

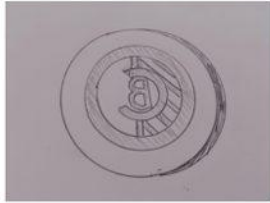
Making
Multiples



Poker Chip: Monogram



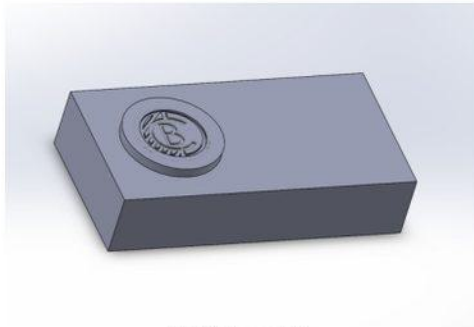
Design Iteration I



Drawing



CAD



CAD Insert in
Mounting Block

In my first design iteration of the poker chip I created a monogram of my initials, facing West.

This chip represented my name and reflected both my American and English heritage. The crossed lines evoke traditional English insignia, yet the letters move West, signifying the shift to America and the West coast.

Looking West indicates not only a direction of motion, but also the Western perspective and ideals of freedom and exploration.

Prototyping



3D-Printed Chip Prototypes



3D-Printed Chip Mold
Prototype

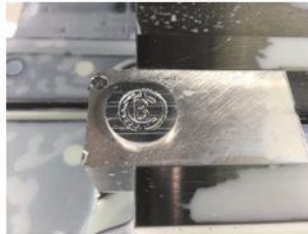
To get a better sense of the form, I rapidly prototyped the chip and chip insert using 3D printing.

While imperfect, they helped confirm my decision to face the monogram left if using only one side

Manufacture: Insert I



Post-Turning



Mounted, Post-Milling

Manufacturing the chip insert was relatively straightforward. After turning and tapping the stock on a lathe I secured the insert to a mounting block.



Pre-Finishing



Finishing

This mounting block was held in turn in a vice as the insert envelope was milled in the VF1. After machining, the insert was sanded to 1200 grit.



Manufacture: Chip I



Mold Open

As a class we loaded the chip inserts into the mold



Mold Closed, Ready for Injection

We then loaded assembled the rest of the mold and secured it in the Arburg, following the procedure for injection

Parts: Chip I



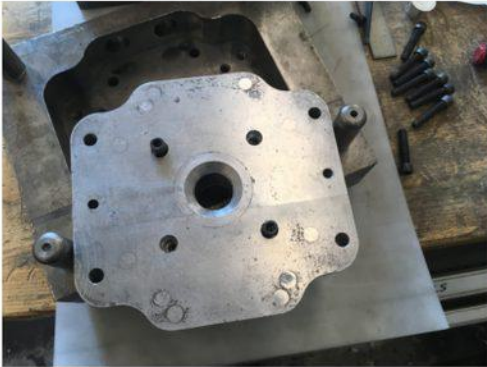
Design & Manufacture: Iteration II



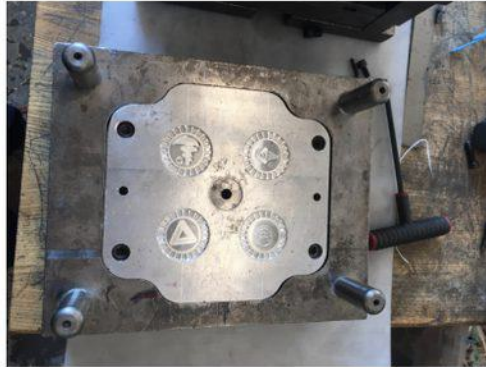
Upon reflection, I realized I could further the symbolic imagery of the chip by making use of its inherent duality.

I thus created a mirror image of the original poker chip.

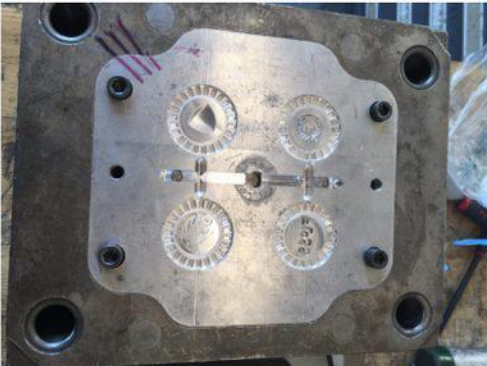
Manufacture: Chip II



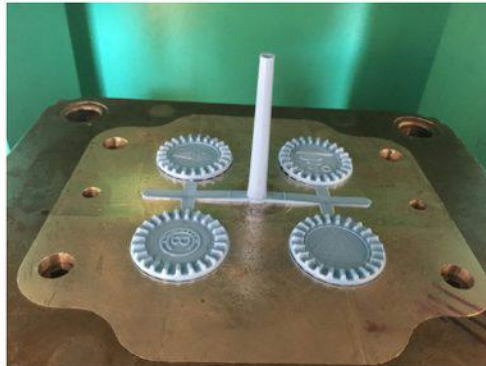
Removing Previous Insert



Inserts in Mold



Inserts in Mold



Parts in Mold



Burnt Mold Release

Disassembling and reinstalling the steel mold, I then proceeded to shoot parts as performed in the first lab. After some initial mold release burn issues, manufacturing proceed smoothly

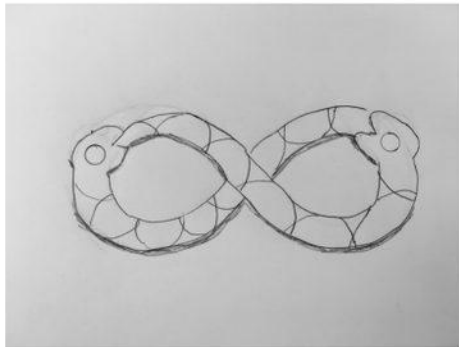
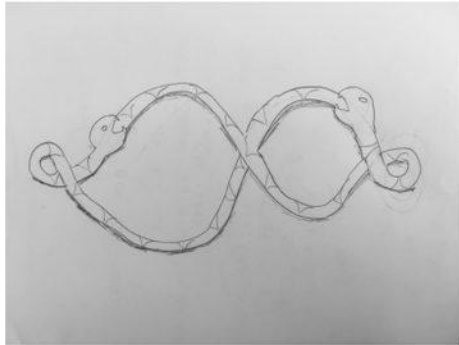


Mini Mold



Ouroboros

Design: The Ouroboros



A Couple Early Sketches

A symbol dating back to the 14th century, BC, the ouroboros depicts a serpent or drake consuming its own tail and represents the cyclical chain of life and death.

To better represent the duality of life and death I chose to use two snakes in my design.

I then played with ways of incorporating the linkage holes into the design itself, either as extra loops in the snake bodies or as eyes.

Prototype

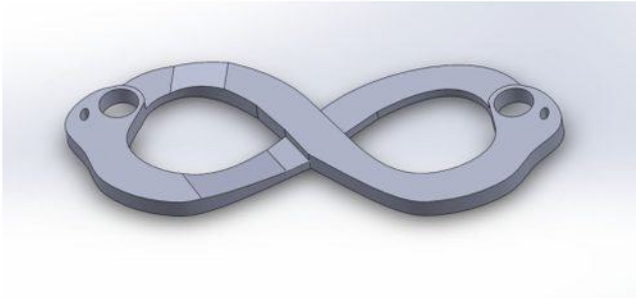


To help inform my design decisions, I created a clay model of the planned form



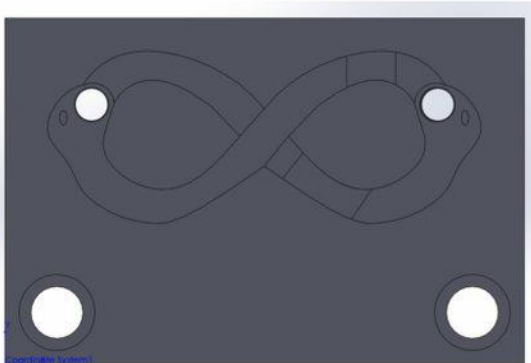
I also considered scanning the form to serve as a basis for CAD but had previously experienced trouble removing all artifacts from similar models, leading HSMWorks to struggle to yield appropriate CAM, and so chose not to do so here

Designing the Injection Mold: Iteration I



Ouroboros CAD

Upon CADing, I realized that the prescribed dimensions inclined the linkage holes to constitute the snake jaws rather than eyes or body



Mold CAD

To create the mold model I simply subtracted the ouroboros model from that of the stock

Manufacture: Mold I



Cutting Tools



Incorrect Runner Position



Re-drilling



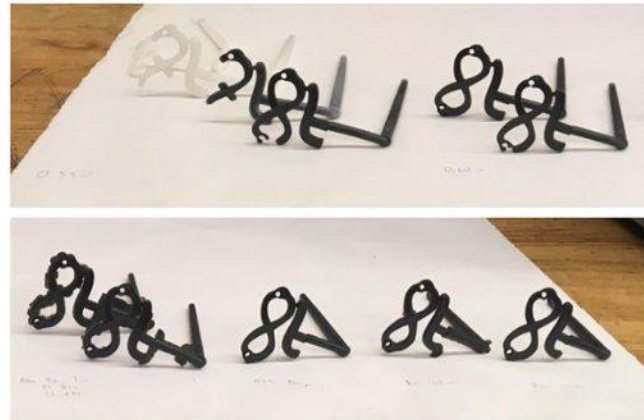
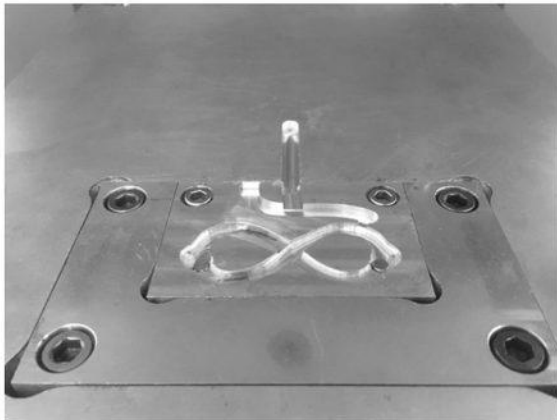
Final Mold

Manufacturing the mold on the VF1 simply required securing the stock in the vise. After facing the piece to 0.45", I proceeded to cut the requisite features using a variety of cutting tools.

During this process, I accidentally used an $\frac{1}{8}$ " drill and had to redrill the ejector holes. I also initially forgot to include a gate and runner and failed to center the runner correctly.

Manufacture: Parts I

After the initial standard set-up procedure, I then proceeded to adjust the injection process as shown in the picture below.



Manufacture: Additional Observations

Flash

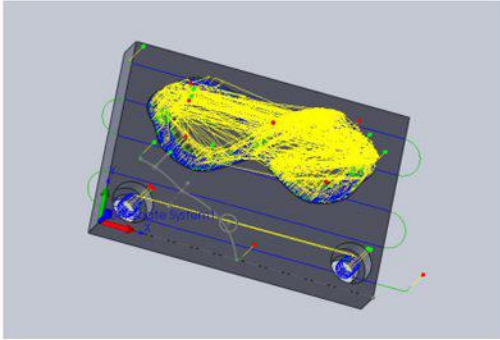


Adaptive-Clear
Rough Operation



This first iteration experienced two small issues: flash around the ejector pins and machining marks evident on the 3D level transitions. It also lacked the curved edges which I had hoped to achieve to more closely resemble a serpent

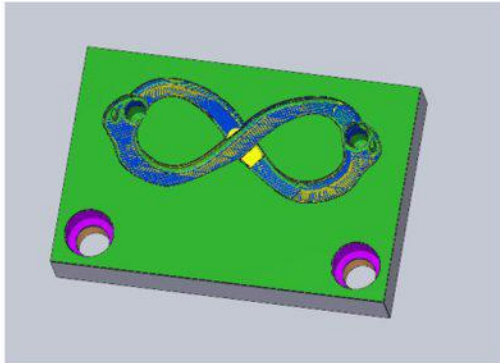
Redesigning and Manufacturing the Injection Mold



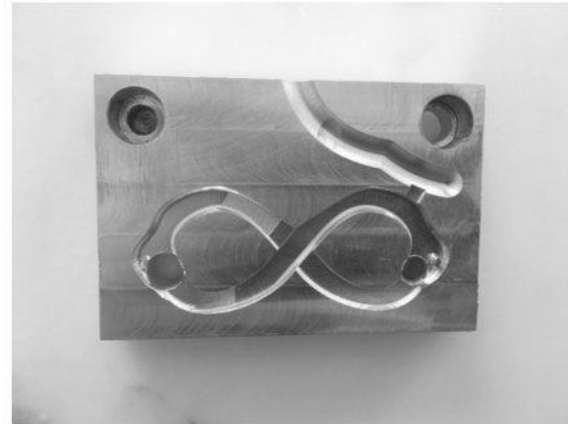
CAM

To address these issues, I added fillets and used scallop as a finishing pass.

Unfortunately, when touching up the fastener and ejector holes I accidentally swapped the drills and used the larger fastener hole drill size for the left ejector hole, rendering it unusable



Stock Simulation



Mold II

Manufacture: Mold III



Instead of remaking an entire new mold, I instead addressed these issues by experimenting with curing Form2 High Temperature resin within the mold

Manufacture: Link



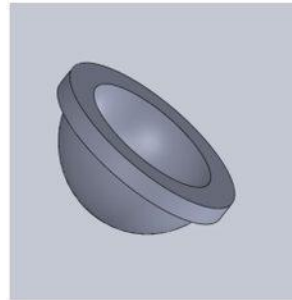
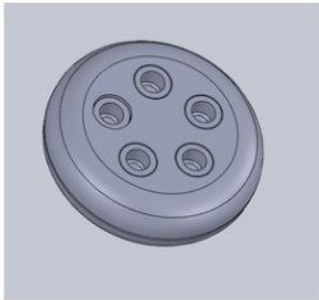
This method worked surprisingly well. After loading the modified insert into the mold I was able to achieve the desired smooth surface as shown by the clear and light blue parts above. The original black version is shown for comparison.



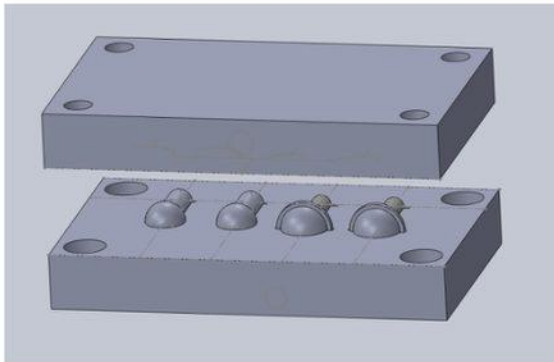
Pencil Holder

Any Angle Art

Refined Design: Ball and Socket



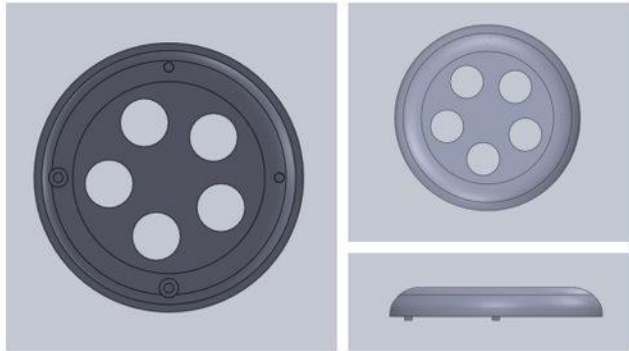
Parts CAD



Mold Assembly

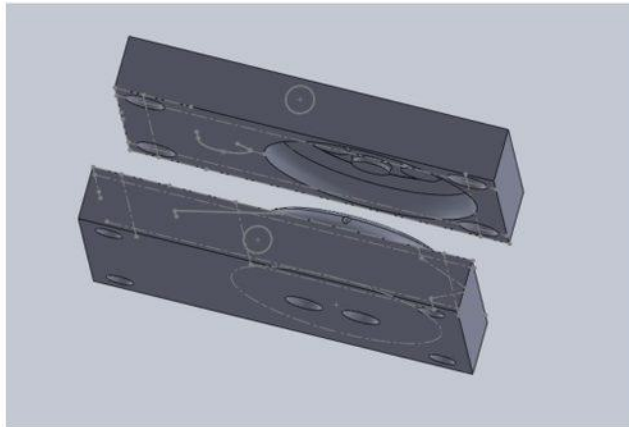
With this in mind, I re-CADed the parts and created the molds through a combination part subtraction and the molding tools provided in Solidworks

Refined Design: Outer Shell



CAD

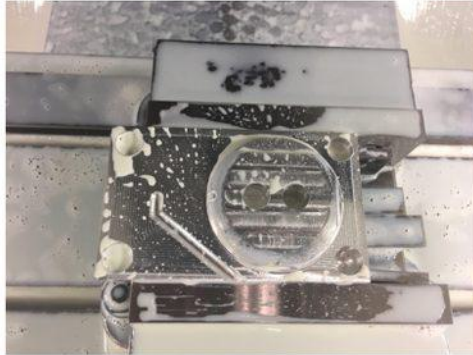
The shell and the associated mold sides were created in a similar way.



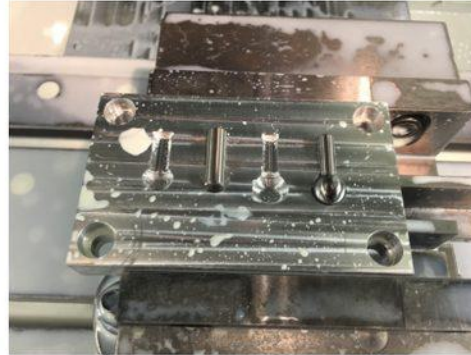
Mold Assembly

Note that the trace operations depict the location of the gate and runner, which jumps from the B to A-Side mold in order to improve flow during shooting.

Manufacture: Inserts



Shell B-Side



Ball & Socket Mounted,
Post-Milling



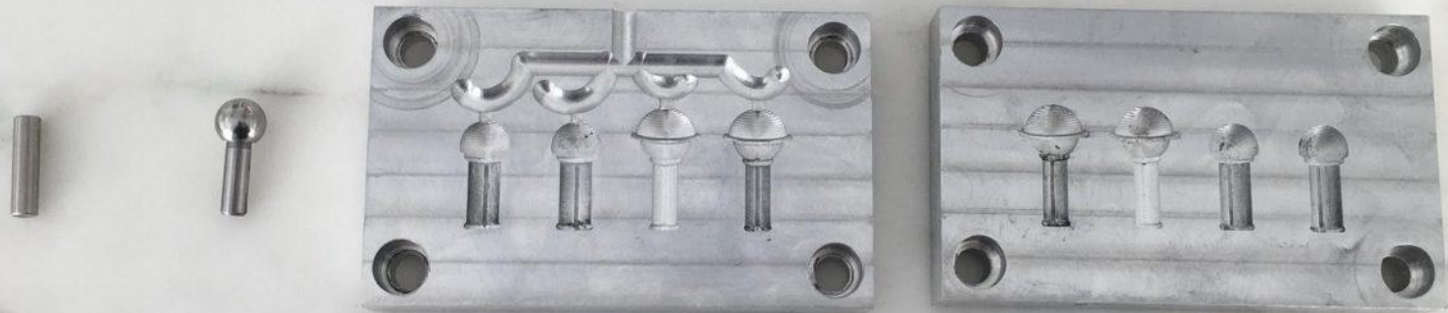
Machining



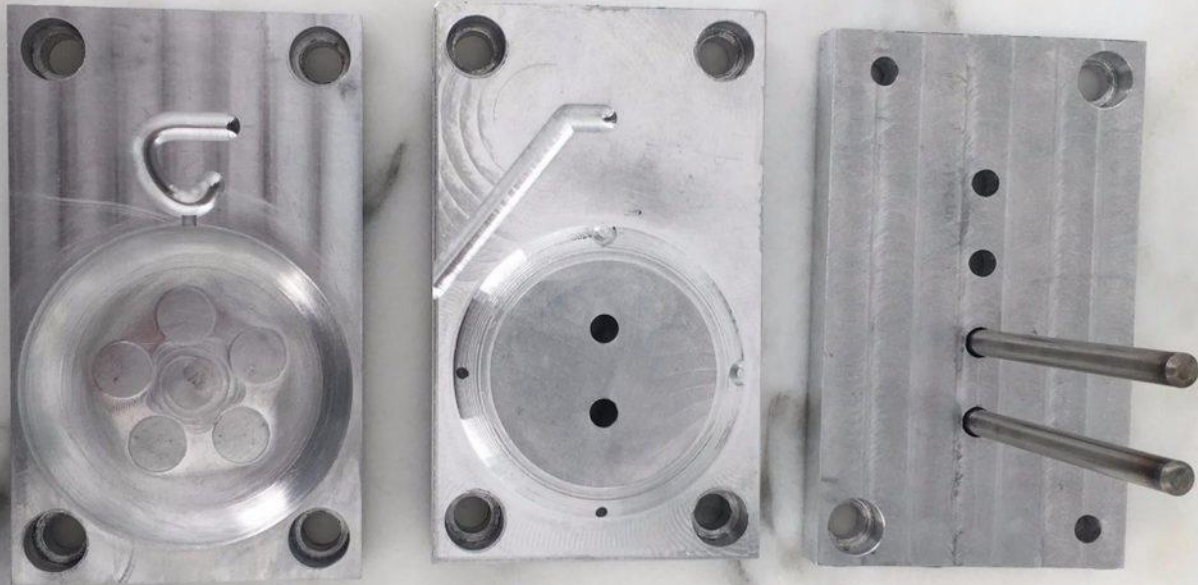
Ball & Socket Gates
and Runners

Machining proceeded largely without mishap and involved mostly adaptive clears followed by a variety of finishing operations such as parallel and scallop.

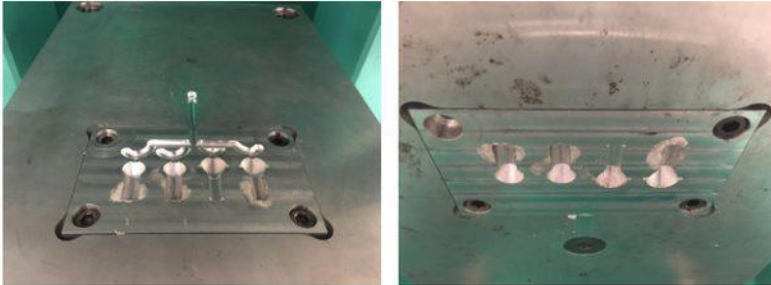
Manufacture: Ball & Socket Mold Inserts



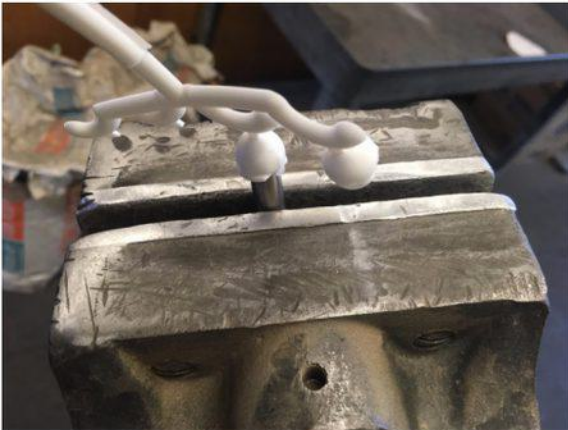
Manufacture: Shell Mold Inserts and Ejector Plate



Manufacture: Ball and Socket Joints



To produce the ball and socket joints I followed standard arburg operating procedure. The ball and socket manufacture presented two new challenges: adhering the core to the mold and removing the core from the shot part.



A small dab of surf wax effectively solved the adherence issue, while a vise helped remove the cores for each cycle.

Manufacture: Ball and Socket Joints



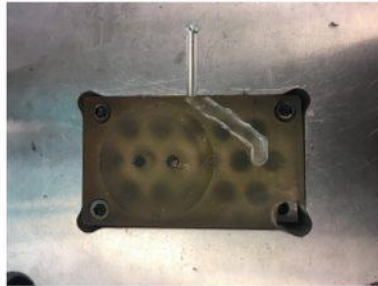
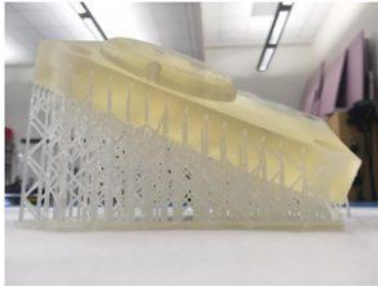
Tight core adherence was hugely important for part success, as shown here. For the ball shot on the left, the insert was loose and slid toward the ball end of the mold, effectively shutting off mold flow to that part and resulting in flash in the other parts

Manufacture: Ball and Socket Joints



A 4-hour session's worth of ball and socket joints

Manufacture: Outer Shell Round I



Form2 Shell B-Side Mold

To produce the shell, since CNC machining time was limited I initially printed the B-Side mold using high temperature resin on the Form2.



Ejector Pin Sizing

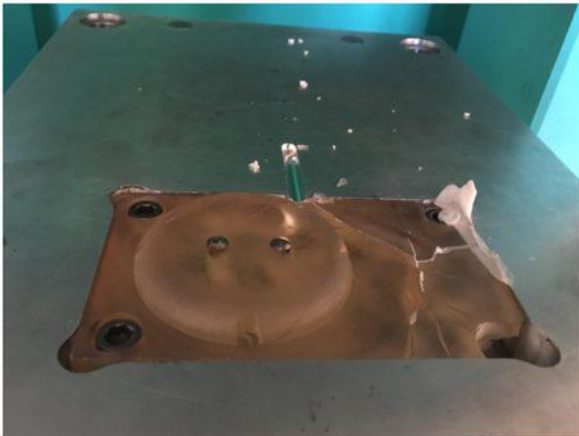
I also machined the runner using a hand mill, as the component had been a trace operation on the original model

Manufacture: Outer Shell Round I



This mold worked fairly well,
although after roughly fifty cycles
it cracked due to thermal stress

A broken sprue also proved a
challenge to remove



Manufacture: Outer Shell Round I Parts



The parts from this initial round with the Form2 did have some flaws. Firstly, the A-Side of the Shell insert was not fully sanded and left distinct machining marks, shown top right.



The pins also broke off quickly and left the bosses without holes, as depicted in the bottom picture to the left

To address these issues, I continued molding with the Aluminum B-Side and sanded the A-Side



Manufacture: Outer Shell Round II

I continued to mass produce the shell parts with the Aluminum B-Side and sanded A-Side over the course of several sessions.

Parts Round II: Challenges



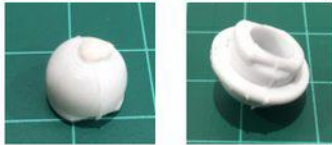
One small issue that I initially encountered was excessive flash in the runner, as shown top right.

However, by adding a brass shim and increasing the clamping pressure I was able to produce parts with hardly any noticeable flash as shown top left.



Note that some minor flash still occurred near the rim, likely due to the sanding performed on the A-Side. A quick pass with an X-Acto blade removed this flash in the finished parts

Assembly



I then assembled the parts, using a dab of surf wax to secure the balls into the socket joints and plastic dots to allow the shells to support uneven loads more readily.



I mounted the joints into the shells with hot glue and fastened them together using the intersecting bosses

Some models I chose to leave without the joints to sit in the original helical pattern

Final Work





