# Cryogenic Composite Testing

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## Background and Objective

Composite Wrapped Pressure Vessels (COPVs) are usd to store liquids that undergo large forces. Jacobs has been testing the loads that COPVs can endure by performing tensile tests on individual fibers in cryogenic environments. The epoxy used to hold the composite fiber tows would become brittle and cause testing to fail prematurely.

The team's objective is to determine an epoxy that can withstand cryogenic conditions and allow for successful tensile tests.

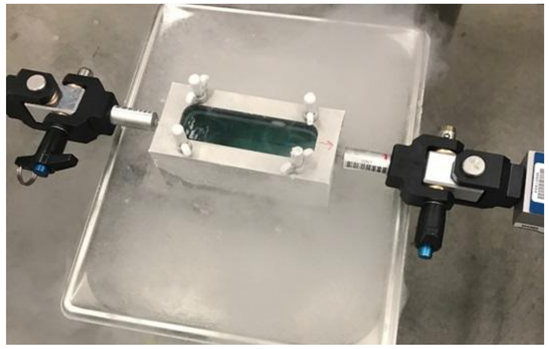

***Figure 1:*** *Jacobs Cryogenic Bath*

## Requirements

- Withstand cryogenic temperatures
- Withstand tensile loading of 900 lbf
- Consumer grade

## Previous Work

- Epoxies selected and ordered
- Test setup and testing procedure created
- Coupons designed and machined according to ASME standards

## Cryogenic Bath

***Figure 2:*** *The original Cryogenic Bath with the exposed crack*

Upon testing cured coupons, subfreezing temperatures rendered vessel unusable by propagating a crevice of approximately three inches from the base cap upward. This allowed liquid nitrogen to leak making it impossible to test coupons.

## Test Coupons


***Figure 3:*** *Fully assembled test coupon*

Three different epoxies will be tested:

- 3MTM Scotch-WeldTM Epoxy Adhesive
- Armstrong A-12 Epoxy
- ResinLab EP11HTFS Gray Epoxy

The two pieces of the test coupon are epoxied together in the middle using one of the three test epoxies.

Each test coupon has a doubler on each side to keep the applied load straight. Each doubler is attached using the Armstrong Epoxy

## Future Work

This project will be continued into the beginning of the Spring 2021 semester. The cryogenic bath needs to be redesigned and fabricated before the team can proceed with testing the epoxy samples. Once a satisfactory bath is developed, the team will finish testing the samples and perform data analysis to determine the optimal epoxy for Jacobs to

## Test Setup

***Figure 4:*** Mark-10 TSFM500 test stand

- A single joint shear lab test will be performed
- The sample will be submerged in liquid nitrogen throughout testing to simulate cryogenic conditions
- Each epoxy will be tested at least two times to ensure accurate data
- The desired epoxy will be the one that does not fail under cryogenic temperatures at the specified load of 1000 lbf

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