



**LaACES
Student
Ballooning
Course**

Constructing a Standard LaACES Payload Box



Materials for Construction

DG1
BHI9

- This lecture will cover the steps needed to construct a standard LaACES payload box
- Materials used in this lecture are:
 - Polystyrene foam sheet (DG2, BHI2) 100 cm²)
 - Straight edge/right angle tool
 - Sharpie
 - Exacto knife or band saw
 - Sandpaper
 - Masking & carpet tape
 - Polyurethane glue
 - 2 straws
 - 4 plastic grommets
 - Roll of econokote
 - Heat sealing iron

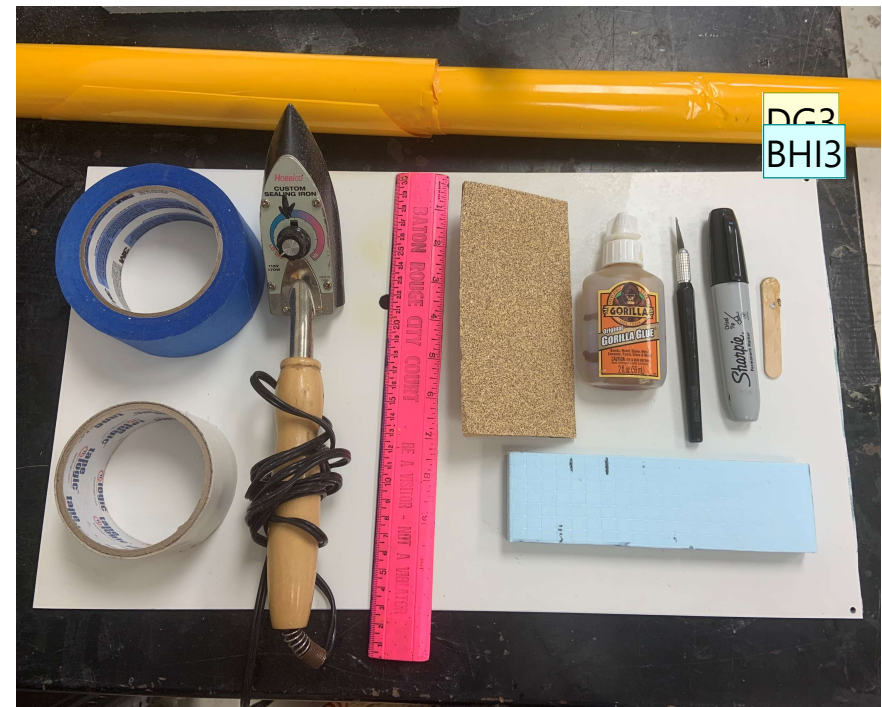


Figure 1: Materials needed for construction

Slide 2

- DG1** Needs a proper title
Doug Granger, 2/3/2020
- DG2** do you need to include the size to make a proper box?
Doug Granger, 2/3/2020
- DG3** No figure caption, but you have them in all the other images. add a caption and correct numbering
Doug Granger, 2/3/2020
- BHI2** will do
Blaine H Irle, 2/3/2020
- BHI3** done
Blaine H Irle, 2/3/2020
- BHI9** how's that?
Blaine H Irle, 2/3/2020



Cutting the Foam

- The enclosure will be a rectangular double-walled box with outer dimensions of (22.6cm x 15.4cm x 11.8 cm)
- 12 pieces will be cut from the polystyrene sheet (1.4 cm thick)
 - 2 Outer side panels (21cm x 8.6cm)
 - 2 Outer end panels (13.8cm x 8.6cm)
 - 2 Inner side panels (17.6cm x 5.4cm)
 - 2 Inner end panels (10.6cm x 5.4cm)
 - 2 Outer top & bottom covers (22.6cm x 15.4cm)
 - 2 Inner top & bottom covers (19.2cm x 12.2cm)
- Use a straight edge to outline the pieces that will be cut
- Cut the 12 pieces from the sheet with a knife or band saw as described in the previous lecture



Figure 2: mark foam with a sharpie



Preparing the Walls

- Once the pieces are cut, take the outer end and side panels and arrange them as displayed in figure 2 below
- Sand the edges of your panels as needed until they sit flush with one another
- Once they are flush apply masking tape at the outside of the joints



Figure 3: Arrange the walls to ensure they're flush

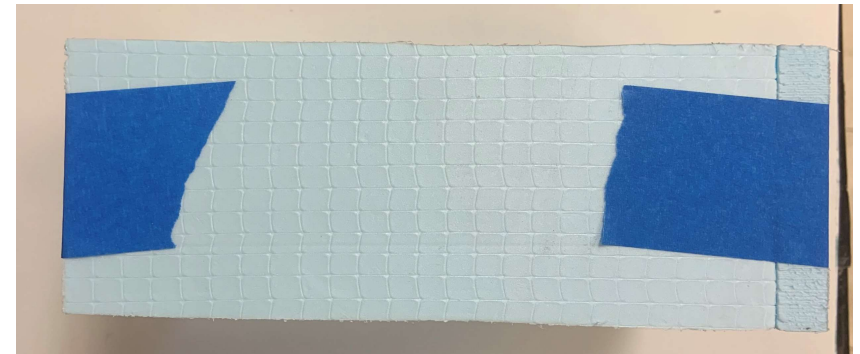


Figure 4: Apply masking tape to the outside of the joints



Preparing the Walls

- Mark the inside of each joint with a sharpie
- Peel back the masking tape from one joint and unfold your walls
- Place masking tape to the left and right of each of the joints

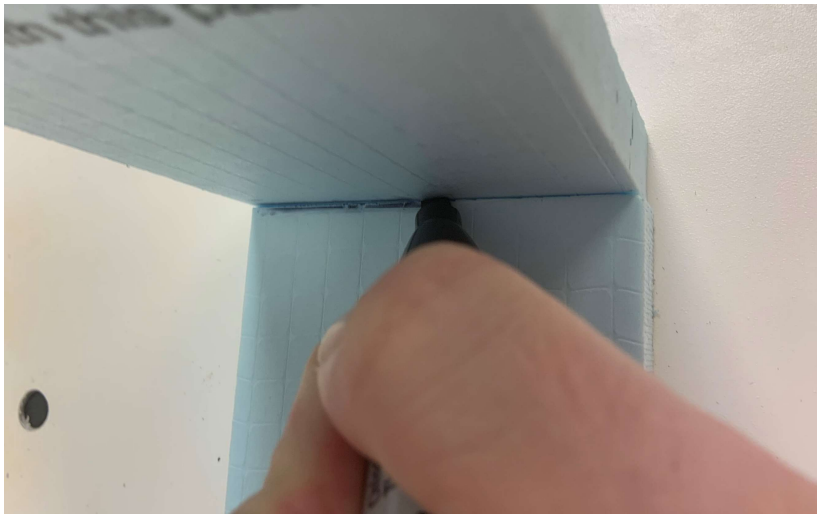


Figure 5: Mark the inside of each joint with a sharpie

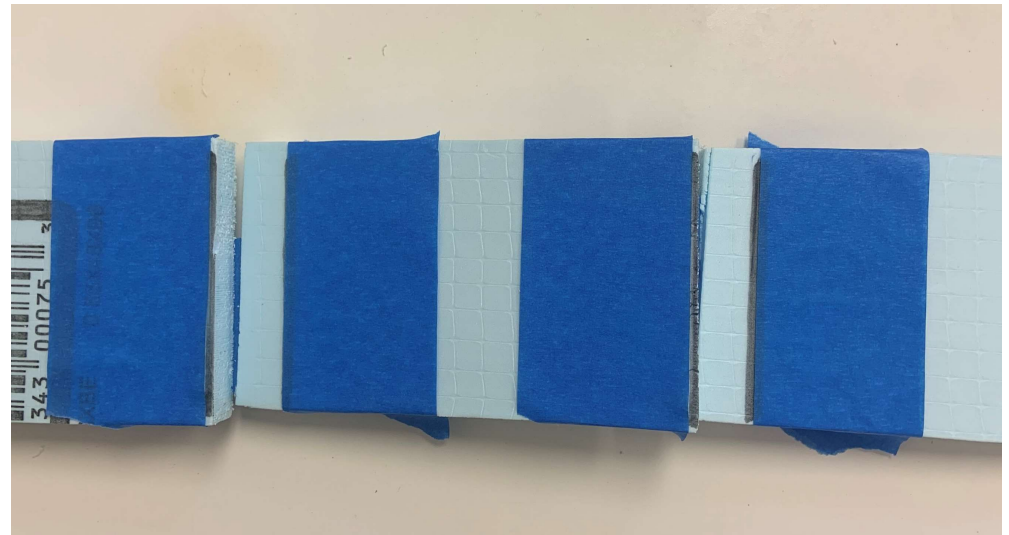


Figure 6: Apply masking tape on the outside of each mark



Gluing the Walls

- Lightly wet the foam on the left side of each joint
- Now apply polyurethane glue to the foam on the right side of each joint.
- Firmly tape the joints back together and wait for the glue to cure ~50 minutes



Figure 7: Apply Polyurethane glue to the right side of the joint

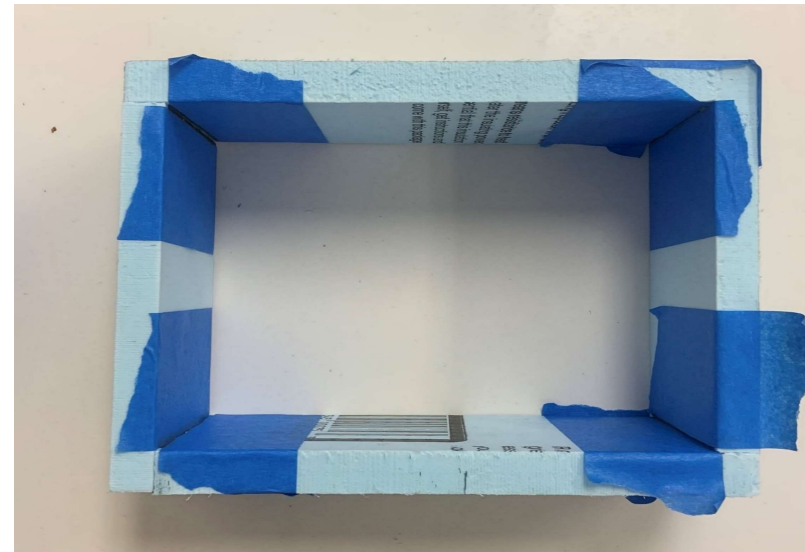


Figure 8: Close the joints and let the glue cure



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Gluing the Walls

- Note: you can use more tape to apply even pressure DG4 BHI1 to the joints.
- If the glue expands out of the joint onto foam wipe away with a tongue depressor
- While the glue cures, repeat slides 4 through 6 with the inner wall pieces.
- When the glue is dry remove all the tape you have applied
- See next slide for tips on the inner wall piece



Figure 9: A finished wall piece

Slide 7

DG4

"even pressure"

Doug Granger, 2/3/2020

DG5

Move down 1 bullet. more complete linear flow

Doug Granger, 2/3/2020

BHI1

fixed

Blaine H Irle, 2/3/2020

BHI10

done

Blaine H Irle, 2/4/2020



Assembling the Exterior Beams

DC8
BHI5

- Take the outer wall piece you have assembled and sand any edges as needed
- Now take the inner and outer bottom pieces
- Lightly moisten the top side of the outer ^{DC6} _{BHI6} piece to activate the glue and apply glue to the bottom side of the inner piece
- Apply glue to the bottom edge of the outer wall piece and set it on the outer bottom piece
- Now set the inner bottom piece on the outer bottom piece
- Apply pressure with weights or clamps as you wait for the glue to cure ~50 min
- Sand as needed so that all pieces sit flush with each other
- See next slide for figures to guide you

Slide 8

DG6 Why are you wetting it? might need to explain that
Doug Granger, 2/3/2020

DG8 Assembling the Exterior Box.
Doug Granger, 2/3/2020

BHI5 done
Blaine H Irle, 2/3/2020

BHI6 I explain polyurethane glue is moisture activated in the "payload construction considerations" lecture. If you feel I should mention it again I can add it.
Blaine H Irle, 2/3/2020



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Assembling the Bottom Cont.



Figure 10: Apply glue to the bottom edge of the outside wall piece



Figure 11: Set the outside wall piece on the outer bottom piece



Assembling the Bottom Cont.



Figure 12: Apply glue to the bottom side of the inner bottom piece



Figure 13: Place the inner bottom piece on the outer bottom piece



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Assembling the Bottom Cont.



Figure 14: Apply pressure as the glue cures with weights



Adding the Inner Walls

- Take the inner wall piece you have made and sand down any edges as needed
- Glue the bottom edge of the inner wall piece and lightly wet the top of the inner bottom piece
- Place the inner wall piece inside the outer wall piece
- Apply pressure with weights as the glue cures



Figure 15: Apply glue to the bottom edge of the inner wall piece

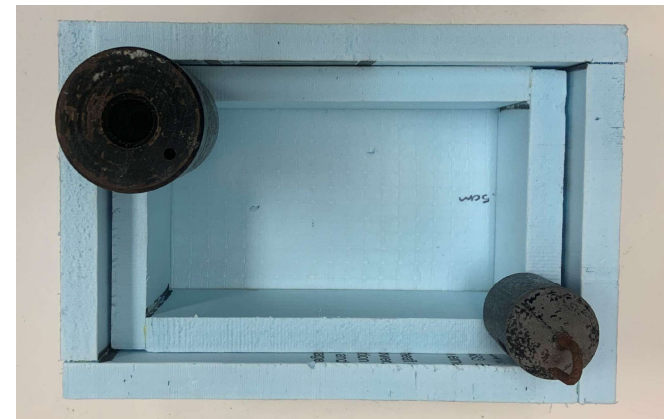


Figure 16: Apply pressure as the glue cures with weights



Adding Holes for Straws

- To interface with the flight string your payload must have 2 holes 17cm apart that extend vertically through the payload
- Reinforcing these holes with straws will prevent the flight string from wearing away the foam
- You will need to make a circular hole (0.64 cm diameter) on both of the inner side panels DG7
- These holes will be 2.8 cm from the wall's edge
- You can make these holes with a drill or drill press and a quarter-inch bit
- See next slide for an illustration

Slide 13

DG7

Need to explain how to make a square cut out in the presentation

Doug Granger, 2/3/2020



Adding Holes for Straws

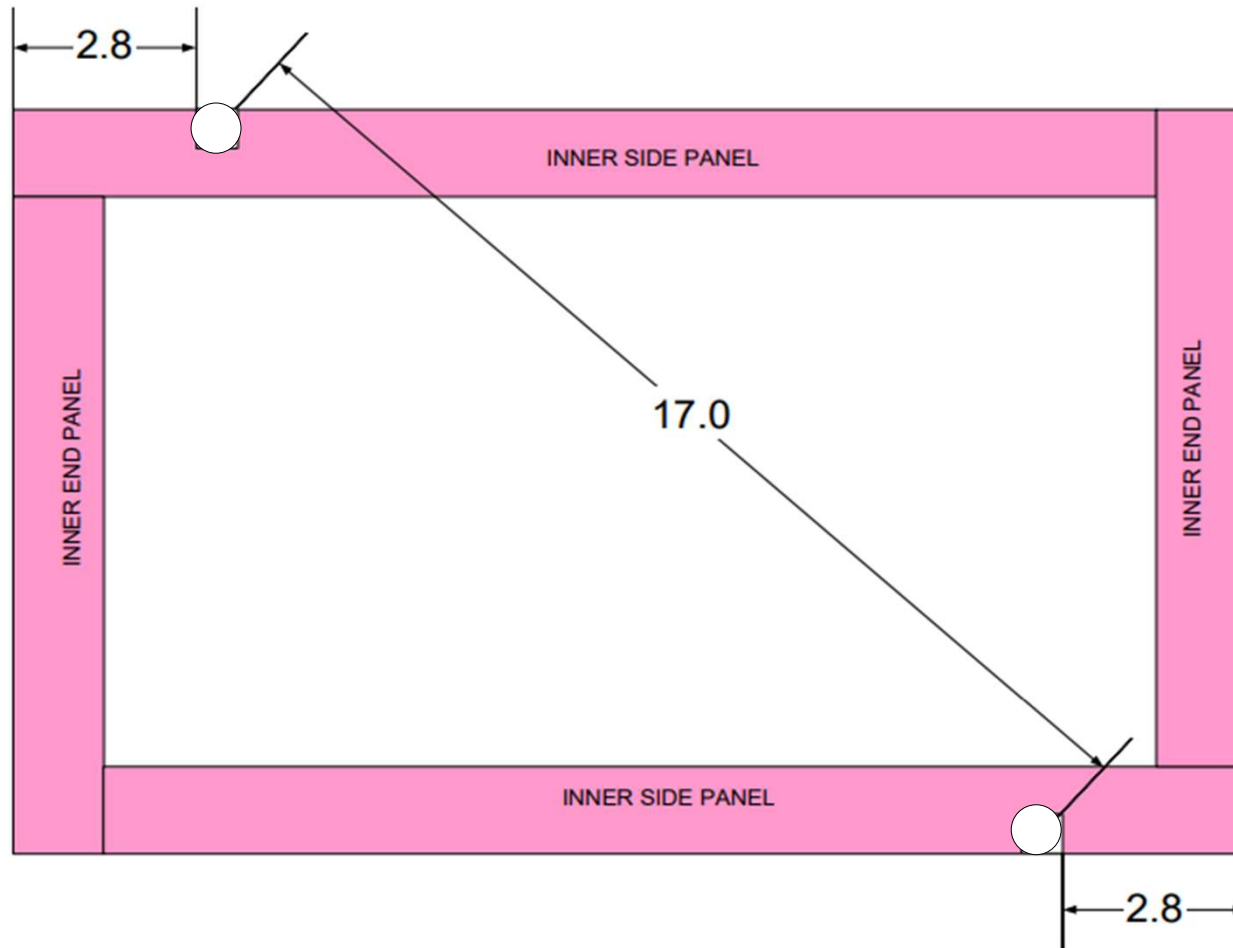


Figure 17: Drawing detailing flight string channels



Adding the Straws

- If you have not yet made the holes for the flight string do so now with a drill or drill press (0.25" bit)
- Once the holes have been made add a bead of polyurethane glue and insert the straws and wait for the glue to cure
- Once the glue has cured cut off the excess straw and sand as needed



Figure 18: Make holes in the inner wall for the straws



Figure 19: Add straws, cut, and sand



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Assembling the Top

- Take the inner top piece and place it on the top edges of the inner wall piece you have just glued down
- Apply carpet tape to the top side of the inner top piece
- Place the outer top piece centered on to the carpet tape

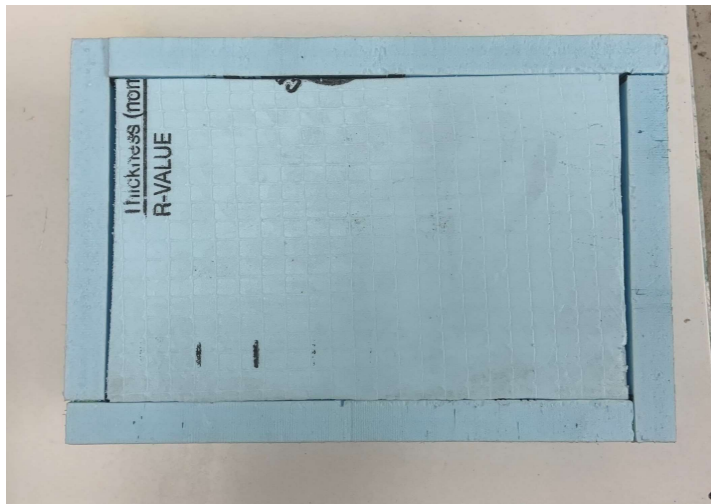


Figure 20: Inner top piece resting on the inner wall piece



Figure 21: A fully assembled top piece



Adding Straws to the Lid

- You will need to make holes for the lid similar to the ones you just made
- Make sure your holes in the lid align with your box holes before making them!
- Drill two holes through the top, 2.8 cm from the inner top piece's edge
- Add the straws, remove excess, and sand as you previously did

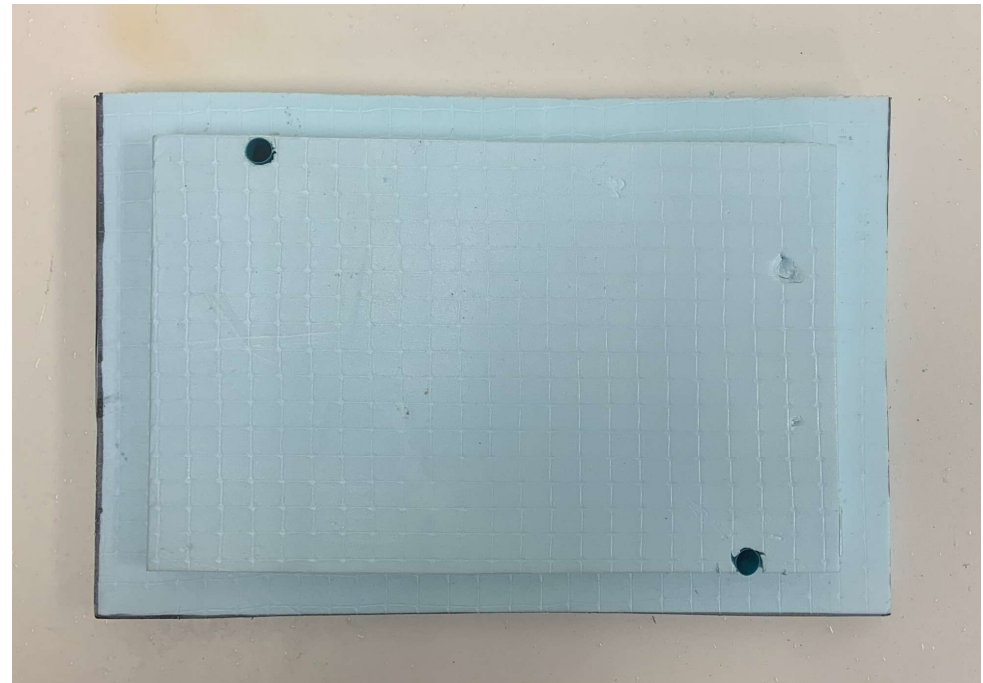


Figure 22: Lid with straws added



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Adding Econokote

- Take your heat sealing iron and set it slightly above medium heat
- Make sure that the outside of the bottom and side walls are fully covered in econokote
- Econokote should cover the top of the outer and inner walls
- Remove protective film before applying
- Apply the econokote by smoothly going over it with the iron
- Make sure to smooth out any air bubbles that form during the process
- Prevent bubbles from forming by starting at the center and working outwards
- Repeat this process for the top
- See next slide for more figures



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Adding Econokote



Figure 23: Start in the center and work your way out

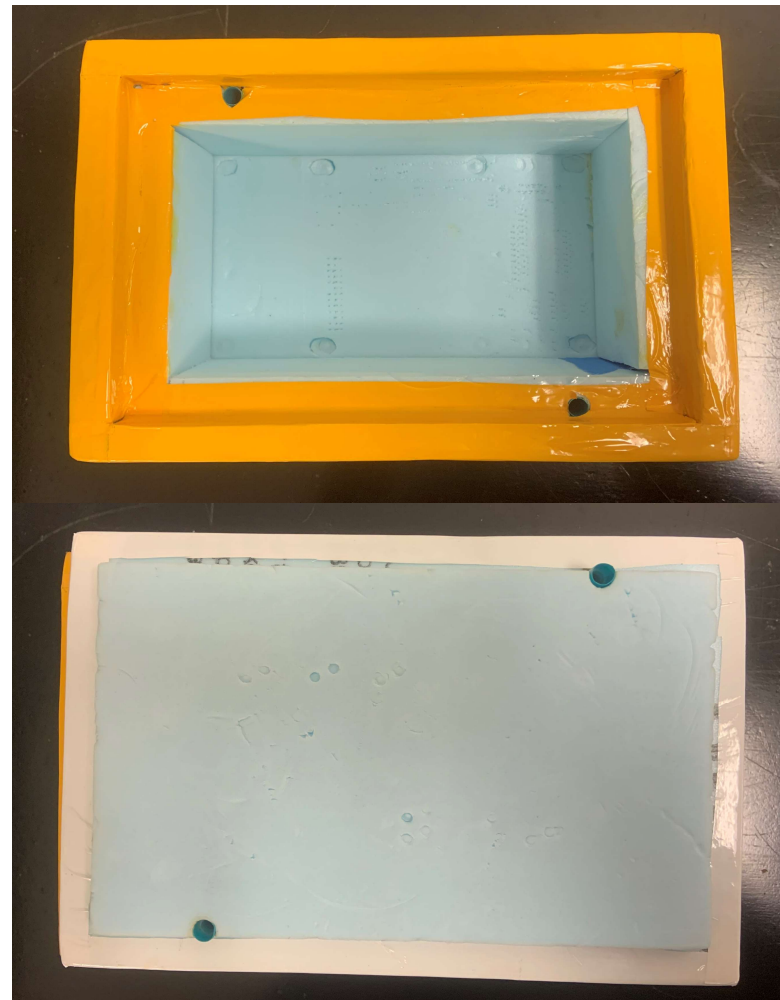


Figure 24: Finished top and bottom piece



Adding Grommets

- Carefully Puncture the Econokote, making a small x, where your four holes for the flight string are with the tip of a knife.
- The Econokote should now flap down when adding a grommet
- Glue plastic grommets into the holes to further secure the flight strings and keep the strings from wearing away at the foam.

DCO
BHI7.10
BHI8



Figure 25: Top with plastic grommets added

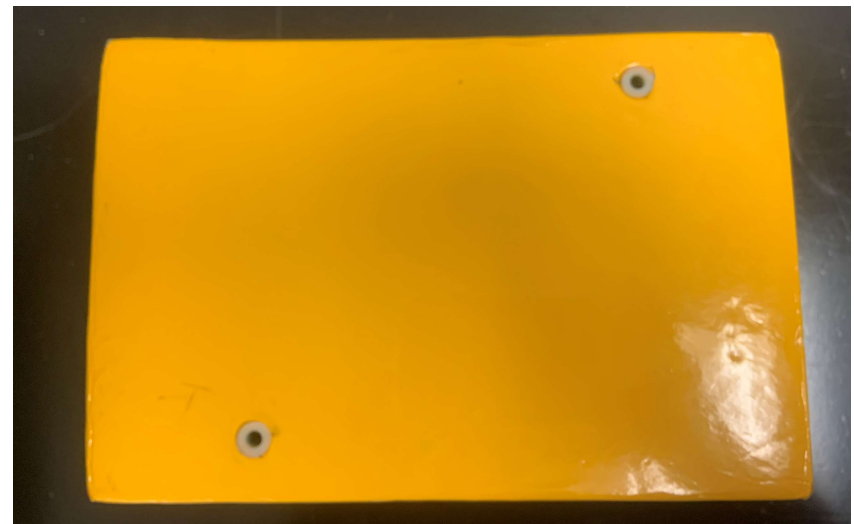


Figure 26: Bottom with plastic grommets added

Slide 20

DG9

Carefully puncture....

Doug Granger, 2/3/2020

DG10

Of "use the tip of the knife to cut a small X in the econokote on top of the drilled hole. This should now flap down when adding the grommet.

Doug Granger, 2/3/2020

BHI7

done

Blaine H Irle, 2/3/2020

BHI8

how is this?

Blaine H Irle, 2/3/2020



Adding Foam Inserts

- You can cut and add foam inserts to the inside of the box to secure different components during flight
- These inserts can be secure with glue or carpet tape
- Some inserts may need to be frequently removed and should not be glued down
- A foam divider between a payload's power supply and electronics is common.



Figure 27: Box with inserts added to hold Megasat