Spectra Plus audio analysis software--how I use it in guitar making

Wood Testing

For classical and flamenco guitars I consider the selecting of the wood to be of critical importance. Nylon strings are not very powerful compared to steel strings, and we need to use wood that will be as acoustically efficient as possible in order to build a responsive guitar.

When a guitar turns out especially to your liking, and you want to be able to make another one as good, you need to know the properties of the wood that went into it. Tonewoods vary vastly more than I expected when I first began testing them--factors of 2 and 3 are not uncommon--and suppliers grade them mostly on appearance.

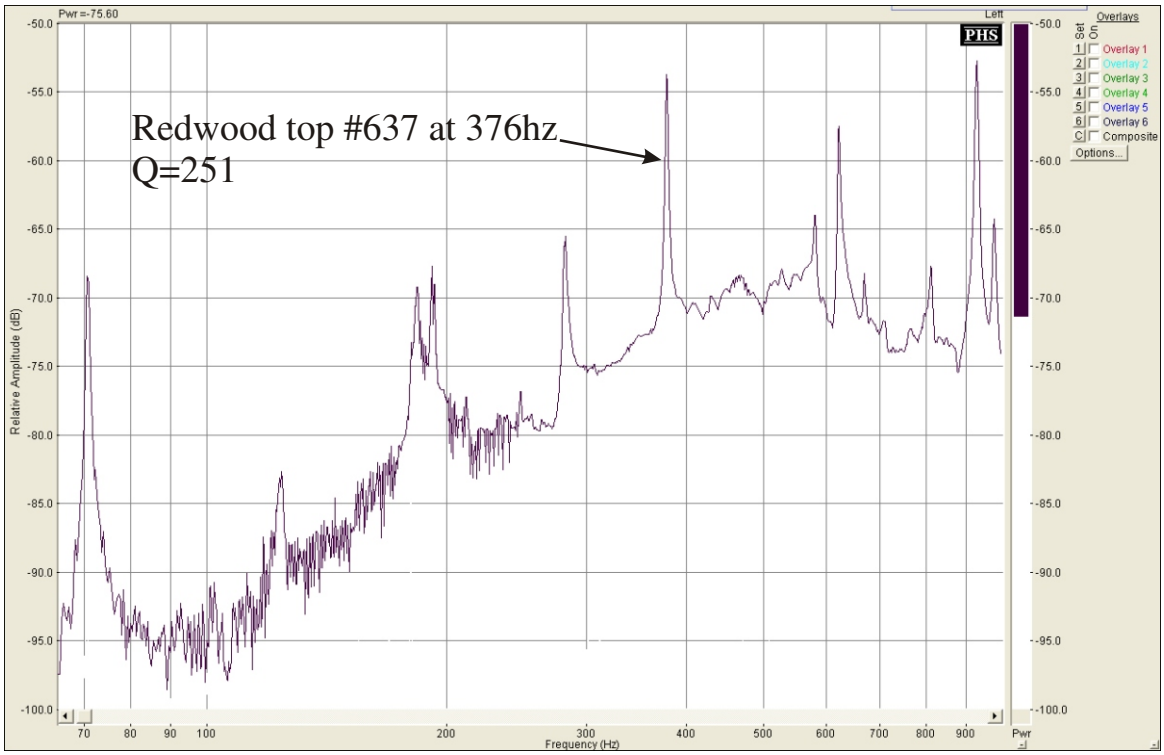
I do several mechanical tests for stiffness and density, and I use Spectra Plus to run a “Q” test on half of a prospective top or back. “Q” is a measure of acoustic power loss in a piece of wood, and is roughly equivalent to how long the “tap tone” rings. I do all of these tests in less than 15 minutes per top or back.

Q is entirely independent of the mechanical properties! The redwood top below has Q’s as high as old Brazilian rosewood, at half the density of the rosewood. High Q wood makes a louder guitar with longer sustain.

I chose this long grain vibrational mode as the one to represent a sample of wood, as it is usually a strong peak and is in the upper treble range of the guitar. It has five peaks and four nodes, the nodes being indicated by the poppy seeds lining up in the areas of minimum vibration.

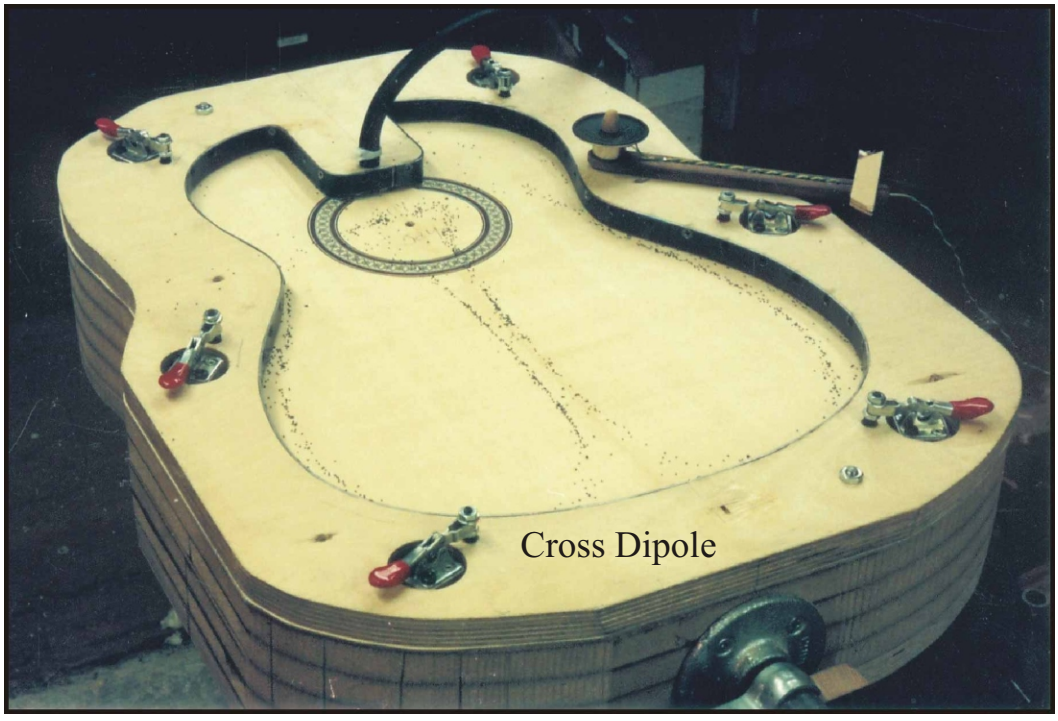
Redwood top #637 at 376hz
Q=251

This is the spectrum from 65hz to 1000hz for the redwood top on the previous page as displayed in Spectra Plus. You can check the Q of any of the resonance peaks by using the magnifying glass to look at it, and right clicking. Spectra plus then tells you the frequency of the peak, its bandwidth at the 3db down points, and calculates the Q. The .wav file can then be stored for future reference

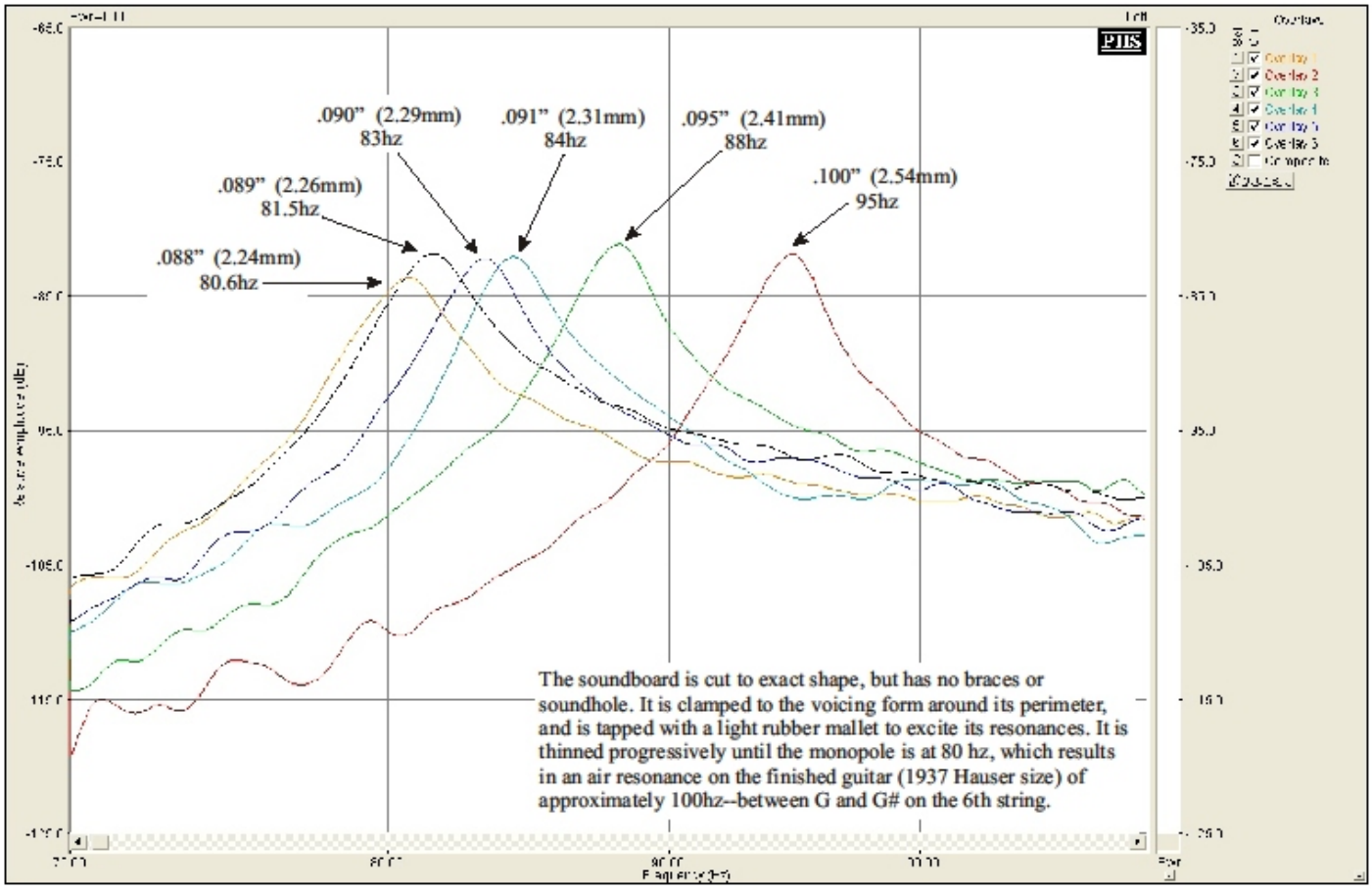


The all important question “How thick/thin do I make the top?” is answered by seeing where its various vibrational modes occur when it is held around it’s perimeter as if it were glued to a set of sides. You don’t need to build an elaborate holding device like this one. A simple cork lined plywood frame will do--more on this later.

The graphs on the next page show a top at various stages of thinning, and the resulting frequencies of the lowest “monopole” resonance. I like to thin my tops until the monopole at this stage is at 80hz. Then the finished guitar has an air resonance about 100hz. At this point it’s possible to compare soundboards directly to each other by weight, and Q’s and placements of their resonances. I now do all that before the rosette goes in, so that it’s still possible to reject a top that tests below par.



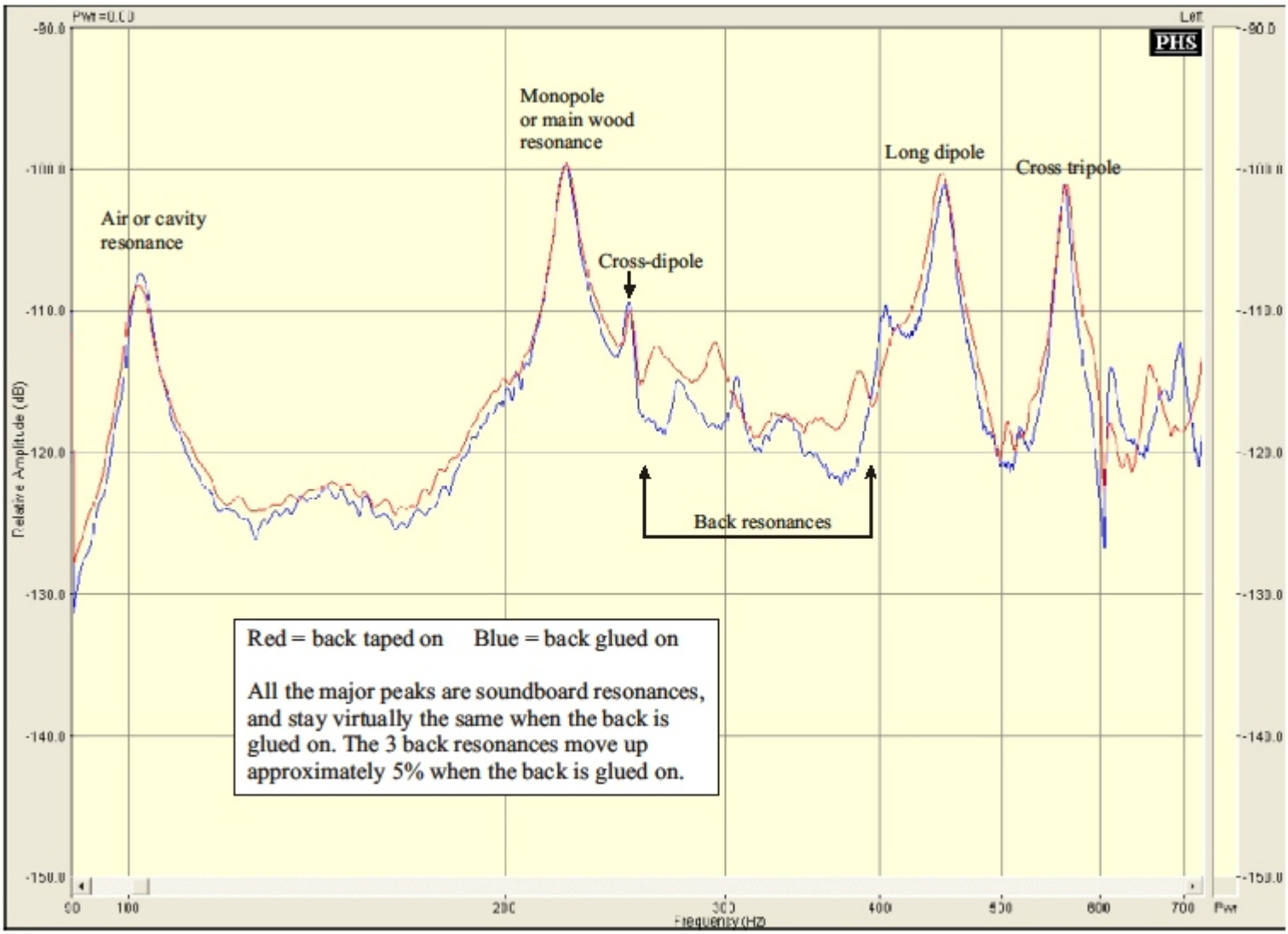
Initial voicing of a Euro-Spruce soundboard using Spectra Plus



The next use of Spectra Plus comes when the guitar is almost finished. The back is fitted, and ready to glue on, but instead it is taped on with binding tape. This does a remarkably good job of simulating a glue joint. It is possible to check the positions of the top resonances with a high degree of accuracy.

With the back readily removable, and replaceable, you can make any number and kind of adjustments to the sound box, and check to see their effects. Every change that is made will affect the entire response curve to some extent, as all the resonances are coupled to each other. Being able to see all the effects by viewing the whole spectrum is invaluable.....When the back is glued on, its resonances rise a predictable 5% in frequency.

The next page shows Spectra Plus' overlay feature, which allows comparing up to six graphs in different colors.



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