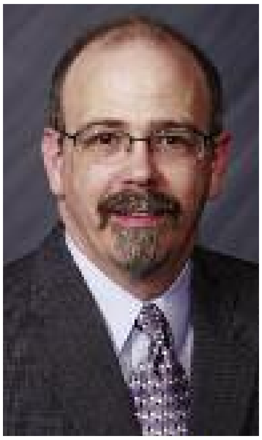
TOOLING BY DESIGN | PETER ULINTZ



Peter Ulintz has worked in the sheetmetal-forming industry since 1978. His background includes tool and die making, tool and process engineering, engineering management and product development. Peter also operates the website ToolingbyDesign.com, a source for the transfer of modern metalforming and tool-and-die technology, and which promotes the use of "Performance-Based Die Engineering Strategies."

Peter speaks at PMA seminars and roundtables focusing on tool and die design, die maintenance, deep drawing, stamping simulation, tooling for stamping high-strength steels and problem solving in the press shop.

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Pressing Questions...and Answers

Q: I am a raw material supplier (brass) and we currently supply coils to a stamping company having difficulty drawing parts from our material. Our control charts for tensile, yield, elongation and grain size all indicate our process is stable and in control, yet our customer continues to have difficulties. To give you an idea of the size of this part, it is the bottom of a light bulb.

Our customer describes the problem as: "Splitting appears at the beginning of each coil and again when we are close to the center of each coil… We have been able to run the material by refurbishing the tool and roughening up (sandblasting) the die and strippers to hold the material during drawing. This roughening process has to be done on a daily basis, with considerable downtime. The latest lot of material received does not appear to be performing any better."

I understand that the first reaction is to question the raw-material supplier, but is there something within the stamping process that may be contributing to the problem that we may be overlooking?

A: Blaming the material supplier sounds quite rational to me. After all, finding a good scapegoat consumes far less time than conducting root cause analysis!

But seriously, a couple of things your customer describes have my attention.

First, its comment regarding the forming problems being present at the beginning and middle of the coil suggests a thermal issue may be contributing to the problem. Depending how long it takes to change a coil during production, the die temperature may be changing (decreasing) which in turn changes the clearances between the draw post and die ring. Once the initial adjustments are made at coil change to eliminate the start-up problems, the press is turned back on and the die begins to heats up again, which in turn reduces the drawing clearances and restricts material flow. This is particularly true when failures occur near the end of the drawing process in an area where material is in compression and thickening.

Another possibility is that the force being applied by the draw pad may be too low. A common corrective response to part breakage is to reduce the draw-pad pressure to allow material to "flow better." This can be the wrong approach, especially when there is insufficient pad pressure to begin with. When draw-pad pressures are too low, wrinkles and buckles form in the sheetmetal surface as it flows toward the die cavity. Since there is not adequate clearance between the punch and die to accommodate these wrinkles, material flow is impeded and excessive stretching and tearing can occur. If draw-pad pressure is reduced as a solution to the splitting problem, the situation worsens.

In this particular case, the correct solution is to increase draw-pad pressure to retard material flow and prevent wrinkle and buckle formations in the sheet. Draw-pad pressure requirements should be calculated and then confirmed in the tooling before trying any other solutions. Simple formulas are readily available in die-engineering handbooks to get you close. For more precise results, computer metalforming simulations should be employed.

Perhaps the most significant statement made by your customer was that sandblasting the die components seems to solve the problem, if only temporarily. Sandblasting the die components effectively retards the flow of material by increasing the friction between the die surface and the sheetmetal. Unfortunately, as the material is drawn across the pressure pad hundreds and thousands of times it is smoothing the sandblasted surface, which in turn decreases the friction (requiring the tool to be sand blasted again).

An alternative to sandblasting would be to minimize or eliminate the lubrication between the die and sheetmetal surfaces in the area of the tool being sandblasted. This may require that lubrication be applied only to one side of the sheet. Altering the amount and location of the lubricant will change the friction coefficient in the affected areas of the die, which the sandblasting also accomplishes.

Finally, I am assuming the die was designed correctly to begin with. This means the draw reduction ratios (percent reduction), die radius, punch-nose radius, pressure-pad calculations and die-polishing techniques were correct and are being maintained throughout production.

Q: In 1977 I enrolled in a tool and die apprenticeship. Since then I have worked as a tool and die maker, die designer and estimator. For the past 10 years I have freelanced until a lot of my customers went out of business. My question is pretty straightforward: Is there still any future left in this industry?

A: Yes. Without question there is a very exciting future for our industry. The question that really needs to be asked is, "What will our industry look like in the future?" It is important for us as an industry to answer this question appropriately because it changes how we train our apprentices.

For example, 10 years ago the beginning of a die design involved unfolding the product geometry into a blank, determining the best blank orientation for feeding and optimal material utilization, and then creating a strip layout with all of the process steps. Today, the beginning of a die design involves acquiring material properties, converting product geometry into finite element models, defining frictional conditions, applying restraining forces and establishing boundary conditions.

In the future, dies will be designed and built using what I call, *Performance-Based Die Engineering Strategies*. The premise is that we design and build dies in a manner similar to that of product designs. Design criteria will be based on performance requirements such as loading conditions, deflections, velocities, wear, vibration and thermal conditions. Many of the technologies for this approach already are available; but, who do we have that is qualified to implement it?

Further out into the future, performance requirements for stamping die will be directly linked to the performance requirements of the stamping. Advanced computer programs will concurrently design the metal stamping and its corresponding die, based on an "optimization target." Possible targets might include minimum part weight, maximum performance, least cost for the die based on the number of stampings to be produced, or the adaptability of the die to make multiple stampings with very different features and/or dimensions.

Not convinced? MIT and other universities already are beginning the foundations for such a system. **MF**