

# MATERIALS AND FABRICATION

# WHAT MATERIAL AND FAB TECHNIQUE SHOULD I USE?

Part Size

Resolution

Material Properties (Mechanical, Thermal, Reactive, etc)

Part Geometry

Production Scale

Environment

Hand vs. Machine Control

Aesthetics

Cost

# OVERVIEW

- Materials
- Digital Fabrication Techniques
- Analog Fabrication Techniques
- Finishing Techniques
- Scalability

# MATERIALS

# MATERIAL SELECTION

Polymers (thermoplastic vs. thermoset)

Metals (several alloy properties)

Ceramics (firing)

High-Performance (gore-tex, kevlar etc)

Composites (carbon fiber, honey comb, fiber glass...)

Natural Materials (textiles, paper, leather, etc)

GSD Material Library

<http://www.matweb.com/>

<https://www.inventables.com/>

<http://www.thistothat.com/>

<http://www.onlinemetals.com/aluminumguide.cfm>

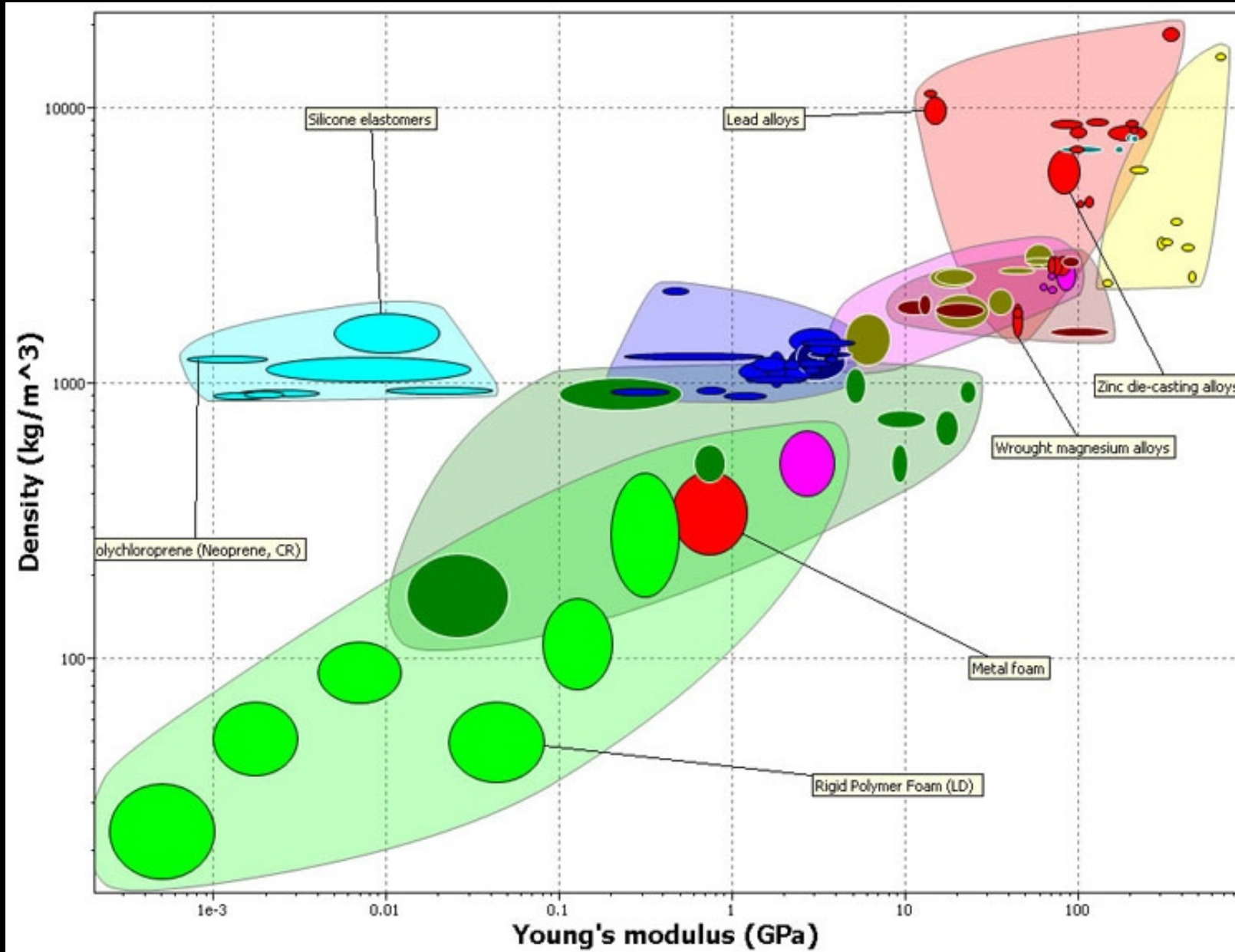
# Materials and Design

The Art and Science of Material Selection in Product Design



Second Edition

Mike Ashby and Kara Johnson



# DIGITAL FABRICATION



# LASERCUTTING





# LASERCUTTING

2D

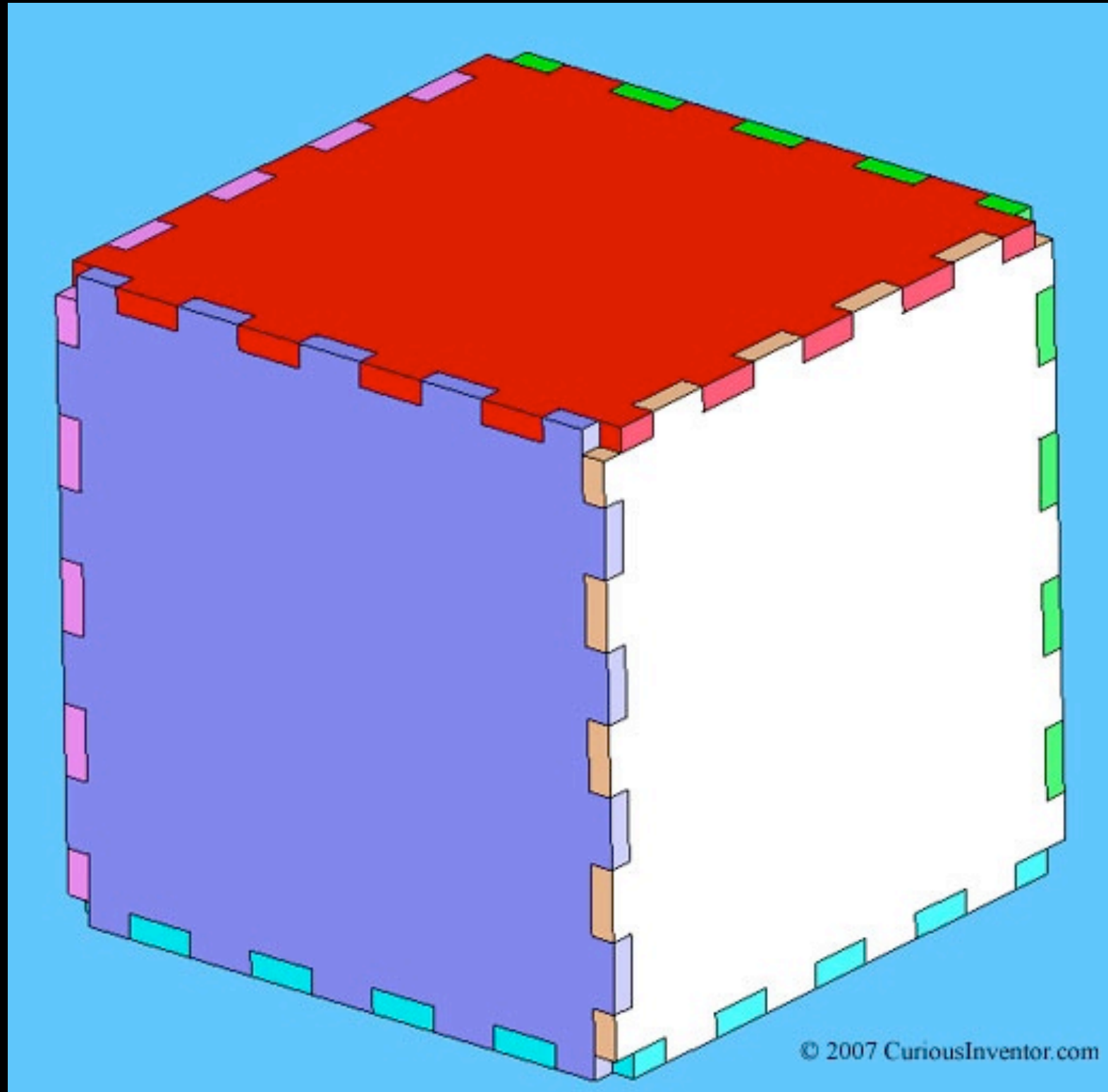
Limit on thickness

Angled cuts

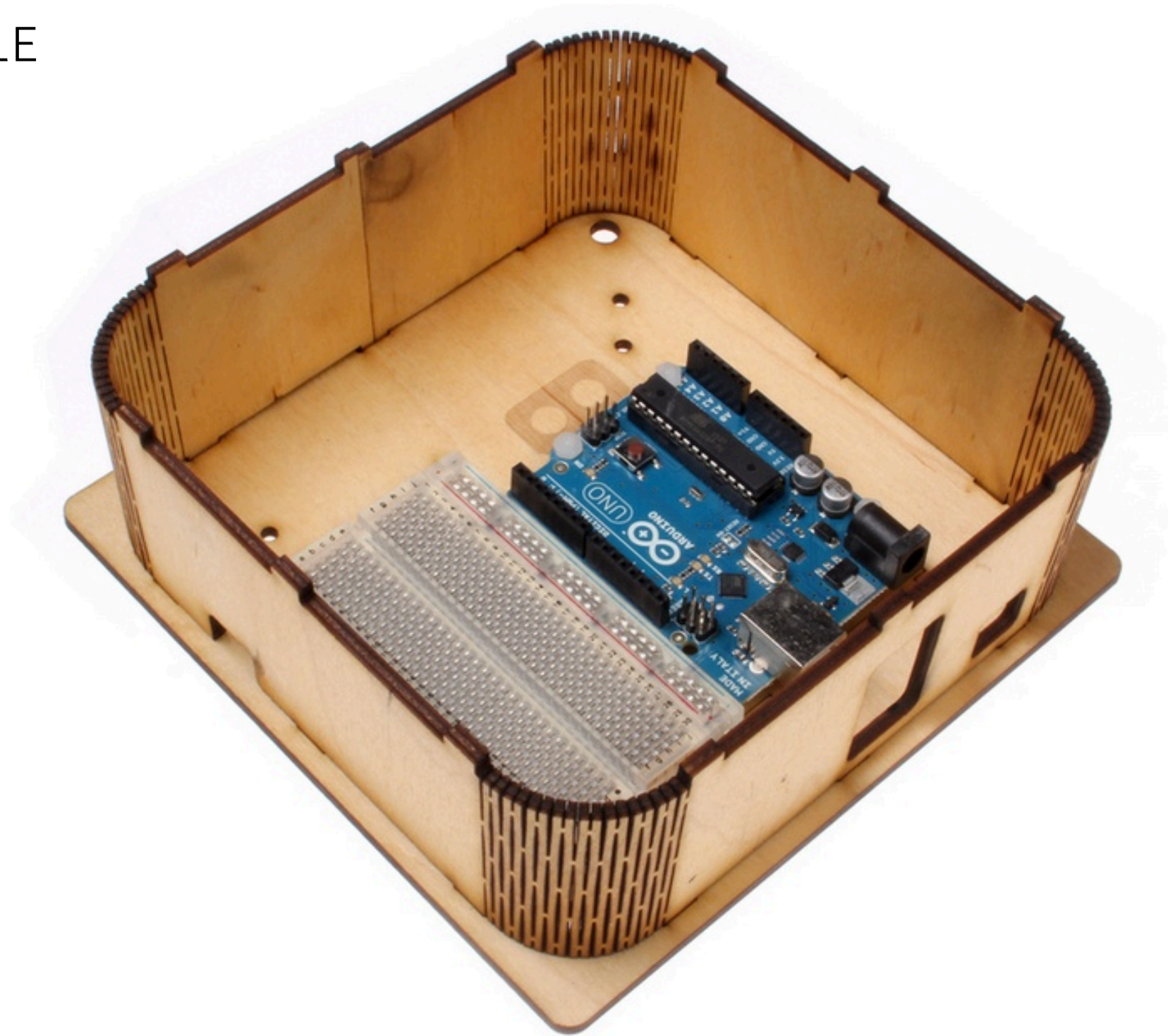
Tool offset

Most materials (due to fumes, melting, reflection etc)

# SNAP FIT

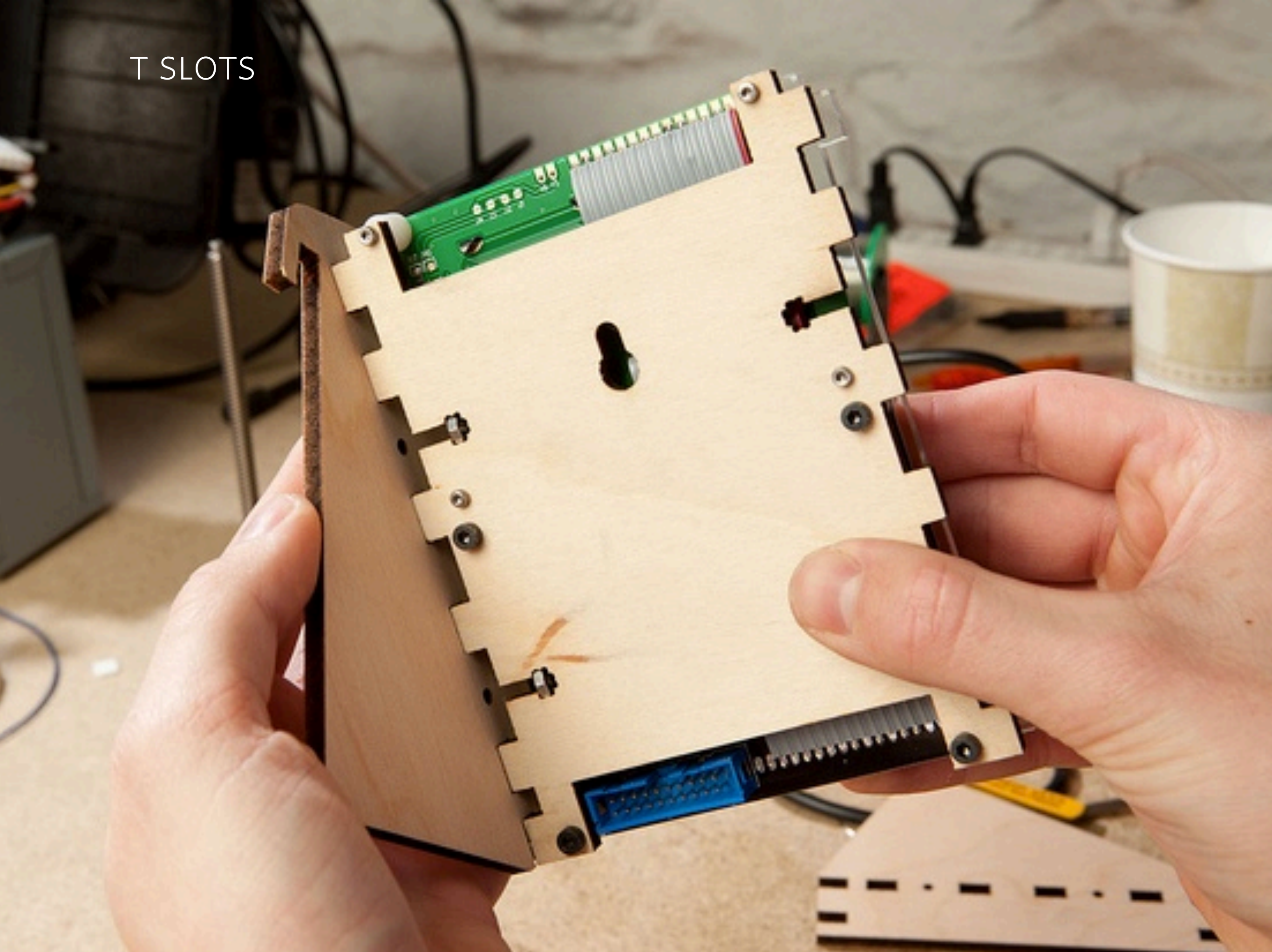


BENDABLE



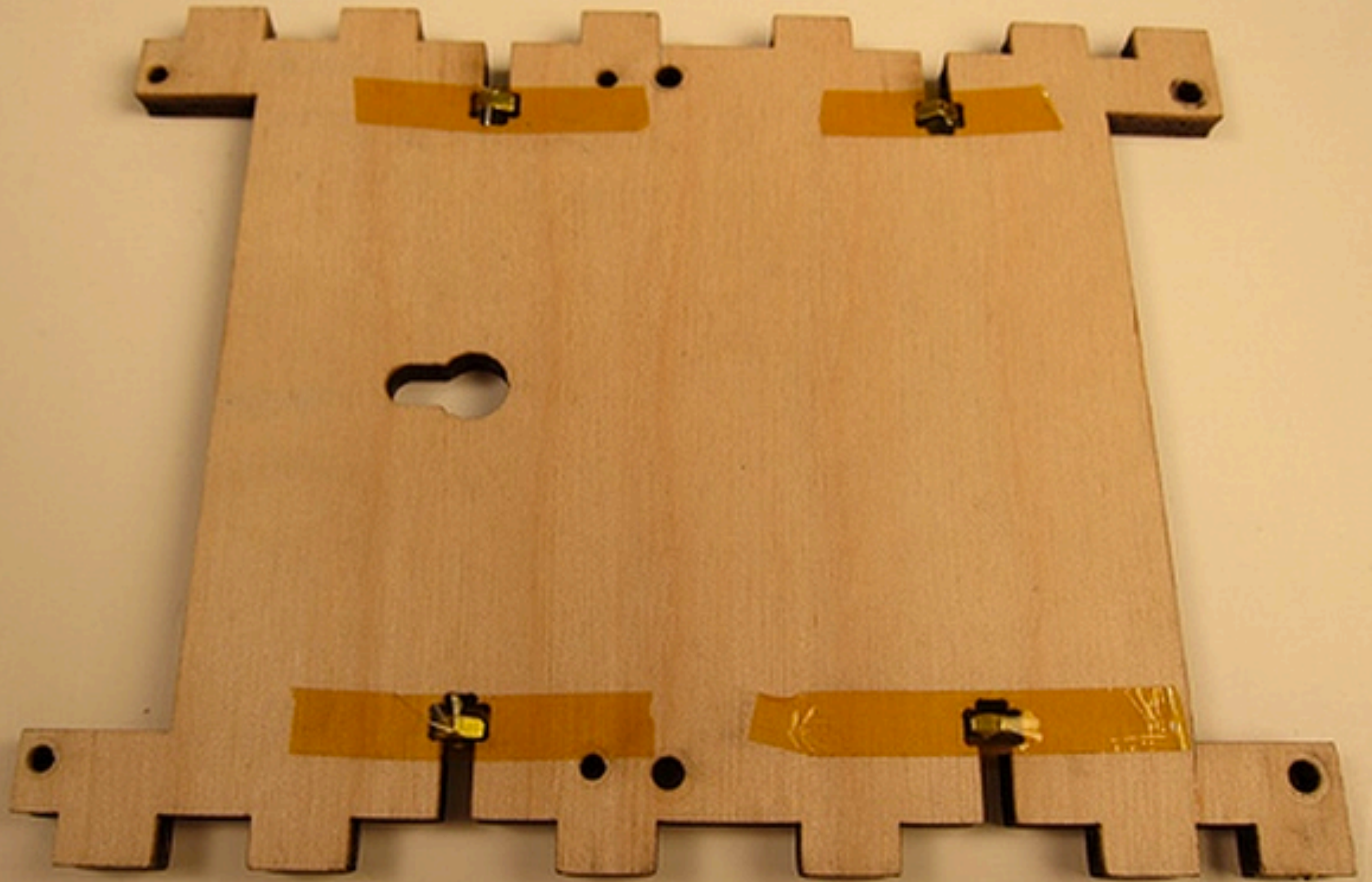


T SLOTS





# T SLOTS



# 3D PRINTING

Lots of different techniques with different properties

Resolution

Material properties

Cost

Aesthetics

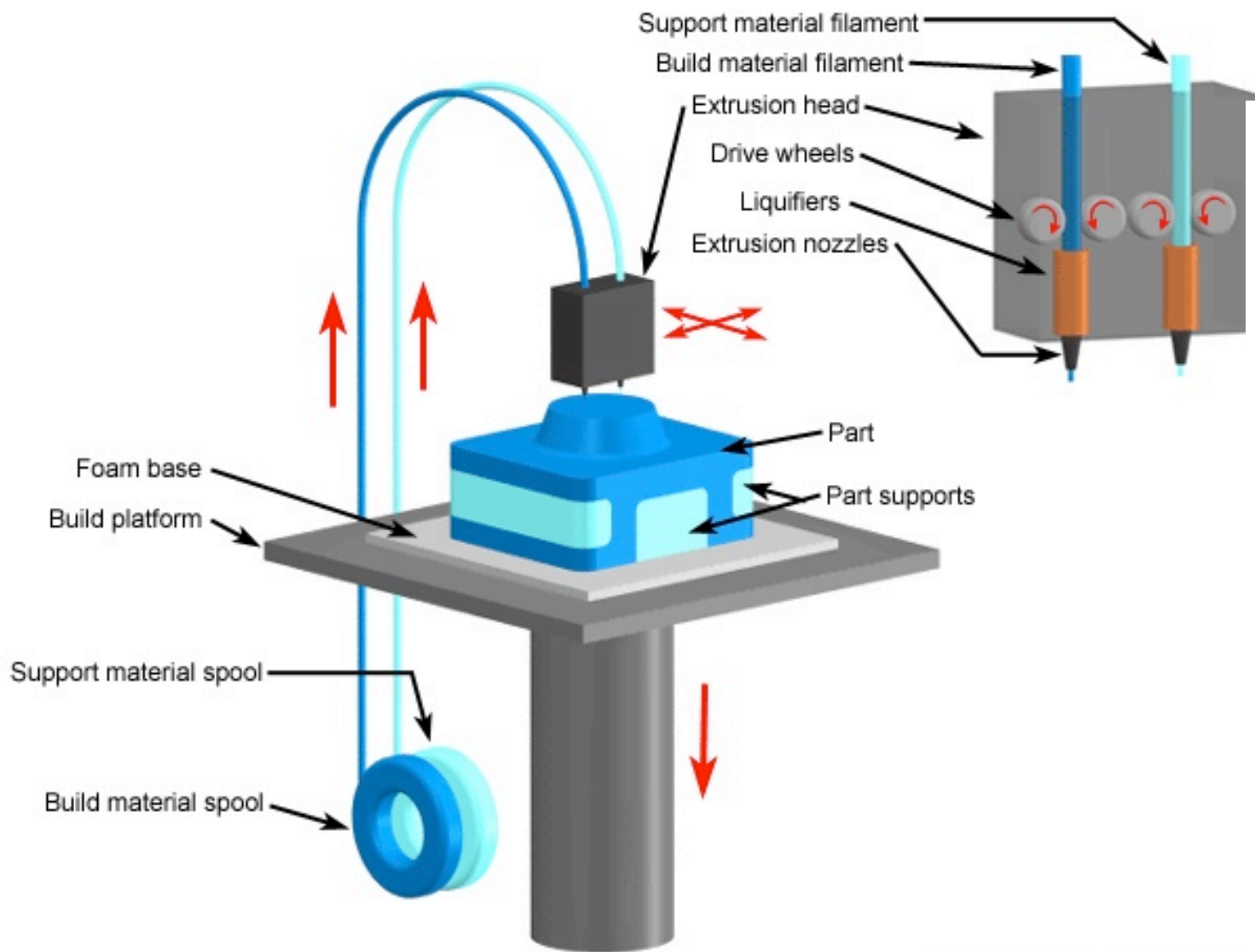
<http://i.materialise.com/>

<http://www.shapeways.com/>

Amit Zoran and Peter Schmitt



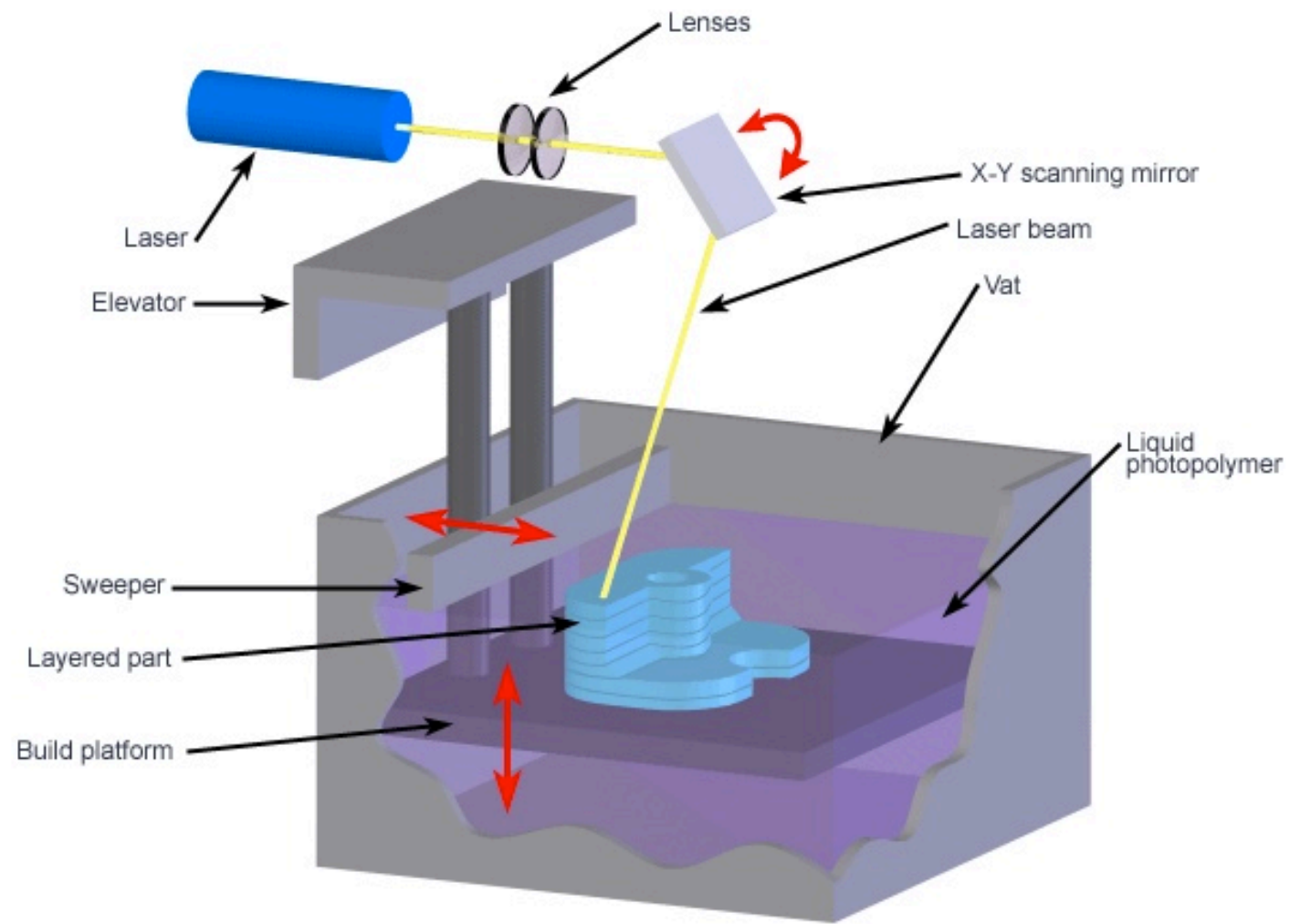
# FUSED-DEPOSITION MODELING (FDM)



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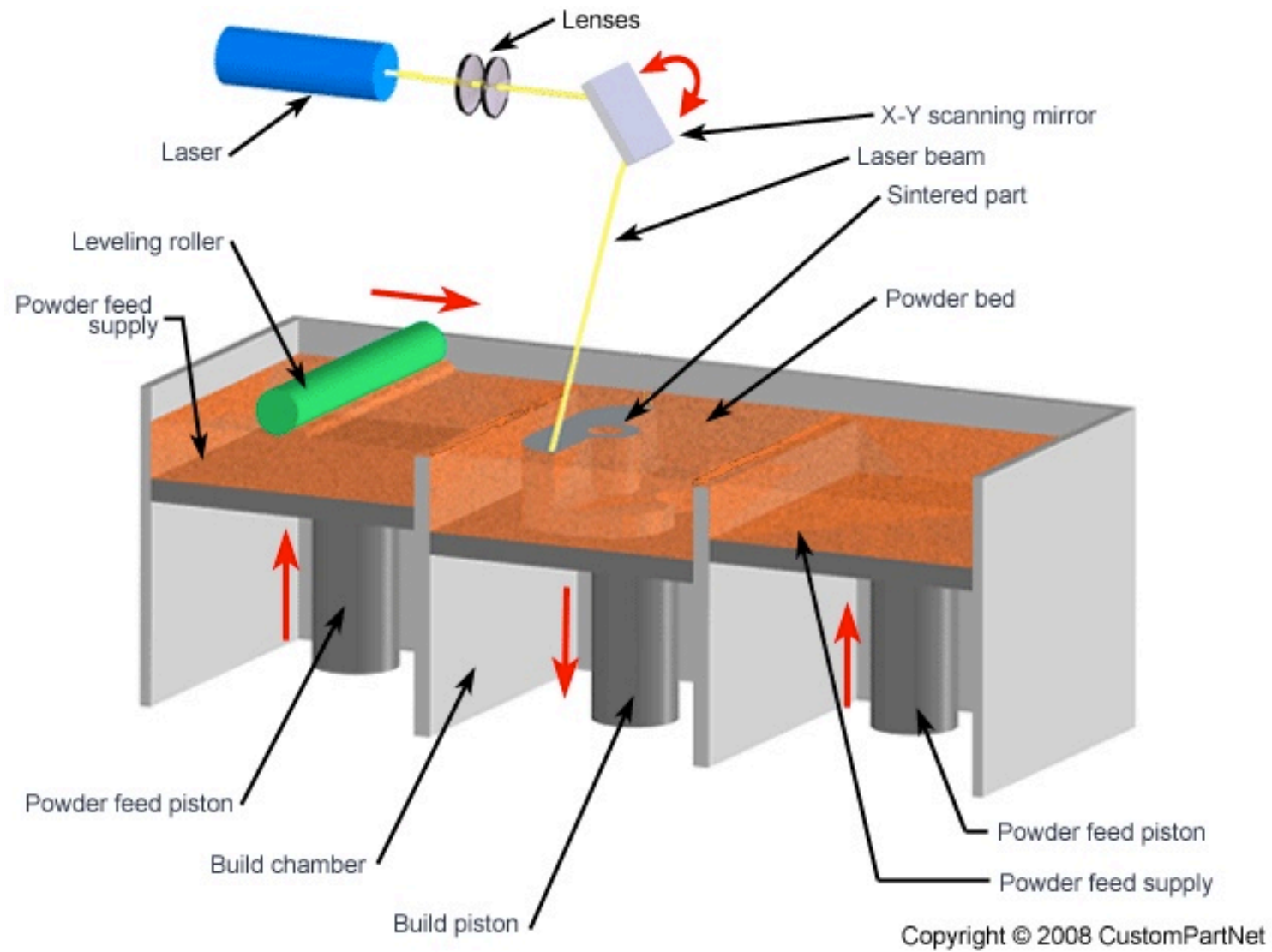


# STEREOLITHOGRAPHY (SLA)

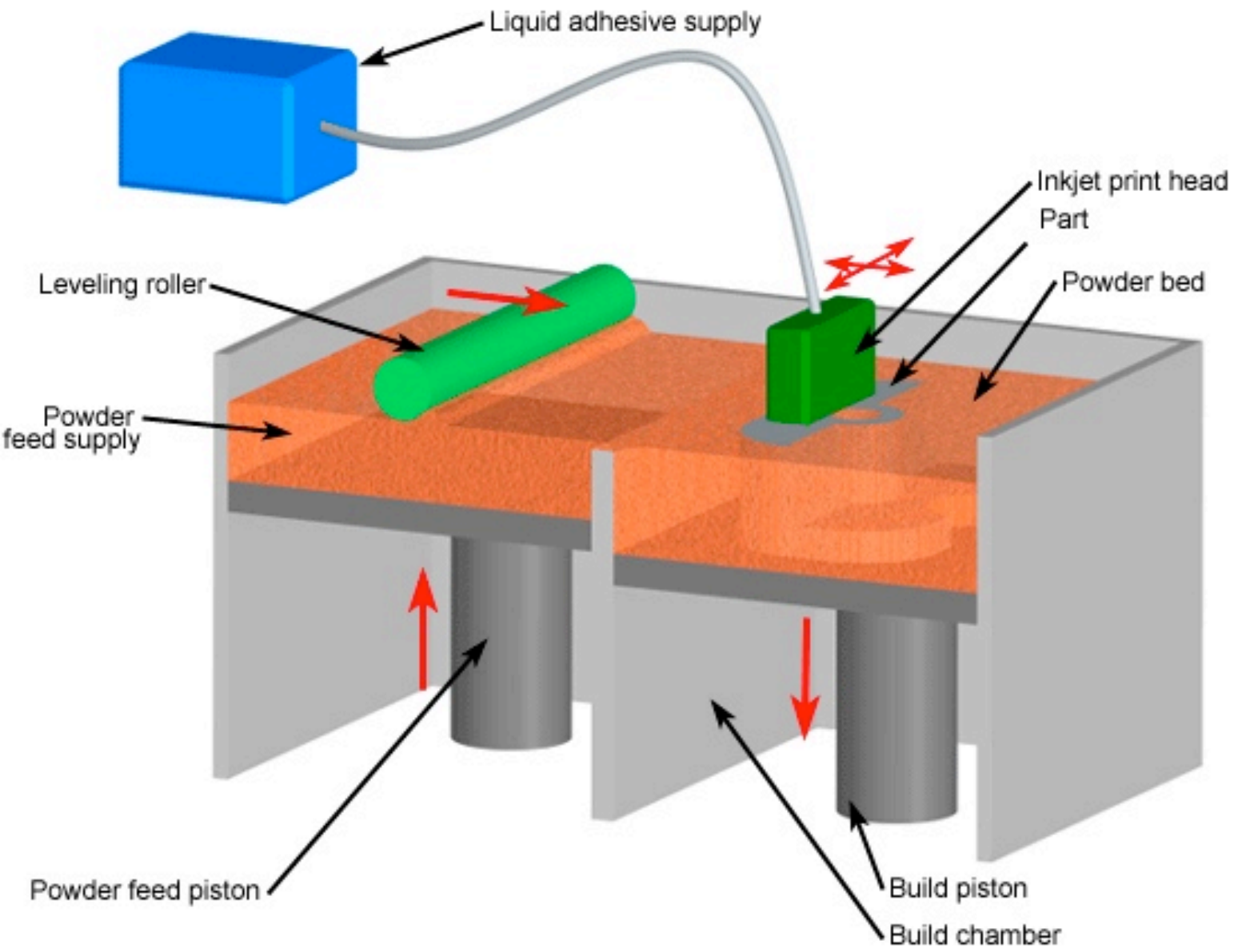




# SELECTIVE LASER SINTERING (SLS)



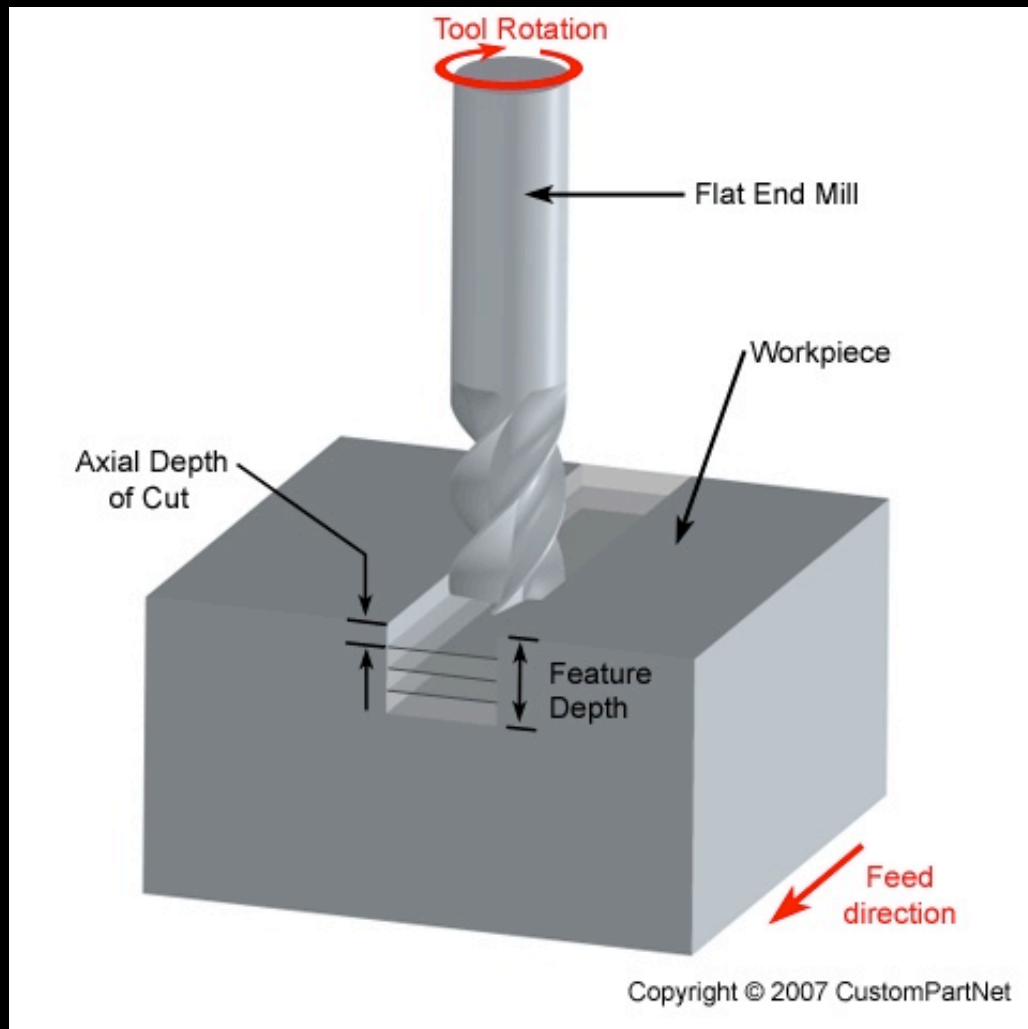
# 3D PRINTING



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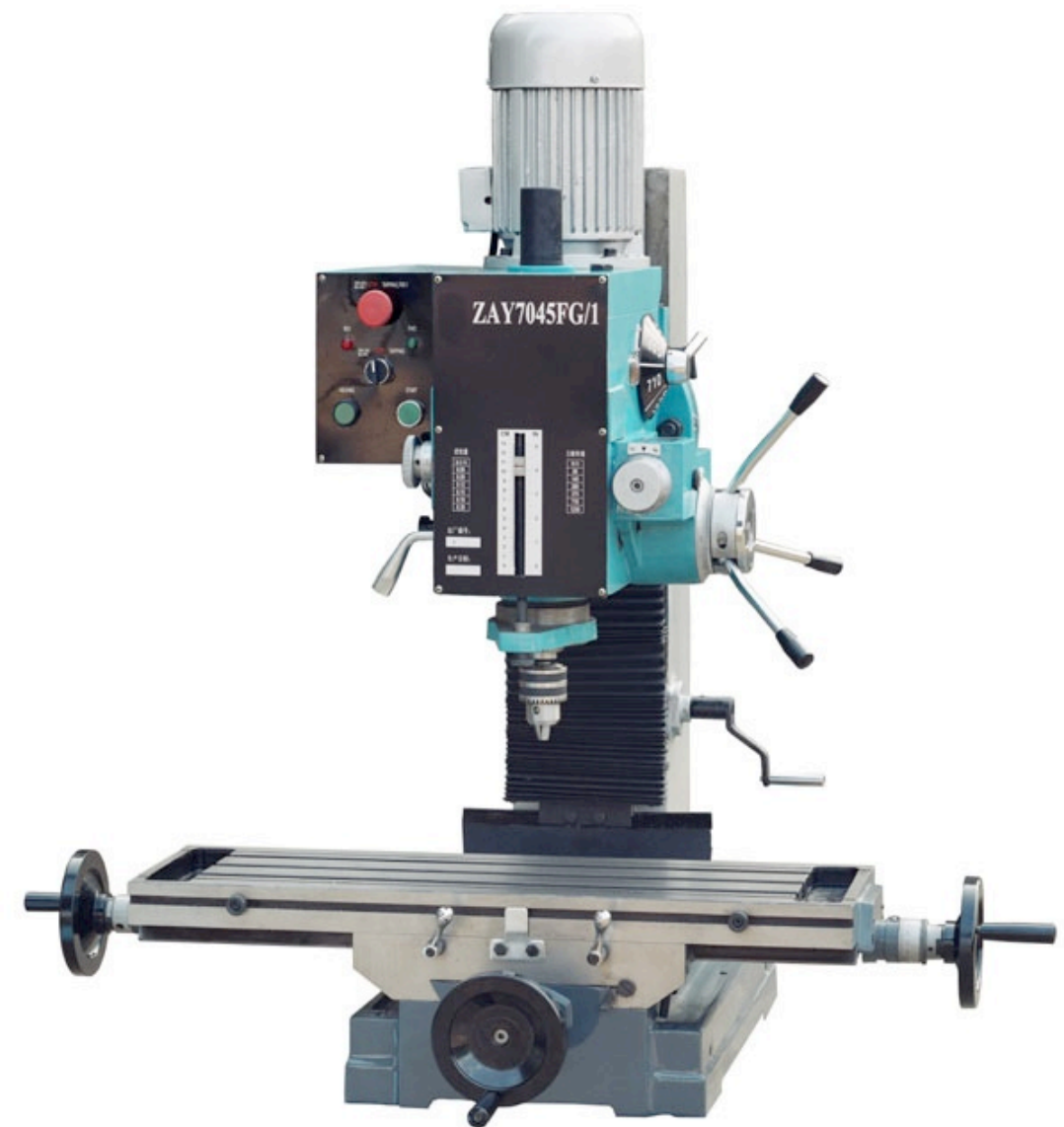


# CNC MILLING



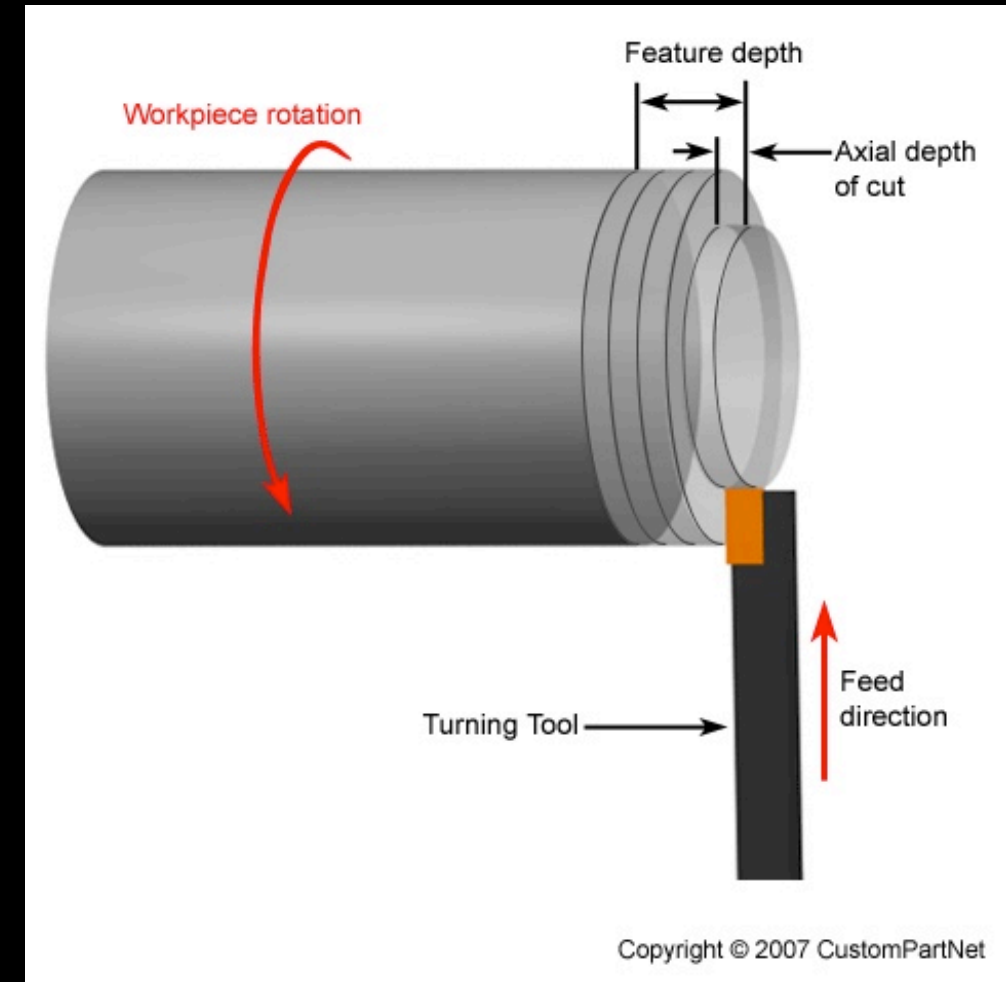
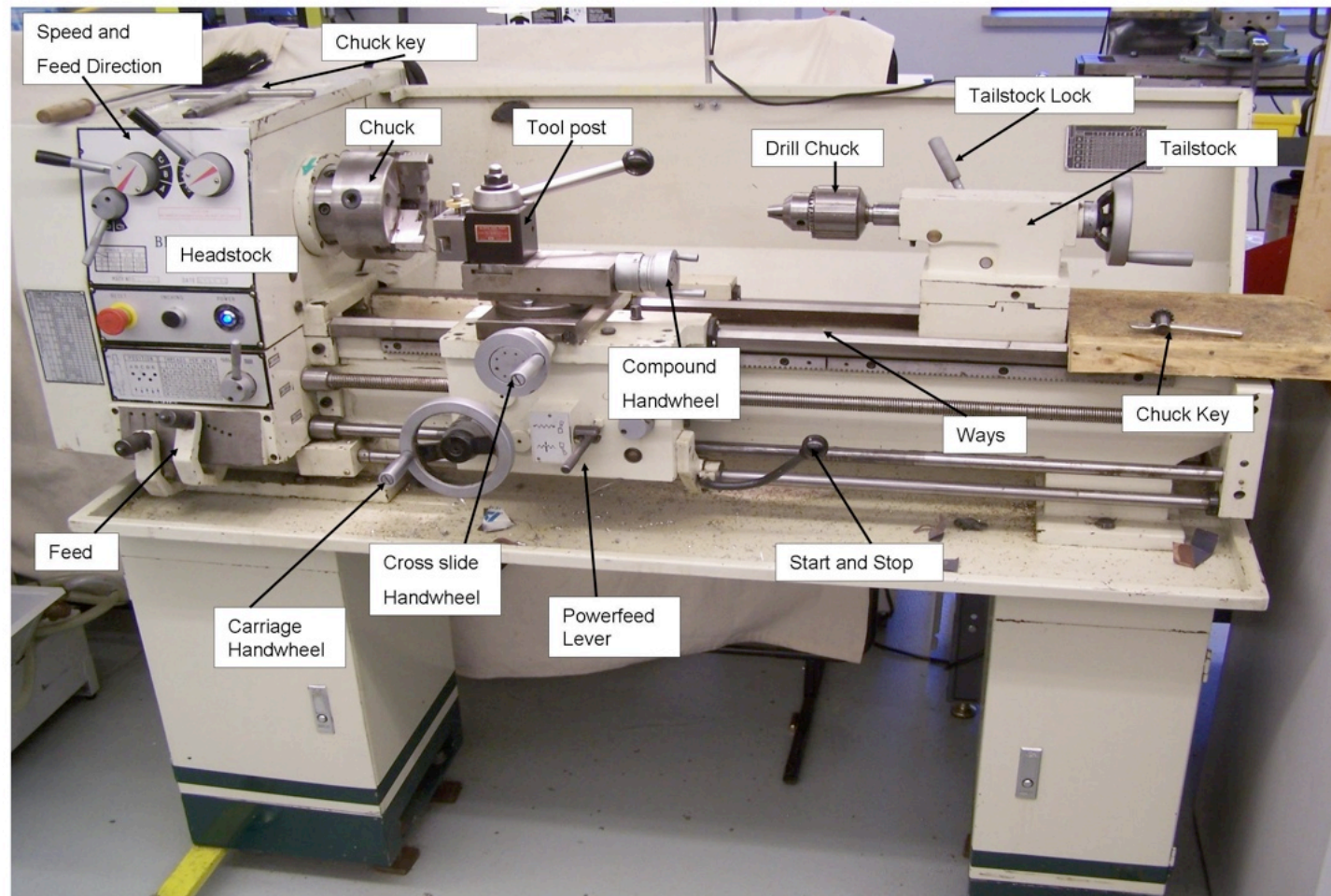


# MILLING





# CNC TURNING



# SUPPLIERS

<http://www.mcmaster.com/>

<http://www.onlinemetals.com/>

<http://www.sdp-si.com/web/html/products.htm>

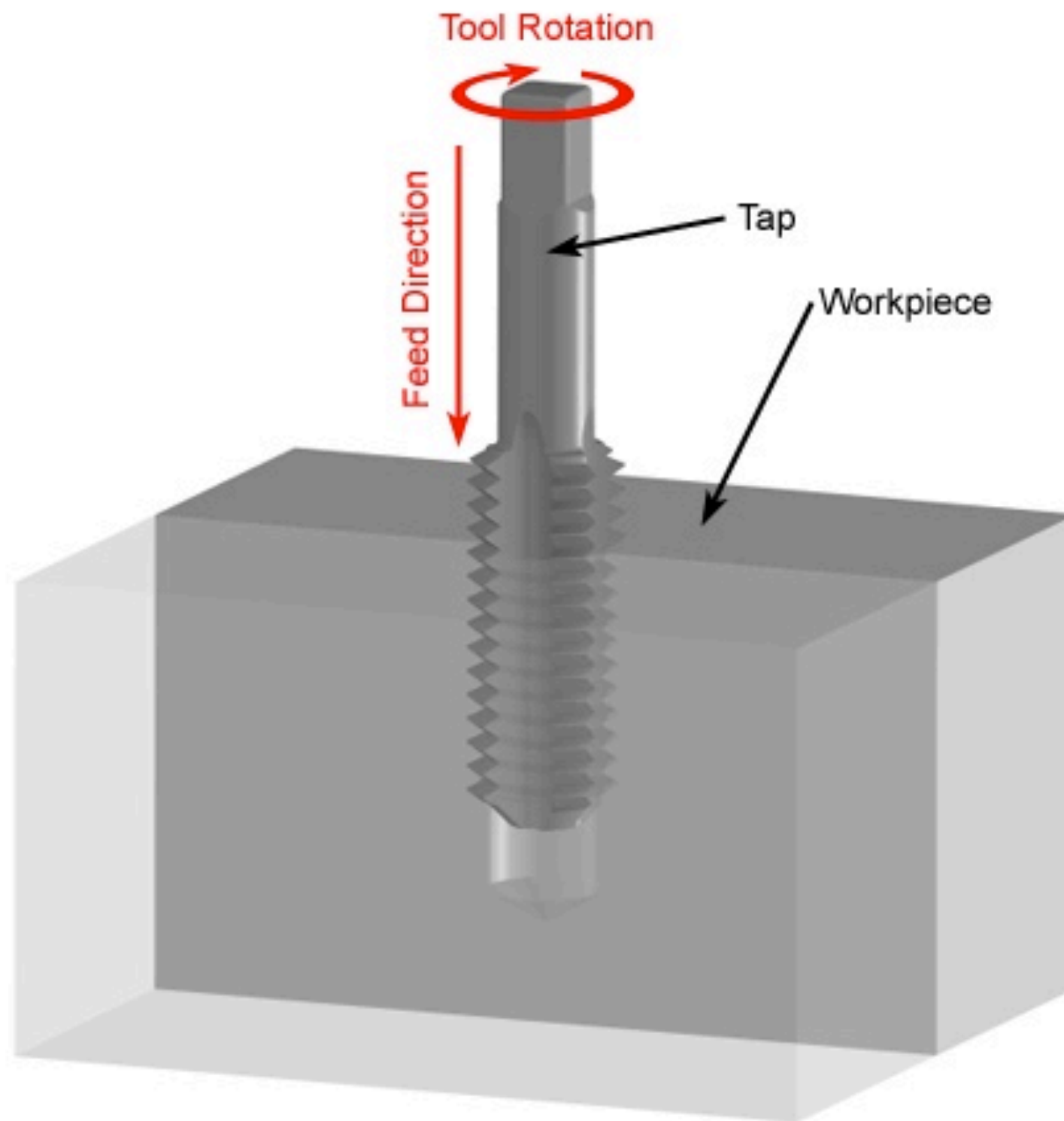
<http://www.aliexpress.com/wholesale/wholesale-alibaba-express.html>

<http://www.jfreeman.com/>

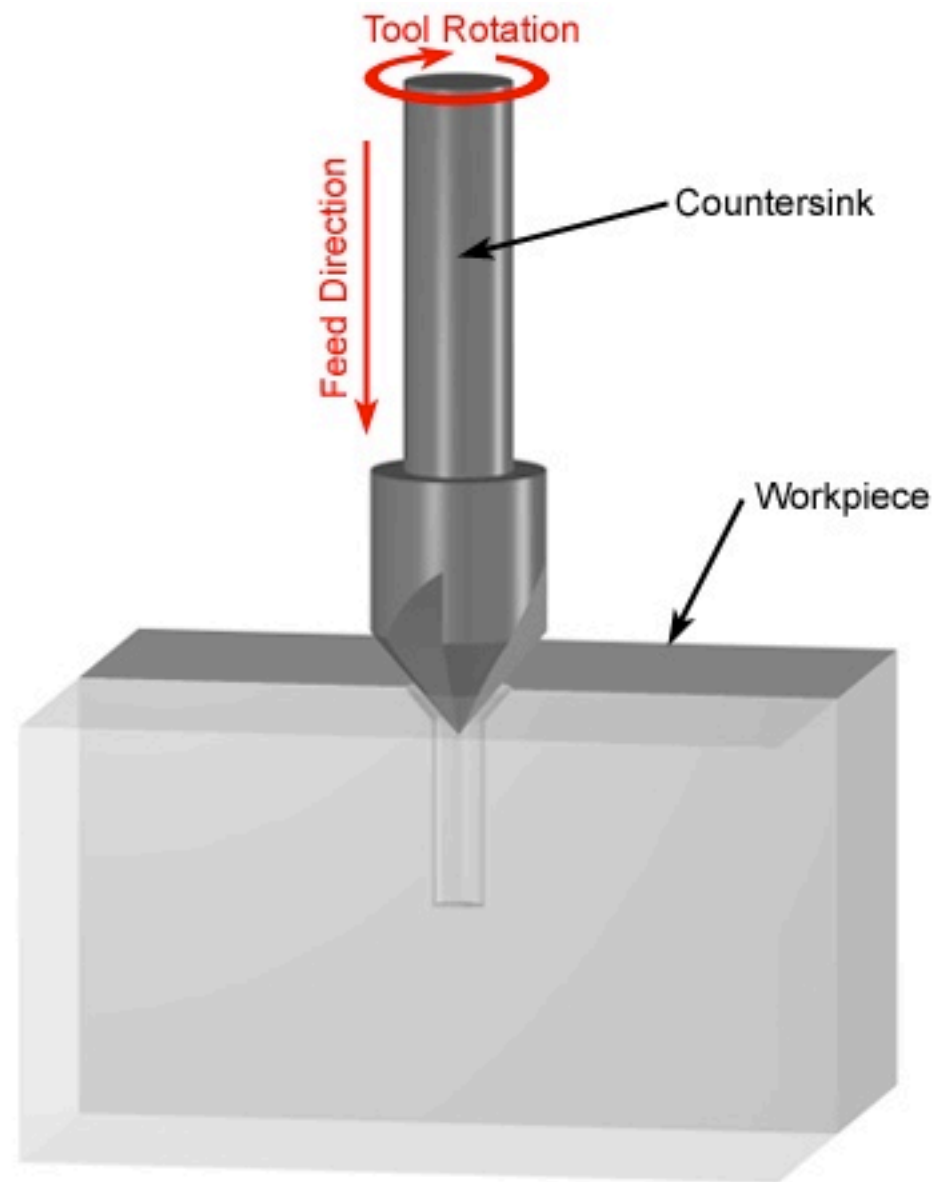
<http://www.lessemf.com/>

# ANALOG FABRICATION

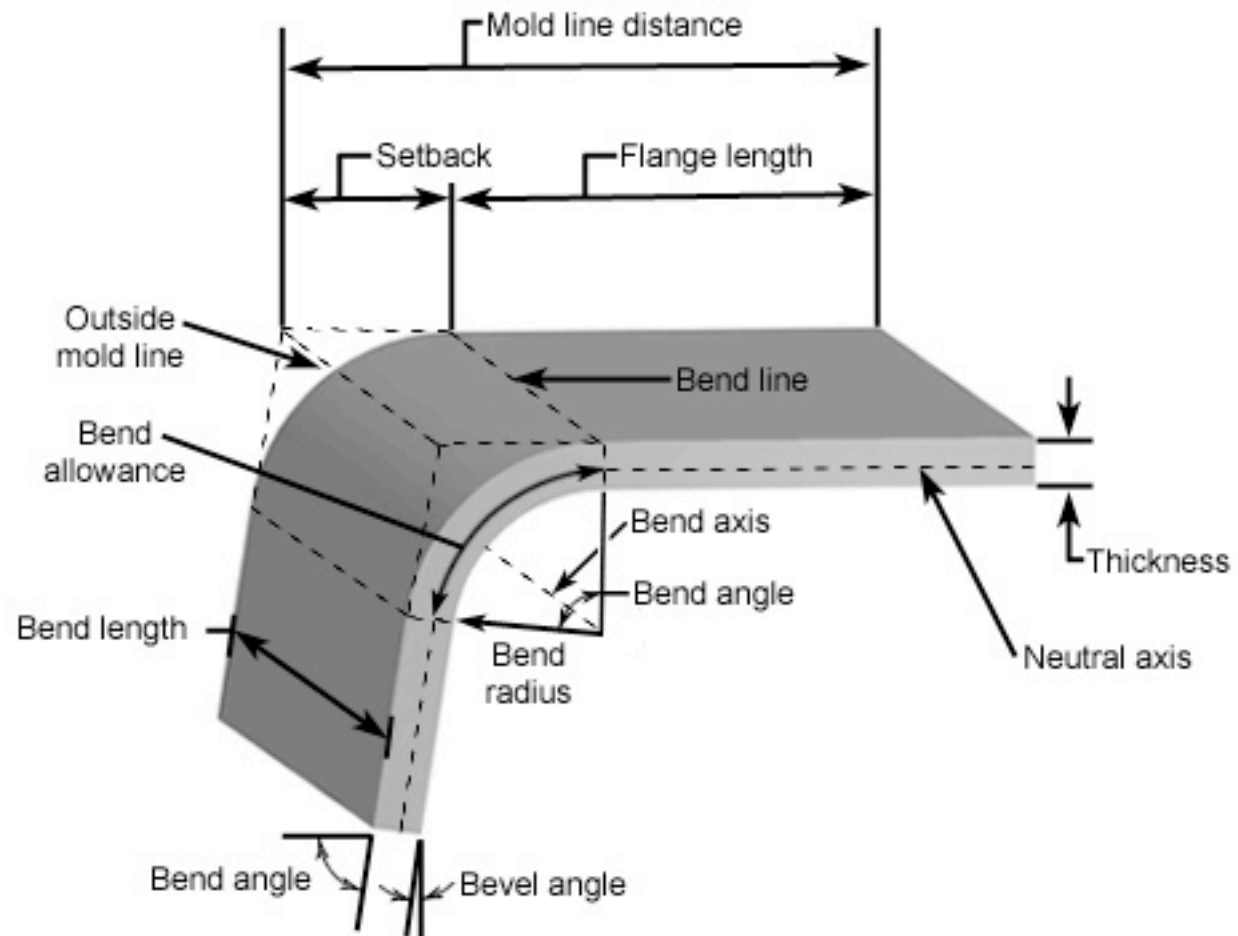
# TAPPING



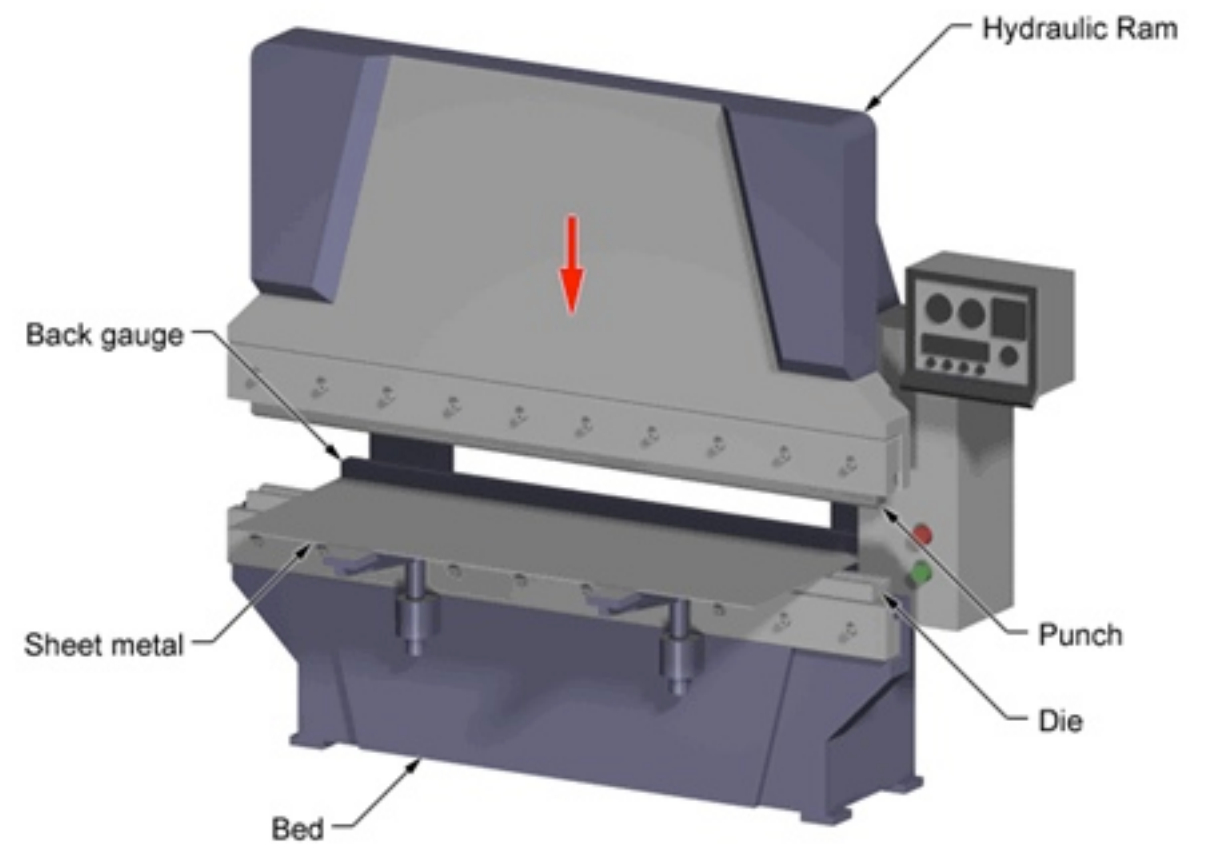
# COUNTER SINKING



# SHEET FORMING (BENDING)

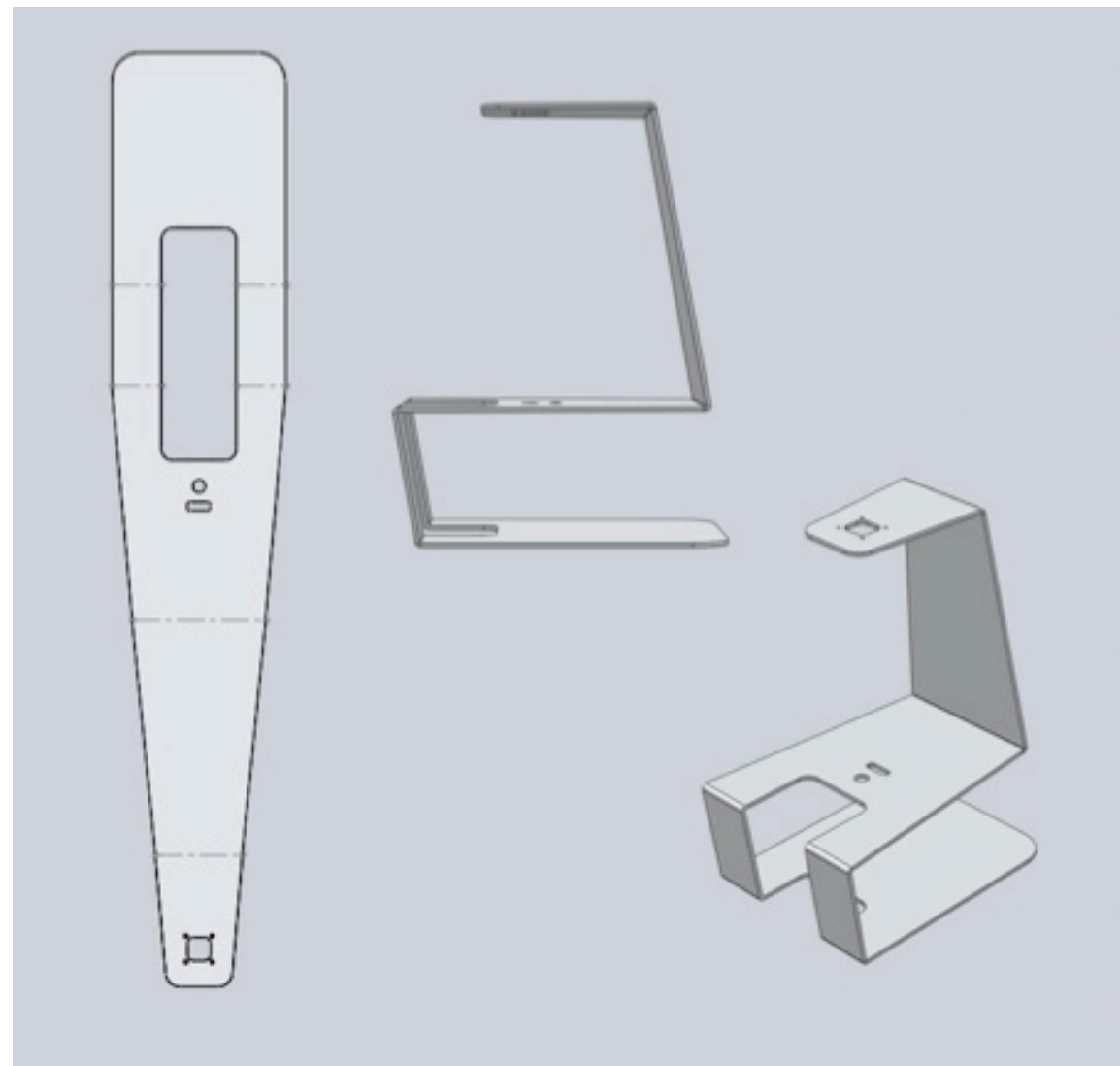


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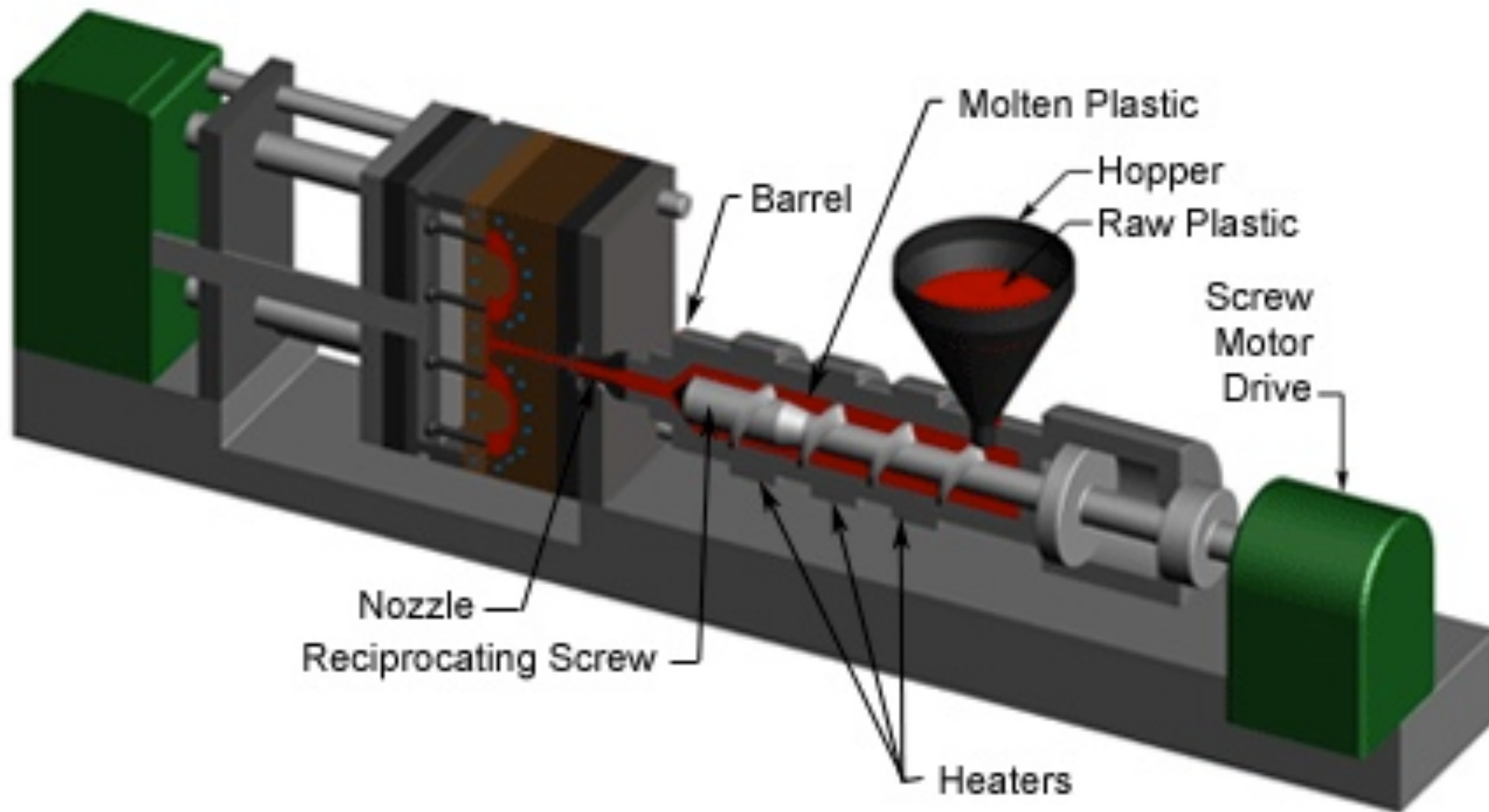




# CASTING



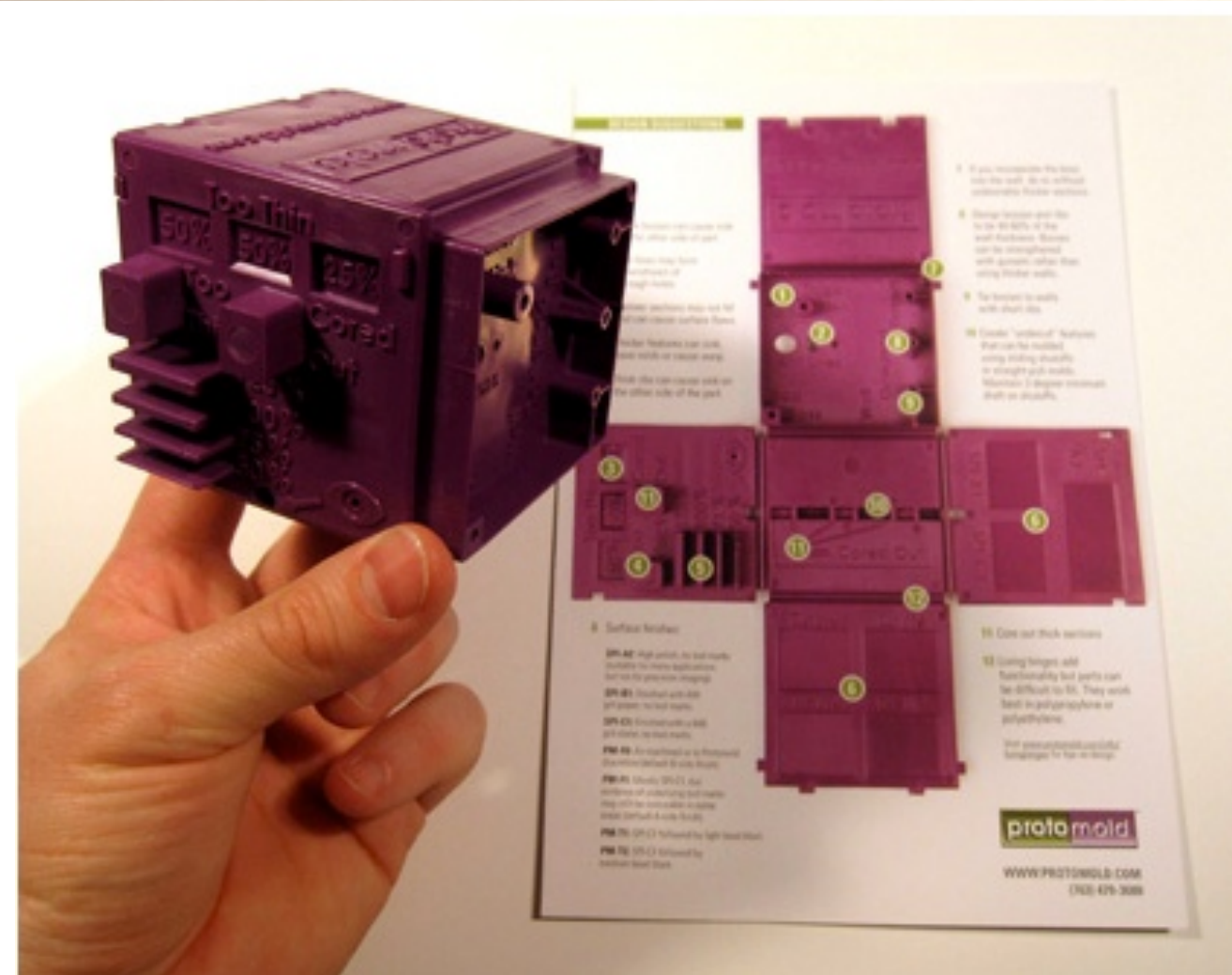
# INJECTION MOLDING





# PROTOMOLD

The image shows a Protomold assembly tool, which is a custom-built mold for creating small plastic parts. The tool is composed of several colored blocks: a blue base block, a green top block, and a yellow ejector pin. The blue base block has various pins and features labeled: 'Return Pin', 'Runner', 'Alignment Pin', 'Ejector Pin', and 'Side Action'. The green top block has labels: 'A-Side', 'Clamp', 'Pocket', 'Gate', and 'Alignment Pin'. A yellow ejector pin is shown separately in the foreground.





# PROTOMOLD

Required Changes (3)

Moldability Advisory (7)

Other Info (3)

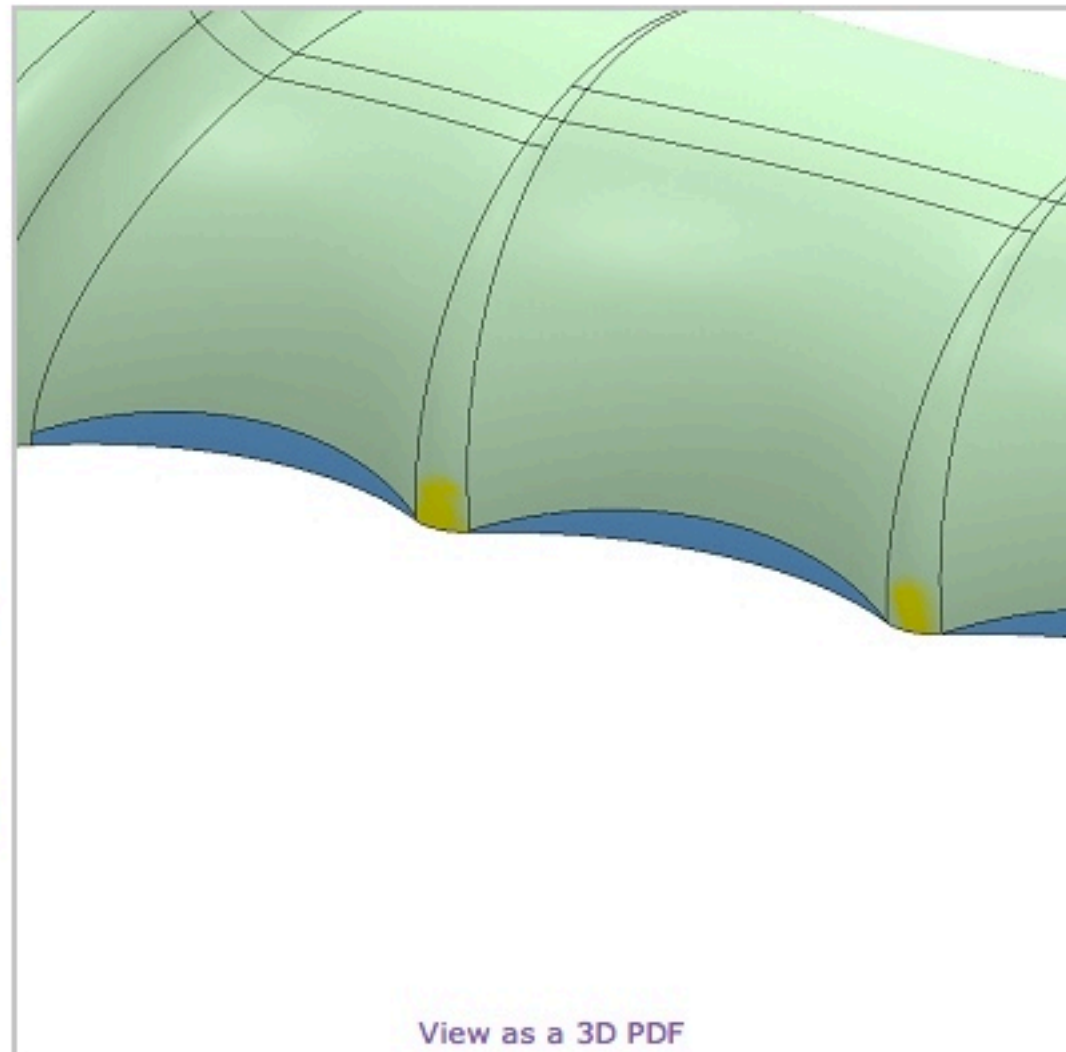
**The following illustrations indicate part design considerations for optimal performance in the injection molding process.**

**Moldability Advisory:**

1. Zero Draft
2. Thin area
3. **Thin area**
4. Thick area
5. Texture
6. Texture
7. ProtoFlow® fill analysis

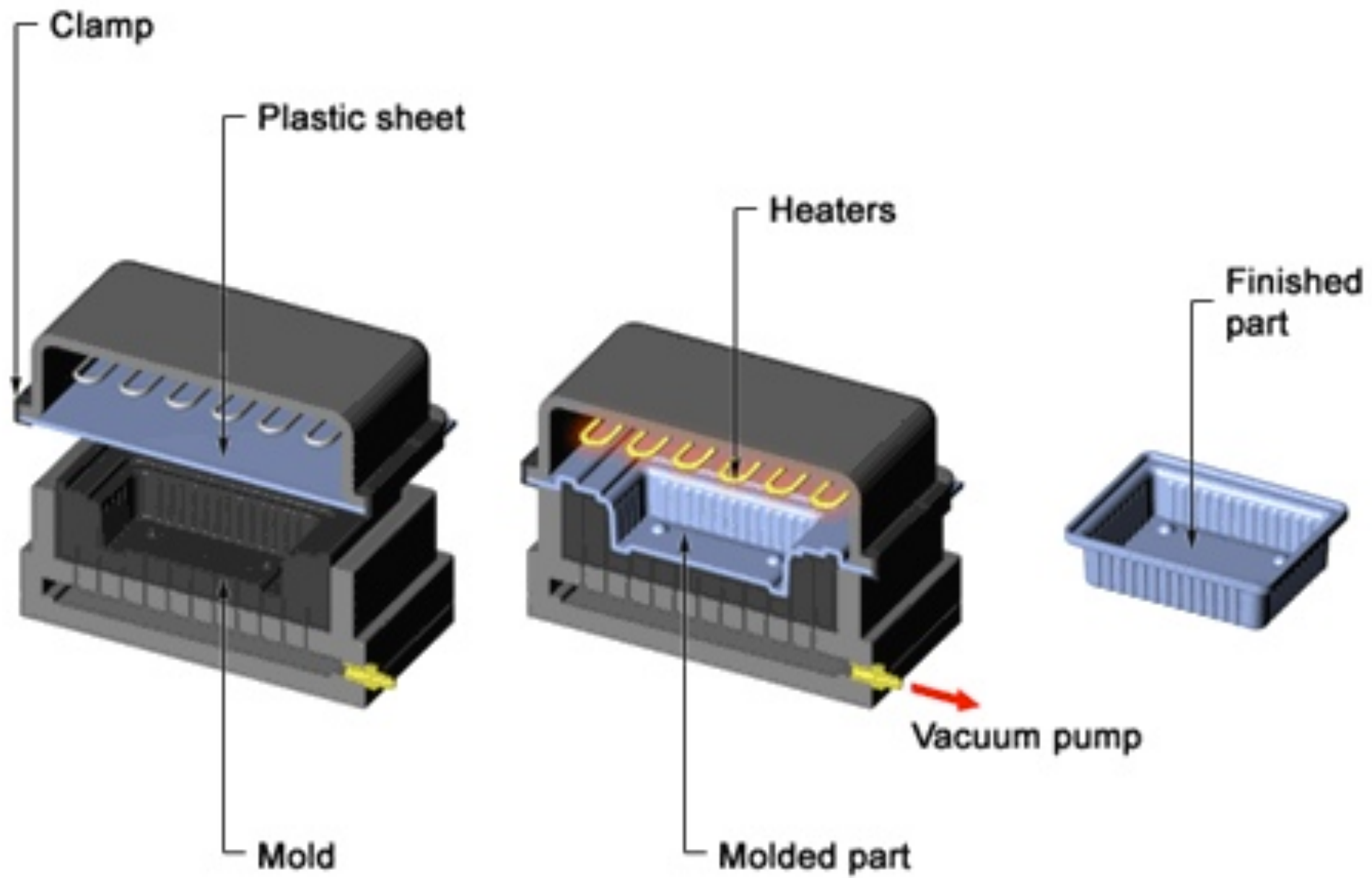
## Thin area

Yellow color coding indicates areas where part thickness is significantly less than nominal. These areas may have fill problems. See the [Recommended Wall Thickness by Resin](#) page and the [Uniform Wall Thickness](#) page for guidelines. For details, clarification, options, or alternatives, please contact a [Customer Service Engineer](#) at [customerservice@protolabs.com](mailto:customerservice@protolabs.com) or call 877.479.3680.



[View as a 3D PDF](#)

# VACUUM FORMING





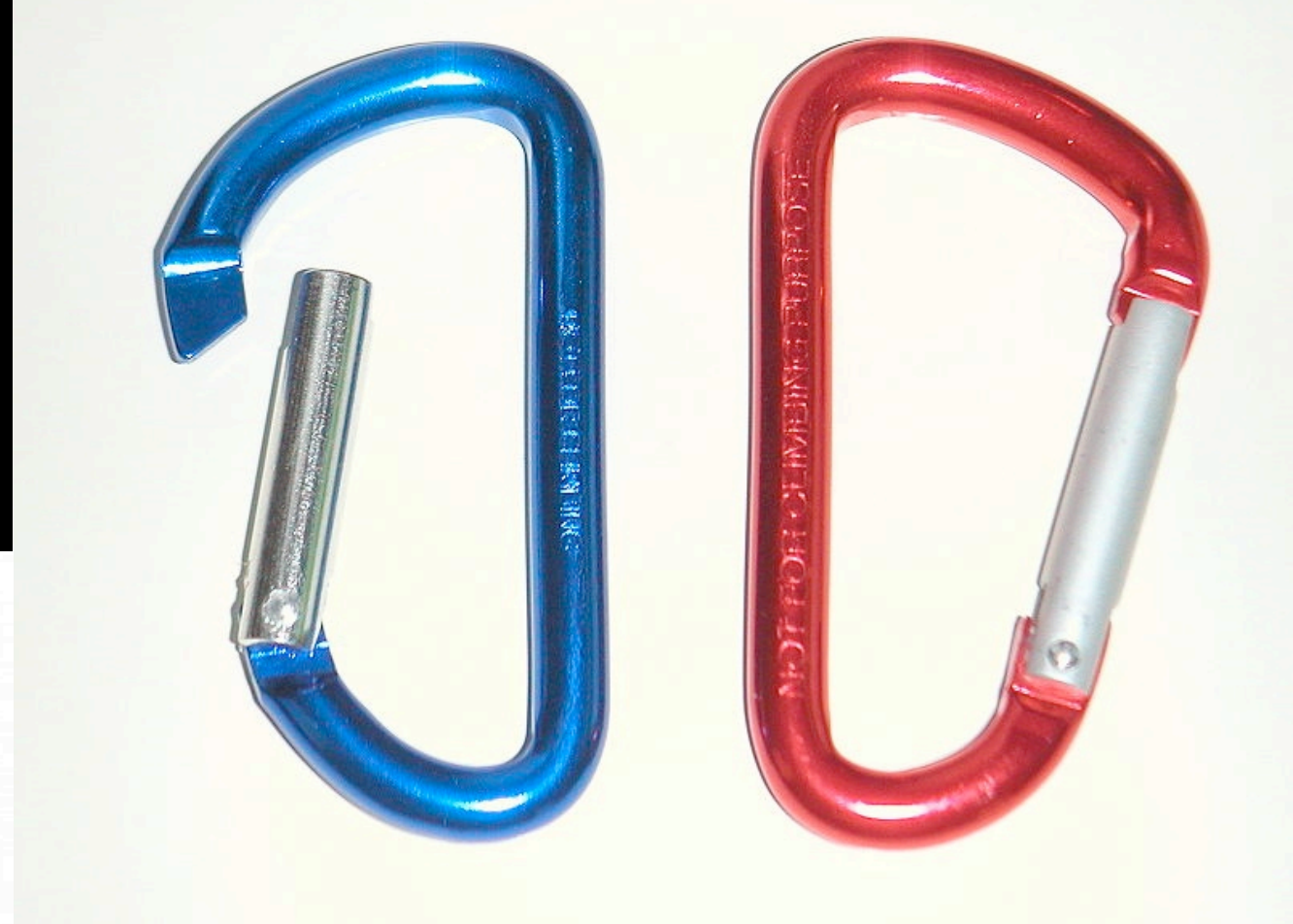
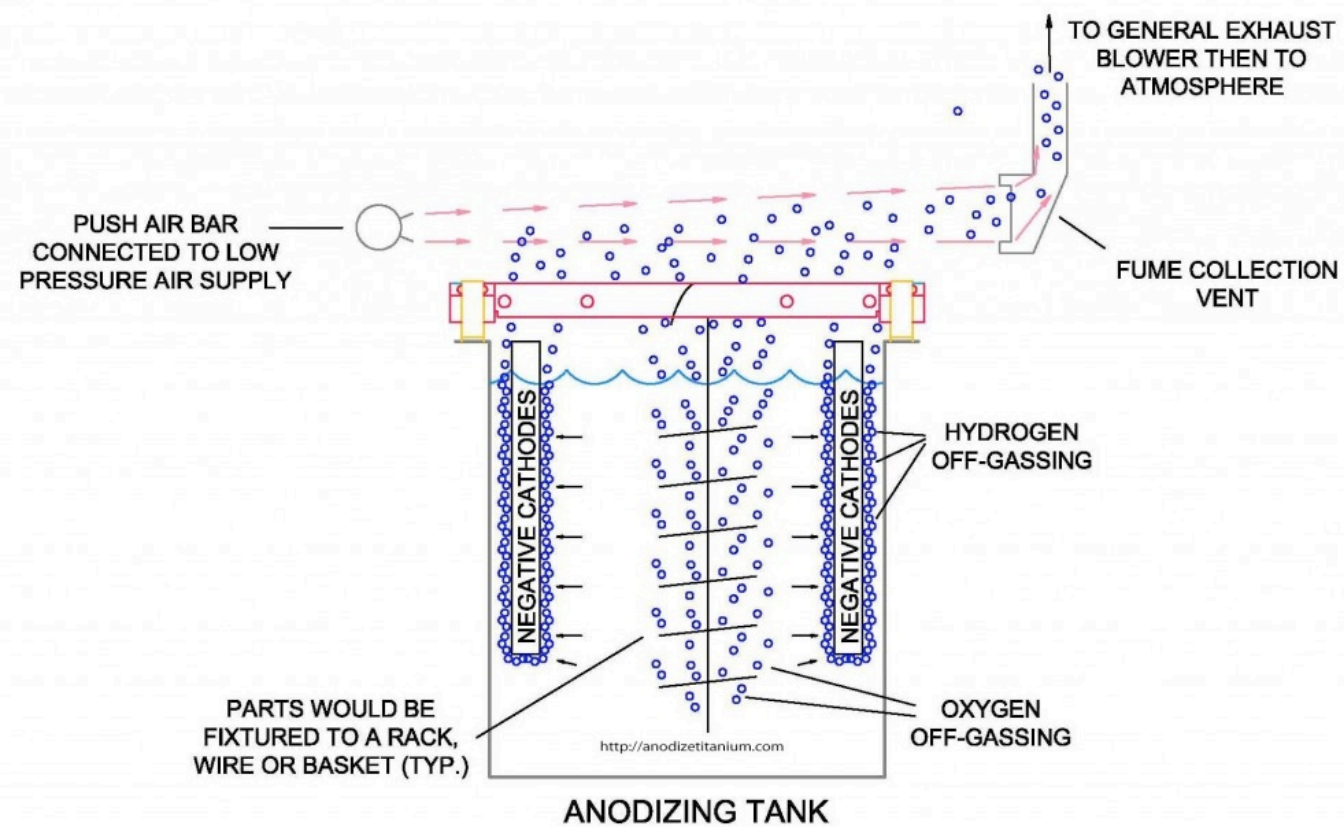
FINISHING

# ABRASIVE BLASTING





# ANODIZING





# POWDER COATING





# VENEERING



# SCALABILITY

Dependent on how material, fabrication technique, assembly and labor come together.

Laser, waterjet cutting, milling - small to medium scale (very dependent on set-up)

3D Printing - small scale (cost and time are high, but labor is low)

Casting - medium scale (fast, although labor can be intense)

Injection Molding - gazillion scale (cheap, fast, little labor)

