EDU[**CAD**]TION **STUDY GUIDE**

How to Design Parts That Pass DFM

Chapter 5, Lesson 2

SendCutSend

Minimum Hole Size

Minimum hole size depends on the cutting method:

- **Fiber Laser:** Determined experimentally by cutting progressively smaller holes until the laser either fails to pierce, leaves an incomplete cut, or creates an unclean edge. This establishes the smallest manufacturable hole size for each material and thickness.

- **CNC Router**: Limited by tool diameter. The router cannot cut a smaller hole than the bit itself. However, slightly larger holes can be interpolated for better roundness and precision.

Energy and Material Interaction

- During cutting, the machine introduces energy into the material, similar to electrical current flowing through a fuse.

- Thicker material can absorb more heat before distortion occurs, while thinner material reaches critical temperature faster and risks burning, melting, or warping.

- This concept leads to two key design metrics:
    - **hole-to-edge distance**
    - **bridge distance**

Hole-to-Edge Distance vs. Bridge Distance

- **Bridge Distance**: The minimum material width between two parallel cut lines, such as between a slot and an edge. Even though we cut one line at a time, this region absorbs high energy. (see Figure 1.1).

- **Hole-to-Edge Distance**: The minimum distance from the edge of a hole to the nearest edge or another feature (see Figure 1.1). Because heat exposure is shorter in these tangent areas, the requirement differs slightly from bridge distance. If either distance is too small, excess heat or stress can cause parts to fail, much like blowing a fuse.

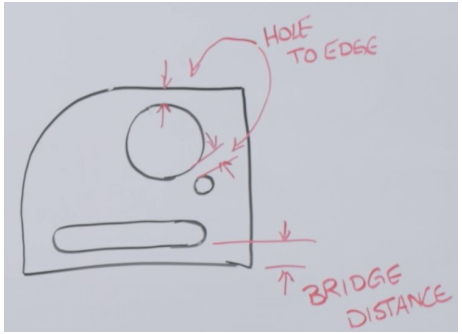

Figure 1.1

DFM Standards and Rules of Thumb

- SendCutSend determines manufacturable limits through real-world testing, cutting progressively smaller features until failure occurs, then backing off slightly for reliability.

- General Rule of Thumb:
    - **Minimum hole size** = 50% of material thickness.
    - **Minimum bridge width** = 50% of material thickness.

Example: For 0.100″ aluminum sheet, both minimum hole and bridge dimensions should be ≥ 0.050″.

- Unlike hole or bridge width, there is no rule of thumb for **hole-to-edge** as spacing varies based on hole radius and part geometry.

- Tighter curves require more clearance to maintain part strength and prevent burn-through.

Note: *If you design below these limits, always check SendCutSend's material guidelines for exact tested values.*

Floating Geometry and Bridge Application

- Floating geometry refers to islands or internal shapes that would otherwise fall out after cutting (like the inner sections of an 'O' or 'A').

- To keep these in place, designers add bridges, narrow connections that tie internal geometry to the main body.

- These bridges should meet the minimum bridge thickness rule to maintain strength while staying visually subtle.

Warping and Heat Effects

- Warping occurs when too much heat is concentrated in one area, especially when cutting parts with many internal features or thin cross-sections.

- As more geometry is removed, the material absorbs heat unevenly, causing twisting or cupping. SendCutSend mitigates this by alternating cut locations and spreading heat distribution, but excessive cut density can still lead to visible deformation.

- Designers should maintain adequate spacing and avoid over-cutting lightweight sections.

Summary

The cutting process doesn't just shape your design, it defines its physical limits. By understanding kerf, energy distribution, and DFM minimums, you can design reliable, manufacturable parts that meet both performance and aesthetic standards.

Learn more at https://sendcutsend.com/education/