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Metal 3D Printing Opens New Doors for Industry

Metal additive manufacturing (AM) is the hottest subject in the industry. It is revolutionizing how companies design, test, manufacture, and distribute products. With all the hype surrounding this disruptive technology, there are several major items all users new to metal additive manufacturing should understand upon entering the AM workspace.

The freedom possible in the manufacturing process allows designers to create optimal designs without restrictions from conventional manufacturing processes. Design for Manufacturability (DFM) has long been the method by which components were designed, and it subsequently drove design standards and practices by which compromises to performance, weight, cost, materials, and other factors were necessary to result in a producible part. With additive manufacturing, the restrictions from DFM are greatly eliminated allowing designers freedom to create, optimize, and push the limits of component development. As a result, designs become lighter, structural capabilities and product durability increase, products perform at higher efficiencies and temperatures, and assemblies are eliminated—all of these results combine to equal lower total cost.

A common misconception is that AM will replace and/or eliminate conventional machining. Although AM allows for the creation of highly advanced and complex designs, it often does not produce end-use features required by many applications. Due to the additive process, the surface finish and tolerances may need selective machining of key features. It is critical during the DFM process that the design and manufacturing teams communicate and coordinate activities to produce a design that is optimized not only for the AM process, but also for the subsequent conventional machining required.

Although additive manufacturing is able to produce highly-complex end-use parts, it also provides excellent opportunities to optimize and develop advanced techniques for current processes such as investment casting, injection molding, and precision machining. Injection molding dies can be designed and produced with conformal cooling passages near the surface of the die which will create more efficient cooling, and as a result reduce injection time-in-die, improving production rates and product costs while also improving die life.

The large investment in tooling lead time and cost is eliminated with the ability to print parts directly. Early in the development cycle of a product, the manufacturer can produce prototypes and end-use parts with minimal post-processing tooling, accelerating times to market. In addition, AM reduces the potentially large investments in casting/forging dies and numerous machining and transfer fixtures. As the development cycle transitions from low-rate to high-rate production, the savings continue to grow by eliminating the recurring costs associated with tooling inspection, validation, maintenance, and ultimate replacement.

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AM is often portrayed as a process in which a user simply loads a 3D model into the machine, hits the print button, and hours later a finished part is waiting. Although printers utilizes the 3D model as the primary input for production, there are several steps between creation of the model and achieving a successfully built part. Due to the layer-by-layer process, there are many considerations the designer and manufacturer must be aware of when preparing a build. The most notable items are the build orientation which is not only *XYZ* location but also the rotation of the part relative to the build plate, as well as support structure which is added to produce high-quality, dimensionally accurate products by mitigating thermal stress and distortion.

The impacts of AM will continue to multiply as the technology continues to advance. The industry is only now starting to understand the potential of what metal additive manufacturing can bring to countless markets and producers are beginning to realize the vast impact this technology will have on current products, and also the endless possibilities it creates for future products.