

# Thickness Mapping Methods

By Jeff Loen

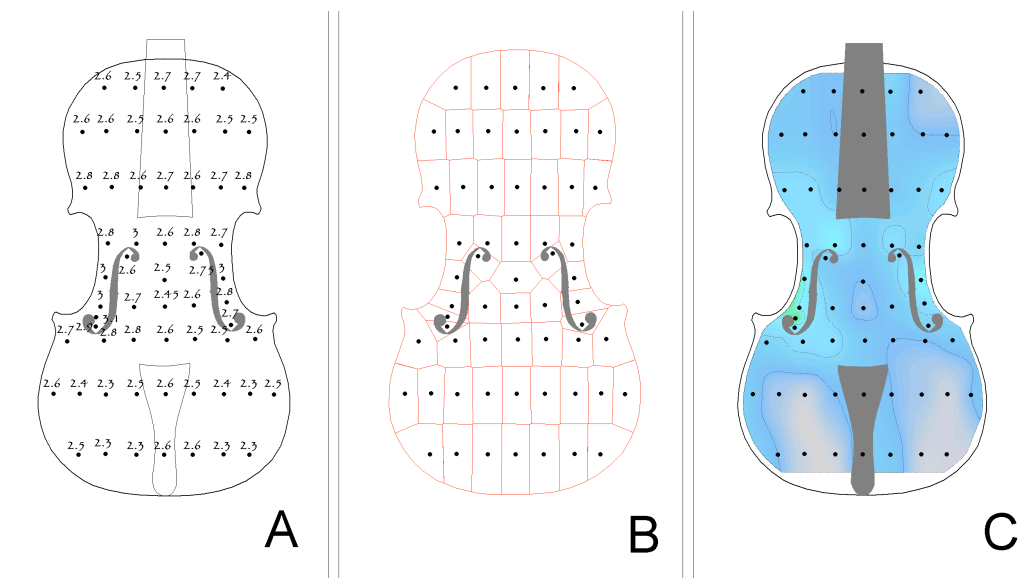
Kenmore Violins

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Digital maps of thickness measurements provided by Samuel Zygmuntowicz were systematically contoured and colored using commercially available mapping software. The objective of computer mapping is to depict arrays of discrete data points as continuous surfaces. Colored contour maps of violin plates foster more intuitive understanding of the pinching and swelling of the spruce tops and maple backs, and makes it easy to compare and contrast thickness distributions of the three outstanding violins in this study.

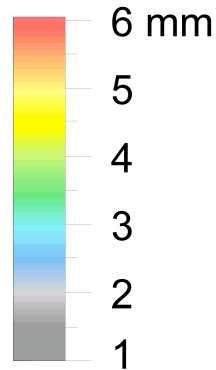
Digital processing of thickness data points begins with defining a coordinate system based on millimeter distances. Point locations (fig. 1A) are given coordinates based on this system, and thickness values for each location are typed into a database. Additional map layers are built by digitizing polygons to represent plate outlines, ff-holes, fingerboard, and tailpiece from a photo or drawing. Basically a stack of map layers is constructed having a flat “non-earth” geographic map projection based on millimeter distances.



**Figure 1.** Steps in making a graduation contour map. A. Raw data points showing thickness in millimeters. B. Voroni net (red lines) overlaid on data points, part of the process of natural neighbor interpolation. C. Graduation contour map (contour interval 0.25 mm) based on new values calculated at the nodes of Voroni net. Black dots indicate original data point locations.

Computer algorithms for mapping 3-D surfaces are based on interpolation. The computer operator chooses one of several standard interpolation routines (such as inverse distance weighing, triangular integration networks, or natural neighbor), determines the spacing of the polygonal net, selects colors to be displayed, and specifies the contour interval. In natural neighbor interpolation (the method used here), a polygonal net is superimposed on the raw data points (fig. 1B), and new

values are calculated for each intersection in the net based on an analysis of the surrounding original values. Consequently, a grid surface is established that incorporates the original data points plus these “new” interpolated data points. The resulting net of data points was contoured using a 0.25 mm contour interval (fig. 1C). In order to effectively communicate changes in wood thickness visually, contour maps are colored using hot colors such as red and yellow for thick areas and cold colors such as gray and blue for thin areas (see fig. 2).



**Figure 2.** Color ramp showing relationship of colors to wood thickness in graduation contour maps. Hot colors indicate thick areas; cold colors indicate thin areas.