MANY BENEFITS

FLOWFORMING YIELDS PRECISION, ACCURACY & KEEPS AN OPERATION COMPETITIVE

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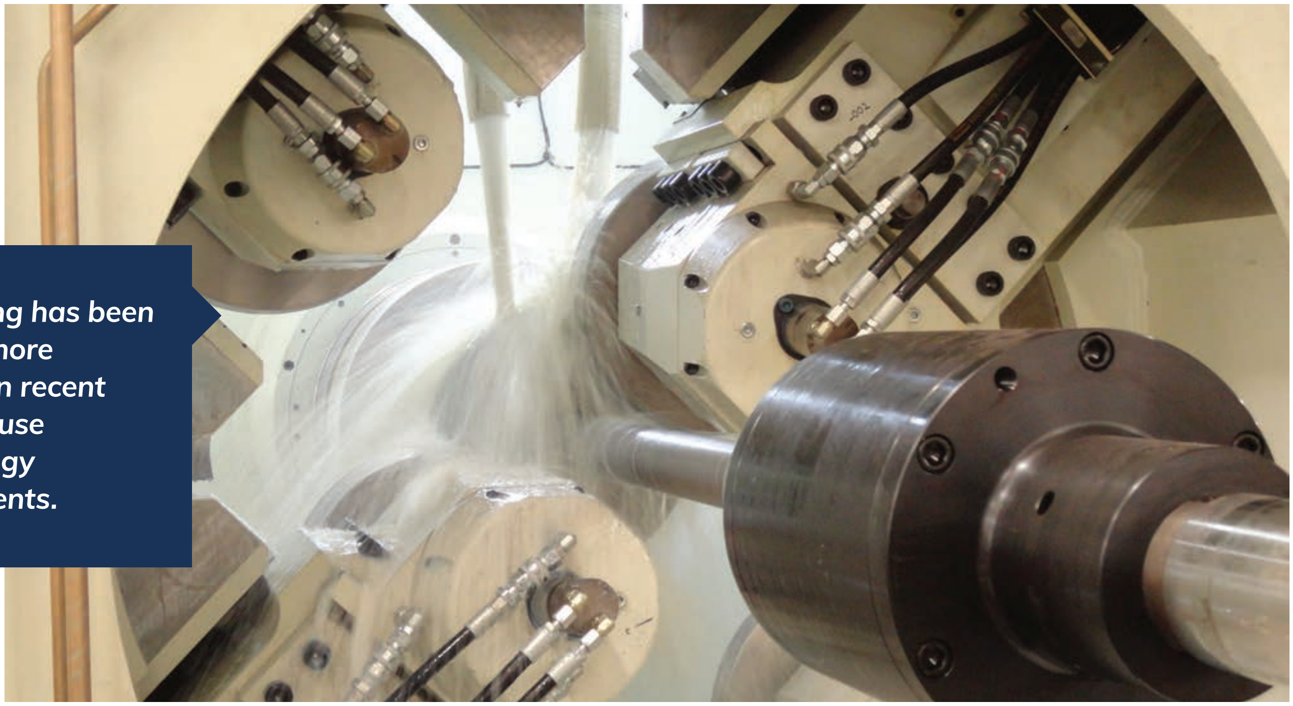
WITH MANUFACTURING ENVIRONMENTS on a continuously evolving trajectory, the benefit has always been greater with lean and efficient manufacturing methods that provide low cost and repeatability. Although new nonmetallic materials have been increasingly making their way into product designs, the utilization of traditional materials continues to be a large part of commercial and aerospace requirements.

Aircraft engine components are often an assembly of diverse parts that are manufactured using various processes. A significant number of these parts are manufactured using sheet metal forming, and the manufacturing is often performed in numerous steps. Furthermore, if the assembly involves welding of different parts, distortion is likely the result. With the ever-increasing costs of raw materials, machining of symmetrical parts out of forged rings is becoming less cost effective, as up to 85 percent of the material can be lost to machining chips. For these reasons, the use of near net shape manufacturing methods is appealing. One of these alternative fabrication methods is called flowforming.

Over the last 60 years, flowforming has been used in commercial and defense industries; however, the process has been looked at more favorably in recent years because of the advancement in flowforming technology. Industries, such as aerospace, favor flowforming because it lends itself well to hollow, thin-walled symmetrical shapes with close-tolerance requirements of the wall thickness and profile.

Flowforming has been looked at more favorably in recent years because of technology advancements.



Also, flowforming has the ability to form many different types of materials. Typical applications include materials such as inconel, hastalloy, columbium and stainless steel (austenitic, ferretic and pH type).

Flowformed products can be produced as one-piece components that are near net shape. This is very desirable because it reduces costs when compared to multi-piece manufacturing methods. Flowforming also provides significant cost savings in several key areas. It significantly reduces testing requirements due to the elimination of welds, and it yields less wasted material in the finished component. Therefore, it uses less energy for manufacturing.

Flowforming is sometimes referred to as a controlled metal-spinning process. Similar to metal spinning, the flowforming process forms various metals against a hardened mandrel.

The difference between flowforming and metal spinning is that metal spinning utilizes a relatively thinner starting material and a larger diameter starting blank. Metal spinning forms the part to the mandrel or punch and usually requires the addition of exter-nal heat to keep the material malleable. This lends itself to a lack of control which results in a wide variations in wall thickness and profiles that are neither predictable nor repeatable.

Modern flowforming, which is done in ambient temperature, ensures a repeatable forming process because it uses computer modeling and CNC equipment to control the wall thickness and profiles to a few thousandths of an inch.

The optimum wall thicknesses for flowformed parts ranges from .010 to .375 inches, and can be produced for less cost than other methods. Parts with a length-to-diameter ratio of 2.5 to 1 or greater typically produce the best results.

The design of the preform is one of the most critical starting points of a successful flowformed part. Advanced computer modeling helps to ensure the success of the final component by reducing development time and wasted material.

The process of designing an optimal flowformed part starts by reverse engineering the end product. Understanding the amount of volume of material in the final part is a key to determining the starting thickness of the material and developing the preform. The preform is the initial shape of the part prior to flowforming.

Each flowformed part requires a unique preform and tooling to achieve the preform shape. The preform can be created using a number of processes including deep drawing, machining or forging.

The flowforming process begins by rotating the preform on a hardened mandrel and compressing it with a set of two, three or four forming wheels. While the preform is being compressed it begins to form along the contour of the mandrel. The gap between the mandrel and the forming wheels will determine the final thickness of the finished part. This gap can change or remain constant anywhere along the length of the part, allowing for different wall thicknesses throughout the part. Flowforming is the only metal-forming process that allows the flexibility to vary the wall thickness to produce thicker and thinner sections in any combination without material removal.

After flowforming, other processes can be applied to the final part such as reforming, finishing and machining as needed.

Flowforming has the ability to form many different types of materials.

IDEAL CANDIDATES

Because the flowforming process is conducted in an ambient environment, many materials cold work as a result of the amount of strain that is introduced to the material during the process. Cold working changes the mechanical properties of the metal, usually by increasing the ultimate tensile and yield strength, but also significantly reducing the elongation.

For example, cold working of austenitic stainless steel will typically double the mechanical strength. 304-grade stainless steel in the annealed condition has a tensile strength in the mid 80 ksi range with elongation of about 55 percent. After a 60 percent reduction in material thickness by the flowforming process, typical mechanical properties are 160 ksi ultimate tensile, but the elongation is reduced to approximately 15 percent. However, increased strain hardening is not necessarily an asset because the original product specification may have been designed based on the attributes of the starting material. In order to return the material to the original mechanical properties of the metal, flowformed parts can be fully annealed by heat treating at a specific temperature.

The basic limitation of flowforming is its restriction to parts that are symmetrical around a centerline. In other words, it can only be used for parts that are conical or tubular in overall shape.

Not all materials can be flowformed successfully. Certain titanium alloys or tempered aluminums, for example, are not ideal metals for flowforming. In many applications, materials of 15 percent elongation or better make ideal candidates for flowforming.

A VIABLE ALTERNATIVE

If you are seeking a creative and cost-effective solution to complex, hollow metal shapes, then flowforming may be a viable alternative to the traditional fabrication and metal forming processes. Across the spectrum of industries, flowforming provides a seamless, single-piece, cyclical and contoured component that answers the need for thin wall requirements.

Moreover, flowforming saves cost by reducing the number of components in an assembly, by reducing non-destructive testing due to the elimination of welds, and by efficiently utilizing material and eliminating waste.