

DIY Vacuum Forming

Chris Lee

chris@chrislee.tv

DIY Vacuum Forming

- ✦ What is the process of vacuum forming?
- ✦ Equipment options
- ✦ Common problems
- ✦ Resources
- ✦ Example project: **Robotech Cyclone Suit**

What is vacuum forming?

- ✦ **Start** with a sheet of plastic and a mold (or “buck”).
- ✦ **Heat** the plastic until it softens.
- ✦ **Stretch** the plastic over the mold.
- ✦ **Vacuum** out the air between the mold surface and the plastic, pulling them tightly together.
- ✦ **Cool** the plastic until it hardens in the shape of the mold.
- ✦ **Separate** the plastic from the mold.



Start with a sheet of plastic.

Thermoplastics:

High Impact Polystyrene Sheeting (HIPS)



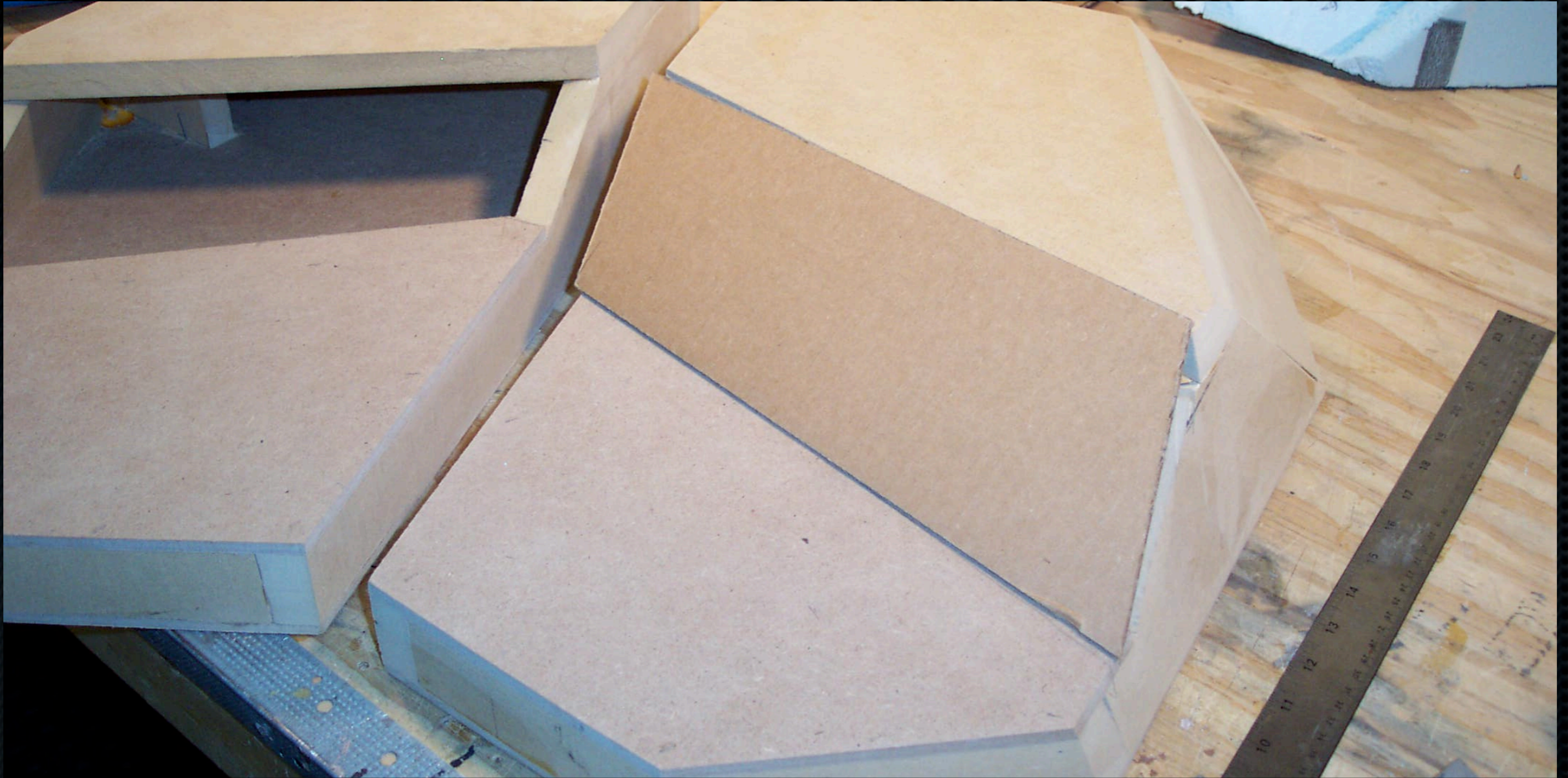
Make a mold or “buck”.

Carve, shape, build, or otherwise construct the positive or negative form that you want.



Several types of mold material.

Use wood, metal, foam, clay, or a combination.



Avoid vertical sides.

Slope all vertical sides slightly inward.

Beware of undercuts.



Fill any gaps for a tight seal.
On wood, use an auto body filler compound.



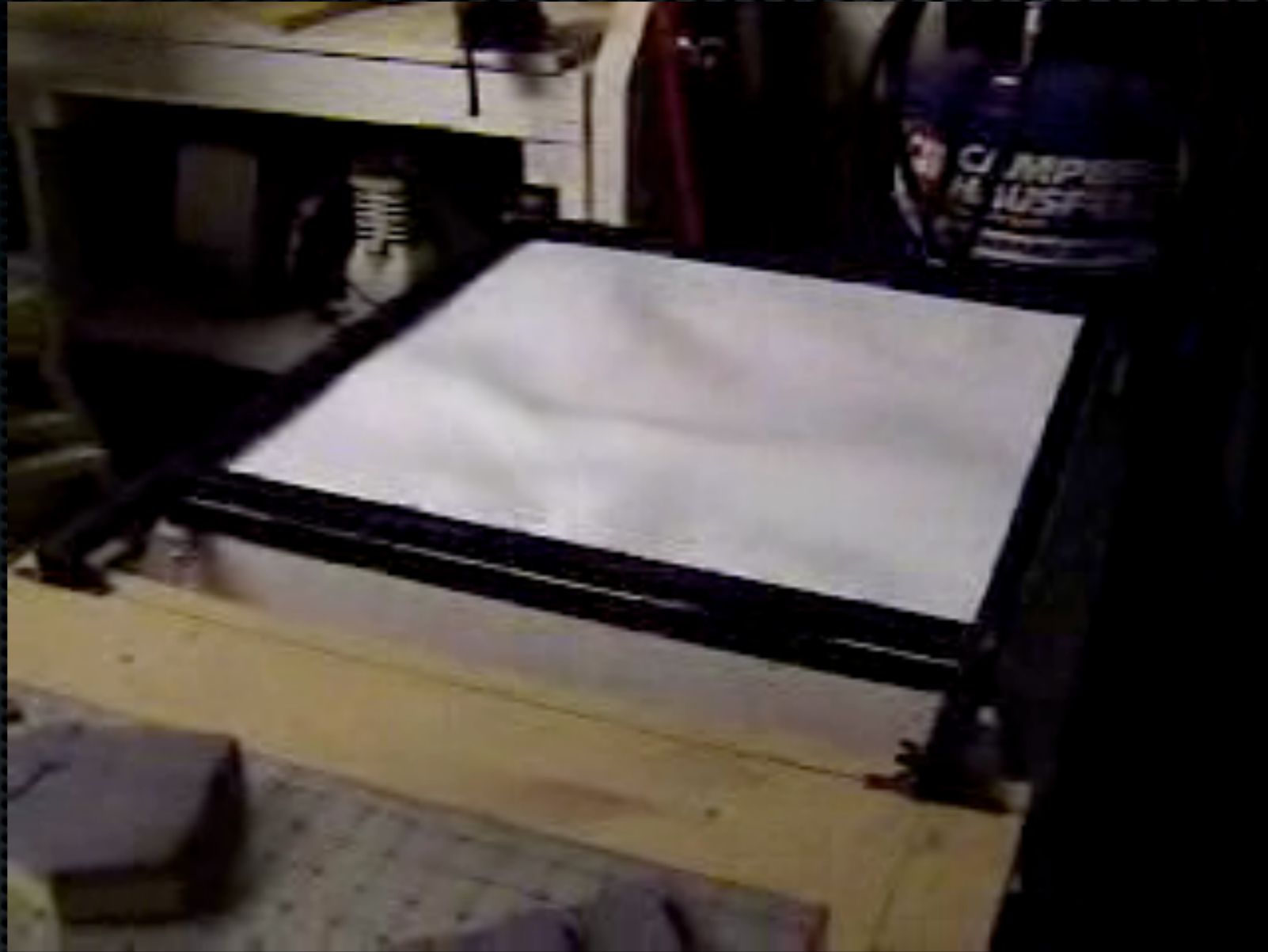
Smooth finish (if needed).

Sand, add more filler, sand again, ad nauseum.



Finished bucks.

Ready for vac-forming.



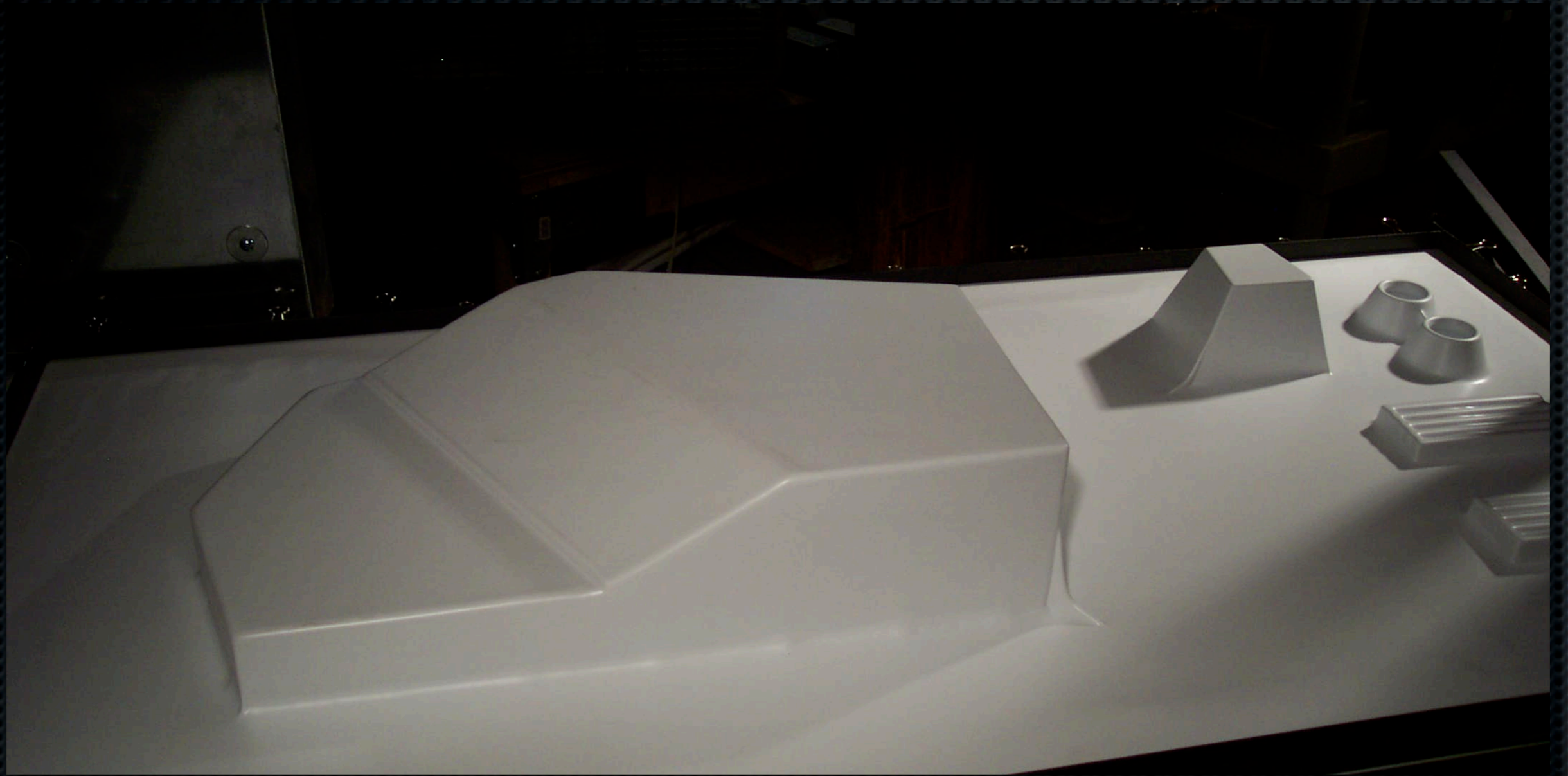
Heat the plastic until it softens.



Arrange molds on the platen. Spacing is important.



Stretch the plastic over the mold.



Pull the plastic tight to the mold.



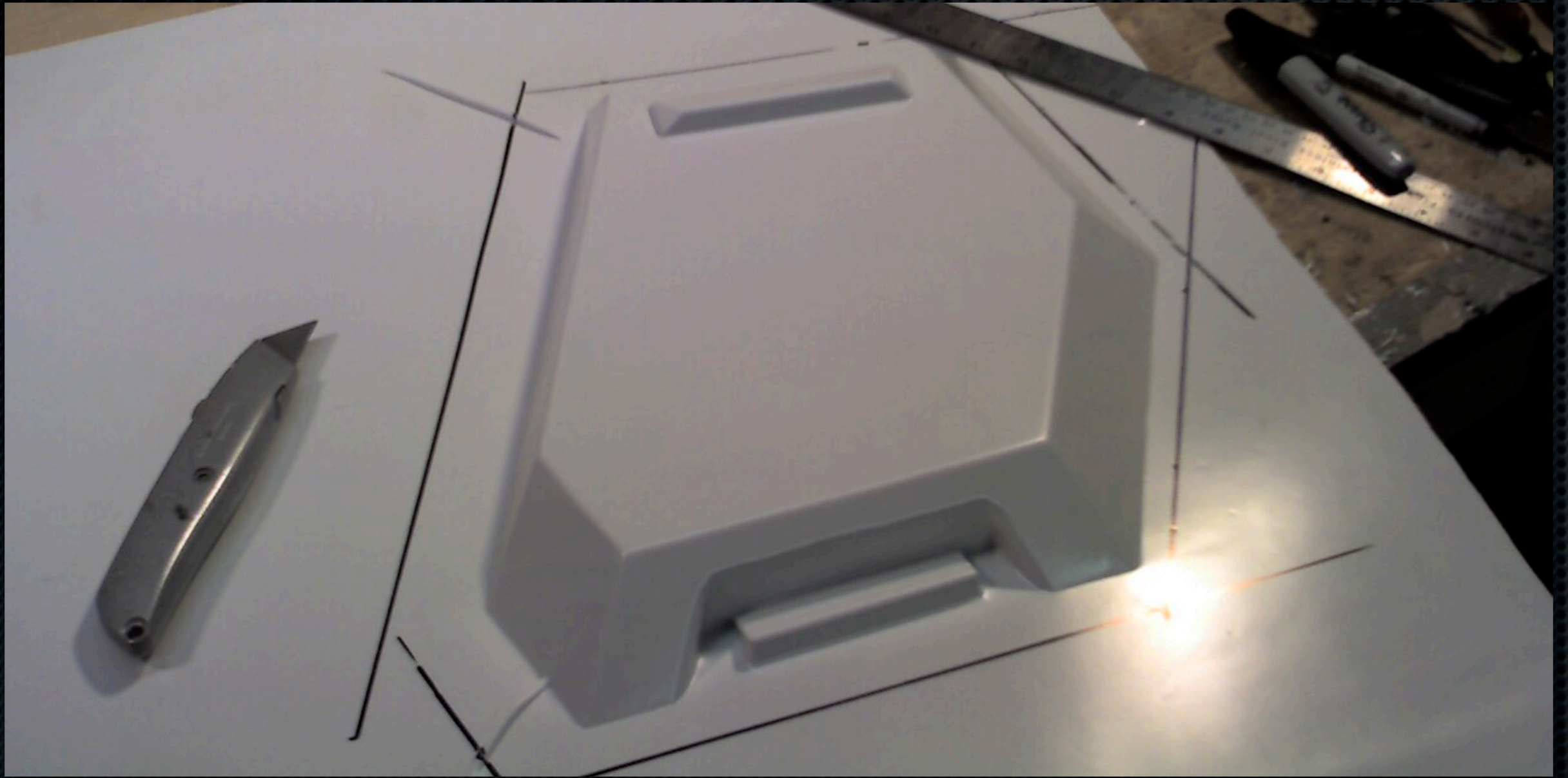
This is the **vacuum** part of vacuum forming.



Cool the plastic until it hardens.



Separate the plastic from the mold.



Trim, sand, clean-up, paint.

Equipment Options

Equipment must provide:

- ✦ Rigid frame to hold the plastic sheet by its edges
- ✦ Safe, controlled method for heating the plastic
- ✦ Perforated surface (platen) for mold placement
- ✦ Air-tight seal between frame and platen
- ✦ Method for vacuuming the air from under the plastic
- ✦ Fan for cooling the plastic and oven

Vac-Form Equipment Types

- ✦ **Basic:**
Independent heating and forming areas
(cheapest)
- ✦ **Intermediate:**
Flip-over design
(most popular)
- ✦ **Advanced:**
Top-mounted oven with carrier frame
(best results)

Basic equipment

- ✦ Independent heating and forming areas
- ✦ Lowest initial cost
- ✦ Example:
**MAKE Magazine
Kitchen Floor
Vacuum Former**



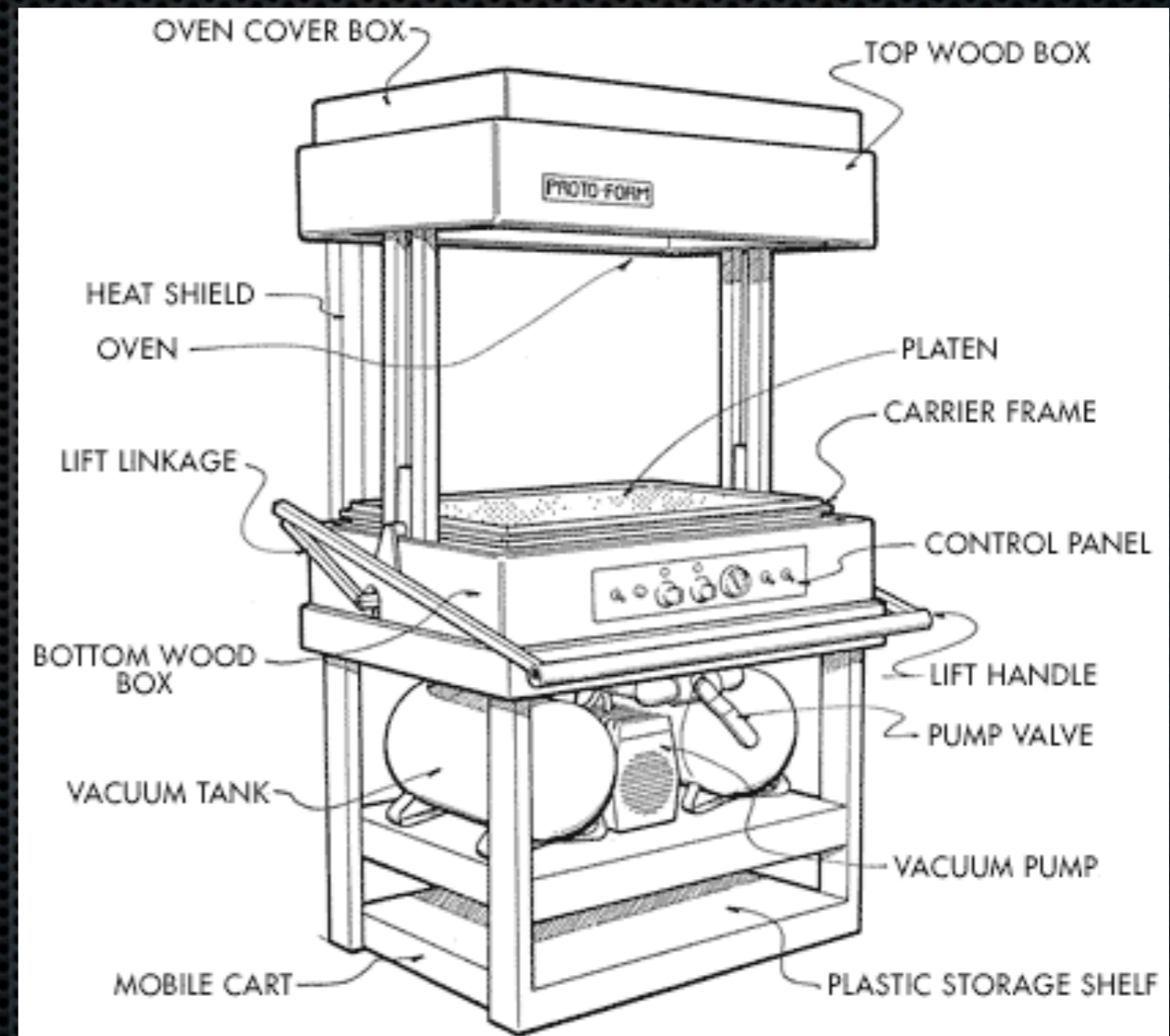
Intermediate equipment

- ✦ Flip-over machine
- ✦ Most popular, good value
- ✦ Example:
Thurston James' design



Advanced equipment

- ✦ Top-mounted oven with carrier frame, high-power vacuum pump and tanks
- ✦ Best results, highest initial cost
- ✦ Example:
ProtoForm 2448



Common Problems

Common problem #1: **Moisture absorption**

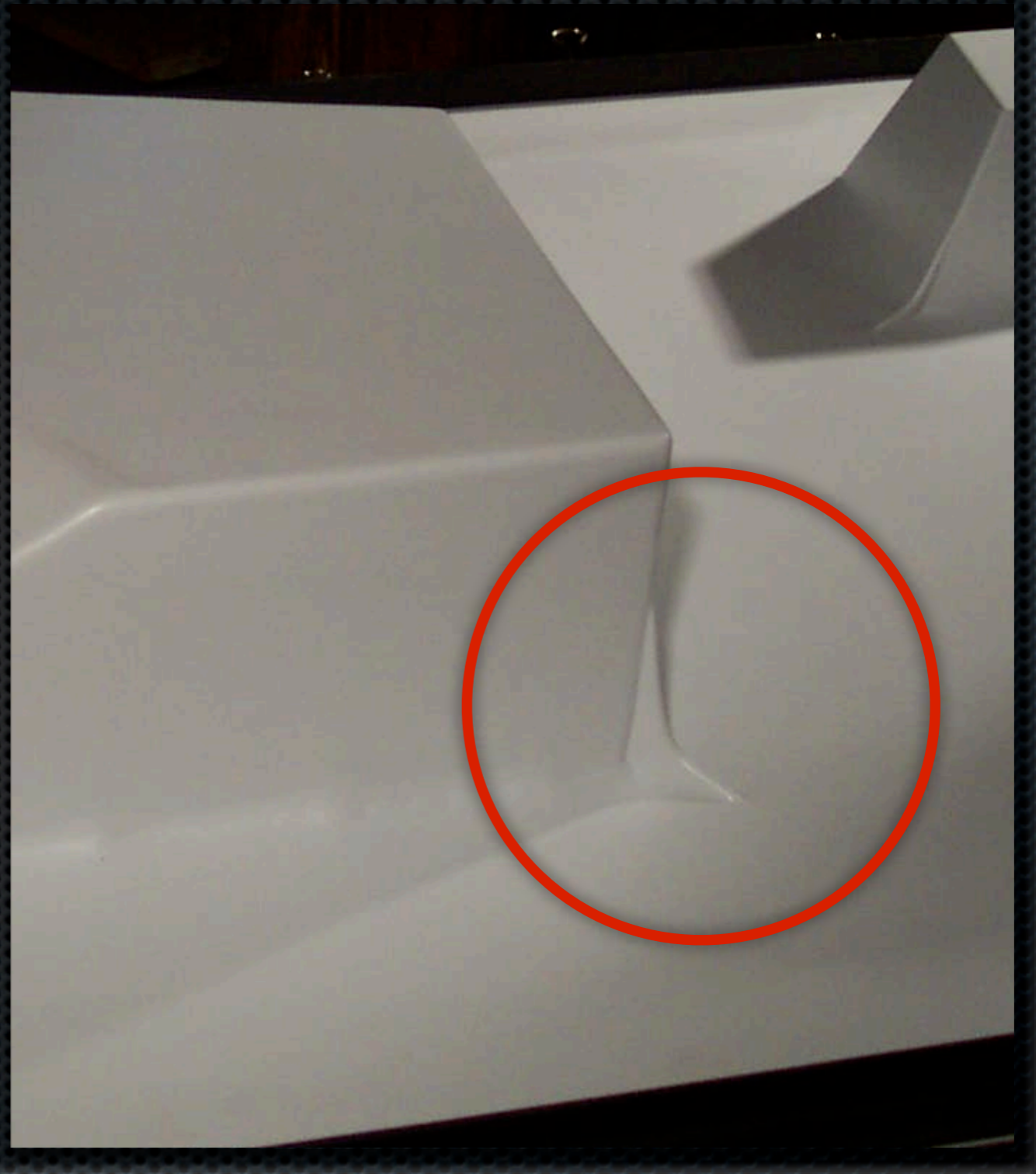
- ✦ Plastic can absorb moisture.
- ✦ Moisture turns to steam when heated and expands, forming bubbles within the plastic's inner layers.
- ✦ **Solution:** Dry the plastic for an extended period at high but sub-melting temperature.

Common problem #2: **Webbing**

- ✦ Webs may form in the plastic around the mold edges.
- ✦ Due sometimes to overheating of the plastic.
- ✦ Can also occur when a mold is too tall or large or parts of the mold are too close together.
- ✦ **Solution:** Monitor plastic temperature and softness, keep molds shallow and adequately spaced.

Common
problem #2:

Webbing



Common problem #3: **Undercuts**

- ✦ Molds with undercuts will be difficult or impossible to separate after forming.
- ✦ Vertical mold walls can be as bad as undercuts.
- ✦ **Solution:** Always taper any vertical walls and avoid undercuts. Use riser blocks if necessary.

Resources

Resources

- ✦ **Plastic stock:**

World of Plastics - Hendersonville TN

- ✦ **MAKE Magazine Kitchen Floor Vacuum Former:**

<http://makezine.com/11/vacuumformer/>

- ✦ **Thurston James' design flip-over machine:**

<http://www.tk560.com/howtoguides.html>

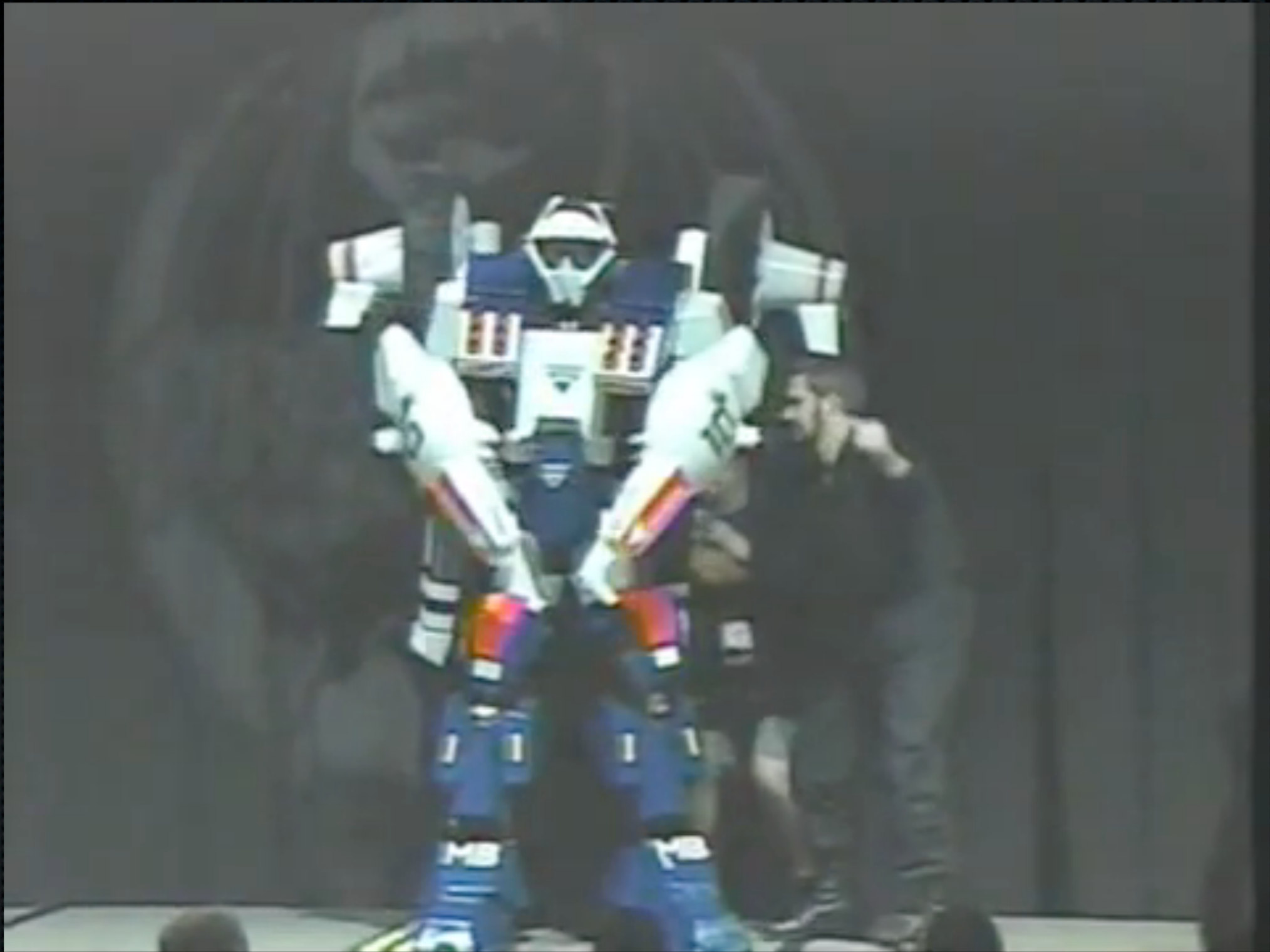
- ✦ **ProtoForm 2448 machine:**

http://www.build-stuff.com/1002plans_proto-form.htm

- ✦ **My projects site (ProtoForm, Cyclone, & more):**

<http://chrislee.tv/projects>

Example Project:
Robotech Cyclone Suit



DragonCon 2007 Masquerade

DIY Vacuum Forming

Chris Lee

chris@chrisee.tv