICH.COM

We Deliver Precision®

ULBRICH.COM

Nickel Alloys

EXHIBITING HIGH STRENGTH AND EXCELLENT CORROSION RESISTANCE, NICKEL ALLOYS WERE DEVELOPED FOR USE IN BOTH HIGHLY CORROSIVE OR HIGH-TEMPERATURE ENVIRONMENTS. ADDING OTHER ALLOYS SUCH AS MOLYBDENUM, CHROMIUM, AND IRON MODIFY THESE ALLOYS FOR USES.

CORROSION RESISTANT ALLOYS

In addition to them being inherently resistant to some chemicals, these alloys can be highly alloyed with elements that will improve their corrosion resistant properties.

- Hastelloy® B-2 UNS N10665
- Hastelloy® B-3 UNS N10675
- Hastelloy® G-30 UNS N06030
- Hastelloy® G-3 UNS N06985
- Hastelloy® C-22 UNS N06022
- Hastelloy® C-4 UNS N06455
- Hastelloy® C-276 UNS N10276

HIGH TEMPERATURE GRADES

These Nickel-based alloys offer superior performance at temperatures above 1832°F which makes them suitable in extremely harsh environments. High Temperature Nickel alloys offer many characteristics including excellent weldability, workability & ductility.

- Hastelloy® X UNS N06002
- Haynes® 242 UNS N10242
- Inconel® 617 UNS N06617
- Haynes® 188 UNS R30188
- Haynes® 263 UNS N07263
- Inconel® 625 UNS N06625
- Haynes® 214 UNS N07214
- Haynes® 282 UNS N07208
- Inconel® 718 UNS N07718
- Haynes® 230 UNS N06230
- Haynes® HR-120 UNS N08120
- Inconel® X750 UNS N07750

OTHER HIGH PERFORMANCE NICKEL

High Performance Nickel Alloys are designed with good strength and to resist oxidation and carburization at elevated temperatures. Alloys such as Monel are in this category due to their good ductility and use under a wide variety of corrosive conditions.

- Monel® 400 UNS N04400
- Monel® 401 UNS N04401
- Monel® 404 UNS N04404
- Monel® K500 UNS N05500
- Inconel® 600 UNS N06600
- Inconel® 601 UNS N06601
- Inconel® 702 UNS N07702
- NiSPAN-C® 902 UNS N09902
- Nickel 200 UNS N02200
- Nickel 201 UNS N02201
- Nickel 270 UNS N02270
- Permanickel 300® UNS N03300
- Incoloy® 800 UNS N08800
- Incoloy® 825 UNS N08825
- Alloy 80/20 Ni Cr UNS N06003

THERMAL EXPANSION ALLOYS

These Nickel Alloys have a chemical composition that is controlled within narrow limits to assure precise uniform thermal expansion properties. They are used in a wide range of applications where thermal changes of a metal must be factored into the design.

- Alloy 36 UNS K93600
- Alloy 46 UNS K94600
- Alloy 42 UNS N94100
- Alloy 42-6 UNS K94760
- Alloy 29-17 Kovar® UNS K94610
- Alloy 52 UNS N14052

We Deliver Precision®

ULBRICH.COM

Stainless Steel

ULBRICH ROLLS ALL FIVE CLASSIFICATIONS OF STAINLESS STEEL ALLOYS IN MULTIPLE PRODUCT FORMS FOR OUR CUSTOMERS.

AUSTENITIC

With exceptional resistance to heat & corrosion, unsurpassed strength and formability, these grades are the most common with many positive characteristics driving demand.

- Type 201 UNS S20100
- Type 204Cu UNS S20430
- Type 301 UNS S30100
- Type 301Si UNS S30116
- Type 302 UNS S30200
- Type 302HQ UNS S30430
- Type 303 UNS S30300
- Type 303Se UNS S30323
- Type 304(V/LV) UNS S30400
- Type 304L UNS S30403
- Type 304Cu UNS S30430
- Type 305 UNS S30500
- Type 309 UNS S30908
- Type 310 UNS S31000
- Type 310S UNS S31008
- Type 316 UNS S31600
- Type 316L UNS S31603
- Type 316LS UNS S31673
- Type 316LVM UNS S31673
- Type 316Ti UNS S31635
- Type 317 UNS S31700
- Type 317L UNS S31703
- Type 321 UNS S32100
- Type 330 UNS N08330
- Type 347 UNS S34700
- Nitronic 30 UNS S20400
- Nitronic 32 UNS S24100
- Nitronic 33 UNS S24000
- Nitronic 40 UNS S21900
- Nitronic 50 UNS S20910
- High Carbon Steel Wire
- AL-6XN® UNS N08367
- 20 CB-3® UNS N08020

MARTENSITIC

Because of its chemical composition, Martensitic steel can be hardened & strengthened through heat and aging treatments, making it stronger than other stainless types. The Martensitic grades cover a wide range of applications, from combating comparatively mild corrosive conditions to creating maximum strength & stiffness for cold formed parts.

- Type 420 UNS S42000
- Type 420LC UNS S42000
- Type 420HC UNS S42000
- Type 440A UNS S44002
- Custom 450 UNS S45000
- Custom 455 UNS S45500
- Type 410 UNS S41000
- Type 416 UNS S41600

FERRITIC

Defined as a straight chromium non-hardenable by heat treatment and only slightly hardenable by cold rolling class of stainless alloys which have chromium ranging from 10.5% to 30% and a carbon level under .20%. Ferritic grades differ from other stainless types in two crucial regards: its chemical composition and its molecular grain structure.

- Type 430 UNS S43000
- Type 430Li UNS S43000
- Type 434 UNS S43400
- Type 436 UNS S43600
- Type 444 UNS S44400

PRECIPITATION HARDENING

PH alloys are similar to other stainless and nickel-based alloys, with one major exception: They contain small additions of copper, aluminum, phosphorus, or titanium. Exhibiting high strength & toughness in service, they are good for parts that are extensively drawn.

- 15-7 MO® UNS S15700
- A286 UNS S66286
- 17-4 PH® UNS S17400
- AM 350® UNS S35000
- 17-7 PH® UNS S17700

DUPLEX GRADES

Containing a two-phase microstructure of ferritic & austenitic, Duplex are known for their stress corrosion cracking resistance, excellent strength, and good toughness & ductility.

- Alloy 2507 UNS S32750
- Alloy 2205 UNS S31803, UNS S32205
- Alloy 2304 UNS S32304

We Deliver Precision®

Special Metals

AVAILABLE IN PRECISION ROLLED STRIP AND WIRE

COBALT

Cobalt Alloys are also sometimes referred to as “super alloys” as they perform well in corrosive environments and high temperatures while retaining strength. They are also used when wear resistance is required, such as in jet engines, turbines, & dental implants.

- Haynes® 25 L-605 UNS R30605
- Haynes® 188 UNS R30188
- MP35N® UNS R30035
- Ultimet® UNS R31233
- Waspaloy® UNS N07001

NIOBIUM

Pure niobium is a nuclear ‘reactor grade’ with a high melting point. It is extremely corrosion resistant & is also used in medical & high-temperature industrial applications.

- Niobium Type 1 & 2 UNS R03400 UNS R04210

ZIRCONIUM

Zirconium has superior corrosion resistance and high heat transfer efficiency. In addition it has good ductility, formability & strength comparable with common engineering alloys.

- Zirconium 702 UNS C15100

NITINOL

Nitinol is a shape-memory alloy. This nickel-titanium alloy “remembers” its original, cold-forged shape: returning the pre-deformed shape by heating. Shape-memory alloys have many use benefits for applications in industries including medical and aerospace.

TUNGSTEN

Tungsten round wire has high temperature strength and good electrical resistance. It is often used in medical applications as well as in heating elements for various industries.

TANTALUM

Tantalum is highly ductile, and superconductive material that can be drawn into a thin wire. Tantalum wire is a popular material used in electronics capacitors and a critical component in the manufacture of state-of-the art semiconductors. The metal is used in dental and surgical instruments and implants, as it causes no immune response.

- Tantalum Wire UNS R05200 UNS R05400

BI-METALS

Depending on which materials are combined, bi-metal construction comes with the added benefit of large weight savings or even higher strength alloys for your critical applications. Ulbrich provides copper-clad bi-metal material manufactured into both round and flat wire sizes, single and multi-end, and bare and silver plated for microwave and RF cable products, aerospace, military, satellite, and electronic applications.

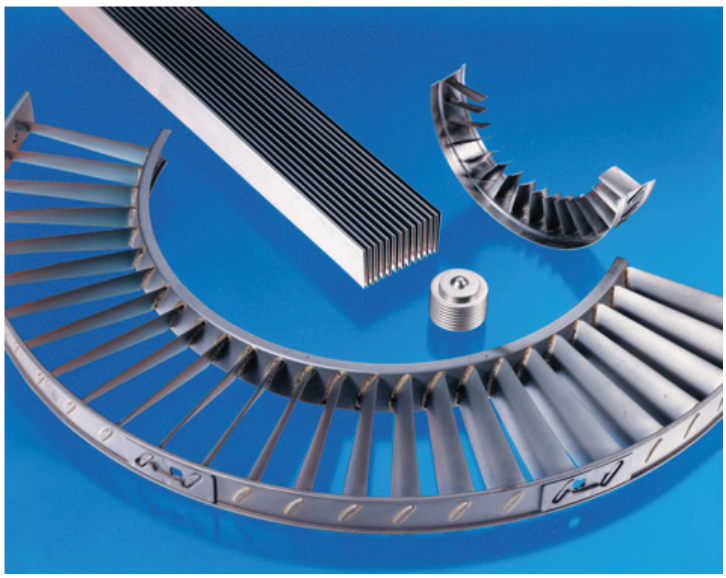
- Ulbrich Lite Weight Silver Plated Copper Clad Aluminum (SPCCA)
- Ulbrich High Strength Silver Plated Copper Clad Steel (SPCCS & CCS)

How to Specify Aerospace Alloys

You have combed the metals references and found the perfect alloy for that troublesome part in one of the company's best-selling products. It has the corrosion resistance, deep draw formability, design strength . . . everything.

Now enter the real world of supply and demand.

Your local service centers indicate they do not have the alloy in the temper and thickness you need, and they are not too optimistic about finding it. And your order is not large enough to have one of the big, integrated mills produce a heat lot.



HOW SPECIFYING ALLOY PROPERTIES, NOT CHEMISTRY, CAN SOLVE YOUR PROBLEMS

The answer is to be more flexible in your spec. Do not lock into a single alloy or chemistry. This is especially true when dealing with stainless steels and nickel-based alloys because there are so many options available. But the very extent of the selection will work in your favor if you can give the supplier some latitude.

Instead of naming a chemistry, specify the properties and characteristics that are critical to the success of your application. These include resistance to specific types of corrosion, operating temperatures of the part, wear resistance, strength, elongation and processing characteristics such as formability, weldability, etc. Within this framework, suppliers of these alloys can usually meet your requirements.

The characteristics of stainless steel and nickel-based alloys are created by alloy additions to the base metal. In today's world, there is a chemistry available, either in a generic or proprietary alloy, that will meet almost every need, no matter how specialized.

HOW A STAINLESS STEEL & SPECIAL METALS SERVICE CENTER/RE-ROLL MILL CAN HELP

If your order is large enough, an integrated producer can meet your requirements, but it may be months before a heat of that metal is produced. If your quantity is small or if you find it impossible to wait for the mill's lead time, your service center can tap their vendor sources to meet your specification with a similar alloy, one that is specifically processed to meet, or at least come close to, the chemistry you have specified.

The service center can utilize their reroll sources to custom produce the finished product from previously produced hot or cold rolled bands. Those coils are precision rolled and annealed from thicker gauges to the specific dimensions and properties specified. In this way, a reroll source can provide their customers with most specialty requirements. In fact, the reroll mill may actually assist in writing the specification, especially if the alloy requires precision gauge tolerances or a special surface finish. With work hardening and thermal processing elements involved, ordering these alloys often requires a special understanding of applied metallurgy.

FACTORS TO CONSIDER WHEN SPECIFYING ALLOYS FOR AEROSPACE APPLICATIONS

Even specifying a common alloy such as Type 301 series stainless steel can be a challenge because of the wide compositional range within the standard AISI chemistry. Stainless Type 301 (high tensile) will achieve a tensile strength of 270-300 ksi, but there is another T-301 composition at the other end of the spectrum, which work hardens relatively slowly, making it ideal for deep drawing applications.

Other grades of 300 series stainless can be just as versatile – and sometimes confusing. Stainless grades 309 and 310, for example, are high temperature alloys used mostly for furnace fixtures because of their high carbide and oxidation resistance. However, if the designer is looking for deep drawing properties, 309 or 310 will again provide excellent design choices. Both grades have the high alloy content that permits extensive forming.

For all but the most specialized applications, there are usually three or four compositional choices among the stainless steels and nickel-based alloys that will meet numerous combinations of corrosion resistance, wear resistance, tensile strength or high temperature cycling requirements.

YIELD AND TENSILE STRENGTH

Indicating a tensile strength figure is appropriate for specifying castings, forgings and other heavier steel applications. It does not always work for many wrought strip products, such as stainless steel and nickel-based alloys.

In certain design situations, such as springs, yield strength may prove to be more meaningful than tensile strength. Yield strength approximates the theoretical point at which a material stops being elastic and becomes plastic. Some alloys reach their yield point just before failure, others, reach it relatively early on the stress/strain curve. Specifying strictly by tensile strength does not do justice to alloys having a greater yield strength.

Another major concern of stampers is springback. This characteristic can also be controlled by annealing the material at specific points in the rolling sequence. However, springback is a function of the relationship between the tensile and yield strength of the metals and will vary among alloys. Furthermore, tt is also important to know how ductile the material needs to be for a specific application.

METAL SURFACE FINISH

Stainless and nickel-based alloys can be surface finished to impact cosmetic appeal, carry lubricant more effectively, or provide the additional surface area needed for good sealing or bonding. Finish should be specified in microinches by either an RMS (root mean square) value or an arithmetic average of the surface roughness as measured by a profilometer. It is advisable to indicate the surface roughness within a range of acceptable finishes.

THE IMPACT OF GRAIN SIZE ON MANUFACTURING

Grain size is important for fabricators because of its effect on forming or deep drawing of strip products. If grains are too coarse or lack uniformity, the sidewalls of deep drawn components may roughen up and “orange peel”. If the grains are too fine, the part may tear. When the appropriate grain size is not immediately available, it can be custom produced by thermal processing.

Smaller grain sizes create more uniform mechanical properties in alloys. They also alter hardness, tensile strength, yield strength, and the relationship between tensile and yield strength. If there is a maximum yield strength specified, for instance, heat treating to attain a certain grain size must be controlled within the acceptable yield & tensile strength parameters.

The ASTM grain size code has a range from 0-13 —the lower end of the range indicating coarser grains, and the upper end, a finer grain. A typical specification for stamped parts is 7 to 9. Special processing will attain grain sizes beyond that range, but anything over 13, the steel is approaching non-recrystallisation.

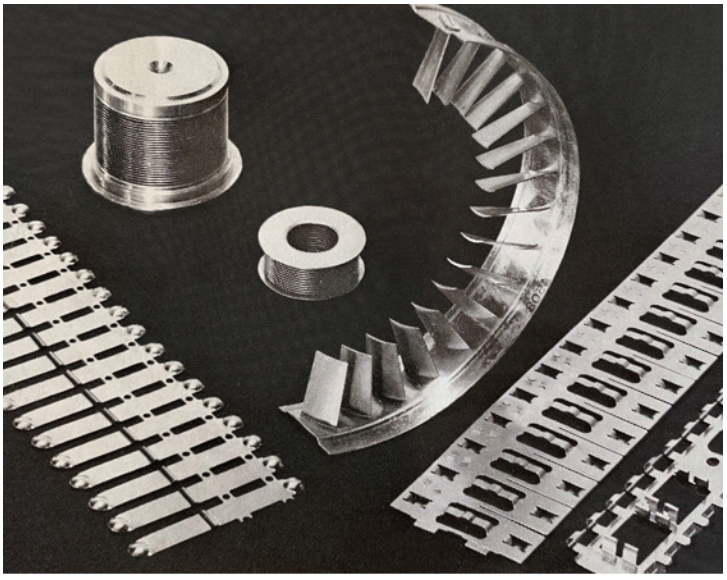
ANNEALING & TEMPERED CONDITIONS

Annealed or cold rolled stainless steels are available in ¼ hard, ½ hard, full hard, and spring temper hardness which is referred to as extra full hard. These tempers are achieved by rolling specific area reductions on fully annealed material. The amount of area reduction required, and the resulting temper will vary among alloys. Soft tempers are sometimes needed to withstand severe bends and accept deep drawing. As the temper increases so does strength, but formability is reduced. With today’s advanced processing equipment and technology, some materials can be varied as much as 200 ksi over a range of tempers at any specified yield strength or tensile strength value.

It is possible to tailor stainless and nickel-based alloys to meet specific requirements even if they are beyond the ordinary specifications of the material. For example, Armco Steel’s 17-7 PH precipitation-hardening alloy is normally available annealed or in 60% cold rolled, Condition C. But it can be specially rolled in other forms, such as 1/2C and 3/4C. These grades are more formable than Condition C, but will precipitation harden with greater strength than the annealed condition.

REMEMBER, SPECIFYING NICKEL OR STAINLESS IN YOUR SPEC IS ALL ABOUT FLEXIBILITY.

Writing specifications that are somewhat flexible gives suppliers a chance to ferret out a solution rather than just saying ‘no’. If the alloys are not available at the service center, they are readily obtainable from a re-roll mill. Cold rolled steel & special metal re-rollers exist throughout the metal industry. But, in the stainless, nickel and cobalt-alloy market, they are especially important because these higher priced metals are expected to meet more stringent specs that require extreme precision. Minute changes in metallurgy or surface finish can be a key factor in the success of many of these applications.



We Deliver Precision®

ULBRICH.COM

Our Industry Leading Capabilities

TAILORED TO YOUR EXACT SPECIFICATIONS

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.

Strip Coil Rolling & Slitting Capabilities

OUR ROLLING TOLERANCES

Our rolling divisions, Ulbrich Specialty Strip Mill (USSM) and Ulbrich Precision Alloys (UPA), provide specialized strip metal coil, not readily available from others, engineered to exacting specifications. Cold Rolling is the cornerstone of Ulbrich, and the heart of the conversion process. Rolling at Ulbrich is considered “cold rolling” because we do not increase the temperature of the material before we roll it. Our ability to deliver a customized and consistent product within precision and ultra precision tolerances allows us to provide our customers the material they need to create enhanced products and processes. The Ulbrich strip mills' diversity of equipment and experienced staff enables us to establish robust processes capable of supplying a precise and consistent product for use in a wide variety of applications across multiple industries.

THE SLITTING PROCESS

Slitting can serve as both the initial and final operation in the conversion process at Ulbrich. All of the slitters are similar in concept and operation, but vary greatly in size. Our larger machines are dedicated to slitting the heavy gauge incoming coils up to 54″ wide to mults used for re-rolling. At the other end of the process, slitting is used to separate a material at finish gauge and temper into the width ordered by the customer. Apart from width: edge condition, coil inner diameter, coil support, coil size, interleaf and accumulation method are all characteristics of the final product that are realized during final slitting. Our operators will make adjustments to the clearance as they are preparing to slit the material in order to minimize the edge burr as much as possible. Once a coil is slit to final width, it can be packaged and delivered to the customer.

ULBRICH ROLLED STRIP SIZE RANGES

Thickness Range: .0003″ – .125″ (0.0075 – 3.175mm)

Thickness Tolerance (Standard): +/- 3% standard
(Tolerances better than 1% can be achieved based on criteria)

Thickness Tolerance (Extreme): +/- 1%

EDGING AVAILABLE

#1 ROUND EDGE

#3 SLIT EDGE

#5 SQUARE EDGE

PRECISION ROLLED STRIP COIL SIZE RANGES

Width Range: .016″ – 48″ (0.406mm – 1219mm)

Width Tolerance (Standard): +/- .005″ (+/- 0.127mm)

SERVICE CENTER SLIT COIL SIZE RANGES

Width Range: .065″ – 52″ (0.8128mm – 1320mm)

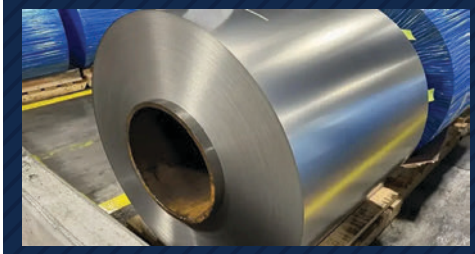
Width Tolerance: +/- .005″ (+/- 0.127mm)

Wide-Width, Light-Gauge Precision Strip Rolled for Peak Performance

From titanium and stainless steels to high-performance nickel and cobalt alloys, Ulbrich provides the right material, rolled to precise specifications, to meet the most demanding requirements in aerospace, medical, semiconductor, automotive, and many other critical industries.

Unmatched Precision Rolling Capabilities

AVAILABLE AT ULBRICH PRECISION ALLOYS AND ULBRICH SPECIALTY STRIP MILL



Wide Width

WIDTH RANGE:

.016 – 48”

(.406 – 1219 MM)

Tolerance: +/- .005" (+/0.127mm)

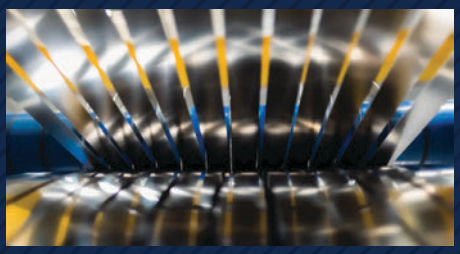
Light Gauge

THICKNESS RANGE:

.0003 – .125”

(.0075 – 3.175 MM)

Tolerance: +/- 1-5%



165+ Alloys

SPECIALTY ALLOYS AVAILABLE

Including titanium, stainless steel, nickel-based & other special metals

Wherever You Are in Product Development, Ulbrich Can Be Your Strategic Partner

Whether you're developing a new product or ramping up full-scale production, our metallurgical expertise, advanced manufacturing facilities, and commitment to engineered excellence help you move faster, minimize risk, and deliver higher-performing parts.

Ulbrich

We Deliver Precision®

BUILT FOR CRITICAL APPLICATIONS

- Edge-Welded & Hydroformed Bellows
- Heat Shields & Thermal Insulation
- Nuclear Reactors & Land-Based Gas Turbines
- Plate Heat Exchangers & Titanium Shims
- Flexible & Heater Circuits
- Medical Devices & Implantable Components

START BUILDING WITH PRECISION

ALLOYS AVAILABLE

Stainless Steels: AM350, A286, 304, 316L, 321, 347, 444

Titanium: Titanium Grade 1, Titanium Grade 2

Nickel Based: Inconel® 600, Inconel® 625 and 625LCF, Inconel® 718, Hastelloy® C276, Hastelloy® X, Nickel 201

CERTIFICATIONS

AS9100D, ISO 9001:2015, Pratt-Whitney LCS

SLITTING CAPABILITIES

Light Gauge:
Thickness: .0005 – .008” (0.0127 – 0.2032 mm)
Widths: .068 – 12” (1.727 – 304.8 mm)
Standard Width Tolerance: +/- 0.003” (0.0762 mm)

Standard:
Thickness: .002 – .045” (0.0508 – 1.143 mm)
Widths: 0.500 – 24” (12.7 – 609.60 mm)
Standard Width Tolerance: +/- 0.005” (0.127mm)

HIGH-SPEED REWINDING

Thickness: .002 – .025” (0.0508 – 0.635mm)
Widths: 6 – 42” (152.4 – 1066.8mm)
Standard Width Tolerance: +/-0.50” (12.7mm)

PACKAGING

Standard Export Packaging
Specialized / Custom Packaging Available Upon Request

PRIMARY MARKETS AND APPLICATIONS SERVED

Aerospace: Heat Exchangers, Gaskets, Fasteners

Industrial/Electronics: Bellows for Semiconductor Manufacturing

Power Generation: Gaskets, High Pressure Seals

Alternative Energy/ Hydrogen Fuel Cell: Stack Components, Separator Sheets, Anode / Cathode Plates

SUPPLY CHAIN PARTNER

Flexible MOQs and Reduced Lead Times

We Deliver Precision®

ULBRICH.COM

Precision Shaped Wire

DESIGNED WITH YOUR SUCCESS IN MIND

WIDTH RANGE
.020″ – 1.50″
(0.508mm – 38.1mm)

THICKNESS RANGE
.005″ – .335″
(0.127mm – 8.509mm)

COMMON SHAPES AND CUSTOM WIRE PROFILES PRODUCED TO CROSS-SECTIONAL PERFECTION

Our cutting edge shaped wire rolling mills allow us to meet the demanding dimensional tolerances your business requires as tight as +/- .0025mm (.0001”). With features such as automatic on-line gauge control and data acquisition technology allowing us to roll wire faster with extreme precision and consistency, Ulbrich has near limitless wire capabilities for any application.

IN-HOUSE TOOLING CAPABILITIES SUPPORT SPEED TO MARKET

Our in-house toolmakers allow us to remain nimble and to react quickly to customer demands and ensure the highest quality and consistency, particularly with new shapes. What would typically take days or weeks with an outside toolmaking company, Ulbrich can prototype things very quickly, iterating rapidly and pushing product out usually within a couple hours.

OUR SHAPED WIRE MANUFACTURING COMBINED WITH OUR UNMATCHED MATERIAL EXPERTISE

Ulbrich was built on a foundation of material knowledge and a dedication to investing in critical equipment, enabling us to rise to the challenges of modern industrial production. Combining a focus factory approach with a robust supply line, Ulbrich Shaped Wire has become synonymous with metallurgical expertise. This allows us to leverage a wide selection of alloys in our wire rolling mills, which furthers our rapid prototyping and custom shaped wire capabilities to develop superior wire for customers whether they require a standard or custom cross section for any market.

Ulbrich Steel and the Space Race

It was 1969 – when the Civil Rights Movement reached its apex, when the Vietnam War raged on, when Rolling Stone magazine published its first issue, when Star Trek first aired on television, and when NASA began to launch manned rockets towards the Moon. The 1960's brought about great technological change, especially due to a curiosity with space travel and because of the innovations by American manufacturers like Ulbrich. 50 years ago, at a critical juncture in American history, Ulbrich Stainless Steels & Special Metals, Inc. – the "Biggest Little Steel Mill in the Country" was already adept in the milling and conversion of metal alloys.

As the United States competed with the Soviet Union in the Cold War, a highly publicized "Space Race" for ensued technological and political supremacy. NASA was given a mission set by President John F. Kennedy on May 25, 1961, as part of his inauguration speech: to perform a lunar landing with an American crew and return to Earth. Eight years later, with the help of Ulbrich Steel, Apollo 11 took off for the Moon. Ulbrich was part of an American manufacturing effort rising to the occasion in support of manned space travel.

Before becoming a critical cog in NASA's supply chain, Ulbrich was fulfilling an important steel manufacturing market niche – highly specialized, smaller quantities. Steel companies known as melt mills such as U.S. Steel and Allegheny Ludlum traded high volumes of steel and dealt in larger quantities. They sold stainless steel on 10,000 pound coils – too many pounds for small manufacturers to convert, form and keep in their inventory. Practical applications for thin gauge metals grew and demand for small quantity orders also increased. Ulbrich bought large quantity coils in various sizes and gauges, then milled and slit the material to narrow widths and even smaller gauges for customers.

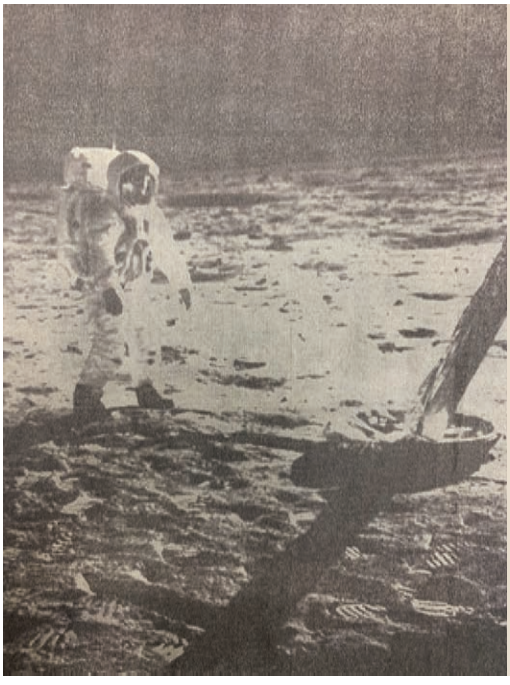
By 1969, Ulbrich's customized approach made the company a prime candidate from which "original equipment manufacturers" like North American Rockwell, United Technologies, Hamilton Standard, Grumman Aircraft, Collins Aerospace and others could purchase small quantities of stainless steel and special metals like titanium. Ulbrich often developed trial orders with customers so that every aspect of the material could be tested and re-tested. Eventually, the correct specifications were met and specialty metals including nickel and titanium alloys were purchased by major manufacturers for state- of-the-art devices and top-secret aerospace projects.

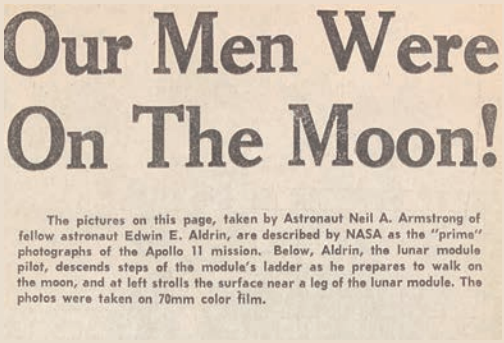
On July 20, 1969, all of America's industrial advances were on display when Apollo 11 landed on the Moon. The feat was accomplished using precision milled steel and specialty metal supplied by Ulbrich. Customers such as United Technologies and Hamilton Standard formed the metal into interstellar components. 300 pounds of thin precision strip stainless steel and titanium supplied by Ulbrich was utilized in numerous applications aboard the Apollo 11 spacecraft.

Applications included seals, bellows and apparatuses for the landing gear of the Lunar Module (LM) nicknamed "Eagle" – the first crewed vehicle to land on the Moon. Ulbrich metal was also in the Command and Service Module (CSM) referred to as "Columbia" – the propulsion unit that towed the Lunar Module through space. On the outer structure of the CSM was a heatshield made up of stainless steel brazed honeycomb for which Ulbrich supplied the raw material. In other areas of the mission to the Moon, Ulbrich had a hand in manufacturing oxygen and fuel tanks, mechanical clamps, and even components of the manned spacesuits.

The Apollo 11 spacecraft carried astronauts Neil Armstrong, Edwin "Buzz" Aldrin, and Michael Collins on their historic, first voyage to the Moon and back from July 16 to July 24, 1969. On the day of liftoff, the Ulbrich Family, Fred Sr. and his wife Ada, Fred Jr. and Dick Ulbrich attended an official viewing in Cape Canaveral. "There were several thousand of us, about a mile and a half away," Fred Ulbrich Jr. once recalled. "We were in the bleachers. They made us wear goggles and made sure we didn't look when it went off, and that was quite a thrill."

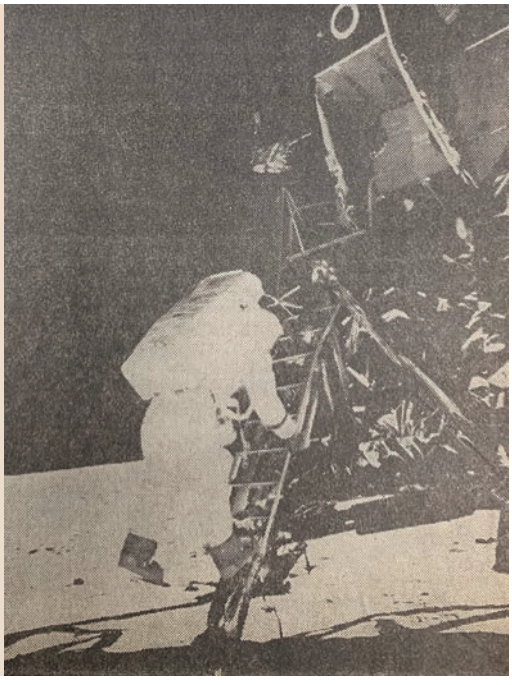
Ulbrich was perhaps the least known metal supplier to have concocted solutions for the Apollo missions. Precision metal was critical to the spacecraft and Ulbrich continued to supply metal for components of future Apollo spacecraft such as the next successful moon landing in 1971. The achievement is a testament to the extensive capabilities of Ulbrich as a rolling mill and to its high quality, precision products. This story of success is also tribute to the craftsmanship and professionalism of working men and women at the company throughout its lifespan.





Our Men Were On The Moon!

The pictures on this page, taken by Astronaut Neil A. Armstrong of fellow astronaut Edwin E. Aldrin, are described by NASA as the "prime" photographs of the Apollo 11 mission. Below, Aldrin, the lunar module pilot, descends steps of the module's ladder as he prepares to walk on the moon, and at left strolls the surface near a leg of the lunar module. The photos were taken on 70mm color film.



Manage Global Risk by Reshoring Your Supply Chain

In today's volatile supply chain environment, manufacturers are under increasing pressure to reduce risk, maintain consistent quality, and improve lead times. Find stability, speed, and strategic control with Ulbrich's sourcing strategies, tailored to your unique needs.

Need metal melted and manufactured in the U.S. to avoid tariffs? We offer it. Prefer global sourcing? We're a domestic partner that can manage its complexity for you. Unsure which? We can help you find the most effective path forward.

Why Leading Manufacturers Choose Ulbrich

MATERIALS WE SUPPLY

We provide leading manufacturers Precision Strip, Shaped & Fine Wire in 165+ specialty alloys, including:

- Stainless Steels (300 & 400 series, PH grades)
- Nickel & Cobalt Alloys (Inconel®, Hastelloy®, Haynes®)
- Titanium & Titanium Alloys

- **Hybrid Sourcing Model:** Global and domestic material access with regional reliability.
- **Custom-Engineered Material:** Tight tolerances, tailored specs, and consistent quality.
- **Speed & Flexibility:** Support for rapid prototyping and quick-turn production.
- **Inventory Optimization:** Buy in smaller, more frequent batches to improve cash flow.
- **Expert Support:** From metallurgical guidance to supply chain planning, we help you navigate complex challenges and stay production ready.

INDUSTRIES WE SUPPORT

- Automotive
- Aerospace & Defense
- Energy & Power Generation
- Medical Devices
- Oil & Gas
- Industrial Components
- Electronics & Semiconductors

BRIDGING GLOBAL REACH WITH DOMESTIC SUPPORT

Whether you're seeking tariff relief, shorter lead times, or more control over critical inputs, Ulbrich can help. Our domestic reroll mills and service centers are backed by a global sourcing network, giving you options without the headaches.

Ulbrich®

We Deliver Precision®

DISCOVER HOW ULBRICH CAN HELP YOU CREATE A MORE RESILIENT SUPPLY CHAIN

Knowledgeable Leadership in Aerospace Metals

ALWAYS LOOKING FOR WAYS TO INNOVATE & IMPROVE UPON AEROSPACE APPLICATIONS

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 aerospace device 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 steels and special metals to the Aerospace Industry. 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 aerospace application 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**

Contact Ulbrich For Your Aerospace Needs!

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