Beveling: The Magic of Insignificant Splinters

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I. Beveling represents an often ignored but important element of reed design and adjustment. Understanding why and how to contour the reed shape by utilizing these seemingly insignificant splinters of cane is crucial to crafting successful reeds.

A. Bevel Functions:

1. Contrary to popular thought, the bevel's primary function is to modify (if needed) the shape's contour to correctly position the reed's mechanical fulcrum, thus ensuring that the resultant reeds will possess both reverse wire function (an indispensable characteristic of all truly superior reeds) and tip openings that resist collapse (see Illus. I, "Relative Strengths of the Various Mechanical Fulcrums").
2. A secondary function serves to produce stable hermetically sealed tubes and reed/bocal junctures by creating mechanically secure "butt" or "lap" type side-seam closures (see Illus. IIa, "Bevel Variants Compared").
3. The bevel may also be utilized to reduce the interior static volume of the reed tube, a structural equivalent to using a narrower shaper. (With certain very narrow shapers, beveling may be counter indicated; however, the resultant tube stability and hermetic integrity will be compromised.)
4. A rather subtle fourth bevel contribution helps reinforce the normally desirable laterally damped degenerative/regenerative curve tip function by mechanically stressing the two reed blades' four linear lines of inflection.

B. The amount and method of beveling depends on the final reed proportions desired and the shaper being used. Individuals must experiment with the bevel contour until assured that the reed's mechanical fulcrum is correctly placed at or slightly behind the first wire position or all subsequent reed making efforts will be to no avail (see Illus. I, "Relative Strengths of the Various Mechanical Fulcrums" and Illus. IIa–b, "Bevel Variants Compared"[1]).

C. Insightful manipulation of the bevel's length and depth, coupled with varied distribution of wire-pattern placement on the shaped cane, offers a consistent, accurate method for modifying shaper contours. In modifying the shape utilizing wire placement, the relative distance between the wires (the wire pattern) remains the same, but this pattern migrates up and down the shape. Locating the wire pattern closer to the tip produces a wider resultant shape, while placing the wire pattern closer to the back produces a narrower resultant shape.[2] Such flexibility, when combined with selective beveling, offers the possibility of producing functionally similar reeds from a variety of shapers, or conversely of producing a variety of dissimilar reed types from a single shaper.

1. Both of these pedagogic advantages are especially effective when using 127mm (5") gouged cane, for such longer cane offers the liberal option of 6.35mm (1/4") of wastage that may be trimmed in any desired proportion from the back and/or tip ends of the shaped cane, the practical equivalent of owning many shapers. (Shorter cane lengths may be used to similar advantage; however the resultants will be more limited in scope.)
2. Intelligent utilization of such flexibility in shaper resultants creatively liberates both teacher and student alike, without incurring the expense of purchasing a multitude of costly shapers.

D. The following explanations and sketches specifically depict a methodology used in producing the traditional symmetric (four-sided), 30° down from vertical, full (100%) depth bevel (see Illus. III). The precise angle of the bevel should actually vary somewhat in response to the differences in the natural curvature of individual sticks of cane, the gouge contour being used, and the degree to which the reed tube is rounded out.[3] This variability probably explains the small discrepancies in bevel angles recommended by various accomplished reed makers.

Rather than attempting to cope with these minute variables, the author recommends using a 30° (1/3 of a right angle) bevel angle as both rational and easy to conceptualize when teaching and making reeds. In addition, because of angle complementarity the same 30° angle may be applied to both symmetric (down from vertical) and asymmetric (up from horizontal) designs (see E and F below and Illus. IIa–b, "Bevel Variants Compared").

E. The following specific personalized bevel contour and method is dictated by the author's version of a parallel scrape (tip-taper[4]) Knockenhauer type reed, derived from the back of a long, wide shaper using 127mm (5") long, gouged cane with the over 6.35mm (1/4") of wastage all being trimmed from the tip end of the reed blank. Change any of the above variables and the reed bevel would of necessity have to be modified in a compensatory manner. This bevel is produced as follows:
   1. With a penknife or sapphire fingernail file, begin a shallow bevel at the collar (shoulder) position with the beveling tool held at a 30° angle to the lower inner edge of the vertical side-axis of the shape (see Illus. III, "Traditional 30º, Full, Four-Sided, Symmetric Bevel");
   2. Gradually deepen the 30° bevel until reaching full (100%) depth at the second wire position;
   3. Continue the bevel at full (100%) depth and consistent 30° angle until reaching the back of the shape then;
   4. Carefully duplicate the identical bevel contour on the inner edges of all four sides of the shape.
   5. Note: a common symmetric four-sided beveling error is to bevel at too horizontal an angle on all four sides, resulting in opposing channels on the interior of the reed and a leaky tube/bocal juncture (see Illus. IIa.3, "Common Symmetric Beveling Error").

F. An alternate type bevel produces equally acceptable results and is in some form used successfully by many prominent reed makers. This bevel can be described as an asymmetric (two-sided), 30° up from horizontal (or 60° down from vertical), variable depth (0% to 100%) bevel.
   1. Its basic structural difference is that only one opposing edge is beveled on each half of the tube, and at a 30° angle up from horizontal rather than down from the vertical axis of the shape (see Illus. IIb).
   2. This asymmetric beveling on only two opposing edges of the tube produces "lap"-type tube seams. These overlapping closures are less stable than the symmetric "butt"-type, however, they have the advantage of automatically ensuring reasonably consistent directional lateral slippage.

G. With the use of either type bevel (or combination thereof) achieving the same tube dimensions and fulcrum function on shapers with narrower throat and tube widths would require starting the bevel further toward the butt-end of the reed on the shape and/or reducing the bevel depth.

II. Bevel Applications:

A. There are, of course, countless other individual bevel variants in use. For example, one respected reed maker creatively combines both type bevels to maximize the more positive elements of each. This unique bevel originates at the collar (shoulder) position as a shallow two-sided asymmetric bevel, thus ensuring consistent, and in this case desired, lateral slippage. It then increases gradually in depth to the second wire and finally converts to a four-sided symmetric bevel from slightly before the third wire position to the back of the shape. This combination design improves tube stability, reverse wire function, mechanical fulcrum strength, and hermetic integrity of the tube closures as well as reed/bocal junctures.

B. An equally renowned artist reed maker who uses a very narrow shaper removes all wires from an unbeveled and unwrapped reed blank, ideally after one year of seasoning, then with wires removed, opens the butt end to sand-in a short, full, four-sided symmetric bevel at the back of the already formed previously unbeveled tube. He then rewires (reversing the wire twist sides), wraps, opens the tip, and finalizes the reed. Although somewhat labor intensive, the short, accurate four-sided symmetric bevel produced by this method improves reverse wire function, mechanical fulcrum, tip opening strength, and creates a hermetically tight juncture between reed and bocal. All this from a little 9 to 10mm-long bevel, without encouraging, in this case, unwanted excess lateral slippage.

C. Which way represents the correct way to bevel? They both do, for these two outstanding professionals have, like many others, intelligently utilized the magic power of the bevel's "insignificant splinters" to solve problems inherent to all reed making. Simply put, their excellent reeds would not be their excellent reeds without their excellent individualized bevels.

III. Most student and some professional reed makers could profit from a personalization of their bevel contour by manipulating one or more of the following bevel variables.

A. Overall Bevel Depth:

1. Beveling of any kind always reduces both the outside diameter (O.D.) and the inside diameter (I.D.) of the tube at the point of the bevel. Reducing the size of the shape and its resultant tube as follows:
2. Assuming a fully rounded tube, constructed from concentrically gouged cane, controlled selective beveling of either the four-sided symmetric or two-sided asymmetric variety will, when using the recommended 30°/60° complementary bevel angles, predictably reduce the resultant reed tube diameters (both O.D. and I.D.) by an amount approximately equal to 75% of the gouge thickness, at the point of bevel, times the percentage of bevel depth (0% to 100%), also at the point of bevel. For example,
3. Assuming that a given shape used with unbeveled 1.2mm thick concentrically gouged cane produces a fully rounded 6.2mm O.D. and 3.8mm I.D.[5] structural arch at the position of its second wire:
   a. Using a maximum 100% bevel depth would reduce the tube diameters by an amount roughly equal to 0.9mm (75% of 1.2mm times 100%). The resulting diameters at the point of the bevel would be approximately 5.3mm O.D. and 2.9mm I.D. This would be the smallest possible tube diameter achievable at this point from this shape.
   b. Using a partial bevel depth of 50% would reduce the diameters by approximately 0.45mm (75% of 1.2mm times 50%). The larger resulting tube would have a 5.75 O.D. and a 3.35mm I.D.
   c. Using an even smaller bevel depth of 25% would reduce the diameters by even less, specifically 0.225mm (75% of 1.2mm times 25%), producing a tube with a 5.975mm O.D. and a 3.575mm I.D.
4. Changes in any or all of the tube bevel variables will affect the resulting tube diameters. Obviously, the bevel's influence on reed tube size and contour is very real, predictable, and subject to individualized control ad infinitum.
   a. The individual's challenge is to correctly modify (if needed) the proportional bevel length and depth contours to provide compatible mechanical fulcrum strength, consistent reverse wire function, stable tip aperture openings, and hermetically secure tube/bocal closures.
   b. Section III: B (below) may offer aspiring reed makers sufficient insight and directionality to ensure success in their individualized quest.

B. Bevel Length and Proportionate Depth:

1. Originating the bevel and/or increasing its proportionate depth further back on the tube (toward the butt end) results in overall larger "reed cavities," stronger mechanical fulcrums, improved reverse wire function, and more open tip apertures less prone to collapse.
   a. These structural changes impact the three major components of acoustic "Reed Contribution" as follows: "static volume" (the inner capacity of a reed's cavity at rest [sans bocal overlap]) is increased; "vibratory contribution" (the relative amplitude [vigor] of blade oscillation) is also increased; while "damping" (acoustic friction) of the reed blades (both lateral and linear) is reduced (see L. Hugh Cooper and Mark Avery, "Reed Contribution," Journal of the International Double Reed Society. 13:3 [1991], p. 59).
   b. Such modifications in reed contribution (all else being equal) will broadly affect the reed's response spectrum as follows: Lowered pitch center, improved low register

response, less secure high register; and a more vibrant open projective quality of sound, capable of producing broad flexible timbral, dynamic, and pitch nuance at the expense of requiring greater control through the use of a pro-active embouchure/breath relationship.

2. Originating the bevel and/or increasing its proportionate depth further forward on the tube (towards the collar) results in smaller overall reed cavities, weaker mechanical fulcrums, diminished reverse wire function, and less open tip apertures more prone to collapse.
    a. These structural changes will in general affect the three major components of reed contribution in manners similar in nature but opposite in effect to those cited in section III, B, 1, a (above).
    b. The reed's response spectrum will in general also be affected in a similar but opposite manner to those cited in Sec. III, B, 1, b (above), producing higher pitch reeds, less responsive low register, more secure high register, and a less vibrant, more subdued (damped), homogeneous, easier to control, but less projective quality of sound.
    c. Note: the author recommends avoidance of the paradoxic and misleading use of "brighter" versus "darker" terminology when describing variance in tonal characteristics. For, in reality, the "brightest" sound consists predominantly of raucous low frequency partials, while the "darkest" sound is practically devoid of vibrant lows. In fact, the latter's soft, subdued, phantom fundamental is perceived primarily through the internal heterodyne effect occurring within man's physiologically creative non-linear hearing mechanism. See L. Hugh Cooper, "The Four Major Physiologic Parameters of Man's Music System."

IV. Final Resultants:
  A. Mixing the above bevel variables in conjunction with changes in the location of the wire-pattern placement, forward (larger reeds) or back (smaller reeds) on the shape, allows excellent results to be obtained with almost any given shaper.
  B. Bevel modifications combined with wire-pattern shifts thus offer a more economical and flexible approach to shape variety than buying a multitude of shapers or grinding down an existing one.
  C. At most it will only take a few experimental pieces of cane to find a combination that really works for you.
  D. When you find the right combination, rays of enlightenment will break through the dark clouds of innocence.

V. Conclusion:
  A. You now know the why of beveling.
  B. It is up to you to devise the specific how.
  C. Now go do the right thing!

NOTES

1 Note: the proportional relationships of tube diameters shown in Illustrations IIa and III are somewhat exaggerated to visually enhance the bevel's marked effect on reed tube size and contour.

2 For a discussion of the effects of relative wire placement, see Other Observations — Wire Functions and Placement, which includes a discussion of pre-Etruscan structural arches and first-class Archimedean levers in reed design.

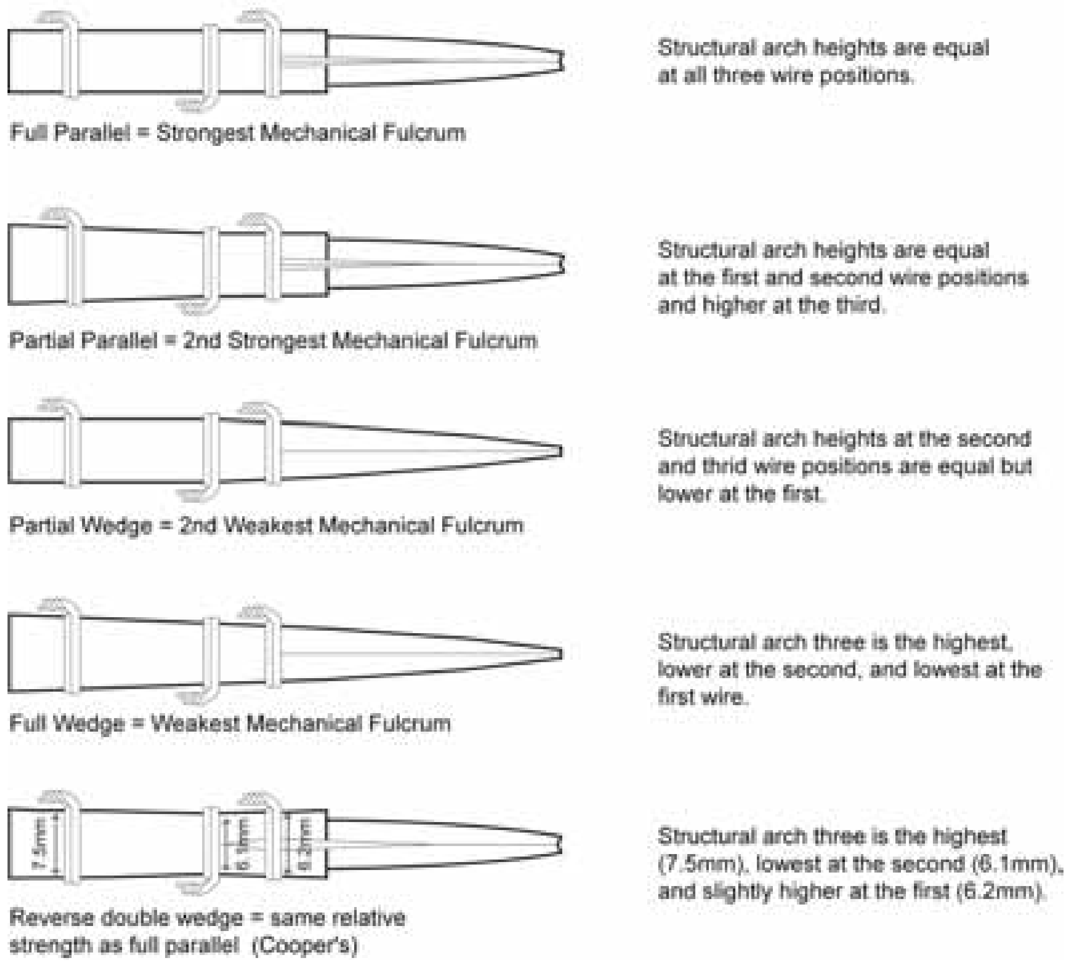
3 The rounded out 30° bevel angle given here represents a practical pedagogic approximation; however, assuming a fully rounded reed tube constructed from 2.54cm (1") diameter concentric gouged cane, a 27° angle would be geometrically more precise.

4 Lou Skinner's terminology; see James R. McKay, The Bassoon Reed Manual: Lou Skinner's Theories and Techniques (Indiana University Press: 2000).

5 The difference between the outside and the inside tube diameters is always twice the thickness of the gouge at the point of measurement.

Relative Strength of Mechanical Fulcrums

Illustration I



First wires ideally function as fulcrums of an Archimedean, First-Class (teeter-totter like) lever system. As such, when properly constructed, any vertical change in the height of the reed tube's structural arch, occurring behind the first wire position, should result in a directionally opposite vertical shift at the reed tip aperture. (Basis of reverse wire function)

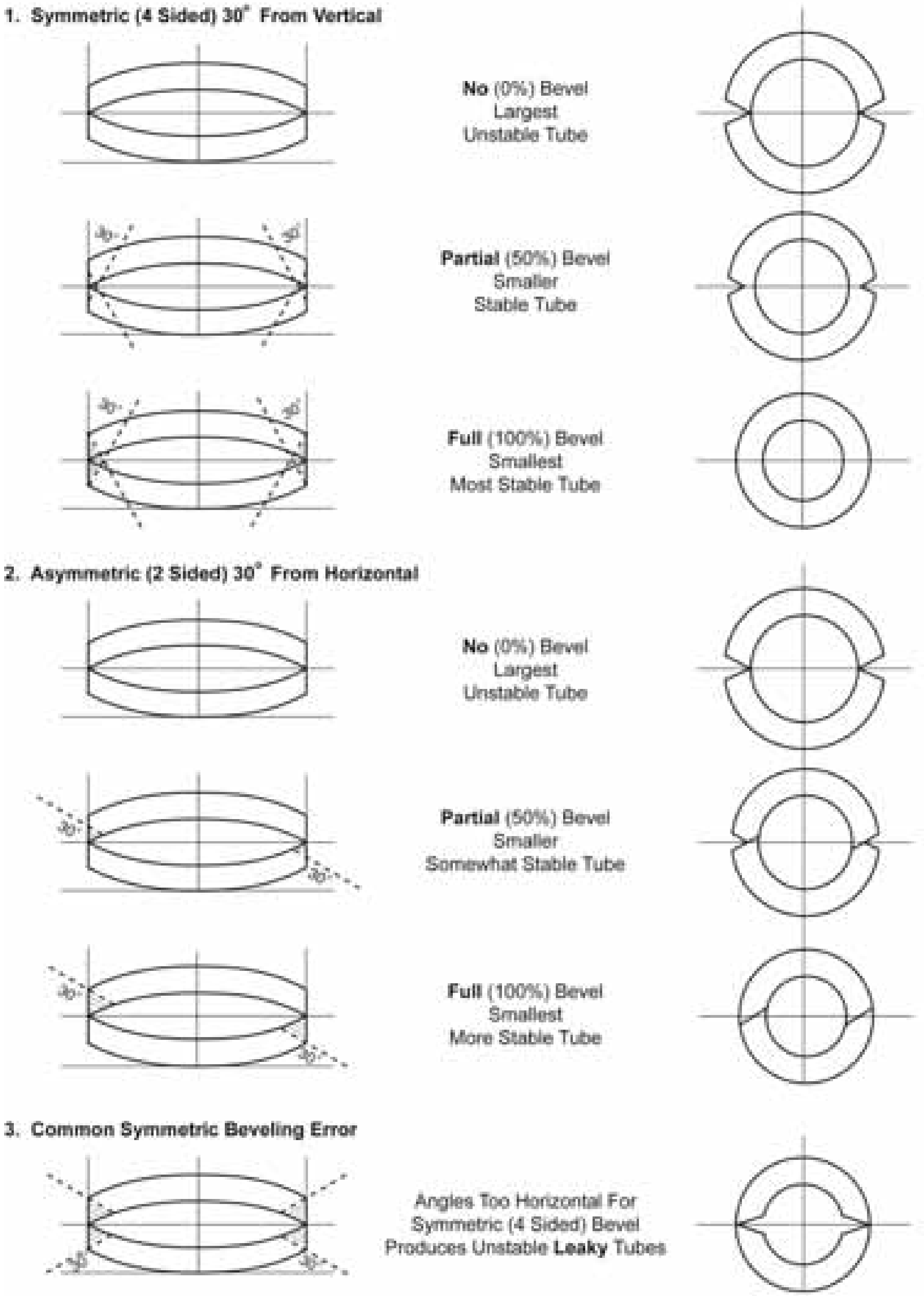
The structural arch heights are measured with a vernier caliper immediately in front of the first and second wires and as close as practical behind the third.

The arches may be varied by changing the shape, arching the 1st and 2nd wires more or less, and varying the placement and depth of the bevels.

Also note that the full and partial parallel, as well as reverse double wedge sketches are depicted with both collars and parallel scrape blade contours representing a normal configuration for these fulcrum types.

Bevel Variants Compared (Cross Sections)

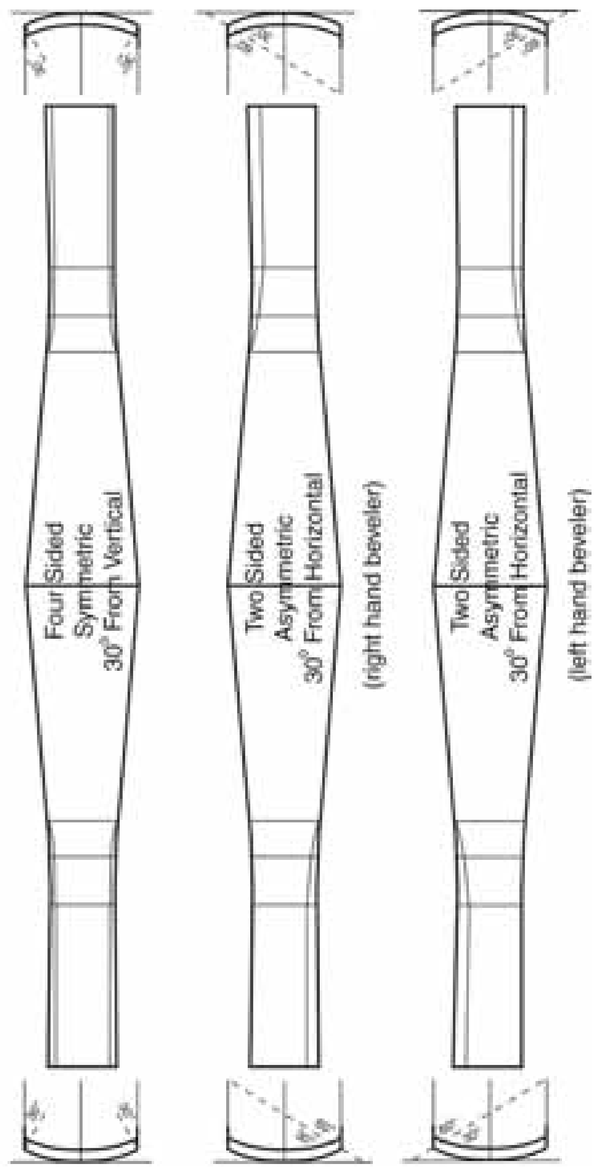
Illustration IIa



Note: Selective corrective beveling reduces the reed's resultant tube diameter by an amount approximately equal to the percentage of the bevel depth (0% to 100%) times 75% of the thickness of the gouge at the point of bevel.

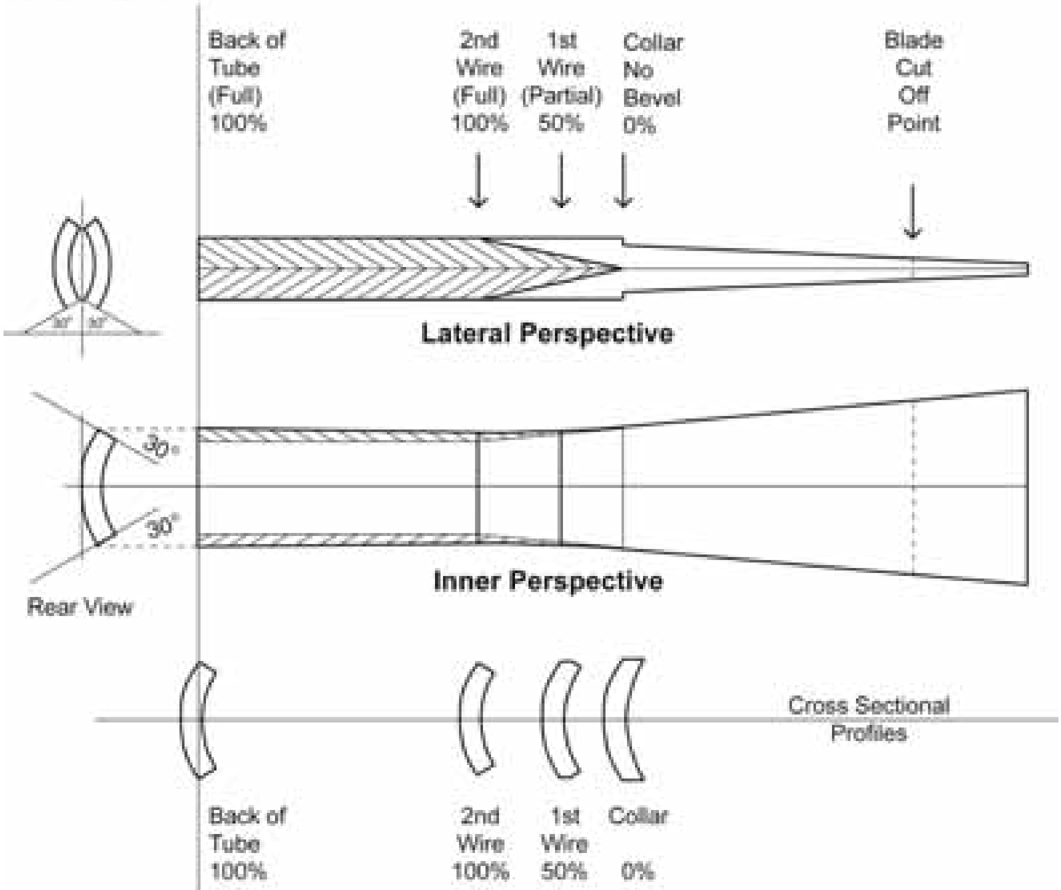
Bevel Variants Compared (Longitudinal Sections)
Four Sided Symmetric and Two Sided Asymmetric Bevels Compared

Illustration IIb



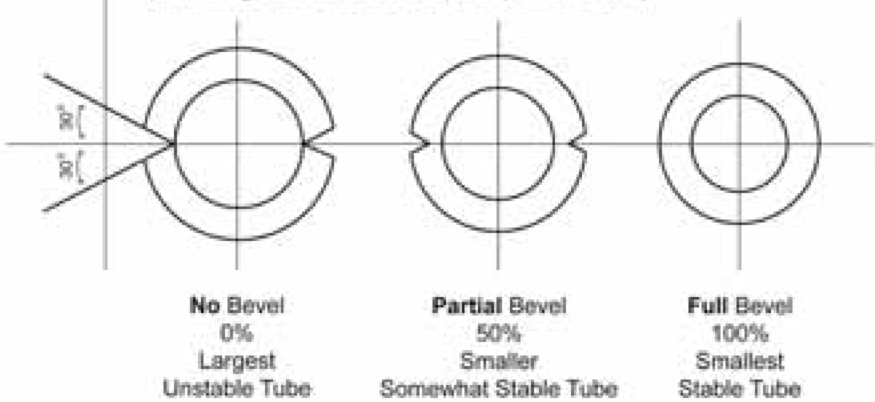
Traditional 30°, Full, Four Sided, Symmetric Bevel

Illustration III



Note: Gouge thickness and diameters exaggerated to better depict bevel contour

Effect of bevel depth on diameter of reed tube (assuming same width of shape at point of bevel)



Note: Selective corrective beveling reduces the reed's resultant tube diameter by an amount approximately equal to the percentage of the bevel depth (0% to 100%) times 75% of the thickness of the gouge at the point of bevel.