Metal Alloys For Stamping & Deep Drawn Part Manufacturing

At Ulbrich, we understand that the stamping process benefits greatly from materials that are consistent and uniform through and through. With our stringent specifications and commitment to buy only from the highest quality suppliers, our narrow width rolling mills with automatic gauge control can provide an extraordinarily tight thickness tolerance along the width and length of all coils, insuring stability in the drawing process and producing parts with minimal burrs. We utilize state-of-the-art equipment that further enhances our material quality for stamping and deep draw operations in all the critical markets we proudly serve.

Ulbrich

We Deliver Precision®

CAPABILITY WHITEPAPER

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Alloys for Stamping & Deep Drawn Parts

Through Ulbrich's state of the art annealing furnaces and advanced rolling practices, we are able to offer metal that is optimal for manufacturing deep draw stamped applications.

FACTORS & CHARACTERISTICS THAT IMPACT THE DECISION-MAKING PROCESS

- Formability
- Workability
- Weldability
- Ductility
- Chemistry & Grain Size
- Tensile & Yield Strength
- Corrosion Resistance
- End-Use Application

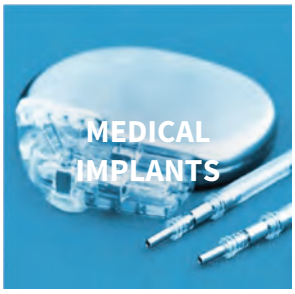
SUPPLYING STAMPERS OVER 165 ALLOYS

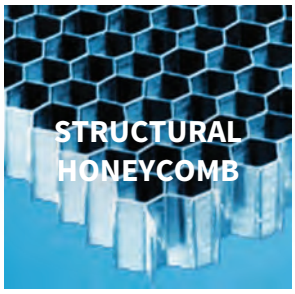
Working with our in-house equipment and rolling mill team, your order of precision strip, foil or wire metal for deep draw parts can be slit, cut-to-length, annealed to various common or custom tempers, rolled to the thinnest gauges, and more. At Ulbrich, our customers come first, so we're able to meet the needs of orders both large and small.

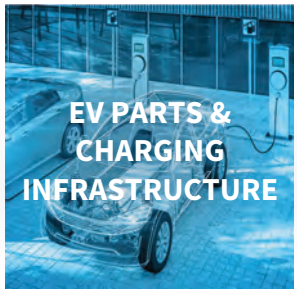
FLATNESS & PRECISION GAUGE CONTROL

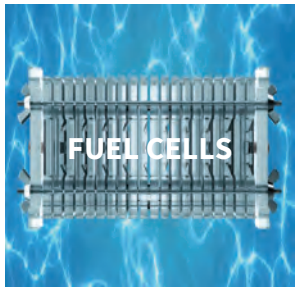
We pride ourselves on providing unparalleled metal flatness and superior surface finish and oxide control. Employing a technically advanced automatic gauge & shape control system to monitor real-time variations of thickness and flatness throughout the length of each coil that we roll makes us the top choice in all of the critical markets we serve.

DEEP DRAWN STAMPED PARTS BENEFITTING FROM ULBRICH PRECISION ROLLED METALS









Forming Stainless Steel and Nickel Alloys

As part requirements continue to become more advanced, a more complex raw material may be needed to keep up with improving designs. Cheaper alternatives, while cost-saving, can introduce defects and errors across all manufacturing processes. These can be solved may times by correct alloy selection and design. Ulbrich specializes in stainless steels and specialty metals, and has been aiding its customers as their needs, as well as the needs of the rapidly evolving industry, have continued to change for almost a century.

There are many considerations that need to be taken when selecting a specialty metal like a nickel-based alloy or a stainless steel for a customer's design. Mechanical properties continue to be more specified and stringent with every new product and lend themselves to creating a more consistent part that can be used in critical applications without error. Formability and strength are also variables to be considered when selecting an alloy, as many different factors can influence these properties. Through partnership and development with a mill or reroll source, a specification that maximizes the chance for repeatable success can be created.

As the needs of customers and consumers continue to advance and become more challenging, selecting a more highly engineered product can help save production time and capital. When looking at formability, stainless steel and nickel alloys become the go-to material for fulfilling advanced requirements.

FORMABILITY

The relative formability of metal is characterized by the R/T ratio – a ratio of the radius of the bend to the thickness of the strip – or minimum bend radii. A 3T minimum bend radius means the smallest radius to which a material can be bent without cracking is three times its thickness. But with the use of custom processed strip, higher precision processing equipment and controlled composition of the metal, there is less reliance on these guidelines today.

Formability can be adjusted according to the limitations of the material and the complexity of the part. One important property used to modify formability is grain size. Adjusting the grain size of the material can greatly improve formability, as the grain size can be manipulated through processing steps to improve characteristics that better suit post processing operations. Example: deep draw applications typically require a coarser grain to allow the material to flow while maintaining properties throughout the draw.

A great deal also depends on the depth and complexity of the part, and the number of stations in the progression. For blanking, a finer grain is appropriate. The greater strength assures an effective, clean punch through the material. However, too fine a grain can make the material so resistant to deformation that it can pull apart in the die.

As the coarseness of the grain increases, the microstructure can begin to lack uniformity. This can cause issues in all post-processing operations, but particularly stamping operations. The stamper needs to start looking for “orange peel” at the edges and sidewalls of the parts, especially those that are deep drawn. If orange peel does not occur and surface roughness is not a major factor, a grain size can be specified as even coarser, which results in a very soft, easy-to-form material. However, in order to achieve this structure, the material may require more customer and precise processing through the final anneal. In the case of nickel alloys, a little finer grain than stainless is recommended for best results.

ADJUSTING GRAIN SIZE

Once the extent of the forming operation is known, a specification can be determined to ensure success with the product. First, the metallurgist will create a specific process in order to target the mechanical properties and grain size specified by the customer.

To confirm the results, samples from the heat will be examined in the metallography lab. Grain size will be measured, and mechanical properties will be tested and reported. These measurements are imperative not only to Ulbrich, but to the customer as well. Knowing what the mechanical properties are on the material being used is key in preparing and tooling for the job ahead.

HITTING THE SPECIFICATION

If formability were the only objective in specifying the annealing process, meeting the customer specification would be relatively easy. But there are other factors which must be considered. In many cases, a grain size smaller than ideal for forming may be needed to provide the required mechanical properties. When this is the case, a material compromise must be reached within the specification being created.

Stainless steel can be specified in annealed or cold rolled tempers. The latter are designated ¼ hard, ½ hard, full hard, and extra full hard tempers depending on strength requirements. What is important to remember, however, is that strength and formability are inversely related. Everyone wants the strongest and most formable material for their designs, but this is simply not achievable. Increasing temper limits the amount of forming that can be done, as there is a maximum amount of deformation every material can handle before breaking. That limit decreases with an increase in temper and mechanical properties. Even forming the ¼ hard temper requires significantly more effort than regular annealed material.

TOOLING

The mechanism that makes stainless steel and nickel alloys corrosion resistant is an oxide formation. Oxides on the surface of a metal are extremely abrasive. These alloys will impose more rapid tool wear than straight carbon steel, and galling can be a very serious problem. Tungsten carbide tooling and extreme pressure lubricants are always required, although it is possible to do short pilot runs with hardened tool steel. Since stainless & nickel alloys do not accept reductions as readily as carbon steel, the tooling should also take this into account. On complex parts, one or two additional stations might be required in the die progression.

PRODUCTION

Because the higher strength of these alloys creates more resistance at the die face, some accommodations may be required in production. This could include somewhat slower press speeds than are normal for carbon steels, a more powerful press, or some combination of these factors. It is recommended to consult with a metallurgist or product expert before making your alloy selection.

ALLOY SELECTION

Type 301 is a good candidate for stamped parts because its range of tensile and yield strengths is extremely vast when compared to other stainless steels. It is true that Type 301 can take a great deal of pulling and stretching, but its tendency to work harden quickly means that annealing is generally required to soften the material to avoid stress cracking or splitting. For this reason, Type 301 is usually not employed in operations involving severe deep drawing.

Type 305, on the other hand, exhibits a much narrower range between yield and tensile strengths, and the spread narrows during plastic deformation. But its relatively high nickel content gives it a slow work hardening rate. Yield strength and tensile strength increase very slowly during forming, so it can be worked over a series of dies without getting extremely hard or brittle. Extensive forming is usually possible before it is necessary to stop for annealing.

The initially high elongation of 305 falls off rapidly, however, so it is not suitable for operations involving stretching. Even for deep drawing operations, the metal should be allowed to flow freely through the hold-down pads in the die to hold stretching to a minimum. Unless the part is locked into another alloy, Type 305 is the grade of preference if the choice is left to the stamper.

The straight chromium grades of the stainless that are most commonly fabricated by cold forming are Types 410, 420 and 430. Compared to carbon steel, the strengths and hardness of the 400 series of alloys are higher while elongations are generally lower. This means more power must be applied to achieve plastic deformation.

If the application requires a nickel alloy, the one with the highest nickel content will be easiest to form. Among the proprietary alloys, Monel® 400 and Inconel® 625 are somewhat less formable but offer superior mechanical properties. Stampers are also drawing other nickel-alloys, particularly Hastelloy® C-276, Hastelloy® X as well as Haynes® 230. None of these alloys are highly ductile, but they can be rolled and annealed to provide very acceptable formability.

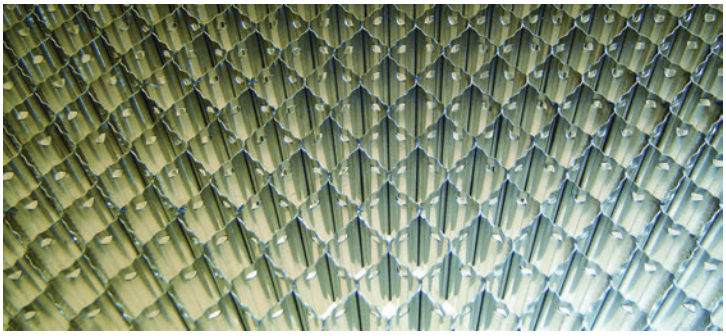
CONFER, CONSULT, COMMUNICATE

The best information the stamping producer can provide to the supplier of stainless or nickel alloy strip is a drawing of the part. Metallurgists familiar with forming processes can tell from the severity of the bends and complexity of the part which alloy and temper to recommend.

For complex shapes, the stamping manufacturer may want to go back to the buyer and inquire why the part is being made in stainless or nickel alloy. If the user is looking for greater strength, there isn't too much leeway in adjusting the metal for greater formability. But if improved corrosion resistance is the major reason, which it often is when the alloys are specified, the user may be willing to accept a softer material.

Honeycomb applications, as one good example, can be a challenge for both stamper and materials supplier. Honeycomb is utilized in aircraft and aerospace applications in which high strength and stiffness must be combined with minimal weight. It consists of thin, narrow strips of metal with a cold formed pattern of parallel U-shaped ridges with often repeating detailed features. The strips are spot welded to one another, layer upon layer, at the apex of the nodes. Although the forming of the nodes is shallow, uniformity of detail must be maintained throughout the strip for the pieces to match up and structural integrity of the welds to be maintained. Both formability and material thickness must be consistent.

Although processing stainless steel and nickel alloys may require some extra design effort, there are substantial benefits beyond the inherent alloy system that can be achieved. These include more rapid production rates, longer life of the tooling, a better-quality part, and the knowledge that your shop is gaining some 'bankable" expertise in producing higher cost, higher performance parts.



Alloys for Aerospace Applications

NICKEL ALLOYS:

INCONEL® 718
UNS N07718, AMS 5596, AMS 5597, ASTM B670, WESTINGHOUSE NFD310021

INCONEL® X750
UNS N07750, AMS 5598, AMS 5542, ASTM B 637, ASME SB 637

WASPALOY®
UNS N07001, AMS 5544

HASTELLOY® C-276
UNS N10276, ASTM B582

HAYNES® 282
UNS N07208, AMS 5951, ASTM B 637

HAYNES® 230
UNS N06230, ASTM B435, AMS 5878

TITANIUM ALLOYS:

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 B265, ASTM GRADE 21

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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

Titanium

PRODUCED AS COMMERCIALLY PURE OR ALLOYED, TITANIUM IS LIGHT WEIGHT, CORROSION RESISTANT & ABLE TO WITHSTAND EXTREME TEMPERATURES. THIS MATERIAL HAS GREAT STRENGTH, WELDABILITY AND WORKABILITY. ULBRICH'S STANDARD ROLLING CAPABILITY IS 5%; HOWEVER, WE CAN GO DOWN TO A ROLLING TOLERANCE OF 2% IN AN IDEAL CASE.

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

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How Do Alloy Characteristics Impact Formability and Deep Drawing?

Deep-drawing stainless steel and nickel alloys means balancing many opposing factors. Adjusting hardness values to suit process requirements aids the decision-making process.

A print comes into the stamping plant for a deep-drawn part made in a familiar grade of stainless steel. No problem. Until you notice that the strength specification of the finished piece is quite a bit above what is normally produced in the process. A specification calling for a tensile strength of 175,000 and a yield strength of 135,000 psi translates into three-quarter-hard material. That's much too hard for forming. In stainless steel, the preferred range for incoming material is between the annealed condition and one-half-hard.

THE IDEAL MATERIAL

Stampers want ductile materials that easily cold form. But specifiers of high-performance alloys usually don't consider formability—they want strong, hard & tough parts. The ideal is a material that bends easily during forming but doesn't bend at all once it's a part. That's a tall order. But with a little help from two under-appreciated factors—work hardening and heat treatment—stainless steel can approach that ideal.

FORMABILITY

Forming occurs somewhere between the yield strength and tensile strength of the material. If yield isn't exceeded, forming doesn't occur, but exceeding the tensile strength results in material fracture. In higher-strength materials, the window between yield and tensile is very small. It's almost impossible to achieve desired formability and required tensile strength in the same material without taking some extra steps.

Usually, repeated press action as a part travels through a progressive die induces enough cold working to bring the material to quarter-hard or half-hard, often sufficient. When such cold working does not bring desired hardness, stampers have a couple of options.

They can beef up tooling and choose a press that's large enough to cold form a harder and stronger material. Such an option, besides its high cost, may result in part tearing or fracture as well as wear and tear on the tooling and press. There are always tensile tests performed on the material which can be a good indicator of how it will do with a deep draw test.

A better option may be forming the parts first and heat treating them later to elevate hardness and strength. For this option, an alloy must be selected with two hardness values in mind: ductile enough for cold forming and hard enough to meet finished part specifications. Hardness is the proxy for strength.

With high-performance alloys, hardness isn't the only consideration. The buyer usually wants corrosion resistance, elevated temperature properties and other attributes. The job is finding an alloy within that specification that can climb the hardness scale to whatever value the buyer needs. To minimize cost, this should be done in the fewest numbers of passes through the rolling mill and furnace at the material supplier, and a minimal number of stamping stations at the metal forming operation. Of course, this can sometimes depend on thickness as well.

HARDNESS LEVELS

Quarter-hard, half-hard, full-hard, and spring-temper-hard (also referred to as extra-full-hard) are achieved by rolling specific percentage reductions on annealed materials. Hardness values stated here are actual specifications, not just rules of thumb – they are covered by an ASTM designation that refers to specific tensile-strength levels.

Quarter-hard is nominally 125,000 psi minimum tensile strength; half-hard is 150,000, three-quarter-hard is 175,000 and full-hard is 185,000 psi. You'll find a 25,000-psi spread between each figure except in the case of the three-quarter and full-hard, where the data converge because the work-hardening curve flattens out.

Yield minimums also exist for these hardness values. At Ulbrich Steel, we use 75,000, 110,000, 135,000 and 140,000 psi, respectively. Pulling sample parts on a tensile tester is the preferred method for measuring these properties. But Rockwell hardness testers are much more common in stamping plants than tensile-test equipment, so specification, Rockwell C numbers are useful, especially for 301 and 302 stainless, but aren't very accurate for alloys with lower work-hardening rates.

NICKEL AND NICKEL ALLOYS

For this group of alloys, those with higher nickel contents will be easiest to form. These include pure nickel and, among the proprietary alloys, Monel 400 and Inconel 718 and 800. All other nickel-based alloys commonly are cold formed, including Inconel 625, Hastelloy C-276, Hastelloy X and Haynes 230. While none are highly ductile, they can be rolled and annealed to provide acceptable formability. Those that can be effectively cold formed to a final hardness are Inconel 625, Inconel 718, Incoloy 800 and Monel 400. Others are age-hardenable, notably Inconel 718, Waspaloy 5, Inconel X750 and Monel K-500.

Inconel 718 can be cold worked to a desired hardness or age hardened to even higher levels. Using standard cold-working procedures, annealed 718 can be heat treated to levels higher than 180,000 psi while cold-worked material can be raised to minimum levels of 250,000 psi after heat treatment. Consult with an experienced Ulbrich metallurgist for the optimum formability and strength parameters.

300-SERIES STAINLESS

The 300 series of austenitic stainless steels can only be hardened by cold working – heat treating is not an option. Because cold working takes place within the plastic range between yield strength and tensile strength, a look at a table of properties might suggest that Type 301 would be a good candidate for stamped parts because its range is comparatively wide. This grade cab handle much pulling and stretching but has a tendency to work-harden quickly. For that reason, 301 is not recommended for the deep drawing process.

Type 302 is the mid-range choice. Its mechanical properties and forming behavior fall somewhere between that of 301 and 305, so it offers benefits and shortcomings of both.

Type 305 exhibits a much narrower range between yield and tensile strengths but is the preferred grade for deep-drawn applications. About 90 percent of stainless deep-drawn parts are produced from this grade. Because of its relatively high nickel content, work hardening increases very slowly during the forming process. It can be drawn over a series of goes without becoming extremely hard or brittle and extensive drawing usually is possible before annealing is required. The initial elongation of 305 falls off rapidly, however, so it is not suitable for operations that induce severe stretching.

400-SERIES STAINLESS

These martensitic stainless steels are more versatile because they can be strengthened through cold working and heat treatment. Even in the soft-annealed state, 400-series alloys are stronger than carbon steels, elongations are generally lower, and the metals are harder. This more power must be applied to achieve plastic deformation.

When parts don't sufficiently harden during stamping, the stamper has another option – heat treating. After heat treating, parts are removed from the furnace at relatively high temperatures, from 1750 to 1850°F, and quenched to achieve a specific hardness.

Grade 410 normally is hardenable between Rockwell C35 and 45, whereas Grade 420 hardens in the low to middle C50s, and Grade 440A hardens in the high C50s and low C60s.

These grades are considered deep-hardening, so quenching in ambient air usually achieves desired results. Water and oil quenching are options in special cases. For 420 and 440A, stress-relieve the parts to avoid a structure that is too brittle. This may vary slightly with sheet metal but the overall takeaways are the same.

PRECIPITATION-HARDENING ALLOYS

Whenever martensitic grades aren't sufficiently hardenable, a precipitation-hardening stainless steel should be considered. Such steels contain small additions of copper, aluminum, titanium or phosphorous. Parts are cold formed in the relatively soft solution-annealed condition and then age-hardening treated, in which the added elements precipitate as hard intermetallic compounds that increase hardness & strength.

Precipitation-hardening stainless steels such as 17-4PH, 17-7PH, A286 and AM350 are similar and may be used interchangeably, depending on availability in the desired gauge and temper. Due to a significant increase between annealed and final hardness levels, post-heat treatments with these alloys are more involved.

Alloys 17-7PH and A286 can be heat treated in conditions ranging from the annealed or solution-treated condition to a series of cold-reduced tempers that, with proper heat treatment, can produce surprisingly high properties. With multiple heat treatments and tempers to consider, a stamper should review specific requirements and heat treat cycles with an experienced metallurgist to obtain optimum results for formability and strength.

Both 17-4PH and AM350 are rarely provided in the cold-worked condition due to their high strengths in the annealed condition and the fact that subsequent heat treatments will provide extremely high strength levels. Despite being more complex, PH 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.

OTHER FACTORS

The material selected and the processes used to prepare these alloys for stamping must take into consideration some additional factors.

GRAIN SIZE

Punch tests are not good hardness indicators on comparatively soft materials, so a material's grain size often is used to indicate formability. In forming, it is desirable to have consistent grain size. Grain size can be controlled by a reroll mill within a very close range by monitoring the temperature of the annealing furnace and the speed at which the strip passes through the line.

If grains are too coarse or lack uniformity, sidewalls of deep-drawn components may roughen up and "orange-peel." If the grains are too fine, the material may become too difficult to form. ASTM grain-size scales assign a value of 00 to the coarsest-grained and the softest materials and 13 the finest-grain sizes from a coarse size of 6 to a fine size of 12.

Generally speaking, deep drawing is best accomplished in the grain-size range of 6 to 10 and blanking in the 9 to 12 range. However, formability and strength requirements may dictate a more specific range, provided properties can be agreed upon by the producer of the material. A great deal depends on the depth and complexity of the part, and the number of stations in the progression.

DIRECTIONALITY

This refers to the tendency of strip to exhibit different properties in the direction it was rolled compared to the opposite direction. Rolling is performed in one direction only, so the more rolling passes occurring, the more directionality occurring.

SPRINGBACK

This is a function of a material's yield strength. The higher the yield strength, the greater the springback tendency. Depending on the accepted springback level, the tooling designer should work toward a yield-strength range that avoids or compensates for this tendency while designing dies. A designer can estimate how much the part will spring back and then design to overbend it by the same amount. How much, exactly, is difficult to determine, because springback tendency varies from material to material and temper to temper.

METALLURGICAL HELP

If designers are uncertain about what alloy to specify for a high-strength part, they should consult a metallurgist. Once these specialists know how to deep a draw or how severe a bend is anticipated, they can use the material tensile and yield strength data to estimate how much it can be formed without causing a fracture. Sometimes its necessary to overdesign the part in terms of alloy selection just to obtain the needed formability characteristics without risking defects or potential failure sites.

Poor formability has many negative results. Troublesome parts and die-progression samples are in constant evaluation in our department at Ulbrich Stainless Steels to determine where a problem might lie. We look at three prime sources – the alloy, the tooling and the forming operation.

Whether the shortcoming occurs in the alloy or not, this is where adjustments usually are made because it is the fastest, easiest and least costly factor to control. Fortunately, these remedies usually are successful. When they aren't, the metal former must examine other facets of its operation.

We Deliver Precision®

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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)

Rerollers Meet Growing Needs for Metal Stampers

Metal strip for stamped parts usually is supplied by service centers that buy the material from large mills and slit it to width for their customers. At least, that is the common perception. But there is another layer in the supply network, which often is unrecognized.

These are the precision rerollers that create the dimensional and metallurgical characteristics that are beyond the equipment capabilities and narrow size range carried by most service centers. Rerollers are growing in importance every year as companies look for ways to increase production, improve cost efficiency and, at the same time, produce a higher level of quality for their customers.

Rerollers exist throughout the metal industry, but in the stainless, nickel and cobalt alloy market they take on greater importance because these higher priced metals are expected to meet more stringent specifications. Minute changes in metallurgy or surface finish can be a key factor in the performance of many stamped parts.

Some typical services performed by reroll mills include: Rolling to precise gauge, increasing formability, adjusting grain size, controlling springback, adjusting temper, improving surface finish and solving customer problems.

ROLLING TO PRECISE GAUGE

Stainless steel strip and wire, as well as nickel and cobalt-based alloys in various forms are available from integrated producers and made to standard mill tolerances. Rerollers often inventory large quantities of these materials. At Ulbrich, we work with over 165 different alloys in all. These mill partners supply metals which are prepared for stamping by rolling to very close thickness tolerances, customizing the mechanical properties and providing the desired surface finish.

Ulbrich operates multiple rolling mills of various size across our global footprint to handle the many different material requirements they are expected to meet. This equipment enables the company to consistently produce high quality strip to the tightest possible gauge tolerances and maintain a precise, uniform thickness level throughout the entire coil.

If rolling requires several passes, an element of work hardening becomes a factor. This can be removed by processing the material through an annealing cycle in order to return it to the desired level of formability. At Ulbrich, seven controlled-atmosphere, bright annealing furnaces are used to meet these metallurgical adjustments.

In addition to our precision rerolling capabilities, Ulbrich operates several service centers through out North America which provide supply chain management services for customers who require them. Regardless of your material needs or challenges, Ulbrich is here to serve our incredible manufacturing customers. If you'd like to learn more, contact a specialist today via call, email or submit an RFQ on our website!

PROVIDING FORMABILITY

Naturally, stampers want material that is easy to cold form for their manufacturing operations. Formability, however, is inversely related to the very thing users may want when they specify the more specialized alloys – greater strength and hardness. Example: corrosion resistant springs.

Working an effective trade-off between strength, hardness and formability is one of the major services provided by the metallurgical staffs at the reroll source. With close engineer-to-engineer collaboration with our expert metallurgists, alloys can be processed so they can be drawn, formed, blanked and even deep drawn, just as effectively as other metals. It is important to take into account the tool or machine being used with metal stamping and a re-roller can help make sure the appropriate material is selected for a specific manufacturer.

TEMPER

If formability were the only objective in producing strip products, meeting the specification would be relatively easy. But there are other factors that must be considered. One factor is rolling the material to specific tempers.

Stainless steel, nickel and cobalt alloys can be specified in either annealed (soft) or in cold-rolled tempers. The tempers are designated quarter hard, half hard, full hard and extra full hard, depending on strength requirements. These tempers are produced by rolling specific percentage reductions in the thickness of the strip.

For stamping applications, most material is supplied in the annealed or soft state. Tempers of quarter hard require significantly more effort to form. Tempers above that level are rarely used by the stamping industry, except for blanking.

SPRINGBACK

Another major concern of stampers is springback. This characteristic also can be controlled by annealing the material at specific points in the rolling sequence. However, springback is a function of the relationship between tensile and yield strength of the metal and will vary among alloys.

GRAIN SIZE

The metallurgical yardstick most stampers use to gauge the formability of strip products is grain size. If the grains are too coarse, or lack uniformity, sidewalls of deep drawn components may roughen up and show evidence of orange peel. If grains are too fine, the part may tear during forming.

When the grain size of the metal isn't on target, rerollers can adjust their annealing equipment. By closely controlling the temperature of the furnace and the line speed of the strip passing through, it is possible to provide a precise grain size range as measured by an industry wide accepted ASTM grain size value.

Grain size values range from 0 to 13, with the lower end indicating coarser grains and the upper end a finer grain. For most deep drawing applications in stainless steel, 8 to 9 on the ASTM scale is the recommended window.

For blanking, an even finer grain size of 10 to 11 is appropriate. The greater hardness assures a good, clean punch through the material.

SURFACE FINISH

Stainless, nickel-based and cobalt-based alloys can be surface finished by reroll shops to a bright reflective finish, a matte surface that carries lubricant more effectively or other special surfaces needed for good welding, brazing or bonding.

Finish can be specified either as an RMS (root mean square) value, or as an arithmetic average of the surface roughness as measured by a profilometer. It is advisable for stampers to indicate surface roughness within a range of acceptable finishes.

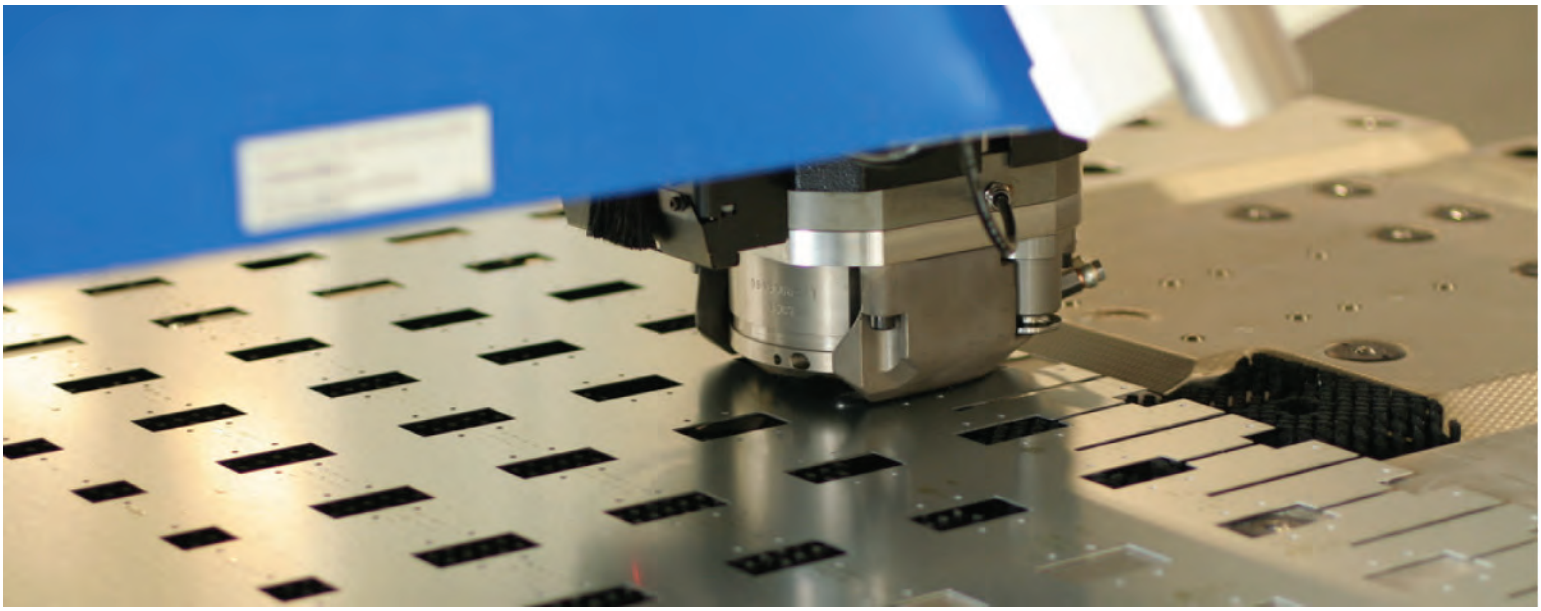
Specifying a 10 microinch RMS maximum will result in a bright reflective finish as low as 4. As the roughness of the surface increases, rerollers must operate in a broader range. For a 25 microinch RMS, for example, a designer should specify a 20 to 40 microinch RMS.

Surface finishes can be imparted by the face of the work rolls in the rolling mill. Highly polished carbide rolls create a mirror bright reflective finish. Shot blasted steel rolls are used for 20 to 40 microinch RMS matte finishes. An RMS 60 microinch is about as rough a surface that can be created in the process.

Ulbrich also processes over 70 stainless steel, nickel alloy and cobalt alloys in the metal wire format. In our manufacturing, not only do we provide needed dimensional and metallurgical characteristics for forming parts to specification, but our shaped wire division can also produce special profiles, in addition to round (for cotter pin applications), square, keystone and others.

CONCLUSION

With all the different alloys in the market now, it can be difficult to find something that meets your exact specifications, especially if you have a stringent aerospace or medical application. The variety of different stainless, nickel-based and cobalt-based alloys now being offered by the integrated mills, the presence of rerollers to tailor them to meet stringent specifications and the effective channel of distribution from the service center industry gives stampers plenty of options in meeting all of their customers' requirements. By working closely with all three levels of suppliers, it is possible for stampers to use this marketing arrangement for maximum potential in serving their customers. Basically, re-rollers can work with metal stampers to make sure the chain of supply is there to meet their demand and requirements.

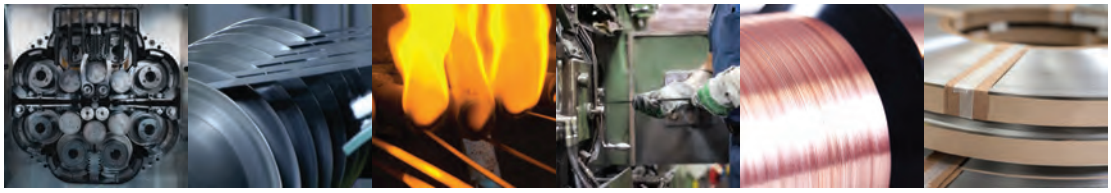


We Deliver Precision®

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

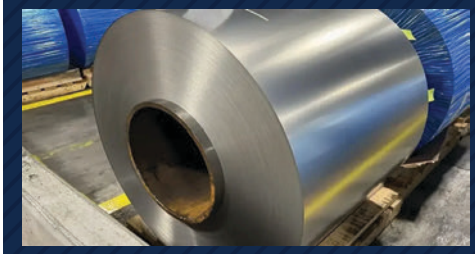
With production and shipping capabilities spanning the entire globe, we are able to accommodate steel and metal product packaging and transit to almost any international destination.

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)

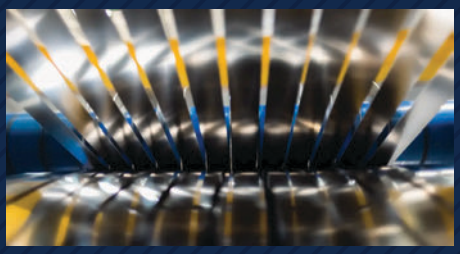
Light Gauge

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

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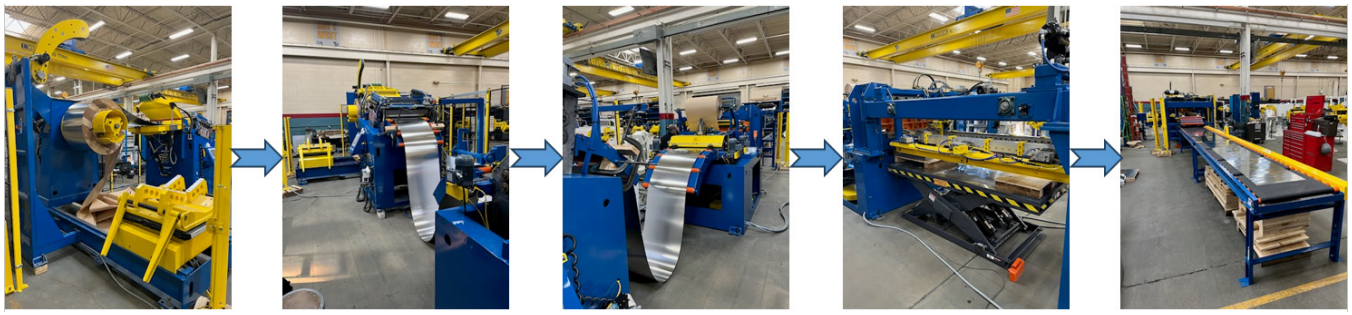
ULBRICH.COM

NEW PROCESSING CAPABILITIES

Ulbrich of Illinois' CTL Line Cuts Wider Widths & Lighter Gauges



Ulbrich Stainless Steels & Special Metals, Inc. is proud to announce that we've upgraded our processing capabilities by installing a new Cut-to-Length line in our Ulbrich of Illinois facility. This state-of-the-art equipment will allow our Midwest metal service center to cut wider widths & lighter gauges than ever before.

Ulbrich of Illinois can now uncoil, shear, and auto-stack sheet with widths up to 30" and gauges as light as 0.004. Alloy products available to be processed include stainless steel, aluminum, electrical steel, and more.

Expanding our in-house processing capabilities allows us to save our valued customers time and money. Your specialized projects demand specialized tools able to solve your most pressing challenges. Contact us today to learn how Ulbrich's many value-added services can help you improve your manufacturing output.

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)

We Deliver Precision®

ULBRICH.COM

Precision Shaped Wire

MINIMIZES OR ELIMINATES COSTLY STAMPING OPERATIONS BY BEING NET OR NEAR NET IN SHAPE

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.

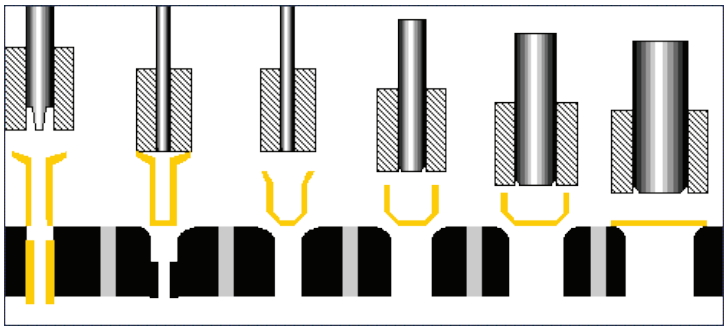
OUR SHAPED WIRE MANUFACTURING COMBINED WITH OUR UNMATCHED MATERIAL EXPERTISE

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.

The Benefits of Shaped Wire for Stamped Parts Manufacturing

The stamping process, also known as pressing, typically involves continuously running flat metal in coil form through a tool and die. The output of that process results in a stamped product manufactured to the specification needed for the part. In some cases, manufacturers will also utilize blanks for their production, which are also used for individual stamping.

A stamping press is designed specifically for stamping metal parts out of raw material, and upon running material, a tool and die will form the metal into a specified shape. Several types of stamping techniques may be used to achieve an end product, including punching, blanking, bending, coining, and more. Each of these processes can be effective in arriving at the desired shape, however, there are different cost variables involved with each.



HOW CAN SHAPED WIRE BENEFIT STAMPERS?

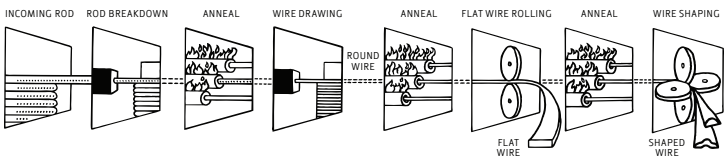
Starting with a Shaped Wire Product can supplement the stamping process by pre-rolling in features to the material that otherwise cannot be stamped in. This is a tremendous advantage to stampers as using a pre-formed profile will allow the stamper to start with a near-net shape, potentially replacing some initial stamping or forming steps. The elimination of these steps could increase overall production yield by reducing processing time, tooling costs & scrap.

THE IMPORTANCE OF SCRAP REDUCTION

Today, far more manufacturers are focusing on reducing scrap from production. This is beneficial to the environment and the manufacturer's bottom line, while also giving customers the opportunity to see a reduction in cost and turnaround time which makes the manufacturer more competitive. As many stamping processes are multi-step, progressive processes, less scrap is typically produced when starting with a shaped wire product. Generally, using a shaped wire product can provide tighter tolerances over the alternative, which might help eliminate certain stages or steps in the stamping process that may otherwise be necessary when using regular flat material. This is possible through Ulbrich's capabilities to pre-shape material.

At Ulbrich Shaped Wire, we produce a shaped material manufactured into its final profile by rolling round wire flat and then shaping the material by pulling or pushing the material through steel rolls. To start, we take round wire that progresses through the wire shaping process, where it is drawn down to what we require as our starting size. The drawing process elongates the wire and leaves an extremely low percentage of product leftover as scrap. This wire is then used to begin our rolling and shaping process. Fortunately, the overall scrap levels remain low, and this savings is essential as it helps provide our customers with the most competitive pricing we can offer.

THE ULBRICH SHAPED WIRE PROCESS



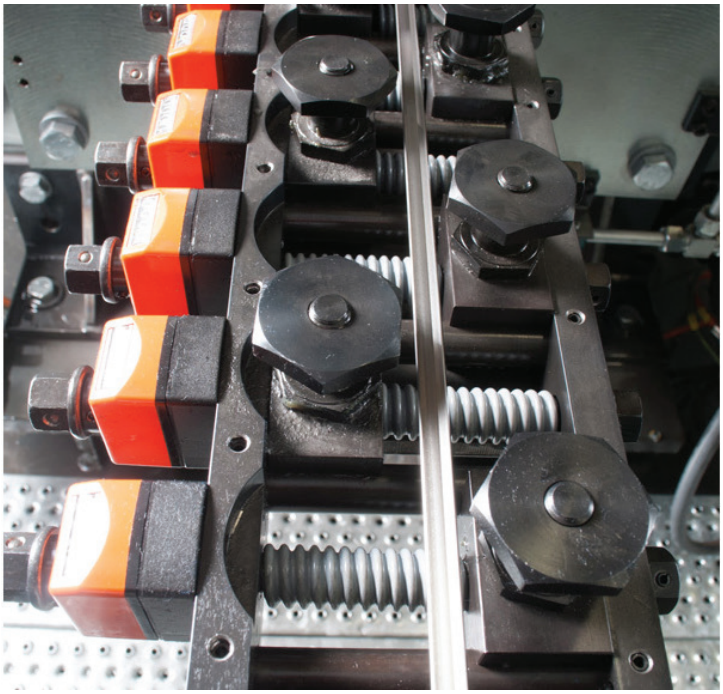
By combining this process with what a shaped or profiled product can offer, the stamper receives raw material that positions them very competitively once they begin running their jobs. This same benefit is afforded to our customers. When it hits their shop floor, the shape being near net allows them to avoid the scrap that would otherwise be produced by performing the operations to achieve the shape they need to start their manufacturing. This is not only advantageous from a scrap prevention perspective but also in production speed.

HOW SHAPED PROFILE WIRE MINIMIZES COSTLY MACHINING

It's all about maximizing yield and reducing scrap. By rolling the material to shape rather than removing material, Ulbrich can take full advantage of the entire metal wire material. When machining metal, there is ultimately a lot of material lost in the process. Unlike machining, when shaping wire to a specific profile, the process is essentially "squeezing" (elongating) the material through a group of steel rolls/dies. The amount of material you started with is preserved. Since coils can potentially weigh a thousand pounds, the possibility of eliminating countless hours of machining time due to a near-net-shape result is very real.

Another benefit that the ability to pre-shape wire presents is in reducing costs due to the potentially high expense of tooling/dies. Quite often, tooling is the costliest part of the stamping process, outside of a press' initial cost. The dies must be acquired, and if there is a custom aspect to them, the time it takes to have them manufactured translates into even more cost. Suppose a pre-shaped product might afford the manufacturer the chance to eliminate the need to buy tooling while also reducing the number of potential die changes that must be made. In that case, there is an added cost reduction benefit to be had.

One good example of what Ulbrich can provide includes blade products for specific applications. For instance, a customer initially using a flat strip product needed to add processing to skive the edges. In contrast, Ulbrich was able to supply them with a shaped profile, allowing them to eliminate the additional edging operations. This was a boon to their entire manufacturing operation as it saved them a ton of time and money.



CRITICAL STEPS FOR QUALITY PRODUCTS DEVELOPED AT ULBRICH SHAPED WIRE

At Ulbrich Shaped Wire, we constantly analyze our operations and offerings in a never-ending quest to optimize what we do and innovate. We are extraordinarily data-driven and continually learning and iterating on the things we do and the products we sell.

On the customer side, developing a process that will provide a customer with value-added raw material begins with initial inquiry and investigation. Working together with our team of experts, Ulbrich Shaped Wire often takes concepts provided by our customers and works with them in a highly collaborative way to arrive at an outcome that will provide cost savings.

Technical conversations are very common as we ultimately want to provide a functional profile that saves costs for our customers. These conversations surround the determination of alloys, material properties, tolerances, and individual needs. We take extra care to review any specifications with our customers and our best-in-class engineering and metallurgy teams to ensure quality and compliance.

Upon agreement, a technical drawing is provided for approval to make sure that it meets our customer's needs. We also have a team of product managers available at all times throughout the development process for additional commercial support. Once we have ensured that we are aligned with our customers on the concept and material needs, we will produce the final profile.

ULBRICH SHAPED WIRE'S ROLE IN PROCESS IMPROVEMENT

Metallurgical and technical excellence are high priorities at Ulbrich Shaped Wire. Our broad product offerings and robust supply line enables us to leverage a wide selection of alloys in our wire rolling mills, which furthers our rapid prototyping & custom wire profiling capabilities to develop superior wire for customers whether they require a standard or custom cross-section.

Ulbrich Shaped Wire can provide material that offers a stamper the opportunity to eliminate the need for tooling steps by getting the material closer to the final stamped part outcome. Improvements in both process time and cost reduction are seen when the amount of setup time due to the number of tooling changes is reduced. Additionally, we can add features to the profile that cannot be achieved during the stamping process. Some of these features might include rounded sections, bladed edges, or unique dimensional requirements.

One of our most powerful capabilities is our ability to partner with our customers in order to understand their operations and material needs completely, which enables us to collaborate on the design of the wire material's profile to meet their needs and optimize their production processes. Starting with a "near net" shape may allow stampers to remove early press operations necessary when starting with a flat blank. Reducing the number of stamping operations can lower processing time, tooling costs & scrap.

COMMON SHAPES & CUSTOM WIRE PROFILES

Ulbrich works with 300 series and 400 series stainless steels, Titanium, and Hi-temperature advanced Nickel Alloys such as Inconel and Monel. Overall, Ulbrich has worked with more than 165 alloys throughout the years.

All tooling is custom manufactured in-house by our state-of-the-art New England tooling center. Some of the basic profiles that we provide include half rounds with special corner radii, rounded sides, bladed or razor-edged flats, wedge wire and Kamm profiles, and many other custom profile products. Depending on the profile's complexity, shapes are provided in net or near-net suitable for stamping, coining, forming, or machining. Ulbrich provides the highest value material by offering the least downtime and part variability, allowing our customers to produce higher quality products at a lower overall cost.

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 Forming Metals

ALWAYS LOOKING FOR WAYS TO INNOVATE AND IMPROVE UPON STAMPING 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 deep drawn part 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 deep drawn stamping 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 Stamping Needs!

info@ulbrich.com | **800-243-1676**

Ulbrich

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