CONTRABASSOON FINGERING CHART

or,

The Contranomicon

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Contents

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m e . s u b c o n t r a b a s s o o n . c o m

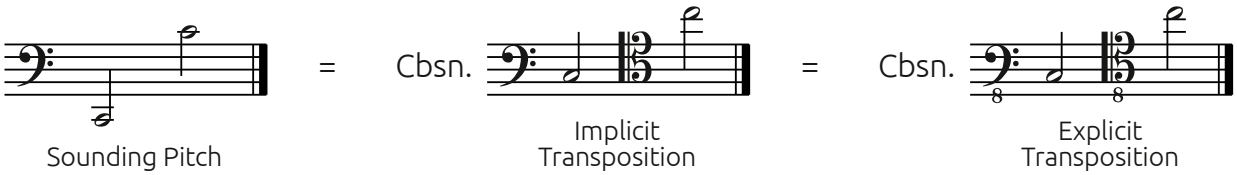
Introduction

Much more so than bassoons, contrabassoons vary greatly from one instrument to another. As a result, fingerings that work well on one instrument may be poor or completely ineffective on another. However, rather than try to accommodate endless possible permutations of instrument makes, models, and keywork configurations, I am presenting my personal fingerings *as is*. In other words, this chart should not be interpreted The One True Fingering Chart™ but simply as one data set with which contrabassoonists can inform their own personal fingerings.

All fingering diagrams in this chart were created with my Legni woodwind fingering fonts. These fonts are available for most common—and a few uncommon—woodwinds and can be downloaded for free at subcontrabassoon.com/legnifont.

Notation

The contrabassoon is written one octave higher than it sounds. Most commonly, this transposition is implicit and standard bass and tenor clefs are used. I prefer to make the transposition explicit through the use of ottava clefs, and this notation is used throughout this chart. Either notation is completely acceptable in contrabassoon parts as long as one or the other is used consistently.

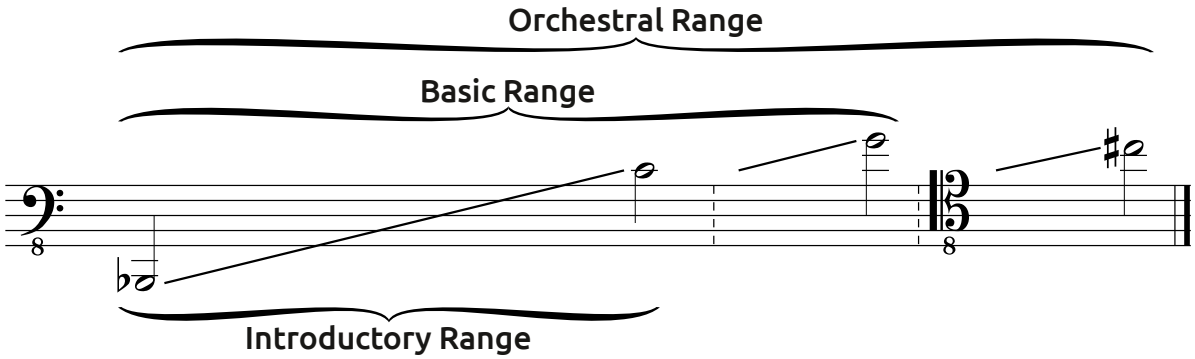


Sounding Pitch | Implicit Transposition | Explicit Transposition

(note for composers)

This chart is primarily intended as a resource for contrabassoonists, not composers. While I believe the contrabassoon is much more capable than composers often give it credit for, I would urge caution and common sense before citing this chart as evidence that a desired note, trill, or multiphonic is reasonable to write. I have made every effort to find the best possible fingering for each of the items included in this chart, but sometimes "best" means "least terrible" rather than "good." Take care to read the following pages on range, and to factor in any of the warnings and explanations that may be included below the fingerings.

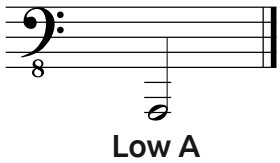
Range



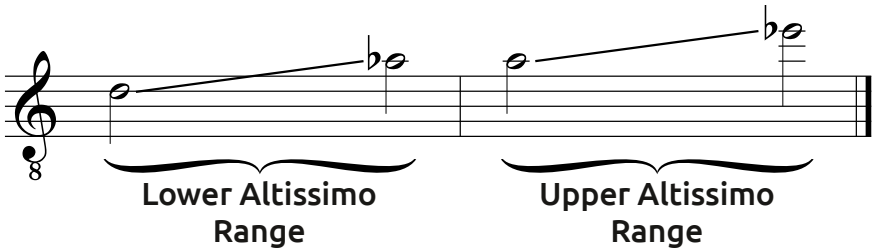
The introductory range covers B♭0 up to C3. As the fingerings in this range are mostly very similar or identical to bassoon fingerings, this range is accessible to most experienced bassoonists with little contrabassoon practice.

The basic range extends the introductory range up to G3 and covers a large majority of the contrabassoon repertoire. Many of the most important pieces in this repertoire take for granted a fluent command of this entire range, so it is vital that any bassoonist wishing to be taken seriously on contrabassoon be proficient here.

The orchestral range extends the basic range up to C♯4 and covers virtually the entire orchestral, ballet, and opera repertoire. In my opinion, if the contrabassoon were held to the same standards as the other orchestral woodwinds—sadly, this is definitely not the case—this would be its "textbook range." With time and practice, this range is achievable on almost all contrabassoons.

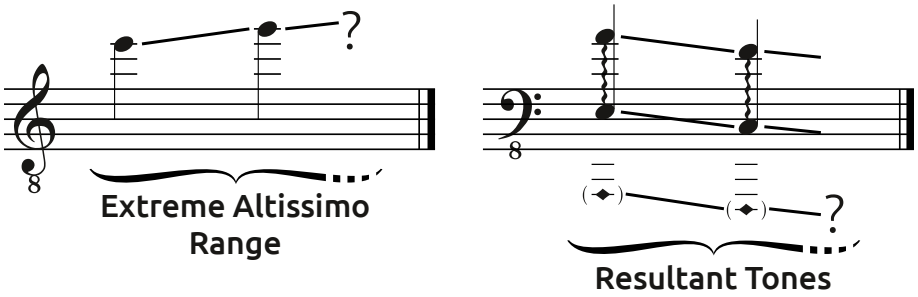


Like bassoon, low A occasionally occurs in parts for contrabassoon. Unlike bassoon, contrabassoons built with a range to A0 are not terribly uncommon. On such instruments, A0 is no more difficult than B♭0. For contrabassoons lacking this additional semitone, an inexpensive and effective low A extension can be made. *(see appendix D)* With an extension in place, A0 is played by fingering B♭0, B♭0 becomes impossible, and B0 becomes noticeably stuffy. Extensions below A0 are possible *(see appendix E)*, but difficult to make, awkward to use, and uncalled-for in the repertoire.



The lower altissimo range covers from D4 to A♭4. On many contrabassoons this range can, with much practice and care, be played with good intonation and characteristic tone quality. Articulation, however, can be inconsistent; some notes speak more readily than others and certain slurs are likely to be unplayable. This range is primarily limited to solo repertoire, but does appear in orchestral works very rarely.

The upper altissimo range extends from A4 up to E♭5. In my opinion, on a traditional contrabassoon (as opposed to a Fast-system contrabassoon or contraforte) this range is far too deficient in reliability, tone, articulation, and intonation to be musically useful.



The extreme altissimo range covers E5 and higher. I have personally only been able to play in this range by placing my teeth directly on the reed, with accordingly atrocious tone. At present, I cannot consider this range any more than a novelty, and even that is being generous.

The resultant tones are multiphonics in which the two fundamentals form an acceptably harmonic relationship that reinforces a low difference tone below the range of the contrabassoon. These are almost entirely unexplored, and much work remains before they could be deemed musically viable.

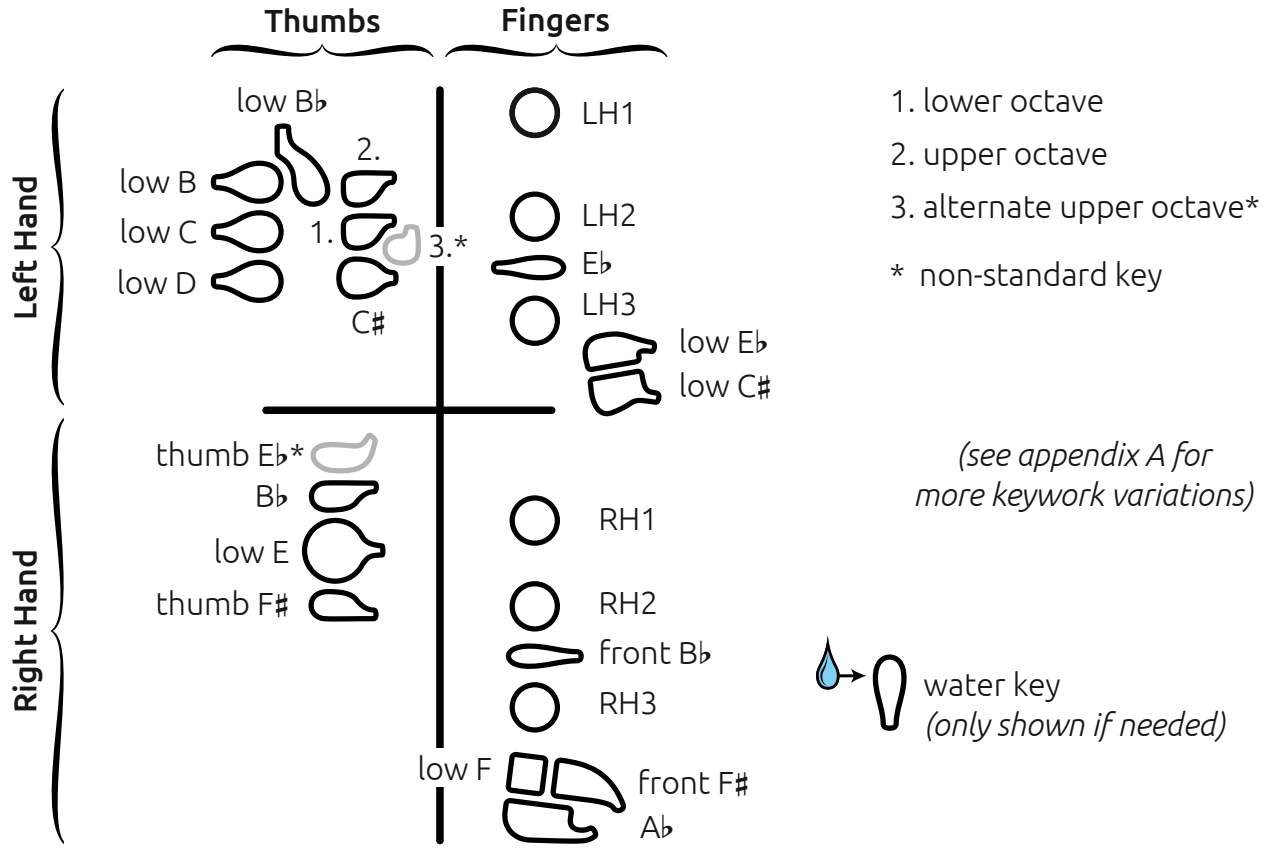
My Setup

In order to judge how effective my fingerings are likely to be on your setup, it may be helpful to know more about mine:

The main contrabassoon I use is a Mollenhauer made in the early 2000's (serial number 9xx). My primary bocal is a Heckel C3 which has a stronger and better in-tune upper register than the Mollenhauer bocals that came with the instrument.

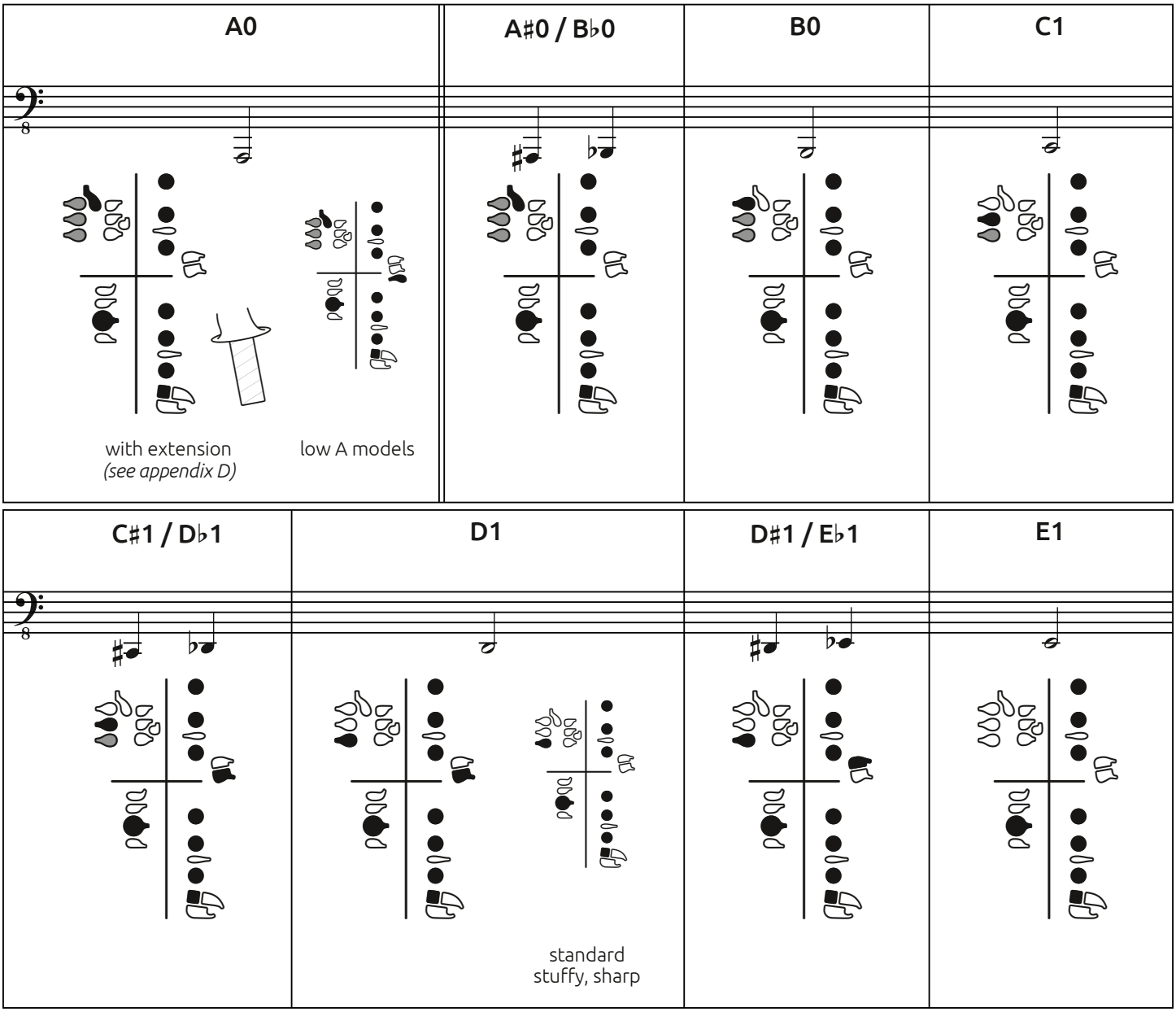
My reeds measure approximately 67–68 mm overall, with a 34–35 mm blade length and 20 mm tip width. They are shaped using a Skinner-Braunstein #1 flat shaper made by Fox.

My keywork is relatively spartan; just the standard contrabassoon keywork with the addition of an alternate E♭ key for the right thumb and an alternate touch for the upper octave key for the left thumb (between and to the right of the C♯ and lower octave keys). Personally, I find the alternate upper octave key touch more convenient in all circumstances and have abandoned using the standard touch entirely.

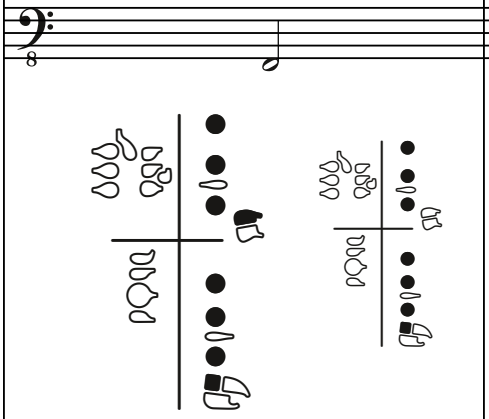


Fingering Chart

○	●	●	● *
Key is not depressed	Key is depressed	Key is automatically activated by the instrument's mechanism and can be depressed or not at the player's convenience	Key requires a special technique (see notes)



F1



or low C♯ key instead of low E♭ key with D1

standard sharp

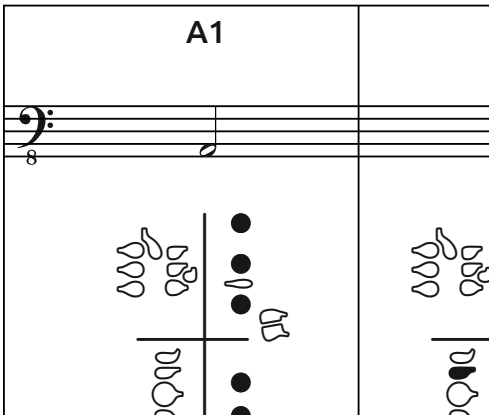
F♯1 / G♭1

flat
poor tone

G1

G♯1 / A♭1

A1



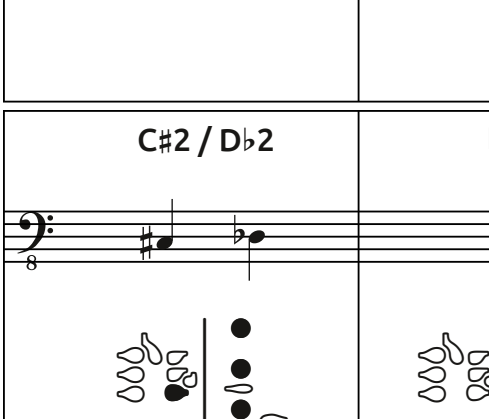
A♯1 / B♭2

useful with
E♭2 or F♯1

B1

C2

C♯2 / D♭2



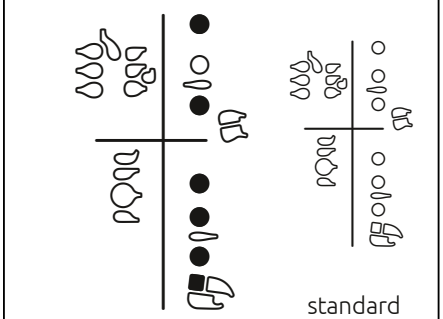
D2

D♯2 / E♭2

useful with
F♯1 or F♯2-G♯2

E2

F2



standard
flat, useful in
technical
passages

F♯2 / G♭2

sharp
useful with F2
or G♯2

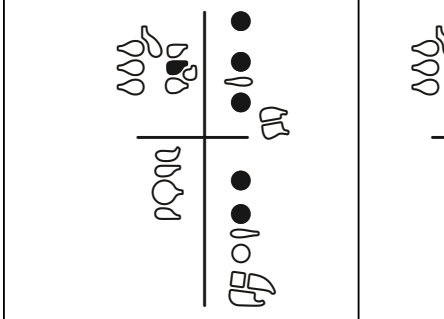
G2

G♯2 / A♭2

low C♯ key lowers
pitch

*lower octave
key, “half-hole”
mechanism, or
both, highly
dependent
upon setup

A2



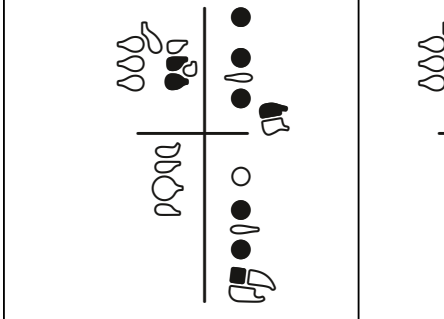
A♯2 / B♭2

useful with
E♭2

B2

C3

C♯3 / D♭3



RH and stabilizes
low E♭ raises pitch

D3

RH stabilizes

D♯3 / E♭3

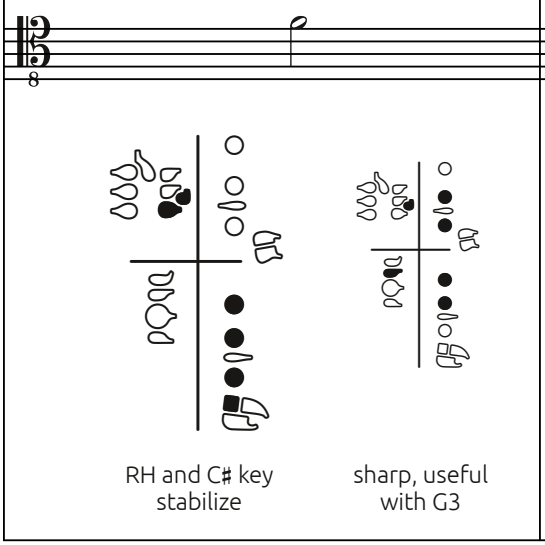
RH stabilizes

useful with
B♭2

E3

C♯ key stabilizes

F3



RH and C♯ key stabilize

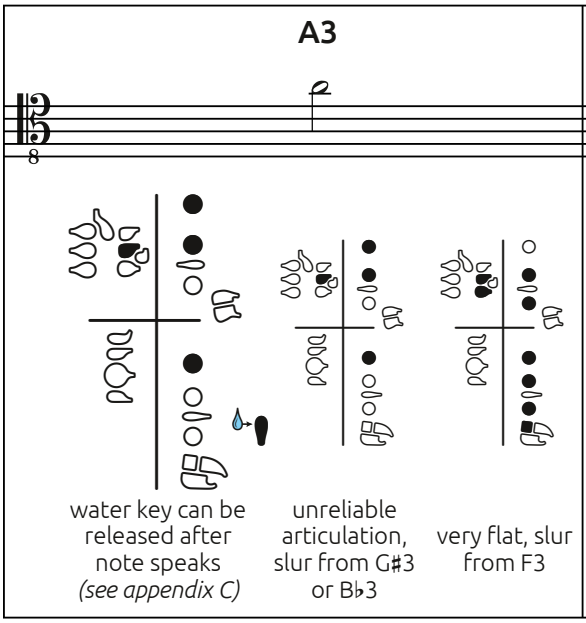
sharp, useful with G3

F♯3 / G♭3

G3

G♯3 / A♭3

A3



water key can be released after note speaks *(see appendix C)*

unreliable articulation, slur from G♯3 or B♭3

very flat, slur from F3

A♯3 / B♭3

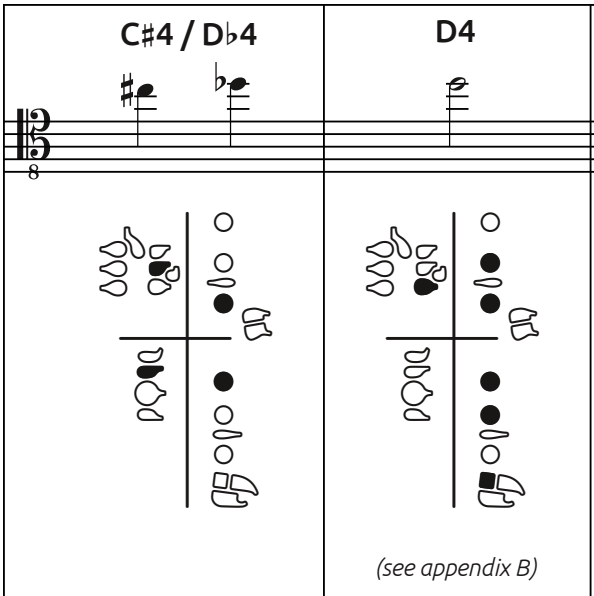
slightly sharp, useful for wide slurs

B3

or alternate E♭ key with D4

C4

C♯4 / D♭4



D4

(see appendix B)

D♯4 / E♭4

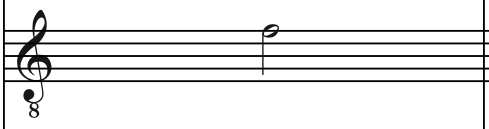
E4

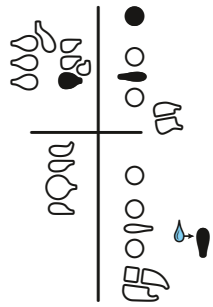
water key can be released after note speaks

cannot be articulated, slur from E♭4 or F4

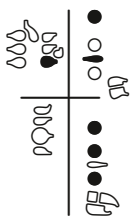
cannot be articulated, slur from D4

F4



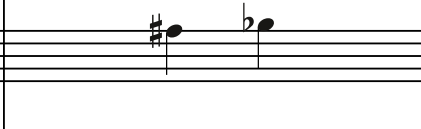


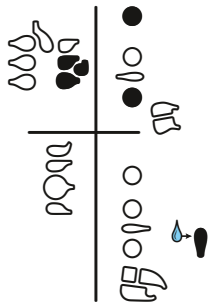
or alternate E♭ key with F♯4



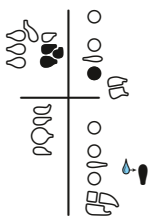
slur from E4

F♯4 / G♭4



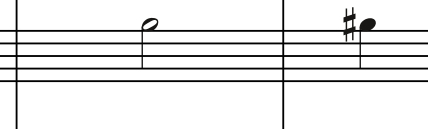


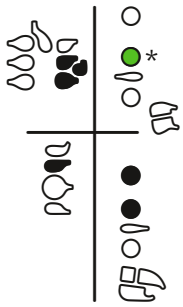
flat



unreliable articulation, slur from F4

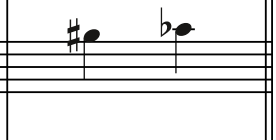
G4

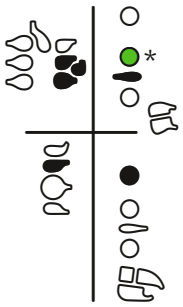




*if necessary, relax LH2 to leak pad slightly

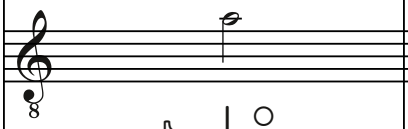
G♯4 / A♭4

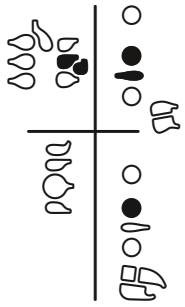




*if necessary, relax LH2 to leak pad slightly

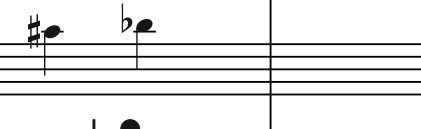
A4

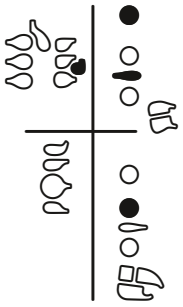




flat unless pinched
easier and better in-tune with teeth on reed

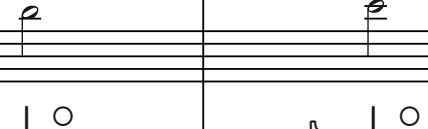
A♯4 / B♭4

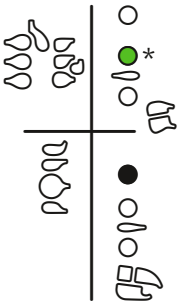




flat, unstable, cannot be articulated, slur from A4
easier and better in-tune with teeth on reed

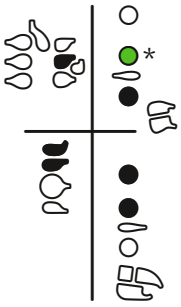
B4





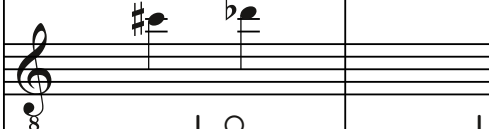
very sharp, unstable, cannot be articulated, slur from C5
*if necessary, relax LH2 to leak pad slightly

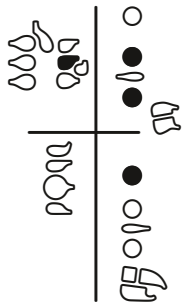
C5



hesitant, easier but sharp with teeth on reed
*if necessary, relax LH2 to leak pad slightly

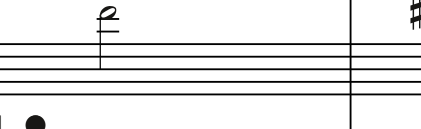
C♯5 / D♭5

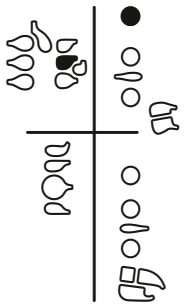




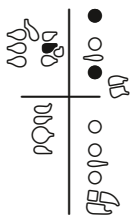
hesitant, easier if slurred from C5

D5



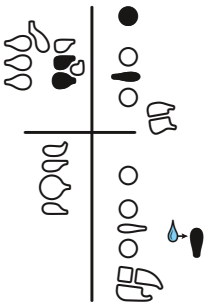


cannot be articulated, slur from C♯5



cannot be articulated, slur from C♯5 with teeth on reed

D♯5 / E♭5

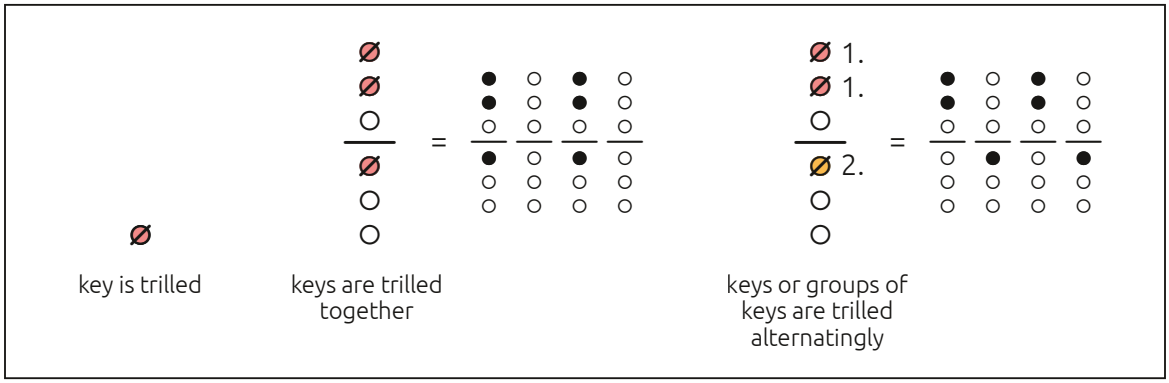


very unstable, cannot be articulated, slur from D5

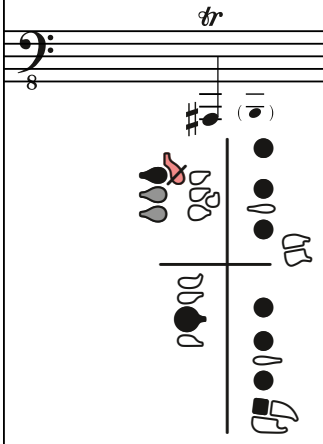
extreme altissimo fingerings included on page 30...

resultant tone fingerings included on page 31...

Trill Fingering Chart



A♯0 ~ B0



clumsy

B♭0 ~ C1

clumsy

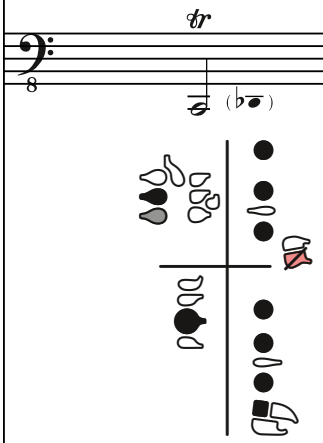
B0 ~ C1

clumsy

B0 ~ C♯1

poor tone

C1 ~ D♭1



C1 ~ D1

clumsy

*or close pad closed by low D key with knee for easier trill

C♯1 ~ D1

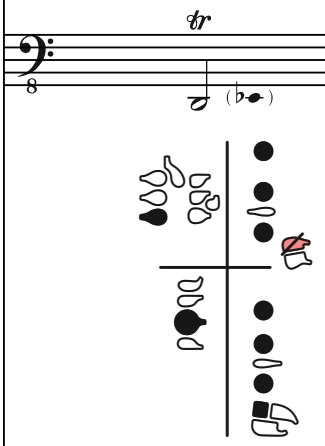
clumsy

*or close pad closed by low D key with knee for easier trill

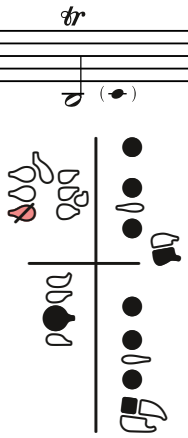
C♯1 ~ D♯1 / D♭1 ~ E♭1

*wedge low C♯ pad open, impractical otherwise

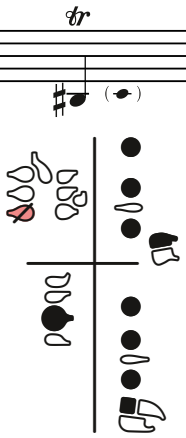
D1 ~ E♭1



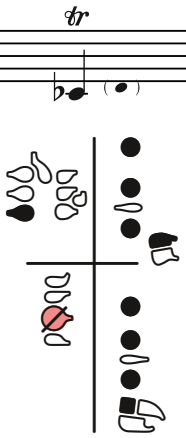
D1 ~ E1



D♯1 ~ E1

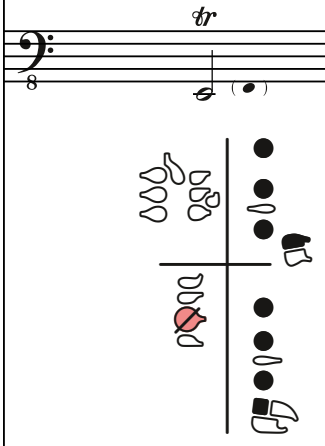


E♭1 ~ F1

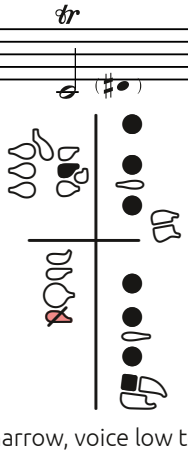


narrow

E1 ~ F1

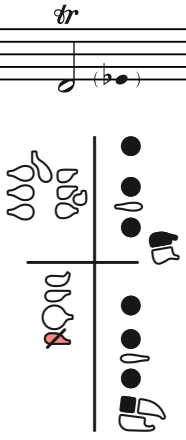


E1 ~ F♯1

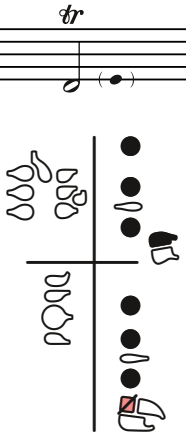


narrow, voice low to
prevent upper octave
*or close pad closed by low E key
with heel and omit lower octave key

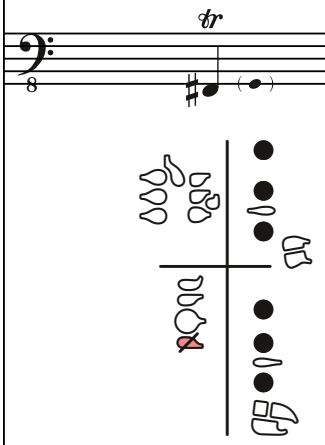
F1 ~ G♭1



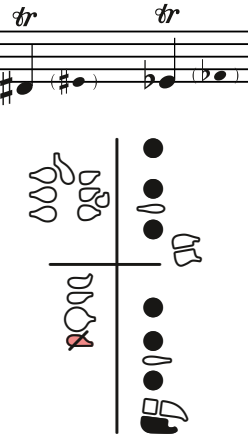
F1 ~ G1



F♯1 ~ G1

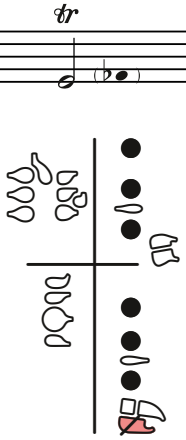


F♯1 ~ G♯1 / G♭1 ~ A♭1

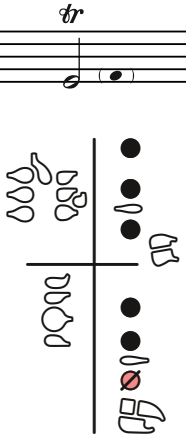


narrow
if possible, use
full fingerings

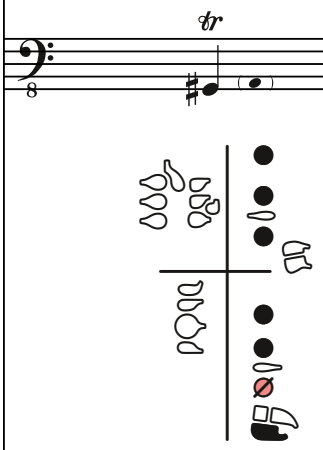
G1 ~ A♭1



G1 ~ A1



G♯1 ~ A1

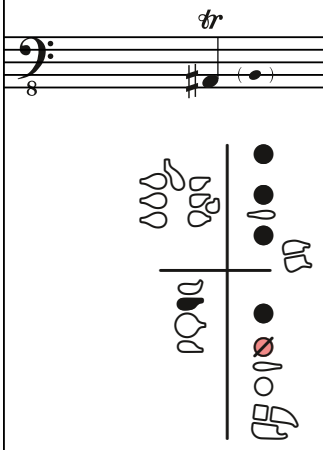


G♯1 ~ A♯1 / A♭1 ~ B♭1

A1 ~ B♭1

A1 ~ B1

A♯1 ~ B1



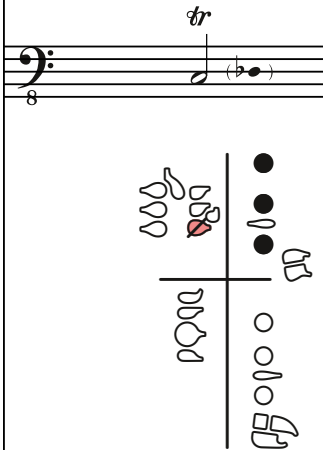
B♭1 ~ C2

B1 ~ C2

B1 ~ C♯2

wide
begin with standard fingering
voice low to prevent
multiphonic

C2 ~ D♭2

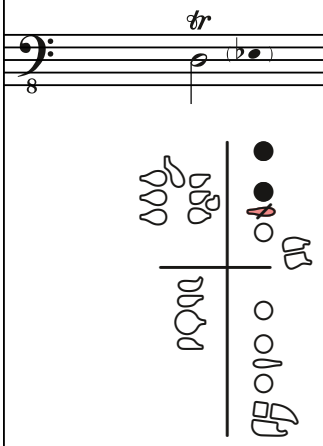


C2 ~ D2

C♯2 ~ D2

C♯2 ~ D♯2 / D♭2 ~ E♭2

D2 ~ E♭2

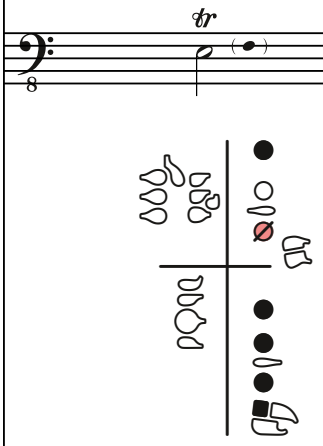


D2 ~ E2

D♯2 ~ E2

E♭2 ~ F2

E2 ~ F2



narrow
begin with standard fingering

E2 ~ F♯2

sharp
begin with standard fingering

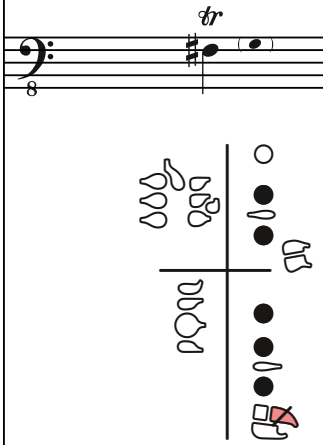
F2 ~ G♭2

begin with standard fingering

F2 ~ G2

begin with standard fingering

F♯2 ~ G2



F♯2 ~ G♯2 / G♭2 ~ A♭2

begin with standard fingering

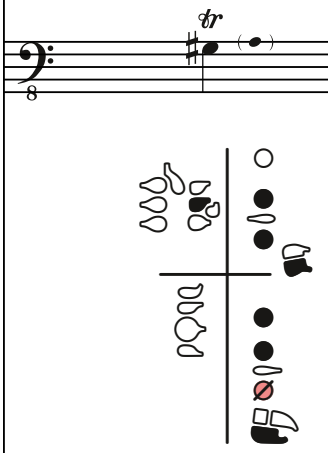
G2 ~ A♭2

begin with standard fingering

G2 ~ A2

begin with standard fingering

G♯2 ~ A2



wide

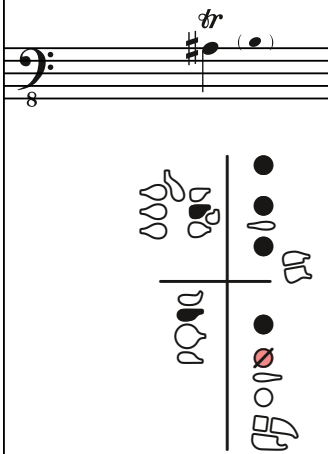
G♯2 ~ A♯2 / A♭2 ~ B♭2

narrow
begin with standard fingering

A2 ~ B♭2

A2 ~ B2

A♯2 ~ B2



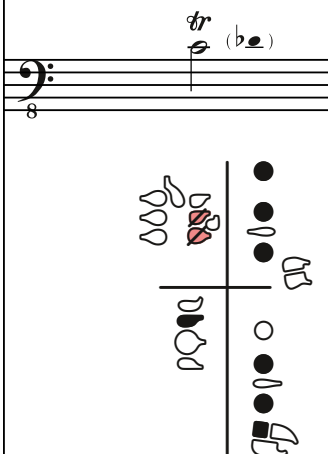
B♭2 ~ C3

B2 ~ C3

B2 ~ C♯3

begin with standard fingering

C3 ~ D♭3



begin with standard fingering
voice high to maintain upper octave

C3 ~ D3

begin with standard fingering

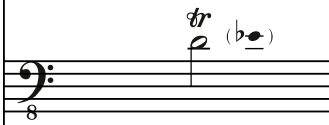
C♯3 ~ D3

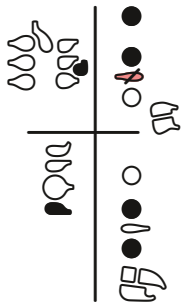
wide
begin with standard fingering

C♯3 ~ D♯3 / D♭3 ~ E♭3

narrow
begin with standard fingering

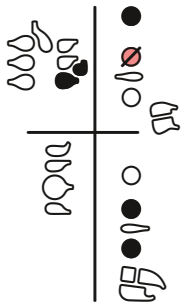
D3 ~ E♭3





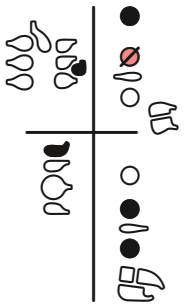
begin with standard fingering

D3 ~ E3



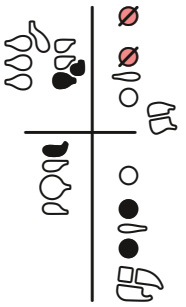
narrow
begin with standard fingering

D♯3 ~ E3



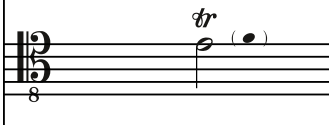
slightly wide

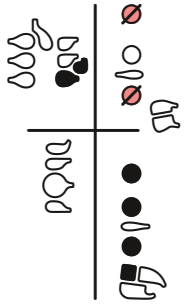
E♭3 ~ F3



wide
begin with standard fingering

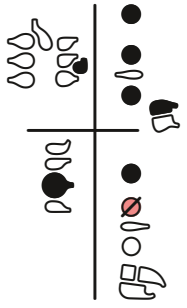
E3 ~ F3





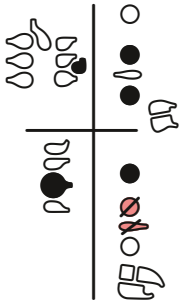
begin with standard fingering

E3 ~ F♯3



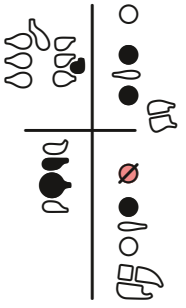
narrow
begin with standard fingering

F3 ~ G♭3



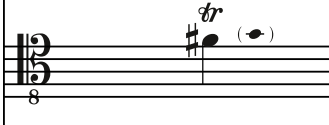
begin with standard fingering

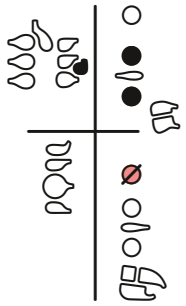
F3 ~ G3



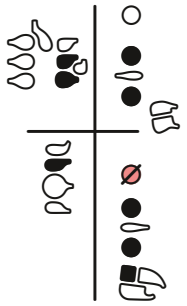
sharp
begin with standard fingering

F♯3 ~ G3



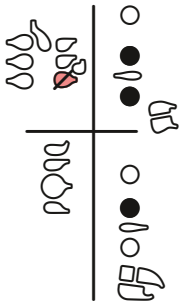


F♯3 ~ G♯3 / G♭3 ~ A♭3



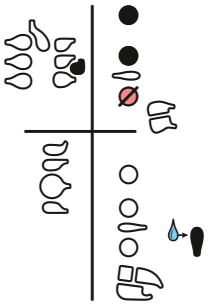
begin with standard fingering

G3 ~ A♭3



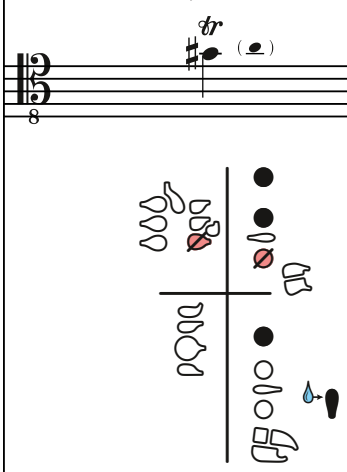
begin with standard fingering

G3 ~ A3



sharp
begin with standard fingering

G♯3 ~ A3



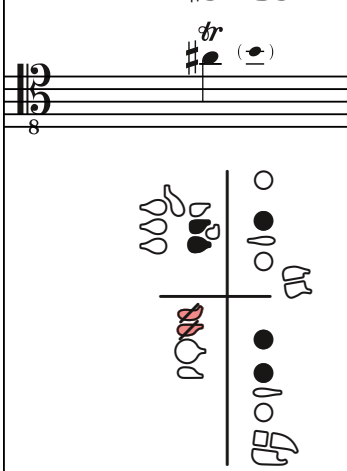
G♯3 ~ A♯3 / A♭3 ~ B♭3

A3 ~ B♭3

A3 ~ B3

clumsy
begin with standard fingering

A♯3 ~ B3



begin with standard fingering

B♭3 ~ C4

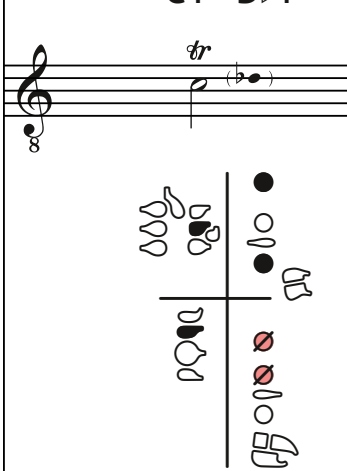
begin with standard fingering

B3 ~ C4

B3 ~ C♯4

begin with standard fingering

C4 ~ D♭4



begin with standard fingering

C4 ~ D4

difficult and clumsy
begin with standard fingering

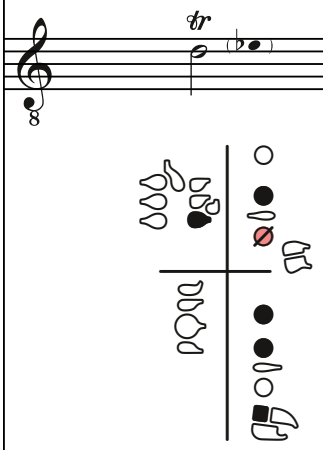
C♯4 ~ D4

narrow
begin with standard fingering

C♯4 ~ D♯4 / D♭4 ~ E♭4

difficult
begin with standard fingering

D4 ~ E♭4



D4 ~ E4

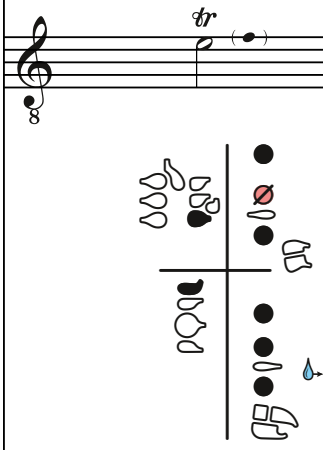
difficult
begin with standard fingering

D♯4 ~ E4

E♭4 ~ F4

clumsy

E4 ~ F4



E4 ~ F♯4

difficult

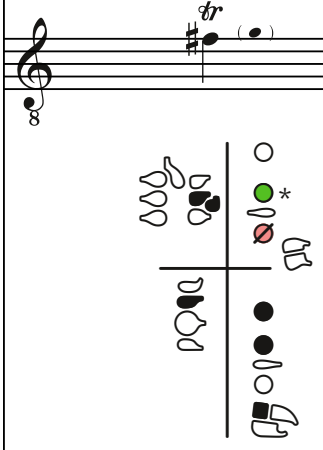
F4 ~ G♭4

clumsy

F4 ~ G4

?

F♯4 ~ G4



*if necessary, relax LH2 to leak pad slightly

F♯4 ~ G♯4 / G♭4 ~ A♭4

?

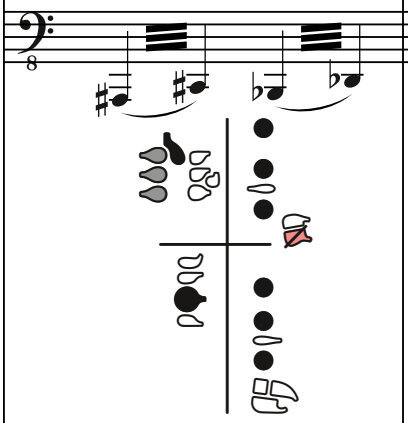
G4 ~ A♭4

G4 ~ A4

?

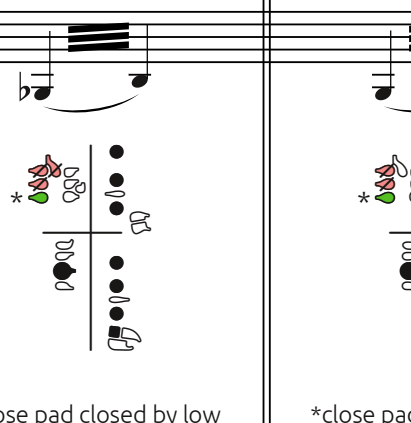
Tremolo Fingering Chart

A♯0 ~ C♯1 / B♭0 ~ D♭1



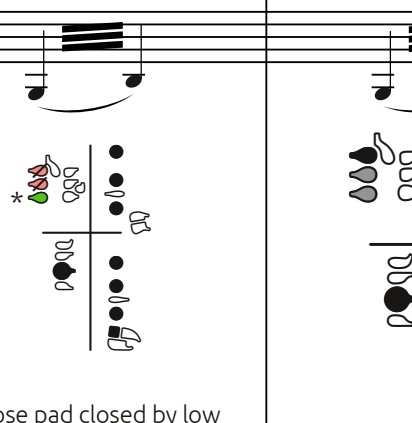
poor tone

B♭0 ~ D1



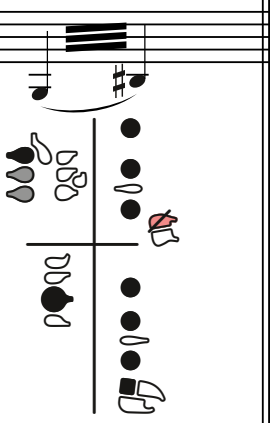
*close pad closed by low D key with knee impractical

B0 ~ D1



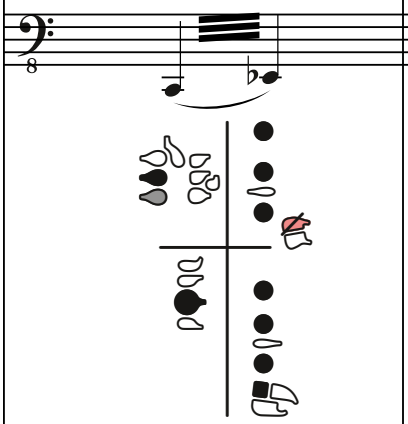
*close pad closed by low D key with knee impractical

B0 ~ D♯1



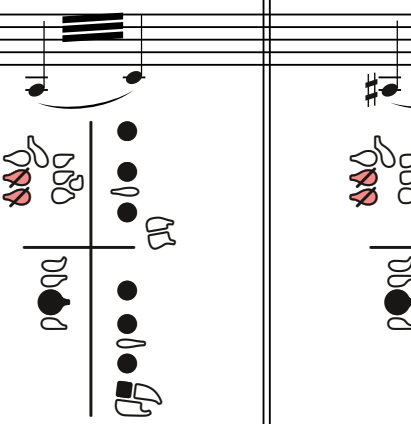
poor tone

C1 ~ E♭1

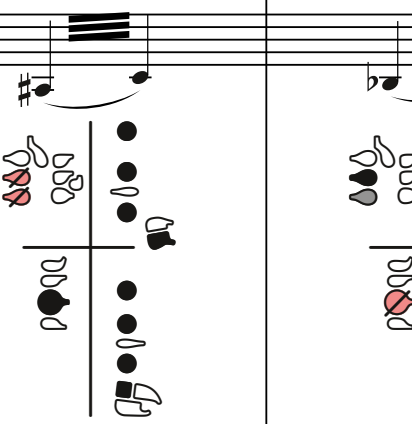


poor tone

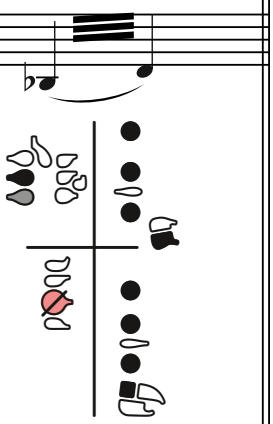
C1 ~ E1



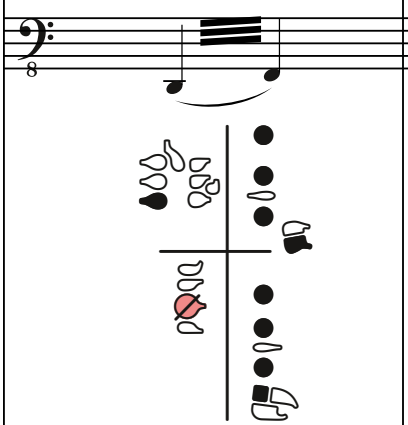
C♯1 ~ E1



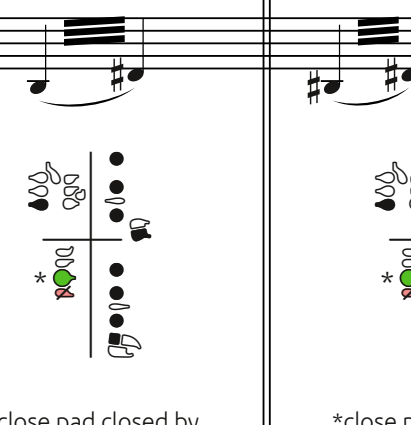
D♭1 ~ F1



D1 ~ F1

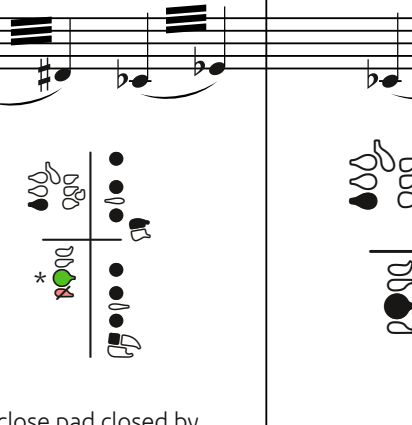


D1 ~ F♯1



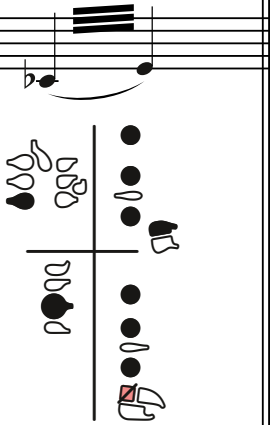
*close pad closed by low E key with heel impractical

D♯1 ~ F♯1 / E♭1 ~ G♭1

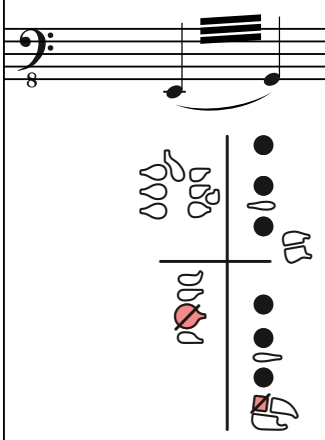


*close pad closed by low E key with heel impractical

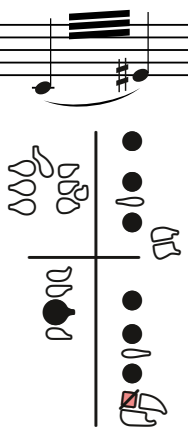
E♭1 ~ G1



E1 ~ G1

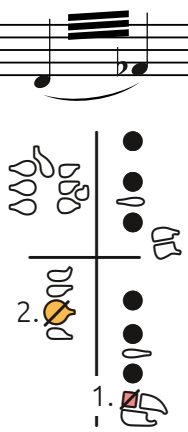


E1 ~ G♯1



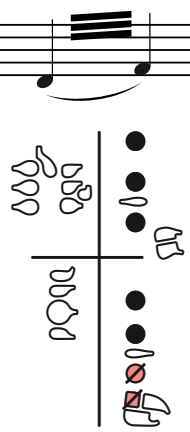
narrow
poor tone

F1 ~ A♭1

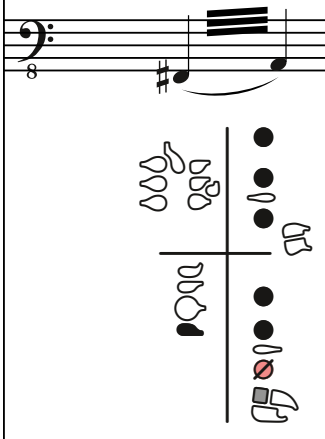


clumsy
narrow
poor tone

F1 ~ A1

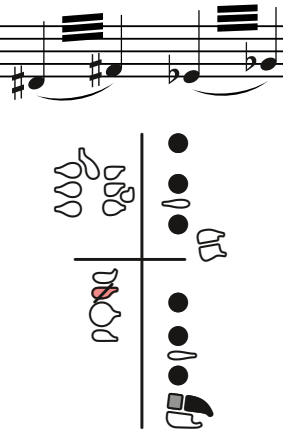


F♯1 ~ A1



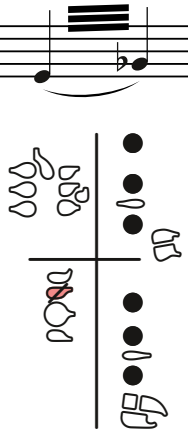
wide

F♯1 ~ A♯1 / G♭1 ~ B♭1



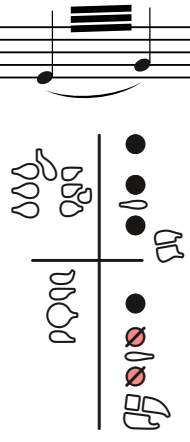
wide

G1 ~ B♭1

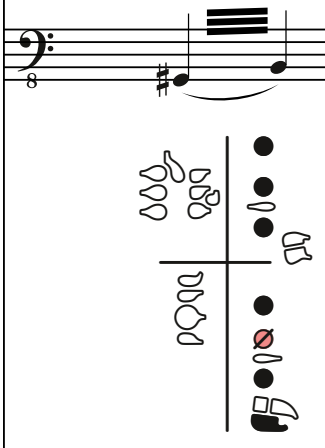


narrow

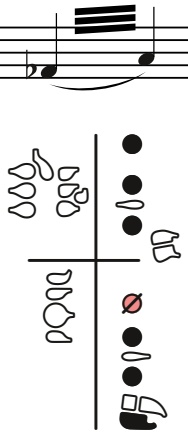
G1 ~ B1



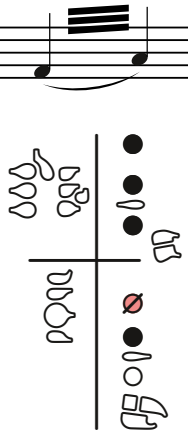
G♯1 ~ B1



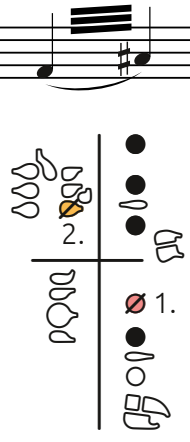
A♭1 ~ C2



A1 ~ C2

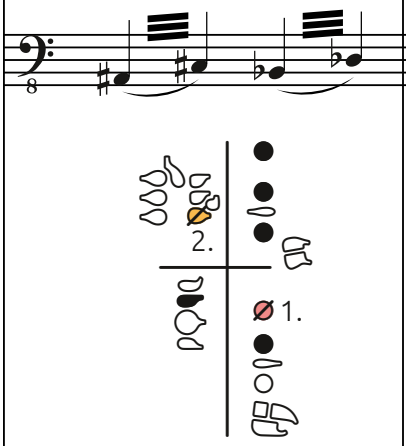


A1 ~ C♯2



clumsy

A♯1 ~ C♯2 / B♭1 ~ D♭2



clumsy

B♭1 ~ D2

clumsy

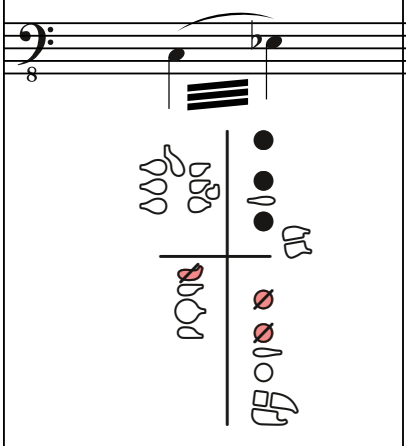
B1 ~ D2

poor tone

B1 ~ D♯2

clumsy

C2 ~ E♭2

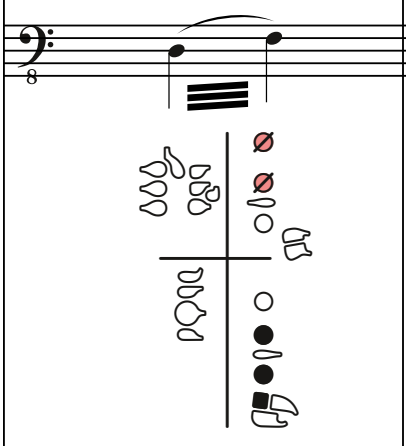


C2 ~ E2

C♯2 ~ E2

D♭2 ~ F2

D2 ~ F2



D2 ~ F♯2

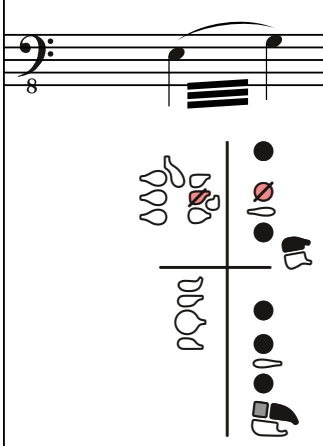
clumsy

D♯2 ~ F♯2 / E♭2 ~ G♭2

wide

E♭2 ~ G2

E2 ~ G2



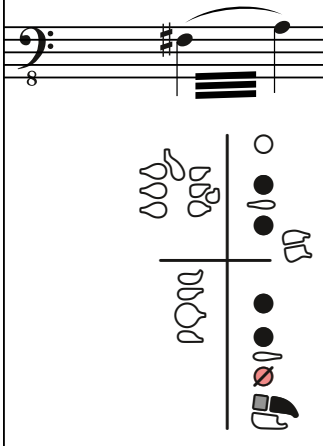
E2 ~ G♯2

clumsy

F2 ~ A♭2

F2 ~ A2

F♯2 ~ A2



F♯2 ~ A♯2 / G♭2 ~ B♭2

poor tone

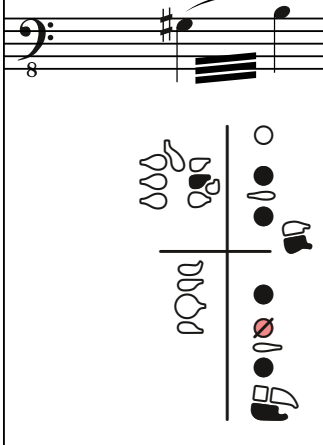
G2 ~ B♭2

poor tone

G2 ~ B2

poor tone

G♯2 ~ B2



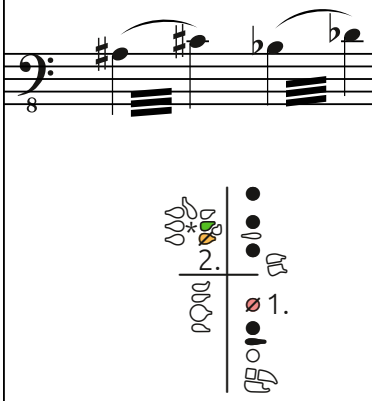
A♭2 ~ C3

A2 ~ C3

A2 ~ C♯3

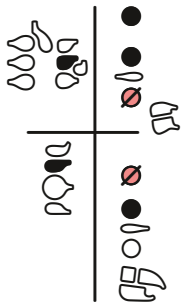
*open u-tube octave vent with right thumb impractical

A♯2 ~ C♯3 / B♭2 ~ D♭3



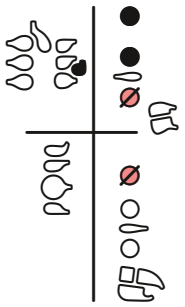
*open u-tube octave vent with right thumb impractical

B♭2 ~ D3



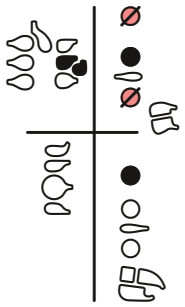
clumsy

B2 ~ D3



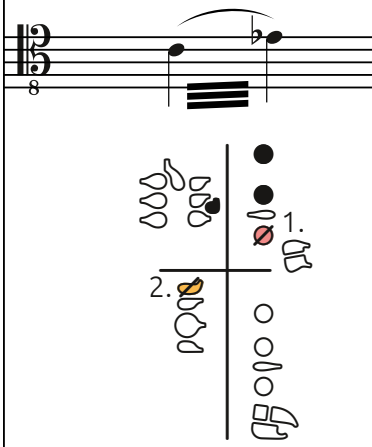
clumsy

B2 ~ D♯3



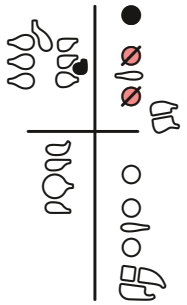
poor tone

C3 ~ E♭3

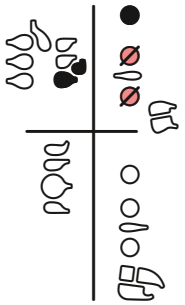


clumsy

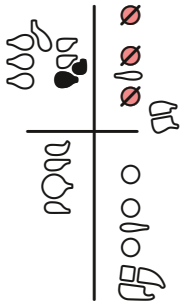
C3 ~ E3



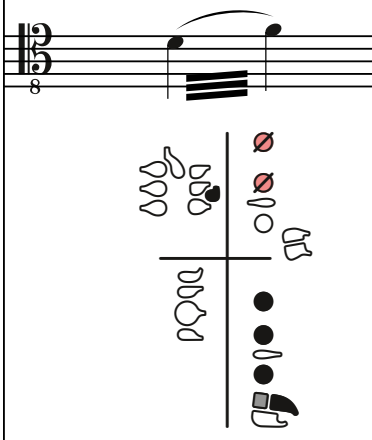
C♯3 ~ E3



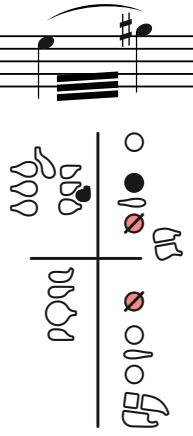
D♭3 ~ F3



D3 ~ F3

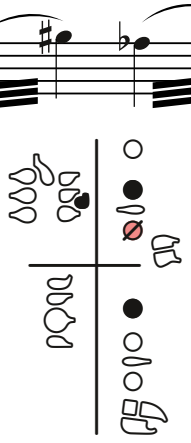


D3 ~ F♯3

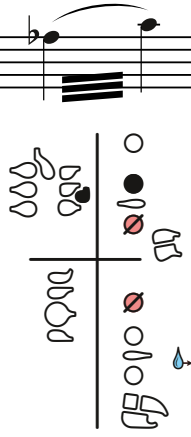


clumsy

D♯3 ~ F♯3 / E♭3 ~ G♭3

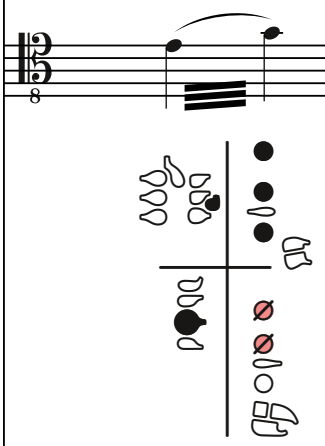


E♭3 ~ G3

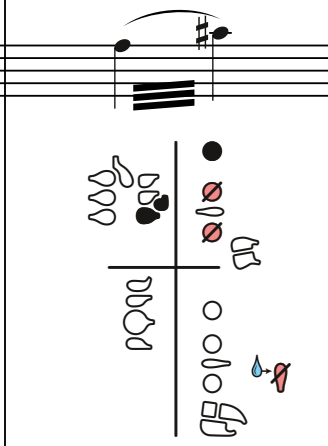


very poor tone

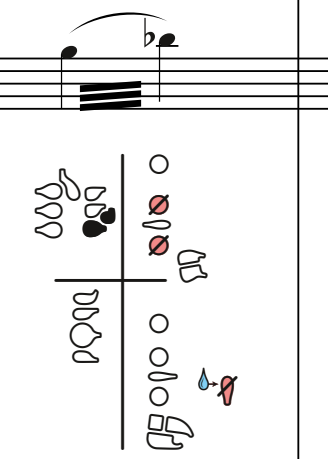
E3 ~ G3



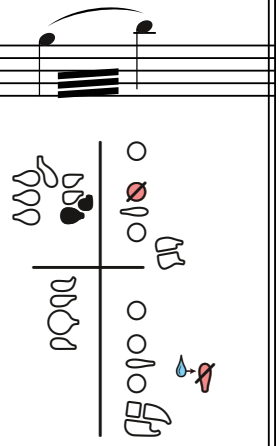
E3 ~ G♯3



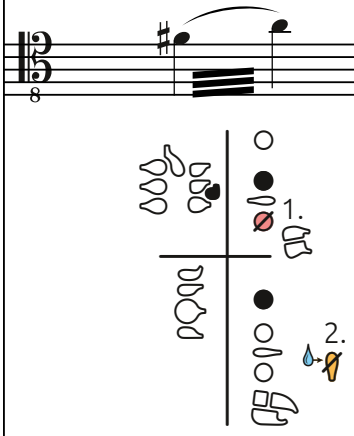
F3 ~ A♭3



F3 ~ A3

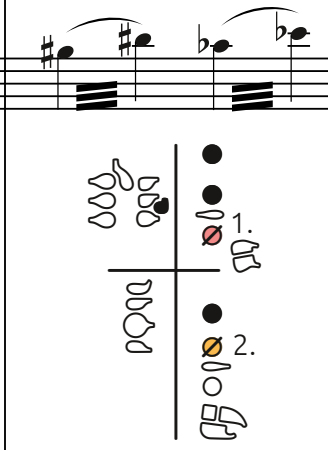


F♯3 ~ A3



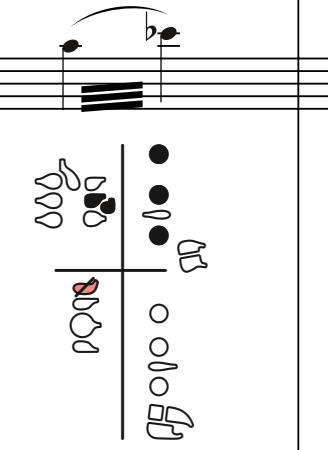
clumsy

F♯3 ~ A♯3 / G♭3 ~ B♭3



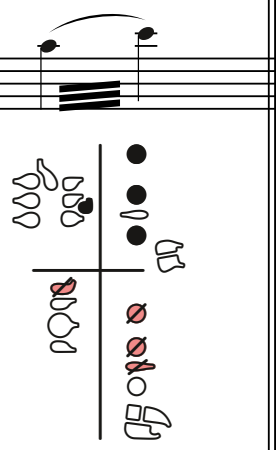
clumsy

G3 ~ B♭3



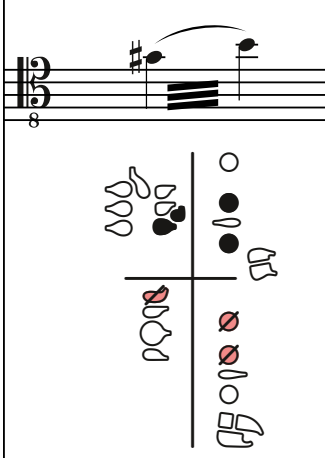
poor tone

G3 ~ B3

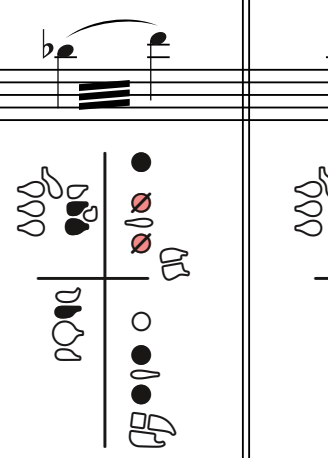


poor tone

G♯3 ~ B3

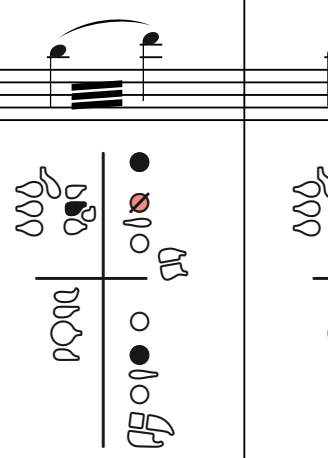


A♭3 ~ C4



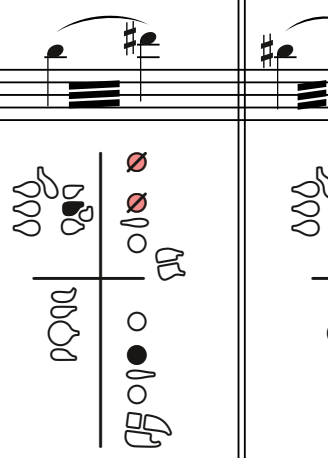
poor tone

A3 ~ C4



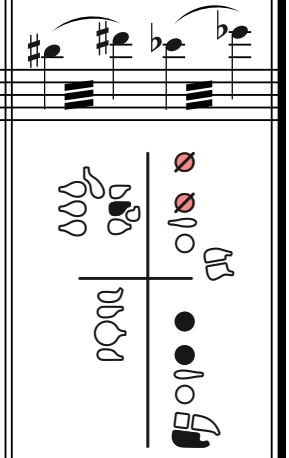
narrow

A3 ~ C♯4



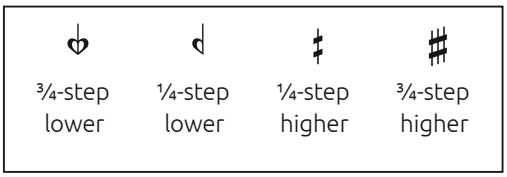
poor tone
narrow

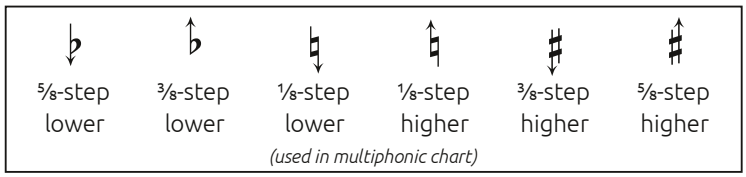
A♯3 ~ C♯4 /
B♭3 ~ D♭4

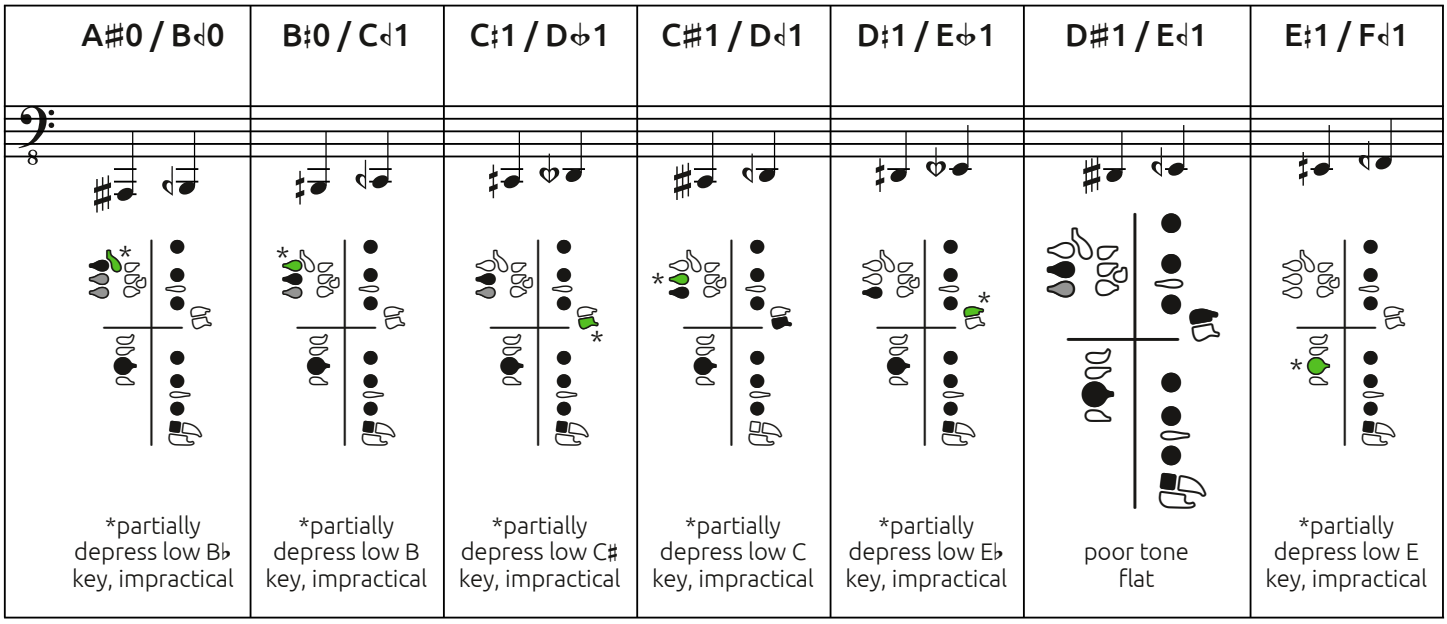


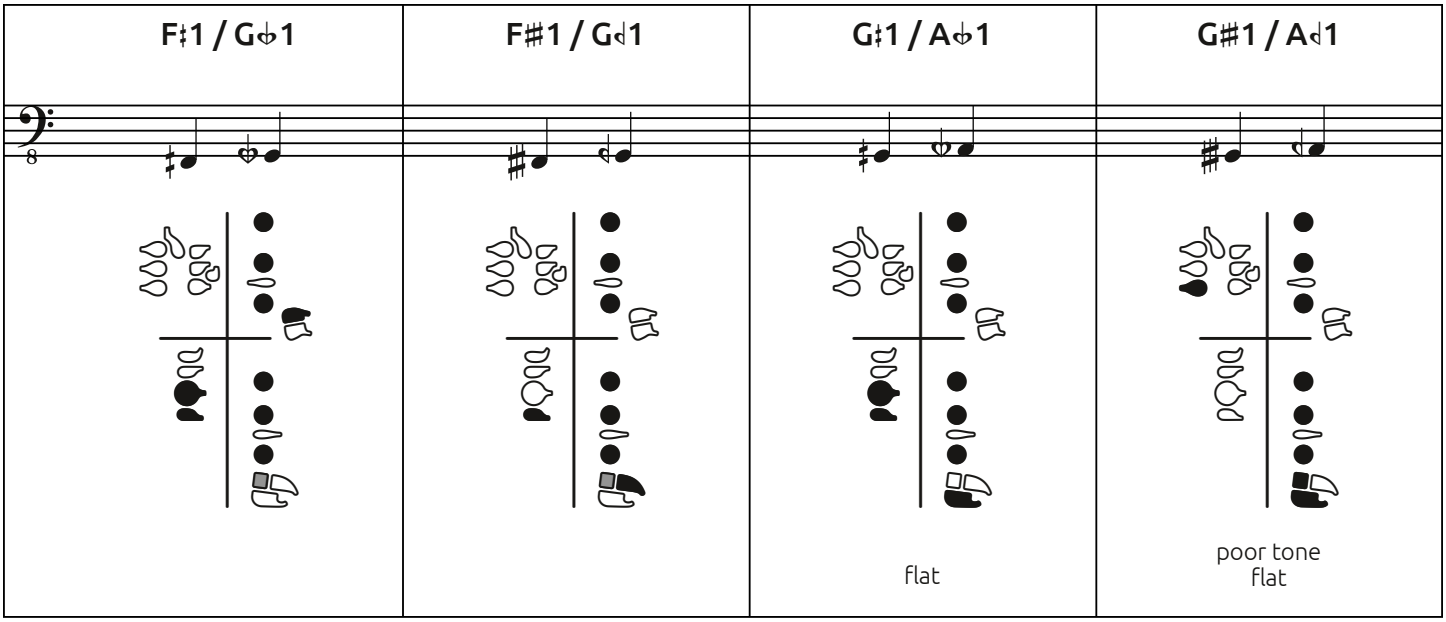
Quartertone Fingering Chart

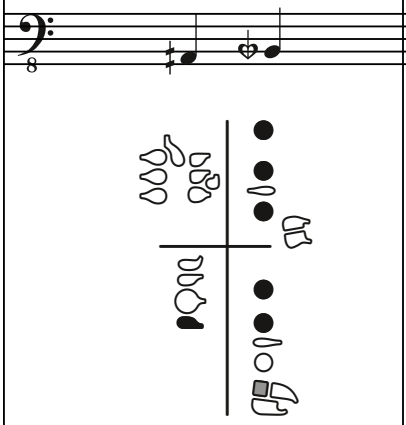
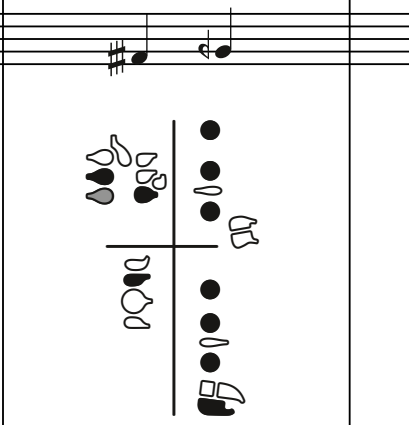
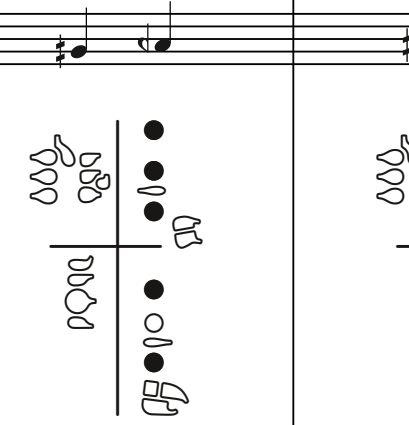
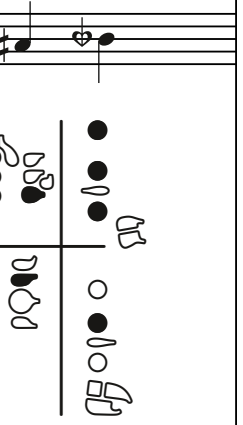
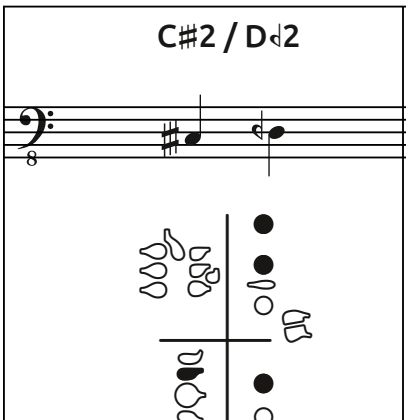
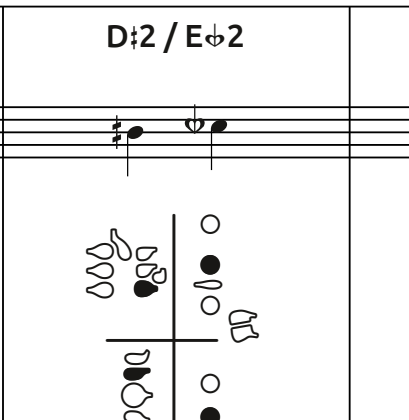
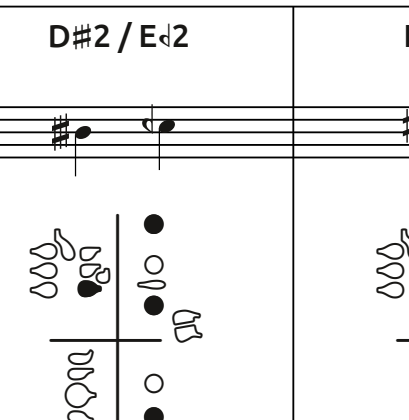
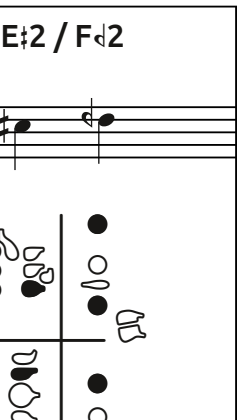
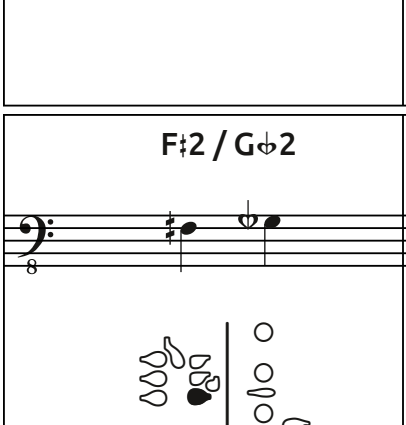
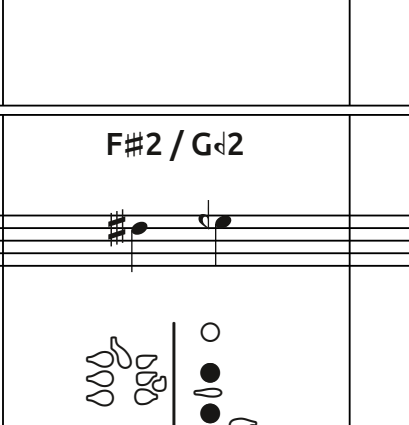
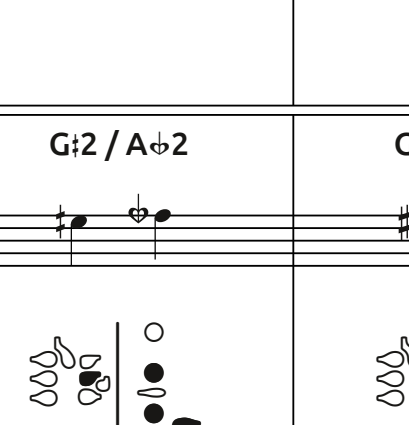
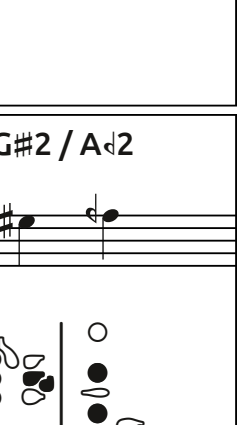
Like other modern orchestral woodwinds, the contrabassoon was not designed to play quartertones. While quartertone fingerings can be found—at least, outside of the lowest register—they often suffer from a combination of tuning inaccuracy, timbral inconsistency, or technical clumsiness.



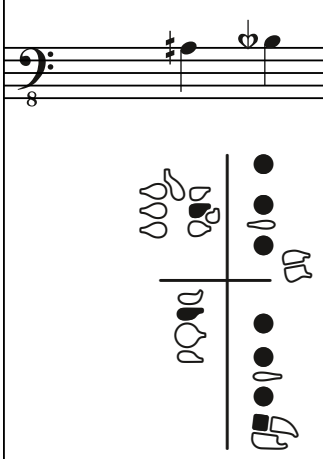






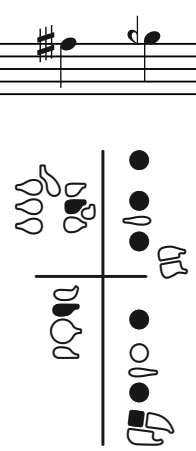
A♯1 / B♭1	A♯1 / B♮1	B♯1 / C♮2	C♯2 / D♭2
			
C♯2 / D♮2	**D♯2 / E♭2**	**D♯2 / E♮2**	**E♯2 / F♮2**
			
F♯2 / G♭2	**F♯2 / G♮2**	**G♯2 / A♭2**	**G♯2 / A♮2**
			
			flat

A♯2 / B♭2



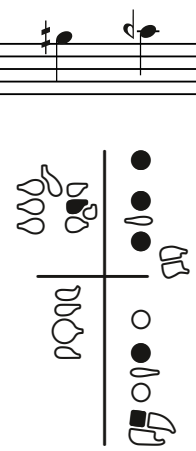
sharp

A♯2 / B♮2



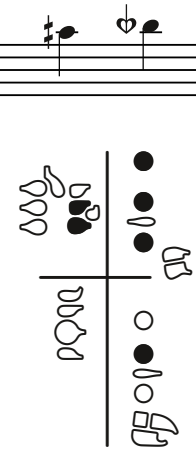
sharp

B♯2 / C♮3



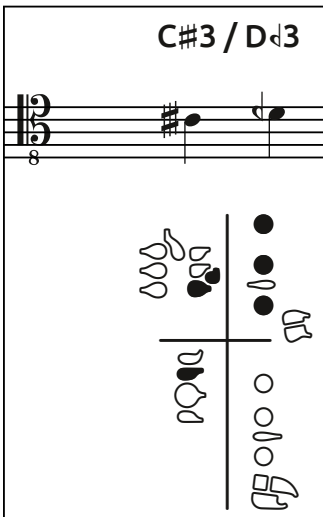
sharp

C♯3 / D♭3



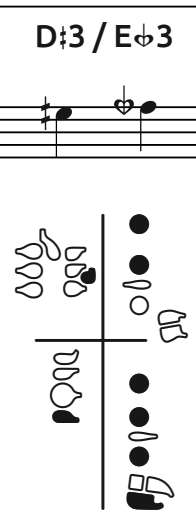
sharp

C♯3 / D♮3

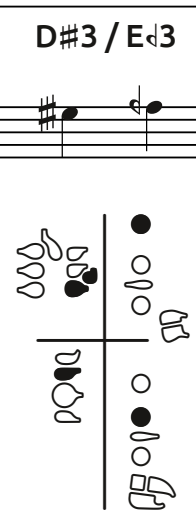


flat

D♯3 / E♭3

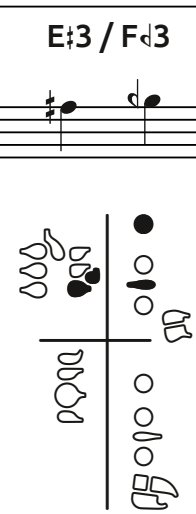


D♯3 / E♮3

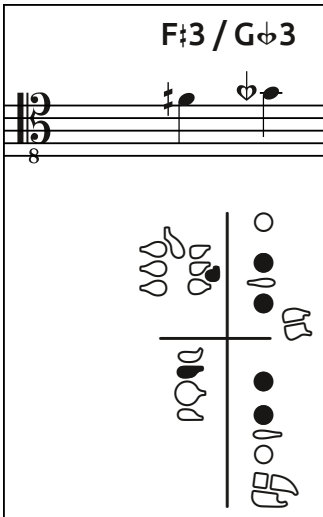


sharp

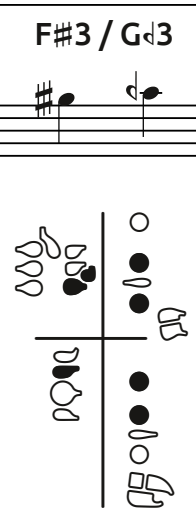
E♯3 / F♮3



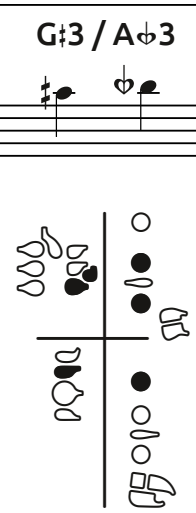
F♯3 / G♭3



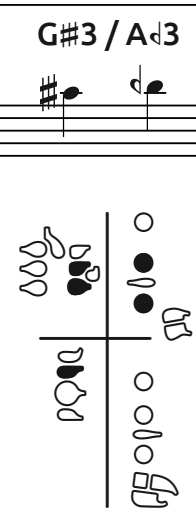
F♯3 / G♮3



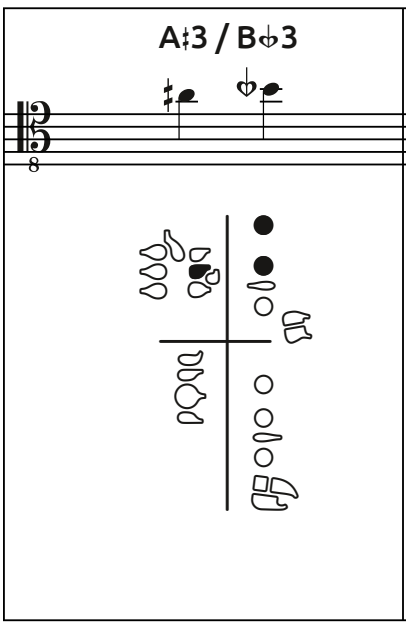
G♯3 / A♭3



G♯3 / A♮3



A♯3 / B♭3



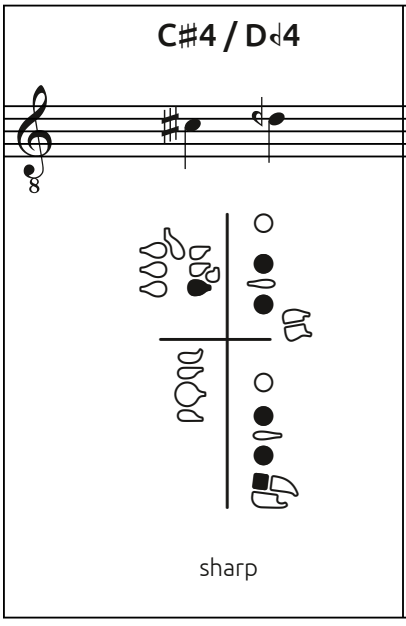
A♯3 / B♭3

B♯3 / C♭4

sharp

C♯4 / D♭4

C♯4 / D♭4



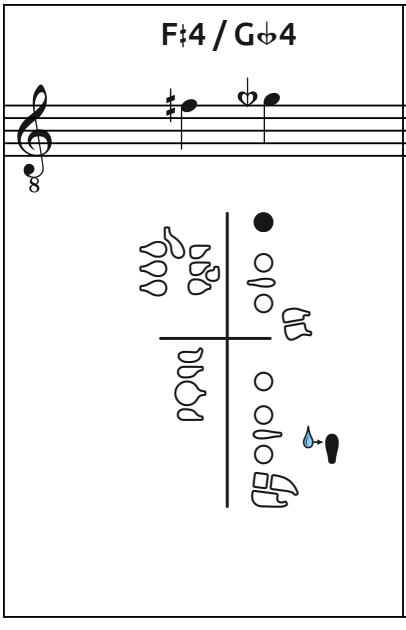
sharp

D♯4 / E♭4

D♯4 / E♭4

E♯4 / F♭4

F♯4 / G♭4



F♯4 / G♭4

G♯4 / A♭4

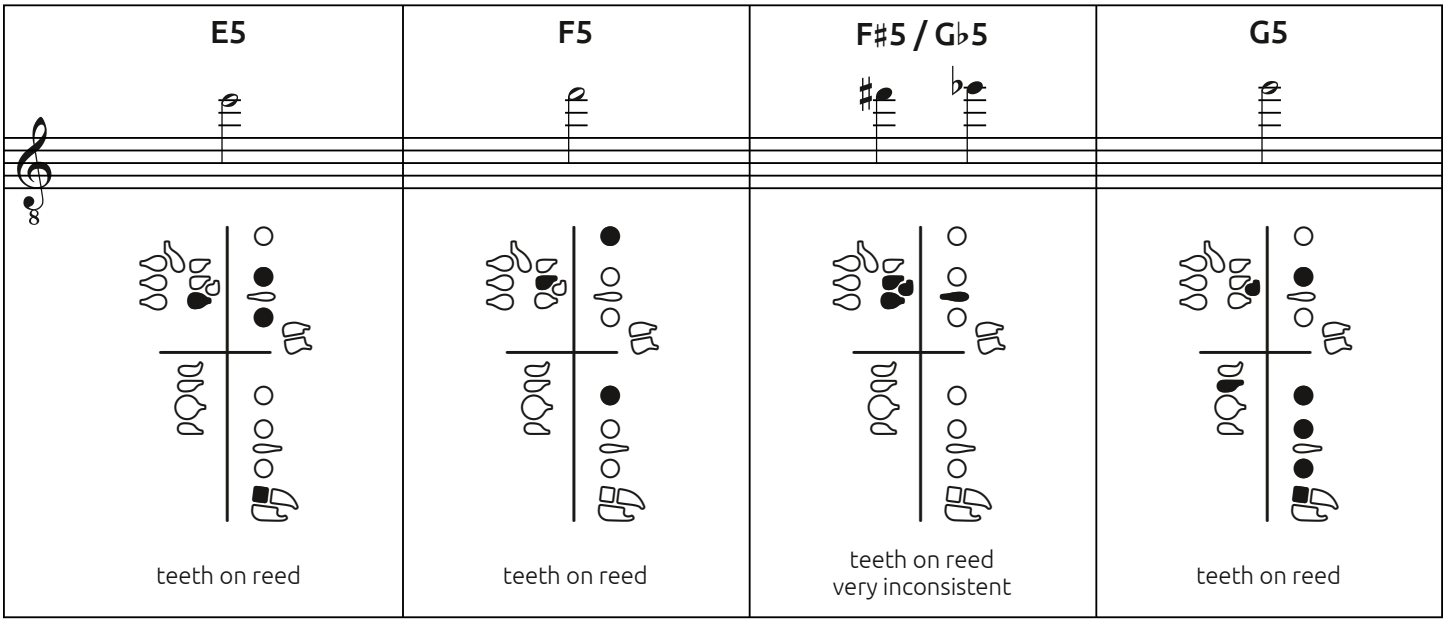
*if necessary, relax LH2 to leak pad slightly

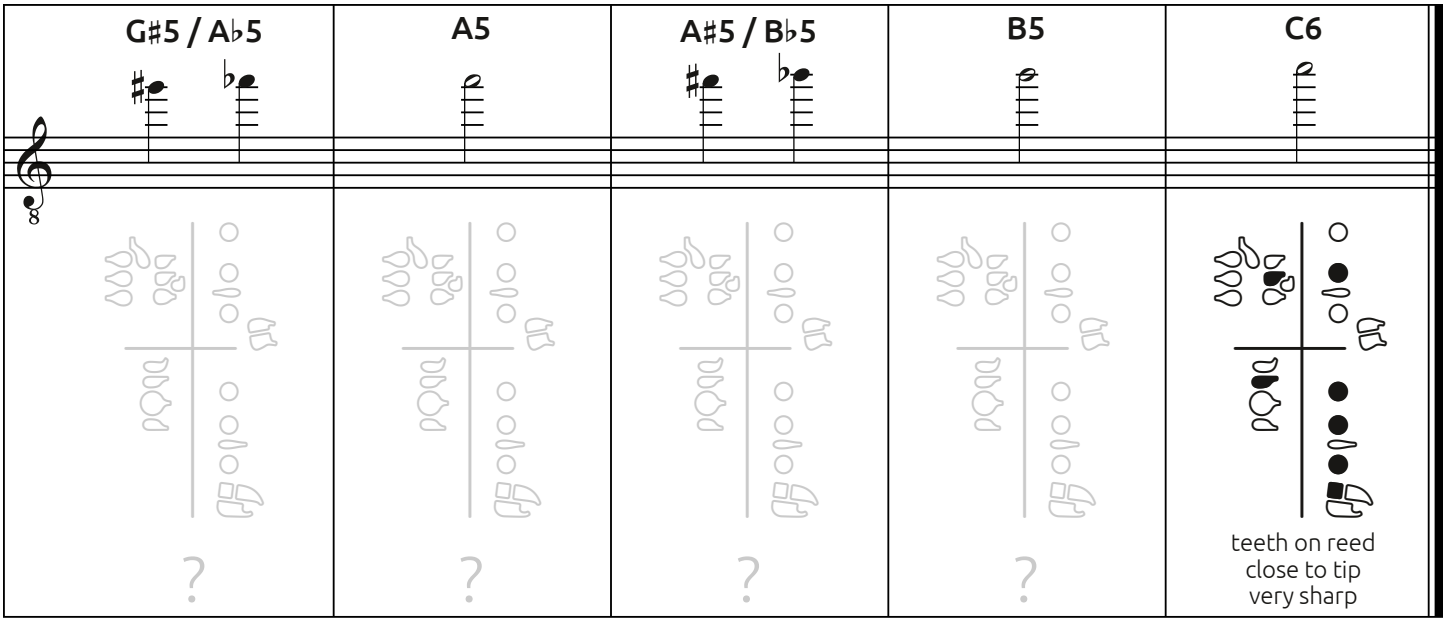
G♯4 / A♭4

Extreme Altissimo Fingering Chart

These fingerings are provided for experimentation purposes only. All are difficult, unreliable, and highly reed-dependent.

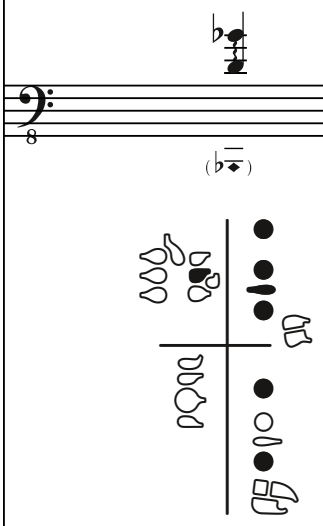
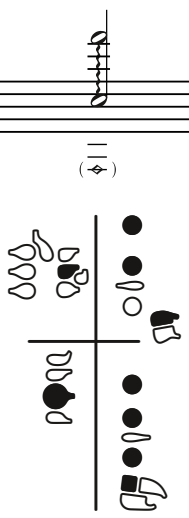
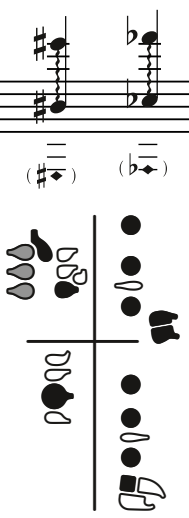
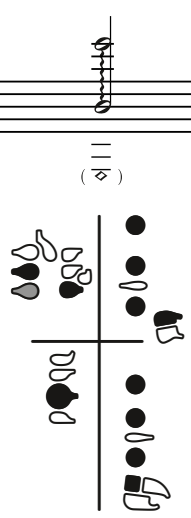
(to any composers who have made it this far, kindly pretend that this page is blank)

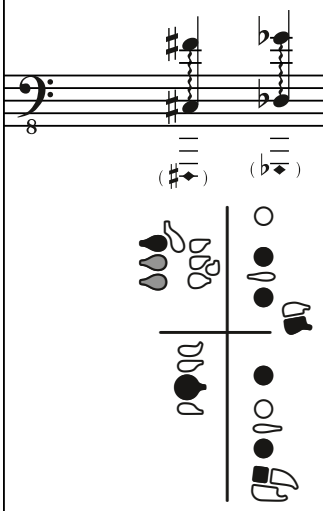
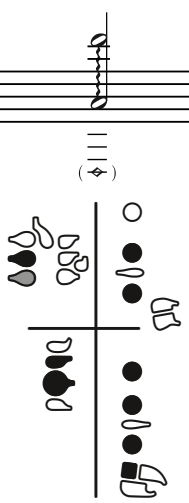
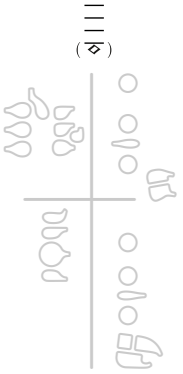
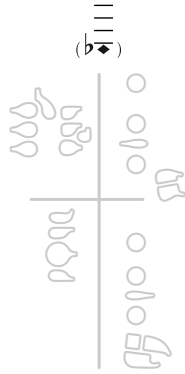




Resultant Tone Fingering Chart

These fingerings are provided for experimentation purposes only. The resultant tone effect is dependent upon achieving a rather precise pitch relationship between the two fundamental tones. This may happen only at a specific voicing, at a specific dynamic, by adding or omitting keys, or may not happen at all on a given instrument. If a resultant tone is produced, its tuning likely cannot be altered without spoiling the effect entirely. *(see appendix F for more information on multiphonics)*

B♭0	A0	G♯0 / A♭0	G0
			
unconvincing effect possibly useful if using low A extension	passable effect	tense good effect	lax and loud good effect

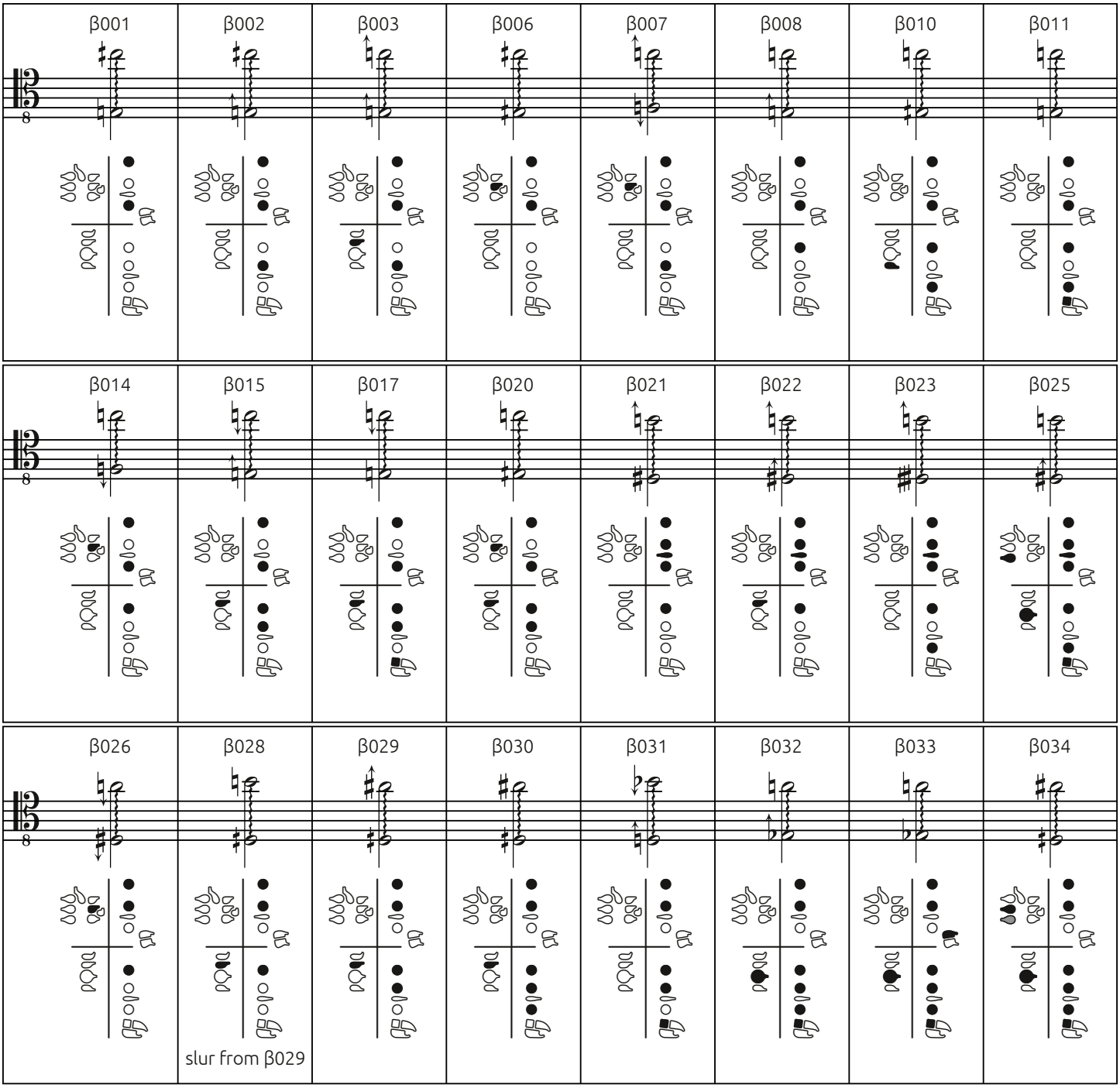
F♯0 / G♭0	F0	E0	E♭0
			
inconsistent very flat poor effect	inconsistent very loud passable effect	?	?

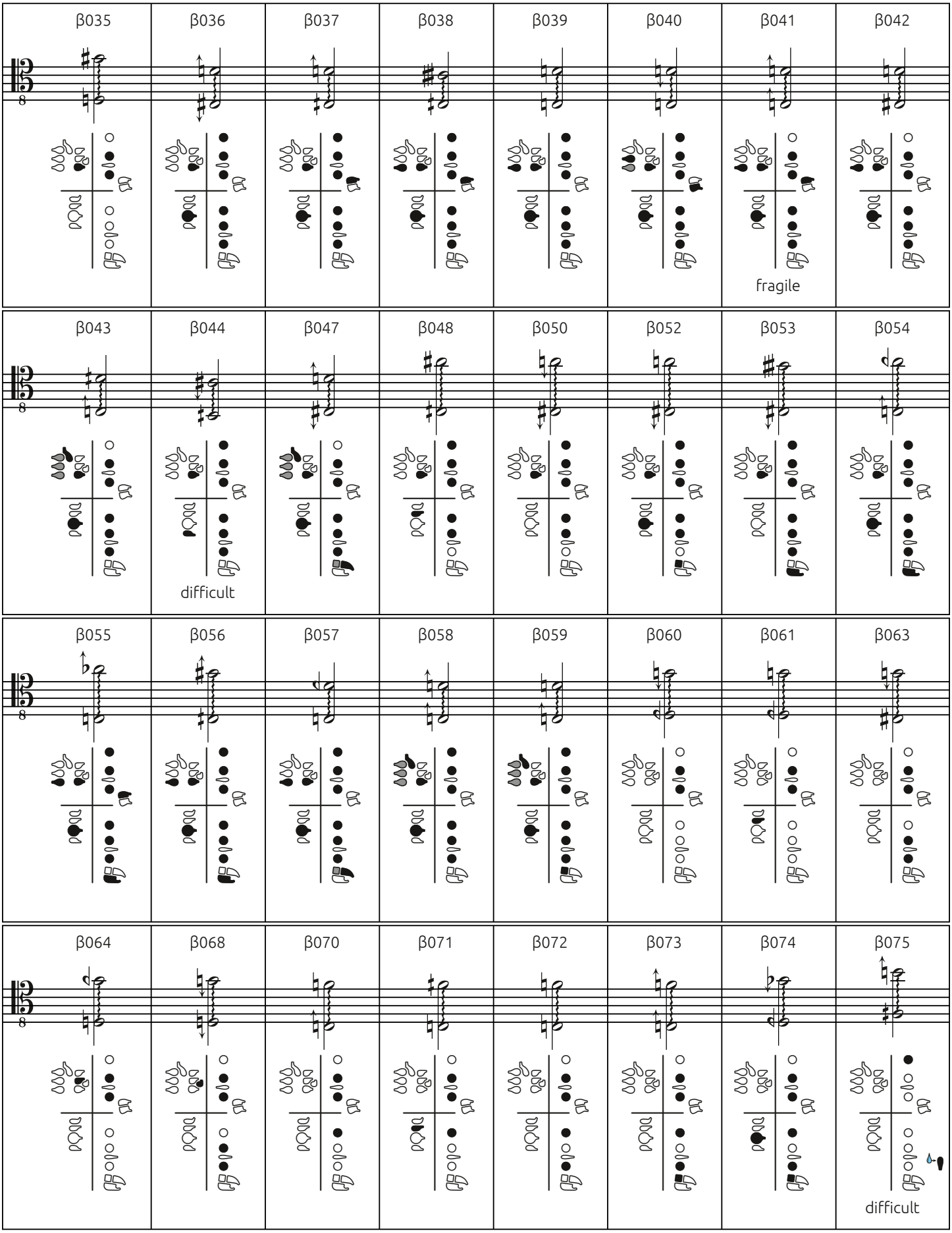
Multiphonic Fingering Chart *(preliminary)*

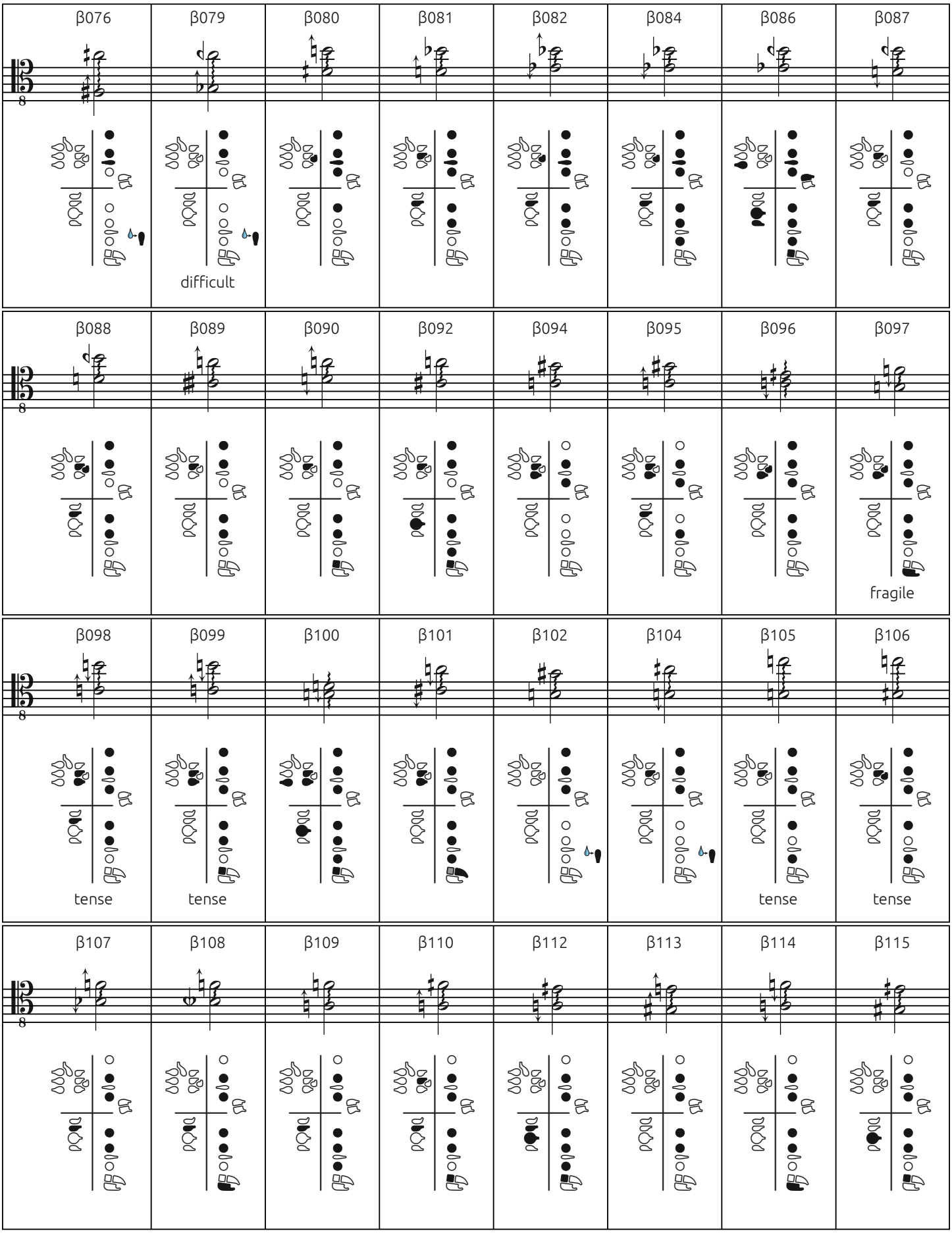
While woodwind multiphonics have been studied seriously for over half a century, the contrabassoon has very often been overlooked in these efforts. Despite this, the contrabassoon has great multiphonic potential similar to bassoon and oboe.

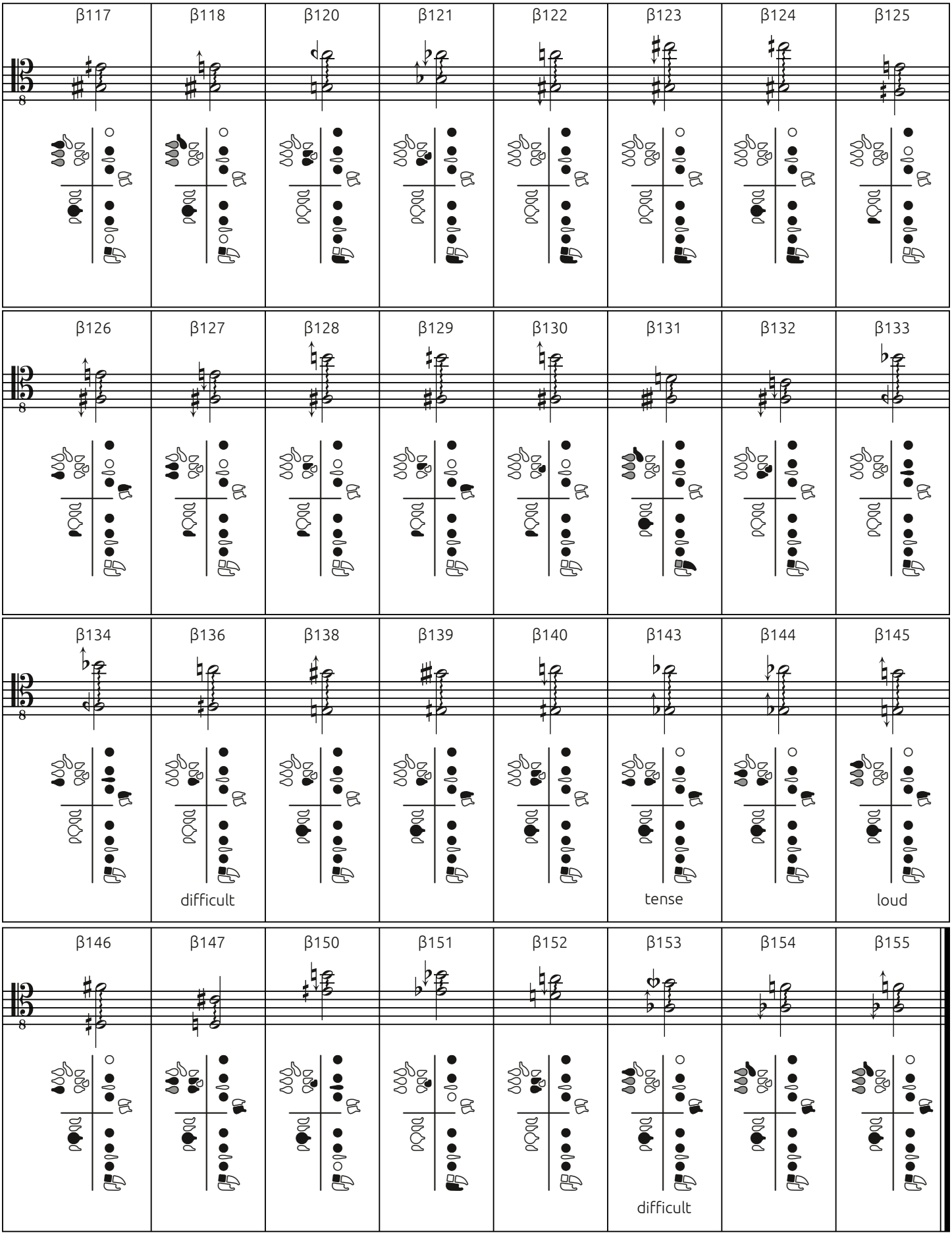
All of the multiphonics included in this chart are notated with their fundamentals (rounded to the nearest eighthtone), and have been assigned a temporary reference label. Many of these fingerings can be modified slightly by adding additional keys further down the instrument. This chart is preliminary and not exhaustive.

For a more thorough explanation of woodwind multiphonics and of the multiphonic notation used in this chart, see appendix F.




β035
β036
β037
β038
β039
β040
β041
fragile
β042
β043
β044
difficult
β047
β048
β050
β052
β053
β054
β055
β056
β057
β058
β059
β060
β061
β063
β064
β068
β070
β071
β072
β073
β074
β075
difficult


β076
β079
difficult
β080
β081
β082
β084
β086
β087
β088
β089
β090
β092
β094
β095
β096
β097
fragile
β098
tense
β099
tense
β100
β101
β102
β104
β105
tense
β106
tense
β107
β108
β109
β110
β112
β113
β114
β115


β117
β118
β120
β121
β122
β123
β124
β125
β126
β127
β128
β129
β130
β131
β132
β133
β134
β136
β138
β139
β140
β143
β144
β145
difficult
tense
loud
β146
β147
β150
β151
β152
β153
β154
β155
difficult

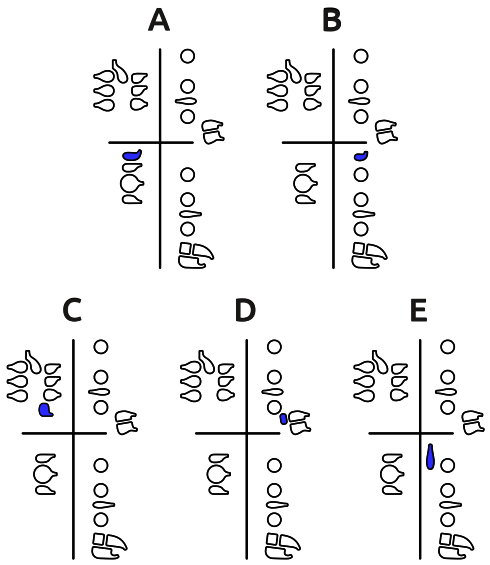
Appendix A – Keywork Variations

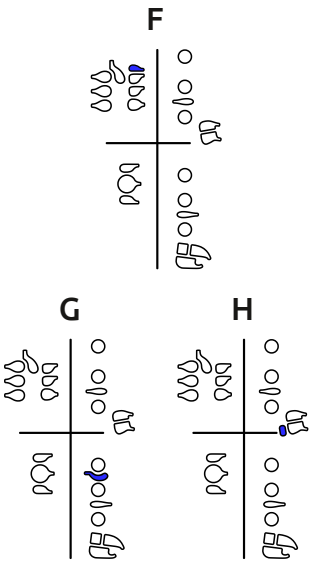
The keywork of most professional-level woodwind instruments has more or less completed the experimentation process. Today, these instruments are both able to meet the technical demands of the vast majority of the repertoire, and are highly standardized between manufacturers. With contrabassoon, in contrast, this refinement and standardization process is still very much ongoing. Manufacturers and performers address the various deficiencies in contrabassoon keywork in different, and occasionally incompatible, ways.

(This list is not exhaustive.)

E♭ keys

As the standard E♭ key is unfamiliar to bassoonists and awkward to use in many situations, an alternate E♭ key is the most common non-standard keywork addition on contrabassoons. The most common types of alternate E♭ key are the right thumb E♭ key (**A**) and the right index finger E♭ key (**B**). Less common types include the left thumb E♭ key (**C**), left pinky E♭ key (**D**), or the saxophone-style side E♭ key (**E**). Each type has its advantages and disadvantages. Instruments with more elaborate keywork may have multiple alternate E♭ keys.



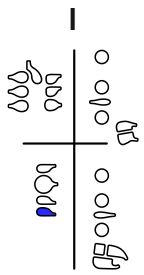


C♯ keys

Due to the demands placed on the left thumb, an alternate C♯ key is also advantageous, though significantly less common than an alternate E♭ key. The most simple type is the alternate C♯ key touch (**F**) which allows a C♯ key to be used in combination with the upper octave key on instruments lacking the alternate upper octave key touch. The right middle finger C♯ key (**G**) and left pinky C♯ key (**H**) generally require a second C♯ tonehole on the front of the body joint. As with alternate E♭ keys, it is possible for an instrument to have multiple alternate C♯ keys.

A♭ keys

Though standard on bassoon, the right thumb A♭ key (**I**) is much less common on contrabassoon. When present, it may open the same tonehole as the standard A♭ key, or have its own tonehole.



F♯ keys

Though older contrabassoons may lack the front F♯ key, most contrabassoons have the same two F♯ keys found on bassoon. However, contrabassoons have three broad types of setups regarding the F♯ toneholes:

1) Two F♯ keys open a single tonehole. On these instruments, there will be no difference in tone or intonation between the two fingerings in either octave.

2) Two F♯ keys open two different toneholes that are very similar in dimensions and position. On these instruments, there may be slight differences in tone or intonation between the two fingerings, but either fingering is likely to be effective in either octave.

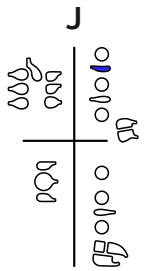
3) Two F♯ keys open two different toneholes that are dissimilar in dimensions, position, or both. On these instruments, there are likely to be significant differences in tone and intonation between the two fingerings, and certain octave/fingering combinations may be noticeably less effective than others.

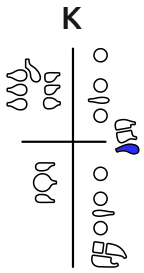
B♭ keys

While the large majority of contrabassoons have the same two B♭ keys as bassoon, some instruments discard the unpopular front B♭ key, either to make room for more keys or to bring the other right hand keys closer together. However, this key can still be rather useful if the instrument possesses a right thumb E♭ key.

e/f♯ trill key

The e/f♯ trill key (**J**) is another key that is standard on bassoon but often absent on contrabassoon. Without it, the E2/F♯2 trill is precarious at best and impossible at worst. This key requires an additional tonehole.





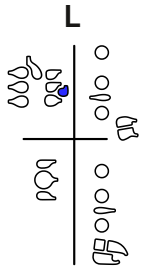
Low A key

Contrabassoons with a low A bell have an additional low A key (**K**). This key is generally positioned for the left pinky, below the low C♯ key.

Divorced E mechanism

Standard contrabassoons have a linkage that automatically closes the pad closed by the low E key whenever the lower octave key is used. This improves the tone, stability, and intonation of most of the middle-register notes that use the lower octave key. However, this linkage can negatively impact G♯2 when played using the lower octave key. The divorced E mechanism replaces this linkage with one that closes the pad closed by the low E key whenever RH3 is not used. This retains the benefits of the traditional linkage without adversely affecting G♯2, and can extend some benefits to the lower octave as well.

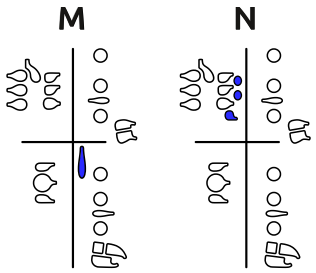
Alternate upper octave key touch



With standard contrabassoon keywork, it is difficult to move quickly from the C♯ key to the upper octave key due to the intervening lower octave key. Additionally, there are notes (E3 and F3 especially) which greatly benefit from both the C♯ and upper octave keys in combination. The alternate upper octave key touch (**L**) lessens or solves, respectively, these issues.

Standard harmonic vents

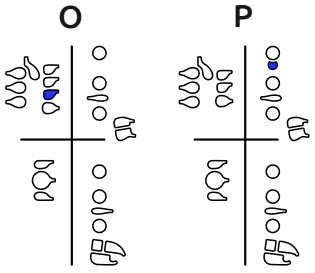
A standard contrabassoon has four harmonic vents. The first is opened automatically by the half-hole mechanism. The second and third are opened simultaneously by the lower octave key. The fourth is opened by the upper octave key. Like all reed instruments, the placement, size, and number of these vents are an acoustic compromise. However, the contrabassoon octave system is noticeably deficient compared to other instruments. In particular, G♯2 (which falls in the gap between the ideal ranges for the half-hole vent and lower octave vents) and C♯3 through E♭3 (which fall between the ideal ranges for the lower octave vents and upper octave vent) are generally less than satisfactory. These deficiencies have been addressed in a few different ways, all of which remain uncommon.



Middle octave vent & key

The middle octave key is an additional key and vent specifically for the notes C♯3, D3, and E♭3. When present, its touch can be found as a palm/side key for the right hand (**M**), in a variety of positions for the left thumb (**N**), or both.

G vent & key



The G vent key is a very uncommon additional key and vent specifically for the notes G2 and G♯2. When present, its touch can be found for the left thumb (**O**) or the left index finger, in a position analogous to rolling down to the bassoon's half-hole (**P**).

Fast-system

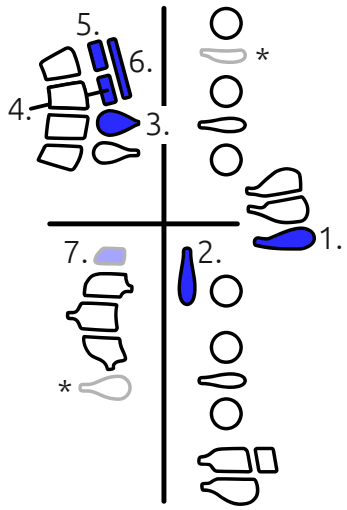
The Fast-system reworks the contrabassoon's harmonic vents entirely. The system features six harmonic vents in contrast to the standard four. While the half-hole mechanism and vent remain unchanged, the other five harmonic vents are controlled by just three octave keys (the standard lower and upper octave keys, plus the non-standard middle octave key) through an elaborate series of linkages and mechanisms. Though Fast-system instruments generally have a large complement of additional keywork (available on non-Fast instruments and discussed above), the Fast-system is properly defined by this octave system.

Contraforte

Whether the contraforte is simply a subtype of contrabassoon or a completely separate instrument is a matter open to debate. Regardless, it is designed to fill the role of a contrabassoon and to be played by contrabassoonists. Beyond the superficial visual differences (most noticeably the thumb keys), the most important differences between its keywork and that of a traditional contrabassoon are:

1. low A key as standard
2. side E♭ key as standard
3. single automatic octave key
4. twelfth key for third-harmonic notes
5. fifteenth key for fourth-harmonic notes
6. alternate C♯ key for use in combination with 4. & 5.
7. optional twentieth-plus key for fifth- and sixth-harmonic notes

* while technically optional, contrafortes are typically provided with e/f♯ trill and thumb A♭ keys as well

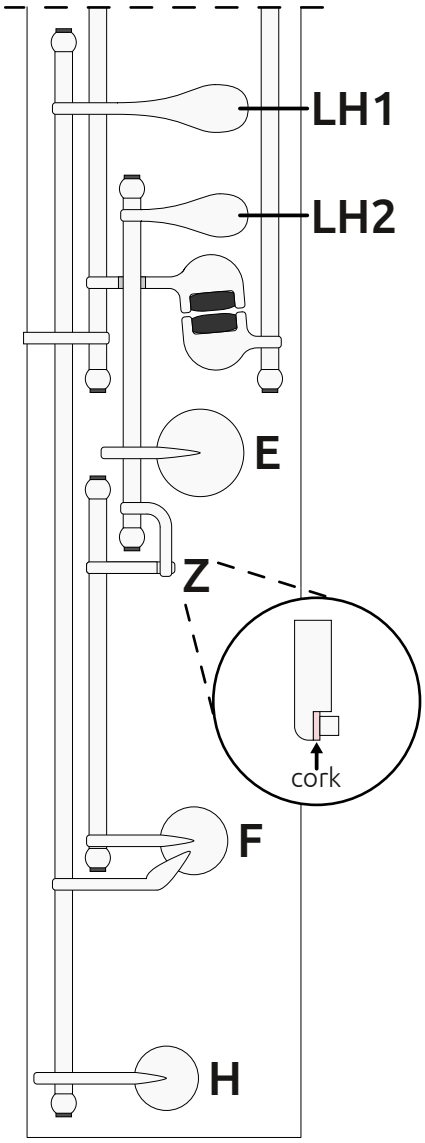


Kronwalt-system

The Kronwalt-system is a very recent development that combines a traditional contrabassoon form factor with some innovations borrowed from the contraforte. These include the contraforte's twelfth key, fifteenth key, alternate C♯ key, and twentieth-plus key. The system also includes a side E♭ key as standard.

Appendix B – Half-Hole Mechanism Adjustment

Since all contrabassoon toneholes are covered by pads (rather than directly by the fingers) a bassoon-style half-hole is not possible. Instead, the contrabassoon has an automatic half-hole mechanism, a typical arrangement of which is diagrammed below:



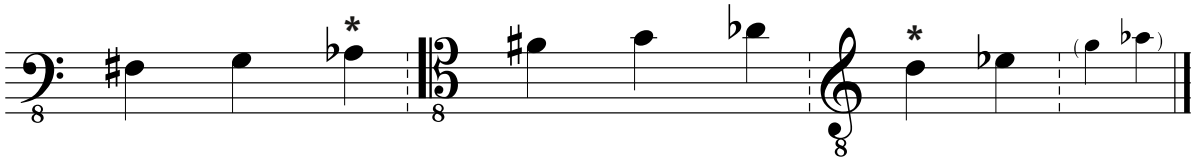
E is the tonehole for E2 and E3. **F** is the primary tonehole for F2 and F3. **H** is the half-hole vent and secondary tonehole for F2 and F3. **E** is closed directly by LH2, **H** is closed directly by LH1, and **F** is closed indirectly by either LH1 or LH2. As a result, the contrabassoon's equivalent of a half-hole is produced automatically whenever LH2 is depressed but LH1 is not.

The significant, but unavoidable, drawback of this system is that the amount of half-hole is fixed and cannot be shaded for different notes. It is therefore critical that the mechanism be well adjusted.

The most obvious setting is to adjust the mechanism so that **F** is fully closed whenever the half-hole is active. This setting works well on some contrabassoons. However, it is often beneficial for **F** to leak slightly when the half-hole is active. This is particularly important for D4 and E♭4, which may be impossible otherwise.

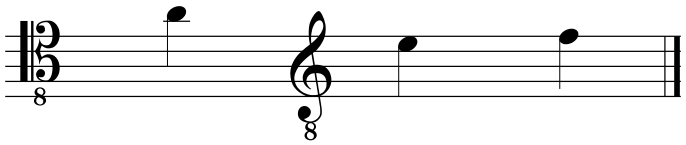
The degree to which **F** leaks while the half-hole is active is regulated by the cork at linkage **Z**. The cork can be sanded thinner for more leakage, or replaced with thicker cork for less leakage. However, if the cork is too thick, **E** will leak and virtually the entire playing range will be unstable or unplayable.

The most sensitive notes to this adjustment are A♭2 (if played without LH1) and D4, but all half-hole notes should be checked for intonation and reponse while adjusting this cork.

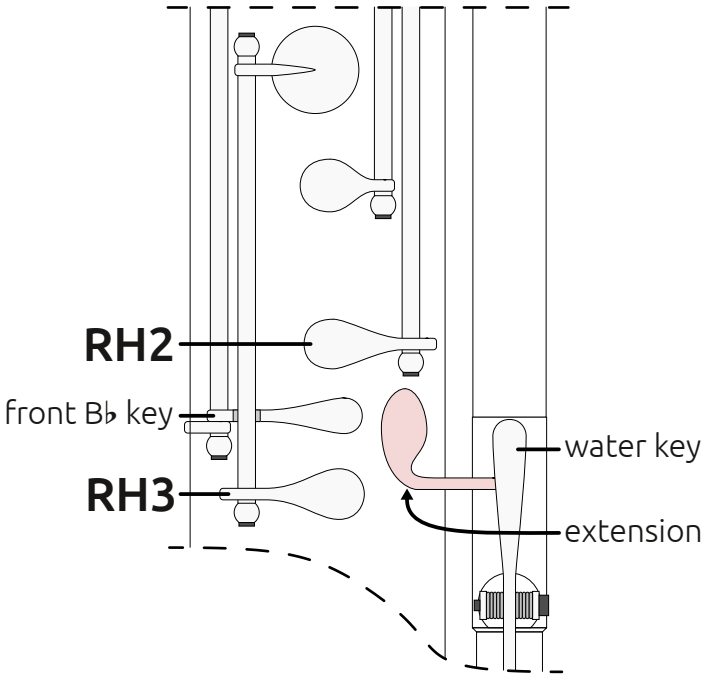


Appendix C – Water Key Extension

The contrabassoon's water key vent (located on the tuning slide) is not positioned or sized for musical purposes. However, on at least some instruments it is—by pure coincidence—well-suited to serve as a harmonic vent that can improve the reliability of some otherwise troublesome notes:



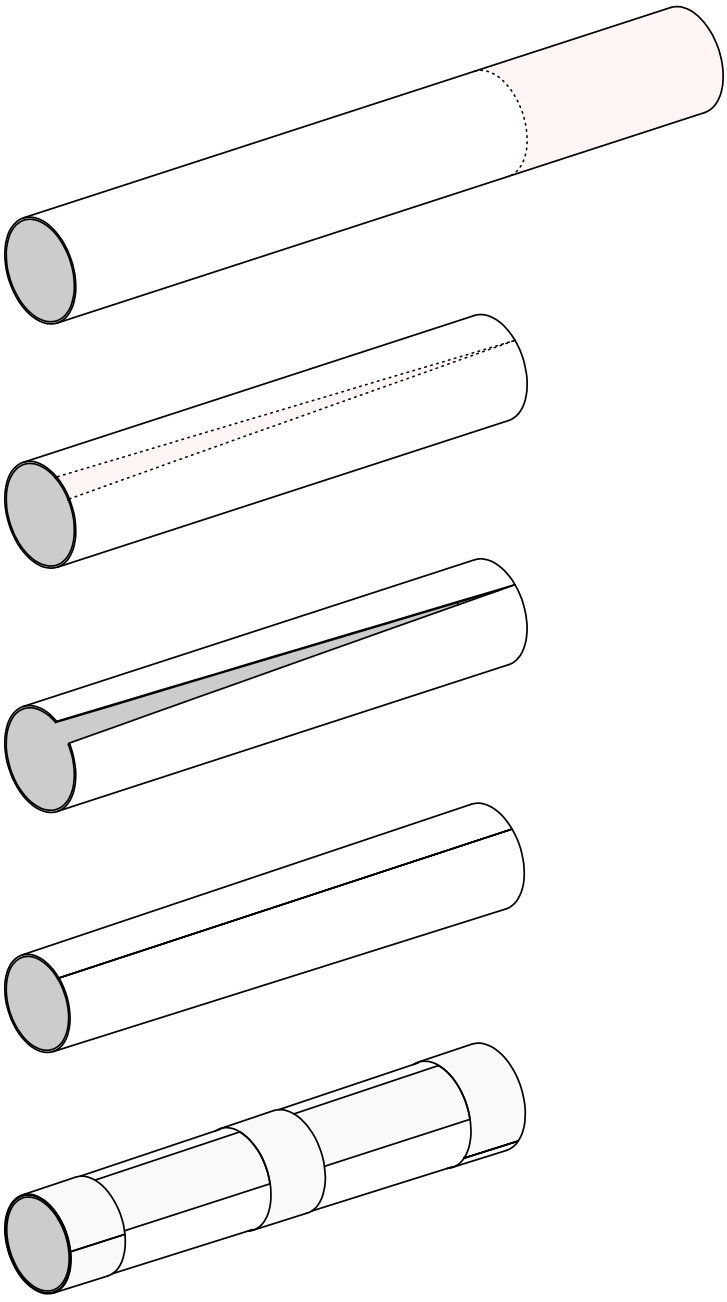
However, the water key touch is not designed to be easily accessible while playing, making it difficult to use in many situations. For this reason, I have soldered a key extension onto my water key, allowing it to be used easily by either RH2 or RH3.



Appendix D – Low A Extension

A lightweight, inexpensive, and effective conical low A extension can be made using a 3-inch cardboard mailing tube. Before beginning construction, it is helpful to have enough material for at least two extensions so that the first can serve as a trial to establish dimensions.

Construction is straightforward:



Cut to length. If this is first extension for this particular instrument, cut long so it can be shortened for tuning. On my instrument, a length of 425 mm results in an in-tune A0.

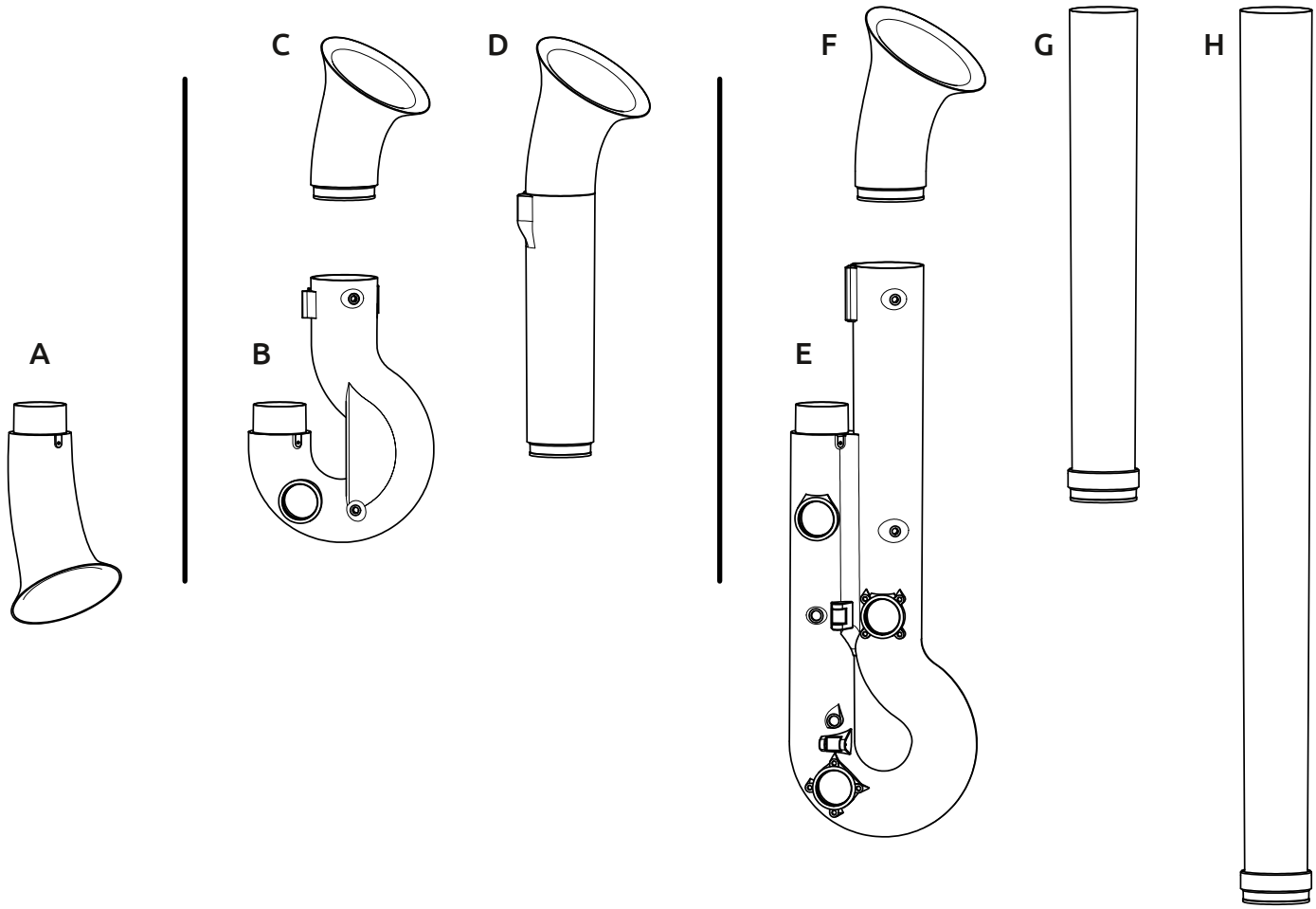
Cut a long triangular wedge out of the tube lengthwise. The width of the removed wedge should be such that this end will fit in the bell comfortably and securely. A wedge approximately 19 mm wide results in an outside diameter of 73 mm, which is a good fit for my instrument.

Close the seam using duct tape. Wrap in matte black electrical tape for appearance, if desired.

Appendix E – Lower Extensions

Earlier revisions of this chart detailed a method to make extensions below A0 using mailing tubes and PVC fittings. I have come to question the wisdom of extensions made in this manner due to the stresses they can place on the instrument if not handled carefully. Furthermore, it is my hope that soon the subcontrabassoon will be able to play in this range with much greater control and flexibility than could ever be achieved with a collection of giant contrabassoon extensions.

If an extension below A0 is needed, I believe that 3D-printing offers a much more elegant and less dangerous solution. 3D-printed extensions can be a fraction of the weight, and can be designed to mount securely to the instrument rather than relying upon a friction fit in the bell. Illustrated below are some of the 3D-printed extensions I have tried:



		Overall Length	Bore ID Start	Bore ID End	Tonehole Position	Tonehole ID
A	Replacement low B♭ bell	190 mm	59.6 mm	127 mm	–	–
B	Keyed low A bell	440 mm	58.2 mm	63.1 mm	90 mm	39 mm
C	Bell for **B**	149 mm	63.1 mm	139 mm		
D	Low A♭ extension for **B**	439 mm	63.1 mm	145 mm	–	–
E	Keyed low G bell	1118 mm	58.2 mm	70.0 mm	90 mm 405 mm 737 mm	39 mm
F	Bell for **E**	167 mm	70.0 mm	75.6 mm	–	–
G	Low F♯ extension for **E**	540 mm	70.0 mm	154 mm	–	–
H	Low F extension for **E**	995 mm	70.0 mm	80.4 mm	–	–

Appendix F – Multiphonics In-Depth

Multiphonic Foundations

Multiphonics[1] mystify many performers and composers, and much of the available literature does little to change that. But at its core, a multiphonic is simply a sound that results when a woodwind produces two (or, theoretically, more[2]) fundamental tones simultaneously. In that regard, it is similar to a two-note chord. However, a multiphonic differs from a chord (or at least from a musically useful chord) in two critical aspects:

> 1) In a chord, the performer can rely upon precise intonation of each chord member. This is accomplished either by tuning each chord member in advance (e.g. piano), by having each chord member be able to be tuned individually by the performer (e.g. a violin double-stop), or by having two different performers each responsible for one chord member (e.g. a contrabassoon duet). But in a multiphonic, the two fundamental tones are produced by a single air-column controlled by a single performer. A fingering, voicing, embouchure, or airstream change that alters the intonation of one fundamental also affects the other. But this coupling is not equal or linear; a small adjustment to one fundamental may affect the other trivially or greatly, depending on the idiosyncrasies of the instrument. Chords rely upon achieving a precise pitch relationship between two notes, but in a multiphonic a desired precise pitch relationship is often impossible.
>
> 2) In a chord, difference tones and summation tones (collectively, combination tones) are a rather minor part of the sound. Combination tones may cause a chord to be heard to "beat" if the chord members are out of tune or "ring" if they are well in tune, but are not strong enough to be perceived separately. But in a multiphonic, the two fundamentals being produced simultaneously in a single air-column creates much stronger combination tones; strong enough to be perceived as separate components of the sound. In fact, in many multiphonics the single most prominent component of the sound is one of these combination tones.

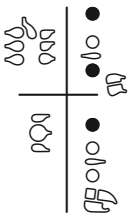
Adding the above two points together, one has a sound where the precise relationship between its fundamental tones create a complex and unintuitive array of strong combination tones that often have no clear relationship to the fundamentals or to one another, but also where that precise relationship is beyond the player's direct control. This gives multiphonics a unique sound but also introduces no small degree of chaos; performers and composers who wish to use these sounds should embrace both.

---

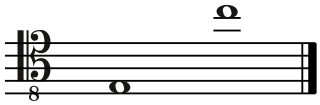
[1] Throughout this appendix, "multiphonic" will be used as a shorthand for "woodwind multiphonic." Other instruments use the term "multiphonic" to refer to different techniques, but this section is only concerned with woodwind usage.

[2] If multiphonics with three or more fundamentals actually exist in practice, I have yet to find clear evidence of one.

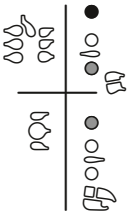
As an example, this fingering produces an easy multiphonic on my setup,



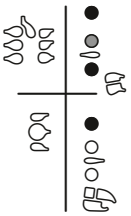
...which has fundamental tones of E2 and C4.



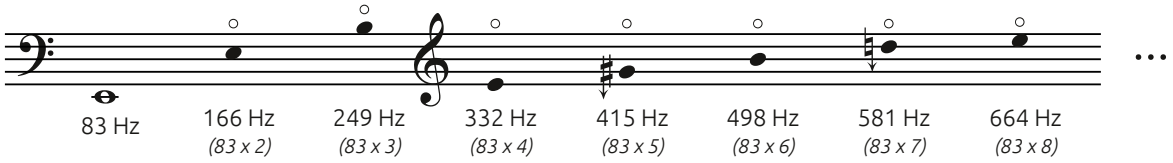
E2 is produced by the open LH2 tonehole,



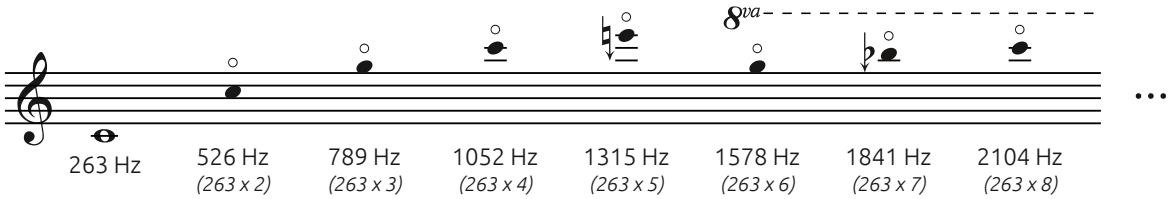
...while C4 is produced as a sharp fourth partial of B1 with the open LH2 functioning as a vent.



Above the E2 fundamental, there is a conventional harmonic series: E3, B3, E4, G♯4, etc...

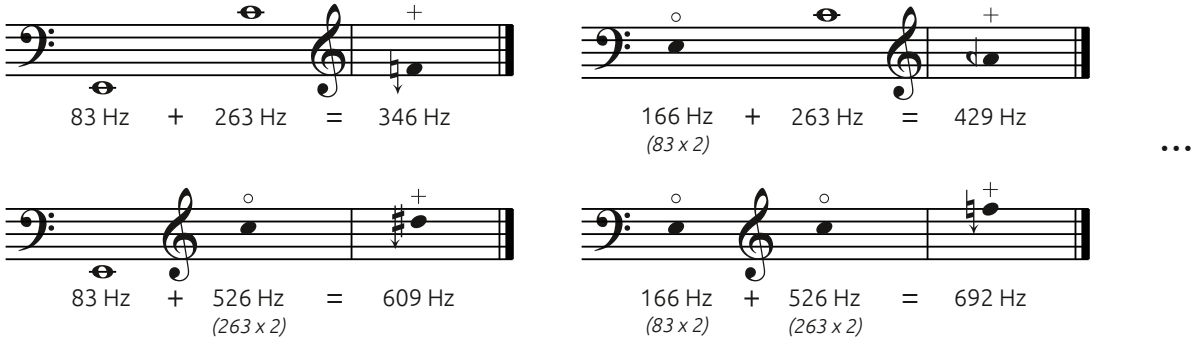


Likewise above the C4 fundamental: C5, G5, C6, E6, etc...

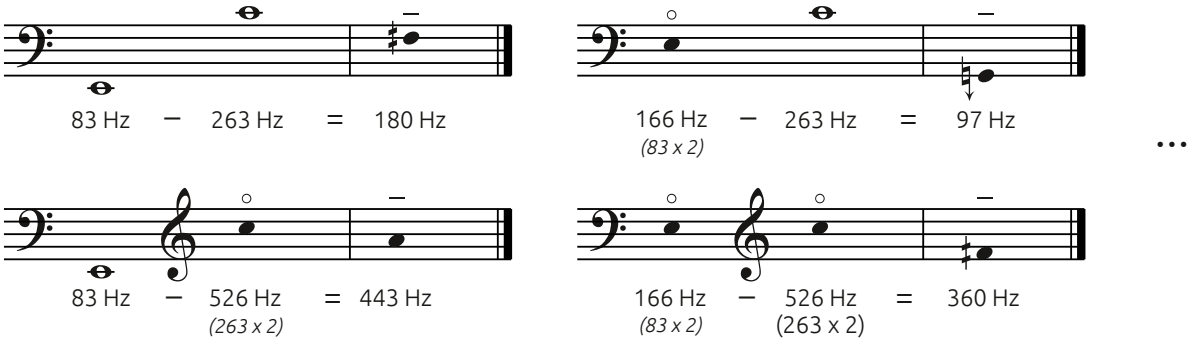


With just the fundamentals and harmonics, the resulting sound would be the same as if two contrabassoonists played E2 and C4 as a chord. The sound takes on its unmistakable multiphonic character when the combination tones are considered.

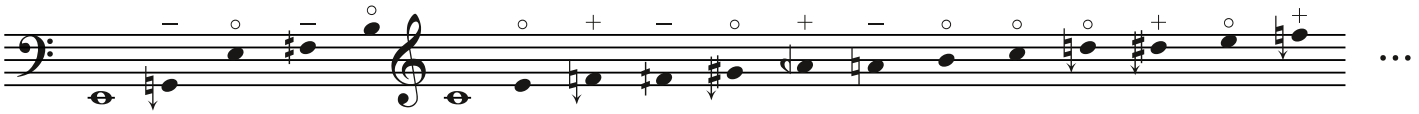
The summation tones can be found by simple addition of the frequencies of the fundamentals with each other, or of one fundamental with a harmonic of another, or of a harmonic of one fundamental with a harmonic of another fundamental. A small sample of possible summation tones is illustrated here:



The difference tones can be found similarly through subtraction[3]; one fundamental from another, one fundamental from a harmonic of another, a harmonic of one fundamental from another fundamental, or a harmonic of one fundamental from a harmonic of another fundamental:

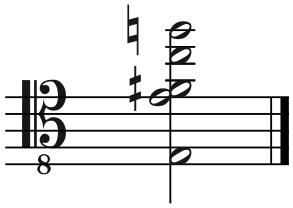


Added together, one gets a diverse collection of possible tones that may look haphazard and random, but which can be ascertained using only the frequencies of the two fundamental pitches. On some multiphonics, only a few of these are salient; on others, dozens are:



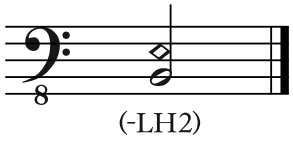
Multiphonic Notation

Early efforts at multiphonic notation threw all of the fundamentals, harmonics, summation tones, and difference tones into one big pile, picked out the loudest tones, and came up with a notation similar to this:



Even if a fingering were provided—one would hope so—the chord itself would be of no help whatsoever for a performer attempting to produce the sound. Any information that could be useful is obscured by and indistinguishable from information that is not.

Some composers, realizing this, took the opposite approach and developed a variety of tablature notations:

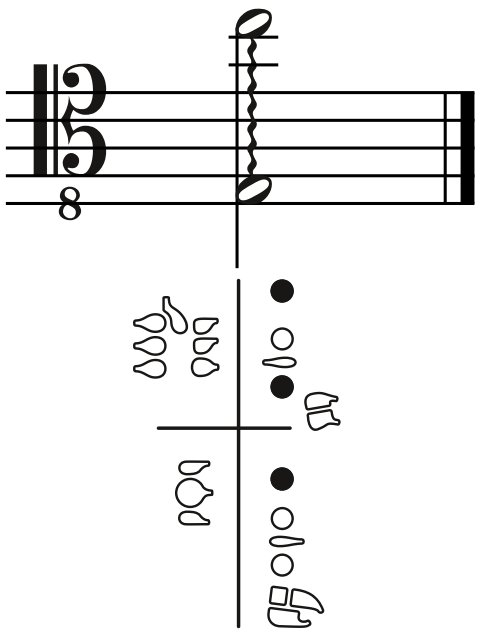


These notations indicated exactly which keys to depress (unless the fingering became too complicated), but gave the performer no hint of what sound they should expect. If a fingering did not work the performer had no information with which to find an alternate solution. The performer also had no way to verify whether the sound they were producing was the sound the composer intended.

---

[3] It is only the magnitude of the difference that matters in this case; any negative sign should be gleefully ignored.

Thankfully, some of the more recent multiphonic research and compositions limit the notation to only the information that is most useful to the performer; the two fundamentals and the fingering. I believe this is the most practical solution. Performers have everything they need to perform the sound, including information to make a substitution if necessary, without any extra clutter.



To this, I add a vertical wavy line. This serves three goals. Firstly, to stand in visually for the unwritten combination tones. Secondly, to gently remind composers that despite looking superficially like a chord, the resulting sound will be quite different. And lastly, to assure performers and conductors that the composer did indeed intend a multiphonic, rather than a divisi for multiple players.

I believe that notating one or more combination tones does more harm than good:

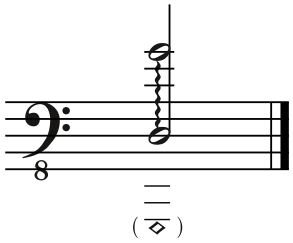
1) The primary purpose of music notation is to provide relevant and concise information to the performer, not to document every perceivable nuance of the sound.

2) These tones arise automatically when the indicated fundamentals are produced, not through any extra effort of the performer.

3) These tones are very sensitive to the exact tuning of the fundamentals, which cannot be tuned fully independently. A 10¢ deviation in one of the fundamentals (which can easily be found between different instrument makes, reeds, and performers, especially when using non-standard fingerings) can produce a 25¢–50¢ deviation in some of the difference tones, more than enough to render a microtonal accidental incorrect and create confusion.

4) The relative strength of these tones, and therefore which of of the multitude of tones would be notated and which would be ignored, is a product of the exact timbre of the harmonic series of the fundamentals. The fourth-most prominent component of a multiphonic on one instrument may be only the sixth-most prominent on another. This is beyond the scope of our notation system to represent.

The one exception I would make is when the two fundamentals are intended to create a harmonic relationship. The causes all of the components of the multiphonic to work together to simulate a harmonic series based upon one of the lower difference tones. In this situation, I do believe it is helpful to indicate this tone (the resultant tone).



Multiphonic Analysis and Categorization

The downside of this notation is that determining which components of a multiphonic are fundamentals, and which are combination tones, is not always straightforward. Even with a recording and a known fingering, there is sometimes ambiguity. This is particularly true on fingerings where an octave vent or the half-hole vent is open. On such fingerings, there is often a strong tone between B1 and F2 which could be either a fundamental with the vent acting as a leak, or a difference tone between middle-register and upper-register fundamentals. With the multiphonics on pages 32–35, when I was unable to determine whether this tone was a fundamental or difference tone using spectral analysis, I defaulted to whichever interpretation more closely matched the fingering.

The multiphonics on pages 32–35 were sorted and temporarily labeled according to my interpretation of how the fundamentals were produced. As examples:

β001 through β007 are most likely produced by the first partial of E2 and the fourth partial of C2,

β008 through β014 by the first partial of E2 and the fourth partial of B1,

β021 through β025 by the first partial of E♭2 and the fourth partial of B1,

β107 through β110 by the second and third partials of B♭1,

β154 and β155 by the third partial of C♯1 and the sixth partial of B♭0.

However, there is even more ambiguity here and this particular sorting and labeling should be viewed as preliminary and subject to further study. Labels that were skipped (for example, β004) were used for multiphonics which were not acoustically distinctive from another multiphonic with an easier fingering, and for resultant tones which were listed separately on page 31.

Multiphonic Recordings

Recordings of all of the multiphonics included on pages 32–35 and the resultant tones from page 31 can be found at subcontrabassoon.com/contrabassoon_multiphonics. When transcribing the notation of these multiphonics, I averaged the intonation across several samples; the specific recordings included at the link above may not match the averaged transcription precisely.

Revision History

1.0	Jan 2018	original
1.1	Feb 2018	corrected divorced E mechanism description
2.0	Mar 2022	major revision
		added tremolo, quartertone, and multiphonic charts
		replaced appendix E, added appendix F
		added cool alternate name
2.1	Apr 2022	minor typographical corrections and edits
		added notation section
2.2	May 2022	minor corrections
2.3	Sep 2022	minor corrections
2.4	Dec 2022	minor updates

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