

SFGD Foam Adhesive Testing

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Requirements

- We need a reliable method to attach the soft foam to the carbon fiber on the SFGD box walls.
- The holes in the foam must line up with the holes in the carbon fiber.
- These two requirements drive the adhesive selection:
 - The adhesive must be reliable. Once attached, we do not want the foam to shift around, especially any shearing motion at the foam-carbon fiber interface while the box walls are being installed.
 - The adhesive must allow enough time for the foam to be positioned properly before drying.

Adhesives

- Four adhesives have been tested so far, and several conclusions have been made.
 - 2 spray adhesives, 1 “permanent” and 1 “repositionable”
 - 2 brushable adhesives, 1 “permanent” and 1 “repositionable”



Loctite General Purpose Spray Adhesive



Aleene's Original Tacky Adhesive

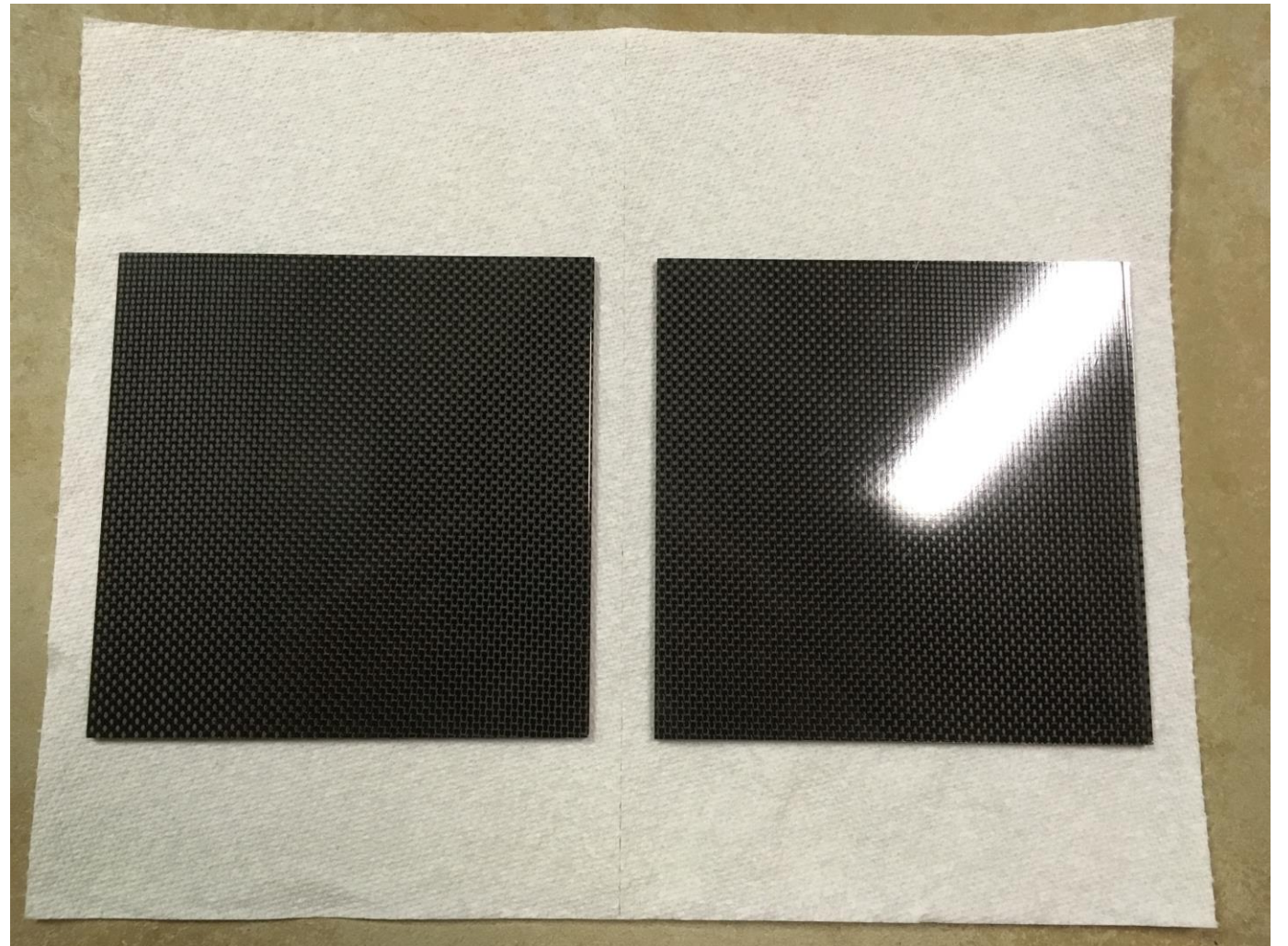


Aleene's Repositionable Tacky Adhesive



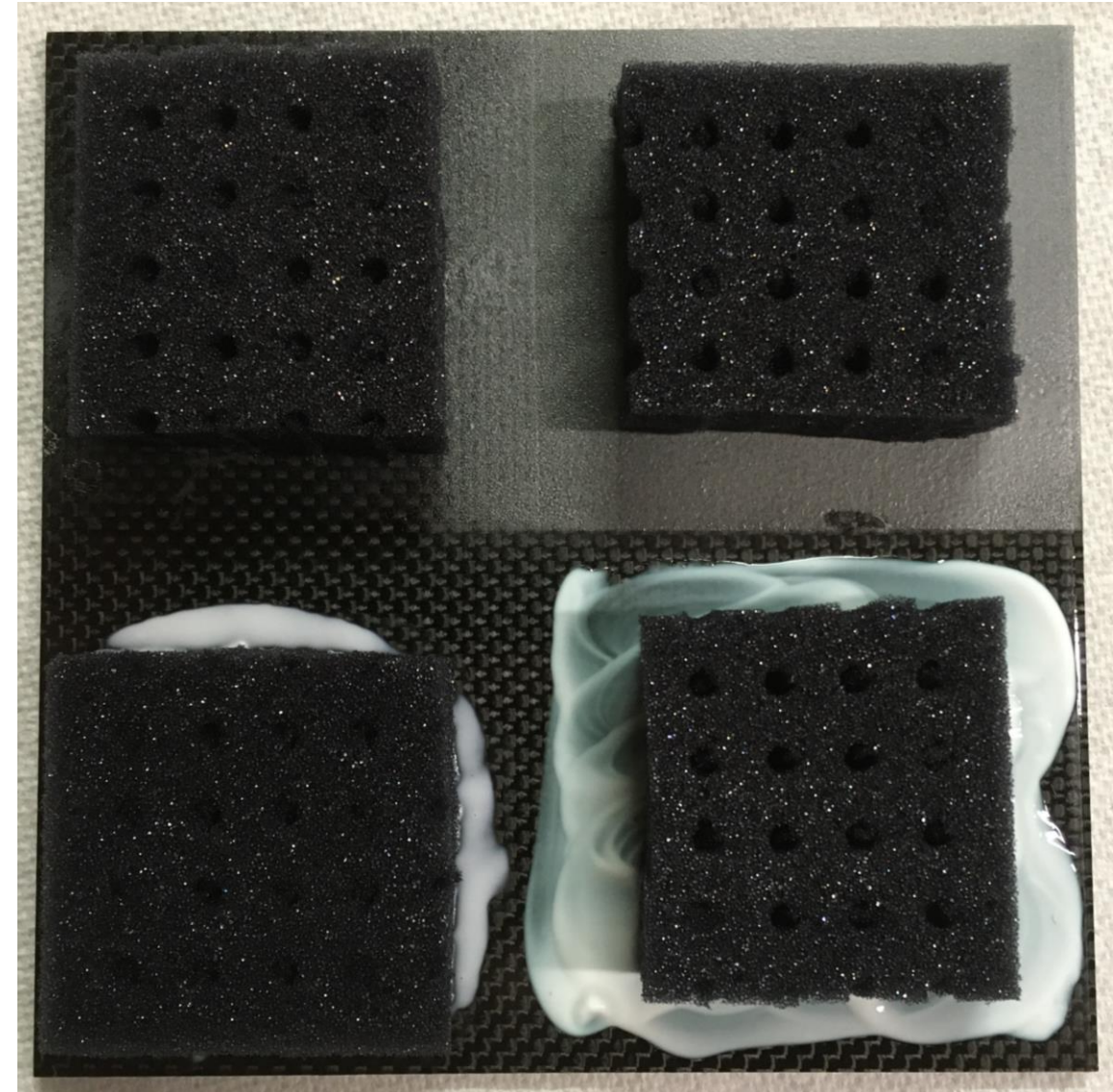
Carbon Fiber Plate

- Each adhesive was used to attach a 2" x 2" square of foam to a 6" by 6" square of carbon fiber with a gloss finish.
- Each carbon fiber sample was prepared for testing with a wash in Dawn dish soap followed by thorough drying.



Glue Application

- The sprayable adhesives were applied to the carbon fiber per the directions on the can. The brushable adhesives were applied two ways. On the first sample they were applied by smearing with a glove. This resulted in a thicker, less even coat. On the second sample they were applied by brushing with a spare piece of foam. This resulted in a thinner, more even coat.



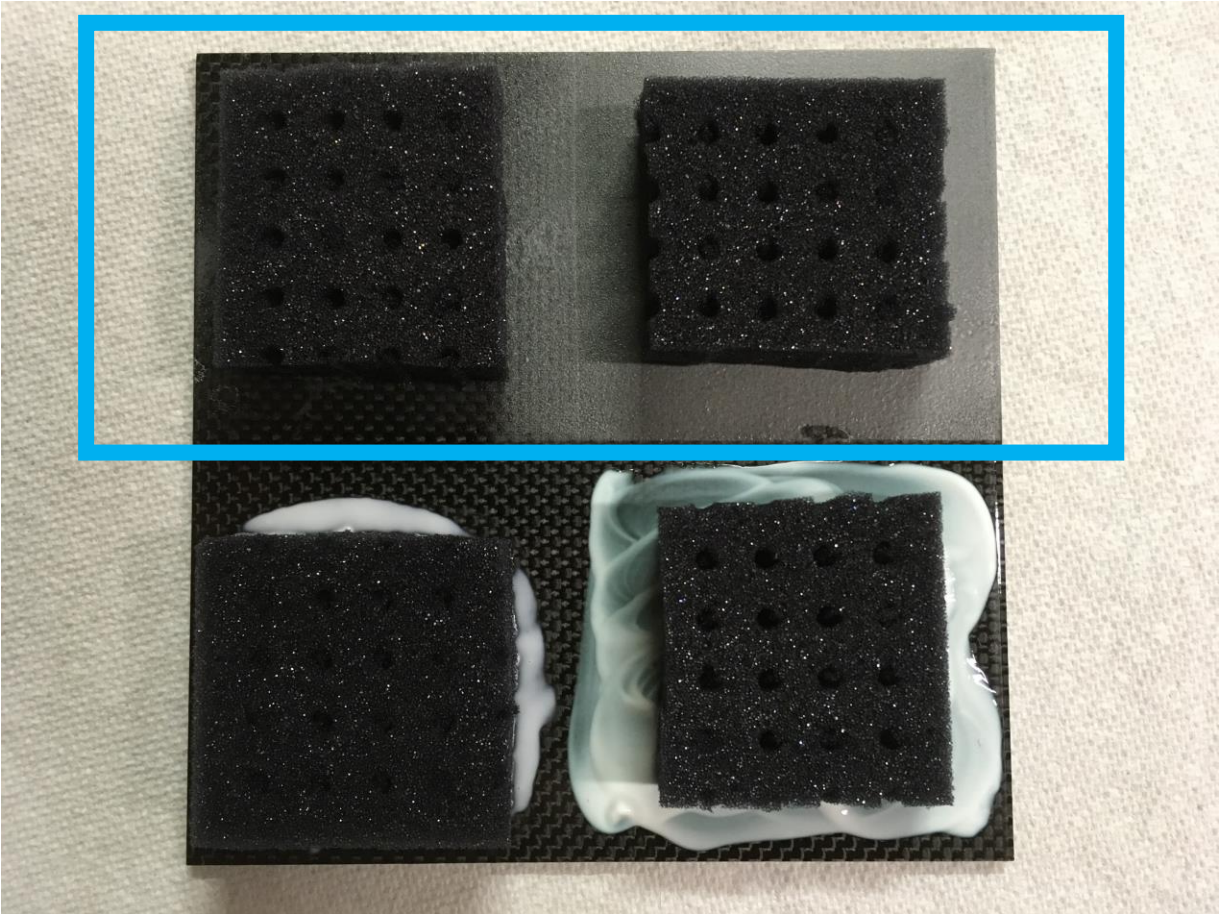
Initial Impressions



Initial Impressions

- The sprayable adhesives are quick and easy to apply. The coat on the carbon fiber is controllable and very even. It is unlikely that adhesive accumulation in the carbon fiber holes will be a concern with these.
- The brushable adhesives are best applied with the foam brush to control the coat evenness. The thickness of the coat with this method isn't very controllable. It comes out very thin. Smearing the adhesives on can result in a thicker, but less even, coat. One concern with the brushable adhesives is that any brushing or smearing action will migrate adhesive into the holes in the carbon fiber plate.

Test Results: Spray Adhesives



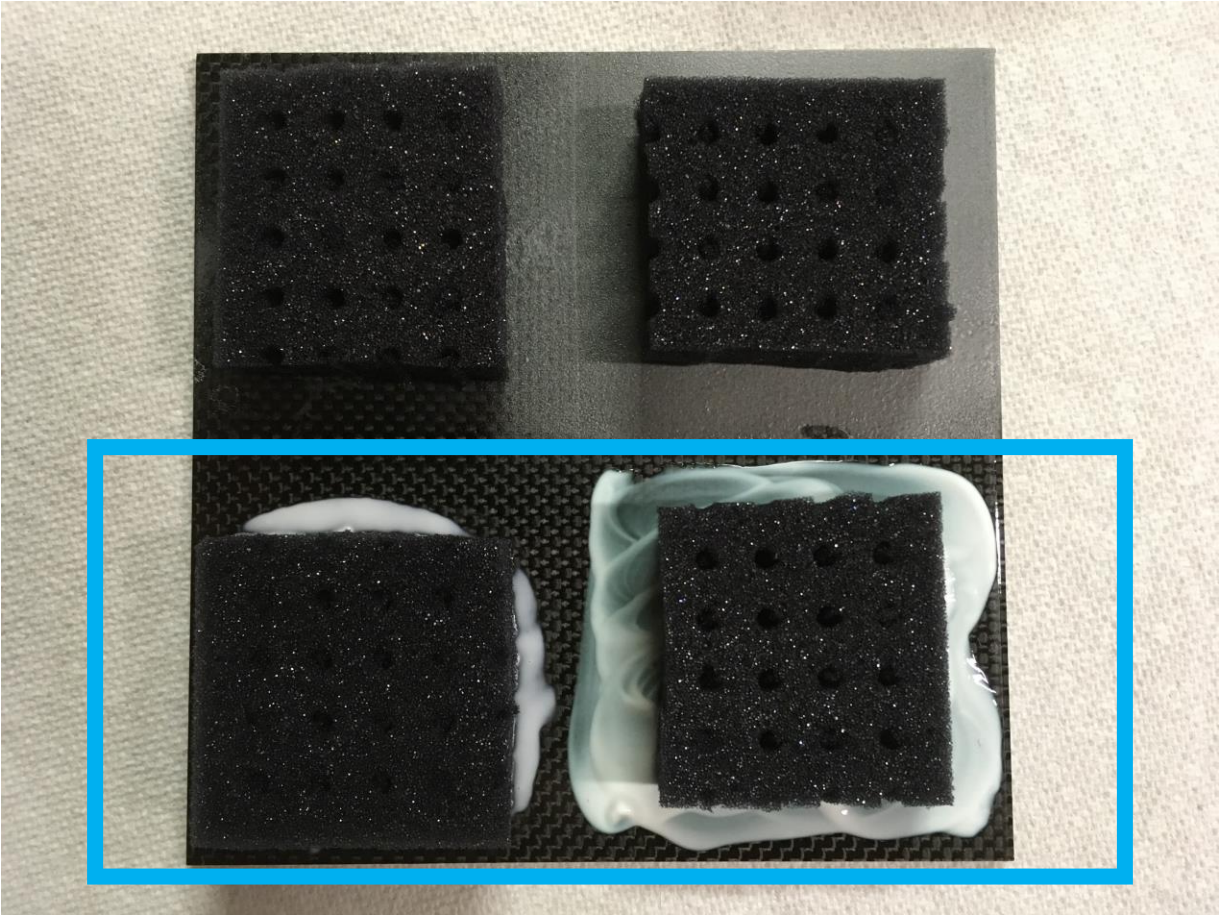
Test Results: Spray Adhesives

- Of the sprayable adhesives, both are immediately very tacky.
- After 5 minutes, the Loctite adhesive is already drying, and isn't likely repositionable. The Scotch adhesive is still tacky, and probably is somewhat repositionable. However, repositioning through shearing/sliding motion seems much less advisable than repositioning by unsticking/re-sticking the foam.
- After 15 minutes, the Loctite adhesive is mostly dry. The Scotch adhesive is still tacky, although the repositionability seems much lower by this point in time.

Test Results: Spray Adhesives

- After 30 minutes, the Loctite adhesive is almost completely dry. The Scotch adhesive hasn't changed substantially from the 15 minute mark.
- After 1 hour, 30 minutes, the Loctite adhesive is dry. The Scotch adhesive hasn't changed from the 30 minute mark.
- After 1 week, the Scotch adhesive still hasn't changed. It remains tacky, although the foam piece doesn't seem repositionable in this state. Rather, it feels like it could be removed but not re-adhered.

Test Results: Brushable Adhesives (Spread On)



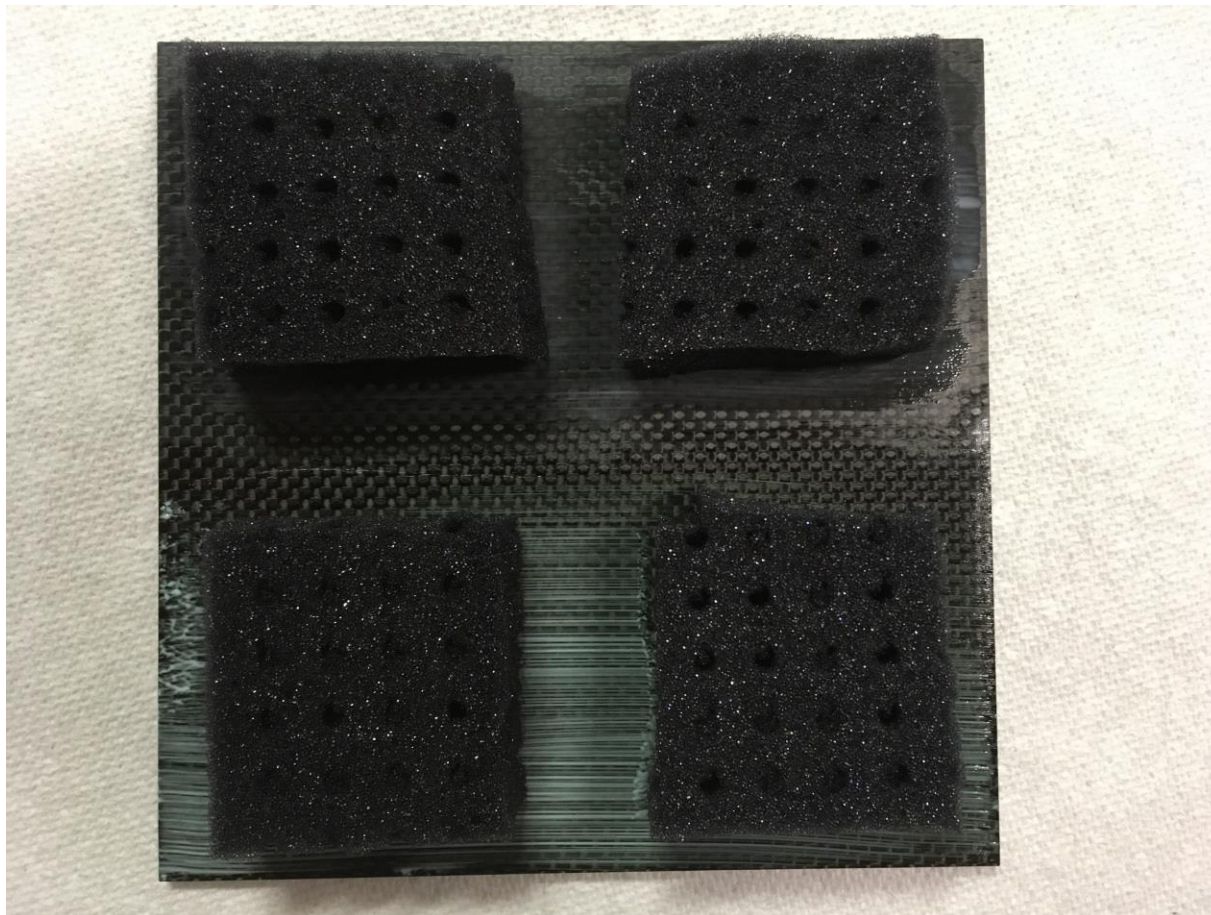
Test Results: Brushable Adhesives (Spread On)

- Immediately, the original tacky formula is higher viscosity than the repositionable version.
- After 5 minutes, both the original and repositionable formulas are repositionable.
- After 15 minutes, the original formula is beginning to take a set and feels only slightly repositionable. The repositionable version is still very liquid.
- After 30 minutes, the original formula is partially dried and no longer repositionable. The repositionable adhesive is still liquid.

Test Results: Brushable Adhesives (Spread On)

- After 1 hour, 30 minutes the original formula is mostly dry. The repositionable version is still mostly liquid, with the thinner spots becoming much tackier.
- After 1 week, the repositionable adhesive is very tacky. No repositionability remains, however.

Test Results: Brushable Adhesives (Brush On)

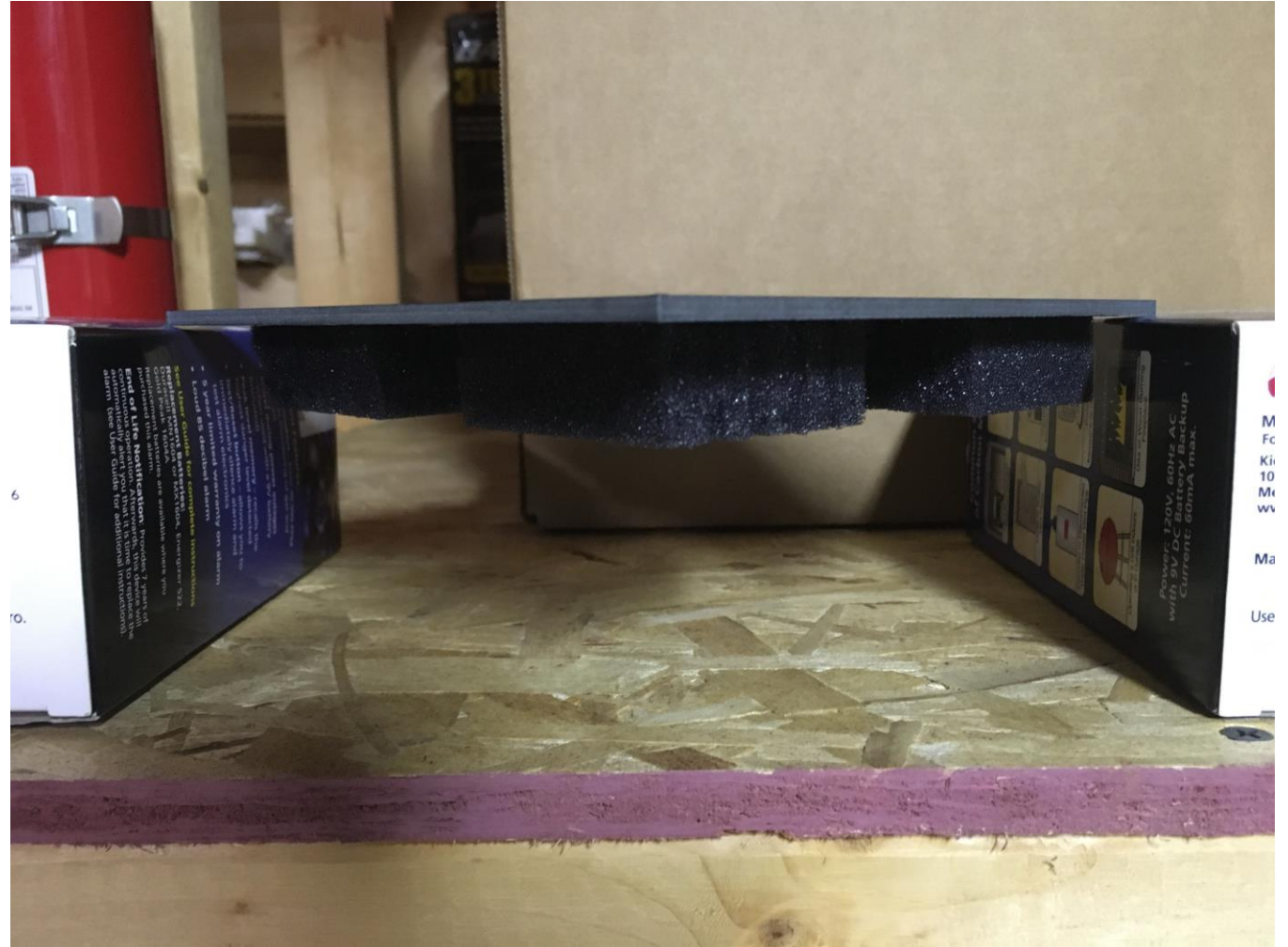


Test Results: Brushable Adhesives (Brush On)

- After 5 minutes, the original formula is mostly dry, with no repositionability possible. The repositionable formula is mostly wet and not very sticky. The foam could easily fall off at this point.
- After 10 minutes, the original formula is totally dry. The repositionable version is very tacky, and while the foam could be removed easily it doesn't feel like it's re-attachable.
- After 1 week, the repositionable formula is still very tacky. This is likely the “dry” state of this adhesive.

Test Results: Upside-Down Adhesion

- After 1 day of drying, the samples were inverted for 1 day. Despite noticeable differences in adhesive power between samples, no foam samples fell off.



Conclusions

- The Loctite adhesive is easy to apply evenly, dries quickly, and has very good adhesion to the foam.
- The Scotch adhesive is easy to apply evenly, but it never really dries in the conventional sense. It remains tacky even after 1 week. The adhesion to the foam is only moderate, but repositionability feels suspect.
- The original tacky adhesive is difficult to apply evenly when spread, so this method is not recommended. When brushed, it dries quickly, but only has moderate adhesion to the foam.
- The repositionable tacky adhesive is difficult to apply evenly when spread, so this method is not recommended. When brushed, it never really dries, rather remaining very tacky. The adhesion to the foam is decent, but there is no repositionability possible.

Conclusions

- Adhesives that remain tacky after “drying” raise concerns about long-term effects on the foam (will they chemically react?). Also, these adhesives may “creep” over time, blocking the holes in the carbon fiber.
- Of the adhesives that dry, the brushable one dries just as quickly as the Loctite spray adhesive. However, the Loctite is easier to apply and has much greater adhesion to the foam
- Based on these test results, a spray adhesive is recommended.
- This test examined consumer products available in the USA. We should also examine industrial adhesives for this application, as they are likely higher performance and globally available.

Next Steps

- We should investigate spray adhesives that:
 - Dry completely with good adhesion
 - Are easily available anywhere
 - Are from an “adhesives” manufacturer
- 3M offers a wide variety of spray adhesives and has worldwide manufacturing and distribution.
 - https://www.3m.com/3M/en_US/bonding-and-assembly-us/spray-adhesives/
- In particular, the “Multi-Purpose 27” and “Super 77” spray adhesives look promising for this application.
- Tests will be performed with each of these adhesives using the same methods outlined here.

Next Steps

- 3M “27” Spray Adhesive
- https://www.3m.com/3M/en_US/p/d/b40069391/

Overview
Details
Resources
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Large Volume Order



Hover to zoom

- Provides professional, industrial strength for demanding applications at an economical price
- Includes a versatile adhesive that bonds a wide range of lightweight materials
- Offers a fast, aggressive tack for a quick bond that reduces set time
- Bonds paper, cardboard, fabric, insulation, plastic, metal, wood and more

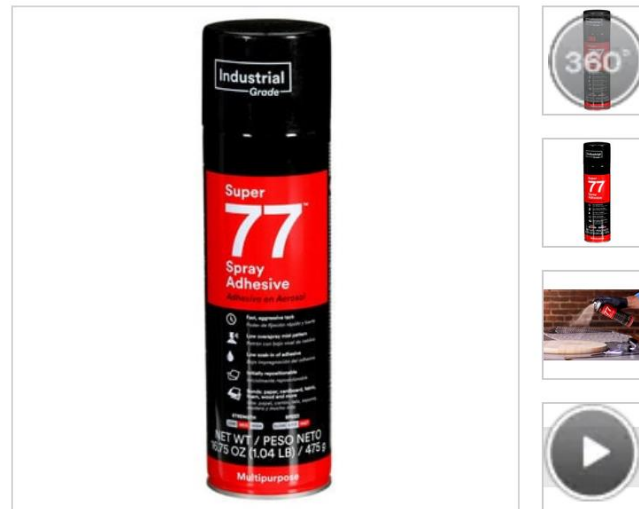
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Next Steps

- 3M “Super 77” Spray Adhesive
- https://www.3m.com/3M/en_US/p/d/b40071862/

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- Versatile adhesive that bonds a wide range of lightweight materials
- Provides professional, industrial strength for demanding applications
- Offers a fast, aggressive tack for a quick bond that reduces set time
- Bonds paper, cardboard, fabric, insulation, plastic, metal, wood and more

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Ideas

- Circling back to the requirements on the first slide, we want a reliable adhesive (we will investigate the 3M options to see if they meet the criteria) and we also need to be able to align the foam and carbon fiber holes.
- Glue repositionability is one way to achieve this. Another way is to ensure that the foam is already aligned perfectly when it is first set against the carbon fiber.
- This second option is worth exploring, as it allows the choice of a quick drying, high performance adhesive independent of repositionability (which is suspect when weighed against ultimate adhesion) or drying times.

Ideas

- A simple 3D printed “exoskeleton” can be designed which sits on the “non-glued” side of the foam and engages many or all of the foam holes to ensure that they do not shift relative to each other.
- This effectively turns the soft, flexible foam into a rigid part, allowing alignment of just a few holes to automatically ensure alignment of every hole.
- A basic design and prototype of this concept is in process. A simple 3D printed foam “exoskeleton” along with the correct spray glue choice will ensure quick, easy, and reliable joining of the flexible foam to the carbon fiber.