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A Sound Analysis of the Silverstein Ligature and a Comparison with Other Ligatures

WHAT GIVES A YOU A REAL BUZZ?

The Silverstein clarinet ligature differs substantially from existing ligatures in that the reed is held in place by several cords of woven space age fabric that are tensioned from a rear mounted screw (see Figure 1). In addition the Silverstein has sidebars through which the cords pass and the position of these bars can be moved around the mouthpiece to change the angle of the cord tension. Moving these bars to different positions varies the pressure profile across the reed. By comparison, existing ligatures either use metal or some form of fabric as the fixing method and provide little or no means for adjusting the pressure distribution over the face of the reed.

Fig. 1

Subjective responses of the Silverstein clarinet ligature indicate that it gives a far richer sound than other ligatures and that adjustment of the sidebars alters the focus of the sound.

It is the purpose of this report to remove the subjectivity of a human listening experience by examining the spectral response of the clarinet under controlled conditions (as far as possible) using a range of different ligatures. A critical comparison of the responses of commonly available ligatures can then be made against the Silverstein model.

Test Arrangement

The microphone used for the test was a DBX RTA-M for real time audio analysing, part no. PHM919. This microphone is an omni-direction electret condenser with a flat frequency response from 20 Hz to 20kHz. The amplifier and phantom feed was provided from a Behringer Eurorack MX802A set to a flat EQ. The signal output was analysed using a Textronix TDS2002B using the maths FFT (Fast Fourier Transform) option.

Significant changes in the spectral response of a clarinet can be obtained by close microphone proximity at different positions of the instrument, but since the purpose of this test is to assess listener experience, the microphone was placed approximately 1.5 metres from the instrument where variations in response are primarily dependent on reed set-up and air speed through the instrument. To minimise the variations imposed by the player all tests were carried out on an open G, and the player attempted to maintain a constant airflow. Before capturing an FFT trace, the audio volume was checked for consistency in the time domain.

In all tests the FFT was performed with a sample rate of 25k sample(s) with a maximum bandwidth of 12.5kHz and a frequency resolution of 12.3 Hz.

The Test and the Rest

To spare readers much more techno geek-speak I will try to translate the findings of my dear friend Dr Watson (no – really, I am no Sherlock Holmes but he is Dr Watson!) who is also a fine amateur clarinettist. After testing the Silverstein we tested four other well-known brand ligatures, owned by me, and the results were quite a revelation.

The Silverstein ligature was so much more full of harmonic interest it left most of the other ligatures in the shade and much duller sounding.

The closest ligature in a harmonic comparison is one that dates back to the 1970s and is made of a rubber compound with just four pressure points on the reed.

All others were almost equally placed in the harmonic stakes and included metal with interchangeable plates, Chedeville type rubber compound material with ceramic insert, traditional metal with two vertical bars and the aforementioned 1970s rubber compound with four points of contact.

At this point you are probably thinking what difference does all this make? To a player who plays just for fun, perhaps not a lot, but to the keen, more serious amateur player and professionals, to get the best results via their equipment is crucial and amateur players are often just as discerning as professional players in my experience; sometimes more so.

Without wishing to patronise readers I must mention to those who are unfamiliar with the jargon that harmonics are the things that make up the parts of a note, just like the colour spectrum in pictures. In many photo-editing programmes it is possible to change the hue and saturation, etc. It is much the same when making a comparison of sound and harmonics produced in that sound, as in this comparison.

In layman's photographic terms this ligature gives the largest number of pixels i.e. definition and in simple sound terms more colour, volume, focus, presence and interest. The result is a fuller more vibrant and projecting sound.

On a personal note I found the ligature to enhance my sound as if quietly amplified and without any extra input from me was several decibels louder, hence making the job of professional clarinet playing more economical in terms of input to output, a pet subject of mine which is why I have spent almost four decades trying to produce the most efficient and economical mouthpiece now used by over one hundred leading players worldwide. One can liken the ligature's efficiency to the modern hyper-efficient motor car engines of today with terrific performance compared to the older models with slow acceleration and more thirsty fuel consumption.

All the claims that the research team at Silverstein have made seem to be borne out in this test. The advertising says one can soak the ligature and it will keep the reed moist. This

is true in one sense but not significantly so whilst actually playing as most of the surface area of the reed touched by the 'strings' of the ligature is dense, almost impermeable, reed-bark and whilst in the mouth the reed is automatically moist.

The problem of drying out is more apparent when the reed is not being played and this is really where the Silverstein comes into its own – in dry, badly humidified rooms. During a rehearsal at Welsh National Opera I left my reed cap on the mouthpiece and moistened ligature with the reed attached and when I returned from a 20-minute break to the rehearsal room with very low humidity, much to my surprise and joy, the reed still played beautifully so this is a definite advantage. Reeds I had left out on the stand (the tray below the music stand holds all my accessories etc.) looked like 'crinkle cut crisps' whilst the one held on the mouthpiece by the ligature (the ligature having been soaked in water) was moist and eminently pliable and playable.

Playing In Concert and Opera Performances with the Silverstein

Having tested the product for some weeks now I am fully apprised of the variability one can achieve in response and sound colour by altering the tension of the tensioner screw, repositioning the strings by pulling the strings downward or by moving the side bars into several different positions. The variety of responses and sounds one can achieve is a revelation in itself.

Some saxophone players in the U.S.A. have preferred the application of the ligature in an offset side position, whereas I prefer the traditional position as pictured below.

The fixing of the ligature is critical, as of course positioning of the reed is. Given a little time to learn the best position for the sound you wish to achieve I am convinced most people would agree this is a superior product for a new age of development of clarinet accessories which the Silverstein Works people intend to produce in future.

I have no hesitation in recommending this product to any serious minded clarinettist wishing to improve their tone and have an ease of response, particularly in the high register. The ligature is available in many sizes and even custom, made-to measure sizes for those with unique or unusual mouthpiece sizes.

An 'easy-measure' chart is downloadable from the Silverstein site www.silversteinworks.com to enable the ideal size for your mouthpiece to be made should you wish to order direct from the workshop. Or as I did, one can measure with an accurate caliper device and send the mouthpiece dimensions to Silverstein for a bespoke service. There are of course the standard sized ligatures made to fit most mouthpiece types currently available.

I have found the team at Silverstein to be genuinely interested in producing a product that has integrity and is well engineered and robust enough to cope with professional use – it is well made and extremely strong.

Cost is very competitive compared to other well known brands and presentation of the ligature is excellent. It is presented in a beautiful box and there is a lot of support from the customer service team who take their work very seriously.

Prices in USA begin at a very modest $140, for the Bb standard clarinet ligature. Uniquely (as I believe no other ligature company offers this) it comes with a lifetime guarantee, the manufacturers are so confident of its durability.

So after much investigation, it is 'elementary my dear Watson'. I shall be using it in future for all performances and recordings.

With thanks to Sean Yang, director, Silverstein Works for his co-operation in helping to compile this review.

1. Results

In each of the following tests, an open G was held, checked for consistent audio volume in the time domain and then captured as an FFT trace. The data was then transferred to MS Excel for plotting.

Three tests are presented for the Silverstein ligature with the sidebars in different positions on the mouthpiece.

1.1 Results for Silverstein Ligature

A test of audio volume was carried out prior to capturing the FFT trace. The fundamental in all cases is -26dBV +/- 1dBV.

1.1.1 Silverstein Ligature with Side Bars in Position One

This test was carried out with the side-bars of the ligature in position one as shown in Figure 2.

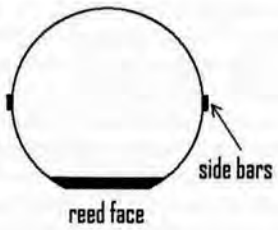
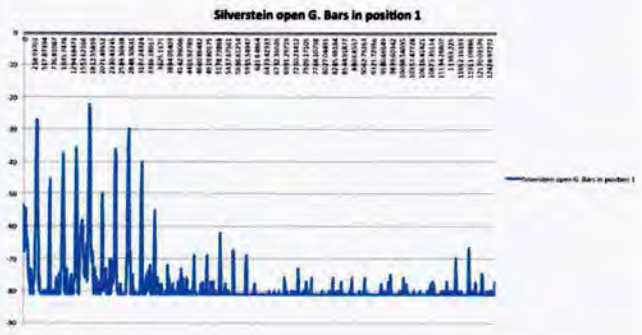


Fig. 2: Plan view of mouthpiece with sidebars in position one

The frequency plot for open G is shown in Figure 3.

Fig. 3: Silverstein Ligature open G. Sidebars in position one



The response in Figure 3 clearly shows the fundamental frequency (at a reference level of approx. -27dBV), with strong components (varying between -10 and -20 dB of the fundamental) up to the ninth harmonic. Of particular interest is

the strength of the fifth harmonic, which exceeds the fundamental by 5dB. Harmonics are also present above the tenth but at levels that would be relatively inaudible.

1.1.2. Silverstein Ligature with Sidebars in Position Two

This test was carried out with the sidebars of the ligature in position two as shown in Figure 4.

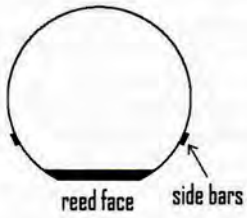
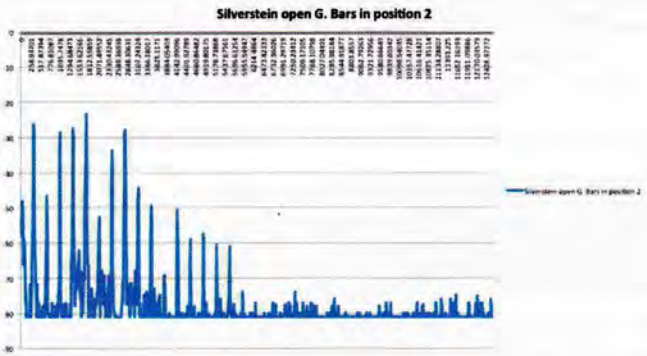


Fig. 4: Plan view of mouthpiece with side-bars in position two

The frequency plot for open G is shown in Figure 5.

Fig. 5: Silverstein Ligature open G. Sidebars in position two



As with position one, the response in Figure 5 with the sidebars in position two clearly shows the fundamental frequency (at a reference level of approximately -26dB V), with strong components (varying between -10 and -20 dB of the fundamental) up to the ninth harmonic. Again, of particular interest is the strength of the fifth harmonic, which exceeds the fundamental by 3dB and also the much stronger third and fourth harmonics. Harmonics are also present above the tenth but this time 10dB stronger than the levels with the sidebars in position one.

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1.1.3.Silverstein Ligature with Side Bars in Position Three

This test was carried out with the side-bars of the ligature in position three as shown in Figure 6. In this position the side bars were almost touching the reed edge.

The frequency plot for position three is shown in Figure 7.

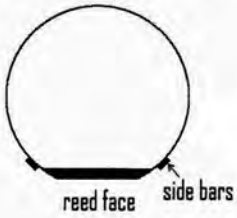
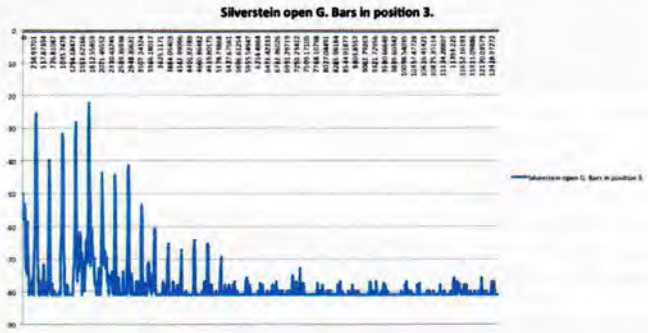


Fig. 6: Plan view of mouthpiece with sidebars in position three

Fig. 7: Silverstein Ligature open G. Sidebars in position three

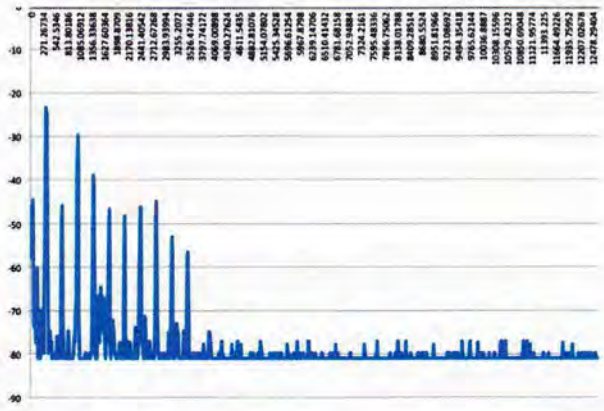


The response in Figure 7 clearly shows the fundamental frequency (at a reference level of approx. -25dBV), with strong components (within 20dB of the fundamental) up to the eighth harmonic. Again, the fifth harmonic dominates, being 3dB greater than the fundamental. Also the third and fourth harmonics have increased considerably being just 7dB and 3dB (respectively) less than the fundamental. Harmonics are still present above the ninth, but at levels a little less than obtained with the sidebars in position two.

1.2. Results for Bonade Ligature

To maintain test parameter consistency, the audio volume was checked before capturing the FFT plot. The frequency response is shown in Figure 8.

Fig. 8: Bonade Ligature, open G



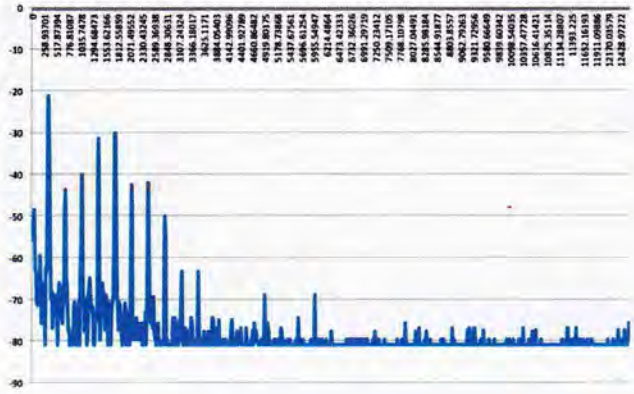
The fundamental is clearly present at a reference level of -23dBV (i.e. within one or two dB of the reference level used for the Silverstein). It can be seen that all harmonics are present up the tenth. There are no harmonics present above the tenth unlike the Silverstein, i.e. the Bonade ligature is acting as an

effective low pass filter. Furthermore the levels of the fifth harmonic and above are significantly reduced in comparison to the Silverstein. In fact the fifth harmonic is 22dB down on the fundamental and as such will have a dramatic effect on the sound when compared to the Silverstein.

1.3. Results for the Drake Ligature

To maintain test parameter consistency, the audio volume was checked before capturing the FFT plot. The frequency response is shown in Figure 9.

Fig. 9: Drake Ligature, Open G



The fundamental is clearly present at a reference level of -21dBV (again within a few dB of the Silverstein test reference). There is a significant reduction in the second and third harmonics (around 20dB relative to the fundamental) and about 10dB reduction in the fourth and fifth harmonics. As with the Bonade ligature there is a significant low pass filtering effect above the tenth harmonic.

1.4. Results for the Luyben Ligature

To maintain test parameter consistency, the audio volume was checked before capturing the FFT plot. The frequency response is shown in Figure 10.

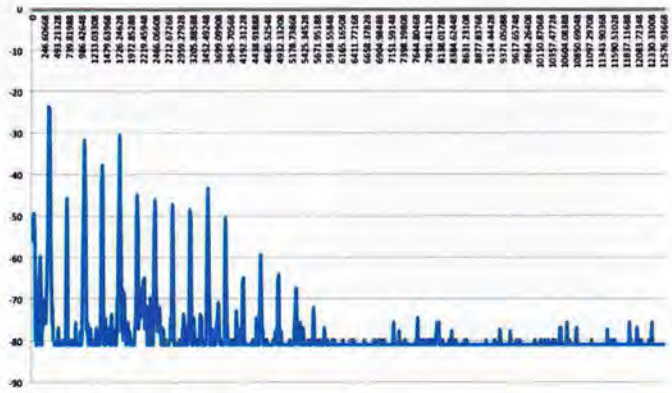


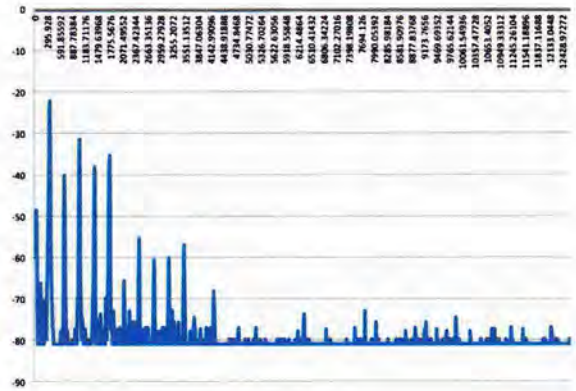
Fig. 10: Luyben Ligature, open G

The fundamental is clear at a reference level of -24dBV (within a few dB of the Silverstein tests). A broader spectrum is obtained compared to the Bonade and Drake ligatures and has a similar spectral spread to the Silverstein (with side bars in position three). However, in comparison with the Silverstein, the lower harmonics are more attenuated.

1.5. Results for the Optimum Ligature

To maintain test parameter consistency, the audio volume was checked before capturing the FFT plot. The frequency response is shown in Figure 11.

Fig. 11: Optimum Ligature, Open G



The fundamental is clearly shown with a reference level of -23dB (again within a dB of the Silverstein reference level). The first five harmonics are significant but the sixth to tenth harmonics suffer attenuation of 32dB or more relative to the fundamental. There is no significant contribution above the tenth harmonic.

2. Conclusions

Subjective listening suggests that the Silverstein ligature provides a much richer sound than the other ligatures used in this test. This is confirmed from the spectral characteristics obtained. There is less attenuation of the lower harmonics while the higher harmonics are not completely filtered out as they are with the Bonade and Drake ligatures.

The Silverstein has a more mellow and rich sound with the sidebars in position one, which is mainly due to the dominance of the fifth harmonic. With the sidebars in positions two and three the added wider spectrum together with the dominant lower harmonics (especially the fifth) gives not only a richer sound but adds focus and projection, especially useful if playing in a large hall.

The Bonade and Drake ligatures give a much duller sound, which is due to the filtering effect of the higher harmonics and the reduction in levels of the lower harmonics.

The Optimum ligature, although favoured by many clarinettists, does not provide the bandwidth of the Luyben ligature. The Optimum sounds less dull than the Drake or Bonade owing to the shape of the filtered spectrum, but in subjective tests the Silverstein outperformed the Optimum.

The Luyben performed well in the test giving a richer sound than the Optimum due to the wider bandwidth but in-band attenuation dulls the sound.

Overall the Silverstein outperforms all others in this test manly due to the wider bandwidth (bars in position two and three) and significant contribution (less attenuation) of the lower in-band harmonics (bars in all positions) and the significant contribution of the fifth harmonic.

Leslie Craven is the principal clarinettist of Welsh National Opera and **Robert Watson** is the Senior Lecturer, Electronic Engineering, University of South Wales.