NORTHERN ARIZONA UNIVERSITY

Payload Separation System

Midpoint Review

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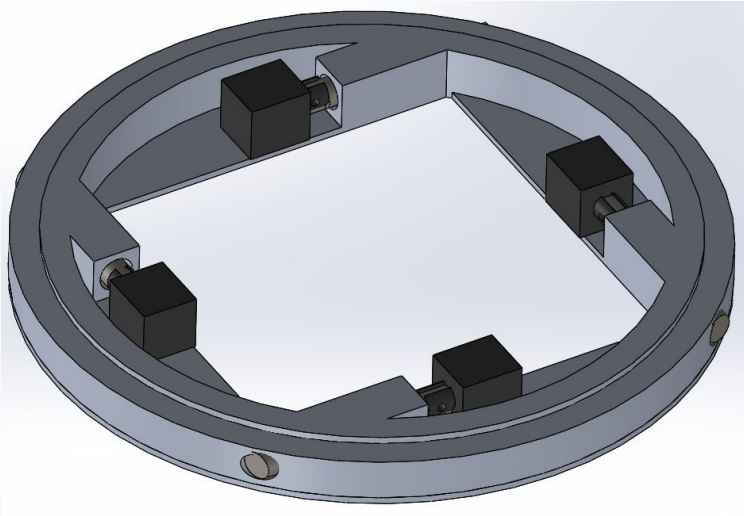
Orbital

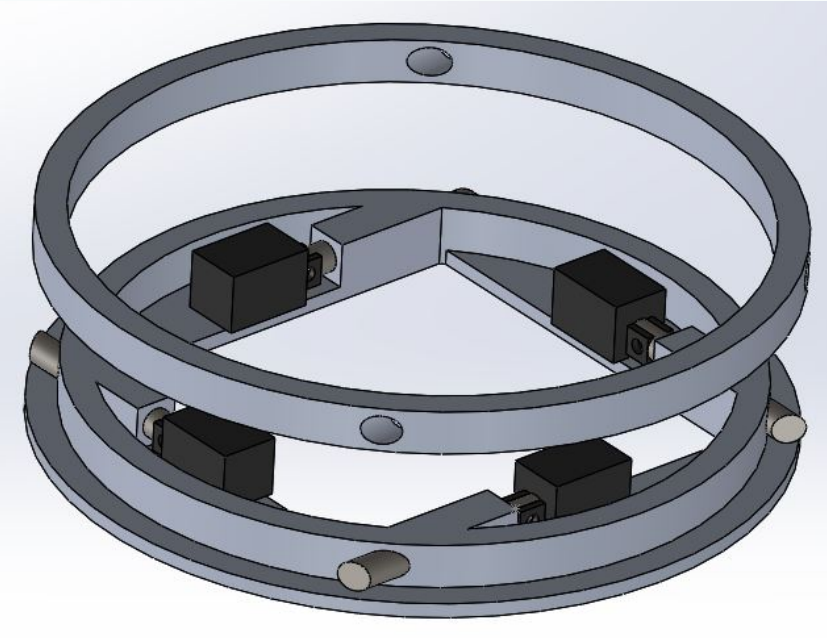
Overview

- Final Design
  - Payload Ring
  - Rocket Ring
  - Solenoids
  - Keys
  - Kickoff Springs
- Back Up Plan
- Final Failure Analysis
- Testing
  - Key and PR Failure
  - Separation and Reliability
  - Spring Testing
- Bill of Materials
- Gantt Chart
  - Spring 2014
- Conclusion
- References

Final Design



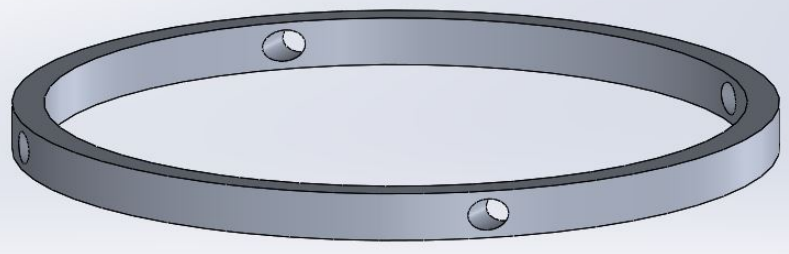
Engaged

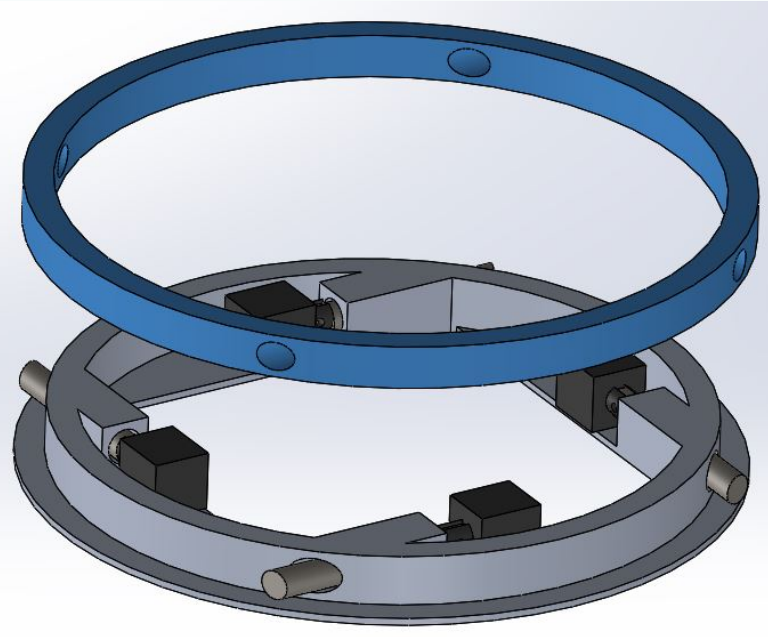


After Separation

Payload Ring

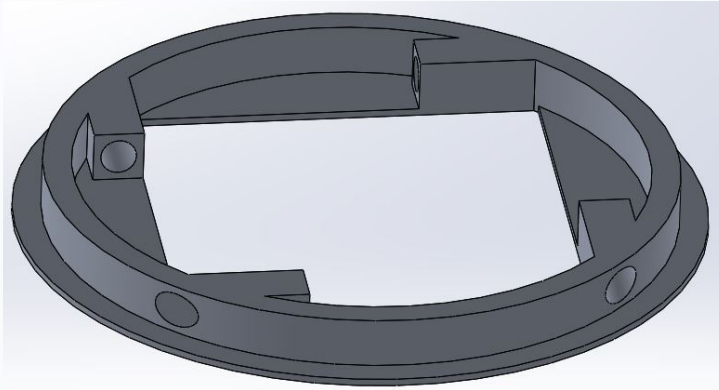
- Begin with 12” x 12” x 1” Al
- G-code generated by CAMworks in SolidWorks
  - Contour path cuts out inner diameter plate
- Outer diameter turned on a lath

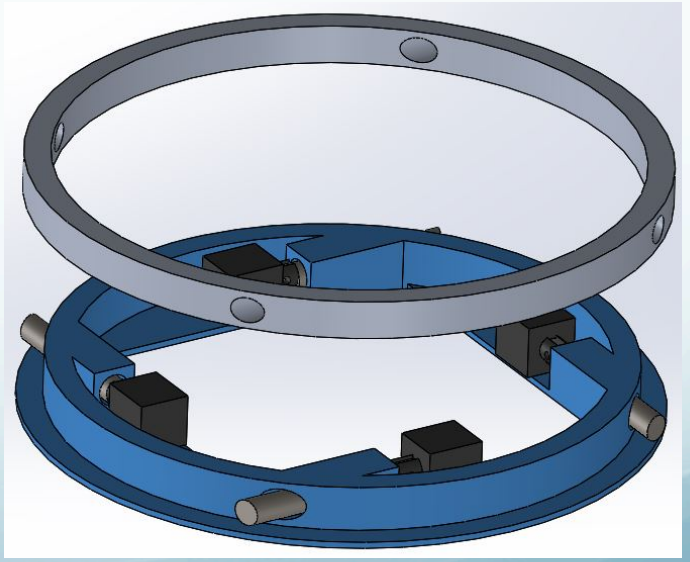




Rocket Ring

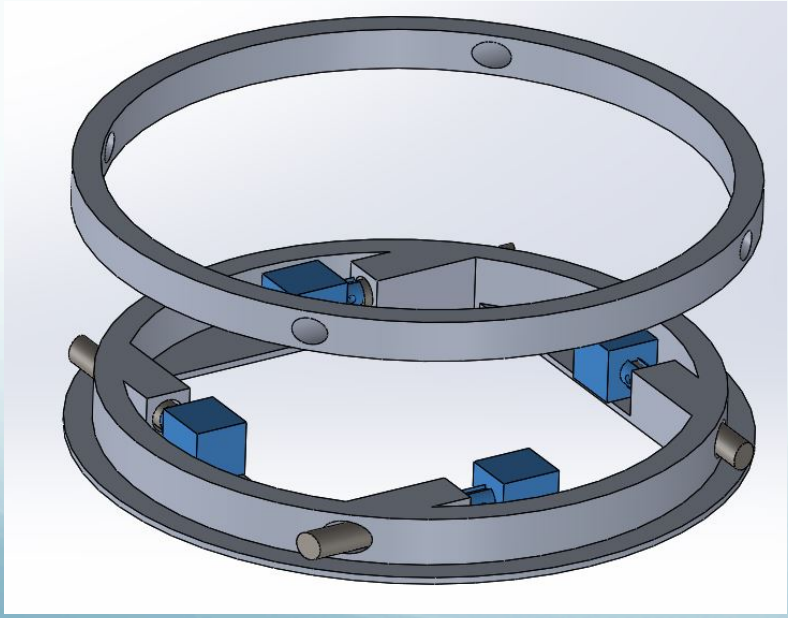
- Similar to Payload Ring
- G-code in Haas
  - Milled out center square plate with contour path
  - Milled out pockets for base plate and key housing
- Turned off ears of outer square plate with lathe
- Turned outer lip using lathe
- Hand milled key holes in the housing
- Cut shallow recess for spring using hand mill

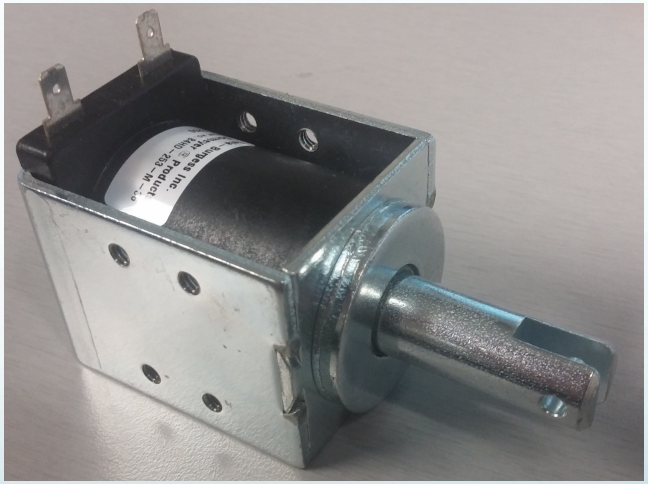




Solenoid

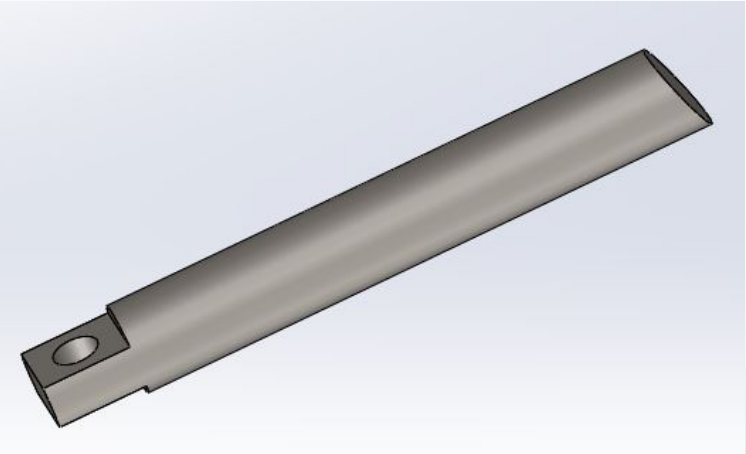
- Steel keys will be secured to the plunger
- Solenoids will be bolted to base plate
- Purchased from Newark element14
  - 4801 N Ravenswood Ave, Chicago, IL 60640

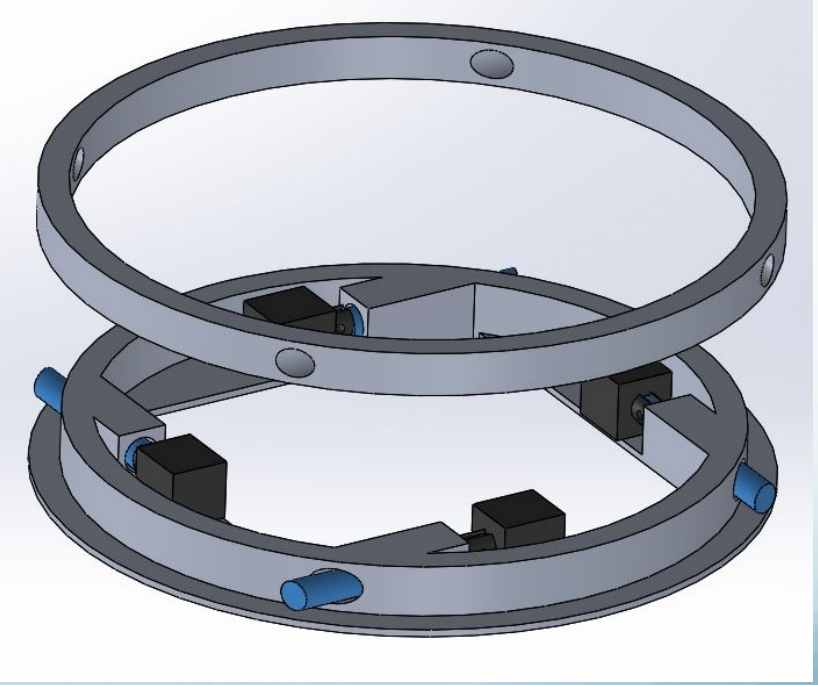




Keys

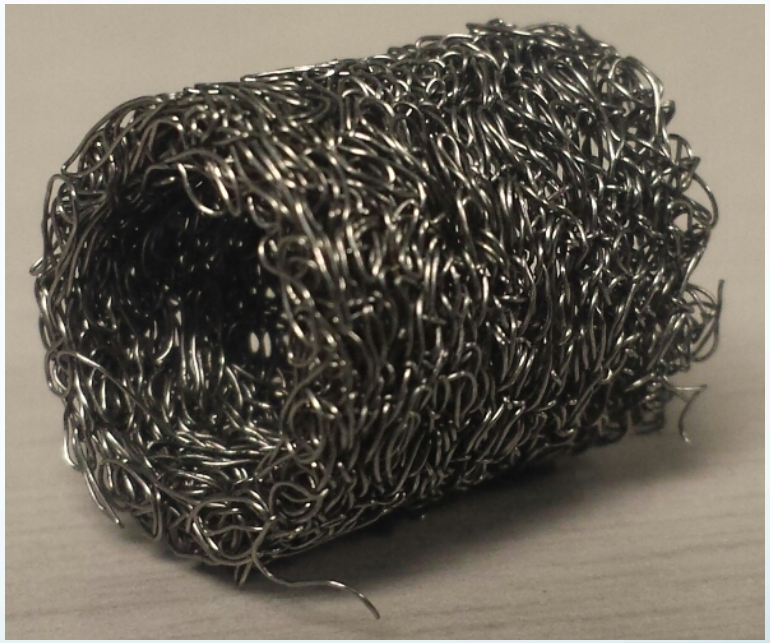
- Round 0.49’’ dia. steel stock
- Drill pin hole into tab for solenoid attachment
- Cut diagonal edge to fit into 0.5’’ hole





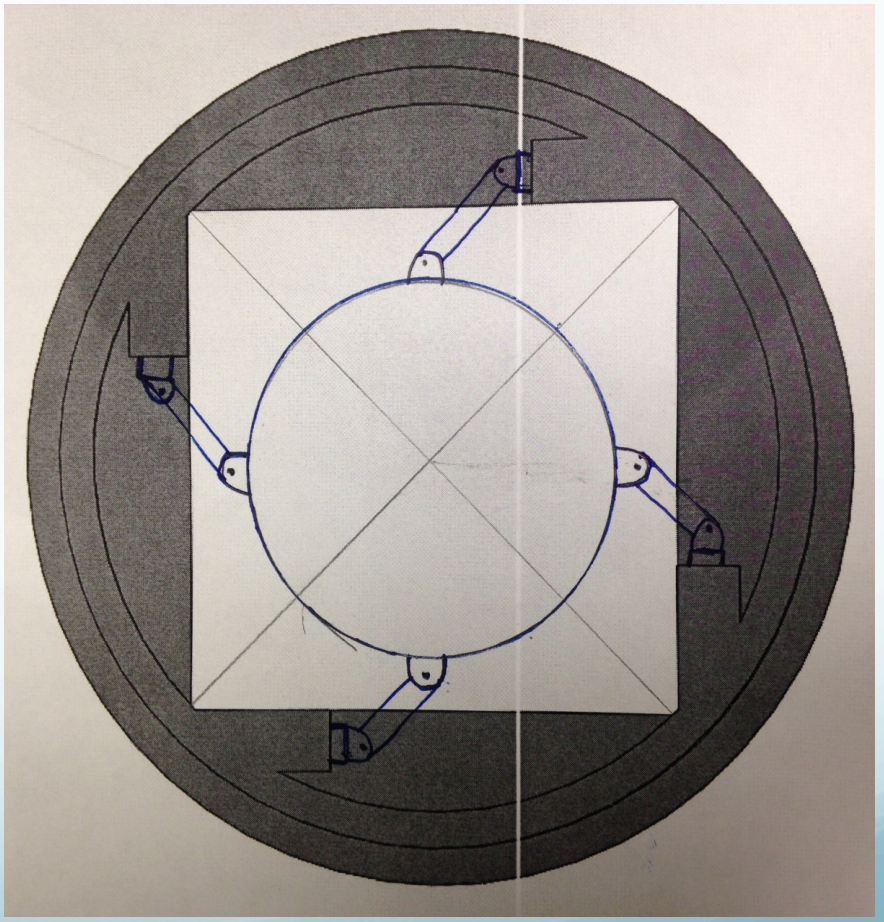
Kickoff Springs

- 4 Kick off Springs placed symmetrically along the lip of the rocket ring
- Donated by Kinetic Structures in Phoenix, AZ
  - Contact: Harry Artenian, President
- The springs will sit in the recessed holes on the lip of the rocket ring

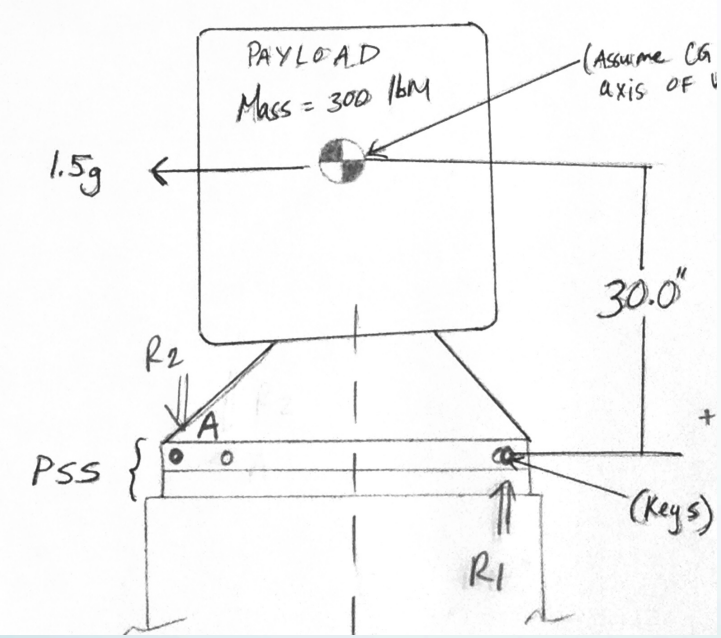


Back up Plan

- Partially ridged system allows for manipulation of keys given movement in others
  - Protects against failing solenoid
  - Ensure separation



Failure Analysis



Acceleration [ft/s²]	134.5
G's	4.178
Force/Key [lb]	313.3
Force Due to Moment/Key [lb]	1125
Shear (Keys) [lbf/ins²]	7325.4
Shear Yield (Key) [lb/ins²]	42456
Factor of Safety (Keys)	5.796
Tear Out (PR) [lb/ins²]	11064.1
Bearing Stress (PR) [lb/ins²]	4639.8

Testing

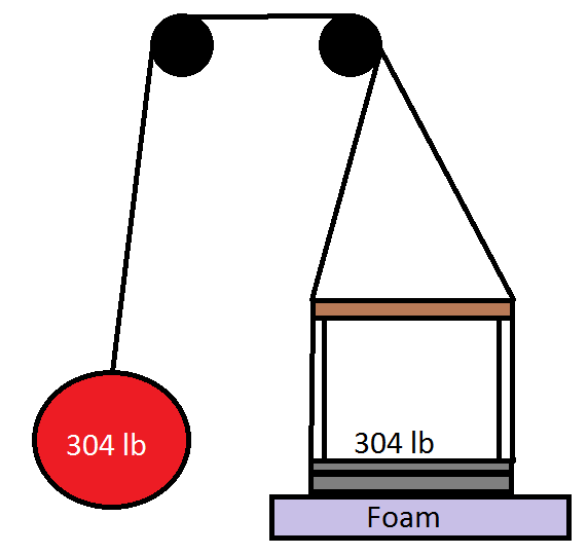
- Two Situations and springs that need to be Tested:
  1. Prove keys can withstand max g's in longitudinal and lateral directions
  2. Prove complete separation at half scale of a 300lb load with minimal shock
  3. Find load application, desired spring constant, and damping coefficient of mesh springs

Key & PR Failure Test

- 500 KIP hydraulic ram to provide load and feedback
- Tested under tension
  - RR lip not allowing for compression test
  - Results will not be changed

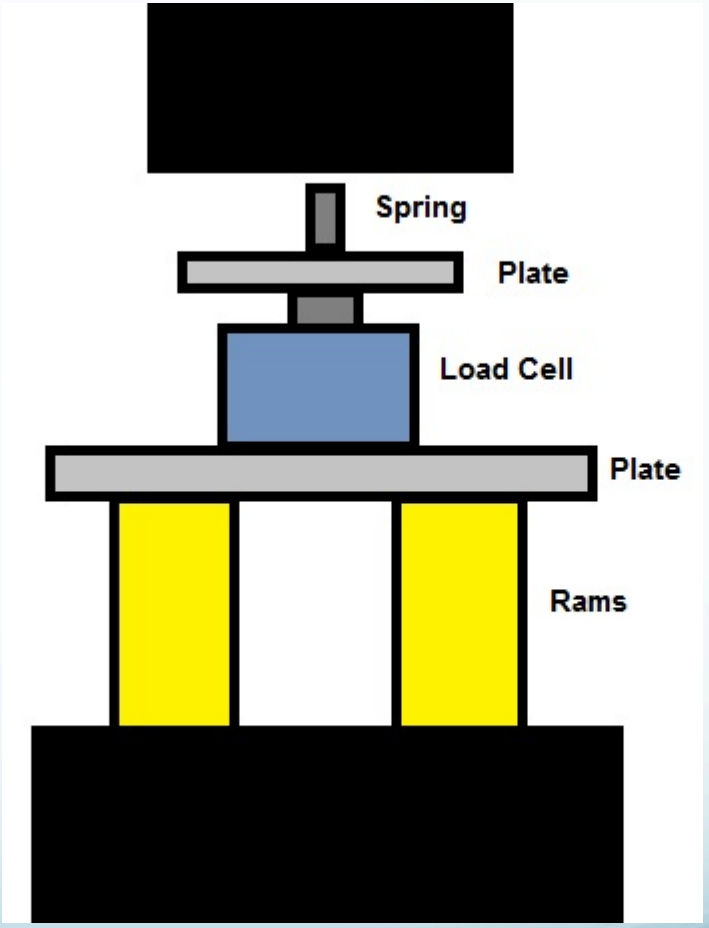
Separation & Reliability Test

- Pulley system attaches the P.S.S. to the equal amount of weight countering the system.
- Once balanced, the solenoids will deploy and the system will separate.



Spring Testing

- Testing in Rm 117 with Dr. Tuchscherer
- 500 KIP hydraulic ram as a place holder
- Load cell and Rams are connected to DAQ
- Testing for:
  - Loading application, F
  - Spring Stiffness, k
  - Unloading rate, c
  - Plastic deformation, **e**

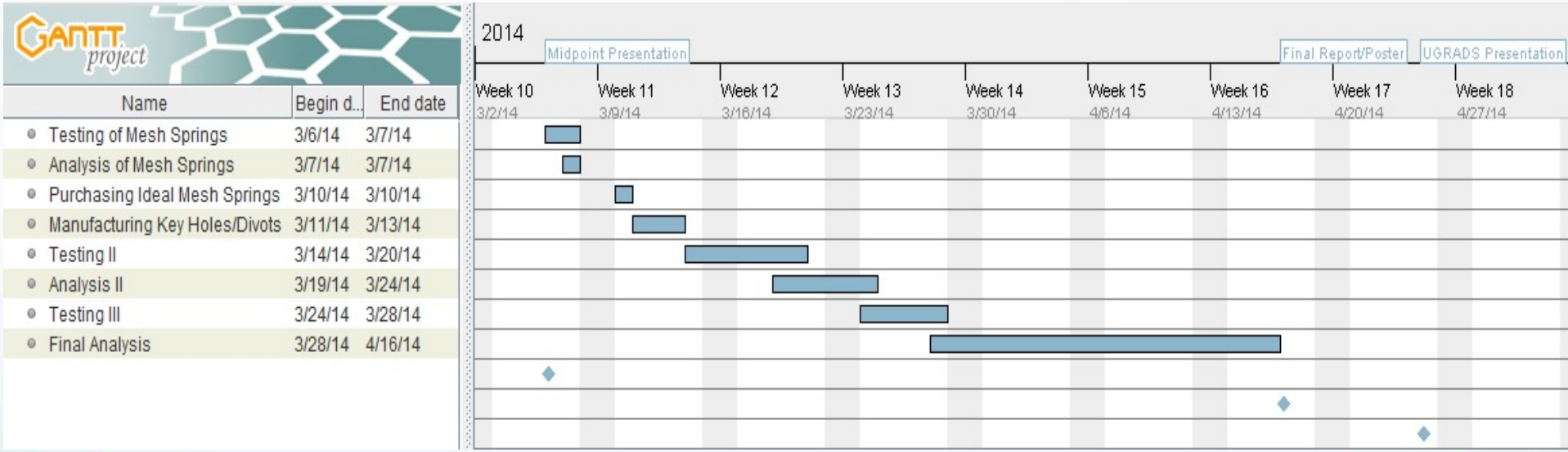


Bill of Materials

- For one 12’’ diameter Payload Separation System
- Budget – $1000

Material	Quantity	Unit Cost
Carbon Steel Key 0.5" dia x 3’ long	1	$15.00
7075 Aluminium plate 24" x 48" x 1"	1	Donated
Solenoid	4	$39.10
Nuts/ Bolts/ Misc.	TBD	$50.00
K & M Services	N/A	$65.00
Total Cost		$286.40

Gantt Chart: Spring 2014



Conclusion

- Used SolidWorks models to effectively communicate changes in the final design, manufacturing, and new back up plan
- Performed additional analysis caused by g's in longitudinal and lateral directions on payload
- Reviewed future testing plans for PSS failure and separation
- Re-calculated a bill of materials
- Updated project plan and reviewed using a Gantt Chart

References

[1] "Online Metal Store." *Online Metal Store | Small Quantity Metal Orders | Metal Cutting, Sales & Shipping | Buy Steel, Aluminum, Copper, Brass, Stainless | Metal Product Guides at OnlineMetals.com*. ThyssenKrupp Materials, NA Company, n.d. Web. 05 Dec. 2013. <https://www.onlinemetals.com/merchant.cfm?pid=10435>.

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[8] Baldwin, Bryan. "Pegasus User's Guide." Orbital Sciences, 1 Apr. 2010. Web. 5 Dec. 2013.

Thank you for listening,

QUESTIONS?