# Cane Hardness and Flexibility: Related Measurements Leading to Better Bassoon Reeds

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In September, 1970 an article appeared in the *Philadelphia Inquirer* titled "Woodwinds Raise Cane". During World War II, obtaining cane from southern France was difficult. **Sol Schoenbach**, according to the article, happened to mention the problem to a friend from Oaxaca, a resort situated near Mexico City.

' "Why, you can get all the cane you want in Oaxaca," the man said. "It grows there and all the players in the village bands use it to make reeds."

This seemed too good to be true, but Schoenbach decided to try it.

"It cut like butter,and it vibrated like steel; it gave the subtle nuances you need in chamber music ensembles, yet it had enough body and stiffness to hold its own in a full orchestra fortissimo. It was really great," said Schoenbach.

All of his friends who tried it agreed and urgently wanted more. When contacted the Oaxaca man said, "How much do you want?" Arrangements were made to ship a second batch with 'visions' of railway carloads later!!

But the second batch --- it was dry, tough, and lifeless. It splintered, quickly dulled the edges of any cutting tool. Schoenbach got back on the phone again.

"Say, this is funny," said the man from Oaxaca. "It seems there was a little old guy who used to bring the cane into town on his back to sell to the musicians. Well, he died last winter, so we just had some school kids go out and cut some cane for you ----no, I don't know where the little old guy got his cane --- nobody else knows either. You mean some cane is better for making reeds than others?" '

And so it goes --- the search for good cane, then and now continues!

The above story reflects the frustration many double reed players experience in finding 'good cane'. How does one determine what constitutes 'good cane', and what can be done to help insure reliability in finding it in the future?

Two excellent articles previously published in the IDRS journals are, in my opinion, very helpful in this regard. The first titled "Reed Making Notes: Selection of Gouged Cane", was published in Journal Number 19, July 1991, and was written by **Lewis Hugh Cooper**, then Professor of Music (Bassoon) at the University of Michigan School of Music, and edited by **Dr. Mark D. Avery**, Professor of Music (Bassoon), Northern Michigan University. Cooper's notes on selecting and preparing gouged cane are outstanding. Paying attention to his recommendations on how to select and prepare bassoon cane will definitely improve any reed maker's success rate.

*Left to right:* ***John Heard, Russell Hinkle, Robert Williams, Leonard Sharrow***

The second article is titled "The Effects of Hardness and Stiffness of Bassoon Cane upon Performance of the Reed" and was written by **Lawrence J. Intravaia**, published in Vol. 19, No. 3, 1996. This paper was sent to the IDRS by his wife after his untimely death in 1973. Although at that time the test equipment for cane was not available for accurately evaluating cane hardness and stiffness, Intravaia's paper was outstanding work directed towards carefully analyzing cane to improve reed making by having a reliable method of testing cane for potential excellence. It was Intravaia's article that further inspired me to write this article and share my findings on the subject.

Again, I wish to note that when both of the above articles were written, the authors did not have access to some of the excellent evaluation equipment that is now available to reed makers today.

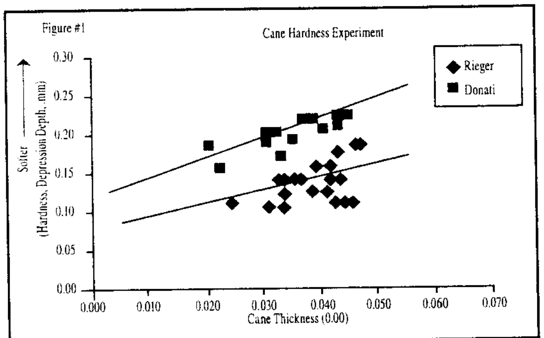
Each year several of my bassoonist friends join me for a "bassoon gang retreat" at my place in northern lower Michigan. This is a time for fun and relaxation as well as the sharing of reed making techniques and theories. At one of these retreats, **Bob Williams,** principal bassoonist of the Detroit Symphony Orchestra, brought his cane hardness tester along for the group to use. At the conclusion of the time together, Bob left the hardness tester with the understanding that I would return it to him when I returned to my home in Farmington Hills, MI, later that week. The hardness tester fascinated me and provided an opportunity to explore several questions I had about cane:

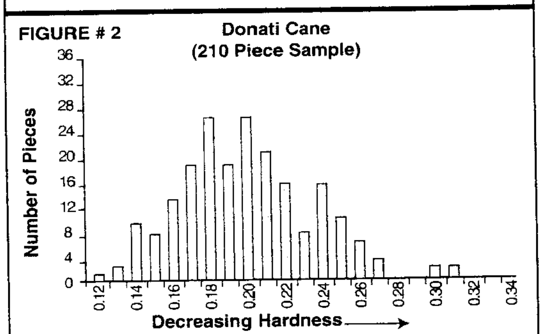
- How does hardness vary with thickness of the gouge?
- What is the variation of hardness within large samples of cane?
- How comparable are different suppliers?
- Is cane hardness determination a major factor to improving one's success rate in reed making?

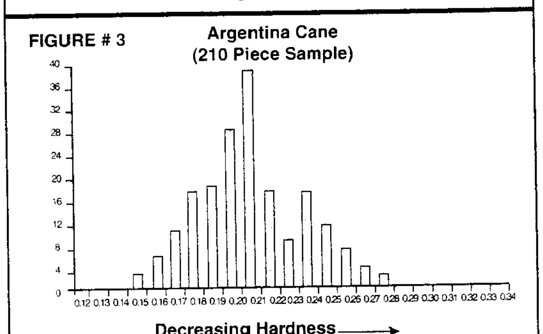
## EXPERIMENT #1

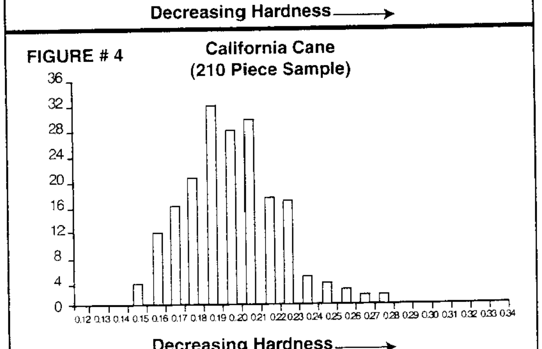
The first experiment I conducted was to hardness test the cane from two different suppliers. Both had an eccentric gouge. Each piece of cane was checked for thickness and measured for hardness at the same point. The data obtained from each cane supplier was plotted on a graph depicting cane thickness vs hardness. Note from this graph (Figure 1) that the data from each supplier sampled required the drawing of a 'best fit' line through the data points due to the variation in readings obtained. Conclusions drawn from this first experiment were:

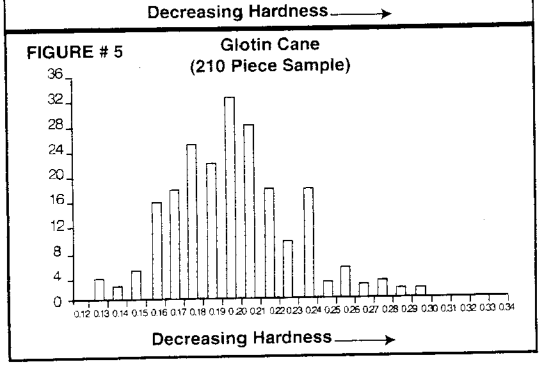
1. As expected, cane increases in hardness as it gets closer to the rind.
2. On average, .006 (.15 mm) thinner




cane is approximately 2 points harder.

3. Significant variation in hardness exists between pieces of cane.

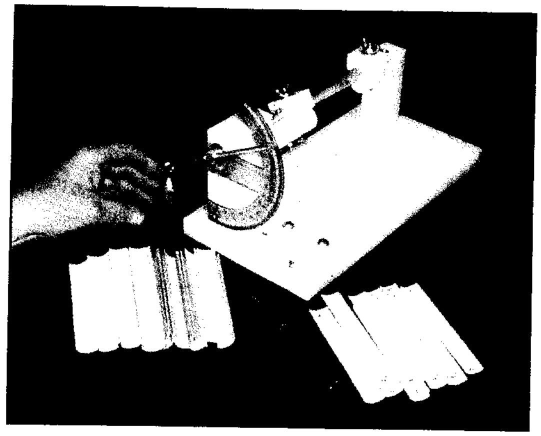
It should be noted at this point that the cane hardness tester used was a Mitutoyo Hardness Tester obtained from Reeds-n-Stuff in Annaburg, Germany. This device measures ball penetration into the cane in millimeters with the same load applied each time; hence, more penetration indicates softer cane. The (2) point change in hardness mentioned above is actually .02 millimeters change in ball penetration.

## EXPERIMENT #2

Because of the variations encountered in the first experiment, it was decided to hardness test a large sample of cane from one supplier. The graph shown in figure 2 reflects the data obtained from 210 pieces of Donati cane. (It should be noted at this point that all cane tested was accurately gouged and selected to .049 -.051 thickness (1.25mm). The results of this test reflect a fairly normal distribution of hardness ranging from .12mm to .31mm (almost 20 points of variation) with the median range of .18mm to .20mm.

The results of this first test prompted me to do the same for three other suppliers. Figure 3 is cane from Argentina which ranged from .15mm to .28mm in hardness with the median at .20mm to .22mm. Figure 4 is California cane ranging from .13mm to .28mm with the median at .18mm to .20mm. Figure 5 is Glotin cane ranging from .13mm to

.30mm with the median .19 to .21mm.



*Photograph 2 (Patent pending on fixture)*

Conclusions drawn from this experiment are as follows:

1. A large sample of cane produces hardness test results which generate a fairly normal distribution.
2. Although some variation exists between suppliers, the resulting distributions are similar.
3. Substantial variations in hardness exist in cane from any supplier, (none of suppliers presorted the cane into hardness ranges).
4. In my opinion, the results of this experiment indicate that a reed maker cannot assess the true quality of a batch of cane by making a few reeds.
5. Hardness testing is a good way to cull out those pieces of cane that a reed maker should not waste time working on. (The extreme ends of the distribution which are too soft or too hard.)

At this point it was thought that selecting the range of hardness that best fit my style of reed and characteristics of playing was all that remained and that reed making success would be greatly enhanced. It was fairly easy to find ranges of hardness I did not like, and, results within the range I preferred (.20mm - .24mm) were much improved. However, hardness reading alone did not always result in consistently excellent reeds!

Evaluation of cane through reed making demands accuracy and consistency in construction. Each of the reeds tested used the same shaper, profiler, wire placement, mandrel penetration, cut-off length, etc., and a Rieger tip machine so that the best possible evaluation of cane samples could be accomplished. Both of the articles mentioned above stress the importance of accuracy and consistency reed to reed. Without such workmanship it is impossible to make an accurate evaluation.

Since hardness turned out not to be the 'smoking gun' that I had hoped it was, I began to think about what other factor may be involved. It was at this point I remembered the article written by Lawrence Intravaia. I had also seen people twist cane by hand in selecting which piece to use in making a reed. These were attempts to assess 'flexibility'. Since I had marked each piece of cane with its hardness number, was there a way to accurately measure flexibility and correlate the two?

## EXPERIMENT NO. 3

Photograph 2 is a picture of a fixture designed and built to accurately measure flexibility. The piece of cane to be tested is held fixed at one end while the opposite end is clamped in a headstock which is allowed to rotate when a fixed load is applied on the pointer shaft. The opposite end of the pointer aligns with a protractor. Flexibility is measured by reading the degrees of twist resulting by applying the weight. Prior to the test, each piece of cane is trimmed to the same width for consistency. Two hundred pieces of hardness tested cane were tested and their flexibility readings recorded. Figure 6 is a plot of hardness vs flexibility for the cane tested. Each number on the chart indicates the number of pieces found at a particular hardness and flexibility reading. For example, twelve pieces were found with .20 hardness and 33° of flexibility. The results were somewhat surprising:

- Cane tested with the same hardness has significant variation in flexibility.
- As cane hardness decreases, flexibility generally increases (as expected), but softer cane can be found with ***less*** flexibility --- and conversely so.

The next step was to make reeds with cane selected across the array of results.

| Degree of Twist | 0.15 | 0.16 | 0.17 | 0.18 | 0.19 | 0.20 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | | | | | 1 | | | | | | | | |
| 29 | | | 1 | | | | | | | | | | |
| 30 | 2 | | | | 1 | 1 | 1 | | | | | | |
| 31 | 1 | 1 | | | 4 | | | | | | | | |
| 32 | 1 | | 4 | 6 | 6 | 6 | 1 | | 1 | | | | |
| 33 | 1 | 1 | 4 | 4 | 4 | 12 | 5 | 3 | 1 | 1 | | | |
| 34 | | | 3 | 3 | 8 | 7 | 5 | 6 | 5 | | 1 | | |
| 35 | | | 2 | 1 | 4 | 5 | 8 | 4 | 5 | 3 | | | |
| 36 | | | 1 | 3 | 5 | 5 | 3 | 4 | 6 | 1 | 1 | | 1 |
| 37 | | | | 1 | 3 | 2 | 2 | 5 | 1 | 1 | | | |
| 38 | | | | | 2 | 1 | 5 | 2 | 2 | | 3 | | |
| 39 | | | | | | 3 | 1 | | 2 | 1 | 3 | | |
| 40 | | | | | | 1 | | | | 1 | | | |
| 41 | | | | | | | | | | | | | |
| 42 | | | | | | | 1 | | | | | | |
| Number of Pieces Tested at a Specific Hardness | 5 | 2 | 15 | 18 | 38 | 43 | 32 | 24 | 23 | 8 | 8 | 0 | 1 |

*Figure 6*

The purpose of making the test reeds was to evaluate the effect of various hardness and flexibility combinations. Again, this was accomplished by accurately constructing reeds and finishing each of them with an identical amount of work. Finishing involved accurately cutting the blades to length, Rieger tip machine finishing, wet sanding with equal number of passes, and then play testing. As indicated in the test results, certain hardness/flexibility combinations immediately produced excellent results. These particular reeds remained the best in subsequent playing sessions. Some of the less desirable reeds eventually performed better after additional finishing work, but never made it into the reed case I would take to the concert hall.

Figure #7 reflects the fourteen sample pieces of cane selected for comparison tests. (Note that the test reed numbers are cane samples selected from left to right across Figure 7.) The results were as follows:

1. .15/32°. This reed had a peep pitch[1] of F, a good upper register, a poor lower register, and lacked lower partial presence.
2. .17/32°. Similar to number one, lacking low partials, and not responsive in the lower register.
3. .17/36°. This reed had a peep pitch of Eb, was stable on C# and E, played well in both upper and lower registers, but did not have a particularly rich sound (lacked lower partial presence).
4. .19/34°. Excellent reed, good mix of high and low partials producing a rich sound, both high and low registers respond well, peep pitch of E$, flexible (pp and *f*).
5. .20/32°. Excellent reed, similar to number 1). The peep pitch was Eb, good upper and lower registers, good flexibility (pp and *f*
6. .20/34°. Excellent reed, peep pitch of Eb, good response in all registers, flexible, good mix and high and low partials.
7. .20/37°. Excellent reed, bright, good mixture of high and low partials, flexible, peep pitch of Eb, C# and E, slightly unstable.
8. .20/39°. Peep pitch slightly lower than Eb, bright, more difficult to control, good low register, not as responsive in upper register, C# and E slightly unstable.
9. .21/34°. Excellent reed, rich sound, both high and low registers respond well, peep pitch of Eb, flexible.
10. .21/37°. Excellent reed, similar to number 4 and number 5.
11. .23/32°. Good reed with good upper and lower register, slightly warmer, peep pitch of Eb, flexible, good mix of high and low partials.
12. .22/38°. Peep pitch of D, C# and E unstable, not focused, poor upper register.
13. .22/33°. A good reed, peep pitch of Eb, somewhat unstable when pushed, warmer sound, good lower register, good upper register.
14. .25/38°. Peep pitch of D, C# and E unstable, good lower register, poor upper register, warm sound, blades over damped.

| Degree of Twist | 0.15 | 0.16 | 0.17 | 0.18 | 0.19 | 0.20 | 0.21 | 0.22 | 0.23 | 0.24 | 0.25 | 0.26 | 0.27 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | | | | | 1 | | | | | | | | |
| 29 | | | 1 | | | | | | | | | | |
| 30 | 2 | | | | 1 | 1 | 1 | | | | | | |
| 31 | 1 | 1 | | | 4 | | | | | | | | |
| 32 | (1) | | (4) | 6 | 6 | (6) | 1 | | (1) | | | | |
| 33 | 1 | 1 | 4 | 4 | 4 | 12 | 5 | (3) | 1 | 1 | | | |
| 34 | | | 3 | 3 | (8) | (7) | (5) | 6 | 5 | | 1 | | |
| 35 | | | 2 | 1 | 4 | 5 | 8 | 4 | 5 | 3 | | | |
| 36 | | | (1) | 3 | 5 | 5 | 3 | 4 | 6 | 1 | 1 | | 1 |
| 37 | | | | 1 | 3 | (2) | (2) | 5 | 1 | 1 | | | |
| 38 | | | | | 2 | 1 | 5 | (2) | 2 | | (3) | | |
| 39 | | | | | | (3) | 1 | | 2 | 1 | 3 | | |
| 40 | | | | | | 1 | | | | 1 | | | |
| 41 | | | | | | | | | | | | | |
| 42 | | | | | | | 1 | | | | | | |
| | 5 | 2 | 15 | 18 | 38 | 43 | 32 | 24 | 23 | 8 | 8 | 0 | 1 |

Number of Pieces Tested at a Specific Hardness

*Figure 7*

The above test results clearly demonstrate the importance of combining hardness and flexibility readings. Reeds made from a hardness range of .19 to .21 produced the best results providing the flexibility was not too high. For example, cane with a hardness of .20 and flexibility of 32° produced excellent results but cane with the same hardness and 39° flexibility resulted in an unstable, difficult to control reed. Also, there appears to be an inverse relationship between hardness and flexibility, ie, cane that is softer requires less flexibility to make a good reed where as harder cane requires greater flexibility to achieve acceptable results. It should be noted again that the exact same results may not be achieved by every reed maker due to differences in shapes, profiles, and construction dimensions, etc., but I am convinced that each reed maker can determine what range of hardness vs. flexibility works the best for him/her and dramatically improve his/her ability to consistently make excellent bassoon reeds.

## CONCLUSIONS

- Hardness testing is a valuable tool for improving cane selection. Today's hardness testers are accurate and easy to use.
- Cane is harder closer to the rind. The effect of this fact is more pronounced on reeds made with eccentric gouged cane than it is with those made with concentric gouged

cane due to the amount of thickness change required to obtain a significant change in hardness.

- Hardness testing of a large batch of cane reflects a large variation in hardness and a normal distribution of readings. Although some variation exists between batches and suppliers, their results are quite similar. Hardness testing is an excellent method of sorting out cane which is both too soft or too hard to waste time working on.
- Flexibility combined with hardness readings provides powerful information for the reed maker and eliminates some of the 'mystery' of why some cane provides much better results. L Hugh Cooper's article mentioned above states that "the greatest investment of a reed maker is time". Sorting cane by hardness and flexibility provides the ability to select cane to an individual's liking and eliminates most of the drudgery of searching for those 'great reeds'.

The fixture I have designed is simple and easy to make. I envision a day when reed makers will either own a similar fixture or suppliers will have cane available sorted by hardness and flexibility. Perhaps the search for that special place for cane known only to the little old guy from Oaxaca, Mexico, won't be necessary after all!

## (FOOTNOTES)

1. Peep pitch – the high pitch crow of the reed, accompanied by placing one's embouchure over the 1st wire of the reed and gently blowing. For my reed length. Eb is desired.

(***Editor's Note:*** This article represents, to my mind, a significant breakthrough in the constant and ever-elusive search for good bassoon cane. I endorse it strongly. Moreover, **L. Hugh Cooper**, Prof. Emeritus-Bassoon from the University of Michigan School of Music and IDRS Honorary Member, has added his strong endorsement as well: "As an octogenarian who has spent the greater portion of a long life coping with the vagaries of reed cane, I wish to recommend, without reservation, James M. Poe's ingenious, yet elegant methodology for pre-determining the relative suitability of individual pieces of reed cane. In view of Poe's findings, perhaps it is now time for aspiring double reed makers to set aside their crystal balls and oui-ja boards to join engineer/bassoonist Jim Poe in a new reed age based on enlightened technology. Enjoy!")

***James M. Poe*** *is a retired automotive executive who has played the bassoon as an avocation for 30 years. He has played with several community orchestras and small groups in the midwest. Currently is principal bassoonist with the Livonia Symphony in southeastern Michigan. James holds a mechanical engineering degree from the University of Michigan, and a MBA from Michigan State University. Interest in the reed making challenge has led him to study the subject with numerous professional bassoonists and to write a reed manual which includes information obtained from research on the subject. James lives in Farmington Hills, Michigan ,with his wife Jeraldine(Jerri). He has three children and soon is to have five grandchildren.*