Why I Choose Titanium – Flute Talk 1997

For several years I have researched the possibility of making flutes out of such high-tech metals as titanium, niobium, or tantalum and finally concluded that the best choice would be titanium. There are inherent difficulties in machining and joining titanium parts, but a titanium flute would weigh less than half as much as a silver flute. Early flutes were made out of wood until Theobald Boehm introduced the silver flute in 1852. Louis Lot built the first all gold flute 30 years later, and Verne Powell built a platinum flute about 1832. There has been a steady progression from softer to harder materials because harder materials give a faster response that is especially welcome on rapid articulations.

With only a rough idea of the difficulties that lay ahead, I decided to build a titanium flute several years ago. It took more than a year to find a supplier of titanium tubing drawn to the correct diameter in small quantities. The tubing for 35 flutes finally arrived after another six month delay.
I first affixed a silver lip plate and risers to a titanium headjoint tube with five-minute epoxy because soldering or brazing these to titanium is impossible. I experimented with this titanium headjoint and found that it had a louder, brighter tone and a faster response than silver headjoints. Other flutists agreed with this conclusion after playing on the titanium headjoint.

In exploring the characteristics of titanium I experimented with anodizing, a method of plating metal for such purposes as inhibiting corrosion, wear, and abrasion, and decorative finishing. Anodizing consists of electrically depositing a metal substance such as aluminum from an aqueous solution in a electrolyte cell to create a hard, non-porous film on a metallic surface. The plating substance can be mixed with one or more chemicals to achieve a colored surface, so this new flute could be made in any color.

Although the basic design of the flute has not changed much over the centuries, some design concepts are functional and others aesthetic. I experimented with the radius of the outside of other lip plate under the chin and at the far side of the hole to find the best relationship for most players, then had some titanium castings of the lip plate and riser brazed on the tube. The outer edge of the lip plate functions only to protect it from bending against the flute, so I increased the stiffness of the lip plate with additional bends or facets rather than using a smooth curve for a new aesthetic appearance.

Assembling the lip plate to the tube was a major obstacle in making the titanium headjoint. Flutes made from precious metals have always been soldered or brazed with torches, but titanium oxidizes so quickly that this was not possible. I learned that bicycle frames are made from titanium tubing and are welded together inside a glove box filled with inert gas. A company that specializes in producing brazing alloys for titanium and other high-tech metals suggested brazing the parts by the same method used in the aerospace and medical fields. With some new clamping techniques, this worked and a titanium headjoint was finally assembled.

Titanium was difficult to machine for a crown and required special taps to cut the treads. After breaking a number of taps, I finally produced a usable crown. Next in the quest to produce a new flute was a barrel and box joints made of titanium. It took a special reamer to make the inside of the barrel tube, but it burned up after making only six good parts. It seemed clear this would be very expensive and time consuming so I decided to try assembling silver parts on a titanium tube to get a preview of how an all titanium flute would play. One month before the 1996 NFA Convention I built two titanium flute bodies and finished one flute with silver keys, so if one body were damaged there would be a spare.
The bodies arrived bent from the brazing company, because the silver ribs had expanded twice as much as the titanium during brazing. As the metals cooled, the ribs contracted twice as much as the titanium. Before cutting open the tone holes, the tubing had to be straightened without damaging the body.
There were other surprises along the way, but these were the biggest challenges. Once I figured out how to handle the metal, assembling the rest of the flute was no different than a silver flute, except that the engraving had to be done by laser instead of by hand. Because titanium is so durable, the keywork can be made thinner and lighter than other precious metals. Other advantages of using titanium range from responsiveness to dynamic control.

Flute makers of yesterday used silver because it was readily available. As the are of flute making has been perfected over the years, flutists are basically satisfied with the established product; however, if flute makers experiment with different metals on the traditional system, new tonal colors may result. Titanium is one possibility.