



# Guitar Heroes

## How to Restring a Guitar

Begin by loosening and removing the old strings using a string winder. Once the strings are off, insert the new strings into the bridge—either through the back of the guitar (for electric) or by securing them with bridge pins (for acoustics). Pull each string tight and thread it through the appropriate tuning peg, winding it around the peg while tightening it to pitch. Aim for 2–3 wraps around each peg for stability. Once all strings are installed, clip any excess string ends.



## Problems with Traditional Pegwinders

- 1.) Peg turning head is one size, resulting in wobbly motion
- 2.) Manual wind motion
- 3.) Peg winding takes ~ 150 turns for 6 strings
- 4.) No string clipper
- 5.) No string clipper
- 6.) Poor hand grip



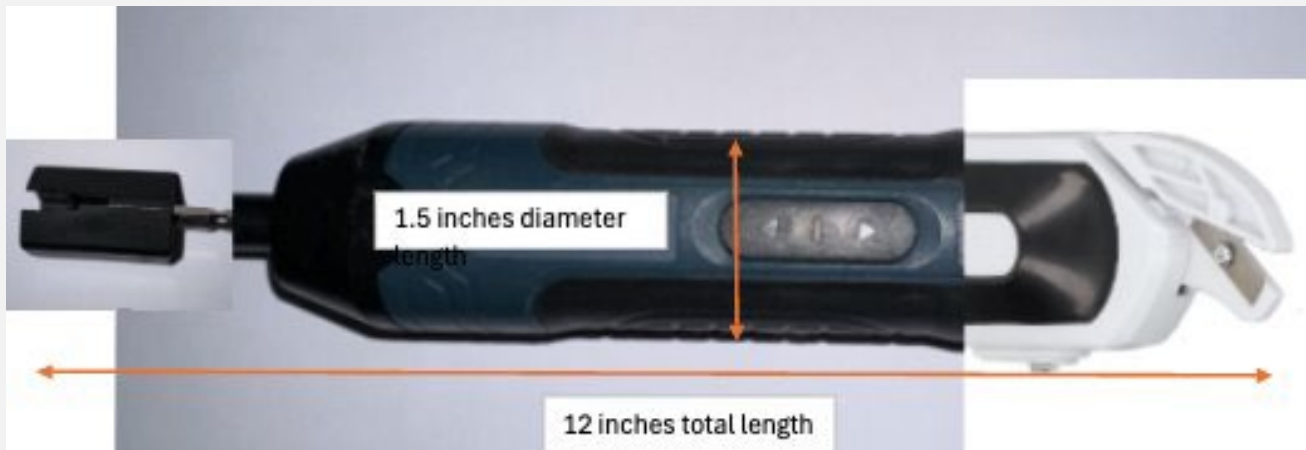
### Project Goals:

- Create a 3D prototype of new and improved pegwinder
- Make a profit 2x more the production cost

### New Features:

- 1.) Battery-powered functionality for tuning peg wind/unwind
- 2.) Attached manual string cutter
- 3.) Ergonomic handle
- 4.) Secure peg turning head (remove wobble motion)
- 5.) Pin Puller

### Initial Conceptual Design:



## Design Goals and Constraints

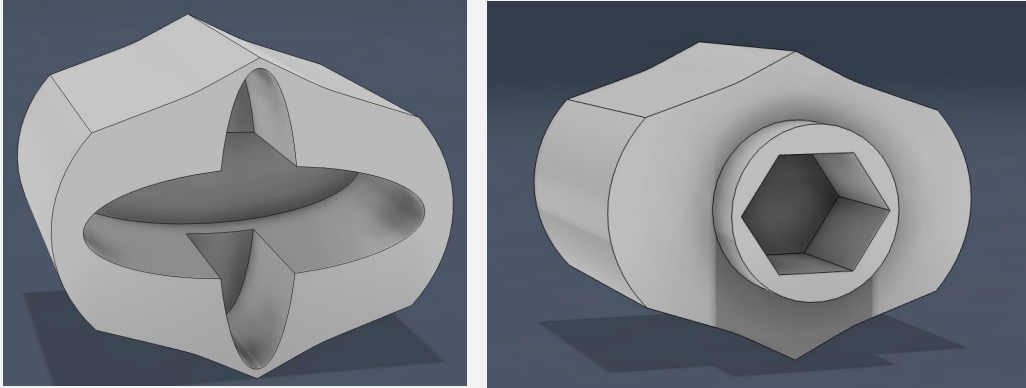
Number	Design Input	Target Value	Validation Method	Pass/Fail
1	Dimensions	6" total length, 1.5" wide, 1.5 in height	Visual	Pass
2	Weight	0.30 lbs	Scale	Pass
3	Material	High Density Polyethylene	Density Test	Pass
4	Components	Peg turning head, main body, string clipper	Visual	Pass
5	Peg Turning Head Dimensions	Acoustic: 0.88" long, 0.70" wide, 0.25" high. Electric: 0.70" long, 0.50" wide, 0.20" high	Visual	Pass
6	Comfortable Grip	4 circular cutouts	Visual	Pass
7	Logo	Apollo lyre	Visual	Pass
8	Company Name Engraving	0.15" high	Visual	Pass
9	Battery Voltage	3.7 V lithium rechargeable battery	Multimeter Tool	Pass
10	ON/OFF	Button on top of main body	Visual	Pass
11	L / R	Left loosens and right tightens strings	Visual	Pass
12	String Cutter	Attached to underside of main body	Visual	Pass
13	Main Body	Phillips head screws used to hold body together	Visual	Pass
14	Bridge Pins Removal	Add pin puller to back of main body	Visual	Pass
15	Shelf Life / Reliability	3-5 years	Quality of Materials	Pass
16	Unit Production Cost	\$30	Compare cost to other pegwinders	Pass
17	Motor Speed	250-300 RPM Range	Read Motor Specifications	Pass
18	Forces (Torque / Tension)	Tension < 18 lbs, Torque < 2 inch per lb	Torque = Force * Distance. Apply force to a peg at a defined distance of 3 inches until movement is observed	Pass

The design goals were used to create the pegwinder. The material choice was between high density polyethylene and ABS. HDPE better for low-stress items, ABS better under high pressure and weight. HDPE is fully recyclable, reduces our carbon footprint, has high durability and rigidity, and is cheaper and more popular for mass-produced items than ABS.

## Final 3D CAD Prototype Design

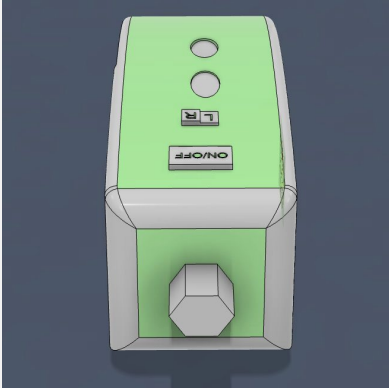
The prototype was split into 3 major components:

### Peg Turning Head:

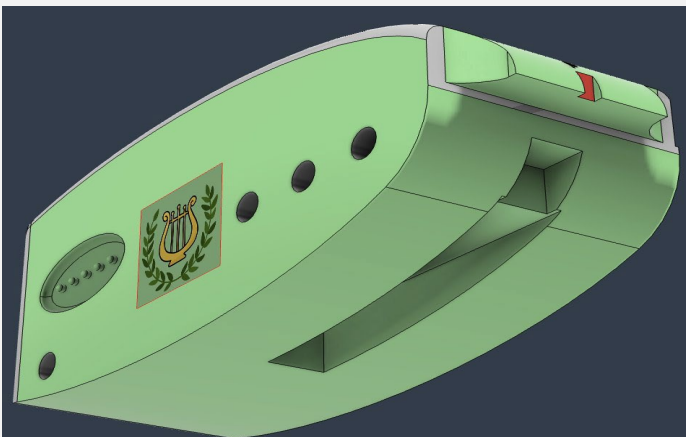
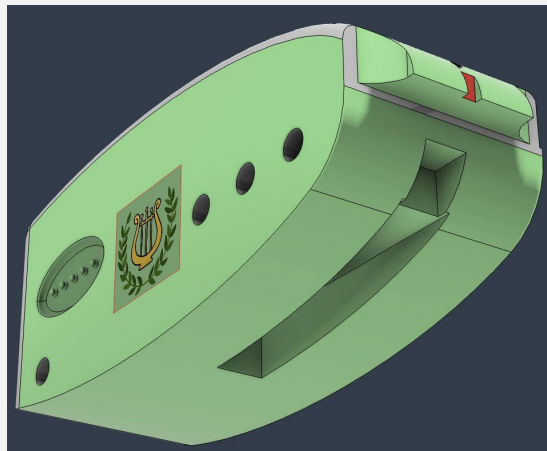
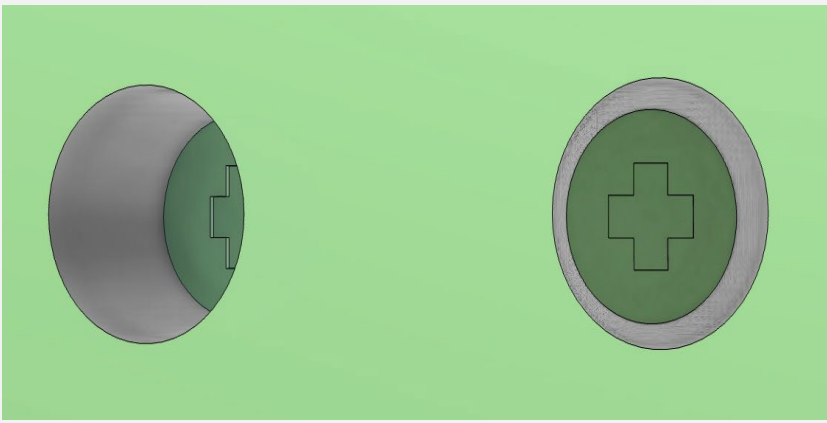


The material is made from HDPE and has a flower-like shape. It is designed to fit both acoustic and electric tuning pegs. In the manufacturing facility it is created by injection molding. Injection molding is good for parts that are mass produced because the molds are repeatable and there is a low defect rate.

### Main Body:

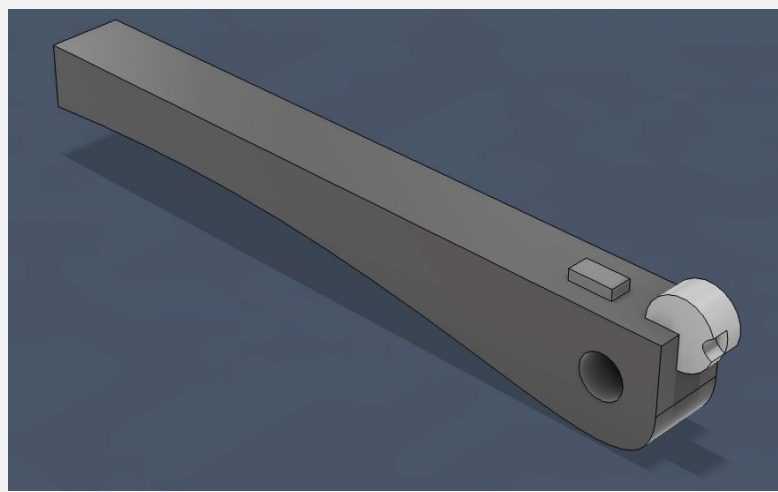


The material is made from HDPE and has an ellipsoid shape. It is a lime green color which pops out more on store shelves. There is an ON/OFF button which turns the pegwinder on and off. There are four circular cutouts with grips for a more ergonomic handle. Apollo's lyre logo is hot stamped on one side while the company name, Apollo Pegwinders, is engraved by CNC machining on the other side. Flat Phillips head screws hold the component together. There is a bridge pin puller on the back and the string cutter is attached underneath.

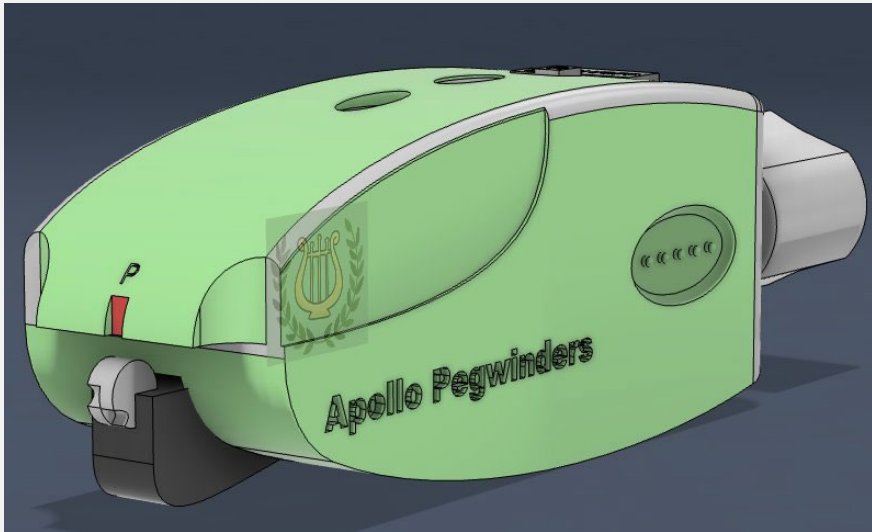
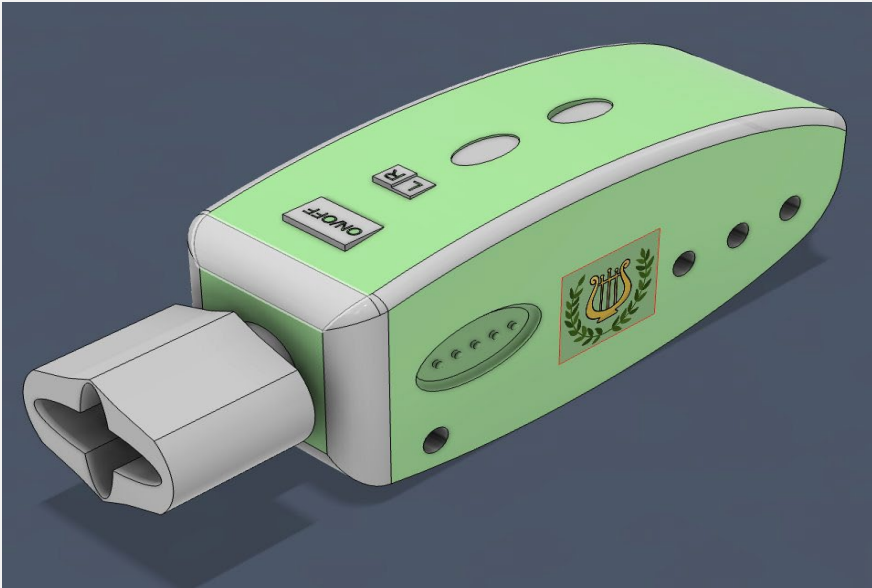


### String Clipper:

The material is made from HDPE for the base and stainless steel for clipper. The clipper has a spring/latch system used to open and close it. The base is created by injection molding and the stainless steel head is created by CNC machining.



### Final Design:



## Production Cost Summary and Sales Price

Production Cost Summary per Unit			
Key Items	Reference	Cost, \$ per Unit	Comments
Motor	DC 3V 2800 RPM	6.153	Bulk price 30% discount included
Gears	3x, 18 sets of teeth	0.8685	
Peg Turning Head	HDPE injection mold	0.24	Reference Cost
Main Body	HDPE injection mold	0.72	Main Body is 3x larger than Peg Turning Head
Clipper	Stainless Steel	0.43	Use stainless steel nail clipper cost approximation
Battery	3.7 V rechargeable Li-Ion, 1200 mAh	4.249	Bulk price 30% discount included
Circuit Board		0.5	Assumed
Total		13.16	
Note: Cost from Internet Search			

The total price to create the physical prototype would be \$13.16. It takes into account the price to create the 3 major components and the internal components as well.

### Sales Price per Unit Baseline

Found 2 battery-operated guitar tuning tools with avg cost of \$52  
To be competitive we will offer ours at \$30/unit

Sales Price = \$30/unit



Ernie Ball Power Peg Pro String Winder  
\$34.99



T2 Smart Guitar Tuner  
\$69.99

The pegwinders to the left were used as an idea for how to price the Apollo Pegwinder.

Production Cost ~ \$13, Sales Price = \$30, Profit = 30/13 = 2.3x. **Goal Exceeded.**

### Students & Faculty Advisors

Jason Melendez, Brian Williams  
Dr. Bradley

### Sponsorships

N/A