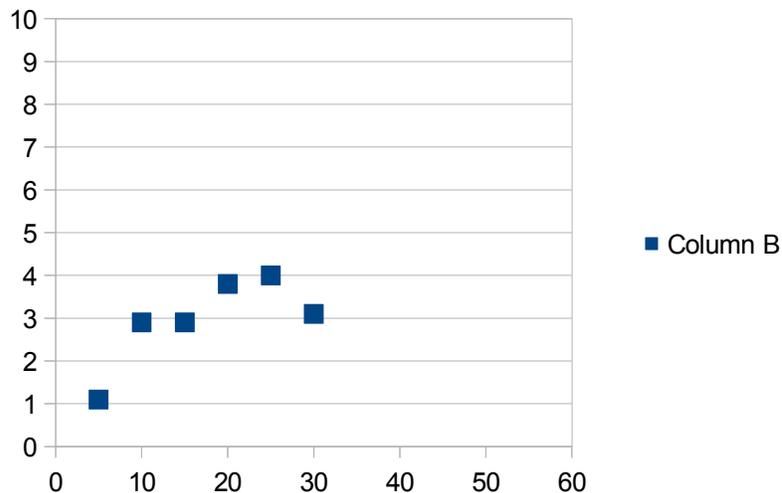


Fisher Space Systems, LLC
Progress Report #15
Inflated Beam
04/15/2013 – 04/19/2013

Monday, 04/15/2013

I cut a new Mylar sheet 8' long and 18" wide (2" overlap). I taped the sheet forming a tube 5.1" in diameter. I fed the Mylar sheet through the bulkhead hole in the flange and enclosed it with the Kevlar sleeve. I pressurized and performed some preliminary measurements at 5, 10, 15, 20, 25, & 30 psig. The effective modulus of the Kevlar/Mylar was 1.4, 3.8, 3.8, 5.0, 5.2, & 4.0 x 10⁹ N/m² respectively. The effective modulus is represent as a percentage of the Kevlar modulus (131 x 10⁹ N/m²) in the chart below.



The air pump was just barely keeping up with the air leaks in the Kevlar/Mylar beam.

Tuesday, 04/16/2013

I cut two new flanges 5.28" in diameter out of 3/4" plywood. I cut a 3/4" bulkhead hole and six 1/4" holes for the carriage bolts. I sanded (16 grit), cleaned (denatured alcohol), and epoxied (Devcon 5 min epoxy from Lowes). I went to cut another 8' Mylar sheet but only had 4' left. I tried to modify the 5.1" diameter Mylar beam to 5.28" but failed. It did not hold pressure. I ordered some more Mylar.

Wednesday, 04/17/2013

Success!!! While I waited on the new Mylar, I took the 4' piece remaining and made a 5.28" diameter beam. I epoxied the carriage bolts into the flange and covered them with 2 mil drop cloth. I used 3M double sided tape to drape the drop cloth over the top part of the flange and taped it to the top of the 3/4" plywood flange. The Mylar tube just barely fit around the flange. I had to tug and pull it into place. I was afraid that I might have stretched the Mylar to far.

I left about 1/2" of the Mylar sticking up over the top of the 3/4" plywood flange. Using Hobby Lobby 30 minute cure epoxy, I epoxied the inside of the outer rim of the flange between the Mylar and the flange. I put the top piece on, folded the Mylar toward the center, and bolted the top piece into place. I did the same on the opposite side. I let it dry for 1 1/2 hours.

I pressurized the Mylar beam to ~ 4 psig and found no leaks. I covered the Mylar beams with the Kevlar sleeve, draped the ends over the carriage bolts, and secured with flat washers and hex nuts. I pressurized the Kevlar/Mylar beam to >60 psig, absolutely no leaks. Once the pump gauge settled down after pressurizing the Kevlar/Mylar beam, it didn't move.

However, the shape of the Kevlar/Mylar beam is a little irregular. I suspect I need smaller diameter flanges and Mylar beams. But the beam was strong and stiff.

Thursday, 04/18/2013

I did some research on weaves. Apparently, what I'm looking for is the plain weave on a circular loom.

Friday, 04/19/2013

I did some more research on the internet. The FH250 circular loom from China is used to make fire hoses. It is capable of plain and twill weaves. The diameters range from 2 - 25 cm.

I tried higher pressures on the Kevlar/Mylar beam. The Mylar blew at ~ 70 psig. It blew around the flange where I had to stretch it over the flange.

Summary

I tried feeding the Mylar sheet through the bulkhead hole in the flange and then enclosing it with the Kevlar sleeve. When I pressurized the beam, it didn't hold the pressure. I got some preliminary measurements but, I'm not confident in the results.

I decided to try larger flanges and a different sealing technique for the Mylar beam. I cut two new flanges 5.28" in diameter out of 3/4" plywood and sealed the Mylar with epoxy. It worked very well. I managed to get up to over 60 psig. However, the beam shape was slightly irregular which would make measurements a little difficult. When the new Mylar comes in next week, I will try 5.1" diameter flanges and Mylar.

The Kevlar beam has a braided weave which causes the Kevlar sleeve to shrink when pressurized. It also results in an irregular shape and diameter. There are circular looms which produce a plain weave or twill weave. The looms are mainly used to weave fire hoses.

Lessons Learned

- Feeding Mylar through the bulkhead holes does not work.
- Epoxy the carriage bolts and the rim around the flange does work.