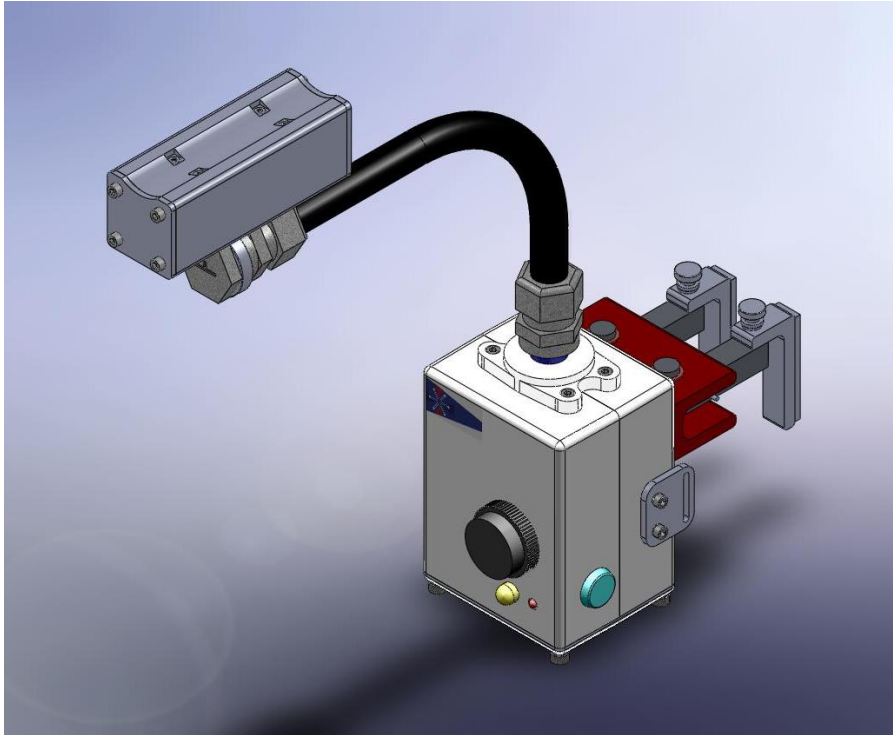
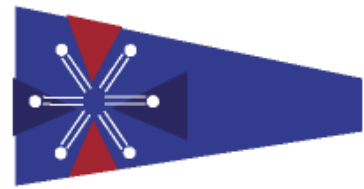
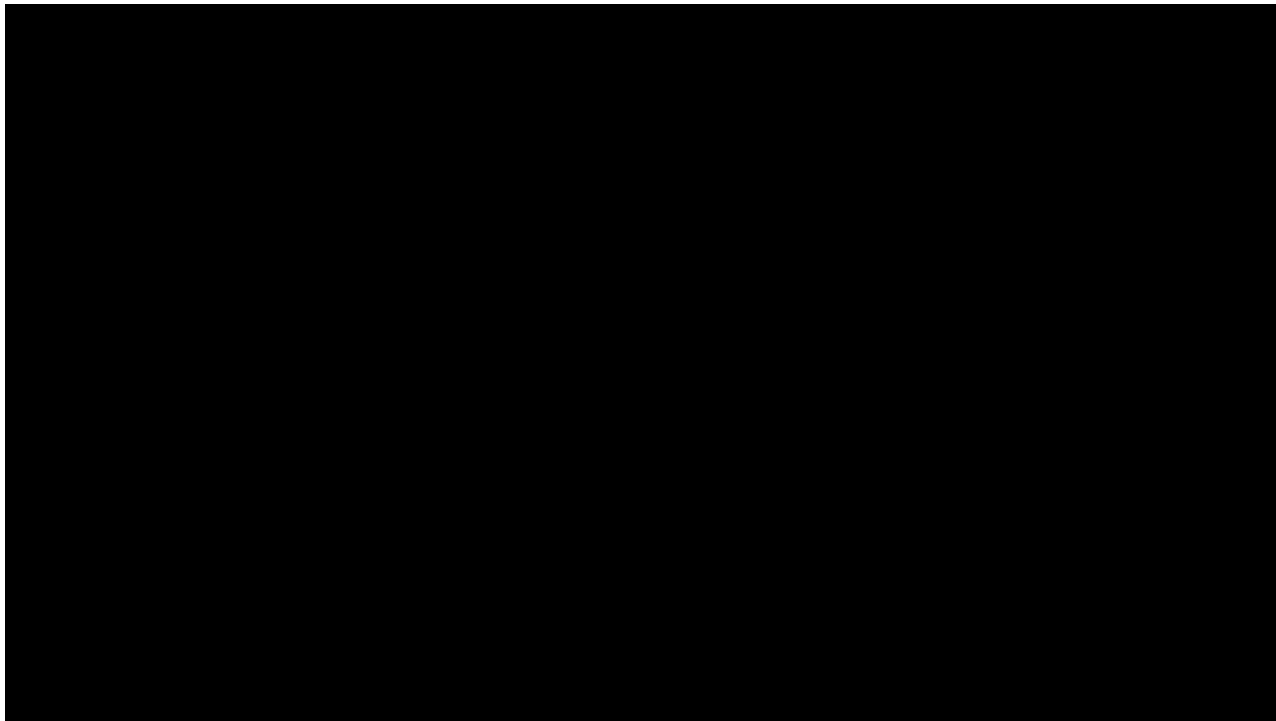
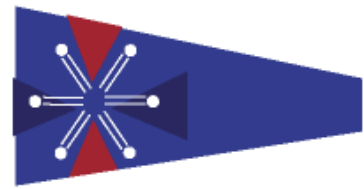


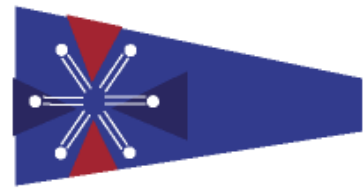
BoomAlert



David Aguilar, Ben Conrad, Lisa McGill,
Jordan Wachs, and Scott Sardina



Video 1: Serious injury can occur if it by boom.



- Important Sailing Terminology
- Prior Art
- Experimental Results
- Electrical Design
- Mechanical Design
- Market Research
- Demonstration
- Conclusion



Figure 1: Preliminary sailing test on Lake Mendota

Important Sailing Terminology

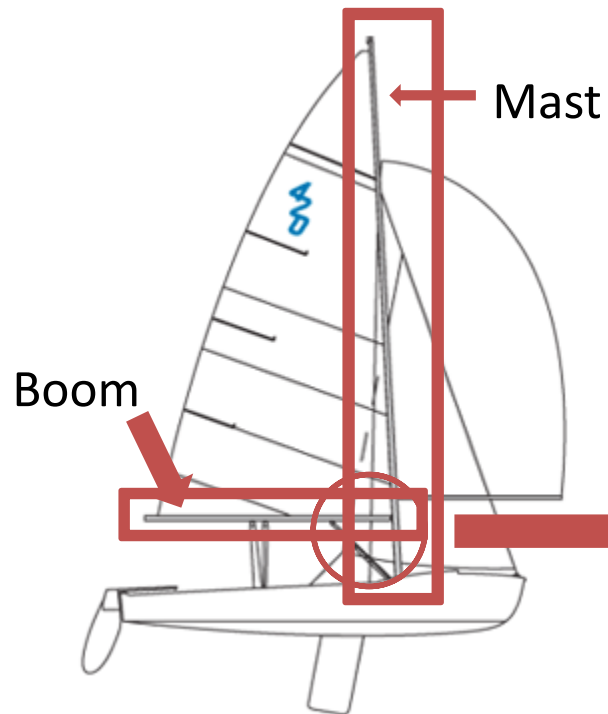
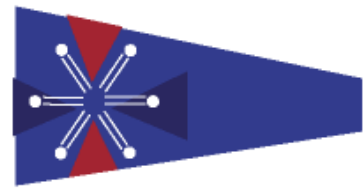


Figure 2: Club 420 Sailboat Layout

Wind
Direction

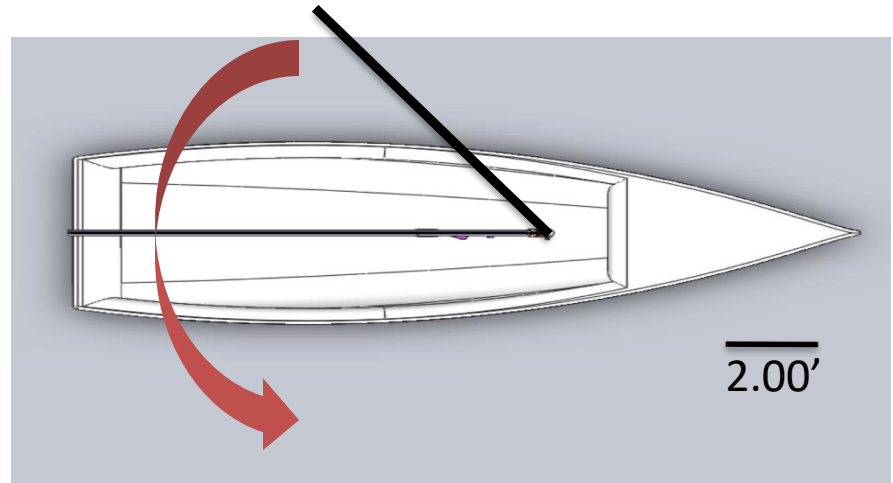


Figure 4: Auto Jibe

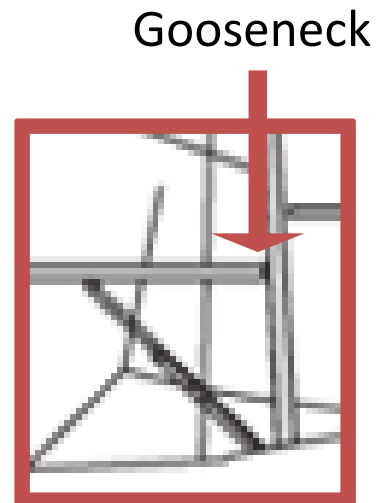


Figure 3: Gooseneck Detail

The prior art hinders boat performance

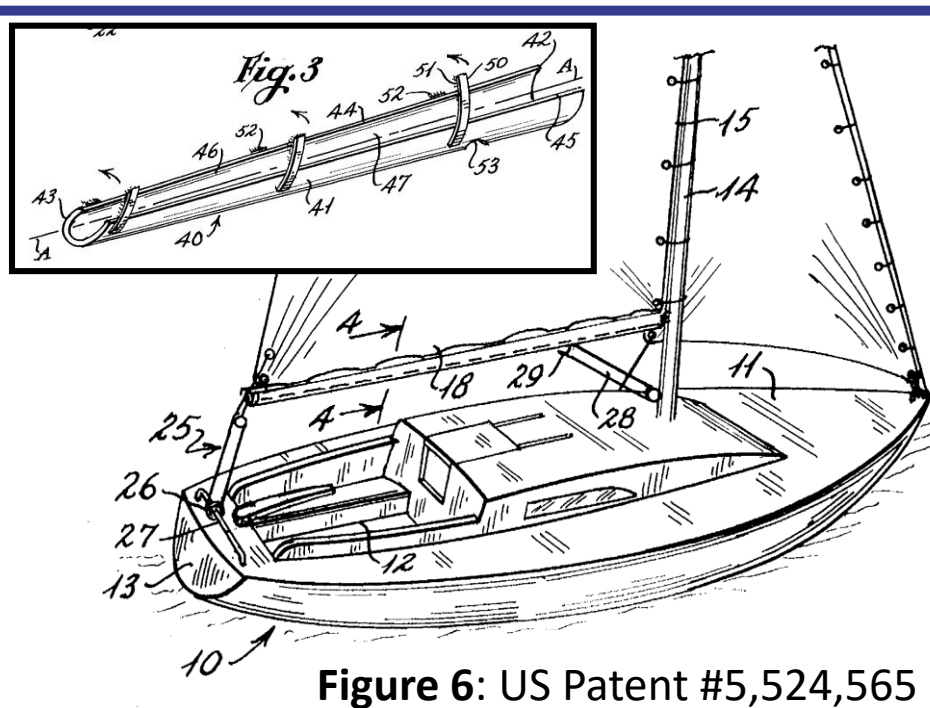
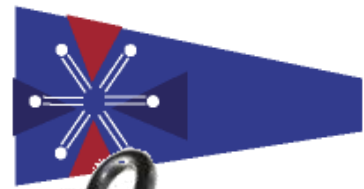


Figure 6: US Patent #5,524,565



Figure 8: Wichard Gyb'Easy



Figure 7: Walder BoomBrake

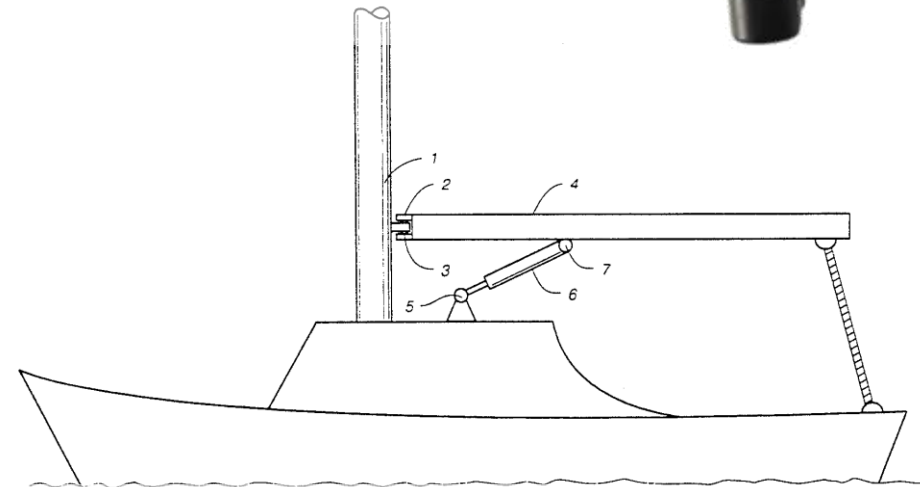
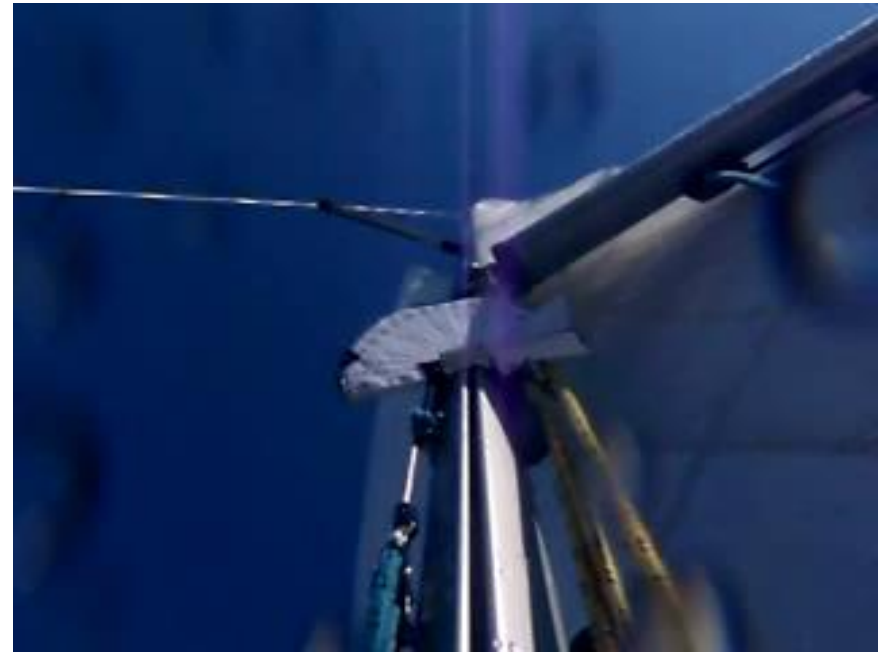
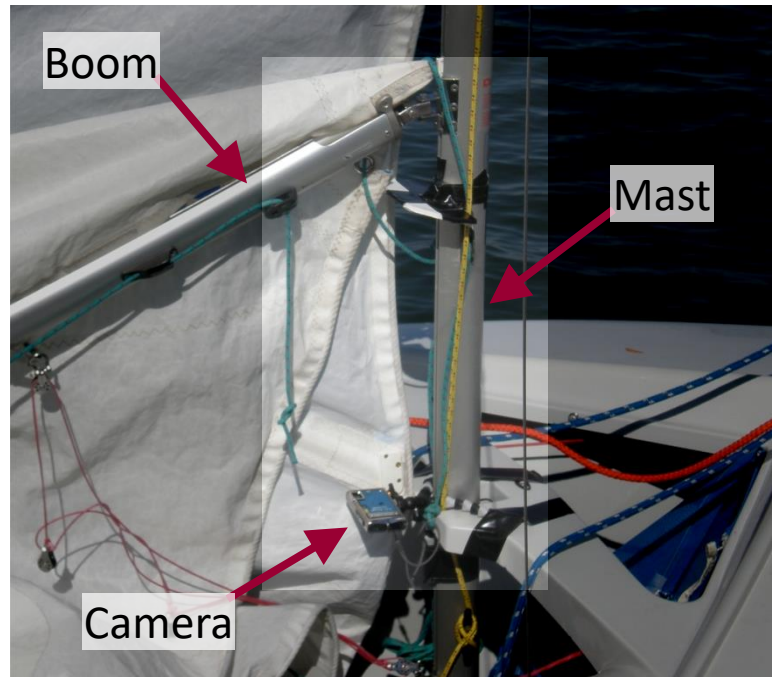
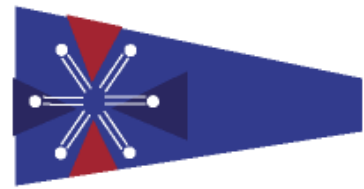


Figure 9: US Patent #5,333,567

Sailing test setup and measurement



Video 2: As seen by camera



Figure 10:
Test setup

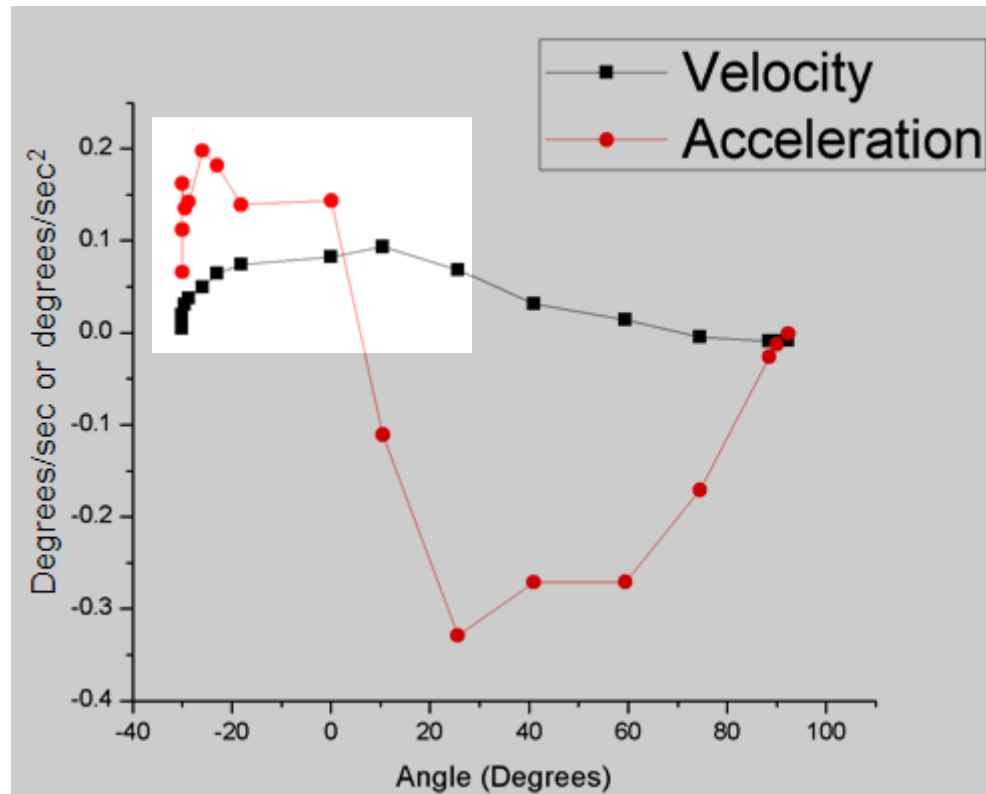
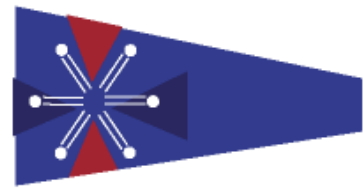
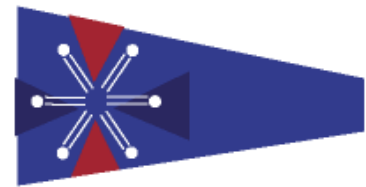


Figure 11: Boom acceleration leads to dangerous velocities

- On the Club 420, approximate boom tip speed of 0.41 m/s
- Boom sweeps across boat in 0.6s
 - Alert event detected in $\sim 11.7 \mu\text{s}$
 - Crew has 0.4-0.2s extra time



- Dual Alert
 - Light Emitting Diode (LED) Strobe & Buzzer
- Adjustable acceleration threshold
 - Located in battery compartment
- Test Button
- Low battery indicator

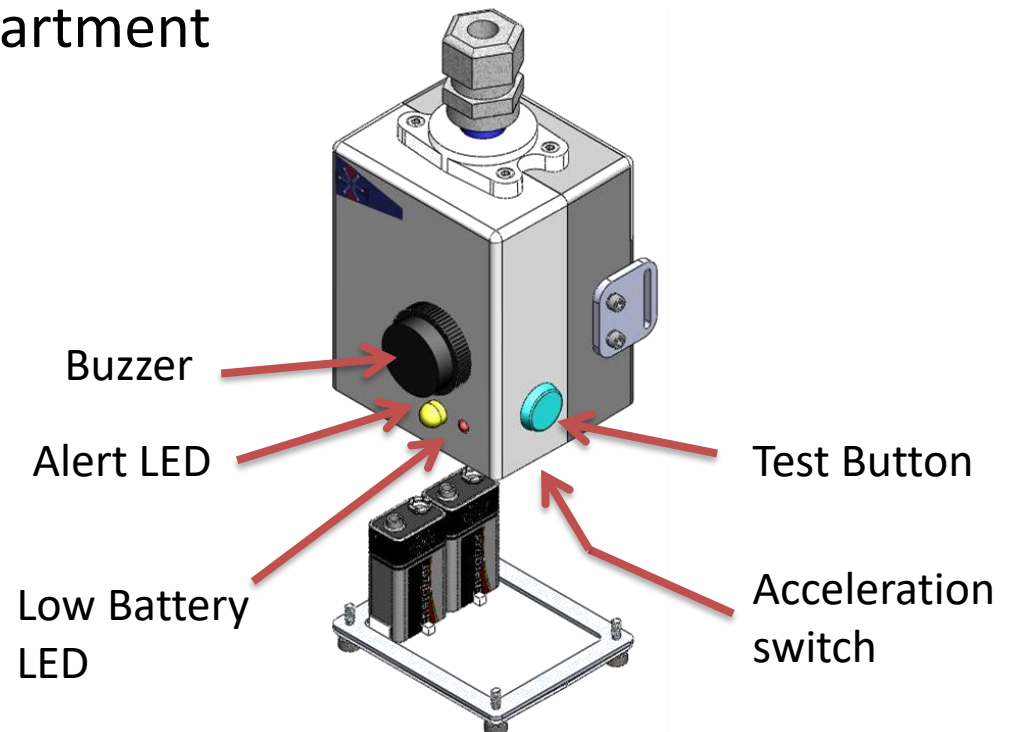
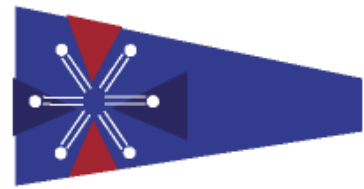


Figure 13: User features



- Accelerometer
 - Measures tangential boom accelerations
- Position Sensor
 - Measures boom position
 - Enables alarm zone option
- Alarm
 - 95dBA two-tone buzzer
 - 45lm alert LED

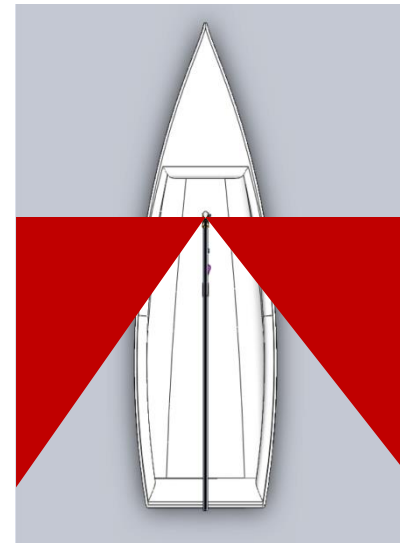


Figure 12: Location of optional alert zones

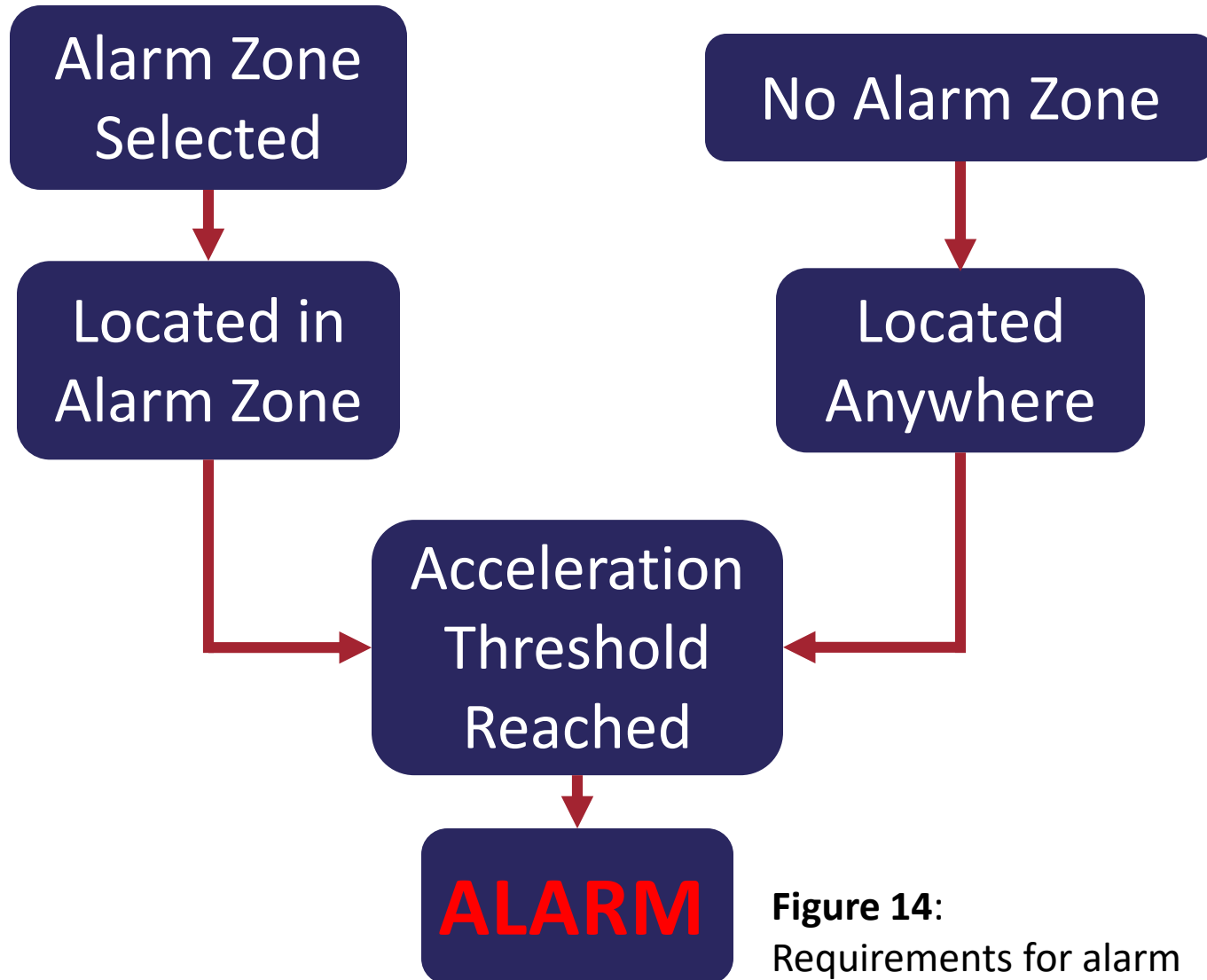
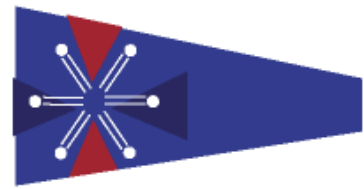


Figure 14:
Requirements for alarm

Main Mechanical Design Components

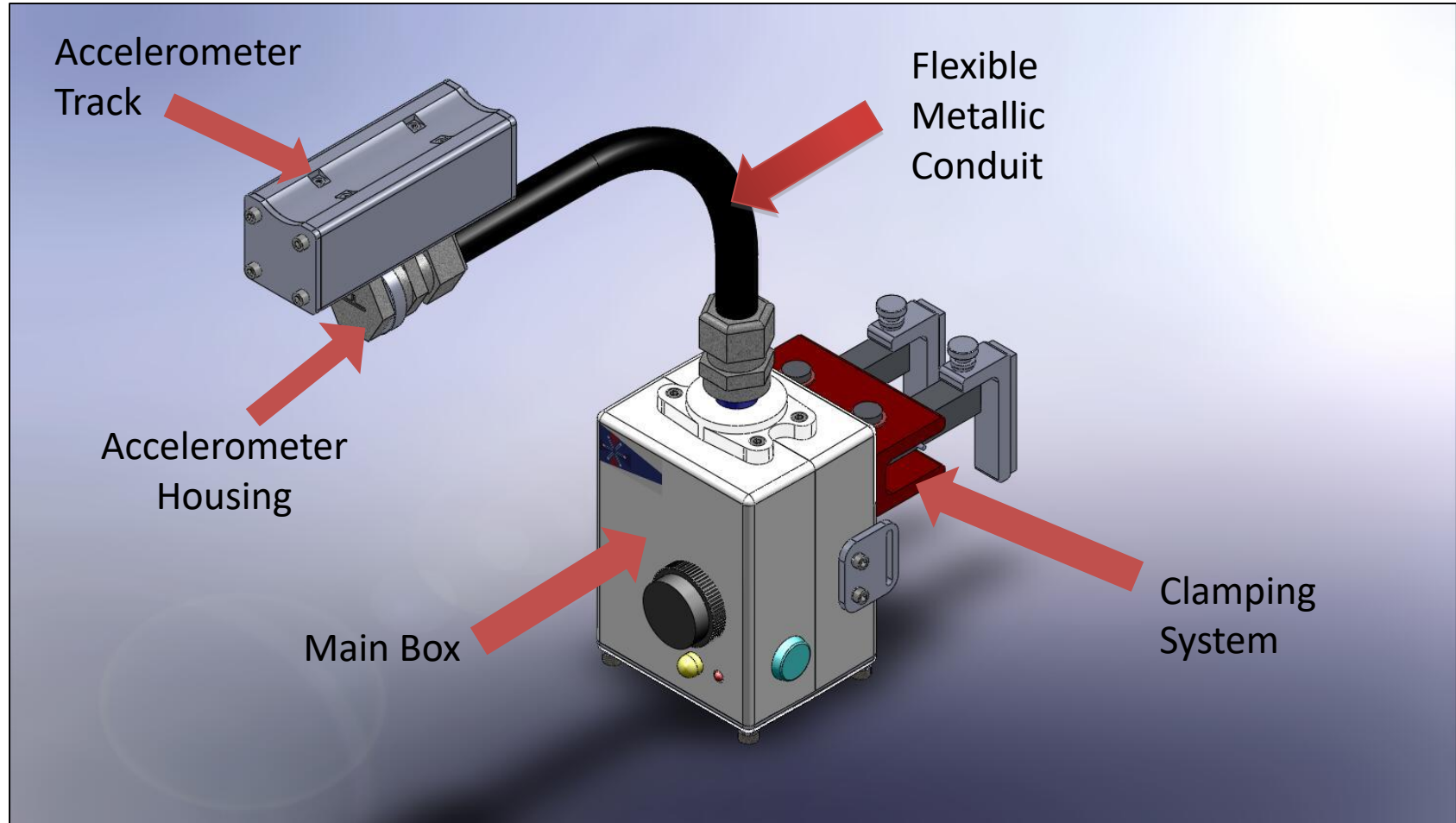
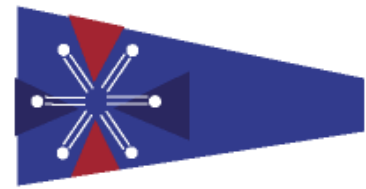
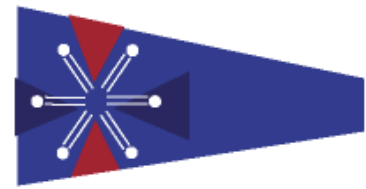
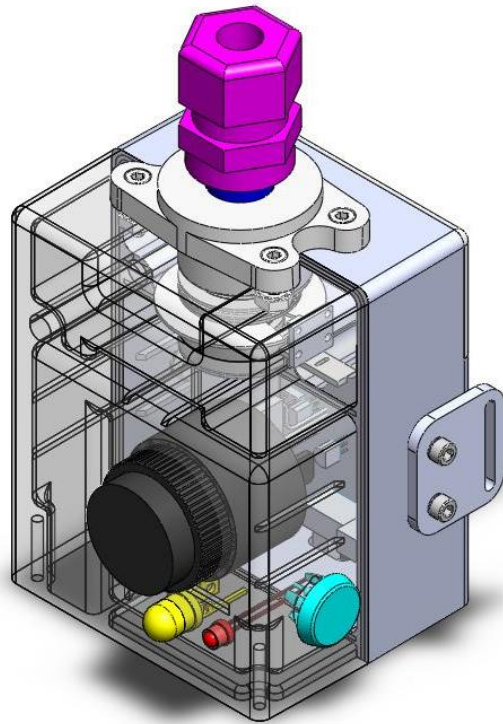


Figure 15: *BoomAlert* major components



Main Box Assembly



Rotating Shaft Section

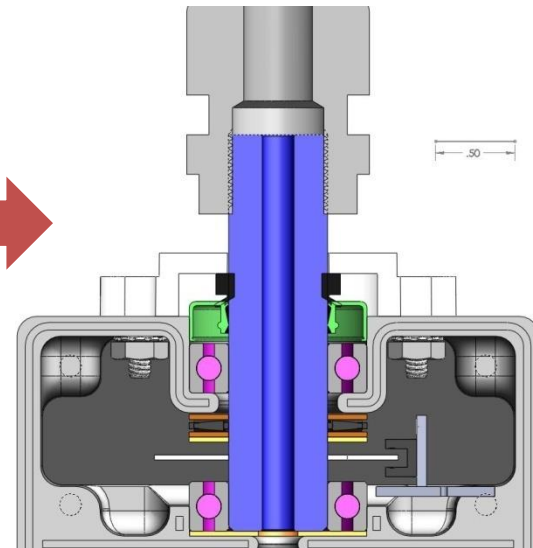
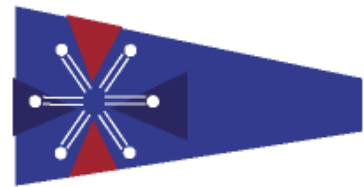


Figure 16: Rotating shaft enables alert zones but requires environment seal

Rotating Shaft Sealing and Position Sensing



- High density polyethelene (HDPE)
- 316 stainless steel
- Wires from the accelerometer go through the middle of the shaft
- **Female hub** conduit fitting
- **V-ring housing** protects sealing system from large contaminants
- **VA Type V-ring** rotates with shaft
- **Oil seal** hugs the shaft, forming a seal
- Seal is both static and dynamic

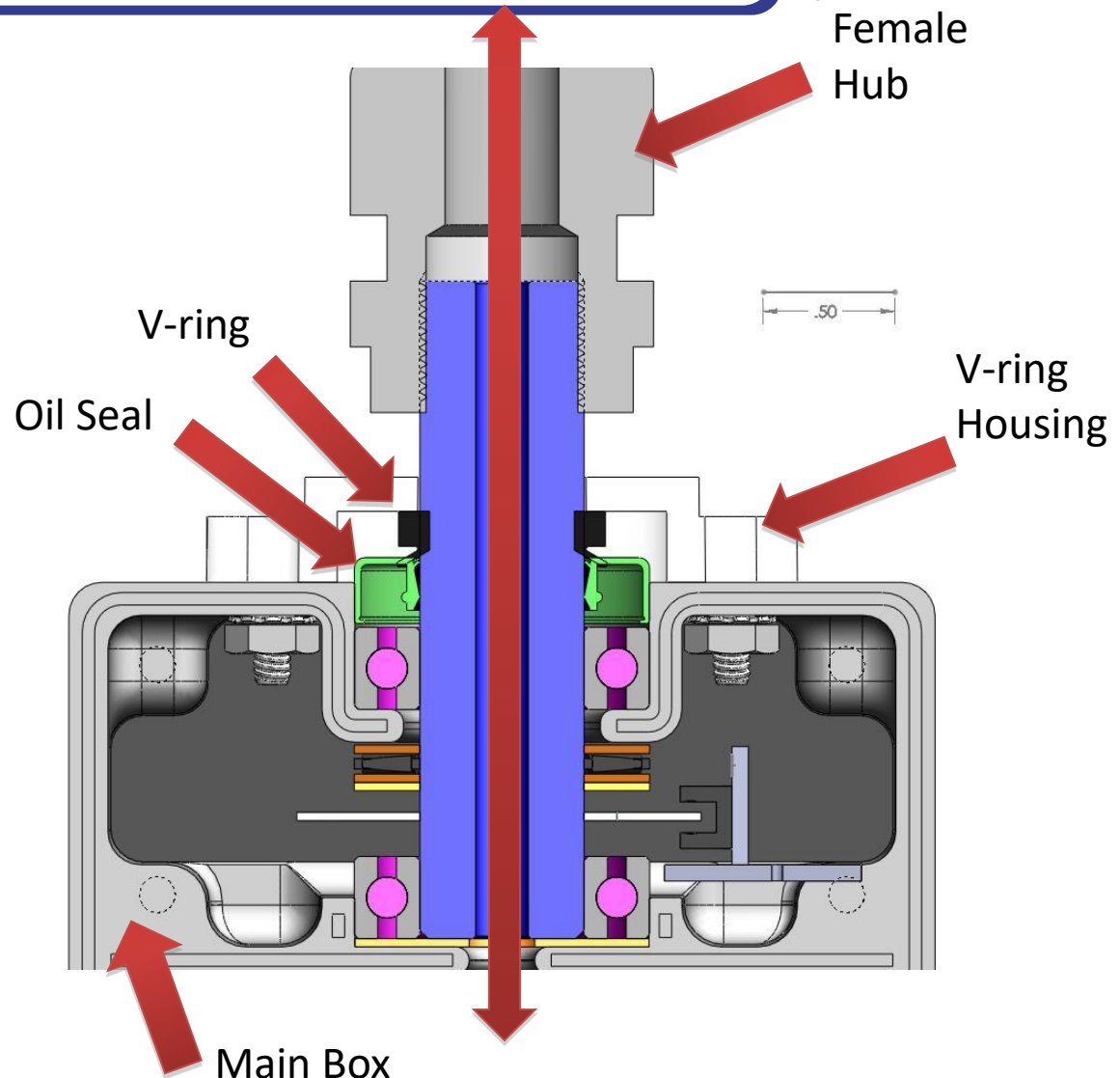
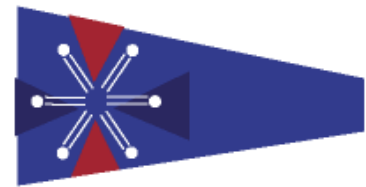


Figure 17: Sealing the rotating shaft

Rotating Shaft Sealing and Position Sensing



- **Plastic ball bearings** with glass balls
- Stainless steel **needle roller thrust bearing**
- **Photo diode** senses position by the position disk
- **Rotator plate** lowers coefficient of friction at end of shaft

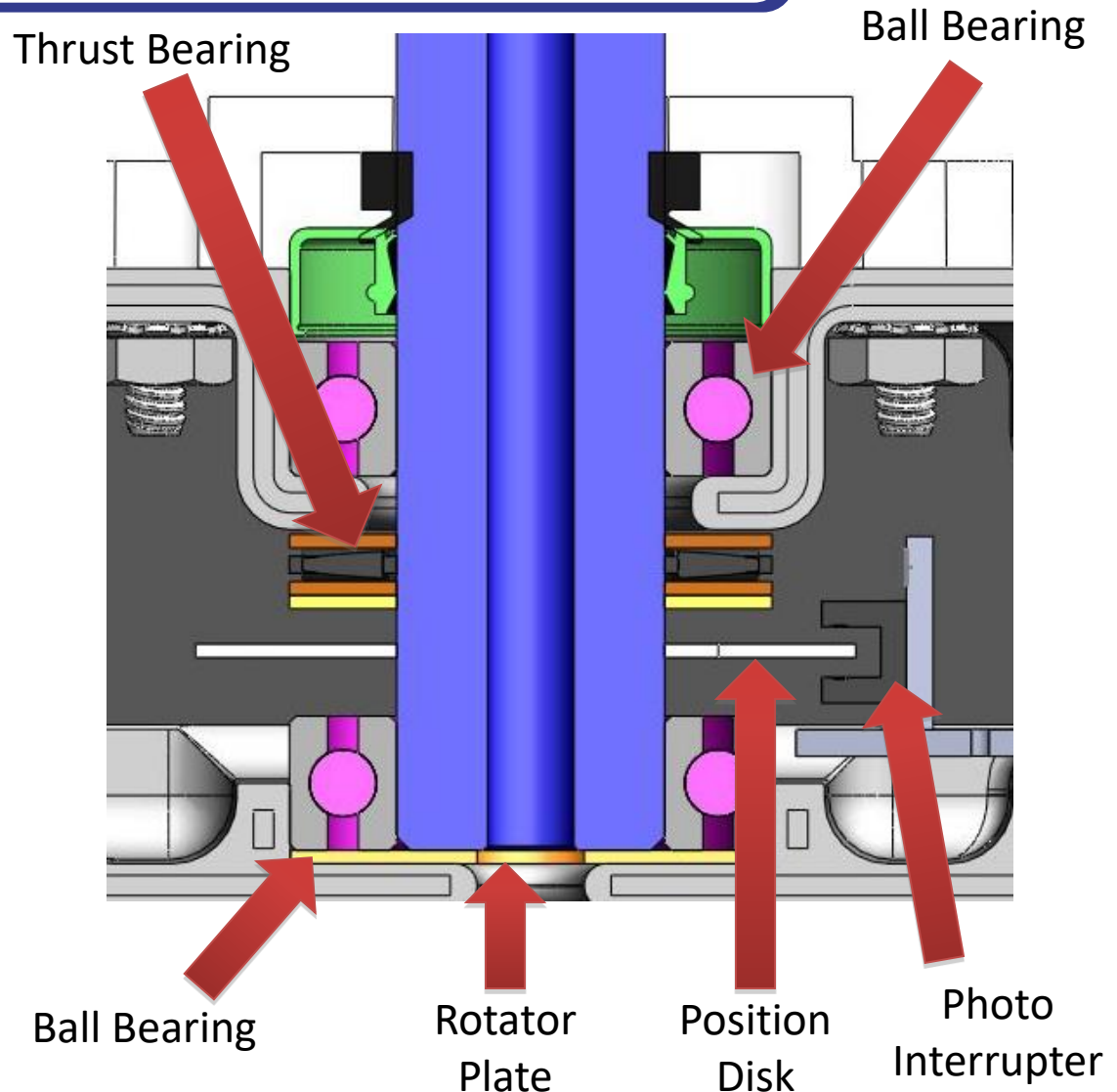
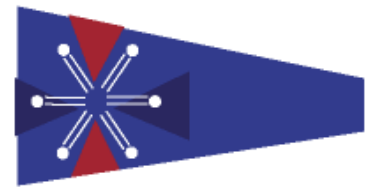


Figure 18: Rotating components

Bottom of the Box is Removable to Change the Batteries



- Remove the bottom of the box by four thumbscrews
- **Captive screws** and washers
- Lock washers for vibrations
- Two **9V batteries**
- 9V battery snaps
- Buna **gasket** seal

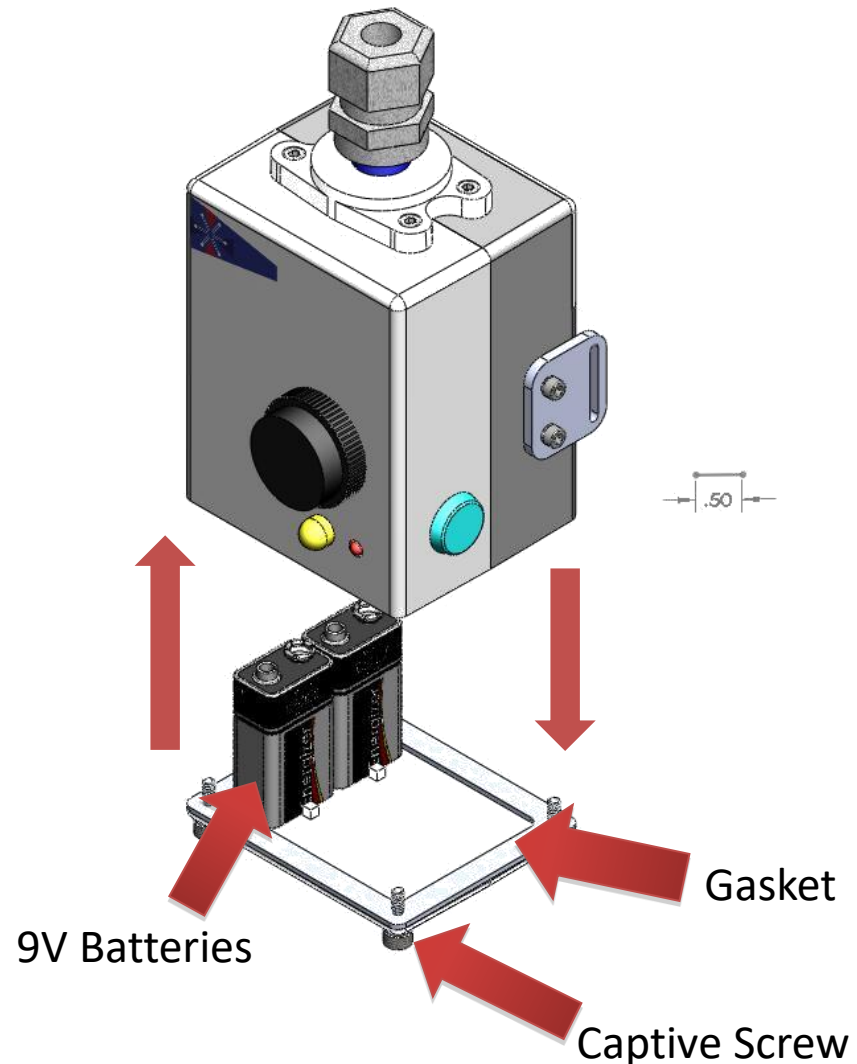
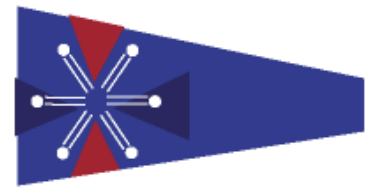


Figure 19: Removable battery cover

Accelerometer Housed in Custom End Cap



- Accelerometer glued onto holder
- Accelerometer cap mates with a liquid tight conduit fitting
 - constructed of 316 stainless steel

Accelerometer

End Cap

Accelerometer Holder

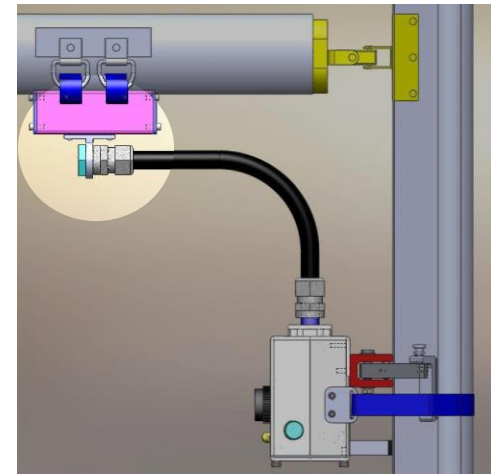
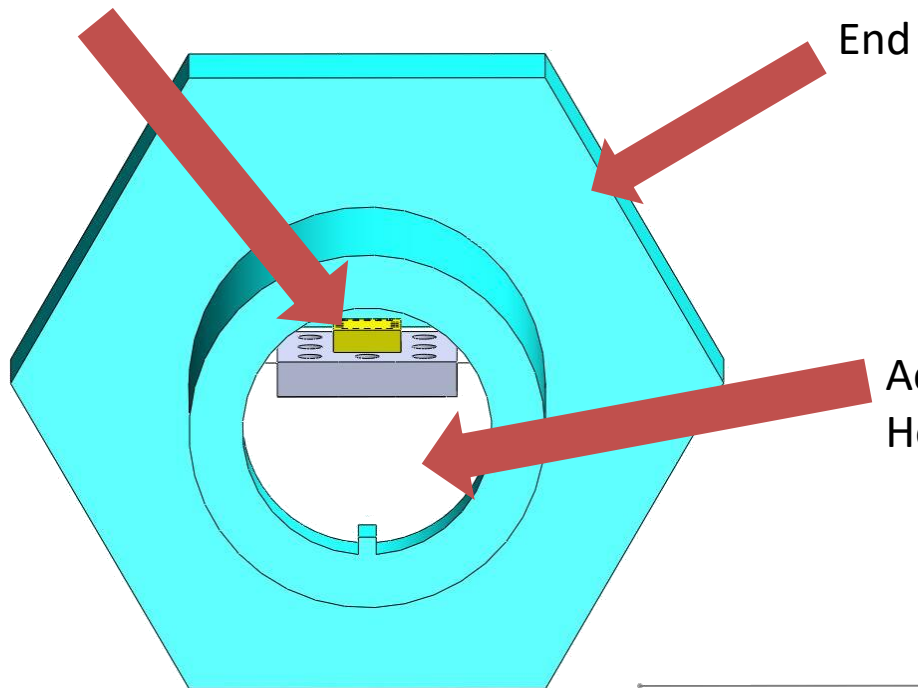
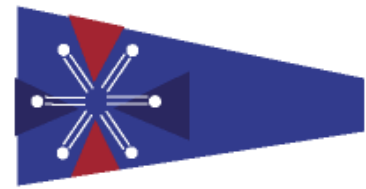


Figure 20: Accelerometer and cap holder

Explanation of track assembly



- Offset of rotational centers
- Results in the accelerometer taking an elliptical path
- 2" offset of the gooseneck and *BoomAlert* center results in a 1" path difference

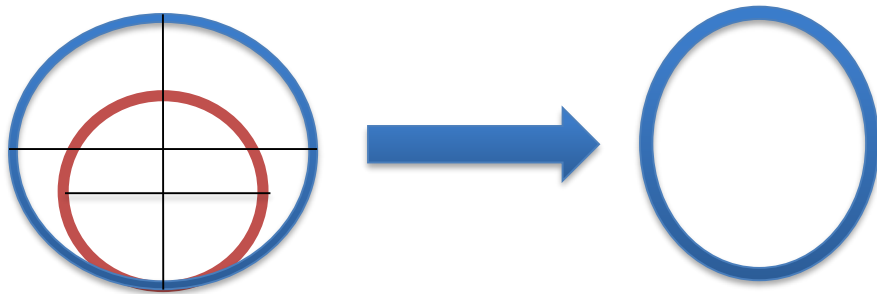


Figure 21: Combination of two offset circular rotational results in an ellipse

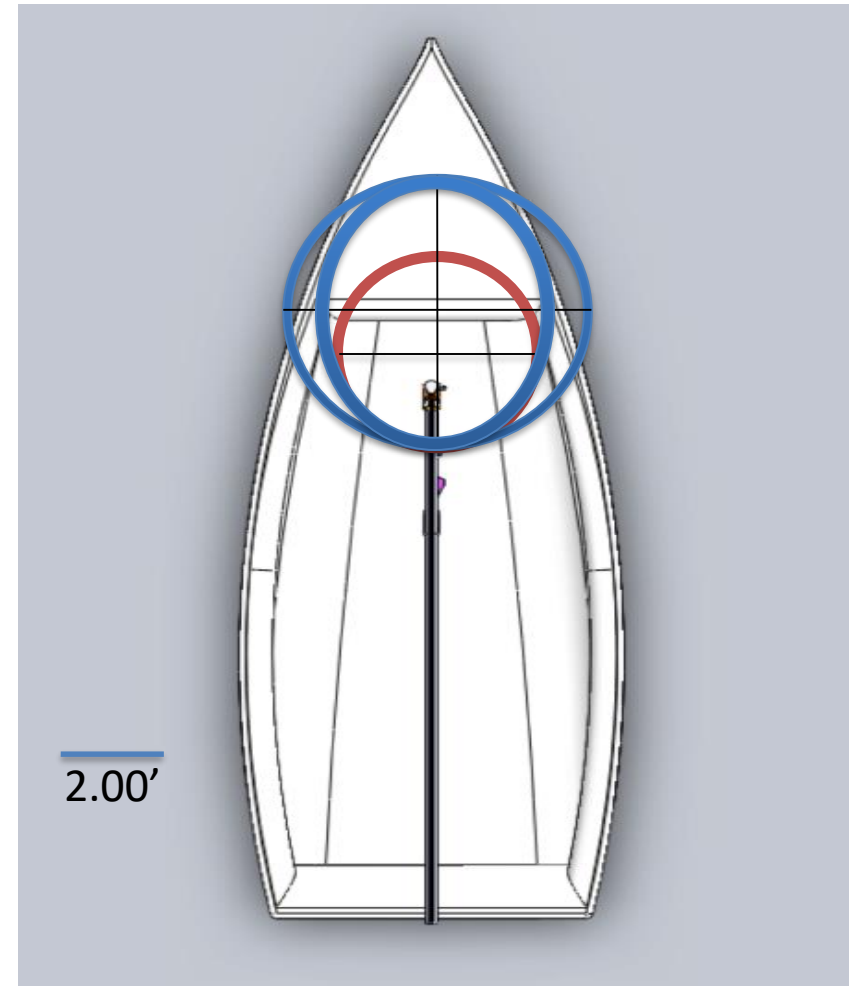
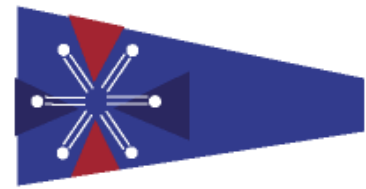


Figure 22: Accelerometer Path outlined on a Club 420 Sailboat



- 'D' Ring bracket
 - Allows for secure mounting when it is not possible to wrap lines around boom
 - Glued to boom, most likely point of failure

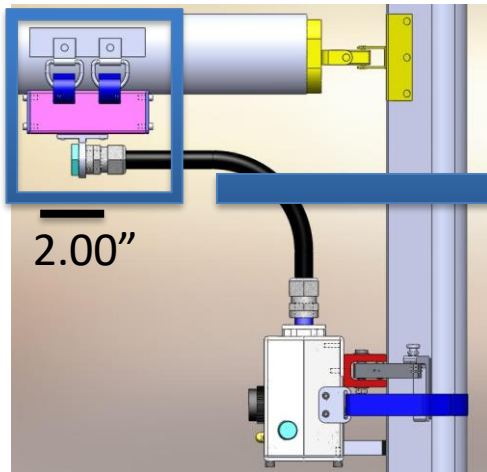


Figure 23: BoomAlert clamped at gooseneck

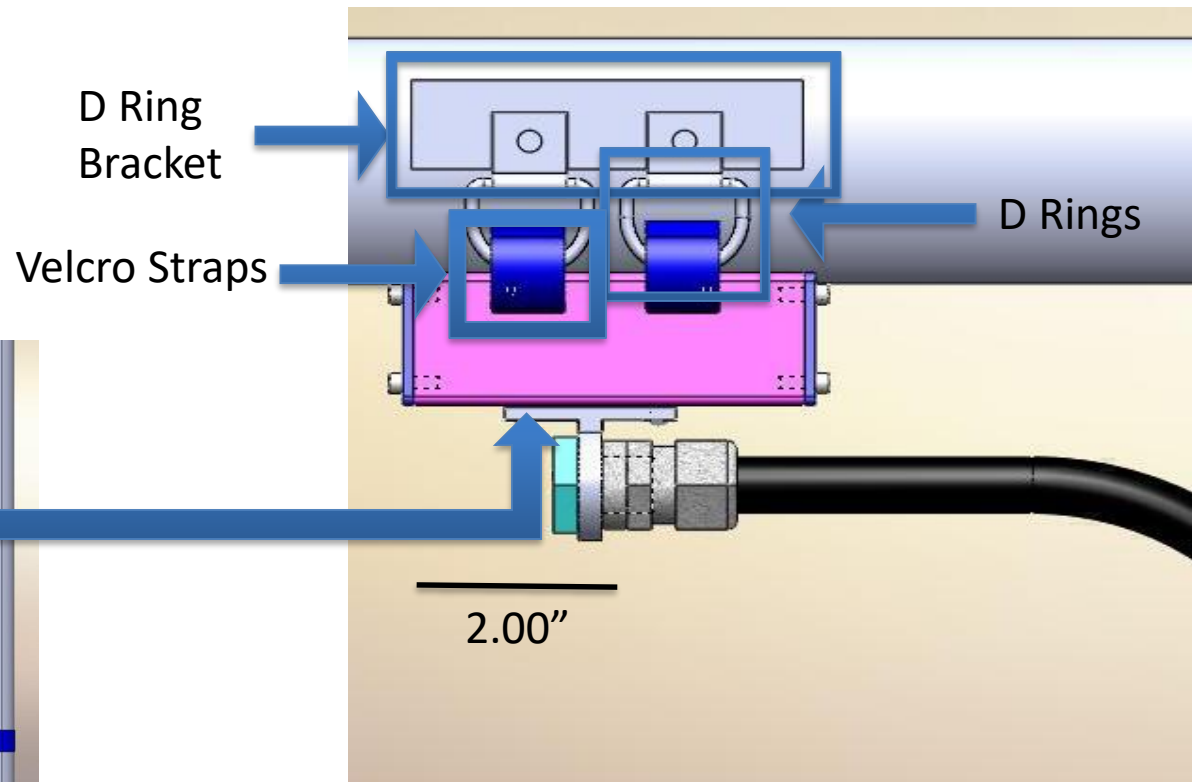
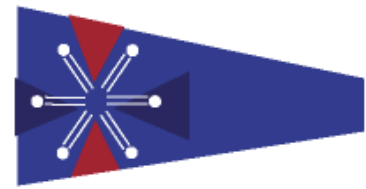


Figure 24: Track mounting detail

Clamping system for box



- Consists of two assemblies
 - 'C' extrusion
 - Polypropylene Strap
- Feet lined with neoprene rubber
 - 316 Stainless Steel (ASTM A582/A582M-05)
 - Coefficient of static friction $\mu_s = 0.48$
- Arms
 - 316 Stainless Steel (ASTM A582/A582M-05)
- Spring
 - Wire Diameter = 0.08"
 - Spring constant $K = 125 \text{ lbs/in}$

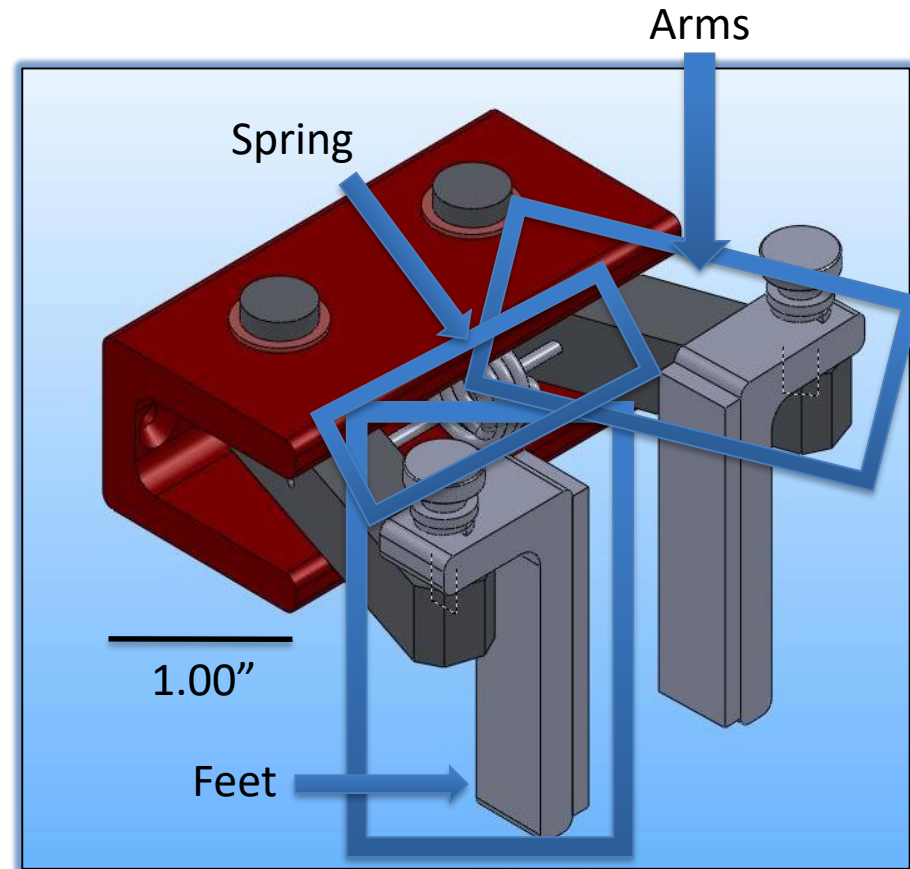
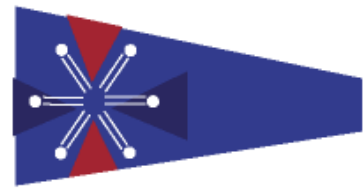


Figure 25: Box Clamping System

Polypropylene strap attachment



- Polypropylene strap
 - Tensile Strength = 300lbs per (ASTM D6775-02)
 - Lined with neoprene rubber, coefficient of static friction $\mu_s = 0.48$
- Strap Bracket
 - 316 Stainless Steel (ASTM A582/A582M-05)
- Bumper
 - Lined with neoprene rubber $\mu_s = 0.48$

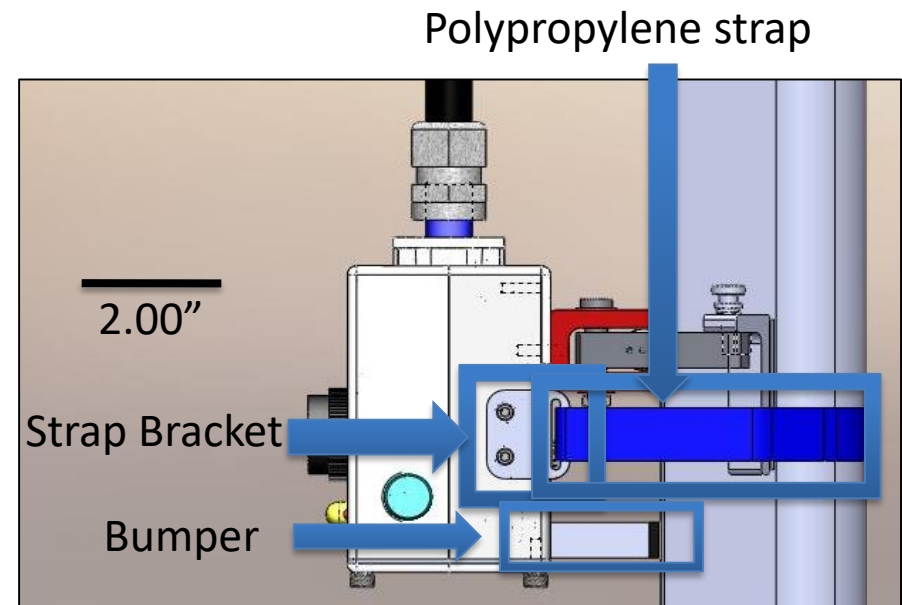
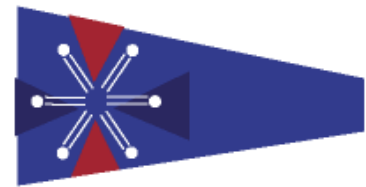


Figure 26: *BoomAlert* clamped on to mast

Market analysis



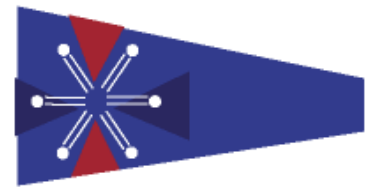
Total Cost of *BoomAlert*, per unit

Components and Manufacturing	\$ 158.68
Conservative	\$ 238.02
Profit	50%
List Price	\$ 357.03
Total Cost	\$ 464.14

Yearly profit, including cost of liability insurance
and market capitalization

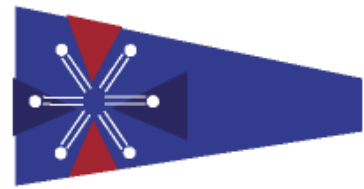
Year	1	2	3
Average US Boats Sold	14318.63	14318.63	14318.63
Market Capitalization	1.0%	2.0%	5.0%
Total <i>BoomAlerts</i>	429.5589	859.1178	2147.7945
Liability Insurance	\$20,000	\$20,000	\$20,000
Year-End Profit	\$ 31,121.80	\$ 82,243.61	\$ 235,609.02
Three Year Sum	\$ 348,974.44		

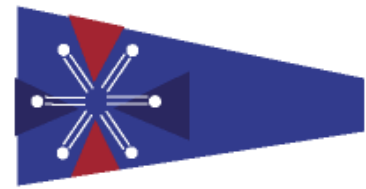
Comparison with Preliminary Design Specification



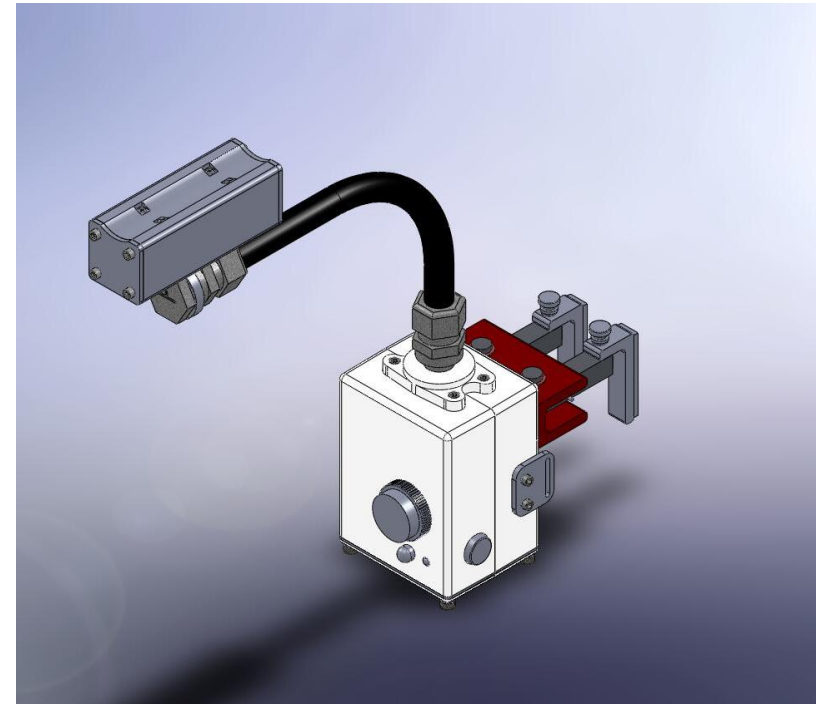
	PDS	Actual
Material	Nylon 6/12	HDPE T50-200
Weight	4.41 pounds	10 pounds
Size	No larger than 20'' x 3''	14.07'' x 13.03'' x 3.52''
Batteries	Change every 3 years	Change after every season
Component Cost	\$126.78	\$158.68
Performance	Minimum time of 0.15 sec to react	Given 0.4 seconds to react

Demonstration



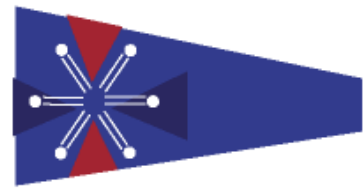


- For novice sailors, boom accidents are the #1 cause of injury
- *BoomAlert*
 - will warn the crew of rapid boom movements
 - is an improvement over the prior art
 - is economically feasible



We are pursuing intellectual property

We will be publicizing *BoomAlert* and look forward to public interest and comment



Questions?