

Department of Agricultural and Biosystems Engineering (ABE)

TSM 416 Technology Capstone Project

# ADM Demonstration Model Sifter

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**Client:** Archer Daniels Midland Company, 4666 Faries Parkway, Decatur, Illinois 62526, www.adm.com

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  - Michael Means, Director of Process Improvement, Michael.Means@adm.com
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# 1 PROBLEM STATEMENT

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## Problem Statement

Archer Daniels Midland Company was established in 1902 by George A. Archer and John W. Daniels under the name Archer-Daniels Linseed Company. To summarize Archer Daniels Midland Company, here is a snapshot from their mission statement, “Today, we’re one of the world’s largest agricultural processors and food ingredient providers, with approximately 32,000 employees serving customers in more than 170+ countries. ADM has a globally recognized value chain that strives to connect the harvest to the home” (*Archer Daniels Midland, 2018*).

The problem we worked to solve is improving operator knowledge of sifter and sieve operation and function. There is general lack of experience in the milling industry due to employee retirement and the difficulty of attracting and retaining employees in a demanding industry. Sifters are essential components to the milling process. Employee knowledge of material flow, particle size separation, and maintenance are critical for operators to understand. Without the proper knowledge and practices, sifters will not be used to their full potential. Two demonstration model sifters are required to aid in employee development and allow for valuable interactions with sifter components, concepts, material flow, and maintenance.

Known attributes of the problem:

- Sifter concepts and topics are challenging to communicate effectively and clearly
- Sifters are large, moving pieces of equipment that pose various safety concerns if employees are unaware and not cautious when working around them
- Test sifters are to be used in the ADM Milling Academy Class
- Test sifter operation aims to be around 15-20 minutes for adequate operator training sessions
- People need to be able to see inside the sifter to show stock flow and sifter flow paths
- An additional small granulation sifter will be used for demonstrating size separation

It is crucial for operators to understand the operation, material flow, maintenance, and above all, safety of sifters. The demonstration sifters will aid in the knowledge required by ADM’s mill operators and lessen the inherent employee risks inside mills. Increased knowledge and experience, also presents a beneficial business opportunity of running ADM’s sifters more efficiently. Two improvements include keeping a higher percent of flour out of the feed streams and improved extraction yields.

## Business Case Statement

ADM is in need of two small-scale sifters to aid in teaching wheat flour millers and other employees. Each model will have its own purpose. The granulation sifter will be used to sift only for size and demonstrate how a sifter sorts stock by material size. The Tru-Balance sifter will be used to show material flow and visual demonstration of the internal components of a sifter.

The education of ADM's mill operators strategically allows safer and more efficient operation of a crucial piece of milling equipment. Increased knowledge also dictates the more effective use of finite resources. Decreased risk and better production are byproducts of an increased knowledge.

## 2 GOAL STATEMENT

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Our goal was to design and update and modify a Tru-Balance 221 wheat sifter. The modifications allow increased visibility and access to sifter outputs for teaching purposes.

- The main objective is to enable employees to visually examine the interior of a sifter during operation. This assists in training mill operators to comprehend the components, concepts, and material flow that are associated with full scale wheat sifters (Wiechman, 2018)
- In addition, compile a Standard Operating Procedure (SOP) for operation and cleaning of the model including possible risks and hazards to the operator (Means, 2018)
- **Specific objectives include:**
  - Improvement of a sifter that meets all client criteria and constraints:  
**Criteria**
    - Showing the flow path within the sifter
    - Run time of 15-20 minutes
    - Easy setup and operation**Constraints**
    - Clear side panels
    - LED lighting system
    - Self-contained material collection
- **Rationale**
  - Relatively portable sifter able to be used in a variety of settings
  - Enhanced viewing allows direct understanding of the process being taught
  - The ability to be ran for 15-20 minutes per ADM's request
  - Sifter will hold inputs and catch outputs with separate containers

## 3 PROJECT PLAN/OUTLINE

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### A. Methods/Approach

- **Reference Materials**
  - For the intent of this project, a variety of resources were utilized to allow for the thorough retrofit and deployment of the sifters into the ADM Milling Academy curriculum.
    - ADM was very accommodating to our questions and their wealth of knowledge was great to utilize.
    - Various group members also possessed a wide range of skill and experiences which also aided in the development of the project.
- **Data collection**
  - Data for this project pertained to the information needed to safely operate and thoroughly train employees regarding sifter operations.
    - Throughput of the Tru-Balance sifter was needed to allow for 15-20 minutes of run time
    - Electrical specifications required to safely supply each aspect of the final product with sufficient power was also needed (motor, feeder, lights, receptacles, etc.)

- **Skills**
  - The team working on this project contained a vast amount of valuable knowledge regarding general milling operations, design and creation of parts, product testing, and continuous development.
  - Group members have worked alongside one another to help others understand the milling process as well as the operation of various types of sifters to assist in the creation of this demonstration model. The group was also fortunate enough to tour the Barilla milling operation in Ames to supplement their current knowledge on the topic.
  - Courses in our curriculum that aided in the development of this project include:
    - TSM 116, TSM 210, TSM 216, TSM 240, TSM 340 and TSM 363
- **Proposed Solutions**
  - After assessing the current scenario and utilizing our various resources, we were able to compile a list of retrofit requirements to allow the ADM Milling Academy to adequately train their mill operators.
  - Addition and implementation of the following created a successful project:
    - Clear side panels to allow trainees to visualize flow paths
    - Increased feeder speed to allow for 15-20 minutes of run time
    - Lighting and imaging systems for close-up views of product in hard to see areas
    - Self-contained material collection bins to reuse material for various training sessions
    - Implementation of electrical sequencing for safe operation of the sifter and its components
    - Addition of a brake sifter to shoe extraction rates
  - ADM assisted in the retrofit process prior to shipment of the sifter to its location in Ames. By diligently working alongside ADM we were able to successfully deploy this piece of equipment and it will operate to the desired standards set forth to aid in the milling academy curriculum (Flack, 2018).
- **Organization**
  - The team met at least once a week throughout the entire process to discuss general project updates.
  - Other meeting times throughout the week were addressed accordingly as milestones needed to be accomplished, documents need to be reviewed, and implementations of the solutions occur.
  - Current document organization was being facilitated with the utilization of GrabCAD. Other forms of communication between the group, ADM contacts, and ISU faculty were face-to-face interactions, email, text message, and phone calls.
  - Based on the communication and project ideas, a list of major milestones was developed.
    - Define essential project requirements
    - Design effective, functional components to support use of training model
    - Fabrication and implementation of various sifter elements (Behrens, 2018)
    - Product operation, testing, and validation of newly added sifter features

- Documentation of sifter operation, cleaning procedures, and technical specifications
- The group of students worked together in the event of any unexpected setbacks to remain on track with the given timeline. The project was successful by working together and helping each other out. This would not be possible without the assistance of all group members.

## B. Results/Deliverables

There is a list of essential milestones that had been set forth that played a role in the development of the main project deliverables (Petersen et al., 2017; Koziel, 2018; Vanstrom, 2018). Each major milestone is listed below with its associated week of completion. In addition to the major milestones, we were able to coordinate the main deliverables for the project, too.

- Define essential project requirements
  - 11-6-2017
- Design effective, functional components to support use of training model
  - 1-1-2018
- Fabrication and implementation of various sifter elements
  - 2-26-2018
- Product operation, testing, and validation of newly added sifter features
  - 3-19-2018
- Documentation of sifter operation, cleaning procedures, and technical specifications
  - 4-2-2018

Project Deliverables:

- Demonstration model sifters
  - Existing Tru-Balance sifter needed to be retrofit to show the flow of stock during sifter operation
  - Small-scale granulation sifter needed to be utilized for showing separation of stock by granulation in a sifter
- A standard operating procedure was established for the model including possible hazards and risks to the operator
- Technical specifications needed to be provided for the fabrication and retrofit of the demo model
  - Bill of Materials

## 4 BROADER OPPORTUNITY STATEMENT

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The implementation of the Tru-Balance 221 and small granulation sifter into the ADM Milling Academy had many benefits outside of the classroom. By utilizing the newly implemented demonstration sifters, ADM will be able to train their operators with a more hands on approach. Benefits such as transparent sifter box walls, sufficient run times, and well-lit sifter box internals, operators in training will be able to gain a better understanding of the essential components of sifting equipment. In the simplest of forms, it is important to understand the basic fundamentals of milling. Each member of ADM's milling team must understand sifter operation, material flow, maintenance, and safety to successfully operate sifting equipment efficiently and effectively.

Utilization of the two demonstration sifters will allow ADM to improve their in-house education programs as well as improve workplace safety. Sifters are a huge component within a wheat mill and it is important that operators are well trained and taught to perform their job in a safe manner.

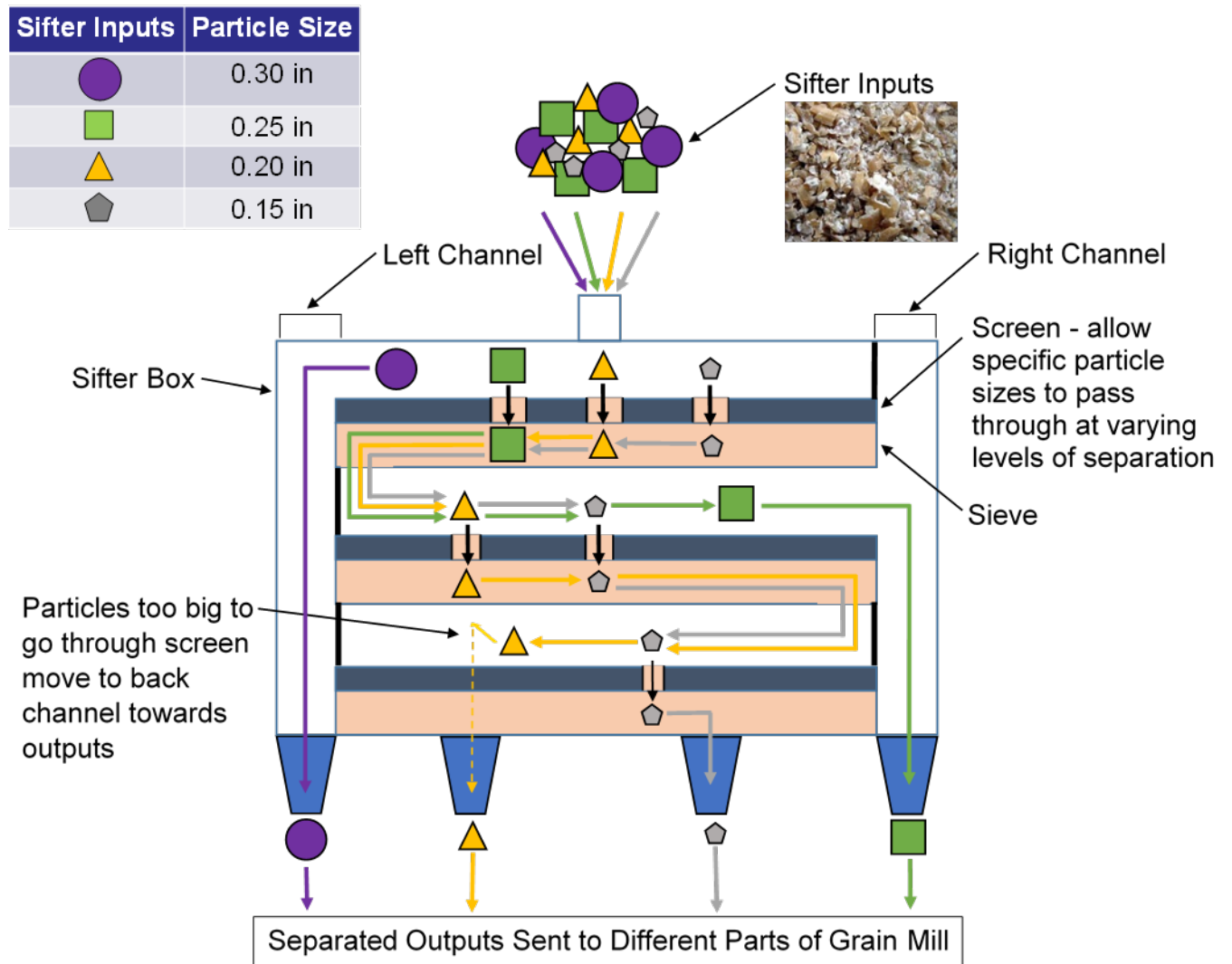
## 5 PROJECT SCOPE

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### Project Scope

- Small-scale demonstration models and related SOP were required for ADM's Milling Academy educational class
  - ADM provided a sifter in working condition
    - Great Western Tru-Balance 221
    - Small scale granulation sifter
  - To increase visibility for the operation of a test sifter that will assist in training mill operators in the areas of sifter components, concepts, and material flow
  - To provide features (lights, self-contained stock collection bins, safe electrical circuit) for safe and easy operation
  - Deploy a consistent and dependable unit that would sufficiently operate for 15-20 minutes to allow for proper operator training
  - Documentation of technical specifications and bill of materials

## 6 GRAPHICAL ABSTRACT



## 7 REFERENCES

Alex Petersen, Charles Isbell, Jake Flattum, Michael Delagardelle, Joseph R. Vanstrom and Jacek A. Koziel. Ford P558 Extended Running Board – Product / Process Flow Improvement Event. Final Report. TSM 416 Technology Capstone Project, April 28, 2017.

“Archer Daniels Midland.” *ADM*, [www.adm.com](http://www.adm.com).

Dr. Jacek Koziel, ISU Course Instructor, personal communication, Oct. 2017 - Apr. 2018.

Jake Behrens, ISU 240 Lab Coordinator, personal communication, Oct. 2017 - Apr. 2018.

Joe Vanstrom, ISU Course Instructor, personal communication, Oct. 2017 - Apr. 2018.

Department of Agricultural and Biosystems Engineering ([abe@iastate.edu](mailto:abe@iastate.edu)) aims to be a premier team serving society through engineering and technology for agriculture, industry and living systems. ABE welcomes opportunities to discover and improve new technologies for all stakeholders. 7

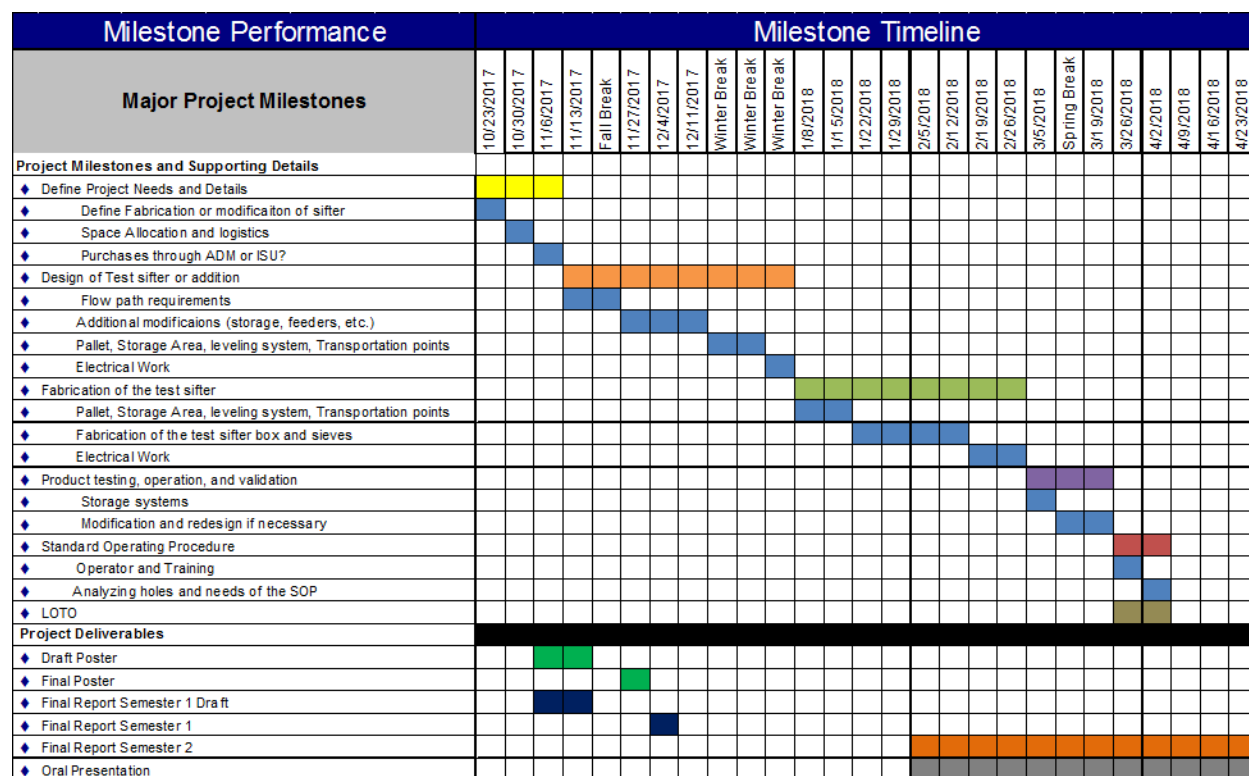
Michael Means, ADM Director of Process Improvement, personal communication, Oct. 2017 - Apr. 2018.

Michael Wiechman, ADM Technical Miller (PI Group), personal communication, Oct. 2017 - Apr. 2018.

Richard Flack, ADM Econo-Flo Manager, personal communication, Oct. 2017 - Apr 2018.

## 8 APPENDIXES

Process Gantt Chart with Milestones and Deliverables





### Beginning stages of the Tru-Balance sifter



### Generalized ideas and locations of implementation on the Tru-Balance sifter



**Various viewpoints of the small-scale granulation sifter and sieves**





**Tru-Balance as of 12/7/2017**



### **Ingredient Feeder for Project Use**



**Sifters as of 1/23/2018**







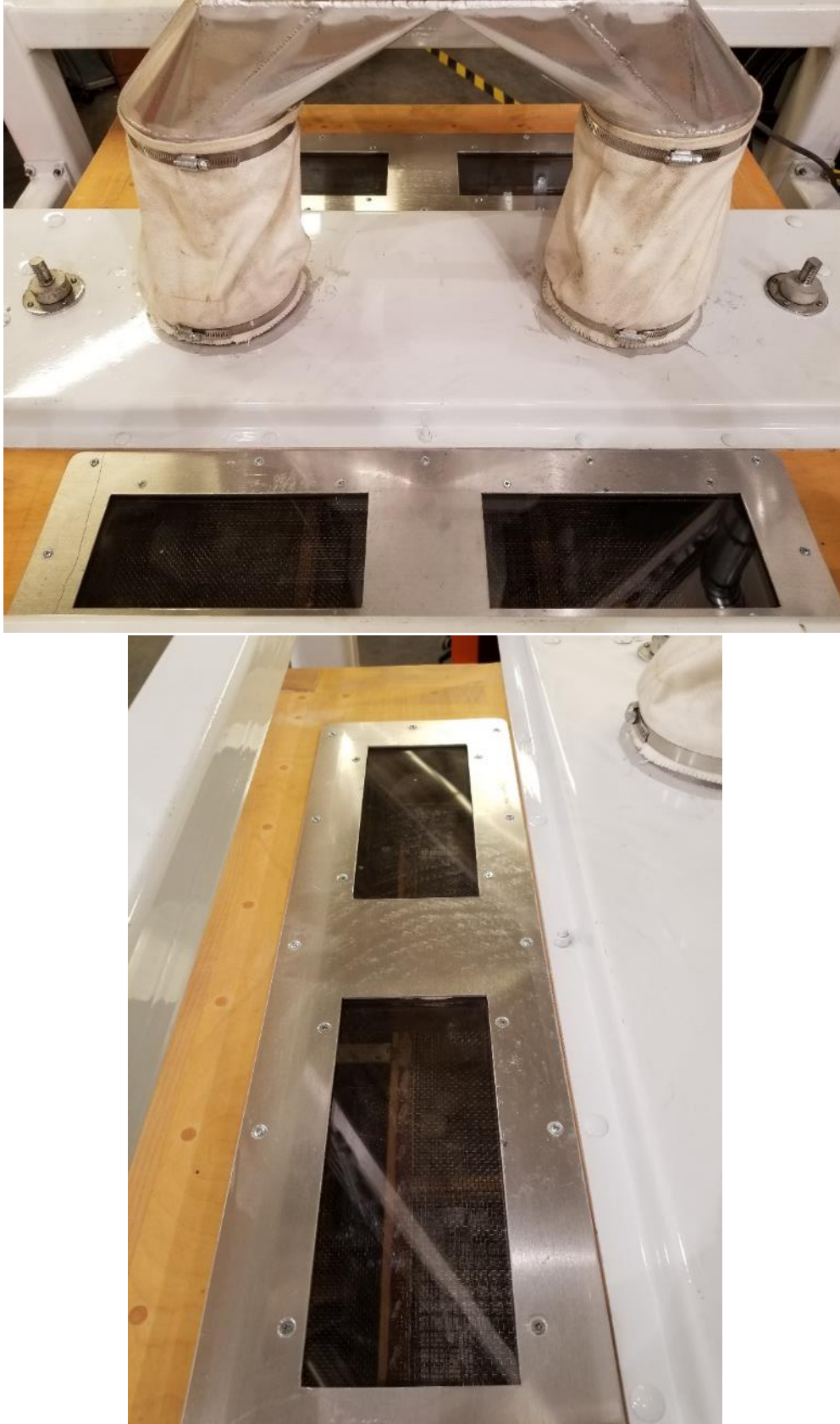




















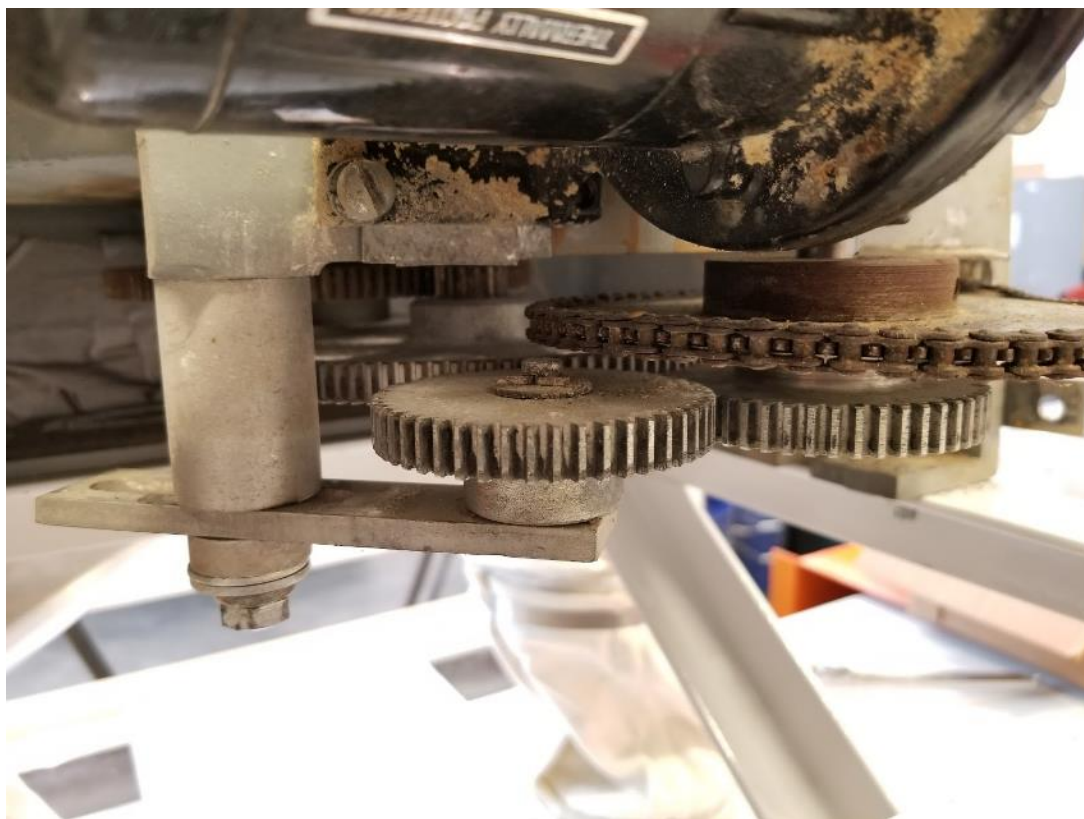




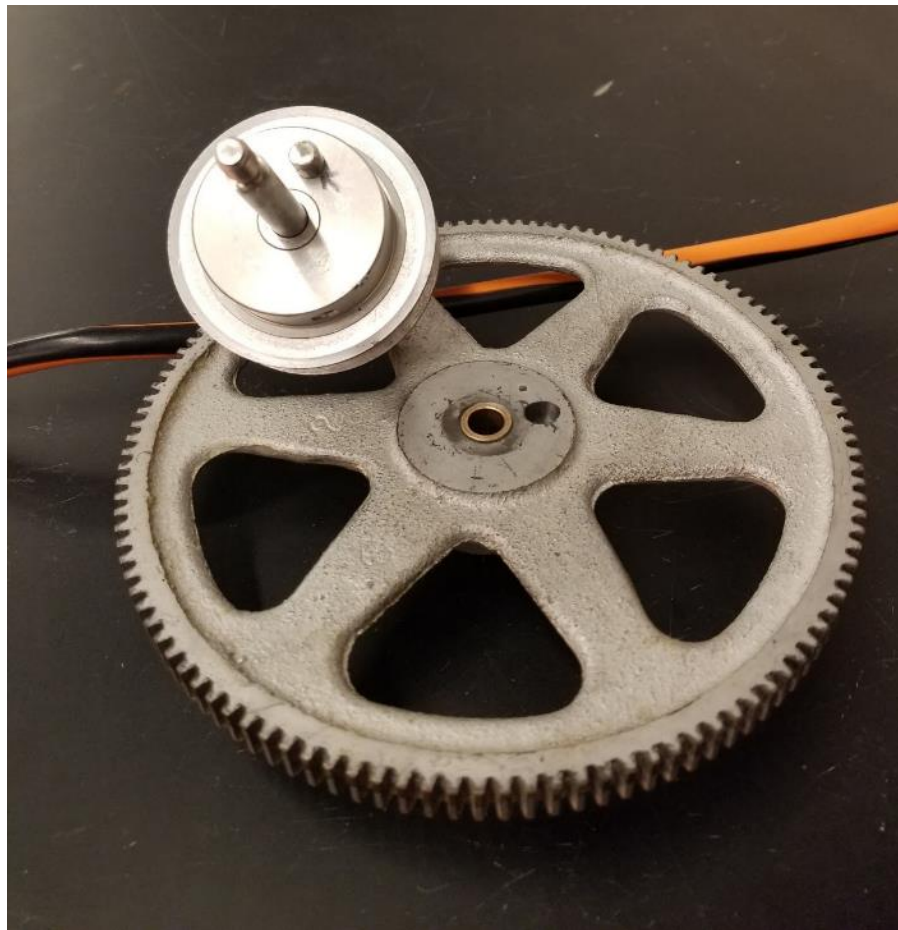
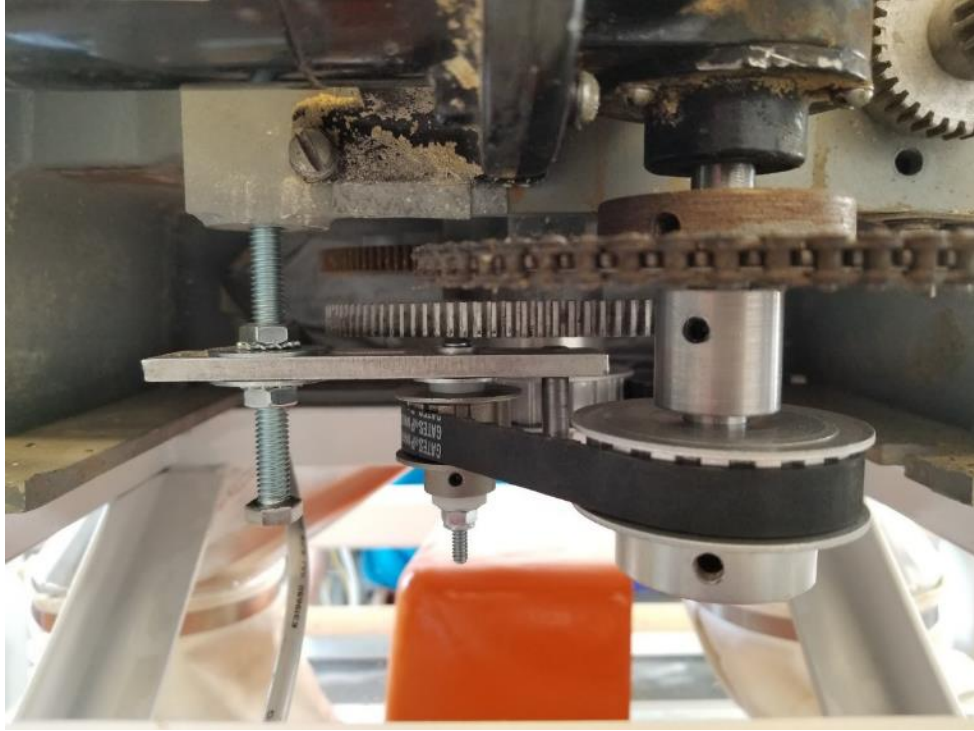
**Tru-Balance as of 4/4/2018**









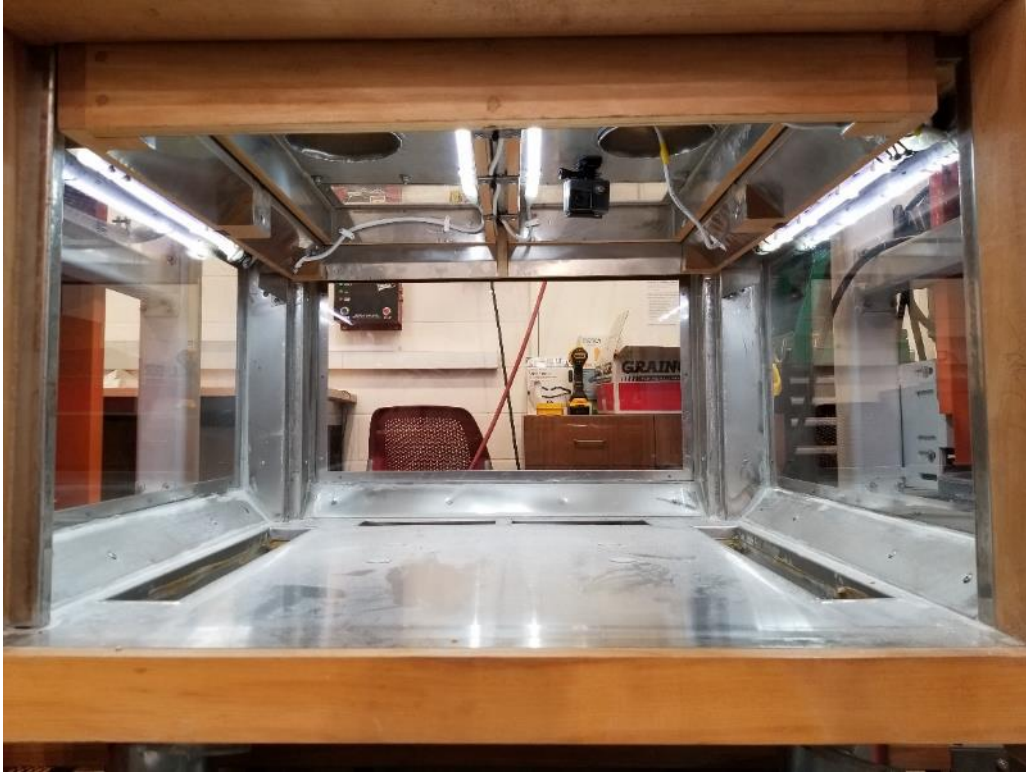




Tru-Balance as of 4/14/2018



















**Tru-Balance as of 4/24/2018**



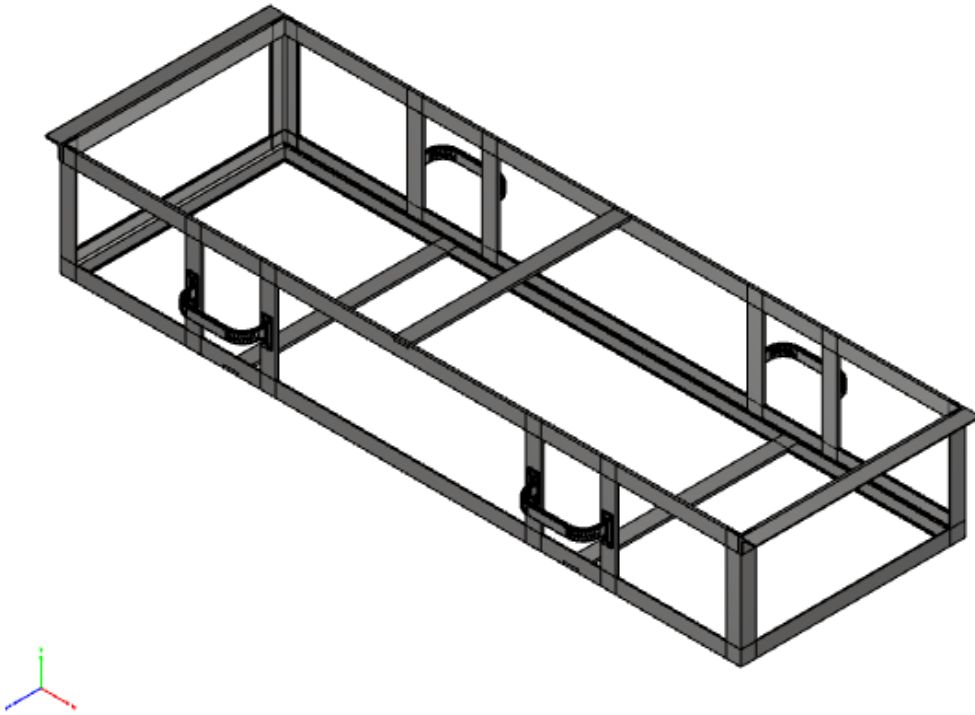




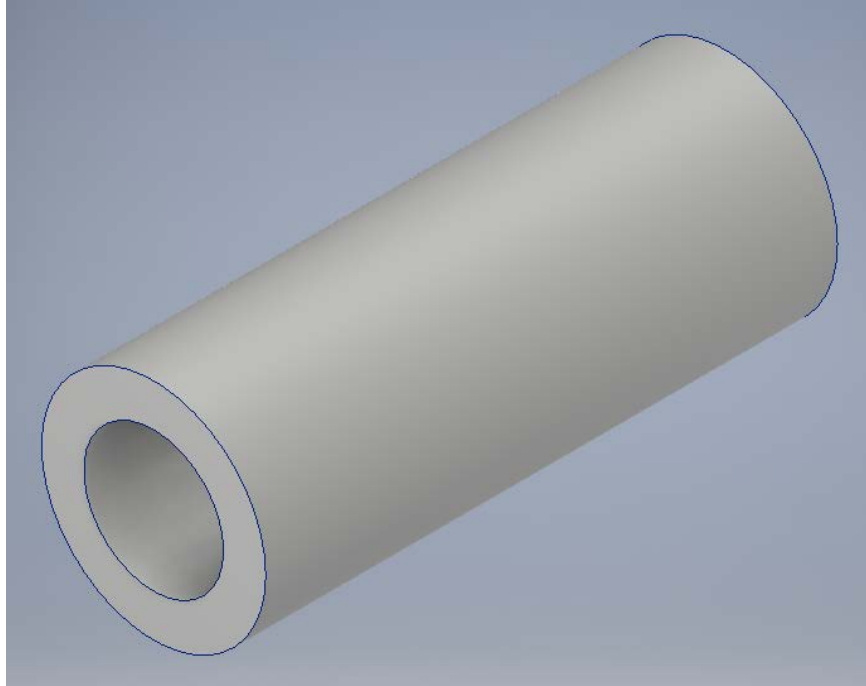
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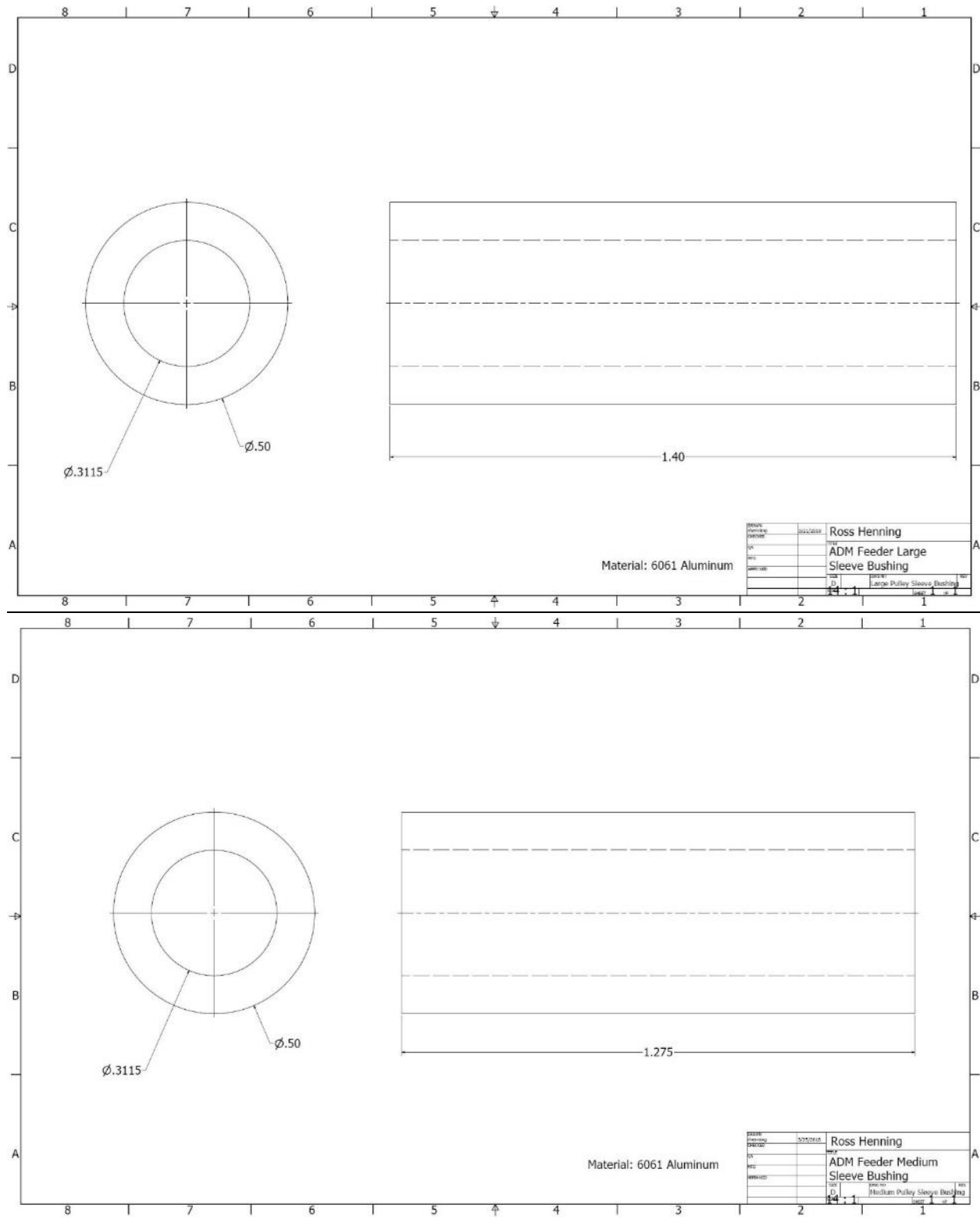
### Parts Designs



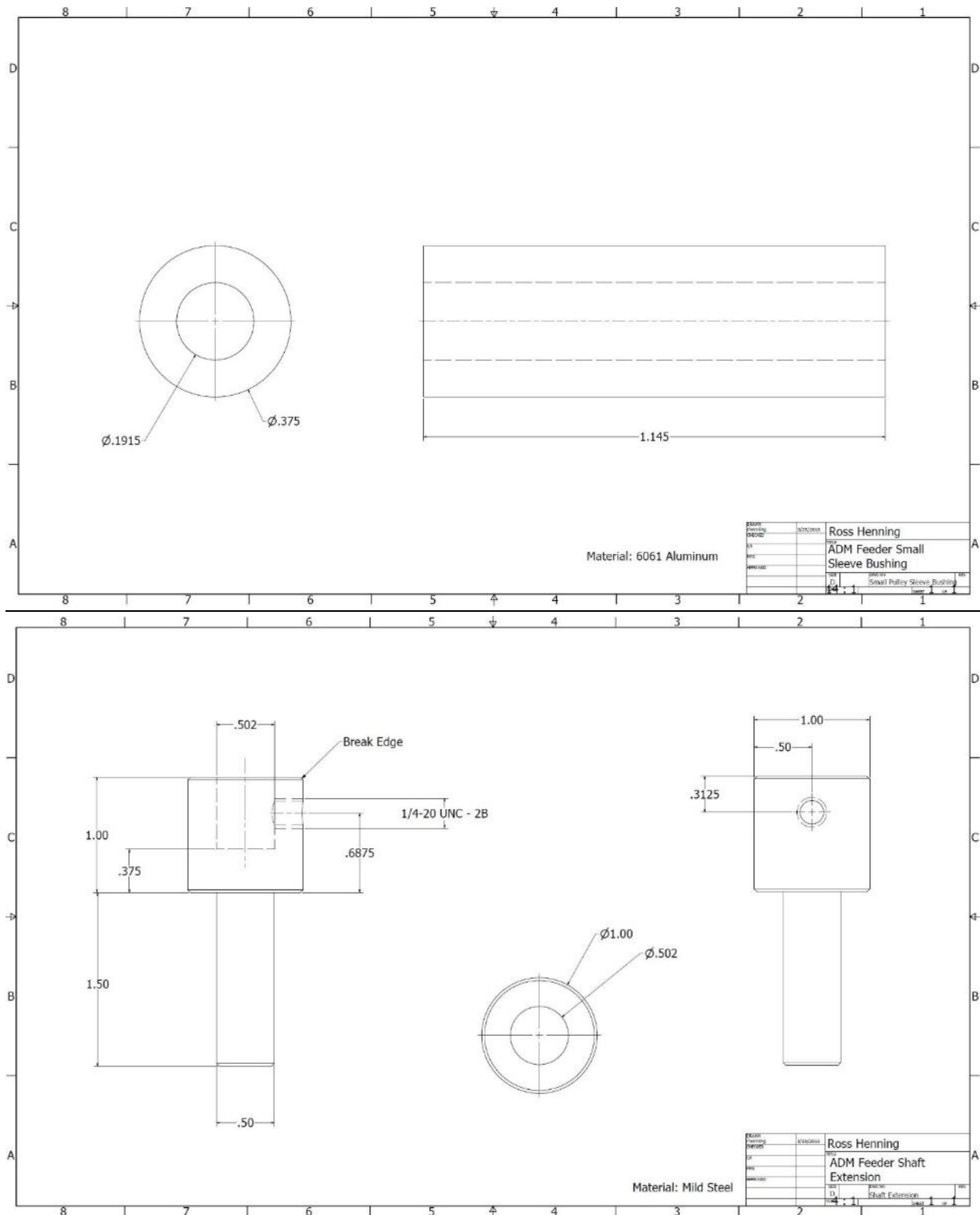




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### **Parts Ordering Forms/Receipts**

Product	Location	# To Order	Unit Price	Overall Price	USPC Code	Manufacturer #	USPC Code
Weld On Handles	Grainger	4	\$ 2.62	\$ 10.48	30171505	1WAE3	30171505
U-Bolts	Grainger	4	\$ 4.45	\$ 17.80	31161616	53425 3	31161616

Product	Location	# To Order	Unit Price	Overall Price	Item #	Manufacturer #	UNSPSC Code
Anti-Static Spray	Grainger	1	\$ 14.45	\$ 14.45	<b>1KRN8</b>	<b>SC0610000</b>	<b>15121520</b>
Plastic Toolbox	Grainger	1	\$ 9.50	\$ 9.50	<b>437U09</b>	<b>131252</b>	<b>24112401</b>



600 N County Line Rd  
Elmhurst IL 60126-2081  
630-600-3600  
chi.sales@mcmaster.com

Iowa State University  
609 Bissell Rd  
Ames IA 50011  
Attention: Jake Behrens

Purchase Order  
**442-M3746770**  
Order Placed By  
**Richard Flack**  
McMaster-Carr Number  
**8315386-01**

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03/08/2018

## Packing List

Line	Product	Ordered	Shipped
1	<b>1304N11</b> L Series Corrosion-Resistant Timing Belt Pulley for 1/2" Maximum Belt Width, 2.375" OD	1 Each	1
2	<b>1304N18</b> L Series Corrosion-Resistant Timing Belt Pulley for 1/2" Maximum Belt Width, 4.044" OD	1 Each	1
3	<b>6484K112</b> L Series Timing Belt, Trade No. 165L050	1 Each	1
4	<b>6484K113</b> L Series Timing Belt, Trade No. 195L050	1 Each	1
5	<b>90298A594</b> 18-8 Stainless Steel Shoulder Screw, 5/16" Diameter 2-3/4" Long Shoulder, 1/4"-20 Thread	1 Each	1
6	<b>90298A595</b> 18-8 Stainless Steel Shoulder Screw, 5/16" Diameter 3" Long Shoulder, 1/4"-20 Thread	1 Each	1
7	<b>97395A445</b> Dowel Pin, 316 Stainless Steel, 1/8" Diameter, 5/8" Long, Packs of 10	1 Pack	1



600 N County Line Rd  
Elmhurst IL 60126-2081  
630-600-3600  
chi.sales@mcmaster.com

Iowa State University  
609 Bissell Rd  
Ames IA 50011  
Attention: Jake Behrens

Purchase Order  
**442-M3758115**  
Order Placed By  
**Richard Flack**  
McMaster-Carr Number  
**1073713-01**

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03/22/2018

## Packing List

Line	Product	Ordered	Shipped
1	<b>1304N11</b> L Series Corrosion-Resistant Timing Belt Pulley for 1/2" Maximum Belt Width, 2.375" OD Your Part Number: <b>7752</b>	1 Each	1
2	<b>6495K23</b> Timing Belt Pulley, L Series, Press Fit Mount with Set Screw, 1.438" OD Your Part Number: <b>7752</b>	1 Each	1
3	<b>6484K146</b> L Series Timing Belt, Trade No. 187L050 Your Part Number: <b>7752</b>	1 Each	1
4	<b>90298A594</b> 18-8 Stainless Steel Shoulder Screw, 5/16" Diameter 2-3/4" Long Shoulder, 1/4"-20 Thread Your Part Number: <b>7752</b>	1 Each	1
5	<b>90298A595</b> 18-8 Stainless Steel Shoulder Screw, 5/16" Diameter 3" Long Shoulder, 1/4"-20 Thread Your Part Number: <b>7752</b>	1 Each	1
6	<b>90145A546</b> 18-8 Stainless Steel Dowel Pin, 1/4" Diameter, 1-1/2" Long, Packs of 10 Your Part Number: <b>7752</b>	1 Pack	1

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Order #W925597826  
Placed on: Mar 09, 2018

### Billing Information

Brian Davis  
609 Bissell Rd 1201 Sukup Hall  
AMES IA 50011

Payment Method: VISA \*\*\*1031

Item	Price/Item	Qty	Line Total
<b>Store Pickup (23 items)</b> 2335 Se Delaware Ave #2107, Ankeny, IA 50021			
<b>Items picked up from store #2107</b>			
7 in. Stainless-Steel Clamp	\$1.98	2	\$3.96
<b>Available: Today</b>			
3/4 in. EMT Conduit	\$4.70	1	\$4.70
<b>Available: Today</b>			
Ideal WINGTWIST Assorted Red and Yellow Wire Connectors (150-Pack)	\$6.97	1	\$6.97
<b>Available: Today</b>			
Southwire 3/4 in. x 25 ft. Ultratite Liquidtight Flexible Non-Metallic PVC Conduit	\$20.26	1	\$20.26
<b>Available: Today</b>			
3/4 in. Electrical Metallic Tube (EMT) Compression Connectors (5-Pack)	\$3.69	1	\$3.69
<b>Available: Today</b>			
GE Silicone Iron Grip 10.1 oz. Clear Silicone Adhesive	\$7.97	1	\$7.97
<b>Available: Today</b>			
3/4 in. Liquid-Tight Push-In Connector	\$5.53	4	\$22.12
4 in. Welded Square Electrical Box, Raised Ground	\$1.95	2	\$3.90
<b>Available: Today</b>			
3/4 in. 90-Degree NMLT Push Connector	\$5.21	2	\$10.42
<b>Available: Today</b>			
Ideal Combo Grounding Screw (10-Card)	\$1.27	1	\$1.27
<b>Available: Today</b>			
4 in. Square Exposed Work Cover 2-Device 6-in-1 Universal Cover	\$2.72	2	\$5.44
<b>Available: Today</b>			
1/2 in. 0.260 - 0.375 Strain-Relief Cord Connectors (2-Pack)	\$5.52	1	\$5.52
<b>Available: Today</b>			
Ideal 12 AWG Solid Grounding Pigtail with Screw, Green (50-Pack)	\$16.97	1	\$16.97
<b>Available: Today</b>			
Everbilt 72 in. x 3/4 in. x 3/4 in. x 1/8 in. Plain Steel Angle	\$9.97	4	\$39.88
<b>Available: Today</b>			
4 in. 2-1/8 in. Deep One Gang Utility Box	\$2.05	2	\$4.10
<b>Available: Today</b>			
Everbilt #10 x 1/2 in. Slotted Zinc-Plated Steel Hex-Head Sheet Metal Screw (10-Piece per Pack)	\$1.18	3	\$3.54
<b>Available: Today</b>			
3/4 in. x 1/8 in. x 48 in. Plain Steel Angle	\$6.57	1	\$6.57
<b>Available: Today</b>			
1 Gang Handy Box Duplex Receptacle Cover	\$0.64	1	\$0.64
<b>Available: Today</b>			
Everbilt 1 in. x 72 in. Plain Steel Angle with 1/8 in. Thick	\$10.88	1	\$10.88



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### Available: Today

Everbilt 1 in. x 48 in. Plain Steel Angle with 1/8 in. Thick	\$7.97	2	\$15.94
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### Available: Today

1 Gang 4 in. Utility Steel Cover	\$0.63	1	\$0.63
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### Available: Today

Master Flow 36 in. x 48 in. Galvanized-Steel Flat Sheet	\$16.74	2	\$33.48
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### Available: Today

20 Amp Commercial Grade Duplex Outlet, White	\$2.99	2	\$5.98
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### Available: Today

### Store Pickup (2 Items)

2335 Se Delaware Ave #2107, Ankeny, IA 50021

### Items picked up from store #2107

Hydro Crunch 12 in. Adjustable Metal Worm Duct Clamps (2-Pack)	\$8.49	1	\$8.49
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3/4 in. Zinc Rigid Box Spacer (2-Pack)	\$1.21	1	\$1.21
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### Ship To Home (1 item)

609 Bissell Rd 1201 Sukup Hall, AMES, IA 50011

#1 ACC Steel Conduit and Pipe Hangers (5-Pack)	\$2.67	2	\$5.34
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### Expect It On Mar 15

### Ship To Home (1 item)

609 Bissell Rd 1201 Sukup Hall, AMES, IA 50011

1 in. x 72 in. Plain Steel Flat Bar with 1/8 in. Thick	\$9.72	7	\$68.04
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### Expect It On Mar 16

### Ship To Home (1 item)

609 Bissell Rd 1201 Sukup Hall, AMES, IA 50011

Leviton 15/20 Amp Industrial Toggle Switch, White	\$4.89	4	\$19.56
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<b>Subtotal</b>	<b>\$337.47</b>
Pick Up In Store	<b>FREE</b>
Shipping	<b>FREE</b>
Sales Tax	<b>\$21.19</b>
<b>Total</b>	<b>\$358.66</b>
You Saved	<b>\$10.49</b>



Order #WD10797770

Placed on: Mar 28, 2018

## Billing Information

Brian Davis

Payment Method:

Item	Price/Item	Qty	Line Total
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### Store Pickup (1 item)

2335 Se Delaware Ave #2107, Ankeny, IA 50021

### Items picked up from store #2107

Hydro Crunch 8 in. Adjustable Metal Worm Duct Clamps (2-Pack)	\$8.27	1	\$8.27
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### Available: APR 03 - APR 06

<b>Subtotal</b>	<b>\$8.27</b>
Pick Up In Store	<b>FREE</b>
Sales Tax	<b>\$0.50</b>
<b>Total</b>	<b>\$8.77</b>

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LEDsupply - Order Completed

### Order Details

Order ID: 115811

### Billing and Shipping Information

#### Billing Information

Brian Davis,

Email Address: [bdavis95@iastate.edu](mailto:bdavis95@iastate.edu)

#### Shipping Information

Brian Davis,

[2000 Sunset Rd.](#)  
Ames, Iowa, 50014  
United States

USPS Shipping Tracking Number: 9405510200682709497406

[Click to Track](#)

### Order Content

Product ID	Product Name	Price	Quantity	Total
LS-AC50-CW-006	AC 5050 SMD LED Strip Lights Options: Color : Cool White 5000K Length : 6 Feet (~\$13.00)	\$29.99 (Not Taxable)	1	\$29.99
LS-H2-JUMP-03	Jumping (Linking) Cable(s) for AC 5050 LED Strips Options: Length : 3-Foot (~\$0.99)	\$6.98 (Not Taxable)	3	\$20.94
				Subtotal Amount : \$50.93
				Discount : \$0.00
				Shipping (Priority Mail) : \$14.02
				Tax Amount : \$0.00
				Current Total : \$64.95