Reed Selection and Sound Quality of an Alto Saxophone

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Abstract

To investigate the relationship between reed stiffness and sound quality, the same note (concert B^b)was played on an alto saxophone with six different reeds (1.5, 2, 2.5, 3, 3.5, and 4). The relative amplitudes of the first four harmonics for each of the reeds were compared. It was found that the softer reeds had the greater amplitude in upper harmonic intensities. Additionally, it was found that each harmonic followed a general trend, although they did not follow the same trends in relation to one another.

Keywords: saxophone, reed size, harmonics

I. INTRODUCTION

The source of excitation in a saxophone is the reed. A turbulent stream of air causes the reed to oscillate, resulting in the formation of a complex series of standing waves within the chamber of the saxophone[1].

Reed stiffness ranges from 1 to 5, no units, with the larger numbers indicating stiffer reeds. A reed acts as a cantilever, as seen in figure 1. A stiffer reed with a greater thickness will resist bending more than a softer reed[1]. Stiffer reeds will support greater lip forces before sound is eliminated or a squeak is produced.

Sound quality is called the 'timbre', which is a complex quality related to the harmonic content of a sound, among other things[2]. A saxophone note is comprised of multiple frequencies, or harmonics. The pitch perceived by the ear is the fundamental frequency. The harmonics provide what is known as a "fuller" sound – this is one component of what musicians refer to as the timbre of a sound[1].

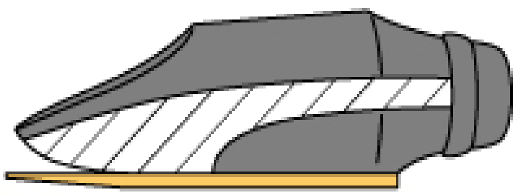

Figure 1. A diagram of a typical mouthpiece with the reed in position during play[3].

A study at the University of Valencia presented evidence suggesting that the brand of a reed did not significantly affect the timbre of an oboe[2]. This study investigates a similar phenomenon, looking at reed number (stiffness) for Vandoren brand reeds for an alto saxophone, to determine whether, for the same mouthpiece (Selmer S-80 C*), reed number affects the timbre.

II. METHODS

A Vernier Microphone was placed at the height of the saxophone' bell. A concert B^b was played on the saxophone throughout the experiment – three trials for six reed numbers ranging from 1.5 to 4. Two different reeds are shown in figure 2. As can be seen, the reeds have the same length and widths, but the lower numbered reeds begin to taper nearer to the base (on the right) than the larger numbered reeds, and are also thinner

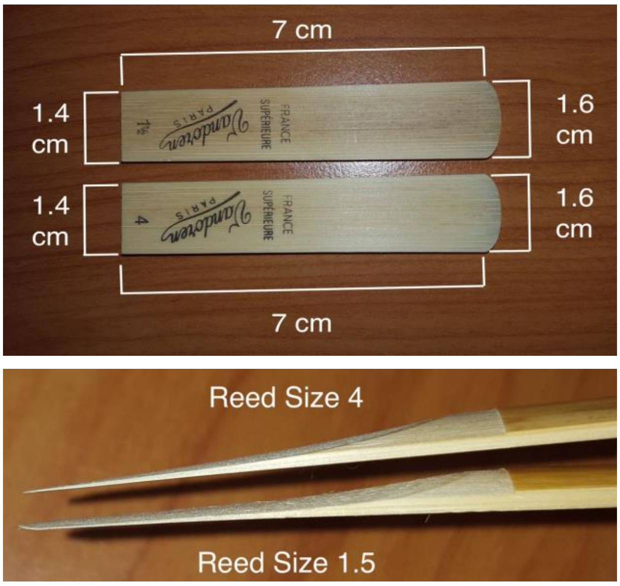

Figure 2. Top and side views of the largest and smallest reed numbers used. Notice both reeds have the same dimensions, but that the lower numbered reed tapers off nearer the base of the reed and is thinner towards the tip.

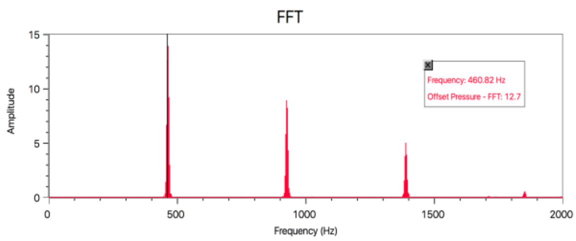

Figure 3. A sample FFT graph displaying the relative amplitude of the sound pressure of four different harmonics for trial 1 of reed number 2.5.

towards the tip (on the left).

The sound was recorded at 100,000 samples per second for 0.2 seconds. Using an FFT analysis, the relative amplitudes of the sound pressure were found for each harmonic of each reed size, as shown in Figure 3.

III. RESULTS AND DISCUSSION

The relative amplitudes of the first four harmonics for each of the reed sizes tested are shown in figure 4. As can be seen, the thinner reeds, 1.5 and 2, had the highest relative amplitudes for the 2nd and 3rd harmonics. Interestingly, reed size 2 shows an greater amplitude of the 2nd harmonic but a lower amplitude of the 3rd harmonic, compared to reed number 1.5. As the reed number

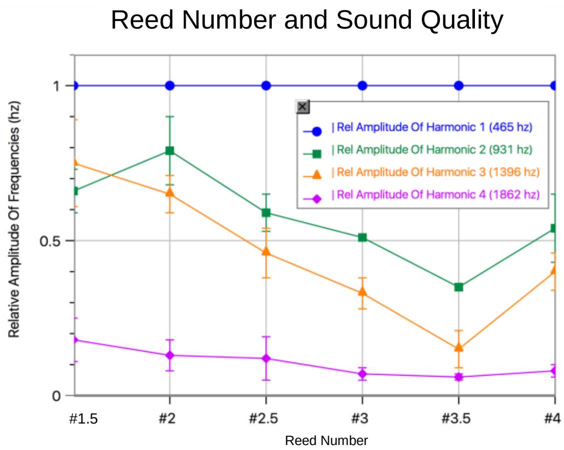

Figure 4. The relationship between reed stiffness and relative amplitude for the first 4 harmonics. The amplitude of the first harmonic was used to normalize the data.

increased beyond number 2, the relative amplitudes for both of these harmonics decreased steadily, until both harmonics significantly increased in amplitude for the largest reed size. There seems to be a fairly consistent pattern of decreasing amplitudes with increasing reed numbers, although no conclusions can be drawn regarding the reasons for this. The sudden change in the trends with the largest reed is worthy of further investigation.

From reed numbers 2 to 3.5, harmonics 2 and 3 followed the same trend proportionally to one another. The relative amplitudes of the 4th harmonic, in comparison to the second and third, are relatively low. Although this may suggest the 4th harmonic is not affected by reed size, the same pattern of increases and decreases as harmonics and 2 and 3 are still evident, simply less pronounced.

It must be noted that the saxophone was played by the author during this investigation, thus the embouchure was not strictly controlled. A slight change in embouchure may have changed the relative amplitudes of the standing waves in the saxophone resulting in random errors in the results. It is recommended that a mechanical device to play the saxophone with a controlled embouchure be developed to further study the effect of reed number on harmonic composition.

IV. CONCLUSIONS

For the alto saxophone, the two softest reeds sizes tested (1.5, 2) create sounds with the greatest variations in harmonic intensity with the “fullness” of the sound to the ear decreasing with increasing reed number. Figure 4 suggests that an audience listening to a saxophone being played with varied reed numbers will hear a richer sound for saxophones with softer reeds, with the timbre becoming progressively less full with increasing reed size.

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