Concept to Production at the Speed of Light: Metal Springs and Stamping Business Responds to Quickening Pace

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The pace of product launch continues to pick up throughout every industry, responding to the speed at which information is exchanged and the perceived need to introduce the latest product revision to beat competitors. Such rapidity is especially seen in medical instruments, firearm components, and parts produced for the consumer, automotive, and electronic industries. Original equipment manufacturers are pushing the envelope to get from concept to production in the fastest possible time.

To meet original equipment manufacturers' need for fast pace in the world of metal stamped parts and springs, engineering expertise is taking on an even more important role. Expertise in prototyping parts to test and prove design concepts, suggesting ways to reduce secondary operations to decrease cost, and providing value engineering consulting, are key engineering skills that ensure the success of projects. Behind it all is a foundation of communications and two-way dialogue that ensures that products meet customer requirements.

Starting Off on the Right Foot—Initial Customer Contact
No matter what the industry, or the schedule requirements, each project should begin by establishing lines of communication to get an in-depth understanding of a customer's design, objectives, and material requirements. A discussion of part dimension tolerance is essential. Some tight tolerances may add significant cost, and may not be critical, while others may be achievable at no additional cost. Understanding the key dimensions and the most critical part tolerances is extremely valuable to both parties when developing the final part print.

The next important steps include: familiarizing oneself with the product, including models and 3-D drawings, followed by talking to the customer to get a clear idea of what is needed, and identifying critical characteristics. These steps are followed by internal discussions to develop recommended options for design, tooling, and production.

The initial customer contact phase set the scene for a successful project for Aragon Surgical, a Palo Alto, CA-based startup medical device firm that significantly reduced its costs by converting a fully machined part to a stamped part with machined features.

Brandon Loudermilk, Aragon Surgical's senior research and development engineer, explained that he was looking to reduce the overall cost of the firm's previously

released laparoscopic surgical device, and was given the task of finding ways to decrease costs on as many parts as possible. The jaw housing was one of the higher priced parts, making it a good candidate for alternatives. In addition, there were problems getting sufficient parts from the existing supplier.

At the initial contact with Aragon Surgical, engineers at Connecticut Spring & Stamping (CSS) [1] began the process by looking at the part and discussing ways it might be stamped instead of machined from a solid tube.

“When we started I thought there was no way anyone could stamp this part to be perfectly round and make it function properly,” says Loudermilk. Engineers at CSS then held several conversations, discussing numerous steps to arrive at the most important features on the part, and how it could be stamped within the necessary tolerances. Web-conferencing played a significant role, so the two groups could go back and forth quickly and remain on the same page. In just a few short weeks, they came to an agreement, and were able to begin working on production tooling.

One interesting aspect of the early conversations was that CSS engineers showed Aragon another piece they make—a lock barrel for a high end commercial door lock that was similar in many ways to the jaw housing. “When I saw how they could produce that part, how round it was and how good the finish was, it made me consider talking to them more about stamping this part,” says Loudermilk.

Once they started talking, CSS engineers went over the part print with a fine-toothed comb, adjusting the 3-dimensional CAD model and marking up the original drawing with their initial ideas. The groups discussed the tight dimensions, stepping through each feature to see if they could hold the tolerances, looking at the mating parts to see what the critical features were and how the mating parts interacted. The groups also considered which features were critical, which features could be machined out, and how the part would have to be aligned. Many emails, redlined drawings, and web meetings later, the agreement was made, and it was only the first phase.

The tooling costs were significant, but the high per part savings made the investment worth it. When the component was made as part of a tube, it was held to a tolerance of plus or minus 1/1000th of an inch. The stamped component is capable of plus or minus 2/1000th of an inch. Even though the tolerance is 1/1000th more, the part is fully functional in the design at a significant savings.

The startup firm was conservative with its capital, and went through numerous

discussions to arrive at an agreement, which included amortizing the tool costs used to stamp the part. According to Loudermilk, “We paid up front for a certain quantity of parts, with the additional cost going towards paying for the tool costs. This enables us to get cheaper parts quickly, without putting out our capital up front. After the initial run was consumed, the tooling comes out of the piece price, making it that much more attractive and profitable.”

Loudermilk estimates that the initial run was 20-30 percent cheaper. When the tooling costs come out, the new stamped jaw housing is 50-60 percent cheaper than the machined version, while still meeting all the design specifications.

Prototyping—if at first you don’t succeed, keep trying
One fact in the metal stamping and springs industry is that metal components are often the last to be sourced. Since plastic parts cannot be changed without significant mold costs and very long lead times, stamped metal parts and springs frequently need to adjust to other parts’ restrictions. Accordingly, prototyping is a very important part of the design development process.

Is raw material cost a main concern, or is tooling cost the biggest issue? Getting this information up front is essential to develop a prototype or series of prototypes to meet their needs. With a brand new product, enough detail is needed to work out the best material to make a prototype that can be manufactured in a production scenario.

Tony Morefield, director of manufacturing and engineering services for Sunnyvale, CA-based Avantis Medical Systems, used the prototyping phase to great advantage to develop a cost effective spring for a catheter, which is fitted on the end to lock the part into the working channel of a scope. Avantis had experienced quality issues with its original supplier and was looking for a spring that would perform well in the instrument.

Spring tolerances were key, as there were tight angles Avantis needed to be held for the spring to perform properly. As part of the research and development process for the part, CSS went through about four revisions where they tested slightly different angles and dimensions on the spring.

“Actually, it’s interesting, but at first I didn’t even realize we were prototyping,” says Morefield. “We received feedback from the original drawings that the engineers were not comfortable they could manufacture the part as designed. We revised the drawings live on conference calls and discussed the design to see where we had leeway as far as changing tolerances. This method was great for coming to an agreement quickly on what the next revision would look like.”

From CSS’s perspective, the Avantis process was different than many because Avantis had a design with tolerances and bend angles that made it extremely difficult to manufacture. Engineers made a few suggestions on the bend angles that connect two coiled sections of the spring. Opening up some tolerances to make the part manufacturable, and supplying a prototype to try it out worked well.

According to Morefield, the result of the prototyping effort has been successful—“We have been through a lot of benchtop testing, and have used the instrument on about 100 patients. We are now in the midst of a full commercial launch.”

Value Engineering

Stamped metal and springs are used in millions of products across the gamut of industries. In fact, experience with metal movement allows a reduction in cost and the development of new solutions. Moreover, skilled engineers can increase value and reduce costs by designing tools with flexible options for change by adding skip stations in a die for a nominal up front tool cost. Additional cutting or forming can be added if needed.

Value engineering helps customer design parts that are within a tight tolerance and yet very manufacturable and consistent in the long run. Value engineering is most effective when engineers are familiar with consumer product range, and can apply what they have learned in the past to new products. For example, CSS has been

working closely with Springfield, MA-based firearms manufacturer Smith & Wesson for more than 40 years, providing prototyping, high-speed progressive die stamping, and short-run die stamping on a variety of parts for different models of Smith & Wesson firearms.

One recent example where fast track value engineering helped Smith & Wesson was the development of their new Bodyguard series, the first personal protection models with integrated lasers. Smith & Wesson's goal was to provide the most state-of-the-art, concealable, and accurate personal protection possible. The company needed to solve a variety of design and manufacturing challenges before launching the models at the Shooting, Hunting, Outdoor Trade Show and Conference (SHOT Show).

According to Ginger Chandler, Smith & Wesson's Vice President of New Product Development, "One of the most important things we look for is value engineering and value analysis to help us reduce costs, and for this project, CSS provided us virtually a one-stop-shop for very fast feedback that helped us design the models for manufacturability."

She adds, "We are under considerable cost pressures and appreciate suppliers who actually look for opportunities to keep costs as low as possible. CSS utilizes their extensive experience to enhance every new project. "

Working closely with Smith & Wesson, CSS made several different prototypes and explored multiple options concerning the internal stamped grip frame assembly, a large part that holds the trigger bar and determines how the trigger feels. Design revisions were quickly incorporated for a variety of small components, which is especially important where interfaces are critical. For example, in the Bodyguard project, CSS promptly made changes identified during the design and testing process to the original stamping tool for the trigger bar.

Production Tooling

There are multiple options for developing a customer's individual production tools, and time pressures may play a factor in which options are appropriate.

Progressive die tools provide more consistent results, and allow a higher capacity. With a progressive tool, there is not as much variation, and the process is more stable.

Bridge tooling, a lower cost tooling option that can be used to produce a certain number of parts, is an interim measure that can be used while the full blown production tooling drawings are being designed and produced. It is most often used when the customer is not 100 percent certain the design is stable. About 10 percent of projects utilize this type of tooling, which can be applied to test the final assembly in the real world. If the design works well, the tooling is finalized; if not, changes can be made more easily. Bridge tooling may also be used if production lead times or budgetary concerns do not allow for full blown progressive die sets. Since bridge tooling involves multiple single-stand operations, it may lead to process variation.

Nearing the End of the Line—Running Parts Off a Progressive Tool
At this stage, the issues are quality and capacity. At CSS, the new tool group gets each new order, builds the tool, stamps out tooling samples and conducts the first production run. When customer approval is obtained, the new tool group hands the tool and the process off to the production floor after working out the details of the required quality inspection program.

Tooling plays a key role in the race to get products to market quickly. For example, the Aragon Surgical part requires a unique rotary head used on milling the portion of the part that gets machined after it is stamped. After the part is formed, it goes into the milling operation for surfaces that need certain finish and accuracy.

Quality Control and Inspection
While the manufacturing steps are all taken with the aim of moving parts from concept to completion quickly, the last step, quality control, is never sacrificed for the sake of speed. Every job goes through a rigorous quality inspection process, with a frequency according to customer-specific requirements. All jobs are checked prior to the start of production, and receive in-process inspections and a final quality inspection.

Other steps may also be taken for ensuring quality, depending upon the part. For example, Aragon Surgical parts, which are electro-polished and sent out for laser marking, are packed in trays to eliminate scratching during shipping.

From the initial customer contact and quotation phase, to prototyping, to value engineering, production tooling, running parts off progressive tooling, and quality control and inspection, the metal springs and stamping business has had to adapt to this rapid pace. Lessons learned by medical device manufacturers, Aragon Surgical and Avantis Medical Systems, and firearms manufacturer, Smith & Wesson, show that each step plays an important role in moving a part from concept to completion at the blazing speeds now considered normal.

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[1] http://www.ctspring.com/