# LEARNING LAB: CNC & VACUUM FORMING

- How to book equipment
- Meet the equipment
- What materials can be used and cost
- Software

But first…

- How do these Learning Labs work?

- We give you the basics and resources, you do the deep dives.

- More information on the [Fabrication and Robotics Lab page](#)

- This space is intended for users 13 and up. Younger users must be accompanied by a responsible adult who has a relevant badge.

- How do you make an equipment booking?

  - Reservations may be made once per day,
  - up to 2 times per week,
  - for a maximum of 5 times per month.
  - After the limit has been met, users may still access the tools on a walk-in basis if equipment is available.
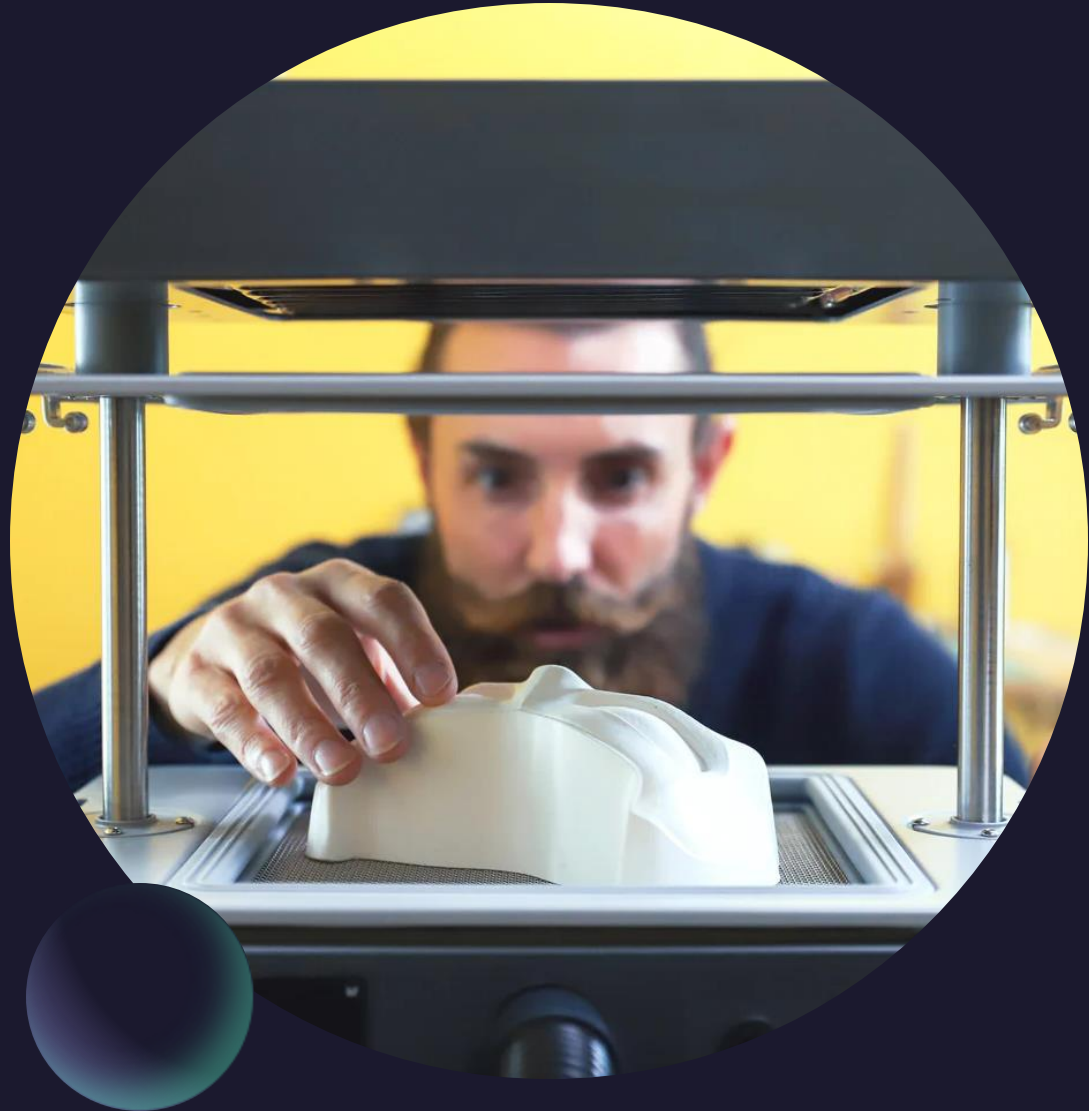
What do we have here?

Snap Maker 3 in 1

Snap Maker head can be changed out to be a CNC, Laser, or 3D printer.

Danger
• MOVING Parts

Mayku Vacuum Former

Many types of plastics available for different mold making needs. Thin packaging plastics to food grade safe plastics.

Danger
• HOT surfaces
• Patron must stay 15 mins after use to ensure Form box has cool off

Always clean up after yourself: clean build plate, put away materials, and clean up workspaces.

snapmaker

CNC CARVING

Types of Materials: Snap Maker CNC

Snap Maker 3 in 1

OK for Milling:

- Wood, acrylic, PCB, carbon fiber sheet, foam

Do NOT Mill:

- Metal, glass and gem are not supported.

Available for Sale

- Plywood:
  - 12 x 24in Sheets $8.70 per sheet

- Acrylic:
  - 12 x 12in sheets $9 per sheet
  - 5.5 x 10in sheets $4.50 per sheet

- How does payment work?
  - Supply fees are added to your library card and can be paid online or at any self-check out in the building.
  - If a patron has over $10 worth of fines on their library card, we cannot sell you supplies until you clear your card.

What is a CNC and CAM Software?

- **CNC**

  - Computer numerical control (CNC) is a manufacturing method that automates the control, movement and precision of machine tools through the use of preprogrammed computer software, which is embedded inside the tools. CNC is commonly used in manufacturing

- **CAM Software**

  - Software that tells a machine how to make a product by generating toolpaths.

  - Learn More about CAM
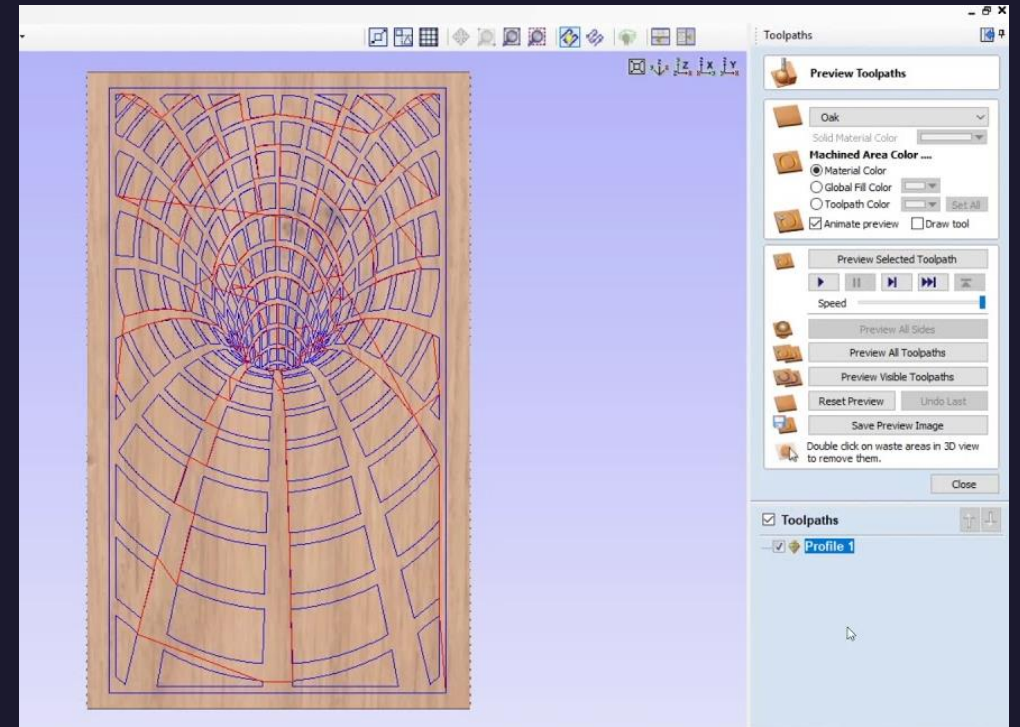
CAM Software: Snapmaker Luban

CAM Software: V-Carve Pro

Types of Toolpaths

Luban

- **Vector (.SVG Files)**: Follows vector lines to cut

- **Engrave (.SVG Files):** Engraves out the inside of the vector lines

- **Relief Mode (.STL File):** Creates tool paths to make a relief of the 3D model

V-Carve Pro

- **Profile Cut (.SVG File)**: Follows vector line to cut

- **Pocket (.SVG File)**: Engraves out the inside of the vector lines

- **3D milling (.STL File):** Creates tool paths to make a relief of the 3D model

Step Down VS Step Over

- **Step Down (Cut Depth):** how deep the bit is going with each pass.

- **Step Over (Cutting Width):** is the total thickness of the cut when viewing the cutting tool from above. It can be no more than 100% of the cutter's diameter.

- (Example: When your cutting grass you want to overlap cut sections to get a good finish)
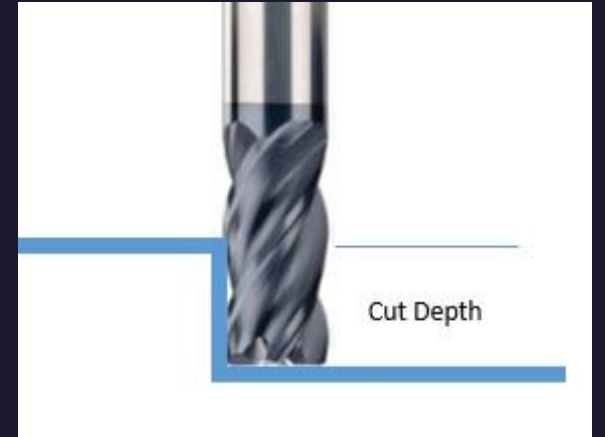
Types of Bits

Flat End Mill (double cut)	Flat End Mill (single cut 3.175)	Flat End Mill (double cut 1.5)	Ball End Mill	Carving V-bit
3.175mm	3.175mm	1.5mm	3.175mm	.0125mm
Standard milling and material removal. 2 flutes can remove more material	Good for standard milling and material removal	Standard milling and material removal in small areas	Final surfacing	Fine detail engraving

Installing Bits

Spring Collet
Collar
www.cnicsparetools.com

- Make sure **Sprint Collet** is inserted correctly into the **Collar** and screwed in tightly with wrenches to the milling shaft

- When setting the **Milling Bit** into **Spring Collet** make sure the it is not too far up or sticking too far out.

- Leave at lease 1/4in spacing between the flutes of the bit and the Collar.
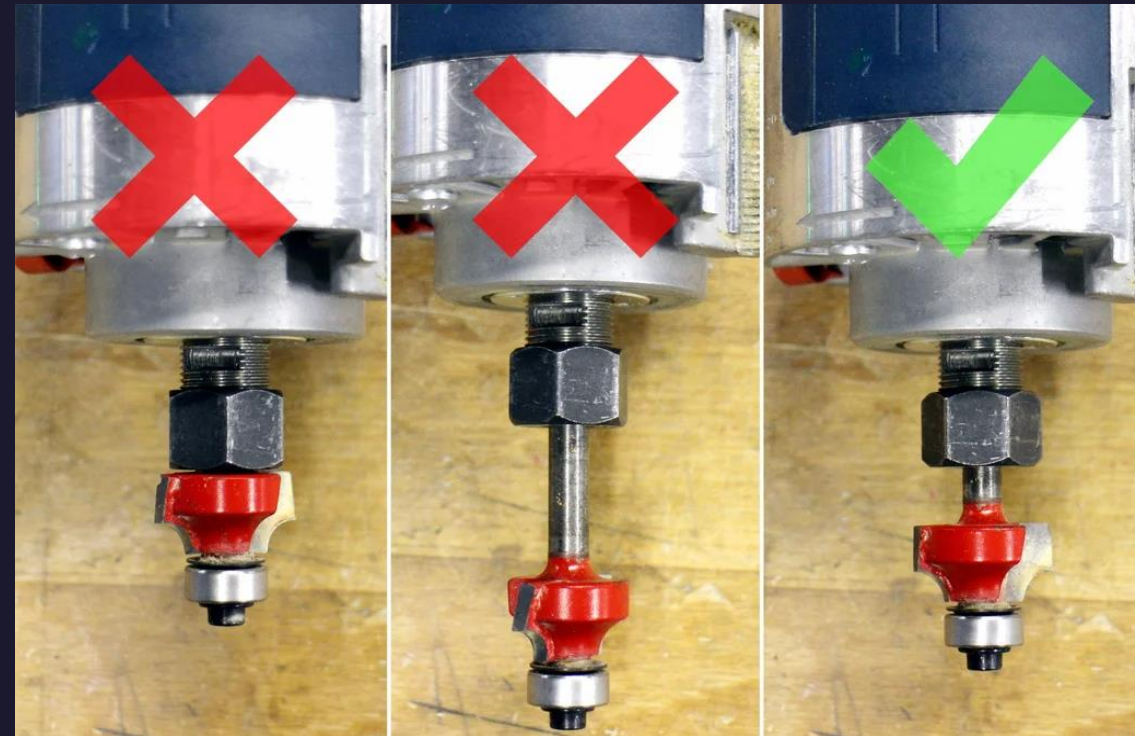
Setting up the CNC Bed

- Make sure your material fits on the CNC bed and will not hit the side rails or case.

- Clamp your project down on at lease 3 sides.

- Make sure you have the correct bit in the machine and it is installed properly.

- HOME the machine in the center of your project.

- Make sure the door is closed before pressing start and remains closed until the project has finished.

Mayku Form
Box

Types of Materials: Mayku Form Box

Mayku Form Box

OK for Vacuum Forming:

- Soft woods, MDF, most plastics, high-density tooling foam, 3D printed plastics, PLA, ABS, resin, stacked card and paper, Play Dough, and air-drying clay, potatoes.

Do NOT Vacuum Form:

- Plasticine, wet clays, origami paper with larger voids in the center (these will crumble), freshly spray painted objects, or living things and body parts.

Available for Sale

- Mayku Form Sheets Plastic Sheets
  - 0.5mm White Sheets $2 per sheet
  - 1.0mm Transparent Food-Safe Sheets (PETg) $2.50 per sheet

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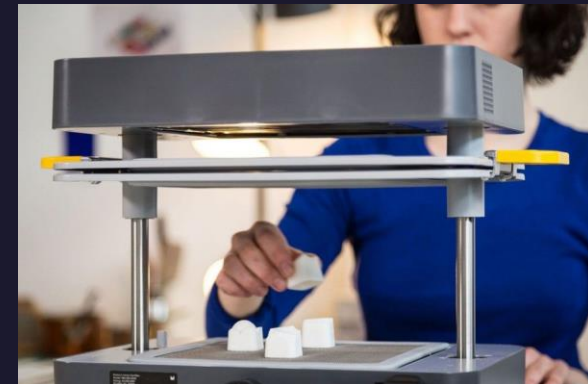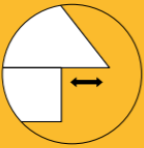
Additional Things to Consider

Rule #1
Remove all undercuts

Undercuts make it difficult to remove templates once they have been formed. Make sure your design doesn't have any ledges or indents that could stop a template from being removed.
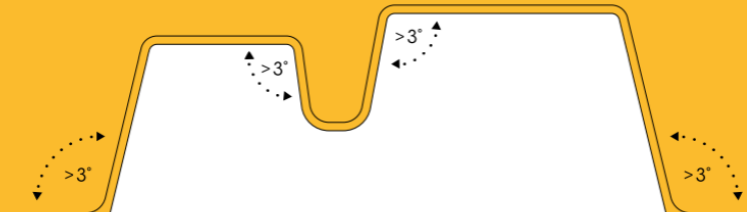
Undercut

No undercut

Rule #2
Add draft angles

Draft angles are slopes on the edges of your templates. They help you remove templates from the vacuum form very easily. The slopes on the edges of your forms should point outwards not inwards, so templates come out with little effort.
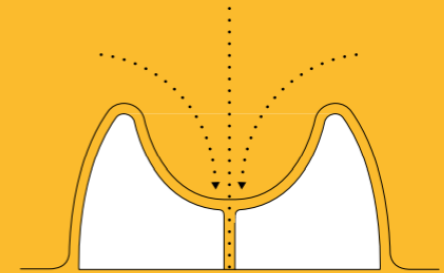
>3°

>3°

>3°

>3°

Rule #3
Add air holes

Adding air holes will allow air to flow freely through your design to the vacuum plate. This will help your Mayku Sheet get into the tiniest of spaces.
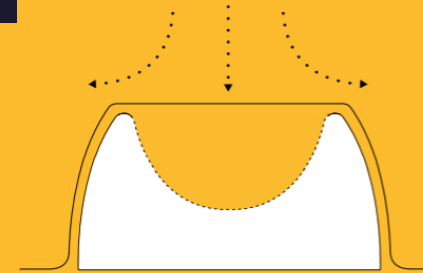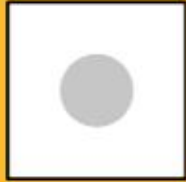
Air blocked

Air free

Space

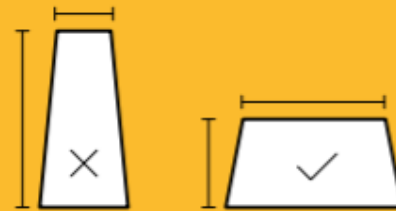Ensure that your objects are as close to the center of the vacuum plate as possible.

Packing

If you are placing multiple objects on the plate, ensure that you leave at least 3cm between them. Leave more space for taller or larger objects.

Height / Width Ratio

Generally, templates should be wider than they are tall. This helps avoid thinning at the top of the form.

Avoid Webbing

Avoid sharp angles less than 90 degrees. This can cause 'webbing', as the sheet material can bunch and fold onto itself. Also ensure that you lower the trays softly when forming.

Mayku Desk Top Vacuum Former