Tuning and Voicing the Clarinet: Procedure and Techniques

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In the fall of 1971 I began undergraduate clarinet study at Fresno State College (now California State University, Fresno) with Russell S. Howland. I soon learned that Mr. Howland was not only an extremely accomplished clarinetist and teacher, but that he possessed a complete knowledge of woodwind acoustics. In fact, he taught a class in musical acoustics with one of the Physics professors. Mr. Howland always played along with us in lessons as a means of supporting our sometimes insecure playing and to give us a good reference point for pitch. During my second lesson he felt that my side Eb/Bb (right hand) was a little low in pitch and did I want him to correct it? I had no idea this type of thing could be done, but I handed over my clarinet in blind faith. He had a workbench in his studio and I watched in quiet terror as he took the key off my clarinet and began filing the tone hole. After he handed me the corrected clarinet I played the note while he played unisons, fourths, fifths and octaves around it. The pitch was definitely improved and then he continued quite casually on to the rest of the lesson. Throughout the first year we made several minor adjustments to my clarinet and always in theis careful, organic manner. He was always eager to explain what he was doing so that I would have an elementary understanding of clarinet acoustics. I attribut much of my interest in acoustics and design to the very utilitarian instruction I received as an undergraduate.

Since those early student years, I have spent much of my life dealing with the intonation problems of the clarinet from the perspective of a performer and a repair person. I wrote an article for "The Clarinet" magazine in 1986 (Vol.13 no.2). It is entitled, "Tuning the clarinet: Technique and Procedure". The following is a reworking of that article with some additional opinions and information. I have also added a section at the end that discusses some intonation problems and corrections associated with mouthpieces and barrels. Although the amount of the information here may seem overwhelming at first, I believe anyone with a little patience should be able to learn how to resolve minor problems that occur in most clarinets.

TUNING THE CLARINET

In this time of ever-higher performance standards and greater competition for jobs, superior intonation has become a major preoccupation of musicians. Although the obsession with tuning gadgets is bordering on the neurotic, the proliferation of inexpensive tuners does afford us a greater awareness of the deficiencies of our instruments. Despite this technological sophistication, musicians are ultimately left in the performance situation with their ears as the arbiter of pitch. This ambiguity of science and musicianship regarding the production of musical pitches places the job of physically tuning a musical instrument in the category of art, subjective at best. As such, an artist striving for complete mastery of his instrument must have an understanding of its acoustical phenomena and assume an active role in making modifications to suit his individuality

In addition to the variables of embouchure, mouthpiece, and reeds, clarinetists must contend with an instrument that has an inherently aberrant scale. The conundrum that has plagued clarinet makers for centuries is the compromised position of the B-flat vent tube. Each fundamental mode of the clarinet can be excited into vibrating at its second partial (interval of a twelfth) by venting the air column at a position approximately one third of the distance from the mouthpiece to the first open tone hole of the fundamental tone. If the vent is placed to either side of this ideal location the pitch of the twelfth will rise. Very simplistically, this is one reason for the occurrence of wide twelfths at either end of the clarinet. Ideally (but impractical) every fundamental tone should have a respective vent tube to actuate a correct twelfth. The register vent is further compromised because it must also function as a tone hole for Bb1. A hole large enough to produce a true Bb1 would be too large to properly excite the second partial. Consequently, we have a mis-sized and misplaced hole for Bb1, unequivocally the worst tone of the clarinet. Fortunately, clarinet bore design has improved over the past fifty years to accommodate some very serious acoustical problems encountered in much earlier instruments. A little investigation into the nature of instrumental acoustics and past clarinet design will elicit a healthy respect for contemporary clarinets, imperfect as they may be. Still, unless the clarinet has a *significant* renaissance in design, all variations on the single vent system will possess compromises. These compromises, dictated and mass-produced by manufacturers, are not always those performers would choose.

The intent of this paper, then, is to offer a systematic method and proven procedures for making subtle adjustments to suit the individual. However, it is important to acknowledge from the outset that, given the compromised tuning schema of the clarinet, pitch aberrations can only be altered and not perfectly corrected.

PROCEDURE

To avoid confusion, I will refer to tones in "clarinet pitch" and use conventional octave notation. (The tones below C1 are simply E, F, G etc.)

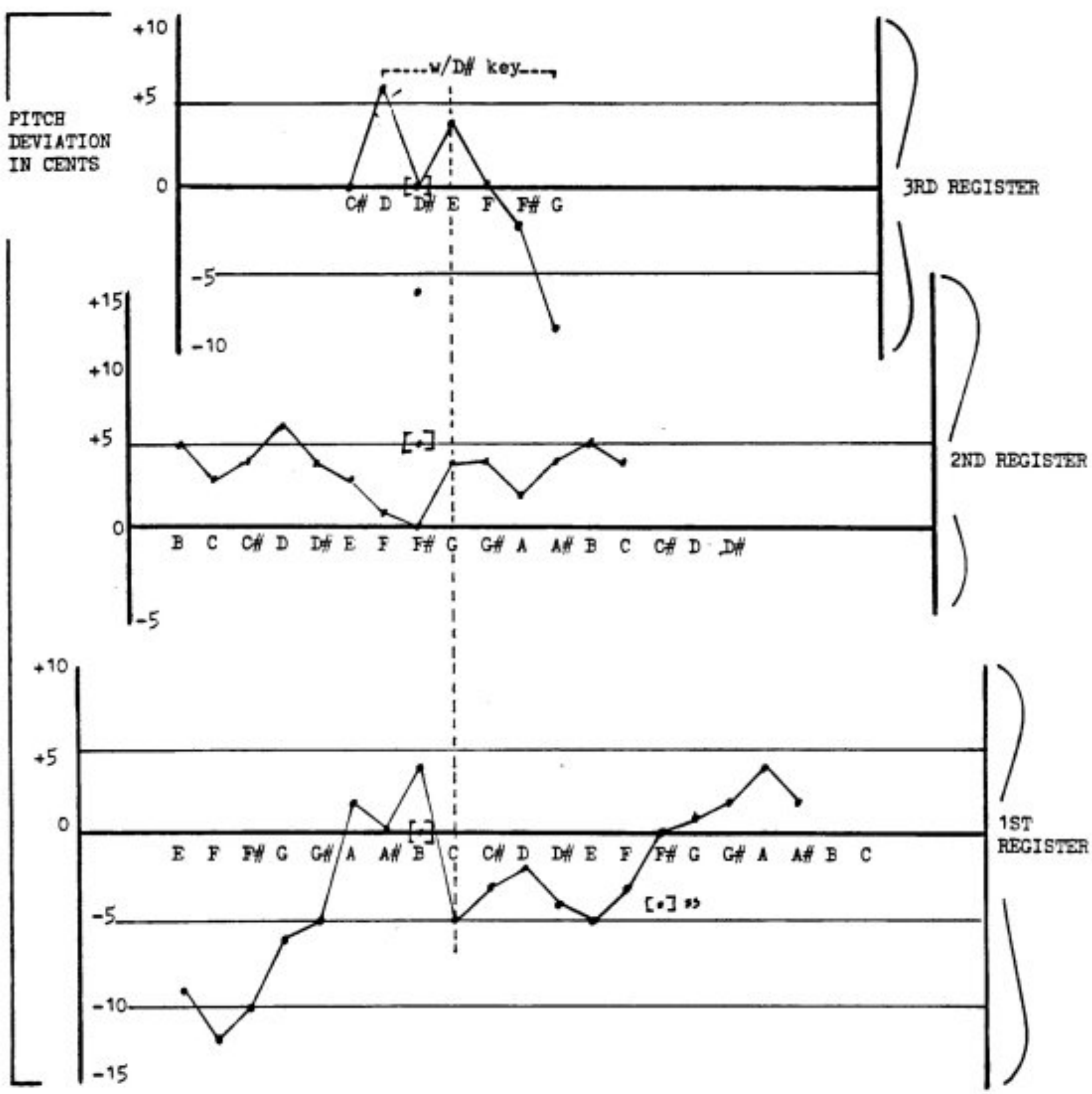
Before jumping into the fray, let us establish some guidelines to insure consistent results throughout the tuning process:

I. Make a grid similar to **Ex.1.** (See next page)

II. When testing pitch, properly warm up your instrument and work in a familiar space (preferably your practice studio). Be sure the room is a comfortable temperature - about 65-70 degrees Fahrenheit.

III. Use a quality tuning apparatus that is graduated in cents. I still use my Korg AT-12 with a needle, but the small Korg CA-20 for about $20 is fine.

IV. Set the pitch level calibration to the level where you most commonly play. I have tuned my instruments to A= 441, as I have rarely played in an orchestra that stays at A =440.



Example 1. Pitch Curve

Example 1. is a graphic representation of an adjusted Buffet R-13 B-flat clarinet.(#134661 my own, now retired!).

To understand the graph, imagine that the **First Register** line represents the full length of the clarinet bore reading low to high from left to right. The **Second Register** line represents the overblown twelfth produced by venting the register key. The **Third Register** line represents the seventeenth produced by venting the register key and raising the first finger of the left hand. The partials are exactly in line vertically to demonstrate registral relationships. (See the dotted line trisecting C1, G2, and E3) Where a tone is available by use of an alternate fingering the standard fingering (without "side keys") has been plotted and the alternate given parenthetically (I have tuned both E-flat/B-flat fingerings identically. l +1 B flat not plotted)

To thoroughly understand the tuning characteristics of the clarinet, plot an empirically derived curve as in **Ex.1**. This graphic analysis will prove invaluable as a reference point for any pitch adjustment. To plot the pitch curve of your instrument, invite a friend to assist you and follow to the prescribed guidelines. Tune your warmed clarinet, to an audible "A" concert. Simulating an ensemble method of tuning will produce a more realistic representation of the aberrations of your instrument as they occur in performance. The 'long" B natural (C for A-clarinets) must remain slightly sharp to accommodate the overall tuning schema. However, as a matter of performance practice, we have learned to ad just these tones with the embouchure during initial tuning.

Most performers are sufficiently aware of the method of "pulling" the barrel to adjust their instruments but at the risk of sounding pedantic tune the *overall* length of your clarinet. This initial tuning is the basis of all other adjustments and must be done carefully. The most common mistake I see (hear!) is adjusting the long B at the barrel only, which may cause an inordinate flattening in the throat area. (This is also a very common problem with bass clarinet tuning) The clarinet can be pulled at the barrel, middle joint and bell for a more even tuning. (I have played Buffet clarinets for most of my life and I have found the lower joint to be tuned consistently too sharp on most R-13 models. Consequently, I have installed a 1/2mm tuning ring in the middle tenon of both my Bb and A clarinets).

Now that your clarinet is properly warmed and "tuned" you can begin the process of plotting a pitch curve. Without looking at the tuner, play lowest E with a firmly supported and centered tone for about five seconds. Your assistant should record the reading after the needle on the tuner has stabilized. Continue chromatically through the entire range of the instrument without favoring any tones. Allow for periods of rest to relax the embouchure (If you use "resonance" fingerings in the throat tones as part of your normal technique, register your results with these fingerings. Take note of the tuning without these adaptive fingerings for reference). To be completely objective, it is advisable to follow this procedure with several good reeds and to average your results

Once the pitch curve is completed, study it and think about it for a day. From rehearsals and performances, you should know the problems on your clarinet, and hopefully the data collected will support aural observations. Now some objective choices must be made; to what degree should the tone(s) be corrected? It is impossible in an article to impart the experience that makes these qualitative decisions easy. But. If you work carefully and thoughtfully you can make intelligent choices based on the information given here.

As a general rule, I suggest tuning Bb and A clarinets and any auxiliary clarinets to similar parameters (particularly the throat tones) as much as possible. This allows for a uniform approach in fingerings and internal voicing, minimizing the problems associated with switching or doubling. Ultimately, careful listening in the ensemble will tell you the practical limits of any adjustments.

Here are a few axioms to keep in mind as you work.

* It is easier to flatten pitches in performance than to sharpen them.

* "Short tube', tones (closer to mouthpiece) are more flexible than "long tube" tones

* "Short tube" tones are most significantly affected by the position or length of the barrel.

* Adjustments to any fundamental tones affects all related partials and vice versa.

The tuning biases I prefer come from my own performance experience and from working with other professionals in resolving the tuning problems of their clarinets. Looking at the pitch curve in **Ex.1**. It is apparent that I have left the throat tones with adaptive fingerings slightly sharp (to allow for pulling) The majority of tones (G/D2 -F1/C2) are split almost evenly between the registers and the "bell" tones favor a closely in tune second register. If you have never done any pitch adjustment you may want to use this curve as a guideline. But, be aware that your mouthpiece may not allow for working within these exact parameters. (Please note that this represents an adjusted Buffet R-l3 clarinet c. 1975). Every manufacturer has his own ideas about tuning, and curves may vary dramatically. I have found that Buffet will occasionally make rather significant, but unannounced changes to the R-13. This makes a good argument for owning B flat and A clarinets of the same make, model and year.

When the correctable tones have been identified start with one or two in the same area. Do not try to make a complete adjustment in one sitting. Allow a few rehearsals to get used to, or further adjust any altered tones. By focusing your attention on one area at a time, you will reach a solution much sooner, and the changes over the range of your instrument will be gradual.

TECHNIQUES

I. Lowering pitch

Now that a systematic method for tuning has been established, we can discuss specific techniques for lowering and raising pitch. Though it may seem obvious, it is worth mentioning that the pitch of a tone is determined by the hole(s) that *emits* the tone. Some tones (side F#1, G1, A1, Bb1) are produced with two holes, but even these are affected most significantly by the open tone hole closest to the mouthpiece. (The notoriously sharp B2 on R-13 Eb clarinets should be adjusted by filling the open hole immediately next to the index finger *and* the next larger hole.)

Most pitch adjustments will be downward and can be accomplished by either lowering a pad or adding material to the upper half of the appropriate tone hole. Lowering a pad in most cases can be as simple as adding cork to a lever. If you must bend a key and are not familiar with bending techniques, I suggest working with a qualified craftsman. Lowering a pad will only flatten a tone a few cents before it becomes stuffy. My preference is to position a pad as low as possible without restricting tone quality. Once this ideal location has been set any pitch adjustment must be done inside the tone hole.

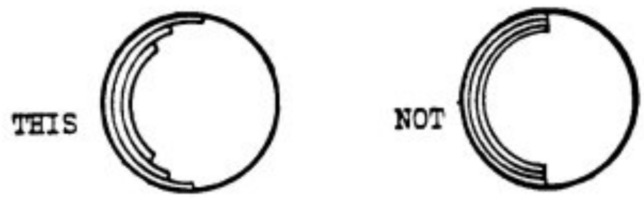
A pad that is often ignored as a solution to lowering the sharp pitches of the upper clarion is the register vent pad. This pad can be set as close as 1mm without making the throat Bb terribly noisy and will lower A2 –C3 as much as five cents.

An area that is often too sharp on most Buffet R-13 clarinets is the lower clarion, C2-E2. I use a .5mm-tuning ring between the upper and lower joints to lower the entire pitch in this range. Some tones (D2 and C#2) may still need material in the tone hole.

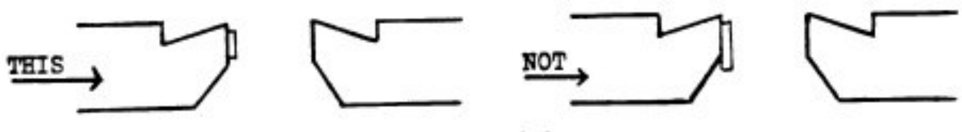
Working inside a tone hole requires great care and patience. A valuable aid for this exacting work is a leak light. These can be made quite simply and inexpensively, or purchased from repair supply companies. A leak light placed in the bore will clearly illuminate the work area and aid in neat, accurate work. Sloppiness will reflect audibly in your results. The timbre and stability of a tone is affected by any protrusions, rough edges or pronounced eccentricity in the hole shape. To have the greatest effect in lowering pitch, all tuning work should be concentrated on the upper half of the hole (closest to the mouthpiece). In some instances, such as large bass clarinet tone holes, I will place material around the entire perimeter. This has a greater affect on the 12th than on the fundamental.

The most common method for lowering pitch is the use of black vinyl electrical tape. Although this method is a quick fix, it has several drawbacks; a) tape loses its adhesive qualities from. finger oils and moisture, and may release at a. very undesirable moment and b) tape allows for step tuning only and infinite adjustments of pitch are not possible. But for those bent on this method here are some suggestions.

- Using; a leak light to illuminate the work area, clean the tone hole thoroughly with alcohol and a pipe cleaner or Q-tip.
- Use contact cement to adhere first layer to wood.
- Step layer tape to the outermost edge. **See Ex. 2. below**



Avoid protrusions into bore. **See Example 2a. below**



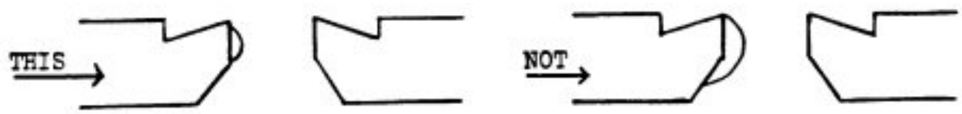
Large tone holes (lower joint of bass clarinets) require a great deal of material to affect the pitch, and cork has proven very suitable. (I prefer using several layers of E-poxy). Cork strips are available from various supply sources in thickness of 1/64 inch, 1/32 inch, and 1/16 inch. For most large tone holes, use 1/16. Follow the suggestions for tape adjustments, but for adhesion, apply contact cement to one side of the cork and to inside of tone hole. Allow the cement to become tacky before aligning the cork in the hole. With the cork in place, file the abrupt ends smooth so they blend with the arc of the hole circumference. If the pitch has been flattened too much, file cork to adjust. Any cork protruding into the bore can be carefully trimmed with an Exacto knife. When you are satisfied with the adjustment, coat the cork with one or two applications of clear nail polish to form a moisture proof and sound reflective surface.

For lowering pitch, especially in smaller holes, I have found Duro Master Mend Metal Repair E-poxy to be the best available material. This has the advantage of good adhesion and can be easily filed once it has set (allow 30~40 minutes) This material "flows" and presents a smooth hard surface. This type of filler has a working time of about five minutes, so it is best to work on only one or two holes at a time. I prefer this method and never resort to using tape except when someone wants to experiment before committing to changing a hole.

With a leak light in the bore to illuminate the work area, clean the tone hole with a pipe cleaner and alcohol. Hold the joint vertically (mouthpiece end down). Using a small implement, such as a paperclip wire, carefully coat the half of the tone hole nearest the mouthpiece with E-poxy Use more material than necessary (about 1/8th of the hole) to allow for filing to shape. The material should coat I80 degrees of the hole. Do not let any material flow into the undercut portion of the tone hole. Immediately wipe away any excess above the seat, Leave the joint in a vertical position while the E-pox-E sets. After about 40 minutes, the. result should look somewhat like **Example 3** and **Example 4.**

Maintain a smooth arc. **Example 3.**

• Avoid protrusions into undercut area. **Example 4.**



Once the material has set it can be filed with a small round file. I use small diameter chainsaw files. Maintain a smooth shape that tapers into the circumference of the tone hole. I always leave the tone a little lower in pitch than I think might be necessary and wait until I have played in an ensemble to make any final adjustments.

II. Raising pitch – Undercutting or reshaping tone holes

There are two terms that are often used interchangeably when describing the method of adjusting a tone hole to raise pitch. They are "undercutting" and "fraising". Fraising comes from a French word meaning to drill or countersink. When clarinets are made at the factory some tone holes must be shaped at the bore with a variation of a cone or dome to correct the pitch or the voicing. Generally, large bore clarinets such as the older Selmer Series 9 clarinets had rather large (diametrically) tone holes with no undercutting. This produces a very sonorous sound, but the twelfths are erratic – usually very sharp in the chalumeau when playing pp. The introduction of the R-13 clarinet by Buffet in the early 1950's was a move toward a smaller bore (stepped in the upper joint) and smaller, but highly "fraised" or undercut tone holes to produce better twelfths.

Dr. Lee Gibson wrote an article on this subject for the ***The Clarinet*** in Vol. 12, no.3. He gives a good description of undercutting and its affects on pitch. I believe most of his statements are primarily theoretical. All of my concepts are derived from basic empirical work.

For this discussion it is most important to note that the purpose of undercutting a tone hole is to a) raise the pitch of the fundamental or to b) improve the voicing. When a tone hole is undercut the fundamental tone is sharpened. Gibson states that the twelfth will be lowered as well. In my experience there may be a slight narrowing of the ratio of the twelfth, but the pitch of the twelfth and the seventeenth also rise.

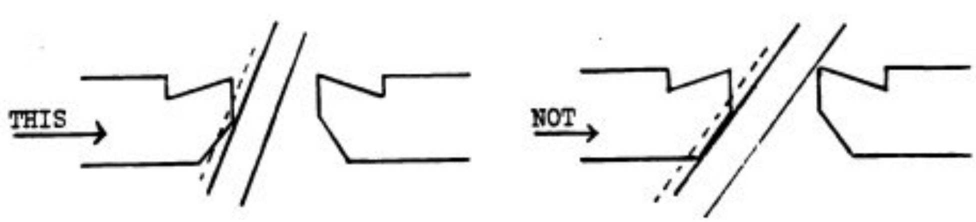
I would like to underscore the importance of being cautious when using this procedure. In my experience, most professional quality clarinets require undercutting only in the tones closest to the mouthpiece. Improvement in this area can and should be made with a barrel first. (See following section on mouthpieces and barrels). ***Mistakes in undercutting can ruin an instrument*** . An over adjustment can cause stuffiness or instability. When a tone hole has too much fraising it is also difficult to locate the pitch center; the note feels "wild" to the player. The following suggestions are made in the context of "touch up" work. If you feel you have a major acoustical problem with a tone on your clarinet, I urge you to work with a qualified, ***experienced*** craftsman.

The method I use for adjusting pitch upward is not strictly undercutting, because it does not generally involve cutting the entire perimeter of the tone hole at the bore. I use a small diameter chainsaw file and adjust the shape of the existing undercut portion. (See **Example 5.**)

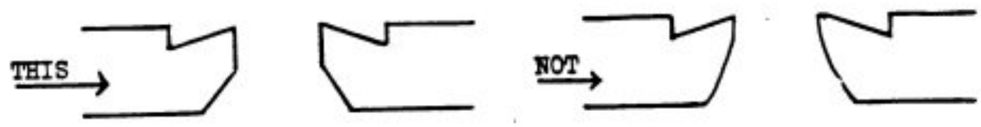
Before cutting a tone hole, be certain that the pitch of a flat tone cannot be corrected by raising a pad or simply cleaning the hole. Also, most clarinets tend to be flat in the area of throat tones "E" and "F". This area becomes inordinately flat when the barrel joint is pulled more than a half millimeter. The gap created cause a localized enlargement of the bore. Use of tuning rings is highly recommended to avoid this problem.

In the case of tone holes that have been undercut at the factory, I usually work on the upper (mouthpiece end) perimeter only. When working on holes that have no previous undercutting, start with just the upper perimeter. If a slight amount of undercutting has not raised the pitch significantly, remove the same amount from the lower perimeter. Continue this process until you have reached the desired degree of improvement. This method will encourage a more uniform shape to the undercut portion.

To adjust the tone hole, use a fine round file slightly smaller than the inside diameter of the tone hole. With a leak light in the bore, position the file as shown in **Example 5**. Turn the file so that it cuts when pulled away from the instrument. This method allows for greater control and the likelihood of forcing out chips near the bore is far less. Again, avoid irregularities such as deep grooves. Work slowly! Once wood is removed, it is difficult to replace. Examining **Example 5**, it can be seen that the intent is to shorten the tube of the tone hole rather than to enlarge the diameter of the undercut area at the bore. As you cut, try to maintain an abrupt edge at the beginning of the "cone" (**Example. 6**). If this edge becomes round or blunt the tone is attenuated less abruptly, resulting in a loss of center and immediacy of response. This shape also encourages upper overtones which we hear as "bright". (Keep this in mind when shaping filled holes.)



Example 5.



Example 6.

Tones that most often need correction are throat tones E1-Bb1. If you are certain the problems persist regardless of mouthpiece or barrel then reshaping the hole to sharpen the pitch is required. Here are a few tips that will keep you from over adjusting.

Throat E and F tend to be low on most clarinets. I believe that a ten cent spread between the twelfths is very acceptable. If you must adjust these holes remember that you will be raising the pitch of B1 and C2 a twelfth above. The hole that emits F1 also actuates the third mode (the altissimo register). If this hole is overly enlarged the altissimo register can become unstable.

Throat G1 is an entirely independent note and can be adjusted with out much fear.

Throat A1 is produced by both the G#1 and the A1 tone hole. Raising G#1 will also raise A1. The pitch of throat Bb 1is a function of the A1 tone hole and the vent tube. If you raise the pitch of A1 you will also increase the pitch of throat Bb1.

III. Adjusting Vent tubes

The vent tube or "pip" functions as both a register vent and as a tone hole for throat Bb1. Many "A" clarinets (especially R-13 Buffets) have a flat throat Bb1. The register vent can be shortened to improve this note, but there are several considerations before proceeding.

A shortened vent tube will also raise the pitch of the upper clarion (left hand). The tones G2 – B2 tend to be sharp on most "A" clarinets and some "Bb" clarinets. A shortened tube will also raise the pitch of B1 (middle line B natural) slightly. Standard Buffet "A" clarinet register tubes are .580" long. I remove .020" only. Shortening the "A" clarinet register tube also has the positive affect of minimizing the sub-tone that can plague some clarinets on A2. As the tube becomes shorter there is also a slight loss of focus to tones Bb1 – D2. Everything is a compromise!

VOICING

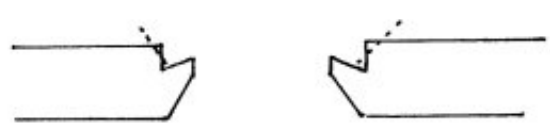
When a clarinet has a tone that is too dull, stuffy or too bright slight adjustments to the either the shape of the tone hole or the undercut portion can be changed to improve the quality. This is called voicing. For the most part this falls in the category of "Don't try this at home". I will explain some of my techniques and remedies, but use this information carefully.

Most often players will complain about a tone that is stuffy. Usually this is caused by an incorrect pad height. A slight raising of a pad over a tone hole will remedy this problem. The use of cork pads has become very common in the upper joint of clarinets, but a lack of attention to the shape and size of the pad can cause "venting" or "hissing". We can hear this as performers and it reduces the carrying power of the tone. Cork pads are often left with rather abrupt edges, which cause turbulence as the air from the tone hole passes them. After installing a cork pad, I remove the key and round the edges of the pad (staying away form the pad seat) with a well-worn emery board. 400 sandpaper will work too. Cork pads on register keys should be tapered severely so that the register key can remain close to the vent tube for proper intonation in the upper clarion. Cork pads over the C#1/G#2 tone hole should also be tapered.

On some clarinets the throat E1 vents against the pad and is very noisy. If the pad is at maximum aperture and the tone is still venting the tone hole has most likely been too severely undercut at the bore. This can usually not be corrected, but it can be minimized. The entire circumference of the tone hole must be enlarged, but this should only be done with a special tapered cutting tool. Most clarinet tone holes on smaller bore clarinets (most current model professional instruments) are not cylindrical. They are larger at the opening and reduce towards the bore and then flare where the undercutting begins. This narrowing of the tone hole causes a Venturi effect, increasing the air speed. Thus a tone hole that has too much undercutting produces a fast air stream that vents against the pad. As a player and as a Buffet dealer for many years I simply avoided purchasing instruments with this problem regardless of how good they may have been in all other respects.

When tuning larger tone holes downward (generally bass clarinets) with a great deal of E-poxy the tone can become restricted. I will open the bottom side of the tone hole to relieve stuffiness. When doing so it is important to keep the angle of the cut as close to vertical as possible, but avoid cutting into the tapered portion of the tone hole seat.

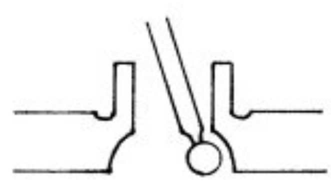
Stuffy chalumeau "Gs" are common on Buffet "A" clarinets. Avoid working on the inside of the tone hole – this is a terribly fussy note and you may make the problem a lot worse. If the pad height is correct, I will cut the "wings" around the tone hole and this improves the sound remarkably. (See **Example 7.**).



Example 7.

A stuffy "G" can also be the result of a mis-matched bell. When the bell choke (the step created by the bore reduction at the small end of the bell meeting the flare of the lower joint) is too small a marginally bad "G" will become worse. I have had good result with changing the diameter of the bell at the choke, but you will also affect the stability of the upper clarion. Please note that this adjustment is subtle and must be done concentrically. Often this tone can be improved by simply turning the bell until you reach a position that minimizes the problem

Occasionally a tone will "jump out" of the scale because it is overly "bright" and "thin" when compared to its neighboring tones. Most often the tones that are troublesome are the "F2" and "E2" in the clarion and their respective partials in the altissimo, "D3" and "C#3". These are relatively easy to correct, but again you will need a special tool. I use a sphere shaped Dremel tool that was sold by Ferree's some years ago as a tool for refacing tone holes. (**See Example 8**). I do NOT use this in a power device, only as a hand tool.



<---Mouthpiece Bell --->

Example 8.

The undercut portion of these tone holes on Buffet clarinets is "dome" shaped, not tapered. In order to dampen the tone the undercut portion closes to the bell must be slightly increased. Because no keys need to be removed, I work on these holes very slowly. I will take a few scrapes applying an upward pressure, and then test the tone. It is easy to work back and forth with a player until the desired dampening is achieved. This method of reshaping the tone hole has some other positive affects. Resistance is created which lends stability to the altissimo and the tone begins to "blossom" with a fuller sound.

THE INFLUENCE OF MOUTHPIECE AND BARREL ON INTONATION

Without question the mouthpiece is the component of the clarinet that can exert the greatest degree of variation on the intonation of the entire system. There is a narrow range of minimum to maximum overall volume for a mouthpiece that will create good modal ratios and proper fundamental pitch. Dr. Gibson states that this optimal volume is 13.5cm3. When a mouthpiece volume falls out of this range it will play either too sharp (small volume) or too flat (large volume). Regarding volume and interior shape, an interesting inverse relationship exists between the bore and the tone chamber. Mouthpiece makers achieve a variety of tonal colors by playing with this equation, indeed develop their signature sounds this way. However, the bore cannot exceed roughly two-thirds of the overall volume without compromising modal ratios.

The intonation of a properly designed mouthpiece can be compromised by the style of facing that is applied. Short/close facings tend to play sharp where as long/open facings tend to play low. This knowledge can be used to correct inherent problems of improperly made blanks. A low pitched mouthpiece can be shortened from the tenon end, but the character of the sound will also change. I have had succes improving mouthpieces that were sharp by adding a .5mm tuning ring to the end of the tenon. Some intonation irregularities can be balanced with a properly matched barrel. In fact, the barrel must be considered as part of a coupled system with the mouthpiece.

In the design of the earliest clarinets, the mouthpiece and barrel were one unit. It probably became clear to makers early on that as mouthpieces broke it was simpler to make the mouthpiece and barrel joint separately. The separation of mouthpiece and barrel becomes the most common design beginning in the middle 18th Century . Now in the 21st Century the clarinetist is offered enough variations in mouthpiece and barrel combinations to make his head spin. The barrel has become not only an element of proper intonation, but also one of tone production.

A properly designed mouthpiece should generally require a 66mm barrel (on a Bb Buffet R-13) to play in a range of A=440-441. 67mm or 65mm barrels are acceptable. Buffet A clarinets generally require a 65mm barrel, but 66mm or 64mm are also acceptable. When one is forced to use a barrel outside of these limits there is a problem with either a) the mouthpiece, b) the clarinet, or c) the person producing the sound.

Barrels, no matter the outside shape, fall into two categories: tapered and non-tapered. The design of the Buffet R-13 clarinet calls for a barrel with a nominal bore of 14.95mm with no linear reduction (taper). This translates into a dimension at the mouthpiece end of the barrel of .589"-.590". The reason for this is to compensate for the flattening in the third mode (tones above C3 – the "altissimo"). This design suits small bore mouthpieces such as those provided with Buffet clarinets.

For several reasons, most players in the U.S. have come to prefer larger bore mouthpieces similar to the design of Frank Kaspar. This larger bore mouthpiece coupled with the non-tapered barrel creates two problems of intonation. The third mode is too sharp and the throat tones are flat. Welcome Hans Moennig and the reverse cone tapered barrel. Reverse cone barrels are larger at the mouthpiece end. Moennig barrels as made by Buffet are .589"-.590" at the mouthpiece end and reduce to about .579" at the opposite end.

Moennig's innovation for American clarinetists was not a new idea. It had been in place with German clarinets for many years, but we must credit Mr. Moennig for introducing the use in this country. The prevailing clarinets favored in the U.S among professional players until about 1960 were large bore (Selmer). As Buffet came into dominance, players did not want to give up their large bore mouthpieces designed for these large bore clarinets. Moennig's tapered barrel was the ideal compromise.

The rather severe reduction in the barrel bore has several positive affects. The third mode is not as sharp and the twelfths near the mouthpiece are reduced in size. The throat tones are sharper and brought into better focus. The choke created by the step at the juncture of mouthpiece and barrel can add a nice resistance that increases response and adds center to the tone.

FINAL THOUGHTS ON INTONATION

Tuning devices have become so inexpensive and so pervasive that one cannot attend a rehearsal without seeing the wind section light up like a Christmas tree. There is no doubt the information we gather from these devices helps out performance and ear training tremendously. However, one cannot simply rely on a tuner to do the job the ear needs to do. Electronic tuners are calibrated to display our pitch production as a function of tempered tuning. This is a good starting point, but we do not play tempered tuning in the ensemble setting. One may be able to play perfectly "in tune" with his tuner at home and find that some tones are still "out" in the ensemble. Tuning within the ensemble is based on the organic generation of the overtone series and is called "just" intonation. Attention to proper intonation within the ensemble is matter of experience and training.

With this information in mind, it is important to acknowledge that re-tuning one’s clarinet is always a matter of compromise. One need’s to accept at some point the imperfect nature of his instrument and learn to adjust pitch in performance to achieve the most satisfying musical results. But that is another paper entirely.