pfRICH – End Ring and Mirror Substrate Update

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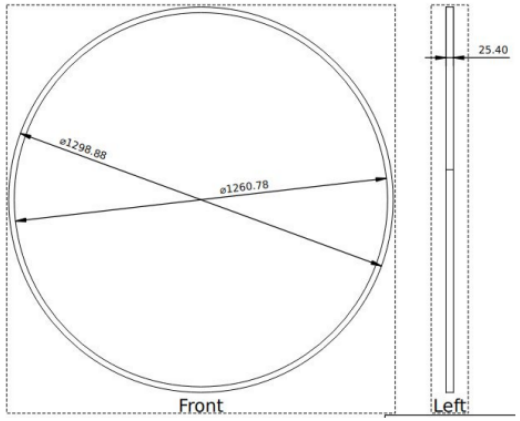
Mirror Substrate

- Waiting on coating results for the flat plate sample sent to Bill
- Discussion at ANL Collaboration meeting with Bill – put on a coating on CFRP base
- Details to be discussed by Bill

End Ring Updates

Base Numbering Design



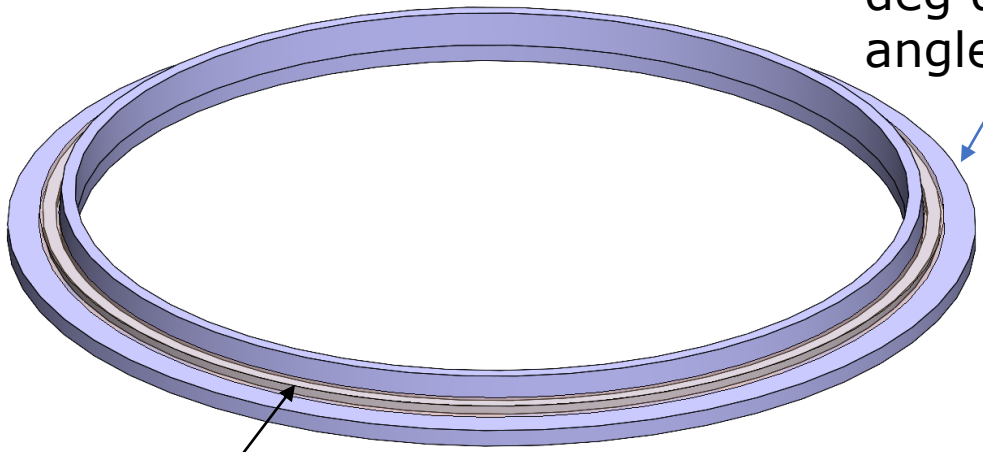
Base parameter:

- Endring Inner diameter: 126.078 cm, 49.637
- Endring thickness: 2.54 cm, 1″
- End-End vessel length: 43.095 cm, 16.967″

Material thickness:

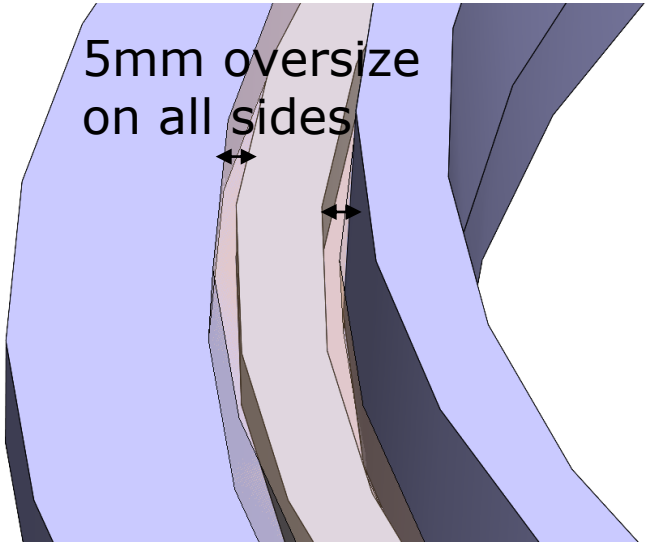
- Carbon Fiber Thickness: 0.5mm
- Honeycomb thickness: 1.905 cm, 0.75″

Dimensions from Alex / Bill's presentation on 8th Jan.



Tool with 3 deg draft angle

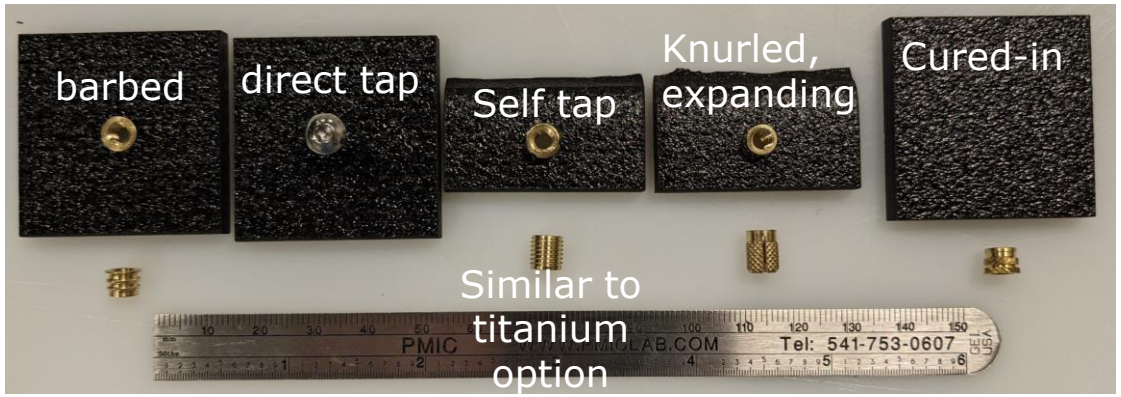
Stock oversized for final CNC machining of end Ring



5mm oversize on all sides

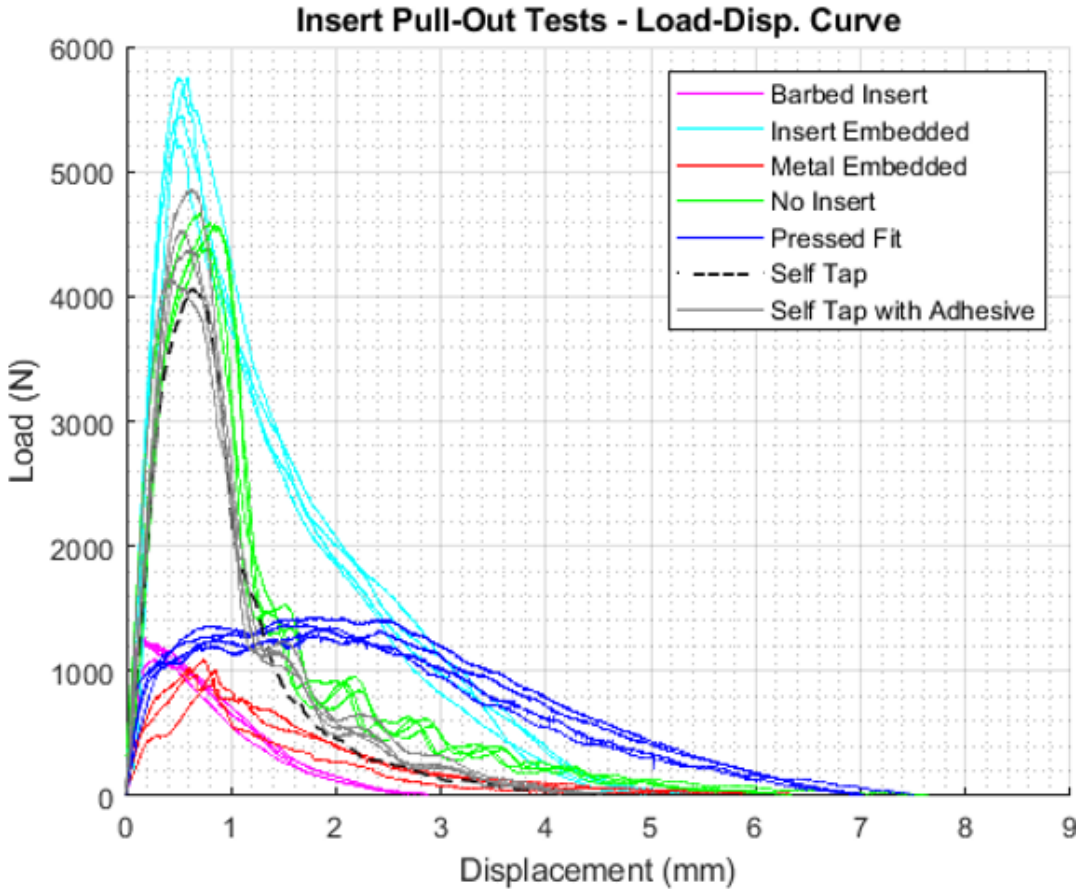
Insert options

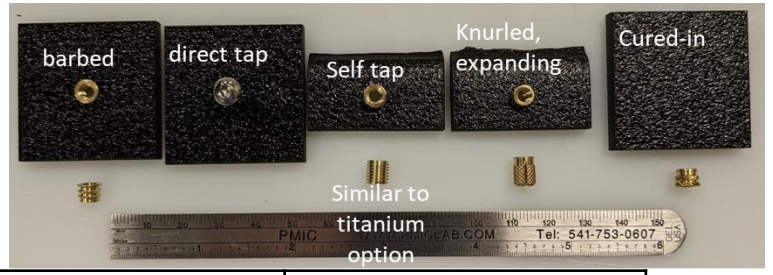
- Presentation from Garam Kim and Swapneel Kulkarni



- 5mm thick carbon fiber reinforced laminate
  - 20 ply of AS4/NB321
- Test specimen size: 1.5” x 1.5”
- Test specimen manufacturing process.
  - Ply layup – cure – cut individual test specimen – drilling – insert installation
- Test specimen group
  - No insert (just drill and tap direct on the laminate) – Try first!
  - Self-tapping insert (drilling and putting insert)
  - Barbed insert (drilling and bonding in the laminate)
  - Press fit insert (drilling and bonding in the laminate)
  - Chevron insert (installing the insert during layup)

Combined Load vs. Disp. Response*

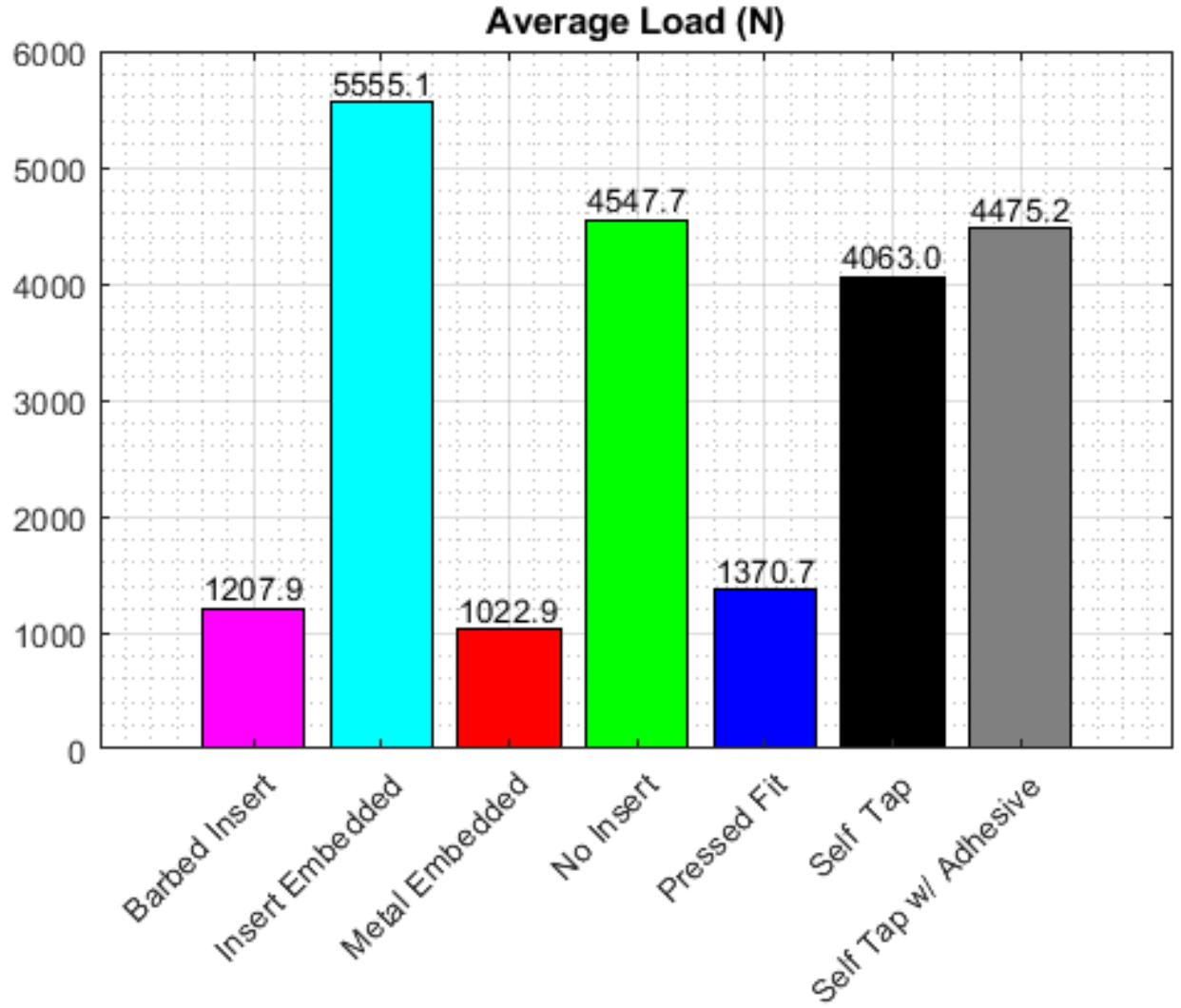


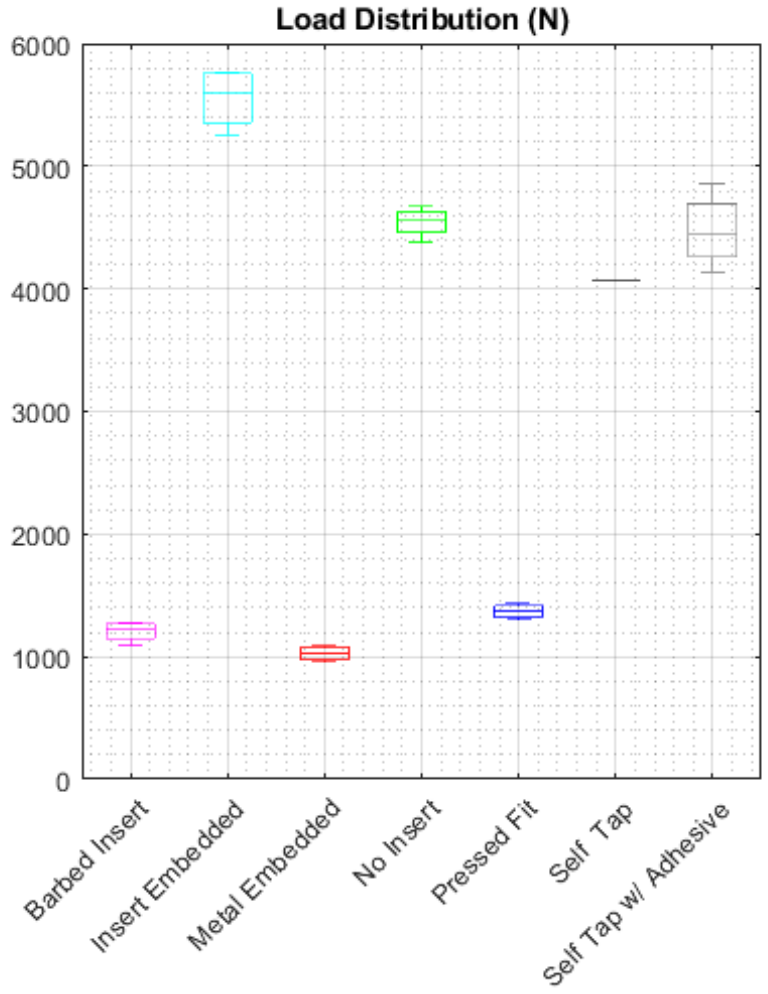


Insert Type	Average Max Load (N)	Average Displacement at Max Load (mm)
Barbed Insert	1207.9	0.174
Insert Embedded (Cured in)	5555.1	0.525
Metal Embedded (metal plate, tapped)	1022.9	0.713
No Insert	4547.7	0.771
Pressed Fit	1370.7	1.773
Self Tap**	4063.0	0.644
Self Tap w/ Adhesive	4475.2	0.551

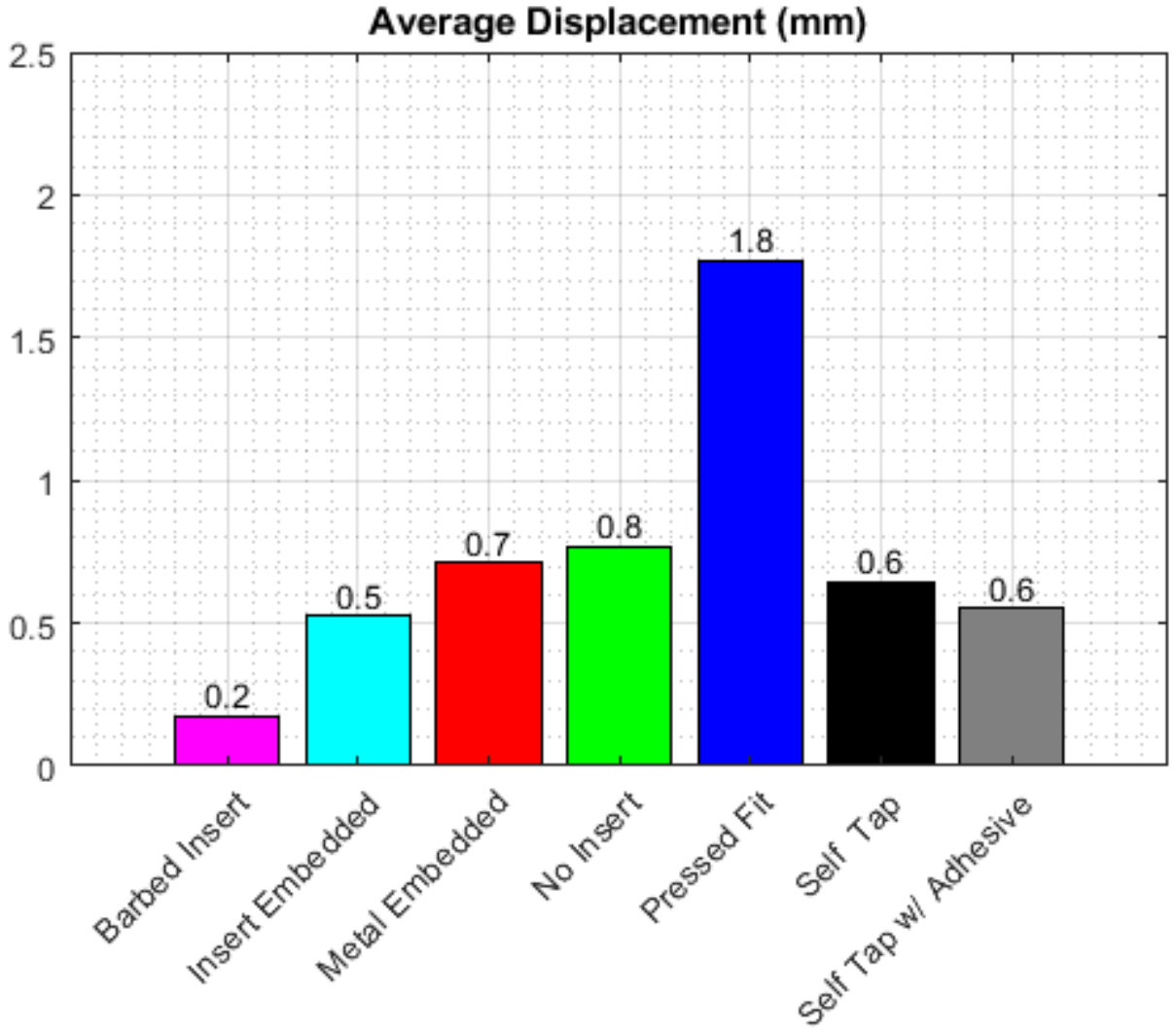
**Results of samples tested on 22kip only

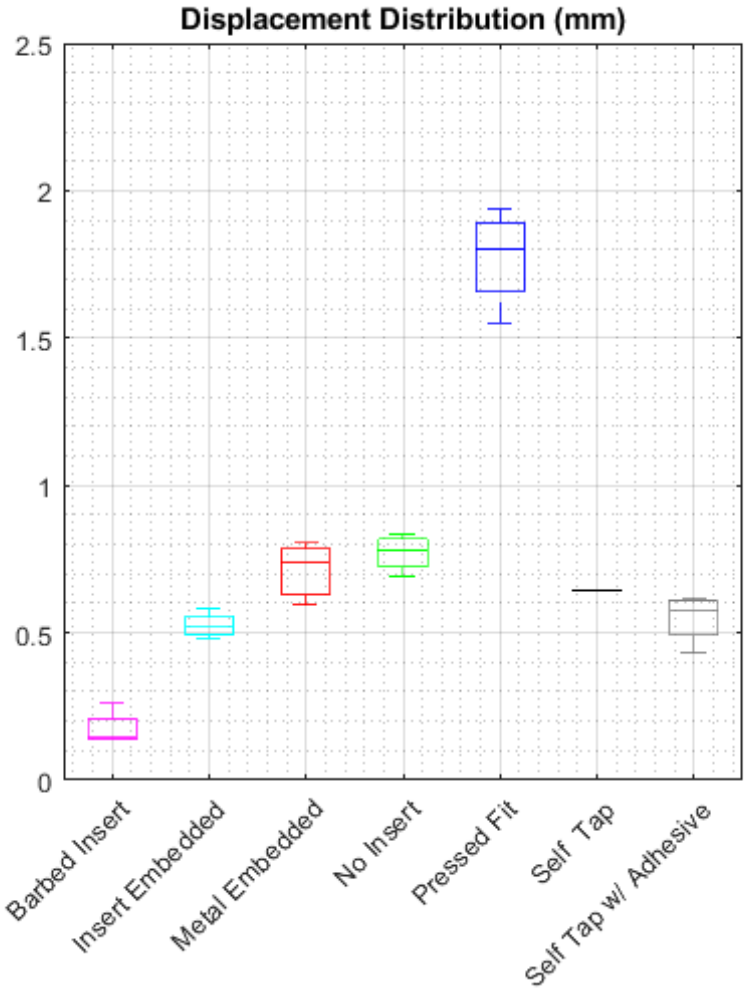
Max Load Comparison





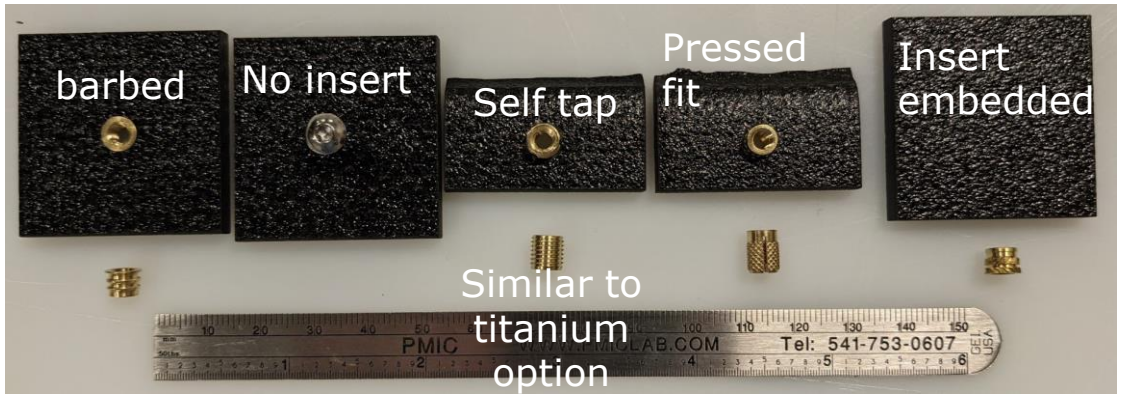
Displacement at Max Load Comparison

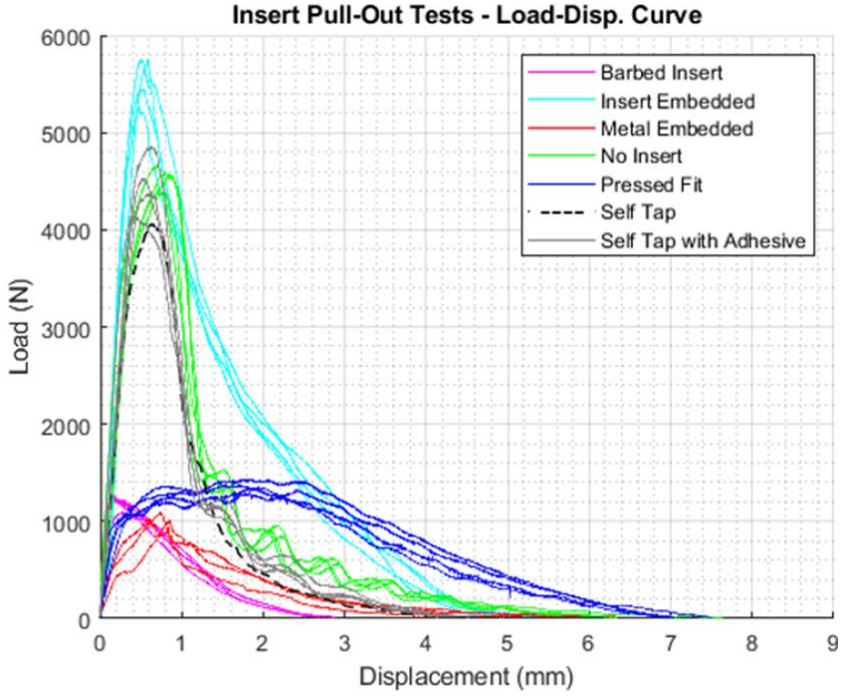




Conclusions

- M4 inserts for End ring
  - 4 metallic designs being tested in brass
  - Titanium options available is desired
  - Cured-in (called “insert embedded” later) is too difficult to place accurately
  - Direct tap into CFRP fails quickly with fatigue load cycles – threads weak
  - **<u>Self Tap with adhesive is the best option</u>**





On-going at Purdue Univ.

- Simulation for gasket compression for end ring and sensor plate attachment
- Selection of tooling material for the end ring; options are -
  - Carbon Fiber filled Themoplastic Printed mold
  - Tooling block
  - Aluminum mold
- Decision based on cost – will be made within next 2 weeks
- Going on in parallel –
  - Tool shape compensation simulation for the end ring layup
  - Studies for making End Ring in a single part OR 4 parts bonded together
  - Decision based on how much will the part warp upon curing and cooling since this is a 1-inch-thick part. (Stock is 35 mm layup)