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A: California luthier and musician Michael DeTemple designs titanium electric guitar saddles and tremolo blocks, which reduce weight and enhance the instruments sonic properties. 
www.detempleguitars.com/temp/intro_1.php

B: Horie Corp. is unveiling its new line of titanium aroma diffusers, which features decorative graphical elements created by the company’s artistic anodizing techniques. 
www.horie.co.jp

C: Spectore Corp., well known for its jewelry designs, is now exploring 3D/additive manufacturing as a viable technology for producing other consumer products. 
http://spectore.com
# MEET THE ITA

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Michael DeTemple is an American original, having cascaded throughout the 1960s and 1970s rock and blues music scene, working as a road and session musician with the likes of Bob Dylan, Eric Clapton, Van Morrison, Neil Young, Pete Townsend, and Rick Danko and The Band. DeTemple, age 70, proudly states that he has been a professional musician for 60 years—he was paid $10 as a 10-year-old banjo player.

The mustachioed DeTemple grew up in the Los Angeles area and today has a workshop in Sherman Oaks, in California’s San Fernando Valley. While his list of legendary musical associates is impressive, DeTemple, for the last 25 years, has been best known as a builder of hand-made, highly sought after electric guitars, which feature parts (the saddle, tremolo block, back plates) made from titanium.

His guitar designs, Stellacasta and Spirit Series models, are inspired by Fender Stratocaster and Telecaster solid body guitars. DeTemple designed his titanium guitar parts, which are manufactured by a metalworking contract shop. He is especially proud of his “Titanium Trem Assembly” design consisting of titanium saddles and titanium tremolo block. He said a guitar saddle is an adjustable piece of the bridge that the string rides on and allows the length and height to be changed to properly intonate the guitar. The Tremolo Block is the actual anchoring piece for the strings on a tremolo bridge.

The introduction of Titanium Trem Block was a major sonic and weight breakthrough for the famous Fender Stratocaster guitar, according to DeTemple, noting that the original blocks were made of cold rolled steel. With an emphasis placed on lighter weight guitars, the change from steel to titanium reduced the weight of the guitar by over a quarter pound.

DeTemple provides a detailed account of his selection of titanium on his website (http://www.detempleguitars.com/temp/intro_1.php). He explains that the metal parts of an electric guitar should have a “reserved presence,” with the created by string vibration is transferred to the guitar body without being absorbed by the metal material. This happens because of a unique hexagonal close-packed crystallization structure of titanium, which also stabilizes strings vibration. A light metal that is hard to bend has naturally better tonal properties.

“What makes titanium sound so great? Titanium has the absolute best of these sonic-friendly properties. And after careful and extensive experimentation, we chose titanium for our bridge saddles.”

While the titanium bridge is standard on DeTemple’s hand-made guitars, he often receives requests to retrofit other guitars with the part. According to DeTemple, his titanium saddles “bring out the beautifully rich wave motion inherent to your guitar. Thanks to the distinctive sound quality of titanium and our unique processing technologies, we’ve created new bridge saddles that we believe blow-away the tone of conventional versions.” He declined to provide details on the titanium design work or the specific metal alloy used for the saddle, and didn’t identify the contract shop that produces the guitar parts.

The master luthier introduced his titanium guitar parts to the music industry 16 years ago. Among its music-friendly characteristics, DeTemple said that because titanium has a lower internal damping factor than steel, brass or aluminum, it allows the string’s natural vibrations to last longer and improves the definition from string to string.

“I tried brass, aluminum, various steels and also the products that other companies made,” he wrote on his website. “I still wasn’t hearing the tone that I knew my guitars were capable of producing.
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I then tried titanium for the saddles and found the answer. I knew immediately I had found a very important part of the equation that had been missing for me. Not only did it reduce the weight of the guitar but it was so musical. I never heard any upgrade on a guitar that seemed so dramatic and dynamic. Since then we have been developing many other titanium parts for the aftermarket. We have sent thousands of various titanium parts to customers all over the world with over 99-percent satisfaction."

In addition to building guitars, DeTemple also has compiled an impressive resume as a performer on the guitar, banjo and mandolin. As a teenager, he was a four-time winner of the Topanga Canyon Banjo and Fiddle Contest. He caught the attention of Academy Award composer Earl Robinson. Robinson invited DeTemple to perform his “Winterfest Concerto for Five String Banjo and Orchestra;” a 45-minute solo with the Los Angeles Philharmonic Orchestra. Academy Award winner Elmer Bernstein conducted two of the concerts performed by DeTemple. Following that collaboration, Bernstein asked DeTemple to play on many of his film projects. The two remained friends until Bernstein’s death in 2004.

Aside from DeTemple’s guitar innovations, titanium has demonstrated its metal as a material of choice for other musical instruments. The International Titanium Association recognized the efforts of drummer and designer Ronn Dunnett as the recipient of its 2016 Titanium Applications Development Award, honoring him for the development of his titanium snare drum shell. As for describing titanium’s percussive, sonic properties when used as a drum shell, Dunnett said the metal creates an almost gong-like sound wave, with multiple levels of vibrations. The complexity of sound has an “inherent dissonance” and rings like voices in a choir or the strumming of a guitar chord. In addition, titanium, as a drum shell material, eliminates the “organic weirdness” typically associated with wooden drum shells, according to Dunnett.

Inventor Michael DeTemple offered a first-person account of details and insights on his titanium guitar parts.

When I developed the TTA-01 The Titanium Tremolo Assembly™, I was excited about removing over one quarter pound of weight from the Fender Stratocaster™. I have always looked for and played light weight electric guitars as I feel they sound better and seem to inspire me from the moment I pick them up.

I installed the prototype Titanium Tremolo Assembly in my personal guitar and the weight differential immediately took the back seat compared to the musicality that the new bridge brought to my guitar. I felt more connected with my hands to the instrument than ever before thus allowing me to feel and make tone changes just with my hands.

The bridge gave a more complete harmonic content and vastly improved the tuning aspects of the guitar. Even plugging in to my tuner gave me great insight as to the way the bridge affected the quality of the notes. My tuner locked on to the notes quickly and didn’t waiver. It really was a very visual way of seeing the way the bridge affected the notes and tuning. I was not just hearing the difference, I was seeing the difference.

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Edward Rosenberg, the chief executive officer of jewelry designer and manufacturer Spectore Corp., shared his abiding optimism and occasional impatience with progress in the evolution of 3D/additive manufacturing technology and its potential to transform business for titanium consumer product markets.

A self-described industry maverick, Rosenberg offered his insights during a presentation titled “The Evolution of Powder Metallurgy and Additive Technology into Today’s Consumer Products Arena,” at the TITANIUM USA 2017 conference and exhibition, which was held last October in Hollywood FL.

A third-generation jewelry designer, Rosenberg, during his remarks, reviewed the state of the art for additive manufacturing—its opportunities and challenges. “The real trick, the real challenge, is how do we make (Additive Manufacturing) competitive with current manufacturing techniques and create products in the consumer’s eye that make it a value proposition?”

There were several “challenge points” on his checklist for additive manufacturing technology to move forward: reduce the price of the production equipment and the process; boost output levels; develop new alloys and material combinations; find a way to drastically reduce the amount of downtime required to clean out the system and eliminate material contamination from one job to the next.

As usual, Rosenberg was candid and to the point, answering the questions that he raised regarding 3D as a viable manufacturing technology for a range of consumer products. “Can we be competitive? Yes. Can we do it today? No. Can we do it soon? Yes. Everything I’ve seen so far tells me so.”

Rosenberg, in particular, is keen on the proposition that 3D technology can usher in a new generation of titanium alloys and material combinations, such as pairing titanium with a precious metal like gold or platinum. Several times he mentioned the need for consumers to recognize “perceived value” in a product as part of the formula for success. “In order to establish the market perception (of perceived value) in jewelry or consumer products, you have to show people something they can relate to. I think creating new alloys for consumer products is hot stuff.”

He takes great pride in having witnessed the evolution of the ancient craft of jewelry making. He said his company, Deerfield Beach, FL-based Spectore (http://www.spectore.com), has been combining titanium and precious metals for many years, creating innovative jewelry designs. “When I started my company 40 years ago, I saw an opportunity to create new categories of materials for the consumer products market, particularly in jewelry. I thought the industry needed a shake-up and some change, and that’s what my life has always been all about, whatever I’ve done.” Rosenberg recalled that one of the company’s very first collections featured 18k gold with titanium and precious stones. He admitted it was “a bit ahead of its time” in terms of a mainstream consumer product line, “but looking back now, it was where we would be headed as an end game.”

Many jewelry designers and manufacturers around the world appear to share Rosenberg’s views on “hot stuff” and new trends taking hold in this high-end consumer market. As special section on jewelry, published in the Dec. 1, 2017 edition of The New York Times, indicates a new paradigm has emerged in this “luxury” consumer market, where a new generation of consumers see jewelry as an artistic statement, rather than a gaudy sign of wealth and status. It’s a mindset that is likely to open doors for a greater appreciation of titanium in this plum consumer market.

The renowned Finnish jewelry designer, Bjorn Weckstrom, quoted in the Times section and described as a pioneer in avant-garde and experimental jewelry, said he wanted jewelry “to be not just a symbol of wealth. I wanted it to be a symbol of culture and art. The rich people were staying with their diamonds. The middle classes were the ones who wanted something different and new.”

A separate article in this special section by the Times indicated there is a genera-
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Rosenberg ‘Hungry, Curious’ and Impatient On Evolution of 3D for Consumer Products (continued)

Rosenberg has had the same zest for innovation when it comes to using titanium to design consumer products. “Maybe the consumer doesn’t completely understand titanium, but they know that it’s cool,” he said, adding that what’s needed from the titanium industry is a marketing campaign to capitalize on that allure. “Today’s consumers want cool, durable and exciting. They want to make a statement. They’re looking for something different.”

During that interview Rosenberg quoted the philosophy of Michael Porter, the influential Harvard Business School professor, author and industry guru. “When it comes to competing in business, Porter said you can’t succeed by being the best, because the best is easy to copy. You can only succeed by being the most innovative. You have to keep reinventing.” He said this mantra of innovation and reinvention is central to competition in the global jewelry business, adding that the commitment also involves speed to market and the ability to design tooling that enables a product to hit the “sweet spot” for pricing in consumer markets.

“The jewelry business is 3,000 years old, but we set out to introduce a contemporary metal (titanium) to the market. This was a foreign concept to many people. It wasn’t easy. Businesses are built on certain foundations. It can be hard to convert and difficult to change, but that’s the challenge for innovation. The perception in many consumer markets is that titanium is very expensive, difficult to manufacture and hard to repair. There’s a big disconnect between form and function. Most of the time, the hang-ups people have about titanium are completely untrue. They’re uncomfortable with trying something new. We have to show that titanium provides value compared with other materials.”

A 2008 article in The New York Times captured Rosenberg’s enthusiasm for titanium as a jewelry material. “As a young jeweler in the early 1980s, Edward Rosenberg liked to anodize titanium in baths of champagne or Coca-Cola—anything electrolytic—just so he could watch the naturally grey metal blush from bronze to cobalt to turquoise,” the article stated. “With each electric charge, an oxide layer formed, causing an optical phenomenon akin to the iridescent shimmer of peacock feathers or oil on water. While gold and platinum still dominate the fine jewelry market, titanium has made inroads at the very highest echelons of the jewelry universe thanks to a handful of world-class designers who have been seduced by its feather weight and kaleidoscopic possibilities.”

Rosenberg was born at Coney Island Hospital, New York City, in 1947. He was introduced to the jewelry business at a young age, working with his parents at their store in New York’s Lower East Side, in the shadows of the Manhattan Bridge. His father Leon learned the trade (from his father) while in Austria, in the days when being a jeweler meant you also needed to be a locksmith and a blacksmith. Leon came to America in 1924. Rosenberg attended New York College, Pratt Institute and the New York Institute of Technology and was involved in the music business in the late 1960’s.

Rosenberg hopes that this spirit of being a catalyst for change can be captured via additive manufacturing technology. He’s confident that the technology will realize its promise and potential—he just wants things to happen sooner rather than later. “I’m hungry and very curious. I just think we’ve got to get there a little quicker.” Additive manufacturing provides the freedom for designers to go beyond the tool paths of milling machines in a CAD/CAM production environment, he said. “As the (additive) process has evolved, so did the materials.”

During his presentation at the recent TITANIUM USA conference, Rosenberg said “the quest for design freedom” has led to the advent of 3D printing/additive manufacturing. The technology as evolved to “a host of different materials, both pure and mixtures, including contemporary and precious materials.” He said this capability today provides for “enormous opportunities, not only in prototyping, but as we continue to improve efficiencies and lower cost, we improve the value proposition in production. This brings an all-new dimension to manufacturing, with the creation of formulated alloys and compounds, including combinations of materials that historically were thought to be not compatible as an alloy.”

Interviewed four years ago, Rosenberg had the same zest for innovation when it comes to using titanium to design con-
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Update on Binder-Jetting Additive Manufacturing Technology

Several times during his presentation at TITANIUM USA 2017, Edward Rosenberg made mention of “binder-jetting” technology, a process he identified as having the potential to accelerate the evolution of 3D/additive manufacturing.

Two websites provide background information on this technology. The Additive Manufacturing Research Group of Loughborough University, Leicestershire, UK (http://www.lboro.ac.uk/research/amry/about/the7categoriesofadditivemanufacturing/binderjetting/) outlined the process, saying binder jetting uses two materials; a powder based material and a binder. “The binder acts as an adhesive between powder layers. The binder is usually in liquid form and the build material in powder form. A print head moves horizontally along the x and y axes of the machine and deposits alternating layers of the build material and the binding material. After each layer, the object being printed is lowered on its build platform.”

The Loughborough University research group did point out that, due to the method of binding, “the material characteristics are not always suitable for structural parts and despite the relative speed of printing, additional post-processing can add significant time to the overall process. As with other powder based manufacturing methods, the object being printed is self-supported within the powder bed and is removed from the unbound powder once completed.”

The research group provided a step-by-step method for binder jetting:

1. Powder material is spread over the build platform using a roller.
2. The print head deposits the binder adhesive on top of the powder where required.
3. The build platform is lowered by the model’s layer thickness.
4. Another layer of powder is spread over the previous layer. The object is formed where the powder is bound to the liquid.
5. Unbound powder remains in position surrounding the object.
6. The process is repeated until the entire object has been made.

A separate organization, ExOne Co. (www.exone.com) also weighed in on the binder-jetting technology. “There are various methods of 3D printing in existence, and there is often confusion among the many offerings. Many of these techniques center around building parts through a melting or welding process—using lasers or melted material—to fuse each layer together. These processes typically require a build plate to be added to the part for part stability throughout the build process. Such processes require significantly more material. The build process itself is also time-intensive.”

ExOne explains that binder jetting is an additive manufacturing process in which a liquid binding agent is selectively deposited to join powder particles. Layers of material are then bonded to form an object. “The print head strategically drops binder into the powder. The job box lowers and another layer of powder is then spread and binder is added. Over time, the part develops through the layering of powder and binder. Binder Jetting is capable of printing a variety of materials including metals, sands and ceramics. Some materials, like sand, require no additional processing. Other materials are typically cured and sintered and sometimes infiltrated with another material, depending on the application. Hot isostatic pressing may be employed to achieve high densities in solid metals. Binder Jetting is similar to traditional paper printing. The binder functions like the ink as it moves across the layers of powder, which like paper, forms the final product.”

According to ExOne, binder jetting is unique technology because “it does not employ heat during the build process. Other additive techniques utilize a heat source which can create residual stresses in the parts. These stresses must be relieved in a secondary post-processing operation. Additionally with Binder Jetting, the parts are supported by the loose powder in the job box, thus eliminating the need for a build plate. Spreading speeds for Binder Jetting continue to significantly outperform other processes. Binder Jetting has the ability to print large parts and is often more cost-effective than other additive manufacturing methods.”

Founded in 2005, ExOne is a spin-off of Extrude Hone Corp., Irwin, PA, a global supplier and developer of precision nontraditional machining processes and automated systems. “Three-dimensional printing emerged as the core technology for ExOne, which currently supplies services, systems and solutions for manufacturing in the digital age, including three-dimensional printing in industrial grade materials such as sand and metals.”

In 1996, Extrude Hone became the exclusive licensee of the 3DP (three-dimensional printing) process developed at the Massachusetts Institute of Technology (MIT) for metal parts and tooling. The company has been awarded over $14 million in research contracts by various organizations including the Office of Naval Research, the National Science Foundation and the National Institute of Standards and Technology for development and commercialization of the process, materials and equipment for defense and commercial industrial applications.

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Horie Embarks on a ‘Fragrant’ Approach For New Titanium Consumer Product Line

The new consumer product line from Horie Corp., Niigata, Japan, is a family of titanium aroma diffusers, which contain organic aroma oil. They are five types of aroma oil (Love, Citrus, Power, Peace and Luxe) and 10 patterns of titanium diffuser colors. The combination of aroma oil and diffuser color can be specified by the consumer. They include:

- Love/Pink1100/Magenta660
- Citrus/Green820/Beige060
- Power/Gold550/Pink Gold
- Peace/Blue220/Green Pink
- Luxe/LightBlue300/Blue Purple

The Horie titanium aroma diffusers recently were introduced for sale in the Japanese market, and will be officially unveiled for the U.S. market at the annual New York International Gift Fair, Feb. 3-7, 2018 at the Jacob K. Javitz Convention Center in Manhattan. Horie representatives said that the introduction of this product line marks titanium’s advance into the lucrative aroma consumer product market.

The aroma diffusers are made of pure titanium (CP) titanium, designed and manufactured in Japan. Horie achieves the colorful, artistic images and shimmering, decorative designs on the diffusers via anodizing and heat treatment. A company representative said the graphical elements for the diffusers are intended to create a “more luxurious feeling” for this product line.

Founded in January 1984, Horie consumer product lines include tableware (beer and sake cups, utensils, designer mugs and tumblers) cookware (pans, pots and kitchen gadgets), personal-item gifts and jewelry (bracelets, body piercings, earrings, bangles, necklaces, facial scrubbers, pill cases), stationery (card cases and envelope-opening knives), and “odd” goods (decorative panels and etchings). During the last 20 years Horie also has won contracts to design monuments and public art, such as “The Shoal” at the Stratford Centre in London, the monument at the 21st Century Memorial Park in Koriyama City, Japan, and the gate and monument at the Industries Promotion Center, Niigata Prefecture, Japan.

As for its signature technology expertise, Horie underlines its capabilities for “titanium surface engineering,” which involves anodizing and other metal treatment techniques. According to company profile information posted online (http://www.horie.co.jp/gaiyou_e.htm), Horie touts its research and development expertise. “The most important consideration on manufacturing products is: how can we utilize
The following chart provides a quick overview of the features and advantages of TFC's coating processes:

<table>
<thead>
<tr>
<th>substrates</th>
<th>advantages</th>
<th>benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titanium</td>
<td>Stable base for other coatings &amp; adhesive bonding; appearance; color coding</td>
<td>Prevents fretting &amp; galling</td>
</tr>
<tr>
<td>Titanium Alloys</td>
<td></td>
<td>Natural, reproducible colors</td>
</tr>
<tr>
<td>Aluminum</td>
<td>Non-toxic;</td>
<td>Corrosion-resistance</td>
</tr>
<tr>
<td>Steel</td>
<td>Non-hazardous;</td>
<td>No hydrogen embrittlement</td>
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<tr>
<td>Alloys</td>
<td>Nonpolluting</td>
<td>High operating temperature (1100°F)</td>
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<tr>
<td>Titanium</td>
<td></td>
<td></td>
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<tr>
<td>Aluminum</td>
<td>Hardness; eliminates burning &amp; dissolution of parts</td>
<td>Allows aluminum application where wear, corrosion or other factors would otherwise exclude its use</td>
</tr>
<tr>
<td>Aluminum Alloys</td>
<td></td>
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</tr>
<tr>
<td>Virtually all metals</td>
<td>Automatic &amp; manual application; TFC processes comply with a variety of mil specs; combines with other coatings</td>
<td>Provides excellent lubricity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improves corrosion resistance</td>
</tr>
</tbody>
</table>

Titanium Anodizing
Ion Vapor Deposition of Aluminum
Hardcoat Anodizing of Aluminum
Solid Film Lubricants
the characteristics of the material.” Horie executives feel that by exploiting these inherent material characteristics, especially in the case of titanium, defines the value of a product.

For most of its products, Horie’s material of choice is CP titanium. “When our company begins development for a new product, we also try to harness the characteristics of the material we are using, which is titanium,” Horie states on its website. “We believe that utilizing a material to its fullest extent gives the product more value, than just using a material because it’s there. Through our daily focus on research and development, we have observed titanium from many different angles to create original products.”

A relatively small company (20 full-time employees), Horie indicates that, through its anodizing coloring technique, it can achieve a pallet of 124 colors in its titanium consumer product lines by manipulating the thickness of the metal’s oxide film.

Interviewed in 2016, company executive Akemi Tanabe described her father, Takuji Horie—the director, president and chief executive officer of Horie—as her “life-long mentor.” As the company patriarch, Tanabe said her father “is involved in all aspects of the manufacturing process, and is also a mentor to all Horie employees.”

She applauded the efforts of the International Titanium Association’s Women in Titanium (WiT) committee, to encourage women to join the ranks of the titanium industry. Mentoring, as a business practice and philosophy, is high on the list of priorities for the WiT committee. Committee members network with women in the titanium industry and encourage high school and college women to enter the field. “If we can present the ‘softer side’ of titanium, the beauty of colored titanium products, I think there may be more women interested in joining the titanium industry,” she said.

Tanabe provided insight into Horie, saying her executive roles include serving as the director of business planning and sales, and export/import trading manager. She said Horie’s business mission is to develop and manufacture unique, value-added titanium products; not the kind of titanium products engineered for the aerospace industry or industrial markets, but products that can find their way into the everyday lives of consumers.

“I listen to our client’s opinions and ideas regarding all products, in hopes to apply them to our future development projects,” she said. “Explaining the wonders and unique characteristics of titanium to clients can be difficult at times, but we’re trying our best, as we believe that it’s our mission to disseminate the image of titanium not just as a commercial or industrial product, but also as a consumer product.”
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TITANIUM USA 2017 hosted 857 guests in Miami, Florida.

James S. Paddock, winner of the 2017 Titanium Lifetime Achievement Award with current ITA President Henry Seiner, Vice President of Business Strategy for TIMET, Titanium Metals Corporation.

Delegation included titanium industry professionals from 28 different countries.
Business leaders, educators, metallurgists, designers and engineers and manufacturing representatives from throughout the world gathered at the Diplomat Resort and Spa, Hollywood, FL, on Oct. 8-11 for TITANIUM USA 2017, the 33rd annual international conference and exhibition sponsored and organized by the International Titanium Association (ITA).

Highlights of the gatherings, which attracted more than 800 attendees, included presentations by three distinguished guest speakers: Raphaël Duflos, vice president, metallic materials procurement, Airbus S.A.S.; William Shaffer, director, Boeing Commercial Airplanes Supplier Management; and Mike Mullane, an author and career astronaut.

Coinciding with the overall event in Florida, Major Heather Penney and Mona Dine served as the featured speakers for the third annual Professional Development Day sponsored by the Women in Titanium (WiT) committee, which was held October 8th. Major Penney served as an F-16 pilot in the 121st Fighter Squadron at Andrews Air Force Base, MD for over 10 years. As the Sept. 11 terrorist attacks were unfolding, she was ordered into the air in her F-16 fighter jet to confront United Flight 93 before it reached Washington DC’s airspace. However, as documented, Flight 93 crashed in Shanksville, PA, as heroic passengers fought to take control of the aircraft. This tragic development ended Penney’s mission on that fateful day.

Ms. Dine is the president and owner of Pacesetter Coaching & Consulting, Pittsburgh, and discussed strategies on how people can recognize opportunities to take appropriate actions in order to grow within their careers. She has over 20 years of experience in human resources and recently worked with two global manufacturing companies as a talent strategist. Dine is an International Coach Federation (ICF) certified professional coach specializing in career and leadership development.

Lifetime Achievement Award

The ITA honored industry visionary James Paddock, who worked to establish a reliable international supply chain for the titanium industry and helped sustain and enlighten the domestic market through his support of a fledgling trade association, as the recipient of the prestigious “Lifetime Achievement Award.” Paddock, who spent more than 40 years in the industry, is best known for his leadership of Titanium Industries Inc., a global supplier of specialty metals for the aerospace, industrial, medical and energy markets. Founded in 1972, Titanium Industries operates in Rockaway, NJ, as well as facilities and sales offices around the world.

Paddock’s son Brett, the current president and chief executive officer of Titanium Industries, and Brian J. Malloy, vice president and chief commercial officer, Carpenter Technology Corp., were installed as members of the ITA’s board of directors during the conference.

Distinguished Guest Speakers

Mullane’s presentation, “Beware: Normalization of Deviance,” defined this cautionary phrase as “getting away with short-cutting safety best practices until that ‘deviance’ becomes your ‘norm.’” He urged conference attendees to “guard yourself against ‘normalization of deviance’. Embrace responsibility, ownership, and accountability. Be a courageous self-leader.”

He warned that Normalization of Deviance typically leads to product recalls, loss of customers, environmental lawsuits, and injuries and fatalities. It also can result in “your worst nightmare.” As such, he cited a nightmare: the explosion of the Challenger Space Shuttle on Jan. 28, 1986, which was viewed by a national TV audience. He referred to this tragic
episode in American history as a “pressure-driven predictable surprise.”

According to Mullane, there are lessons to help business leaders from slipping into a Normalization of Deviance. His list includes:

- Maintain a sense of vulnerability
- Procedural compliance should be a religion
- Risk has no memory
- Set challenging but attainable goals
- Daily mission success reflects your heroism
- See something; say something; do something
- Have a questioning attitude. Be situationally aware

Shaffer, in his talk on “Business Environment and Supply Chain,” estimated that airlines will need over 41,000 new commercial jets between now and the year 2036, which represents a value of $6.1 trillion. He said single-aisle aircraft represent 72 percent of that delivery total, with Asia representing 41 percent of the $6.1 trillion market value by region, followed by North America, Europe and the Middle East.

Boeing, he said, is ramping up its production rates to 74 planes per month, a level it expects to achieve next year (compared with 44 planes per month in 2011). Boeing has boosted production levels, in large part, due to alliances with its supply chain partners. According to Shaffer, 65 percent of Boeing’s overall airplane costs come through its extensive global supply chain. He offered a profile of the supply chain: 4 million deliveries per day to Boeing facilities; $43 billion in annual

In order to guide this massive effort, he outlined four principles: a system that’s integrated; dynamic (responsive to changes in demand, flexible global sourcing, with faster decision making); resilient (marked by risk reduction, the ability to quickly recover from supply chain shock, and transparent); and competitive (emphasizing innovation, market-based pricing, more options and more suppliers). He then touched upon four objectives: market access (industrial participation and supplier diversity); velocity/flow (rate capable, focusing on logistics, packaging and handling); business incentive alignment (multiple sources with full-spectrum contracting); and affordability (through competition and control).

Duflos, during his presentation, offered his own outlook for near-term commercial aerospace market conditions. His forecast was slightly different than that of Shaffer, saying that new passenger and freighter aircraft demand would be 35,000 jets during the next 20 years.

Boeing, said Shaffer,单-aisle jets (24,807 units) will account for the biggest chunk of demand. As for a dollar value, he said this 20-year global demand for jets is $5.3 trillion.

Like Shaffer, Duflos said single-aisle jets (24,807 units) will account for the biggest chunk of demand. As for a dollar value, he said this 20-year global demand for jets is $5.3 trillion.
Airbus, as of July 2017, has 17,287 orders, with a backlog of 6,726 jets, according to Duflos. Regarding the status of Airbus’ global supply chain, he said each day Airbus manufacturing requires more than 30 tons of titanium, and that new aircraft models will need even more titanium. “The input weight of titanium is 18 times higher on the A350XWB than on the A330,” he said. “Titanium is key for Airbus.”

He noted that the twin-aisle A350 series represents the “key driver” for growth opportunities for titanium in the Airbus global supply chain. Online information posted by Airbus indicates that more than half of the A350XWB is made up of carbon-fiber material. The A350XWB has a long-range flight capability of 8,100 to 9,700 nautical miles, and can be configured with 280 to 366 cabin seats. The jet utilizes Rolls-Royce Trent XWB engines and has a wing span of 64.8 meters (212.4 feet).

Going forward, the European aerospace giant’s strategy for sourcing titanium through its global supply chain revolves around three key points: delivery on commitments (a stable and robust supply of metal and the demonstrated agility by suppliers to shorten lead times and sustain shifts in build rates); boost competitiveness (improve titanium’s ever-critical “buy-to-fly” ratio and explore opportunities to improve the “total cost of ownership of flying parts”); and prepared for the future (suppliers that demonstrate the ability to push competitive solutions, innovations and new technologies.)

Airbus and Boeing together historically account for more than 95% of structure demand annually.
Airline Monitor peaks in 2020 and Teal peaks in 2021.
Airline Monitor recovers more quickly and at a faster rate.

World Industry Demand Trends
The titanium industry demand trends speaker session, typically the most popular panel during the annual conference, was split into demand trends by market and demand trends by region. Beginning on 40,000 metric tons this year, and likely will to climb to around 45,000 metric tons by 2019. His estimate is a composite of outlooks from Boeing, Airbus, Teal and Airline Monitor, along with an internal Timet forecast, and doesn’t include timing offset or spares factors.

As for the global commercial jet market, Seiner said that for regional shifts in air traffic, Asia/Pacific accounts for one-third of global air traffic. North America is just under a quarter of global traffic, Europe is just over a quarter, and the Middle East is a 10 percent of global traffic. Seiner spelled out these numbers with two bar charts, citing Airline Monitor figures as of June 2017 as a source of the estimates.

Jet fuel, as a share of global commercial airline expense, is expected to drop to below 20 percent in 2017, compared with 36 percent in 2008. Seiner reasoned that “reduced fuel costs lead to increased operating profit, thus more cash on hand to purchase new (jet) models. Fuel, he said, represents 20 to 30 percent of an airlines overall operating costs. He tracked this volatile global market, saying that the price of Brent crude oil hovered at the $100 a barrel level between 2011 and 2014. The price in 2017 is in the $50 to $60 a barrel range.

Jeremy Halford, president, Arconic Titanium and Engineered Products, spoke about how titanium is “Shaping the
WiT Executive Committee with Heather Penney, 9/11 Jet Fighter Pilot

TITANIUM Fun Runners

TITANIUM Spouse Programming included “Paint & Sip”

Golf Classic Winning 4Some: Dave Miltenberger, Brad Ewers, Mitch Allenspach, Jim Perryman Jr.

Student Programming Industry Tour at Sintavia LLC 3D Printing facility


Spectore Corporation Industry Related Tour
Future of Defense.” He began by offering three “fundamental messages:” the global defense market is expanding and spending is increasing for modernization and recapitalization of outdated platforms; the demand for titanium in defense structures and propulsion is growing, however pressure for affordability remains; and innovations in material, processes and products is expected to drive titanium growth in the defense sector.

As geopolitical tensions and active conflicts have increased in recent months, global defense and security spending is estimated to reach $1.8 trillion in 2017, dominated in expenditures by the Americas, followed by Asia/Oceania, and Europe. By way of comparison, global defense and security expenditures registered $1.7 trillion in 2016. Halford noted a projected 9-percent growth for airframes between 2015 and 2020, while advanced engines will grow 33 percent and ground combat vehicles will increase 40 percent during the same period.

Wade Leach, senior vice president, commercial, for ATI, shared his observations in his talk on “Titanium Demand and Trends in the Commercial Aero Engine Market.” Leach said that development trends for next-generation aerospace engines include green technology (reduced emissions and noise reduction), enhanced performance (improved fuel efficiency, higher thrust and increased bypass ratio and pressure) and lower operating cost (reduced maintenance and extended service intervals).

As for titanium trends in next-generation engines, he touched on four points: the use of premium-melted titanium; new titanium alloys, titanium powders developed for additive manufacturing; and advanced manufacturing processes such as linear friction welding and flow forming.

Citing the International Air Transport Association (IATA) and Airline Monitor as sources, Leach presented a chart that tracked “aero engine forecast/OEM engine share.” The forecast is that the number of aerospace engines will top 4,000 units by the year 2020 and will surpass 5,000 units by 2028.

Kevin J. Cain, the president of Uniti Titanium LLC, gave an overview and five-year forecast for industrial titanium demand. Focusing on the chemical processing, desalination, oil and gas, power generation business sectors, along with secondary markets (mining, automotive, shipbuilding, cathodic protection, recreation and consumer products and architecture), Cain said the industrial titanium demand forecast for 2017 will be 25,000 metric tons, and will climb to nearly 30,000 metric tons by the year 2021. He pointed out that this forecast doesn’t include shipments within Russia and China.

Cain also gave a global forecast for some industrial markets in 2017 and beyond. He said that for trends in the chemical process industry (CPI), $185 billion in U.S. petrochemical projects are in the construction or planning phase. He said that, globally, capital spending (in CPI) is forecasted to reach $473 billion in 2017 and $500 billion in 2018. Cain cited the numbers from the American Chemistry Council.

Michael Metz, the president of VSMPO-Tirus US, forecasted that titanium demand for the Russian market, mostly reflecting aviation and industrial business sectors, would dip this year to about 9,000 metric tons, compared with 10,000 metric tons in 2016, but would rebound to 10,000 metric tons in 2018. The demand level was 13,000 metric tons in 2014.
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Metz said that Russian titanium sponge producers (Avisma and Solikamsk Magnesium Works) had an output of nearly 39,000 metric tons in 2016. VSMPO represented the lion’s share (97.4 percent) of titanium ingot production in 2016 (60,599 metric tons), while smaller companies combined for an ingot output of 1,600 metric tons.

Yoshinori Onoe, the chairman of the Japan Titanium Society and the executive vice president and head of the iron and steel business for Kobe Steel Ltd., said Japan accounted for 29 percent of global titanium sponge production in 2016. Onoe indicated that overall global sponge production in 2016 registered 185 kilotons. Japan captured 11 percent of titanium mill product shipments in 2016. Total global mill product shipments last year registered 150 kilotons.

Onoe noted that production of large titanium aerospace parts is underway at a 50,000-ton hydraulic forging press at Japan Aeroforge Ltd., the joint venture established in 2011 by Kobe Steel, Hitachi Metals Ltd. and other partners in the Okayama Prefecture. An online news article posted by Forging Magazine reported that titanium forging has been in development and certification at the site since 2013. A July 2016 report by Kobelco stated Japan Aeroforge initiated production of forged parts used in the landing gear of the Airbus A350XWB.

“The Japan Titanium Society continues to work to promote expansion of new applications in titanium and help nurture the next generations of leaders to our industry,” Onoe said.

Mohamed Bouzidi, the head of the strategic business unit, aerospace and land turbines, at Aubert & Duval S.A., Paris, provided titanium demand trends from a European perspective. Bouzidi said titanium melted product demand in the European Union would reach nearly 40,000 metric tons by 2020, compared with just over 20,000 metric tons this year. By way of comparison, he said worldwide titanium melted product demand will surpass 220,000 metric tons in 2020.
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Bouzidi said the European Union represents 5 percent of overall global titanium melted capacity (about 20,000 metric tons), compared with the United States (31 percent), China (27 percent) and Russia (20 percent).

**World Titanium Industry Supply Trends**

A presentation by Thomas Höhne-Sparborth, senior analyst at Roskill Information Services Ltd., tracked global output levels of key titanium categories up through the year 2016. Sponge output reached 186 kilotons last year. VSMPO is the world’s largest sponge producer (23 percent of global output), with most of the material used in house for ingot/mill production he said, with some sponge sold externally. Toho Titanium and Osaka Titanium each account for 12 percent of world sponge output. Scrap exports reached 55 kilotons in 2016.

Melt products in 2016 totaled 199 kilotons. He said China soon will overtake the United States as the world’s largest producer of melt products. According to Höhne-Sparborth, there is no bottleneck in global melt capacity—an estimated 447 kilotons. VSMPO is the single largest producer of titanium melt products, with 17 percent of global production.

Global mill product output reached 148 kilotons in 2016, as China (34 percent), the United States (26 percent), Russia (20 percent) and Japan (11 percent) account for over 90 percent to the world’s total output of titanium mill products.

Offering an outlook for mill products, he said demand for this category is expected to reach 213 kilotons by the year 2026, at a compound annual growth rate of 3.6 percent. Consumer and medical applications, aerospace and industrial all have a strong growth outlook, he said.

Vincent Rocco, product manager for alloys and powders, AMETEK Reading Alloys, examined master alloys and supply trends for vanadium and molybdenum—two key alloy elements. A master alloy is a value-added, semi-finished product, created for use as a raw material by the titanium industry, which typically contains two or more alloying elements to achieve enhance properties, such as enhanced heat and corrosion resistance, for a specific application (Ti6Al4V for example). Vanadium and molybdenum master alloys account for approximately 90 percent of the total annual demand volume.

World vanadium production in 2016 reached 75,000 metric tons and is estimated to be slightly higher in 2017. Consumption of vanadium, the vast majority of which goes to the global steel industry, is slated to reach 90,000 metric tons in 2017. Global molybdenum production hit 500 million pounds in 2016 and is estimated to register 560 million pounds of consumption in 2018.

David McCoy, executive chairman, TZMI, gave an overview of titanium mineral markets. Pigment accounts for 91 percent of titanium feedstocks, compared with 6 percent for metal. Most titanium feedstocks are used to make TiO2 pigment. The two routes are chloride, using chlorine and carbon to make TiCl4
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as an intermediate (the same as titanium sponge); and sulfate, using sulfuric acid to leach titanium from feedstock.

Charles Stone, North American scrap procurement manager for Timet, discussed market dynamics for titanium scrap. Using data from the United States Geological Survey, titanium ingot production will reach about 75,000 metric tons in 2017, compared with mill product production of 40,000 metric tons. Scrap consumption will be nearly 60,000 metric tons in 2017, while sponge consumption will be 35,000 metric tons.

Hirotomo Maekawa, executive officer, Toho Titanium Co. Ltd., discussed titanium sponge supply trends. Maekawa said Toho has three sponge plants: Chigasaki, Wakamatsu and Yanbu. Regarding future trends of global sponge supply, Maekawa said “the normalization of demand/supply balance is going on due to the right sizing of worldwide operational capacity, based on the survival of the fittest. The demand for aerospace applications continues to grow in the long run.” Among the big changes in global sponge trade and supply, the operational production capacity of titanium sponge in China has been shrinking since 2013. China, in 2016, became a net importer of titanium sponge.

**Titanium Market Economic Drivers**

Richard Aboulafia, vice president, analysis, the Teal Group, laid out his thoughts on the global aircraft market outlook (Higher and Scarier; Strengths, Weaknesses and Uncertainties in Aircraft Markets). Aboulafia, an often-quoted source for aerospace information in the titanium industry, provided a chart that identified the Airbus A320/Neo, the Boeing 737NG/MAX, the Airbus A350XWB, the Boeing 777/X and the Boeing 787 as the projected top five commercial aviation programs, ranked by cumulative delivery values, 2017-2026. Number six on his list, on the military aviation side, is the Lockheed Martin F-35 fighter jet.

In a recent interview, Aboulafia said the titanium industry continues to benefit from the commercial aerospace sector’s “super cycle” of good business, which began in 2004. Aboulafia said that, going back to the 1950s, the aerospace industry typically would experience seven “good years” followed by three “bad years.” However, the current aerospace super cycle has lasted more than a dozen years, even taking into account the relatively tepid performance of 2017 and 2016. He projected commercial aerospace would see a modest uptick in 2018, driven by continued strong growth in air traffic, especially in the Asian market.

Chris D. Olin, senior research analyst with Longbow Research, in his presentation, declared that his firm is “bullish” on titanium. “The macro backdrop is strong and there is increased confidence in the US economy,” he said. “Industrial-related markets are becoming less of a headwind. Aerospace has become an increasing pull on demand. Growth in single-aisle jet production and introduction of next generation aircraft designs are finally offsetting the (Boeing) 777 production cuts last year. The most consistent feedback we are getting is that ‘the forgers are busy’. Inventories are much better balanced, distribution are more likely to ‘build holdings’ over the next few months.”

Olin said the outlook on titanium growth in 2018 is 6 to 7 percent. “Longbow Research projects total Western World titanium market demand at 210 million pounds in 2018 (+7%), with 3-4 years of sustainable growth potential. We see peak demand near 235-240 million pounds in 2020 (20-25% upside).”
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titanium demand by the year 2020 could reach 240 million pounds.

He also weighed in on other aerospace metal categories. “The nickel-based alloys group is looking for 5 percent growth next year. However, this market probably has the most upside in 2018 and 2019 as the next-generation engines gain traction. The outlook for aerospace aluminum plate is a plus-2 to 3 percent next year. There is still too much inventory in the channel (777 hangover). The 2018 exotic alloy growth target is plus 3 percent.”

Glenn McDonald, a senior associate with AeroDynamic Advisory LLC, an aerospace consulting firm, spoke on “Aerospace Supply Chain Trends: Implications for Titanium.” McDonald said total titanium demand is expected to grow at 4 percent per year through 2021. “Increasing 787 rates will drive some growth in titanium,” he said. “F-35 will drive titanium content as well. Longer term, flattening wide-body production rates will slow growth in titanium. Wide-scale adoption of additive manufacturing for structural parts represents a downside risk.”

He said Norsk Titanium is producing four structural parts on the Boeing 787 using its rapid-plasma deposition process. “Norsk expects the FAA to eventually certify the manufacturing process and material properties, enabling the process to be used on other parts for the 787 and other aircraft.” He added that Airbus also is introducing an additive manufactured titanium part in its A350 series.

McDonald also discussed the possibility of Boeing launching a “middle-of-market” aircraft, commonly referred to as the 797, which would “prioritize cost reduction over new technologies” in the supply chain. “The total market size for this category of aircraft is relatively small, and Airbus has the option to capture parts of this market inexpensively by stretching the A321 or offering a heavily discounted A330-800Neo,” he said. “Therefore, keeping development and production costs as low as possible take priority.”

**Ti In Medical Technology**

Don Urbanowicz, principal at Urbanowicz Consulting LLC presented a talk on “Market Dynamics Impacting the Orthopedic Industry.” According to Urbanowicz’s market overview projections, orthopaedic product sales—(joint reconstruction, spine, trauma, arthroscopy/soft tissue and orthobiologics)—will reach an estimated $49.8 billion in 2017, $51.5 billion in 2018, and will climb to $57.3 billion by the year 2021, all of which presents an attractive growth-market opportunities for titanium (and other metal competitors).

He also pondered the near-term roll of additive/3D printing as a viable technology to produce titanium orthopaedic products. Urbanowicz said 3D printing would be appealing to surgeons for solving complex trauma and joint replacement cases. He also wondered whether 3D printing might “disrupt the current business model by eliminating off-the-shelf implants and be printed by hospitals.”

Prabh Gubbi, Ph.D., materials scientist/research manager for Zimmer Biomet Dental, discussed “The Role of Titanium in Implant Dentistry.” Citing a study by Grand View Research Inc., Gubbi said the global dental implants market is expected to reach $6.8 billion by the year 2024.

He confirmed that titanium is the “de facto metal of choice in implant dentistry,” due to its superiority in resisting corrosion or toxicity in tissues, lack of allergic reaction and mechanical strength. “Commercially pure titanium has the highest resistance to corrosion and is often regarded as the most biocompatible metal due to its stable/inert oxide layer,” Gubbi said. “Over 50 years of clinical research with higher than 95 percent overall success/survival rate make dental implants the best option for replacement of missing teeth.

Dean Hutchinson, product manager, Shoulder Arthroplasty, spoke about the “Opportunities for Materials Innovation in Orthopedics.” Hutchinson said the typical cost of an arthroplasty procedure—the surgical reconstruction/replacement of a joint to relieve pain and restore range of motion—is $40,000 for a hip, $35,000 for a knee; and $21,000 for a shoulder.
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3D/Additive Manufacturing
Christian Décailliet, marketing and business development manager, Tirus International SA, considered the challenges facing additive manufacturing. Décailliet offered a list of challenges as food for thought: equipment, process control, labor, powder metal, finishing operations and non-destructive testing, and qualification processes. All of these categories represent challenges to improve the economics of the additive manufacturing technology. He identified equipment and process controls as being the main cost drivers that would improve the process. By contrast, he indicated that titanium powder metal is not a major cost driver.

“The actual fast growing acceptance of additive manufacturing for metals is the result of more than 25 years of intensive research and development work,” he said. “Powder bed fusion and direct metal deposition are complementary technologies, each with its advantages and limitations. For the powder bed fusion technology, the largest cost driver and therefore the main growth barrier, is by far the equipment. For the economics of additive manufacturing technology, high requirements towards process parameters monitoring and finishing operations must not be underestimated. The qualification process for additive manufacturing parts, especially for aerospace applications, is long, complex and costly, and the costs are borne by the parts manufacturer.”

Décailliet said selective laser melting and electron beam melting (SLM and EBM) are forecast to grow at a 36 percent compound annual growth rate due to the growing use of 3D printing to manufacture production parts in metals, particularly in aerospace. The SLM and EBM technologies have the highest growth rates and will represent more than 50 percent of the additive manufacturing market value during the next 10 years.

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Leanne Gluck, the deputy director, workforce and education outreach, America Makes – National Additive Manufacturing Innovation Institute

Norsk Titanium is producing structural parts on the Boeing 787 using its rapid-plasma deposition additive manufacturing process, a business development in early 2017. Chet Fuller, chief commercial officer for Norsk Titanium, offered an overview of the company. Norsk has two additive manufacturing production sites: Honefoss, Norway; and Plattsburgh, NY. The company, he said, has 12 rapid plasma deposition (RPD) machines, 23 machines in backlog, 105 employees, and has invested (to date) $275 million in the technology. The Norsk RPD system uses titanium wire in an argon environment and plasma torches. The equipment features a closed-loop process control system that monitors more than 600 data points per second.
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“Cost-Effective Metal Additive Manufacturing with xBeam 3D Metal Printing” was a talk presented by Dmytro Kovalchuk, co-owner and director, JSC NVO Chervona Hvilya. Kovalchuk said that “despite the progress reached in demonstrating the capabilities of 3D metal printing, the actual implementation of specific metal parts into real industrial production is still the exception rather than the rule. The reasons are expensive raw materials, complex and expensive equipment, the needs for subsequent technological operations to obtain the required metal structure and properties, as well as still substantial finishing.”

According to Kovalchuk, the xBeam system “favorably differs from other metal additive manufacturing technologies” by reducing the production cost due to the capability of using cheaper feedstock materials, high productivity with good manufacturing accuracy.

As he described at the TITANIUM USA 2016 gathering, the xBeam technology features an electron beam in shape of hollow inverted cone that’s used to create a molten pool on the substrate and for melting of feedstock material. Feedstock is supplied in the center of molten pool with the hollow conical electron beam. He said a pilot xBeam system is well suited for research and development work as well as small-scale manufacturing.

Chris Schade, Hoeganaes Specialty Metal Powders LLC, addressed the subject of “Titanium Alloy Development for Additive Manufacturing Utilizing Gas Atomization.” Schade provided an update on the electrode induction melting gas atomization process (EIGA) and the potential use of titanium scrap as a cost-effective source of powdered metal in additive manufacturing applications.

Schade said the EIGA process utilizes bar feedstock to make powder. “There is no refractory contamination due to the method in which the material is melted. Bar stock can be pre-certified for chemical analysis and inclusion content. Scrap was utilized to make round bars, which was then utilized in the EIGA process. Inclusion analysis was performed on the atomized powder to ensure cleanliness.”

Melting and atomizing methods were developed to produce titanium alloy powders from scrap materials, according to Schade. “Oxygen pick up from melting to atomizing is minimal utilizing ISM/gas atomizing and EIGA processing. The scrap sources examined exhibit a consistent chemistry with minimal losses during the melting processes utilized. Testing methods were developed for analysis of the levels of inclusions and contaminant particles in the atomized powders. Shape and porosity measurements, important for the additive manufacturing process, were developed utilizing image analysis. Several titanium alloy materials were successfully atomized and will be studied in the future in the additive manufacturing process.

Schade identified two alloys under review for the EIGA process: Beta 21S Alloy (UNS Number R58210), originally developed as the matrix for titanium metal matrix composites; and Ti-6Al-6V-2Sn (UNS Number R56620), a heat treatable, high-strength titanium alloy with higher strength and hardenability than that of Ti-6Al-4V.

Leon Prentice, Ph.D., program director, CSIRO Manufacturing, discussed “An Advanced 3D Model for Rapid and Melt-Less Additive Manufacture of Titanium.” Prentice talked about the benefits of cold-spray additive for titanium manufacturing, describing it as a “melt-less” process that avoids oxygen sensitivity issues. It’s a “rapid” additive manufacturing technique (deposition at supersonic speeds) with a low-carbon footprint (elimination of melting in a vacuum) and low capital costs (manufactured under atmospheric conditions). The system can deposit material at more than 10kg (22 pounds) per hour.

As an innovation center for additive manufacturing, CSIRO established its advanced cold spray technology facilities in 2003 with a Kinetic 2000 system from Germany. Prentice said the center has grown to be one of the most advanced labs in the world contributing development of additive technology, working in partnerships with companies such as Boeing and Airbus.

Regarding commercial opportunities for its technology, he said CSIRO has initiated design of industry scale solid-state additive manufacturing systems for flat and milled products with considerable commercial benefits. Future strategic trends for CSIRO include: collaborating with industry to virtually deposit cold spray additive structure with highly reduced residual stress; tailor designed cold-spray systems for targeted industries; the creation of shorter paths for titanium manufacturing in aerospace and biomed-
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Edward Rosenberg, chief executive officer of Spectore Corp., discussed “The Evolution of Powder Metallurgy and Additive Technology into Today’s Consumer Products Arena.” Spectore is a designer and producer of jewelry and consumer products with an extensive fleet of CNC equipment. Rosenberg said “the quest for design freedom has led us to the advent of what today is known as 3D printing, additive manufacturing technology or stereolithography.”

The technology has evolved to “a host of different materials, both pure and mixtures, including contemporary and precious materials.” Rosenberg said this capability today provides for “enormous opportunities, not only in prototyping, but as we continue to improve efficiencies and lower cost, we improve the value proposition in production. This brings an all-new dimension to manufacturing, with the creation of formulated alloys and compounds, including combinations of materials that historically were thought to be not compatible as an alloy.”

Powder Metallurgy

“Innovative Powder Metallurgy Processes for Manufacturing Titanium Alloy Components for Critical Applications” was the topic presented by Professor Orest M. Ivasishin, Ph.D., a member of the National Academy of Science of Ukraine. He serves as the director of the Institute of Metal Physics (IMP) in Kyiv, Ukraine. He said the Institute for Metal Physics (Ukraine), the Titanium Institute (Ukraine) and ADMA Products Inc. have developed an approach for producing additive manufacturing parts by using hydrogenated titanium powder metal. Hydrogen, he explained, serves as a temporary alloying element and activates sintering, which promotes higher sintered density in parts. The use of TiH2 instead of titanium powder can achieve a 99-percent density and part mechanical properties equivalent to those of machined ingot materials, using a cost-effective “press-and-sinter” technique.

“Layered Structures of Ti-6Al-4V-Based Materials Produced by BEPM” was the topic presented by Serge Prikhodko, Ph.D., associate adjunct professor, Department of Materials Science and Engineering, UCLA. According to a 2015 online technical paper, high-strength alloys of blended elemental powder metallurgy (BEPM) can be produced from powder blends based on hydrogenated titanium powders. Hydrogen strongly affects the diffusion controlled process of alloy formation and influences the phase composition of the titanium matrix.

Prikhodko showed slides of microstructures, sintering parameters, and alloy compositions using this technology. He cited anti-ballistic armor as an application area for BEPM alloys. He said that, to date, 20 different titanium alloy systems were fabricated using the BEPM approach using hydrogenated titanium powders. “Our evaluation of the alloy’s chemical composition, structure analysis and mechanical properties indicated (there’s) a feasibility for a chosen method of alloy fabrication,” he noted in his concluding remarks. “Some modifications of technology are required at the stage of compaction and sintering to achieve improved morphology and composition of the inclusions. The limited array of alloys will be selected for further hot rolling and improvement of their structure by rapid heat surface treatment aimed to deliver the final product with high anti-ballistic properties.”

In another talk that focused on anti-ballistic material properties and BEPM alloys, Dmytro Savvakin, Ph.D., leading researcher, Department of Physics, Strength and Ductility of Inhomogeneous Alloys, Institute for Metal Physics, Ukraine, offered thoughts on the “Fabrication of Layered Ti-6Al-4V Plates by Cold Isostatic Pressing Powder Metallurgy for Anti-Ballistic Protection Application.”

Savvakin said that, for anti-ballistic titanium structures, “desirable protection characteristics can be achieved by a combination of layers with different properties due to different composition and/or microstructure. BEPM, he said, is a promising, cost-effective approach to produce blended layers of titanium materials, combining properties of hardness and ductility. The aim, he said is BEPM
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powder metallurgy. “Upon sintering, different shrinkage values for blends, which composition corresponds to alloy and composites, resulted in shape distortion and delamination. This negative phenomenon was avoided by optimization of base powder size, parameters of blend preparation, compaction and sintering. Produced plates were characterized with uniform microstructure and sufficient hardness/ductile properties within each layer, as well as good bonding and perfect interface between layers of different composition. Ballistic testing demonstrated promising ballistic performance of plates produced with used approach.”

Zak Fang, Ph.D., a professor at the University of Utah, gave a talk on “An Alternative to the Kroll Process; a Low Cost Powder Production Technology that Meets the Industry Standards for Titanium Sponge Has Been Demonstrated.” Fang began his presentation by pointing out the challenges that stem from the use of traditional powder metal titanium. “Blended elemental” (BE) titanium powder is low cost, “but the properties of BE titanium are unsatisfactory.” He also noted that the “pre alloyed” (PA) powder metal category, “but its cost advantage over wrought titanium is small to none.”

Fang said that while powder metallurgy is considered a low-cost alternative to produce parts, there are “issues plaguing conventional powder metal titanium after four decades:” mechanical properties (fatigue performance and fracture toughness); microstructure (coarse lamellar as-sintered microstructure and residual porosity); and cost (powder is too expensive, along with the associated cost of high-pressure consolidation and sintering).

As a solution to these inherent challenges, he proposed the HAMR (hydrogen-assisted Mg reduction) to produce TiO2. The process, he said, has the capability to deliver low cost and high performance. Magnesium (Mg) is used as a low-cost reductant in the process. Fang also made reference to a new Utah GSD (granular-sintering deoxygenation) process, which can utilize powder made from titanium scrap and can achieve customized particle size distribution. He said GSD represents a “breakthrough” technology for deoxygenation. “The ability to deoxygenate the powder is a key to this technology,” he stated.

Shaan Oosthuizen, Ph.D., the principal engineer for the Council for Scientific and Industrial Research (CSIR), discussed the “CSIR Titanium Process for Continuous Titanium Powder.” Established in 2007, the CSIR’s Titanium Center of Competence (TiCOC),” was created to explore “upstream titanium metal production and downstream titanium fabrication industries in South Africa.” The center is involved in titanium additive manufacturing and powder metallurgy, along with investment casting and primary processes.

The CSIR’s TiCOC is developing a continuous process for non-melt powder, which is suited to near-net shape products. The patented CSIR titanium process focuses on the continuous metallothermic reduction of titanium tetrachloride in molten salt medium. In the scale up and commissioning of the process a number of key challenges have been met and overcome, and a continuous process for the production of 2kg/hour crystalline titanium powder has been demonstrated, according to Oosthuizen.

He pointed out that CSIR is not mandated to act as a commercial entity, only as a research partner and technology licensor. The group has filed patent on the CSIR process in the United States, China and the European Union, and several years ago signed a memorandum of understanding with Boeing that covers joint research into using titanium powder in industrial applications.

Kurt Faller, founder and chief executive officer, MetCon LLC, presented a paper on “Super-Improved Titanium Pickling: Electrochemically Improving Yield, Throughput and the Environment.” Faller began by pointing out that titanium pickling (chemically removing scale, cracking/defects and contamination from the surface metal) requires dangerous acids and environmentally problematic. There are worker safety concerns, costs associated with proper disposal of pickling chemicals and troublesome variations in the pickling process.

The MetCon process, as outlined by Faller, is a patented electrochemical surface modification process, which involves surface reactions controlled by a rectifier and numerous processing options, depending on the rectifier settings. The MetCon process was developed as a cost saving alternative to conventional metal conditioning. He described it as a “friendly chemistry and process” where the electrolyte is an aqueous weak acid—96 percent purified water and a balance of citric acid and ammonium.
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According to Faller, the MetCon pickling process also provides other benefits. He said it “optimally replaces grinding or machining and eliminates subsequent pickle steps. It electrochemically blends defects while preserving metal typically ground away. MetCon delivers minimum of 2 percent, and typically 3-6 percent step yield improvement compared to Midwest grinding or machining.”

Edward Jones, technical director, Hangsterfer Laboratories Inc. shared his thoughts on “Advanced Metalworking Fluids.” Jones explained that metalworking fluids are often the most overlooked yet most crucial aspect of the machining process. “The right lubricant can increase surface quality and extend tool life,” he said. “Specifically, the development of advanced metalworking fluids has led to significant improvements in machining. Hangsterfer’s recently had their advanced metalworking fluid, S-787 independently tested. The results showed that S-787 increased surface quality and reduced cutting forces by at least 40 percent over other traditional cutting fluids.

Hangsterfer fluids comply with current and coming regulations and help metalworking companies overcome the challenges with material, process and environmental requirements. Hangsterfer is a family-owned business that has developed a full line of emulsifiable oils, semi-synthetics, synthetics, straight cutting oils, drawing and forming compounds, EDM fluid and machine lubricants.

The presentation by Terry Banach, senior consultant, Slickers Technology GmbH & Co., KG, involved “Quality Ultrasonic Inspection of Bar and Tubular Products,” which dealt with the challenges of reliable ultrasonic detection of hidden cracks and pinholes in titanium and zirconium tubes. Banach said ultrasonic testing provides “defect-free and dimensional integrity using automated inspection.” It inspects full-body volume of metallic materials (ferrous and nonferrous) without damaging the material and delivers 100-percent coverage of the metal product.

Banach described an ultrasonic inspection technique known as “Pulse Echo,” which is similar to Sonar. He said sound energy is transmitted into a metal product under test conditions. After the sound energy is transmitted, the test equipment monitors any echoes from the bar or tube. “A returning echo may indicate a defect condition or an unexpected geometrical boundary. The sound energy transmission is repeated at uniform transmission and receiving intervals.” The pulser sends out an electrical pulse and a transducer converts the electrical energy into an ultrasonic wave. The transducer receiving the ultrasonic “echo” converts it into an electrical signal, which is delivered to the receiver.

“The Effect of Rolling Temperature on The Microstructure of Ti-6Al-4V Titanium Alloy Wire” was presented by Li-Yuan Li, specialty alloys quality assurance engineer, China Steel Corp. Li said his company has developed a tandem rolling process to fabricate coil with high weight, with uniform quality and higher production efficiency in the downstream processes.

In his summary remarks, Li said that, in the tandem rolling mill process, China Steel examined rolling temperatures in a range of 1050°C to 870°C, and found that 870°C would improve the microstructure from Widmanstatten lamellar structure to uniform equiaxed and dual phase. “The microstructure is most uniform and the elongation is highest when rolling at 870°C (1600°F), because the actual rolling temperature in the core is already lower than Tβ (1008°C).

Commercial Aerospace

Andy Woodfield, consulting engineer, GE Aviation discussed Jet Engine Titanium Quality Committee: 2017 Updated.” The Jet Engine Titanium Quality Committee (JETQC) was formed in 1990 under the auspices of the Federal Aviation Administration (FAA). The committee’s primary purpose is to share premium quality (PQ) inclusion data as an early warning system, which involves industry PQ data compiled annually and reported back to titanium alloy smelters. For his presentation, Woodfield defined quality as the “freedom from inclusions” in a titanium alloy—interstitially stabilized hard-alpha titanium (low-density inclusions) and high-density inclusions.

Woodfield said the JETQC is expanding its membership, with new melters and original equipment manufacturers in qualification. In addition, there have been improved billet inspection methods,
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such as multi-zone ultrasonic inspection. “There has been significant reduction in PQ titanium industry inclusion rates,” he said, which represents a “tremendous effort by melters to identify and eliminate potential inclusion sources.”

Don Nelepovitz, president of HyperForm Technologies, delivered a talk on “Engineering, Manufacturing and Materials Capabilities.” Nelepovitz said that innovating engineering and manufacturing capabilities “bridges the gap between engineered products and manufacturing suppliers,” which in turn provides new capabilities to aerospace projects. Nelepovitz referred to the capabilities of HPST (high-precision sheet titanium) forming. “The highly uniform forming environment has demonstrated exacting process repeatability and yields formed components with little or no material surface alpha-case,” he said. “Innovative titanium sheet handling during forming allows superior material flow that aids in significantly improved thickness retention.”

He explained that the HPST forming technology utilizes readily available tooling material that is both lower cost and gives shorter lead times. Using current state-of-the-art computer simulation technology, costly process development trials have been eliminated, resulting in rapid achievement of first article titanium components and assemblies. “The typical no alpha-case outcome has eliminated the need for post-form chemical milling. This cutting edge technology (HPST) will widen the range of titanium-engineered products and enhance the usefulness of titanium to aerospace and other industry applications.”

Nelepovitz described HPST as an ultra-clean process in a precisely controlled forming environment with maximum run-to-run repeatability, which brings a precision forming process to sheet and plate. For military aircraft, applications for HPST are F-35 structural panels and F-22 titanium structures.

‘Tech Talks’
Shawn Chaney, business development manager, Fort Wayne Metals Research Corp., offered thoughts on “NiTinol Shape Memory Alloys: Advantages of Utilizing these Unique Alloys and their Applications.” NiTinol is a binary alloy comprised of approximately equal parts nickel and titanium with mechanical properties like no other metal.Chaney said NiTinol is used in medical devices such as orthopedic implants, orthodontics, and cardiovascular stents due to its unique properties, however, it is also utilized in space systems, aircrafts, and industrial devices. Because of NiTinol’s properties such as shape memory, super-elasticity, corrosion resistance, and the ability to be controlled via temperature, it has many advantages in various applications in the medical device, automotive, industrial, and aerospace markets. His presentation focused on the various NiTinol alloys, the unique properties of each and how they compare to other metals, applications for use, and their advantages.

Patrick Connell, president, Kocks Pittsburgh Co., discussed the capabilities of “4D Eagle, The New Gauge from Kocks for Bar, Wire and Rod Quality Assurance.” Kocks Pittsburgh is a sister company to Friedrich Kocks. Connell said that, following the latest tendencies in the marketplace, which require highest gauge measuring frequencies in order to display the bar in the most accurate way, and without mechanical movement of the sensors.

Pat Connell said the 4D Eagle offers maximum reliability for best dimensional tolerances, improved quality of rolled product, higher yield and profitability and an overall reduction in scrap.

Keith J. Pollan, president, AccuFit Solutions Inc., in his presentation “Using AccuFit Solutions’ New 3D Planning Technology to achieve Higher Margins,” declared that “profit is a planned result. If you are not measuring it, you are not managing it.” Pollan said AccuFit’s Solutions Planning Software is a financial and operational tool designed to: avoid costly worst-case planned orders with low-yield results; reduce the quantity average size of remnant material; reducing scrap by planning high-yield scores; target obsolete inventory that has been written off by reserves; and improve working capital and cash flow.
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Harald Korbel, vice president, Intelco Melting and Casting Technologies, GmbH, provided feedback on “Closing the Gap Between Enterprise Resource Planning Systems and Machine Data by Means of a Titanium-Production Specific Knowledge Data Processing Software.” Korbel talked about the current “digital transformation in manufacturing” and how his company can provide solutions to identify production workflow in titanium from sponge to packaging and shipping.

Korbel said there is strong demand for a “holistic” software solutions that can close the gap between ERP (Enterprise Resource Planning, often termed as Level 4) systems and the machine and production data. He said his company approach also extends to Level 3 (material, equipment, maintenance and quality management inside a plant), Level 2 (extracting data from programmable logic controllers (PLCs) and integrating process models) and Level 1 (managing PLCs and the interface with sensors). “We have to understand the process, material and information flow and figure out how we can consider specific customer requirements.”

1st International anTi Corrosion Conference

The first anTi Corrosion day was hosted on Wednesday, October 11th in conjunction with the TITANIUM USA event. Distinguished speakers from chemical processing and other industries using Titanium and other CRAs presented a high level of interesting topics. The objective of the event was to provide attendees with everything they need to know from how to specify materials of construction, how to ensure long lasting, cost effective equipment, and how to inspect CRA materials during operations. Delegates found the event to be a “one stop shop” to come and meet with experts from the global titanium industry all in one convenient location. Announcements for the next anTi Corrosion day is anticipated in the near future. Chuck Young, Business Development Manager / Metallurgist for Tricor Metals moderated the day-long event and Chuck is also the ITA 2017 Global Industrial Applications Chair.

Notes from a Metallographer

Frauke Hogue, FASM, metallographer, Hogue Metallography, shared her knowledge on the “Metallography of Commercially Pure Titanium and Its Alloys.” Hogue, in 1981, began her work as an independent consultant in metallography, working mainly in the greater Los Angeles area, providing metallographic services to failure analysis companies. Since 1985 she has been teaching intensive courses at ASM International and at companies throughout the United States and abroad. She developed “Practical Interpretation of Microstructures” in 1998, which consists of a collection of about 300 mounts and a notebook of annotate images of various materials and conditions. This was followed by “Metallography for Fasteners” and “Metallography for Failure Analysis.”

Chlorate, Chloralkali, Chlorine Dioxide Applications

Dennis J. Schumerth, ASME fellow, principal and owner of, Titanium Tubular...
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Consultants, addressed the topic of “Microbiologically Induced Corrosion Effects on Titanium and Other Metals.” Schumerth examined fundamental corrosion environments where microbiologically induced corrosion (MIC) flourishes. He said MIC corrosion triggers a form of pitting in metals, ultimately consuming the material itself, caused by sulfuric/sulfurous reducing bacteria (SRB) colonies resident in many cooling water systems. “Similar attack has come from Iron/Sulfur Oxidizing Bacteria (SOB) and hydrogen producing bacteria.” The treatment of sewage effluent in waste systems is another area of concern.

For more than four decades Schumerth has worked in a technical and managerial service role accomplishments within the electric power generation industry. He underlined titanium’s immunity to MIC attack. By way of comparison, he noted the susceptibility of other metals to MIC corrosion—stainless steel, yellow metals/brass alloys, copper/nickel alloys, and aluminum. In order to prevent MIC damage, he advised those in the power generation business to select the proper materials, focus on regular cleaning and maintenance, maintain proper biocidal control and minimize nutrient introduction.

Brian Kryzanowski, metallurgical engineer, DAK Americas-Alpek Polyester, presented a paper on “Titanium Requirements and Findings in the Purified Terephthalic Acid Process.” The production of purified terephthalic acid (PTA) production involves using equipment such as pressure vessels, agitators systems, internal packings, heat exchangers, valves, pipes, tubing, flanges, and supports at very demanding process conditions. Ensuring the reliability of the process requires PTA producers to use materials of construction that perform excellent properties at reasonable costs, Kryzanowski said.

Kryzanowski said that in more than 40 years of experience in PTA production, titanium, with excellent corrosion resistance and the highest strength/weight ratio for metals, is still the optimum material over other alloys. However, due to considerations for the cost of solid titanium, it’s necessary to use metallurgical materials like coatings, linings and claddings systems that allow economical savings; making projects more attractive for investment, while maintaining a safe engineering solution. He said a common practice with pressure vessels is to use carbon steel as structural material bonded by the explosion process to a protective thin wall of titanium cladding. He said that Alpek Polyester has developed methods to attach process internals to carbon steel in titanium-clad systems.

Benjamin McCurry, PE, senior expert, materials engineering and inspection for BASF Corp., addressed the topic of “Hydriding in Titanium: Detection and Prevention.” McCurry explained that hydrogen pickup in reactive metals is a concern in chemical processes where cathodic corrosion reactions involve the evolution of hydrogen. The corrosion reactions can be due to corrosion of the base metal itself or the result of corrosion by galvanic coupling.

McCurry showed a series of slides that tracked the performance of titanium Grade 7 in hydrochloric acid (HCL) environments. He reviewed practical experience in HCL and organic acid environments including some of the methods used to monitor and measure hydrogen uptake in these materials.

“Over time, hydrides can lead to loss of ductility and embrittlement and equipment must be monitored throughout the life cycle,” he said. “Hydride formation is not an exact science as susceptibility can be affected by material processing, residual and applied stress, and other factors that may not be easily recognized. Non-destructive testing methods for detection of hydriding are not universally accepted/proven making monitoring difficult and intrusive.”

A talk by Vivek S. Murthi, technical applications specialist, business development, De Nora Electrode Technologies Inc., explored “Electrochemical Applications of Titanium; Anti-Corrosion and Dimensionally Stable Anodes.” Murthi said most metals actively dissolve when anodically polarized in aqueous electrolytes. Commercially pure titanium oxidizes and forms a thin surface oxidation film or passive oxide. “Titanium oxides are non-conductive in the anodic direction and limit current flow to only a few mA/cm2. Titanium oxides provide excellent corrosion resistance to the base metal in aqueous sulfate and chloride electrolytes. Surface oxidation prevents use of titanium independently as an anode without the addition of a catalyst.”

As spelled out in an abstract of his presentation titanium-based DSA® (dimensionally stable anodes), Murthi said titanium finds a special place amongst
ABOUT TITANIUM ASIA 2018
This event will provide a platform to gain insights into the Asian titanium industry and will serve as a premier networking venue for business executives and consumers of titanium alike. Many managers from prime contractors as well as sub-tier suppliers are coming as they recognize the efficiency of attending TITANIUM events, hosted regularly in the US and Europe.

EXHIBITING AT TITANIUM ASIA 2018?
Phase I of the Exhibition Floorplan is now available on a "first-come, first-serve" basis so we encourage you to register for a kiosk display today!

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Corporate sponsorship for TITANIUM ASIA 2018 is a fantastic way to draw attention to your organization, provide goodwill to the industry to support the event, and an effective means of increasing your visibility within the titanium community.

Location:
Grand Hyatt Singapore
10 Scotts Road, Singapore 228211

www.TitaniumAsia.org

Hosted by International Titanium Association
Tel: 1-303-404-2221   Email: ita@titanium.org
all the valve metals due to its corrosion resistance in moist chlorine gas and chloride containing solutions. “This is the basis for the largest number of titanium applications, which are naturally suited for application in industrial electrochemical processes, micro-electronic devices, super-capacitors, and even as catalysts.”

His presentation reviewed the role of titanium-based DSA® electrodes in a wide range of electrochemical applications including corrosion protection, chlor-alkali processes, water disinfection, metal plating and metal finishing. Murthi said that for DSA® Dimensionally Stable Anodes, a titanium substrate is covered with mixed metal oxide (MMO) catalyst coating layer. The MMO coating is a homogenous layer of precious metal and valve metal oxides. For substrate preparation, the coating/MMO type is “dependent on electrochemical application. Coating loading depends on lifetime requirements.” He also discussed cathodic protection for steel in reinforced concrete structures, such as in marine environments, transit systems, bridge decks and parking garages.

Lester M. Dobosz, materials science and technology manager, ERCO Worldwide (a division of Superior Plus LP), addressed “Titanium in Chlorate, Chloralkali and Chlorine Dioxide Applications.” His talk was “an overview of where titanium use is essential or optional, what alternative materials are used. Advantages and disadvantages, type of corrosion, which may occur.”

Because of its self-healing oxide coating, titanium is immune to all natural environments, resists corrosion in oxidizing, doesn’t stress crack in most conditions, and resists erosion/corrosion in seawater. However, he noted that titanium does have some limitations (acidic fluoride environments, hot chloride solutions, hydrogen embrittlement, some organic acids), which can be avoided with titanium grade selection or some process modification or special surface preparation. “In some electrochemical applications, non-metallic (fluoropolymers) are a better option,” he said. “In some process conditions (chlorine dioxide generation) there is no substitution to titanium.

Dobosz also said that for galvanic corrosion, titanium is resistant, but it will usually cause more rapid damage to a less resistant active material to which it is coupled. “Titanium usually will be the more noble metal and is the cathode in the galvanic cell. Titanium should not be coupled directly to less noble metals, such as carbon steel. Titanium coupled with stainless steel can make it prone to localized corrosion: crevice corrosion or pitting corrosion.”

“One-For-One Condenser Retubing with Titanium Alloy Tubing” was presented by Kevin Squires, Senior Project Coordinator, Day & Zimmermann (Condenser Services). According to Squires, there are several considerations to consider for retubing a condenser: severe wall loss; 10 percent or more of the total amount of tubes are either plugged and/or have failed; existing tube material leaches out onto components (turbine, feedwater heaters) or deposits unacceptable chemicals into cooling water source, which is harmful to ecosystem. He proposed titanium as a retubing material because it’s immune to contaminants from cooling water, chlorine attack and under-deposit pitting.

Brian J. Saldanha, engineering fellow, chemicals and fluoroproducts, corrosion technology and materials engineering, the Chemours Company discussed “Titanium and Zirconium vs Nickel-Based Alloys for Corrosive and Hazardous Processes in the Chemical Processing Industry.” His presentation included case histories to exemplify various corrosion mechanisms and failure modes of high-performance nickel-based alloys compared with titanium and zirconium alloys in extremely corrosive and hazardous processes in the Chemical Processing Industry (CPI).

During his talk, Saldanha stressed the necessity for a thorough understanding of process conditions that are essential for long-term reliable performance of reactive metals and discussed mitigating strategies to proactively alleviate failures.
His presentation outlined a list of specific titanium and zirconium alloy grades used in some common corrosive media. “Reactive metals will exhibit excellent reliability in many common applications including severe corrosive media,” Sutherlin said. “Proper alloys and alloy grades should be carefully chosen when using these metals in corrosive environments. These alloys will behave differently depending on factors such as alloy composition, temperature, concentration, impurities in the environment and required post fabrication treatments. For certain severe corrosive media, post fabrication surface pre-treatments (such as chemical conditioning) and heat treatments may be required. These materials will provide many years of trouble-free use in your application, if the proper criteria are followed.”

**Coming Attractions**

The International Titanium Association (ITA; website: http://www.titanium.org) has put together a slate of events for 2018, which will include the first TITANIUM Asia 2018 conference and exhibition, which will be held February 4-5th at the Grand Hyatt Singapore in conjunction with the Singapore Air Show.

The sixth annual TITANIUM Europe 2018 conference and exhibition will be held 14th – 16th May at the Melia Sevilla Hotel, Seville, Spain. The event will include a tour of the Airbus M400 Plant in Seville. The Airbus A400M Atlas is a multi-national, four-engine turboprop military transport aircraft. It was designed by Airbus Military (now Airbus Defense and Space) as a tactical airlifter with strategic capabilities to replace older transport aircraft, such as the Transall C-160 and the Lockheed C-130 Hercules.

The Bellagio Resort in Las Vegas, Nevada will be the site for TITANIUM USA 2018, which will run October 7-10th.

All three trade shows are produced by the International Titanium Association, which is based outside of Denver, Colorado USA. The ITA is a membership-based international trade association dedicated to the titanium metal industry. Established in 1984, the ITA’s main mission is to connect the public interested in using titanium with specialists from across the globe who may offer sales and technical assistance. Working through its extensive membership resources, the ITA looks to expand the knowledge base for the metal, providing technical literature and sponsoring seminars and conferences. The ITA educates engineers, designers and business executives on titanium’s superior properties and explains how those properties can be applied to enhance products and services. The ITA also strives to advance ideas in research, design, metallurgy and engineering, and serve as the leading forum to cultivate the exchange of ideas and support a diverse, dynamic, global industry.

Current ITA membership is comprised of more than 200 organizations and over 1,500 individual members worldwide. Jennifer Simpson serves as the executive director of the ITA. For additional information about membership or 2018 events, contact the ITA by phone (1-303-404-2221) or email (ita@titanium.org).

The executive summary was written by Michael C. Gabriele, freelance writer on behalf of the International Titanium Association (ITA). The ITA has made a conscientious effort to ensure the accuracy of the information supplied. The Association accepts no responsibility for and does not warrant the accuracy and completeness of the information. Additional information may be available which may have a material effect on the intended use and interpretation of this information. The information supplied should in no way be interpreted as an industry recommendation by the Association or industry.
International Titanium Association (ITA), has issued a “Call for Papers” to be presented at the first TITANIUM ASIA 2018, to be held 4-5th February 2018 at the Grand Hyatt Singapore located at 10 Scotts Road, Singapore.

“It was a natural progression for the International Titanium Association” stated Jennifer Simpson, executive director of the ITA, “We have successfully hosted the US Conference which is now comprised of nearly 1,000 titanium related professionals annually; ITA has had a regular delegation of 400 in Europe since 2013; and now ITA has selected Singapore as our first venue for the TITANIUM ASIA event”. TITANIUM ASIA will be held the day before the Singapore Air Show officially starts and ITA will offer roundtrip transportation to and from the Singapore Air Show included with conference registration.

TITANIUM ASIA 2018 is organized and hosted by the International Titanium Association (ITA), the titanium metal global trade association representing the World’s Primary Titanium Metal Producers who together account for over 90% of worldwide titanium production. ITA provides a forum for the exchange of ideas within the industry and educates the public on every aspect of using titanium metal within their design. ITA is comprised of over 200 member organizations representing North America, Europe, Asia and Australia.

The Call for Papers Deadline is December 31, 2017.

ITA is seeking technical papers on the topics of Commercial Aerospace; Industrial markets, specifically topics of waste water treatment, seawater cooling, seawater corrosion, power generation and gas processing and oil refining; Land Based Military Applications; and Titanium melting technologies. Abstracts from ITA Members, Non-Members and Academia are encouraged and welcomed.

Click Here To Submit Your Information
New Nadcap accreditation for Fluid Distribution Systems is the fifth for Fine Tubes

Reflecting its commitment to the strictest quality processes, Fine Tubes, a leading manufacturer of high-performance tubing, has secured Nadcap accreditation for Fluid Distribution Systems. This is in addition to accreditations the company already holds for Heat Treating, Non-Destructive Testing, Fusion Welding and Chemical Processing.

This latest award is a highly significant measure of the Plymouth, UK-based company’s capabilities in the manufacture of titanium (Ti-3-2.5) hydraulic system tubing for the aerospace industry. Fine Tubes is one of the very few suppliers qualified to produce the high-pressure titanium tubing used in the hydraulic systems on the Airbus A350 and A380.

Together with its other four Nadcap accreditations, this new achievement qualifies Fine Tubes for the industry-recognised AS5620 industry standard required by Boeing for its suppliers of titanium hydraulic tubing.

Phil Adderley, Director, Quality & Technical for Fine Tubes, commented, “Securing this fifth Nadcap accreditation definitely puts us at the forefront of the industry and will significantly strengthen our position when bidding for new contracts. Customers will know that they can have every confidence in our ability along with our adherence to quality procedures and the compliance of our products with the most-demanding standards.”

Nadcap is an internationally-recognised accreditation system, administered by the Performance Review Institute (PRI), covering all key manufacturing and production processes used within the aerospace industry. To secure its Fluid Distribution Systems accreditation, Fine Tubes was audited by an independent industry expert against a series of stringent checklists.

Fine Tubes’ QA Manager, Rob Eatwell, added, “Our PRI auditor was extremely thorough during his two-day visit to our Plymouth site. But, we had prepared ourselves comprehensively. As a result, the audit went very well, and we are now one of the very few companies to hold five Nadcap awards simultaneously.”

Together with Superior Tube, Fine Tubes is part of AMETEK Specialty Metal Products. Both companies have supplied the aerospace industry with high-performance tubes for more than 50 years. Their precision products are used in airframes, aircraft engines and aerospace instrumentation, where they are relied upon to withstand the most-critical operating conditions.
Above Material Technology Press Release

Above Material Technology AMT announced that it will showcase top-quality titanium wires, powders, and wire arc AM parts at Europe Titanium 2018, the leading international trade fair for the Titanium industry, May 14-16, 2018. AMT will be located in booth 35.

AMT is very good at welding metallurgy. AMT is very professional in producing World Top Quality Titanium Alloy Wires at superior Strength and Elongation, and Titanium alloy powders at superior Density and Flowability, for 3D Printing or Additive Manufacturing and welding. AMT holds annual production capacity 500 tons in Titanium alloy wires and powders.

As part of Europe Titanium exhibition, AMT will display titanium wires with silver shiny spooled with superior micro-alloyed as well as Low Impurity. AMT Titanium Rod owns pretty logo printing and neat end-cut. The diameter of AMT Titanium Wires and Rods can be 0.1-5.0mm.

At Titanium Europe, AMT will also showcase Titanium Powders at highly spherical with few satellite and porosity. The oxygen and other contaminants are very low and the particle size distribution is tailorable.

Moreover, AMT 3D Printing Parts by Titanium Wire Arc AM will be shown as exhibits, Wire Arc AM is a very promising technology to produce large components with moderate complexity at superior performance and lower cost in the size of 6-10 meters long.

"With innovativeness, strictly quality control, competitive price and extensive technological expert, we are committed to high quality customer demand and can always keep high quality owing to consistent process and quality management," said Mr. Minston Zhu, Senior Engineer from AMT. "New plant for unique patent processes and products is under construction."

Announcing our Partnership with GNR Srl OES & X-Ray Diffractometers

Verichek is proud and excited to announce that we are now the distributor for GNR GNR Optical Emission Spectrometer and X-Ray Diffractometers in industrial domain, in USA and Canada.

Verichek is now partnering with GNR and Lune as the sole US distributor for their product lines. GNR specializes in OES, XRD, and Retained Austenite Analysis Instrumentation. Lune manufactures Convective Heat Flow Temperature Control Equipment. Together with Verichek’s years of Positive Metal Identification; OES Calibration, Repair and Servicing experience makes Verichek your one-stop shop for your metal testing needs.
Arconic, Airbus to Advance 3D Printing for Aerospace under Multi-Year Cooperative Research Agreement

To Produce, Qualify Large-Scale 3D Printed Airbus Airframe Components

- Will jointly develop customized processes and parameters to make structural, 3D printed metal parts up to approximately 1 meter (3 feet) in length
- Combines Arconic’s expertise in metal additive manufacturing and metallurgy with Airbus’s know-how in final aircraft part design and qualification
- Builds on Arconic’s comprehensive capabilities to manufacture 3D printed aircraft components using a variety of metals-based additive technologies

NEW YORK and FRANKFURT, GERMANY, November 15, 2017 – Arconic (NYSE: ARNC) today announced a multi-year cooperative research agreement with Airbus to advance metal 3D printing for aircraft manufacturing. Together, the companies will develop customized processes and parameters to produce and qualify large, structural 3D printed components, such as pylon spars and rib structures, up to approximately 1 meter (3 feet) in length. The deal combines Arconic’s expertise in metal additive manufacturing and metallurgy with Airbus’s design and qualification capabilities, building on its experience with regulatory agencies for certification.

“This agreement combines the expertise of two of the world’s top aerospace additive manufacturing companies to push the boundaries of 3D printing for aircraft production,” said Eric Roegner, Executive Vice President and Group President, Arconic Engineered Products and Solutions and Arconic Defense. “Additive manufacturing promises a world where lighter, more complex aerospace parts are produced cheaper and faster. We’re joining forces to make that potential a reality in a bigger way than ever before.”

Under this agreement announced at the Formnext additive and advanced manufacturing conference in Frankfurt, Germany, Arconic will use electron beam high deposition rate technology to 3D print parts. This technology is ideally suited to produce larger aerospace components because it prints them up to one hundred times faster than technologies used for smaller, more intricate parts.

In addition, Arconic will demonstrate the benefits of its proprietary Ampliforge™ process, which combines traditional and additive manufacturing. The Ampliforge™ process treats a near complete 3D printed part using an advanced manufacturing process, such as forging, which enhances the properties of 3D printed parts – increasing toughness, fatigue and strength versus parts made solely by additive manufacturing – and reduces material input and production lead times.

Arconic will draw on additive and advanced manufacturing capabilities at its facilities in Cleveland, Ohio and at the Arconic Technology Center outside Pittsburgh, Pennsylvania.

Arconic, Airbus and 3D Printing
Arconic’s comprehensive capabilities – from materials science and additive manufacturing expertise to qualification and supply chain management experience – are helping grow our partnership with Airbus.

Last September, Airbus announced a 3D printing breakthrough involving a smaller component equipping the airframe – a 3D printed titanium bracket installed on a series production Airbus commercial aircraft, the A350 XWB. This achievement is paving the way for Airbus to design 3D printed parts in the future that are even more complex and lighter weight. Arconic is producing these titanium brackets using laser powder bed technologies at its additive manufacturing facility in Austin, Texas.

Arconic announced three agreements with Airbus last year. Under those deals, Arconic agreed to 3D print titanium and nickel airframe components, such as fuselage and engine pylon components, made using laser and electron beam powder bed processes. Those agreements established Arconic as an innovation partner to Airbus in the fast-growing metal 3D printing space.
Forecreu is a specialty metals processing company with worldwide markets in the field of orthopaedics and some aeronautics/consumer applications.

Historically, to achieve its small hole/extra thick wall tubing in the ¼” to ¾”, the company has been using composite extrusion, followed by warm drawing techniques. The initial core, transformed into wire, is then extracted using ductile properties of the material.

To reach shorter lead time, reduced cost and unlimited capacity, Forecreu has developed a hot rolling technology and recently commissioned an 8 stands “baby Kocks” together with its bar or coil heating system. The black composite extruded bars are then Kocks rolled and, either supplied straight from rolling- or further calibrated - heat treat, ground & UT test to meet tight requirements of the industry.

The well known Kocks triangular 120° rolls technology keeps an ideal positioning of the plugged hole.

Input in bar is 1” and ½” in coil, halving the initial diameter. Output is 1/8” min in coil or bar.

The equipment can turn solid bars/coils into bars/coils as well. Access for outside R&D/test partner, as well as contract work is made available.

www.forecreu.com

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**Keywell Metals Expands Credit Facilities for Continued Growth**

Southlake, TX, November 27, 2017: Keywell Metals LLC continues to work successfully with its banking partners to expand its credit facilities to accommodate the continuing strength and momentum in its trade and toll related businesses. This is the second expansion of credit facilities during 2017 and comes on the back of significant existing, new customer and new supplier activity. The company continues to grow and as a result doubled the personnel and hours of operations in the Falconer plant to meet increased demand in the Titanium business. Processing and settlement times have been reduced even further than industry standard and customers and suppliers are taking notice. Ross Gatlin, CEO of Prophet Equity, the private equity firm from Southlake, TX, that owns Keywell commented, “Our banking partners, customers and suppliers continue to be impressed with the operating prowess and financial strength of the new Keywell Metals. Enhancing our credit lines again this year to facilitate additional domestic and international trade growth due to the positive momentum of our expanded business lines was a priority objective for 2017. Following the completion of the credit facility expansion in the beginning of the year, significant new business wins highlighted a need for additional expansion and we recently successfully completed a second increase.” Philip Rosenberg, Head of Commercial Sales and Purchasing commented, “Keywell is continuing with strong momentum as we near the end of 2017 with existing customers increasing their demand and new customers inquiring and partnering with us on new opportunities.”

Dan Buwalda, Director of Operations added, “The recent expansion of our Falconer plant has allowed us to increase our capacity as we continue to meet the demands of our titanium customers.”

Headquartered outside Charlotte, NC Keywell Metals LLC is a leading supplier of recycled titanium, high-temperature alloys and stainless steel in North America. The Company is highly focused on achieving the fastest and most accurate service in the industry so that suppliers can settle with their scrap generators with confidence and consistency. The Company is owned by Prophet Equity, a private equity firm based in Southlake, Texas, with approximately $1B of assets under management. Its control equity investments focus on strategically strong, lower and middle market businesses with significant value creation potential. For more information visit www.keywell.com or www.prophetequity.com
Laboratory Testing Inc. Hires a Senior Fracture Mechanics Manager

HATFIELD, PA, December 12, 2017 – Laboratory Testing Inc. (LTI) has announced that Dr. Matthew A. Adler of Hatfield, PA has joined the company as Senior Fracture Mechanics Manager. In this role, he oversees LTI’s Fracture Mechanics Lab and Fracture Technology Associates (FTA) including FTA fracture mechanics test systems and software.

The Lab predominantly performs Fatigue Crack Growth Testing and Fracture Toughness Testing to ASTM and other recognized test specifications. The FTA Software includes two primary applications for performing mechanical tests, Fatigue Crack Growth Rate (FCGR) and Non-Linear Fracture Toughness (NLFT). Dr. Adler has over a decade of hands-on experience in experimental fatigue and fracture using FTA software-controlled systems.

Dr. Adler is a graduate of Lehigh University, where he earned BS, MS and PhD degrees in Mechanical Engineering. He was a graduate research assistant in the University’s fracture mechanics Sinclair Laboratory in the Mechanical Engineering Department where he studied variable amplitude fatigue crack growth and aging aircraft as part of damage prognosis systems.

His professional career includes nearly eight years of employment in the NASA Marshall Space Flight Center (MSFC) program in Huntsville, AL. Most recently, Dr. Adler was with the program as an employee of Jacobs Technology, Inc. / Jacobs ESSSA, where he held the concurrent titles of Aerospace Manager and Damage Tolerance Subject Matter Expert. Earlier, he had been with Integrated Concepts and Research Corporation as a Damage Tolerance Engineer, while working at MSFC. During his tenure at MSFC, Dr. Adler used FTA systems to help return the Space Shuttle fleet to flight on two occasions following high profile failure investigations.

Dr. Adler also has two years of experience as Director of Advanced Fracture Mechanics at a materials testing laboratory. He has been an active leader within the ASTM E08 Committee on Fatigue and Fracture, as well as a participant in ASTM E28 (Mechanical Testing) and ASTM G01 (Metals Corrosion).

LTI has NADCAP and A2LA accreditations for fatigue crack growth and fracture toughness testing. These tests are performed on computer-controlled servo-hydraulic mechanical test systems that operate with FTA software and provide loads ranging from 40 lbf. up to 100,000 lbf., cycling at a rate of up to 40 hertz. Testing is performed between temperatures of -150°F and 2000°F. The Fracture Mechanics Lab also has a high-precision inspection microscope for measuring dimensions of specimens before testing and crack surfaces after testing.

The New Generation: ELEMENTRAC® ONH

ELTRA presents the latest generation of ONH analyzers for the determination of oxygen, nitrogen and hydrogen in inorganic materials with a fresh new design and advanced features.

Highest precision with even better reproducibility of the measurement results combined with a considerably reduced consumption of carrier gas are the main features of the ELEMENTRAC® ONH series. The core of the new analyzer is the powerful impulse furnace with ELTRA’s optimized sample drop mechanism which allows for a wide range of sample materials and sizes: from granules to whole pieces of materials such as steel, copper, titanium or silicon.

The new analyzer generation is equipped with a precisely tuned IR measuring system (furnace, catalyst, IR detector) for oxygen determination. Nitrogen and hydrogen concentrations are measured by highly sensitive thermal conductivity cells which provide accurate results even for very low measuring ranges. For the first time it is now possible to use consumer-friendly argon as carrier gas.

The comprehensive software is easy-to-use and offers a variety of diagnosis and analysis tools which simplify routine tasks in the laboratory.

Advantages:

- High precision and reduced gas consumption thanks to newly developed furnace
- Highly sensitive determination of hydrogen and nitrogen by thermal conductivity analyses
- Precise oxygen measurement from ppm level to percentage range
- Optional use of argon as carrier gas
Perryman Announces Advanced Manufacturing Campus
Provides Foundation to Support Long Term Strategic Growth Plan

Houston, Pennsylvania, November 15, 2017 — Perryman Company announced today it has purchased approximately 35 acres of land and buildings located adjacent to the company’s current headquarters and manufacturing facilities in Houston, PA. The new campus complements the fully integrated titanium operations of Perryman’s other campus locations in Houston, PA, California, PA, and Frackville, PA.

Over the last eight years Perryman has continued to invest in additional manufacturing capacity across all of its operations as well as expanding its footprint through acquisition. “The vision for Perryman to maintain sustainable growth has been in place since 2008. At its core, is the commitment to meeting the needs of our customers and to be ready to support them in advance of their requirements,” commented Frank Perryman, President and Chief Executive Officer of Perryman Company. With this investment, Perryman will be in position to support its current and future growth for the next 10-15 years.

Aerospace and Medical industries continue to be key drivers for Perryman. “Technology advancements in materials are occurring simultaneously with advancements in new aircraft design and orthopedic procedures. This campus will be dedicated to supporting Perryman’s growth opportunities in these and other industries,” said Perryman.

Titanium used in the additive/3D industry has been identified as an area for immediate growth. Viewed by many as a transformative technology, Perryman has been supporting titanium additive/3D users for over 10 years. “Our strength as a fully integrated titanium producer uniquely positions us to support the growth of this emerging industry. Our aim is to ensure there’s a reliable, high quality source of supply,” stated Perryman. The new campus will provide a solid foundation for Perryman to proactively expand titanium operations.
Solar Atmospheres Thermally Treats First FAA Certified Ti-6Al-4V Structural AM Aviation Components

October 31, 2017 - Hermitage, PA - Solar Atmospheres successfully processed the first FAA Certified structural additive manufactured Ti-6Al-4V parts that were produced by Norsk Titanium AS destined for installation on a Boeing airplane. The vacuum stress relief was compliant with the stringent AMS 2801 and other OEM specifications.

Norsk Titanium’s printing technology of these aft galley supports, along with other flight critical components, signals the ancillary cost benefits that customers may realize with additive manufacturing: lead time reduction, lower inventory requirements, and future spare parts continuity assurances. Solar Atmospheres processed the initial production components for Norsk in March.

Norsk’s US facility in Plattsburgh, New York will produce multiple 3-D printed components for the world’s premier commercial aircraft OEMs. The company is also exploring other applications in the defense sector including the next generation aircraft, naval vessels, and land-based vehicles.

Bob Hill, President of Solar Atmospheres of Western PA states, “We are extremely proud to partner with innovative additive manufacturing companies such as Norsk Titanium. Today, we can clearly see how this revolutionary manufacturing process has departed from the hype realm and is entering into everyday reality.”

For additional information about Solar Atmospheres, contact Mike Johnson at 866.982.0660, ext. 2223, or mike@solarwpa.com, and visit www.solaratm.com.

Hunan Xiangtou Goldsky Titanium Metal Co., Ltd.

Hunan Xiangtou Goldsky Titanium Metal Co., Ltd. has successfully produced Gr.5 coil with dimension of 1.5mm*1220*C, which of quality has been recognized by some customers. Goldsky is one of the leading manufacturers for titanium coil & plate in china, and it will focus on titanium alloy production in the coming year.
UTRS and Achemetal Announce Groundbreaking Joint Venture in Titanium Industry

(Butte, Montana) – Universal Technical Resource Services, Inc. (UTRS) has entered into a joint venture with Achemetal, Inc., called Universal Achemetal Titanium, LLC (UAT) to commercialize its groundbreaking patented process for extracting and refining titanium developed over the past decade. UTRS is an established government services firm with decades of experience in solutions technology. Achemetal, Inc., is a metals supplier dealing in specialty and rare earth refractory metals worldwide.

“The UTRS scientists in Montana invented a game-changing process for extracting titanium from ore that is more flexible, requires fewer steps and will significantly reduce the costs of titanium when compared to the Kroll process,” said James Sun, owner of Achemetal. “This innovative method reduces production costs and pollution, and doesn’t require the use of any harmful chemicals.”

UTRS scientists located at its Butte, Montana, prototype facility and laboratory created a patented process (https://www.google.com/patents/US20130164167 that uses two major steps that effectively combine extraction techniques, electro-refining, and metal processing practices to produce titanium directly from titanium-bearing ores. This innovative process provides access to domestic titanium supplies not usable by other processes, and will reduce reliance on foreign materials in manufacturing.

The formation of UAT propels the process into the demonstration phase from the laboratory scale only, proving the ability to commercialize the process. The strategic location of the facility provides access to the many resources (human, natural and economic) that Montana and the Western region of the United States has to offer. Sun brings over 40 years of experience in metallurgical engineering to the operation.

“Our goal was to replace the expensive, environmentally harmful, outdated Kroll process that is used internationally today in titanium production,” said Jim Cox, Ph.D., UTRS Laboratory Director. “In doing so, we are able to create a more cost-efficient and environmentally friendly process to manufacture titanium, making it more accessible to industries both within and outside of aerospace and allowing us to take advantage of domestic ore supplies previously unusable.”

This market-disrupting process was conceived over 10 years ago, when UTRS identified Montana as an emerging technology frontier.

For more information about this joint venture or the patented process, please contact Ben Kohler at (406) 494-3434 or bkohler@utrs.com.

Paul Nagy newly hired as Tricor Metals Market Manager position

Tricor Metals, Wooster, OH announced that Paul Nagy has accepted a position as Market Manager. Paul will report to Tricor’s Chuck Young, Business Development Manager and Metallurgist.

“We feel Paul’s broad experience marketing steel and titanium metal products to industry will allow him to quickly learn about Tricor’s products and services and help our customers as they look for custom designed ASME fabrications, titanium mill products, and aerospace welding wires”, stated Tricor’s Chuck Young.

Paul was previously employed in sales positions with Contractors Steel, Tico Titanium, Samuel & Sons, Castle Metals, and Carpenter Technology; to automotive, aerospace, chemical, oil & gas, and refinery served markets.

Paul is a graduate of Western Michigan University.

Paul will work from his home in Michigan and travel extensively covering the Midwestern USA region for Tricor Metals and can be reached at pnagy@tricormetals.com, 330.264.3299 x2234.
Ulbrich Stainless Steels & Special Metals, Inc. leads innovation in Titanium Foil

Ulbrich Stainless Steels & Special Metals, Inc. continues to provide titanium UltraLite Foil® as thin as .0125 mm (.0005") for the most demanding applications.

Since Ulbrich’s expansion into UltraLite Foil® in 2006, the company has supplied titanium and titanium alloy foil for critical markets including medical, aerospace, chemical processing and power generation. Ulbrich offers continuous coil up to 300mm wide with exacting tempers ranging from annealed to full hard.

With more than 12,000 sq. ft. of dedicated space for its UltraLite Foil® program, production consists of rolling, tension annealing, slitting and packing. Ulbrich’s commitment to continuous improvement has led the quality department to achieve and maintain the following certifications: ISO 9001, ISO 17025, NADCAP, GEAE, Rolls Royce, LCS and A2LA. Thanks to the exceptional development and supply chain partnership capabilities, coupled with the experienced product managers and metallurgists on staff, Ulbrich is able to meet specific customer requirements.

Ulbrich Stainless Steels & Special Metals, Inc., headquartered in North Haven, Connecticut, is a 4th generation, family-owned precision re-roller and distributor of stainless steel and special metals strip, foil, shaped & fine wire, sheet, plate and bar products for use in the medical, automotive, nuclear and aerospace industries. Ulbrich offers twelve locations in five countries across North America, Europe and Asia, with additional sales representation world-wide.

For more information, please visit Ulbrich.com or contact us at 1-800-243-1676.
The International Titanium Association Presents

TITANIUM EUROPE 2018
14-16 MAY 2018 • SEVILLE, SPAIN

Attend The Largest Titanium Industry Event In Europe!

www.TitaniumEurope.org
Optional Workshops and Tours During The Event

Continuing Education Workshops
ITA is pleased to offer two educational workshops on Monday, 14th May:
Fundamentals of Titanium Metallurgy and Metallography of Titanium & Its Alloys

Airbus M400 Assembly Line
The second prototype A400M, Grizzly 2, at the 2010 Farnborough Airshow

This year’s conference will enjoy an industry related tour of the Airbus M400 Plant in Seville. The Airbus A400M Atlas is a multi-national, four-engine turboprop military transport aircraft. It was designed by Airbus Military (now Airbus Defence and Space) as a tactical airlifter with strategic capabilities to replace older transport aircraft, such as the Transall C-160 and the Lockheed C-130 Hercules. The A400M is positioned, in terms of size, between the C-130 and the C-17; it can carry heavier loads than the C-130, while able to use rough landing strips. Along with the transport role, the A400M can perform aerial refuelling and medical evacuation when fitted with appropriate equipment. The A400M’s maiden flight took place on 11 December 2009 from Seville, Spain. A total of 174 A400M aircraft had been ordered by eight nations by July 2011. In March 2013, the A400M received European Aviation Safety Agency (EASA) certification. The first aircraft was delivered to the French Air Force in August 2013.

Special Thanks for our friends at Airbus SAS for making this tour possible.

Visit Sevilla 3 Hour Tour by Bus Transport
Bus transport will visit the Triana neighbourhood, The Plaza de toros de la Real Maestranza de Caballeria de Sevilla and The Macarena Basilica church

Visit Sevilla Walking Tour (3.5 hours)
Discover the most important sites in Seville on this 3.5 hour walking tour with an expert, English speaking local guide, who will explain the city’s fascinating 2000-year history.
New Job Announcements

- Jeff Sasek, Plant Manager at Dynamet Washington Operations at Carpenter Technology Corporation
- Karina Graziani, Member Services Administrator at International Titanium Association
- Michael Green, Account Executive at Dominion Metallurgical
- Rigoberto Vazquez, V.P. of Sales at Sunland Aerospace Fasteners
- Dave Ochar, Vice President, Aerospace Sales - North America at Bodycote Thermal Processing, Inc.
- James Fortman, Quality Engineer II (Platforms & Services) at BAE Systems, Inc
- Steve Sparkowich, Director of Business Development -Industrial Products - Carpenter Technology

Work Anniversaries

- Christopher Bassett - 2 years at GKN Aerospace
- Rebecca (Bach) Lane - 2 years at Airbus Group Inc.
- Kathryn McNamara - 10 years at Carpenter Technology Corporation
- Steve Patera - 4 years at Titanium Processing Center
- Nate Fairfield - 7 years at Uniti Titanium
- Nasser Mikhail - 5 years at Titanium Industries, Inc.
- Gromovich Dmitry - 20 years at VSMPO-AVISMA
- Armin Schneider - 1 year at Arconic

Retirement

Conny Palmer
Manager of Business Development for Sandvik Materials Technology
With the organization 47 years, retiring December 2017.

Florence Therrien-Haynes
Raw Material Purchasing Manager for Weber Metals
With the organization 33 years, retiring December 2017.

Publication Announcement

Elsevier, an information and analytics company and provider of scientific, technical, and medical information, is seeking proposed chapters submissions for an upcoming title, “Titanium for Consumer Applications”. This title will be a review of the use of titanium within the consumer industries including architecture, kitchen appliances, sporting goods, art, jewelry, etc. Published by Elsevier, the key focus of this work will be to provide a better understanding of the specific applications of Titanium in the Consumer industry, explain why Titanium is useful within this industry, and will include a review of potential future applications. Chapter Submissions are solicited in the following topical areas, although submissions that succinctly describe ground breaking work across the field of titanium in consumer applications are also welcome.

Kitchen Equipment, Cutlery, Pots and Pans, Blenders, Bowls, Titanium in Jewelry, Watches, Glasses frames, electronics, Sporting equipment including golf clubs, skis, tennis rackets, climbing pieces, skates, Musical Instruments, Ornamental Artwork, Health Care Goods, Auto and motorcycles, Buildings and Architecture, Decorative Cladding and Anti-corrosive applications

Editors: Francis (Sam) Froes, Consultant, Ma Qian, RMIT, Melbourne, Australia and Mitsuo Niinomi, Tohoku University, Japan.

Additional information and proposed submissions may be sent to the attention of Sam Froes via email at ita@titanium.org.
Announcements

In Memoriam

Stanley Abkowitz, 90; Titanium Industry Pioneer

Mr. Stanley Abkowitz, an award-winning pioneer in the U.S. titanium metals industry and the founder of Dynamet Technology Inc., succumbed on Oct. 29, at the age of 90.

A 1948 graduate of the Massachusetts Institute of Technology (MIT), Abkowitz, who was trained as a metallurgist, quite literally helped to establish the American titanium industry through his work on developing Ti-6Al-4V, the widely used alloy that shaped numerous aerospace, industrial and commercial designs and applications. In essence, Abkowitz’s work marked the coming of age of titanium’s promise as “the wonder metal.”

A member of the Watertown Arsenal, MA, during the early 1950s, an Army research center for titanium, Abkowitz’s titanium/aluminum/vanadium alloy was hailed as a major breakthrough with strategic military significance for the United States. This was the era when Cold War tensions dominated the world order. In those early years, titanium production was ramped up for the production of the Lockheed U2 spy plane, which was introduced in the mid-1950s, flew at a dizzying altitude of 70,000 feet, and monitored military installations in the Soviet Union.

The New York Times, in its May 17, 1954 edition, carried an article titled “Titanium Studies Bring New Alloy; Light Material Developed by Army Reported as Tough as High-Strength Steel:"

…laboratory tests showed the alloy to be 40 percent lighter in weight than high-strength steel. However, it is highly corrosion resistant and has properties that compare favorably with those of steel used in making heavy weapons, tanks and armor plate. The alloy was worked out by Stanley Abkowitz, a member of the arsenal’s laboratory staff who was serving as a technical supervisor of a contract with the Armour Research Foundation of Chicago. The foundation is one of many agencies engaged in titanium research for the arsenal under government contract.

Abkowitz went on to publish the first technical paper on the Ti-6Al-4V alloy on June 10, 1954, unveiled during a technical symposium held at Columbia University, NY. One year later he published Titanium in Industry, the first book to document the emergence of the young titanium business. Abkowitz, in 1999, also wrote a monograph titled The Emergence of the Titanium Industry.

In 1972, Abkowitz founded Dynamet Technology, which was based in Burlington, MA, and focused on the development of titanium powder metallurgy. In June 2014 RTI International Metals Inc. acquired Dynamet. One year later aluminum giant Alcoa purchased RTI.

The International Titanium Association (ITA) lauded Abkowitz’s distinguished career by acknowledging him in 2000 as the first recipient of the organization’s prestigious “Titanium Lifetime Achievement Award.” He also won the ITA’s 2013 “Applications Development Award” for his work that marked a new era for the use of titanium powder metal technology in the aerospace industry.

In 2005 ASM International (originally known as the American Society for Metals), awarded him its Lifetime Achievement Award. A 1972 ASM Fellow, Abkowitz also received the William Hunt Eisenman Award in 1999. He holds 24 patents and has authored 60 papers and articles on titanium technology.
Arcam Group provides cost-efficient Additive Manufacturing solutions for production of metal components. Arcam’s Electron Beam Melting (EBM®) technology offers design freedom combined with excellent material properties and high productivity. Arcam provides Electron Beam Melting systems through Arcam EBM in Sweden, powder metals through AP&C in Canada and implant contract manufacturing through DiSanto in the U.S.

Busch Vacuum Pumps and Systems is one of the largest manufacturers of vacuum pumps, blowers, and compressors in the world. Our products are at the forefront of vacuum and low pressure technology. The Busch product range offers the largest selection of industrial vacuum pumps available in the world today. We offer more than 50 years of experience and expertise in vacuum system manufacturing, and can provide customized solutions for a variety of vacuum applications.

Calvi Holding S.p.A. holds equity investments in several manufacturing companies with specific focus on metallurgy and mechanics. Since 2004, Calvi Holding S.p.A. has been committed to creating value based on a network model, which develops synergies to provide its clients with products and solutions that are increasingly innovative and competitive.

Formed in London in 2016, Cumberland Highstreet Partners was created in response to the need for executive leaders to have access to a team of proven, experienced professionals who possess a deep domain knowledge of manufacturing. We bring accomplished and creative industry experts to the table who have personally led significant organizations. We are executives with proven track records of successfully navigating the ever-changing needs and requirements of industry.
Welcome New Members

Custom Marine
STAINLESS EXHAUST

Manufacturer of titanium exhaust systems. Every CMI header is built to exacting standards that have made them the number one choice for offshore racers and performance-oriented boaters who demand on-water performance. CMI headers are manufactured using state-of-the-art materials, like 316L and 317L stainless steel, offering superior corrosion resistance and durability. A unique, patented bending process assures uniform wall thickness and eliminates any rippling and crazing of the tubing during production. Semi-automated tungsten inert gas welding, plus heat treating of the complete manifold following assembly, significantly reduces internal stresses that commonly cause fatigue, corrosion and premature failure in most high performance applications. To complement its header systems, CMI also manufactures custom tailpipes, exhaust accessories and integral mufflers for virtually any single, dual, triple or quad engine configuration, including small block or big block applications, Chevrolet and Buick V-6s and Ford 460 and SVO’s. With CMI, boaters get a combination of performance and reliability unparalleled by any competitive products on the market.

Exova
Testing, calibrating, advising

Exova Group plc is a leading provider of laboratory-based testing and related advisory services, operating primarily within the Testing segment of the Testing Inspection and Certification ("TIC") sector. Exova has been hired to do the autoclave work for the NACE MRO175 testing of Gr 12 project by the ITA Industrial committee.

By joining the ITA as a Vendor member Exova would become an active participant in the ITA committee dedicated to industrial applications.

Exova would also benefit from discounted registration at the annual events, would receive a complimentary company description in the membership directory and would be able to take advantage of a variety of other ITA membership benefits.

Flowserve

Flowserve manufactures and services fluid motion control solutions for the world’s toughest, most critical applications.

For the biggest challenges of fluid motion control, customers worldwide rely on the engineering, project management and service expertise of Flowserve. We deliver more than the most complete portfolio of reliable valves, pumps and seals available.

EXPERIENCE IN MOTION
Our global team of more than 18,000 employees in 55 countries can put together the total solution—from project planning to lifecycle maintenance programs to some of the most proven technology on the planet. All so you can get more from your capital investment. Exceed your operational goals. And always come through, when failure is not an option.
Welcome New Members

Hoeganaes Corporation, founded in 1953, has a network of companies encircling the globe. This international focus, combined with our own manufacturing facilities in the United States, Europe and Asia, along with marketing representatives around the world, enables us to serve customers effectively on a global basis.

Since our beginning, Hoeganaes’ primary mission has been simple yet vital: anticipate and serve our customers’ needs. Through the continuing support of our customers, Hoeganaes Corporation has led the industry in developing products and processes that allow the production of parts with more complex geometries, higher densities, and improved dynamic properties.

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Baoji JHY Titanium Industry Co., Ltd was founded on 25-09-2002. It is a professional manufacturer for titanium and titanium alloy fasteners and machined products. We can produce them according to different standards, like GB, ISO, DIN, ANSI and JIS etc. They are widely used in petroleum, metallurgy, chemical, pharmacy, marine engineering, racing car, motorcycle, bicycle, yacht, outdoor camping and sports equipment.

Our company insist the “Quality First” strategy rather than “Low priced” one to earn trust from customers, which has been proved correct after 15 years in this industry. Now over 85% our products are exported to Japan, United States, United Kingdom, Germany, Netherlands and other European countries.

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Jiangsu Tiangong Technology Company Ltd was founded in 1981, Our company stared in 2012 to produce titanium products, including rods, tubes, plates, and wire materials. Products in full compliance with GB/T3621, ASTMB265, ASTMB338, ASTMB348 standard, related technical indicators have reached the advanced level in the industry, meeting the user’s application requirement.

Products are widely used in the petrochemical, sail. Offshore industry, energy generation and other related industries, typical applications: Titanium and titanium alloy bar for hot-rolling; Medical devices; Titanium alloy standard parts; Various types of titanium equipment; Ion-exchange membrane, divide slot; Titanium and titanium alloys used in construction board.
Welcome New Members

K-TIG

KEYHOLE TIG WELDING

K-TIG is a full-penetration welding technology designed to help fabricators to be more productive – by an order of magnitude.

K-TIG is a TIG/GTAW welding system capable of performing a traditional 6-hour TIG weld in 3 minutes, to a quality standard which meets the most demanding requirements of the nuclear, aerospace & defence industries.

Luoyang Hexin Titanium Industry Co., Ltd

Luoyang Hexin Titanium Industry Co., Ltd was founded in 2014. Our company produces titanium products since 2014, including rods, tubes, plates.

Products are widely used in petrochemical, sait. Offshore industry, energy generation and other industries. Typical applications include: Titanium and titanium alloy bar for hot-rolling; Titanium alloy standard parts; All kinds of corrosive fluid transmission pipeline system; Titanium bicycle tube; automobile exhaust pipe; Offshore aquaculture

Multi-Etch

Is a low-acid (pH 6.8), far safer etchant for titanium and other metals, with a less toxic waste stream, when compared with hydrofluoric and nitric acids.

Preparing titanium with Multi-Etch enables anodizers to produce brilliant colors and welders to achieve welds that can withstand the rigors of deep space and deep ocean uses.

Multi-Etch is also used to brighten titanium mill products and tumbled titanium parts, and to erase anodizing mistakes. Industries regularly using Multi-Etch include aerospace, medical, dental, marine, architectural, industrial, jewelry and other arts.
Welcome New Members

NobelClad is the world leader in the field of explosion welding. We have more than half a century of expertise, and we are the one company with the most global resources and infrastructure committed to clad, offering bi-metallic solutions for complex industrial markets, including oil and gas, chemical, and transportation. We work with global partners across the supply chain not only to deliver the highest-quality, most cost efficient clad materials on time, but to inform and help develop project specifications from the onset. Our design ingenuity, technical proficiency, and unparalleled dependability make us an invaluable resource for process architects, engineers, and fabricators alike. That’s why our clad materials are the preferred specification for high stakes industrial infrastructure applications all over the world. Specialties: Explosion Welded Clad, Longitudinally Welded Pipe, Pressure Vessels, Heat Exchangers, Structural Transition Joints, Electrical Transition Joints, Cryogenic Transition Joints, Flat Plates & Cylinders, Heads, Tube Sheets.

Oerlikon

Oerlikon is a leading global technology group providing market leading technologies and services. Oerlikon has more than 13,800 employees at over 180 locations in 37 countries and sales of CHF 2.331 billion in 2016. The group is structured in three Segments: Surface Solutions, Manmade Fibers and Drive Systems, each operating under their own well-established brands and with their own market-specific strategies. It has a long-standing presence in Asia, particularly in the emerging markets of China and India, a strong foundation in Europe and serves the most important markets in the Americas. In 2016, the group continued to invest over 4% of its annual total sales in R&D, corresponding to CHF 94 million, and filed 67 patents worldwide.

PennState

Materials research conducted by iMatSE students and faculty lead to advances and discoveries that become the building blocks of tomorrow. Through formal coursework in small classes and participation in cutting-edge sponsored research, students in the Intercollege Graduate Degree Program in Materials Science and Engineering enjoy a graduate education that prepares them well for their future careers.

iMatSE students receive full funding (stipend and tuition) in the form of fellowships or research assistantships. Program Highlights:
- Penn State ranked #1 in funded materials research in the US (NSF)
- Thesis-based Ph.D. and M.S. degrees
- Multi-disciplinary research programs and centers
- Over 50 MatSE and affiliated faculty members
- Approximately 150 current graduate students
- Specialized laboratories and shared facilities
Welcome New Members

Manufacturer of industrial saw blades. The oldest cutting tool manufacturer in North America, Simonds offers one of the broadest and most trusted names found anywhere in the world of cutting tools. Many industries have grown to depend on the quality and innovation of Simonds products and services. We have a continuing tradition of quality, design, and innovation. Simonds has innumerable patents, a global leader in high-performance and high-production sawing. The first bandsaw manufacturer in the world to be ISO certified and we remain certified so today. We set our goals high and our customers have grown to expect it.

Since 1832… The Professionals’ Edge.

The Precision Thin Metals (PTM) business of Arnold Magnetic Technologies produces thin and ultra-thin alloys that improve the power density of motors, transformers, batteries and many other applications in Aerospace, Industrial, Automotive, and Medical markets. Customers rely on us for thin-rolled titanium in applications that demand high performance and consistent quality. Arnold’s Precision Thin Metals business offers titanium products in a number of commercially pure grades and several standard alloy compositions. Our titanium and titanium alloys are available in cold rolled or annealed condition, and as thin as 2 microns. Located in Illinois, PTM is a non-traditional supplier to the defense sector and Nadcap certified for heat treatment.

Precision Metal Grinding is a grinding service company that supports the aerospace and medical industry. Providing the highest quality of surface finishes for critical applications (Ra and Rz). Capable of machining thin sheet (minimum: 0.008”) and thick plate (maximum: 6.00”) up to 78.00” wide x 230.00” long. Precision Metal Grinding offers a standard thickness tolerance of +/- 0.001” and can provide +/- 0.0005” upon request. Our standard practices ensure consistency over large orders and from batch-to-batch. With years of experience under our belt, we are capable of machining Titanium, Stainless Steel, Aluminum, Nickel-base Alloys, Magnesium, Cobalt-base Alloys, Zirconium and others.
At Scanacon, our mission is to help stainless, titanium, zirconium and specialty alloy finishers achieve efficient, high quality production at the lowest cost.

With over 30 years’ experience as the World’s preferred supplier of acid management equipment, our knowledge, experience and equipment offers the producer the ability to achieve productive, efficient and cost effective finishing operation. Our solutions have consistently proven themselves across a wide range of pickling, etching and milling applications for all wrought and cast forms.

Scanacon understands that ease of use, low maintenance requirements and efficiency is key to designing process equipment that delivers value, day after day. No two producers or applications are exactly alike. Delivering value requires a knowledge that can only be gained by experience and is why Scanacon continues to be the chosen supplier for acid management system by all major producers, worldwide.

SES is a leading supplier of equipment and services for the metals, metals-forming and related industries. SES has the ability to handle projects ranging from small specialty items to major capital expansions, as well as redesign and rebuild of existing equipment. Our capabilities include transfer cars, transporters and all associated melshop equipment, slab handling equipment, long product handling and processing equipment, strip processing equipment, coil handling equipment, custom-designed and -built equipment, automation & Level I/II system design, complete system integration, PLC, drives, & HMI integration, power and control system design, and facilities engineering.

Structure Medical is a leading manufacturer of medical implant products that are used by orthopedic surgeons to treat disorders of the musculoskeletal system. Orthopedic surgeons use these medical devices to treat trauma, sports injuries, degenerative diseases, tumor and congenital conditions.

Structure Medical was founded in Naples, FL in 2004 and established a second facility in Mooresville, NC two years later. The company uses the most advanced machine tooled available around the world to produce products that meet the highest quality standards.
T-M Vacuum Products has more than 50 years' experience designing and manufacturing various standard and custom size vacuum furnaces and vacuum ovens in both rough and high vacuum configurations with temperatures up to 2,000°C.

We specialize in all metal hot zones and strive to create the best vacuum furnaces and vacuum ovens possible. Our team of experienced engineers and highly skilled technicians build the best systems in the industry. Our systems typically exceed 20 years of life in a full-time 24/7 production environment. This means that each vacuum furnace and vacuum oven, you purchase from us is the most advanced and cost effective on the market.

As an ITA member company, T-M Vacuum is more than happy to assist customers in choosing the right vacuum furnace to meet their needs. Contact us or visit our web site for more information.

Founded in 2014, Titomic Limited is an advanced manufacturing company providing the world’s largest and fastest additive manufacturing systems. The Titomic Kinetic Fusion process is based on spraying metal power at supersonic speeds to create industrial scale parts and complex surface coatings.

Titomic provides engineering services which include R&D for new super alloys, metallurgy for surface coatings, and rapid prototyping of industrial scale parts.

Titomic’s range of powders enables to production of high performance industrial scale Titanium parts comparable in cost to mill products, engineered castings and forgings.

Titomic can create new cost-effective applications for Titanium across multiple industries, including Aerospace, Marine, Mining, Oil & Gas, Defence, Medical, Power Generation, Chemical Plant, and Transportation industries.

Verder Scientific Inc., comprised of the Retsch, Carbolite Gero, and ELTRA brands sets the standard in high-tech scientific equipment serving research institutions, analytical laboratories as well as manufacturing companies for decades. The company manufactures and supplies instruments for sample preparation, elemental analysis as well as heat treatment of solid materials.
5ME

www.5ME.com

5ME is a technology company entirely focused on Manufacturing Efficiency. One of the core components within its solution portfolio is Cryogenic Machining Systems. 5ME has developed a unique, multi-patented solution for routing liquid nitrogen through a machine tool as well as inside the cutting tool to provide the most efficient means of removing heat from the metal cutting process. By taking the cutting tool to -321°F, 5ME’s technology is an enabler for processing difficult to machine materials - like Titanium, up to 5 times faster than what is possible with traditional water or oil-based coolants. It also has significant benefits with respect to part quality as white layer, grain boundary distortion, residual stress, and burr formation are all dramatically reduced. Additionally, it offers environmental benefits by eliminating coolants from the metal cutting process.

Above Material Technology Co., Ltd.
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www.amt-alloys.com

export@amt-alloys.com

Above Material Technology Co., Ltd (AMT) is very good at welding metallurgy. AMT is very professional in producing World Top Quality Titanium Alloy Wires at superior Strength and Elongation, and Titanium alloy powders at superior Density and Flowability, for 3D Printing or Additive Manufacturing and welding. AMT holds annual production capacity 500 tons in Titanium alloy wires and powders.

AMT Titanium alloy Wires are silver shiny spooled with superior micro-alloyed as well as Low Impurity. AMT Titanium Rod owns pretty logo printing and neat end-cut. The diameter of AMT Titanium Wires and Rods can be 0.1-5.0mm.

Our Titanium Powders are highly spherical with few satellite and porosity. The oxygen and other contaminants are very low and the particle size distribution is tailable.

With innovativeness, strictly quality control, competitive price and extensive technological expert, we are committed to high quality customer demand and can always keep high quality owing to consistent process and quality management. New plant for unique patent processes and products is under construction.

ADMA Products, Inc.
+1-330-650-4000

www.admaproducts.com

ADMA Products Inc. is AS9100 registered fully integrated manufacturer of ADMA Hydrogenated Titanium Powder, ADMATAL® net shape and near net shape powder metallurgy titanium and titanium alloy products. These products, produced by ADMA under its proprietary and patented “solid state” (non-melt) consolidation processes, meet all critical specifications and standards, including Aerospace Materials Specifications (AMS). Components made from ADMA Hydrogenated Titanium Powder are characterized by high purity, refined microstructures, low oxygen content, excellent “weld-ability”, low energy input, almost 100% “buy to fly ratios”, low cost, and performance that is superior to those of titanium ingot based products. ADMA additionally specializes in stainless steel, nickel, niobium, zirconium and other advanced materials produced by powder metallurgy processes.

Akrapovič Titanium Castings LLC
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www.akrapovic-foundry.com

Akrapovič is a producer and supplier of Titanium investment casting and carbon-fiber composites products. With many years of experience and constant development in the Titanium processing industry we can offer our customer high quality build to print products out of required certified material, precision and flexible delivery time and full service approach of our high specialized team support.
Titanium Buyers Guide (continued)

ALD Vacuum Technologies GmbH
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info@ald.vt.de

ALD Vacuum Technologies – High Tech is our Business

ALD is a worldwide leading supplier of advanced furnace systems for melting, casting, coating and heat treatment of metals under vacuum.

ALD furnaces are used for the production of especially pure and specially alloyed metals, materials and parts. Our customers are comprised of the leading manufacturers of materials used in aerospace, energy, semiconductors, medical and commercial markets for a variety of applications that require those super-alloys, reactive and refractory materials as well as rare earth and powder materials.

ALD Vacuum Technologies also is the industry leader in EB PVD Thermal Barrier Coating Systems and our Precision Casting Systems are used for super-alloy, Titanium and Ti Aluminide cast parts. Our expertise in heat treatment furnace technologies and sintering furnace technologies are utilized by leading automotive manufacturing companies as well as the tool manufacturing industries for highly critical parts in gear case and fuel injection systems and specialty tools.

ALD has worldwide representation and services through wholly owned subsidiaries in North America, Japan, Russia, Mexico, India, Thailand, Poland, France and China. With more than 20 representatives across the globe, working together with nearly 400 employees at our corporate headquarters in Hanau, Germany ALD is able to provide timely and knowledgeable services and support.

ALD is part of the AMG, Advanced Metallurgical Group N.V., Netherlands, a public listed technology company with leading market position and interesting growth potential.

Alloy Works, Inc.
704-645-0511 ext. 118
JWoock@Alloyworks.com
Todd.Tomczyk@timet.com

Alloy Works, a TIMET company, specializes in plasma cold hearth melting titanium aluminides, standard titanium alloys, and CP. AlloyWorks products are used to produce parts in aerospace, industrial, and military applications. AlloyWorks is AS9100, ISO 9001 certified and holds approvals from several leading engine companies.

Alloy Metals Company
562-219-7831
www.alloymetalsco.com
moe@alloymetalscompany.com

Alloy Metals Company is a full line distributor and key supplier of aerospace, defense and industrial grade titanium and other hard alloys.

Ampere Scientific
www.amperescientific.com

Ampere Scientific is the manufacturer and distributor of the VARmetric measurement system, seamlessly integrating existing process measurements and passive sensor technologies to monitor and visualize arc locations during the melting process. VARmetric couples with standard process signals to evaluate process dynamics and correlate this data with product quality measures. Thus, for the first time ever, the VARmetric system allows the user to visualize and act upon deleterious operating conditions, conditions that are not apparent in traditional VAR monitoring systems, during melting, conditions that could lead to safety related operations or defect formation.

American Prosthetic Components

American Prosthetic Components is a manufacturer of prosthetic components.

American Titanium Works LLC
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www.americantitaniumworks.com
Vincent.rocco@ametek.com

American Titanium Works LLC is completing plans to build a new, green-field, integrated, world-class titanium manufacturing facility in the southeast of the United States. ATW is targeting the defense, industrial, commercial, consumer and emerging markets with a range of products and services including alloy and commercially pure titanium plate, bloom, billet, slab, and ingot.

Applications for our products will include defense ballistics and general military equipment construction, chemical processing equipment, oil & gas systems, pulp & paper production facilities, medical implants, and a wide and growing range of consumer goods.

Reading Alloys
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Reading Alloys is one of the world’s premier manufacturers of high quality master alloys as well as titanium metal powders. Our products are approved for use in critical aerospace and medical applications that require the most stringent quality requirements and demand the highest purity.

MASTER ALLOYS
Reading Alloys produces a wide variety of master alloys comprised of vanadium, molybdenum, niobium, chrome, and aluminum among other elements. Critical applications include:
• Rotor grade titanium
• Aerospace and non-aerospace grade titanium
• Vapor phase aluminizing (VPA)
• Commercial metals
• Super alloy metals applications

HYDRIE-DEHYDRIE (HDH) TITANIUM POWDERS
Reading Alloys manufactures high purity hydride-dehydride (HDH) titanium powders:
• Thermal Spray/Medical Powders - Ti sponge, Cp Ti, and Ti 6Al/4V
• Ti powders for Powder Metallurgy (P/M) applications
• Ti powders for sputtering targets
• Advanced Coating Alloys Al/Cr, Al/Co, CODEP
In addition, a series of gas-atomized specialty powders for hard-facing, brazing, and thermal sprays further complement the product offerings.

ADVANCED MANUFACTURING PROCESSES

Reading Alloys is known for its superior expertise in the following processes:
- Aluminothermic smelting
- Induction melting
- Vacuum sintering
- Toll melting
- Cold isostatic press (CIP)
- Hydride/dehydride (HDH)

Our quality system is certified to ISO 9001:2008 and AS9100C and we have a fully accredited lab that is NADCAP certified.

For the widest product portfolio, unsurpassed reliability, and unmatched technical expertise, trust Reading Alloys.

Reading Alloys, AMETEK Eighty Four, Fine Tubes, Superior Tube, Hamilton Precision Metals and AMETEK Wallingford – all leading manufacturers of advanced metallurgical products, such as powder, strip and tube – form the AMETEK Specialty Metal Products division.

Arcam Group

Arcam Group provides cost-efficient Additive Manufacturing solutions for production of metal components. Arcam’s Electron Beam Melting (EBM®) technology offers design freedom combined with excellent material properties and high productivity. Arcam provides Electron Beam Melting systems through Arcam EBM in Sweden, powder metals through AP&C in Canada and implant contract manufacturing through DiSanto in the U.S.

Architectural Titanium LLC

+1-785-842-2299
www.architecturaltitanium.com

Architectural Titanium provides the most experienced consultants for worldwide applications in architecture, art and design. We look forward to the opportunity to share our expertise and support your design concepts through the entire process of samples, details, specifications, procurement, fabrication and installation.

Aries Alloys

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India’s leading Stockholder of Titanium, Nickel Alloys & Stainless Steel Mill Finished Products, Re-Usable & Scrap.

ARIES Manufacturing

+1 704-289-8531
www.aries-manufacturing.com

ARIES Manufacturing: ARIES Manufacturing, formerly marketed as The Cyril Bath Company and ACB Company, is part of an International corporation known as the ARIES Alliance. This group of aerospace focused businesses provides innovative metal forming and joining solutions to the aerospace industry. The foundation of its technologies is stretch forming of aluminum alloy sheet for fuselage skins, as well as aluminum and titanium profiles for airframe structure components. The company’s stretch presses are equipped with the latest CNC control systems, designed and developed by its in-house software engineers. Our stretch forming customers include the leaders in commercial and business aircraft manufacturing, in addition to their complete supply chain network.

ARIES Manufacturing has developed a very innovative Hot Stretch Forming process, or HSF®, to contour titanium profiles for airframe component applications. This high temperature forming process precisely stretch forms titanium extrusions to the exact part design contour. The hot stretch formed part is then machined and finished into a critical airframe component. This valuable forming process saves starting titanium weight by offering a near net profile solution; contoured in a controlled, repeatable process, with minimal residual stress. In addition, under ARIES Manufacturing, we hot form and superplastic form titanium sheets for applications in nacelle and pylon components. Our facility in Nantes, France operates 12 hot forming/Superplastic Forming presses of varying sizes. Additionally, we can laser or machine trim, spot weld, hot brake form, and perform assembly work. All of our hot presses are designed and built within our corporation businesses. Finally, ARIES manufacturing has a facility in Grenoble, France that can perform pocket milling and final trimming on large aluminum alloy fuselage skins. This contract manufacturing work utilizes our internal expertise and design engineering of a very innovative “mirror milling” type CNC machining center.

Tel: +1 704-289-8531 • www.aries-manufacturing.com

ATI

+1-412-394-2800
www.ATImetals.com
inquiries@ATImetals.com

ATI is a global manufacturer of technically advanced specialty materials and complex components. We are a market leader in manufacturing differentiated specialty alloys and forgings that require our unique manufacturing and precision machining capabilities and our innovative new product development competence.

Our capabilities range from alloy development, to melting and hot-working, through highly engineered finished components. We are also a

Arconic

+1-231-894-7330
www.arconic.com

Arconic (NYSE: ARNC) creates breakthrough products that shape industries. Working in close partnership with our customers, we solve complex engineering challenges to transform the way we fly, drive, build and power. Through the ingenuity of our people and cutting-edge advanced manufacturing techniques, we deliver these products at a quality and efficiency that ensure customer success and shareholder value. For more information: www.arconic.com. Follow @arconic: Twitter, Instagram, Facebook, LinkedIn and YouTube.
leader in producing nickel-based alloy and titanium-based alloy powders for use in next-generation jet engine forgings and additive manufactured products.

Creating Long-Term Value Thru Relentless Innovation®

Follow ATI: LinkedIn, Facebook and Instagram.

Avon Metals Ltd.
+44-1452-874500
www.avonmetals.com

Avon Metals are a primary & secondary aluminum smelter manufacturing high performance aluminum-based master alloys and alloying products for the wrought aluminum, titanium and superalloy industries. We are actively engaged in the strategic sourcing & trading of primary and scrap metals for industry including Titanium CP & 90/6/4 solids & turnings, Titanium sponge, Strontium Metal, Electrolytic Manganese Flake, Silicon Metal, Aluminothermic Chromium Metal, Primary Magnesium, Hafnium Crystal Bar and ingot, Zirconium/Zircalloy, SHG Zinc, Pure Tin ingot, Pure Lead Shot, Rhenium Pellets, Tantalum and Niobium.

BAHCO
+1-800-446-7404
www.snapon.com/industrialbrands
industrialbrands@snapon.com

Bahco’s 3860 Multi Chip Carbide bandsaw blade has been developed specifically for cutting Titanium Alloys. The 3860 Multi Chip Carbide blade improves and optimizes Bandsaw operation with a World leader in Cutting Technology. In the 1980’s Bahco developed and Patented the first “Set Tooth” Carbide Bandsaw blade to provide fast, efficient cutting of exotic alloys and have led the way in this sector ever since.

Bahco is a registered trade name of Snap-on Incorporated a leading global innovator, manufacturer and marketer of tools, diagnostics, and equipment, software and service solutions for professional users. Products and services are sold through the company’s franchisee, company-direct, distributor and Internet channels. Founded in 1920, Snap-on is a $2.8 billion, S&P 500 Company headquartered in Kenosha, Wisconsin. Our Mission - The most valued productivity solutions in the world. Snap-on Incorporated P.O. Box 1410 Kenosha, WI 53141-1410, U.S.A. 262-656-5200.

Banner Medical
+1-800-323-9732
www.banner-medical.com
dstoettner@banner-medical.com

Banner Medical specializes in providing complete single-source cold finished bar, plate, sheet and supply chain solutions for the medical, dental, and aerospace industries. We carry over 1 million pounds of raw and finished goods inventory to service our customers quickly. Our complete offering of stainless, titanium, aluminum, alloy, nickel and cannulated products coupled with unique value-added services sets Banner Medical apart. Some of these unique value-added services include:
- Custom supply chain management solutions
- Complete traceability from melt source to finished product
- In-house non-destructive testing

Banner Medical apart. Some of these unique value-added services include:
- Vendor managed inventory (service) and JIT programs
- Line marking
- Niton Gun material analysis
- Near-net shape machining
- Precision saw cutting
- Waterjet cutting

Quality Throughout
Each Banner facility is ISO 9001: 2008 certified. Medical production facilities are ISO 13485:2003 certified. Our Carol Stream facility is also AS9100C: 2009 certified

Baoji JHY Titanium Industry Co., Ltd
+86 917 3372 996
stella@ti-bolts.com

Baoji JHY Titanium Industry Co., Ltd was founded on 25-09-2002. It is a professional manufacturer for titanium and titanium alloy fasteners and machined products. We can produce them according to different standards, like GB, ISO, DIN, ANSI and JIS etc. They are widely used in petroleum, metallurgy, chemical, pharmacy, marine engineering, racing car, motorcycle, bicycle, yacht, outdoor camping and sports equipment.

Our company insist the “Quality First” strategy rather than “Low priced” one to earn trust from customers, which has been proved correct after 15 years in this industry. Now over 85% our products are exported to Japan, United States, United Kingdom, Germany, Netherlands and other European countries.

Baoji Titanium Industry Co., Ltd
+86 917 3382 075
www.baoti.com
iedept@baoti.com

Baoji Titanium Industry Co., Ltd (Baoti) is the biggest manufacturer of titanium mill products and titanium alloys in China. An integrated production system that includes melting, forging, rolling, drawing and fabricating enables Baoti to manufacture various products such as titanium sponge, ingot, billet, bar, wire, plate, sheet, tubing, forging, casting of all grades of CP titanium and most titanium alloys as well as many down-stream products in accordance with AMS, ASTM, MIL, ASME, ISO, DMS, AWS, JIS specification. These products are widely used in every kind of industry ranging from aerospace and automotive to sports, medical, chemical and petrochemical industries. Baoti is an ISO9001 and NADCAP approved company.

Baosteel Special Metals Co., Ltd.
+86-021-26032903
www.baosteel.com

Baosteel Group is the largest and most advanced integrated steel company in China. Baosteel Special Metals Co., Ltd is a subsidiary company of Baosteel Group. Baosteel Special Metals Co., Ltd grew out of Shanghai No. 5 Steel Works, and started manufacturing of titanium alloys since 1968. The main titanium products include: ingot, slab, billet, bar, plate, coil, stock, isothermal forging and so on.
Beijing Hongda Titanium Science & Trade Co., Ltd
+86-10-82274866
www.chinabti.com.cn

Beijing Hongda Titanium Science & Trade Co., Ltd was established in 2002, and is located in Beijing, China. We are a professional manufacturer of titanium and titanium alloy. Our products mainly include sheets, plates, bars, strips, rods, wires, forgings, and processing titanium. As a leading corporation of titanium in China, we always stick to “Quality First”. We have ISO 9001:2008 quality certificate. We sincerely hope to establish long and friendly business relations with clients from all over the world.

BHN Special Materials Ltd.
+86 411 8924 9999 ext 8088
www.bhn-materials.com
sales@bhn-material.com

BHN special Materials Ltd. is a leading high quality master alloy producer in Dalian, P.R. China. BHN is certified according to EN9100:2009 and ISO 9001:2016.

BHN provides the full range of Vanadium, Molybdenum, and Niobium containing binary alloys for the Titanium Industry for aviation, military, and medical application in China and abroad.

The expertise of BHN is to supply tailor-made multinary master alloys well designed to simplify the customers’ manufacturing process to improve their competitiveness. To learn more about BHN, please visit our website at http://www.bhn-materials.com

BIBUS METALS
+41 44 877 54 11
www.bibusmetals.com
info@bibusmetals.ch

BIBUS METALS Group is 100% Swiss owned and since 1979 a leading distributor and stockholder of Titanium (CP and Titanium alloys) as well as Nickel based alloys, Cobalt-Chromium and 316LVM (1.4441) in Europe and Asia. BIBUS METALS Group is a supplier for different applications in medical, chemical, aerospace, automotive, oil & gas, power generation industries and offers:

Sheets/Plates; Wire/Bars; Tubes/Pipes; Strip/Foil; Welding wire; Screw/ Nuts; Profiles

The fully integrated Service Centres are located in Switzerland, Germany, Czech Republic, Poland, Hungary and China to ensure reliable and rapid service for customers worldwide.

Where necessary the entities of the Group are certified according ISO 9001, EN/AS 9120 for aerospace and EN ISO 13485 for medical. Quality, flexibility and tailored solutions are of great importance for the whole BIBUS METALS Group.

For further information please email to info@bibusmetals.ch

Blaser Swisslube Inc.
+41 34 460 01 01
www.blaser.com
m.hensel@blaser.com

Blaser Swisslube AG is an independent and family-owned Swiss company founded in 1936. Blaser Swisslube is represented in more than 60 countries on all continents. The company develops and produces high-performance cutting fluids for customers who manufacture tiniest to large titanium components as well as critical and structure components, particularly for aerospace and medical. Blaser Swisslube’s goal is to optimize manufacturing processes and to improve their economic efficiency, productivity and machining quality. In close cooperation with the customers Blaser Swisslube presents new solutions to fully exploit the potential of machines and tools by using the right metalworking fluid which becomes a liquid tool. This promise is backed by excellent products, customized services, competent experts and its long experience in the metalworking industry. For more information please visit www.blaser.com.

Bodycote
+1-310-604-8000
www.bodycote.com

With more than 170 locations in 21 countries, Bodycote is the world’s largest provider of thermal processing services. Through heat treatment, metal joining, surface technology and Hot Isostatic Pressing (HIP), Bodycote improves the properties of metals and alloys, extending the life of vital components for a wide range of industries, including aerospace, defense, automotive, power generation, oil & gas, construction, medical and transportation. Customers in all of these industries have entrusted their products to Bodycote’s care for more than 30 years. For more information, visit www.bodycote.com.

Busch Vacuum Pumps and System
1-800-USA-PUMP
www.buschusa.com
info@buschusa.com

Busch Vacuum Pumps and Systems is a leading manufacturer and retailer of vacuum pumps, blowers, compressors and customized systems using vacuum technology. Busch offers over 50 years of experience and the largest selection of industrial vacuum pumps available today to meet the demand for vacuum and pressure technologies in every industry.

Busch USA is one of 61 subsidiaries within the global family-owned Busch Company that has been managed by members of the Busch Family since its inception in 1963. Due to this, Busch USA has also adopted a family-owned business approach to serving our customers. Busch USA is comprised of our Busch LLC Sales Company and Busch Manufacturing LLC Company, both headquartered in Virginia Beach, Virginia, which is also home to our engineers, product specialists, customer service professionals and manufacturing teams dedicated to quality and innovation. Busch USA is a networking hub of factory-owned service and distribution centers and representatives.
CEFIVAL and SIDERVAL manufacture special sections and tubes with hot extrusion process to obtain near net shape Profiles. The shapes are studied and manufactured according to customer’s requirements in a wide range of solid and hollow sections. Our manufacturing process improves the buy to fly ratio. Main grades are titanium, inconel, carbon steel alloys, super alloys, stainless steels and other on requirement. Main application fields are aeronautics for aircraft ring engines (CFM56, GE90, GP7000, CF6-80, SM146, Gen X) and structural parts (such as seat tracks, floor and wings stiffeners, door hinges...), Power Generation for nuclear (ia drive rods) and conventional applications, medical and food industry.

**Chaoyang Jinda Titanium Co., Ltd.**

+86 421 2976177

[www.jinda.cc](http://www.jinda.cc)

Chaoyang Jinda Titanium Co., Ltd. (Jinda Titanium) was founded in August, 2006. The main products are Jinda brand titanium sponge (famous brand products in Liaoning Province) and titanium ingot and other processed products. Production ability per year for titanium sponge is 10,000 tons, for ingot is 2000 tons and 40,000 tons for anhydrous magnesium chloride.


The quality of Jinda titanium sponge is stable. Self R & D MHT-90 high-quality titanium sponge and small size titanium sponge have become the preferred raw materials of aerospace and defense, marine engineering and other high-end usage of titanium industries.

Jinda Titanium is a member of the International Titanium Association, the vice managing director of Chinese non-ferrous metal industry association titanium zirconium Hafnium Branch, the vice managing director of Titanium Industry Progress and the director of Baoji Titanium Association. Jinda Titanium comprehensive ranks forefront in titanium industry.

**Chesapeake Industrial Cleaning Products, Inc.**

+1-410-340-9052

[www.chesapeakeindustrial.com](http://www.chesapeakeindustrial.com)

Chesapeake Industrial formulates and supplies manufacturing chemicals and degreasers to titanium recyclers and processors. Cleaners for removing oil from turnings, dirt and oil from scrap, cutting fluids from formed products and other typical operations are our expertise. Chesapeake provides a wide range of formulated products from general cleaners to high spec materials made at facilities in several US locations. Products specifically designed for individual operations can be formulated for costs often lower than ‘off-the-shelf’ materials. Chesapeake has served customers in the titanium industry for over 10 years. Drums, Totes and Bulk deliveries of materials are all available.
China Huaxia Special Metal Limited
0086-21-58770128
helen@nonferrous-metal.com  csm@nonferrous-metal.com

China Huaxia Special Metal Limited is one of the largest manufacturers of titanium, nickel & nickel alloy, stainless steel/duplex & supper duplex with forms at sheet/plate, seamless tube/pipe, bar/rod, wire, welded pipe, seamless & welded fitting, flange, valve, clad material etc. With the logo CSM (China Special Metal), we hope to be the best one of special metal manufacturer in China. CSM always treat the quality as our life. CSM invest the quality and future. CSM material have been widely used in oil & gas industry, chemical industry, construction industry, sports industry etc, many big companies in these field have approved CSM material. CSM took the pride in CSM titanium sheet used in 2012 London Olympic Village decoration, CSM has the mission to be the enterprise to improve the position of Chinese titanium products in the international market.

China Steel Corporation
+886-7-802-1111

China Steel Corporation provides high quality titanium products, including ingot, plate, sheet, bar, wire coil and tube, for a wide range of applications in architecture, chemical industry, heat exchangers, copper foil facilities, fasteners, desalination, electronics, sports industry, leisure and moving forward to biomedical and aerospace application.

The stable and reliable quality of CSC’s titanium products have gained the acceptance of Asia industries widely, and CSC has also been selected as the first priority provider to purchase their needed titanium materials owing to CSC’s quick and efficient technical services. CSC will continue to improve customer services and the technical technologies both for customers and CSC itself to promote Titanium Alloy products' international competitiveness.

Cogitic Corporation
www.cogitic.net

Cogitic is an engineering and manufacturing company specializing in the machining, assembly and test of complex components and assemblies produced from exotic alloys. Large 5-axis capability with full CMM validation of all products.

Consarc Corporation
+1-609-267-8000
www.consarc.com
sales@consarc.com

Consarc Corporation, an Inductotherm Group Company, is a manufacturer of vacuum furnaces for the titanium forging and casting industry. Consarc custom designs and manufactures Reactive Vacuum Arc Remelting (RVAR) furnaces for primary electrode melts of compacted sponge titanium and titanium alloys, and secondary melt furnaces for remelting fully dense electrodes. Consarc also designs and manufactures fully customized Induction Skull Melting (ISM) systems for melting titanium in a refractory free environment for casting or ingot withdrawal. Consarc ISO 9001-2008 certified, and with operations on 5 continents, is well equipped to tackle fully customized furnace projects globally.

Continental Steel and Tube Company
+1-954-332-2290
www.continentalsteel.com

Continental Steel and Tube Company is one of the world’s leading value added volume suppliers of quality metals. With an outstanding global reputation, our team of expert sales associates can supply a comprehensive inventory of metals to meet any application requirements.

Continental Steel supplies a wide range of metals including, titanium, stainless steel, nickel, steel, aluminum, hot/cold rolled, galvanized, and stainless and electrical steel in carbon and alloy grades. Our long list of Titanium Grades includes CP4 Gr1, CP3, Gr2, CP2Gr3, CP1 Gr4, Gr7, Gr5 Ti 6AL-4V, Gr6, Gr9, Gr 12, Gr 19 (Beta C) & Gr 11. Our materials are available in tubing and pipes in either seamless or welded, coils, sheets, strips, plates, angels, bars, rounds squares, hexagons, and other custom shapes.

Cristal Metals Inc.
+1-815-221-2281
www.cristalmetals.com
itp.billing@cristal.com

Cristal Metals was formed in 1997 as International Titanium Powder (ITP) to develop and commercialize Armstrong Process® patented and proprietary technology for high purity metal and alloy powders with specific emphasis on titanium. Armstrong Process® technology is intended to lower the production cost of powders suitable for direct consolidation, to lower the manufacturing costs of titanium products through powder metallurgy processing, and to reduce the environmental impact of titanium production.

CSIRO High Performance Metal Industries
+61 3 9545 8644
leon.prentice@csiro.au

The High Performance Metal Industries Program is engaged in applied research across the metal value chain, specialising in novel metal production techniques, interfaces/corrosion, energy systems, metal forming, and additive manufacturing / 3D printing, particularly for Titanium and its alloys. Strong Multiphysics modelling techniques are combined with practical experimentation to understand and develop advanced solutions for global industry. HPMI partners with industry and other research providers around the world, in applied research or to develop new technologies. HPMI also provides consulting services, use of specialized facilities, additive manufacturing training, and aims to be a global leader in the knowledge and application of fundamental metals technologies. It runs CSIRO’s ‘Lab22 Innovation Centre’ – the largest metallic additive facility in the Southern Hemisphere. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is Australia’s primary national research body, with over 5,000 researchers active over a wide range of fundamental and applied research challenges.

Cumberland Highstreet Partners
http://cumberlandhighstreet.com

Formed in London in 2016, Cumberland Highstreet Partners was
Titanium Buyers Guide (continued)

created in response to the need for executive leaders to have access to a team of proven, experienced professionals who possess a deep domain knowledge of manufacturing. We bring accomplished and creative industry experts to the table who have personally led significant organizations. We are executives with proven track records of successfully navigating the ever-changing needs and requirements of industry.

Custom Marine
920-450-9939
www.custommarine.com
cmorth@custommarine.com

Manufacturer of titanium exhaust systems. Every CMI header is built to exacting standards that have made them the number one choice for offshore racers and performance-oriented boaters who demand on-water performance. CMI headers are manufactured using state-of-the-art materials, like Titanium, 316L Stainless, Inconel and duplex alloys offering superior corrosion resistance and durability. A unique, patented bending process assures uniform wall thickness and eliminates any ripping and crazing of the tubing during production. Semi-automated tungsten inert gas welding, plus heat treating (where applicable) of the complete manifold following assembly, significantly reduces internal stresses that commonly cause fatigue, corrosion and premature failure in most high performance applications. To complement its header systems, CMI also manufactures machined components, custom exhaust accessories and integral mufflers for virtually any engine configuration. With CMI, boaters get a combination of performance and reliability unparalleled by any competitive products on the market.

Danobat S. Coop
+34 943 748 177
www.danobatcuttingsolutions.com www.danobatgroup.com
sales@saws@danobat.com

Sixty years have gone by since DANOBAT manufactured its first machine. Nowadays, DANOBAT Sawing Division does not simply make saws, but innovates in the field of machine tools.

DANOBAT strategy is to offer custom solutions for highly complex sawing applications on high-tech products offering bandsaws and circular saws. The aerospace, automotive, railway, wind power, oil and gas sectors and outsourcing workshops are the main trading sectors.

The technological leadership of DANOBAT in the development and manufacture of horizontal and vertical saws makes it possible to offer leading-edge and highly effective sawing solutions to our customers.

DANOBAT provides solutions for solid bars, pipes and plates with the highest accuracy.

Automatic band saw machines, wagon style or gantry for large dimensions, vertical plate bandsaws and circular saws are the solutions offered by DANOBAT.

DHL Drawback Services
+1-585-328-7130
www.dhldrawback.com

DHL Drawback Services is a licensed Customhouse broker specializing in duty drawback matters. With offices in Houston, Texas and Rochester, New York, we have over 20 years’ experience obtaining the maximum in allowable duty drawback refunds and excise tax credits for our clients in a compliant, timely, thorough, and professional manner that imposes the least amount of administrative burden on our client’s time and resources.

DKSH Switzerland Ltd.
+41 44 386 72 72
www.dksh.com
ti@dksh.com

Pioneers in sourcing of Titanium bars and plates from Japan and China: DKSH Advanced Metals is part of a Swiss group with 140 years of experience in bridging Asia and the West. For the last 30 years, we have been instrumental in introducing high quality titanium and titanium alloys from top quality Japanese and Chinese producers to European, US and South East Asian customers. We serve stockists as well as end users in the Medical, Aerospace, Automotive, Chemical, Oil & Gas and other high tech industries. Our wide range of services includes access to a comprehensive stock of Ti semi-finished products, advanced supply chain management such as vendor managed inventory and subcontracting for machining and forging, tailor made financing solutions and metallurgical expertise. Our deeply rooted knowledge of sourcing and subcontracting markets coupled with our Swiss sense for premium quality ensures that we remain at the forefront of innovation when it comes to serving your needs.

Duferco SA

Duisburg Tubes Production AG
+49 203 6003 315
www.dtp-ag.eu
sales@dtp-ag.eu

The Duisburg Tubes Production AG is a German manufacturer and developer of high quality seamless tubes made of zirconium, titanium and nickel-based alloys with over 50 years of experience.

As a supplier of cladding tubes for fuel rods for the nuclear industry the DTP AG is the reliable partner for all demanding applications. To fulfill all quality requirements is the second nature.

The range of application is as mentioned before the nuclear industry. Moreover the use in all kinds of tubular heat exchangers, in the aviation industry, in the chemical industry, in the oil and gas industry, in the food processing industry and many other demanding environments.

The cold pilger mill seamless tube production is a special form of cold rolling and guarantees high precision and close tolerances. The combination of pilger know-how and the sophisticated annealing knowledge leads to an extraordinary product quality.

The quality management system is conform to ISO 9001, ISO 5001, ISO 14001 and EN 9100.
**Titanium Buyers Guide (continued)**

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**Edge International**
+1(937) 395-7222  
[www.edgeintl.com](http://www.edgeintl.com)

Edge International, located in Dayton, Ohio, is an ISO 13485-certified stocking distributor of raw materials, specializing in medical grade Cobalt-alloys, Stainless Steels and Titanium for the manufacture of implants and instruments for the orthopaedic, spine and trauma markets. Edge works with its customers to provide cost-effective solutions and concentrates on the medical market to ensure the highest level of compliance, quality and service. Value-added services include precision grinding to size and tight tolerances, precision sawing, non-standard grades and sizes, and just-in-time inventory programs. Edge conducts business internationally, supplying to customers around the globe.

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**ELG Utica Alloys, Inc.**
+1-315-574-1680  
[www.elguticaalloys.com](http://www.elguticaalloys.com)

EUA is one of the world’s largest Titanium, Nickel and Cobalt alloy recycling companies. We operate under the tightest quality standards, utilize the latest equipment, offer unparalleled service, are fed by over 40 sister yards worldwide and have the financial backing of ELG Haniel GmbH.

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**Evraz Stratcor, Inc.**
+1-312-533-3650  
[www.evrazstratcor.com](http://www.evrazstratcor.com)

EVRAZ Stratcor offers titanium producers one-stop shopping for all their master-alloy requirements. Using a state-of-the-art, ISO approved production facility that is focused on meeting the ever-increasing quality needs of the aerospace industry, we can provide a full range of vanadium and other master alloys, including innovative and customized specialty alloys that are marketed and managed by EVRAZ Stratcor, Inc. based in Chicago, Illinois.

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**EWI**
+1-614-688-5000  
[www.ewi.org](http://www.ewi.org)

EWI is the leading engineering and technology organization in North America dedicated to developing, testing, and implementing advanced manufacturing technologies for industry. Since 1984, EWI has offered applied research, manufacturing support, and strategic services to leaders in the aerospace, automotive, consumer electronic, medical, energy, government and defense, and heavy manufacturing sectors. By matching our expertise to the needs of forward-thinking manufacturers, our technology team serves as a valuable extension of our clients’ innovation and R&D teams to provide premium, game-changing solutions that deliver a competitive advantage in the global marketplace. To learn more, visit www.ewi.org, email info@ewi.org, or call 614.688.5000.

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**Exova**
[www.exova.com](http://www.exova.com)

Exova Group plc is a leading provider of laboratory-based testing and related advisory services, operating primarily within the Testing segment of the Testing Inspection and Certification (“TIC”) sector.

Exova has been hired to do the autoclave work for the NACE MRO175 testing of Gr 12 project by the ITA industrial committee.

By joining the ITA as a Vendor member Exova would become an active participant in the ITA committee dedicated to industrial applications.

Exova would also benefit from discounted registration at the annual events, would receive a complimentary company description in the membership directory and would be able to take advantage of a variety of other ITA membership benefits.

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**FAE S.A.**
54-11-63261493/94/95  

fae@conuрафae.com

FAE is an Argentinean company qualified by Airbus for supplying hydraulic titanium Ti-3Al-2.5 tubing for Family 320. Also is the first Latin-American company in getting a tier one contract with EADS group. One of its main activities, apart from aerospace, is the manufacturing of seamless commercial pure titanium and titanium alloy tubes straight or U bend for heat exchangers which are up to 35 meters long. These tubes are also made in nickel alloys 690 & 800 for steam generators for nuclear power plants. The nuclear business is the origin of the company and the Zirconium cladding tubing for the nuclear fuel elements constitutes the main product of the company. It also produces ingots and bars in titanium alloys and bright annealed finish seamless instrumentation titanium tubes (O.D ¼” up to 5/8”). FAE is certified according UNE EN 9100: 2009, ISO 9001: 2008, ISO 14001: 2004, OHSAS 18001: 2007, PED 97/23/EC & CSA N285.0 standards. Its products are exported to countries all over the world and they are used in aerospace and corrosion resistant applications. Now also NADCAP certified company for heat treating and non-destructive test.

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**FE Mottram Ltd.**
+44 1142446723  
[www.femottram.com](http://www.femottram.com)

UK manufacturer of tailor-made and high grade ferro titanium.

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**Fine Tubes**
+44 (0)1752 876416  
[www.finetubes.com](http://www.finetubes.com)

sales.finetubes@ametek.com

Fine Tubes, part of AMETEK Specialty Metal Products, is a leading global manufacturer of precision tubing in high performance titanium, stainless steel, nickel and zirconium alloys.
The company manufactures tubes in both seamless and welded forms used in critical aerospace applications for the civil aircraft, defence and space sectors.

**TITANIUM TUBE EXPERTISE**
- Seamless titanium tubes from 1 mm (0.040 in) OD to 50 mm (2 in) OD
- Straight lengths up to 5.5 metres (18 ft.)

**TITANIUM ALLOYS**
Fine Tubes offers a comprehensive portfolio of titanium tubing in the following alloys:
- Ti CP (Grade 1), Ti CP (Grade 2), Ti 6Al/4V (Grade 5), Ti 3Al/2.5V (Grade 9), Ti 5Al/4V and Ti 4Al/2.5V.

The tube mill has achieved NADCAP approval for Ultrasonic Testing, Heat Treatment, Fusion Welding, Chemical Processing and Fluid Distribution Systems.

**WORLD CLASS FACILITY**
Based in the United Kingdom, Fine Tubes operates several state-of-the-art titanium processing facilities including:
- Pilger Rolling Mills
- Draw Benches
- Vacuum Furnace Heat Treatment
- Chemical Processing and Conditioning & Degreasing

**AEROSPACE APPLICATIONS**
Critical hydraulic, mechanical and structural applications include:
- Hydraulic and pneumatic control systems
- Aerospace Engine tubes
- Instrumentation and transmission tubing
- Mechanical tubes
- Actuation

Fine Tubes, Superior Tube, Hamilton Precision Metals, AMETEK Wallingford, AMETEK Eighty Four and Reading Alloys – all leading manufacturers of advanced metallurgical products – form the AMETEK Specialty Metal Products division.

**Flowserve**
(972) 443-6500
www.flowserve.com

Flowserve manufactures and services fluid motion control solutions for the world’s toughest, most critical applications.

For the biggest challenges of fluid motion control, customers worldwide rely on the engineering, project management and service expertise of Flowserve. We deliver more than the most complete portfolio of reliable valves, pumps and seals available.

**EXPERIENCE IN MOTION**
Our global team of more than 18,000 employees in 55 countries can put together the total solution— from project planning to lifecycle maintenance programs to some of the most proven technology on the planet. All so you can get more from your capital investment. Exceed your operational goals. And always come through, when failure is not an option.

**Forecreu**
World leader in high speed steel hollow bars for drills and coolant fed taps.
World leader in cannulated bars in stainless steel and titanium for surgical tools and implants.

**Fort Wayne Metals**
+1-260-747-4154
www.fwmetals.com
info@fwmetals.com

Fort Wayne Metals has a long history of producing precision titanium bar, wire and wire-based components for demanding applications. For many years, our efforts focused exclusively on the medical device industry. But our skills are just as valuable in aerospace applications.

After all we understand the critical importance of quality; our employees have experience producing materials for applications designed to save lives. We uphold the highest quality standards throughout our production process – beginning with melting material in our own furnace. We are 9100C and ISO 9001 certified, and maintain an A2LA - ISO/IEC 17025 compliant Materials Testing Laboratory.

Available diameters:
- Wire: 0.001” (0.0254mm) to 0.062” (1.5748mm)
- Coil: 0.040” (1.016mm) to 0.500”(12.70mm)
- Bar: 0.0787” (2.0mm) to 0.500” (12.70mm)

Available grades:
- Commercially pure Titanium (ASTM F-67 · ASTM B348 · ASTM B-863 · ISO 5832-2)
- Grades 1 - 4
- Alloyed Titanium
  - Ti-6Al-4V ELI (ASTM F-136 · ASTM B-348 · ASTM B-863 · ISO 5832-3)

**Friggi N.A.**
+1-519-421-9291
www.friggiamerica.com
info@friggiamerica.com

Friggi N. A. Inc., provides premium metal and aluminum cutting solutions to the North American market. With over 70 years manufacturing experience we now offer large vertical plate and block saws, high-speed carbide saws, plasma, and waterjet cutting solutions. Within our product line, we offer specialized equipment to cut challenging materials like Titanium or exotic metals with extreme precision and performance. Our plate saw capacity is over 20 feet and our Gantry models will cut blocks up to 140” with minimal material handling. Machines are available in automatic or semi-automatic version to cover any requirement. We service many key market segments including aerospace, automotive, defense, oil and gas, steel service centers, forging and mold makers. Whether the application is to cut ferrous or non-ferrous metals for ingot, bar, block, or plate we offer the best solution for our clients’ production needs.

**G&S Titanium, Inc.**
+1-330-263-0564
www.gs-titanium.com

G&S Titanium manufactures many grades of titanium in the form of round and hex bars, fastener wire, spring wire, weld wire, precision
ground medical bars, and fine wire. This includes the standard grades such as CP Gr. 1-2-3-4, 6Al-4V, 6Al-4V Eii, as well as hard to find alloys such as 3-8-6-4-4, 13-11-3, 6-2-4-2, 8-1-1, Gr. 7, Gr. 9, Gr. 12, 21S, 230, 679, 685, 829, etc.

Gautier Specialty Metals, LLC
814.535.9200
www.gautierspecialty.com
sales@gautiersteel.com

Gautier’s premier plate mill provides rolling capacity for advanced high performance metals to a variety of industries.

At its heart is a 58” wide 4 High Mesta Reversing mill, capable of rolling the most difficult of specialty metals. The mill is expandable to 110” wide in the future. Building on Gautier’s long legacy of short lead times and excellent customer service, GSM will be able to provide high quality alloy, tool and stainless steel as well as advanced nickel based and titanium alloys.

Large Alloy Selection: Alloy & Tool Steel, Stainless Steel, Nickel Based Super Alloys and Titanium

Built for Conversion on a quick turnaround.

GfE Metalle und Materialien GmbH
+49 911 9315 299
www.gfe.com
alloys@gfe.com

GfE, founded in 1911 and being part of AMG Advanced Metallurgical Group N.V., is a leading manufacturer and global supplier of high performance metals and materials.

We offer a wide range of high-quality master alloys that meet the highest technical requirements for different specialized sectors, mainly aerospace, super alloy industry and ship-building.

Furthermore titanium as high-purity HDH powder is produced by GfE for thermal spray coatings. Its specific characteristics offer an advantageous material for porous layers on medical implants.

Our product spectrum is completed by inter-metallic Titanium Aluminum light weight alloys, known as gamma Titanium Aluminide alloys. Its present applications include low pressure turbine blades (LPT) for civil aircraft engines as well as turbocharger wheels for the automotive industry.

GfE is certificated in accordance to ISO 9001, EN 9100, ISO 14001, ISO 50001 as well as BS OHSAS 18001 and operates an accredited laboratory according to DIN EN ISO/IEC 17025.

Global Titanium Inc.
1-313-366-5300
www.globaltitanium.com

Global Titanium is a leading producer of ferrotitanium, titanium scrap products, and titanium HDH powder. Located in Detroit, Michigan, Global Titanium serves the steel, stainless steel, aluminum, and titanium industries. Global Titanium is an ISO 9001:2008 registered company with a strong commitment to safety, quality, and customer service.

GKN Hoeganaes
856-829-2220
www.hoeganaes.com

Hoeganaes Corporation, founded in 1953, has a network of companies encircling the globe. This international focus, combined with our own manufacturing facilities in the United States, Europe and Asia, along with marketing representatives around the world, enables us to serve customers effectively on a global basis.

Since our beginning, Hoeganaes’ primary mission has been simple yet vital: anticipate and serve our customers’ needs. Through the continuing support of our customers, Hoeganaes Corporation has led the industry in developing products and processes that allow the production of parts with more complex geometries, higher densities, and improved dynamic properties.

Hoeganaes Corporation R&D, always market driven, continues to focus on products and processes that respond to industry needs. All of our products are backed by the finest applications support staff in the industry.

Hoeganaes Corporation, with six manufacturing facilities in the United States, Europe and Asia to meet customers’ needs worldwide, continues to invest in programs that expand our product capacity while improving metal powder manufacturing. This ensures that a quality raw materials supply will be readily available well in advance of industry demand.

Goldman Titanium, Inc.
716.823.9900
www.goldmanti.com
info@goldmanti.com

Goldman Titanium, Inc. purchases and processes scrap titanium in order to supply the highest quality finished product to our customers. As a pioneer in the titanium industry, our company was first established in 1955, and we have continuously expanded our business over the years. Titanium is the only metal we handle, making us experts in our field.

Goldman Titanium is certified to ISO 9001: 2008 and AS9100:2009, Rev. C, complying with the rigorous requirements of the aerospace and defense industries. Our company’s products have been approved by major U.S., European, and Asian melters, as well as by master alloy producers, steel and stainless steel producers, and ferro titanium producers.

Grandis Titanium
+1-949-459-2621
www.grandis.com
titanium@grandis.com

GRANDIS TITANUM is an ISO 9001:2008 certified worldwide supplier of titanium products like Titanium Bars, Sheets, Plates and Wire for Industrial and Chemical applications. Company maintains warehouses in Los Angeles and Rotterdam, and USA sales offices in California, Ohio.
Titanium Buyers Guide (continued)

and Oregon. We also have sales offices in South Korea, China, Russia, Belgium and Italy.

Haynes International Inc.
+1-765-456-6000
www.haynesintl.com
rburke@haynesintl.com gspalding@haynesintl.com

Haynes International, Inc., headquartered in Kokomo, Indiana, USA, is a leading developer, manufacturer and marketer of high-performance nickel- and cobalt-based alloys used in corrosion and high-temperature applications. Our highly-trained staff and technicians provide superior customer service, worldwide technical support and one-on-one consultation in selecting the proper alloy for the application. In addition to stocking our standard product forms, our global service centers offer value-added services to shorten your cycle time, reduce material waste and increase your operation’s efficiency. Haynes International is a partner in your entire material management system and provides value far beyond the alloys themselves. Additionally, Haynes produces HAYNES® Ti-3Al-2.5V alloy which is used for aircraft hydraulic systems. Our seamless Grade 9 titanium tubing is produced to AMS 4943, AMS 4944, AMS 4945, SB 338/B 338Gr9 and UNS R56320.

Hempel Special Metals GmbH
+49208 6204 0
www.hempel-metals.com

Hempel Special Metals in Germany is one of the largest stockists for Titanium, Nickel Alloy and Zirconium in Europe with companies in England, Poland, Switzerland, Italy and various sales representatives. Our main businesses are chemical process industry, flue gas desulfurization, oil & gas, medical and watch industry. Besides all standard titanium grades we stock special grades (Grade 4, 5, 5-ELI, 7, 9) in bars, sheet/plates and tubes. Our services include individual stocking, cutting, sawing, plasma, laser- and water jet cutting, individual bar marking and turning. We supply material tailor made and in packages for special projects.

Hi-Tech Alloys, Inc.
+1-925-937-3836

Incorporated in 1982

Hogue Metallography

Services Include:
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- Sample Preparation - metals and non-metals
- Documentation - macro and micro
- Interpretation of Microstructures and metallographic
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- Selection of optimum consumables
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Consulting may be performed on site, in the field, or at my laboratory. Training Courses Offered.

HORIE Corporation
+81-256-66-2237
www.horie.co.jp
a-tanabe@horie.co.jp

Horie Corporation is the world leader at surface engineering of Titanium such as precision coloring, etching, grain controlling and the solution provider to complex titanium fabrications. Horie has developed its original titanium technology using Horie’s electro-chemical technology and surface treatment technology. Our titanium knowledge provides our customers with unequaled solutions in titanium. Horie will continue to develop many new products and search the unlimited possibilities and beauty of titanium.

Inductotherm Corp. - Long Products Division
+609-267-9000
www.inductotherm.com
sales@inductoerm.com
President: Bernard Raffner
Director - Technical: Bert Armstrong
Director – Sales: Andrew Procopio

PRODUCTS and SERVICES - Inductotherm manufactures a complete line of induction heating and boosting systems for titanium slabs, billets, blooms, bars and rods prior to rolling. Other products include vacuum induction melting, holding, pouring, heating and coating equipment for thermal applications in air or controlled atmospheres for the metals industry. Coreless and channel furnaces with capabilities up to 500 tons; power supplies up to 42,000 kW; automatic pouring systems with vision control; computer controls and charge handling systems.

Industrial Metals International Ltd.
+1-631-981-2300
www.industrialmetals.com

IML is a supplier of bar, sheet, tube, wire, rings and forgings in aluminum, titanium, nickel stainless steel, alloy and bronze products. In business for over 40 years, IML is approved by companies such as Rolls Royce, Boeing, Airbus, UTAS, GE, and Pratt and Whitney. Located near JFK Airport in NY, IML is able to offer same day shipping to countries worldwide with no minimum order charge for stock items.

Inteco
www.inteco.at

Being a supplier and partner to the steel and general melting industry since 1973, INTECO is proud to be until today the only single source supplier worldwide who offers and has already put into operation all production processes for the liquid treatment of steel, ferroalloys and super alloys such as:
- Melting (EAF, SAF)
- Refining (LF, VD/VOD, AOD, RH & Auxiliaries)
- Casting (CC, IC etc.)
- Special Melting & Remelting (VIM, ESR, Pressure ESR, ESRR, VAR) and Titanium Production Technologies
- Automation & Level 2 Systems (incl. Titanium-Workshops)
- Consulting Services
Invera
+1-514-925-8558
www.invera.com
peterd@invera.com

Invera is the leading supplier of ERP software for the metal distribution industry. Our STRATIX software provides advanced functions for sales, inventory control, production, shipping and outside processing of specialty metals.

Metal Specifications, Mill Test Certs and third party certificates can be controlled within STRATIX and as required emailed to customers upon shipment.

Full product traceability enables companies to have complete control and accountability of all material purchased, processed and shipped to customers.

Invera also provides INVEX for eCommerce and Customer Web Service options over the internet. Coupled with the INVEX-CRM applications companies can optimize the sales process by recording quotes, activities and tasks. STRATIX-ONE a Decision Support & Management Dashboard provides executives and managers with real time sales, operations and financial information.

Because STRATIX was designed from the ground up for metal distributors and processors the inventory can be accessed using metal industry nomenclature. A complete solution tailor made for titanium metal companies.

Jiangsu Tiangong Technology Company Ltd.
0511-86319358
www.tggj.cn
rongjun_liang@tiangong-tools.com

JIANGSU TIANGONG TECHNOLOGY CO., LTD was established in 2010, is a wholly owned subsidiary of Tiangong International. The company is located in JuRong City, JiangSu Province, our company is a production, sales strategy based on titanium and titanium alloy new materials. Tiangong has smelting, forging, hot rolling, cold rolling, finishing a series of production process of finished materials, the main products are titanium ingot, titanium bar, titanium tube, titanium plate, titanium coil, hot rolled tape. Titanium wire etc..

K-Tig
www.k-tig.com
belinda.latz@k-tig.com

K-TIG (Keyhole TIG), a variant of GTAW, is a high speed, single pass, full penetration welding technology that welds up to 100 times faster than TIG welding in materials up to 16mm in thickness, and typically operates at twice the speed of plasma welding. K-TIG reduces power and gas consumption by up to 95%, dramatically reduces labor costs and routinely delivers overall savings in excess of 90%.

K-TIG is ideally suited to Titanium, exotic materials and most corrosion resistant materials. K-TIG is a robust process with a board operating window and simple set-up requirements.

K-TIG welding requires no edge bevelling of the materials, and eliminates the need for wire consumables by autogenously welding the parent materials in both pipe and plate.

Save the time, labor, energy and cost of V-prepping your materials and eliminate the need for setting root gaps. Plus, tack welds are simply consumed in the K-TIG process. K-TIG can even be used to perform a sealing pass around the joint prior to welding if airtight purging is required for reactive materials like titanium.

K-TIG is a TIG/GTAW welding system capable of performing a traditional 6-hour TIG weld in 3 minutes, to a superior quality standard but don’t take our word for it. We prefer to let our customers do the talking:

“K-TIG has significantly improved our cost position and greatly improved our delivery times. The results speak for themselves – faster welding, less consumables, less prep, cleaner welds, reduced re-work and higher quality. The machines are easy to use, simple to setup and the K-TIG team is great to work with.”

Jeff Thomas, Vice President, Operations, TITAN Metal Fabrication

KASTO, Inc.
1-724-325-5600
www.kasto.com
sales@us.kasto.com

KASTO, Inc is the world’s only COMPLETE supplier of Metal Cutting Machinery offering all available Metal Sawing methods. These include Band Saws, Plate & Block Saws, Cold Circular Saws & Hacksaws. Customers benefit from un-biased recommendations about which Metal-Cutting Equipment is best for their application. We also offer complete Storage and Retrieval Systems!

Kevin Kreitman, EFO
530-921-1711
kkkreitman@gmail.com

Chief Kreitman has 36 years’ experience in the fire service beginning his career as a firefighter in Albany, OR. He was Fire Chief with the City of Albany from 1999 until accepting the Fire Chief’s job with the City of Redding, CA in Sept. 2008. Kreitman developed significant experience during his time in Albany dealing with the numerous metal industries handling materials that presented unique fire hazards. Based on those hazards, Kreitman wrote a paper on the proper handling of titanium and zirconium metal fires.

He’s a member of National Fire Protection Association (NFPA) Combustible Metals committee and has been active in the standard process with emphasis on the development of the Fire Prevention, Fire Protection and Emergency Response Chapters. He has written articles on dust & combustible metal hazards and conducted presentations at national conferences; he has assisted NFPA and the National Institutes for Occupational Safety and Health on investigations and publications dealing with combustible metal hazards, and was an author of the Combustible Metals chapter in NFPA’s recent 9th Edition of the Fire & Life Safety Inspection Manual.
Keywell Metals, LLC
+1-773-572-6173
www.Keywell.com

Keywell Metals, LLC is the industry leader in specialty steel recycling and a worldwide purchaser, processor and seller of titanium scrap metal for ingot formulation, alloy additions and ferro-titanium production. In addition to the complete range of processing capabilities, Keywell Metals, LLC operates the largest and most modern fully equipped on site analytical laboratory in the scrap metal industry. Every product shipped from Keywell Metals, LLC is fully certified and guaranteed to meet Customer Specification.

Kings Mountain International (KMI)
+1-704-739-4227
www.kmiinc.net
sales@kmiinc.net

Kings Mountain International (KMI) is an ISO 9001:2015 / AS 9100D certified precision grinding company.

KMI processing includes:
- Flat / Tapered / Contoured precision thickness machining
- Tolerances to +/- 0.001” (.0005” upon request)
- Sizes up to 110” x 360: larger sizes upon request
- Weight control for Aerospace applications
- Thin sheet grinding to .010”
- Surface Finishes from 250 RMS to 12 RMS and finer
- Polishing of sheet and plate to #3, #4 or #8 mirror. Non-directional also available

Benefits:
- State of the art measurement instrumentations
- Experience with all types of metals
- Plate / Sheets arrive clean, damage free and ready for fabrication

Industries we serve:
- Aerospace / Defense/ Energy / Commercial Aircraft / Architecture

Kropp Forge
www.kroppforge.com

Kropp Forge opened as a job forging shop in 1901. Output was limited to flat die work produced on three small hammers. Today, Kropp Forge is an industry leader, producing high quality forged materials in over 450,000 sq. ft. of production space using small and large hammers as well as hydraulic presses. The plant produces a wide variety of forgings ranging from 3,000 pounds to parts weighing just a few pounds. Our Markets include: Military and Commercial Aerospace, Power Generation, Oilfield/Petrochemical, Construction Equipment, Heavy Truck and other General Industrial forgings. Materials Forged include: Titanium, Nickel Based Alloys (Inconel), Stainless Steel, Steel and other forgeable grades of material. We furnish product as forged, Heat Treated, Rough Machined and/or Finish Machined and are equipped for Non-Destructive and/or Destructive Testing.

Laboratory Testing Inc.
800-219-9095
www.labtesting.com
sales@labtesting.com

The Materials Testing, Nondestructive Testing and Calibration Services offered by Laboratory Testing Inc. (LTI) help clients deliver the highest quality products and meet stringent quality requirements. Our test results provide information necessary for product development, material verification, production control and other important business decisions. The Lab is accredited by A2LA (American Association for Laboratory Accreditation) and fully qualified:
- ISO/IEC 17025 certification
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Our technical experts and service-focused support team help clients meet their testing and calibration needs and quickly get the answers they need. With a 104,000 sq. ft. facility, Lab Testing, near Philadelphia, PA, is one of the largest independent testing laboratories in the USA and fully capable of handling and testing materials of all shapes, sizes and quantities. Call or visit www.labtesting.com for a fast quote.

L.C.M.A.
+352 26 55 43-1
www.lcma.lu

L.C.M.A. is a global producer, processor, and distributor of a wide range of semi-finished titanium and titanium alloy products for aerospace, medical, petrochemical and industrial applications.

We work with several manufacturers based in Ukraine and Europe who convert our Grade 1 to 5 ingots in forged and rolled bars, sheets, plates, coils, spools, electrodes, tubes and more. LCMA is ISO 9001:2008 and EN9100:2009/AS9100:2009 aerospace approved and is PED97/23EC certified.

Being part of a vertical structure LCMA controls quality at all production processes and all products are US, EC and HB tested. We deliver to customers all over the world and our Quality, Experience, Flexibility, Short lead time, Large stock and Competitive prices makes us one of the key players on the market.

Please contact us at fax: +352 26 55 13 45 or Email: lcma@pt.lu

LAI International
+1-518-273-3912
www.laico.com/industrial

LAI International (formerly Zak Incorporated) is a fully integrated design, fabrication, machine, and test facility. We engineer, manufacture, and refurbish crucibles, liners, molds, and accessories for the remelting and production of specialty metals. Our manufacturing and consulting experience has contributed significantly to the VAR, ESR, Plasma, EB, C.C., and EBPVD processing industries. This experience, along with our
Titanium Buyers Guide (continued)

precision CNC machining capabilities, will extend your product life cycles and improve the reliability of your process. Our ISO 9001-2008 certified services include a full range of dual pallet, multi-axis CNC machining centers with live tooling; MIG, TIG, and stick welding of copper and other dissimilar metals; hydro, helium, X-ray and other available NDT services. For more information about Zak Incorporated, please visit us at www.laico.com/industrial

Laube Technology
(888)-355-2823
www.laubetitanium.com
tisales@laube.com

Laube Titanium Mill Products is a division of Laube Technology. Laube began its long history of quality and service in 1948 as a Chicago based warehouse distributor of steel mill products. Anticipating the growing influence of the Pacific Rim countries in supplying product to the United States, Laube’s corporate offices were moved to the west coast in 1961. Strategically poised, Laube became an industry leader, pioneering the importation of metal products from Asia and elsewhere. Today the Laube group consist of three separate divisions. Those are: Titanium Mill Products; Offering titanium forms of sheet, plate, bar, tube, pipe, and coil from both domestic and foreign mills. The Custom Metal Parts division, which specializes in providing the industry with unique metal components usually designed for a specific use; and Electronic Components and Assemblies Division. This department supplies all types of custom control panels and keyboard assemblies. Laube is a privately held, family run company and continues in its proud heritage of providing decades of quality product at competitive costs.

LOTERIOS S.p.A., a TIMET Company
+39-02-9648281
www.loterios.com

LOTERIOS S.p.A. core business: TIMET Italian Service Center (sheets, plates, bars, forgings, etc.) and leading fabricator of titanium pipe, fittings, shell and tube heat exchangers and vessels as required.

Louyang Hexin Titanium Industry Co., Ltd

Louyang Hexin Titanium Industry Co., Ltd was founded in 2014. Our company produces titanium products since 2014, including rods, tubes, plates.

Products are widely used in petrochemical, sait. Offshore industry, energy generation and other industries. Typical applications include: Titanium and titanium alloy bar for hot-rolling; Titanium alloy standard parts; All kinds of corrosive fluid transmission pipeline system; Titanium bicycle tube; automobile exhaust pipe; Offshore aquaculture.

Luoyang Titanium Group (LTiG)

Luoyang Titanium Group, Inc. (LTiG) is the exclusive North American Representative of Luoyang Sunrui Wanjji Titanium Industry Company Limited (Sunrui Wanjji). Sunrui Wanjji primarily produces high-quality (pure and near pure) titanium sponge for the domestic (Chinese) and international markets. In our capacity as North American Representative, LTiG is responsible for Sunrui Wanjji’s entrance into the North American titanium market.

Since its inception, the evolution of the black sand has been a global effort that has inspired scientists, scholars and entrepreneurs alike. We live in a global economy where free-flowing-resources, pursue global opportunities and titanium is arguably one of the best example of a global commodity, fulfilling the growing demands of a multi-nation audience of consumers. Luoyang Titanium Group Inc., along with our global partners, sees our existence and opportunity for growth, as an extension of the global titanium phenomena.

For more information about our products and services; email corporate@LTiGus.com or by calling 707-787-LTiG.

Mair Research S.p.a.
+39 0445 634 444
www.mair-research.com
salesdept@mair-research.com

Since 1977, MAIR Research has offered specialized equipment and services to the steel industry, specifically helping tube and bar producers to create profitable and efficient production processes in a safe environment.

The highest levels regarding innovation and quality are achieved through young and well experienced technical personnel, for the electrical design, software programming and the pre and after sale service.

Single stand-alone equipment or customized complete and integrated finishing lines are developed by an experienced team of technicians and are entirely manufactured in two modern production facilities covering a total surface area of 36000 sqm.

Mair Research has gained significant experience in the field of finishing lines for ERW and Seamless tubes by supplying turnkey solutions to customers in over 45 nations.

Recently a great number of producers of OCTG tubing have chosen Mair Research as supplier of their finishing lines taking the tube from the mill and delivering it in a bundle after having undergone the required finishing and testing operations (e.g. ID beam removal, chamfering, hydro testing, visual and NDT inspections, coating, automatic bundling and strapping). Data management and tube tracking are all features developed by our staff and integrated in the lines.

The range of Mair Research comprises also Bar finishing equipment with the possibility to supply fully integrated lines (e.g. peeling, straightening, multi-cutting, chamfering, automatic bundling and strapping).

Makino
1-800-552-3288
www.makino.com

A world leader in advanced CNC machining centers, Makino is committed to providing high-performance, leading-edge machining technologies and innovative engineered process solutions that enable manufacturers to focus on making what matters. Makino offers a wide range of high-precision metal-cutting and EDM machinery, including horizontal machining centers, vertical machining centers, 5-axis
machining centers, graphite machining centers, and wire and sinker EDMs.

Makino’s flexible automation solutions provide reduced labor costs and increased throughput in a variety of production volumes and designs. Makino’s engineering services offers industry-leading expertise for even the most challenging applications across all industries. For more information, call 1-800-552-3288 or visit makino.com.

ATS-MER, Materials & Electrochemical Research (MER) Corporation
+1-520-574-1980
www.mercorp.com

The technologies MER pursues includes: Rapid Additive Manufacturing, Titanium Powder and Fabrication by Additive Manufacturing, Metal and Carbon Matrix Composites, Electrochemical Systems, Porous Materials, Coatings, Spinel and Nanotechnology. MER develops processing to produce titanium more economically that includes lower cost than sponge and downstream additive manufacturing processing to produce low cost titanium components. These technologies include producing titanium powder directly from ore/TiO2 at a cost substantially lower than that of Kroll sponge, engineering the Kroll process entirely in one reactor at a reduced cost, producing titanium alloy powder from ore/TiO2 and one-step production processing near net shape alloy components at a cost of under $10/lb.

Medart, Inc.
+1-724-752-2900
www.medartglobal.com
sales@medartglobal.com

Medart designs and manufactures centerless bar peelers, coil to coil peelers, coil to bar peelers, straighteners, fastener wire pay-off systems, take up systems, plane straighteners and engineered material handling equipment. Purpose built processing equipment for the titanium industry.

METALVALUE
+33680562848
metal@honnart.fr

METALVALUE provides strategic consulting services and invests into selected industrial companies.

Metalwerks PMD, Inc
+1-724-378-9020
www.metalwerks.com

Metalwerks PMD, Inc. produces a wide variety of specialty metals, superalloys and developmental alloys in Iron, Nickel and Cobalt based alloys. We melt current and developmental titanium alloys in ingot form from 400 grams to VAR ingots weighing up to 5000 pounds. We also convert these ingots into mill products for use by our customers.

Metalalysis Ltd.
+44 (0) 1709 872 111
www.metalalysis.com

kartik.rao@metalalysis.com

Metalaysia is a UK-based technology company, which has developed a proprietary process to produce metal powders at low cost using electrolysis. It is currently focused on the production of tantalum and titanium alloy powders for use in conventional and additive manufacturing, with a variety of applications in industries including aerospace, electronics, bio-medical, petro-chemical and automotive.

MetCon, LLC
+1-724-888-2172
www.MetConLLC.net

MetCon provides conditioning and finishing services for both intermediate and finished products, including bloom, billet, bar, plate, sheet, and machined or fabricated components employing a patented “Green” electrochemical technology. Product yields and costs are dramatically improved when compared to conventional processing. The technology can also provide alpha case removal, precise gauge removal, and ultra-bright micropolishing. MetCon is based in Monaca, PA, 30 miles northwest of Pittsburgh.

Mega Metals, Inc.
+1-602-258-6677
www.megametalsunlimited.com

Mega Metals Inc., is a globally recognized high quality processor of Titanium Turnings and Solids. We are certified by major mills and casting houses for prepared aerospace grade material. Our philosophy is to unite the highest quality in customer service with the highest quality of our materials, in order to serve the expanding international demands of the metals recycling industry.

METRACO NV
+32 56 234400
www.metraco.be

European traders of ferro-alloys and non-ferrous metals. Specialized mainly in ferro titanium, titanium sponge and manganese metal. Supplying all grades of FeTi 70 % and buyers of titanium scrap and low grade sponge for FeTi production. Supplying steel grade sponge directly to steelmills and masteralloy producers worldwide.

MetSuisse Distribution AG
+41 44 586 02 74
www.metsuisse.com
info@metsuisse.com

MetSuisse reflects the precision and high quality products the industry requires. Being the first metal distribution company specializing in the medical and watch industry, MetSuisse has been able to specialize in sourcing for these industries. The stringent and precise requirements found in the medical & watch industry has given us the experience and abilities required to meet the various requests. Next to our experience we are the first metal distribution company specialized in the medical industry, and operate strictly according to ISO 13485 (Medical) and the GDP standards valid for pharmaceuticals (besides ISO 9001). Currently, we are specialized mainly in the metals titanium, zirconium, CoCrMo, medical stainless and tungsten alloys. However, you can contact us with any of your sourcing requests. We work with dedicated partners.
Multi-Etch is a low-acid (pH 6.8), far safer etchant for titanium and other
metals, with a less toxic waste stream, when compared with hydrofluoric
and nitric acids. Preparing titanium with Multi-Etch enables anodizers to
produce brilliant colors and welders to achieve welds that can withstand
the rigors of deep space and deep ocean uses. Multi-Etch is also used
to brighten titanium mill products and tumbled titanium parts, and to
erase anodizing mistakes. Industries regularly using Multi-Etch include
aerospace, medical, dental, jewelry and other arts, marine, architectural,
and industrial.

nanoPrecision Products, Inc.
+1-310-597-4991
www.nanoprecision.com

nanoPrecision Products is a designer, developer & manufacturer of
precision products with applications in the telecommunication, data
communications, consumer electronics, mil/aero and bio &medical
device markets. We employ various metals in our products including
titanium. The products we are introducing to the market that utilize
titanium are anticipated to consume large volume of material.

NEOTISS
+33 1 70 98 30 05
www.neotiss.com
contact.fra@neotiss.com

NEOTISS is leader in the manufacturing of titanium and stainless steel
thin welded tubes serving all demanding industry markets from power
generation to desalination, process, automotive and more. Our products
include not only bare, straight tubes but enhanced surface tubes, such
as low fin, helix and corrugated tubes as well as u-bent tubes for special
applications. The highest level of quality and safety in the market is
guaranteed by stringent control procedures and unchallenged technical
experience. The best testimony of product quality is the long list of
references, worldwide. Our R&D teams develop ambitious innovation
and research programs to enhance the performance of the tubes in the
toughest environments. We have high manufacturing capacities, with
production mills on three continents, Asia, North America and Europe,
(namely in China, France, India, South-Korea, the USA) as well as a
secured access to superior quality titanium strip.

NF&M International
www.nfm-titanium.com

NF&M International, Inc., subsidiary of VSMPO-Tirus US, is a producer
of premium quality triple melted and standard grade titanium bar and
billet products for the aerospace market and manufacturer of small-
diameter precision tolerance bar and seam free coil products for
aerospace fastener, automotive and medical applications. NF&M also
provides a wide range of conversion services, including intermediate
grinding and finishing of bar/billet, heat treating, straightening, bar
peeling, bar polishing, pickling and inspection. NF&M’s Nadcap approved
laboratory performs room temperature tensile, hardness, hydrogen
analysis and micro/macrostructure evaluation.

Multi-Etch LLC
info@multietch.com

Multi-Etch LLC is a low-acid (pH 6.8), far safer etchant for titanium and other
Titanium Buyers Guide (continued)

NobelClad is the world leader in the field of explosion welding. We have more than half a century of expertise, and we are the one company with the most global resources and infrastructure committed to clad, offering bi-metallic solutions for complex industrial markets, including oil and gas, chemical, and transportation. We work with global partners across the supply chain not only to deliver the highest-quality, most cost efficient clad materials on time, but to inform and help develop project specifications from the outset. Our design ingenuity, technical proficiency, and unparalleled dependability make us an invaluable resource for process architects, engineers, and fabricators alike. That’s why our clad materials are the preferred specification for high stakes industrial infrastructure applications all over the world. Specialties: Explosion Welded Clad, Longitudinally Welded Pipe, Pressure Vessels, Heat Exchangers, Structural Transition Joints, Electrical Transition Joints, Cryogenic Transition Joints, Flat Plates & Cylinders, Heads, Tube Sheets.

Norsk Titanium AS
518-324-4010
www.norsktitanium.com
info@norsktitanium.com

Norsk Titanium AS is the world’s pioneering supplier of aerospace-grade, additive manufactured, structural titanium components. The company is distinguished in the aviation industry by its patented Rapid Plasma Deposition™ (RPD™) process that transforms titanium wire into complex components suitable for structural and safety-critical applications. Norsk Titanium is a tier-1 supplier to Boeing and is committed to cost-reducing aerostructures and jet engines for the world’s premier aerospace manufacturers. RPD™ is the world’s first FAA-approved, 3D-printed, structural titanium, delivering substantial lead-time and cost savings for aerospace, defense, and commercial customers.

North American Alloys
+1-800-985-2250
www.northamericanalloys.com
steve@northamericanalloys.com


Contacts: Michael Shulimson – President, Steve Meredith, Director of Sales and Peter Rockefeller, Warehouse Manager

Nu-Tech Precision Metals
+1-613-623-6544
www.nutechpm.com
shook@nutechpm.com

Nu-Tech Precision Metals manufactures by hot extrusion seamless pipe, tube, fittings, bar, rod and shapes for nuclear, aerospace, military, medical, offshore, mining, chemical, sub-sea and corrosive environments. Extruded shapes, especially those for the aerospace industry in 6Al-4V, fit within a 12” (300 mm) circle size. Our extrusion process creates a near-net shape that reduces material and machining costs overall. Our ability to alpha-beta process results in improved fatigue resistance over beta extrusions...contact us to learn more about how this process will benefit your extrusion requirements. Seamless pipe from 1.5” (40 mm) to 14” (350 mm) plus specialty sizes and wall thickness. In-house finishing options including OD grinding or machining, ID honing or boring, hot straightening, pickling, non-destructive testing and electron beam welding are a few of the services we offer.

Oerlikon
https://www.oerlikon.com

Oerlikon Metco is a global leader in surface engineering solutions that bring benefits to customers through a uniquely broad range of surface technologies, equipment, materials, services, specialized machining services and components. The surface technologies such as Thermal Spray and Laser Cladding improve the performance and increase efficiency and reliability. Oerlikon Metco provides a comprehensive manufacturing, distribution and service network, catering to aviation, medical, power generation, automotive and other strategic growth industries such as additive manufacturing and operates a dynamically growing network of more than 50 sites in EMEA, Americas and Asia Pacific.

“Titanium Valley” Special Economic Zone” OJSC
+7-343-378-45-83
www.titanium-valley.com
welcome@titanium-valley.com

Titanium valley is the special economic zone (SEZ), based in Russia, Sverdlovsk region, where unique conditions for production organization and development are created. The territory of the SEZ is located close to the OJSC “VSMPO-Avisma” Corporation”, the world’s largest titanium producer, supplier of raw materials, forgings and finished production for Boeing, Airbus, Rolls Royce, Goodrich, Embraer, GE. Thus, the territory is known after the name “Titanium Valley”. The companies investing in the SEZ get prepared sites with all the necessary utilities. Moreover, they are exempted from customs duty on import of capital goods, VAT as well as from the corporate profit for the first 10 years. For the moment there are 8 resident companies, organizing their production in different industrial spheres at the SEZ. The key resident is LLC “Vsmpo-New Technologies”, that will start their production of machined titanium components for aerospace companies, mostly for Boeing, in 2017.

OSAKA Titanium technologies Co., Ltd.
+81 3 5776 3103
www.osaka-ti.co.jp

OSAKA Titanium technologies Co., Ltd. manufactures premium quality titanium sponge mainly for aerospace use, high-purity titanium billet and polycrystalline silicon for semiconductor industry, titanium powder for powder metallurgy and additive manufacturing, and other titanium-silicon related products.

Paris Saint-Denis Aero
http://www.psdaero.com

PSD AERO is one of the main suppliers for raw materials products of key players in the aviation sector, like for example AIRBUS, SNECMA, EUROCOPTER, DASSAULT AVIATION, etc. Our Quality Management
System meets the IAQG’s series requirements.

With our experience and rigor acquired during the last few decades, the company consists of 90 staff members that have enabled them to increase their turnover 10 times over in 10 years.

PCC Metals Group

www.precast.com/

The PCC Metals Group joins together PCC’s metals companies: TIMET, a vertically integrated titanium supplier; and Special Metals, a leader in nickel alloy development. With over 200 years of collective experience, each organization is an original stronghold and remains a leader in their respective industries by developing and producing specialty alloys to meet customer demands. By uniting the unique capabilities of each company, the PCC Metals Group is able to better serve customers in the specialty metals market and bring successful product solutions to market.

Perryman Company

+1-724-746-9390
www.perrymanco.com

Perryman Company is a vertically integrated producer of specialty titanium products. Our operations include melting, forging, and fabrication to finished products, Perryman’s quality, technical expertise, and customer service is unmatched. Our Spectralloy facility is engaged in the recycling of titanium revert raw material for use in various titanium melt processes in the manufacture of titanium ingots. Perryman supplies and services customers in the aerospace, medical, consumer, recreation, infrastructure and 3D printing/additive manufacturing markets worldwide. Approvals include ISO9001:2008; AS9100, and NADCAP. Perryman Company is headquartered in Houston, Pennsylvania. Company offices are located in Philadelphia, Los Angeles, London, Zurich, Tokyo, and Xi’an.

Plymouth Engineered Shapes

800-718-7590
www.plymouth.com
jake@plymouth.com

Plymouth Engineered Shapes is the premiere provider of near-net extruded shapes for a large variety of applications. All customers want to squeeze more cost out of their parts, and Plymouth Engineered Shapes offers the solution in Titanium, Stainless steel, Alloy steel, or Nickel-based alloys. Our Engineers are capable and willing to work with your design engineers to develop the most optimum near-net shapes possible to make your finished parts. No other manufacturer in North America offers so much experience in special shape technology, or provides so many value-added options to meet your product specifications.

PMA Engineering/Design Group

253-926-0884
www.pma-engr.com

PMA Engineering/Design Group brings a broad and extensive depth of engineering and operating experience in titanium to work for you. With our expanded resources, and our understanding of the critical requirements of the RG/PG world opens the door for us to benefit your organization. Our experience and ability to assist across all facets of an operation, including sponge, sponge processing, scrap and scrap handling, scrap processing, blending, melting, finishing, flattening, and other operations, allows for integrated, comprehensive solutions.

We can partner with you to Optimize Processes and assist with reviews of your operations in regards to RG/PG standards and expectations. We will utilize our experience to upgrade or replace equipment to improve or increase your production capabilities. We can provide Facility Audits, Feasibility Studies, FEED Studies, and Detailed Engineering for new process and manufacturing facilities, including the integration of your control and data systems for reporting, chronological documentation and MIS reporting. And, we can audit your processes against industry quality standards and provide paths for continuous quality improvement.

We partner to make you better.

Praxair Surface Technologies

www.praxairsurfacetechnologies.com

We engineer gas atomized metal powders in a wide range of standard alloys for all your additive manufacturing techniques and applications. We’ve also developed a proprietary atomization process specifically designed for titanium. Out cobalt, iron, nickel and titanium metal powders for additive manufacturing flow easily and deposit evenly.
President Titanium Co., Inc.  
+1-800-225-0304  
www.presidenttitanium.com  
sales@presidenttitanium.com  

President Titanium has the largest inventory of domestic 6Al/4V, 6Al/4V ELI, and Grade 4 titanium bar, sheet & plate in the country. We have been serving the aerospace, military and medical industries since 1973. Most orders shipped in 1-2 days, call for our free booklet.

Product Evaluation Systems, Inc.  
724-834-8848  
www.PES-Testing.com  
Mic@PES-Testing.com  

Product Evaluation Systems, INC. (PES) is an independent testing laboratory, specializing in mechanical, metallurgical, chemical and non-destructive testing and analysis. Since 1979, PES has been proud to offer exceptional personalized response to customer needs. The company includes a team of key personnel with 20-40 years of individual experience in machining, testing and metallurgical evaluation. PES is both NADCAP and ISO 17025 accredited and holds multiple customer accreditations such as GE Aviation, Pratt & Whitney (MCL), Rolls-Royce Aerospace and ATI Nuclear. Accreditation awarded to PES covers mechanical testing, test specimen preparation, metallography, chemical analysis and nondestructive evaluation. Industry sectors include, but are not limited to, Aerospace, Power Generation, Oil & Gas, Mining and Recovery/Reclamation.

Quebec Metallurgy Center  
+1-819-376-8707  
www.cmqrtr.qc.ca  

The Quebec Metallurgy Center is a technology transfer center located in Trois-Rivieres, Quebec, Canada. Our activities focus on supporting the technological development of manufacturing companies in the metallurgical sector. CMQ has developed a broad expertise on the transformation and development of advanced alloys such as titanium, zirconium, aluminum and nickel. Our semi-industrial metalworking facility is equipped for short series production with controlled atmosphere casting, induction skull melting, plasma arc melting, permanent mold, shell mold and sand mold casting; advanced welding, thermal spraying, heat treating, hot isostatic pressing, additive manufacturing (directed energy deposition, binder jetting and ultrasonic welding) and non-destructive testing.
RathGibson
+1-608-754-2222
www.rathgibson.com
inquiry@pccenergy.com

Company description: RathGibson is one of the world’s leading manufacturers of precision welded tubing and pipe in both stainless and specialty alloys. From straight lengths to coil, welded and drawn, or seamless tubing and pipe, our products can be made from any of our 40 high-performance alloys so that they will reliably perform no matter how demanding or corrosive the application. At RathGibson, a successful technical process to meet any customer requirements is a priority, so that only the finest and most high quality tubing is delivered. That is why RathGibson invests in unique capabilities to develop customizable products for industries including power generation, renewable, oil and gas, petrochemical, food and dairy, beverage, pharmaceutical, and general commercial.

ReMelt Scientific, Inc.
+1-330-440-0402
www.remeltinc.com
sales@remelt.net

ReMelt Scientific is a global supplier of Titanium Chip Melt Preparation Systems and Weigh and Blend systems. We specialize in titanium and high temperature alloy chip crushing, centrifuging, aqueous wash and solvent cleaning, thermal drying, fines screening, and magnetic and gravimetric separation to prepare chips to for melting. We also specialize in Weigh and Blend systems that weigh and blend titanium chips, sponge, master alloys, aluminum, iron, and TiO² to achieve customer specified chemistry requirements.

Renton Coil Spring Company
+1-425-255-1453
www.rentoncoilspring.com
info@rentoncoilspring.com

Renton Coil Spring Co. (RCS) is a world-class spring manufacturer for aerospace and performance markets and has been providing superior quality parts and performance since 1949. Design and material capabilities, along with complete performance solutions has lead RCS to become a top supplier of quality springs, wire forms, assemblies, and flat metal parts with thousands of applications across the world.

Reactive Metals Studio, Inc.
+1-928-634-3434
www.reactivemetals.com

Founded 1981, a supplier of exotic metals to include titanium and niobium to the jewelry and decorative arts market. We consult, teach and supply anodizing equipment. We supply jewelry components, chain and findings in titanium. We are small order specialists catering to the medical, crafts and arts community. RMS distributes MULTI-ETCH, a user friendly titanium etch. Multi Etch prepares titanium jewelry, medical & dental components for bright, smooth anodizing without the dangers of Hydrofluoric acids.

Retch Systems LLC
+1 (707) 462-6522
www.retechsystemsllc.com
sales@retechsystemsllc.com

Retch is the world’s leading supplier of Electron Beam (EB) and Plasma (PAM) Cold Hearth furnaces for melting and refining titanium and titanium alloys. Retch advanced vacuum metallurgical systems also include Vacuum Arc Remelt (VAR), VAR Consumable (Skull) Casting, EB and PAM Consolidation furnaces, Plasma Welders, Vacuum Induction melting (VIM), Precision Investment Casting (DS/SC/EQ), Cold Wall Induction melting and casting, Vacuum Heat Treating, and Gas Atomization for metal powder production. All our furnaces are available in various sizes and configurations, from simple laboratory-scale to large, custom engineered systems. Further, we provide customer access to a wide range of in-house resources, including technology, material and process development. Identifying customer needs, as well as understanding the importance of producing relevant, viable, and cost-effective technologies, is the foundation upon which Retch is built.

Rex Heat Treat
+1-215-855-1131
www.rexht.com
chris.constable@rexht.com

Rex Heat Treat is a family owned and operated business that was founded in 1938. We take pride in our ability to partner with our customers to gain insight regarding their future needs. We are a leader in customer service and quality for the heat treating industry. Our unique furnace design allows us to water quench titanium raw material and formed parts up to 16’ long to meet aerospace and medical specifications. We have furnaces capable of annealing up to 30,000 lbs. in one batch and we are approved by almost all major Aerospace companies. We have 3 locations in Eastern United States, Anniston Al., Bedford PA., and Lansdale, PA. Rex Heat Treat has experienced metallurgists on site and we offer testing services. We look forward to exceeding your expectations with timely communication and time performance.

Roll Forming Corporation
+1-502-633-4435
www.rfcorp.com

Roll Forming Corporation’s Aerospace division offers Inline custom welding solutions and advanced fabrication applications. RFC’s highly skilled and experienced laser welding team is NADCAP approved for a range of aerospace welding and laser welding processes. Additionally RFC offers in house NDT, CWI and NADCAP accredited inspection.

Roll Forming Corporation has taken the initiative in technical development, and collaborating with our customers to find creative solutions to overcome many program hurdles. Our laser welders put us at the forefront of the Aerospace industry in-line laser welded fabrications, RFC continues to lead the way as our inline custom welding solutions, and advanced fabrication applications are RFC’s core competencies. For more information call (502) 633-4435 ext. 338.
Rolled Alloys
+1-800-321-0909
www.rolledalloys.com
sales@rolledalloys.com

Rolled Alloys, a global leader in specialty alloys, offers a comprehensive inventory in titanium, stainless steels, nickels alloys and cobalt alloys. We offer extensive processing capabilities, in-depth knowledge of material specifications, supply chain management support, and metallurgical expertise.

Rolled Alloys holds many quality approvals and certifications in the aerospace and medical industries. We are a preferred supplier to companies that are respected around the world for their exceptional quality standards.

Roskill Information Services Ltd.
+44 (0)208 417 0087
www.roskill.com
info@roskill.com

Roskill global market reports include the latest information on supply, demand, end-use applications, trade and prices for a wide range of metals and minerals including titanium, molybdenum and vanadium. Roskill reports also provide informed forecasts of future trends.

Roskill’s expert researchers make a thorough and objective analysis of all available data, from sources across the globe. This includes a large and invaluable network of contacts including the key industry players in these markets, making Roskill’s research unrivalled in terms of breadth, depth, accuracy and expertise.

To build on this wealth of data, Roskill also offers bespoke consultancy services that can help to explore and understand any specific scenarios or analysis requirements you may have.

S. Letvin & Son, Inc.
+1-310-327-0590
www.titaniumscrap.com

S. Letvin & Son, Inc., specialists in processing high temperature scrap metals, has been in business since 1947. We prepare a high quality 6/4 titanium feedstock package that meets AMS 4928 Chemistry specifications. We have developed a unique and proprietary process to return mixed 6/4 titanium fasteners to specification 6/4 titanium. The final product is 6/4 titanium “Rotor Grade” feedstock; heavy, dense, clean and extremely consistent in chemistry and gases. Our 6/4 titanium feedstock package is approved and desired by most major US titanium mills, as well as many smaller investment casters worldwide.

S+D Spezialstahl Handelsgesellschaft mbH
+49-211-230999-10
www.s-d-group.com
d.verhoeven@s-d-group.com

The S+D Spezialstahl / S+D Speciality Metals Group is one of Europe’s largest stockists for semi-finished high-performance materials like titanium and titanium alloys, special stainless steel for aviation and aerospace or nickel and nickel alloys.

We supply into the following markets:
• Aviation and Aerospace / Motor Sports / Defence Technology / Medical Technology
• Offshore / Petrochemical / Chemical and Process Engineering / Plant and Equipment Manufacturing / Electroplating / Turbine Manufacturing / Marine Engineering / Energy Industry / Automotive Industry / Universities and Research
• Institutes

We deliver just in time any time. At S+D we are able to cut all our materials according to our customer’s exact requirements utilising our “state of the art” bar saws and plate saws. We also offer precision water jet cutting. Our just in time service provides our customers with cost savings and security of supply. S+D is aerospace approved according to EN 9120 issued by DNV GL

Sandinox Comercio, Importação e Exportação LTDA
+ 55 15 3335 3565
www.sandinox.com.br

Established in 1986, Sandinox is the largest medical distributor for the Brazilian market, offering a full range of products in titanium, cobalt, and stainless steel alloys for the medical industry. Our goal is the constant search for technologically advanced products and materials that will ensure quality and the desired satisfaction of our customers.

Sandvik Materials Technology Product Unit Special Metals
+46-26-260000
www.smt.sandvik.com

Product Unit Special Metals with two manufacturing locations (Sweden and USA) belongs to Sandvik Materials Technology and is a long term experienced manufacturer of seamless tubes and complementary products in Titanium, Titanium alloys and Zirconium based materials for a broad range of industrial applications as well as applications within nuclear, aerospace and medical industries.

The full scale commercial manufacture, which started in 1964 is fully integrated from VAR-remelting of Titanium resp. Zirconium sponge up to finished product.

Scanacon, Inc.
330-877-7600
www.scanacon.com

At Scanacon, our mission is to help stainless, titanium, zirconium and specialty alloy finishers achieve efficient, high quality production at the lowest cost.

With over 30 years’ experience as the World’s preferred supplier of acid management equipment, our knowledge, experience and equipment offers the producer the ability to achieve productive, efficient and cost effective finishing operation. Our solutions have consistently proven
Titanium Buyers Guide (continued)

themselves across a wide range of pickling, etching and milling applications for all wrought and cast forms.

Scanacon understands that ease of use, low maintenance requirements and efficiency is key to designing process equipment that delivers value, day after day. No two producers or applications are exactly alike. Delivering value requires a knowledge that can only be gained by experience and is why Scanacon continues to be the chosen supplier for acid management system by all major producers, worldwide.

Schaffer Grinding Co., Inc.
+1-323-724-4476
www.schaffergrinding.com
info@schaffergrinding.com

SCHAFFER GRINDING CO. is a toll processor of aerospace alloy materials including: Titanium, high temperature alloys, nickel based alloys, and ferrous materials. Processes include: Precision sheet and plate grinding (90” X 240”), band saw cutting, planer milling, rotary and surface grinding. Schaffer Grinding offers its customers coast to coast service with production facilities in California and Ohio.

Sector3 Appraisals, Inc.
+1-718-268-4376
www.sector3appraisals.com

Sector3 Appraisals, Inc. is a metals and chemicals valuation company offering a complete portfolio of asset valuations and advisory services regarding inventory, machinery and equipment and risk management.

Service Steel Aerospace
+1-800-426-9794
www.ssa-corp.com
sales@ssa-corp.com

Service Steel Aerospace is a customer oriented stocking distributor of high performance stainless steel, titanium, alloy steel, nickel based super alloy, and managing steel. We are committed to providing quality products to the aerospace industry and other critical application industries throughout the world. SSA performs a wide array of value added processing services designed to meet the specific needs of our customers. Our commitment to the quality and service has made SSA the leader in the industry for over 40 years.

SES, LLC
330-821-3322
www.seseng.com
ses@seseng.com

SES is a leading supplier of equipment and services for the metals, metals-forming and related industries. SES has the ability to handle projects ranging from small specialty items to major capital expansions, as well as redesign and rebuild of existing equipment.

Shaanxi Lasting Titanium Industry Co., Ltd.
00 86 29 89651035     00 86 29 89651082
www.lastingtitanium.com
sales@lastingtitanium.com     titanium01@263.net

Shaanxi Lasting Titanium Industry Co., Ltd. is the leading Titanium manufacturer and exporter in China. With more than 20 years’ experience, we own two mills in Baoji -The Chinese Titanium City. We are mainly engaged in melting, forging, rolling and machining manufacturing line in titanium and titanium alloy, with an investment of USD 50 million. Exported 3000 mt ingots, 2500 mt forgings and 5000 mt machined parts annually. Our main products include titanium ingots, slabs, bars/rods, plates/sheets, pipes/tubes, forgings, fittings, wire, powder, standard parts, non-standard equipment and other corrosion resistant metals such as zirconium, tantalum, tungsten, molybdenum, niobium.

Sierra Alloys / TSI Titanium PRV Metals Companies
+1-626-969-6711
www.prvmetals.com

Manufacture and supply forged and rolled products in Titanium alloys, nickel-cobalt base alloys, precipitation hardened stainless and high alloy steels from small rectangular and round bar to large section size open die forged bar and stock.

Simonds Saws
www.simondsinternational.com

Manufacturer of industrial saw blades. The oldest cutting tool manufacturer in North America, Simonds offers one of the broadest and most trusted names found anywhere in the world of cutting tools. Many industries have grown to depend on the quality and innovation of Simonds products and services. We have a continuing tradition of quality, design, and innovation. Simonds has innumerable patents, a global leader in high-performance and high-production sawing. The first bandsaw manufacturer in the world to be ISO certified and we remain certified so today. We set our goals high and our customers have grown to expect it.

Since 1832... The Professionals’ Edge.
Solar Atmospheres provides vacuum thermal processing for titanium material, parts, forgings, and weldments. With the world’s largest commercial vacuum furnaces up to 48 feet long, Solar is capable of vacuum processing furnace loads of bar, billet, sheet, and plate up to 150,000 pounds under 1X10-6 Torr vacuum levels. Specific heat treat services provided are: degassing, beta annealing, homogenizing, age hardening, creep forming, hydriding/dehydriding, stress relieving and Fluorescent Penetrant Inspection. ISO9001:2008 / AS9100C Registered, Nadcap Accredited for heat treating and NDT (Non-destructive testing), MedAccred Accredited for heat treating, and Boeing approved in heat treating, NDT (Non-destructive testing) services and BASCA (Beta Anneal Slow Cool Age). Solar Atmospheres serves customers with plants located in Pennsylvania, South Carolina, and California.

Solar Manufacturing, Inc.
+1-267-384-5040
www.solarmfg.com
info@solarmfg.com

Solar Manufacturing designs and manufactures high performance, technically advanced and energy efficient vacuum heat treat furnaces. Models range from compact R&D size furnaces to mid-size horizontal production furnaces to huge car-bottom vacuum furnaces for large heavy workloads. Our furnaces feature improved graphite insulation materials, curved graphite heating elements, tapered gas nozzles, high velocity gas quench systems, SolarVac® 4000, and 5000 interactive control systems, and ConserVac energy management system. We design for vacuum heat treat processes such as hardening, brazing, annealing, stress relieving, normalizing, tempering, sintering, low pressure carburizing and vacuum gas nitriding. Solar knows vacuum heat treating inside out. Our engineers and metallurgists bring decades of expertise to the design side of the business and our knowledgeable technicians provide world-class manufacturing keeping Solar in the forefront of vacuum furnace innovations. As an ITA member company, Solar welcomes the opportunity to assist our customers in choosing the right vacuum furnace, replacement hot zone, spare parts and service for your needs.

Specialty Metals Company
+32- 2645-7670
www.uktmp.kz
Sylvain.gehler@specialtymetals.be
Danielle.vanoverschelde@specialtymetals.be

Specialty Metals Co is the major shareholder of UKTMP (Ust Kamenogorsk Ti Mg plant) located in Kazakhstan. UKTMP produces Ti sponge, CP and alloy ingots and slabs.
Starrag USA Inc.
+1-859-534-5201
www.starrag.com
ussales@starrag.com

Engineering precisely what you value

Starrag Group is a global technology leader in manufacturing high-precision machine tools for milling, turning, boring and grinding workpieces of metallic, composite and ceramic materials.

Principle customers are internationally active companies in the Aerospace, Energy, Transportation and Industrial sectors. In addition to its portfolio of machine tools, Starrag Group provides integrated technology and maintenance services that significantly enhance customer productivity.

Aero Structures
The trend towards ever-more complex and larger structural components, which have to be manufactured within narrow tolerances and within short cycle times, means that innovative manufacturing technologies are crucial. The services offered by the Starrag Group range from five-axis machining of high-tensile titanium alloys to high-performance cutting of aluminum through to precision machining of transmission housings.

Aero Engines
Aeroplane engines are subject to continuous further development and improvement in order to meet demands for greater efficiency, lower kerosene consumption and lower noise emissions. As a long-term partner to the jet engine industry, the Starrag Group offers state-of-the-art production solutions and technologies for the machining of engine blades, blisks and casings made from the most sophisticated materials.

Avionics
Avionics is a collective term for the electrical and electronic systems used on aircraft and satellites. Flight control, management, communications and navigation systems are the main avionics systems in use today. Avionics systems are highly complex and extreme precision is required. Starrag’s machine tool competencies in this market segment are in the areas of injection systems, combustion chambers, gyroscopes and flight control components.

Supitomo Corporation of Americas
+1-847-384-5275
www.sumitomocorp.com
shinya.kuriyama@sumitomocorp.com

Sumitomo Corporation of Americas (SCOA) is a wholly-owned subsidiary of Sumitomo Corporation, which is one of the leading trading companies in Japan. SCOA is an integrated global trading firm with diversified investments in a wide variety of industries, products and services.

Supra Alloys, a division of Titan Metal Fabricators
805-388-2138
www.supraalloys.com
sales@supraalloys.com

Supra Alloys offers a fully-stocked Titanium Service Center with the convenience of extensive in-house processing capabilities, with a Management System certified to AS 9100 C & ISO 9001:2008. Located in Camarillo, California USA, Supra routinely provides Titanium for applications in the aerospace, chemical processing, medical, metal finishing and sports/recreation industries throughout the world.

T-M Vacuum Products, Inc
856-829-2000
www.tmvacuum.com
eurbanski@tmvacuum.com

T-M Vacuum Products has more than 50 years’ experience designing and manufacturing various standard and custom size vacuum furnaces and vacuum ovens in both rough and high vacuum configurations with temperatures up to 2,000°C.

We specialize in all metal hot zones and strive to create the best vacuum furnaces and vacuum ovens possible. Our team of experienced engineers and highly skilled technicians build the best systems in the industry. Our systems typically exceed 20 years of life in a full-time 24/7 production environment. This means that each vacuum furnace and vacuum oven, you purchase from us is the most advanced and cost effective on the market.

As an ITA member company, T-M Vacuum is more than happy to assist customers in choosing the right vacuum furnace to meet their needs. Contact us or visit our web site for more information.

TE Wire & Cable
+1-201-845-9400 1-888-4TE-WIRE
www.tewire.com
sales@tewire.com

TE Wire & Cable LLC, a Marmon Wire & Cable/Berkshire Hathaway Company, is a premier thermocouple and specialty wire and cable manufacturer that was formed from the Wire and Cable Division of the Thermo Electric Corporation. Since 1941, the company has been manufacturing high-quality wire and cable solutions for the thermo-sensing and temperature measurement markets. TE Wire & Cable manufactures a full line of thermocouple wire and cable—from iron and nickel-based alloys to copper instrument and control cable. The company maintains an in-house ISO17025 Accredited laboratory directly certified by the National Institute of Standards and Technology (NIST), allowing...
Titanium Buyers Guide (continued)

it to calibrate its own wire. This results in a higher quality product at a lower cost and with improved performance. TE Wire & Cable is highly regarded as the industry leader and has maintained a reputation for providing high-quality temperature measurement wire and cable products with short lead times and competitive prices. TE Wire’s thermocouple wire and thermocouple extension cable solutions can be used for several metallurgy applications, including heat treatment, component testing, furnace surveys and metals production.

Tekna Plasma Systems
www.tekna.com

Tekna offers spherical titanium powders specifically engineered for additive manufacturing applications.

These powders are produced by inductively-coupled plasma, a proprietary technology developed by Tekna which leads to high-purity powders having high density and flowability.

The Council for Scientific and Industrial Research (CSIR)
+27-128412600
www.csir.co.za

The Council for Scientific and Industrial Research (CSIR) is South Africa’s leading national research and development organization. The Titanium Centre of Competence (TiCoC) within the CSIR has a mandate to develop technology building blocks needed to establish a new South African titanium industry. The TiCoC is developing a suite of complementary technologies to add value to South Africa’s vast resources of titanium. This programme primarily focuses on the development and commercialisation of cost-effective processes for primary titanium metal production and its conversion into finished and semi-finished products. The recently established Titanium Pilot Plant situated on the CSIR campus, is an important milestone in this entire process. Parallel to this the TiCoC is developing and adapting technologies to consolidate “low-cost” titanium powders into products. Formal collaboration agreements have been signed between the CSIR and global companies such as Boeing, Airbus and EADS. These mutually beneficial agreements support South Africa’s long-term economic development goals that include the supply of titanium to many industries, including aerospace.

The Pennsylvania State University

Materials research conducted by iMatSE students and faculty lead to advances and discoveries that become the building blocks of tomorrow. Through formal coursework in small classes and participation in cutting-edge sponsored research, students in the Intercollege Graduate Degree Program in Materials Science and Engineering enjoy a graduate education that prepares them well for their future careers.

iMatSE students receive full funding (stipend and tuition) in the form of fellowships or research assistantships. Program Highlights:

- Penn State ranked #1 in funded materials research in the US (NSF)
- Thesis-based Ph.D. and M.S. degrees
- Multi-disciplinary research programs and centers
- Over 50 MatSE and affiliated faculty members

- Approximately 150 current graduate students
- Specialized laboratories and shared facilities

Thermo Scientific

Thermo Scientific delivers best-in-class handheld and mobile x-ray fluorescence (XRF), near infrared (NIR), Fourier Transform Infrared (FTIR), and Raman-based analytical instruments to meet customers’ most demanding applications. Our Niton XRF analyzers serve metal processing, manufacturing and recycling customers in more than 75 countries, with more than 40,000 units installed worldwide. A culture of innovation and a distinguished history of breakthrough achievements have defined our instruments since we released the first handheld XRF analyzer in 1994. Now, with the introduction of the Thermo Scientific Niton XL5, the fastest, most accurate and smallest XRF alloy analyzer has arrived. Part of the Niton family of industry-leading instruments, Niton XL5 offers energy, metal fabrication and automotive industries performance, portability and speed never before seen in a handheld analyzer.

TiFast
+39 0744 7361
www.tifast.com
info@tifast.com

TiFast is a European leader in the production of titanium bars, ingots, billets and wires for the aerospace, medical, defence, racing and industrial markets worldwide.

TiFast, located in Italy, has the most modern plant in Europe for the production of titanium fully integrated with an ingot melting facility, a bars and wires rolling mill, a precision finishing shop, laboratories and R&D facilities.

TiFast can supply titanium bars with very close tolerances, special heat treatments including stress relieving and a full range of finishing. TiFast also started to offer Titanium triple melted quality for critical applications.

TiFast is certified NADCAP for Aerospace and ISO 13485 for Medical Device. TiFast is also certified ISO14001, TUV ADWO, AS 9100, ISO 9001, PED.

Timesavers International B.V.
+31 (0) 113 239910
www.timesaversint.com
timesaversint@timesaversint.com

Manufacturer of wide-belt grinding and brushing machines for stainless steel sheet and coil finishing; laser cut, punched, routed and flame cut deburring and edge radiussing; cast iron, ferrous, non-ferrous and titanium high precision calibration. Timesavers is based in Goes, The Netherlands, with regional offices around the globe in Shanghai (China), Taichung (Taiwan), Kuala Lumpur (Malaysia) an Timesavers Inc, in Minneapolis (USA). Worldwide the company has more than 200 employees supported by a network of local dealers and partners.
Titanium Buyers Guide (continued)

TIMET, Titanium Metals Corporation
+1 610-968-1300
www.timet.com

Titanium Metals Corporation (TIMET) is one of the world’s largest fully integrated titanium producers. Since 1950, TIMET has been leading the industry in mill and melted products, supplying nearly one-fifth of the world’s titanium. We convert rutile ore into sponge; melt and refine ingot and slab; and manufacture mill products. TIMET has a global network of service centers supported by its seven primary melting or mill facilities in Henderson, Nevada; Toronto, Ohio; Morgantown, Pennsylvania; Vallejo, California; Witton, England; Waunarlwydd, Wales; and Ugine, France. With products ranging from sophisticated high temperature alloys used in jet engines, to advanced corrosion resistant alloys used in the chemical industry, TIMET’s reach spans the breadth of the titanium applications, and has the technical depth to support developments across a wide range of applications. TIMET’s fully integrated supply chain, dedicated research facilities, and decades of experience make us the partner of choice for titanium.

TITANIUM ENGINEERS supplies Titanium Bar, Seamless Tubing and Finished Components for oilfield and other industrial markets. Our capabilities include the expertise to process titanium to meet demanding and unique customer specifications. We specialize in bar, seamless titanium tubing and also offer products manufactured by: forging, rolling, and machining using common ASTM grades of titanium including: Titanium Grade 5, Titanium 6-2-4-6, Titanium Beta-C. With our metallurgical background we will support your team from design, through prototyping, and finally into full-scale production of components.

Titanium Engineering
+1-281-265-2910
www.titaniumengineers.com

In 1996, Titanium Consulting & Trading further expanded its operations by setting up dedicated facilities to manufacture finished products on request. Processes available include cutting, welding, forming, turning, heat treatment and finishing.

TITANIUM Consulting & Trading S.r.l.
+39-055-642543
www.tct.it
info@tct.it


Tipro produce aerospace titanium bars and wires for many years and signed LTA with some famous aerospace companies.

As a AS9100 and EN 9100 approved company, we can supply titanium products as follow: AMS 4921;AMS 4928 ; AMS 4965; AMS 6931; AMS -T-9047 ; BS TA11 ;

Titanium Buyers Guide (continued)
Titanium Buyers Guide (continued)

Metal finishing services include: Titanium Anodize; Hardcoat Anodize of Aluminum; IVD Aluminum Coating; and Application of Solid Film Lubricants. We are a small, women owned business, and have been family owned and operated since 1970.

Titanium Products and Consulting, Inc.
+1-412-779-6358
www.titaniumproductsandconsulting.com
info@titaniumproductsandconsulting.com

The focus of Titanium Products and Consulting, Inc. is primarily in two areas. The first is a consulting role for titanium and titanium alloy products, processes and applications. The second is to provide manufacturing and conversion capability with value added properties to enhance your applications performance and lower the overall cost. The ultimate goal is to provide enhanced customer service and technical assistance to make it easier and cheaper for new applications to be developed.

Titanium Industries, Inc. (T.I.)
+1-973-983-1185
www.titanium.com
sales@titanium.com

T.I. is the global leader in specialty metals supply for the aerospace, medical, industrial and oil & gas markets. Holding the world’s most complete inventory of specialty metals across a global service center network. T.I. delivers supply solutions at all levels of sophistication and complexity. With a globally experienced and technically driven team, T.I. has been providing dependable, quality driven service to our customers since 1972.

Titanium International Group SRL
+39-051-6814893
www.titanium.it
tig@titanium.it

TIG is an European stockist and distributor of Titanium, Nickel alloys and Steels for Aerospace, Medical, Automotive and other high demanding end use markets.

TIG is EN9100 and EN9120 certified and has several customers approvals. TIG provides cut to size services with more than 30 saw cut machines and 3 dynamic waterjet cut machines.

Contact us for a quotation! Your mission is our priority!

Titanium Processing Center
+1-888-771-9449
www.titaniumprocessingcenter.com

AS 9100 and ISO 9001 certified, Titanium Processing Center is your go to source for quality titanium products. Titanium Processing Center is a stocking distributor of a wide range of titanium mill products. Our standard inventory of titanium bar, sheet, plate, tubing and pipe is complimented with specialty fasteners, fittings, forgings and fabrications. In-house capabilities include waterjet & saw cutting, shearing, turning and drilling.

All material is mill certified and fully traceable to the original manufacturer. Our dedicated staff is committed to providing our customers with the courteous and prompt attention that they deserve. Delivering quality products on-time and in compliance with your requirements remains our priority at Titanium Processing Center.

Titanium Buyers Guide (continued)

Contact us for a quotation! Your mission is our priority!

Titanium Buyers Guide (continued)

T.I. is a stocking distributor of a wide range of titanium mill products. Our go to source for quality titanium products. Titanium Processing Center is AS 9100 and ISO 9001 certified, Titanium Processing Center is your go to source for quality titanium products. Titanium Processing Center is a stocking distributor of a wide range of titanium mill products. Our standard inventory of titanium bar, sheet, plate, tubing and pipe is complimented with specialty fasteners, fittings, forgings and fabrications. In-house capabilities include waterjet & saw cutting, shearing, turning and drilling.

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Titanium Buyers Guide (continued)

The focus of Titanium Products and Consulting, Inc. is primarily in two areas. The first is a consulting role for titanium and titanium alloy products, processes and applications. The second is to provide manufacturing and conversion capability with value added properties to enhance your applications performance and lower the overall cost. The ultimate goal is to provide enhanced customer service and technical assistance to make it easier and cheaper for new applications to be developed.

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Titanium Buyers Guide (continued)

TMS Titanium is a leading supplier and stocking distributor of titanium mill products to a variety of industries including, aerospace, medical, racing and commercial. By combining product and industry knowledge, commitment to specialty industries, access to titanium and reliable inventory, TMS is able to consistently provide titanium to its customers in order to keep their production moving forward. TMS works with their trusted network of suppliers, finishers and fabrications to fulfill their customers’ specific titanium needs, while producing the best quality products available.

Toho Titanium Co., Ltd.  
+81 467 87 7023  
www.toho-titanium.co.jp

Toho Titanium Company, Ltd. manufactures titanium metals such as premium quality titanium sponge for aerospace and other applications, titanium ingot (CP and Alloy), high purity titanium ingot/billet for semiconductor industry and electronic materials including high purity titanium dioxide and ultra-fine nickel powder etc.

Trepanning Specialties, Inc.  
+1-562-633-8110  
www.trepanningspec.com

Trepanning & machining services. Specializing in hollow bar conversions to pipe, tube, ring and sleeves. Size capacity up to 55” O.D., 21” I.D yielding a 26” core & can saw cut up to 22”. Work with stainless steel to more “exotic” high temperature materials like Titanium, as well as non-metallic materials such as plastic and wood. Full machine shop offering trepanning, gundrilling/BTA, turning, saw-cutting, facing & specialty emergency services. We offer blind shipments. Material can be provided. Family run and Veteran owned since 1973. Contact us via phone (562)633-8110 or email: trepan spec@yahoo.com.

Tricor Metals  
330.264.3299  
www.tricormetals.com  
info@tricormetals.com

Introduction
We are a woman-owned, small business with facilities in Wooster, OH, Conroe, TX, Plymouth, MI and Oxnard, CA with over 25 years’ experience in the supply of titanium mill products, titanium forgings and fabrication of ASME Code equipment for the petrochemical, pharmaceutical, mining, aerospace, and bio-medical served markets.

What we do
We provide quick-ship service center sales and processing of ASTM and AMS grades of titanium mill products and titanium forgings. We also design and build fabricated process equipment built with the most advanced corrosion resistant metals, provide reactive metal and high alloy welding repair services, and supply high performance Astrolite® welding wire.

Where are our facilities
Our fabrication and distribution facilities are in Wooster, Ohio and Conroe, Texas. We process and distribute aerospace grade welding wire from our Astrolite Alloys division in Oxnard, CA. And we operate a technical sales office in Plymouth, MI.

Titanium mill products & custom forgings
We maintain one of the world’s most complete inventories of titanium mill products in ASTM grades for corrosion including sheet, plate, pipe, fittings, bar, billet, wire, tubing, and fasteners. And we maintain staged billets for custom forgings. We offer advanced processing including water jet cutting, saw cutting, and shearing. We provide custom parts manufacturing and just-in-time inventory for ‘blanket’ order processing to meet our customer’s needs. We stock AMS-grades of titanium sheet, plate, bar and billet for aerospace and bio-medical served markets.

Fabrication of advanced corrosion resistant metal
In our ASME code shops in Ohio and Texas we build custom process equipment including: tanks, towers, pressure vessels, piping spools, shell & tube heat exchangers, plate and frame heat exchangers, and custom welded parts. We specialize in advanced metals for solving corrosion such as titanium, tantalum, zirconium, niobium, nickel alloys, duplex stainless and stainless steel.

Field and factory weld repairs
Our repair teams can be mobilized globally for field work. Or we can repair in our facilities. We specialize in welding of advanced corrosion resistant metals like titanium, tantalum, zirconium, niobium, nickel alloys, duplex stainless and stainless steel. Available with 24 hour notice for emergency repairs.

Astrolite® Alloys - Welding wire and titanium for aerospace
We stock, process, clean, process, and package Astrolite® UltraGrade™ high performance welding wires for aerospace, power, and turbine engines.

TZMI, Inc.
+1 281 956 2500  
www.tzmi.com  
marketing@tzmi.com

TZMI is an independent consulting company that works with a wide range of global clients to provide insight and expert advice on opaque mineral, metal and chemical sectors. Our uniqueness is that TZMI contains technical and operational experience, together with strategic and commercial competency, to provide a full service offering to our clients.

As trusted advisors, our reputation is underpinned by having an experienced cross-section of technical specialists around the globe. TZMI partners with clients from the private and public sectors to provide bespoke solutions across markets and strategic services; and also technical and engineering services. Our clients range from the world’s 500 largest companies through to mid-sized companies and small businesses.

TZMI regularly releases market reports and periodicals on relevant subject matters which support the consulting activities and ensure up-to-date, high quality and comprehensive data, analysis and information is provided. TZMI annually hosts the largest titanium and zircon industry conference. Email: marketing@tzmi.com
Our certifications include AS9100, AS9100 Belfast, ISO 9001, ISO 13485, GE S1000, Pratt & Whitney LCS, And Laser Machining/Cutting Approvals NADCAP AC7116, GE-S422 and Pratt PWA 119.

United Performance Metals is headquartered in Cincinnati, OH and maintains sales and stocking locations in Oakland, CA, Los Angeles, CA, Hartford, CT, Chicago, IL, Greenville, SC, Belfast, Northern Ireland, Budapest, Hungary and Singapore. For more information, visit www.upmet.com.

O’Neal Industries (ONI), the largest family-owned group of metals service centers in the United States, is the parent company of United Performance Metals. With sales of approximately $2.2 billion in 2017, ONI is based in Birmingham, Alabama, and has more than 80 specialized facilities throughout North America, Europe and Asia.

__Uniti Titanium__
+1-412-424-0440
[www.uniti-titanium.com](http://www.uniti-titanium.com)

Uniti Titanium brings together two major global titanium producers with complimentary manufacturing and technical capabilities, Allegheny Technologies Incorporated (ATI) of the United States, and VSMPO-Avisma (Verkhnaya Salda Metallurgical Production Association - Berezniki Titanium -Magnesium Works) from Russia, to create a joint venture focused on titanium mill products for industrial and other non-aerospace, non-military and non-medical markets. Uniti Titanium integrates the synergistic use of raw material, melting, hot rolling, finishing, research and technology resources of the two companies.

__Universal Technical Resource Services, Inc.__
+1-856-667-6770
[www.utrs.com](http://www.utrs.com)

Engineering services company, primarily focused on delivering services to the US Government. UTRS maintains a research and development facility working with material science projects, specifically with titanium and titanium alloys.

__UTC Aerospace Systems__
+1-216-429-4227
[www.utcaerospacesystems.com](http://www.utcaerospacesystems.com)

Provide, Manufacture and Assemble landing gear for the aerospace industry.

__Verder Scientific, Inc__
+1-267-757-0351

Verder Scientific Inc., comprised of the Retsch, Carboline Gero, and ELTRA brands sets the standard in high-tech scientific equipment serving research institutions, analytical laboratories as well as manufacturing companies for decades. The company manufactures and supplies instruments for sample preparation, elemental analysis as well as heat treatment of solid materials.
Titanium Buyers Guide (continued)

Verichek Technical Services, Inc.
+1-412-854-1800
www.verichek.net
Sales@verichek.net

Verichek Technical Services, Inc. is an ISO/IEC 17025:2005 Accredited Laboratory for PMI Testing and OES Calibration. We provide a value-added service to our customers in the form of Training, Preventative Maintenance, Spare Parts, and Calibration of OES Instrumentation. As a third party service and calibration provider to businesses in the metals industry, we also offer the best and highest quality OES instrumentation product line, OBLF. Additional offerings include rental and refurbished instrumentation for cost-effective solutions to our customers. In 2017, Verichek has established preferred Service Contract pricing to our customers – we offer customized annual calibrations, 24/7 phone and web support, emergency repairs, discounted parts, training, and much more! Visit our site or call us to learn more!

Vested Metals International LLC
904-495-7278
www.vestedmetals.net
info@vestedmetals.net

Vested Metals International is an ISO 9001 and AS9100 certified raw material specialty metals distributor with decades of experience specializing in hard to find alloys, grades, and sizes. We offer various grades of stainless steel, titanium, tool and alloy steels, aluminum, and high temperature nickel and cobalt based alloys. We pride ourselves on helping customers meet and exceed niche requirements.

VSMPO - AVISMA
+7-34345-55764
www.vsmpo.ru

VSMPO-AVISMA, the world’s largest producer of titanium, holds more than 300 international quality certifications and approvals at major aerospace OEMs and medical device companies. VSMPO-Tirus operations in the US, the UK, Germany and China provide regional sales, distribution and service center processing.

VSMPO - Tirus, US
+1-720-746-1023
www.vsmpo-tirus.com

VSMPO-Tirus, US is the North American sales and distribution division of VSMPO-AVISMA, the world’s largest producer of titanium, holding more than 300 international quality certifications. VSMPO-Tirus US distributes ingot, forgings, slab, sheet, plate, bar, and billet to the aerospace, medical, and consumer products industries. VSMPO-Tirus US also manufactures small diameter bar and coil for medical and aerospace fastener applications.

VSMPO - Tirus China Ltd.
+86 10 8455 4688

VSMPO-Tirus China Ltd. is the Chinese sales and distribution division of VSMPO-AVISMA, the world’s largest producer of titanium, holding more than 300 international quality certifications. VSMPO-Tirus China distributes ingot, slab, sheet, plate, bar and billet to the aerospace, medical, and consumer products industries.

VSMPO Tirus GmbH
+0049 69 905477-25
www.vsmpo.de

VSMPO TiRus GmbH is responsible for the sales and distribution of titanium semi-finished products in Europe (except the UK), Brazil and Israel to the aerospace, medical and automotive industries. The company was established in 1999 in Frankfurt/Main. The German affiliate of the largest vertically integrated international titanium producer VSMPO-AVISMA offers optimum service, including custom-made processing of semi-finished products as well as a comprehensive transport service. We offer cut-to-size material (bars, billets, sheets and plates) to meet our customers’ individual operational needs. TiRus GmbH also distributes electrodes, ingots, rolled rings and different types of forgings.

VSMPO Tirus UK Ltd.
+(0) 1527 514111

VSMPO Tirus UK Ltd. is the UK’s sales and distribution division of VSMPO-AVISMA, the world’s largest producer of titanium, holding more than 300 international quality certifications. Tirus UK distributes ingot, forgings, sheet, plate, bar, and billet to the aerospace, medical, and consumer products industries.

VSMPO Titan Ukraine Ltd.
+380 562 313092
www.tw-vsmpoavisma.com

VSMPO Titan Ukraine Ltd. is fabricator of seamless tubular products from titanium and its alloys. It is a part of the world’s largest producer of semi-products and finished titanium products - JSC Corporation VSMPO-AVISMA (Russia) which supplies billets and bars to the plant. It is guaranteed of quality competitiveness of manufactured production for the customers. Annual production capabilities of the enterprise is 700 tons of cold-finished titanium tubes (diameter 3-134 mm and wall thickness 0,2-9 mm), and in cooperation additionally 200 tons of hot-finished titanium
Titanium Buyers Guide (continued)

tubes (outside diameter 169-325 mm and wall thickness 7-30 mm). Engineers and technical specialists are developing new technologies of titanium tubes production and new types of products. For example, octahedral and ribbed tubes, special kind of thin tubes for silphons, technologies of long-length tubes production, etc. VSMPO Titan Ukraine Ltd. has all equipment necessary for different tests and QA inspections. It allows manufacturing not only according to the international and national standards, but meeting any customer’s requirements.

Webco Industries
+1-918-245-2211
www.webcotube.com
titanium@webcotube.com

Webco delivers North America’s widest range of tubular products, rapidly fulfilling urgent orders and helping customers avoid costly unscheduled shutdowns and production delays. Customers in the aerospace, automotive, chemical processing, industrial, oil & gas, power generation and other industries, rely on Webco’s strength, agility, and innovation to deliver solutions for their most challenging requirements. In fact, Webco manufactures and distributes millions of feet quality tubing made to meet today’s most demanding specifications. Our welded and seamless titanium tube products are available in variety of grades and sizes, standard/off-the-shelf or tailored to meet customers’ unique requirements.

Webco maintains a culture for relentlessly pursuing process and product excellence, enabling ever-improving productivity/product quality. For a current list of our ISO, TS, PED, and other certifications as well as ASME, ASTM, and other specifications offered, visit webcotube.com.

Weber Metals, Inc.
+1-562-602-0260
www.webermetals.com

Weber Metals, Inc. specializes in Aluminum and Titanium open and closed die forgings for the Commercial and Military Airframe, Air and Land Turbine, Nuclear and Semiconductor industries. Our press sizes range in size from 1200 to 33,000 tons. We have capabilities to perform heat treatment, non-destructive and destructive testing in house. Our forgings range in size from 1 pound to 11,000 pounds. Our aluminum stress relieved forgings are some of the most stable products in the industry for machining.

Wellmet International Inc.
+1-909- 594-9639
www.wellmetusa.com

We supply and distribute Titanium Sponge and Titanium Powder. We represent the largest Titanium sponge and powder producers in China. We can also supply other non-ferrous metals which are of Chinese origin with approved quality. The Titanium Sponge producer is ISO9001:2008 certified and sponge quality is approved by world main consumers.

West Penn Testing Group
+1-724-334-1900
www.westpenntesting.com

West Penn Testing Group is a full-service, independent testing laboratory with diverse inspection and testing capabilities since 1952. They provide an extensive array of non-destructive, chemical, metallographic, failure analysis and mechanical evaluation services, serving customers in these industries: aerospace, medical, power generation, commercial, military, raw materials, refractories, oil and gas, and the automotive industry. They have three locations in New Kensington, Pennsylvania and Richburg, South Carolina and perform testing nationally and internationally. Their 79,000 sq. ft. facilities accommodate parts up to 20,000 lbs. www.westpenntesting.com

Western Superconducting Technologies Co. Ltd.
+86-29-8651-4505
www.wstitanium.com
dxh@c-wst.com

Western Superconducting Technologies Co., Ltd. ( WST ), founded in 2003, is headquartered in Xi’an, China. WST is leading supplier of titanium and its alloys material including Ti6Al4V, Ti6Al4V ELI, Ti6242, Ti6246, Ti662, Ti811, Ti38644, Ti1023, Ti6Al7Nb, NbTi in the forms of ingot, billet, forging, slab, bar, rod, wire and profile in the domestic & oversea market. Our products are mainly used in aerospace, medical, automotive industries and other critical industries. WST possess most advanced 10 tons VAR furnaces and series of high speed forging presses to manufacture 6000 tons ingots and 4000 tons bars per year. We have gotten the certificate of ISO 9001, AS 9100, NADCAP and ISO 14001, strict quality control system make largest assurance for our high quality products. WST’s titanium alloy bars hold over 85% domestic aerospace market.

Westmoreland Mechanical Testing & Research Inc.
+1-724-537-3131
www.wmtr.com
us.sales@wmtr.com

Westmoreland Mechanical Testing & Research is a world leader in materials testing. Celebrating our 50th year in business, WMT&R serves a broad range of industries including aerospace, automotive, medical, and power generation. We support our customers with our highly-skilled staff and advanced facilities. Our turnaround time is unrivaled, and with over 300,000 square feet of accredited production and testing space, we have the capacity and equipment to handle any materials testing project. WMT&R’s testing expertise includes: Mechanical Testing, Composites, Fatigue, Stress/Creep Rupture, Fracture Mechanics, Metallography, Chemical, Heat Treat, Thermal Analysis, and Physical Properties Testing. For more information, please visit www.wmtr.com or email us.sales@wmtr.com.

Wyman Gordon
http://www.pccforgedproducts.com/brands/wyman_gordon/

Wyman Gordon is a worldwide supplier to the aerospace and industrial gas turbine markets. We hold quality accreditations for all of the major airframe and engine manufacturers for both civil and military applications. Wyman Gordon creates rotating closed-die forgings which are critical for aerospace and land-based gas turbines. Wyman
Gordon also manufactures structural forgings for airframe, nuclear, petrochemical, power generation, and space applications.

Xi’an Metals & Minerals Import & Export Co., Ltd.
+86-29-65659719  +86-29-65659718
www.tiwmo.com
info@tiwmo.com  wxd@tiwmo.com  hj@tiwmo.com

As a leading manufacturer and distributor of Titanium, Molybdenum and Tungsten products in China, Xi’an Metals and Minerals Import & Export Co. Ltd., has joined into manufacturing, researching and competing in Titanium industry. We supply Titanium and its alloys in various forms as per ASTM, AMS and other main internationally recognized specifications. Our advantage is the most competitive prices as well as guaranteed high quality! Our products are exported worldwide, and gained high reputation because of their excellent performance.

ZIROM S.A.
+40 246 216666
www.zirom.ro
zirom@zirom.ro

ZIROM came into prominence, over the last decades, as one of the largest producers of titanium and titanium alloys in Central and South-Eastern Europe. Ever since the foundation, a permanent emphasis has been laid on its development, through technological optimization and through development of the technology for melting titanium and zirconium scrap by combining EB and VAR technologies, and further, the development of free forging process.

The products manufactured, ingots and forged semi-finished products, are intended both for cutting edge fields (aviation and nuclear areas) and various fields (metallurgy, chemical industry, medical technique and devices).


Zirom can also provide a series of services like melting the secondary recycle materials, turning/grinding/cutting/milling the surface of products, full chemical and mechanical analyses, LP, US +Eddy testing.
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