



SIO Drogue Investigation



Figure – Scripps Pier Sunset by Scott Cunningham

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Introduction

- 2 years of SVP production at SIO
 - Baseline for performance
- Drogue Life < Expected
 - Terminations
 - Tether Material
 - Drogue Fabric
 - Drogue Bridal



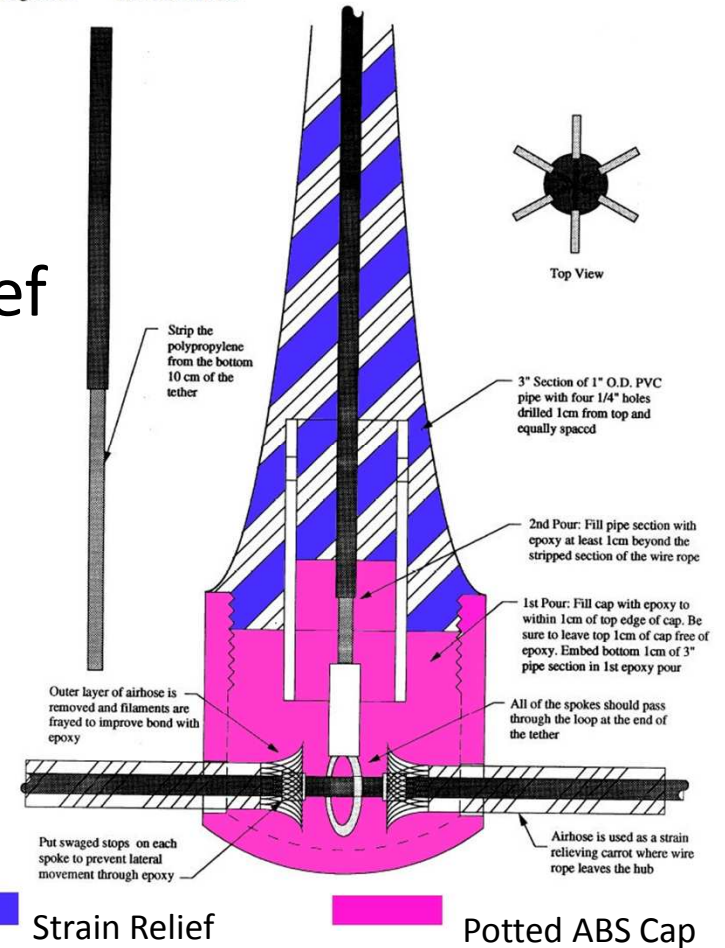
Terminations

- Drifter Design Manual
 - Potted Epoxy Cap
 - Potted Wire Rope Strain Relief



*Barometer Drifter Design Reference

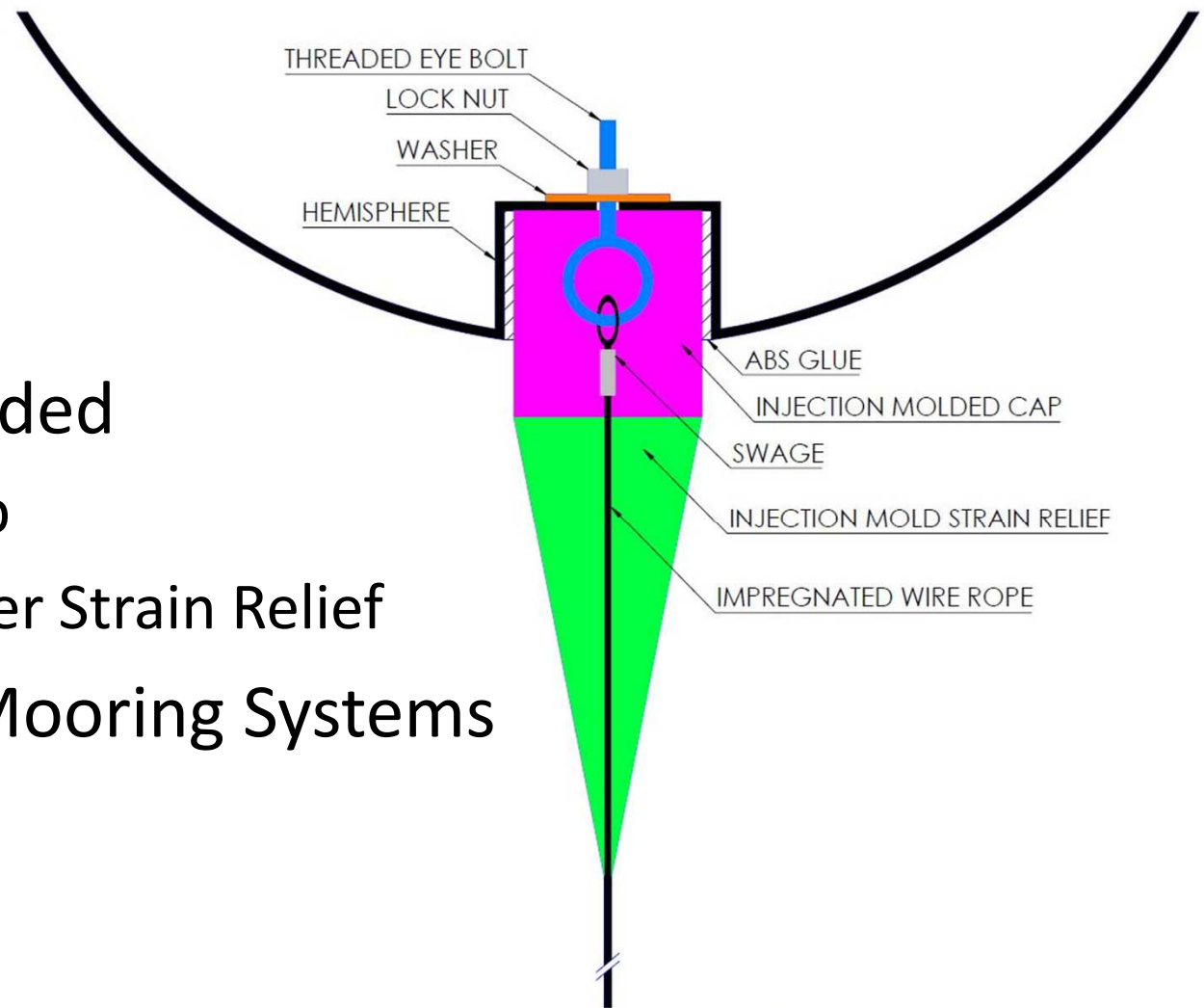
Figure 9. The radial hub.



*Barometer Drifter Design Reference

SIO Terminations

- Injection Molded
 - ABS Bolt Cap
 - 35 Durometer Strain Relief
- Tested with Mooring Systems



*NOT DRAWN TO SCALE

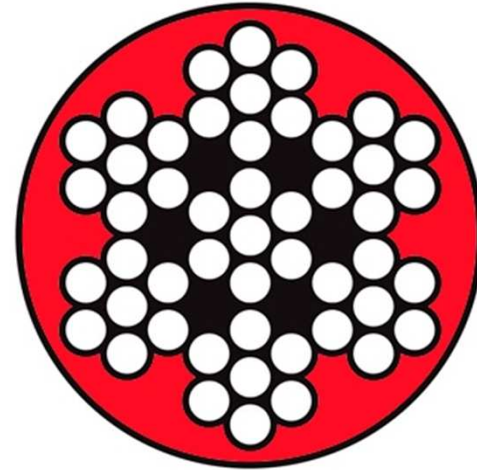
Early Testing

- Mooring tests
 - Isolate termination and tether performance
- Tether Failure before Termination Failure
 - Kinks
 - Corrosion

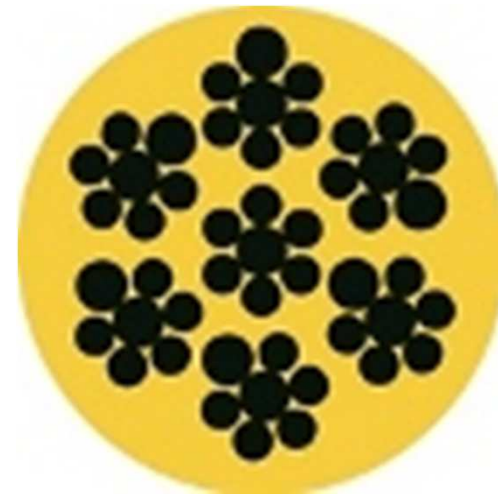


Tether - Spacelay

- Traditional
 - Internal Wear/Friction
 - Coated Jacket
- Spacelay
 - Isolated Strands
 - Impregnated Jacket
- 1/8" OD Spacelay Alternatives
 - Synthetic Rope
 - Larger OD Spacelay



Traditional Coated Wire Rope



Spacelay

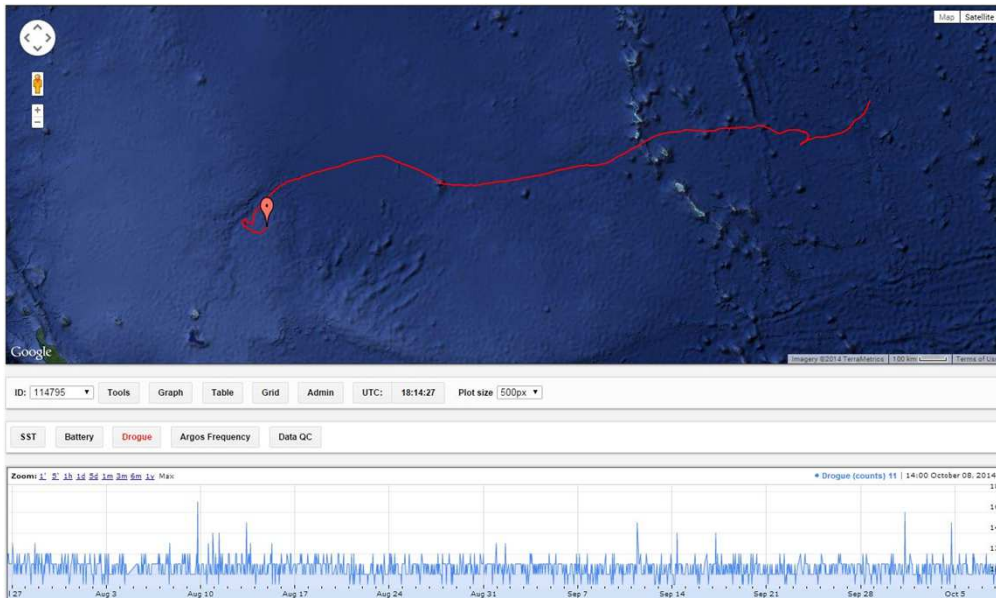
1/8" Spacelay Alternatives

- Synthetic Ropes
- Termination Issues
 - Swages – Not Applicable
 - Knots – Decrease strength
 - Splices - Expensive
 - Injection Molding – Not Applicable



Synthetics Application

- Sample in the field for 4 months, more to come!



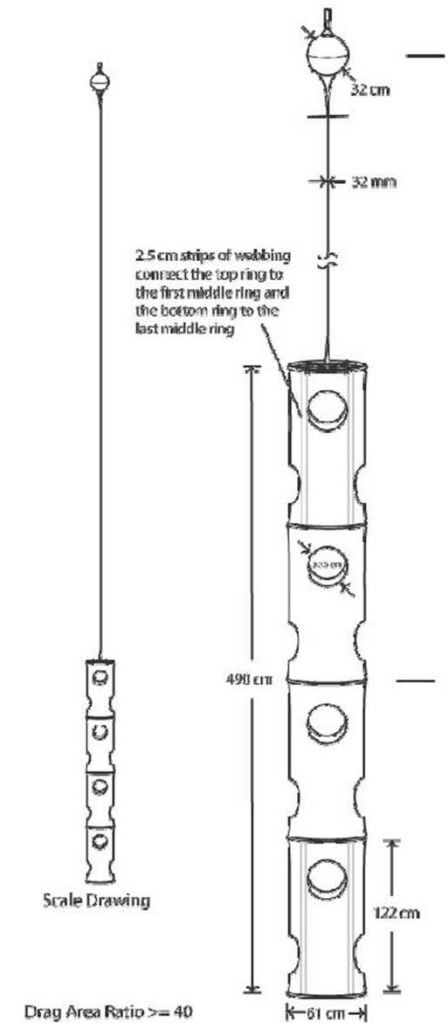
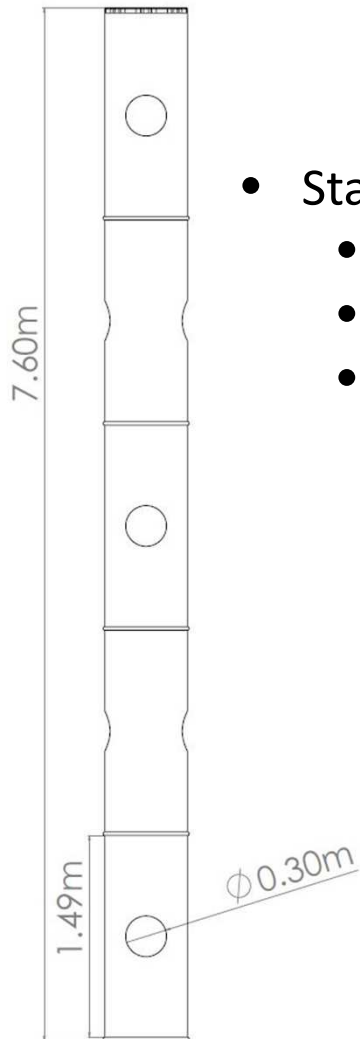
1/8" Spacelay Alternatives cont.

- Switch to larger OD Spacelay – 1/4"
- Increased Break Strength – 400%
 - Increased Corrosion Time
 - Increased Kink Resistance
- Improved results but still underperforming



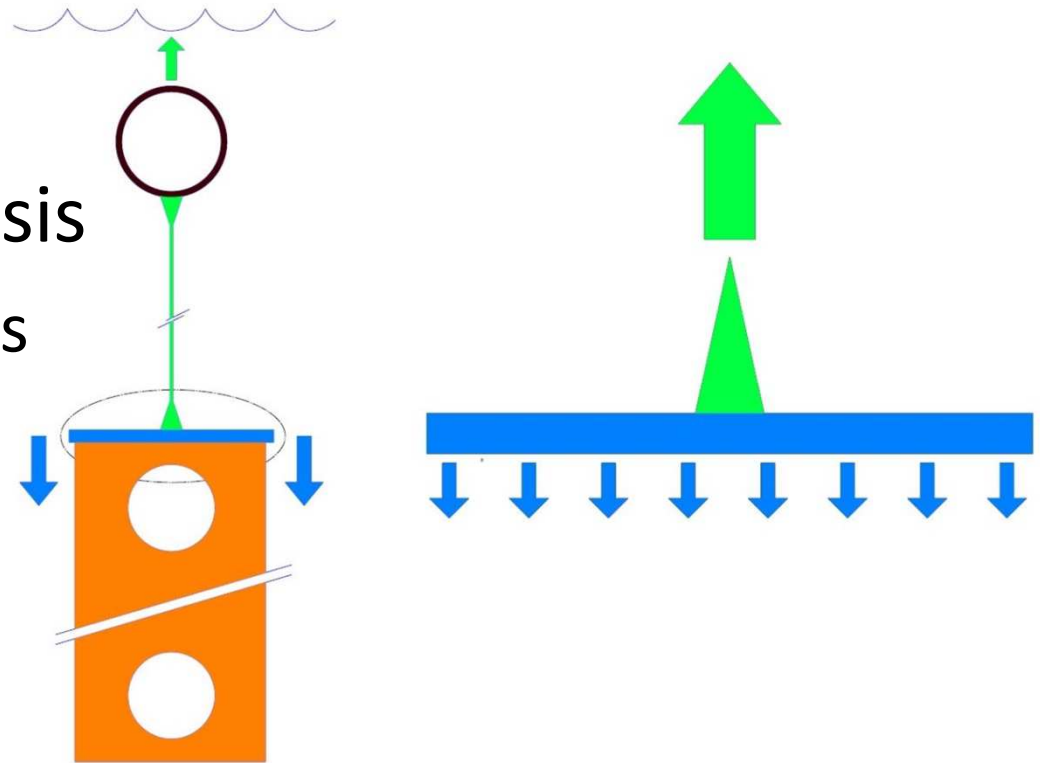
Drogue Fabric

- Standardized
 - 600 Denier Cordura Nylon with Rip Stop
 - Double Zig Zag Stitching
 - Rigid PVC Section Support Rings



Drogue Bridal

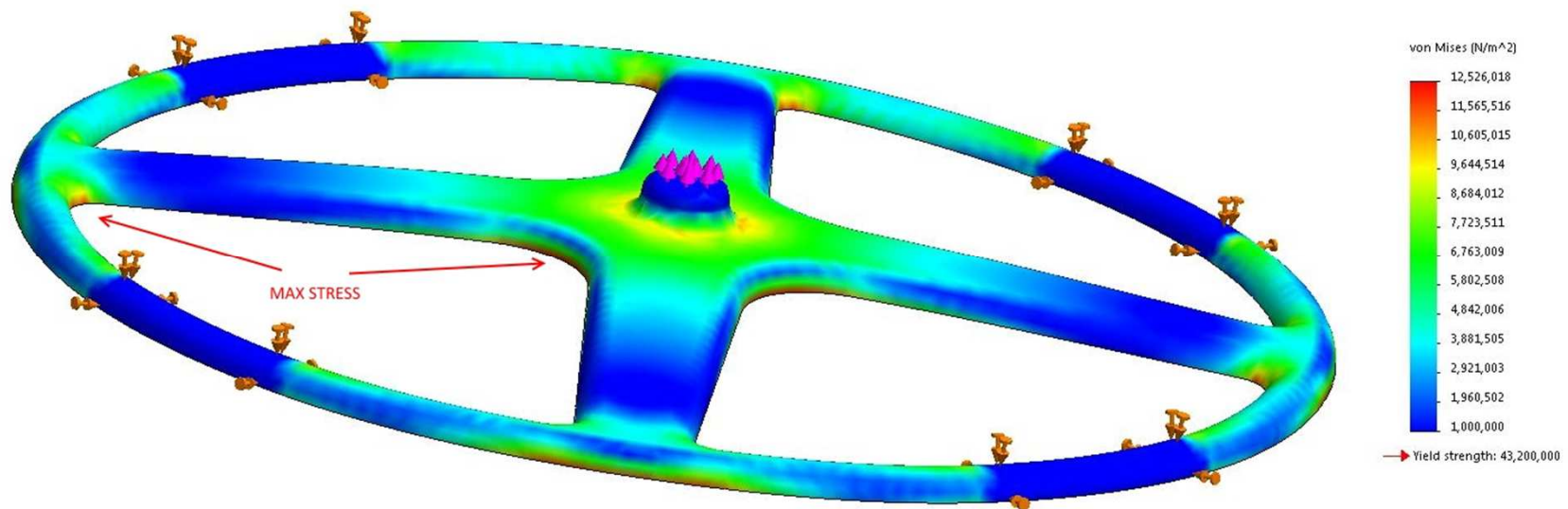
- Rigid ABS Plastic
- Finite Element Analysis
 - Stress Concentrations
 - Deflections
 - Fatigue



*Force diagram while surface float is submerged

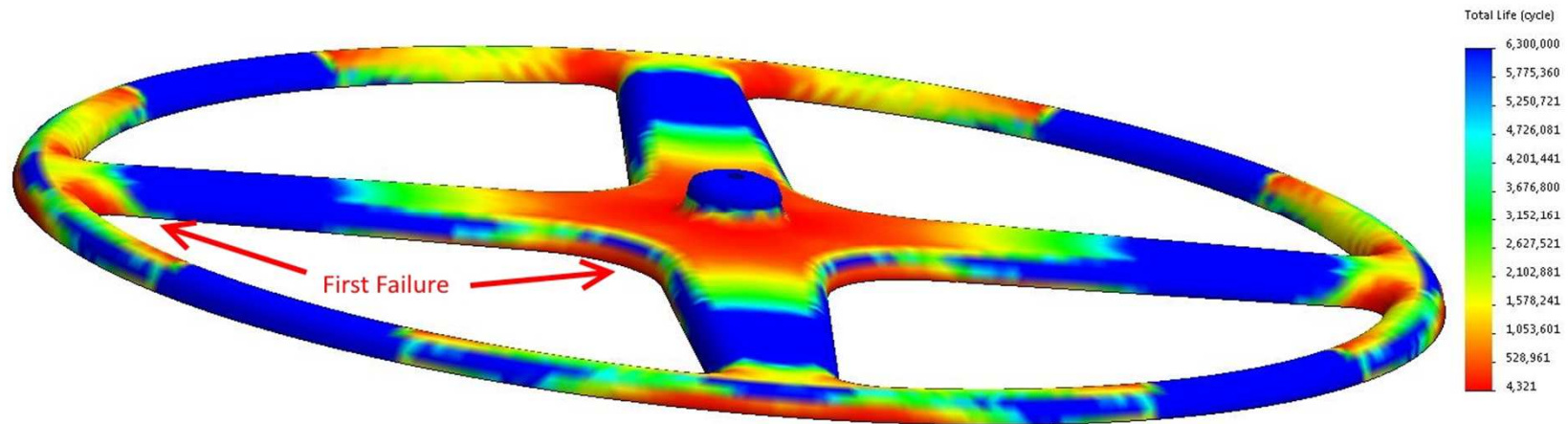
Original Rigid Drogue Bridal

- Max Stress = 28.97% of Breaking Strength of ABS
 - Max Stress < Breaking Strength => Fatigue Problem



Simulation Results

Failure at 4,731 cycles



- SIO Improvements
 - Material
 - Thickness
 - Design
- 30% decrease in stress concentration
- 30,000% increase in fatigue life

Closing Remarks

- Mooring Tests Isolate:
 - Injection Molded Bolt Cap + Carrot
 - Consistent Quality
 - Tether
 - Integrating Synthetic Line
- Simulations/Field Recoveries/Lab Tests Isolate:
 - Drogue Fabric
 - Standardized
 - Drogue Bridal
 - Undergoing Optimization



Thank you!

Questions?