The following article is the first in a series by L. Hugh Cooper (1920-2007). He was a Professor Music (Bassoon) at the University of Michigan from 1945 to 1997, and a charter member of the International Double Reed Society.

Reed Making Notes Two: Cooper's Cubist Reed Concept

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Decatur, Illinois

INTRODUCTION

Recognizing the many factors that influence reed making, including instruments, tuning, timbre, and performance venues, each individual must ultimately fashion a reed that satisfies their own needs. This paper includes specific dimensions depicting the author's version of a parallel scrape (tip taper) Knockenhauer style reed produced from 127mm (5") gouged cane, and shaped on a long, wide, folding shaper whose narrowest point (9.8mm, second wire position) is 43mm back of the fold. The cubist reed concept provides a flexible procedure that may be adapted successfully for use on various shapers, gouges, and reed types.

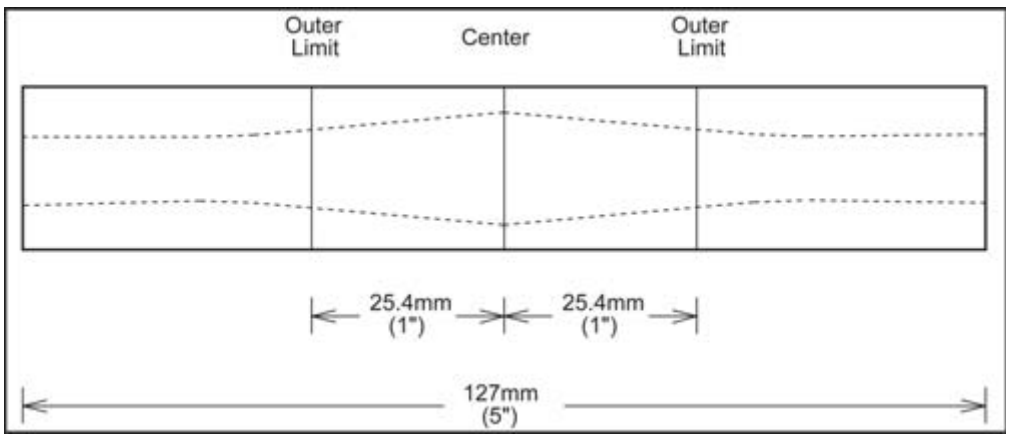
While acknowledging the extreme importance of gouge contour in crafting reeds, the following methodology begins at the gouged, stick cane stage of manufacture, and describes a relatively easy structured approach to hand profiling. The cubist concept is economical in time, material, and cost of equipment. The time frame is approximately 10 minutes (sans curing and wrapping) from soaked cane to playable first stage reeds.

More importantly, using only basic hand tools, the reeds produced by this method rival or surpass those obtained by means of expensive sophisticated machines. The author is adamant that students learn hand profiling early on as a liberating skill offering freedom to experiment with various blade contours and reed designs during their formative student years. The cubist concept has proven itself over many decades of teaching to be an efficient flexible means to that end. It is hoped that this approach will also prove to be a positive contributing factor in your future reed making efforts.

HAND PROFILING

Use only properly selected, prepared, and soaked cane (see Cooper, L. Hugh. "Reed Making Notes One: Selection and Preparation of Gouged Cane," *International Double Reed Society Journal*, IXX, July 1991, p. 43).

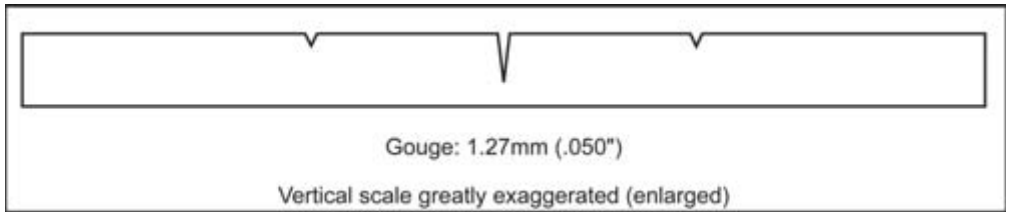
1. Locate and mark on the shell/bark (epidermis) side the exact longitudinal center of each piece of gouged cane.



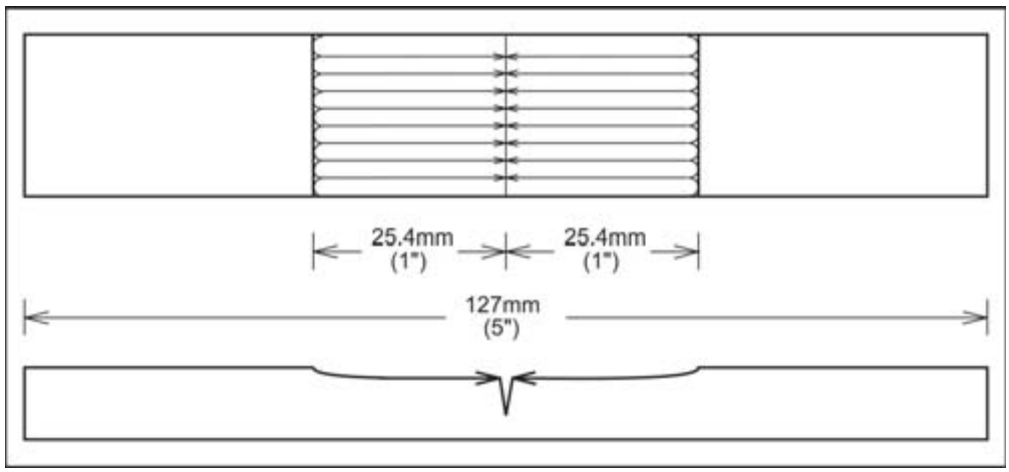
2. Determine and also mark the outer limits of the desired length of the blade profile (approximately 25.4mm [1"] or slightly less). *Note*: Only a short rudimentary profile is used with the "cubist" reed concept; however, the same technique may be utilized to create a semi-finished profile by extending the profile's outer limits

back to any desired collar (shoulder) position, and further refining the blade contour while the cane is still on the easel.

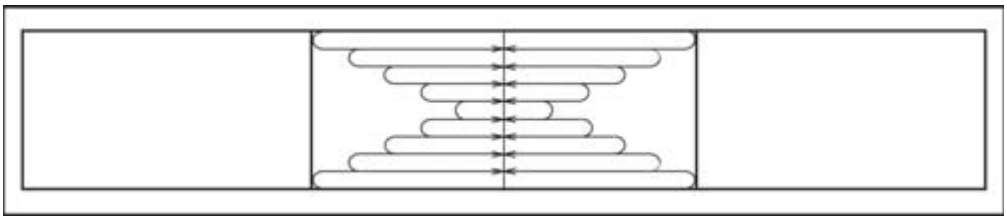
3. With the cane on an appropriate sized easel (25.4mm [1"] to 31.8mm [1 1/8"] in diameter, depending on the inner curve of the specific gouge) and using a small, sharp, thin bladed knife such as a "pen" blade of a jack knife, exacto knife, or similar tool:
   a. Deeply notch the center mark at a right angle to the longitudinal axis of the cane (approximately 2/3 the thickness of the cane), taking care not to cut through the thinner edges if using an eccentric gouge.



   b. Then notch the outer limits of the profile in a similar manner, but in this instance just barely through the shell/bark. Again, use caution towards the possibly thinner edges (see above sketch).
   c. To strip (cut) the shell/bark from the profile area(s), take the cane and easel in one hand, then securely hold the cane on the easel with pressure from the thumb. This useful digit remains out of harms way up on the shell/bark beyond the furthest outer profile limit, while the fingers are safely tucked under along the side of the easel. With the longitudinal axis of the cane pointing away from you and the upper arms securely against the body, use the same thin bladed knife to strip (cut) the shell/bark from the furthest profile area. *Always* cut from the furthest profile limit towards yourself and the center fold notch on the cane. (Should the knife slip, the upper arms resting against the body will prevent injury.) Each individual cut should be narrow (a minimum of 9 or 10 indexed cuts across the width of the cane) and just under the shell/bark. After one blade area is stripped of shell/bark, reverse the easel and/or the cane and repeat the process on the other blade.



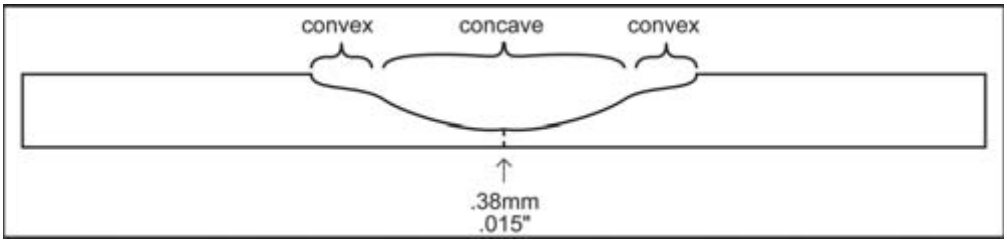
d. Holding the cane and easel in a similar manner, use the same knife to "cut in" a stepped arrow head pattern on each blade area, as before, always cutting toward you and the center fold notch.



i) Each cut should gradually deepen as it progresses toward the center fold location, and ideally each cutting should drop free as it intersects the initial deep center notch.

ii) After cutting in the arrow head pattern on both blades, use a coarse file, such as a 6 to 8 inch half-round bastard or a Swiss "Grobet" 0 or 00 cut pillar file, to eliminate the ridges left by the preceding knife cuts and to refine the profile.

iii) Actual measurements are not critical (one of the advantages of this cubist methodology); however, the blade contours must be evenly graduated to each side of the center fold position to insure that the grain strata of the predetermined back thickness will be intersected equidistance back from the center fold. *Note*: Although a straight taper will suffice, it is preferable to have a center line (spine) blade contour that represents a very elongated double "lazy S ( )" curve. The curve starts with a slow concave sweep up from the center mark and turns into a straight taper or slightly convex configuration toward the back. Also, while not obligatory, a suggested thickness at the center fold of .38mm (.015") folds easily with a minimum likelihood of breakage.



iv) Using a dial indicator setup, or a cane gage, find and then mark with a pencil the location of both points on the mid-line of the profile that intersects the thickness desired for the back of the reed blade (.71mm [.028"]). These points of reference on each blade of the profile should be *equidistance* from the center fold location and a little more than half of the distance from the center mark to the outer limits of the profile. Should these points not be equally spaced, replace the cane on the easel and file the thicker side down until the two opposing blades are balanced. *Note*: Although the author's preferred dimensions are given below, the actual back measurement may be any predetermined thickness that lies between .38mm (.015") at the fold to nearly 1.27mm (.050") at the back. The short rudimentary profile intersects all intervening grain strata. Choose any thickness appropriate for your reed concept and it can be located on the slope.

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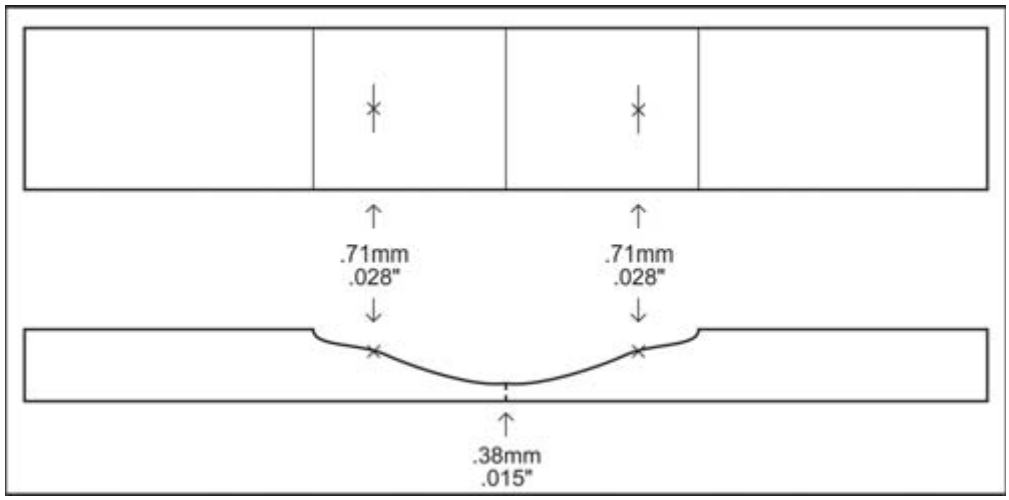


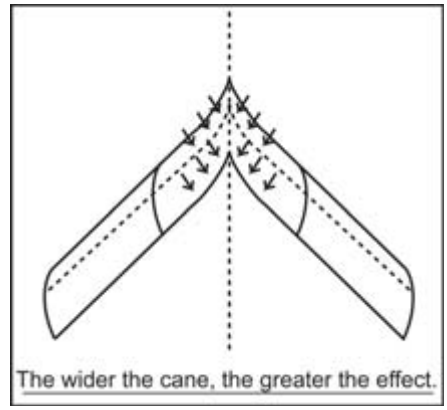
v) After completing the profile and clearly marking the two critical future reference points, carefully measure again to re-establish the *exact* center fold location, then accurately mark the spot. Be sure, for any inaccuracy will result in a double error when the cane is folded causing an imbalance between the opposing blades of the profile, as well as subsequently dictating an involuntary change in shape and wire placement.

vi) When positive of the center fold location, place the cane back on the easel and with the profiling knife, lightly score, at right angle to the grain, completely across the blade at the center fold mark.

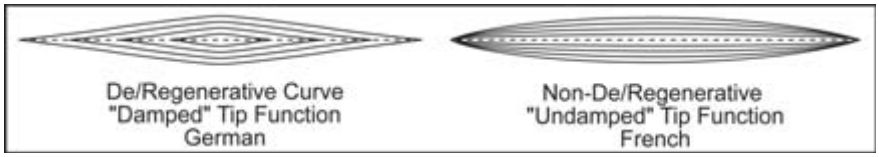
FOLDING AND SHAPING THE PROFILED CANE

For a variety of reasons the author prefers a folding type shaper, rather than the straight (multiple) style. Some advantages of the folding shaper are: 1) Few straight shapers are acceptably accurate, while the majority of the folding shapers usually are. The degree of difficulty involved in matching the four machined side contours of a straight shaper is exponentially greater than matching the two opposing sides of a folding type. Only a few very expensive "Rolls Royce" straight shapers are accurate enough to seriously consider. 2) Folding type shapers are much easier to accurately load. 3) When using a folding type shaper the cane is folded prior to shaping, thus insuring that the two halves of the shaped cane will exactly match. 4) Prior folding of full width, unshaped, semi-profiled (or fully profiled) cane also helps to pre-establish the degenerative/regenerative tip function so desirable in finished reeds (see comparative sketches).

Do not narrow the profiled cane to the width of the shaper tip until after folding. Important mechanical stressing of the blade area(s) takes place when wide, full width (19-20mm or more) profiled cane is folded back on itself (see adjacent sketch). Such stressing of the cane produces a permanent distortion of the cane fibers that predisposes the resultant reed tip opening to function, very nearly, as de/regenerative closures. This manner of tip function, in some degree, is considered an intrinsic part of a German reed design, as opposed to the gradually flattening arcs of the French genre (see comparative sketches). Any reed making procedure that encourages de/regenerative curve tip function should be embraced. *Note*: Although the phenomenon is not depicted in either drawing, a lateral expan-



sion of the tip width occurs as its curvature decreases during the closing portion of the reed's vibratory cycle, while, in a similar but opposite manner, the tip width narrows as its curvature increases during the opening phase of the cycle.



In a true de/regenerative curve tip function, the contour of the tip opening at any given moment in the vibratory cycle would represent a smaller or larger version of the tip contour at any other moment in the cycle. In a well balanced reed the smallest version "winks" out in the exact center of the tip as it closes (rolls) in from the sides and then "winks" open again as it gradually enlarges (rolls) out to its maximum size. This type tip function (or any other) can easily be observed as you slowly close and open the tip with the thumb and index finger. One key to balanced reeds is balanced tip function, preferably including some degree of de/regenerative curve closure, unless of course the performer wishes to produce the more undamped French timbre basically produced by having the full tip width open during most of the vibratory cycle.

The above de/regenerative curve phenomenon represents the major advantage to be gained by the use of a folding style shaper. Simply put, all else being equal, use of a folding type shaper will result in a higher percentage of excellent smooth, free, dark reeds than will be produced while using a straight (multiple) shaper.

It should also be noted that the single advantage of a straight shaper is its design potential which allows the shaping of several pieces of gouged cane at once. Strangely, this design feature is seldom exploited due to the difficulty encountered in accurately loading a straight shaper with multiple pieces of cane.

While recognizing the author's reservations regarding the use of straight shapers, they may be used with acceptable results.

FOLDING

1. With the center mark accurately incised, bend the profiled cane, curved side down, over a blunt, thin, straight edge, such as a thin metal rule or back edge of the profiling knife, lined up with the center mark of the cane. Hold the cane on the flat side of the straight edge with one hand. Depress the unsupported length of the cane down firmly with the fingers of the other hand until the cane is almost folded back on itself. *Note*: As a point of interest, visually observe the marked stressing that takes place in the blade area(s) during the folding process (see sketch above). It is this permanent distortion of the cane fibers that will ultimately influence the tip contour and function in the finished reed.
2. Just before the fold is completed, remove the knife or straight edge or it will act as a fulcrum and the resultant leverage will tend to cause the cane to break open at the fold. With the straight edge removed, complete the fold and gently apply finger pressure along the fold line to finalize the operation. Do not allow the folded cane to spring open, but keep it in a folded configuration until placed on the shaper. Continued flexing at the center fold will soon cause the fold to break open.

LOADING THE SHAPER

1. Without allowing the folded cane to spring open, hold the cane with its outer edges parallel and proceed to narrow the wide folded cane to match the tip width of the shaper. Using the same thin bladed profiling knife, cut (split) *equal* amounts off each side rail until the folded cane's width is reduced to that of the shaper tip. Exercise great care during this narrowing process, as removing cane unequally will destroy the side to side symmetry of the gouge (assuming some degree of gouge eccentricity).
2. With the cane width now reduced to match the shaper tip, open the folded cane a sufficient distance to allow

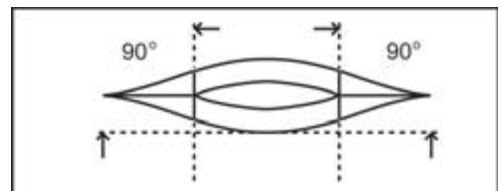
insertion of the metal tongue of the shaper into the folded cane up to the center fold. With the shaper tongue inserted, partially tighten the shaper's locking mechanism. Visually center the piece of cane to the longitudinal axis of the shaper, making sure that the center of the cane exactly concurs with that of the shaper. Any needed corrections can be made by slipping the cane side to side with your fingers while the cane is still loosely clamped on the shaper. When positive that the shaper tongue is centered within the folded cane, further tighten the locking mechanism. (Observing the shaper's shadow graph through strongly back-lighted cane offers an excellent visual perspective of the shaper's placement within the folded cane.)

SHAPING

1. With the cane aligned on the shaper, use the same thin bladed knife to strip (cut) away the majority of the excess cane extending out beyond the shaper contour. Attempt to accomplish this with one long deep cut down each side, starting at the tip and deepening as it progresses toward the back. To avoid shifting of the loosely secured cane during this procedure, hold the blade areas tightly on the shaper with the thumb and fingers of one hand.
2. With the greater portion of the excess cane removed, check again for alignment and if still accurate, fully tighten the shaper's locking mechanism. *Note*: Fully tightening the locking mechanism prior to removing the excess cane will cause a high percentage of the canes to crack. Full width canes are especially vulnerable at the back of the tube where the opposing edges are often impinging on each other due to the cane's curvature.
3. Holding the side of the knife parallel to the vertical axis of the shaper (sides), start a cut at the tip of the shaper and draw the knife from the front of the contour towards the back.
4. *Stop* the above stroke approximately 10mm (3/8") from the back of the cane, and then make a shaping cut from the back of the contour forward a sufficient distance to intersect the previous stroke. This counter stroke will avoid splitting off the slight flare at the back of the tube.
5. Don't attempt to specifically correct isolated high spots, but use long strokes, always starting from the shaper tip, picking up exposed cane as the knife follows the steel contour of the shaper from the tip nearly to the back of the shape.
6. Continue to refine the shape both front to back, and the shorter back towards front, until the knife will no longer pick up a shaving.
7. When positive that all superfluous cane is removed down to the steel contour of the shaper, remove the shaped piece of cane from the shaper. *Note*: Never use abrasive paper or files to smooth the edges of the shaped cane while it is still on the shaper, for this misguided practice will soon erode the shaper and change its critical contour.

After removing the cane from the shaper, lightly sand the edges, holding the lateral axis of the cane perpendicular to a flat surface (usually the front area of a work bench or table) faced with 220 grit wet or dry abrasive paper. The finished edges should be smooth and vertical to the lateral aspect of the shape throughout the full length of both rails.

1. Holding the two halves of the shaped cane together with the thumb and fingers of one hand, use a short "sawing" motion to sand from the back of the tube forward, focusing the abrasive covered edge of the work area toward the narrowest point on the shape (usually occurring at or slightly in front [towards the tip] of the second wire position). Repeat the procedure on the other side of the shape.



Rear Perspective of Folded and Shaped Cane

2. Then using less pressure, gently sand in a similar manner from the fragile corners of the tip back to the shape's narrowest point. Repeat the process on the other rail.
3. Care must be taken not to narrow the shape beneath the desired dimensions. It is usually wise to order

a shaper slightly wider than desired to allow for this sanding procedure. One must also take care not to destroy the side to side symmetry of the shape while sanding (planing) the rails. Vernier calipers or a micrometer are indispensable tools for checking the accuracy of the shape's lateral dimensions. Several critical points should be checked while finish sanding and sizing the shaped cane's contour. Important references are the shaped cane's width at the tip, mid-blade, 1st wire, 2nd wire, and back of the tube. Variances as little as 0.10mm (.04") from the norm will cause noticeable inconsistencies in the playing characteristics of the finished reed.

After completing the sanding and sizing procedure, one may satisfactorily move directly to the next stage of reed manufacture (tube formation). However, ideally, the profiled, folded, and shaped cane should be tied off in its folded state (a short length of waxed florist string works well for this purpose), and left in a ventilated area to thoroughly dry before attempting the above final sanding and sizing. This delay in sequence recognizes the need for addressing the marked differences encountered in shrinkage from piece to individual piece of cane. The author's personal shaper is deliberately oversized to allow for this natural distortion and still have sufficient cane width for the final sanding and sizing process. He also routinely teaches hand shaping as both an accurate corrective technique and a conceptually liberating methodology.

FORMING THE TUBE

Beveling: The bevel's primary function is to modify the shape contour (if needed) to correctly position the reed's mechanical fulcrum so as to ensure that resultant reeds possess both reverse wire function (an indispensable characteristic of all truly superior reeds) and tip openings that resist collapse. Other bevel functions include: 1) Producing stable hermetically sealed tubes and reed/bocal junctures by creating secure "butt" or "lap" type side-seam closures. 2) The bevel also can be used to reduce the interior static volume of the reed, a resultant equivalent to using a narrower shaper. 3) A fourth rather subtle effect reinforces the reed's de/regenerative curve tip function by exerting mechanical stress down the two blades' four linear lines of inflection.

The following represents the traditional full (100%) symmetric (four sided), 30° from vertical beveling methodology used by the author.

1. With a penknife or sapphire finger nail file, begin the bevel shallow at the collar position while holding the chosen tool on the inner edge of one side of the shape, at a 30° angle to the shape's vertical axis.
2. Gradually increase the bevel to full (100%) depth by the second wire position, then,
3. Continue at full depth and consistent 30° angle to the back.
4. Carefully duplicate the above bevel on the inner edges of all four sides of the shape.

An alternate type bevel produces equally acceptable results. This bevel can be described as an asymmetric (two sided) 30° from horizontal (or 60° from vertical) variable depth (0% to 100%) bevel. (See sketch below: "Four Sided Symmetric and Two Sided Asymmetric Bevels Compared.") With the use of either basic type, achieving the same tube dimensions and fulcrum function on narrower shapes would require starting the bevel further back on the shape and/or reducing the bevel depth. Understanding why and how to contour these seemingly insignificant splinters of cane to satisfy the structural needs of specific shape contours and wire placements is crucial to crafting successful reeds. (For additional information, see Cooper, L. Hugh. "Beveling: The Magic of Insignificant Splinters," *The Double Reed*, Vol. 28, No. 4, 2005, p. 77.)

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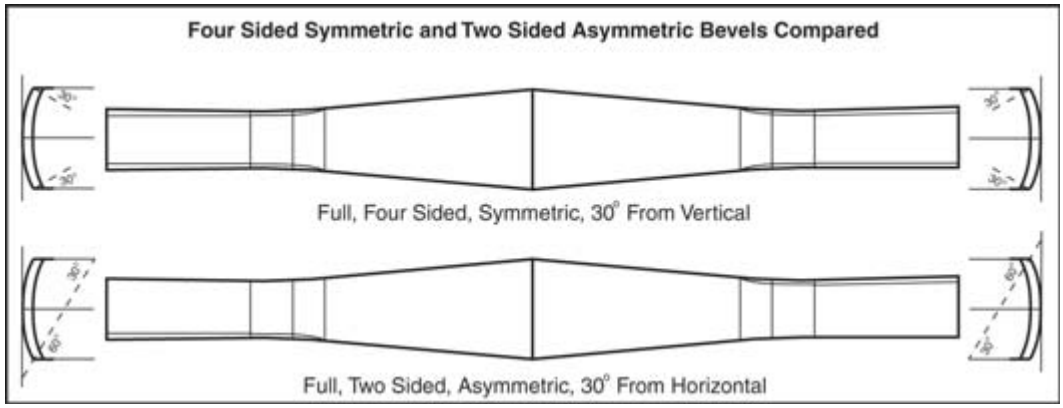
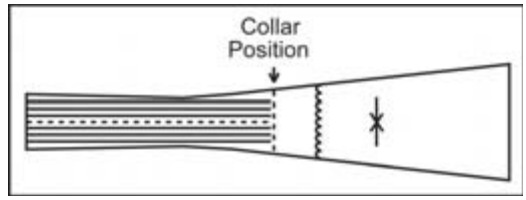
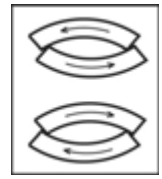


Scoring: Score 7 cuts barely through the shell/bark, extending from the collar position to the butt. (Other reed types may require starting the scoring further back.)



1. Make the first scoring cut down the exact center of each tube section using a penknife or pointed exacto blade.
2. Add two more scores that equally divide the distance from the center cut to the edge of the shape, one to each side of the center.
3. Carefully divide the four resultant divisions in half for a total of seven scores that define 8 equal segments (see sketch).
4. Note: The author prefers a dominant center score; however, some makers eliminate this score entirely to avoid possible major cracks from extending into the blades while forming the tube. If a center score is used it must be placed with precision at the exact center of the tube.

Slippage: In the author's opinion some degree of slippage is an integral part of all successful reeds. The optimum direction of tube and blade slippage is determined by how an individual uses their embouchure to better control dynamics and timbre during performance. (The reed is variably dampened by using subtle lateral and/or rotary motion [torquing] to selectively apply more or less lip area to the reed surfaces without significantly changing embouchure pressure.)

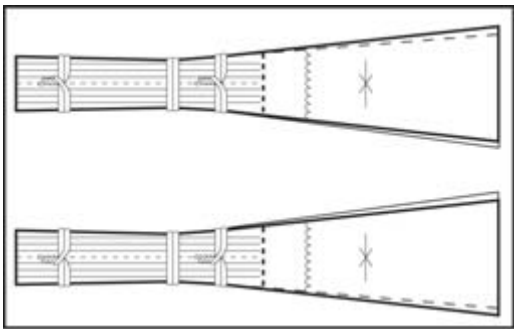


1. If embouchure torquing is to the right (most common) slip the upper butt end to the left at the back of the reed.
2. If torquing is applied to the left (much less common) slip the upper butt end to the right (see adjacent sketches).

Uncontrolled random distribution of slippage roughly results in a 50/50 directional "divisi" ensuring that half of one's playable reed production will be uncomfortable to play for any given individual (a guaranteed 50% failure rate). While those reeds produced that have both edges of one blade slipped inside the other blade are a total loss. Such haphazard resultants can be eliminated by the following procedure:

1. Establishing consistent directional slippage prior to wiring the reed (as outlined above) or,
2. Use of a two-sided asymmetric bevel, which guarantees consistent directional slippage dependent on which edge of the reed tube is beveled. (Lower right edge/upper butt slippage [most common]; lower left edge/upper butt slippage to right.)

The direction of wire twist should also concur with and reinforce blade slippage; wire twists should be counter clockwise if upper butt half is slipped to the left and clockwise if slipped to the right (see sketches below). (For additional information, see *Slippage: Reed Makings Most Benevolent Fault*, a future article.)



Placement of first and second wires: With correct slippage and desired first wire position pre-determined, wrap the wire (22 gauge, soft brass) twice around the folded and shaped cane, taking care not to cross the wire on the reverse side of the blank.

1. With the wire loosely wrapped around the cane, finger-twist the wire ends (in correct direction) two or three times until the wire stays in place on the tube.
2. Using reed pliers, tension the wire by pulling the twist side taut away from the cane while holding the blank with the fingers of the other hand, then use fingers to slide the tensioned wire into its correct position.
3. Again, pull hard with the pliers to tension the wire creating a small isosceles triangle under the twist. (Make sure the two wire legs are equal in length.)
4. With little or no tension, twist the wire to take up the slack.
5. After several cycles of pulling to tension and then twisting to take up slack the small triangle of wire is almost eliminated.
6. Tension the wire once more and then with a firm grip on the wire, push the pliers toward the cane and with a quarter turn close the remaining gap and lock the twist.
7. Make sure that no open space remains under the wire or major cracks will occur while forming the tube.
8. Place the second wire with its twist on the opposite side. Then proceed to tension, twist, and lock as above until the second wire is snug on the cane.
9. Clip excess wire twist off both wires leaving 4 or 5 twists.

Separate the scored tube segments by inserting one tip of the small long nose pliers between the two halves of the reed butt.

1. With a slight twisting motion of the pliers separate the center score from the back up to the second wire.
2. Repeat the process in a like manner until all eight toothpick size segments are completely separated extending from the second wire to the back of the reed.
3. Then repeat the splitting process on the blank's reverse side.
4. Note: Some reed makers accomplish this segmentation by using a single edge razor blade to slice in from the butt to the second wire, or in some cases, the first wire position. However, such incised separations are all parallel and not in concurrence with the curvature or grain of the cane.

Rounding out the tube: Open the tube by pinching the second wire from the sides with the long nose pliers until the mandrel can be inserted.

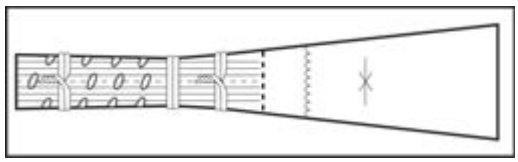
1. Insert the mandrel while slightly rotating your wrist from side to side as the reed tube is held from the sides, at the first and second wire position, with the fingers of the other hand.
2. After inserting the mandrel the proper distance (this will vary with different mandrels and shapes, but once

the proper insertion depth is established consistency is important), place the third wire as above.

3. With the mandrel inserted the proper depth, "mash" the tube down hard on the mandrel with the circular opening on the reed pliers. Start at the butt end and work forward to the second wire. After sufficient forming with the reed pliers, pull to tension the third wire and then rotate it completely around the reed tube while on the mandrel. After a 360° rotation, twist and lock the third wire in its original position. Again "mash" the reed tube with the reed pliers working from the butt to the second wire. Concentrate especially on the side seams. Depending upon the amount of bevel, dictated by a given shaper, the side seam from the second wire to the butt should neck in.
4. When satisfied with the rounding out procedure, grasp the second wire with the pliers, pull to obtain slack and then, rocking your wrists in opposite directions, rotate the second wire completely around the reed while maintaining considerable tension on the wire with the pliers. After a 360° rotation, twist and lock the second wire in position.
5. Snug up the first wire slightly. *Do not over tighten*. Twist at most ¼ to ½ turn. Remove the reed from the mandrel and visually inspect. The tube should be *perfectly round* at the back, tapering to a nearly round configuration at the second wire. The reed tube, at this stage, should still be quite elliptical at the first wire position. If the tube is not rounded out from the butt to the second wire, replace on the mandrel and work with the reed pliers and wires until it is! Sand or file the butt end of the reed square with the longitudinal axis of the reed. The reed blank should be able to stand upright when set butt end down on a level table.

Dry the reed tube blank on a drying board mandrel for several days. When the blank is perfectly dry, again insert the mandrel to its correct depth (the seam of the tube will separate). Work the reed tube while dry with the circular hole in the reed pliers, starting at the butt and working forward to the second wire. Tension the third wire, rotate 360°, twist, and lock in position. Tension the second wire, rotate 360°, twist, and lock in position. Tighten the first wire only if necessary and then very little. It *must* be loose when the reed is dry! (This is a characteristic requirement of short bladed reeds.)

File herring bone notches on the reed tube in back of the second wire (four rows). This procedure helps lock the thread wrapping on the tube and also improves the second wire's reverse function.

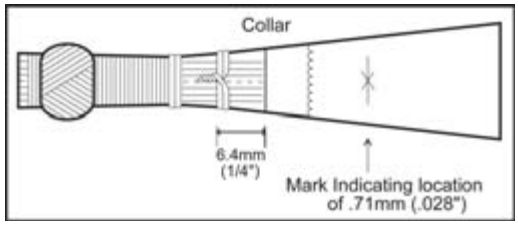


Wrap the tube and the turk's head. *Do not, under any circumstances, use duco cement or other type lacquers and glue under the wrapping*! (This one misguided procedure has ruined more potentially good reeds than any other, except perhaps the equally calamitous mistake of tightening the first wire excessively.)

1. After wrapping, use duco cement or lacquer on the *exterior* of the thread (3 or 4 coats). Avoid getting cement or lacquer on *any* part of the exposed tube. Let the coating dry thoroughly for several days with the reed on drying board mandrels. Sand or file any dried cement from the butt.
2. *Ideally*, hide your blanks away for a year before finishing. (This phenomenally improves results. However, one may proceed to the next stage with acceptable results.)

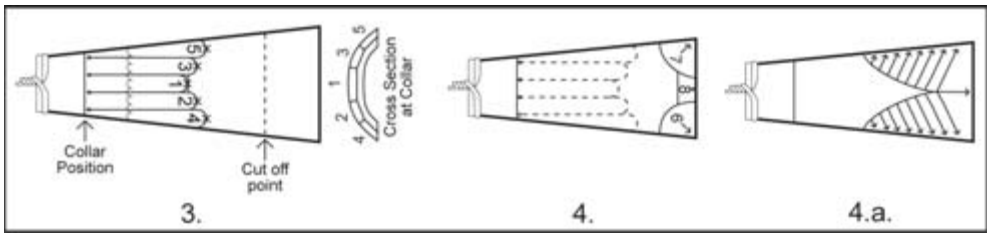
CUTTING IN THE BASIC BLADE PATTERN

1. Soak the reed in water up to the 1st wire until capillary action causes the water to rise through the vascular bundles from the blade area up to the butt end of the reed (always a good indication that the reed is ready to work on or play).
2. With the wetted reed on the mandrel, mark and cut in the collar (approximately 6.4mm [1/4"] from *back* of first wire). Care must be taken not to cut through the cane, especially at the sides where the gouge is thinner.
3. Make the following cuts using a thin pen-knife blade (actually a splitting process). These five cuts (splits)



express the blade contour in five flat planes (cubist).

a. Cut #1 — from the .71mm (.028") mark (or other predetermined measure) back towards the collar.
b. Cut #2 and #3 — start slightly closer to the tip and cut back to the collar.
c. Cut #4 and #5 — start even closer to the tip and cut back to the collar.
d. Repeat the five step process on the opposite blade.
e. Open the tip by cutting off the excess blade length 29.4mm (1 5/32") in front of the first wire.



4. Cut in the basic tip contour by inserting a flat plaque, and with a paring motion use a sharp, curved-tip knife to make cuts #6, 7, and 8. *Note*: For those individuals without adequate knife technique, the tip contour may be scraped in by normal methods.
   a. With the flat plaque still inserted, use a near lateral knife scrape to reduce the "hump" occurring at the juncture of the back and the tip contours, and to produce the necessary concave wing channel contours.
   b. Using a medium cut file smooth out all previous work, removing the ridges left by the splitting and paring process.
5. Check the tip opening for a reasonably balanced function. If necessary correct the imbalance by additional filing or scraping in appropriate areas.
   a. Adjust the tip opening, if necessary, with the wires to approximately 1.6mm (1/16").
   b. Check the reed for a multiphonic crow. The dominant pitch center ideally should be an E♭.
6. If the reed is too-resistant, check the "spine" thickness 1cm (approximately 3/8") back of the tip. This critical point must not be more than .58mm (.023") thick. If necessary, correct by filing or scraping, blending the other areas into the new spine measurement.
7. Try the reed on your instrument. It should play freely with a homogeneous sound throughout the entire range of the bassoon, preferably a little more vibrant and lower in pitch than desired. This represents a *first stage reed*, playable but lacking in refinement.

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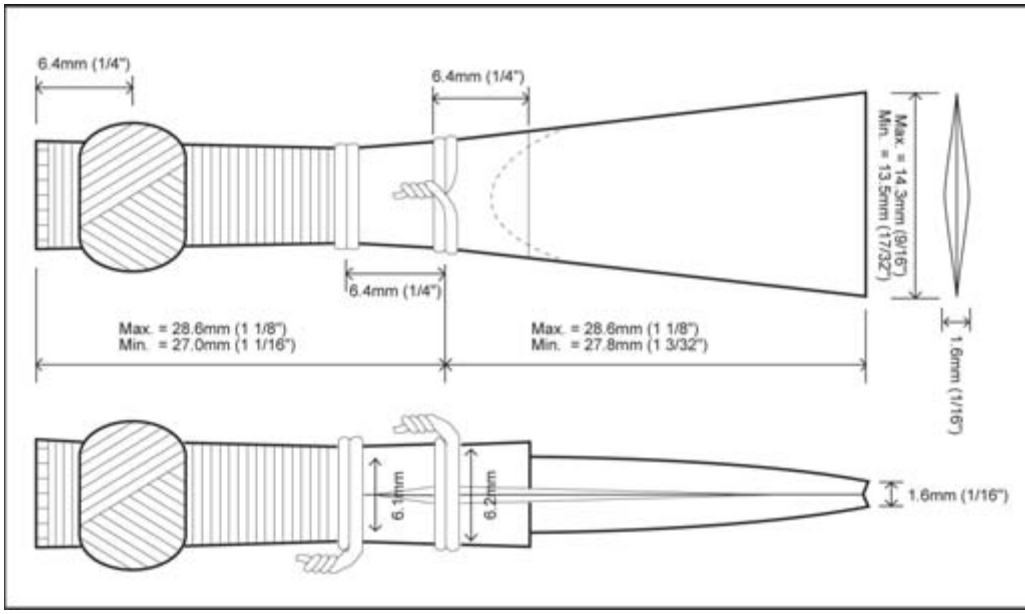
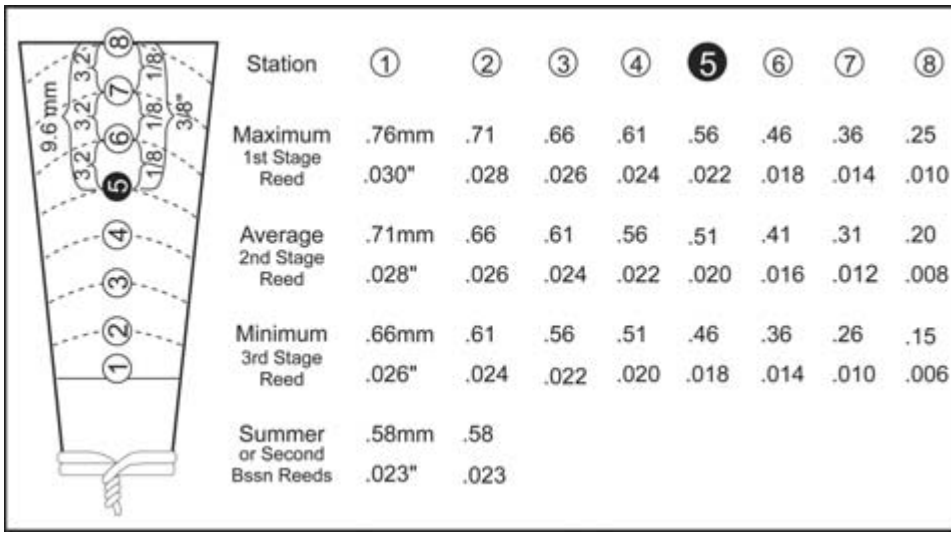
COOPER'S PARALLEL SCRAPE REED (BASED ON "KNOCKENHAUER" STYLE)



Note: Exterior dimensions are predicated on an eccentric gouge tapering from 1.27mm (.050") at the center line to .89mm (.035") at the tip width of the shaper.

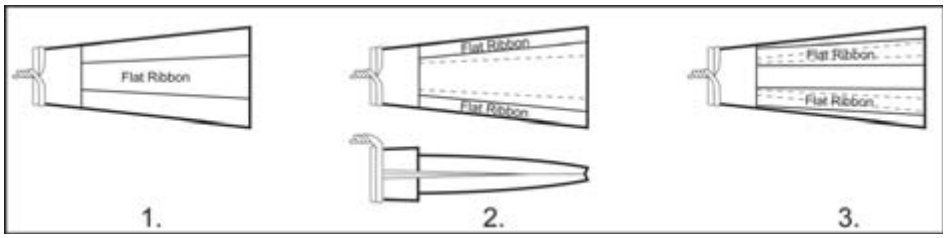


Note: Station number ⑤ is the *most* critical. The average taper from station #1 to #5 is .05mm (.002") per 3.2mm (1/8"), from station #5 to #7 is .10mm (.004") per 3.2mm (1/8"), and from station #7 to #8 is .11mm (.004+") per 3.2mm (1/8"). All metric values are derived from the original English measurements and are rounded to the nearest 1/10 millimeter for exterior dimensions and to the nearest 1/100 millimeter for the blade thickness. Specific values are offered for guidance. Finite blade thicknesses will vary with different cane, gouge, shape, desired pitch center, and personal preference; however, final dimensional admixtures when determined will be remarkably consistent.

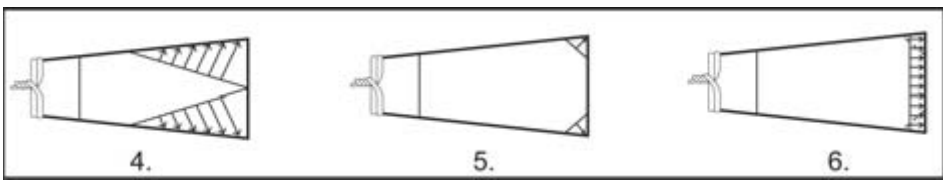
SEVEN FINISHING PROCEDURES

With a shaped plaque inserted in the wetted reed:

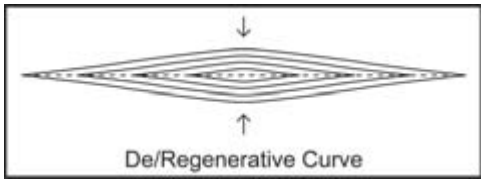
1. Establish the spine (heart) dimensions by filing or scraping a flat ribbon, parallel to the grain, down the mid-fifth of each blade. *Note*: The ribbon widens toward the tip as the arch of the blade flattens.
2. File or scrape flat ribbons, parallel to the shape, down both rails of each blade, matching the straight tapers rail to rail, blade to blade. *Note*: The file line of contact is tangential to the curve of the blade, approximately 1/16" in from the edge of the rail.
3. File or scrape flat ribbons, parallel to the grain, down each intermediate area on each blade. *Note*: This procedure will eliminate ridges left by steps one and two. Avoid touching the spine or the rails which are already established. The author prefers to use a Grobet 4", extra narrow, two sided, 0 cut, pillar file for procedures 1, 2, and 3.



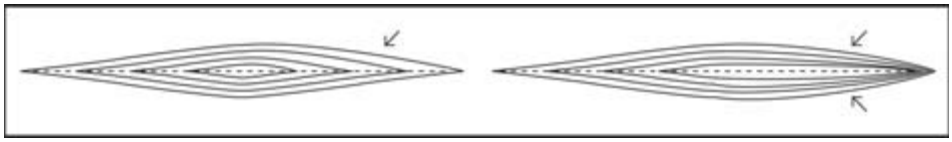
4. With the flat plaque inserted, cut in the wings (channels) of each blade, using a scraping motion with the knife that is nearly a right angle to the grain of the cane. The scrape starts shallow and narrow approximately 2/3 of the distance from the tip to the collar and deepens as well as widens as it progresses toward the tip. *Note*: Avoid actually scraping off the rails and the tip. Confine the strokes to the areas between the spine and the rails. This procedure is of prime importance in establishing the desirable "de/regenerative curve" (cupid bow) tip function and may have to be repeated several times during the finishing procedures.
5. With the flat plaque inserted, "cut in" the ears (corners) of the blade producing small equilateral triangles approximately 3mm per side and tapering towards the corners. *Note*: Care must be taken not to tear off the fragile corners while performing this procedure.
6. With the flat plaque inserted, "snap in" the extreme end of each blade producing a little parallel step approximately 2mm (1/16") back of the tip. Make the knife or scraper "snap" audibly down onto the plaque while chipping out small amounts of cane across the line of the tip. *Note*: The tip scrape blends in with the ears and also tapers slightly from the center line to the corners.



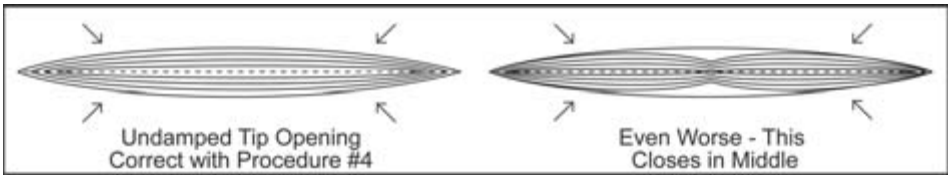
7. Smooth out and refine all previous work with a fine file (sapphire fingernail file) and check the reed for the balanced "de/regenerative curve" tip function. Press the blades slowly together with your fingers while observing visually whether all four quadrants of the tip roll together from the sides and open from the center to the sides smoothly and evenly. If more cupid bowing is required, repeat procedure number 4 until the desired results are obtained. If the function is unbalanced, apply procedure number 4 selectively to the offending quadrant(s) until corrected. *Note*: The tip should roll in from the sides to the center until a miniature version of the original tip "winks" out in the center.



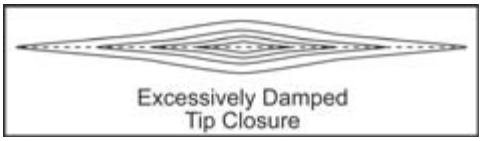
If the tip closes as a succession of intersecting arcs until nearly parallel, it snaps closed and jumps open abruptly, and results in a raucous undamped sound, repeating procedure number 4 will help to correct this problem.



If the tip closes asymmetrically, apply procedure number 4 selectively to the offending quadrant(s).



If the tip is excessively "cupid bowed," the problem usually is caused by a collapsed tube in the area of the first wire. Such a reed is excessively damped and little can be done to correct the problem. *Note*: Opening the tip with the second wire *sometimes* helps a little.



Check the reed for compliance with the seven acoustic reed criteria (see Cooper, L. Hugh. "Reed Contribution," *International Double Reed Society Journal*, XIII, No. 3, Winter 1990, p. 59 for the seven subjective acoustic checks for reed compatibility).

Try the reed on the bassoon. It should play surprisingly well, but don't panic if it has some or all of the following faults.

1. Somewhat on the flat side in pitch.
2. Third space E♮ tends to be unstable and drops in pitch.
3. Sound is a little too open and lacks focus.
4. High register initiations (attacks) unsure.
5. Second space C♯ unstable and drops in pitch.

Playing new reeds even a few minutes will often eliminate many of the afore mentioned problems, certainly the majority will tend to self-correct (probably over-correct) as the reeds are played in.

1. Above all, don't prematurely clip the blades of the more vibrant examples, for in reality the above traits represent desirable characteristics of the more promising reeds.
2. While those new reeds mimicking old "over the hill" predecessors (so favored by neophyte makers) are

already at or near terminal stage.
3. New reeds change dramatically on a daily basis in many diverse ways, but in general as they break in they become more resistant, focused in sound, higher in pitch, and lose their lows as they gain in highs.
4. Experienced makers utilize this predictable directionality by allowing the more vibrant, free, lower pitched, first stage reeds to succeed (at least partially) on their own.

As new reeds heavy-up and sharpen on a daily basis, always check first for symmetry of tip function, correcting as needed by selective use of procedure number 4.

1. When assured that the tip contour is reasonably in balance, both within the four-mirrored quadrants as well as between the two blades, repeat the same seven cubist finishing procedures as often as needed, always following the original sequencing but removing less material at each subsequent stage. Intersperse appropriate wire adjustments and if needed miniscule blade clippings between each cycle of cane removal.
2. Essentially any break-in procedure represents a controlled attempt by each experienced maker to balance the reed's inertia (resistance) and elasticity (flexibility) in a manner that will satisfy the aesthetic taste of the individual within their specific performance venue.
3. Regardless of preferred reed type or methodology, this uniquely personal equilibrium is realized as each individual gradually substitutes structure for substance in the reed design.
    a. Structure: an arrangement of mechanical elements (Archimedes's levers/fulcrums and pre-Etruscan structural arches) that contribute strength to a reed design.
    b. Substance: the physical mass of cane present in the reed blade contour (relative both to dimension and density) that also contributes strength to a reed design.
    c. In effect, when cane is discreetly excised from the blades to restore lost response and flexibility, structural elements are substituted for the cane removed.

Two dominant yet widely divergent reed concepts ultimately determine the extent that structure is substituted for substance. Although neither basic type (wedge or parallel) actually exists in its pure geometric form, each serve to represent opposite extremes of the broad ubiquitous double-wedge genre. The two opposite viewpoints are:

1. Remove as little cane from the reed blade profile as feasible, representing the wedge scrape (straight taper*) reed design, which incorporates strong, heavy, sharply wedged blades, coupled with weaker structural components.
2. Remove as much cane from the reed blade profile as feasible, representing the parallel scrape (tip-taper*) reed design incorporating weak, thin, free, parallel scrape blades coupled with stronger structural elements.

*Note: Lou Skinner's terminology.

Both of the above polarities are capable of producing excellent results and each have their cadre of enthusiastic advocates. However, without arguing relative merit, the author is a confirmed champion of the parallel scrape contour, a reed concept that may be successfully achieved in the following manner.

1. As the seven cubist reed finishing procedures are repetitively cycled, the blades gradually become:
    a. Thinner (weaker) in profile as cane is removed
    b. Shorter (stronger) in length from multiple miniscule clippings and
    c. Narrower (stronger) in width from slippage and or planing of the rails.
2. Meanwhile, first wire fulcrums are gradually arched:
    a. Higher and narrower (stronger) by pinching the first wire ligature from the sides to increase the blade's structural arch strength and size of tip opening
    b. Conversely (if needed) pinching the first wire vertically from the top and bottom will reduce the blade's structural arch strength and size of tip aperture opening.
3. The second (middle) wire's indispensable reverse wire function is utilized to micro-adjust tip openings, pitch

center and freedom of vibration, all without appreciable effect on the blade's structural integrity (strength).

a. Pinching the second wire vertically from the top and bottom should open the tip, lower the pitch, and free up vibration (especially in the low register).
b. Pinching the second wire laterally from the sides should result in equal but opposite results.
c. In the author's considered judgment, reverse second wire function is an essential characteristic of all superior reeds. It is difficult if not impossible to final balance a reed without it.
d. Ideally strive for parallelism between the first and second wire heights. Parallel contour blades require parallel throats.
e. The real beauty of using either first or second wire adjustment is that the effects are readily revocable. If it doesn't work, simply change it back.

Don't be afraid to remove cane! Historically, there have been many more bad reeds because of too much cane left on, than too much taken off.

1. In any respect, if excess cane is removed, arching the first wire a tad more and/or clipping a bit off the tip will quickly compensate for the error.
2. Perceive wire function as a precise tool used to achieve final balance between resistance and flexibility.
3. Adherence to the cubist procedure combined with a little patience and a modicum of luck should result in a reasonable percentage of stable playable second stage reeds, very usable but still requiring a little more in the way of refinement.

Progress beyond this acceptable second stage involves a creative procedure that if successful elevates the mechanical craft of reed making to the level of an art form. Suffice to say that only those individuals willing to risk losing a few second stage reeds can hope to aspire to this higher standard of excellence.

Describing the myriad details involved in such an evolutionary process is beyond the physical scope of this paper, and besides would be akin to reinventing the wheel for the complex process is already concisely addressed in a remarkable research publication written by Mark G. Eubanks entitled *Advanced Reed Design and Testing Procedure for Bassoon*, published in 1986 by Arundo Research Company, Portland, Oregon 97208. This excellent source offers specific detailed information regarding both the diagnosis and correction of specific reed faults during the finalization stage. Individuals seeking guidance in these matters should acquire this publication, and utilize the information contained to refine their own reed finishing skills.

Other recommended publications:

1. *The Bassoon Reed Manual, Lou Skinner's Theories and Techniques*, by James R. McKay, contributing authors Russell Hinkle and William Woodward, published in 2000 by Indiana University Press, Bloomington, IN.
2. *Teacher's Guide to the Bassoon*, by Homer Pence, published in 1963 by H. & A. Selmer, Inc., Elkhart, IN.
3. *Bassoon Reed Making* by Mark Popkin and Loren Glickman, published in 1987 by The Instrumentalist Co., Northfield, IL.
4. *The Art of Bassoon Playing*, by William Spencer, published in 1958 by Summy-Birchard Co., Evanston, IL.
5. *Bassoon Reed Making: A Basic Technique*, by Christopher Weait, published in 1970 by McGinnis and Marx, N.Y., N.Y.

In spite of the detailed reed making instructions outlined above, information garnered from the recommended reading, or for that matter any viable reed making methodology, success or failure of any approach is directly related to the individual maker's acquired tactile skill and experience in the use of the most rudimentary of reed making hand tools. ◆