

AM Metal Powders

BUYERS GUIDE

8

QUESTIONS FOR YOUR METAL POWDER SUPPLIER

METAL ADDITIVE MANUFACTURING is a rapidly growing technology. As AM capabilities grow more sophisticated and efficient, aerospace, automotive, and other industries are starting to close in on the dream of large-scale metal AM. While much of the emphasis in the industry has been on machine technology, metal powders are getting more attention, as parts manufacturers recognize that powder supply, quality, and composition can make a deciding difference in their metal AM operations. Whether your organization is working in prototypes or mass production of metal AM parts, here are eight important qualities to consider in any AM metal powders supplier. We'll also share how **Praxair Surface Technologies** is positioned in each of these areas to help your operation meet the demands of metal AM.

1 CAPACITY

Can your metal powder supplier pour thousands of pounds in one melt?

Whether you need a large or small supply of metal powders, a high melt capacity means your supplier can meet your demand. If you require a large order, capability to produce larger lots reduces your sampling and QC time at delivery. If you order smaller lots at a time, high-capacity melt means more supply on-hand and likely means your supplier has more than adequate processes and procedures in place to continue meeting your supply chain needs. If your supplier can melt in high quantities, you should make sure that also translates into high yield. As yield falls, waste and cost go up. A supplier that can deliver high yield in both coarse and fine particles ensures maximum value for you, whatever technology platform you're using.

Praxair Surface Technologies has the capacity to produce lot sizes that are

thousands of lbs., while maintaining a high yield percentage in both coarse and fine grain particles.

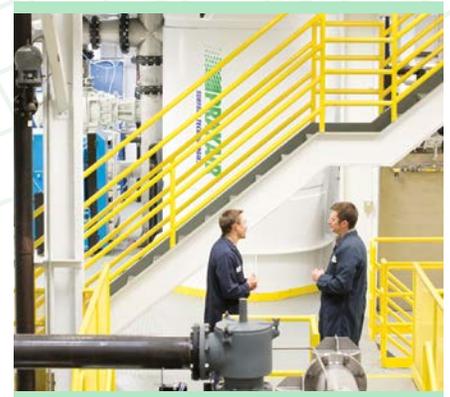
2 FLEXIBILITY

Can your supplier tailor their powders to your projects?

In the burgeoning field of metal AM, the ability to continuously experiment with materials and designs is key to refining your products. AM metal powder suppliers with the capability to deliver specialty compositions, smaller lots and custom-sizing options will help keep your project timelines on-track. When customization is called for, delivery should be measured in weeks, not months. Flexibility should also extend to the platform you're using. Make sure your supplier can reliably deliver powders optimized to your production system.

Praxair Surface Technologies manufactures both large and small lots, delivering powders in quantities as low as 10 lbs. We make metal powders optimized for all additive

platforms and we can also customize composition and sizing to your precise parameters. Praxair stocks standard products in large inventories for fast delivery. Customized products can be delivered in as little as a few weeks, not months.



An on-site visit to an AM metal powder manufacturing facility can be an important learning opportunity when evaluating a supplier. Shown here is a titanium atomizer in Praxair's 300,000 square foot metal powder plant in Indianapolis, Ind., USA.

3 RANGE OF PORTFOLIO

Does your supplier specialize in only a few compositions?

As your metal AM expertise grows, so may your needs for different materials. In addition to titanium alloys, a supplier that can also deliver iron, nickel, and cobalt powders will maximize your options as business demands change.

Praxair Surface Technologies is the only manufacturer that can supply titanium, nickel, iron, and cobalt AM powders at a mass-production scale.

4 TECHNOLOGY

What technology does your supplier use to manufacture its powders?

High-purity, low-gas content atomized powders are the preferred choice for metal AM parts that must meet special industry demands, such as those for aerospace. Understanding the quality of the powders you work with begins with understanding the technology your supplier uses to make them. Make sure your powders are made using vacuum induction melting, combined with argon gas atomization. Vacuum induction melting minimizes oxygen content, maximizes flowability and ensures proper morphology. This translates into better integrity and performance of the finished part with less production waste.

Praxair Surface Technologies only produces AM metal powders using vacuum induction melting with argon gas atomization. In 2015, Praxair

built the world's largest titanium gas atomizer for high-volume production, which added to its existing large-scale production of nickel, iron, and cobalt powders. Our close-coupled atomization technology delivers up to 10x more yield vs. older methods.

5 SAFETY

Does your supplier have a proven track record in metal powder manufacturing safety?

Like most manufacturing, AM metal powder production can be dangerous if not done correctly. A safe manufacturer not only protects its employees but your supply chain as well. A visit to your supplier's facility can reveal a lot about the value they place on safety. The facility should be clean and organized, and safety processes should be meticulously documented and followed. If your supplier has proven safety procedures, they should also be willing to share their best practices with you, to help your organization ensure safe handling throughout your production process.

Praxair Surface Technologies regularly consults with customers to help them improve and refine their safety procedures, building from best practices we've developed over decades of metal powder manufacturing. One example is our proprietary titanium process that allows customers to more safely handle these highly reactive powders.



This article, authored by Praxair scientists, highlights key points about safety, handling, and AM manufacturing with titanium powders.

Selecting a supplier that can provide a wide range of AM metal alloys can be an efficient supply chain solution.



6 QUALIFICATIONS AND CERTIFICATION

Does your supplier carry the necessary certifications for your end-use?

For aerospace and other specialized industries, it's important for your AM metal powder supplier to understand the requirements of your industry and carry the appropriate certifications. Suppliers will be audited regularly by most OEMs and must hold specific regulatory approvals. Your supplier's production system should be set up to meet any specified requirements from top to bottom, including comprehensive traceability, measuring the purity of the raw materials used and documenting the precise composition of the powders you receive, for a reliable, consistent supply chain backed by confirmatory data you can easily access.

Praxair Surface Technologies works with aerospace-grade raw materials which undergo thorough testing in our onsite lab. We carry AS 9100, ISO 9001, and Nadcap certifications. Every lot we produce is fully traceable. Lot reference samples are kept on file and we share final product quality control data with our customers as a matter of routine. Through our onsite testing lab, Praxair can supply additional or customized quality control testing to meet your specific documentation requirements.

in continuous process improvements for AM materials. A supplier that uses proven methodologies like Six Sigma and Lean Manufacturing will be better able to keep up with the future demands of your business. Look for a supplier with a demonstrated commitment to continuous improvement to product quality, consistency, and process efficiency.

Praxair Surface Technologies employs Six Sigma, TPM, Lean Manufacturing, 5S, and other continuous improvement methodologies to keep our processes up-to-speed with the metal AM industry and devise process improvement projects specific to metal AM. For example, a Praxair Lean expert recently completed a project to improve our low-O₂ production process. Praxair also has an onsite metal AM lab, where we are able to design and produce AM parts. This capability helps us learn how our metal powders work in real-world applications—providing insights to continuously improve formulations, efficiency, and quality.



Traceability of metal powders from raw materials to finished goods can provide additional assurance. Barcoding on packaged powders allows for quick and accurate traceability data retrieval.

7 PRODUCTIVITY AND CONTINUOUS IMPROVEMENT

Does your supplier implement formal process improvement methodologies?

With the fast growth and rapid changes in metal AM, it's important that your supplier is actively engaged

8 FINANCIAL BACKING AND INVESTMENT

Is your supplier committed to keeping pace with metal AM growth?

Your powder supplier should be prepared to work with your company for the long-term, and that means investing in technology and infrastructure to support the evolution of metal AM. Atomization systems, comprehensive QC capabilities, and regulated processes take years and millions of dollars to bring online, and must advance alongside the industry. Only suppliers with substantial resources will be able to keep up with the predicted growth of metal AM.

Praxair Surface Technologies has been an industry leader and innovator since 1946. Our parent company, Praxair, Inc., serves a million customers worldwide and has annual sales of \$11 billion. With this backing, Praxair Surface Technologies has made substantial, ongoing investments in metal AM. Significant additions to our infrastructure include our onsite metal AM lab, complete with design and AM part production machinery. Additional capital improvements include our high-capacity titanium atomizer, which enables Praxair to produce high-quality powders while constantly improving and innovating both products and processes.

Praxair AM Metal Powders

Making your dreams for metal AM fly

PRAXAIR SURFACE TECHNOLOGIES has served the aerospace industry since 1946. At any given moment, millions of pounds of Praxair-made powders are in the air, meeting the strict demands of our aerospace customers. We know metal AM will be part of our customers' futures, and we have made a commitment to make it part of our future, too.

EXPERIENCE

With over 40 years of experience in metal powder production, Praxair has the capability and expertise to meet the demands of metal AM, from product development to process innovation.

CAPACITY

Our scalable capacity means we can supply both high volumes for large-scale production and small lots for R&D. Praxair Surface Technologies is the only manufacturer that can supply titanium, nickel, iron, and cobalt AM powders at a mass-production scale.

CONTACT US

to find out how we're making more possible for metal AM:

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Making our planet more productive™

QUALITY

With traceability from raw materials through final product delivery, Praxair *TruForm™* metal AM powders provide consistent product composition, morphology, and particle size to meet even the most stringent industry demands.

SERVICE

Praxair Surface Technologies believes in understanding and fulfilling what our customers need for the growing metal AM industry. We deliver reliable, consistent supplies of standard powders, and efficient production of custom products. Our team is ready to work with you, consulting on products, processes, and safety to help your metal AM operations run smoother, and innovating to improve the entire industry.



Praxair's onsite metal AM lab helps us innovate new products and processes and understand how our metal powders work in our customers' real-world manufacturing applications.

PRAXAIR
SURFACE TECHNOLOGIES

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