



# **Release Lanyard Project**

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# Overview

- ▶ Client
- ▶ Problem Statement
- ▶ Current Design
- ▶ New Design
- ▶ Testing
- ▶ Conclusion

# Client

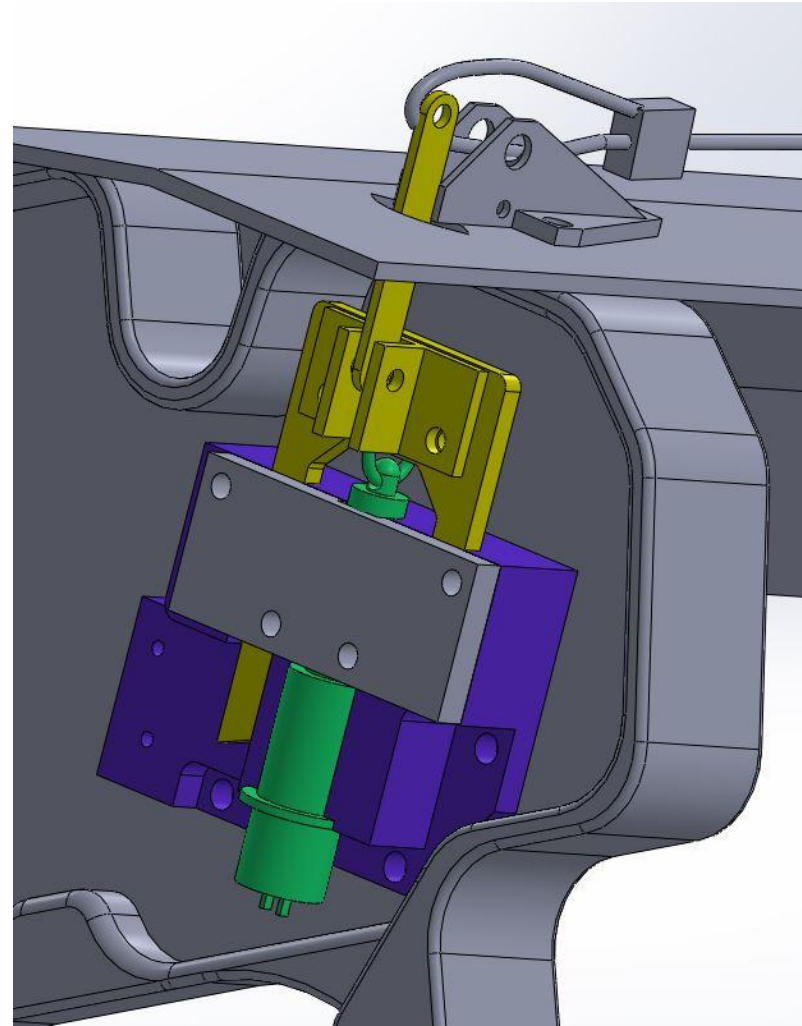
**Raytheon**

**Missile Systems**

- ▶ Raytheon
  - Founded in 1922
  - Global presence in 19 countries
  - Products developed and manufactured:
    - Microwave
    - Radar Systems
    - Missile Systems
    - Infrared Systems

# Release Lanyard

- ▶ Is used to arm the weapon
  - Transfers a mechanical force to an electrical signal
  - Once the slider is pulled, power is supplied to activate the weapon



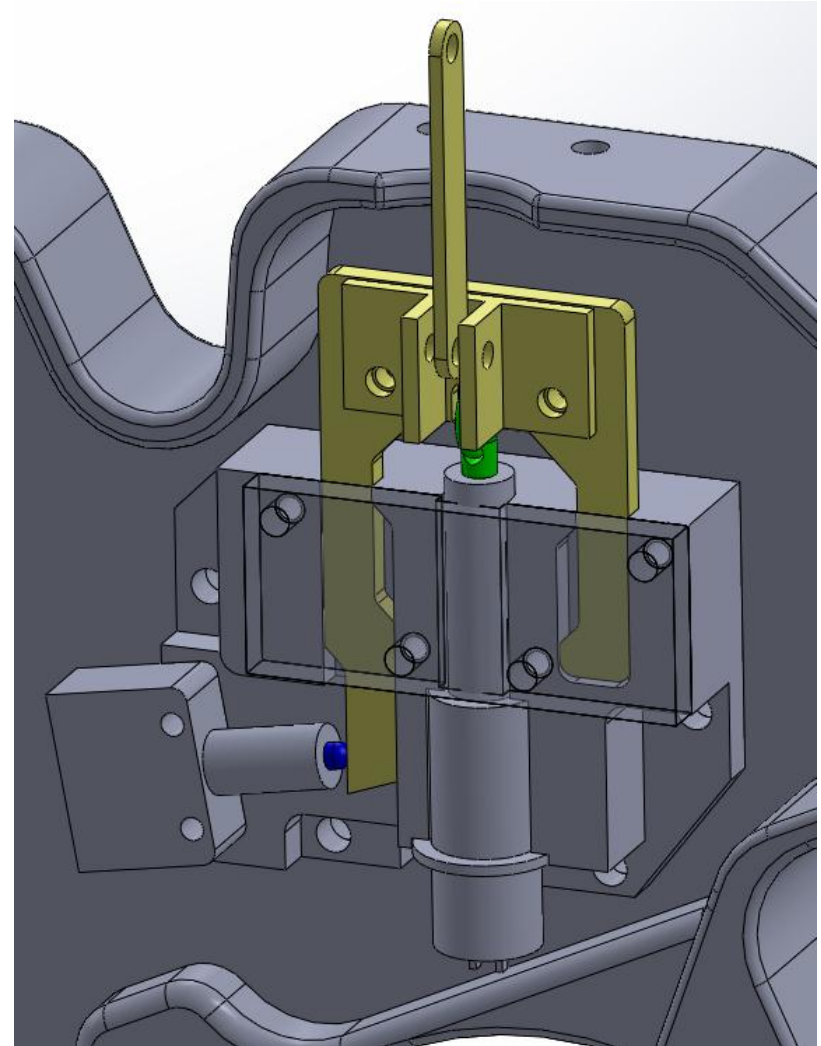
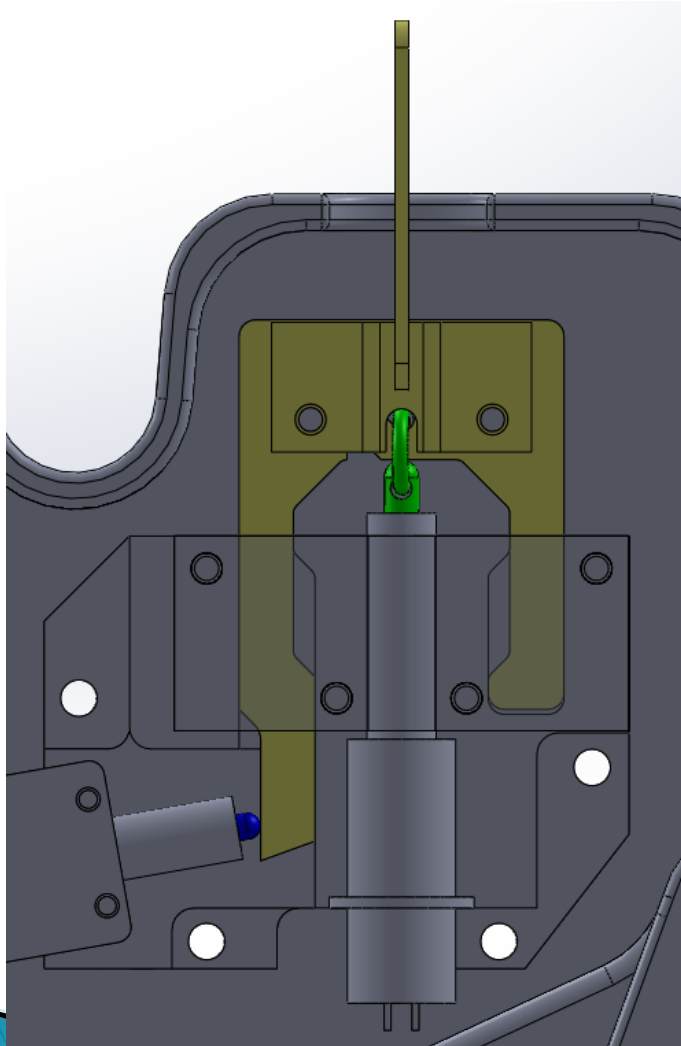
# Problem Statement

- ▶ Weapon systems are not activating
  - Due to freezing temperatures and debris
- ▶ Encounter poor installation
- ▶ Current design cost is too high

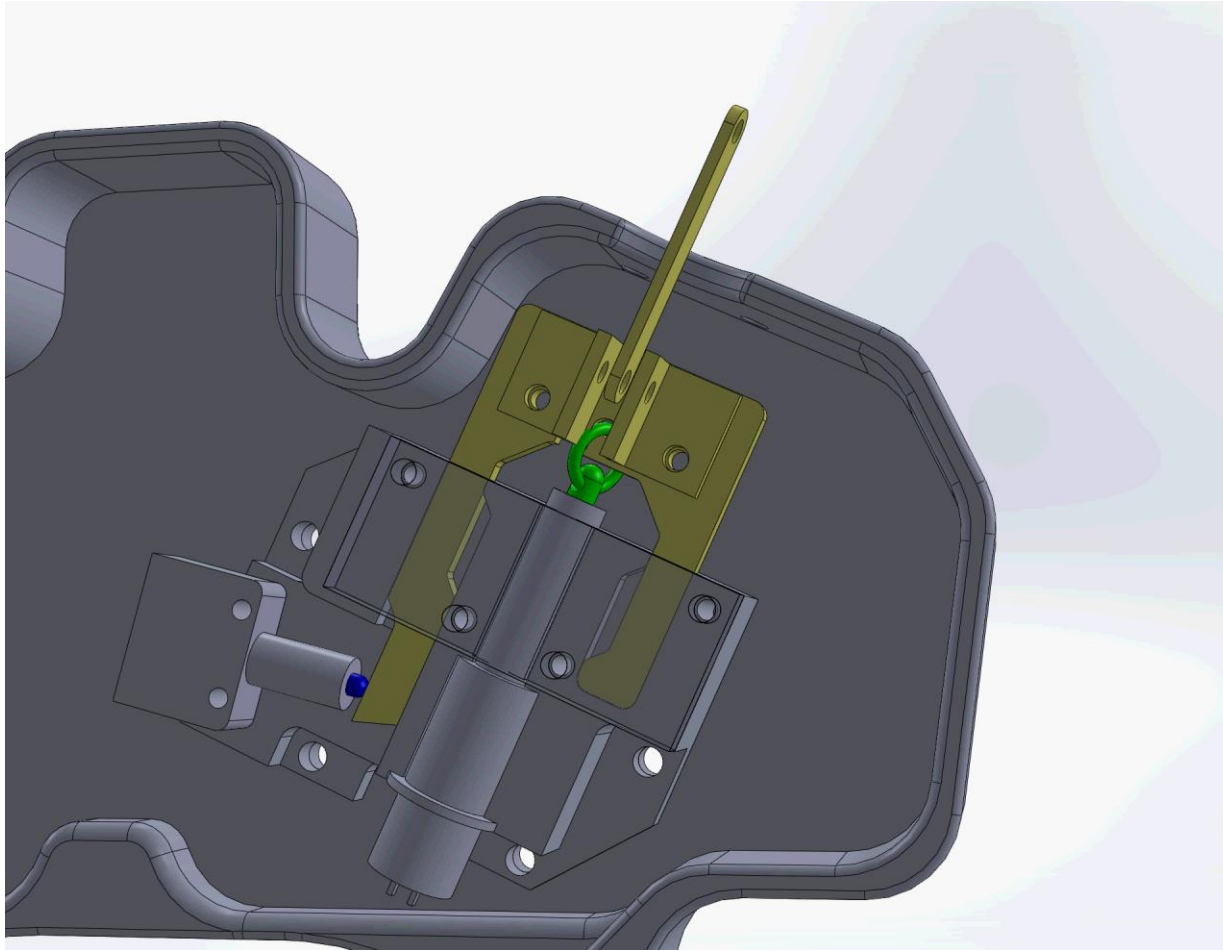
# General Constraints

- ▶ Temperature range  $-60^{\circ}\text{F}$  to  $200^{\circ}\text{F}$
- ▶ Activation force range of 35 to 60lbf.
- ▶ Breaking force of linkage 75lbf.
- ▶ Keep new design under \$300

# Current CAD Design

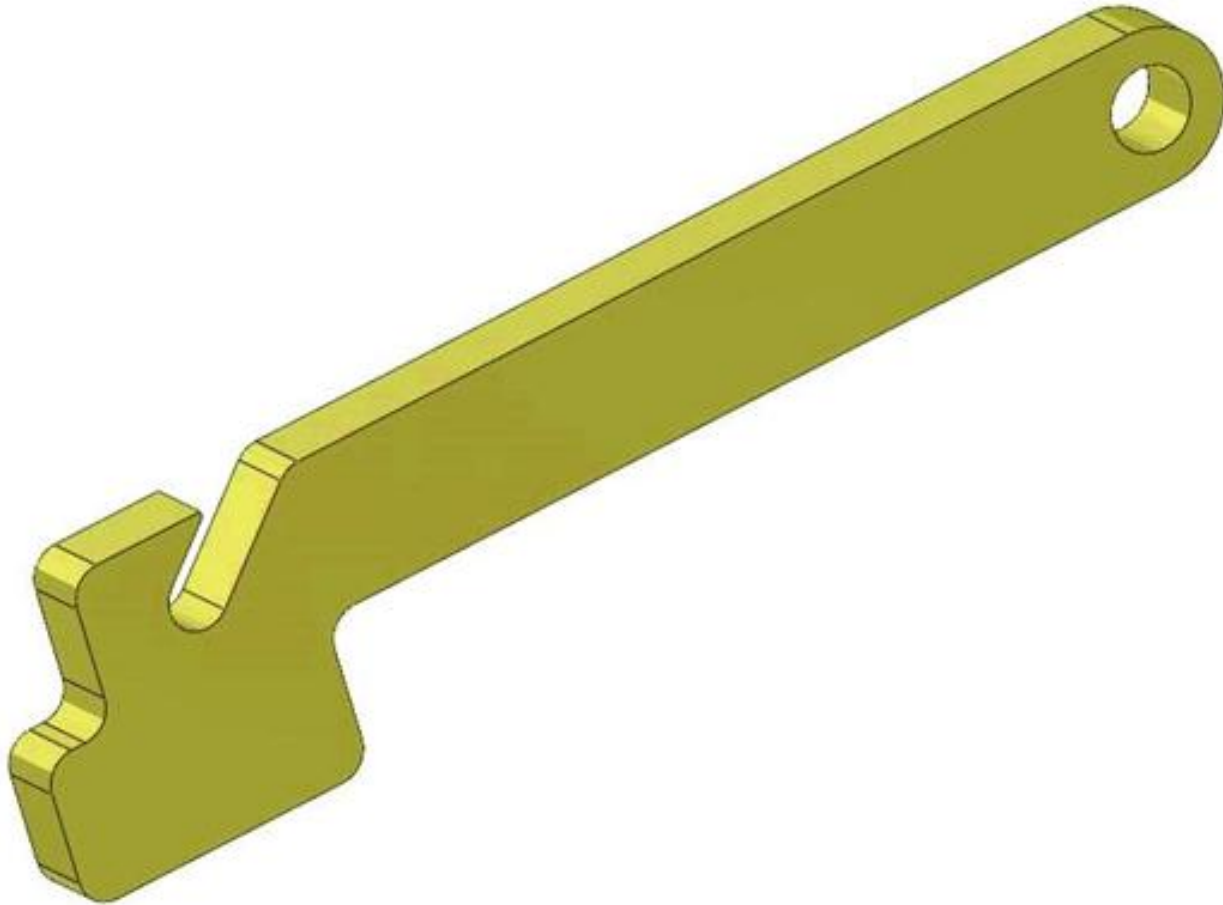


# Current Activation Slider

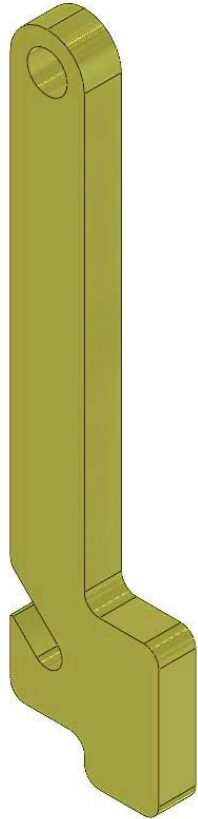




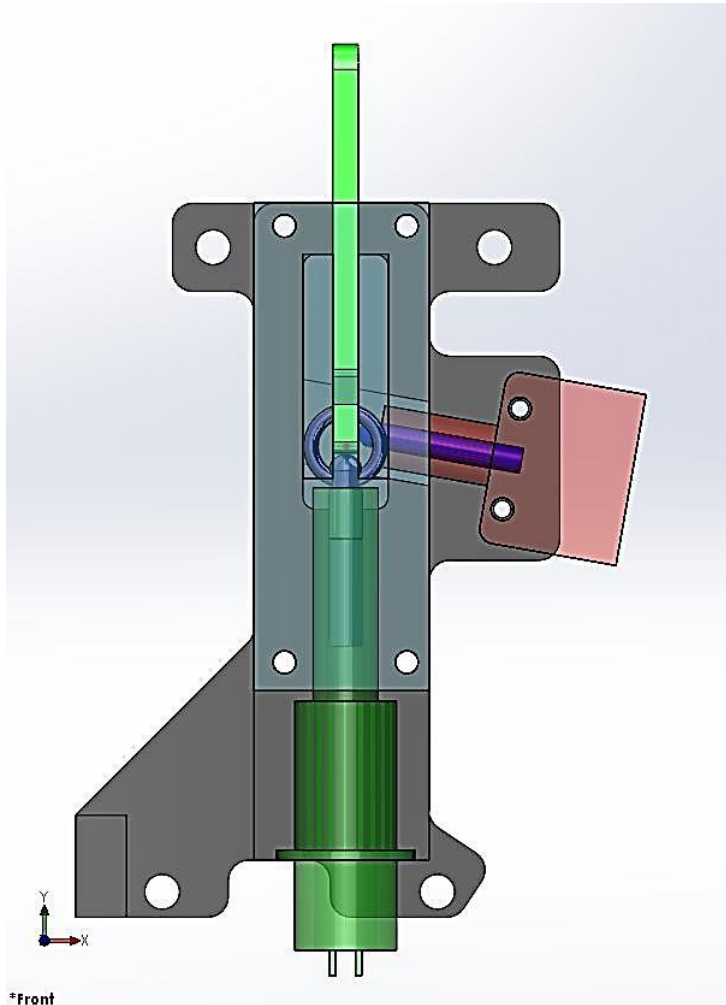
# New Slider Design



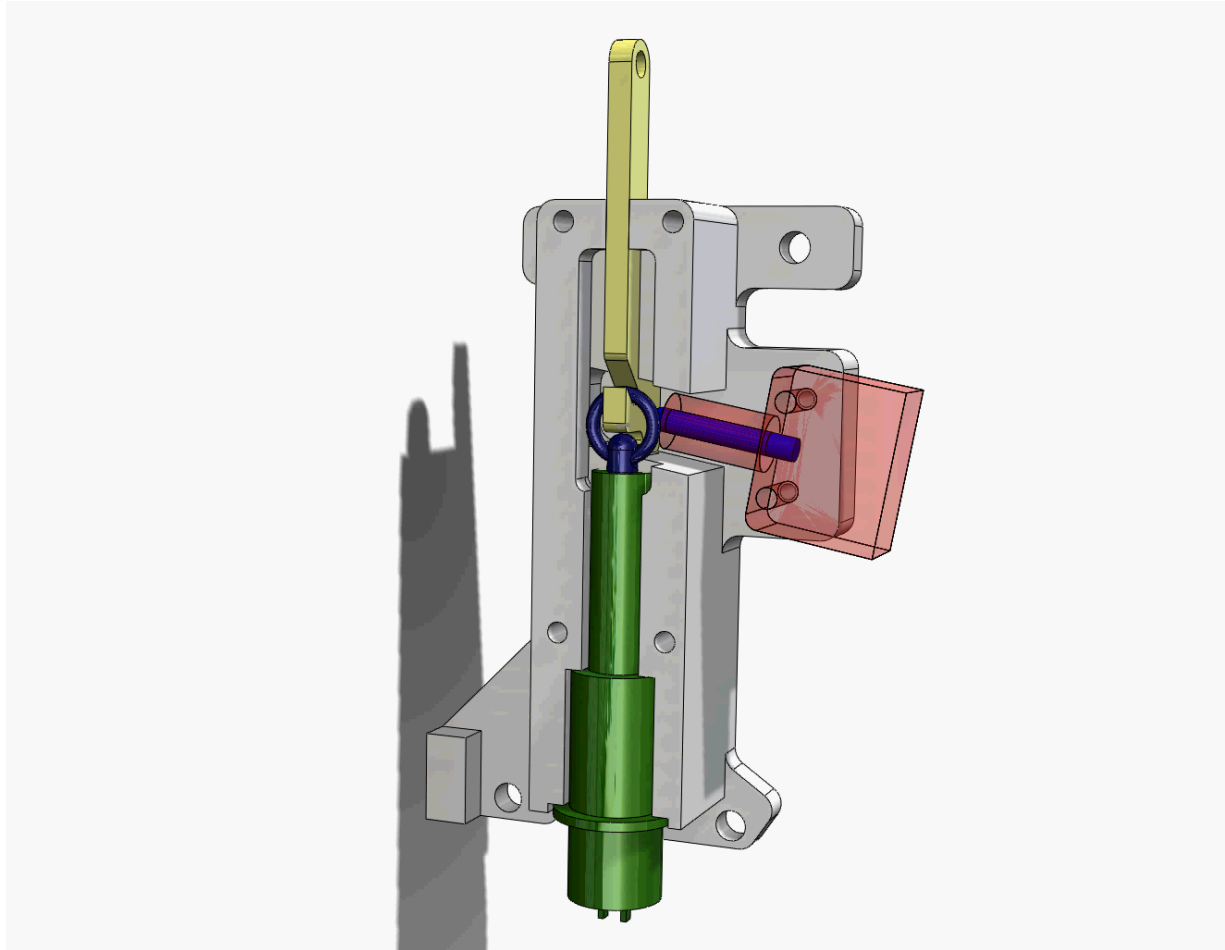
# New CAD Design



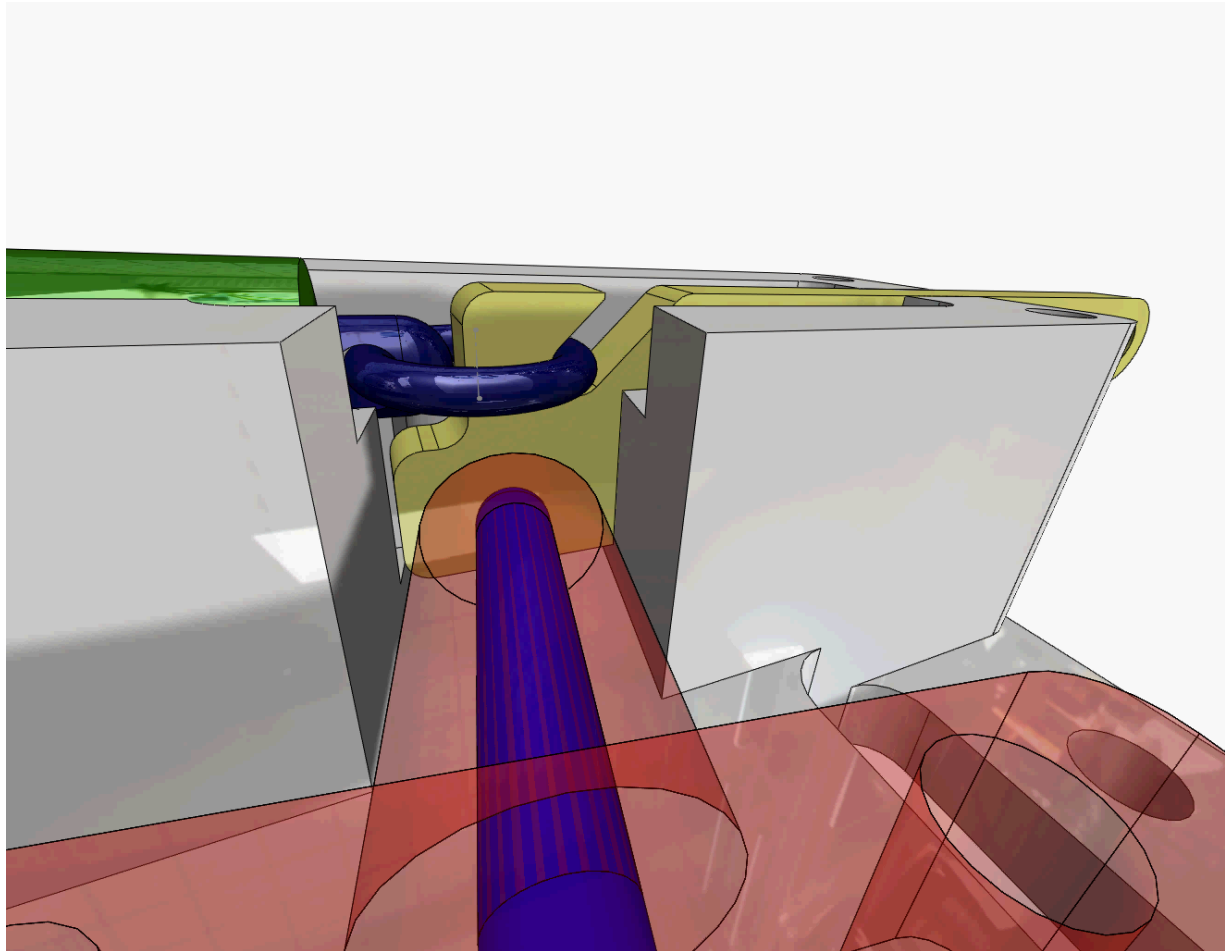
\*Isometric



# New Activation Slider

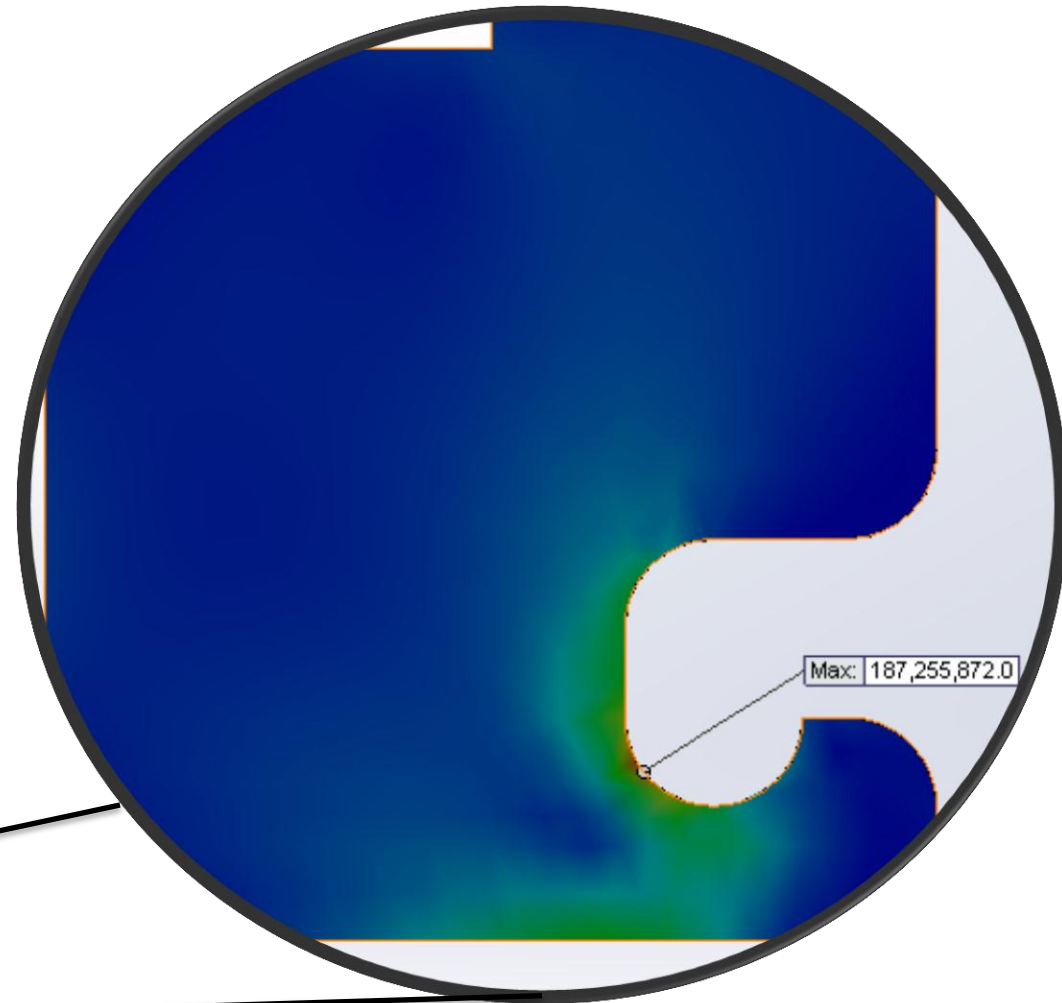
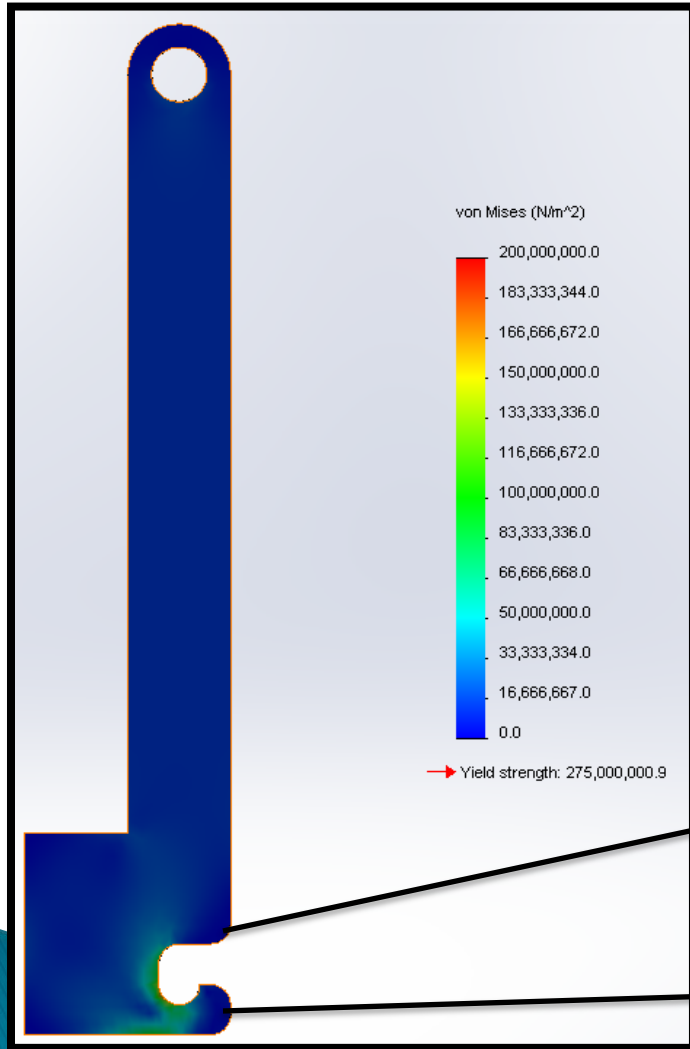


# New Activation Slider



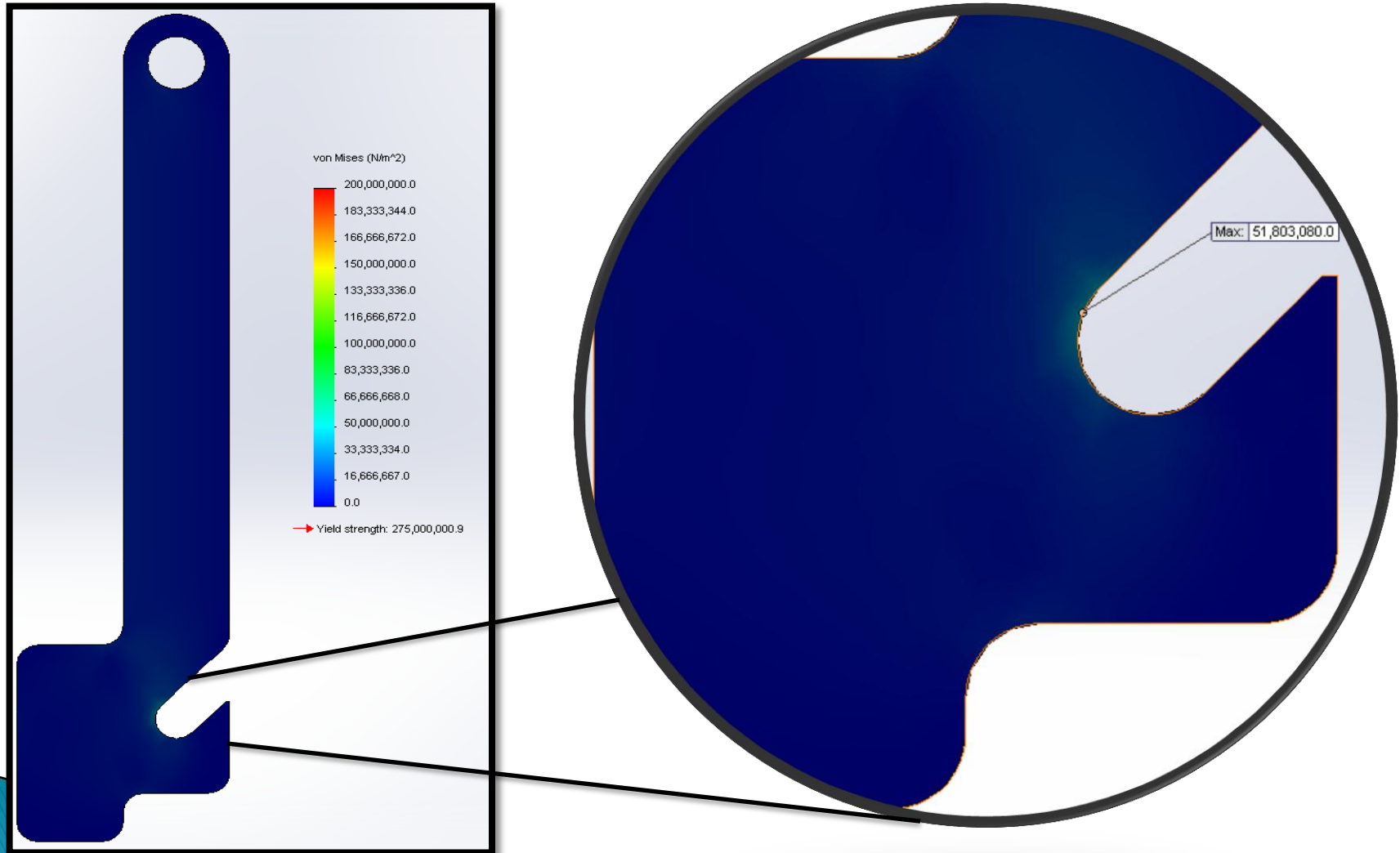
# Finite Element Analysis

First Iteration



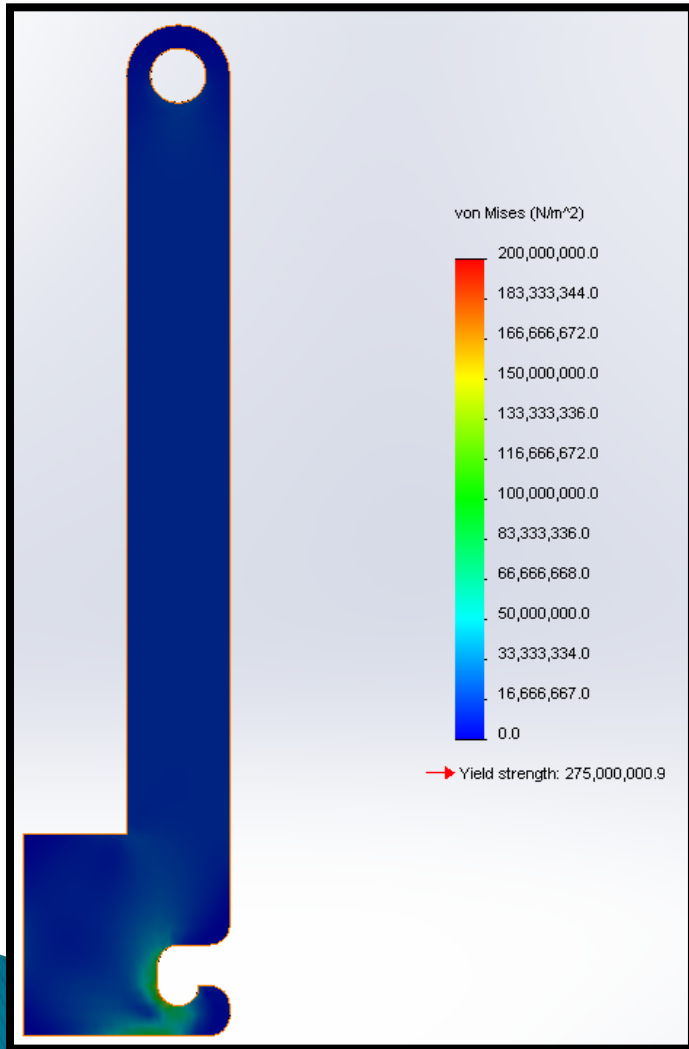
# Finite Element Analysis

Final Iteration

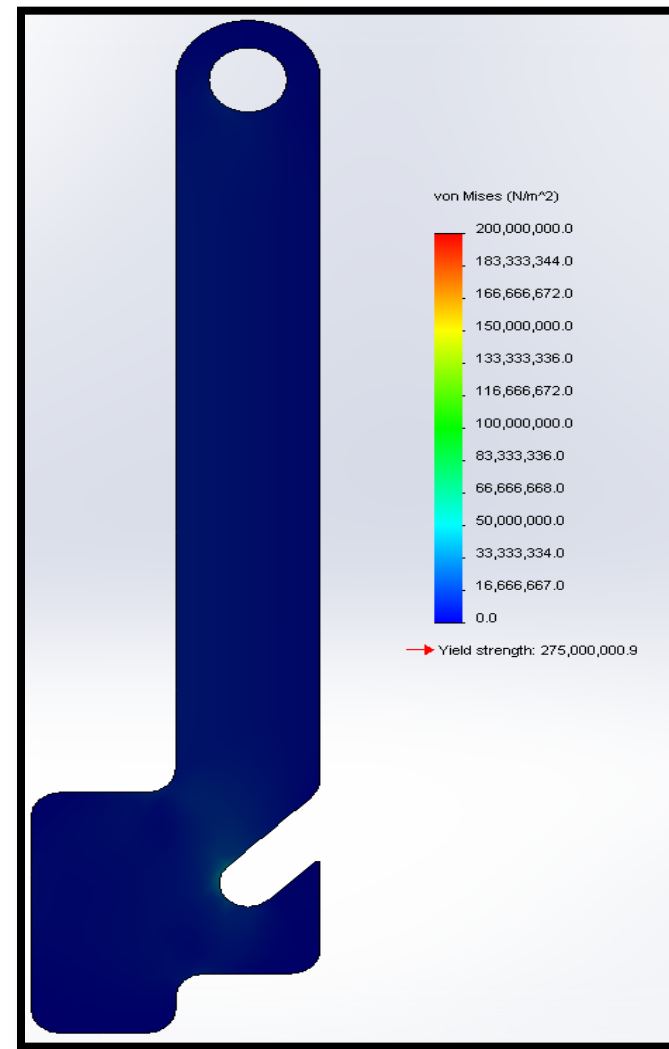


# Finite Element Analysis

## First Iteration

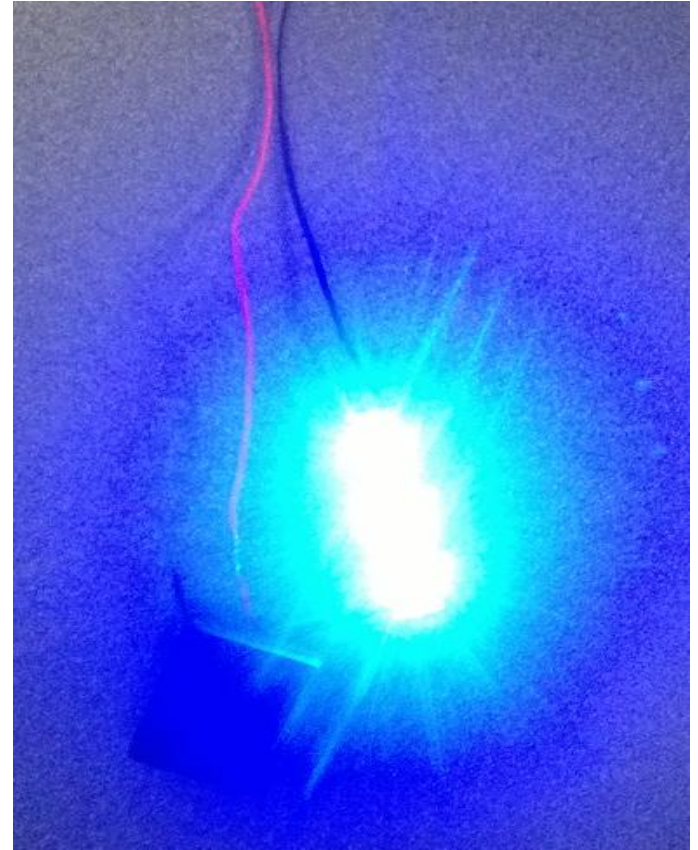
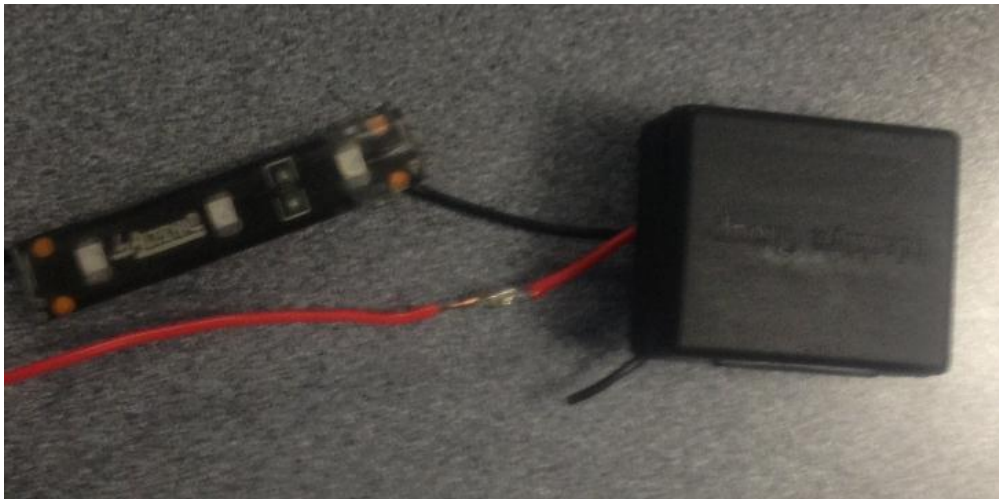


## Final Iteration



# Model Testing

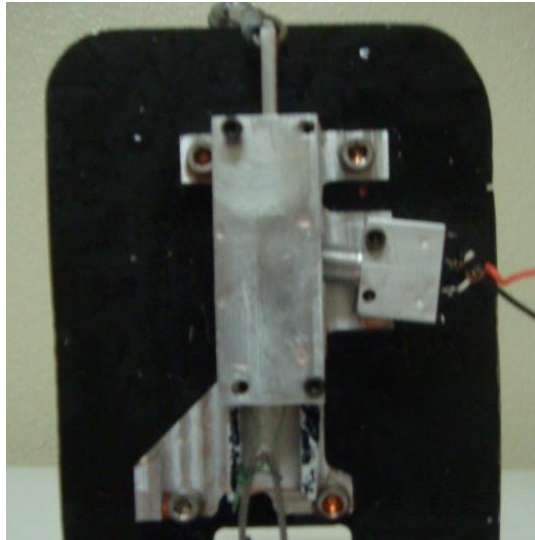
- ▶ Materials
  - Battery
  - Light
  - Electrical wire
  - Battery mount



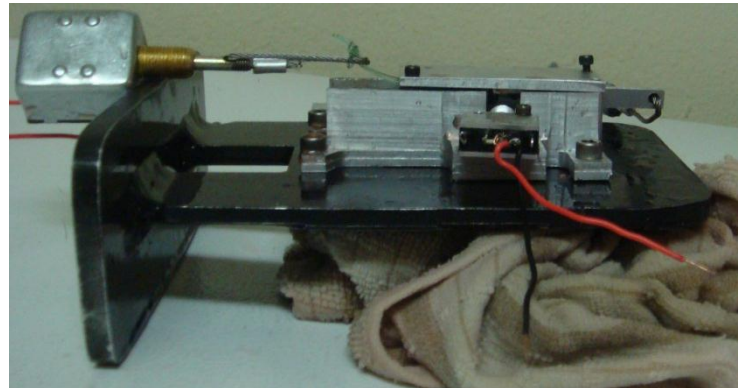


# Experimental Testing

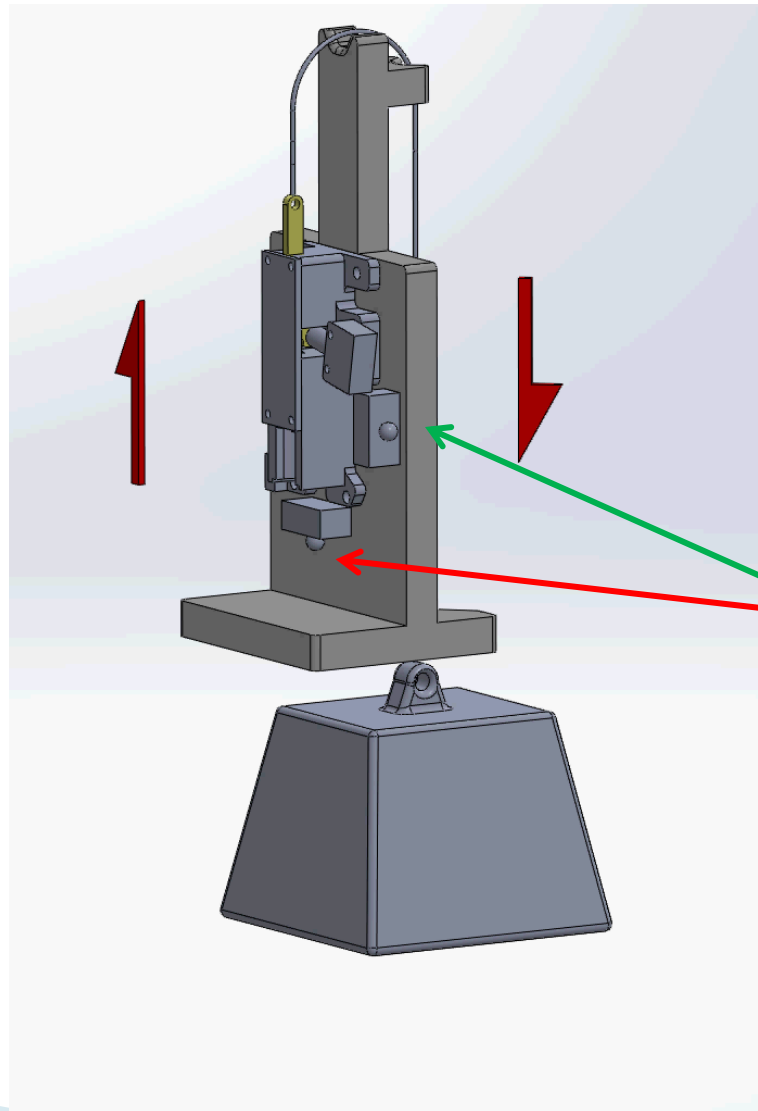
- ▶ 30 minute freeze time
- ▶ Spray every 10 minutes
- ▶ 2 types of freezing orientations



Vertical (Moderate Icing)

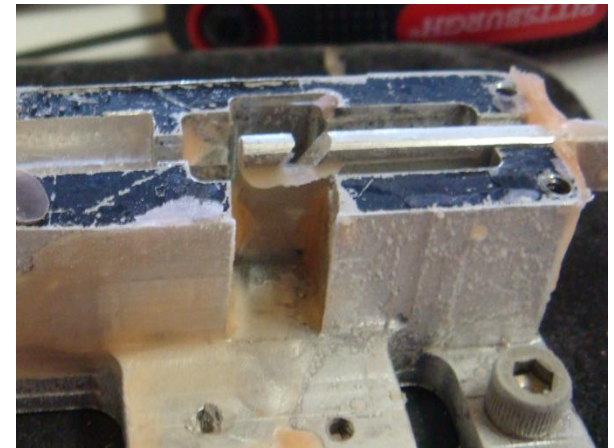
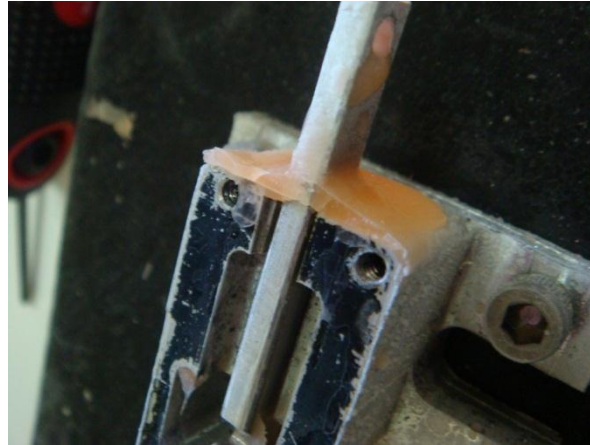
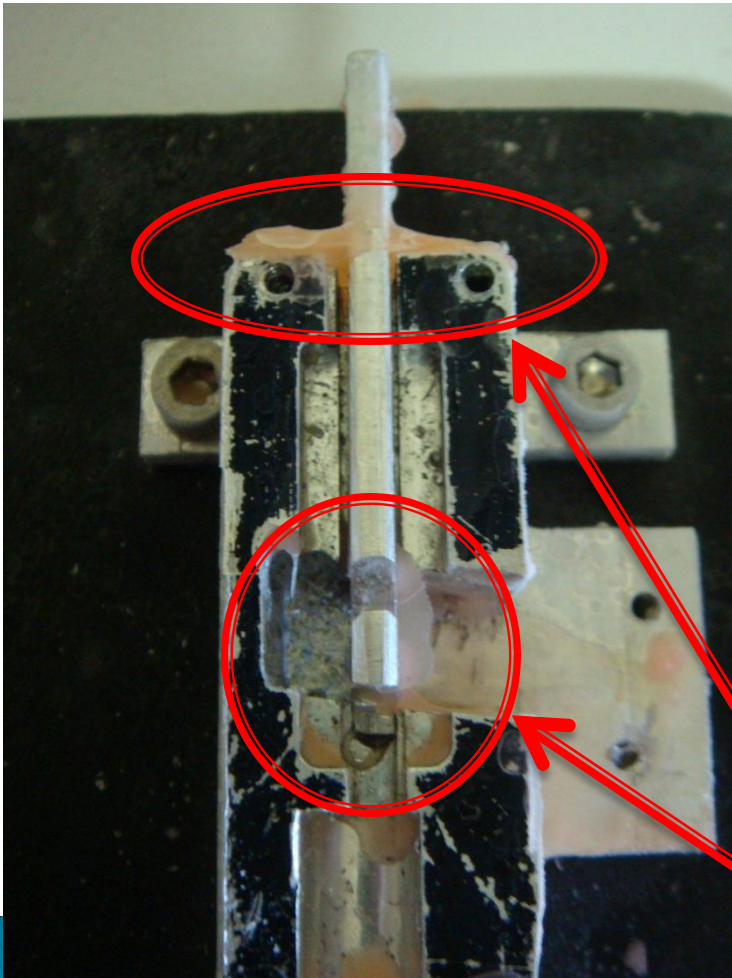


Horizontal (Heavy Icing)



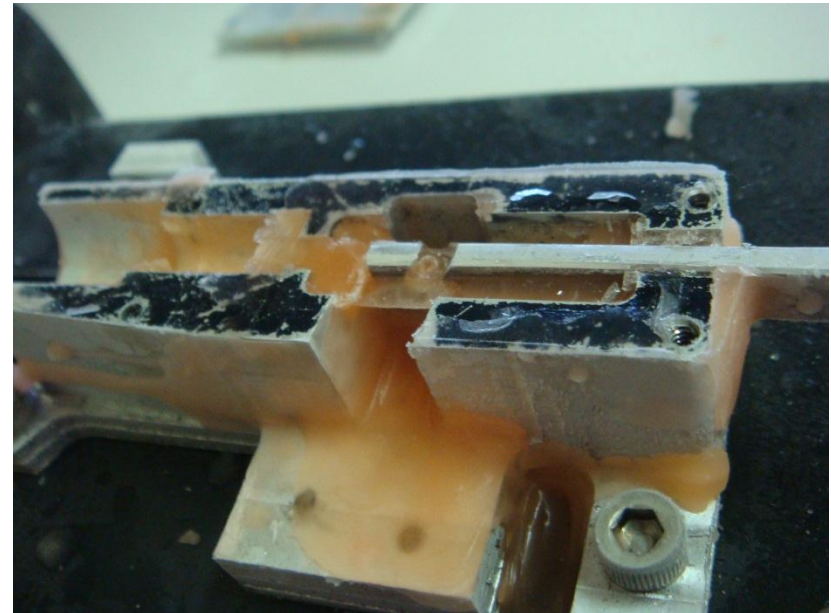
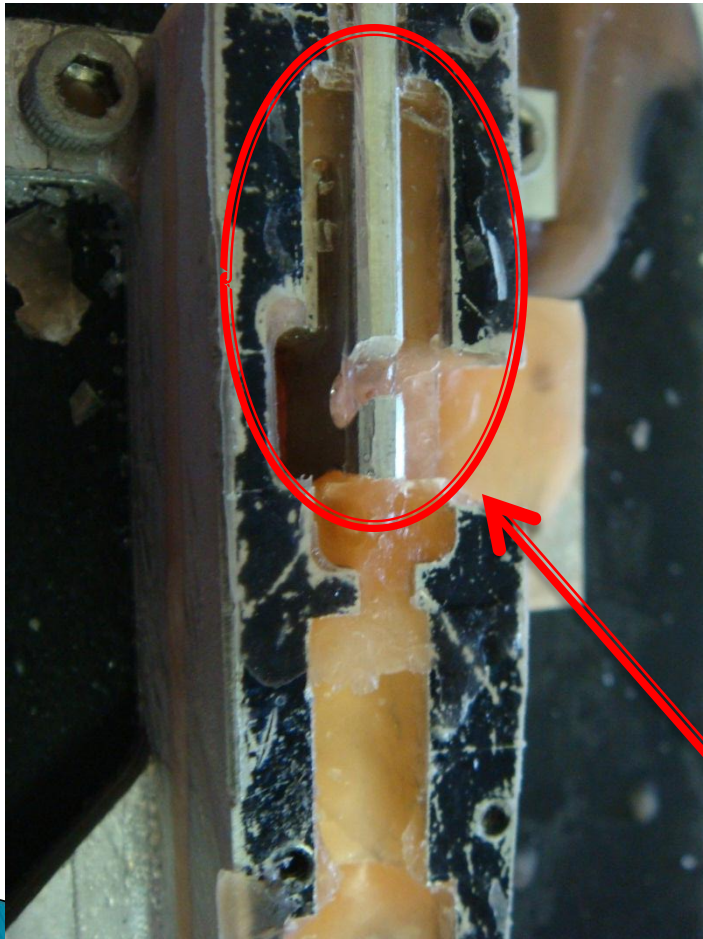
Successful  
Activation

# Testing Conditions (Moderate)



**Problem Regions**

# Testing Conditions (Heavy)



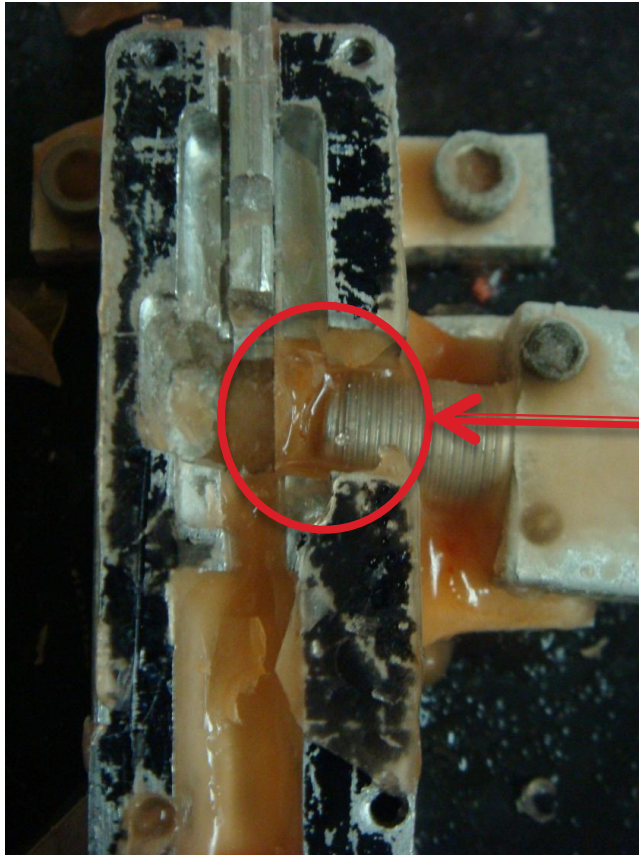
## Problem Regions

Northern Arizona University  
Department of Mechanical Engineering

# Testing Results

	No Ice Build-up	Moderate			Heavy		
Weight (lbs.)	1	1	2	3	1	2	3
35	Pass	Fail	Pass	Fail	Fail	Fail	Fail
40	Pass	Pass	Fail	Fail	Fail	Fail	Fail
45	Pass	Pass	Fail	Fail	Fail	Fail	Fail
50	Pass	Pass	Fail	Pass	Pass	Pass	Fail
55	Pass	Pass	Pass	Pass	Pass	*Fail*	Fail
60	Pass	Pass	Pass	Pass	Pass	Pass	Pass

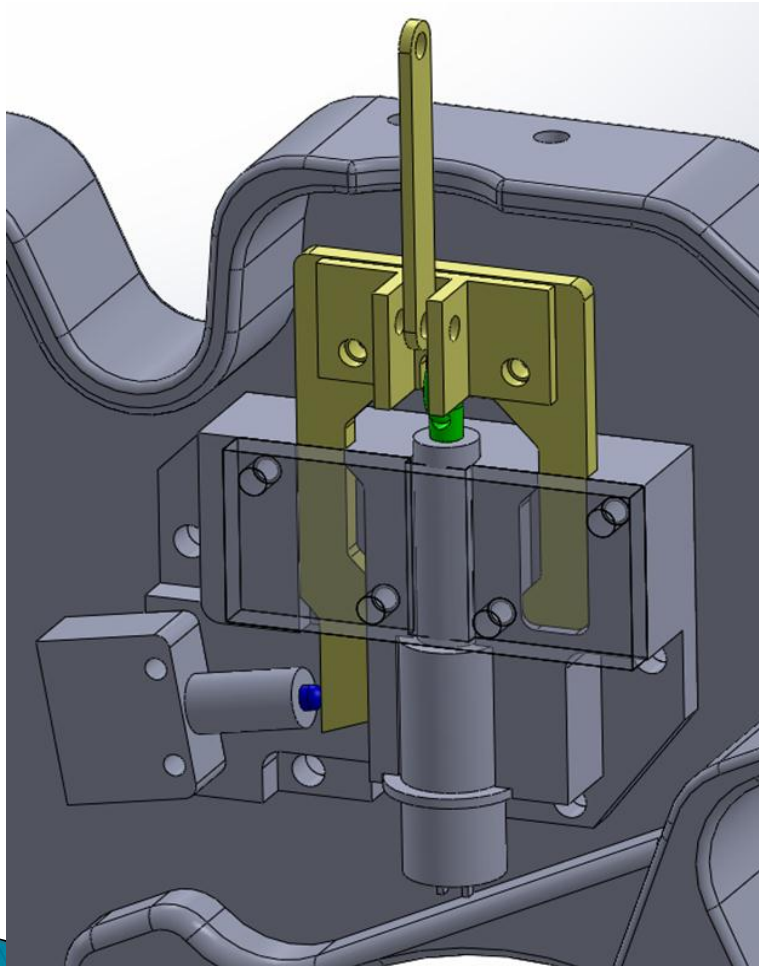
# \*Fail\*



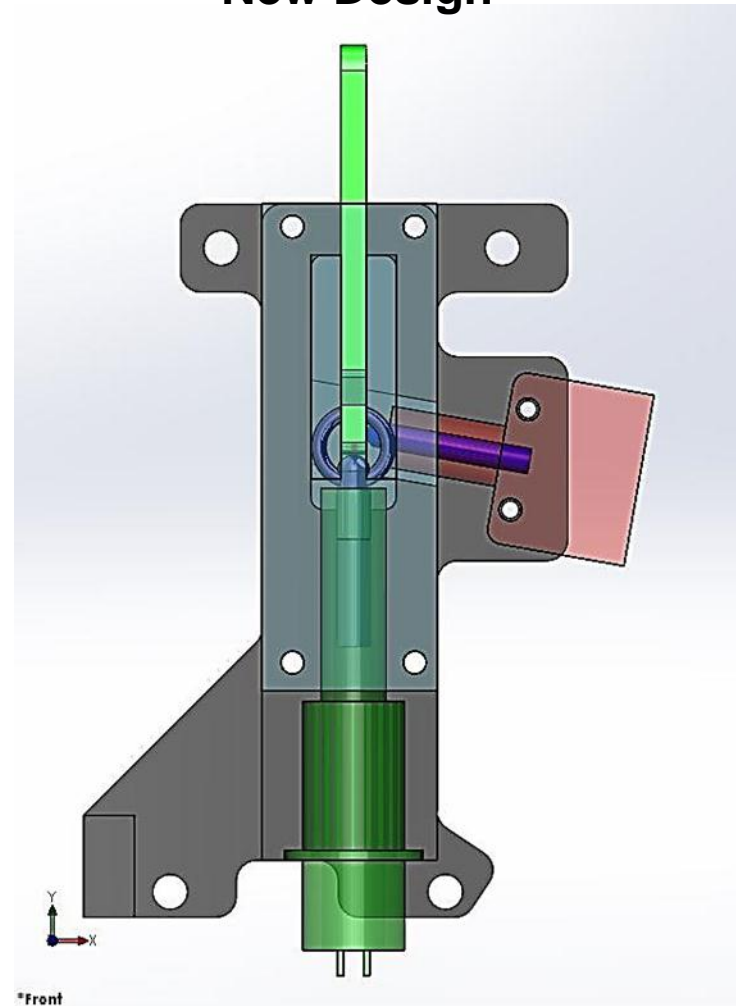
Switch Failure

# Comparison

## Current Design



## New Design



# Comparison

	Current Design	New Design	Reduction (%)
Volume (in <sup>3</sup> )	5.50	5.36	-2.55
Mass	0.21	0.21	-0.28
S.A. (in <sup>2</sup> )	63.22	58.84	-6.93
Concerning S.A. (in <sup>2</sup> )	11.48	6.74	-41.29
Mechanical Components	64.00	52.00	-18.75
Assembly Operations	6.00	4.00	-33.33
Machining Hours	2.60	2.10	-19.23
Machining Costs (\$)	200.00	150.00	-25.0



# Conclusion

## ▶ Problem Statement

- Current weapon systems are not activating
  - Due to freezing temperatures and debris
- Encounter poor installation
- Current design cost is too high

## ▶ New Design

- Improvements:
  - Works under extreme conditions
  - Fewer parts
  - Easier to install

# Acknowledgments

- ▶ Stephen Larimore
  - Raytheon Department Manager
- ▶ Kelly Covington
  - Raytheon Mechanical Engineer
- ▶ Shawn Vause
  - Raytheon Process Engineer

# Questions?