

2016 TSA CNC Production Competition

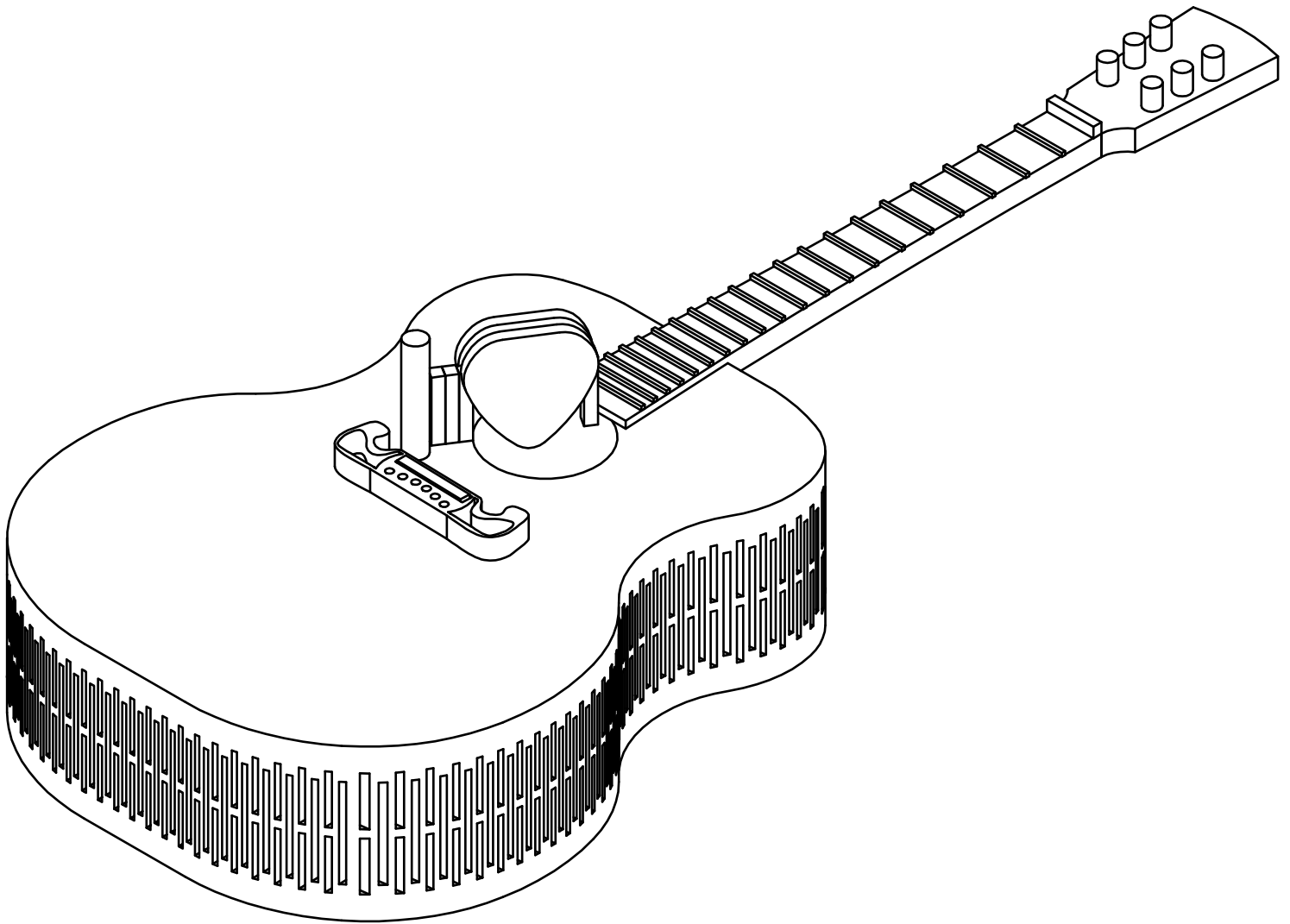
Jeffrey Worley

My teammate, Alexei Garcia, and I submitted all of the following documents to the TSA National Conference when we competed in the CNC production competition and took 1st place. While I cannot take any credit for the painting of the Guitar and the wording of the documentation, I created the 3D model using inventor, all of the sketches using AutoCAD, and operated the laser engraver. Below are images of the final product that we built during the competition at the national conference.



Inventor 3D Isometric Drawing

This is an Isometric view of the 3D model I created in inventor. This was a requirement for the competition. The competition required the bank to be related to the location of the competition. Because the competition was in Nashville, Tennessee, We modeled it after Johnny Cash's Gibson J200 guitar.



Photographic Design Process



Initial designs of the guitar body were tested on multiple blank sheets of wood. Test pieces were used properly calibrate the laser and ensure the result matched computer specifications. A laser engraver was used to cut the outline and every 1/16" x 1/16" tooth inset along the edge of the body. Our first designs used a 1/16" deep raster as a track for the sides, but testing showed that interlocking teeth worked better.



The laser engraving method was also tested for accuracy on smaller assembly parts such as the bridge of the guitar shown to the left. The piece, when modeled, was fairly complex with little over an inch in length. We learned that some smaller parts were highly flammable when exposed to the laser for extended periods of time.



Next, two (2) 1.2 in. long picks were cut with rasters along the inside to fit two sections of plastic (1/8 in. x 1/2 in.) to connect the two sides. The two picks and plastic sides, when assembled, function as a slot for the user to insert a coin of any dimension up to a quarter to be deposited. The plastic pieces were laser engraved



The final product was sanded and painted with multiple layers of acrylic paint to create the "sunburst" paintjob. First, a layer of yellow was applied then red. The middle section was sanded away to create the yellow sunburst affect imitating the Johnny Cash guitar paintjob.

Photographic Design Process



We needed to be able to build it on sight, so we designed a flexible piece of wood. Prototype sketches were designed with a spacing of 0.2 in. per cut. These slats that were far too rigid due to the spacing between cuts being too large and broke very easily as shown to the left. The solution was to place the cuts at intervals of 0.1 in. and to change the thickness of the wood from 0.25 in. to 0.125 in.



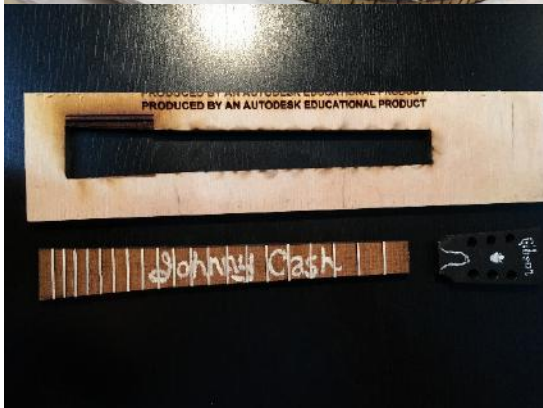
Shown to the left is a working example of the “living hinge” on one of our side slats. Four (4) pieces of 5.5 in. in length were produced with two (2) replacement pieces in the event of a slat breaking. The spacing of 0.1 in. between cuts, shown here, validated that this spacing was the optimal distance for creating the strongest and most flexible side piece.



After a practice assembly run, we found out that just using the flat edge of a slat glued to the rastered edge of the body was not strong enough to hold together. So we altered our design to create interlocking teeth (1/16” x 1/16” in.) spaced 1/4” apart. This solution also reduced assembly time by 20-25 minutes.



The outline (leftover wood) was also repurposed and used as a fixture for gluing the side sections to the face and back. The fixture holds the shape of the bendable sides as they conform to the curve of the body. The extra strips of wood were added to elevate the mold to hold the face and sides flush with each other.

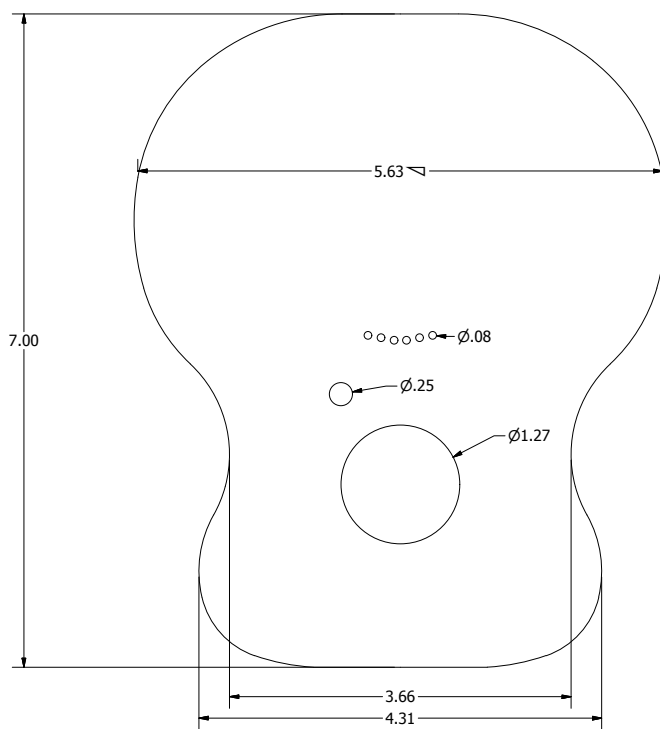


The neck was also difficult due to the unique design of any given guitar. The sloping sides with alternating widths between pieces made designing the individual piece more difficult than the rest. But once we had cut and finished painting the final 1:3 scale model piece, we were extremely satisfied with how it came out.

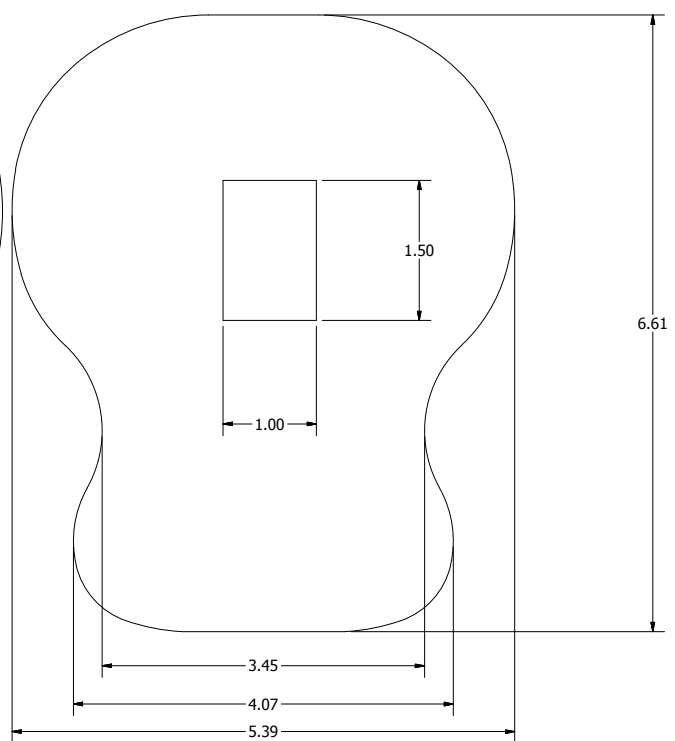
AutoCAD Drawings

These are the AutoCAD sketches that I drew and used to cut out the top of the guitar and the bottom with our laser engraver. All of the following documents are the same for their respective part.

Guitar Top

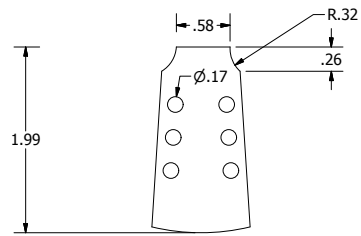


Guitar Bottom

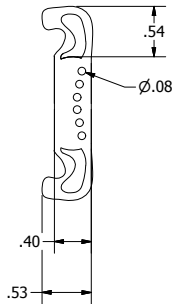


AutoCAD Drawings

Guitar Head

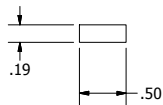


Guitar Bridge

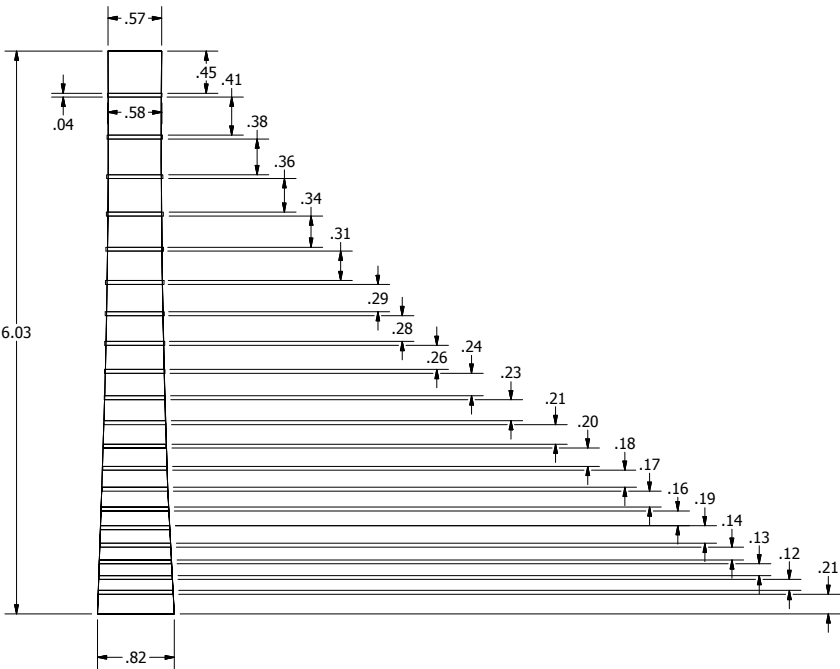


AutoCAD Drawings

Guitar Head Pegs

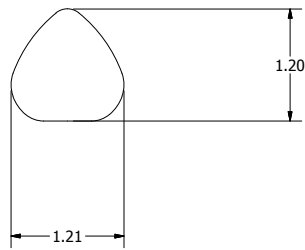


Guitar Neck

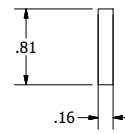


AutoCAD Drawings

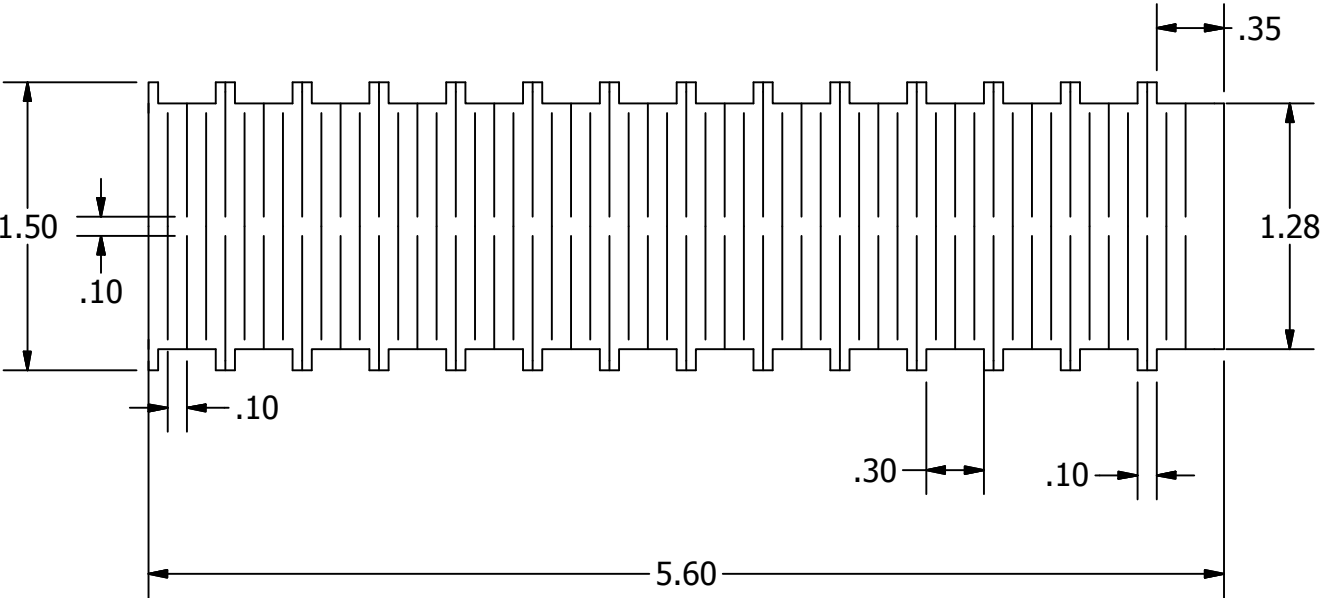
Guitar Pick



Pick Standoff/Neck Nut/Bridge Nut

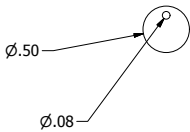


Guitar Wall

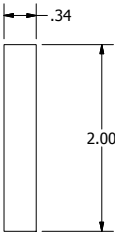


AutoCAD Drawings

Door Fastener

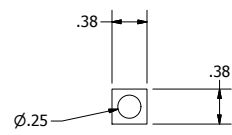


Spring



AutoCAD Drawings

Dowel Holder



Mechanism Dowel

