

## *Adapting Precision Stamping & Forming Processes to Meet Challenges of Ultra-Thin Foil Materials*

This Tech Bulletin provides an overview of the special challenges associated with stamping and forming ultra-thin foil materials at 0.001" (0.0254mm) thickness and below.

Topics addressed in this Tech Bulletin include:

- Overview
- Ultra-small Dimensions & Tolerances
- Special alloys and exotic material considerations
- Tooling and Feeding Design Issues
- Maintaining consistent process control

### **Overview**

Over multiple decades of evolution, precision stamping processes have been repeatedly refined and expanded to encompass a wide range of tight-tolerance, close-pitch, high-precision and light-gauge metal components as well as thicker gauge, larger metal components and assemblies.

However, ultra-thin foil material continues to present special challenges that go beyond mainstream stamping technologies. As discussed in the following sections, these applications often must be controlled to the millionth of an inch, while taking into account special material characteristics, tooling concerns and consistent process control for high-volume production.

### **Ultra-small Dimensions and Tolerances**

With ultra-thin foil applications, the geometries of tolerances and material-to-die clearances can quickly become exponentially challenging. For example, assuming a cutting clearance of 10 percent, when stamping material with a 0.001" (0.0254mm) thickness the punch-to-die cutting clearance would be 0.0001" (0.00254).



To achieve such tight clearances, a number of critical process control challenges are stacked up around the cutting process itself. Living within an overall 0.0001" (0.00254mm) clearance requirement means the alignment of the punch and die must be even tighter. For example, if you're punching a circular piece, and the punch is off center by only 0.0001" (0.00254mm), there will be 20 percent on one side of the part and zero clearance the other. This results in ragged edges, burrs and unusable parts, which drive down yields and drive up costs.

As a result of this stacking-effect, the need to achieve 4<sup>th</sup> decimal point results for the part requires process controls that achieve 5<sup>th</sup> decimal point precision for the tooling, die, feeding and alignment processes. In essence, the critical tolerances for these processes jump from controlling in the thousandths of an inch to needing precision control at the millionth of an inch level.

### **Special Alloys and Exotic Material Issues**

In many cases, the ultra-small tolerance challenges also must cope with special alloys and material properties. Because these types applications are often very delicate devices, such as fine pressure sensors, that must operate in harsh environments, such as automotive or aerospace applications, the thin-foil materials typically require special characteristics.

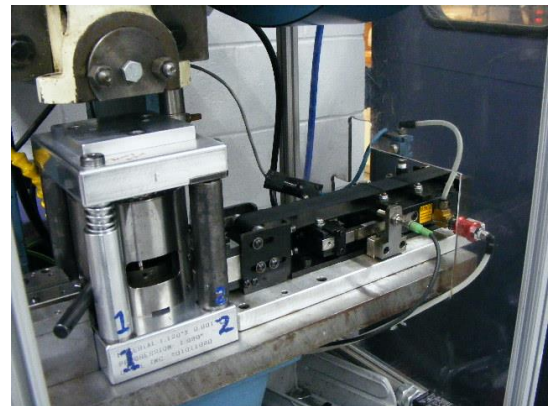
For example, iron-nickel-cobalt alloys such as Kovar or nickel-chromium-based super-alloys such as Inconel may be required to deliver the right combination of high-temp endurance with uniform thermal expansion, strength, corrosive resistance, and other characteristics.

Designing a cutting and forming operation with critical tolerances for these types of thin-foil materials needs to also take into account any special malleability/hardness and other characteristics that might impact the consistency of the forming process.

### **Tooling and Feeding Design Issues**

Everything that supports the core cutting and forming process must be more carefully controlled. This includes precision jig grinding, die formation, feeder design, material preparation and any other issues that can impact consistent alignment at the cutting point.

Feeding can become a particularly difficult issue with ultra-thin-foil materials because of they are too flimsy for many conventional "push" type of feeding processes. Therefore, many of these applications require design of special feeding methods that precisely grip the material and "pull" it into position to avoid the risk of crinkling, misalignment or jamming during the positioning process.



### **Process Control**

With such tight tolerances and critical positioning requirements, it is very important to maintain continuous-loop process control to avoid any drift in key production parameters. Even small amounts of wear or misalignment of the tooling, punch or die can have severe negative impacts on production results. Tight process control is especially important given the relatively high cost of special alloy materials and the high-volume production requirements associated with many of these thin-foil parts.

## Summary

The only way to achieve consistent and cost-effective precision stamping and forming of ultra-thin foil materials is to use a holistic approach that not only controls at the cutting process itself but also takes into account all of the surrounding issues that make precision forming possible. It is important to keep in mind that there is always a multiplier effect between the tightness of the part tolerances and the even more critical tolerances of the process. If you don't have complete control of all these millionth of an inch factors in the tooling and positioning processes, you will never achieve the required thousandth of an inch results at the cutting head.

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More information regarding precision stamping technologies can be found on the web by visiting <http://www.interplex.com/metal-stamping>