



Dog Grooming tool

TEAM 17

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SPONSOR: ENGINEERING TO GO

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Background

A dog's fur is prone to matting or tangling

Textures and characteristic of the coat vary by dog's size and breed

- Short Hair dogs
- Long hair dogs

Grooming issues

- Takes too long
- Tools not ergonomic
- Unpleasant for dogs and groomers

Provide a solution for unpleasant grooming experiences of dogs and caregivers





Background Research

Many types of dog grooming tools on market today

- double sided brushes
- brushes with vacuums
- mat splitter

Most popular dog brushes

- The FURminator
 - Reduces shedding by up to 90%
- Slicker Brush



FURminator

Background Research

No grooming tools with removable rotating heads on the market

Things to consider with a rotary style brush

- Will brush head run risk of getting tangled and twisted into dogs hair?
- Will spinning brush pull too hard and injure dog?



Rotary Head Hair Dryer



Rotary Head Grill Brush

Objectives vs. Constraints

Objectives

- Design tool for use by consumers, groomers, and rescuers
- Untangle pet's hair without harm to pet
- Develop tool that is stress free on dog and groomer

Constraints

- Tool is handheld and ergonomic
- Tool works at low RPM to prevent further entanglement and injury
- Tool is easy to clean and sterilize
- Battery last at least 2 hours at 50% duty cycle
- Total weight is 1 pound or lower

Voice of the Customer

- 63% want an improved handle
- 46% surveyors brushed dog once a week
- 55% of surveyors didn't like grooming their dog "It's a lot of work"
- Surveyors grooming tool lasted about 6 months
- Dogs don't enjoy grooming process
- Price, shape and design were most important to customers
- 26% want something electrical

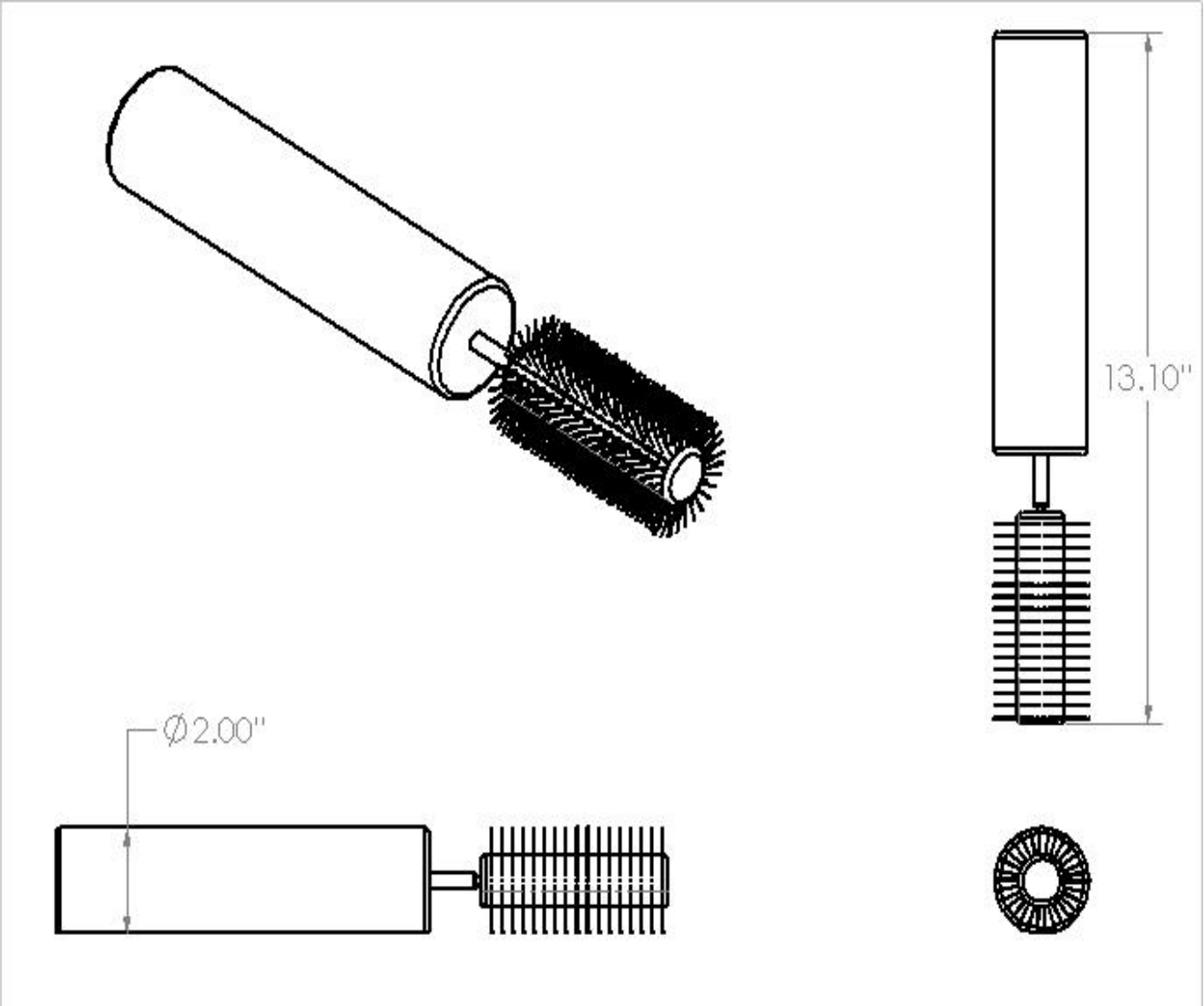
Need Statement

“De-matting a dog's hair can be an unpleasant experience for both the dog and the groomer, especially if the matting has advanced and is deep in the hair or fur. To de-matt or de-tangle, it can be very time consuming and uncomfortable, if not painful.”

Revised Goal Statement

Design and develop a grooming tool that provides both the user and dog with a pleasant, stress free, time efficient grooming experience

Design Concept One



Design Concept One

Positives

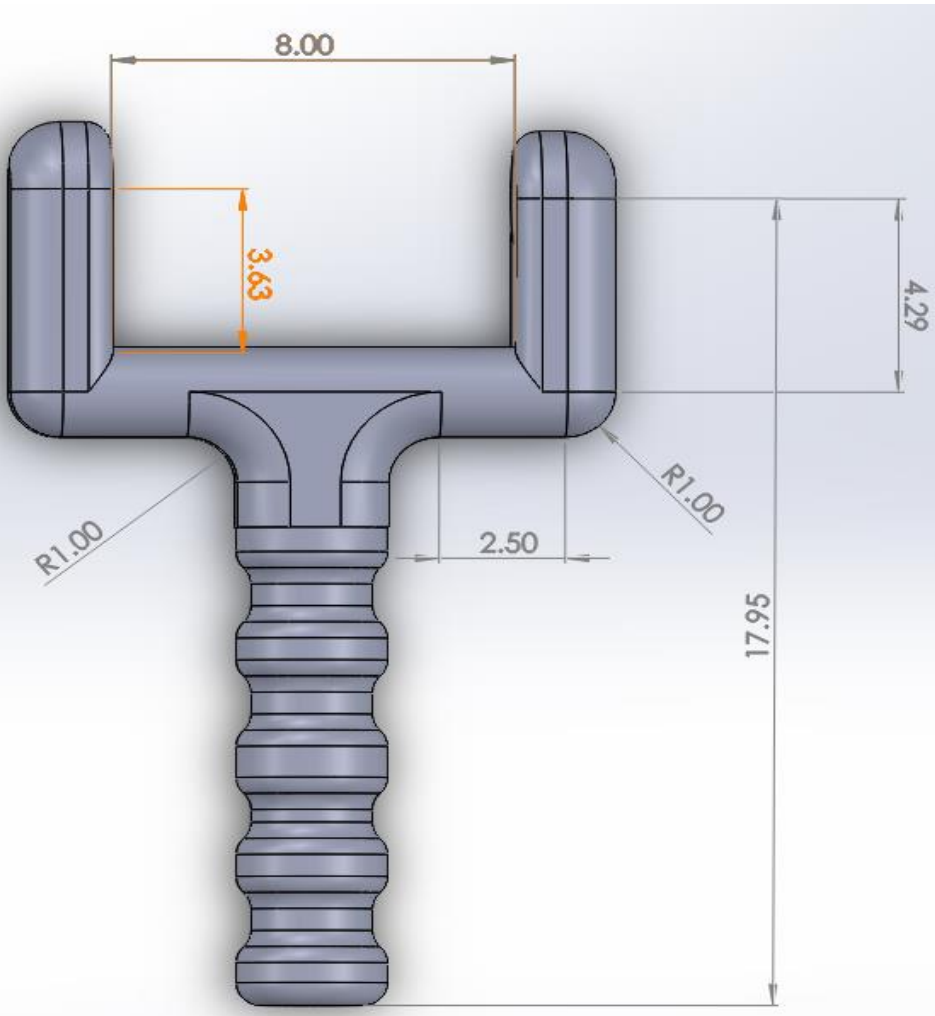
- Simple handle design
- Manufacturability
- Simple brush head swapping

Drawbacks

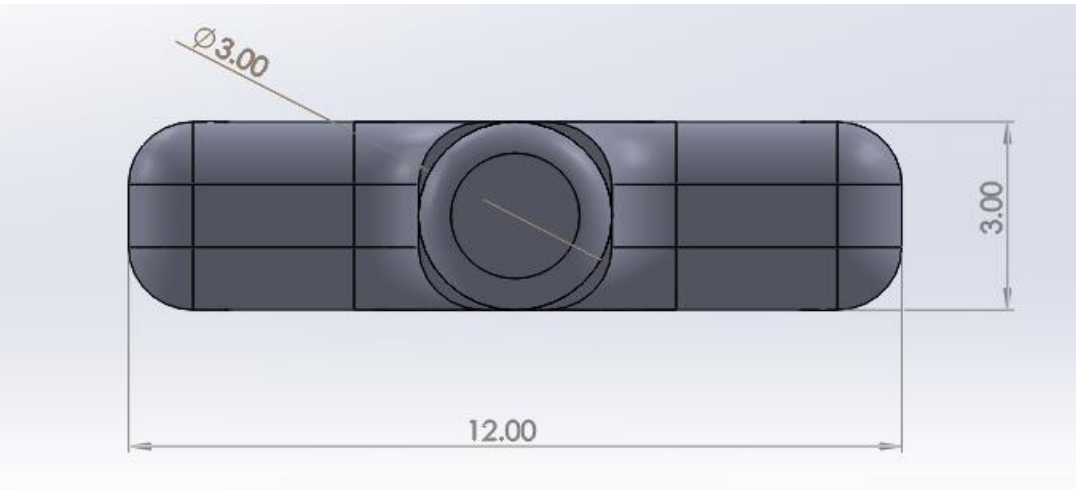
- Ambidexterity
- Requires motor reversing
- Complex head assembly

Design Concept Two: Handle

Front View



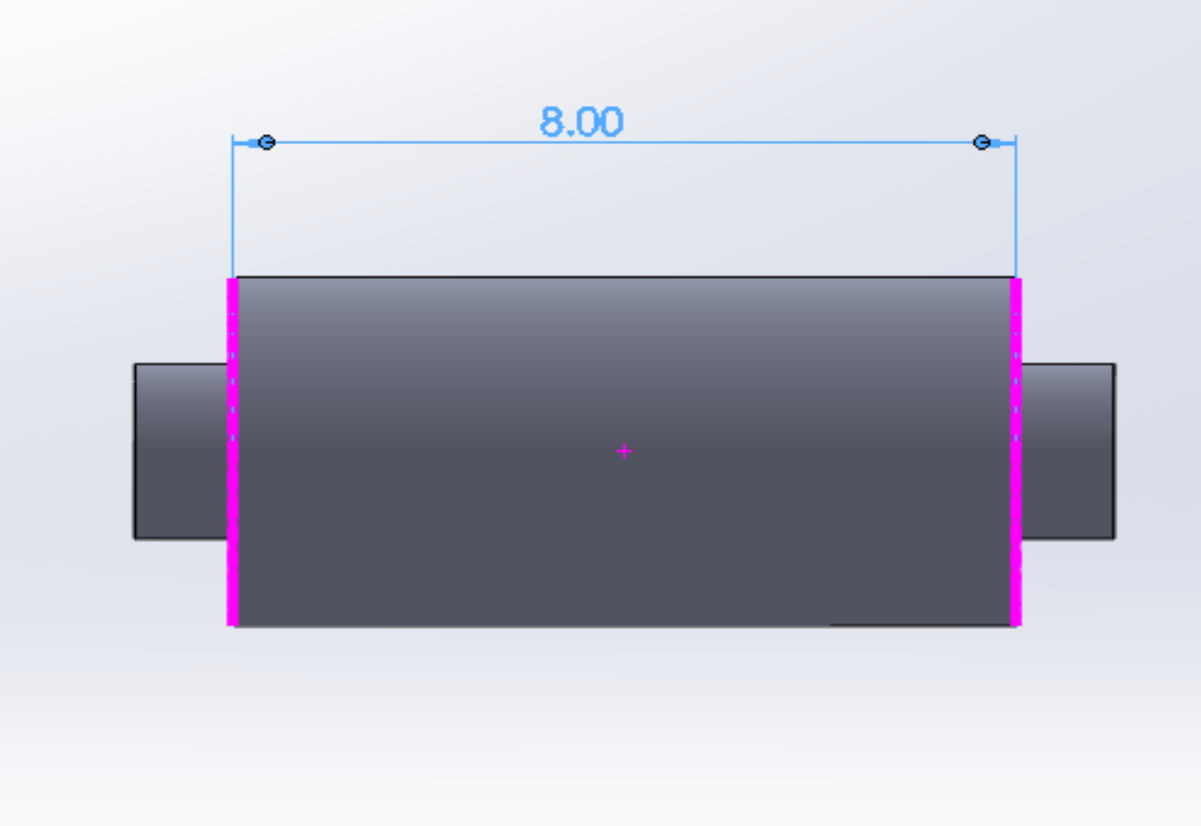
Bottom View



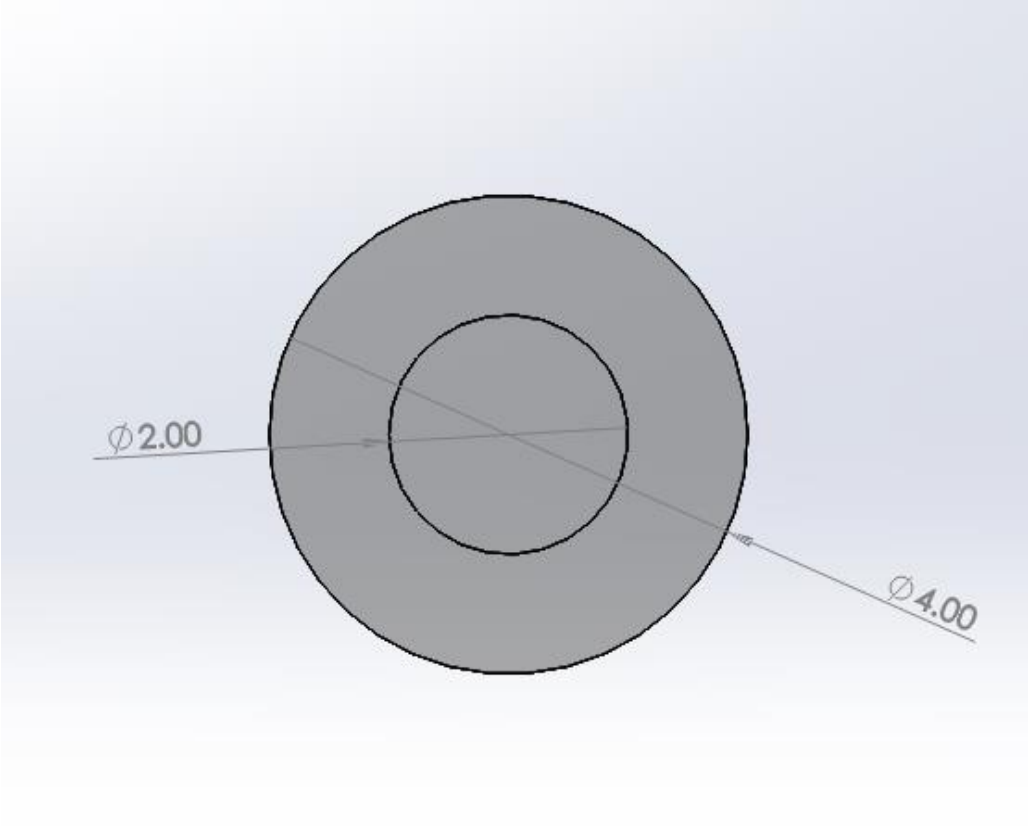
All Measurements in Inches

Design Concept Two: Brush Head

Front View



Side View



All Measurements in Inches

Design Concept Two

Positives

- Ergonomically molded handle
- Keeps hand away from moving parts
- Allows for ambidexterity
- Motor doesn't have to be reversible

Drawbacks

- Grooming motion requires movement all over the place making vertical orientation uncomfortable
- Doesn't account for inclusion of motor, power source, and other components
- No technical analysis behind it

Concept Design: Motor Selection

- Motor needs to provide adequate torque to turn brush head
- Low RPM is a must to ensure pet safety
- Motor must be inexpensive to meet price of manufacturing goals
- Reliability is key to ensure customer satisfaction

Motor Decision Matrix

Decision Factors	Column1	Choice 1	Choice 2	Choice 3	Scores	Column2	Column3
Criteria	Weight (1-5)	AC Motor	DC Motor	Battery Powered DC	AC Motor	DC Motor	Battery Powered DC
Power	3	5	4	3	15	12	9
User Safety	5	3	4	5	15	20	25
Reliability	3	5	4	3	15	12	9
Cost	4	3	4	3	12	16	12
Weight	3	4	5	3	12	15	9
Pet Safety	5	3	4	5	15	20	25
				<u>Total Scores</u>	<u>84</u>	<u>95</u>	<u>89</u>

Concept Design: Brush Head Selection

- Bristles must be designed to slowly work mats out of hair
- They must be sized to give when excessive force is encountered
- If bristles are too large or stiff, they will pull hair causing the animal discomfort
- The bristles must also be durable and able to last for many hours of constant use without failure

Bristle Decision Matrix

Decision Factors	Column1	Choice 1	Choice 2	Choice 3	Scores	Column2	Column3
Criteria	Weight (1-5)	Metal Wire Bristles	Plastic Bristles	Metal Blades	Metal Wire Bristles	Plastic Bristles	Metal Blades
User Comfort	3	3	4	1	9	12	3
Pet Safety	5	4	5	1	20	25	5
User Safety	5	5	5	1	25	25	5
Pet Comfort	5	3	4	2	15	20	10
Reliability	3	5	2	2	15	6	6
Dematting Performance	4	4	3	5	16	12	20
Cost	4	4	4	3	16	16	12
Manufacturability	3	4	3	1	12	9	3
				<u>Total Scores</u>	<u>128</u>	<u>125</u>	<u>64</u>

Concept Design: Handle Selection

- The handle must be lightweight
- Shaped to prevent fatigue of the user's hands
- Materials used in the handle must be durable
- Able to withstand cleaning chemicals without failing
- Texture of the handle material is important to provides adequate grip when wet
- The handle must be easy and cheap to manufacture
- The material must be readily available

Handle Decision Matrix

Decision Factors	Column1	Choice 1	Choice 2	Choice 3	Scores	Column2	Column3
Criteria	Weight (1-5)	Aluminum	ABS Plastic	HDPE Plastic	Aluminum	ABS Plastic	HDPE Plastic
User Comfort	4	3	4	4	12	16	16
User Safety	5	3	4	4	15	20	20
Strength	3	5	3	4	15	9	12
Cost	4	3	4	4	12	16	16
Manufacturability	4	4	5	4	16	20	16
Weight	3	3	5	4	9	15	12
				<u>Total Scores</u>	<u>79</u>	<u>96</u>	<u>92</u>

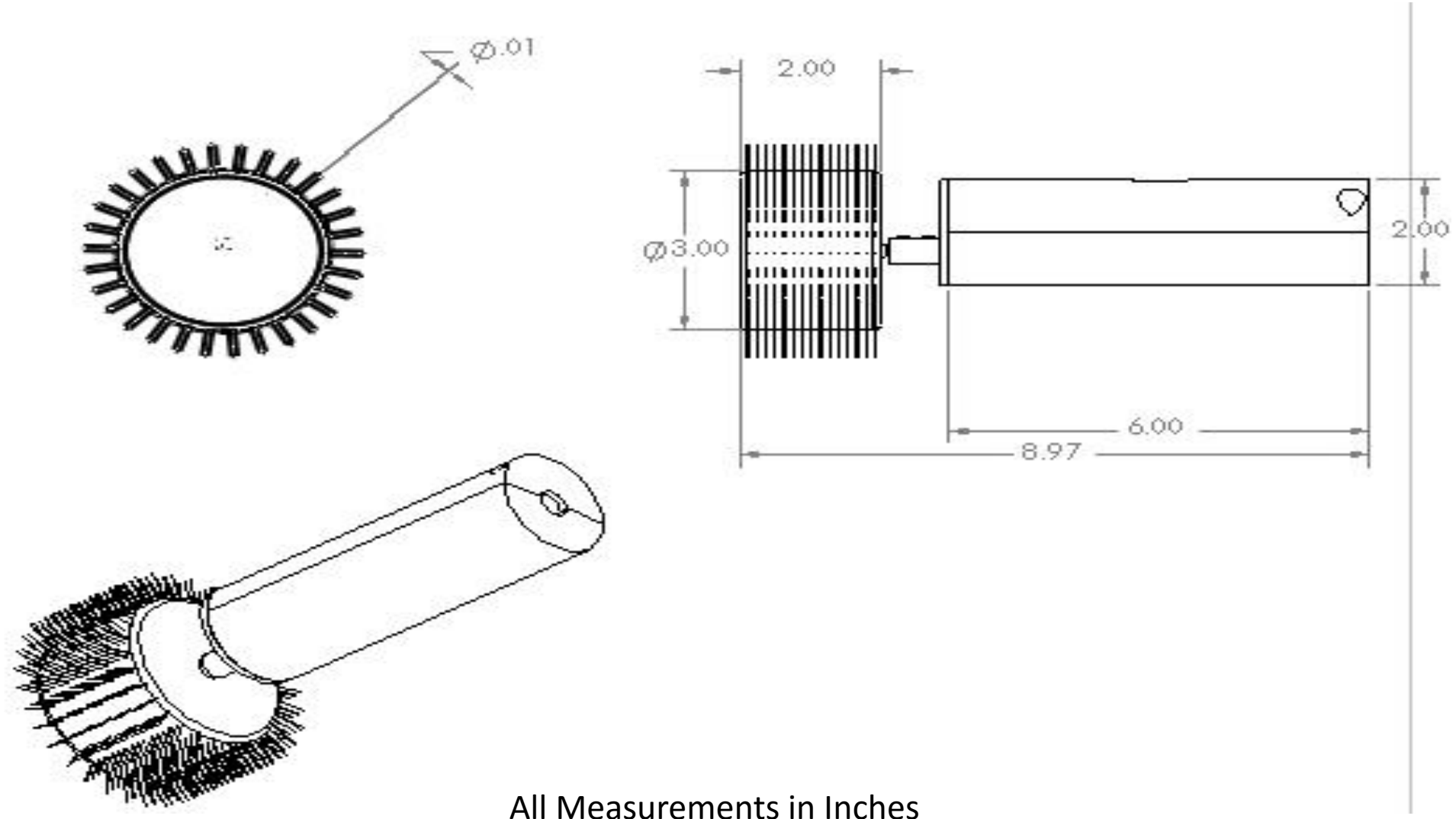
Concept Design: Power Source Selection

- Power options were limited to 120V AC and DC battery power
- Using 120V AC converted to 12V DC was determined to be best
- Using straight AC power was determined to be too costly and unsafe for the user
- Converting AC to DC does away with the battery pack, reducing weight

Final Prototype Design

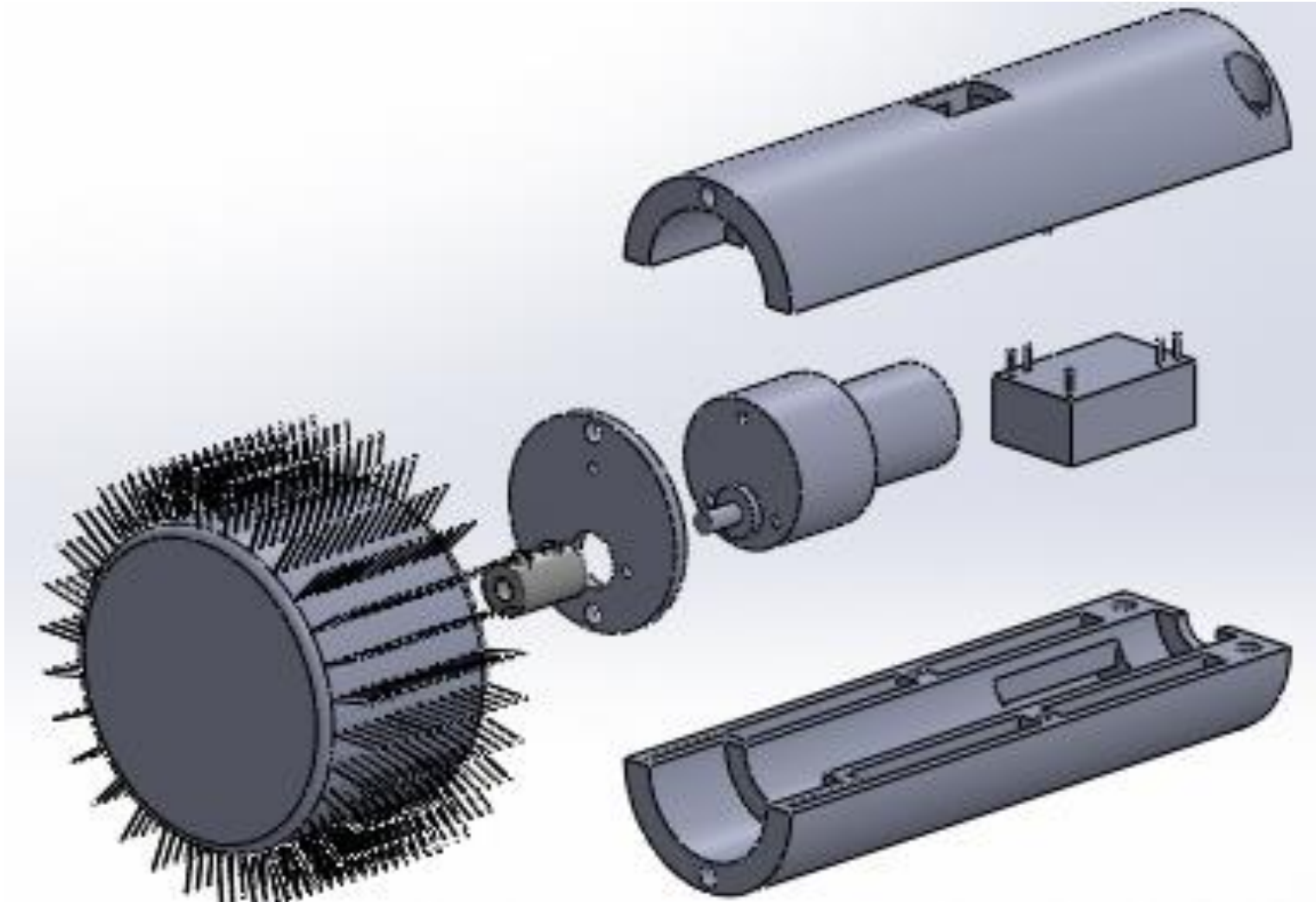
- Simple handle design to be 3D printed out of ABS plastic
- Uses a 12V DC gearmotor spinning at 72 RPM
- Power is transferred through a small AC to DC converter and a simple on/off switch
- The brush bristles are .01" 304 stainless wire
- This design should be compact, lightweight, and easy to use

Final Prototype Design



All Measurements in Inches

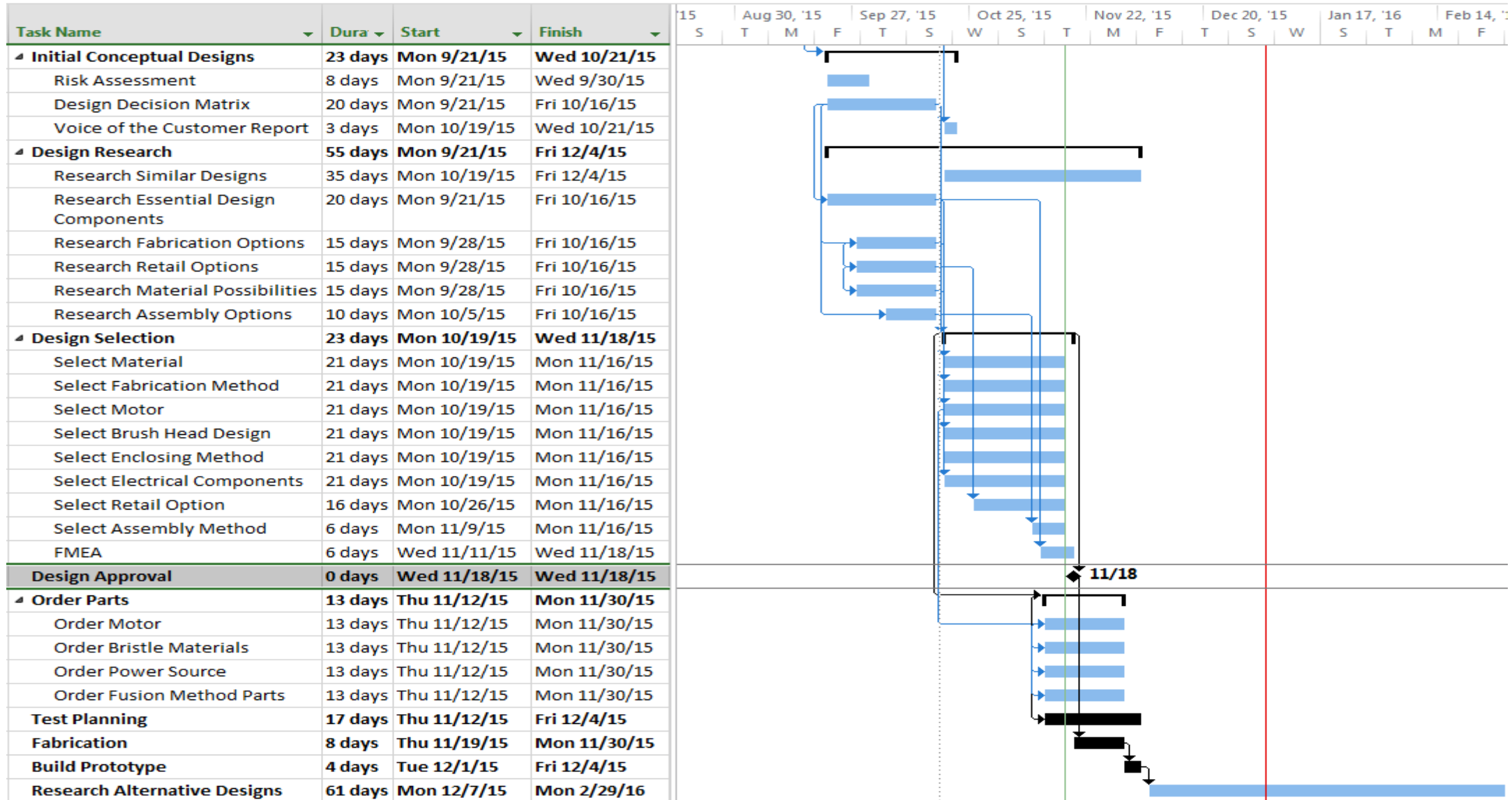
Final Prototype Design



FMEA

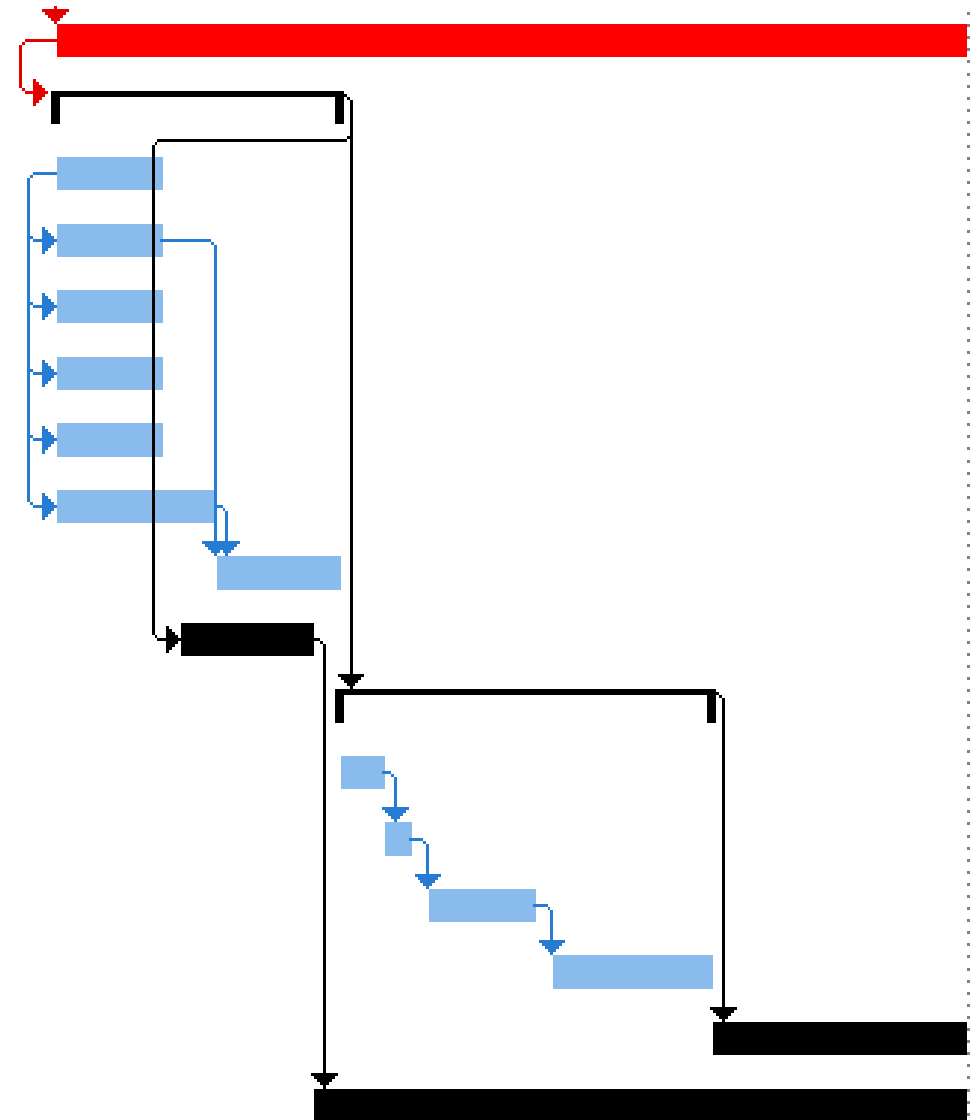
Function	Potential Failure Mode	Potential Effects of Failure	Severity (1-10)	Potential Causes of Failure	Occurrence (1-10)	Process Controls	Detection (1-10)	RPN	CRIT	Action Plan
Detangle Matted Fur	Motor not powerful enough to brush through fur	Motor overheats from excessive loading, Brush becomes stuck in hair, Product does not meet spec	10	Incorrect motor size	7	Select motor with minimum torque needed	4	280	70	Test force needed to pull through matt
				Bad motor installed	1	Test motor before installing	1	10	10	Have multiple motors on hand
				Motor/ shaft binding	5	Check tolerances and check for debris	2	100	50	Design to keep debris out, Test life cycle of product, determine test plan for applied forces
	Bristles to soft and don't break up matt	Brush doesn't meet initial goals	9	Incorrect size wire installed	6	Ensure correct tolerances for manufacturing	2	108	54	Measure bristles on existing brushes
				Length of Bristles	6	Ensure correct tolerances for manufacturing	3	162	54	Measure length of bristles on current brushes

Product Gantt Chart: Phase I



Product Gantt Chart: Phase II

<i>Phase II (January - March)</i>	<i>75 days</i>	<i>Mon 1/4/16</i>	<i>Fri 4/15/16</i>
▸ Test and Analysis I	24 days	Mon 1/4/16	Thu 2/4/16
Test Motor Speed	10 days	Mon 1/4/16	Fri 1/15/16
Analyze Ergonomics	10 days	Mon 1/4/16	Fri 1/15/16
Test Power Source	10 days	Mon 1/4/16	Fri 1/15/16
Test Electrical Components	10 days	Mon 1/4/16	Fri 1/15/16
Test Tool Effectiveness	10 days	Mon 1/4/16	Fri 1/15/16
Test Tool Efficiency	14 days	Mon 1/4/16	Thu 1/21/16
Troubleshoot Issues	10 days	Fri 1/22/16	Thu 2/4/16
Voice of the Customer II	11 days	Mon 1/18/16	Mon 2/1/16
▸ Redesign	30 days	Fri 2/5/16	Thu 3/17/16
FMEA	3 days	Fri 2/5/16	Tue 2/9/16
Design Approval	3 days	Wed 2/10/16	Fri 2/12/16
Build Prototype	10 days	Mon 2/15/16	Fri 2/26/16
Test and Analysis I	14 days	Mon 2/29/16	Thu 3/17/16
Field Trials	21 days	Fri 3/18/16	Fri 4/15/16
Voice of the Customer Report	54 days	Tue 2/2/16	Fri 4/15/16



Conclusion and Future Work

- Prototype Design has been selected and approved
- Failure Mode Analysis has been completed
- CAD drawings have been finalized
- Motor and electrical components are to be ordered
- Brush head manufacturing to be outsourced
- Product testing plan will be developed
- Grooming tool handle will be fabricated
- Prototype will be constructed

PHASE I: COMPLETE

Questions?