



University of Idaho

College of Engineering

ALTERNATE AQUACULTURE VACCINE DELIVERY SYSTEM

TEAM FISH-VAC

BEN, CODY, HASAN

VALUE PROPOSITION



- Vaccinating large quantities of fish efficiently saves money and strenuous effort
- It is our responsibility to support our ecosystems and resources
- Creating an instrument that is easy to use and cheap to maintain is important for the consumer and the supplier.
- An effective and well-engineered product is our goal.

OBJECTIVE

There are many benefits of doing immersion fish vaccination such as having good disease protection, low labor costs and small fish can be easily vaccinated. On the other hand we have some disadvantages, as follows we will need large amounts of vaccine and its less effective than injection. Thus, the goal is design and develop an improved fish vaccination system for aquaculture.

PROBLEM BACKGROUND

Vaccination has taken many forms over the years. Starting with humans and spreading throughout our domesticated and farmed species. For most of us our vaccination comes through needles. This practice works wonders but is a daunting task looking at thousands of 1-2g salmonids. The problems facing engineers are numerous, and in our case, assisting the College of Natural Resources we can bring about new change.



PRODUCT REQUIREMENTS



I Should contain non-specific parts where possible to allow for easy repair

- Standardized hardware/needles
- Regular Arduino style motors
- 120v supply for electrical components
- Agricultural water circulation pump available at most hardware stores
- Designed to be used with existing vaccination tubs

I Two Prototypes (Lab model and production model)

- Lab size model for proof of concept testing
- Functioning Prototype model for IACUC approval and testing
- Full scale prototype for research and advancement

PRODUCT REQUIREMENTS



I Humane method of puncturing the fish

- Needle size for injection vaccine is 21-22 gauge and we are using 25 gauge to decrease damage
- Standard needle depth is 1mm and we are significantly less (PharmaQ)
- Probability of puncturing eye of the fish 0.2
- Initially test without needles to prove system

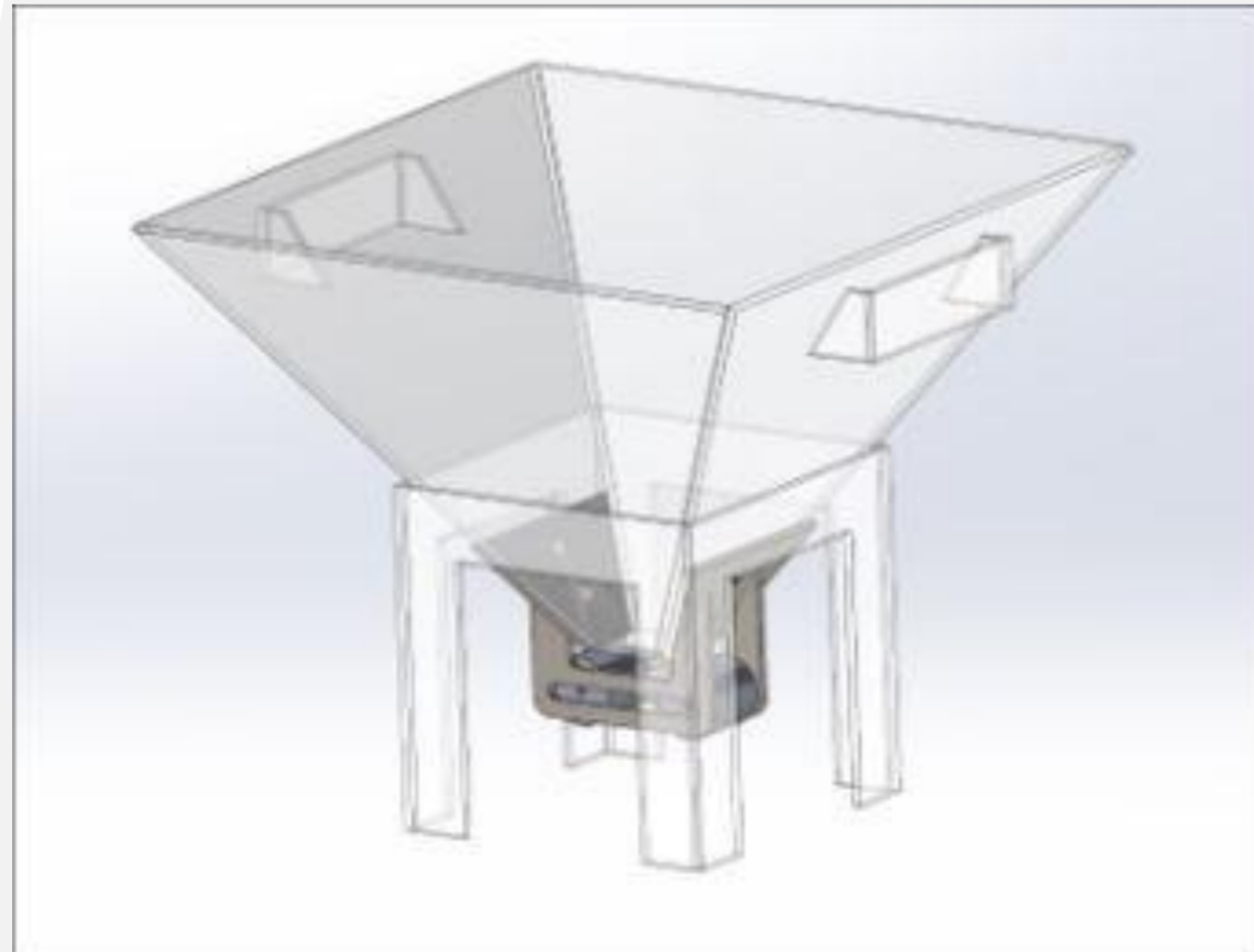
PROTOTYPING EVOLUTION

Cardboard Lab
prototype
model



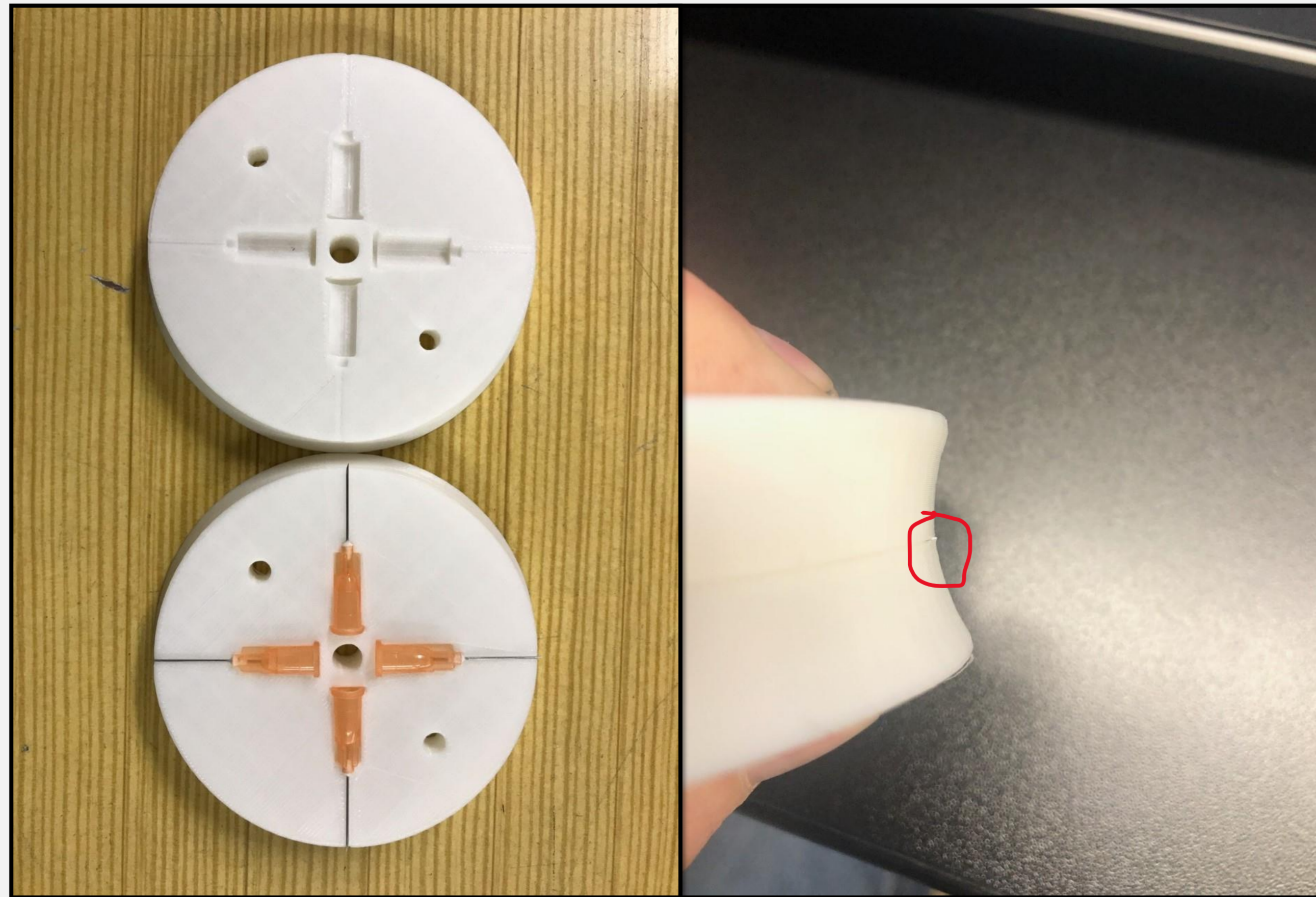
PROTOTYPING EVOLUTION

Initial acrylic Lab
prototype model
testing with
euthanized fish



PROTOTYPING EVOLUTION

Improved 3D
printed Rollers
allowing for
standard
hypodermic
needles



TESTING RESULTS



I Started testing 8/31/2020

- Tested initial lab prototype
 - Test failed. We had to apply too much pressure and could not achieve puncture without damaging the fish.

I Initial prototype 9/4/2020

- Tested same lab prototype with various decreased needle densities
 - Test failed after trying 3 different needle densities. Change of density included increasing space between needle disks, and individually removing 2 out of every 3 needles from disks.

I Initial prototype 9/30/2020

- Modified initial prototype to accept new 3D printed rollers
 - Tested new 3D printed rollers with hypodermic needles. Test **Success** we were able to orient fish with the rollers and achieve puncture under body weight.

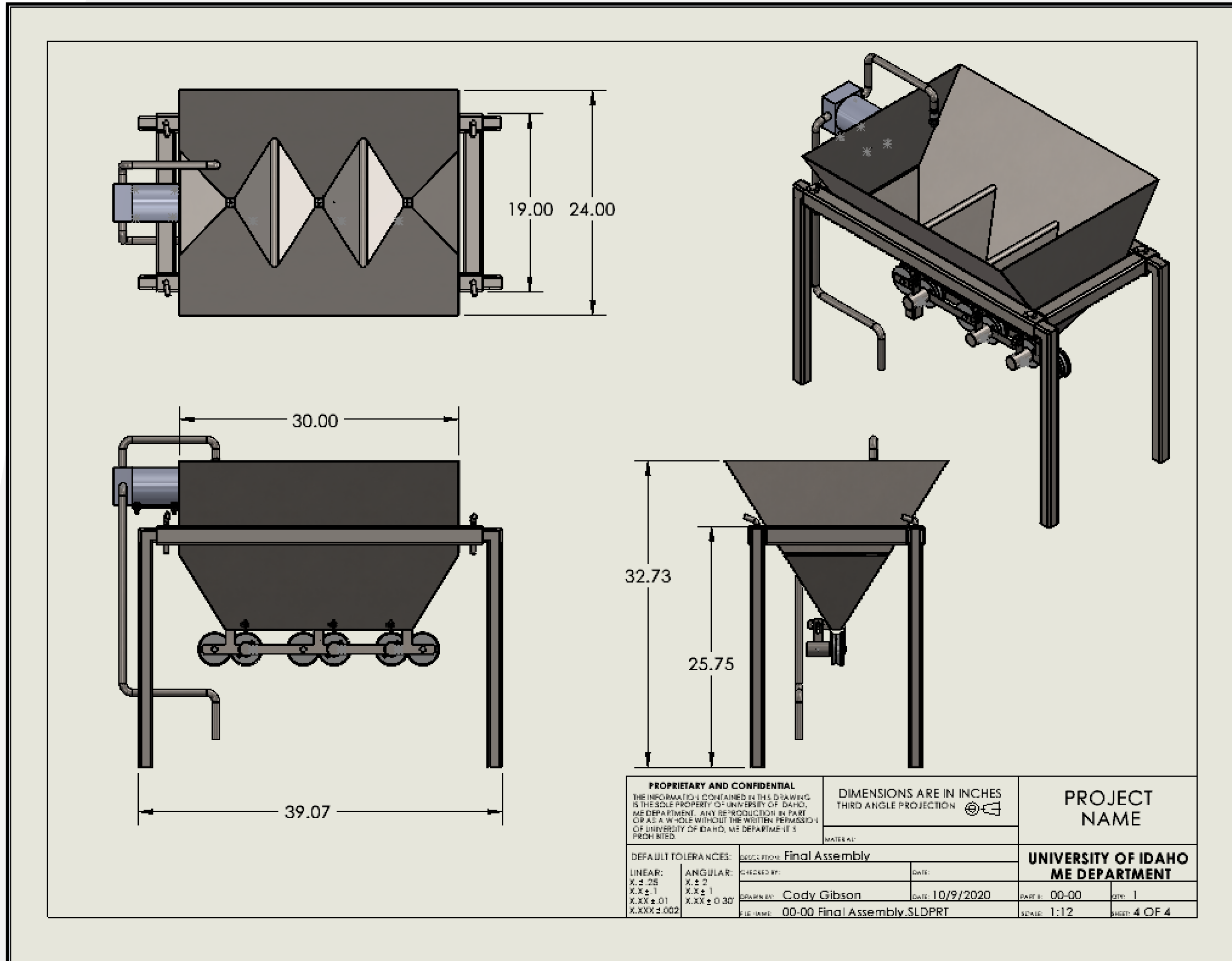
FINAL MODEL ASSEMBLY



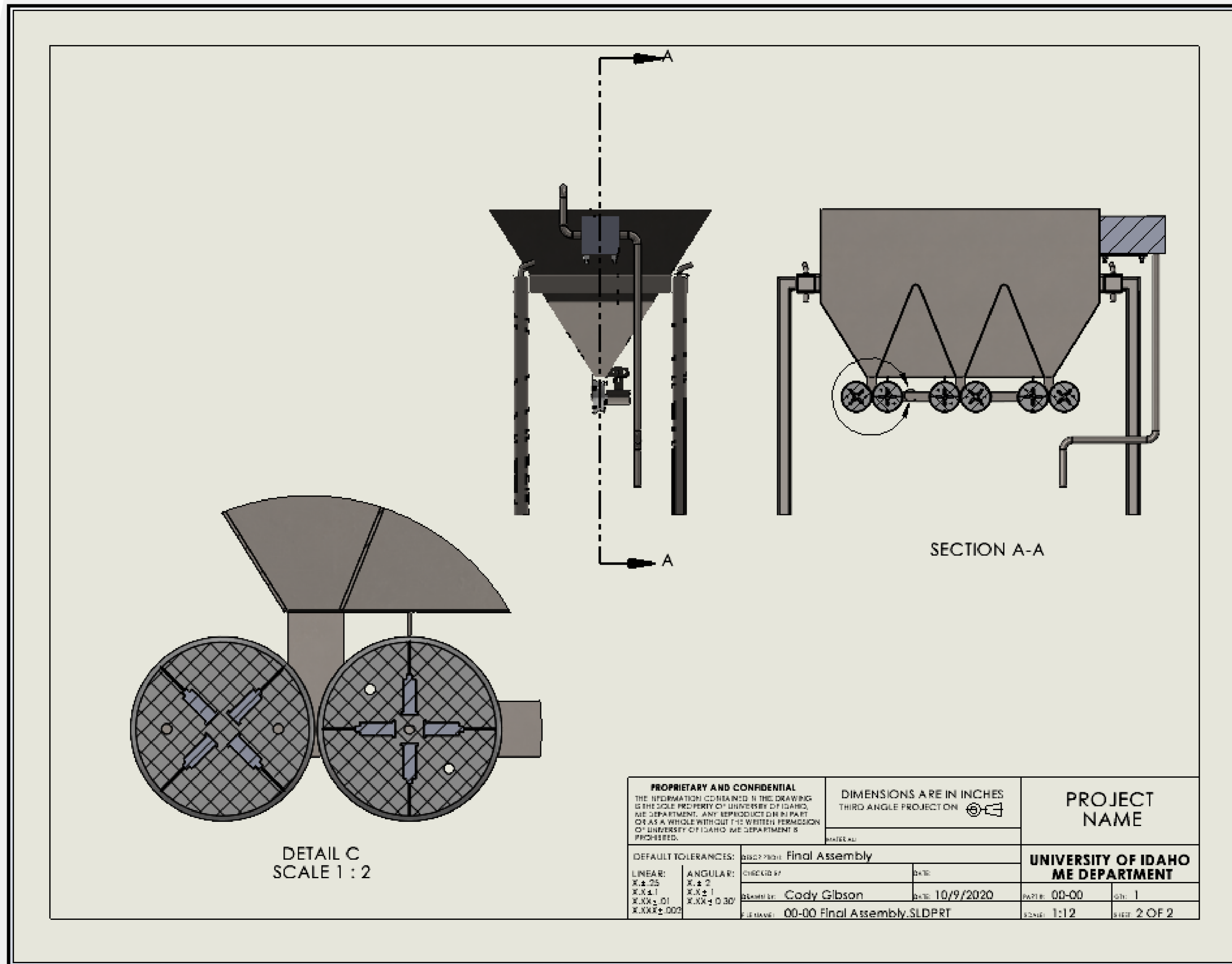
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	02-00	Frame Assembly	1
2	01-00	Chute Assembly	1
3	04-00	Pump Assembly	1
4	03-00	Needle Roller Assembly	3

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DEFAULT TOLERANCES: LINEAR: X ± .25 X ± .1 X.XX ± .01 X.XXX ± .002		DESCRIPTION: Final Assembly C-ECO/20 BY: _____ DATE: _____ DRAWN BY: Cody Gibson DATE: 10/9/2020 FILE NAME: 00-00 Final Assembly.SLDPRT		UNIVERSITY OF IDAHO ME DEPARTMENT PART #: 00-00 QTY: 1 SCALE: 1:8 SHEET 1 OF 2	

FINAL MODEL ASSEMBLY



FINAL MODEL ASSEMBLY

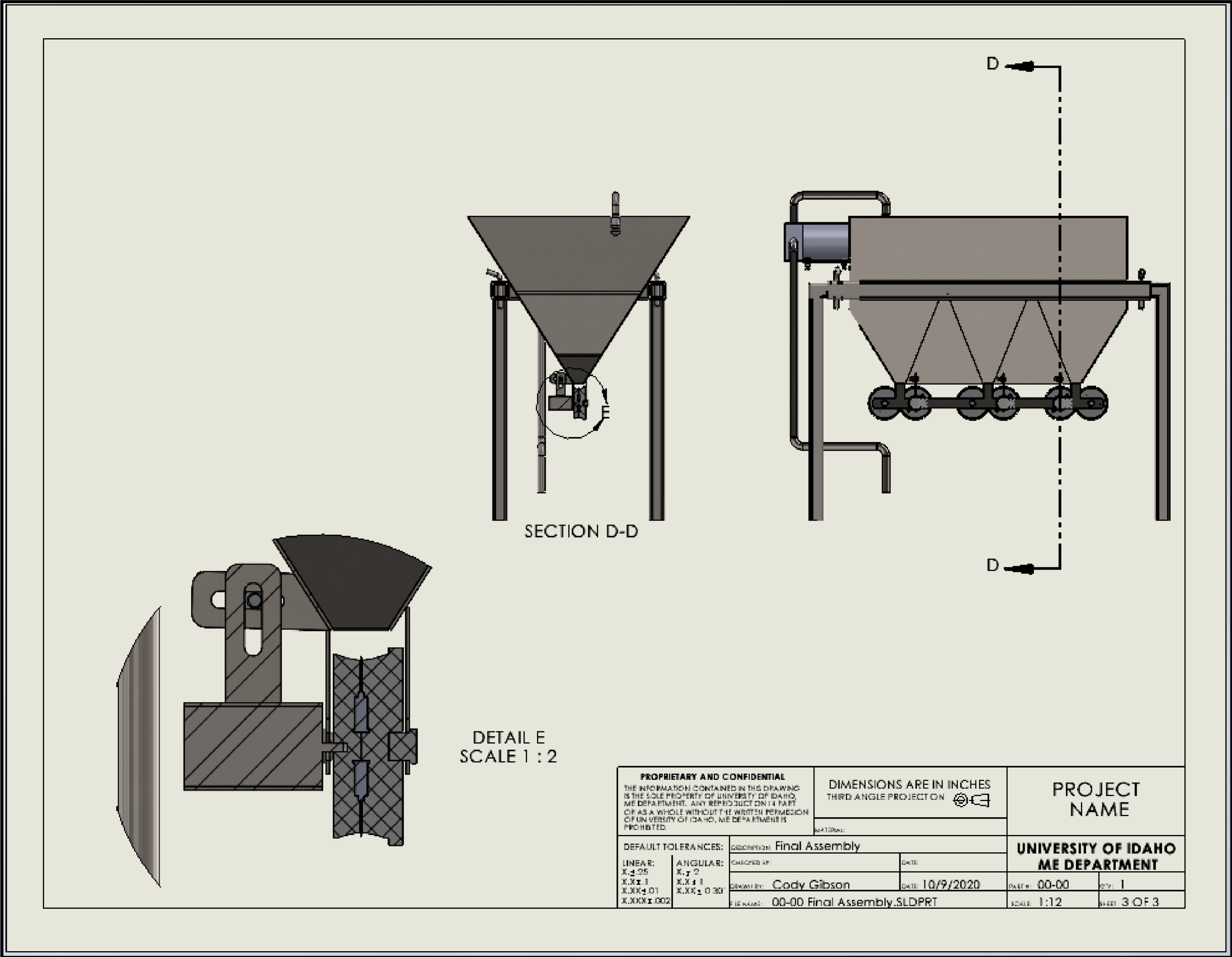


DETAIL C
SCALE 1 : 2

SECTION A-A

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MATERIAL:		DATE:		UNIVERSITY OF IDAHO ME DEPARTMENT	
DEFAULT TOLERANCES: LINEAR: X.X ± .05 X.X ± .1 X.XX ± .01 X.XXX ± .005	ANGULAR: X ± 2 X.X ± 1 X.XX ± 0.30	DESIGNED BY:	DATE:	PART #:	QTY:
FILE NAME: 00-00 Final Assembly.SLDPRT		DRAWN BY: Cody Gibson	DATE: 10/9/2020	PART #: 00-00	QTY: 1
				SCALE: 1:12	SHEET: 2 OF 2

FINAL MODEL ASSEMBLY



SECTION D-D

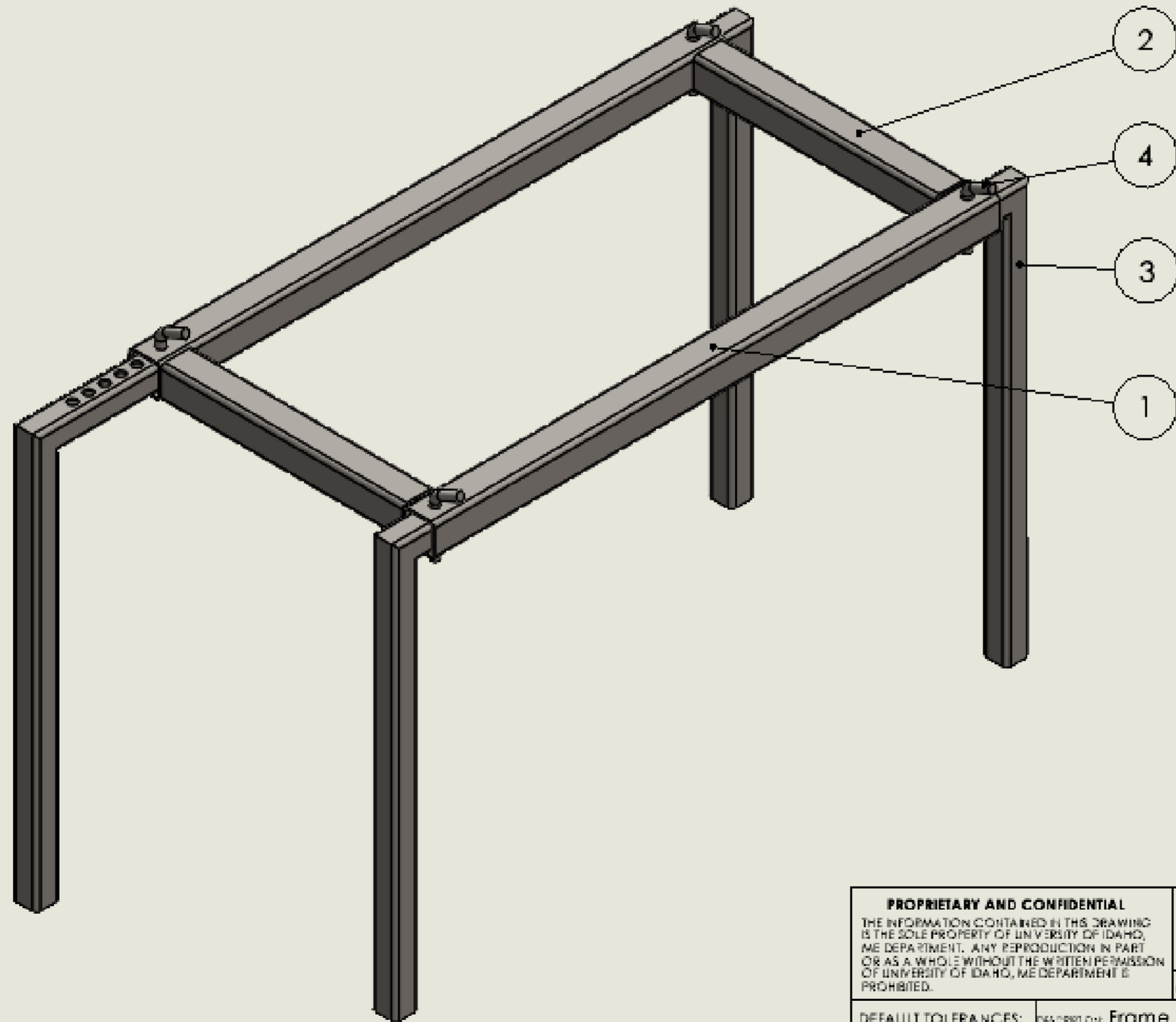
DETAIL E
SCALE 1 : 2

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DEFAULT TOLERANCES: LINEAR: X.3 05 X.XX 1 X.XXX 01 X.XXXX 002		DESCRIPTION: Final Assembly		PART#: 00-00	
ANGULAR: X.1 2 X.XX 1 X.XXX 0 30'		CHECKED BY: Cody Gibson DATE: 10/9/2020		QTY: 1	
		FILE NAME: 00-00 Final Assembly.SLDPRT		SCALE: 1:12 SHEET: 3 OF 3	

FRAME ASSEMBLY



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	02-01	Frame Side	2
2	02-02	Frame Front	2
3	02-03	Adjustable Leg	4
4	02-04	Adjustable Leg Pin	4



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DEFAULT TOLERANCES: LINEAR: X ± .25 X.X ± .1 X.XX ± .01 X.XXX ± .002		DESCRIPTION: Frame Assembly		UNIVERSITY OF IDAHO ME DEPARTMENT	
ANGULAR: X ± 2 X.X ± 1 X.XX ± 0.30°		CHECKED BY:	DATE:	PART #: 02-00	QTY:
		DRAWN BY: Cody Gibson	DATE: 10/9/2020	SCALE: 1:8	SHEET: 1 OF 2
		FILE NAME: 02-00 Frame Assembly.SLDPRT			

MANUFACTURING PLAN



Indented Bill of Materials (BOM)			Manufacturing Plan							Cost	
Part No. or Assy No.	Description	Quantity	Make or Buy?	Source (or Fabrication Location)	Fabrication Technique (if appl.)	Is the Drawing Avail.?	Is the Material Avail.?	Who will lead (Name)?	Target Completion Date	Unit Cost (\$)	Extended Cost (\$)
Full Assy 1											\$ -
Subassembly 1	Chute	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A		\$ -
Subassembly 2	Frame	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A		\$ -
Subassembly 3	Needle Roller	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A		\$ -
Subassembly 4	Pump	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A		\$ -
Subassembly 1	Chute	1								\$ 401.50	\$ 401.50
Part 5	Side Panel	2	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		\$ -
Part 6	Front Panel	2	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		\$ -
Part 7	Divider Insert	2	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		\$ -
Part 8	Roller Mount (Gear Side)	1	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		\$ -
Part 9	Roller Mount (Motor Side)	1	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		\$ -
Part 10	Motor Mount	3	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		\$ -
Part 11	Motor Mount Bracket	3	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		\$ -
Part 12	Motors	3	Buy	Amazon	N/A	No	Yes	Ben	6-Nov	\$ 13.99	\$ 41.97
Part 13	Set Screw	3	Buy	ME Shop	N/A	No	Yes	Ben	6-Nov		\$ -
Part 14	3/16"x1" Hex Head	3	Buy	ME Shop	N/A	No	Yes	Ben	6-Nov		\$ -
Part 15	3/16 Lock Nut	3	Buy	ME Shop	N/A	No	Yes	Ben	6-Nov		\$ -
Subassembly 2	Frame	1								\$ 273.00	\$ 273.00
Part 16	Frame Side	2	Make	Personal Equipment	Plasma Cut/Tig Weld	Yes	Yes	Cody	6-Nov		\$ -
Part 17	Frame Front	2	Make	Personal Equipment	Plasma Cut/Tig Weld	Yes	Yes	Cody	6-Nov		\$ -
Part 18	Adjustable Leg	4	Make	Personal Equipment	Plasma Cut/Tig Weld	Yes	Yes	Cody	6-Nov		\$ -
Part 19	Adjustable Leg Pin	4	Buy	Spence Hardware	Plasma Cut/Tig Weld	Yes	Yes	Cody	6-Nov	\$ 3.50	\$ 14.00
Subassembly 3	Needle Roller										\$ -
Part 20	Needle Roller Motor Side	3	Make	GJ 125	3D Printer	Yes	Yes	Cody	6-Nov		\$ -
Part 21	Needle Roller Driven	3	Make	GJ 125	3D Printer	Yes	Yes	Cody	6-Nov		\$ -
Part 22	Needle Roller Geared	6	Make	GJ 125	3D Printer	Yes	Yes	Cody	6-Nov		\$ -
Part 23	Axle Stub	9	Make	GJ 125	3D Printer	Yes	Yes	Cody	6-Nov		\$ -
Part 24	Needles	24	Buy	Amazon	N/A	N/A	Yes	Cody	6-Nov	\$ 0.20	\$ 4.80
Subassembly 4	Pump										\$ -
Part 24	Pump	1	Buy	Used Farm Equip	N/A	No	Yes	Ben	6-Nov	\$ -	\$ -
Part 25	Pump Bracket	1	Make	Personal Equipment	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		\$ -
Part 26	Spray Ball	1	Buy	Spence Hardware	N/A	No	Yes	Ben	6-Nov	\$ 30.00	\$ 30.00
Part 27	3/8"x5/16" Hex Head Bolt	3	Buy	ME Shop	N/A	No	Yes	Ben	6-Nov		\$ -
Part 28	Spray Ball Bracket	1	Make	Personal Equipment	Plasma Cut/Tig Weld	No	Yes	Ben	6-Nov		\$ -
Part 29	Hose	6	Buy	Spence Hardware	N/A	No	Yes	Ben	6-Nov	\$ 0.69	\$ 4.14
Insert more lines as needed...											
										Total BOM Cost	\$ 769.41

COST/BUDGET



Capstone Project Budget - Summer/Fall												
Project: Fish Vaccination Apparatus												
Last Updated 10/4/2020												
Expense Items	2020						Item Total					
	July	Aug	Sept	Oct	Nov	Dec						
Supplies / Parts / Services:												
Acrylic Sheet	\$ 12.99						\$ 12.99					
Bonding Agent	\$ 7.90						\$ 7.90					
Roller Mount		\$ -		\$ 20			\$ 20.00					
Final Material				\$ 259			\$ 259.00					
Cutting/Shaping					\$ 200		\$ 200.00					
Needles/roller			\$ 10				\$ 10.49					
Stand material				\$ 273			\$ 273.00					
Fasteners			\$ 50				\$ 50.00					
Pump/Hoses				\$ 200			\$ 200.00					
Rapid Prototyping							\$ -					
120v to 12v converter				\$ 17			\$ 16.96					
Motors				\$ 42			\$ 41.97					
Motor Controller case				\$ 20			\$ 20.00					
Consumables				\$ 100			\$ 100.00					
Facilities shop (1hr)					\$ 43		\$ 42.50					
							Totals	\$ 1,255	\$ 2,000	\$ 745		
								Budget	Excess			

PROTOTYPE DESIGN VALIDATION APPROACH

- I** Started testing 8/31/2020
 - Tested initial lab prototype
- I** Initial prototype 9/4/2020
 - Tested same lab prototype with various decreased needle densities
- I** Initial prototype 9/30/2020
 - Modified initial prototype to accept new 3D printed rollers



FINAL PROTOTYPE DESIGN VALIDATION APPROACH

- I** Test for ten minutes with no needles to estimate the number of fish that can be processed per hour 11/6/2020
- I** Apply for IACUC approval to test 11/6/20 or before
- I** Perform tests on euthanized fish 11/13/2020
- I** Start testing live fish Upon IACUC approval in the spring



SCHEDULE



Fish-Vac Project Schedule		ternate Aquaculture Vaccine Delivery System																												
		0/6/2020																												
		2020																												
		June				July				Aug				Sept				Oct				Nov				Dec				
Milestones	Task Description	6/15	6/22	6/29	7/6	7/13	7/20	7/27	8/3	8/10	8/17	8/24	8/31	9/7	9/14	9/21	9/28	10/5	10/12	10/19	10/26	11/2	11/9	11/16	11/23	11/30	12/7	12/14	12/21	12/28
Snapshot 2																														
8/6/2020	Design Validation														0%	50%	100%													
	Design Validation IACUC approval																	25%	50%	75%	100%									
	Needle Testing				0%	100%																								
	Initial Design Proposal					100%																								
	Value Proposition						0%	100%																						
	Lab Test Prototype										0%	20%	40%	60%	80%	100%														
	Lab Testing										0%	20%	40%	60%	80%	100%														
7/27/2020	Concept Design Review (Bench Test Model)					0%	100%																							
9/17/2020	Request Extension for Engineering Release Review														100%															
9/25/2020	Design and print new needled rollers														100%															
9/28/2020	Test Fit needles in new needle roller															50%	100%													
9/28/2020	Review and Update all PM documentation															25%	50%	75%	100%											
10/5/2020	Submit Final Drawing Package to Max for Review															33%	66%	100%												
10/5/2020	Complete Final Prototype Manufacturing Plan															33%	66%	100%												
10/7/2020	Submit Engineering Release Review Documents to Swenson															33%	66%	100%												
10/9/2020	Engineering Release Review																	100%												
10/12/2020	Order all necessary raw materials/parts																			50%	100%									
Snapshot 3																														
10/15/2020	Engineering Release (Drawings)											0%	20%	40%	60%	80%	100%													
	Prototype test results																100%													
	Final prototype design validation																	100%												
Snapshot 4																														
12/6/2020	Final Prototype													0%	11%	22%	33%	44%	55%	66%	77%	88%	100%							
	Validation and Testing																							0%	33%	66%	100%			
	Final Portfolio																							0%	50%	100%				

RISK MITIGATION



I Orientation of fish

- Fish going through at the wrong orientation risk problems of harm to fish, as well as fish jamming. To avoid this we implemented the concave rollers shown in our design.

I Risk of puncture to eyes

- Probability of the needle not hitting the eye is 0.98. Risk of damage of the 2% that do hit the eye under examination.

I Risk of too deep of puncture damaging organs

- As mentioned in requirements our needle puncture is only 0.65mm and standard vaccination depth is 1mm.

QUESTIONS?