

University of Idaho

College of Engineering

#### QUALITY TUGS DESIGN REVIEW

JOSH FREI, NICK LOCKE, CHASE ANDERSON,

MAX JOHNSON

# **PROBLEM DEFINITION**

The goal is to create an airplane tug that can be used with a wide variety of tire sizes and types including those with wheel pants.







## **PRODUCT REQUIREMENTS**

- Minimal user input
- Different size wheels
  - 8.00x6
  - 7.00x6
  - 6.00x6 (wheel pants)
  - 5.00x6
  - 4.00x4
- 4,000 lb. aircraft
- 500 lb. static vertical load
- 5,000 cycles of operation
- Carry load up 2% grade
- Handle variety of surface conditions



### PALLET JACK

- Motorized drive and lift
- 840 lbs. empty weight
- Our device will be a prosthetic to the pallet jack to capture wheels
- Forks:
  - 47 ¼" in length
  - 7 ¼" wide
  - 3 ¼" off of ground
  - 12 ¼" between each fork













- Gate is closed by the operator once tug is in place (pull cord).
- Linear actuator pushes wheel against gate.
- Sliding mechanism uses UHMW plastic to reduce friction and part count (as opposed to bearings).





- Roller bearings are used to "lift" wheel when clamped.
- V shape helps stabilize tires of different widths.



#### DESIGN IDEA 1 ON PALLET JACK









- Very Similar to Design 1
- Uses square tubing instead of steel rod.
- UHMW rollers and sliders
- Can be removed from pallet jack









#### Pros:

- Extremely Strong
- Cheap
- Closed System

#### Cons:

- Must be machined
- Gate system may be complicated
- Extends the pallet jack









- Slot and pin allow to hold gate shut and then open at end of stroke
- Achieves shutting the gate and pulling the tire with one linear motion
- Linear actuator moves arm
- Roller bearing and backing plate for tire to rest on
- Compact enough to fit inside pallet jack forks
- UHMW on sliders









Locking Pin



### DESIGN IDEA 3 ON PALLET JACK



#### <u>Pros</u>

- Compact
- Easy to use(one motion)
- Fits on pallet jack

#### <u>Cons</u>

- Some complicated parts
- Requires some machined parts
- Clearance on 8.00x6" tire is very tight



#### **Future Ideas**

- Improve the hinge to allow for more clearance
- Make the tube frame smaller
- Make the locking pin round and provide a better path for it to travel
- Improve design of components to provide more strength.



### LINEAR ACTUATORS

- Used to push wheel onto device
- Needed stroke length = 10"
- Could run off pallet jack battery or standalone power supply

#### Pros

- Long stroke length
- Light weight
- Small size

#### <u>Cons</u>

- Expensive
- Needs battery
- Requires Control System







### LATCHING MECHANISMS

- May require more than one motion
- Possibly controlling the gate with another linear actuator
- Vertical instead of horizontal moving gate
- Automated latch with servo motor









### RECOMMENDATIONS

- Linear Actuator
- Steel or Aluminum Tube Frame
- UHMW for low friction sliding and reduced part count







#### BUDGET

Capstone: Quality Tugs	Budget											
Project:	Electric Airp	olane Tug										
Last Updated	11/30/2018											
				Yea	ir 👘					ltem		
Expense Items	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr		Total		
Equipment/Tools:												
									\$	-		
Travel:												
Trip to CDA (09/20)	\$ 101.38								Ś	101		
Trip to CDA (March)							\$ 150		\$	150		
Supplies / Parts / Services:												
Steel							\$ 30		\$	30		
Linear Accuators							\$ 360		\$	360		
Springs							\$ 30		\$	30		
Latch							\$ 70		\$	70		
3D Printing Filament				\$ 50					\$	50		
UHMW							\$ 30		\$	30		
8020							\$ 100		\$	100		
Bearings							\$ 160		\$	160		
Angle Plate							\$ 40		\$	40		
Miscellaneous							\$ 100		\$	100		
											\$ 1,221	Subtotal
Shop Usage (est. Hrs):									ŀ	lours		
Machining					15	15	10	5		45		
Welding					10	10	5	5		30		
										0		
										0		
										0		
										0		
						Gra	duate Stude	ent Support	\$	519	including fr	inge
							Sho	o Overhead	\$	500		
							University	/ Overhead	\$	112	5% of all ex	penses
								Totals	\$	2,352	\$ 2,500	\$ 148
											Budget	Excess

### SCHEDULE

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Quality Tugs Schdule									Com	pleted																												
		Project:	ject: Electric Airplane Tug					Upco	ming																													
	:La	st Updated	11/30/1	1/30/18				Late					1																									
		Year		2018							1													2019														
		Month		Sept		Oct Nov						1	D	ec		Jan						Fe	eb			М	ar			Ar	or			Mar	iy			
Task Description	Duration	Due	9/3 9,	/10 9/	/17 9/24	4 10/:	1 10/	8 10/1	5 10/2	2 10/29	11/5	11/12 11	/19 11/2	6 12/3	12/10	12/17	12/24	12/31	1/7	1/14	1/21	1/28	2/4	2/11	2/18	2/25	3/4	3/11	3/18	3/25	4/1	4/8	4/15	4/22	4/29 5;	6 5/1	.3 5/2	.0 5/27
Team Contract	2 days	6-Sep												1																								
Project Requirements Document	1 week	27-Sep																																				
Project Schedule	1 day	2-Oct												1																								
Snapshot Day 1	1 day	9-Oct																																				
Design Validation Plan	1 week	18-Oct												1																								
Project Value Proposition	1 week	25-Oct																																				
Begin Modeling	1 week	24-Oct												I																								
First Draft of Wiki Page	1 week	1-Nov												1																					1			
Three different designs	1 week	31-Oct																																				
Log Book Review	1 day	8-Nov												1																								
Concept Design Review	1 day	15-Nov																																				
Team Member Citizenship	1 day	16-Nov												1																								
Snap Shot Day 2	1 day	30-Nov																																				
Final Design	1 day	7-Dec												1																								
Purchase Prototyping Materials	1 week	7-Dec												1																								
Project Porfolio	1 day	7-Dec																																				
Wikipage Review	1 day	7-Dec																																				
Christmas Break	3 weeks	8-Jan																																				
Expo Registration	1 day	23-Jan												1																								
Detailed Design Review with Client	1 day	4-Feb																																	1			
Finish Modeling Final Design	1 week	11-Feb												1																								
Buying Materials	1 week	18-Feb																																				
Building	5 Weeks	1-Apr																																				
Expo Prep/ Final Adjustments	2 weeks	19-Apr																																				
Expo	1 dav	27-Apr																																				

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### **QUESTIONS?**

