

Science and innovation in the new SILVERSTEIN products

Includes spectrum analysis of some of the new ligatures tested by electronic engineer: Dr Robert Watson and audible evaluations by Leslie Craven formerly Principal Clarinet WNO

History. Several years ago – I (Leslie Craven formerly Principal Clarinetist Welsh National Opera) decided to write a critique of the new concept combination of cord and metal ligatures made by Silverstein. The results of those past oscilloscope and spectrum analysis tests (published in CASS magazine) were quite revealing and proved that the original Silverstein ligature did in fact produce more harmonics than all the other ligatures on test

Silverstein Works. At this juncture I must make the point that the President of Silverstein Works, in America, Mr BK Son has a background of engineering and the ethos of the company is to design equipment to innovate and improve the way we players do things. My contact with the Silverstein sales team and in particular with Mr Sean Yang their Vice – President of Sales has been a truly pleasant experience – nothing was too much trouble for them to help us with these tests and evaluations and the co-operation has been exemplary, even taking the time to telephone me on several occasions from USA to discuss our needs.

Impartiality I confess I cannot be totally impartial in this assessment of the products as I have for over five years (being convinced of their excellence) been an advocate of Silverstein products. This review was designed to show via scientific tests readers how much the new Silverstein products have improved and to show innovative products previously not evaluated in CASS magazine.

The main thrust of the tests prove conclusively that the more expensive ligatures are in our opinion worth the money for many reasons to be outlined below. Unfortunately it is too complex at present to offer tests to prove that the Silverstein makes the upper register feel easier to play and facilitates staccato, so readers simply have to take my word for that until we have time and the access to technology to provide those results.

Introduction and explanation of the tests designed and carried out by Dr Robert Watson with the assistance of Leslie Craven playing the various ligatures and reeds.

This report concentrates on the acoustic properties of the latest Silverstein Bb clarinet ligatures using a cane reed and the new Silverstein ALTA Ambipoly reed. The sound created when blowing any clarinet set-up is dependent on many variables from the embouchure to the physical properties of the clarinet material, reed strength, reed material and ligature - mouthpiece combination. Perceived sound is personal to the player and it is impossible to define a “perfect” sound. The sound we strive for is often influenced by listening to other players and after time each player finds a unique individual sound. Many players find that changing their ligature can change the way they produce sound, some ligatures improve their perceived sound and some have a perceived negative effect. This also depends considerably on the individual’s embouchure. Players who have tried one or other of the Silverstein ligatures remark on the perceived improvement both in the sound and the ease of producing the sound. Furthermore, a listener will often detect an improvement when a Silverstein ligature is being used with comments such as “it sounds so much more interesting and colourful”. This could account for the considerable number of top professional artists who use the Silverstein range of ligatures.

The Test setup (this paragraph is included for the scientific-minded members of CASS so if you do not wish to be apprised of the techno information you can skip this section)

A DBX Condenser Real Time Analyser test microphone was used, connected using an XLR lead, to a Eurorack MX 802A. The gain levels on both preamp and mixer were set to ensure that the signal remained well away from saturation. The microphone was placed near the bell of the clarinet to ensure that room acoustic properties (e.g. floor absorption/reflection) had minimal effect on the results. The results were recorded on a Tektronix ‘scope set to perform FFT (Fast Fourier Transform). The ‘scope was set to 25k sample/s rate and the memory buffer was fixed at 1024 samples. The Nyquist bandwidth was therefore 12.5 kHz giving a 12.2Hz resolution. The notes bottom E (Chalumeau E), and clarion C (1 octave above middle C) were studied each with the three Silverstein ligatures (Hexa, New CRY04, Old CRY04). Note that each of the Silverstein ligatures was used without rubber feet and without a rubber mouthpiece patch. Rubber will affect the harmonic response so its removal eliminates another variable from the set-up. Each time the note was blown at intensity such that the fundamental component of the sound spectra

was consistent. This is difficult to achieve in practice but consistency of the results was obtained to within a few dB for each note. The same clarinet and the same mouthpiece (Craven model) were used throughout. Human variability (subtle changes in embouchure) was reduced by performing all tests in one session. It is important to retain the same intensity owing to the non-linear characteristics of a reed's acoustic impedance. Too much change in air pressure (and hence air flow rate) will alter the harmonic structure of the sound.

Stored data was transferred in CSV format and imported into Matlab for analysis. This report will provide an overview of the processes used. A more in-depth technical report will be placed on Leslie Craven's website www.lesliecraven.co.uk.

The majority of the power was found to be produced in the lower part of the spectrum up to a point where the spectrum starts to fall to 10dB below the fundamental. After the 10dB limit the components start to attenuate with frequency at a greater degree. 10dB represents one tenth of the power and it was decided to use the 10dB point as the limit of the "baseband". A wide 30dB band was also obtained and any components less than 30dB (one thousandth of the power) below the fundamental were eliminated from the calculation as being too low to be of any significance.

Power in a band consisting of line spectra can easily be found with some m-file code using Parseval's theorem. The following power density ratio was defined as:

$$10 \cdot \log_{10} \left(\frac{\text{Power in 10dB band} / \text{number of harmonics in 10dB band}}{\text{Power in 30dB band} / \text{number of harmonics in 30dB band}} \right)$$

This power density ratio (in dB) gives a good indication of the way the spectral power "rolls off".

Two reeds were used: ALTA Ambipoly no 4 and a Marca cane reed. A Craven model mouthpiece was used throughout and 3 ligatures were used: Silverstein Hexa, New version of the Silverstein CRY04 original (Old) version of the Silverstein CRY04.

Results with Chalumeau (bottom) E using a cane reed

These results indicate that the power density for the Hexa ligature is dominant in the lower band closely followed by the New CRY04. The Old CRY04 ligature has a relatively wider distribution of power. It was also found from spectral plots that in the case of the New CRY04, the 5th harmonic was about 1dB greater than the fundamental.

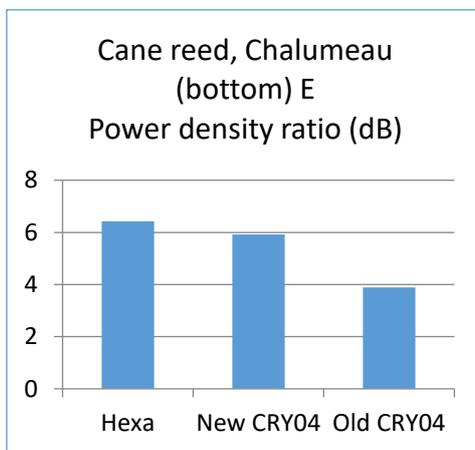


Fig 1: Cane reed, bottom E, Power density ratio (dB)

Results with Chalumeau (bottom) E using an Ambipoly reed

These results indicate that using the Hexa in conjunction with an Ambipoly reed gives a higher power concentration in the lower 10dB band. The New CRY04 gives a slightly less power density concentration.

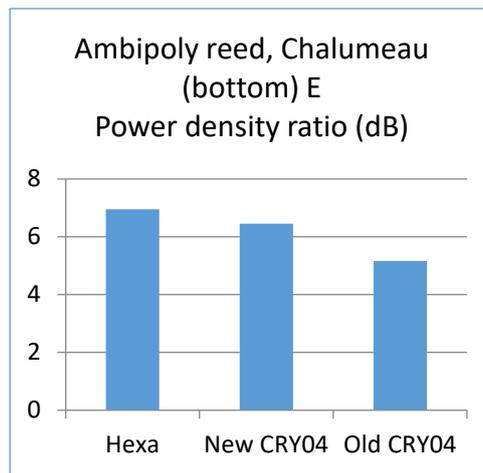


Fig 2: Ambipoly reed, bottom E, Power density ratio (dB)

Results with Clarion C using a cane reed

The New CRY04 has the higher concentration of power into the lower harmonics. The 10dB band is slightly wider for the Hexa which reduces its power density in the lower harmonics. The 10dB bandwidth for this note is 6 harmonics for the Hexa and 4 for the others. This is narrower than the 10dB bands for Bottom E.

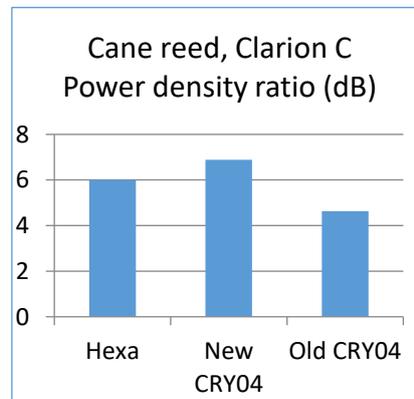


Fig 3: Cane reed, Clarion C, Power density ratio (dB)

Results with Clarion C using an Ambipoly reed - The Hexa and Old CRY04 show the greatest power concentration in the lower harmonics. The New CRY04 has a lower power concentration in the lower harmonics.

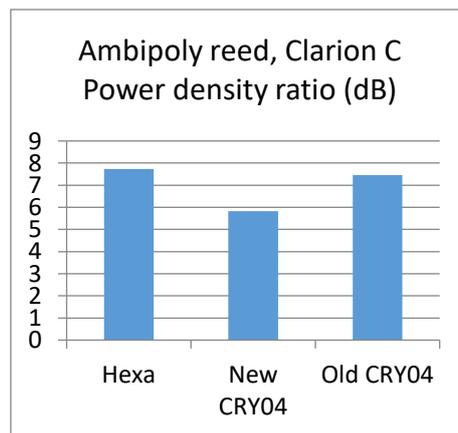


Fig 4: Ambipoly reed, Clarion C, Power density ratio (dB)

Blowing an Open G – an anomalous note.

In addition to the note data reported, open G was analysed. Open G differs from the other notes in this test report in that for all reed/ligature combinations the maximum harmonic amplitude is either the 4th or 5th harmonic. Typical ratios of fundamental to either 4th or 5th harmonic are in the order of 5 to 10 dB.

The following spectral plot for the Hexa ligature with a cane reed is as follows:

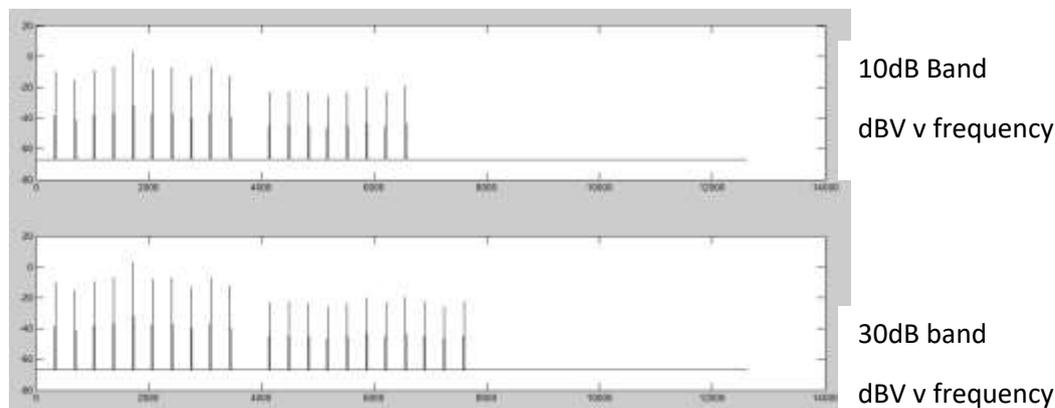


Fig 5: Spectral pots for open G, 10dB and 30dB bands

The above figure shows the fundamental about 10dB below the 5th harmonic.

It can be seen from Fig 5 that open G has a very wide bandwidth (and this is true for the other ligatures but to lesser extent). The Hexa using an Ambipoly reed has an even wider 10dB band. The power distribution at 10dB encompasses most of the 30dB band.

Conclusions

For notes in the lower Chalumeau and Clarion registers and from subjective listening tests, it would appear that good concentration of harmonic power in the 10dB band near the fundamental (5 harmonics in the Clarion, and 5 to 10 in the Chalumeau) gives a satisfactory sound.

This indicates that in the Clarion register best results can be achieved with a Hexa using an Ambipoly reed.

In the lower Chalumeau register best performance was also obtained with a Hexa using an Ambipoly reed

Correlation between actual spectral data and subjective listening especially near the centre of the instrument's range is the subject for future work.

(A note from Leslie: I believe the result for open G is because in the test in the interests of consistency I did not diffuse or reduce the velocity or intensity of air flow for this note. In practice or performance I personally would lessen the air velocity very, very slightly and increase the volume of air used with a slightly lowered tongue position to enhance the sound, utilising the domed concavity of the mouth and the high hard palate to assist resonance and reduce hiss on upper chalumeau notes. This is in direct contrast to the technique required for obtaining good quality sound in most other areas where tongue position should remain high.)

Getting the best sound for your pound

Value for money is often the main criterion in most people's analysis of what to buy. Many players would feel that paying over £100 and even above £150 - £200 (generally the high end market for ligatures) for a ligature would be excessive but in my experience the value the ligature adds to the sound is beyond price. Either one seeks to attain the best sound one can produce, or one makes compromises – I personally cannot compromise on sound. Sound of course is a subjective matter and each has their own concept of what a desirable sound is. This can be based upon one's national "school" of playing style or simply personal preference. Over many years of research and analysis it has been proven that by far the main influences (apart from the player) on the characteristics of the sound are; mouthpiece, ligature, barrel and bell.

These components in my experience are far more important than the main body of the clarinet in influencing the character and amount of focus in the sound that can be produced.

New HEXA ligature

The HEXA is gold plated, has six cords and is studded with Zircons which give it a look of "bling". The added cord does not seem to reduce harmonics, in fact conversely it improves harmonic emission marginally in some areas. The Zircons I presume are cosmetic as we could not really evaluate if they had a practical reason for inclusion.

The combination of the HEXA ligature and the new Ambipoly reed was for me a winner but was equally good with the CRY04 ligature. The reason the CRY 04 is so called is that the material in the metal used for the ligature is cryogenically frozen to below -300 Fahrenheit and the laboratory people from Silverstein found that it integrated the transmission of sound (and harmonics) in harmony with the mouthpiece and did not detract from or reduce the harmonic spectrum. It also is gold plated.

Non-stretch cord. The cords of the ligatures are non-stretch and were developed from a cord used in space missions to lower space explorer vehicles on to distant planets.

Keeping the cane reed moist

The core of the ligature cord is deliberately designed to absorb moisture and hence it can be soaked safely without fear of degradation. This has one significant advantage – in as much as when the reed cap is attached and the player is taking a break it will keep moisture circulating around the reed tip. In my days as principal clarinet with WNO the rehearsal room was often terribly dry lacking humidity and reeds would desiccate during the orchestral breaks (often looking like a crinkle cut crisp!) but when I used a Silverstein ligature and soaked it, this became a thing of the past and I would return from the 15 – 20 minute break to find I did not even have to moisten the reed.

The HEXA ligature and all other Silverstein models (there are several other models not evaluated here) have the same type of cord – but they are available in many different colours – purely cosmetic I believe but I suppose if one had different types of ligature for different instruments it would be good to have them colour coded – for instance a doubler playing different sized saxes could match colour of ligature cord to size of mouthpiece.

New Ambipoly reeds

Silverstein have recently introduced and launched the Ambipoly reed, a polymer reed that actually feels and sounds like a cane reed. The advantage of “plastic” reeds is that the profile change during “playing in time” is minimal and the material becomes more flexible during playing, actually feeling as if the reed is continually becoming more comfortable with the mouthpiece and in fact becomes as one unit, a feeling of being totally controllable but without the disadvantage of becoming saturated as can be the case with cane reeds.

Marrying reed to mouthpiece.

One amazing feature I discovered with Ambipoly reeds is that they can absorb some moisture and in fact the manufacturers advise soaking them for several minutes before use. They then advise to allow time to fit the reed and gently massage the reed into the facing curve of the mouthpiece, then begin playing. My impression was that this plastic reed became more and more familiar with the mouthpiece improving in tone and response by the minute until after a short time it began to sound as good as the best of my cane reeds – that was something I did not expect. Not only did it sound as good but the controllability was far superior – I found I could play very high “pppp” entries at will with no particular preparation – It was quite a revelation.

To try to “catch the reed out” I left it on a clarinet in my studio overnight for several days and went in on a daily basis to “sneak up on it” and try it – only to find on each and every occasion it played perfectly from the outset and in fact because the reed had not been moved off the facing of the mouthpiece it had married with the facing and was in fact improved on a day to day basis – something I found really quite surprising.

Other pro clarinet players who came to my studio during the test period of several weeks noted there was no reedy “hiss” associated with the Ambipoly – a phenomenon that with some cane reeds can be an irritating phenomenon especially in soft dynamics.

The reeds are available in most strengths ranging from 2, 2+, 2.5 upwards in those three gradations up to to 4.5 for Bb and Eb and from 2 - 3.5 in bass reeds. They are also available for all saxes from 1.5 to 3.5 in the same gradations. As far as I am aware Silverstein do not currently make a contra-bass clarinet reed or a bass sax reed. One colleague who came to my studio (for audition advice on the opera repertoire) said “wow that plastic reed has a lovely “fluorescent” sound in the upper register”. I know exactly what he meant as I felt the sound (unlike other plastic reeds I had tried) was soaring, vibrant and singing with a wonderful expressiveness, clearly activating all the necessary harmonics in the spectrum to enable the ear to witness the beautiful sounds produced.

Reedcure – could save lives and reduce the incidence of chest infection in single reed players

Having tested the reeds and the ligatures – I decided to try another new product the Reedcure. I left WNO last year and retired from daily orchestral playing partly because I realised my health had suffered considerably during my time in WNO caused by several bad bouts of pneumonia and pleurisy.

This new reed case – would have been a life saver for me had I owned one when in full time playing mode. The Reedcure when switched on will kill all germs including those that cause Strep throat, Pneumonia and Gastro Enteritis and uses ultra violet light and an ozone generating mechanism inside the actual reed case. It holds up to four reeds and is rechargeable via a USB. It has up to 20 usage hours on one charge. Bearing in mind each sanitising period is just a matter of minutes the battery will not need charging too frequently. When activated by a switch on the side of the case the light glows through a glass window and does its work inside the case, silently sanitising the reeds for safe use.

Asthmatics and those prone to repeat chest infections could benefit from Reedcure. In conclusion these ligatures, reeds and reed-sanitising reed case are not just gimmicks but in my opinion a must-have technology for serious minded amateur and professional players alike.

Average online ligature prices based on a cross section taken from various retailers: for CRY04 Bb and Eb ligatures vary from £165 - £192 inclusive of the Omni cap a rubber mouthpiece cap. Bass ligature prices vary from about £185 - £200+ and Bb & Eb HEXA about £245 - £285. Unfortunately the weak £ has caused prices for all US product imports to be quite high but as I said – what price does one put on sound? For me sound is not something one can quantify in terms of cost. Hence I would pay any amount on gadgets and accessories out there to improve my sound to assist in the quest for the” holy grail” For more information and pricing of all the products visit the Silverstein website: <https://www.silversteinworks.com>