Yamaha 4P Piccolo
EDSGN 100 Personal SOLIDWORKS Project

Emily A Peters
THE PENNSYLVANIA STATE UNIVERSITY - COE
Inspiration

I have played the flute for over ten years and it felt appropriate to model my most recent instrumental interest, the piccolo. After a semester in pep band and another in orchestra, I have had a total of 5 years of piccolo experience. I am actually looking into buying the version I modeled to replace my current one. I own a Bundy student model piccolo made of metal and I made it to All State Band on that instrument. I used it for all of my measurements when designing the resin body Yamaha 4P version (Figure 1). All pieces that appear as medal are “polished silver in SolidWorks. The resin body is rendered with “black plastic.”

Process

I started the project by extruding the body and head joint as separate parts. From there, I used extruded cuts to hollow out the head and drill the mouth plate. The conical bored body was made by lofting a cut from one end to the other. About a dozen end caps and metal band pieces had to be made of matching diameter before assembling the head joint. Some caps required a fillet along the outer rim.

Secondly came the body assembly and inset key cuts. The inset keys sit approximately 2 millimeters in the piccolo and were designed by extruded cuts, some of which were on angled planes. A few additional bands and rings were needed before assembling the whole body.

The last parts to make were the key assemblies. Individual keys were relatively easy to make but hard to assemble into the appropriate pattern. Linear Pattern was not particularly useful for this assembly feature because several keys are unevenly positioned. I ended up making a line of keys at the proper spacing and extruding the bar through all of the keys. Though this took time, it prevented the keys from moving later on in the assembly and solidified the position of the bar. On the end of the piccolo is the “pinky key” with a cork underneath. This was made by mating the vertical padded key (Figure 9) to the assembly and then extruding the bar and cork key from their related planes. This assembly included close to twenty independent parts that I saved the assembly as a single part before proceeding.

The last key I included was the bent key that sits above the surface of the other keys (Figure 6). This was made separately and brought together with the whole piccolo “part” as an assembly of two parts. As a disclaimer, this is why the final “zip” file includes only two pieces (Figure 3). The mate was proving to be rather difficult otherwise.
Challenges

The hardest part of the whole assembly by far were the key assemblies. They were easy features to make individually but were difficult to mate. Because of this, I had to backtrack and try a new approach as described above. This took a lot of time that I had not previously anticipated.

Though I attempted to incorporate linear patterns into the key spacing, I later learned this feature is not used for positioning within existing assemblies.

Lessons Learned

Throughout the SolidWorks portion of Engineering Design, I learned, (maybe the hard way), how to strategically plan and build complex assemblies. Within the first few weeks of class, I picked up on the basics features like sketching, extruding boss/base, lofted cuts, fillets and drawings (Figure 7) by completing the tutorials. I used these features repeatedly throughout my model. Even though I was not able to use the new linear pattern tool in the final product, I believe that it could have been used to drill the holes in the original resin body of the piccolo.

Figure 1: "For Sale: Yamaha 4P Piccolo" from http://www.flutes4sale.com/products/picc-gem-4p
Figure 2: Full Render

Figure 3: Full Model
Figure 4: Rendered Head Joint

Figure 5: Rendered Right Hand Keys
Figure 6: Rendered Left Hand Keys

Figure 7: Dimensioned Drawing