Ulbrich

We Deliver Precision®

EXCEEDING EXPECTATIONS SINCE 1924

ULBRICH.COM

ULBRICH STAINLESS STEELS & SPECIAL METALS, INC.

Global Representation with Service and Distribution Centers Worldwide.

PRECISION ALLOYS FOR PRECISION PARTS

Ulbrich 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.

We Deliver Precision®

The various alloys we process are known for their superior performance and excellent reliability. These products are the result of years of metallurgical development, offering properties well beyond those of ordinary metals. Ulbrich serves in markets as diverse as aerospace, aircraft and automotive, nuclear and solar energy, medical and surgical equipment, chemical processing, electronics and many others. We are an international company that strives to deliver high quality products to various industries.
At Ulbrich, all employees focus their talents and energies in a common direction — total customer responsiveness, total company involvement, total quality commitment and continuous professional development.

Chris Ulbrich

CHIEF EXECUTIVE OFFICER

PRECISION ROLLED STRIP TO CUSTOM REQUIREMENTS

At the Ulbrich Specialty Strip Mill

»We use fully integrated quality sources to supply us with excellent raw material.

»We follow rigid incoming and in-process inspection procedures.

»We have over 165 alloy grades to select from: common stainless steels; nickel and nickel alloys, titanium and titanium alloys plus many other special metal alloys.

»We use historical knowledge from a library of critical processing information and specialized equipment to process all orders.

»All orders are processed efficiently and quickly.

»Our automated mill controls continually monitor the product to make certain all dimensions are within tolerances.

»This is what you should expect from from an ISO 9001:2008 certified producer like Ulbrich.

Pictured above are raw materials as received from our suppliers. We buy stainless steels and special metals from producers known for their high quality and reliability.

FOR EXACT GAUGES AND TEMPERS

WHEN YOUR SPECIFICATION DEMANDS SOMETHING EXTRA, ULBRICH HAS THE CAPABILITIES AND EXPERTISE TO MAKE THE PROPER ADJUSTMENTS.

We have:

»6 Sendzimir Z-mills

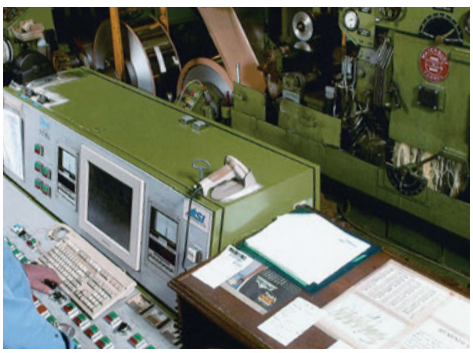
»3 4-high rolling mills

»8 Controlled atmosphere bright annealing lines

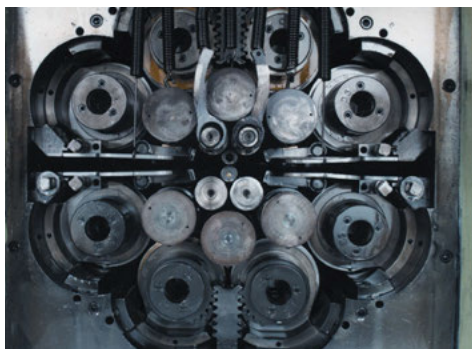
»State-of-the-art finishing equipment

»Coil cleaning, tension leveling, slitting, edging and oscillate winding

Temperature and dew point of our annealing furnaces can be precisely regulated to meet user specifications.



This high speed Z-mill is equipped with automatic gauge control to instantly adjust the roll bite and maintain the desired gauge and close tolerances.



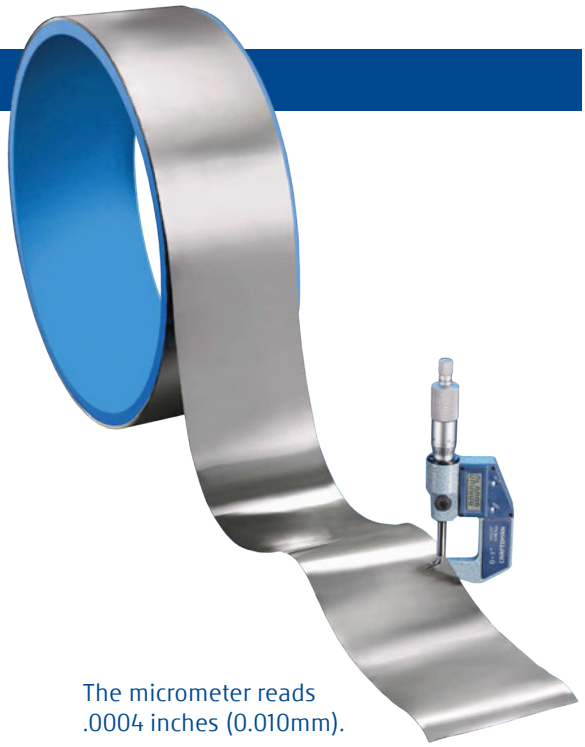
Internal view of a Z-mill.

FOIL AND SMALL QUANTITIES

UltraLite Foil®

»Ulbrich has dedicated itself to being one of the premier producers of stainless steel, special metals and titanium foils. We define UltraLite Foil® as .0015" (0.0381 mm) and lighter.

»Ulbrich has dedicated a new building with UltraLite Foil® rolling, annealing, slitting and washing capabilities.



The micrometer reads .0004 inches (0.010mm).

Small Orders

»We pride ourselves in being able to ship small quantities of any strip product we make or stock.

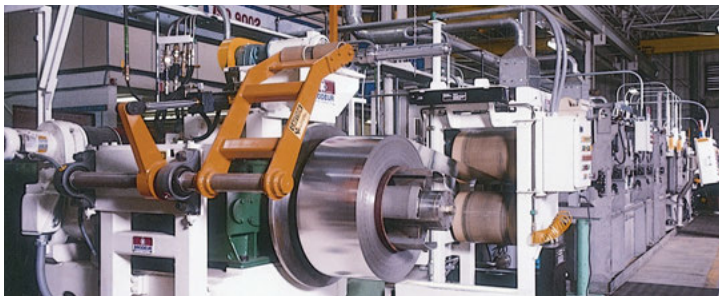
»We use excess material to help our customers develop new applications requiring small quantities for prototypes.

»Whether in production or development, we strive to meet or exceed your expectations in as many ways as we can.

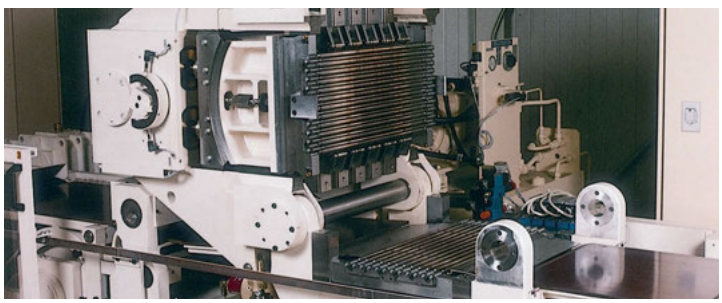
Significant inventory available in numerous size coils for small orders.

ALLOYS AND SIZES

Strip Alloys	Gauge Range	Tempers
300 & 400 Series Stainless Steels	.0004 to .125 inch (0.01 to 3.175 mm)	Fully Annealed Through Extra Full Hard
Precipitation Hardening Stainless Steels	**Width**	**Surface Finishes**
Nickel & Nickel Alloys	14.00 inch max. (356 mm max.)	Dull
Cobalt Alloys		Bright
Titanium & Titanium Alloys		Special Textures
Others on Request		



This high pressure hot water jet cleaning system is used for applications requiring ultra clean surfaces.



We meet requirements for strip that must be truly flat (.005 piw) with the latest in stretch bend leveling technology, with rugged tension bridles and a nest of small diameter bending rolls.

United States of America

LOCATIONS »Connecticut »Illinois

Oscillate (or traverse) wound strip is available on either open coils or spools. Special edges, from deburred to square to full round, are within our capabilities. Orders for production or prototype quantities are processed quickly and efficiently and usually delivered within one week or less.

Strip and Coil Stainless Steel: 300 Series, 400 Series, PH Grades / Nickel Alloys / Titanium and Titanium Alloys / Cobalt Alloys

Gauge Range .002 to .135 inch (0.0508 to 3.429 mm)

Width Range .020 to 54 inches (0.5 to 1368 mm)

Edges Rounded / Square / Deburred

Packaging Ribbon Wound Coils / Oscillate Wound Coils & Spools / Cut-To-Length

Custom wound coils.

Disk packs and I.D. cores in a variety of sizes are available.

Canada and Mexico

Diversified Ulbrich of Canada

LOCATIONS »Toronto »Montreal

Diversified Ulbrich of Canada is a stainless steel and aluminum service center providing sheet, plate, bar, strip, tubing and structural angle to the Canadian Market. In addition to standard stock sizes, we can shear, level, plasma roll, slit or cut to length our products to your exact specifications. Our stainless alloys include the following: 200 Series, 300 Series, 400 Series, Duplex Grades, Invar, as well as 3003 H14 and 5052 H32 aluminum. See Technical Detail page 12 for size ranges.

Ulbrinox

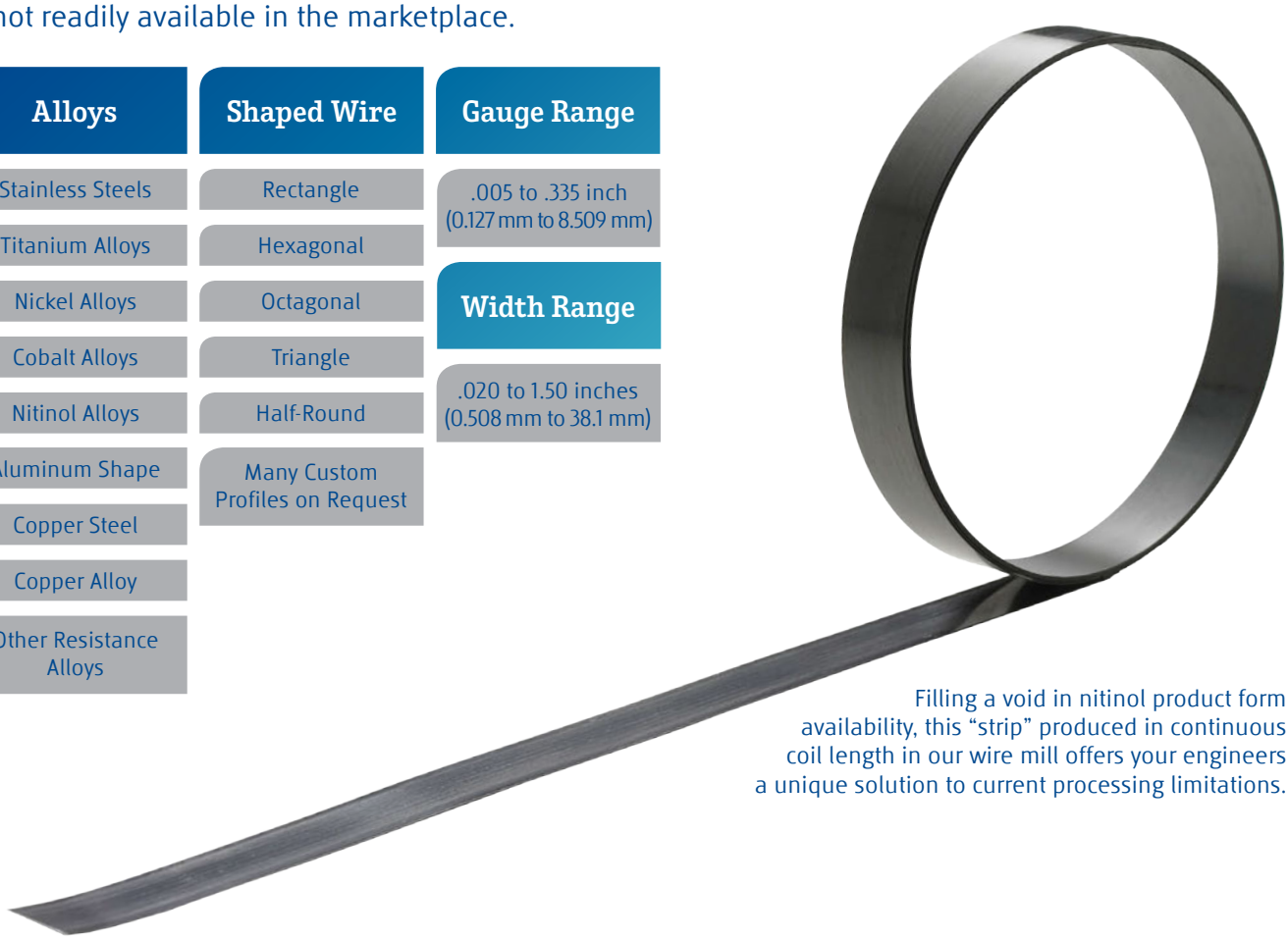
LOCATIONS »Queretaro

Ulbrinox is a versatile service center that offers a wide range of metals including stainless steel, red metals, silicon steel, and aluminum. Ulbrinox provides different inventory management solutions such as JIT, Kanban and Consignment programs in order to help you control stocks and reduce costs.

SHAPED WIRE

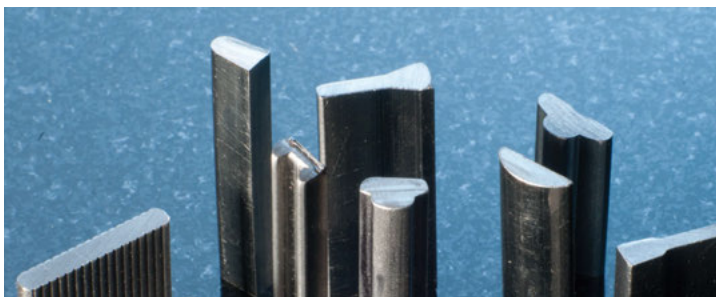
Ulbrich Shaped Wire specializes in the manufacture of custom-made shapes and flats for a wide variety of industries. Depending on the complexity of the profile, shapes may be either net- or near net-suitable for stamping, coining, forming, or machining. All tooling is custom manufactured in-house by our state-of-the-art tooling center. We also offer metallurgical and engineering support for all customers. Ulbrich Shaped Wire supplies a wide range of alloys, including nitinol, which can be provided as a flat, coiled wire product that is not readily available in the marketplace.

Alloys	Shaped Wire	Gauge Range
Stainless Steels	Rectangle	.005 to .335 inch (0.127 mm to 8.509 mm)
Titanium Alloys	Hexagonal	
Nickel Alloys	Octagonal	**Width Range**
Cobalt Alloys	Triangle	.020 to 1.50 inches (0.508 mm to 38.1 mm)
Nitinol Alloys	Half-Round	
Aluminum Shape	Many Custom Profiles on Request	
Copper Steel		
Copper Alloy		
Other Resistance Alloys		

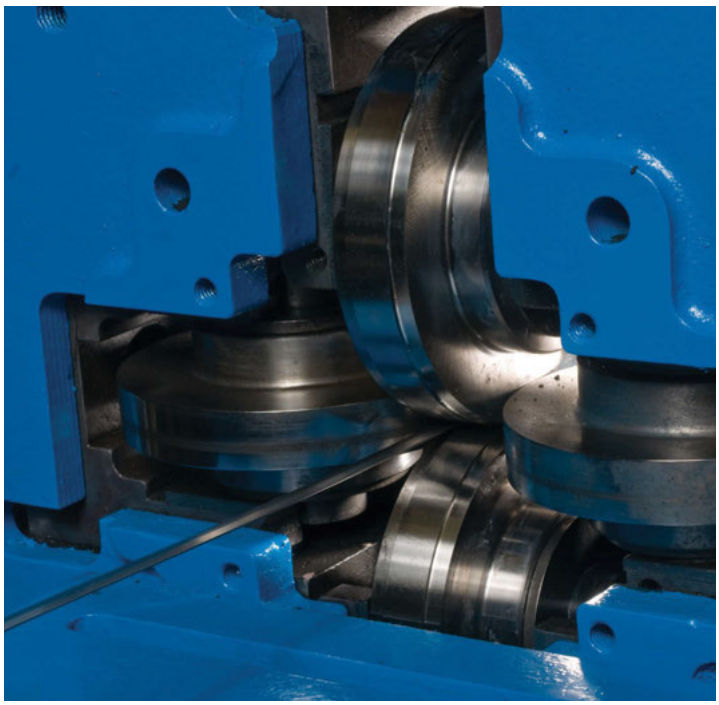


Filling a void in nitinol product form availability, this “strip” produced in continuous coil length in our wire mill offers your engineers a unique solution to current processing limitations.

Our controlled atmosphere strand annealing capabilities ensure consistent mechanical properties and a quality surface finish.



Custom wire shapes offer an all-around reduction in cost and process steps by bringing customers closer to a finished part.



Our shaping mills are equipped with highly engineered tooling designed and manufactured in-house at our state-of-the-art tooling center.

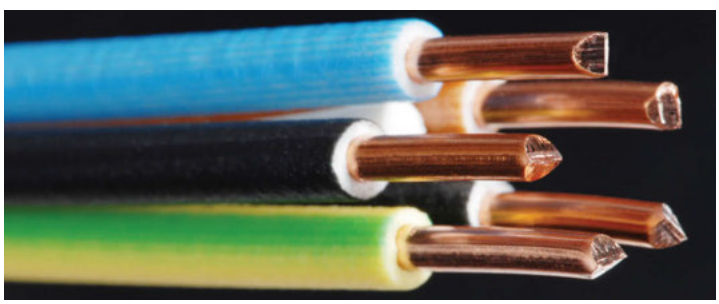
Precision Flat & Fine Wire

Our Precision Flat Wire facilities are capable of producing gauges for many demanding applications serving a variety of industries. Our state-of-the-art “Focus Factory” approach dedicates managers and engineers along with state-of-the-art equipment to produce and manage industry specific requirements.

Our production equipment uses the latest in “on-the-line” gauging and data acquisition technology that generates full statistical summaries with each production run, enabling us to control our process and offer tolerances as tight as +/- .0001 inch (0.0025 mm) on our lightest gauges. Precision spooling of fine wires onto a variety of spools or bobbins using CNC winders enables trouble-free performance in the most demanding applications. We offer a wide range of finishes for photovoltaic applications, saw blades, as well as for certain medical applications.

Plated products for a variety of industries.

Alloys	Gauge Range	Width Range	Applications
Stainless Steels	.0002 to .210 inch (0.00508 mm to 5.334 mm)	.002 to 1.50 inches (0.0508 mm to 38.1 mm)	Tinned copper and aluminum tabs for capacitors
Aluminum Alloys			Aluminum and nickel tabs for batteries
Copper & Brass Alloys	**Rounds**	**Surface Finishes**	Gold plated products for a variety of applications in the electronics, medical, and aerospace markets
Nickel Alloys			Silver-plated copper flat shielded wires for telecom cables
Carbon Steel	.00075 to .400 inch (0.019 mm to 10.16 mm)	Tin and Lead Coated	Silver-plated copper wires for applications in music strings and medical devices
Nitinol		Heat Treated and Tempered	Medical braidwire and mandrel applications
		Bright Polish	Specialty music string and wire products
			Silver-plated and solder-coated copper PV Ribbon for solar cell tabbing and string interconnect



Telecommunications products.

Engineered music wire products.

Precision Flat & Fine Wire

Ulbrich is the perfect source for your ultra-fine wire requirements. We process precision plated and bare wire in various geometries, including rounds, squares, and flats, all to extremely close tolerances.

We process a vast amount of materials for various markets that include: medical, electronics, telecommunications, and energy materials.

Ulbrich supplies materials in spools, cut to length, pancake coils, precision layer wound, and other custom packages. Traverse spools, flanges, various barrels, and bore sizes available to satisfy all your requirements.

Alloys

- Copper
- Phosphorus Bronze
- Beryllium Copper
- Brass
- Monel400
- Copper Nickel Alloys
- Kovar
- Dumet
- Pure Nickel 200/205
- Invar
- Alloy 52
- Other Resistant Alloys

Specialty Alloys

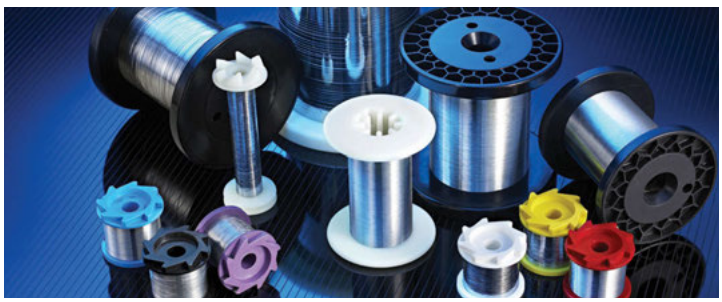
- Copper Clad
- Copper Aluminum Clad
- Aluminum Clad
- Aluminum
- Nickel Plated Steel
- Molybdenum
- Tantalum
- Tungsten
- Titanium Alloys
- MP35
- 300 Series VM
- 430
- FeChrome
- Nickel Alloys

Plating

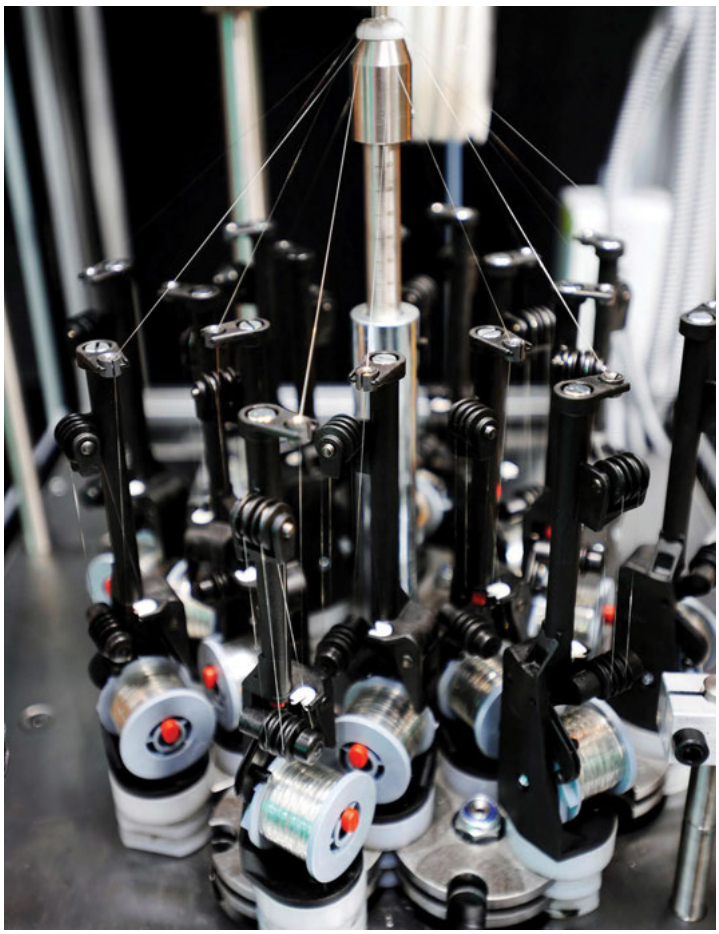
- Gold type I, II, III per MIL-G-45204 Solder per MIL-P-81728*
- Silver per QQ-S-365 and ASTM B-298 Military Standard -1276*
- Nickel per QQ-N-290*
- Tin per MIL-T-10727 Type 2 Solder-ability per MIL-STD-202

*ASTM Specifications

Ultra-fine wire is braided on specialized braiding equipment. Steeger machine shown above on right.



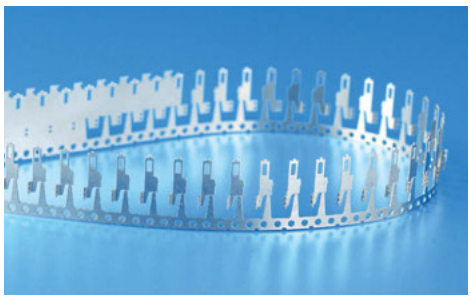
Our exclusive Nitinol rolling process produces a wide spectrum of coiled flat wire sizes, oxides, and mechanical properties of choice.



Close up of multiple precision wire bobbins wound on a Steeger machine.

END-USE APPLICATIONS MADE FROM ULBRICH PRODUCTS

Strip and wire products from Ulbrich Stainless Steels are used in many of the world's leading edge applications, including aircraft engines, automotive components; surgical, diagnostic and other medical instruments; consumer and industrial electronics, chemical processing equipment; solar, nuclear and conventional power generation equipment, and many more.



Carrier strip for electronic connectors

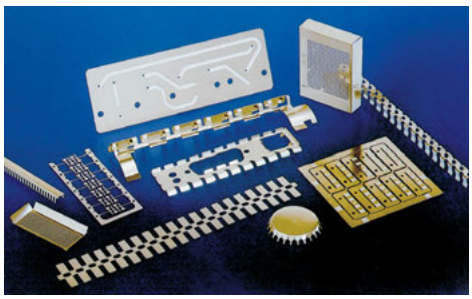
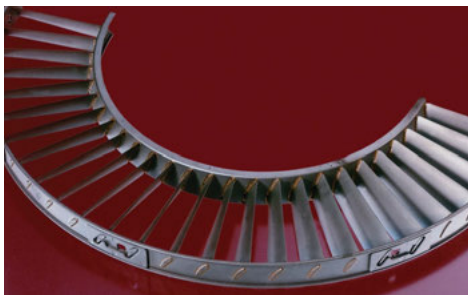


Photo-etched parts

Stainless steel springs

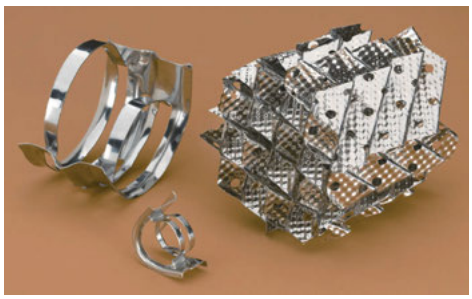


Fixed stator vanes for aircraft and land-based turbines

Electronic components

Automotive components

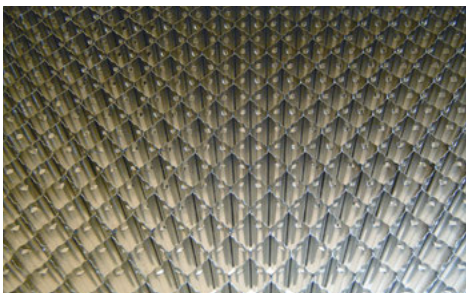
Surgical tools



Random and structured tower packing for chemical processing facilities

Recuperator sections and high pressure seal rings

Hypodermic needle & pacemaker cans



Titanium honeycomb sections

Nuclear energy components

Solar energy components

Aerospace components

TECHNICAL INFORMATION

Strip Rolling Mill Capabilities

Gauge .0004 – .125 inch (0.010 – 3.175 mm)
Width up to 14 inches (up to 356 mm)
Special Textures Rolled or Mechanically Applied
Tempers Dead Soft – Extra Full Hard

Sheet Inventory*

Thickness 28 – 7 gauge
.0149 – .1793 inches (0.378 – 4.55 mm)
Width up to 72 inches (up to 1828 mm)
Finishes 2B, #4 Polish, BA XLBUFF

*Diversified Ulbrich of Canada only

Plate Inventory*

Thickness .1875 – 2 inches (4.76 – 50.8 mm)
Width up to 96'' x 288'' (up to 2438 x 7315 mm)
Finishes HRAP, #4 Polish, Smooth and Diamond Pattern

*Diversified Ulbrich of Canada only

Slitting Capabilities*

Gauge .0004 – .165 inch
(Ribbon wound) 0.010 – 3.429 mm
Gauge .0025 – .060 inch
(Oscillate wound) 0.063 – 1.52 mm
Width .032 – 54 inches
(Ribbon wound) 0.508 – 1368 mm
Width .062 – 1.00 inches
(Oscillate wound) 1.57 – 25.4 mm
Oscillate Face 3.5 – 12 inch max.
(88 – 304 mm)
Ribbon ID 2 – 24 inches
(50.8 – 609.6 mm)
Oscillate ID 5 – 16 inch max.
(127 – 406 mm)
Ribbon OD 48 inch max. (1220 mm)
Oscillate OD 30 inch max. (762 mm)

*The full range of widths can not be produced on all thicknesses.

The certification of our facilities to ISO 9001:2008 confirms the quality standards we've maintained close to a century ago.

EDGES

A.I.S.I. No. 1 — Round edge

Width: 1.500 inches (38 mm) max.
Thickness: .007 – .062 inch (0.1778 – 1.575 mm)

Broken Corner

Width: 3.500 inches (89 mm) max.
Thickness: .062 – .125 inch (1.575 – 3.175 mm)

A.I.S.I. No. 3 — Slit edge

Width: .020 inch (0.5 mm) min.
Thickness: .0009 – .125 inch (0.02286 – 3.175 mm)

A.I.S.I. No. 5 — Square edge

Width: 2.250 inches (57.15 mm) max.
Thickness: .004 – .062 inch (0.1016 – 1.575 mm)

Broken corner

Width: 3.500 inches (89mm) max.
Thickness: .062 – .125 inch (1.575 – 3.175 mm)

WIRE PRODUCTS

Flat Wire Gauge .0002 – .210 inch
(0.0058 – 5.33 mm)
Flat Wire Width .002 – 1.5 inch
(0.005 – 38.1 mm)
Round Wire Dia. .00075 – .400 inch
(0.019 – 10.16 mm)
Shaped Wire rectangular, hexagonal, octagonal, triangular, half-round, many custom profiles on request.

THE ULBRICH FAMILY OF ALLOYS

Alloy Name	Trademark	UNS	C MAX	Ni	Cr	Mo	AMS	ASTM	Density	Description
Austenitic Grades 201		S20100	0.15	3.5–5.5	16.0–18.0			A 240, A 666	0.28	Chromium nickel manganese steel was developed as a satisfactory alternate for Type 301 for many applications.
301		S30100	0.15	6.0–8.0	16.0–8.0		5517, 5519, 5518	A 240, A 666	0.29	Chromium nickel steel, capable of attaining high tensile strength and ductility by moderate or severe cold working.
302		S30200	0.15	8.0–10.0	17.0–19.0		5516	A 240, A 666	0.29	General purpose chromium nickel stainless steel. Its corrosion resistance is superior to that of Type 301. It can be cold worked to high tensile strengths but with slightly lower ductility than Type 301.
303 (wire only)		S30300	0.08	9.00	18.00		5640	A 262, A 314, A 484, A 582	0.29	Alloy 303 is a non-magnetic stainless steel that is not hardenable by heat treatment. Alloy 303 has much better free-machining capability versus 302 and 304, in addition to having good resistance to oxidation at temperatures up to 1700°F.
304		S30400	0.08	8.0–10.5	18.0–20.0		5513	A 240, A 666	0.29	Low-carbon chromium nickel stainless and heat-resisting steel somewhat superior to Type 302 in corrosion resistance.
304L		S30403	0.03	8.0–12.0	18.0–20.0		5511	A 240, A 666	0.29	Very low-carbon chromium nickel steel with general corrosion resistance similar to Type 304 but with superior resistance to intergranular corrosion following welding or stress relieving. It is recommended for use in parts which are fabricated by welding and which cannot be subsequently annealed.
305		S30500	0.12	10.0–13.0	17.0–19.0		5514	A 240	0.29	A high corrosion-resistant alloy with low rate of work hardening, designed for extra deep drawing and spinning.
309		S30900	0.08	12.0–15.0	22.0–24.0		5523	A 240, A 167	0.29	High corrosion-resistant, chromium nickel grade with carbon limited to .08 to reduce carbon precipitation during welding.
310		S31000	0.25	19.0–22.0	24.0–26.0		5521	A 240, A 167	0.29	Similar to 309 with higher resistance to corrosion and oxidation at elevated temperatures.
316		S31600	0.08	10.0–14.0	16.0–18.0	2.0–3.0	5524	A 240, A 666	0.29	Chromium nickel stainless and heat-resisting steel with superior corrosion resistance to other chromium nickel steels when exposed to many types of chemical corrodents; superior creep strength at elevated temperatures.
316L		S31603	0.03	10.0–14.0	16.0–18.0	2.0–3.0	5507	A 240, A 666	0.29	Low-carbon chromium nickel stainless steel with general corrosion resistance similar to Type 316 but with superior resistance to intergranular corrosion following welding or relieving. It is recommended for use in parts which are fabricated by welding and cannot be subsequently annealed.
316TI		S31635	0.08	10.0–14.0	16.0–18.0	2.0–3.0		A 240	0.29	Ti-stabilized version of 316 with resistance to sensitization. (The formation of grain boundary chromium carbides at evaluated temperatures.)
317L		S31703	0.03	11.0–15.0	18.0–20.0	3.0–4.0		A 240	0.29	Similar to 316L but with additional molybdenum to improve corrosion resistance.
321		S32100	0.08	9.0–12.0	17.0–19.0		5510	A 240	0.29	Chromium nickel steel containing titanium. Recommended for parts fabricated by welding which cannot be subsequently annealed. Also recommended for parts to be used at temperatures between 800°F and 1850°F.
347		S34700	0.08	9.0–13.0	17.0–19.0		5512	A 240	0.29	Chromium nickel steel containing columbium and tantalum which is recommended for parts fabricated by welding which cannot be subsequently annealed. Also recommended for parts to be used at temperatures between 800°F and 1850°F.
CARPENTER® 20 CB	3, 8	N08020	0.06	32.5–35.0	19.0–21.0	2.0–3.0		-B 463	0.289	A highly corrosion-resistant alloy used in the chemical industry for applications where corrosion resistance is extremely critical, superior to the general run of 300-type stainless.
Ferritic Grades 430		S43000	0.12		16.0–18.0		5503	A 240	0.28	General purpose grade, corrosion-resistant, straight chromium grade, non-heat-treatable.
430LI		S43000	0.022		16.0–18.0				0.28	Similar to straight 430 in corrosion and mechanical properties. The low interstitials provide improved transverse bending over straight 430.
434		S43400	0.12		16.0–18.0	0.75–1.25		A 240	0.28	Modification of Grade 430 designed for automotive trim and resistance to atmospheric corrosion.
444		S44400	0.025	1.0 max.	17.5–19.5	1.75–2.50		A 240	0.28	A low-carbon, low-nitrogen, ferritic that provides pitting and crevice corrosion resistance superior to most ferritic grades.
Duplex Grades 2304		S32304	0.03	3.0–5.5	21.5–24.5			A 240	0.28	A lean austenitic-ferritic duplex stainless steel with general corrosion resistance similar to 316, but with yield strength nearly double that of austenitic stainless steels.
2205		S32205	0.03	4.5–6.5	22.0–23.0	3.0–3.5		A 240	0.28	A nitrogen-, molybdenum-enhanced austenitic-ferritic duplex stainless steel with general corrosion resistance similar to 904L, but with a yield strength nearly double that of austenitic stainless steels.
2507		S32750	0.03	6.0–8.0	24.0–26.0	3.0–5.0		A 240	0.28	A super austenitic-ferritic duplex stainless steel with exceptional strength and corrosion resistance ideal for chemical process, petrochemical, and seawater applications.
Martensitic Grades 410		S41000	0.15		11.5–13.5		5504	A 240	0.28	General-purpose, corrosion- and heat-resisting chromium steel. Good corrosion resistance and fair machining properties. Can be treated to RC35/45.
416 (wire only)		S41623	0.015		12.0–14.0			A 582	0.282	A highly machinable stainless that is hardenable.
420		S42000	0.15 min.		12.0–14.0		5506	A 176	0.28	Chromium steel capable of hardening to a maximum of approximately RC53/58.
440A		S44002	0.60–0.75		16.0–18.0				0.28	High carbon grade, high chromium, capable of being heat-treated to a hardness range of RC51/62.
Precip Hardening Grades 17-7PH		S17700	0.09	6.5–7.75	16.0–18.0		5528	A 693	0.282	A chromium nickel stainless steel with characteristics of good workability, easy hardening, high-strength, and excellent mechanical properties at elevated temperature, can be heat-treated at relatively low temperature for high-strength properties.
17-4PH		S17400	0.07	3.0–5.0	15.0–17.5		5604	A 693 (Type 630)	0.28	Precipitation-hardening stainless steel with high-strength and good corrosion resistance to 600°F. Used in aerospace, chemical, petrochemical, paper and metalworking industries.
18-9LW	4	S30430	0.10	8.0–10.0	17.0–19.0			A 493	0.29	High-temperature alloy with high-temperature strength. The alloy has good resistance to oxidation and corrosion. It also has good fatigue performance.
PH15-7Mo®	4	S15700	0.09	6.50–7.7	14.0–16.0	2.0–3.0	5520	A 693	0.282	Similar to 17-7PH® alloy, but with molybdenum added for higher strength during heat treatment.
A286	4	S66286	0.08	24.0–27.0	13.5–16.0	1.0–1.75	5525		0.286	An iron nickel chromium alloy designed for service up to 1300°F where high strength and corrosion resistance are required.
AM 350	7	S35000	0.07–0.11	4.0–5.0	16.0–17.0	2.5–3.2	5548	A 693	0.286	Similar to 17-7PH® alloy and PH15-7Mo® alloy, but with slightly higher elevated temperature capability.
Nickel Alloys NICKEL 200		N02200	0.15	99.0 min.				B 162	0.322	Commercially pure nickel. High corrosion resistance. Used in food handling and electronics.
NICKEL 201		N02201	0.02	99.0 min.			5553	B 162	0.322	Similar to Nickel 200 except with a lower carbon content for better formability. Most applications in chemicals.
PERMANICKEL 300		N03300	0.4	Bal					0.316	Age-hardenable, high-nickel alloy, with very good thermal electrical conductivity.

1 Trademark of Special Metals Corporation group of companies
2 Trademark of Haynes International, Inc.
3 Trademark of Carpenter Technology Corporation
4 Trademark of Armco, Inc.
5 Trademark of United Technologies Corporation
6 Trademark of Ulbrich Stainless Steels & Special Metals, Inc.
7 Trademark of Allegheny Ludlum Corporation
8 CARPENTER 20CB-3LR® is a trademark of Hoechst Celanese Corporation

In addition to the alloys produced by sources identified herein by trademarks, Ulbrich can, in many cases, offer equivalent or similar alloys produced by alternate sources.

Ulbrich

We Deliver Precision®

THE ULBRICH FAMILY OF ALLOYS

Alloy Name	Trademark	UNS	C MAX	Ni	Cr	Mo	AMS	ASTM	Density	Description
Nickel Alloys MONEL® 400₂	1	N04400	0.3	63.0 min.				B 127	0.318	A solid-solution alloy with high strength and toughness over wide temperature ranges. Used in electronic components, springs. Corrosion resistant and oxidation resistance to 1000°F.
MONEL® 401	1	N04401	0.5	44.0 min.					0.321	An alloy used for thermal and electronic applications. This alloy is sometimes called Constantan and is 44% Nickel and 56% Copper.
MONEL® K-500	1	N05500	0.25	63.0 min.					0.305	Similar to Monel® 400 and 8482; but with higher tensile strength; a precipitation hardening alloy. Used in oil well drilling collars, doctor blades. Good strength and ductility 423°F to 1200°F.
INCONEL® 600	1	N06600	0.15	72.0 min.	14.0–17.0		5540	B 168	0.304	Has high corrosion and heat resistance combined with excellent strength and workability. Mainly used in corrosive atmospheres. Oxidation resistance to 2150°F.
Nimonic 75	1	N06075	0.08–0.15	Bal	18.0–21.0				0.302	A nickel chromium alloy with good mechanical properties and oxidation resistance at high temperatures. Used for sheet-metal fabrications in gas-turbine engines, for components of industrial furnaces, for heat-treating equipment and fixtures, and in nuclear engineering.
INCONEL® 625	1	N06625	0.1	58.0 min.	20.0–23.0	8.0–10.0	5599, 5869, 5879	B 443	0.305	Outstanding corrosion resistance with excellent fabricability. Good for cryogenic- to high-temperature applications up to 2000°F.
601	1	N06601	0.1	58.0–63.0	21.0–25.0			B 168 DIN 17750	0.293	This Ni Cr Fe alloy is a good alloy for heat- and corrosion-resistant applications. It is an excellent alloy selection for resistance to high-temperature oxidation. The alloy has good resistance to aqueous corrosion, and has high mechanical strength, and is easily formed, welded and machined. It has good resistance to oxidation at high temperatures up to 1250°C and is resistant to carburization and carbon nitriding conditions.
INCONEL® 718	1	N07718	0.08	50.0–55.0	17.0–21.0	2.80–3.30	5596, 5597	B 670	0.296	High strength and corrosion resistance for use in temperature ranges from -423°F to 1300°F. Nuclear applications.
INCONEL® X-750	1	N07750	0.08	70.0 min.	14.0–17.0		5542, 5598		0.3	A precipitation-hardening nickel chromium alloy with useful strength to 1500°F. Good corrosion and oxidation resistance.
INCOLOY® 800	1	N08800	0.1	30.0–35.0	19.0–23.0		5871	B 409	0.29	Nickel iron chromium alloy that is carburization-resistant at elevated temperatures.
INCOLOY® 825	1	N08825	0.05	38.0–46.0	19.5–23.5	2.5–3.5		B 424	0.293	An alloy that is highly resistant to aggressively corrosive environments such as sulfuric, phosphoric acids and seawater.
Ni-SpanC® 902	1	N09902	0.06	41.0–43.5	4.9–5.75				0.293	A nickel iron chromium alloy used in precision spring applications subject to severe temperature fluctuations.
HASTELLOY® C-276	2	N10276	0.01	Bal	14.5–16.5	15.0–17.0		B 575	0.321	Used in chemical industry for resistance to oxidizing agents. Replaces Hastelloy® C and 8482; with better fabricability.
HASTELLOY® C-4	2	N06455	0.01	65.0	14.0–18.0	14.0–17.0			0.312	This Ni Cr Mo alloy has excellent high-temperature stability with good ductility and corrosion resistance. Alloy resists grain boundary precipitates in weld zone making it suitable for chemical processing applications in the as-welded condition. Has excellent resistance to stress corrosion cracking and oxidizing atmospheres to 1900°F.
HASTELLOY® C-22		N06022	0.015	Bal	20.0–22.5	12.5–14.5		B 575	0.314	A versatile nickel chromium molybdenum tungsten alloy with resistance to a variety of industrial chemicals. Superior weldability.
HASTELLOY® G-30		N06030	0.03	Bal	28.0–31.5	4.0–6.0		B 582	0.297	High chromium nickel base alloy with superior corrosion resistance to phosphoric acids and environments with highly oxidizing acids.
HASTELLOY® B-3		N10675	0.01	65.0 min.	1.0–3.0	27.0–32.0			0.333	Used in chemical industry for resistance to hydrochloric acid, sulfuric acid, phosphoric acid. Oxidation atmosphere resistant to 1400°F.
HASTELLOY® X	2	N06002	0.05–0.15	Bal	20.5–23.0	8.0–10.0			0.297	Jet engine components for afterburner sections, blades, tailpipes, furnace applications, honey-comb, bellows, ducting. Good strength and oxidation resistance to 2200°F.
HAYNES® 214	2	N07214	0.05	Bal	15.0–17.0	0.5 max			0.29	Nickel-based, precipitation-strengthened alloy with oxidation resistance to 2200°F. For furnace parts exposed to carburizing, chlorine-contaminated and oxidizing atmospheres; gas turbine parts.
HAYNES® 230	2	N06230	0.05–0.15	Bal	20.0–24.0	1.0–3.0			0.319	Nickel chromium tungsten molybdenum alloy with outstanding resistance to oxidizing environments up to 2100°F for prolonged periods.
HAYNES® 242	2	N10242	0.03	Bal	7.0–9.0	24.0–26.0			0.327	Age hardenable, nickel alloy for use up to 1300°F. Low thermal expansion, good oxidation resistance and excellent aged ductility. Suited for gas turbine engines and chemical process plants.
Cobalt Alloys HAYNES® 188	2	R30188	0.05–0.15	20.0–24.0	21.0–23.0				0.324	A cobalt-based alloy with excellent high-temperature strength and oxidation resistance to 2000°F, combined with outstanding post-standing ductility.
HAYNES® 25 L-605	2	R30605	0.05–0.15	9.0–11.0	19.0–21.0				0.33	Jet engine components, combustion chambers, afterburner parts. Oxidation and carburization resistant to 1900°F. Good high temperature strength.
Ulbraseal 29-17	6	K93610		29	0.20 max	0.20 max		F 1466	0.302	A nickel alloy with low rates of thermal expansion.
Ulbraseal 36	6	K93600	0.050	35.5 – 36.5	0.25 max			F 1684	0.291	A nickel alloy with low rates of thermal expansion. Retains good strength at cryogenic temperatures.
Ulbraseal 42	6	K94100	0.05	41	0.25 max			F 1684	0.297	A nickel alloy with low rates of thermal expansion.
HAYNES® 263	2	N07263	0.06	52.0	20.0	6.0			0.302	This alloy is an age-hardenable, nickel-based superalloy with moderate strength at temperatures up to 1500°F. Used for fabricated aircraft and land-based gas turbine engine parts. Has excellent weldability and ease of cold and hot forming. Good resistance to oxidizing combustion gas environments at temperatures to 1600°F.
WASPALOY	5	N07001	0.03–0.10	Bal	18.0–21.0	3.5–5.0	5544		0.294	Good for high temperature applications. Jet engine turbine wheels, buckets, spacers, shafts.

Alloy Name	N	C	H	Fe	O	Pd	Ti	Density	Description
Titanium Commercially Pure Ti 35A G1	0.03 max	0.08 max	0.015 max	0.20 max	0.18 max		Bal	0.163	Alpha-phase grades of commercially pure titanium with oxygen equivalents resulting in strength levels from low to high. ASTM B265/F67. UNS R50250
Ti 40A G2	0.03 max	0.08 max	0.015 max	0.30 max	0.25 max		Bal	0.163	Alpha-phase grades of commercially pure titanium with oxygen equivalents resulting in strength levels from low to high. ASTM B265/F67. UNS R50400
Ti 55A G3	0.05 max	0.08 max	0.015 max	0.30 max	0.35 max		Bal	0.163	Alpha-phase grades of commercially pure titanium with oxygen equivalents resulting in strength levels from low to high. ASTM B265/F67. UNS R50550
Ti 75A G4	0.05 max	0.08 max	0.015 max	0.50 max	0.40 max		Bal	0.163	Alpha-phase grades of commercially pure titanium with oxygen equivalents resulting in strength levels from low to high. ASTM B265/F67. UNS 50700
Ti G7/11	0.03 max	0.08 max	0.015 max	0.30 max	0.25 max	0.12–0.25	Bal		A commercially pure titanium with a small amount of palladium added to enhace corrosion resistance in a reducing atmosphere. ASTM B265 7/11. UNS R52400

Alloy Name	V	Al	Sn	Mo	Nb	Cr	Zr	Ti+residuals	Description
Titanium Alloys Ti 15-3-3-3	14–16	2.5–3.5	2.5–3.5			2.5–3.5		Bal	A cold-formable metastable beta alloy available in foil and strip which is typically aged to high strengths after fabrication. AMS 4914. UNS R58153
Ti 3-2.5 G9	2–3	2.5–3.5						Bal	Alpha-Beta alloy; considered very weldable. Superior to high-strength C.P.Ti of equivalent strength level in weld toughness and useful temperature range. May be strengthened by cold working. ASTM B265 G9. UNS R56320
Ti Beta 21S, G21		2.5–3.5		14–16	2.3–3.2			Bal	A cold-formable metastable beta alloy available in foil and strip with improved oxidation resistance, elevated temperature strength and creep resistance. ASTM B265 G21. UNS R58210
Ti 6-4 G5 (wire only)	3.5–4.5	5.5–6.75						Bal	Grade 5 titanium is the workhorse of all the titanium grades. It is also know as Ti-6AL-4V or simply Ti 6-4. Its high strength, light weight and corrosion resistance enables Ti 6-4 to be used in many applications. The most common application is for aerospace components. The alloy is also age hardenable by heat treatment to achieve even higher strengths. ASTM B265 G5. UNS R56400.
Ti 6-2-4-2 (wire only)		5.5–6.75	1.5–2.5	1.5–2.5			3.5–4.5	Bal	Ti 6Al-2Sn-4Zr-2Mo has good tensile creep and fatigue properties up to 1000°F. It is the most commonly used high-temperature titanium alloy in jet engine compressors and airframe structures. AMS 4975. UNS R54620.

Alloy Name	ASTM	Density	Description
Other NITINOL (wire only)	F 2063-05	0.233	Nitinol is a metal alloy of nickel and titanium, where the two elements are present in roughly equal atomic percentages. Nitinol exhibits unique behavior such as “shaped memory” and “superelasticity.”
NIOBIUM TYPE 1	B 393	0.31	Pure niobium, reactor-grade, high melting point, corrosion resistant for use in medical and high-temperature industrial applications.
Zirconium 702	B 551	0.235	Exhibits a superior corrosion resistance and high heat-transfer efficiency. Zirconium has good ductility, formability and strength comparable with 17 common engineering alloys.

STANDARD PHOTOVOLTAIC (PV) RIBBON

Base Metal Options

UNS Designation	C11000	C10200
Common Name	CDA110 Cu-ETP1	CDA102 Cu-OF1
Copper Content	99.90%	99.95%
Resistivity (ohm gram/m²) (Annealed) @ 20°C	.15328 max.	.15176 max.

Contact Ulbrich Representatives for temper designation.

Solder Coating Options

A) Solder Alloys 96.5Sn / 3.5Ag | 62Sn / 36Pb / 2Ag | 60Sn / 40Pb | 100Sn

(Other solder alloys available on request.)

B) Coating Thickness .5 to 50 microns

Base Material

A) Base Metal Thickness 0.15 to 0.5 mm (+/- 0.08 mm)

B) Base Metal Width 1.3 to 6.5 mm (+/- 0.008 mm)

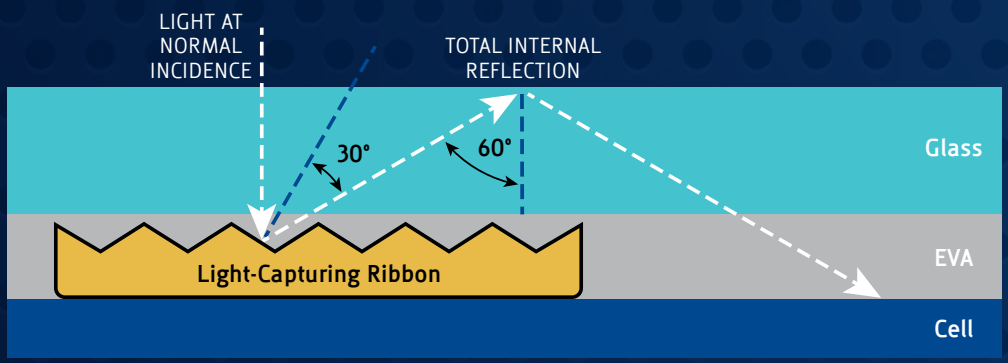
C) Camber 8 mm max. in 1m

D) Yield max. 70N/mm²

Ulbrich Optimum LCR-XP Series

»Premium high-performance line of Light Capturing Ribbon

»Electro-plated silver over a copper base ribbon with light-capturing profile geometry



Silver Coating
»99.99% purity
»Electro-plated from round wire to ensure consistent plating on all sides

Sizes Available
»Thickness Range: 0.12 mm to 0.35 mm (+/- 0.008 mm)
»Width Range: 1.00 mm to 6.00 mm (+/- 0.08 mm)

Physical Properties
»Yield Strength: 65 N/mm² max
»Reduced silver percentage
»Elongation › 25%

Copper Base Material
»ASTM standard copper: CDA110 and CDA102

Reflectivity
»65% minimum and up to 85% potential
»Measured using Ulbrich Reflectivity Gauge
»Measurements taken from the total ribbon grooved surface
»Up to 3% power gain through reflectivity and ribbon cross section optimization

Ulbrich Solar Technologies

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FOR BOTH ULBRICH EMPLOYEES AND ULBRICH CUSTOMERS

The quality policy of Ulbrich Stainless Steels & Special Metals, Inc. encompasses one critical core value:

Enhancing and achieving customer satisfaction through:

- Continuous improvement
- Providing quality products, services, and solutions
- Promoting operational excellence

To support this Quality Policy, Ulbrich will ensure that:

- All Ulbrich employees are given ownership for the quality of product or service that they provide
- Ulbrich will work in partnership with customers, employees, and suppliers to provide excellence in performance and customer satisfaction in a competitive marketplace
- Ulbrich will work to provide solutions to complex problems for its customers
- Ulbrich will work to provide total cost alternatives for its customers
- Ulbrich will work to continuously train their employees and, if needed and desired, train its customers
- Ulbrich will provide a safe work environment for all their employees and its customers
- Ulbrich will use objective measurements to drive continuous improvement in how Ulbrich does its business

The Ulbrich family fully supports this policy. We thank our employees, our customers, and our suppliers for all of their past and current loyalty to Ulbrich.

SINCERELY,

Chris Ulbrich

CHIEF EXECUTIVE OFFICER

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PUB. JULY 2016

UCONN FAMILY BUSINESS HONOREE