



PICK AND CHOOSE

Whether the choice is between investment casting or additive manufacturing, selecting the best process can be a tricky decision. Fortunately, GF Machining Solutions and GF Casting Solutions are on hand to provide a range of solutions that suits both technologies.



In industries where components are used in extreme environments, manufacturers have historically relied on investment casting processes to produce parts. However, with the advent of metal additive manufacturing (AM), those same manufacturers have discovered that many cast parts are more efficient to create with metal AM processes.

But how do shops determine whether investment casting, AM, or a combination of both processes will be the most efficient for their part-production operations? Both have advantages, but manufacturers around the world must consider a wide range of factors to determine which process best fits their needs.

In deciding between investment casting and additive manufacturing, the size of the part has generally been the deciding factor. The initial generations of metal AM technology featured relatively restrictive build areas, but this is changing. New, high-performance powder-based AM machines now feature much larger working envelopes, which makes the technology more competitive with investment casting processes by allowing for building much larger parts.

All shapes and sizes

Part materials also tend to determine what kind of process a manufacturer can use. Metal AM processes require rapidly heating and cooling materials, which generates an extremely refined grain structure. Casting, on the other hand, is

→ DMP Factory 500—optimised solution for large AM parts (right)



capable of producing a single crystalline structure, which can be crucial to the integrity of high-temperature superalloys common in aero engines.

If a part can be built in an additive machine and will not be used in an extremely high-temperature application, metal AM should be considered as a cost-effective solution. This is particularly true when compared to investment casting, given that AM processes require no tooling. For the

large, geometrically-complex parts, such as aerospace turbine rear vanes, casting tooling can quickly become expensive due to its size and precision.

Adding to the expense of investment casting are the long lead-times involved. Many shops rely on outside suppliers for castings, but even when they perform the work in-house, investment casting requires several time-consuming steps to prepare a mould for pouring. Conversely, metal AM part production is now as simple as programming the part with dedicated software, determining

When compared to AM, casting stands out for its material variety and vast size range

necessary supporting structures and launching the job. Although parts may take longer to build with this powder-based AM technology, machines can do so completely autonomously, meaning that large, seamless parts like turbine rear vanes can be completed more efficiently.

However, many manufacturers still believe metal AM technology is out of reach, as the initial or ongoing material costs and cost per part are thought to be too high. Others are concerned about the limited knowledge of AM technology or safety concerns regarding sensitive powdered metals. And while manufacturers recognise that AM represents the future of production, shops still need a partner that understands how to profitably integrate that futuristic technology into their existing workflow.

A sum of the parts

Fortunately, today's AM machines, such as GF Machining Solutions' DMP Flex 350, DMP Factory 350 and DMP Factory 500 significantly lessen or eliminate the concerns about AM technology. Designed to operate as a complete, integrated solution, the DMP series of AM machines, as well as part-separation solutions like the AgieCharmilles CUT AM 500 and software, such as 3DXpert, allow shops to overcome a wide array of manufacturing challenges, including control of part quality, cost, workflows and scalability. In doing so, it enables manufacturers to build higher quality parts, reduce total cost of ownership, simplify process workflows, and scale up production in a factory environment. High-performance laser solutions allow for fine-grained control for additive processes, even for parts built within the large 500 x 500 x 500mm build area of the DMP Factory 500.

GF Machining Solutions' AM technology also includes a suite of software designed to make additive part production accessible for all manufacturers. The 3DXpert software, developed by GF Machining Solutions' partner, 3D Systems, handles the entire AM workflow, from part design to post-processing, while DMP Monitoring enables real-time process optimisation. This helps shops quickly redesign parts to be 'AM-friendly', setting them up to have the fewest possible support structures while maintaining the part's mechanical functionality and integrity.

Of course, the complex geometries and lightweight part features available with metal AM present difficulties when separating parts from the build plate. For example, when parts are separated using vertically-configured cut-off methods, such as conventional wire



EDM or bandsaws, there's greater risk for the first part that is cut off among the other parts around it. Therefore, GF Machining Solutions has also developed a way to handle AM part separation: the CUT AM 500 horizontal wire EDM machine.

Despite these advances in AM technology, there are still many applications that are more efficiently accomplished with investment casting, particularly as production volume increases even further. This casting method also allows for sophisticated part geometries and smooth part finishes that would be difficult or otherwise impossible with other types of casting.

When compared to AM, casting stands out for its material variety and vast size range. Even as additively manufactured parts get bigger, castings can be made as big as the available tooling, in theory. Likewise, it's ideally suited for nickel-based superalloys and other high-temperature applications. But this process requires significantly more expertise than today's simple AM systems, and most shops continue to have outside suppliers run their part production with finished tooling for a casting operation.

Whether casting or AM, shops must realise that both processes do not exist in isolation; they are part of a larger manufacturing workflow. So, whether incorporating an investment casting, AM or both processes, shops benefit greatly when they work with a supplier that can provide complete solutions to support both the upstream and downstream processes.

Typically, suppliers such as GF Machining Solutions and GF Casting Solutions, will provide support for a range of technologies, from high-speed milling, EDM and micro laser machining to laser texturing, automation, AM

and casting. Their experts can work together with shops to construct turnkey systems designed to the customer's exact specifications.

A bedrock of knowledge

These services can be useful for shops inexperienced with AM technology or investment casting techniques, but even experienced shops can benefit from a partnership with an OEM like GF that offers assistance based on its extensive casting and AM knowledge. At the company's Centres of Competence, particularly its AMotion Center in Stabio, Switzerland, customers work collaboratively with company experts. These specialists assist with simulating processes and developing prototypes - and for challenging AM or investment casting processes involving novel materials or complex part geometries, even the most experienced shops can benefit from assistance with testing and optimising various part-production strategies.

Effective OEM partners will also be able to ensure the highest level of part quality. Both GF Precicast, its precision casting division, and the AMotion Center have Nadcap accreditation. When combined with the company's dedication to quality across its entire technology portfolio, this ensures customers will have access to the support they need to build or cast complete parts.

Whether the optimum process turns out to be additive manufacturing or investment casting, OEMs like GF offer support for both in terms of evaluation, technology and full part production as well as provide casting tests and certification. As a result, no matter whether a part is best handled with investment casting or metal AM, shops can receive the support they need from the earliest stages of an application to part validation and delivery.

www.gfcs.com
www.gfms.com

→ Turbine rear vane built in 48 hours at AMotion Center, Stabio (above)

→ The AMotion Center AM expert team, Stabio (below)

