

## APP HAMMERS for the Dusty Strings D550 Hammered Dulcimer iPad App

Here is a description of how to make hammers for the D550 dulcimer app. A bit of experimentation was required to discover what works best.



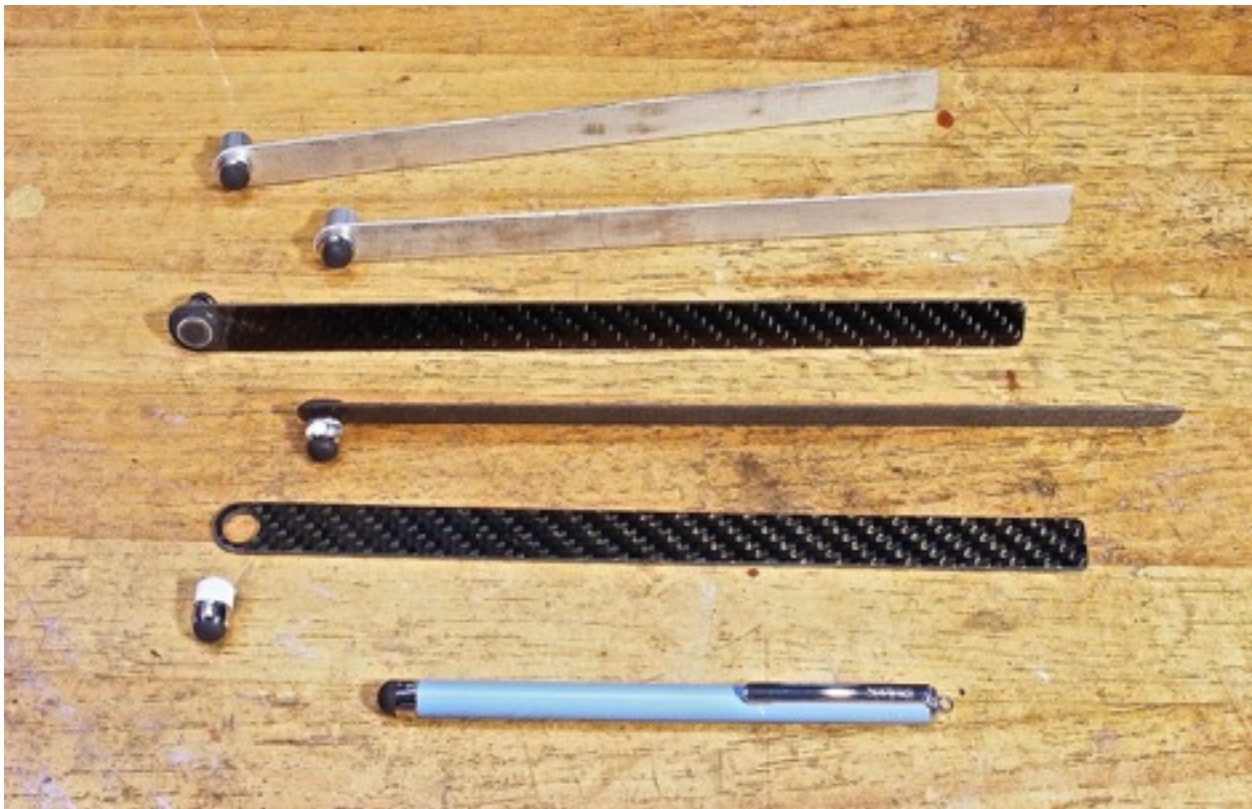
A capacitive tip is required along with electrical continuity with the player's fingers. Using a piece of conductive foam rubber for the tip would be simple and inexpensive. For convenience, I used rubber touch screen stylus tips from off-the-shelf styluses at a nearby box store.

Good electrical connectivity is readily achieved by making the hammer shaft and handle out of a conductive material. I tested aluminum as well as carbon fiber composite; both are convenient and function well.

The playing action needed for touch screen is not the same as hammering a real dulcimer. Instead, the app hammers are used with a combination tapping/pressing action, more like using a stylus. Think of the hammer as a "stylus-on-a-stick." In use, this is not so different as it sounds. One quickly adapts to playing in this manner, and with a little practice one can play with good accuracy and speed. Moreover, the pressing action allows playing easy glissandos, as well as "valley rolls" between treble and bass courses.

Conventional dulcimer hammers are generally not suited for the pressing action. I tried conventional, stiff shafted wood hammers with a conductive

wire between the tip and the grip. However, triggering the touch screen by hammering was inconsistent and the grip did not facilitate pressing. What does work well is a simple, stiff hammer shaft that looks like an oversize pop stick or a narrow tongue depressor. For conductivity, I used a piece of aluminum bar stock 1/16" thick x 1/2" wide x 8" long for each hammer. I also made some shafts of carbon fiber, details to follow. A hole was drilled near one end to accept the tip of a stylus. The hole was drilled slightly undersize and slowly enlarged to allow a tight press fit with the barrel of the stylus. Then the barrel was cut off short and inserted.



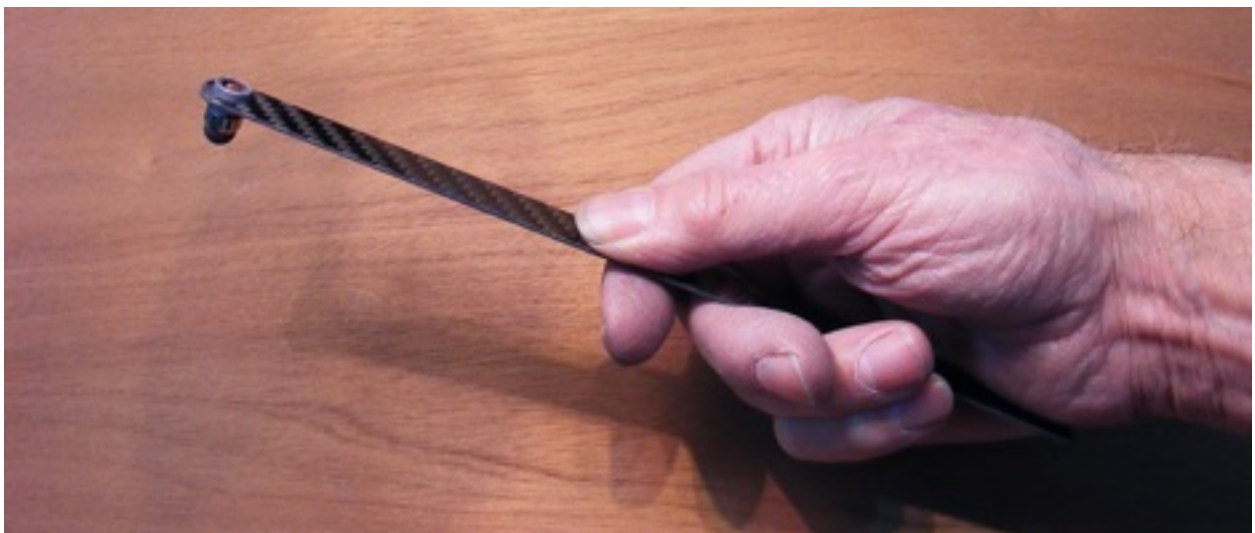
Some styluses have tips that are attached to a removable barrel end. If so, the hole in the shaft can be made to accept the barrel end.

A press fit can also be used with carbon fiber shafts, but glueing is more secure. The stylus barrel should fit snugly for good electrical conductivity. The mating surfaces must be roughened with course sandpaper or a file. The stylus barrel is then secured in place with a fillet composed of a slurry of quick epoxy thickened with graphite powder.



*Aluminum and carbon fiber shafts with stylus tips attached.*

To play, hold the hammer shaft as though you are gripping a fishing rod, with the thumb on top pointing at the tip and the fingers curled underneath. Choke up on your grip so that there is about 3" or 4" from the end of your thumb to the stylus tip. Play by tapping the strings or notes with a slight pressing action.





Both the aluminum and carbon hammers work well. The carbon hammers certainly look nicer and have a more high tech visual appeal. Variations in head weight do not seem to matter much as long as stiffness is adequate.

Recommended hammer dimensions:

- For aluminum bar stock, 1/16" thick (minimum) x 1/2" wide x 8" long.
- For carbon fiber, 5/64" thick (minimum) x 1/2" wide x 8" long.

Originally, my carbon shafts were thinner and more flexible. But the greater stiffness of the aluminum shafts felt preferable in touch screen playing response. So, I laminated more layers of carbon cloth onto the CF hammers bringing thickness from 0.047" to 0.078" (5/64"). With the increased stiffness, touch screen playing response is excellent.

So, are app hammers really necessary, and are they cost effective? On a full-size iPad, it seems possible to play about equally well with bare fingers

or with hammers. When using the fingers, the hands obscure much of the display, which prevents scanning the bridges as one does with a full-size HD. So, the hammers are better in that regard. And they do feel analogous to playing a real dulcimer. And they're fun. On the other hand, the simplicity of just using one's fingers is not to be denied. Using the fingers is much like playing a dulcimer by plucking the strings instead of hammering, and plucking is a popular playing style in some traditions.

As to cost, I experimented with cheap styluses available at a nearby box store. Cost was \$2.99 to \$3.34 each, plus tax. Aluminum bar stock for shafts came to under \$2.00 per pair. So, a pair of aluminum hammers can be made for under \$6.00 not counting labor, tools, or consumables like sandpaper and saw blades. Minimum tools required are hacksaw (or bandsaw), file, sandpaper, and drill (or drill press). So, aluminum is convenient for the do-it-yourself at home craftsman.

Making a single set of carbon fiber hammers at home might be impractical cost wise. I make my own since I have the equipment and materials. You can purchase ready made CF flat panels from suppliers like Rock West Composites. The cost of a panel might be worthwhile if you can use all of it by making many hammers to get the cost per hammer down.

For instance, a 6" x 24" x 0.09" CF panel costs about \$50.00, plus tax and shipping. With skill, luck, and a thin saw blade, you might cut out 15 pairs of hammers, making cost per pair about \$3.34. Add in cost of shipping, stylus tips, labor, shop consumables, and so on. Cutting and drilling CF panels is similar to working with wood. CF is harder than wood but not as hard as metal. However, it will wear saw blades and abrasives much more quickly than wood. For sawing CF panels, it is best to use a slow speed bandsaw with a thin, fine tooth, metal cutting blade. Wear a dust mask and use a shop vac. The dust will cause skin to itch. Industrial cutters use a water jet.

I don't intend to make and sell app hammers, but this information will allow others to make them. I should probably be spending my time on more useful pursuits. But I am having fun with the Dusty Strings D550 app and the hammers!