



Whale Safe Mooring Lines

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University of
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Introduction

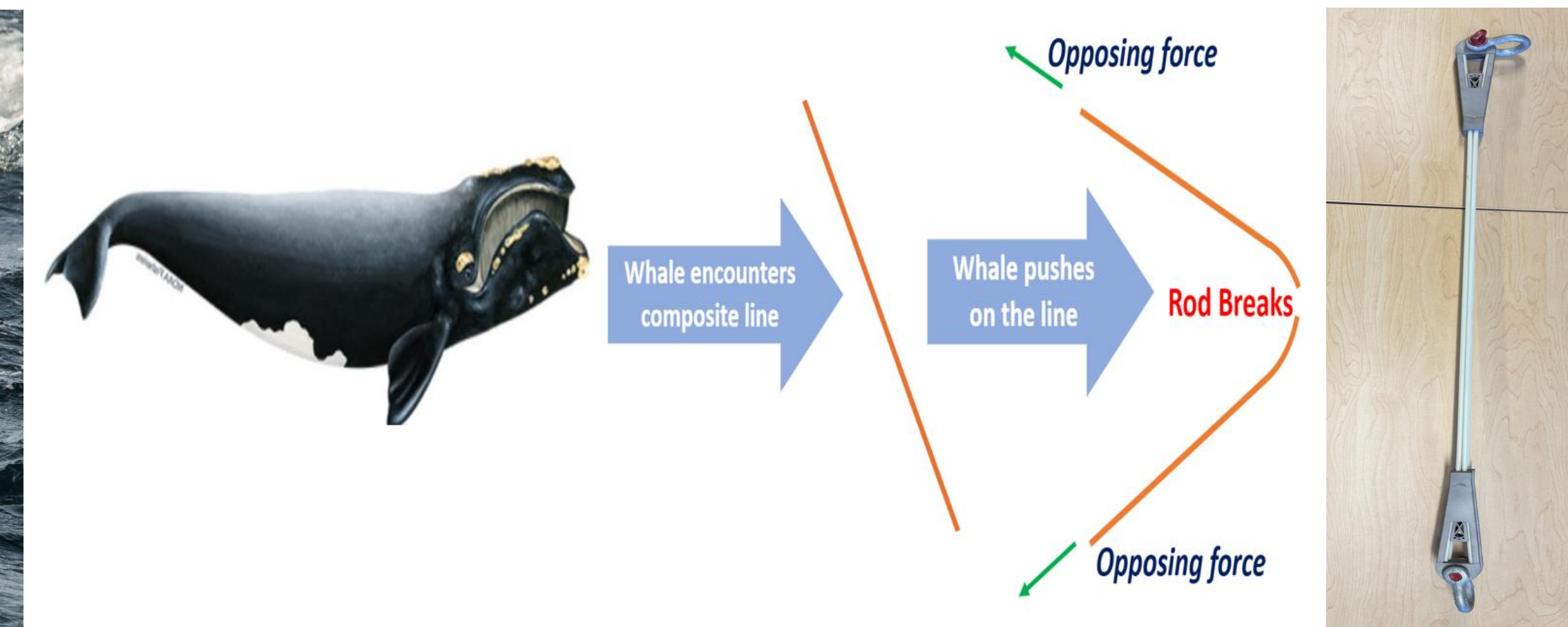
The Whale Safe Mooring Line project aims to protect the critically endangered North Atlantic Right Whale, with fewer than 360 remaining. Entanglement in rope-based fishing gear is a major threat to the species. This project explores fiberglass rods as a safer alternative to traditional mooring lines. Through material testing, prototype development, and manufacturer collaboration, the goal is to deliver a durable, scalable solution that reduces entanglement risk and supports sustainable ocean practices.

Solution to Whale Entanglement Crisis



<https://www.ifaw.org/ca-en/projects/saving-the-north-atlantic-right-whale>

Whale Entanglement Crisis



Our Solution & Final Prototype

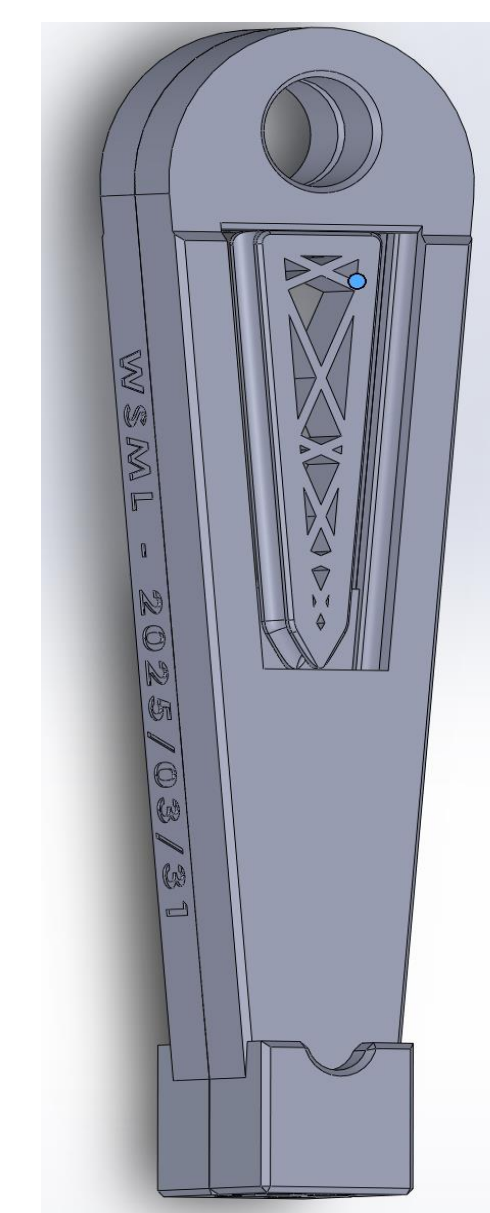
Problems and Solutions

- Fewer than 360 North Atlantic right whales remain; over 85% have been entangled by rope-based mooring lines
- Current systems don't fail safely under lateral impact, putting whales at risk
- This project developed a fiberglass rod system designed to break under lateral force but stay strong under aquaculture tension
- Custom mechanical and adhesive terminations were prototyped and tested for tensile strength

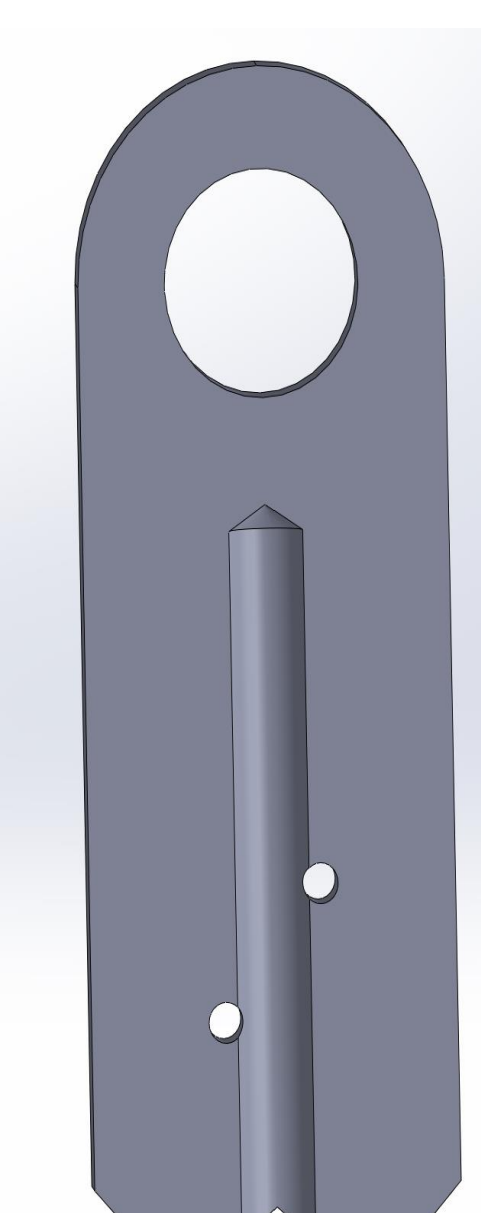
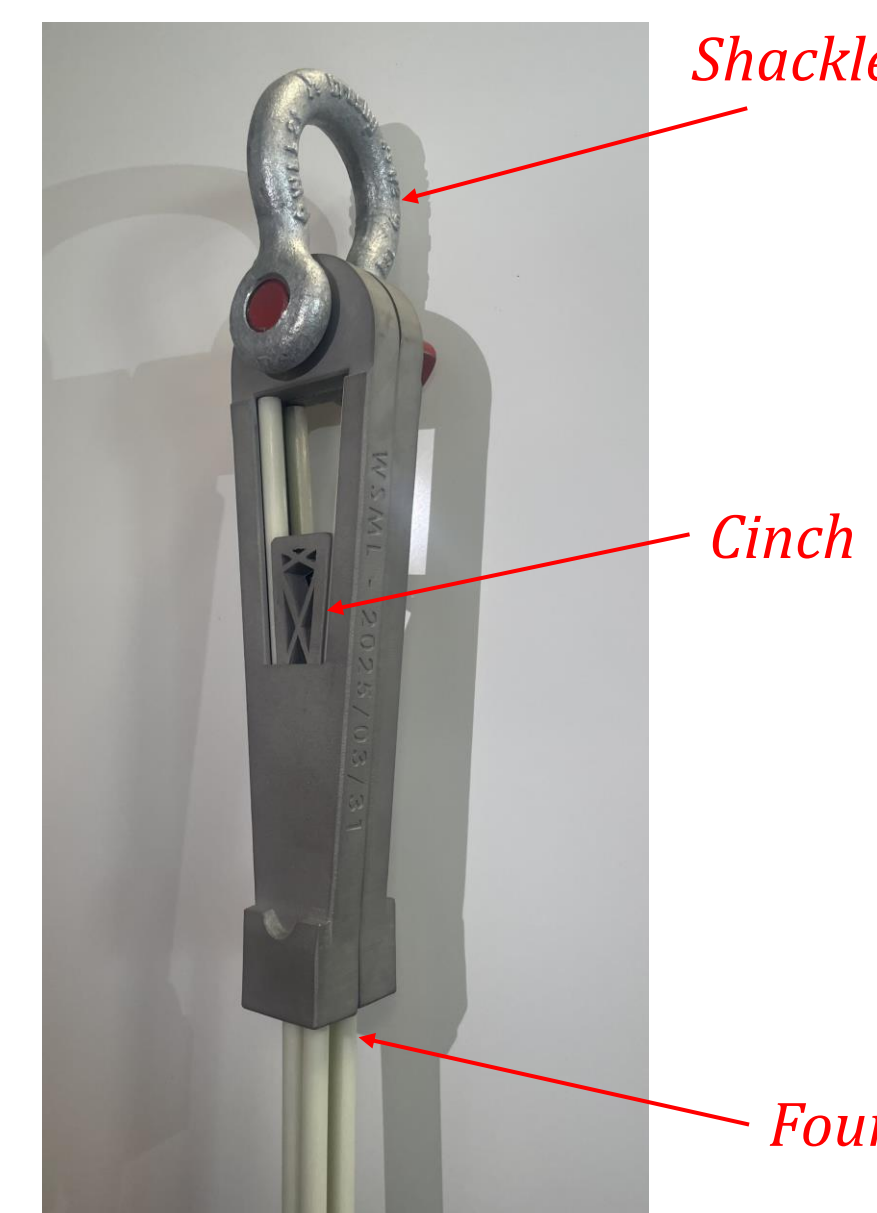
Methodology

- Researched materials with high tensile strength and safe lateral failure
- Selected fiberglass rods for marine durability and tested breaking behavior
- Designed and built terminations to handle aquaculture loads without damage
- Conducted lab testing: tensile, four-point bending, and failure analysis
- Performed saltwater exposure tests and microscopy for degradation
- Completed a one-week field deployment to assess real-world performance

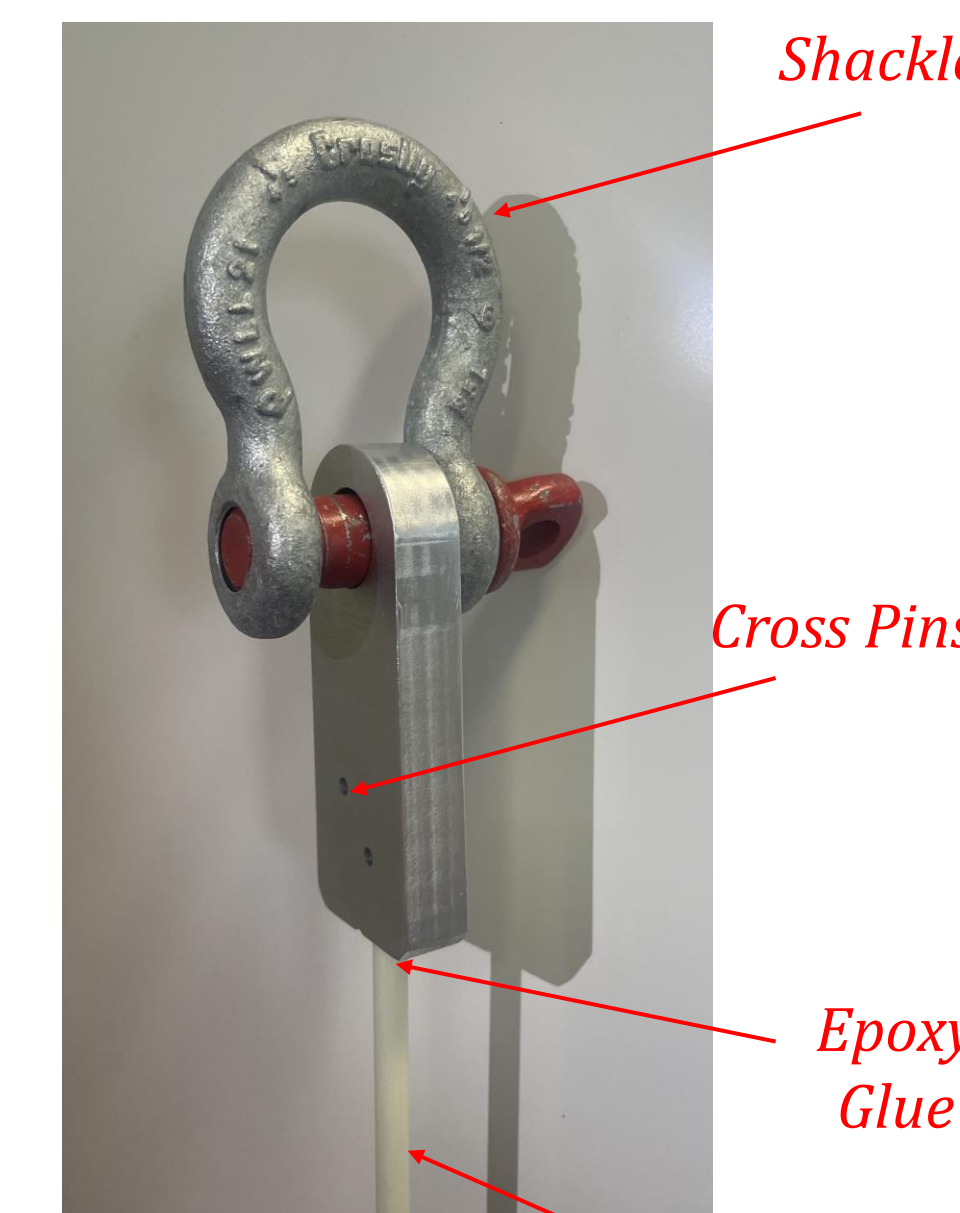
Termination Designs



Mechanical Design



Adhesive Design



Results and Conclusions

- Final prototype was deployed for one week, confirming real-world performance
- Four-point bending showed rods break before 5 kN, matching whale-safe design target
- Tensile tests reached 28,554 N, with some hopefully exceeding 50 kN (aquaculture range: 44.5–89 kN)
- Three-month ocean exposure showed minimal degradation; microscopy confirmed limited wear and intrusion
- Fiberglass rods and custom terminations proved strong, reliable, and viable for whale-safe mooring systems

Testing

- Ocean exposure testing evaluated material durability and resistance to saltwater degradation
- Four-point bending tests confirmed rods break near target lateral forces from whale impact
- MTS tensile testing on full prototypes (rod + termination) measured axial strength and failure modes



Ocean Exposure Test



Four Point Bending Test

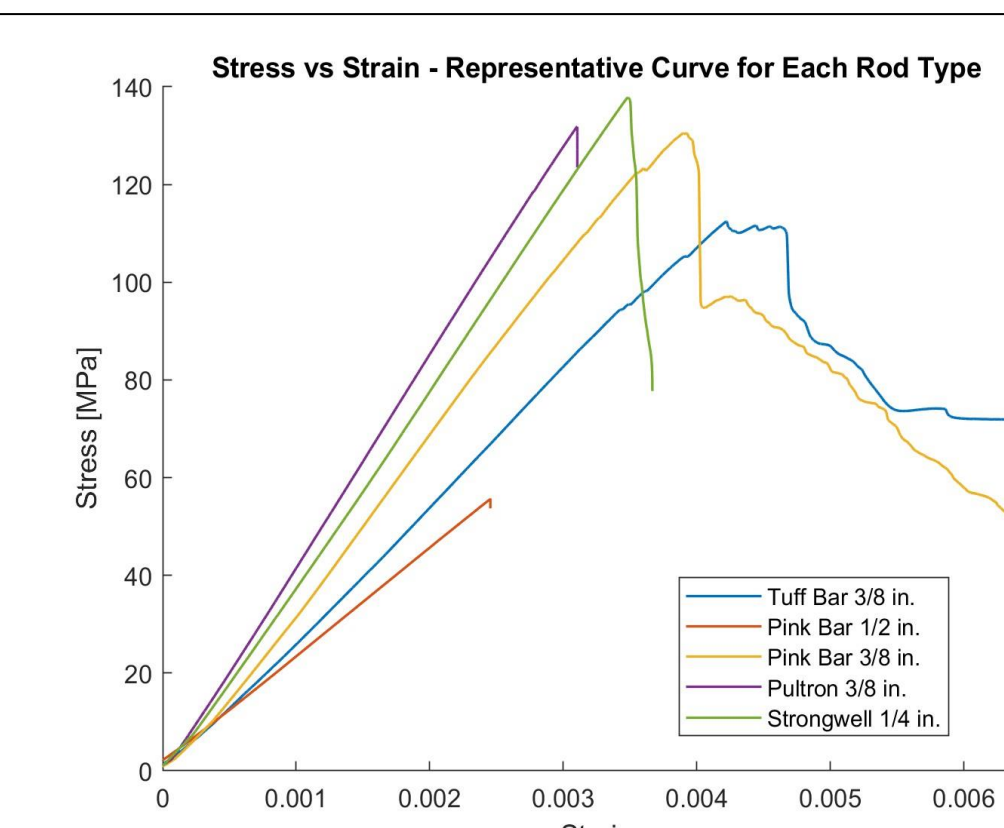


MTS Tensile Test

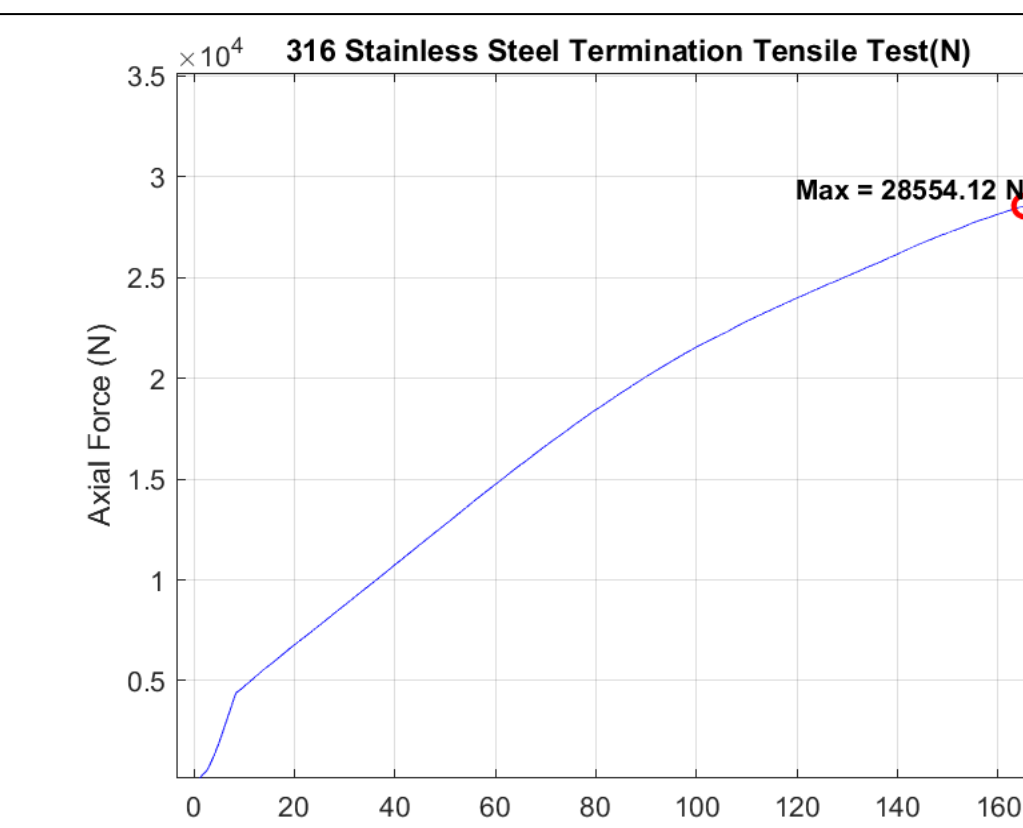
Experimental Results



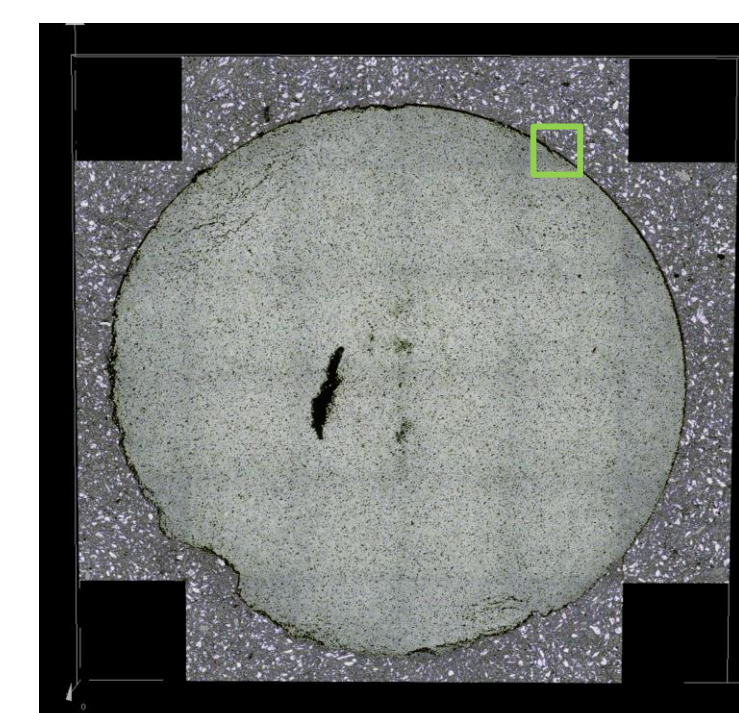
3 Month Ocean Exposure Test



Four-Point Bending Test with ZwickRoell

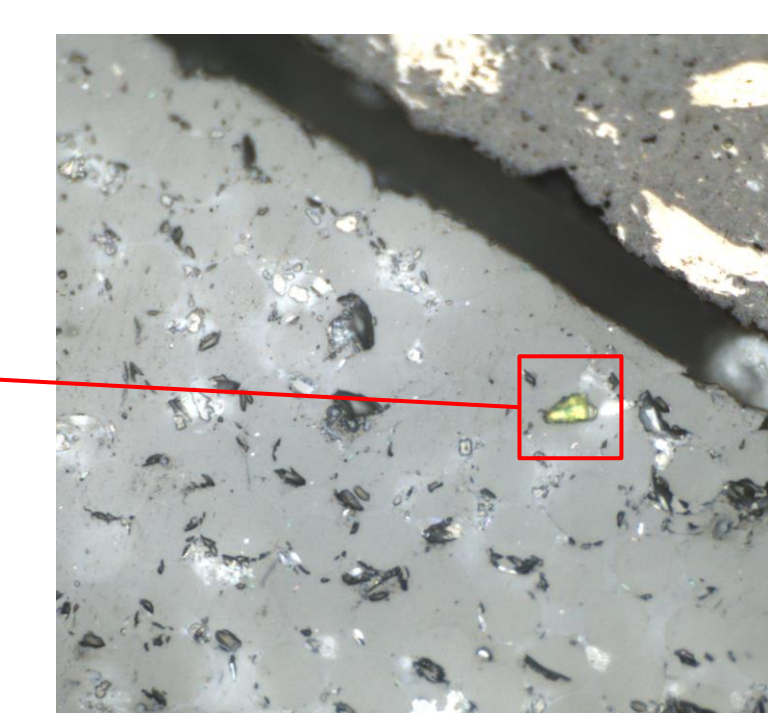


Tensile Test with MTS Landmark



20X Magnification Full Scale View of Strongwell Rod

Some pores are filled with deposits of green matter from sea water.



50X Magnification Targeted view of Strongwell Rod

Future Work

- Refine termination design and explore in-house manufacturing
- Continue ocean exposure testing for long-term durability
- Connect with commercial fishers for adoption
- Expand to aquaculture and fixed gear systems

Acknowledgments

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