# A Quantitative Analysis to Demystify Clarinet Reed Design

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## INTRODUCTION

Reed qualities are of paramount interest to the performer of reed instruments. Clarinetists and saxophonists are unique among this group in that most prefer to buy their reeds from a manufacturer and expect purchased reeds to be compatible with their mouthpiece, instrument and playing style. Players tend not to consider the individual elements of design and material characteristics of the single reed. The existing literature has seldom used a quantifiable approach to evaluate reed design and adjustment. Typically, publications present practical and useful tips on how to approach a reed that does not perform properly. However, information regarding reed properties, such as curvature of the vamp, blank thickness, and cane density, may prove valuable to the performer who is attempting to navigate the array of reed choices that are offered.

Research was conducted to address the following questions about reed qualities: 1) What is the difference between reeds and brands made by various manufacturers regarding shape, size and density? 2) How does a manufacturer differentiate between reeds of similar model but different strengths? 3) What factors of reed structure have the greatest variance in design? (4) How are these structural elements correlated? (5) Can this information be used to identify commonalities between brands to give performers more options for reed selection? Through measurement of reeds and the use of a descriptive analysis, this study aims to develop new methods for examining the relationship between reed design and materials and to provide the basis for future research regarding reed playability. The results of this analysis will provide valuable information to develop a quantifiable method of clarinet reed selection for professional players and pedagogues.

## METHODOLOGY

The reeds chosen for examination in this study were selected for their popularity among clarinet players of all levels, and in several cases, by their respectable history as manufacturers. For each brand, strengths were selected in their medium to medium-hard ranges. Several strengths were measured for each brand in order to compare elements of construction that contribute to strength designation. The final sample included 10 reeds per strength, three strengths (typically strengths 3 to 4) for each of fifteen brands from five manufacturers, for a total of 350 reeds measured.

Each reed in the sample was measured for physical properties, cane characteristics and cut of the vamp. Using calipers, blank dimensions were measured for width, thickness, and lengths of bark area and vamp. Filed status was also recorded. The mathematical slope, defined as the ratio between the change from width at the tip to width at the heel, divided by the length of the reed, was calculated to determine the severity of the taper. Characteristics of the cane were examined for density using a cane hardness tester. The number of fibers across the tip was counted and the evenness of the distribution of these fibers was recorded. The thickness of the tip of each read was measured, using a reed micrometer, at the center and rails. Finally, characteristics of the vamp were measured, including tip thickness; the shape of the vamp's curve from tip to shoulders was obtained by applying a standard mathematical regression model for slope and curvature.

For each reed property measured, the mean, range and standard deviation were calculated and data was summarized according to brand and strength, and for all reeds combined. It was hypothesized that a measurement with a large range of possible results would be of greater importance than one with little variation, therefore, areas of greatest variance

were identified. In addition to ranges for each reed property assessed, correlations between each property were calculated using statistical software to determine which parts of the reed were interrelated. Finally, the results of these analyses were used to determine common groupings of reed styles.

## FINDINGS

An examination of the ranges and standard deviations of each reed property revealed several measurements with wide variation, and thus, likely to play an important role in differentiating playing qualities between brands of reeds. In the table below, the minimum and maximum values and the standard deviations are presented for these characteristics.

| **Measurement** | **Min** | **Max** | **Std Dev** |
|---|---|---|---|
| Blank Thickness | .098” | .144” | .010” |
| Width at tip | .504” | .520” | .003” |
| Width at heel | .395” | .455” | .015” |
| Vamp Length | 1.208” | 1.390” | .040” |
| Cane hardness | 60 | 90 | 5 |
| Tip thickness (center) | .025” | .075” | .008” |
| Straightness of Curve (center) (0=straight line) | .14 | .70 | .09 |
| Slope of curve (Center) | 2.2 | 6.0 | .8 |

Shape of the vamp and cane hardness were the most strongly correlated to the manufacturers’ designation of strength. Stronger reeds tended to be made with harder cane and a more severe curve of the vamp. Surprisingly, tip thickness had no significant correlation to strength. Another interesting correlation included length to thickness, where a thicker blank corresponded to a longer overall reed. A thick blank also correlated to softer cane. Manufacturers whose brands were filed, or French-cut, tended to design their reeds around thin and wide blanks, while unfiled reeds were found to be thicker and narrower.

Based on these correlations and measurements with the largest standard deviations, five reed properties were determined to be important to the design of a clarinet reed: blank thickness, reed width, vamp length, tip thickness, and shape of cut. For each of these properties, each reed brand was then classified according to whether its measurements were below average, average or above average and then brands were compared to see which shared these properties. From this analysis, four basic reed designs among the brands were identified, shown below.

| | Profile 1 | Profile 2 | Profile 3 | Profile 4 |
|---|---|---|---|---|
| Blank thickness | Thin | Thick | Thick | Average |
| Width of blank | Average | Wide | Narrow | Average |
| Vamp length | Short | Average to long | Short | Average |
| Tip thickness | Average | Varies | Varies | Average |
| Curve shape | Average | Varies | Severe | Average |

Five brands had the characteristics of Profile 1, including Rico "Orange Box," Rico Royal, La Voz, Vandoren Traditional, and Mitchell Lurie. The three brands consistent with Profile 2 were Rico Reserve, Vandoren V-12, and Canyes Xilema Artesana. Profile 3 included Rue Lepic 56, Olivieri, and Gonzalez F.O.F. The only two brands that were found to exhibit qualities of Profile 4 were Grand Concert Traditional and Marca.

## CONCLUSION

Through a quantitative analysis of 350 reeds, representing 15 brands from five manufacturers, many properties regarding clarinet reed design were measured. An examination of the ranges, means, and standard deviations of each reed property showed several areas to be important design features, in particular, blank thickness, tip thickness, cane density, and severity of the vamp's curve. Statistically significant correlations existed between several key elements of clarinet reed structure that may begin to explain how specific design elements work together to affect playing qualities. Using this information, reeds could be grouped into four basic profiles, regardless of brand or manufacturer, suggesting limits in acceptable design approaches to commercially available reeds. These findings serve to explain some of the reasons why players prefer one brand over another and also may offer new choices of reed brands with similar attributes. This information will be used in future studies to discover how each design element correlates to performance quality. This study is the first step in ongoing research to demystify the nature of the single reed.

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