

Background and Objective

Jacobs is performing cryogenic tensile tests of T1000 and T800 carbon fiber (CF) tows. They want to complete cryogenic submersion tests on CF tows. Unfortunately, complete submersion tests cannot be done with the current setup because the epoxy holding the CF to the grips fails with the extreme cold, causing the strands to slip out of their grips. In order for the CF tows to be tested in this manner, Jacobs asked NMT for a solution.

The team's objective for this project is to find and test an epoxy that can withstand the cryogenic tensile tests that Jacobs is performing on carbon fiber tows.



Figure 1 : Current test setup at Jacobs Technology

Previous Work

- Solution decided upon
- Epoxies selected and ordered
- Test setup and testing procedure created
- Coupons designed and machined according to ASTM standards

Design Requirements

- Capable of gripping T800 composite fiber tows
- Can withstand tensile loading of 630 lbf
- Suitable for use in cryogenic media
- Compatible with Jacobs' current load frame

Test Setup

A single joint shear lap test will be performed to find a suitable epoxy for Jacobs tensile tests.

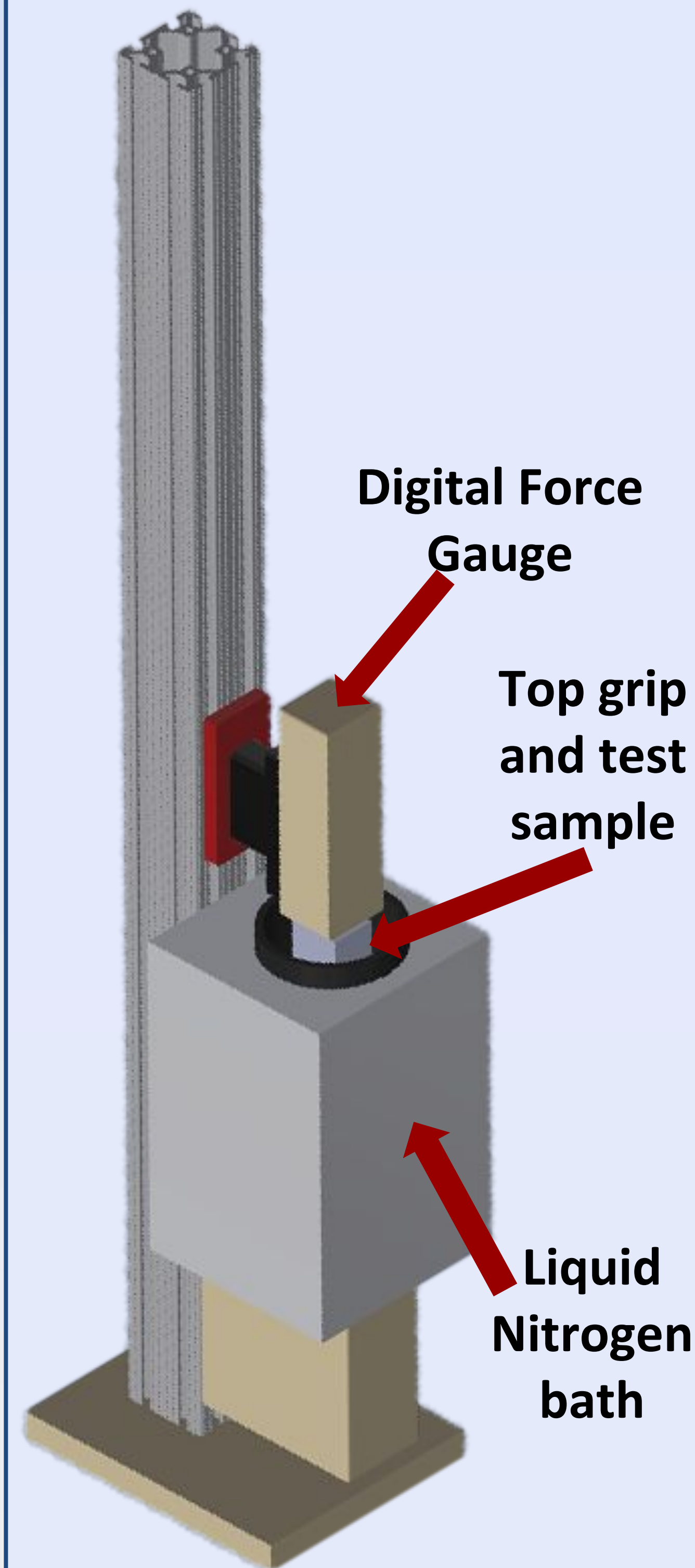


Figure 2: Setup of Mark-10 TFSM500 test stand

Testing nearly started.

The goals completed were:

- 1) Containment system constructed
- 2) All materials gathered
- 3) Preliminary testing of test stand and liquid nitrogen completed

Goal Details

- 1) A plastic pipe was used as a container and styrofoam was used as an insulator to hold liquid nitrogen
- 2) Personal protection equipment and liquid nitrogen logistics were solved
- 3) Test stand connection issues were recognized and addressed

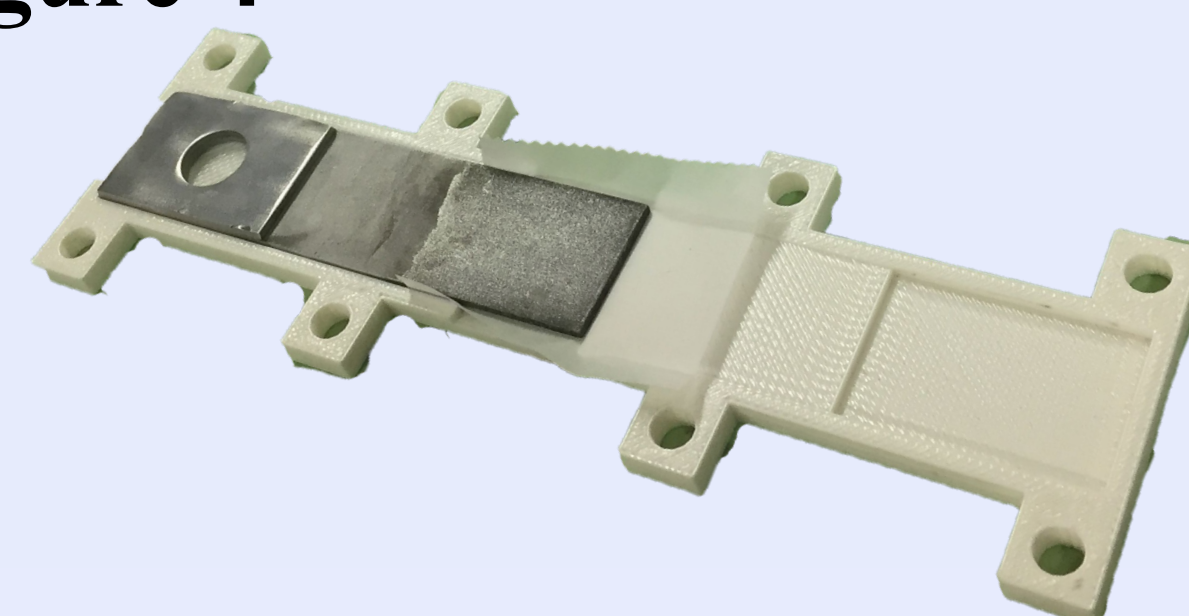
Sample Fabrication

Figure 3



Aluminum coupons were cleaned and etched before applying epoxy

Figure 4



A mold was 3D printed from ABS to hold samples in place while being heated to speed up epoxy cure time

Future Work

- Additional test stand issues will need to be addressed
 - Power cable is needed for the top stationary force sensor
 - Troubleshoot program for force sensor data
- Fabricate more test samples
- Perform testing of all current epoxies
- Test additional epoxies and coupon designs
- Perform data analysis concerning samples' maximum tensile load bearing capabilities and statistical analysis to determine accuracy of results
- Make recommendation to Jacobs based on findings

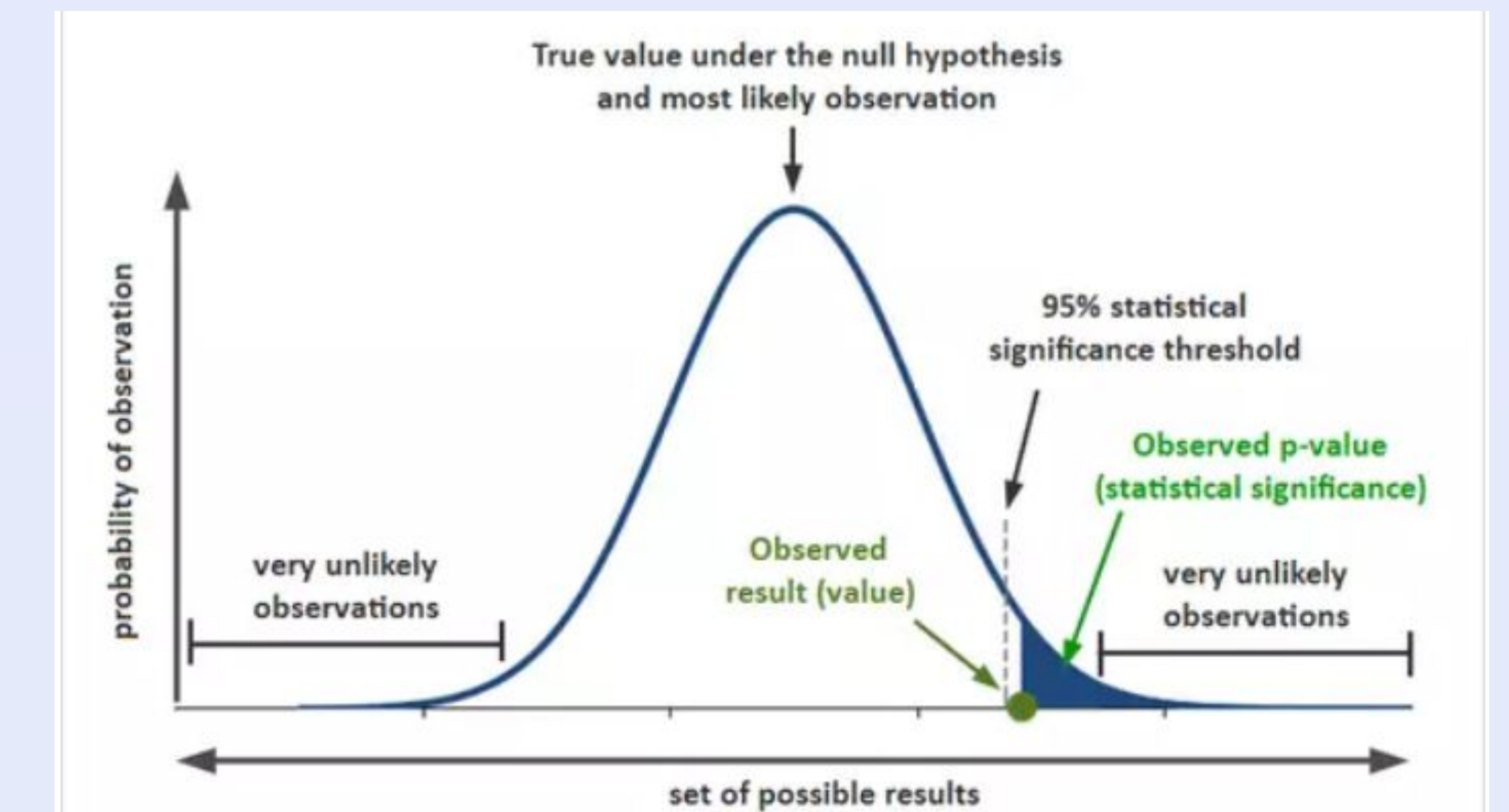


Figure 5: Example P-test to determine testing accuracy

Spring 2020 Design Team



From Left to Right: Angel Chavira (Lead), Curtis Earnest, Ryan Morelli, Andrew Aliser, Mariah Gammill (Lead)

A huge thank you is extended to Nels Iverson for use of his equipment and help with liquid nitrogen handling.