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.
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
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 an ISO 9001:2008 certified producer like Ulbrich.

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.
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.

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

<table>
<thead>
<tr>
<th>Strip Alloys</th>
<th>Gauge Range</th>
<th>Tempers</th>
<th>Width</th>
<th>Surface Finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 &amp; 400 Series Stainless Steels</td>
<td>.0004 to .125 inch (0.01 to 3.175 mm)</td>
<td>Fully Annealed Through Extra Full Hard</td>
<td>14.00 inch max. (356 mm max.)</td>
<td>Dull</td>
</tr>
<tr>
<td>Precipitation Hardening Stainless Steels</td>
<td></td>
<td></td>
<td></td>
<td>Bright</td>
</tr>
<tr>
<td>Nickel &amp; Nickel Alloys</td>
<td></td>
<td></td>
<td></td>
<td>Special Textures</td>
</tr>
<tr>
<td>Cobalt Alloys</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Titanium &amp; Titanium Alloys</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others on Request</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The micrometer reads .0004 inches (0.010mm).

Significant inventory available in numerous size coils for small orders.

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

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.
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.

<table>
<thead>
<tr>
<th>Alloys</th>
<th>Shaped Wire</th>
<th>Gauge Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steels</td>
<td>Rectangle</td>
<td>.005 to .335 inch (.127 mm to 8.509 mm)</td>
</tr>
<tr>
<td>Titanium Alloys</td>
<td>Hexagonal</td>
<td></td>
</tr>
<tr>
<td>Nickel Alloys</td>
<td>Octagonal</td>
<td></td>
</tr>
<tr>
<td>Cobalt Alloys</td>
<td>Triangle</td>
<td></td>
</tr>
<tr>
<td>Nitinol Alloys</td>
<td>Half-Round</td>
<td>.020 to 1.50 inches (.508 mm to 38.1 mm)</td>
</tr>
<tr>
<td>Aluminum Shape</td>
<td>Many Custom</td>
<td></td>
</tr>
<tr>
<td>Copper Steel</td>
<td>Profiles on Request</td>
<td></td>
</tr>
<tr>
<td>Copper Alloy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Resistance Alloys</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
Alloys

Stainless Steels
Aluminum Alloys
Copper & Brass Alloys
Nickel Alloys
Carbon Steel
Nitinol

Gauge Range

Rounds

Surface Finishes

Width Range

Applications

- Tinned copper and aluminum tabs for capacitors
- Aluminum and nickel tabs for batteries
- Gold plated products for a variety of applications in the electronics, medical, and aerospace markets
- Silver-plated copper flat shielded wires for telecom cables
- Silver-plated copper wires for applications in music strings and medical devices
- Medical braidwire and mandrel applications
- Specialty music string and wire products
- Silver-plated and solder-coated copper PV Ribbon for solar cell tabbing and string interconnect

.0002 to .210 inch (0.00508 mm to 5.334 mm)
.00075 to .400 inch (0.019 mm to 10.16 mm)

Tin and Lead Coated
Heat Treated and Tempered
Bright Polish

.002 to 1.50 inches (0.0508 mm to 38.1 mm)

.000 to .210 inch (0.00508 mm to 5.334 mm)

.00075 to .400 inch (0.019 mm to 10.16 mm)

- Telecommunications products
- Engineered music wire products

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.
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
- Nickel Alloys
- Tungsten
- Titanium Alloys
- MP35
- 300 Series VM
- 430
- FeChrome
- Pure Nickel 200/205
- Invar
- Alloy 52
- Other Resistant 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.
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.

**End-Use Applications Made from Ulbrich Products**

- **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**
- **Hypodermic needle & pacemaker cans**
- **Titanium honeycomb sections**
- **Recuperator sections and high pressure seal rings**
- **Nuclear energy components**
- **Solar energy components**
- **Aerospace components**
# TECHNICAL INFORMATION

## Strip Rolling Mill Capabilities

<table>
<thead>
<tr>
<th><strong>Gauge</strong></th>
<th>.0004 – .125 inch (0.010 – 3.175 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Width</strong></td>
<td>up to 14 inches (up to 356 mm)</td>
</tr>
<tr>
<td><strong>Special Textures</strong></td>
<td>Rolled or Mechanically Applied</td>
</tr>
<tr>
<td><strong>Temper</strong></td>
<td>Dead Soft – Extra Full Hard</td>
</tr>
</tbody>
</table>

## Sheet Inventory*

<table>
<thead>
<tr>
<th><strong>Thickness</strong></th>
<th>28 – 7 gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Width</strong></td>
<td>up to 72 inches (up to 1828 mm)</td>
</tr>
<tr>
<td><strong>Finishes</strong></td>
<td>2B, #4 Polish, BA XLBLUFF</td>
</tr>
</tbody>
</table>

*Diversified Ulbrich of Canada only

## Plate Inventory*

<table>
<thead>
<tr>
<th><strong>Thickness</strong></th>
<th>.1875 – 2 inches (4.76 – 50.8 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Width</strong></td>
<td>up to 96&quot; x 288” (up to 2438 x 7315 mm)</td>
</tr>
<tr>
<td><strong>Finishes</strong></td>
<td>HRAP, #4 Polish, Smooth and Diamond Pattern</td>
</tr>
</tbody>
</table>

*Diversified Ulbrich of Canada only

## Slitting Capabilities*

<table>
<thead>
<tr>
<th><strong>Gauge</strong></th>
<th>.0004 – .165 inch (Ribbon wound) 0.010 – 3.429 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Width</strong></td>
<td>.032 – 54 inches (Ribbon wound) 0.508 – 1368 mm</td>
</tr>
<tr>
<td><strong>Oscillate Face</strong></td>
<td>3.5 – 12 inch max. (88 – 304 mm)</td>
</tr>
</tbody>
</table>

**Ribbons ID** 2 – 24 inches (50.8 – 609.6 mm)

**Oscillate ID** 5 – 16 inch max. (127 – 406 mm)

**Ribbons 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.

## Flat Wire Products

<table>
<thead>
<tr>
<th><strong>Gauge</strong></th>
<th>.0002 – .210 inch (0.0058 – 5.33 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Width</strong></td>
<td>.002 – 1.5 inch (0.005 – 38.1 mm)</td>
</tr>
</tbody>
</table>

**Round Wire Dia.** .00075 – .400 inch (0.019 – 10.16 mm)

**Shaped Wire** rectangular, hexagonal, octagonal, triangular, half-round, many custom profiles on request.

---

**IMPORTANT NOTICE**

The information contained in this document is believed to be accurate and complete as of its printing; however, no warranty is made, in regard to that information, as to its accuracy, completeness or otherwise. Specifically, no warranty is made by this document in regard to any of the products or their suitability for any application or use, and no recommendations are made, or opinions offered, by this document, regarding the application or use of those products. All information and statements contained herein are subject to change without notice.
<table>
<thead>
<tr>
<th>Alloy Name</th>
<th>Trademark</th>
<th>UNS</th>
<th>C MAX</th>
<th>Ni</th>
<th>Cr</th>
<th>Mo</th>
<th>AMS</th>
<th>ASTM</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Austenitic Grades</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>201</td>
<td>S20100</td>
<td>0.15</td>
<td>3.5–5.5</td>
<td>16.0–18.0</td>
<td>A240, A 666</td>
<td>0.28</td>
<td>Chromium nickel manganese steel was developed as a satisfactory alternate for Type 301 for many applications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>301</td>
<td>S30100</td>
<td>0.15</td>
<td>6.0–8.0</td>
<td>16.0–18.0</td>
<td>SS17, SS19</td>
<td>A240, A 666</td>
<td>0.29</td>
<td>Chromium nickel steel, capable of attaining high tensile strength and ductility by moderate or severe cold working.</td>
<td></td>
</tr>
<tr>
<td>302</td>
<td>S30200</td>
<td>0.15</td>
<td>8.0–10.0</td>
<td>17.0–19.0</td>
<td>A240, A 666</td>
<td>0.29</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>303 (wire only)</td>
<td>S30300</td>
<td>0.08</td>
<td>9.00</td>
<td>18.00</td>
<td>A640</td>
<td>A 242, A 316, A 484, A 582</td>
<td>0.28</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>304</td>
<td>S30400</td>
<td>0.08</td>
<td>10.0–10.5</td>
<td>18.0–20.0</td>
<td>A240, A 666</td>
<td>0.29</td>
<td>Low carbon chromium nickel stainless and heat resisting steel somewhat superior to Type 302 in corrosion resistance.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>304L</td>
<td>S30403</td>
<td>0.03</td>
<td>8.0–12.0</td>
<td>18.0–20.0</td>
<td>A240, A 666</td>
<td>0.29</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>305</td>
<td>S30500</td>
<td>0.15</td>
<td>10.0–13.0</td>
<td>17.0–19.0</td>
<td>SS14</td>
<td>A240</td>
<td>0.29</td>
<td>A high corrosion-resistant alloy with low rate of work hardening, designed for extra deep drawing and spinning.</td>
<td></td>
</tr>
<tr>
<td>309</td>
<td>S30900</td>
<td>0.08</td>
<td>12.0–15.0</td>
<td>22.0–24.0</td>
<td>A240, A 167</td>
<td>0.29</td>
<td>Has improved oxidation resistance above 1300°F.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>310</td>
<td>S31000</td>
<td>0.25</td>
<td>19.0–22.0</td>
<td>24.0–26.0</td>
<td>A240, A 167</td>
<td>0.29</td>
<td>Similar to 309 with higher resistance to corrosion and oxidation at elevated temperatures.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>316</td>
<td>S31600</td>
<td>0.08</td>
<td>10.0–14.0</td>
<td>16.0–18.0</td>
<td>A240, A 666</td>
<td>0.29</td>
<td>Very low carbon chromium nickel steel with general corrosion resistance similar to Type 316 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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>316L</td>
<td>S31603</td>
<td>0.08</td>
<td>10.0–14.0</td>
<td>16.0–18.0</td>
<td>A240, A 666</td>
<td>0.29</td>
<td>Ti-stabilized version of 316 with resistance to sensitization. (The formation of grain boundary chromium carbides at evaluated temperatures.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>317L</td>
<td>S31703</td>
<td>0.03</td>
<td>11.0–15.0</td>
<td>18.0–20.0</td>
<td>3.0–4.0</td>
<td>A240</td>
<td>0.29</td>
<td>Very low carbon, low nitrogen, ferritic grade with high strength at elevated temperatures.</td>
<td></td>
</tr>
<tr>
<td>321</td>
<td>S32100</td>
<td>0.08</td>
<td>9.0–12.0</td>
<td>17.0–19.0</td>
<td>A240</td>
<td>0.29</td>
<td>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 1500°F.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>321T1</td>
<td>S32101</td>
<td>0.06</td>
<td>9.0–13.0</td>
<td>17.0–19.0</td>
<td>A240</td>
<td>0.29</td>
<td>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 1500°F.</td>
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<tr>
<td><strong>Ferritic Grades</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>403L</td>
<td>S43000</td>
<td>0.02</td>
<td>16.0–18.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Chromium steel capable of hardening to a maximum of approximately RC53/58.</td>
</tr>
<tr>
<td>430</td>
<td>S44000</td>
<td>0.08</td>
<td>12.0–14.0</td>
<td>16.0–18.0</td>
<td>A240</td>
<td>0.29</td>
<td>A high corrosion-resistant alloy, capable of being heat-treated to a hardness range of RC51/62.</td>
<td></td>
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</tr>
<tr>
<td><strong>Duplex Grades</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2205</td>
<td>S22050</td>
<td>0.03</td>
<td>3.0–5.5</td>
<td>21.5–24.5</td>
<td>A240</td>
<td>0.29</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Martensitic Grades</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>410C</td>
<td>S41000</td>
<td>0.12</td>
<td>18.0–18.0</td>
<td>A240</td>
<td>0.28</td>
<td>General purpose grade, corrosion-resistant, straight chromium grade, non-hardenable.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>410L</td>
<td>S41000</td>
<td>0.02</td>
<td>16.0–18.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Similar to 410L with improved transverse bending strength over 410L.</td>
</tr>
<tr>
<td>434</td>
<td>S43400</td>
<td>0.03</td>
<td>18.0–20.0</td>
<td>8.75–1.25</td>
<td>A240</td>
<td>0.28</td>
<td>Modification of Grade 430 designed for automotive trim and resistance to atmospheric corrosion.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>444</td>
<td>S44400</td>
<td>0.02</td>
<td>1.0 Max</td>
<td>17.5–19.5</td>
<td>1.75–2.50</td>
<td>A240</td>
<td>0.29</td>
<td>A light, low carbon, low nitrogen, ferritic grade with good cooling resistance and excellent cold forming properties.</td>
<td></td>
</tr>
<tr>
<td><strong>Frecip Hardening Gradients</strong></td>
<td></td>
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<tr>
<td>17-4PH</td>
<td>S17400</td>
<td>0.09</td>
<td>6.5–7.5</td>
<td>16.0–18.0</td>
<td>A693</td>
<td>0.28</td>
<td>A high chromium 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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17-4PH</td>
<td>S17400</td>
<td>0.07</td>
<td>3.0–5.0</td>
<td>15.0–17.5</td>
<td>5604</td>
<td>A693 (Type 430)</td>
<td>0.28</td>
<td>Precipitation-hardening stainless steel with high strength and good corrosion resistance to 600°F. Used in aerospace, chemical, petrochemical, paper and metalworking industries.</td>
<td></td>
</tr>
<tr>
<td>17-5</td>
<td>S17500</td>
<td>0.09</td>
<td>6.5–7.7</td>
<td>14.0–16.0</td>
<td>2.0–3.0</td>
<td>A693</td>
<td>0.28</td>
<td>Similar to 17-4PH® alloy, but with molybdenum added for higher strength during heat treatment.</td>
<td></td>
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<tr>
<td><strong>Nickel Alloys</strong></td>
<td></td>
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<tr>
<td>NICKEL 200</td>
<td>N02200</td>
<td>0.15</td>
<td>99.0 min.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A nickel-copper-chrome alloy designed for service up to 1300°F where high strength and corrosion resistance are required.</td>
</tr>
<tr>
<td>NICKEL 201</td>
<td>N02201</td>
<td>0.02</td>
<td>99.0 min.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A nickel-copper-chrome alloy designed for service up to 1300°F where high strength and corrosion resistance are required.</td>
</tr>
<tr>
<td>PERMANNICKEL 300</td>
<td>N03000</td>
<td>0.4</td>
<td>Bal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A high nickel alloy with very good thermal electrical conductivity.</td>
</tr>
</tbody>
</table>
### Alloy Name

- **Alloy Name**: HASTELLOY® C-4 N06455 0.01 65.0 14.0–18.0 14.0–17.0 0.312
- **Ti 75A G4**
- **Ulbraseal 29-17 K93610 29 0.20 max 0.20 max F 1466 0.302
- **A nickel alloy with low rates of thermal expansion.**

- **Alloy Name**: HAYNES® 230 N06230 0.05–0.15 Bal 20.0–24.0 1.0–3.0 0.319

- **Alloy Name**: INCONEL® 718 N07718 0.08 50.0–55.0 17.0–21.0 2.80–3.30 5596, 5597 B 670 0.296

- **Alloy Name**: MONEL® K-500 N05500 0.25 63.0 min. 0.305 Similar to Monel® 400 and 8482; but with higher tensile strength; a precipitation hardening nickel alloy with good mechanical properties and oxidation resistance at all temperatures.

### Titanium Alloys

- **Alloy Name**: 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.

- **Alloy Name**: Ti 6-4 G5 is 44% Nickel and 56% Copper. Exhibits a superior corrosion resistance and high heat transfer efficiency. Zirconium has good ductility, formability and strength comparable to 17 common engineering alloys.
STANDARD PHOTOVOLTAIC (PV) RIBBON

Base Metal Options

<table>
<thead>
<tr>
<th>UNS Designation</th>
<th>C11000</th>
<th>C10200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Name</td>
<td>CDA110 Cu-ETP1</td>
<td>CDA102 Cu-OF1</td>
</tr>
<tr>
<td>Copper Content</td>
<td>99.90%</td>
<td>99.95%</td>
</tr>
<tr>
<td>Resistivity</td>
<td>.15328 max.</td>
<td>.15176 max.</td>
</tr>
</tbody>
</table>

| (ohm gram/m²) (Annealed) @ 20°C | 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
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