

Thermal and Mechanical Characterization of C/C Composite Produced via Highly Processable BODA-Derived Precursor Resin System

Mold Documentation

Problem Statement:

The purpose of this document is to describe the features, manufacturing, and implementation of the molds created for use with our Senior Seminar Project.

Features:

When interlinked, the mold is a rectangular prism. It is composed of a female mold, a male mold, and two ejection access plugs. The mold is made of 6061-T6 aluminum. When interlinked the mold is 11.61in x 3.0in x 0.843in (295mm x 76.2mm x 21.4mm).

1. Female Mold

The Female Mold resembles a rectangular prism with a center cavity cut out, and four posts on its top surface.

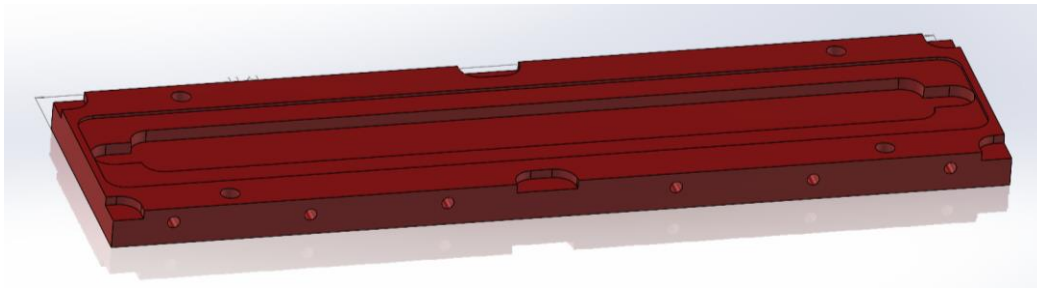


Figure 1 Female Mold CAD without Alignment pins

a. Coupon Bed

The Coupon Bed is the deepest center surface on the female mold. It is where the material for the coupon is placed and cured via pressure and heat into the composite coupon.

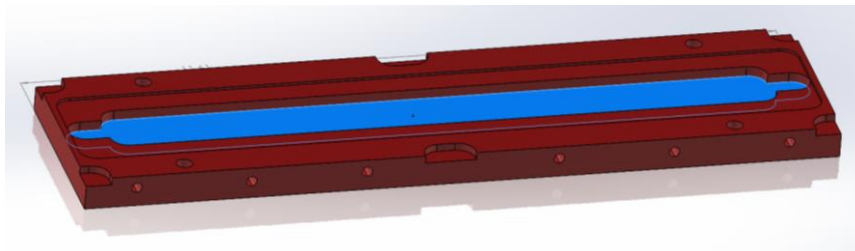


Figure 2 Female Mold with Coupon Bed highlighted

b. Bed Walls

The Bed Walls are the walls around the Coupon Bed. These have a 3° draft to ease the removal of the coupon after curing.

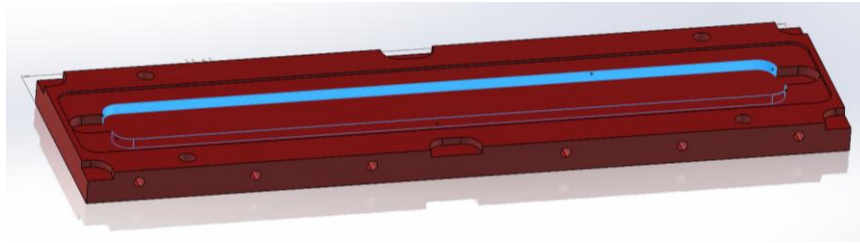


Figure 3 Female Mold with Bed Walls highlighted

c. Ejection Access Cavities

The Ejection Access Cavities are two slots on either far end of the Coupon Bed. The Ejection Access Plugs are inserted into these prior to coupon manufacturing and can be removed to access the bottom edge of the coupon after it has cured.

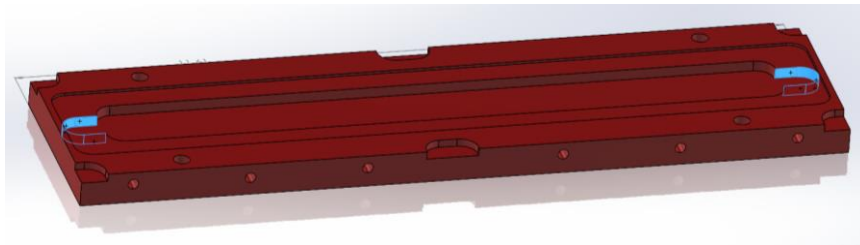


Figure 4 Female Mold with Ejection Access Cavities highlighted

d. Seal Plane

The Seal Plane is a flat plane recessed into the mold, but shallower than the Coupon Bed. This provides an additional surface for the male and female molds to seal together during compression.

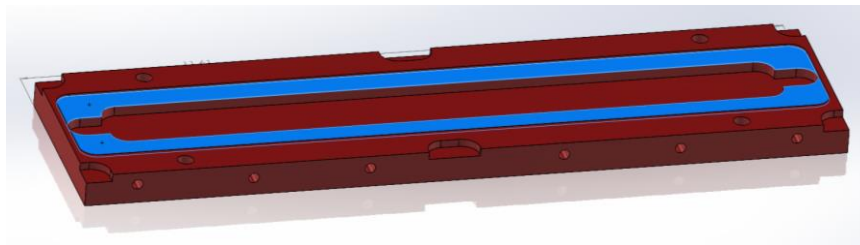


Figure 5 Female Mold with Seal Plane highlighted

e. Alignment Pins

The Alignment Pins are four 1/4" steel dowel pins press fit into holes on the Female Mold. These pins slot into reciprocating holes on the Male Mold to align the two when interlinking.

f. Pry Points

The Pry Points are slots cut into the edges of the Female Mold. These provide spots to pry the Male and Female mold apart if they are stuck together after the coupon cures.

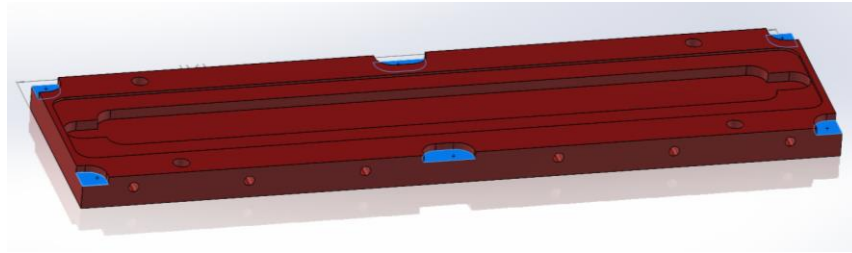


Figure 6 Female Mold with Pry Points highlighted

2. Male Mold

The Male Mold resembles a rectangular prism with a protrusion in its' center.

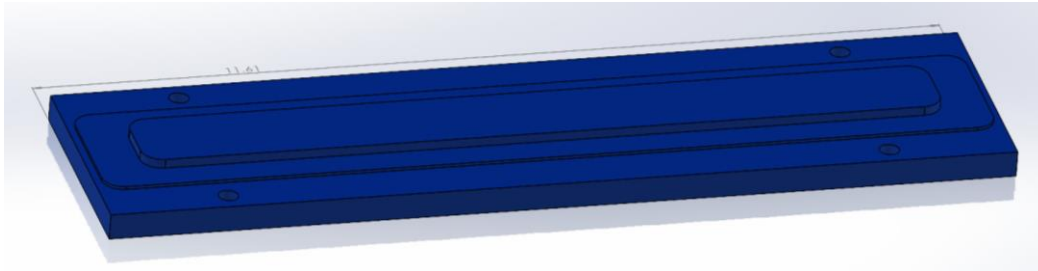


Figure 7 Male Mold CAD

a. Negative Bed

The Negative Bed is a formation protruding out of the Male Mold, reciprocating the Coupon Bed and Seal Plane of the Female Mold. It matches the 3° draft of the Bed Walls.

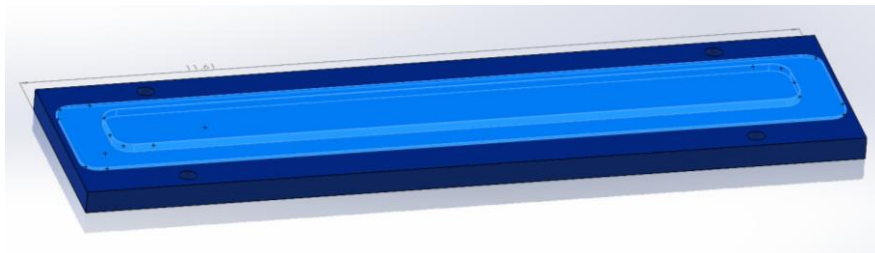


Figure 8 Male Mold with Negative Bed highlighted

b. Alignment Holes

The Alignment Holes are four holes that receive the Alignment Pins on the Female Mold to align the two when interlinking.

3. Ejection Access Plugs

The Ejection Access Plugs are two components that slot into the Ejection Access Cavities on the Female Mold. These plugs are inserted into the Female Mold prior to coupon manufacturing and can be removed to access the bottom edge of the coupon after it has cured. The face of the Ejection Access Plug that is coincident with the Bed Walls has a 3° draft to match the Bed Walls. They also feature a ¼ - 28 threaded hole on the top surface, so a bolt could be installed to aid difficult removals.

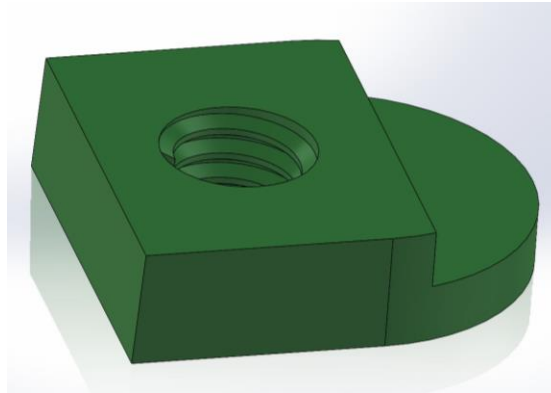


Figure 9 Ejection Access Plug

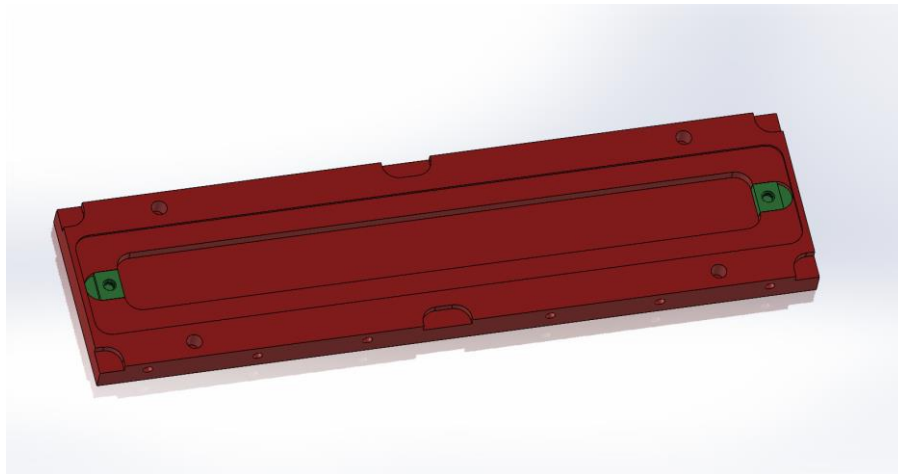


Figure 10 Female Mold with Ejection Access Plugs Installed

Manufacturing:

The mold was manufactured on a Haas UMC-750SS 5-axis CNC Mill, courtesy of the Mississippi State Mechanical Engineering Department.

Use:

1. Preparation

Prior to use, the mold should be thoroughly cleaned and dried, Ejection Access Plugs installed in the Female Mold, and mold release applied.

2. Compression Molding

The material for the composite should then be place inside the Coupon Bed, and a determined method for manufacturing should be followed, interlinking the Male Mold into the Female Mold when required.

3. Coupon Removal

After the coupon has cured, and mold removed from the compression molder, to remove the composite coupon from the mold:

1. First, try to separate the male and female molds by hand. If this works, skip to step 3, if not, continue to step 2.
2. If you cannot separate the molds by hand, pry the molds apart using a flathead screwdriver or similar lever arm, utilizing the Pry Points described in the Features section 1f.
3. After the male and female molds are separated, position the female mold closely over a surface, and slowly turn the female mold upside down.
4. If the coupon does not fall out, place the female mold face down on a surface and hit the back of the mold with your hand or a rubber mallet.
5. If the coupon still does not fall out, remove the Ejection Access Plugs, using needle nose pliers. If additional grip is needed, ¼ - 28 bolts can be installed in the Ejection Access Plugs.
6. With the bottom edge of the coupon now exposed, use a small flathead screwdriver, blade, or similar tool to release the bottom surface of the coupon from mold.
7. Repeat steps 3 & 4 to remove the coupon or lift the coupon from the mold with a finger on each end via the Ejection Access Cavities.