Low-Cost Metal Forming/Stamping

Objective:

The purpose of this project is to investigate the feasibility then design and build a prototype of a low-volume metallic foil shaping process using low-cost dies.

Background:

Some electronic components require shielding to function correctly. This shielding can prevent external interference from reaching sensitive circuits/components or contain the emissions of electrically noisy circuits/components. This is often accomplished with a thin metallic shield.

Metallic shields are manufactured and sold in a variety of standardized shapes, but they can also be custom designed and manufactured for special purposes. Custom shapes can be tailored to fit specific circuit board layouts or product enclosure designs. Unfortunately, the cost associated with creating the tooling and dies for custom shields makes only large volumes economical. Furthermore, deep-draw geometries are often a progressive/multi-stage process making them even more costly to implement.

SEL wants to investigate, and attempt to manufacture, custom shaped thin metal shields using low-cost dies. This would be an experimental process, and we are interested in the capabilities and limitations of using low-cost materials (such as plastic). A successful project will evaluate the process using test geometries that will determine the limits of various thicknesses and materials. This should include evaluations of a progressive and single stamp process.

Expected Challenges:

- The stress in the material must be controlled to allow the material to deform without tearing or wrinkling.
    - Conservation of mass: The material must either stretch and become thinner or be larger than the final shape and flow/slide during the forming
    - Maintaining material ductility (avoiding work hardening) during progressive stamping
- Achieving deep draw depths requires controlling the direction of forming forces
    - Axial only press/stamping will limit the draw depth compared to other techniques
    - Excessive press forces will limit certain techniques from being applied at low cost
- Tool-life analysis will require repetition of the forming process and close inspection/comparison
    - The better the inspection plans and techniques, the fewer cycles will be needed to identify trends
    - Streamlining the process will take more up-front work, but pay dividends once the testing stage is reached

Variables of Interest:

Table 1 below indicates the variables that need to be explored for no less than 3 thicknesses/material combinations.

Geometric Parameters
Depth of Draw
Minimum/Maximum Corner Radius (Punch Direction)
Minimum/Maximum Corner Radius (Non Punch Direction)
Draft Angle
Performance Parameters
Tool Life

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Tooling Cost
Press Force Required
Material Parameters
Alloy/Material
Thickness
Heat Treatment/Hardening Condition

Scope:

This project will likely require a team of Mechanical Engineering Students (possible opportunity for material science).

Key skills: 3D-printing, Tool & Die, Manufacturing, Process Engineering,

Deliverables:

Hardware	Physical conceptual designs
	Functional proof of concept
	Final working prototype
Documentation (Final Report/Portfolio)	Conceptual sketches
	Governing equations and mathematical model(s)
	Analysis and testing results
	Drawing packages and fabrication plans for final design
	Spec sheets and bill of materials

The project includes a total budget of $5000, with ~$2500 directly available to students for design, development, and prototyping purposes.