Compendium of Sonic Possibilities of the Contrabass Clarinet: A Study of Cross-Compatibility and Composer Collaboration

Jason William Alder

PhD 2021

Compendium of Sonic Possibilities of the Contrabass Clarinet:

A Study of Cross-Compatibility and Composer Collaboration

Jason William Alder

A thesis submitted in partial fulfilment

of the requirements of

Manchester Metropolitan University

for the degree of

Doctor of Philosophy

Awarded for a Collaborative Programme of Research

at the Royal Northern College of Music

by Manchester Metropolitan University

2021

Abstract

Compendium of Sonic Possibilities of the Contrabass Clarinet: A Study of Cross-Compatibility and Composer Collaboration is a resource for composers and performers detailing the use of contemporary techniques on the contrabass clarinet. Due to a lack of standardisation of the instrument, the results of using these techniques can vary greatly between instruments from different manufacturers. This resource discusses new and known techniques from the clarinet and wind-instrument lexicon, noting their differences when played on the contrabass clarinet, with particular focus on the cross-compatibility between instruments from the three most-used manufacturers – Leblanc, Selmer, and Eppelsheim. Through collaboration with composers, new techniques were developed with ways of composing for them. Included are fingering charts for the altissimo register, quarter-tones, multiphonics, colour-fingering combinations, and double trills for each of the three contrabass clarinets, audio and video examples of many of the techniques performed on each instrument, and recordings of new compositions created through the collaborative process and improvisations demonstrating the use of the techniques.

The results of this thesis bring greater attention to the contrabass clarinet and provide tools for promoting its use among composers and performers.

Aknowledgements

I'd like to thank my supervisors Dr Sarah Watts and Dr David Horne for their help and guidance on this journey, and all the staff in the Research department and library at RNCM for always being of great assistance to me.

I could not have accomplished this research without the assistance of Tony Fleming for allowing me to use his Eppelsheim contrabass clarinet for data collection. I thank you and am immensely appreciative of your generosity. And my utmost thanks and gratitude to Stéphane Gentil, Henri Selmer Paris, Claudio Puntin, and Benedikt Eppelsheim for allowing me to borrow contrabass clarinets for an extended period of time during the Covid-19 pandemic when I couldn't otherwise have access to them. A special thanks to Georg Kühner for going above and beyond to make and adapt new tools to hand-make me the huge reeds for these beasts!

Thank you, Albert Rice, for your wealth of historical knowledge of clarinets that you've shared with me. Thanks to Bret Newton for the many nerdy chats about music and instruments. And to Cyrille Mercadier, thanks for allowing me to spend a long day in your shop in Paris as you told me so many things about Leblanc and their instruments.

To all the contrabass clarinettists I've chatted with during the past couple years, thanks for indulging me. I hope that this will be useful to us all!

To the composers I've worked with, thanks for all the great music, and more to come!

And last but not least, the greatest thanks go to my family, Jenny, Rafi and Lev, Jane and Rich, and Mimi and Dave, for your continued love, support, and help. Without you, I would never have been able to spend so much time making funny noises on contrabass clarinets.

Table of Contents

List of Figures

List of Tables

Introduction

The B♭ contrabass clarinet is the largest member of the clarinet family in use, sounding one octave below the bass clarinet and two octaves below the B♭ clarinet. There are currently three primary instruments used professionally—those produced by Henri Selmer Paris[1], G. Leblanc[2], and Benedikt Eppelsheim.[3] All three instruments have different designs, keywork, and capabilities that will be discussed.[4]

Lack of standardisation poses a problem when writing music using contemporary techniques—particularly those requiring special fingerings—as many aspects are non-transferrable between instruments due to design differences. When commissioning new works, composers desire a piece to be playable regardless of instrument make; thus, a need exists for a resource that details the cross-compatibility.

This research creates a compendium of contemporary technique possibilities on the contrabass clarinet, useful for both performers and composers, as there are currently limited resources dedicated to the instrument. There is a focus on the production of fingering charts—particularly for multiphonics, quarter-tones, altissimo register, and colour fingerings[5]—however other techniques, such as singing while playing and slap tongue, are examined with particular regard to any differences between the three contrabass clarinets or other members of the clarinet family.

The contrabass clarinet is a relatively new instrument, and its repertoire comparatively limited.[6] A second aim of the research is to add to this body of literature. I

[1] Henri Selmer Paris. https://www.selmer.fr/
[2] Conn-Selmer (Leblanc). https://www.conn-selmer.com/en-us/our-brands/leblanc
[3] Benedikt Eppelsheim Wind Instruments. https://www.eppelsheim.com/en/
[4] A visual comparison of the three contrabass clarinets can be seen in Figure 23.
[5] Further explanations of techniques can be found in Chapter 3.
[6] The first instrument regarded as a B♭ contrabass clarinet was produced in 1889 by Fontaine-Besson (Paris). The history of the contrabass clarinet and its repertoire is examined further in Chapter 1.

have collaborated with composers to explore the instrument's sounds and develop new compositions, endeavouring to discover new contemporary techniques and ways to compose for them. These collaborations and my own improvisations have guided the direction of my research into contemporary techniques, discovering new possibilities in addition to those already known from existing clarinet repertoire.

Chapter 1 discusses the historical development of the contrabass clarinet and its repertoire, detailing its slow acceptance into compositions. Chapter 2 examines the Leblanc, Selmer, and Eppelsheim instruments' design differences and their impact on contemporary techniques. Chapter 3 categorises and describes sound possibilities through contemporary techniques, with references to fingering charts, recorded examples, and their use in composition. Chapter 4 reviews my collaborative processes with composers, how our mutually beneficial relationships helped discover and use contemporary techniques, the compositions produced, and my own improvisations.

Notation

I will refer to pitches as written in standard French notation, treble clef sounding two octaves and a major second lower than written. All notated examples and fingering charts are in this transposition unless otherwise specified.

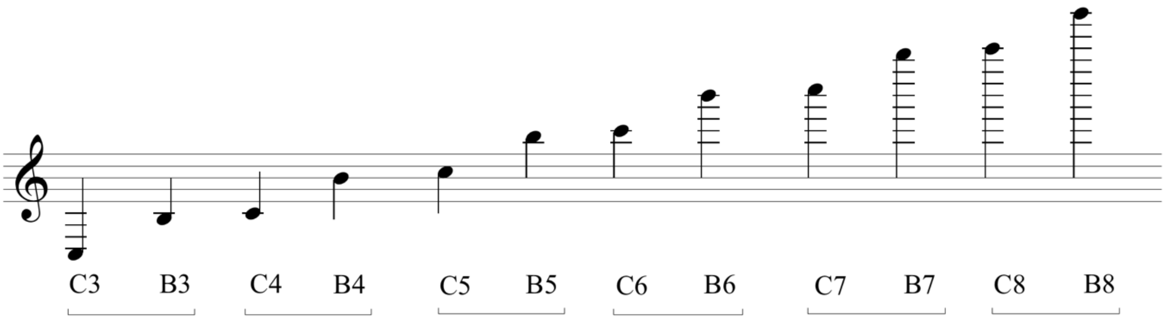


Figure 1. Range by octave, transposed for B♭ contrabass clarinet. Sounding pitch is two octaves and a second lower.

The accidental markings used in the fingering charts and text are:

𝄰 - Three-quarters sharp

♯ - Sharp

𝄲 - Quarter sharp

♮ - Natural

𝄳 - Quarter flat

♭ - Flat

𝄭 - Three-quarters flat

The double trill fingering charts use these additional accidentals:

↑♯ - A bit higher than sharp

↓♯ - A bit lower than sharp

↑♮ - A bit higher than natural

↓♮ - A bit lower than natural

↑♭ - A bit higher than flat

↓♭ - A bit lower than flat

Chapter 1: The History of the Contrabass Clarinet

The contrabass clarinet in B♭ is the primary focus of this research; however, clarinets in the contrabass range in other keys were also made, particularly in E♭.[7] Contra clarinets in C and F have also existed but are now obsolete. The instrument manufacturer G. Leblanc (Paris) has made a B♭ octocontrabass and E♭ octocontra-alto clarinet, one octave below the contra instruments of the same pitch; however, the only extant examples currently reside in a museum.[8]

Nomenclature

The terms E♭ contrabass clarinet, contrabasset-horn, contra-tenor clarinet, contra-alto clarinet, and contralto clarinet were all used at varying points in history to refer to the instrument sounding one octave below the alto clarinet. Adolphe Sax's[9] *clarinette-contrebasse* is referred to in 1846,[10] and Altenburg uses *Kontrabaßklarinette in Es*, *Kontra-Altklarinette,* and *Kontrabasset-horn*[11] in 1912. Lavignac writes about the *clarinette-contralto* in 1927,[12] and Koechlin uses that term in 1954.[13]

---

[7] The E♭ contra(alto/bass- discussed in detail below) clarinet is one octave below the alto clarinet and a perfect fourth above the B♭ contrabass clarinet.

[8] *Le Musée des instruments à vent* in La Couture-Boussey, France houses the octocontra clarinets.

[9] Adolphe Sax was a Belgian instrument-maker and invented, among other instruments, the saxophone as well as designing the modern bass clarinet.

[10] P. H., "De La Musique Militaire," in Revue Britannique: Ou Choix D'articles Traduits Des Meilleurs écrits périodiques De La Grande-Bretagne, ed. Pichot Amédée, vol. 2 (Paris: La Revue, 1846), p. 432.

[11] Wilh. Altenburg, "Adolphe Sax Und Seine Verdienste Um Den Instrumentenbau," *Zeitschrift Für Instrumentenbau*, June 27, 1912, pp. 1017-1021.

[12] Albert Lavignac and Lionel de la Laurencie, "Des Instruments A Vent," in *Encyclopédie De La Musique Et Dictionnaire Du Conservatoire*, vol. 2 Technique, Esthétique et Pédagogie (Paris: Delagrave, 1927), p. 1417.

[13] Charles Koechlin, "Clarinette," in *Traité De L'orchestration En Quatre Volumes, Vol. 1* (Paris: Éditions Max Eschig, 1954), p. 35.

The B♭ instrument one octave below the bass clarinet has been called a contrabass clarinet or double bass clarinet.[14] Earlier iterations of the instrument were called pedal clarinet, *clarinette-bourdon,* batyphone, and *Müllerphone ou Contrebass à anche*. Henri Selmer Paris produced the first widely-distributed instrument in 1931 and called it an E♭ contrabass,[15] and the term became the most widely used for the instrument in this pitch. Around 1959, Leblanc produced an E♭ contra-alto; however, they were the only company to use the term until the 1990s, when Selmer also began using it. Selmer now uses the term contralto[16], which can cause additional confusion as the term *contralto* in Italian refers to the alto voice, between soprano and tenor. Giamperi refers to the *clarinetti contralti* in Fa and Mi♭ with a transposition chart indicating it is referencing the alto clarinet,[17] and Rehfeldt also uses E♭ contralto, in English, for the alto clarinet.[18] Rendall states that the contra clarinet in F was called a contra-tenor clarinet,[19] only further confusing the matter, as it is pitched higher than the E♭ contra. Using the term E♭ contrabass has also caused uncertainty, as the pitch indicator is not always used when referring to the instrument. In researching repertoire, this meant that pieces might be listed simply as having contrabass clarinet with no pitch indication. Further score investigation was then required to determine the intended pitch. Today, contra-alto or contralto is more widely used to distinguish between the instruments; however, there remains debate regarding its accuracy as a term.[20]

---

[14] *Double bass clarinet* is particularly used when translated from other languages.

[15] Further discussion of this instrument on page 11.

[16] Henri Selmer Paris, “Contralto Clarinet | Henri SELMER Paris,” Henri Selmer Paris, June 27, 2019, https://www.selmer.fr/en/product-sheet/contralto-clarinet.

[17] Alessandro Vessella, *Studi D'istrumentazione per Banda* (Milano: G. Ricordi & Co., 1955).

[18] Phillip Rehfeldt, *New Directions for Clarinet* (Berkeley and Los Angeles, CA: University of California Press, 1994), p. 3.

[19] Francis Geoffrey Rendall, “Chapter 12: The Contrabass Clarinet,” in *The Clarinet, Some Notes upon Its History and Construction* (London: Williams and Norgate, 1954), p. 158.

[20] Bret Pimentel, “Bret Pimentel, Woodwinds,” *Bret Pimentel, Woodwinds* (blog), September 6, 2017, https://bretpimentel.com/naming-the-low-e-flat-contrabass-contra-alto-clarinet/. See also Bret Newton, *Band Orchestration*, 2nd ed., vol. 2 (Newton Press, 2019), p. 293, where the term Great Bass is proposed.

Development of the Contrabass Clarinet

Early Instruments

First developments of contra clarinets include the bassoon-shaped *contre-basse guerrière* in B♭ (Dumas, Paris 1808),[21] *Kontrabass-Klarinette* in F and E♭[22] (Streitwolf, Göttingen 1829), batyphon in C (Wieprecht and Skorra, Berlin 1839), and the *Müllerphone ou Contrebass à anche* (Müller, Lyon 1855). In 1850 Kruspe (Erfurt) built an ophicleide-shaped B♭ batyphon. Adolphe Sax (Paris) was building bassoon-shaped contrabass clarinets in E♭ and F and the *clarinette bourdon* in B♭ in the 1840s and -50s, and a metal saxophone-shaped E♭ contrabass clarinet in 1851. Maldura (Milan) developed a bass clarinet-shaped E♭ *contrabasso* by 1881,[23] and Eugene Albert (Brussels) made a 15-key metal contra clarinet in

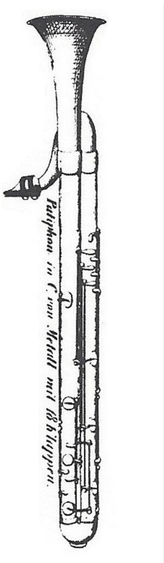


Figure 2. Kruspe Bathyphone in B-flat. From a price list of the Carl and Eduard Kruspe Company, Erfurt, c. 1865.

Figure 3. Wilhelm & Skorra Wieprecht, Bathyphone, Ident. Nr. 2904. Musikinstrumenten-Museum, Staatliches Institut für Musikforschung. Jürgen Liepe.

[21] Albert R. Rice, "Bass, Contra Bass, and Contra Alto Clarinets," in *From the Clarinet D'amour to the Contra Bass: a History of Large Size Clarinets, 1740-1860* (New York, NY: Oxford University Press, 2009), pp. 325-338.

[22] Altenburg, "Adolphe Sax und seine Verdienste um den Instrumentenbau" refers to Streitwolf's instrument as a contrabasset-horn.

[23] Albert R. Rice, "The E-Flat Contra Alto Clarinet by Maldura (1881) and the Contra Bass Clarinets by Besson (1890)," *Journal of the American Musical Instrument Society* XLII (2016): p. 161.

F by 1886, for Gustave Poncelet's clarinet ensemble.[24] Evette and Schaeffer (Paris) made a 21-key metal instrument to E3 in B♭ in a bass clarinet-shape in 1891.[25]

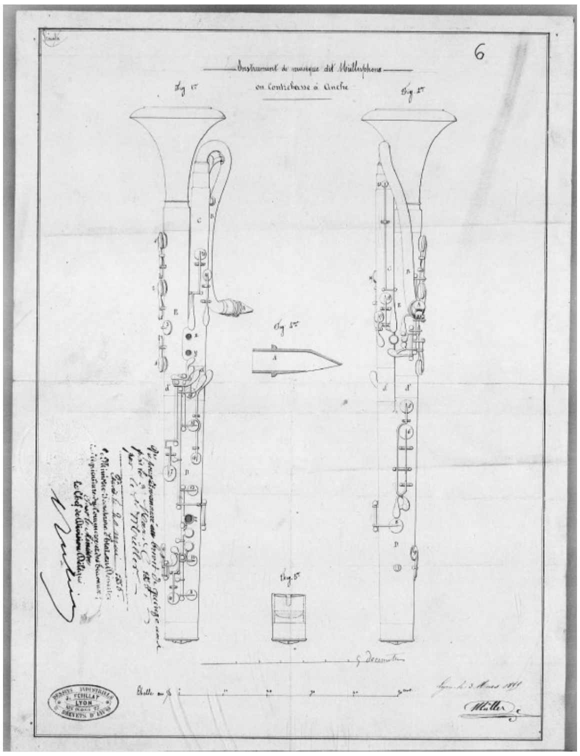


Figure 4. Müllerphone ou contrabasse á anche illustration from patent.

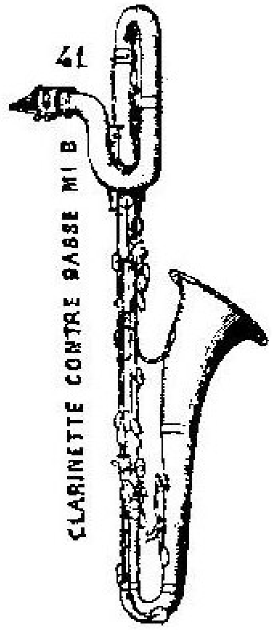


Figure 5. Adolphe Sax E-flat contrabass clarinet, Sax, prospectus (1867), reproduced in Haine and De Keyser, "Catalogue des instruments Sax".

[24] Rendall, *The Clarinet*, p. 158-159. See page 25 for more about Poncelet's ensemble.

[25] William Rousselet and Denis Watel, *Larigot No. XXIV Spécial: Le Livre D'Or De La Clarinette Française*, 2nd ed. (Paris, France: ACIMV c/o M.B. Kampmann, 2013), p.68. The instrument in the Watel collection, serial number 5, has a prototype extension to E♭3. An instrument in the private collection of Pedro Rubio, serial number 6, is only to E3. Rendall, *The Clarinet*, p. 160 states the patent was obtained 29 December 1891 and that it could be made of wood or metal.

Fontaine-Besson

The first usable instrument that is truly classified as a B♭ contrabass clarinet was developed in 1889 by the Fontaine-Besson company (Paris and London).[26] Two models were available utilising either simple-system or Boehm[27] fingerings,[28] with a range to either written E3 (military model) or B♭2 (orchestral model).[29] The construction consisted of a mouthpiece connected to a conical metal neck which connects to a series of wooden joints. At the bottom of the final wooden joint is an upturned metal bell with a pad.[30] An engraving

Figure 6. Fontaine-Besson Pedal Clarinet, Horniman Museum, London, Carse Collection.

Figure 7. 1894 Annuaire des Artistes de l'enseignement dramatique & Musical.

[26] It was also called a *clarinette pédale* or pedal clarinet as it played in the same range as the foot pedals of the organ.

[27] The Boehm-system (or French-system) of clarinet fingerings is the standard clarinet system used in the majority of the world. The other systems in use include German-system, primarily in Germany and Austria, and to a lesser extent Albert (or Simple)-system.

[28] Rice, "The E-Flat Contra Alto Clarinet by Maldura (1881) and the Contra Bass Clarinets by Besson (1890)", p. 173.

[29] J. L. Casembroot, "Nieuwe Speeltuigen," *Caecilia; Algemeen Muzikaal Tijdschrift Van Nederland*, June 1, 1898, pp. 87-89.

[30] See Figure 6.

from the 1894 *Annuaire des Artistes de l'enseignement dramatique & Musical*[31] depicts the instrument with the extended lower range.[32] A metal tube extends from the bottom joint with more toneholes before bending back up with the remaining toneholes and a flared bell at the end, extending to the entire height of the instrument.

Besson promoted their instrument at exhibitions in Paris, London, and Chicago[33] and held a series of concerts at their showrooms in London and Paris[34] featuring the contrabass clarinet played by Louis-Albert Bretonneau of the Paris Opéra Comique, where many musicians and composers heard it. Richard Kohl of the New York Conservatory of Music also performed on the instrument in New York and Germany. Composers such as Charles Gounod, Richard Strauss, and Camille Saint-Saëns spoke favourably of the new instrument's sound and capabilities,[35] and it was awarded gold medals at the Universal Expositions in Saint Louis and Liège.[36] Despite this, it was not very successful apart from a few sold to military bands in England, with poor intonation due to the conical neck and using a simple fingering system rather than the Boehm-system.[37] However, Gustave Poncelet also used it in his clarinet choir at the Brussels Conservatory[38] and conservatories in Nancy and Liège, and the Military School of Music in London purchased an instrument. However, only six extant examples are in museums in Belgium, England, the United States, and Japan. The high price is another speculative factor for its lack of greater success.[39]

---

[31] Montorier, J. "Annuaire Des Artistes Et De L'enseignement Dramatique Et Musical." Paris: Sociétés de Orphéoniques, 1894. p. 380. https://gallica.bnf.fr/ark:/12148/bpt6k124042w/f391.image.

[32] See Figure 7.

[33] Paris (1889 and 1900), London (1890), and Chicago (1893).

[34] London (1891) and Paris (1893).

[35] Casembroot, "Nieuwe Speeltuigen".

[36] Saint Louis (1904) and Liège (1905).

[37] Rendall, *The Clarinet*, p. 160.

[38] Wilh. Altenburg, "Die Contrabass-Klarinette Von Fontaine-Besson Und Poncelet's Klarinett-Concerte," *Zeitschrift Für Instrumentenbau*, November 11, 1898, pp. 121-122.

[39] Rice. "The E-flat Contra Alto Clarinet by Maldura (1881) and the Contra Bass Clarinets by Besson (1890)", pp. 186, 196.

Middle-Period Instruments

Heckel (Wiesbaden) made a 13-key contrabass clarinet to E3 in 1898,[40] in metal due to its "immutability" and the fact that it would not change dimensions like a wood instrument,[41] but stopped producing clarinets in 1948.[42] Buffet-Crampon (Paris) manufactured two styles of metal contrabass clarinets around 1935, one saxophone-shaped to E♭3[43] and one bass clarinet-shaped to E3,[44] both with Boehm-system. An example of a Hüller (Schöneck) 13-key from 1939 and an 18-key Boehm-system Moennig (ca.1900-1950) are in the Shackleton Collection.[45] Both are wood and bass clarinet-shaped with a range to E3. A wooden 26-key contrabass clarinet by an unknown maker in the early 20th Century, possibly from Graslitz, resides in the Museum Sokolov in the Czech Republic, [46] and in the 1930s Ernst Schmidt (Mannheim) built an instrument in G descending to D.[47]

In Italy, Leonildo Desidera (Verona) built a B♭ contrabass in a bass clarinet-shape around 1926[48] and Rampone (Quarna) made a similarly-shaped metal E♭ contra clarinet in the 1930s.[49] Maino & Orsi (Milan) produced a metal saxophone-shaped contrabass in the 1930s, now in their museum,[50] and in the 1960s, Orsi produced metal saxophone-shaped B♭

---

[40] Ibid., p. 189.
[41] Rendall. *The Clarinet,* p. 161.
[42] Wilhelm Heckel GmbH, "Instruments- Clarinet," December 16, 2018, https://heckel.de/en/chronicle/instruments/.
[43] The instrument is currently in the Buffet-Crampon museum in Paris.
[44] Rousselet and Watel, *Larigot No. XXIV Spécial: Le Livre D'Or De La Clarinette Française*, p. 40
[45] Arnold Myers, *Catalogue of the Sir Nicholas Shackleton Collection* (Edinburgh: Edinburgh University Collection of Historic Musical Instruments, 2007).
[46] Dullat Günter, *400 Jahre Musikinstrumentenbau in Graslitz: Katalog Zur Sonderausstellung 2013/14 Im Heimatmuseum Nauheim b. Groß-Gerau* (Nauheim: Heimat- und Museumsverein, 2013), p. 82.
[47] Rendall. *The Clarinet,* p. 159.
[48] Casa Museo Spada, "Musica Da Banda Item J.93," Casa Museo Spada English Version, accessed December 18, 2020, http://casamuseospadaen.blogspot.com/2017/01/blog-post_10.html.
[49] Rice, "The E-flat Contra Alto Clarinet by Maldura (1881) and the Contra Bass Clarinets by Besson (1890)", p. 195.
[50] Ibid.

and E♭ instruments using a simplified Boehm-system to E3 that Linton (Elkhart) imported and sold under their name.[51]

None of the aforementioned instruments currently exist in great numbers, however those from Linton occasionally appear on the used market.

Selmer E♭ Contrabass

The first contra clarinet with larger-scale production and still used today is the Boehm-system E♭ instrument from Henri Selmer Paris.[52] It was first produced in 1930 at the request of Austin Harding[53] for a modern E♭ contrabass clarinet.[54] It was initially made in grenadilla wood descending to E3[55], but later made of rosewood[56] and offered to E♭3 or D3.[57] The current instrument, called a contralto clarinet, is to E♭3 and made of rosewood.[58]

Figure 8. Selmer E♭ contra clarinet. Photo by Jason Alder.

[51] "Linton Prestige Woodwinds," *Linton Prestige Woodwinds* (USA, 1967).

[52] Model 26 in Europe, Model 40 in the United States.

[53] President of the American Bandmasters Association and director of bands at the University of Illinois.

[54] Richard K. Weerts, "The Contrabass Clarinet in the Modern Symphonic Band," in *Woodwind Anthology: A Compendium of Woodwind Articles from the Instrumentalist*, vol. 2 (Northfield, IL: Instrumentalist Co., 1999), pp. 110-111.

[55] H&A Selmer, Inc., "The New Selmer E♭ Contrabass Clarinet," *The Reed Section*. (Elkhart, IN: H&A Selmer, Inc., 1931), p. 40.

[56] H&A Selmer, Inc. *You'll Play Better with a Selmer*. (Elkhart, IN: H&A Selmer, Inc., 1951), p. 10.

[57] Henri Selmer Paris. *Instruments De Musique*. (Paris: Henri Selmer Paris, 1963).

[58] Henri Selmer Paris, "Contralto Clarinet | Henri SELMER Paris," Henri Selmer Paris, June 27, 2019, https://www.selmer.fr/en/product-sheet/contralto-clarinet.

Selmer's E♭ contra clarinet was adopted early-on by Ross Gorman of the NBC Studios in New York, who reports using the instrument for multiple broadcasts,[59] and Georges Delville of the French *Garde Republicaine*[60] and Sextuor de Clarinettes de Paris.[61]

George Bundy was the manager of Selmer's New York retail store in 1911. In 1927 he purchased the store and created H&A Selmer (USA) to import Selmer Paris products, and began manufacturing a line of plastic clarinets under the Bundy name in Elkhart, Indiana.[62] By 1964 Bundy was producing a Boehm-system E♭ contra to E♭3[63]. Selmer USA bought the Buescher Band Instrument Company in 1963 and produced an E♭ Boehm-system plastic instrument to E♭3 in the 1970s,[64] identical to the Bundy model. The Buescher line ceased in 1983, and in 1985 the Bundy instrument was rebranded as Selmer (USA)[65] and is no longer produced.

The Leblanc Corporation

In the mid-1930s the Belgian acoustician Charles Houvenaghel, working with the Parisian company G. Leblanc, designed a new B♭ contrabass clarinet. Made of metal and descending to C3, it is a curved instrument that wraps upon itself. The mouthpiece attaches to a neck-piece at about half the instrument's height that slides into an upwards tube. A top U-

---

59 H&A Selmer, Inc., "The New Selmer E♭ Contrabass Clarinet". Gorman is featured in the advertisement.

60 The Garde Republicaine is a military band of the French Republican Guard.

61 Sextuor de Clarinettes de Paris. (n.d.). *The Clarinet, volume 2 LS 1077* [Vinyl recording]. London. The sextet– comprised of E♭ sopranino, B♭ and A soprano, E♭ alto, B♭ bass, and E♭ contrabass clarinets – were all (except bass clarinettist Jean Dubois) members of the *Garde Républicaine* and performed exclusively on Selmer clarinets.

62 "Selmer." Conn-Selmer, Inc. Accessed November 28, 2020. https://www.conn-selmer.com/en-us/our-brands/selmer.

63 H&A Selmer, Inc. *Selmer Band Instruments*. (Elkhart, IN: H&A Selmer, Inc., 1964), p. 10.

64 Vincent Bach. Buescher Band Instruments. (Elkhart, IN: Vincent Bach, 1971).

65 The Selmer Co. Band Instrument Price List Area A January 1, 1985. (Elkhart, IN: The Selmer Co., 1985).

bend attaches this tube to a long downwards tube, with another U-bend at the bottom attaching another long upwards tube that comes up alongside the neck. The instrument, Model 340, is described by Leblanc as a curved contrabass clarinet and colloquially called the "Paperclip" contrabass clarinet due to its resemblance to the shape of the office supply.[66] Houvenaghel used this curved design for several low clarinets produced by the company. The 1930s yielded the curved B♭ instruments of bass, contrabass, and octocontrabass (one octave lower than the contrabass) clarinets. Around 1959 the curved E♭ contra-alto clarinet to low C began production, and in 1971 the E♭ octocontra-alto clarinet (one octave below the contra-alto) was completed.[67] While few curved bass clarinets were produced, and only one of each of the octocontras,[68] the contrabass clarinet became widely popular with over 3000[69] instruments produced, largely due to American wind bands. The Leblanc E♭ contra-alto clarinet was also relatively popular, but far fewer were built.[70]

Figure 9. Leblanc Model 340 "Paperclip" B♭ contrabass clarinet. Photo by Jason Alder.

[66] See Figure 9.

[67] Leblanc Léon et al., *Léon Leblanc 1900-2000: Un Homme, Un siècle: a Man, a Century* (La Couture-Boussey: Le Musée des instruments à vent, 2020), p. 91. Although Houvenaghel had begun making prototypes of the octocontra-alto, he would not see it completed in his lifetime. He died in 1966, and the instrument was completed in 1971 for the 25th anniversary of Leblanc USA in Kenosha.

[68] Some reports have made unsourced claims that three octocontra-altos have existed, but there is no evidence to support this. The instruments in the museum in La Couture-Boussey are the only known examples.

[69] Rolf Borch, *Contrabass Clarinet: Orchestral Excerpts and a Brief History* (Oslo: Norwegian Academy of Music, 2015), p. 11.

[70] Based on an independent survey conducted of instruments and serial numbers of Leblanc instruments, approximately 700 contra-altos were made.

The first contrabasses built by Leblanc around 1935 descended to C3, had the four side-trill-keys standard on clarinets, a forked A♭3/E♭5 fingering, and an altissimo half-hole mechanism.[71] They were marketed as having a five-octave range.[72] These "A series" instruments[73] could be regarded as a prototype-model, with approximately 25 made.[74] When Leblanc began full production of the instrument, they simplified the design. The lowest note was only D3, it had only one side-trill-key,[75] and the altissimo and forked mechanisms were removed. These instruments were marketed and produced mainly for the United States high school and university wind band programmes; thus, one can assume the extra features were deemed unnecessary, and manufacturing costs were reduced by removing them. Exact production dates for this era do not exist; however, I estimate that manufacture of these instruments began in the late 1940s or early 1950s after Leblanc USA formed in 1946 in Kenosha, Wisconsin as an American distributor. In the late 1950s they made an instrument to C3 again, but with only one side trill-key and no other extra features. Both low-D and low-C models were offered congruently, and in 1963 Leblanc introduced straight metal contrabass and contra-altos in bass clarinet-shape, descending to E♭3. For a brief period, Leblanc offered five contra clarinets — curved B♭ contrabasses to D3 and C3 and straight to E♭3, and curved and straight E♭ contra-altos to C3 and E♭3, respectively.[76] Shortly thereafter[77] low-D curved contrabasses were removed from the product line leaving only the curved low-C and straight

[71] The forked mechanism allows A♭3 and E♭5 to be played by lifting the right-hand second finger. The altissimo half-hole makes playing in the highest range easier.

[72] G. Leblanc Corporation. "The All Metal Contra Bass Clarinet in B♭," n.d.

[73] Per the prefix "A" in the serial number.

[74] From conversation with Cyrille Mercadier, a Parisian repair person who had a close relationship with the Leblanc company, was the repairer of the octocontra-alto clarinet before its resignation to a museum, and has one of the A series instruments.

[75] Trill Key 1 was kept, for E♭4/B♭5. Please see Figure 24 fingering diagrams in Chapter 3 for more information.

[76] G. Leblanc Corporation. "Contra" Clarinets. (Kenosha, WI: G. Leblanc Corporation, 1963).

[77] ca. 1964-65.

low-E♭ models. Leblanc Paris stopped producing contrabass clarinets in the 1990s and eventually ceased all French operations, moving to Kenosha. An American-made curved contrabass,[78] was made from at least 2002 but ceased production a few years later when the Kenosha factory closed and moved to Elkhart, Indiana in 2008.

The Vito brand was a US subsidiary of the Leblanc company based in Kenosha and had produced plastic student-line clarinets since the 1950s. This line included straight E♭ contra-alto and B♭ contrabass clarinets to E♭3, which later sold under the Leblanc brand. These are the only contra clarinets currently produced by the Leblanc company.

Tom Ridenour worked at Leblanc for 8 years from 1989 making advancements in clarinet mouthpieces and acoustics.[79] Now he has his own company, Ridenour Clarinet Products, making clarinets made of rubber. Around 2009 he developed contra clarinets and reportedly produced three B♭ instruments and one in E♭.[80]

Current instruments

For 40 years, the Leblanc instrument was the only low-C B♭ contrabass clarinet available. Around 1976, Henri Selmer Paris added a wooden rosewood B♭ instrument in a large bass clarinet-shape to their product line to match their E♭ contrabass, however, descending to C3.[81] The mouthpiece attaches to a long S-shaped neck tube that connects to a

---

[78] Model LC340, it is distinguished by black chrome-plating rather than the nickel-plating of the French models.

[79] Ridenour Clarinet Products, "About Tom Ridenour," accessed September 9, 2020, https://www.rclarinetproducts.com/about-tom-ridenour.

[80] Bobby McClellan, "Thread: Ridenour Contrabass Clarinet," 2016, https://forum.saxontheweb.net/showthread.php?120862-Ridenour-contrabass-clarinet.

[81] The Selmer Paris archives (courtesy of Douglas Pipher) list an instrument shipping in December 1976. A Selmer B♭ contrabass mouthpiece first appears in The Selmer Co. *What to Look for When You Choose Your New Woodwind Mouthpiece*. (Elkhart, IN: The Selmer Co., 1978). A B♭ contrabass clarinet appears in The Selmer Co. *Price List Area A January 1979*. (Elkhart, IN, 1979).

wooden top joint, continues with a bottom joint, and terminates in a very large upturned bell nearly half the instrument's height.[82] Selmer currently produces this widely-used instrument.

Figure 10. Henri Selmer Paris B♭ contrabass clarinet. Photo by Jason Alder.

L. Reidel (Markneukirchen) has produced German system B♭ contrabass clarinets[83] in grenadilla wood, descending to C3. Herbert Wurlitzer (Markneukirchen) offers contrabass clarinets[84] and a 1995 issue of the German reed-instrument magazine *'rohrblatt* contains photos of Mr. Wurlitzer with a contrabass clarinet standing behind him.[85] Martin Foag Clarinets (Hafenhofen) has made two German system E♭ contra clarinets in metal, one to

---

[82] See Figure 10.

[83] Gabi Gleissberg, "Goldene Meister Mit Goldenen Händen," *Freie Presse*, December 8, 2010, https://www.freiepresse.de/goldene-meister-mit-goldenen-h-nden-artikel7543001.

[84] "Clarinets," Wurlitzer Clarinets, accessed December 12, 2020, https://wurlitzerklarinetten.de/clarinets/?lang=en.

[85] "Cover Photo," *'Rohrblatt*, March 1995.

C3[86] in 2018 and the other to E♭3[87] in 2019, with another to A2 in the process of being manufactured at the time of writing, and a B♭ Boehm-system in the planning stages.[88] Instruments from all three manufacturers are handmade to order.

Since 1935, Buffet-Crampon has produced an E♭ contra clarinet with a small bore that uses a bass clarinet mouthpiece.[89] Although still currently produced, these are relatively rare, with only approximately 200 made in those 85 years,[90] likely only on demand. In the early 2000s Buffet created a prototype B♭ contrabass to C3, but it never went into production.

Ripamonti (Milan), also branded as Ripa, lists both an E♭ to E♭3 and B♭ to C3 *clarinetto contrabasso* on their website.[91] They are Boehm-system instruments made in palissandro rosewood, however it is unclear if they are still produced .[92]

In 2008 Benedikt Eppelsheim (Munich) created a new metal B♭ contrabass clarinet, radically redesigning the construction and concept. It is in a bass saxophone-shape, with a range to C3. The instrument has undergone significant improvements to intonation and evenness throughout the range of the instrument. As of mid-2018, fifty-five instruments had been made with seventeen on order,[93] all using the Boehm-system except for one in German-

---

[86] Foag Klarinetten, *Foag E♭ Contra Clarinet in Brass to C* , September 2, 2019, photograph, *Facebook*. https://www.facebook.com/Foag.Klarinetten/photos/a.1411953349113317/2099061590402486.

[87] Foag Klarinetten. *Foag E♭ Contra Clarinet in Black Laquered Metal to E♭* . December 24, 2019. Photograph. *Facebook*. https://www.facebook.com/Foag.Klarinetten/photos/p.2185572288418082/2185572288418082/?type=3.

[88] Martin Foag, *Email correspondence* (2020, September 13).

[89] "Prestige Contra Alto," Buffet Crampon, accessed November 28, 2020, https://www.buffet-crampon.com/en/instruments/clarinets/prestige-contra-alto/.

[90] The author would like to thank Nicolas Baldeyrou, instrument tester at Buffet-Crampon, for finding this information.

[91] Ripa, "Clarinetti," accessed September 13, 2020, https://www.ripamusic.com/categoria/legni/clarinetti/?product_orderby=price.

[92] Although the author has seen and played these instruments exhibited by the manufacturer at trade shows, he does not know of any players using either of them. Requests to the manufacturer for more information were unanswered.

[93] From a serial number list provided to the author from the manufacturer.

system. The instrument is gaining popularity and is used by several professional players and ensembles.

Figure 11. Eppelsheim B♭ contrabass clarinet. Photo from the manufacturer's website.

The Chinese company JinBao has begun producing copies of the Leblanc low-C curved B♭ contrabass clarinet for other brands to sell under their own names.[94] Recently an American company has bought the Martin Freres[95] name and has begun selling E♭ contra clarinets made from ABS and Ebonite, and B♭ contrabasses made from ABS or hard rubber covered with rosewood or grenadilla veneer.[96] Both instruments are to low E♭ and are

---

[94] Some examples include Musikhaus Öllerer GmbH Concerto Kontrabassklarinette, https://www.musikhaus.org/i/concerto-kontrabassklarinette-54641; Consolat de Mar, https://www.consolatdemar.com/product/viento_madera/clarinetes_sec/contrabajos/cl-bc586/; Ripa 123-1M https://www.ripamusic.com/en/prodotto/123-1m-bb-contrabass-clarinet/

[95] The Martin Freres firm began producing clarinet and flutes in France in 1840.

[96] "Alto, Bass & Contra Clarinets," Martin Freres Company, accessed November 9, 2021, https://martinfreres.net/clarinetcatalog/low-clarinets/.

presumably made in China. Inexpensive instruments from China have historically had quality concerns, and these have not yet significantly impacted the contrabass clarinet market.

Two particularly unique contrabass clarinets were recently built. The first is the CLEX (Contrabass Clarinet Extended) designed and built by clarinet maker Jochem Seggelke (Bramberg), electronics engineer Daniel Debrunner, and clarinettist Ernesto Molinari in 2013. The production of sound on the CLEX is acoustic, but small electronic motors operate the pads on the toneholes. The instrument integrates with a computer allowing the fingering system to switch from Boehm to German-systems and allows for new live-electronic possibilities.[97] The second unique instrument was built in 2018 by Stephen Fox (Ontario) from Nylatron using the Bohlen-Pierce tuning system, a 13-step scale that does not repeat at the octave but rather at the 12th, called the tritave.[98]

The current regularly-produced E♭ contra clarinets are by Henri Selmer Paris, Buffet Crampon, and Leblanc USA; and B♭ contra clarinets by Henri Selmer Paris, Benedikt Eppelsheim, Leblanc USA, and JinBao.

Repertoire

The contrabass clarinet has had a slow integration into the repertoire. The earliest uses were at the turn of the 20th Century in occasional operas and orchestral works, but composers stopped including it in later years. Some military bands adopted the instrument, and a mid-century rise in American wind band use coincided with Leblanc's instrument production. French clarinet sextets contributed to its early use in small ensembles, but significant solo and

[97] Ernesto Molinari et al., "Contrabass Clarinet Unlimited: Eine Sensorisch-Dynamische Kontrabassklarinette," *Dissonance* 126 (June 2014): pp. 22-29.

[98] Nora-Louise Müller, The Bohlen-Pierce Clarinet: Theoretical Aspects and Contemporary Applications (Norderstedt: BoD - Books on Demand, 2020).

chamber repertoire did not exist until the 1980s. This may be due to the lack of many suitable instruments, although the instrument's unenthusiastic descriptions in orchestration texts would not have helped.

Dethou includes Sax's contrabass clarinets in E♭ and F and the clarinette-bourdon in B♭ in his *Traité d'Instrumentation* (1873). He writes that the contrabass clarinets are seldom used but could be excellent in the orchestra or military band and that wind bands should use the E♭ instrument.[99] He briefly mentions the *clarinette-bourdon*, writing that it is an octave below the bass clarinet and including a chart showing the written and sounding pitches. He writes that with both instruments, the air is too slow to respond and should only play long notes, and the tone of the first octave is confusing and should only double other clarinets or instruments in octaves. Strauss's 1905 revision of the Berlioz treatise of instrumentation includes a very brief description of the double bass clarinet, only saying that it is in the range of the contrabassoon but with the character of the clarinet.[100] Forsyth (1914) states that it is "scarcely known outside the largest military band combinations,"[101] referencing the B♭ contrabass. His text continues with a description of the Besson instrument. He mentions two pieces in the 1912 London Proms used contrabass clarinet and one of the pieces was for F contra clarinet (the other was Schoenberg),[102] but admits there is no evidence that an F

---

[99] Dethou Léon, *Traité D'instrumentation appliqué Aux Orchestres D'instruments à Vent* (Paris: E. Collet, 1873). "LA CLARINETTE CONTRE-BASSE. on en construit en Fa et en Mi♭. Cet instrument est peu usité, même à l'orchestre, bien qu'il pourrait produire un excellent effet soit dans l'orchestre ordinaire, soit dans une musique militaire. Si on voalait l'employer dans un orchestre d'harmonie, il faudrait prendre la clarinette contre-basse en Mi… LA CLARINETTE BOURDON. Cet instrument est à l'octave grave de la clarinette basse en Si♭… Ces deux derniers instruments ont été inventes. par Ad. Sax. La lenteur de leurs vibrations ne leur permet pás d'émettre des sons rapidement. Il ne faut leur donner que des notes tenues ou des mouvements de basse (mais dans un mouvement lent). Dans ces conditions ils peuvent produire un très bel effet. Les notes de la première octave de la clarinette bourdon et même les premières de la clarinette contre-basse sont d'une sonorité confuse. Il ne faut les employer qu'en doublant l'octave soit par d'autre clarinettes soit par d'autres instruments."

[100] Hector Berlioz and Richard Strauss, *Instrumentationslehre, Von Hector Berlioz. Ergänzt Und Rev. Von Richard Strauss*, vol. 2 (Leipzig: C.F. Peters, 1905), p. 241.

[101] Cecil Forsyth, "The Pedal Clarinet," in *Orchestration* (London: MacMillan and Co., 1914), p. 286.

[102] "All Events - Proms 1912," BBC Music Events, accessed October 2, 2020, https://www.bbc.co.uk/events/rfg2fx/series, Prom 15, 3 September 1912, Queen's Hall.

instrument existed in England at the time. Koechlin (1954) says that the B♭ contrabass clarinet is used in *orchestres d'harmonie*[103] and sometimes in the symphony orchestra. He only incidentally mentions that the *clarinette-contralto*, pitched an octave below the alto clarinet and with a beautiful tone, exists.[104] Piston (1969) lists the B♭ contrabass in a table detailing the members of the clarinet family. He mentions both E♭ and B♭ contras' existence in the text but only discusses the B♭ in more detail. He finishes the section, "the contrabass clarinet is as yet too great a rarity to be considered an available resource in symphonic composition."[105] Adler (2002) gives the ranges of both the E♭ and B♭ instruments and states, "since the contrabass clarinet is of a rather recent vintage,[106] it does not appear in many orchestral scores, but is used frequently in works for band and wind ensemble."[107]

The most positive descriptions come from MacGillivray, who writes, "The contrabass clarinet, with its mobility, wide range of dynamics, and god-like voice, must be by far the most effective instrument in the contrabass range-not excluding the string contrabass- and its neglect by composers is incomprehensible,"[108] and Baines, "This is a good instrument that should receive wider attention."[109]

The E♭ contra has received praise for its easy technical playability and sound.[110]

---

[103] *Orchestres d'harmonie* are wind bands.

[104] Koechlin, "Clarinette", p. 35. "Employée dans les orchestres d'harmonie, et parfois dans les orchestres symphoniques." "Signalons aussi la clarinette-contralto, d'une belle sonorité, à l'8ve grave de la Cl. Alto."

[105] Walter Piston, "The Clarinet," in *Orchestration* (London: Victor Gollanzc LTD, 1969), pp. 163-184.

[106] Adler says it is of a rather recent vintage despite being over 100 years old.

[107] Samuel Adler, "Individual Woodwinds - Contrabass Clarinet," in *The Study of Orchestration*, 3rd ed. (New York, NY: W.W. Norton and Co., 2002), p. 216.

[108] James A. Macgillivray, "Recent Advances in Woodwind Fingering Systems," *The Galpin Society Journal* 12 (1959): p. 70.

[109] Anthony Baines, "The Woodwind Today: The Clarinet," in *Woodwind Instruments and Their History*, 3rd ed. (Mineola, NY: Dover, 1991), pp. 130-131.

[110] Tim Payne, "The Contrabass Clarinets," in *The Versatile Clarinet*, ed. Roger Heaton (New York, NY: Routledge, 2006), pp. 101-108. Payne describes the E♭ contra clarinet as "underrated" and "infinitely more viable in terms of both ease of execution and its ability to blend with a clarinet section." Thomas Ayres also

Manufacturers and band directors lauded its adaptability to easily read from bass clef parts by adding three sharps to the key signature,[111] [112] and in 1979 Norman Heim states more school bands used the E♭ than the B♭ contrabass.[113] Despite this, there is little original repertoire composed for the E♭ contra clarinet outside clarinet ensembles, wind bands, and film scores. The only known orchestral usage also happens to be the first use of a contra clarinet in the orchestra. Saint-Säens wrote five bars at the end of Act III of *Henry VIII* (1883), of a single held F3.

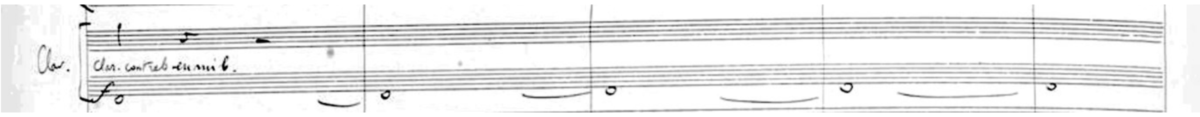


Figure 12. Saint-Saens, "Henry VIII" (1883), manuscript, p. 171. Bass clef in E♭ transposition, sounds a major 6th lower.

Early Opera and Orchestra

The earliest original works to use the B♭ contrabass clarinet were in the opera repertoire. Vincent d'Indy's opera *Fervaal* (published 1895, performed 1897)[114] was the first and included an important part in the second and third acts. D'Indy wrote to Mr Fontaine

---

expresses his preference "for the E♭ contra, because of its more facile technic and more resonant tone." Thomas A. Ayres, "Arranging for the Clarinet Choir," in *Woodwind Anthology: a Compendium of Woodwind Articles from the Instrumentalist*, vol. 2 (Northfield, IL: Instrumentalist Co., 1999), p. 51. (Original work published January, 1957). And Morris Lawrence describes it as having "the most beautiful colors in the band's instrumentation." Morris Lawrence, "The E♭ Contrabass Clarinet," in *Woodwind Anthology: a Compendium of Woodwind Articles from the Instrumentalist*, vol. 2 (Northfield, IL: Instrumentalist Co., 1999), pp. 193-194. (Original work published December, 1966).

[111] Advertisements in both H&A Selmer, Inc. *Selmer Band Instruments*. (Elkhart, IN: H&A Selmer, Inc., 1953) and G. Leblanc Corporation. *"Contra" Clarinets*. (Kenosha, WI: G. Leblanc Corporation, 1963) cite the ease of bass clef transposition as a selling point for the E♭ contra clarinet. Adding three sharps to the key signature and reading bass clef as if it were treble clef, allows an E♭ instrument to easily transpose.

[112] Brian D. Jones, "The E♭ Contra-Alto Clarinet: Misunderstood and Overlooked," in *Woodwind Anthology: a Compendium of Woodwind Articles from the Instrumentalist*, vol. 2 (Northfield, IL: Instrumentalist Co., 1999), pp. 466-476. (Original work published May, 1998).

[113] Norman Heim, "The Clarinet Choir Phenomenon," in *Woodwind Anthology: a Compendium of Woodwind Articles from the Instrumentalist*, vol. 2 (Northfield, IL: Instrumentalist Co., 1999), pp. 311-315. (Original work published November, 1979).

[114] Vincent D'Indy, *Fervaal* (A. Durand et Fils, Paris, 1895).

Besson that "the role of the Pedal Clarinet in Fervaal is so important that several passages…are musically non-existent if the instrument is missing."[115] Ernest Chausson also wrote for it in his opera *Le Roi Arthus* (1886-1895, performed 1903), as well as Dvořák in *The Devil and Kate* (1899), Weingartner in *Orestes* (1902), and Saint-Saëns in *Hélène* (1903).[116] Other early orchestral works include Schoenberg's *Fünf Orchesterstücke,* op. 16 (1909),[117] *Vier Orchesterlieder,* op. 22 (1913), and *Moses und Aron* (1930); Strauss' *Josephlegende* (1914); Varése's *Amériques* (1920) and *Arcana* (1925), and Koechlin's *Le Docteur Fabricus* (1941).

Leopold Stokowski, conductor of the Philadelphia Orchestra from 1912-1941, made over 200 arrangements and orchestrations, several using the contrabass clarinet, including Bach's *Wir glauben all' an einen Gott* (1924) and *Fantasia et Fugue* (1926), and Debussy's *La Cathédrale Engloutie* (1926). His own symphony (date of composition unknown) also includes contrabass clarinet with exposed solo lines, however it went unperformed until 2009.[118] Stokowski and the Philadelphia Orchestra premiered Varése's *Amériques* in 1926 and *Arcana* in 1927 and employed the first full-time orchestral contrabass clarinettist, Frédéric Parme from 1925-1927.[119] The contrabass clarinet gets little further orchestral recognition until the 1960s from composers such as György Ligeti, Gérard Grisey, Iannis Xenakis, and Igor Stravinsky.[120]

---

[115] J L Casembroot, "Het Orkest Van Fervaal," *Caecilia; Algemeen Muzikaal Tijdschrift Van Nederland, Jrg 55,* no. 10 (May 15, 1898): pp. 77-78. "Le rôle de la Clarinette Pédale dans Fervaal est si important que plusieurs passages (notamment l'entr'acte du 2me acte) n'existent plus musicalement si l'instrument manque."

[116] Other early opera uses of the contrabass clarinet include de Lara's *Messaline* (1899), Massenet's *Ariane* (1906), Schoeck's *Penthesilia* (1927), and Honegger's *Amphion* (1929).

[117] Schoenberg scored his *Fünf Orchesterstücke* for contrabass clarinet in A, however this instrument never existed.

[118] Colin Anderson. "Leopold Stokowski's Symphony." *Classical Source*, May 7, 2009. https://www.classicalsource.com/concert/leopold-stokowskis-symphony/.

[119] Harry R. Gee, "French Clarinetists in America," *The Clarinet* 8, no. 4 (1981): pp. 20-22.

[120] To this day, the contrabass clarinet is not regarded as a regular doubling instrument by clarinettists like the E♭ or bass clarinet are. Its inclusion in a work requires extra cost to the orchestra, like hiring a bass flute or bass oboe player.

French Clarinet Sextets

A clarinet sextet by Daniel Bontoux, *Hymne a Sainte-Cécile* (1900), is scored for two B♭ clarinets, basset horn, bass clarinet, contrabass clarinet in F, and contrabass clarinet in B♭,[121] and is the first known chamber work with the B♭ contrabass. Bontoux dedicated other compositions to Pierre Sainte-Marie, author of the first published method for bass clarinet[122] and the contrabass clarinettist for the premiere of *Messaline*,[123] so this work may have been written for an ensemble of his. Three other early French sextets are known, Raymond Loucheur's *En Familie* (1933), Florent Schmitt's *Sextuor, Op. 128* (1952) and Eugene Bozza's *Lucioles* (1963). Schmitt scored for "double bass clarinet", but in the first recording by the Sextuor de Clarinettes de Paris,[124] Georges Delville used an E♭ contra clarinet.[125] Loucheur and Bozza[126] score for B♭ contrabass.

Military Bands and Clarinet Ensembles

Some military bands were early adopters of the contrabass clarinet to fulfil the bass reed instrument's role. Wilhelm Wieprecht, director of the Prussian military bands, was the first to use his invention of the batyphone in *Marsch Sinfonique* (ca. 1860). The *Garde Républicaine's* inclusion of the contrabass clarinet led Florent Schmitt to score for it in his important work *Dionysiaques* (composed 1914, published 1925), written for the ensemble.

---

[121] Thomas Carr Aber, "A History of the Bass Clarinet as an Orchestra and Solo Instrument in the Nineteenth and Early Twentieth Centuries and an Annotated, Chronological List of Solo Repertoire for the Bass Clarinet from before 1945" (dissertation, University of Missouri, Kansas City, 1990), p. 107.

[122] A. Pierre Saint-Marie, *Méthode Pour La Clarinette-Basse, à l'Usage Des Artistes Clarinettistes* (Paris: Evette & Schaeffer, 1898).

[123] L. B., "Courrier Théatral Et Artistique," La Depeche, April 15, 1899, p. 3.

[124] Sextuor de Clarinettes de Paris. (n.d.). *The Clarinet, volume 2 LS 1077* [Vinyl recording]. London.

[125] The Sextuor de Clarinettes performed exclusively on Selmer clarinets, and Selmer did not yet produce a B♭ contrabass clarinet. The ensemble recorded a number of transcriptions and works written for them using the E♭ contra.

[126] Bozza also wrote one of the early significant bass clarinet solo pieces, *Ballade, for bass clarinet and piano* (1939).

Gustave Poncelet was the clarinet professor at the Brussels Conservatory and developed the first clarinet ensemble.[127] By 1894 his ensemble consisted of sixteen students and included both F and B♭ contrabasses,[128] playing arrangements of orchestral works.[129]

Simeon Bellison, principal clarinettist of the New York Philharmonic, founded a successful clarinet ensemble in 1927. He wanted to include the entire clarinet family, from the A♭ sopranino to contrabass, but some instruments, including the contrabass clarinet, were not available in the United States. By 1929 he received the funds to complete the instrumentation. The ensemble began with eight members and within two years had 75, ending with 68 in 1938, including two contrabass clarinettists. The music played by the ensemble was all composed or arranged by Bellison.[130] It was not published and is now in a museum in his native Israel.[131] Both Waln[132] and Ayres[133] comment in the mid-1950s on the lack of published clarinet choir repertoire.

[127] Donna June Pike, "The Clarinet Choir" (Honors Thesis, Ouachita Baptist University, 1969), https://scholarlycommons.obu.edu/honors_theses/585.

[128] J. L. Casembroot, "Nieuwe Speeltuigen," *Caecilia; Algemeen Muzikaal Tijdschrift Van Nederland, Jrg 55,* no. 11 (June 1, 1898): pp. 87-89.

[129] Altenburg, "Die Contrabass-Klarinette von Fontaine-Besson und Poncelet's Klarinett- Concerte" states that the repertoire included Grieg's *La Mort du Roi d'Ase*, Moszkowski's *Serénade*, Mozart's *Second Symphony in D*, Weber's *Moto Perpetuo*, Wagner's *Liebesmahl der Apostel* from *Lohengrin*, Liszt's *Rhapsody no. 14*, Mendelssohn's *Adagio and Rondo*, Brahm's *Hungarian Dances*, Beethoven's *Adagio* from the *Sonate Pathétique.*

[130] Friedrich Pfatschbacher and Nicholas Cox, "The Clarinet Choir: Development of the Clarinet Choir," in *The Clarinet Choir: A Special Form of Ensemble Conquers the World's Concert Platforms* (Hamburg, Germany: Tredition, 2017), pp. 19-25.

[131] John Morgan, "The History of the Clarinet Choir," in *Woodwind Anthology: A Compendium of Woodwind Articles from the Instrumentalist*, vol. 2 (Northfield, IL: Instrumentalist Co., 1999), p. 128. (Original work published February, 1967).

[132] George E. Waln, "The Clarinet Choir," in *Woodwind Anthology: A Compendium of Woodwind Articles from the Instrumentalist*, vol. 2 (Northfield, IL: Instrumentalist Co., 1999), p. 43. (Original work published November, 1955).

[133] Ayres, "Arranging for the Clarinet Choir," p. 51.

The Balanced Clarinet Choir and American Wind Bands

In the 1950s, a movement called the "Balanced Clarinet Choir" began in the United States, advocating a complete clarinet ensemble as the core of the wind band, performing a string section's function.[134] A tenet of this movement was the importance of the contrabass clarinet in the ensemble to maintain proper balance and fill the double bass's role. This coincided with the increased production of the improved contrabass clarinets by Leblanc, with advocation by Alfred Reed, Donald McCathren, Lucien Cailliet, Harold Palmer, Russell Howland, and William D. Revelli working on expanding the repertoire for the balanced clarinet choir as its own ensemble and its role within the full wind band in the American school music programs. The first published work for clarinet choir was Alfred Reed's *Havana Moon* (1955) and included the B♭ contrabass clarinet.[135]

Revelli[136] favoured large numbers of contrabass clarinets. He argued the contrabass clarinet is more agile, fluent, and capable of playing soft passages than the tubas and other low brass instruments, and speculated that, "one day in the not-too-distant future, contrabass clarinets will be found in the majority of our high school bands, just as the bassoons and oboes are today contributing to the effective performances of these musical organisations."[137] The cover of the August 1955 edition of *Etude* magazine features a photo from the Texas Music Educators Association Convention All-Festival Band, conducted by Revelli, of the

---

[134] Alfred Reed, *The Balanced Clarinet Choir* (Kenosha, WI: G. Leblanc Corporation, 1955).
[135] Morgan, "The History of the Clarinet Choir," p. 128.
[136] William D. Revelli was director of bands at the University of Michigan from 1935-1971.
[137] William D Revelli, "The Balanced Clarinet Choir," in *Woodwind Anthology: a Compendium of Woodwind Articles from the Instrumentalist* (Northfield, IL: Instrumentalist Co., 1999), p. 27. Revelli proposed that the balanced clarinet choir should have sixteen B♭ clarinets, four E♭ alto clarinets, four B♭ bass clarinets, and two contrabass clarinets. If there were twenty B♭ clarinets then the numbers should be raised to six E♭ alto clarinet, six B♭ bass clarinet, and three contrabass clarinets; and with twenty-four B♭ clarinets, eight E♭ alto clarinet, eight B♭ bass clarinet, and four contrabass clarinets.

contrabass clarinet section with at least four Leblanc low D curved contrabass clarinets (Figure 13).[138]

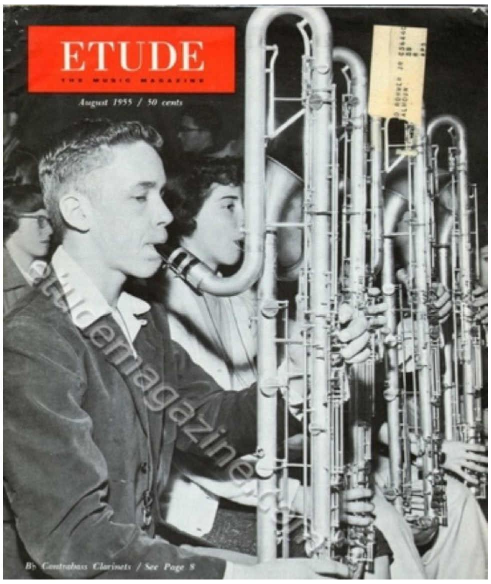


Figure 13. "Etude Magazine" cover, August 1955, showing four Low-D Leblanc contrabass clarinets. Photo by Jack Beers.

The Balanced Clarinet Choir movement profoundly impacted the increased use of the contrabass clarinet and helped it from slipping into obscurity. George Waln wrote in 1955 that "it would be a simple matter to list two dozen bands which now regularly use either the B♭ contrabass clarinet or the E♭ contrabass clarinet or both. The number is gaining by leaps and bounds now with the availability of two outstanding makes of low clarinets." He proceeds to describe the Selmer E♭ and the Leblanc B♭ contrabass clarinets.[139] Today, the standard instrumentation for the clarinet choir and much of the wind band literature includes the contrabass clarinet.

One of the earliest significant uses in wind band was by American composer H. Owen Reed. *La Fiesta Mexicana: A Mexican Folk Song Symphony for Concert Band* (1949) is not only one of his most well-known works but is one of the early examples of a wind band

---

[138] Jack Beers, "B♭ Contrabass Clarinets [Cover Image]," *Etude: The Music Magazine*, August 1955.
[139] Waln, "The Clarinet Choir," p. 43.

symphony and has become part of the core repertoire of the American band.[140] The first movement opens with the toll of church bells and a brass fanfare followed by a low melody emerging from the bass and contrabass clarinet, scored as an octave doubled soli.

Figure 14. H. Owen Reed, "La Fiesta Mexicana", pp. 3-4. Contrabass clarinet sounds a major 9th lower.

Donald McCathren was a clarinettist and Director of Research and Pedagogy at Leblanc. In February 1956, he met composer Alfred Reed at the Texas Music Educators Conference. He asked him to write a five-movement suite to play at the Tri-State Festival in Oklahoma in May, which demonstrated the five sizes of clarinets in the Leblanc family – E♭ and B♭ sopranos, E♭ alto, B♭ bass, and B♭ contrabass – each instrument with its own movement that could be a standalone piece.[141] The resulting *Afro*, for contrabass clarinet and piano[142] is the first solo piece written for the contrabass clarinet. The suite was published in 1966 as *Five Dances for Five Clarinets*[143] alongside five additional pieces, one for each instrument. The second contrabass clarinet piece is entitled *Scherzo Fantastique.*[144] Although McCathren asked Reed to write for the B♭ contrabass clarinet, the pieces are published for

[140] William Berz, "Three Early Works for Band by H. Owen Reed," *Journal of the Wind Association for Symphonic Bands and Ensembles (WASBE)* 10 (2003): pp. 95-105, https://doi.org/https://wasbe.org/wp-content/uploads/2018/02/WASBE_10_2003_Three-Early-Works-for-Band-by-H.-Owen-Reed.pdf.

[141] Douglas M. Jordan, *Alfred Reed: a Bio-Bibliography* (Westport, CT: Greenwood Press, 1999).

[142] There is also a wind band accompaniment for *Afro.*

[143] Alfred Reed, *Afro*, from Five Dances for Five Clarinets, for B♭ or E♭ Contrabass Clarinet and Piano (New York, NY: Marks Music Corporation, 1966).

[144] Alfred Reed, *Scherzo Fantastique*, for B♭ or E♭ Contrabass Clarinet and Piano (New York, NY: Marks Music Corporation, 1966).

both B♭ or E♭ contrabass clarinet.[145] Both *Afro* and *Scherzo Fantastique* are Grade III, intended for student players, and include a Master Lesson Plan introduction from McCathren.

Lucien Cailliet was the Music Director at Leblanc from 1957-1976 and also a driving force in the Balanced Clarinet Choir movement. He was previously employed by the Philadelphia Orchestra with Stokowski as both an arranger and clarinettist.[146] In 1962 he wrote *Le Pionnier* for B♭ contrabass clarinet (or bass clarinet) and piano.[147] Although more difficult than the Reed pieces it is still of a Grade 3 or 4 level,[148] however does descend to a low D, making use of the full range of the Leblanc curved contrabass clarinet most widely available at the time.

---

[145] McCathren recorded *Afro* with the Woodlawn Senior High School Concert Band in 1962 on a B♭ contrabass clarinet (The Woodlawn Senior High School Concert Band. *Woodwinds Brasswinds Percussion*. Vinyl recording, 1962), however when he recorded an album of all ten pieces of the two suites with piano in 1966, he recorded both contra movements on an E♭ instrument (Alfred Reed, *Contest solos for the clarinet family,* with Donald McCathren and William A. Chrystal, Roxas Associates, 196-, Vinyl recording.) I speculate the reason for this is that when McCathren asked for the pieces in 1956, he was working for Leblanc who did not yet make their E♭ contra-alto. In 1958 McCathren left Leblanc to teach at Duquesne University, and later became a Selmer artist (Andrew Druckenbrod, "Obituary: Donald McCathren / Clarinetist, Band Leader and Duquesne Professor," *Pittsburgh Post Gazette*, November 25, 2004, https://www.post-gazette.com/news/obituaries/2004/11/25/Obituary-Donald-McCathren-Clarinetist-band-leader-and-Duquesne-professor/stories/200411250123.) His article *The Teacher's Guide to the Alto, Bass and Contrabass Clarinets* was published in 1965 by Selmer (Donald E McCathren, The Teacher's Guide to the Alto, Bass and Contrabass Clarinets (Elkhart, IN: Selmer, 1965) so it is evident he had made the change to Selmer before the 1966 recording, at which point Selmer did not yet make a B♭ contrabass, so he therefore recorded it on a Selmer E♭ contra clarinet.

[146] Gee, "French Clarinetists in America".

[147] Lucien Cailliet, Le Pionnier (The Pioneer), Solo for B♭ Contrabass Clarinet and Piano (Kenosha, WI: Leblanc Publishing Inc., 1962).

[148] HalLeonard.com, "Le Pionnier (The Pioneer) - Contra Bass Clarinet or Bass Clarinet," accessed September 29, 2020, https://www.halleonard.com/product/3774832/le-pionnier-the-pioneer lists the piece as Grade 3, and Florida Bandmasters Association. "2010 Solo/Ensemble Music List," PDF, 2010 lists the piece as a Grade 4 bass clarinet solo.

Figure 15. Lucien Cailliet, "Le Pionnier (The Pioneer), Solo for B♭ Contrabass Clarinet and Piano" (1962).

Mid-Century Ensemble Works

In 1956 Gordon Jacob wrote a piece for the Hoffnung Festival at the Royal Albert Hall, *Variations on 'Anna Laurie'* for two piccolos, heckelphone, two contrabass clarinets, two contrabassoons, serpent, contrabass serpent, harmonium, hurdy-gurdy, and subcontrabass tuba. The contrabass clarinettists were E.O. Pogson and Reginald Tritton, and a photo of the ensemble shows a Selmer E♭ and a Hüller B♭ contra clarinet.[149] The Hüller belonged to Tritton and is now in the Shackleton Collection.[150] The Festival was a humorous event with compositions commissioned for the event (as may be inferred by the instrumentation of Jacob's piece), and it would appear some on-stage antics took place, as one review states, "bargaining occupied the bars rest among the lower wind… By the end of the piece at least one contrabass clarinet had changed hands."[151]

[149] *The Hoffnung Symphony Orchestra*, photograph, *Discogs*, accessed December 2, 2020, https://www.discogs.com/artist/1974080-The-Hoffnung-Symphony-Orchestra.

[150] Myers, Catalogue of the Sir Nicholas Shackleton Collection, p. 743-744.

[151] Christopher Baines, "Communications Relating to the GSJ's Fiftieth Anniversary," *The Galpin Society Journal* 50 (March 1997): pp. 313-314.

The first work for a contrabass clarinet soloist with orchestra appeared in 1959 by the Dutch composer Guillaume Landré, *Concertante per clarinetto contrabasso ed orchestra.*[152] It was performed on 12 October 1960 by Hans Lemser with the Südwestfunk Symphonieorchester in a concert alongside works by Schumann, Strauss, and Beethoven.[153]

In 1970 Oliver Knussen included the contrabass clarinet in his *Hums and Songs of Winnie-the-Pooh* (revised in 1983) for high soprano and five instrumentalists consisting of flute doubling piccolo, cor anglais, clarinet doubling contrabass clarinet, cello, and percussion. The contrabass clarinet begins the third section of the first movement with a solo line and remains the featured instrument throughout the section. Along with some more demanding rhythmical figures, Knussen wrote a single quarter-tone, and “quasi-gliss”.[154]

Experimentalism and Contemporary Works

The 1970s yielded some flexible instrumentation solo pieces that have joined the contrabass clarinet repertoire. Walter Hekster’s *Play* (1972) is for any clarinet, and Hans-Joachim Hespos originally composed *Pico* (1978) for sopranino recorder. Hespos uses a graphic-style notation, and versions have been played on A♭ sopranino clarinet, contrabass clarinet, and contrabass saxophone.[155] One of the more successful flexible instrumentation pieces is Giacinto Sclesi’s *Maknongan, for a low instrument* (1976).[156]

[152] Guillaume Landré, Concertante per Clarinetto Contrabasso Ed Orchestra (Amsterdam: Donemus, 1960).

[153] “Radio Buitenland 12 Oktober 1960,” *Vrije Geluiden*, Vol. 33, no. 41 (October 8, 1960): p. 46.

[154] Oliver Knussen. *Hums and Songs of Winnie the Pooh.* (London: Faber Music, 1990).

[155] David Smeyers, “The Hespos Phenomenon: A Performer’s Point of View,” *Contact* 33 (1988): pp. 17-19.

[156] Based on cataloguing all found commercially released recordings of contrabass clarinet, Scelsi’s *Maknongan* was the third most-recorded solo piece.

Vinko Globokar wrote two pieces in the 1970s using contrabass clarinet. *Discours IV for Three Clarinetists* (1974) requires each player to use B♭, bass, and contrabass clarinets along with a collection of accessories including mouthpieces for clarinet, tuba, trumpet, and E♭ clarinet; double reeds for contrabassoon, bassoon, English horn, and oboe; and penny whistle. [157] Globokar's musical background includes free improvisation which is reflected in his score. The piece is made of different sections which can be freely ordered by the players. Each section presents musical ideas for the player to use, but is far from a traditional linear score (Figure 16). It was recorded in 1978 by the French clarinettists Jacques di Donato, Jacques Noureddine, and Michel Portal,[158] all of whom perform in both contemporary

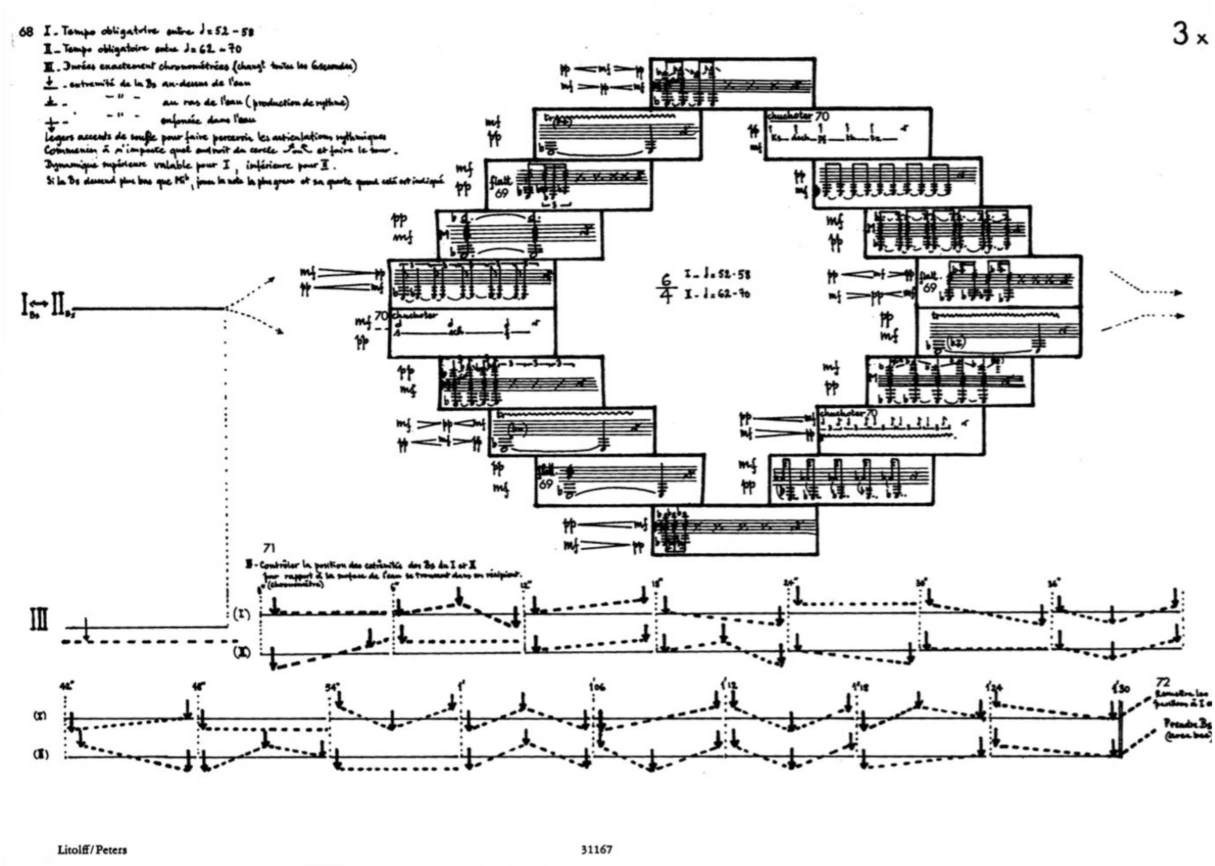


Figure 16. Vinko Globokar, "Discours IV, for 3 clarinettists", p. 9.

[157] Vinko Globokar, *Discours IV, Für Drei Klarinettisten* (Frankfurt, New York, London: Henry Litolff's Verlag / C.F. Peters, 1984).

[158] Vinko Globokar, *Echanges / Res/As/Ex/Ins-Pirer / Discours IV*. (Vinyl recording. Deutsche Harmonia Mundi, 1978).

classical and jazz and improvised music contexts. Globokar also used the contrabass clarinet in his 1975 work *Un Jour comme un autre* for soprano voice with an ensemble of contrabass clarinet, tuba, percussion, electric guitar, and cello.

The Norwegian clarinettist/composer Terje Lerstad was one of the early pioneers of the contemporary contrabass clarinet. Three solo contrabass clarinet works exist in his catalogue: *Three Pieces for Contrabass Clarinet Solo,* op. 101 (1976), *Toccata* op. 183 (1986), and *Tacet 5'33: John Cage in memorium,* op. 199 (1994). *Tacet*, scored for "Male Performer of Bass Saxophone, Contrabass Saxophone or Selmer Contrabass Clarinet",[159] is an hommage to John Cage's *4'33"*.[160] The three movements contain only bars of rest with dramaturgic instructions. *Three Pieces* is written in a more traditional melodic style, incorporating some newer clarinet techniques such as singing while playing to create a dyad[161] and extreme altissimo up to C8. It makes use of the entire range, writing down to C3.[162] *Toccata* goes even further with the advanced techniques, using slap-tongue, multiphonics, and colour fingerings. Lerstad writes up to G7 using standard playing, followed with a G8 using the teeth-on-reed technique, and down to C3, with an instruction at the end of the piece to pull out the tuning slide to make a glissando, enabling the instrument to play the written B2.[163]

---

[159] Terje Lerstad, *Tacet 5'33": John Cage in Memorium,* op. 199 (National Library of Norway, 1994).

[160] Cage's work is in three movements, all of which say tacet, performed by pianist David Tudor in 1952. John Cage, *4'33"* (Edition Peters).

[161] A dyad is two simultaneous pitches.

[162] Terje Lerstad, *Try Stykker for Kontrabassklarinett,* op. 101 (National Library of Norway, 1976).

[163] Terje Lerstad, *Toccata, for Kontrabassklarinett Solo,*op. 183 (National Library of Norway, 1986).

Figure 17. Terje Lerstad, "Toccata" for contrabass clarinet solo (1986).

Lerstad also composed a duo with bassoon, *Scherzo, Fantasy and Fugue,* op. 98 (1976); *Rendez-vous IIb, for four musicians and electronics,* op. 189 (1986) for bass clarinet (doubling contrabass clarinet), bassoon (doubling contrabassoon), trombone, and piano/synth; *Adagio for Contrabass Clarinet and Clarinet Choir, op. 113D* (1986) ; and included contrabass clarinet with eight saxophones in *Jubileumsfanfare til Nordstrand Janitsjarkorps,* op. 133 (1979). He wrote *Madamme de la Moutaine onder het gras,* op. 11 (1982) for six bass clarinet and three contrabass clarinets for Het Basklarinetten Collectief.[164] Lerstad is

[164] Harry Sparnaay, the great Dutch pioneer of the bass clarinet and Lerstad's teacher, led the ensemble Het Basklarinetten Collectief, comprised of his students in Amsterdam.

also distinguished for being one of the only composers to have composed for the Leblanc octocontra-clarinets[165].

Daan Manneke originally composed *Gesti* (1979)[166] for solo bass tuba or bass trombone. He published a version for Harry Sparnaay for bass clarinet; however, on the 1982 recording, Sparnaay plays it on contrabass clarinet and might be the first recording of a work for contrabass clarinet alone.[167]

Significant Solo and Chamber Works

The first significant work to feature the contrabass clarinet was Donald Martino's *Triple Concerto* (1978)[168] for B♭, bass, and contrabass clarinets with sixteen-member ensemble. The three soloists form a six-octave "superclarinet". Rather than performing in harmony, musical material is passed from one player to the next throughout the combined instruments' range.[169]

In the early 1980s, before any substantial works were written specifically for solo contrabass clarinet, Sparnaay asked Gérard Grisey to compose a piece for him.[170] The result was the two-movement *Anubis, Nout* (1983),[171] premiered at the Pontino Music Festival in Italy in June 1984. The *Anubis* movement explores changing timbres by pressing additional

[165] *De Profundis*, op. 139 (1980) for contralto voice, clarinet (octocontrabass with contact microphone and echo effect, and acoustic octocontraalto), string orchestra and tape; *Mirrors in Ebony* for clarinet choir, op. 144 (1981) uses both the octocontraalto and octocontrabass; *Trisonata*, op. 28 (1982) for sub-bass recorder, octocontrabass clarinet, 2 bongos, and harmonium.

[166] Daan Manneke, *Gesti, for Bass Clarinet.* (Amsterdam: Donemus, 1979).

[167] Daan Manneke, "Gesti". *Ruimten*. (Vinyl recording. Attacca, 1982).

[168] Donald Martino, *Triple Concerto* (Newton, MA: Dantalian, 1978).

[169] The piece was premiered and recorded by the Group for Contemporary Music with Anand Devendra (clarinet), Dennis Smylie (bass clarinet), and Leslie Thimmig (contrabass clarinet).The Group for Contemporary Music, Harvey Sollberger, conductor. *Donald Martino / Milton Babbitt – Triple Concerto / Arie Da Capo*. (Vinyl recording. Nonesuch, 1980).

[170] Rhonda Janette Taylor, *Gérard Grisey's Anubis Et Nout: A Historical and Analytical Perspective* (DMA dissertation, University of Arizona, 2005). http://hdl.handle.net/10150/194938.

[171] Gérard Grisey, Anubis, Nout: Deux Pièces Pour Clarinette Contrebasse En Si Bémol (Milan: Casa Ricordi, 1983).

keys while playing notes (colour fingerings). Grisey worked with Sparnaay and Jean-Noël Crocq to catalogue the different timbres each colour-fingering produced for each note. The resulting piece uses fourteen notes with up to six additional colour-fingerings, notated using an additional stave.[172] The piece is only playable on a Leblanc instrument due to the mechanical operation of the keywork of the instrument.[173]

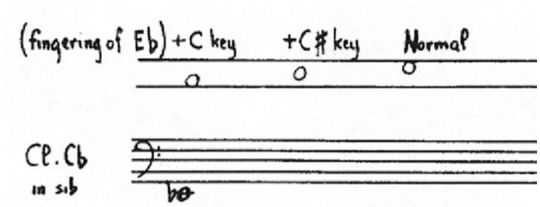


Figure 18. Gerard Grisey, "Anubis", additional keys explanation. Contrabass Clarinet sounds a major 9th lower.

Nout focuses on a quality particular to the clarinet, overblowing the interval of a perfect 12th. More so than other size clarinets, this tone is often clearly heard when playing the fundamental on the contrabass clarinet. Grisey uses this to explore "cross-fading" between the fundamental and the 12th. The movement opens with a pianissimo B5 slurring to the 12th below, E4, but Grisey notates the B remaining in the sound, creating a dyad. The movement continues with the same motif on an A5 and D4, coupled with colour-fingerings. The rest of the movement uses these musical ideas, with circular breathing, to create a lush bed of quiet harmonics. The work has become a core of the contrabass clarinet repertoire and is among the most recorded pieces.

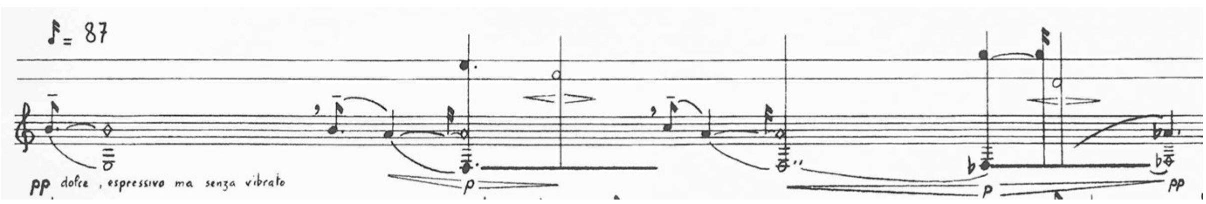


Figure 19. Grisey "Nout" opening. Score is written a major 9th above sounding pitch.

[172] This piece and the notation are discussed more in-depth in Chapter 3.
[173] See "Keywork Designs- Low C3 and C♯3 Linkage" in Chapter 2.

In 1984, Francesco Donatoni composed the next substantial solo piece to become part of the core repertoire, the two-movement *Ombra*[174] for Ciro Scarponi.[175] The compositional style is without using additional techniques. The first movement begins with long, held low notes with crescendos from *pianissimo* to *forte*, gradually adding faster legato rhythms and moving into the upper register. The music then returns to the low register. This time the notes are short, still with piano to forte crescendos, creating spurts of sounds. The rest of the movement alternates between sections of low, isolated notes and higher, fast notes. The second movement contrasts this with staccato rhythmical passages, followed by slurred ascending and descending arpeggios building into a final rhythmic section. The piece finishes with a held B3, intensified with flurried bursts of adjacent notes, always returning to the B until the final gesture, a crescendo into a quick, descending A♭3, G3, E♭3.

Figure 20. Donatoni "Ombra" ending, p. 9.

Around this time, Scarponi played other important works that included the contrabass clarinet by another Italian composer, Luigi Nono. *Io, frammento de Prometeo* (1981) is for three soprano voices, small choir, bass flute, contrabass clarinet, and live electronic

---

174 Franco Donatoni, *Ombra: Due Pezzi per Clarinetto Contrabasso* (Milano: Ricordi, 1984).

175 Although written for Scarponi, the first recording was by the French clarinettist Armand Angster. Ensemble Alternance. *Franco Donatoni – Spiri, Eco, Ombra, Diario, Lame.* (Harmonic Records, 1986).

processing in nine movements, using various formations of the ensemble for each movement. The contrabass clarinet is always used with the bass flute[176] and used in movements I (chorus, bass flute, contrabass clarinet), II (bass flute, contrabass clarinet), VI (two solo sopranos, bass flute, contrabass clarinet, electronics), and VIII (bass flute, contrabass clarinet, electronics). *Io* became part of Nono's larger 1984 opera *Prometeo. Tragedia dell'ascolto*. In 1985 Nono composed *A Pierre. Dell'Azzurro Silenzio, Inquietum* for contrabass flute in G, contrabass clarinet, and live electronic processing.[177]

Armand Angster has helped bring several works into the repertoire, either solo or as part of his Ensemble Accroche Note. In 1986 Marc Monnet composed the solo work *Le Cirque*,[178] centred around the idea of quickly articulated repeated notes, with and without slap-tongues, and *Mélodie* for soprano voice and contrabass clarinet. Pascal Dusapin wrote *Anacoluthe* (1987) for female voice, contrabass clarinet, and double bass, and Georges Aperghis wrote *Cinq Couplets* (1988) for soprano voice and contrabass clarinet.

Figure 21. Marc Monnet "Le Cirque" opening. Score is notated with an ottava bass clef, sounding a major 2nd lower.

Richard Barrett's *Interference* (1996-2000) "forms the basis of the solo part in *Ars magna lucis et umbrae* (1996-2000) for solo performer and ensemble, which is itself a

[176] "Io, Frammento Dal Prometeo," FONDAZIONE ARCHIVIO LUIGI NONO ONLUS, February 7, 2017, http://www.luiginono.it/en/works/io-frammento-dal-prometeo/. The flutist for the premiere performance at the 1981 Venice Biennale was Robert Fabbriciani.

[177] *A Pierre. Dell'Azzurro Silenzio, Inquietum* was also composed for Scarponi and Fabbriciani.

[178] Marc Monnet, *Le Cirque* (Paris: Editions Salabert, 1990).

component of *Dark Matter* for voices, ensemble and electronics (1990-)."[179] It was scored for contrabass clarinet (Leblanc model), (male) voice, and pedal bass drum with amplification and written for Carl Rosman. Despite the male voice specification, female clarinettist Lori Freedman has also released a recording. In addition to playing the contrabass clarinet, the performer must sing a range of four octaves and play a kick drum, sometimes simultaneously. The contrabass clarinet part also spans an extensive range and uses complex rhythms, quarter tones, multiphonics, slap tongue, and colour trills. Barrett takes advantage of the Leblanc instrument similarly to Grisey, utilising its colour-fingering possibilities. It might be possible to play on a different contrabass clarinet because many of the fingerings are cross-compatible, but some are not and would require an alternate solution. Barrett also writes many fingerings for quarter tones and multiphonics that would likely need to be changed or adapted for a different instrument.

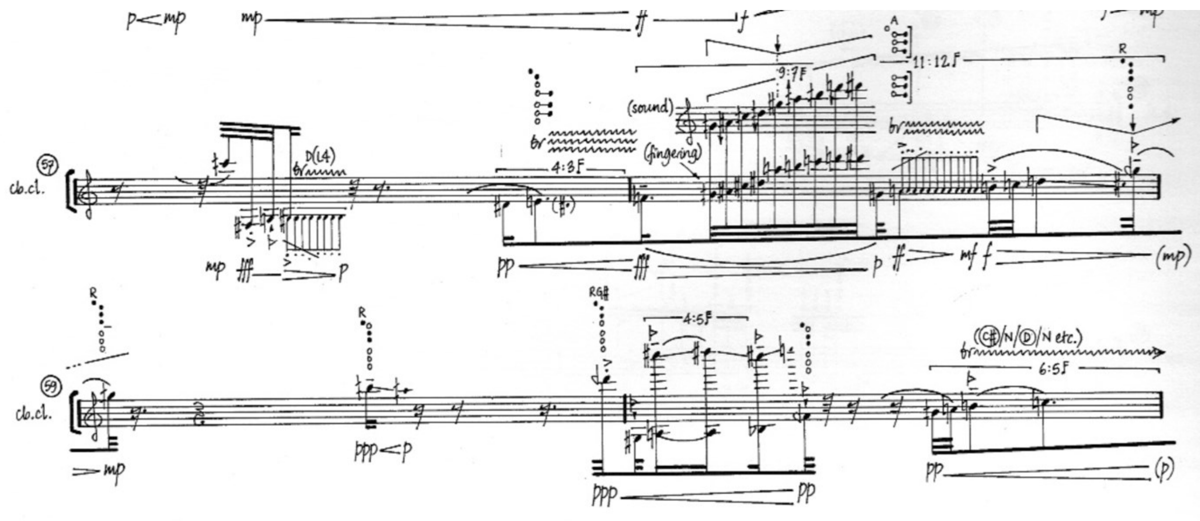


Figure 22. Richard Barrett "Interference", p. 4.

Alain Billaird, the clarinettist from Ensemble Intercontemporain, has interpreted two of the significant works for the contrabass with electronics. Raphaël Cendo

[179] Richard Barrett, Interference for Solo Contrabass Clarinet/(Male Voice)/Pedal Bass Drum, with Amplification (London: United Music Publishers, Ltd., 2000).

composed *Décombres* (2006) for contrabass clarinet and live electronic processing, and Yann Robin composed a cycle of works: *Art of Metal* (2006) for contrabass clarinet and ensemble, *Art of Metal II* (2007) for contrabass clarinet and electronics, and *Art of Metal III* for contrabass clarinet, ensemble, and electronics. These pieces use various extra techniques, including multiphonics, harmonics, different slap-tongues, and the voice.

Summary

While not an exhaustive list, the compositions covered here represent many important or significant works written for the contrabass clarinet. Most compositions that include contrabass clarinet written before the 1970s were mentioned; however, more contemporary works exist, some of which will be discussed in later chapters. In summary, the earliest original compositions are those written for the opera repertoire, the first being d'Indy's *Fervaal* in 1895, and a handful of orchestral music written in the early 20th Century. The use of the contrabass clarinet thrived starting from the 1950s with the Balanced Clarinet Choir movement and its effect on the American band, resulting in a dramatically increased use in these ensembles, supported by the increased manufacture of improved instruments from the G. Leblanc company. Its use in the orchestra began to return with the modern composers of the 1960s. While there were a few mid-century solo pieces written, the first significant works were Grisey's *Anubis, Nout* (1983) and Donatoni's *Ombra* (1984). The contrabass clarinet has increased considerably in modern repertoire; however, it is still relatively rare. The contemporary solo and chamber pieces discussed here are "core", but it is still small and primarily centred around key contrabass clarinettists' work.

Most of the solo and chamber repertoire, and some of the orchestral, necessitates a low-D, but more often a low-C instrument. The contrabass clarinet is unique compared to the bass clarinet because the extended-range instruments became the standard before the limited-range instruments. In a survey of professional contrabass clarinettists, the majority used one of the low-C instruments, with the rest using a low-D curved Leblanc. As the low-D model ceased 30 years before the end of production, favouring the low-C model, the low-C is the choice for professional contrabass clarinettists.

Chapter 2: Differences of the Contrabass Clarinets

Design Differences

The Leblanc, Selmer, and Eppelsheim contrabass clarinets to low-C differ drastically in design. Someone unfamiliar with them might not even know they were the same instrument. The Leblanc curved contrabass clarinet has a silver metal body that wraps upon itself, resembling a paperclip. With a wood body and silver bell and neck, the Selmer looks like a large bass clarinet. The Eppelsheim, in either a black or bronze-finished metal, is in a bass saxophone-shape (Figure 23).

Figure 23. Visual comparison of the three contrabass clarinets. Scale between instruments is approximate.

Despite these differences in appearance and body materials, the closed tube and cylindrical bore make them all contrabass clarinets, though each with a different sound character and playing response. One factor for this is the difference in bore sizes. The bore of a Leblanc is 30mm, Selmer is 34mm, and an Eppelsheim is available with either 32 or 36mm bore sizes.[180]

Keywork Designs

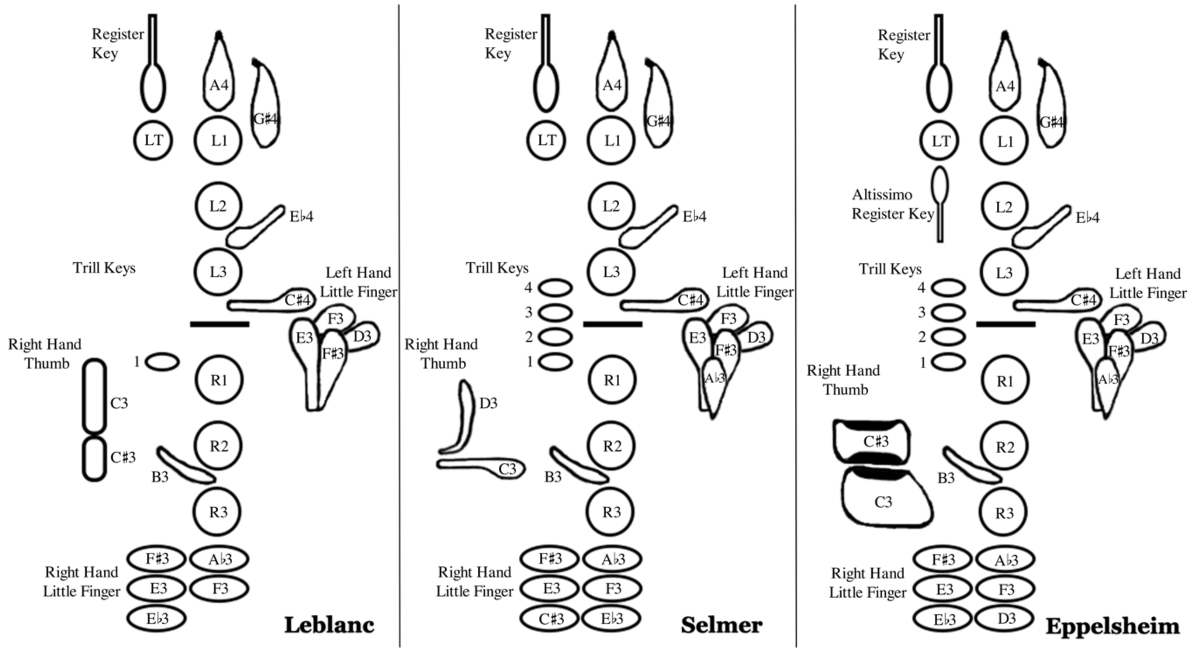


Figure 24. Fingering diagram for Leblanc, Selmer, and Eppelsheim contrabass clarinets. Design by Jason Alder.

All three contrabass clarinets use the Boehm fingering system; however, there are slight operational differences in the keywork of each instrument, illustrated in the fingering diagrams in Figure 24. Some of these differences do not impact the instrument's functionality, for example, the exact configuration of the lowest notes in the right-hand little-finger and the right thumb. This is only a design difference and has no bearing on the playability; however, some other differences do. Figure 25 illustrates which finger operates

[180] The bore size is the measure of the inner diameter of the tube of the instrument. A larger bore allows for a more voluminous sound, while an instrument with a smaller bore has a more compact sound and is more agile. A smaller bore instrument requires less air. The difference in size affects the response of the instrument and the way some contemporary techniques like multiphonics perform.

which keys. The diagram is for an Eppelsheim but applies to Leblanc and Selmer, despite differences in exact key configuration or shape.

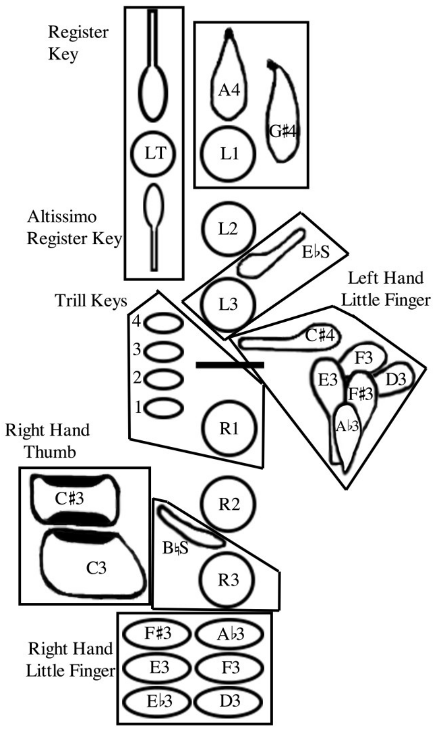


Figure 25. Fingering Diagram of an Eppelsheim with digit indications.

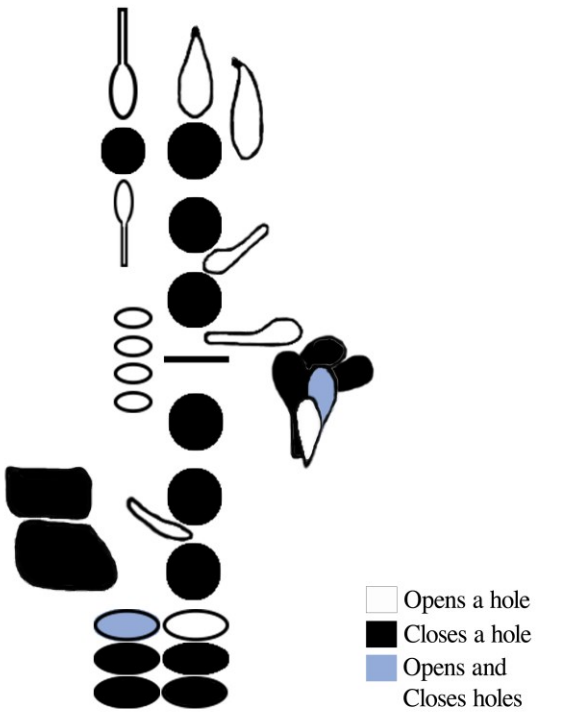


Figure 26. Fingering Diagram indicating keys that open vs close holes.

Figure 26 illustrates which keys will open holes and which will close them:

- Black-filled are open holes. Depressing the key will close it
- White-filled are closed holes. Depressing the key will open it.
- Blue-filled keys are F♯3, which simultaneously close one hole and open another.

Figure 25 and Figure 26 are important for understanding the fingering charts in the Appendix and knowing which keys are available for creating new fingerings, for example, to discover new multiphonics and timbres.

The little-finger key clusters of each hand operate the pitches F3 to D3. The key for a lower pitch will automatically close the necessary holes of higher pitches within the cluster.

For example, the F3 key only closes the F3 pad; E3 also closes F3; E♭3 closes E3, closing F3, and so on. A Leblanc has one fewer little-finger keys for each hand, but this is not fundamentally a problem. The missing keys double already existing ones, providing alternate fingerings to operate the same pad. Some note-sequences are more awkward without the additional key,[181] however, all the possible pitches are still available.

Register Key

One difference that affects functionality is the Register Key.[182] All three instruments have an *automatic system*.[183] Leblanc and Selmer use three separate vent holes to improve tuning and response; one for B♭4, a second for the notes B4–D♯5, and a third for the notes E5 and higher.[184] An Eppelsheim has five vent holes, four of which are automatic.[185] The fifth is the unique addition of an Altissimo Register Key, which makes playing some notes in the altissimo register (from C♯6 and higher) easier. The fourth automatic register vent is significant because of its impact on multiphonics. A fingering that triggers the fourth vent to open on the Eppelsheim will have different results than the other instruments.

---

[181] For example, in an E♭3 to A♭3 sequence on a Selmer and Eppelsheim, the right-hand little finger would play E♭3 and the left-hand little finger would play A♭3, but on a Leblanc both notes need to be played by the same right-finger, causing an awkward jump.

[182] Pressing the Register Key causes an additional vent hole to open and the clarinet to play in the second register, a perfect 12th higher than the fundamental register.

[183] With an automatic register system, a different vent hole will open depending on which other keys are depressed with the register key. With a manual system, separate register keys must be pressed to open the different vents. Charles Houvenaghel and Leblanc developed the automatic register system (U.S. patent 2627776) and it is now used on all professional quality low clarinets.

[184] Pressing the A4 key with the Register Key opens the B♭4 vent. The right-hand third-finger changes which vent opens for B4–D♯5 and E5 upwards.

[185] The first three vent holes are the same as the other instruments, the fourth is for the notes starting from A5, activated by the left-hand third-finger.

Trill Keys

A Leblanc lacks Trill Keys 2, 3, and 4.[186] The absence of these eliminates several fingerings available on a Selmer and Eppelsheim, affecting possible multiphonics, quarter-tones, and colour fingerings.

Articulated C♯

The *articulated mechanism* is an operational difference impacting functionality, not depicted in the diagram. If the C♯4 pad is open on a Selmer or Eppelsheim, the articulated mechanism automatically closes it when pressing R1 or R2. This makes specific note sequences easier to perform,[187] however, the mechanism thereby eliminates multiphonic, quarter-tone, and colour-fingering combinations possible with a non-articulated C♯. Figure 28 illustrates the fingering diagram for G3 with the C♯4 key also pressed. On a Leblanc the

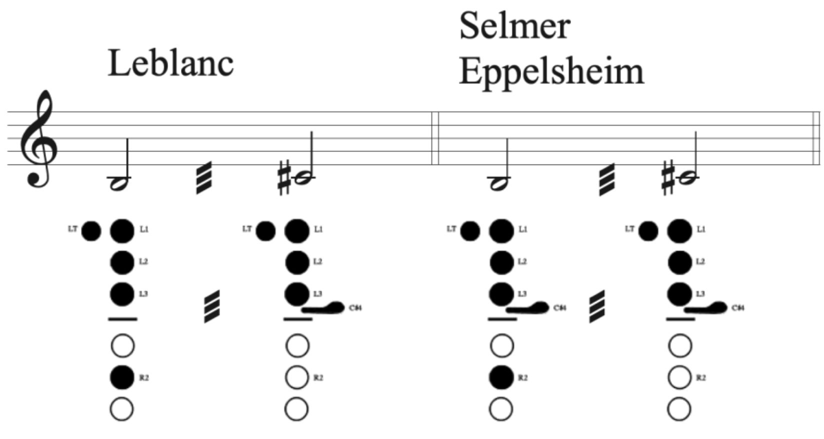


Figure 27. Illustration of the articulated C♯. Trilling B3-C♯3 on a Leblanc requires movement from two fingers in opposing motion. Selmer and Eppelsheim require only one finger to move.

[186] The name Trill Keys may imply that they are only to be used to play trills, however these keys provide alternate fingerings for certain notes and can be used besides trills.

[187] For example, a B3–C♯4 trill. By automatically closing the pad, the player can leave the C♯4 key depressed when playing B3, enabling a trill to be performed by only moving one finger, rather than two fingers moving in opposite motion — one down to close B3, the other up to release the C♯4 key and close the pad. See Figure 27.

opened C♯ pad in this fingering would create a multiphonic, however on a Selmer or Eppelsheim the right-hand fingers would close the pad and produce G3.

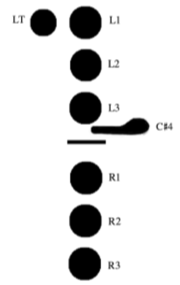


Figure 28. Illustration of the articulated C♯. On a Leblanc the fingering produces a multiphonic. On a Selmer and Eppelsheim it produces G3.

Low C3 and C♯3 Linkage

Another automatic mechanism is the linkage of lowest notes, C3 and C♯3. On a Selmer and Eppelsheim, playing from G3 to C3 requires pushing one key. The linkage automatically closes all the holes for the notes in between. On a Leblanc, the C3 and C♯3 holes can close without closing the others, requiring the D3 key to be pressed (Figure 29). This independence allows more fingering possibilities, explored extensively through the colour-fingerings in the previously mentioned *Anubis, Nout* by Grisey.[188]

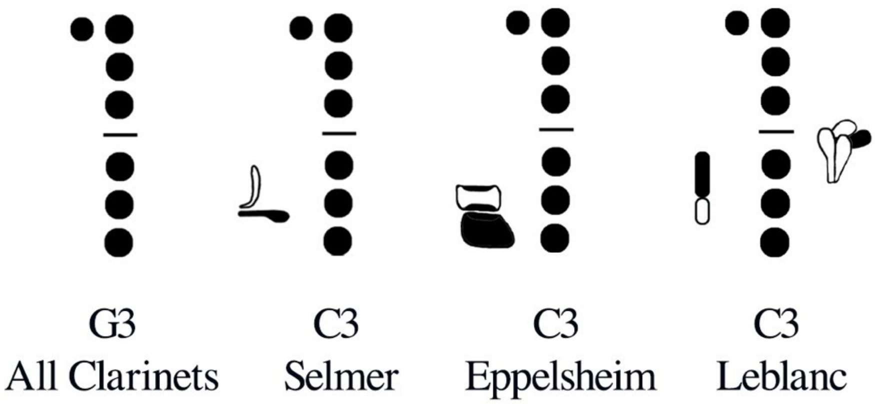


Figure 29. Low C linkage.

[188] A more extensive discussion about *Anubis, Nout* is in Chapter 3: Colour-Fingerings/Bisbigliandi.

E♭4 Sliver Key/Trill Key 1

E♭4 can be played either with the left-hand sliver-key or with the alternate fingering Trill Key 1. On a Leblanc and Selmer, these two keys open two separate toneholes, and opening both simultaneously can result in a colour or tuning fingering possibility. On an Eppelsheim, the two keys open the same pad. This provides a uniform sound regardless of the fingering used but results in reduced additional fingering possibilities.

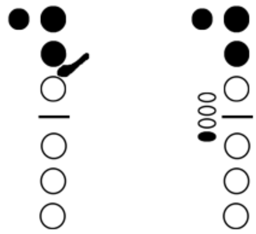


Figure 30. Alternate fingerings for E♭4.

The keywork on a Leblanc is the most limited and the oldest design, but the action is light, allowing a fast response. A Selmer is the most similar to a bass clarinet, but the lowest notes' action is heavy and slow. The build quality of an Eppelsheim is excellent. The key design is more similar to a saxophone, and the hands offset rather than inline. The action in the lower notes is also heavier.

Practical Considerations

The clarinettist's choice of contrabass clarinet is not limited purely to the instrument's sound or functionality. Practical factors are also considered, such as cost and availability.

As Leblanc does not manufacture the instrument anymore, its availability is limited. Instruments are bought and sold on the used market, often originating from sellers in the

United States. Sales are not rare, but the instrument is scarce, usually a handful per year available.[189] The price remains the lowest option available, but supply and demand dictate it will continue to rise.

Selmer's instrument is the most expensive option[190] but is more widely available because of the higher production levels. Due to the high cost, ensembles or academic institutions often own the instruments; however, some individual players also own them, whether obtained new or used.

The cost of the instrument from Benedikt Eppelsheim is between Leblanc and Selmer. They are available but made to order with a waitlist.[191]

Travel and portability also affect a player's instrument choice. The early low-C Leblanc instruments have the toneholes for C3 and C♯3 on a separate removable foot joint,[192] allowing the instrument to disassemble into a small case, approximately the size of an alto saxophone.[193] Later instruments did not have the separate joint, but rather a single, longer tube necessitating a longer case.

The Selmer disassembles into top and bottom joints like a bass clarinet; however, the neck and bell remain attached to their respective joints. The cases are larger and bulkier. Due to the instrument's wood body, it is more susceptible to environmental changes in temperature and humidity, going out of adjustment more easily than the metal instruments,

---

[189] Based on the informal evaluation of sales listed on major websites eBay, Reverb, and of other known clarinet dealers from 2016 to the present. Approximately 5-10 instruments are for sale per year, and current prices range from $5000-8000 USD (£3600-5800 as of March 2021).

[190] The current price in the UK is £25720. "Clarinet." Howarth of London, makers of fine oboes, woodwind specialists. Accessed March 13, 2021. https://howarthlondon.com/instruments.aspx?family=810&brand=9.

[191] The cost is €18000 (£15500 as of March 2021) as given from the manufacturer in email correspondence 26 April 2018. There is approximately two years wait, as told to the author during informal conversations with owners of the instrument.

[192] Around 1971 the design changed and the foot joint was no longer separate, in favour of a single long tube.

[193] Rendall, *The Clarinet*, p. 162.

with potential risk for cracking. This can be problematic when travelling with the instrument to areas with different climates.

Eppelsheim's contrabass clarinet is one piece, except for the bell and neck, thus requiring a large case. As the instrument wraps upon itself, it occupies a similarly sized case as a Selmer.

Table 1. Comparison of the Leblanc, Selmer, and Eppelsheim B♭ contrabass clarinets.

	Leblanc	Selmer	Eppelsheim
First in production	1934	1978	2008
Material	Metal	Wood	Metal
Bore Size	30 mm	34 mm	32 or 36 mm
Keywork	• No trill keys 2, 3, & 4 • Less alternate keys • 3 automatic Register Key vent holes	• Full Keywork	• Full Keywork • 4 automatic Register Key vent-holes • Extra Altissimo Register key • E♭4 and Trill Key 1 open the same pad
Articulated C♯	No	Yes	Yes
Automatic Low C/C♯ linkage	No	Yes	Yes
Portability	• Most compact	• Large • Wood affected by environmental changes causing adjustment problems and potential cracks	• Medium compactness
Cost	\$5000-8000 / £3600-5800 (used, no longer in production)	£25720	€18000 / £15500

Intonation

No clarinet (or any wind instrument) is built to play every note perfectly in tune, but some have achieved better results than others. Tuning charts were produced for each instrument to establish a baseline for intonation, with a reference pitch of A=440hz. I played every fundamental note (C3-B♭4) and the first overblown note from E3 (the 3rd partial, B4-

F6). C3-E♭3 were excluded, as this is the extended range of the instrument and not overblown for standard pitches on low-C clarinets. A tuning device was used to measure and record the pitch deviation in cents. Several readings were taken using different initial tuning reference pitches and different mouthpieces and reeds, as these factors can influence intonation. Regardless of the changes, the overall shape of the line graph mainly remained the same. Data points were taken using a steady, unchanging embouchure. Each note was started by playing the previous note and ensuring the tuner gave the same result as was recorded before moving to the following note. This ensured that the embouchure did not change after breathing or removing the mouthpiece from the mouth between notes. The average of these data points provides the baseline mean tuning curve for each instrument. An additional reading was done for each instrument making small embouchure compensations to adjust the tuning.

Each instrument has its idiosyncrasies, as seen in Figure 31-Figure 35. Figure 35 shows that these tuning problems can be mostly compensated for through small embouchure and voicing changes. This is impractical while playing fast passages, but longer notes can play in tune. Notable problem areas include C♯3 on a Selmer, more than a quarter-tone sharp, and C4 on a Leblanc, 18 cents flat. The Eppelsheim performed remarkably in tune, with most notes at 0 or within +/-5 cents, the most extreme deviations being E♭4 10 cents flat and B4 12 cents sharp.

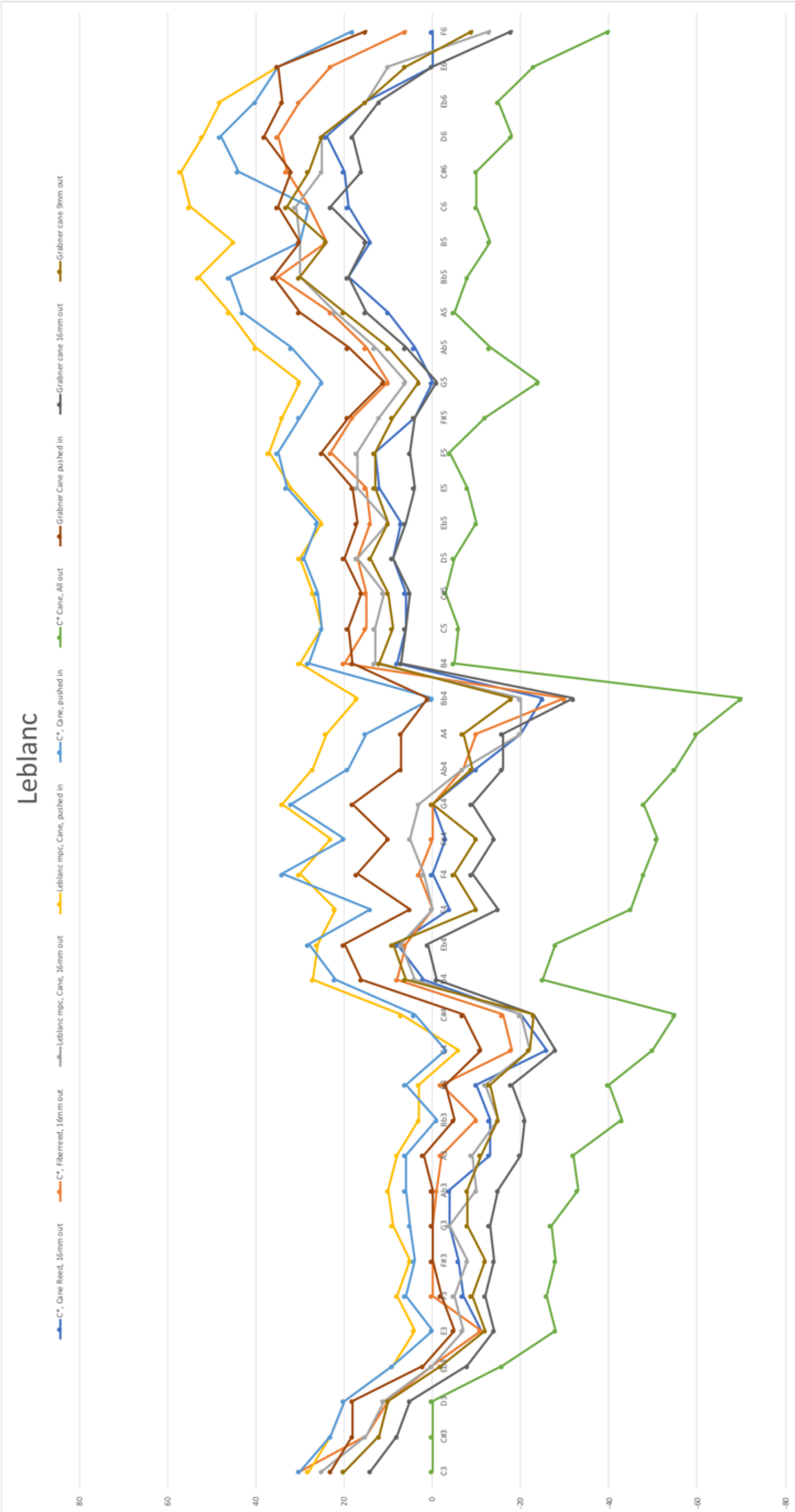


Figure 31. Leblanc tuning chart. The X-axis represents the pitches C3-F6, and the Y-axis represents the deviation from 0 in cents. Each coloured graphline is a different mouthpiece and reed setup or initial tuning reference.

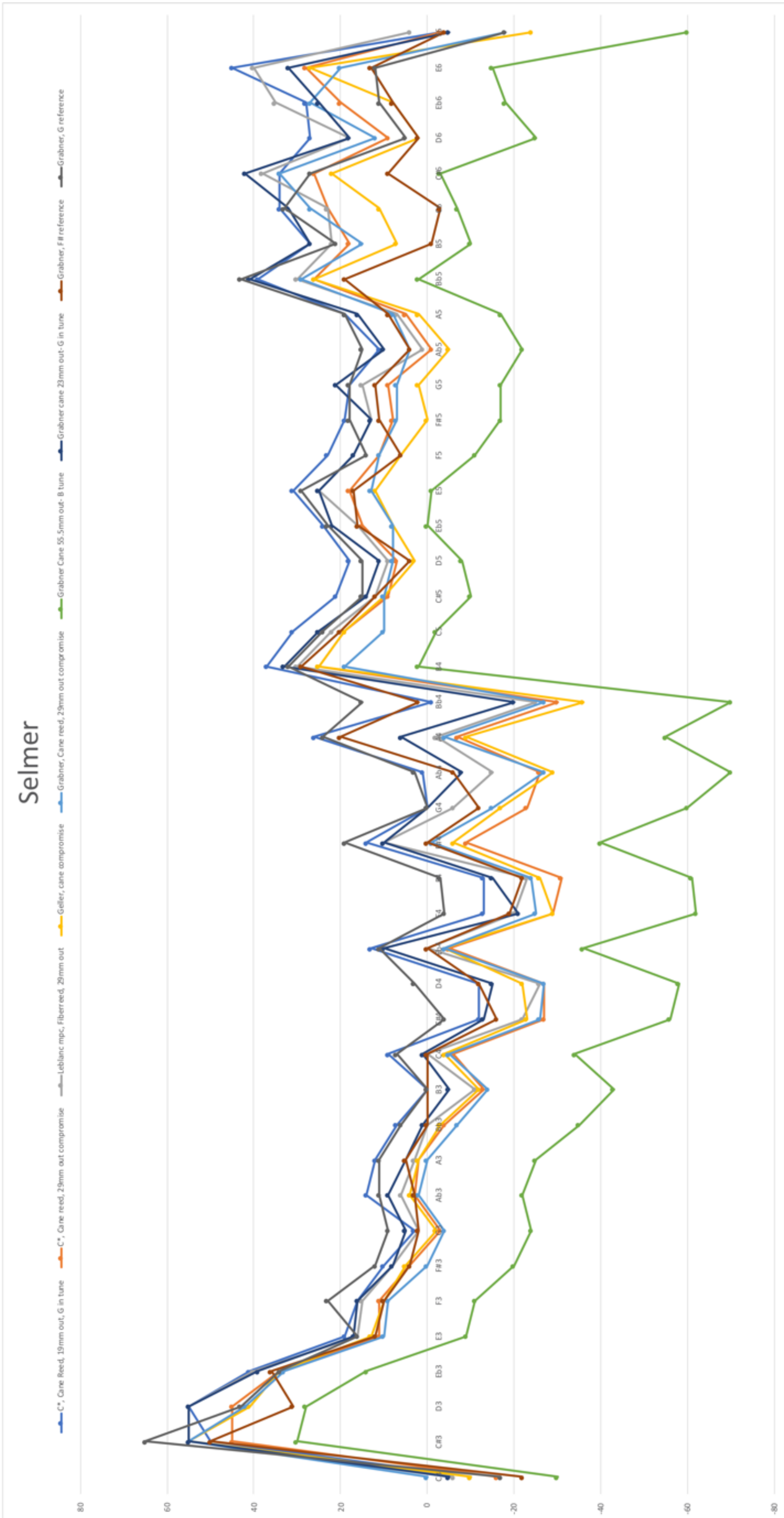


Figure 32. Selmer tuning chart.

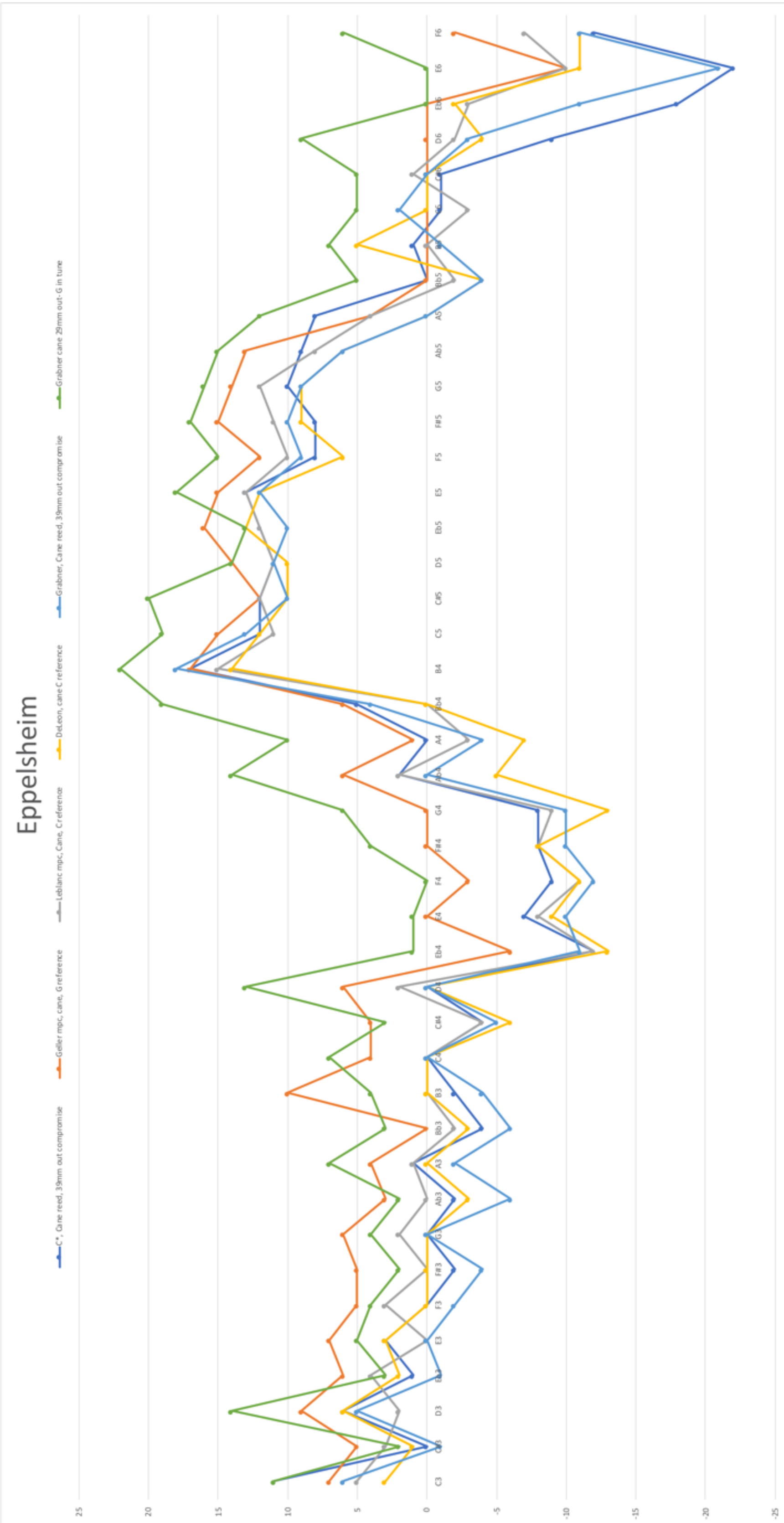


Figure 33. Eppelsheim tuning chart.

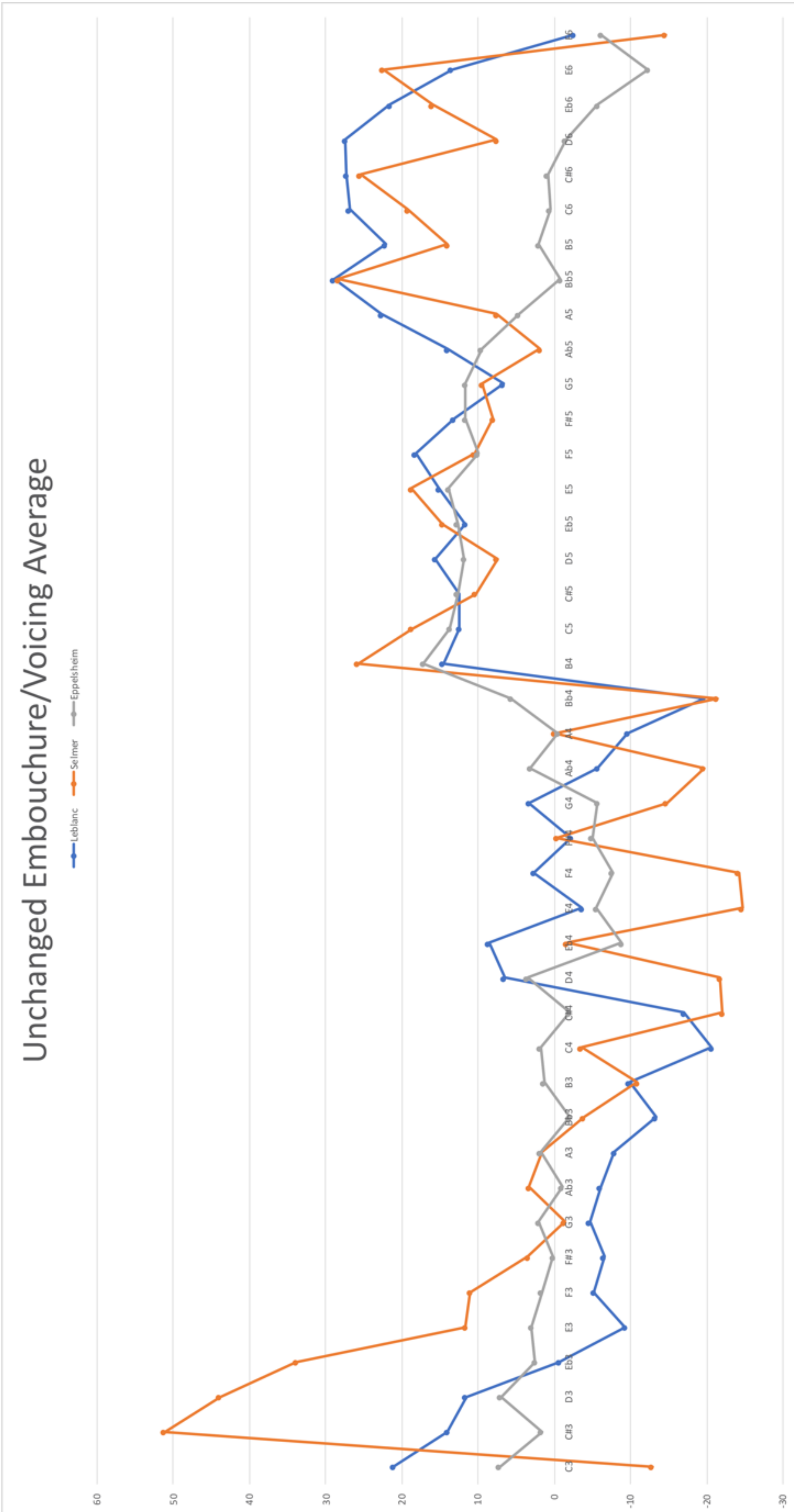


Figure 34. Leblanc, Selmer, Eppelsheim mean tuning comparison, unchanged embouchure.

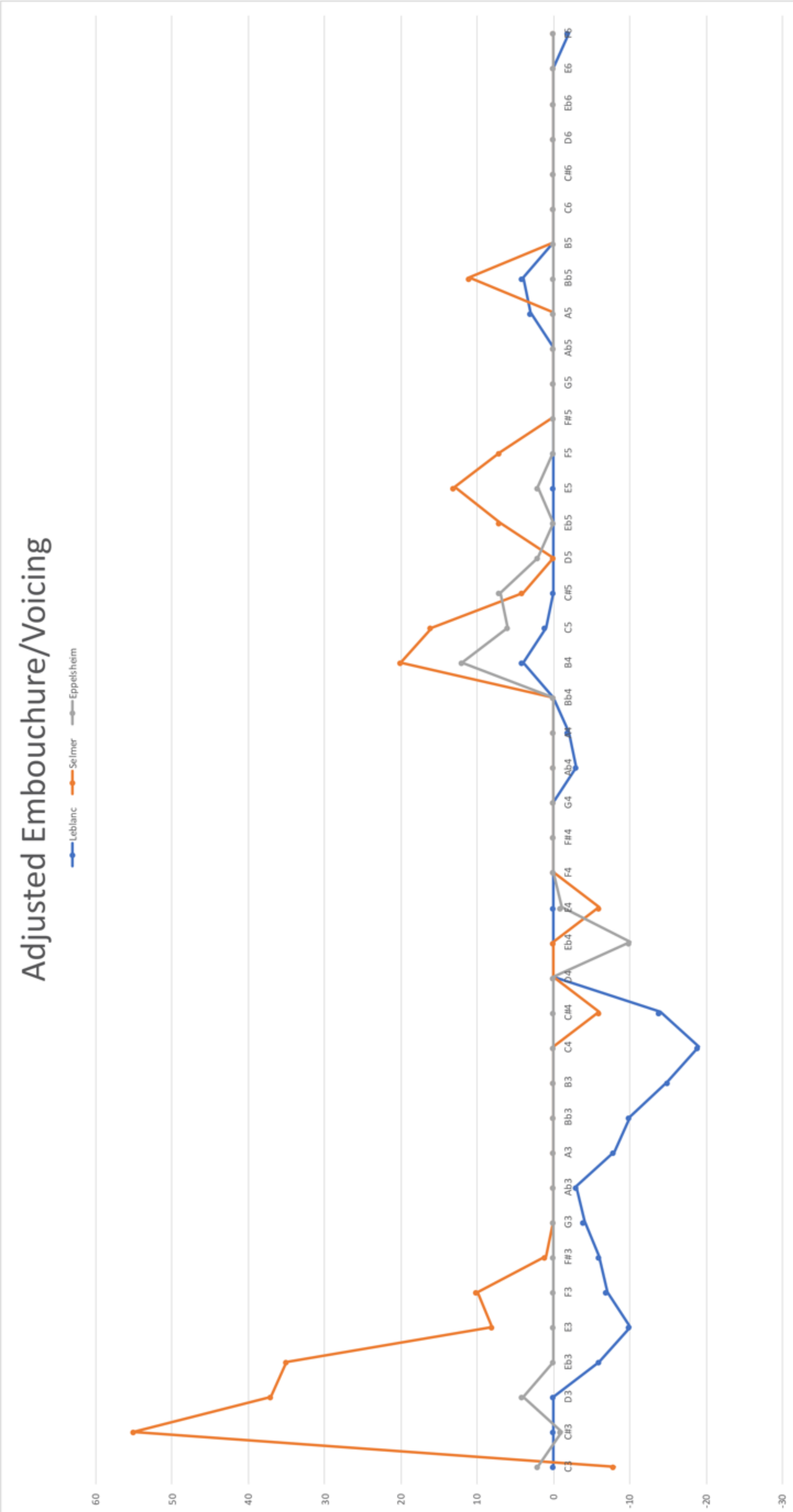


Figure 35. Leblanc, Selmer, Eppelsheim tuning chart with pitch correction adjustments.

Chapter 3: Sound Possibilities, Known and New

In researching contemporary techniques for the contrabass clarinet, an initial step was collecting and categorising known techniques within the clarinet and bass clarinet lexicon and examine techniques used with other instruments. While most of the clarinet techniques did work on the contrabass, some responded differently than the smaller clarinets.

Notable differences include:

- The contrabass clarinet has an extreme range, capable of playing higher partials than smaller clarinets.
- Bass clarinet multiphonic fingerings do not always produce the same results.
- Pitch variation is less versatile in the low and middle registers, negatively affecting quarter-tones, pitch bends, and subtle vibrato possibilities.

Throughout the composer collaborations, the focus was on discovering new techniques and new ways of using them in music. Particular attention was paid to altissimo, quarter-tone, and multiphonic fingering charts; colour fingerings; using the voice; and combinations of techniques.

The techniques are placed into five different categories:

- **Pitch based**- those that centre primarily around the production of pitches.
- **Natural effects**- those that alter the sound of a pitch or create a new sound without modifying the instrument or using external objects.
- **Percussion**- those that use the instrument percussively.
- **Preparation**- those that use external items to change how the instrument functions.
- **Deconstruction**- those that involve removing or rearranging sections of the instrument.

Table 2. List of Contemporary Techniques

Pitch-Based ▪ Altissimo ▪ Quarter tones ▪ Multiphonics o Harmonic glissando ▪ Subtone ▪ Colour fingerings/bisbigliandi ▪ Double trills ▪ Pitch bends **Natural Effects** ▪ Flutter-tongue ▪ Slap o Tone slap o Staccato slap o Open slap o Reed slap ▪ Air sounds ▪ Voice o Growling o Screaming o Singing o Compound multiphonics o Singing without playing ▪ Shaking ▪ Tongue on reed	**Percussion** ▪ Key clicks ▪ Finger Pops ▪ Hitting/scraping bell **Preparation** ▪ Muting ▪ Reed alterations ▪ Alternative sound production **Deconstruction** ▪ Mouthpiece only ▪ Neck & mouthpiece only ▪ Palm ram ▪ Demi-clarinet ▪ Rearranged pieces

Pitch-Based

Altissimo

Appendix: Fingering Charts with Altissimo Quarter-Tones

The contrabass clarinet has the potential for a greater range compared to smaller clarinets. I was able to achieve nearly six octaves on each of the three instruments.[194] However, the top octave is difficult and requires a very resistant mouthpiece and reed setup to reach, much more resistant than I would typically play. A range to C7, typically the top

[194] Up to A♭8 with Selmer and B♭8 with Leblanc and Eppelsheim.

end of the soprano clarinet's range, should pose no problem for the advanced player. C8, corresponding to Leblanc's original five-octave range claim, is an achievable range for professionals.

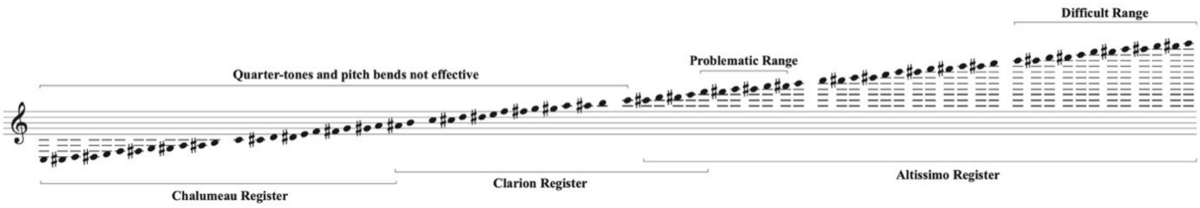


Figure 36. Contrabass clarinet range with register delineations and problem areas.

An exception is the beginning of the altissimo range, from C♯6 until approximately B♭6. C♯6 is when the soprano clarinet begins to use fingerings that overblow to the 5th partial. On the contrabass clarinet C♯6-F6 can be produced in two ways, either continuing the clarion range and overblowing F♯4-B♭4 to the 3rd partial or changing to the altissimo range, overblowing A3-C♯4 to the 5th partial. The 3rd partial fingerings respond more quickly and produce a clear, open sounding note, but F6 can have a thin and constrained sound.

The 5th partial fingerings are more resistant and covered sounding. The lack of an LH1 half-hole mechanism, used on smaller clarinets to play altissimo notes, causes the response to be slower and less predictable. Depending on the musical context, however, these fingerings may still be preferable. F6 and F♯6 are particularly problematic. If using the same voicing[195] as the notes C♯6-E6, they have a thin sound, and the notes from G6 and above will not speak at all. It is, therefore, necessary to change voicing for this range to one with a much lower tongue position than is usually expected by the clarinettist playing in this register. The response is also slow. From approximately B♭6 onwards, the pitches respond more readily.

[195] Voicing is the combination of the internal shape of the mouth, airway, and tongue position while playing.

Composers should take care when using this range not to write fast passages or short notes which may not respond quickly enough.

It should be noted that the pitches in the upper range are highly flexible, and fingerings may fluctuate between players. Factors such as mouthpiece and reed setup, embouchure, air flow, and tuning reference point contribute to varied results with altissimo pitches. Therefore, the contrabass clarinettist should try neighbouring fingerings on the chart to determine what is best in tune for them.

Quarter Tones

Appendix: Fingering Charts with Altissimo Quarter-Tones

Quarter-tones are not effective in the lower ranges of the contrabass clarinet. Attempts to find quarter-tone fingerings in the chalumeau and clarion registers resulted in timbral changes and microtonal pitch changes, but not a full quarter-tone. The pitch is much more flexible in the upper range, so the quarter-tone fingering charts begin from C6. It must again be noted that the intonation in this range can vary significantly with the player. The fingerings are relative to each other so that each will produce a pitch one quarter-tone difference from the fingering on either side of it. However, players may need to consult neighbouring fingerings to find the one most suitably tuned for them.

Multiphonics

Appendix: Multiphonic Fingering Charts

Audio Examples: 0001-0829 Multiphonics

Multiphonics are the production of multiple simultaneous sonorities. There are two primary ways to produce a multiphonic sound, Type 1 or Type 2.[196]

A Type 1 is a spectral multiphonic performed by splitting a fundamental note through manipulation of the embouchure. The result is an array of pitches following the clarinet's harmonic series—the odd-numbered partials. The highest pitch of the multiphonic can be adjusted by the player through embouchure manipulation. A unique feature on contrabass clarinet is the ability to filter out pitches in the middle of the spectrum with the embouchure with relative ease, leaving only low and very high notes. Type 1 multiphonics are more predictable in their pitch content since they follow the harmonic series, however there can be timbral differences between the different contrabass clarinets.

A Type 2 multiphonic is produced using an alternate fingering. Opening a hole in the air column creates a new node, producing multiple pitches simultaneously. Multiphonic fingerings for other sized clarinets may produce a multiphonic on the contrabass, but not necessarily with the same pitches. Rehfeldt (1994) recognises this by producing separate fingerings charts for soprano and bass clarinet and states that while many of the bass clarinet fingerings will work on the contrabass, they are different enough to necessitate their own charts.[197] Watts (2015) also notes that Rehfeldt made his charts with a low-E♭ bass clarinet, changing their response compared to a low-C instrument.[198] The existence of Watts' book alone demonstrates the substantial difference between soprano and bass clarinet multiphonic

---

[196] Sarah Watts, *Spectral Immersions: A Comprehensive Guide to the Theory and Practice of Bass Clarinet Multiphonics* (Ruisbroek-Puurs: Metropolis Music, 2015), p. 1.
[197] Rehfeldt, *New Directions for Clarinet*, p. 48.
[198] Watts, *Spectral Immersions*, p. 14.

fingerings, and she notes the design differences between the instruments as a contributing factor.[199] Given that the contrabass clarinet's design is further different from the bass clarinet, and each of the three contrabass clarinet's design is drastically different from each other, it becomes clear that each instrument requires its own fingering chart.

With both types of multiphonics, it is essential to note that the volume levels of every pitch produced are not the same, and the composite sound should not be regarded as a chord in the same way as one might expect a piano to produce.[200] The most prominent pitches are generally the upper and lower tones, with the middle pitches contributing to the timbre.[201]

Recordings of the multiphonic fingerings in these charts have been analysed with the audio spectral analysis software *Audiosculpt*[202] to accurately determine the frequencies present and at what levels. Each multiphonic was played as a long, held note for the recording, maintaining the pitches as stable and without variation as possible. A partial tracking analysis was performed with an amplitude threshold setting of -60dB, an FFT window size of 8192 samples, and yielding a maximum of eight partials. The analysis highlighted the eight most prominent partials for each multiphonic with their frequency and amplitude. Data was taken when the multiphonic was stable, often at some point in the middle of the recording, and the information notated onto a musical stave. Partials above 1800hz were excluded, as they are beyond the realistic playing range of the instrument.[203] Pitches have been notated tempered to quarter-tones based on the analysis, however it is very important to understand that this tuning is flexible, and different players will likely have differing results.

---

[199] Ibid. p. 12.

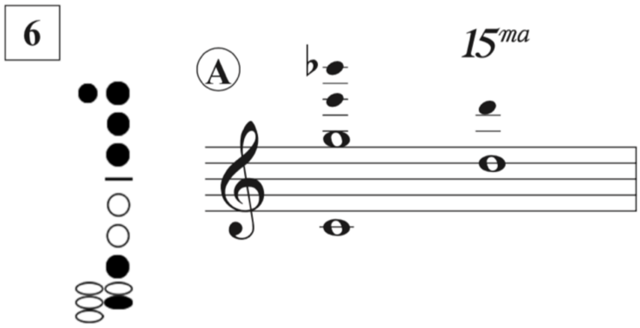
[200] Rehfeldt, *New Directions for Clarinet*, p. 43.

[201] Harry Sparnaay, *The Bass Clarinet: a Personal History*, trans. Annelie de Man and Paul Roe, 3rd ed. (Barcelona: Periferia Sheet Music, 2017), p. 130.

[202] Ircam. "Audiosculpt." Computer software, 2013. http://anasynth.ircam.fr/home/english/software/audiosculpt.

[203] B♭8, the highest note I was able to play, is 1661.22hz.

Multiphonics on the contrabass clarinet have the potential for very wide intervals, sometimes spanning five octaves. Finding an easily-readable notation to accommodate this was challenging. I advocate using French notation, keeping everything in the treble clef, but reading more than ten ledger lines above the stave is impractical. The decision was made to notate the single sound in two clusters. The first cluster spans the pitches C3-C7, the range usually read by clarinettists. The second cluster is for pitches above C7, notated with *8va* or *15ma.* Open noteheads indicate the multiphonic's primary pitches, and the filled noteheads indicate pitches present in the texture of the sound, but not as prominently. The determination of which pitches fell into which category was based on a combination of their amplitude and listening. Some pitches may have had a relatively low amplitude but stood out in the tone cluster, while others had a higher amplitude but were less discernible. The latter was particularly the case with higher pitches. Notes in the second cluster tended to be very close to each other, often with similar amplitudes. These close pitches attributed to the particular harsh timbre, but there was a main top pitch that stuck out or was the pitch that can be considered the target for voicing purposes. When the pitches were more distinct, they were notated with open noteheads but otherwise with filled noteheads. Pitches an octave higher than the target top pitch were often present and attributed to the timbre. These are also notated with filled noteheads. The filled noteheads are included in the charts to give a visual indication of the timbre and density of the multiphonic. When using these notations in a score, it is recommended to only use the primary pitches of the open noteheads, as these are the most important for the player. The example Figure 37 illustrates Leblanc multiphonic 6A. With the fingering shown, the primary resulting pitches will be C4, G5, and D7, with textural pitches E6, B♭6, and D8.



Stability	3
Attack dynamic	***pp–ff***
Attack immediacy	2
Crescendo range	***pp–ff***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

Figure 37. Leblanc Multiphonic 6A.

The first chart was made using a Leblanc and included as many possible pitches and combinations as could be found, notated by ear and with a tuning device. The same fingerings were then played on the Selmer and Eppelsheim instruments, attempting to recreate the pitches achieved in the first instance on the Leblanc and record the results. There were discrepancies as some fingerings were not possible, like those where the articulated C♯/G♯ key or the automatic low-key linkage would affect it. In some instances, the resulting pitches were different, and in other instances, the multiphonic would not respond satisfactorily. When recording the Leblanc multiphonics, some of the pitches obtained initially were not reliably reproducible and therefore removed. The resulting individual charts include the fingerings which were satisfactorily reproducible for each instrument.

Every multiphonic is described in seven categories: stability, attack dynamic, attack immediacy, crescendo range, if the upper harmonics increase with dynamic, if the multiphonic can emerge up from the bottom note, and if the multiphonic can emerge down from the top note. Further explanation of these categories is given in the fingering charts.

As a goal of this resource is cross-compatibility, an additional chart was made which collates the fingerings that produced the same results on all three instruments. The criteria for "same results" was granted necessary flexibility, as each multiphonic on each instrument had a unique timbre. For multiphonics to be the "same," they have the same fundamental and top pitches and share internal pitches; however, they would not always have all the same pitch content or dynamics. An internal pitch on one instrument may have a higher amplitude and be considered prominent (notated with an open notehead); however, on another instrument, it may have a lower amplitude and be textural (filled notehead). The overall result is similar enough for the fingering to be considered cross-compatible.

Harmonic Glissando

A harmonic glissando is a Type 1 multiphonic that uses embouchure manipulation and voicing to change the overtones, producing a glissando through the harmonic series. Type 1 multiphonics and harmonic glissandi are less effective on soprano clarinet but are used with the bass clarinet. They work equally as well on the contrabass clarinet. While theoretically possible from any of the fundamental pitches, they are most effective in the instrument's lowest octave. A composer may indicate which upper pitches to play, but the contrabass clarinettist should have a reference as it is achieved by ear. Harmonic glissandi are often notated graphically, with a line in the stave indicating the glissando contour.

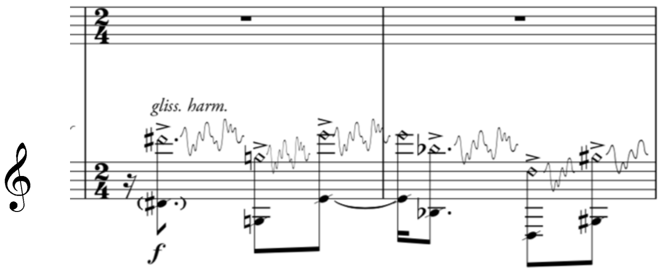


Figure 38. Raphaël Cendo "Decombres" bb. 38-39, harmonic glissando notation.[204]

Chrysakis notates Type 1 harmonics with what he calls "grainy haze", illustrated with the dense wall of black in the score of *Dark Light.*[205] His addition of the up and down arrows towards the end of the line tells the clarinettist to manipulate the embouchure, changing the harmonics and producing the effect of a harmonic glissando.

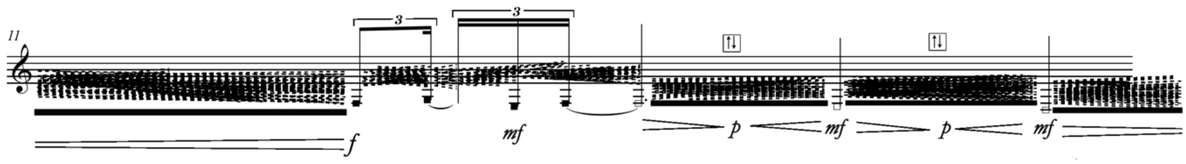


Figure 39. Thanos Chrysakis, "Dark Light" grainy haze.

Subtone

Subtone is an effect caused by under-supporting the airstream and suppressing the upper partials, resulting in an airy, unfocused, muted sound.[206] It is effective at soft and medium dynamics in the chalumeau register. Use in the clarion register is possible, with an increased chance that a lower pitch may also be present.[207]

[204] Raphaël Denco, *Décombres, Pour Clarinette Contrebass & Électronique* (Paris: Maison Ona, 2017).

[205] Thanos Chrysakis, *Dark Light* (Aural Terrains, March 2017).

[206] Marcus Weiss and Giorgio Netti, *The Techniques of Saxophone Playing - Die Spieltechnik Des Saxophons*, 4th ed. (Kassel: Bärenreiter-Verlag Karl Vötterle GmbH & Co. KG, 2018), p. 165-167. The technique is not exclusive to the contrabass within the clarinet domain, but little is written about its use with clarinets. It is primarily known as a jazz saxophone effect.

[207] Under-supporting, or under-blowing, an upper register pitch with the intention of highlighting the lower-register pitch is also a method for multiphonic production.

There is no specific notation. A composer can write "subtone" for a passage or use different noteheads.

Colour-Fingerings/Bisbigliandi

Appendix: Colour-Fingerings Grids

Audio Examples: 0830-0936 Colour-Fingerings

Colour-fingerings alter the timbre of a note by opening or closing extra toneholes to modify its acoustic qualities.[208] *Bisbigliando*[209] is the effect created by trilling these colour-fingerings. Only toneholes that do not substantially affect the pitch (more than a microtonal deviation) or create other undesired effects, such as multiphonics, may be used. Using combinations of the available keys significantly widens the spectrum of possibilities; however, not all key combinations are usable due to mechanical design and operation or the response it produces on the instrument.

This effect was central in *Anubis, Nout*. Grisey composed the piece for Harry Sparnaay and his Leblanc instrument, and utilised its lack of an automatic low C/C♯ linkage.[210]

Grisey's notation includes two stave-lines above the standard stave that indicate which extra colour-key to press.[211] Figure 40 illustrates Grisey's notation for adding the low C and C♯ keys while playing E♭3, and my representation of them on a standard clarinet fingering diagram.

---

[208] Rehfeldt, *New Directions for Clarinet*, p. 20.

[209] Italian for "whispering". In harp notation it is used to tremolo between two enharmonic notes.

[210] See Low C3 and C♯3 Linkage in Chapter 2.

[211] Grisey notated in bass clef, so these would normally be read as E♭2 through A3, however I will be using the treble clef octave designation (French notation) based on fingerings.

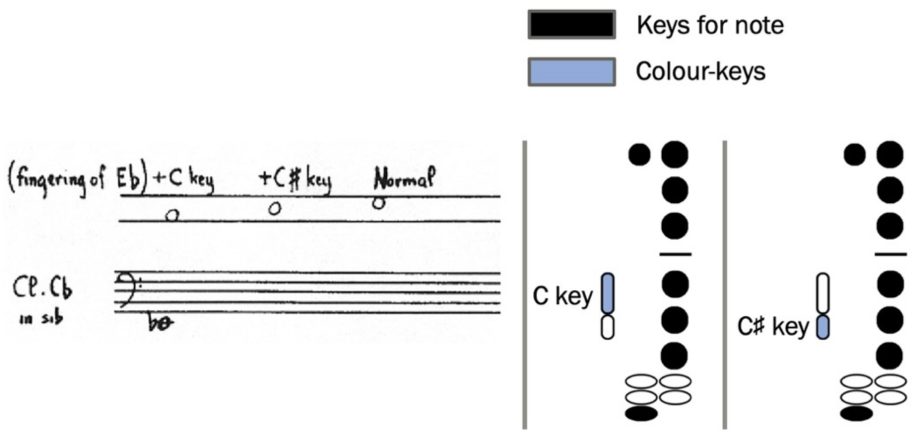


Figure 40. Gerard Grisey, "Anubis, Nout". E♭3 colour-fingering notation with Jason Alder's fingering diagrams.

A3 has more keys available for colour-fingerings. Figure 41 illustrates Grisey's six colour-keys — C♯, C, E, F, F♯, (N for Normal) and G♯ — and their associated fingering diagrams.

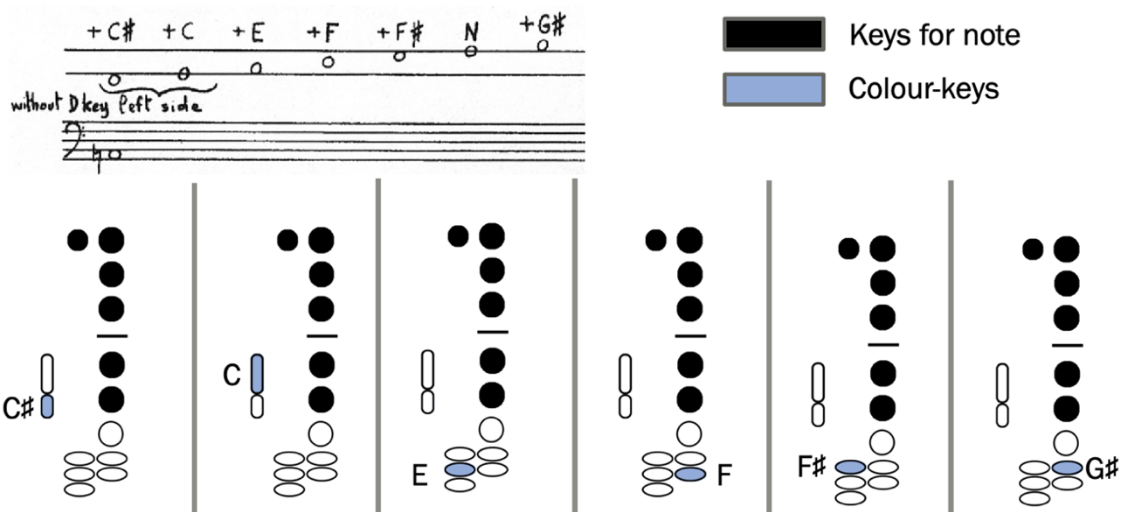


Figure 41. "Anubis, Nout" A3 with colour fingering notation.

Comparing the notation of these two examples highlights a problem with his system; the colour-key notehead position does not stay constant for each note (Table 3). The score in Figure 42 shows that Grisey only notates the two-line stave with the noteheads and does not include the key name. Rather than learning one set of new notations, the contrabass clarinettist must learn a new set for each of the thirteen notes used. In my study of the score, I found it easier to write the key names above the notation (Figure 42).

	E♭3	**A3**
C-key	Above bottom staveline	On bottom staveline
C#-key	Between stavelines	Below bottom staveline
Normal Note	Below top staveline	On top staveline

Table 3. Grisey "Anubis, Nout" colour-fingerings notation comparison.

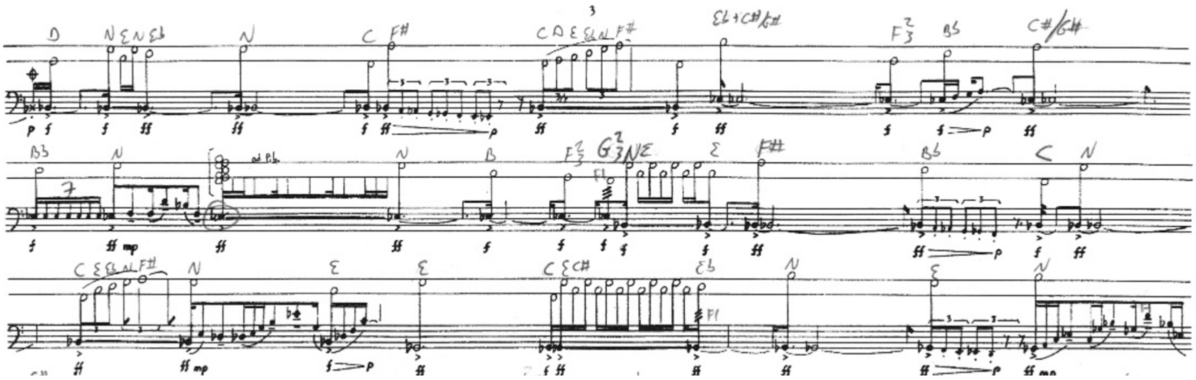


Figure 42. Grisey, "Anubis, Nout", p. 3, with Jason Alder's notation markings.

From E♭3 through C♭4 Grisey only uses one colour-key at a time, but most of the keys can combine for more possibilities. I wanted to explore these other combinations; however, I did not want to create a separate diagram for every possibility. As the number of available colour-keys increases, the number of combination possibilities increases exponentially.

For example, E♭3 (Figure 40) has only two colour-keys and they cannot be used in combination. A♭3 (Figure 43) has six colour-keys— left-hand F, F♯, E, and D, and right-thumb C♯ and C. They can be used individually and each of the four left-hand keys can also be used with each of the thumb keys, creating fourteen total possible fingerings (Figure 44).

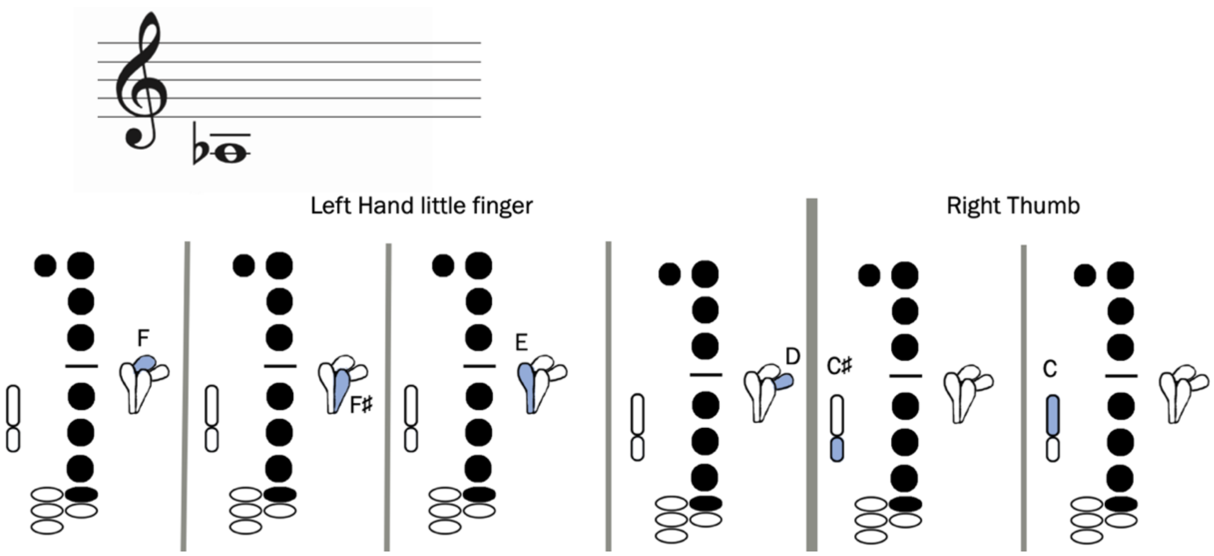


Figure 43. Leblanc A♭3 colour-fingering possibilities.

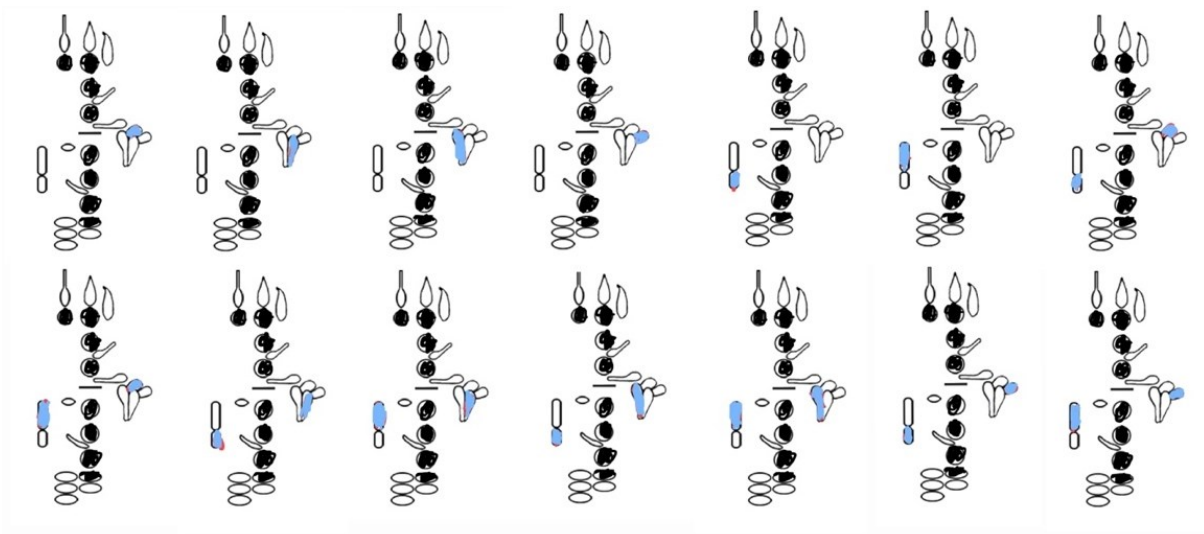


Figure 44. Leblanc A♭3 colour-fingering combinations diagrams.

A3 has eight available keys for colour-fingerings, the six Grisey used (Figure 41) plus right-hand E♭ and left-hand D. Additionally, three right-hand keys — E, F, and F♯— duplicate keys in the left-hand (Figure 45). Three-key combinations are thus possible, but not all the keys can combine with each other. There are a total of 52 different fingerings for 41 unique sound combinations.[212]

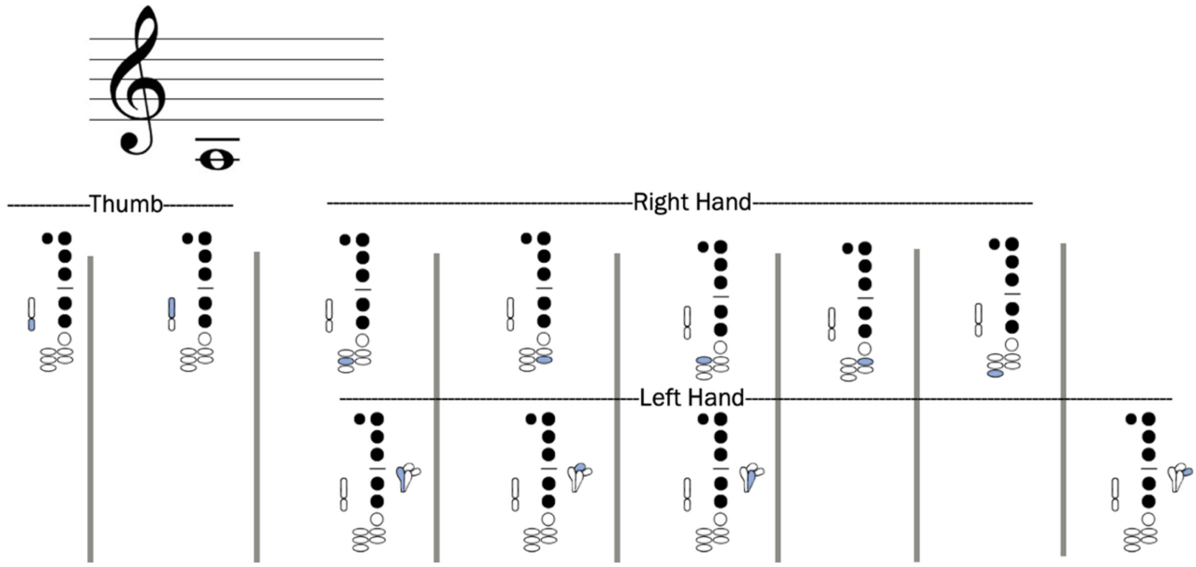


Figure 45. Leblanc A3 colour fingering possibilities. Fingering diagrams in the same column are alternate fingerings for the same note.

The rate at which the number of possible combinations increases as the number of available keys increases is evident. I wanted to develop a system that would clearly show every colour-key and combination possibility without diagramming each one. I limited this to the chalumeau register, E♭3–B♭4, and its first overblown notes, B♭4–F6.

I have defined the relationships of the available key-combinations in grids. Each axis of the grid contains every key on the instrument, and colour-coding illustrates which are used by the left-hand, right-hand, and right thumb. Red gridlines indicate keys operated by the same finger, and therefore only one at a time can be used. Character-coding using numbers, letters, and symbols within each box further defines the finger-combination relationships. Using these grids enables one to identify every possible combination of colour-keys that can

[212] The difference between the number of fingerings and the number of unique sound combinations is because the duplicated keys operate the same toneholes. For example, the combination of Thumb C, Right-hand E, and Left-hand F♯ uses the same toneholes as the combination of Thumb C, Right-hand F♯, and Left-hand E. They are two different fingerings with the same results, thus not a unique sound.

be added to a given note. Figure 46 illustrates the grid for A3, and provides the information to determine all 52 colour-fingerings. Further explanation regarding reading the grids is found in the appendix.

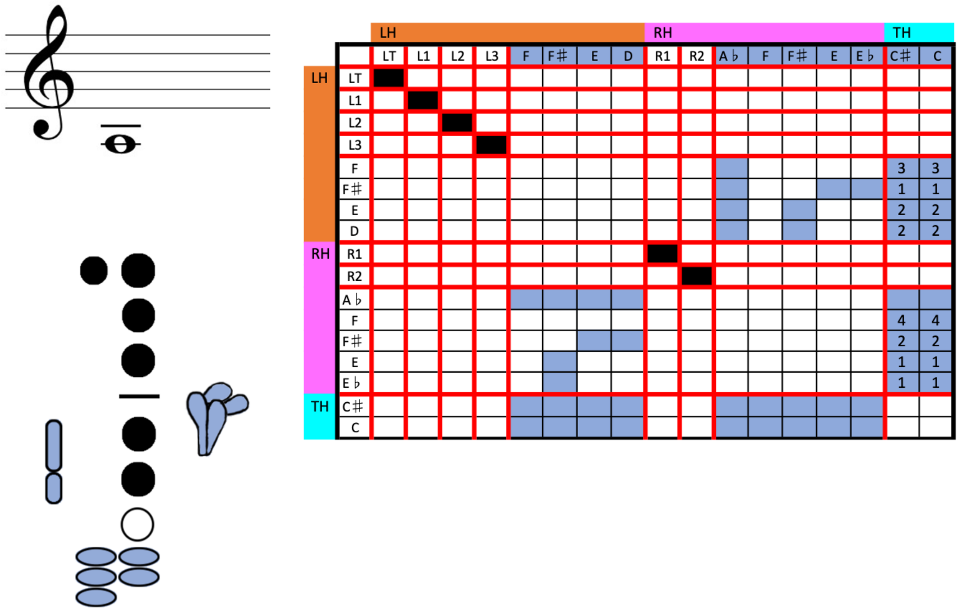


Figure 46. Colour-fingering combinations grid.

The necessity for alternate colour fingerings between the contrabass clarinets is demonstrated in *Orcus* by Richard Bernd Deutsch.[213] The piece opens with a series of colour trills, mainly dominated by B4. This note's fingering involves closing nearly all the instrument's holes and does not leave many options available for colour fingerings. On a Leblanc instrument, it can be produced by closing the C3 pad, utilising the lack of a low C/C♯ linkage as Grisey did. This option will not work on a Selmer and Eppelsheim due to the automatic closing linkage. An alternative for these two instruments is to use Trill Key 4 with

[213] Bernd Richard Deutsch. *Orcus, Für Kontrabassklarinette 2007/08*. (Berlin: Boosey & Hawkes – Bote & Bock, 2016).

the right-hand thumb, which is not an option on a Leblanc because it does not have this key.[214]

Figure 47. Excerpt from "Orcus" by Bernd Richard Deutsch and colour-trill fingerings used on Leblanc and Selmer instruments for B4.

Notation for colour fingerings and trills can vary. Grisey's method works if a composer wants to use a specific key; however, the notehead position should remain constant. Key names, as I have written on my *Anubis, Nout* score (Figure 42), would also be acceptable. Another method is to represent the colour-fingerings with a different notehead, as shown in Figure 48. Specific colour-fingering combinations can be illustrated with fingering diagrams in the same way that multiphonic fingering diagrams are used.

---

214 The charts have been limited to keys pressed by the finger that normally operates it. Expanding to non-standard fingers further exponentiates the possibilities, and introduces potential complications due to the clarinettist's physical characteristics. However, an exception is made for B4, C4, and D4 for Selmer and Eppelsheim instruments. This is the only colour-fingering possibility for these notes, so it is used, but not considered for other notes.

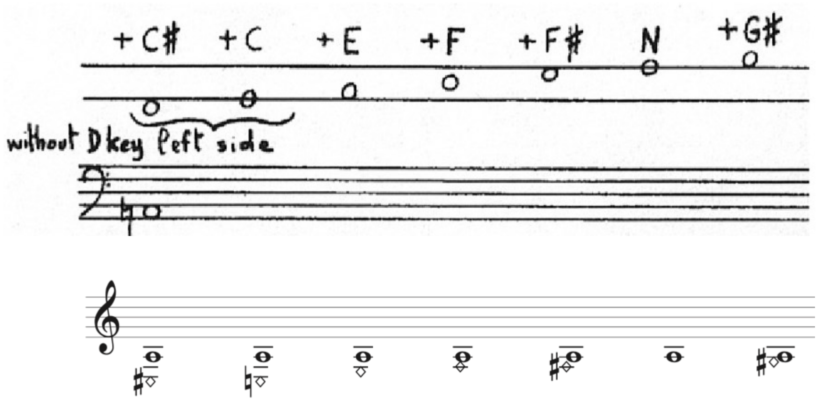


Figure 48. Grisey "Anubis, Nout" notation (above) with suggested alternative notation (below).

Mark Andre composed *iv 7*[215] for a Selmer instrument and included a diagram assigning each key a number or letter. He notates colour-fingerings on a second stave above with the designated key-number or letter above a headless stem (Figure 49).

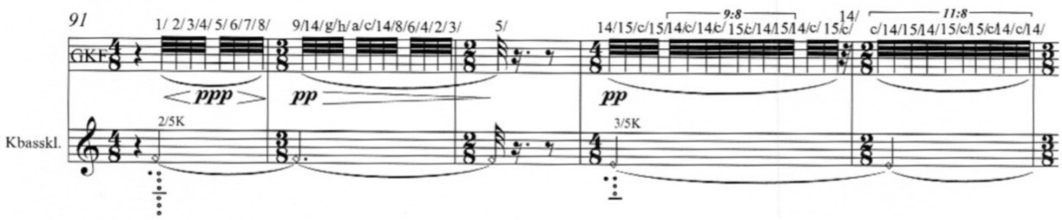


Figure 49. Mark Andre "iv 7" colour-fingerings.

Deutsch notates a non-specified colour change with a + over the notehead in *Orcus*. The performance notes state that the colour trill seen in Figure 47 is a stronger colour-change than this marking (Figure 50).[216]

Figure 50. Deutsch "Orcus" p. 2, colour changes.

[215] Mark Andre. *iv 7*. (Leipzig, London, New York: Henry Litolff's Verlag / C.F. Peters, 2008).

[216] In the *Orcus* performance notes, Deutsch writes that ***tr*** is a "*Klangfarbentriller (heftiger tremolierender Klangfarbenwechsel mit mehren Griffen*)" and + is a "*Klangfarbenwechsel*".

Ann Callaway uses a standard trill notation in *Contraption*,[217] but clearly labels the difference between a trill and colour trill (Figure 51).

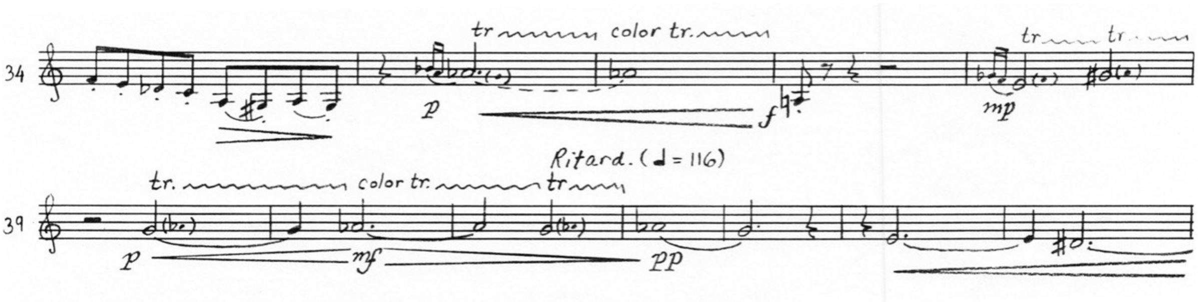


Figure 51. Ann Callaway "Contraption" standard and colour trill notations.

Double Trills

Appendix: Double Trills Fingering Charts

Audio Examples: 0936-1024

Double trills utilise two fingers in alternating motion to perform a trill. There are two possible types. Type 1 is performed on a single note to produce a very rapid trill. This is done either with two fingers of one hand or with one finger from each hand.

Due to physical practicalities, these types of double trills are not possible on every note. On the lowest notes E3, F3 and F#3, both little-finger keys from each hand must be used. These levers operate the same pad, so the instrument imposes a natural restriction on how fast the trill can be performed. If done too quickly, the pad does not have an opportunity to open in between finger changes. The placement of the key and design of the instrument also affects the practicality of execution. The bell of an Eppelsheim restricts the right hand's accessibility to some of the left-hand keys, and the weight of the action of some keys of a Selmer is too heavy to double trill effectively. Type 2 double trills are performed with two

[217] Ann Callaway, *Contraption* (Manuscript, 1991).

fingers on different keys, creating a sequence of 3 or 4 pitches. Due to the exponential number of finger combination possibilities multiplied by their overtones, these were not explored in-depth at this time and could be the subject of further research.

There is no standardised notation for double trills, but something resembling typical tremolo notation and an indication that it is a double trill is acceptable.

In *Tri…Hita…Karana,* Andys Skordis uses a six-line double tremolo marking between two notes to indicate the double trill, and a three-line marking on the note stem to indicate a flutter-tongue (Figure 52).

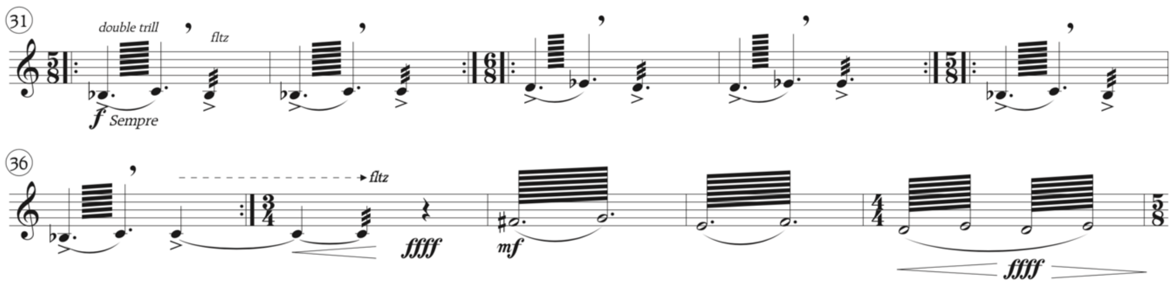


Figure 52. Andys Skordis, "Tri...Hita...Karana" double trill notation.

Pitch Bend

Pitch bend is a change in the tuning of a pitch using the embouchure. A greater change in pitch is achieved in the altissimo rather than lower registers on the contrabass clarinet, and it is easier to bend a pitch down rather than up. Every contrabass clarinettist will have different pitch-bending abilities depending on their mouthpiece and reed setup, so it is impossible to give exact ranges of pitch bends, but in general, the changes in the low and middle register will be microtonal. Bends of a semitone are generally possible in the altissimo register, and up a tone or more in the upper altissimo.

Common pitch bend notation is acceptable. Niels Christian Rasmussen uses a line with the text "bend" in *Gestalten*. As this pitch is being bent up, it requires slowly opening additional keys rather than only using the embouchure.

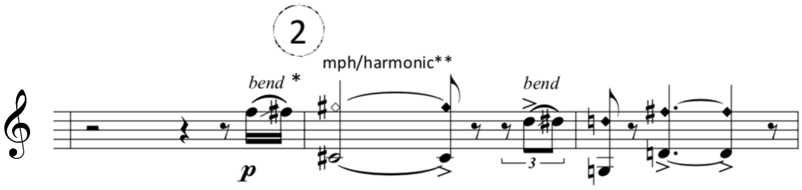


Figure 53. Niels Chr. Rasmussen, "Gestalten", bb. 8-10 pitch bend.

Natural Effects

Flutter-tongue

A flutter-tongue (*flatterzunge* in German or *frullato* in Italian) occurs when a player allows the tongue to oscillate rapidly, rolling the sound for the letter [r] while playing. An alternative technique is to vibrate the uvula in the throat. The effect is a rhythmic disruption to the airflow, creating perforations in the sound. Flutter-tongue is a relatively old concept and dates to at least Tchaikovsky's 1892 use in *Nutcracker* by the flute,[218] and has been adopted by other wind instruments since.

It works best in the chalumeau and clarion registers; however, the effect is less discernible on the lowest notes below G3 because the sound blends into the natural overtones present. The altissimo register is not easy due to the voicing and embouchure shapes needed to produce the notes, which the flutter-tongue disrupts. The effect can be used with only air, without reed vibrations (see Air Sounds). The technique has a more aggressive effect at louder dynamics, but when played at soft dynamics can create a mellow purr.

[218] Roland John Wiley, *Tchaikovsky's Ballets: Swan Lake, Sleeping Beauty, Nutcracker* (Oxford: Clarendon Press, 1985), p. 230. Wiley states Tchaikovsky learned about the technique from his former harmony student and flautist Alexander Vasilevich Khimichenko.

The most common notation for flutter-tongue is three lines on the note stem, as used by Skordis, often accompanied by a text indication in English, German, or Italian of either the whole word or an abbreviation of it the first time it is used.

Slap-Tongue

Audio Examples: 1025-1073

Slap-tongue is produced by articulating in such a way that the reed suctions to the tongue, pulls away from the mouthpiece and slaps back against it when released, creating a percussive attack.[219] Slap-tongue generally works better on larger reeds and mouthpieces, so it is very effective and flexible on the contrabass clarinet. More care, control, and time are necessary for repeated slaps with smaller clarinets;[220] however, this is less so with the contrabass. My experience reveals that quicker repetitions can occur with greater ease, as is needed for Monnet's *Le Cirque* (Figure 21). It is also easier to slap notes in the higher registers on the contrabass clarinet than smaller clarinets, where it works best in the low register. The slap articulation in the altissimo register will likely produce an initial undertone in the pitch. Slap-tongue on the contrabass clarinet is possible at all dynamics.

I have identified four types of slap-tongues with differing effects.

- *Tone slap*: A slap attack of a sustained note. All dynamics are possible. The amount of the slap in the attack can vary from forceful to light. Quick repetitions are possible to the extent that there is still time for the note to sound; otherwise, it starts to become a staccato slap. Subtone pitches can also have a light slap attack.

[219] Harry Sparnaay, *The Bass Clarinet: a Personal History*, trans. Annelie de Man and Paul Roe, 3rd ed. (Barcelona: Periferia Sheet Music, 2017), p. 65.
[220] Ibid., p. 67.

- *Staccato slap*: A slap attack producing a pitch by actuating the reed and immediately returning the tongue to it, stopping any resonance of the note. All dynamics are possible. Quick repetitions are possible, as well as alternating between a normal articulation and a slap.
- *Open slap*: A slap sound, but without much pitch. Rather than producing the slap as an articulation, the tongue pulls the reed down with suction and releases it without any vibrations. Some pitch may occur due to the resonance of the instrument, but not as a product of a vibrating reed. The mouth does not need to be fully formed around the mouthpiece and can be opened to varying degrees to create different resonance (see video demonstration 1073 in Audio Examples). The dynamic contrast can vary according to the tongue's force creating the slap, but it is a smaller range than the pitched slaps.
- *Reed slap*: Only the sound of the reed slapping against the mouthpiece. It is similar to the Open Slap because there is only reed suction and no actuation, and some resonant pitch may occur; however, it differs because no air at all is involved in producing the sound. The result is much softer, and there is very little dynamic contrast.

One peculiar anomaly is that when C3 is slap-tongued on a Selmer, the sounding pitch is A2. This is not the case on a Leblanc or Eppelsheim, and I hypothesise that the much larger bell of a Selmer instrument contributes to this.

Slap tongues have been notated in many different ways. A common method is to use an x notehead. An x on the stem or a diamond or triangle notehead may be preferable for a tone slap with a duration of a minim or greater. The contrabass clarinettist can easily interpret the difference between a tone slap and staccato slap by the note duration. An open slap or reed slap is best indicated with alternative noteheads and additional text to clarify.

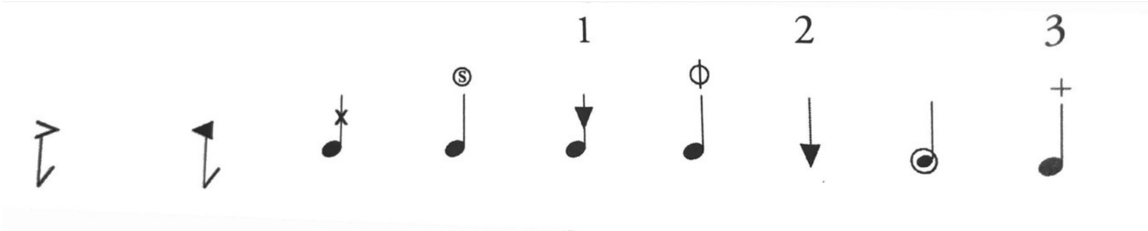


Figure 54. Sparnaay, "The Bass Clarinet", p. 66 slap tongue notations.

In *Art of Metal II,*[221] Yann Robin specifies six different slap notations: *Slap long* (tone slap), *Slaps courts* (staccato slap), three open slaps with varying degrees of the amount the mouth should be open, and open slaps moving from a closed to open mouth (Figure 55).

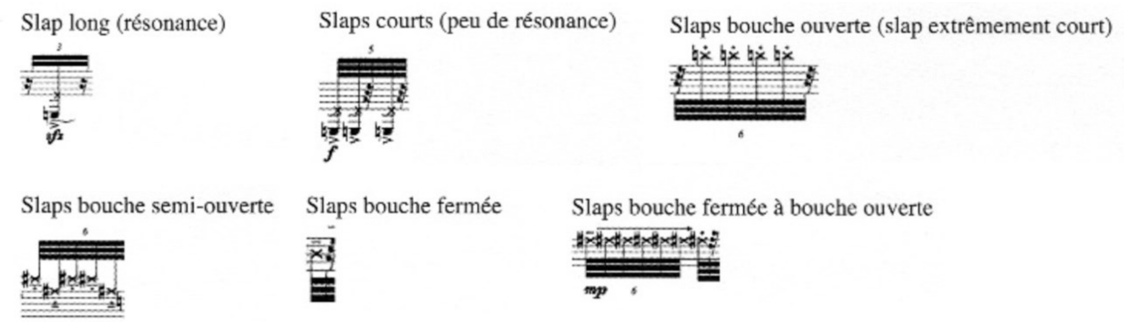


Figure 55. Yann Robin "Art of Metal II" performance notes descriptions of slap tongues.

Air Sounds

The contrabass clarinet can create several sounds incorporating air or wind. One possibility is the ratio of tone to air while playing a note. A contrabass clarinettist can perform this by unfocusing the airstream to allow more air into the sound's timbre. This is better achieved at quieter dynamics so that the difference is audible. Air can also be introduced into the sound by allowing it to escape out the sides of the mouth. The effect is more pronounced than by unfocusing the airstream and is more characteristic of a tyre air compressor.

---

[221] Yann Robin. "Art of Metal II." (Paris: Editions Jobert, 2007).

It is also possible to blow through the mouthpiece without actuating the reed. Closing pads of the instrument can change the air's tone, and the embouchure can alter the timbre. A faint pitch is produced and can change by opening and closing pads. A clarinettist can alternate between pitch and air to varying degrees. The mouthpiece can also be removed from the player's mouth and blown at, with the air directed at the reed and mouthpiece's opening, creating a thinner, sharper sound. Air sounds can combine with whistling, flutter-tongue, and other vocal effects.

Thanos Chrysakis uses a slash through a notehead to indicate a mixed tone and air sound in *Dark Light* (Figure 56).

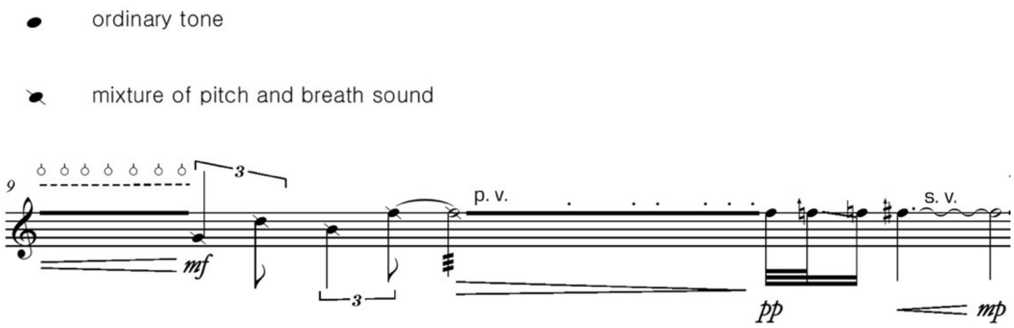


Figure 56. Thanos Chrysakis, "Dark Light" air sounds notation.

Andre combines several air effects in *iv 7*. He notates air to sound ratio on a scale of 1-5. 1/5K is very airy (*sehr viel Luftgeräusch in der Klanggestalt*) and 5/5K is only tone (*nur Klang in der Gestalt des Materials*).

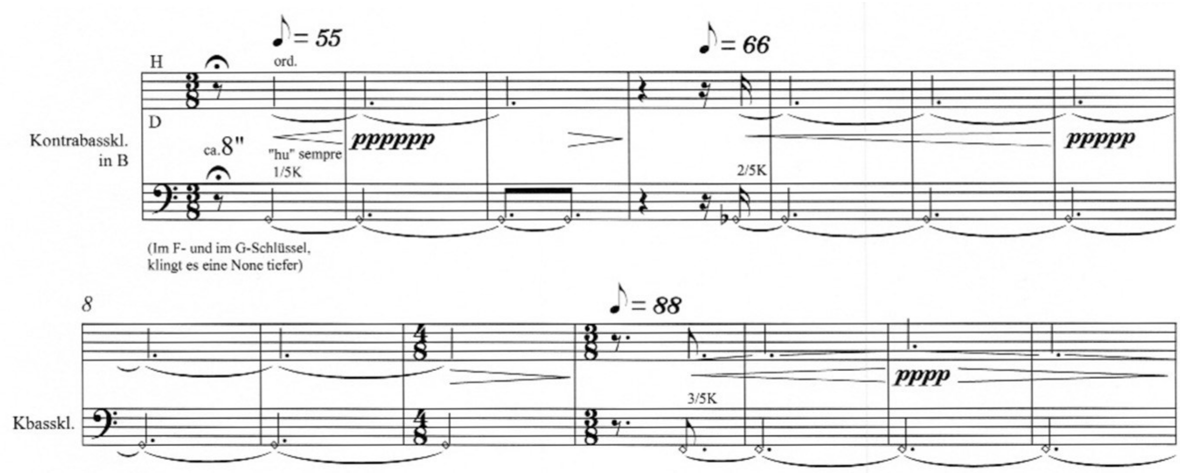


Figure 57. Mark Andre "iv 7" air sounds notation.

Towards the end of the piece, he directs the player to remove the mouthpiece and to whistle. The notation indicates whether the lips should be on or off the instrument, changing the resonance. He also notates the mouth's positions relative to the mouthpiece tenon hole. When positioned to one of the sides, the airstream hits the side of the instrument while whistling to create another sound (Figure 58).

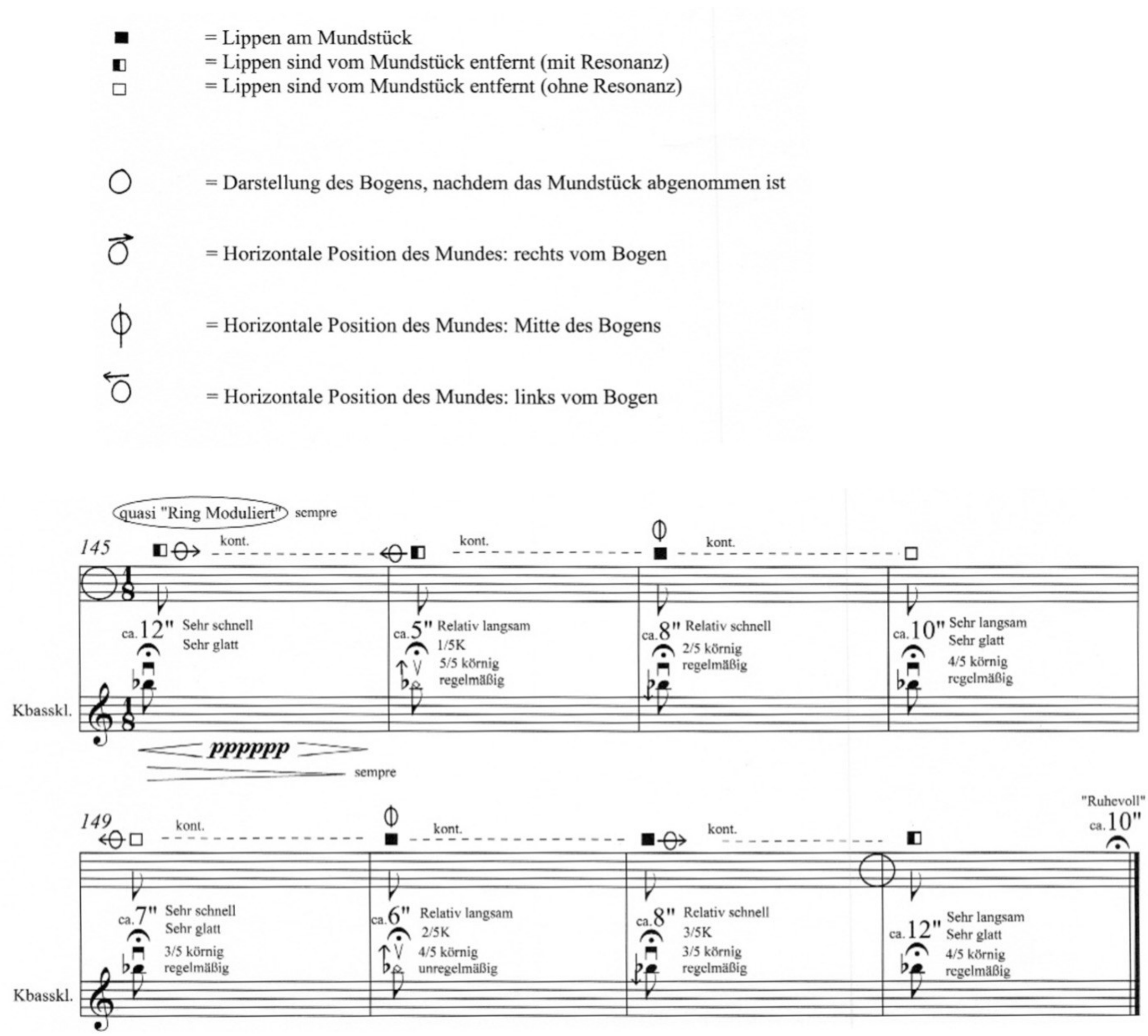


Figure 58. Mark Andre "iv 7" whistling and air sounds.

Aled Smith notates a gradual crescendo with a change from pitch to air and back to pitch using arrows inside a black line which indicates the dynamic level in *vus* (Figure 59). This is followed with an immediate change to loud half-air/half-tone and another immediate change to air only, notated with black circles and white diamonds.

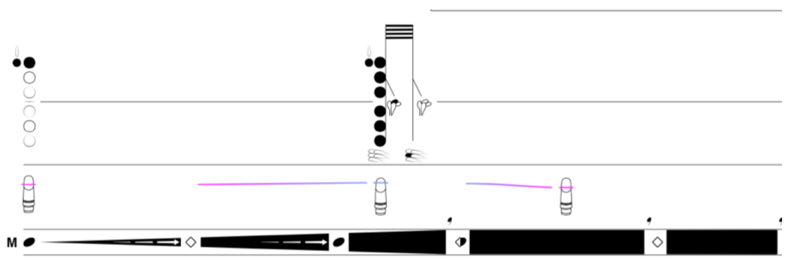


Figure 59. Aled Smith, "vus", p. 15.

Voice

The voice refers to several techniques using the vocal folds, including growling, screaming, singing, and humming with the instrument.

Growling

Growling is a technique utilized in jazz and folk music such as klezmer.[222] It is an unpitched vocal fry, a vibration of the vocal cords in the area where one clears their throat. When the instrument is played simultaneously, the timbre has a distortion-like effect, but without the extra pitch that singing while playing creates.

Skordis notates a growl with text in *Tri…Hata…Karana* (Figure 60). In bar 62, he uses a dotted line with an arrow followed by "growl" to indicate a progression in the effect's intensity. In bar 70, he writes three tied G6 crotchets. The first is a normal note, the second with flutter-tongue, and the third with flutter-tongue and growl.

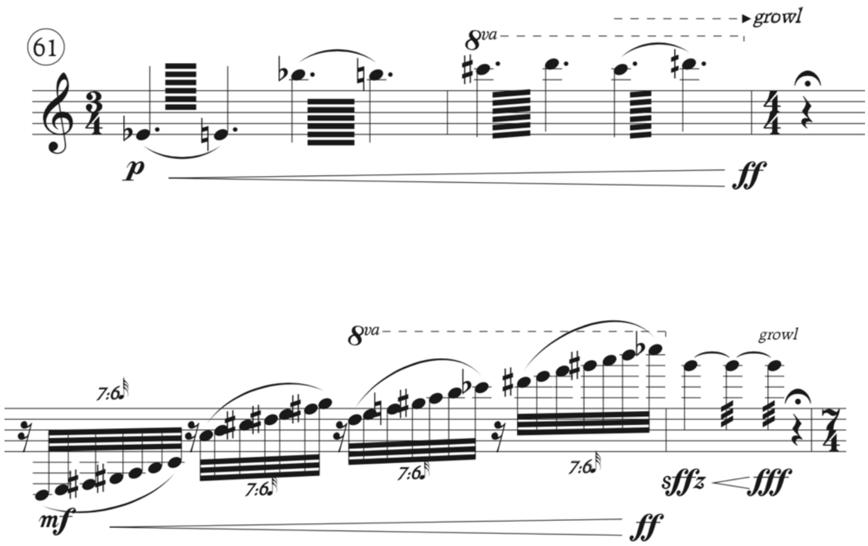


Figure 60. Skordis, "Tri...Hita...Karana" bb. 61-63 (above) and bb. 69-70 (below).

[222] Mitchell Estrin, "The Klezmer Clarinet," Dansr, November 29, 2017, https://www.dansr.com/vandoren/resources/the-klezmer-clarinet.

Screaming

Screaming is an extension of growling, but it is louder and the voice more prominent in the texture. The technique is performed by actually screaming while playing. The note played will likely split into a multiphonic with the higher partials more prominent, in addition to distortion. The technique should not be used for prolonged periods due to the physical demands on the player. Skordis notates screaming with four diamond-heads on the stem (Figure 61). He uses a text indication *+scream* the first time it appears.

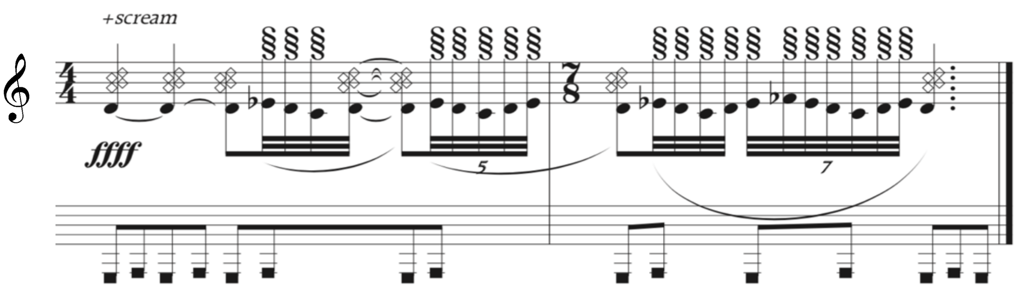


Figure 61. Skordis, "Tri...Hita...Karana" bb. 20-21 scream notation.

Singing while playing

Musical Recordings: 2014 Improvisation- Singing and Playing

Singing while playing is an alternative method to multiphonics of producing multiple simultaneous pitches. Unlike growling and screaming, the voice produces a discernible pitch by singing a vowel sound while playing the contrabass clarinet and can create harmonies. It is also referred to as humming;[223] however, Jeremy Ruth distinguishes between singing and humming.[224] I agree with Ruth's assessment, and the method discussed here supports his

[223] Rehfeldt, *New Directions for Clarinet*, p. 68.
[224] Jeremy Larkham Ruth, "Humming and Singing While Playing in Clarinet Performance: An Evidence Based Method for Performers and Resource for Composers" (dissertation, Arizona State University, 2019).

definition of singing; however, humming will not be discussed.[225]

The production of the different vowels sounds affects the voice's character. Different vowels can be notated or otherwise left to the clarinettist to decide. Like the previous voice techniques, it may add distortion to the timbre, although, it can be less prominent. The introduction of the voice can also cause a note to split into the harmonics of a multiphonic. The interference to the instrument's sound that the voice creates varies depending on the pitches played and sung. The exact effects are unpredictable. A composer using this technique should know that the result is not the same as if a contrabass clarinet and a singer were performing a duo together, but rather a new, blended sound. Singing should always be written in the key of the instrument, and the intended octave for the voice clearly indicated. It is also important to consider the vocal range of the performer when composing, and whether octave transpositions would be acceptable if necessary.

In *Asleep…but Hearing* (Figure 62) Skordis notates sung pitches with diamond heads, using the vowel sound "o".

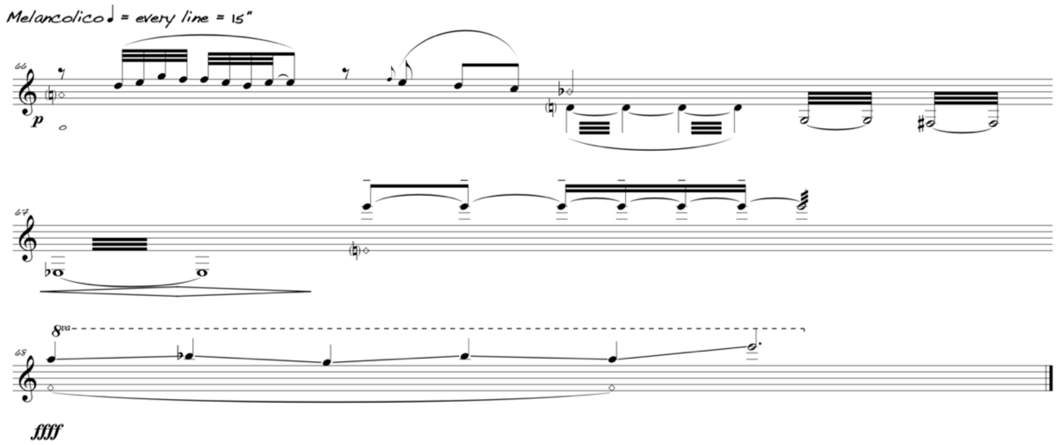


Figure 62. Skordis, "Asleep...but Hearing", bb. 66-68.

[225] Ruth's method for humming while playing involves using a circular breathing technique whereby the humming does not pass through the oral cavity and use the same airstream as the instrument, but rather uses a separate airstream exiting through the nasal cavity, and thus not interfering with the soundwaves of the instrument. While circular breathing is possible on the contrabass clarinet, I found Ruth's humming technique difficult to maintain enough sustained air to be considered useful for discussion here.

Chrysakis notates singing on an upper stave, following the pitches of the contrabass clarinet a minor second higher (Figure 63). No specific vowel is indicated.

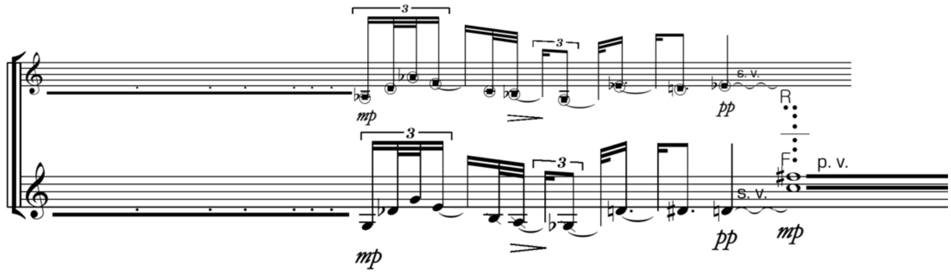


Figure 63. Chrysakis, "Dark Light", b. 18 singing while playing.

This technique can create frequency beatings and difference tones. Beatings are caused by two frequencies close to each other but not exactly in tune. The further apart the frequencies are, the faster the beatings become. This effect can be heard by playing a note and singing the same pitch. Making a slow glissando up or down away from the pitch with the voice will generate the beatings. Difference tones are an acoustic anomaly caused by the difference in the sung and played pitches' frequencies. Playing a pitch and singing a perfect fifth above will generate the perception of a third pitch an octave below the played note.[226] The effectiveness of both of these techniques can depend on the octave of the sung pitch and the player's singing range. This is particularly notable on the contrabass clarinet due to its low range, as only those capable of singing low enough would achieve the effects.

Compound multiphonics

Singing can also be performed while playing multiphonics. After extensive work with composer Mark Dyer in developing this technique, the result has been named *compound multiphonics.* They are possible with both Type 1 and Type 2 multiphonics.

---

[226] For example, the difference of concert pitch A4 (440hz) from its perfect fifth E4 (660hz) is A3 (220hz).

In our research, Type 1 compound multiphonics responded differently depending on the sung note. The resulting overtones reflected where the pitch was within my singing range — lower sung notes produced lower overtones and higher notes produced higher overtones — attributed to the vocal folds' position, which affect voicing. Singing higher notes results in the same voicing needed for playing higher overtones, with a similar relationship between lower notes and lower overtones. This general rule also applied to singing falsetto. I was not able to sing as low as my normal range allows while simultaneously playing.

Type 1 compound multiphonics can play at a loud dynamic. The individual pitches can be heard more clearly at quiet dynamics, and the voice interferes with the overtones less. However, there is also a lower cut-off limit, at which point the overtone is not produced. The fundamental and sung pitch can occur immediately from *niente*, but the overtones require a certain amount of air pressure before sounding.

Figure 64 illustrates the Type 1 compound multiphonic E3 with the 7th partial D6, combined with a sung E5. The introduction of the voice created disruptions in the sound, causing the 11th partial A6 to emerge also.

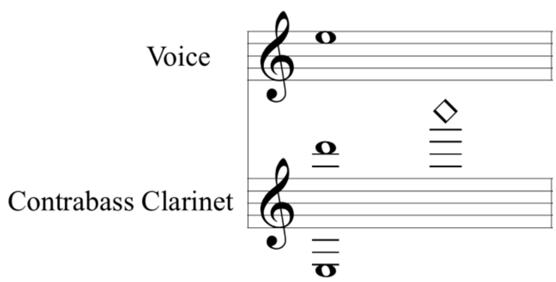


Figure 64. Type 1 compound multiphonic. Both staves sound a major 16th lower than written.

When played as a compound multiphonic, Type 2 multiphonics that have a greater reliance on voicing for production behave like Type 1 compound multiphonics; the overtones follow the voice. More stable Type 2s that allow more flexible voicings are less affected by introducing the voice; the tuning is mostly affected rather than changing the note altogether.

Figure 65 illustrates a unique Type 2 compound multiphonic. The top stave indicates the sung pitch D♭4 and the bottom stave indicates the Type 2 multiphonic produced by the fingering diagram in the middle stave. In this example, the fingering would usually produce F♯6;[227] however, by underblowing it is possible to produce B♭5.[228] This is a delicate multiphonic requiring precise control of the air. Blowing too hard makes the B♭ inaudible, but a minimum air threshold is needed to sing simultaneously, affecting the balance. The B♭ speaks at a lower dynamic than the F♯, so increasing the voice's dynamic, and therefore air pressure, causes the dynamic of the B♭ to decrease.

Figure 65. Type 2 compound multiphonic in upper register.

Similarly, in Figure 66, the introduction of the voice two octaves above the fundamental, at the top of my vocal range, caused the fundamental to disappear.

Figure 66. Type 2 compound multiphonic.

[227] F♯6 is the 5th partial of D4, the fingering of the left hand. Adding the right hand creates the necessary resistance to overblow to the F♯.

[228] A5 is the 3rd partial of D4, but the added right-hand keys raise it to B♭.

Compound multiphonics are generally difficult to control and require time to respond fully; therefore, fast staccato passages are not possible. Dyer sometimes uses staggered entrances of the fundamental, overtone, and voice to allow each element to stabilise. Figure 67 shows the voice enters first, followed by the overtone, then fundamental. In this case, the overtone, a perfect 12th, responded more easily when attacked first and allowing the fundamental to follow.

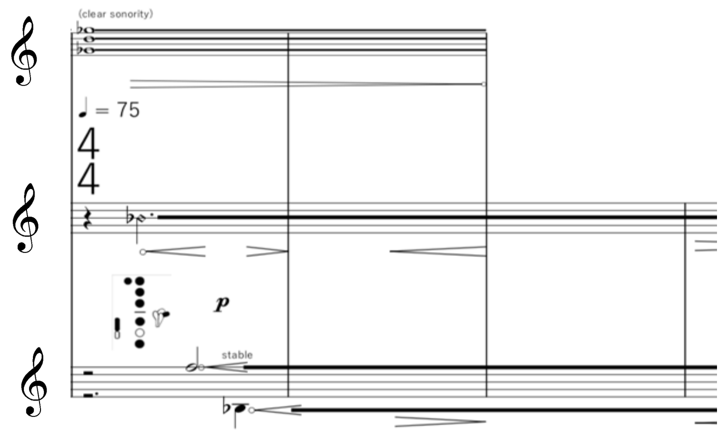


Figure 67. Mark Dyer, "Droning Falsities (for one's self)", bb. 31-33. Top stave electronics, middle stave voice, bottom stave contrabass clarinet.

Figure 68 illustrates a more complex section of *Droning Falsities (for one's self)* with more movement between the multiphonics and sung notes. Dyer shows the relationship between the fundamental of the Type 1 multiphonic in the first bar to the sung pitch entering in the second bar with an arrow. This visual guide helps the player hear the pitch to sing. At the metre change in the fourth bar, the contrabass clarinet stops playing, and only the voice continues. Dyer uses a filled circle marking for "closed-throat" and an empty circle for "open-throat". The arrows between these marks indicate that the player should move gradually from a closed throat to open and back to closed while singing G♭4. He uses the open-throat marks only when the voice is alone. The throat needs to be more constricted to perform compound multiphonics, so closed-throat is necessary whenever playing.

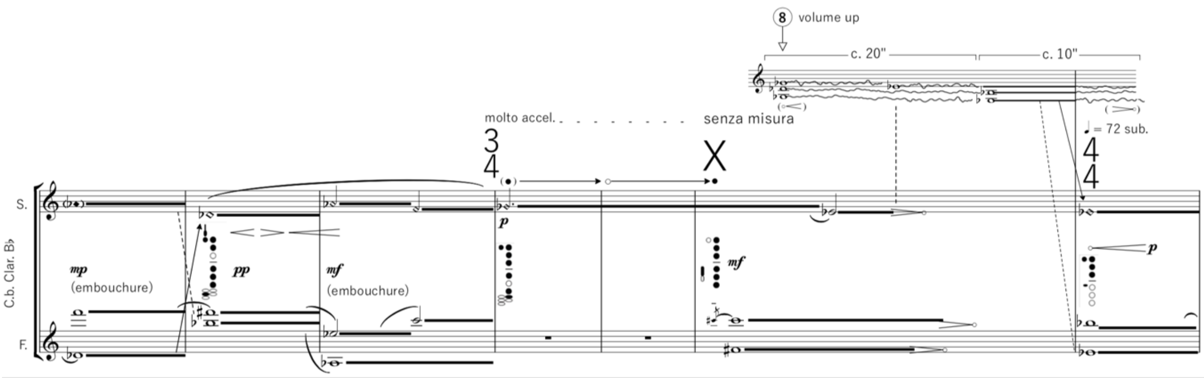


Figure 68. Mark Dyer, "Droning Falsities (for one's self)", p. 7.

Singing without playing

The instrument becomes a resonating chamber by not actuating the reed while using the voice, though the voice itself sounds muted. In addition to singing, other vocal effects can be used such as growling, croaking, humming, whistling, tongue clicks, and other sounds made with the mouth that are not hindered by the mouthpiece. Closing the instrument's keys while singing into it causes timbral changes in the same way as colour fingerings. As more keys are closed, the sound of the voice can become more muted and covered.

Smith uses a series of vocal effects in *vus* (Figure 69). The bottom line, marked with a "T" (throat), indicates various vowel sounds to make into the instrument, with changing fingerings illustrated by the diagrams in the middle of the system. The line above the throat line, "M" (mouth) with the half-white/half-black diamond, indicates actuating the reed in addition to the vocal sounds, with a half-air/half-tone sound. The line finishes using only this sound, with no voice.

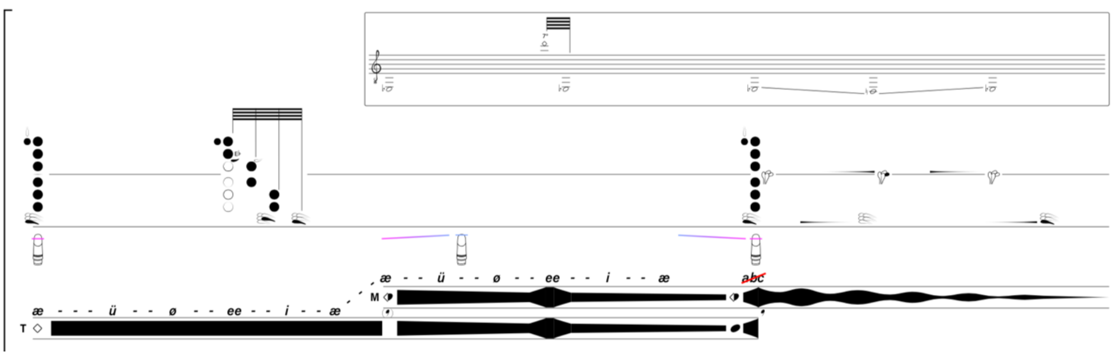


Figure 69. Aled Smith, "vus", p. 23.

Sung Fingerings

Audio Examples: 1074-1076

Musical Examples: 2015 Improvisation- Singing Without Mouthpiece

An acoustic phenomenon was discovered while working with Dyer. Singing certain pitches while closing specific toneholes causes the pitch to change. The top stave in Figure 70 shows a sung pitch followed by a pitch in parentheses. The bottom stave shows notes to finger on the contrabass clarinet. When singing the pitch in the top stave and using the fingerings in the bottom stave, the sung pitch will change to the one in parentheses. Each fingering for a sung pitch creates the effect. A feature of this technique is the ability to trill between two sung pitch much more rapidly than can be done with the voice alone. The intonation of the sung pitch must be accurate, or else the effect is minimised. This technique requires further research to determine its effectiveness for players with varying vocal ranges, particularly those with higher a range. Consulting with a performer is always recommended when composing for contrabass clarinet.

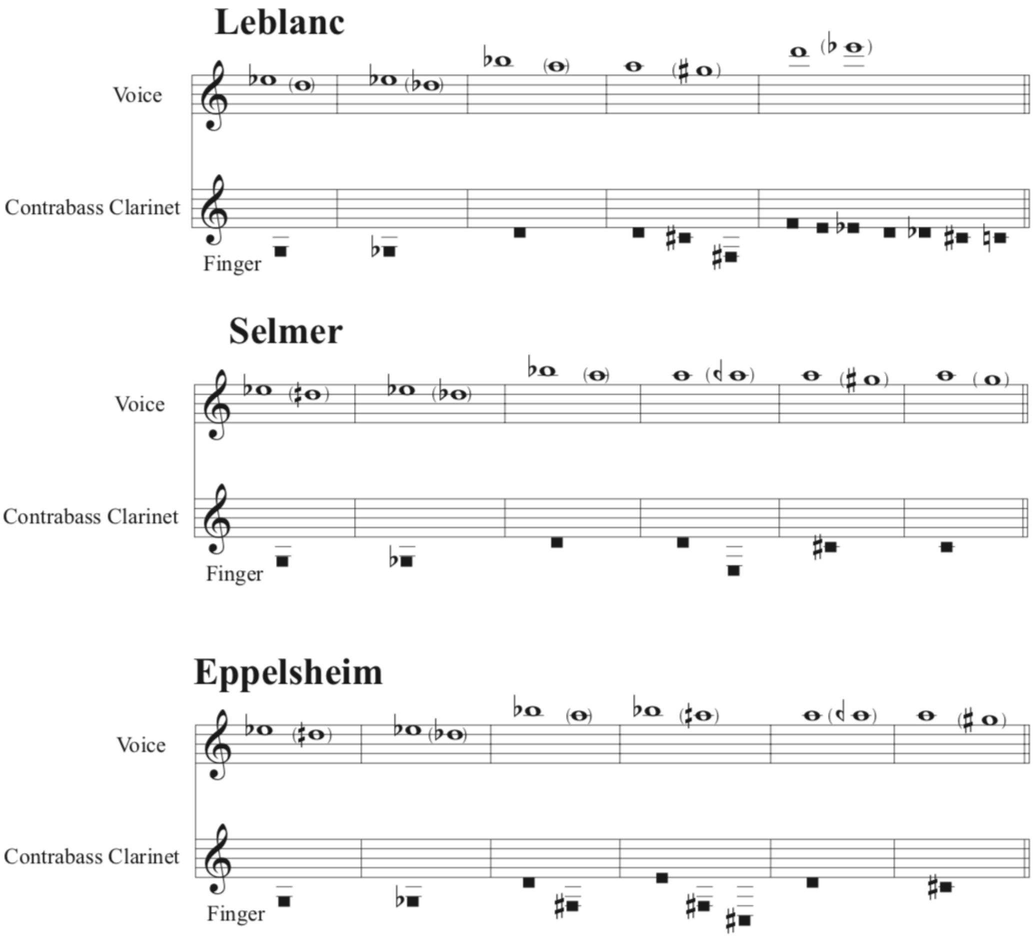


Figure 70. Sung pitches with fingerings. Both staves transposed a major 16th.

Skordis uses this effect in *Tri…Hita…Karana* (Figure 71). While singing an E♭5 using either "e" or "o" vowel sounds, the bottom stave notates a figure using fingerings on the contrabass clarinet. The effect is a rhythmic timbral change to the voice, and each time G3 or F♯3 is fingered, the pitch of the voice changes to D5 or D♭5, respectively.

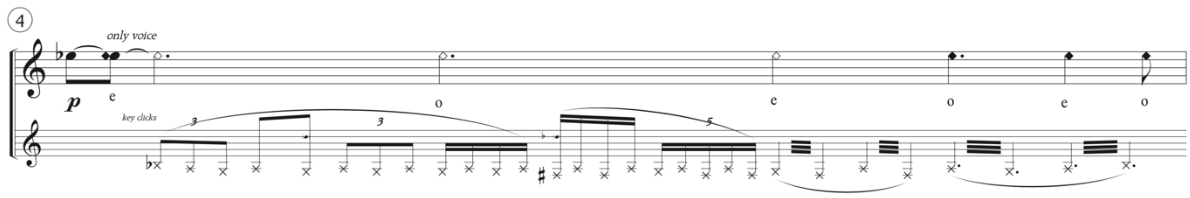


Figure 71. Skordis, "Tri...Hita...Karana", b. 4. Sung fingerings.

Shaking

Audio Examples: 1089 Shaking Contrabass Clarinet (video)

Shaking the instrument to create an extreme vibrato can be effective on soprano clarinet, but is less so with contrabass due to the size and the fact that it often rests on the ground while playing. The instrument must be rocked forwards and backwards rather than shook. The effect can also be achieved by using a very wide and fast vibrato with the mouth. In both cases it is found to have a greater effect on higher notes than lower, similarly to quarter-tones and pitch bends.

Tongue on Reed

Musical Recordings: 2016 Improvisations- Tongue on Reed (video)

Placing the tongue on the reed further down the vamp[229] so that the tip can still vibrate and produce sound creates a muted and dampened effect. Due to the larger surface area of the reed, this is more effective on the contrabass clarinet than smaller clarinets. Holding the tongue in this position while playing results in an airy subtone timbre and lowers the pitch slightly. It is most effective in the chalumeau and clarion registers because it causes the embouchure to be looser. The intensity of the effect can vary with the amount of tongue in contact with the reed. Articulating on this part of the reed allows for an extreme legato, to the point where the sound never stops but still has the sense of articulated notes. Using this articulation on a single note can create an electronic phasing-like wobble effect.[230]

---

[229] The vamp of a reed is the area between the tip and the bark which is cut away to allow it to vibrate.
[230] Please refer to recording *2016 Improvisations- Tongue on Reed (video).*

Percussion

Key Clicks

Musical Recordings: 2020 Improvisations- Keyclicks and Finger Pops (video)

One of the most-used percussion techniques is *key clicks*. They are produced by pressing the keys in a way that they make an audible sound. These are more effective on larger clarinets due to the plateau/covered finger keys rather than the open holes of soprano clarinets, and also because of the resonance the larger bodied instruments provide. Key clicks can produce a dense rattling sound by rapidly depressing many keys at once and in succession.

Smith uses key clicks in *vus*, notated as a fingering diagram (Figure 72). Notating notes in a stave indicating which note to finger for the pop would also be clear.

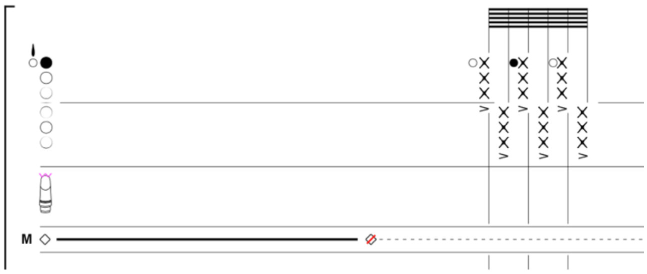


Figure 72. Aled Smith, "vus", p. 41.

Dominik Karski[231] uses a two-line stave to notate right and left hand key rhythmical key clicks.

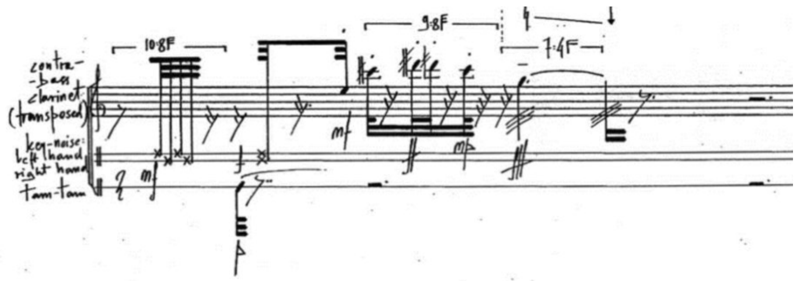


Figure 73. Dominik Karski, "The Outward Impulse", b.1 key clicks.

[231] Dominik Karski, *The Outward Impulse* (Musicaneo, 2007).

Finger Pops

Appendix: Finger Pops Fingering Chart

Audio Examples: 1077-1078 Finger Pops

Finger pops are produced by pressing keys with a hard and swift motion to produce a "pop" sound from the pad hitting the body. Holding down other finger keys corresponding to notes causes the pitch of the finger pop to change. The pitches largely follow the chromatic sequence; however, some quarter-tone deviation occurs in the lower notes. The pitch depends on whether the reed or mouthpiece is on the instrument. The effect is louder when all the fingers close together, but it is also possible to close the pads sequentially for a quieter effect. Keys that open toneholes will only produce the effect when used in conjunction with keys that close.[232]

Rasmussen uses the pitch change of finger pops to create a descending line at the end of *Gestalten*.

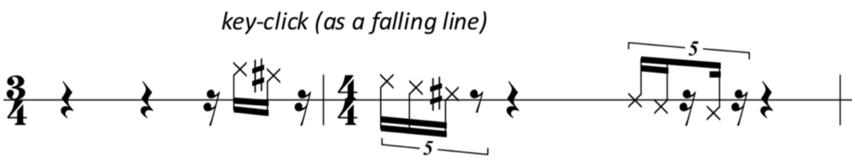


Figure 74. Niels Chr. Rasmussen, "Gestalten", bb. 110-111, finger pops.

Hitting or Scraping the Body

Hitting or scraping the metal parts of the instrument is a technique used with brass instruments.[233] Various materials can be used, such as drum sticks, mallets, triangle beaters, rings, thimbles, and fingernails. The body of the contrabass clarinet does not have much

---

[232] The technique relies on pads closing onto the toneholes. Keys that open toneholes do not cause this to happen.

[233] Stuart Dempster, *The Modern Trombone: A Definition of Its Idioms* (Athens, OH: Accura Music, Inc, 1994), pp. 54-57.

natural resonance, so too soft materials will not produce a loud effect. Although metal, the bodies of a Leblanc and Eppelsheim are covered in keys, and a Selmer is wooden, giving little room to perform this technique. The neck, bell, and bell edge offer the most surface area. Players may be averse to this technique due to potential damage to the instrument.

Smith uses tapping the neck, body, and closed keys of the instrument in *vus*.

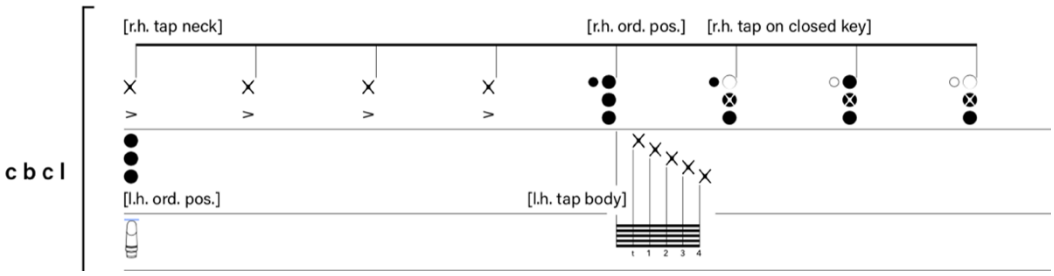


Figure 75. Smith, "vus", p. 53 tapping the body of the instrument.

Preparation

Muting

Audio Examples: 1092 Aluminium Foil on Bell

Muting the contrabass clarinet does not work the same way as with a brass instrument because sound emits through the entire body, not just the bell. Placing something in or covering the bell primarily affects the lowest notes closest to the bell and their harmonics. The best materials to cover the bell are thin enough to vibrate, such as paper and aluminium foil. When covering the bell, the lowest note will not sound unless there is a way for the air to vent.[234]

[234] See Chapter 4, sections with Elspeth Brooke (p. 140) and Shaun Davies (p. 143) for further discussion of muting.

Figure 76. Aluminium foil on bell.

Alternative Sound Production

Musical Recordings: 2023 Improvisation- Alternate Mouthpieces (video)

Alternative sound production sources can be used for varying effects. In *Discours IV,* Vinko Globokar requires the use of trumpet and tuba mouthpieces; E♭ clarinet mouthpiece; oboe, cor anglais, bassoon and contrabassoon reeds; and penny whistle. Other sound sources could include bird and game calls, referee whistles, Acme sirens, and kazoos.

A pitch-based result can be achieved if the alternative mouthpieces and reeds are effectively attached to the contrabass clarinet to create a proper seal. I had success with a tuba mouthpiece in an adapter that fit into the instrument's mouthpiece socket, turning the contrabass clarinet into a sort of ophicleide in which I was able to change pitches to a certain extent (Figure 77).[235] The mouthpiece socket alone can also be used. This is less flexible than a using a tuba mouthpiece for pitch production, however a didgeridoo technique can be used.[236]

---

[235] It should be noted that clarinettists may not have the training to use brass instrument mouthpieces or double reeds. I have no brass instrument training and my results with the tuba mouthpiece felt limited, but a player more familiar with the buzzing mechanism required may have better results.

[236] Weiss, *The Techniques of Saxophone Playing*, p. 151, uses the term *alla tromba* for this technique on saxophone. For contrabass clarinet, *alla tuba* or *alla didgeridoo* can be considered.

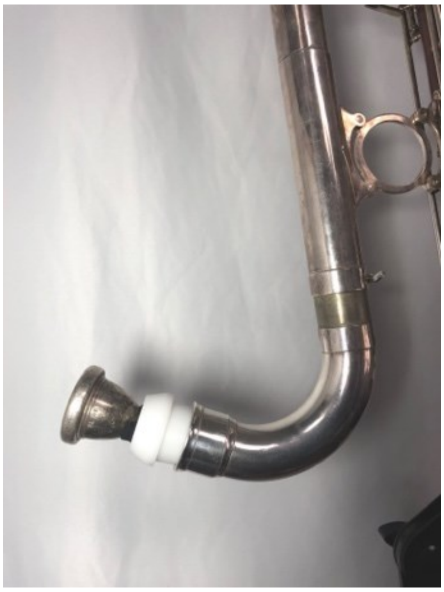


Figure 77. Tuba mouthpiece with adapter on contrabass clarinet.

The sound-making devices such as animals calls, whistles, and kazoos make little use of the toneholes of the contrabass clarinet but use the instrument's body as a resonator. Changing fingerings while using these produces some timbral changes, but the pitch is not substantially affected.

Deconstruction

Musical Recordings: 2022 Improvisation- Deconstruction (video)

Mouthpiece Only

Using the mouthpiece alone produces pitches from approximately B6-B7. The pitch can be bent using the embouchure and altered in other ways by using the hands as a resonating chamber, manipulating the shape and size to create a *wah-wah* effect. The mouthpiece can combine with sound-making devices like animal calls and kazoos.

Mouthpiece and Neck

The mouthpiece and neck can be used alone. Due to design differences and each instruments' neck's length, the pitch created using only these pieces is different. On a Leblanc, it is an E♭6, and on a Selmer it is a C♯6. The Eppelsheim has a two-piece adjustable neck, giving it a greater range of possibilities. Using only the first section produces an A6. Both pieces at the position where the instrument was in tune produced G–5. When pushed all the way together, it produced G≠5 and all the way apart F≠5. These fundamentals can also be overblown. The third partial is flexible enough for bend the pitch down a few tones, but this will be different for each player. Using the hands to manipulate the sound and pitch is also possible, like with the mouthpiece alone. It is possible to place a finger or other stick-like object into the neck while playing, creating a descending glissando, similarly to placing a finger into the headjoint of a flute, and can also combine with sound-making devices.

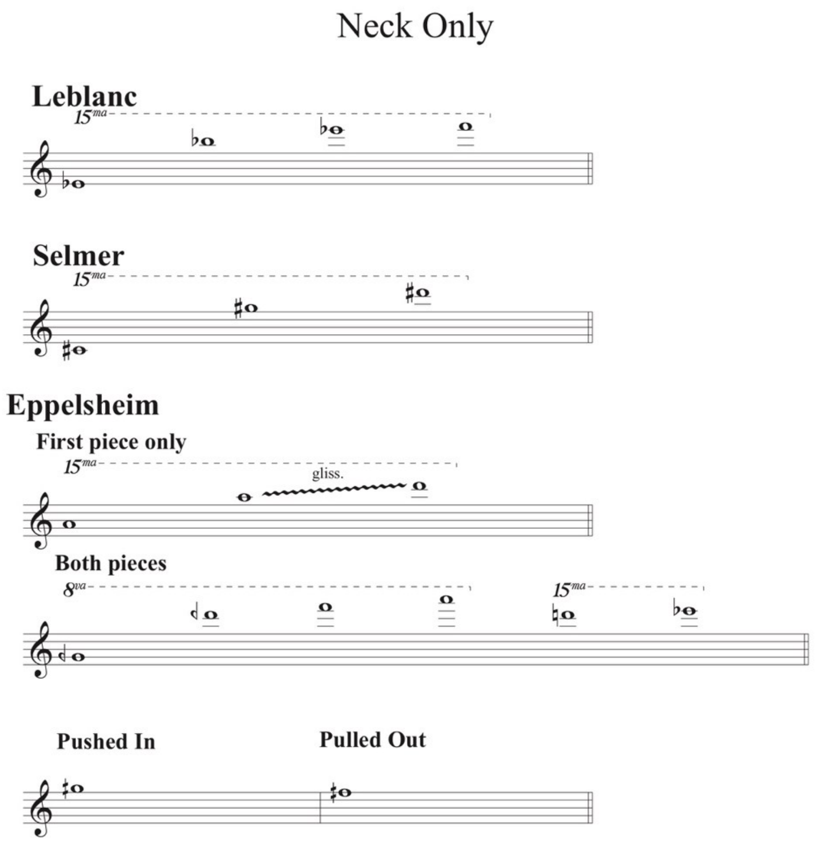


Figure 78. Notes produced by playing with the mouthpiece and neck only.

Palm Ram

Audio Examples: 1079 Palm Ram

A palm ram is produced with the mouthpiece removed, hitting the open socket of the neck with the palm of the hand. An air tone is produced and can change by fingering different notes, limited to those of the left hand. There are two methods:

- Ram the palm onto the socket leaving it in place, producing a pitch a semitone lower than fingered.
- Ram the palm onto the socket and immediately remove it in a single on-off motion, producing a secondary, more prominent, tone an octave higher.

Demi-clarinet and Rearranging Pieces

A half-instrument, or demi-clarinet,[237] utilises only one of the clarinet joints. Playing only the top joint of a Selmer can produce the notes B♭4–C4 as normally fingered, and B4 using Trill Key 4. The keys for B3 and Bb3 are played with the right hand; however, the pads for these notes are also on the top joint. Closing either of them directly produces B3. On a Leblanc, only the keys for the left-hand thumb and first-finger are on the top joint, limiting the options to the notes B♭4–F4, and a sharp E4. As with the neck and mouthpiece only, the right hand can be used at the joint's bottom to manipulate the sound. Placing the mouthpiece onto the bottom joint is not as feasible like on soprano and bass clarinets because it does not fit. On a Leblanc, the mouthpiece is too big, whereas on the Selmer it is too small. It may be possible with an adapter, however this was not tried. Demi-clarinet is not possible on an

---

[237] Smith, William O. *Five Fragments for Double Clarinet.* 1977. Rome: Edi-Pan, Edizioni Musicali. Print.

Eppelsheim because it does not separate into a top and bottom joint. On a Leblanc and Eppelsheim, the bell piece can also attach to the neck.

Figure 79. Leblanc mouthpiece and neck directly attached to bell.

Chapter 4: Working with Composers

Throughout my research I have collaborated with composers to write for the contrabass clarinet's sound possibilities and generate new music. The initial goal was to draw on my own knowledge of the instrument and the composers' creativity and relative lack of knowledge of the instrument to discover new sounds and ways of playing the contrabass clarinet through the collaborative process. However, I discovered that the period of experimentation in the 1960-80s had already uncovered much of what was possible on clarinets. My focus became how these playing techniques differed on the contrabass clarinet compared to the other clarinets and new ways to use them in music. In particular, the use of multiphonics, singing and using the voice while playing, and combining techniques were prominent. The development of compound multiphonics and discovery of sung fingerings are notable outcomes of the collaborations.

The composers I collaborated with were Mark Dyer, Andys Skoris, Oğuz Büyükberber, Bofan Ma, Thanos Chrysakis, Niels Christian Rasmussen, Aled Smith, Elspeth Brooke, and Shaun Davies. The method of collaboration differed with each and there was no pre-determined structure that each session would take, but rather we allowed it to develop organically. In all cases the composer came with some initial ideas of either musical material, sound, or technique to try and the direction of the meeting would evolve from there, with elements being both composer-lead and performer-lead. All sessions were either audio or video recorded for documentation and reference. With Dyer and Skordis, we spent extensive time over multiple sessions trying ideas, suggesting alternate approaches to the musical material, and developing the music through drafts. Büyükberber and I collaborated on a more even artistic level to create the work, using my improvisation as core musical material. Ma came to the session with precise ideas of sounds to produce that we worked through together.

However, Chrysakis asked for specific information that inspired my multiphonic research methods and Rasmussen allowed me more freedom to realise his requests. Collaboration with Smith dealt largely with physical practicalities, notation, technical setup, and the video production. Sessions with Brooke and Davies were experimental, generated from ideas and techniques used on other clarinets. Here I will discuss the working relationships and results of these collaborations.[238]

Mark Dyer – Droning Falsities (for one's self)

Musical Recordings: 2000 Mark Dyer- Droning Falsities (for one's self)

Throughout 2018, Dyer and I met on several occasions to explore the contrabass clarinet. My goals were to discover new sonic possibilities on the instrument and examine innovative ways of using them in music. Our sessions engaged in experimentation, particularly with using the voice, to develop *Droning Falsities (for one's self)*.

In our first meeting, Dyer presented various ideas for me to explore, and I offered my initial feedback to decide which path would be best to follow. Some discarded ideas included playing multiple clarinets, or multiple contrabass clarinets, at the same time. While possible with smaller clarinets, it is not feasible on the contrabass clarinet due to the mouthpiece's size and the amount of air necessary to play it. This led to the idea of playing a clarinet through a clarinet, or combining pieces of multiple clarinets. Clarinet deconstruction and reassembly (demi-clarinets),[239] is possible with soprano clarinet and somewhat with bass clarinet (Figure 80 - Figure 83), however not with the contrabass clarinet without extra adapters, not available at the time.

[238] Recordings of all the compositions can be found in the 2000-2024 Musical Recordings folder.
[239] William O. Smith composed *Five Fragments* in 1977 for demi-clarinets. The clarinettist is required to disassemble a soprano clarinet into top and bottom joints, and place a mouthpiece directly onto the bottom joint.

Figure 80. Demi-bass clarinet, bell connected directly to upper joint.

Figure 81. Demi-clarinet, mouthpiece directly on lower joint.

Figure 82. Bass clarinet neck attached to a soprano clarinet.

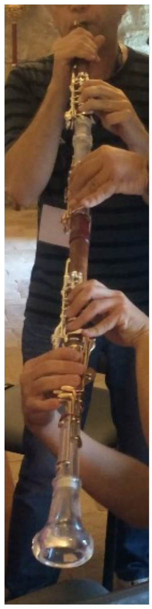


Figure 83. Two clarinets disassembled and reconnected to form one instrument.

One idea pursued was using the body of the instrument as a resonating chamber. I placed a small speaker connected to a mobile phone into the bell and closed the bell by stuffing a pillowcase inside it. I pressed different keys to see if it would resonate differently. The results were as I suspected. As the speaker's sound travelled down different lengths of tube and out different holes, the instrument acted as a frequency filter, but without any profound effect. I also tried to play the contrabass clarinet while the speaker was inside the bell to see if the sound waves disrupted each other, but it was ineffectual.[240]

This led to the idea of treating the contrabass clarinet like a flute stop on an organ pipe. We removed the speaker and used only the pillowcase in the bell as a mute, but as the sound exits the instrument through the first available hole, this type of muting was ineffectual except on the lowest note.

[240] See Audio Example *1090 Speaker in Contrabass Clarinet.*

The main focus of our work centred around singing through the instrument, particularly while playing multiphonics. We have referred to this in our sessions as compound multiphonics. Chapter 3 discussed these results and here I will describe our working process.

In our first session, Dyer presented me with a polyphonic work to play by combining the three multiphonic techniques— using a fingering for a Type 2 multiphonic,[241] splitting its fundamental like a Type 1, and adding singing. This is not entirely possible, as Type 1 and 2 multiphonics cannot be combined. It is possible to manipulate the embouchure and air of a Type 2 in the same way as for a Type 1, thereby changing the sound and producing different harmonics, however once alternate fingerings are used for the Type 2, the overtones can change and not follow the natural series that a Type 1 does. Singing while playing either type is possible.

The first experiment was singing while playing a Type 1. I found the sung note's position within my vocal range directly impacted which overtones the multiphonic naturally produced, with the overtone following the sung pitch. Dynamic ranges of Type 1 compound multiphonics were also explored.

The next experiment was singing while playing a Type 2. In the first multiphonic, I played a perfect 12th, sung an octave above the fundamental, and then changed the sung pitches. The resulting harmonic followed the voice, like a Type 1. Although this was a Type 2, the voicing was similar to a Type 1 to achieve the perfect 12th. With other Type 2 fingerings and intervals the sung pitch had some effect on the overtone, however considerably less.

[241] See Multiphonics in Chapter 3 for definitions of Type 1 and Type 2 multiphonics.

In our subsequent session, Dyer brought a series of chords from multiphonics combined with singing. Several of these included dyads[242] with harmonics close to the fundamental, with instruction to play as a Type 1. Isolating these two close harmonics as a Type 1 was difficult to control. The natural tendency of the Type 1 is to produce higher harmonics. I demonstrated the possibility of isolating the fundamental and one higher harmonic together as a dyad, but explained the accuracy of performing a dyad with a higher harmonic is possible with practise, but unstable.[243]

The Type 2 multiphonics Dyer used were taken from Watts' *Spectral Immersions*, however they did not work on the contrabass clarinet.[244] I had created my own chart for the instrument and consulted it for alternative fingerings, but many were not possible. Following the session, I sent a copy of the chart to Dyer for reference for our next meeting.

In our third session I was presented with a new sketch, using chords based on multiphonic fingerings from my chart, with sung pitches. Our previous sessions mainly looked at multiphonics with relatively low root notes, however this time Dyer used notes in the clarion register as the root and we discovered the effect the voice had on underblown multiphonics.[245] As we encountered new responses from the compound multiphonics I suggested compositional solutions to make their use more practical. In Figure 84, the fundamental B♭3 would disappear when the voice was introduced two octaves higher. I suggested keeping the F as a constant note and alternating between the sung and played B♭s.

---

[242] Two simultaneous pitches.

[243] See Appendix: Contrabass Clarinet Natural Overtones. The higher the partial is in the harmonic series, the closer the pitch is to that of adjacent partials, making voicing more difficult and an increase in the possibility of playing the wrong partial. This is similar to the French Horn.

[244] As discussed in Chapter 3, design differences of the bass clarinet compared to contrabass clarinet contributes to the differences in results.

[245] Underblown multiphonics are produced when playing a note in the upper registers using less air pressure than is required, causing an undertone to sound simultaneously.

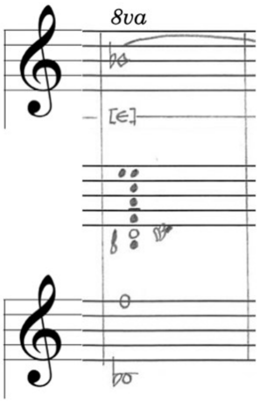


Figure 84. Type 2 compound multiphonic.

In Figure 85, the multiphonic is the 3rd and 5th harmonic of the F, a perfect 12th below C5. The multiphonic responded at the attack, however it was difficult to maintain, eventually resolving on the C. With more air at a higher dynamic I could maintain it longer, but as I ran out of air there was not enough support for the multiphonic. I tried to find a voicing to stabilise it, but found it problematic to sing the A♭4. I needed to keep the pitch A♭ in my head in order to sing it, but I also needed to hear the E♭ to voice it correctly. As I am not a trained singer, this was proving difficult for me, but I felt with more practise it was achievable. This discovery informed the compositional process, providing guides to help me find the correct pitches as I played.

Figure 85. Type 2 compound multiphonic.

Other points came up regarding the best compositional practises for using this material. Some multiphonics take time to respond and develop, so cannot be written as fast staccato passages. Another was that with intervals of a 12th played as a Type 1, it could help to play the 12th first and allow the fundamental to come later by throttling the register key.[246]

Dyer brought a draft recording to our following session, made from recordings of compound multiphonics from our previous meeting. Software was used to manipulate the recordings to remove everything except my voice, which prompted the idea of singing through the instrument without playing. A by-product of the digital manipulation was sound artefacts that sounded similar to flute whistle tones, and we tried to see if I could recreate this while singing. I began by singing into the instrument and closing various keys. The effect was similar to placing the speaker in the bell, although the voice was more pronounced compared to the speaker's sound. Through this process we discovered that certain sung notes will change with specific fingerings.[247]

After exploring the sung fingerings, we searched for sounds to imitate the recording's digital artefacts. Most of the exploration was in the highest register of both my voice and the contrabass clarinet and included

- perspectives on the ability to maintain played pitches while changing the sung pitches;
- dynamics, particularly soft ones; and
- moving from a multiphonic to a compound multiphonic by adding the voice and a sung note into a compound multiphonic.

The fifth meeting between Dyer and I was a reading of the first draft of a score. The writing reflected the elements we had discussed previously and included a tape-part made

[246] See the discussion of Grisey's *Nout* movement in Chapter 1 (p. 35).
[247] See Chapter 3: Singing without playing.

from a recording of the original motet the material was derived from, Guillaume Dufay's *Ave Maria Stella*. One of the characteristics of Dyer's piece is the continuity of the pitch content from bar to bar. Figure 86 shows the piece begins with a compound multiphonic. The multiphonic stops in the second bar, leaving only the voice, followed by another compound

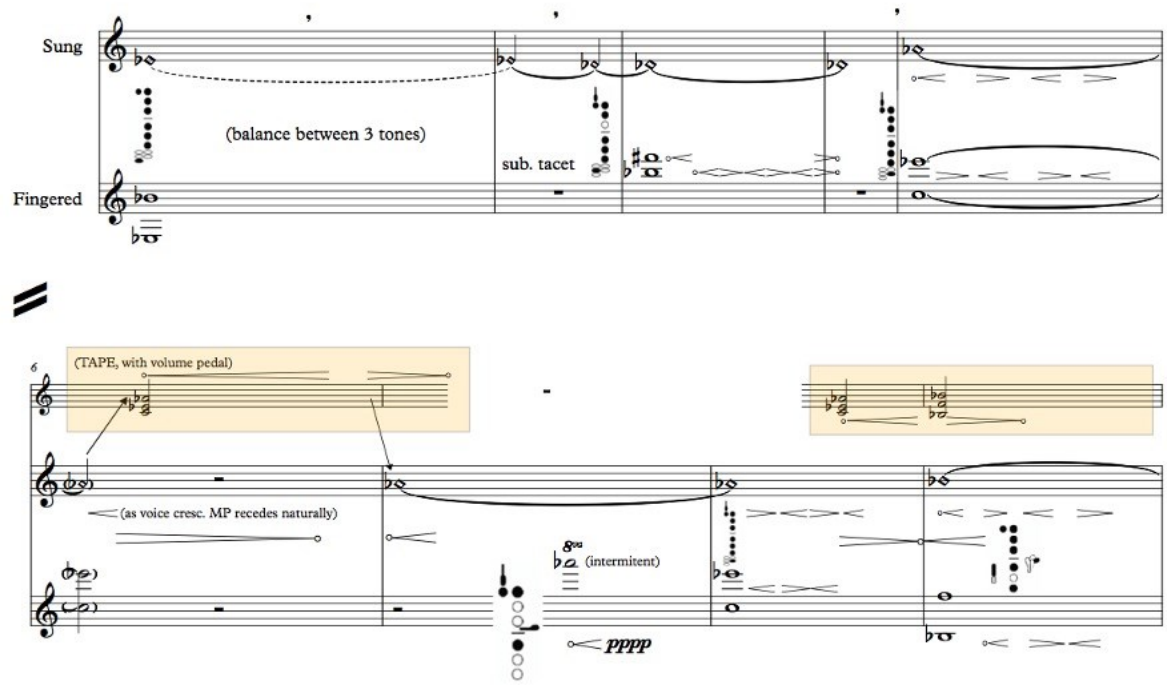


Figure 86. Mark Dyer, "Droning Falsities" first draft, bb. 1-9.

multiphonic in the third bar. In the sixth bar, the tape-part enters with a chord sharing the same pitch content as the compound multiphonic held over from bar five, which then returns in bars seven and eight. In bar nine, the tape again shares the pitch content with the compound multiphonic. Composing this way was a suggestion given in our previous meetings, and I found it very helpful for me to find the correct sung pitch. One note made regarding this type of writing is some of the parts or material may need to be adapted depending on the vocal range of the performer, particularly between male and female voices.

The session continued, working through the piece to determine how the elements flowed together, that the notation was clear, and what changes should be made. One consideration I brought up was the character of my voice while singing. Normally, I would strive to have an open, full sound, achieved with an open throat. However, to blow at the same time, the throat needs to be more closed and constricted, which affects the sound of the voice. This is most important when changing from a sung note into a compound multiphonic, as I would naturally start singing with an open throat, but need to close it as I start blowing. However, transitioning from a compound multiphonic into a sung note, means that my throat is already in this position. This led to experimenting with my ability to transition from a more open to closed throat and back while singing.

Our sixth meeting was working on the first full version of the piece. It greatly expanded on the drafts we had been working through, including many more performance instructions, such as changing the dynamics of individual pitches of the compound multiphonic rather than as a whole unit. At the beginning of the second system of Figure 87 is a compound multiphonic. B♭5 tends to disappear at higher dynamics. Dyer has utilised this in the composition by writing fade-ins and -outs. This notation was a point of discussion to determine what made the most sense from both a theoretical and performance standpoint. For example, I felt it should be clear in the first compound multiphonic of the piece that each voice should enter separately while still understanding that it is a compound multiphonic. Another notation we discussed occurs in Figure 88. The sung note holds over from the previous page and I wanted written reminders of what pitch I was singing to aid moving to the next interval.

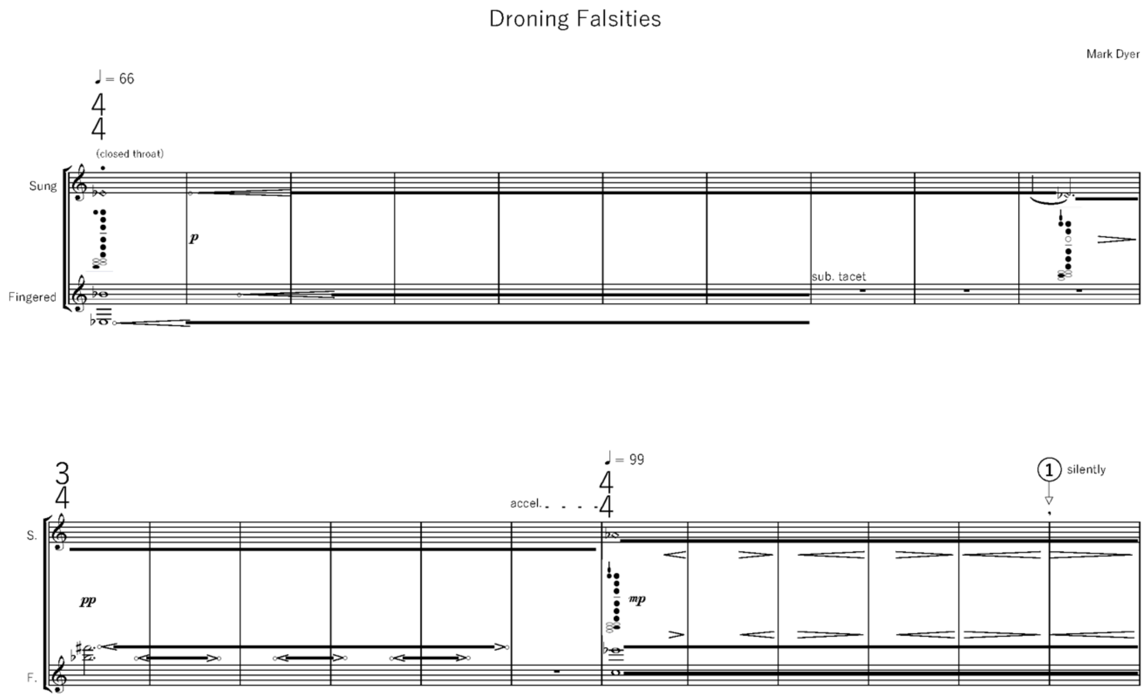


Figure 87. Mark Dyer, "Droning Falsities", final draft, p. 1.

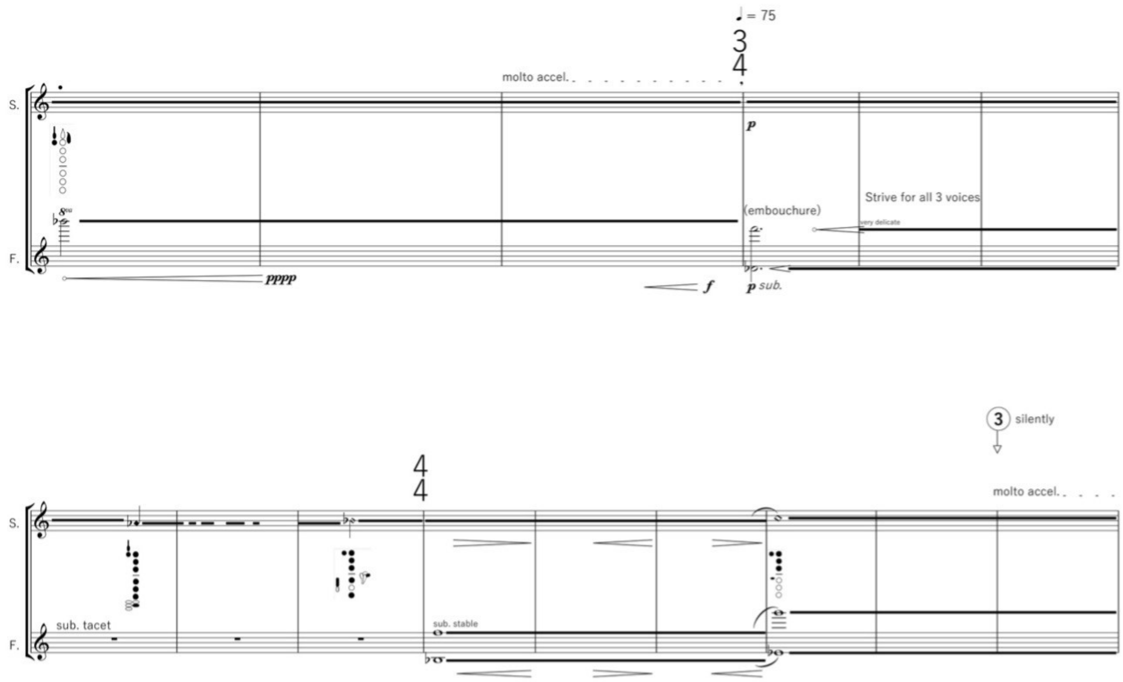


Figure 88. Mark Dyer, "Droning Falsities", final draft, p. 3.

In summary, through a collaborative effort driven by experimentation, feedback and filtering, and reflection and revision, Mark Dyer and I successfully discovered new effects of using the voice while playing the contrabass clarinet. These include how various multiphonics respond while simultaneously singing, how the pitch content is a factor, and how the manner of singing affects it. Additionally, a new discovery of singing through the instrument without playing but changing the fingering had interesting effects.

Bofan Ma – offset iv - backlash

Musical Recordings: 2001 Bofan Ma – offset iv (video)

Audio Examples: 1080-1087 Bofan Ma- Sound Textures Simulations

Collaboration with Bofan Ma focused on reinventing sounds from a previous composition of his. Different materials attached to the bottom of a score created sound textures as they scraped across the music stand as the page turned, and the sound ended with the page falling back onto the stand. I tried to replicate these different textures. After listening to a recording of the sound and analyzing the timbral characteristics, I would find a technique to approximate it, often combining multiple techniques. Ma listened and offered input regarding how closely I conveyed the intended sound and suggestions on improving it. For example, when examining the sound of the piece of 200gsm paper, I initially used flutter-tongue in the lower register of the instrument. This was too low and more closely resembled the sound of the metal plate. We looked for something with less pitch and decided that using flutter-tongue with air-only represented the sound more accurately. A slap tongue G4 followed by quickly closing the keys in succession reproduced the page-falling-back-onto-the-stand sound. We repeated the process for seven different textures, and Ma described each, explaining how I simulated it.

1. **“A Piece of 200gsm Paper”** Flutter on air (tzzzz...), with a flickering, low-register resonance.
2. **“Paper Clips”** Very smooth alternations between an airy hiss and an in-throat flutter/‘growl’ (all into the mouthpiece on the open G) - e.g.: shhh - growl - shhh - growl - shhh....
3. **“A Metal Plate”** Airy, dirty, low, obvious, slowly recurring microtonal pitch bends, merging with indeterminate multi-phonics through changing of embouchure, loosening the jaw, and slightly altering the fingering when necessary.
4. **“Tin Foil/Plastics/Bubble Wrap - Dry”** Very exaggerated, irregular circular mouth movement on the mouthpiece, as if chewing it loudly, with a kiss every now and then, also with randomised fast key clicks.
5. **“Tin Foil/Plastics/Bubble Wrap - Wet”** Same as the above, but with occasional blowing into the mouthpiece (whilst moving fingers).
6. **“An iPad Pro with Millions of Scratches at its Bottom”** A continuous, super grainy, throaty, grumbling croak, like an utterly satisfying, endless burp made into the instrument, along with irregular changes of fingering (speed ad lib.).
7. **“A Super Aged, Thick, Solid, Sound-proof Wooden Door”** Very slow, ascending glissando. within the lowest octave, with a soft and smooth quality, and an imagined directionality towards the unknown.[248]

Ma used these findings in a new composition for bass flute, contrabass clarinet, page-turner, and audience, *offset iv – backflash.* The work uses three scores:

[248] See Audio Examples *1080-1087 Bofan Ma- Sound Textures* for demonstrations of sounds.

- one for the instrumentalists, with the sound descriptions for each player and two mood boards with colours, fonts, shapes, dynamics, adjectives, and directions to design two contrasting sound worlds;
- one for the page-turner, with text instructions of how and when to turn the next page; and
- one for the audience, with text instructions, that gets passed from audience-member to audience-member.

The piece begins with the page-turner opening their score and the instrumentalists playing their designated “Mood Board A” sound. As the page-turner responds to their score’s instructions, the instrumentalists respond to the page-turner with the different sound simulations, and afterwards return to the mood board sounds. Halfway through the performance, the page-turner hands the audience their score and the contrabass clarinet begins to respond to the audience's actions. "Mood Board B" is played if the pages of both the page-turner and audience scores turn simultaneously, and the piece ends when the last page of both scores has been reached.

The collaboration yielded new sound concepts on the contrabass clarinet. By trying to simulate other sounds I was forced to expand my sonic palette, combining various techniques to create new textures. The external feedback of another listener during the discovery process helped shape the textures beyond my own perceptions, and encouraged me to explore beyond my own musical tendencies.

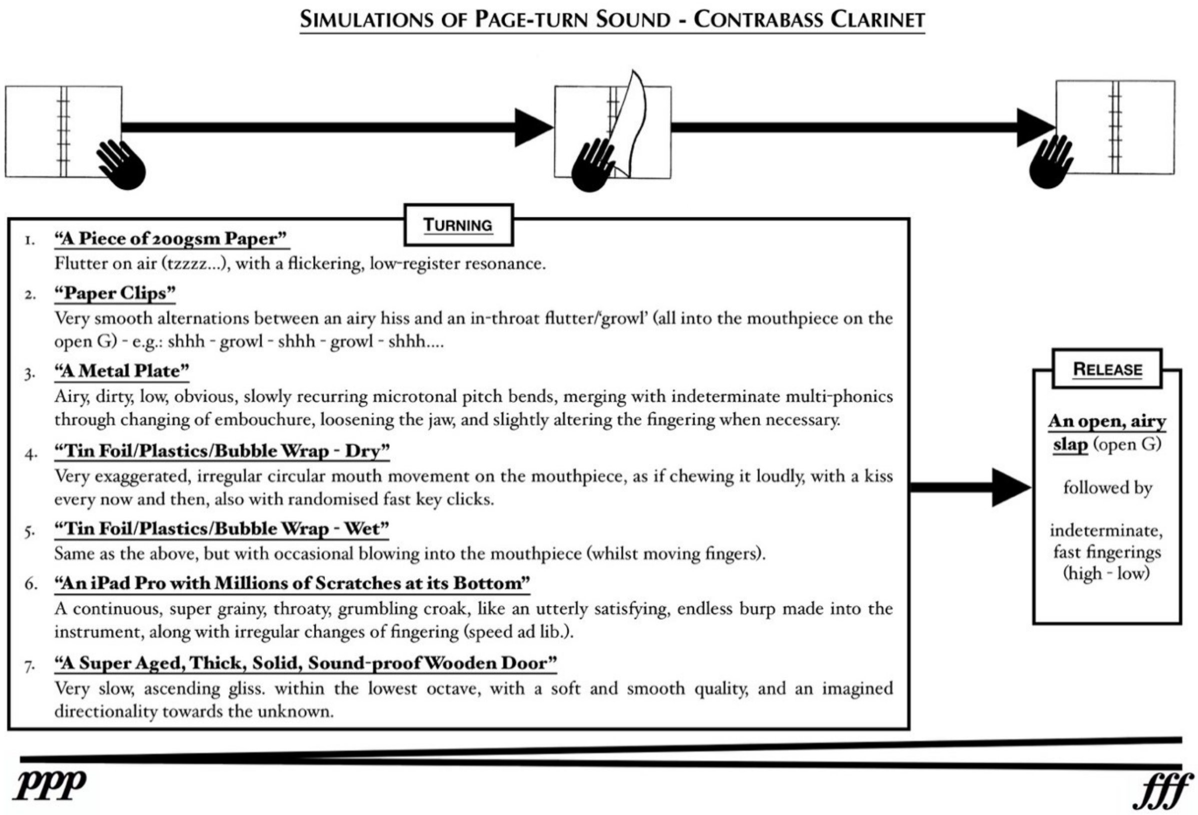


Figure 89. Bofan Ma, "offset iv - backlash", sound texture simulation descriptions, p. 3.

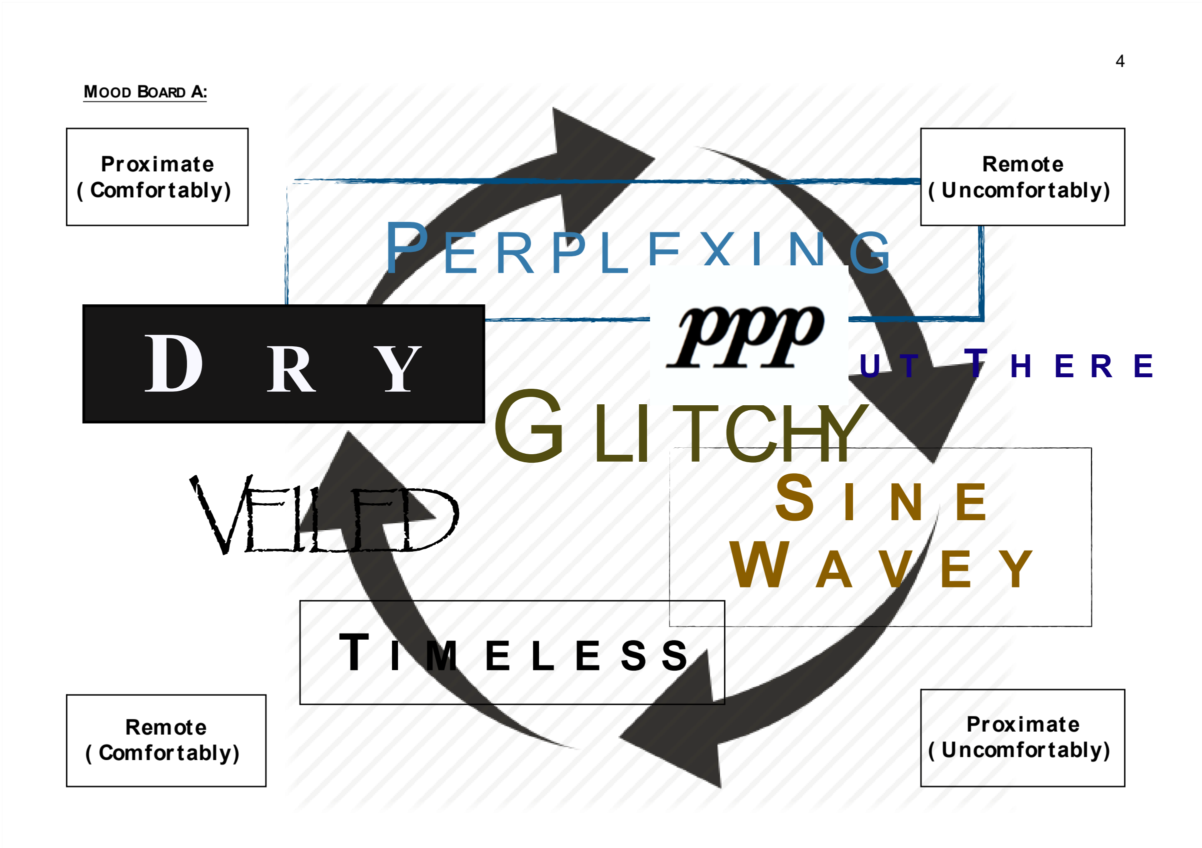


Figure 90. Bofan Ma, "offset iv - backlash", Mood Board A, p. 4.

Oğuz Büyükberber - *Sketchbook*

Musical Recordings: 2002 Oguz Buyukberber – Sketchbook (video)

I was approached by the Netherlands-based composer, improviser, contrabass clarinettist, and visual artist Oğuz Büyükberber in the summer of 2020 to work on a project bringing together musicians in the Netherlands and UK during the Covid-19 pandemic, working entirely remotely with performances delivered online. Our collaboration took shape in a building-block process, adding layers each time we passed material back-and-forth between each other to create *Sketchbook*.

The project's concept was based around Büyükberber's method book for pitch-based non-idiomatic improvisation *Spiral*[249] and a book of sketches he drew, combined with a modular synthesizer he played to create a video as the final output of the work. After initial discussions regarding the piece's direction, Büyükberber gave me pages of miniatures from the book— short compositions each using a dedicated pitch spiral— and asked me to interpret and record them. Büyükberber created an electronic accompaniment with these recordings, which incorporated my playing, his contrabass clarinet playing, and a modular synthesizer. This audio component combined with a video made from a book of sketches he drew, photographed, and animated. Büyükberber sent the video back to me to improvise with freely. My improvisations were less pitch-based and utilised multiphonics, altissimo, colour fingerings, slap tongue, flutter-tongue, voice, air sounds, and double trills in response to the musical and visual content from the video. I videoed my improvisations, and Büyükberber used them to create a new video, mixing the materials from the sketchbook animations and my live playing. With this final video, Büyükberber wrote a text-based score for live

[249] Oğuz Büyükberber, *Spiral : A Personal Approach for Generating Pitch Content for Improvisation/Composition* (Rijswijk: Stichting Donemus Beheer, 2019).

performance. The score includes instructions of musical material to use at certain timecodes throughout the video. The material is improvisatory within a framework and specifies using techniques such as multiphonics, altissimo, voice, and imitation of the pre-recorded audio. The project's final output is a video of myself playing the score, superimposed on top of the sketchbook video, as if I were performing in front of it.

The back-and-forth nature of this working method resulted in layers of artistic content that truly represent a collaborative process in which the individual input can be identified, but blends as a response to previously generated output.

Aled Smith - *vus*

Musical Examples: 2003 Aled Smith- vus (video)

Aled Smith's composition *vus* for contrabass clarinet and effect pedals uses graphics-oriented notation to depict the movements necessary to play the contrabass clarinet. Rather than traditional staves with notes, fingering diagrams illustrate which keys should be closed or opened. This notation style allows multiphonic and colour-fingerings to develop and emerge organically, as the fingers do not always move in the linear way necessary to form standard pitches.

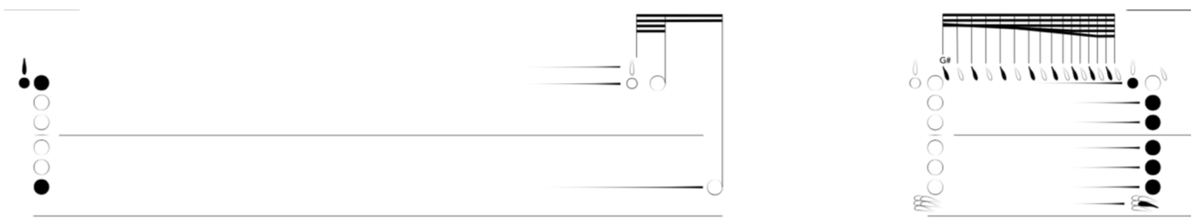


Figure 91. Aled Smith, "vus" p. 1.

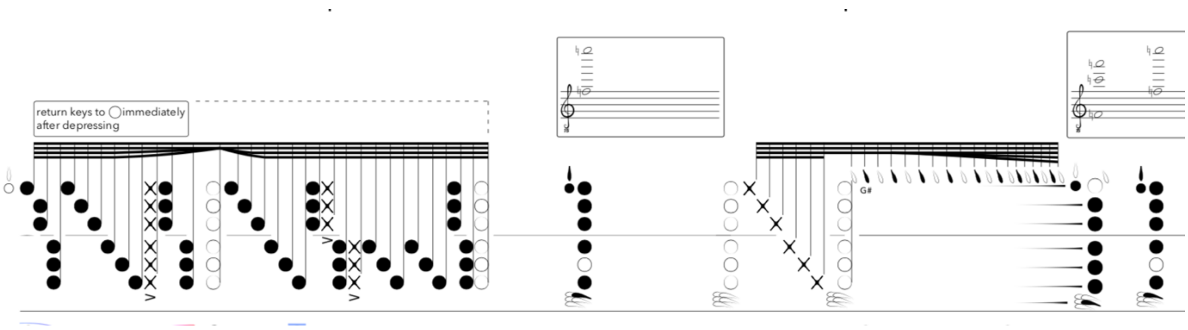


Figure 92. Aled Smith, "vus" p. 4, finger movements.

The diatonic impact that closing keys in order would have, which was not always the desired result, was discussed. We explored methods of notation that mitigated this result, including immediately reopening keys after closing, before the following key closed, or moving the fingers at a speed that would result in a "fall" rather than a descending scale (Figure 92). Black lines leading to or from diagrams indicate gradual finger movements, resulting in further unexpected transitional sounds rather than immediate changes. Legato playing from one multiphonic to the next is often impossible. The "noise" that occurs in-between due to the multiphonic failing during slow finger transitions was a topic of interest and a desired outcome. Creating multiphonics this way is unpredictable by nature. I recommended avoiding notating too-specific multiphonic pitch content, but rather timbral characteristics, such as high and low, or dense and sparse. A traditional stave is used when specific pitches or overtones are required.

Staves for the sound production mechanisms — mouth (M), throat (T), and the mouthpiece — also illustrate their movements graphically. The M stave specifies the amount of air to blow, using a black mark that ranges from a thin line to a filled box and various gradients of shapes in-between. Notation distinguishes whether to:

- actuate the reed to generate pitch (black circle)
- use only air sounds (white diamond)
- move between air and pitch (arrows)

The T stave uses the same black markings as the M stave and designates using the voice.

Figure 93. Aled Smith, "vus" p. 4, Mouth and Throat staves.

The mouthpiece stave illustrates how much mouthpiece to use in the mouth, and coloured markings, on a scale from blue (low) to red (high), indicate the mouth pressure's intensity, creating timbral changes. The mouthpiece notation results from our experimenting sessions exploring the effects of varying these parameters on the sound. Another exploration was in vocal shapes that one could use while playing. Open vowel sounds and consonants that use the tongue can create varying timbral effects on both tone and air sounds by changing the voicing. Letters that use the lips for production, such as B, F, M, P, and V, cannot be produced, but attempting to do so while playing can affect a note's attack. Smith uses varying vocal shapes by printing the corresponding letter or diphthong in the score.

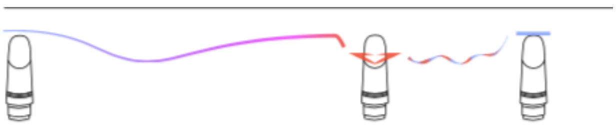


Figure 94. Aled Smith, "vus" p.4, mouthpiece pressure.

The effect pedals are notated on their own stave. The effects used in the piece are (listed bottom to top on the stave in the score): distortion, EQ, looper, delay, volume, and A/B switcher. Each effect occupies a line in the stave. A thick black line notates when it is on, and blank space when off. The looper also uses a dashed line to indicate that it is in recording mode and the thick black line for playback. The delay uses hemidemisemiquavers in a greyscale gradient to show the intensity of the feedback. The volume pedal uses a thin black line to indicate its position. In our meetings, we discussed the effect pedals' technical limitations and ways to change the notation to accommodate them. The primary limitation was that only one pedal could be operated at a time because I perform standing. Earlier versions of the score sometimes required multiple pedals to be turned on or off simultaneously. We worked together to find a good order to perform these movements sequentially. In some cases, a rhythm was assigned to the changes to help facilitate the performance.

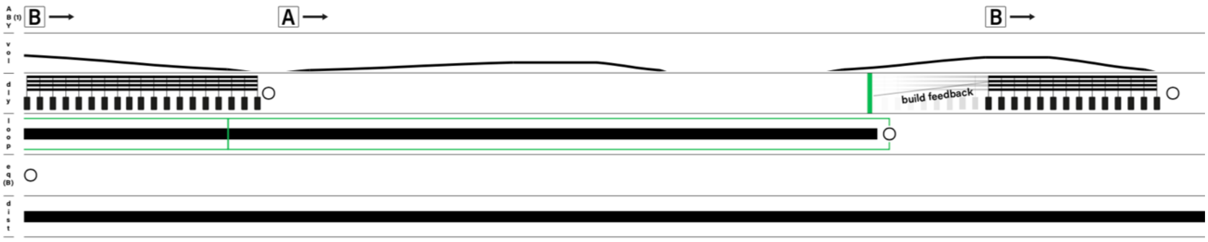


Figure 95. Aled Smith, "vus" p. 32, effects pedals.

The piece received its premiere performance at the 2018 ClarinetFest in the USA[250] and later that year a studio recording and video were made. From the recording, Smith made further changes by removing sections to shorten the piece's length and adjust the form. I ensured there was continuity with the playability of the part and the operation of electronics, suggesting alternatives when necessary—for example, verifying that we did not remove a section where the looper must record if it must play it back later in the piece.

Figure 96 illustrates many of the elements implemented in *vus*. The top line shows the time position of the score (6:40), and the brackets indicate 5 seconds; thus, the page represents 40 seconds. The page begins with the fingering for E♭3, also indicated in traditional notation above it. The mouthpiece is halfway in the mouth with low pressure, and full air plays a tone with a 'shh' vocal shape. The B channel is on with the volume up, and the distortion gets turned on. The tone becomes half-pitch/half-air as the mouthpiece comes out of the mouth slightly and more pressure is applied. The air intensity decreases with the

[250] 28 July 2019, Clarinetfest, Knoxville, USA.

volume pedal, followed by turning on the EQ and the looper playback and increasing the volume pedal, shown in a rhythmic pattern. Simultaneous to the footwork, an overtone emerges just before the blowing stops, and the voice begins with an “hæ” vocal shape as the fingers slowly release and depress keys to come into position to play E♭6. The note sounds at the switch from voice to air on an “fw” vocal shape as the fingers slowly close again to create E♭3 as the air intensity decreases and the harmonics emerge. The fingers release to play E♭4 with voice, moving from the “fw” to “ø” vocal shapes and increasing the amount of mouthpiece and pressure. The fingers then release entirely, and as the change from voice to air with flutter-tongue is made, the fingers slide back on sequentially to cause a falling effect, arriving on E♭5, with a glissando down to D5 and back, as the air intensity decreases and the volume pedal reduces.

In the third time-bracket, the register key releases, the right-hand E♭3 key is pressed as the blowing changes from pitch to air with a “wh” vocal shape, and the looper stops. The air sound intensity increases as the fingers depress keys non-linearly to create colour-fingerings, and the tone becomes half-air/half-pitch before changing to the voice with an “ou” shape. The mouthpiece is in with low pressure. The intensity of the voice increases as the mouthpiece comes out and pressure increases. The EQ turns off as the fingers slide into position to play pitched B♭3 with flutter-tongue, changing to E♭3 and then E♭6. The page ends with E♭6 held at a medium volume with flutter-tongue and the distortion turning off.

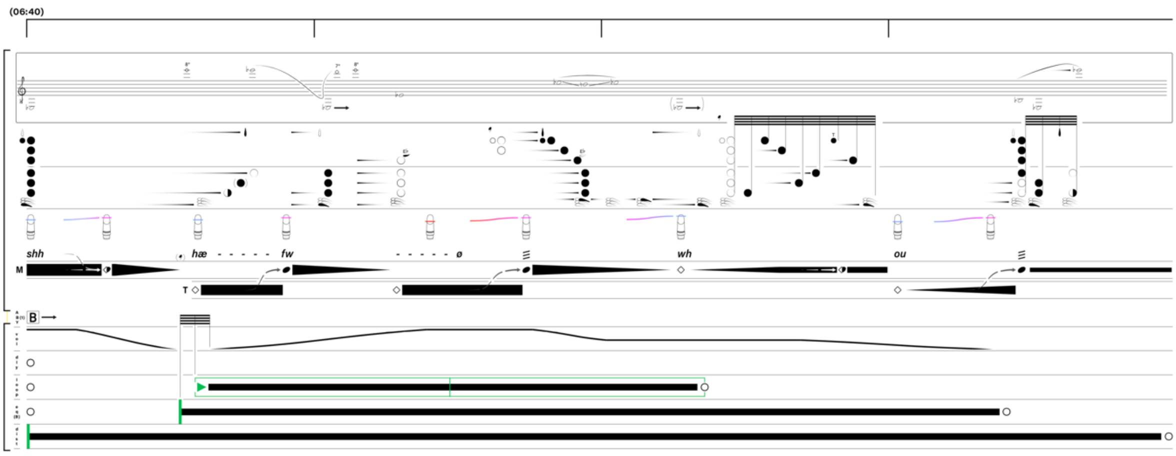


Figure 96. Aled Smith, "vus", p. 21.

Andys Skordis – *Tri…Hita…Karana*

Musical Recordings: 2004-006 Andys Skordis- Tri…Hita…Karana

As Andys Skordis and I were located in different countries, our first collaborative meetings were through video calls, but the piece was finalised in-person in Athens.[251] In our calls, we discussed the general direction and form the work would take. We decided to explore both the instrument's lyrical and aggressive sides and not use electronics. We discussed incorporating physical performance and theatricality, my interaction with the instrument, and the concept of limitations. As the contrabass clarinet is a physically demanding instrument, this affects the length and structure. I suggested a work of 10-20 minutes, and we decided to do a multi-movement work, with each movement focussing on a particular technique and playable as an independent piece.

During our discussion, I mentioned the acoustic phenomenon discovered in my collaborations with Mark Dyer, singing through the instrument and using fingerings to change the pitch. Dyer ultimately did not use this technique, but I thought it might be an

[251] 28-30 November 2019.

exciting concept to explore further with Skordis and demonstrated it to him. I then tried the technique using different vowel sounds and discovered that all the sound needed to be directed through the instrument, requiring the lips to stay wholly closed around the mouthpiece. The vowels "o", "ah", and "eh" work, but "ee" can cause the corners of the mouth to move back and away from the mouthpiece, allowing sound to escape and the fingering changes to have no effect. When I added growling, the fingerings did not change the pitch distinctly but still caused timbral changes. Skordis then asked if I could stamp my feet while singing and changing fingerings, which was possible.

We then experimented with playing multiple clarinets at once,[252] another idea that had emerged with Dyer, but was discarded. The contrabass clarinet mouthpiece is large, with little room for another mouthpiece. The difference in sizes of mouthpieces makes it difficult to seal the embouchure properly, but it is possible. The amount of air required for a second instrument limits the time I can produce sound. I tried a combination of contrabass clarinet with a bass clarinet. Using the right- (incorrect) hand on the upper joint of one of the instruments makes it possible to change pitches on both with the notes C4-B♭4. The result is very airy, and the physicality needed to accomplish playing the bass clarinet with the contrabass clarinet makes it impractical. Using only the bass clarinet mouthpiece and neck as a drone is more achievable. A soprano clarinet was even less practical because of the support needed to hold the instrument, as it does not rest on the floor. Using only the mouthpiece and barrel was more feasible. It allowed me to create different effects by cupping my hand around the barrel's bottom and manipulating the sound by moving it. Holding a kazoo in the clarinet barrel also changed the timbre. Placing the kazoo inside the contrabass clarinet's neck had no effect, and the same with an Irish whistle.

---

[252] See video *1088 Multiple Clarinets at Once* in Audio Examples.

Skordis asked if I could make a glissando on the instrument. Due to the closed pads rather than open holes of a soprano clarinet, glissandi must be performed by slowly opening or closing the keys, and connecting the notes smoothly can be difficult. Descending glissandi in the altissimo register can be performed more easily with embouchure manipulation, bending pitches through the harmonics. He also asked if I could shake the contrabass clarinet while playing. It was awkward with the large instrument, but possible by moving the mouthpiece in and out of the mouth.[253]

Besides our video calls, I provided Skordis with the document I gave to other composers I collaborated with, describing and demonstrating techniques and inspiring the compositional process. Skordis began working on the piece until we met in-person. During this time, we had email exchanges clarifying ways I produce certain sounds, how fast I could play passages he had written, and whether I could circular breathe through some multiphonics.

We met in Athens a month after our last call and held five working sessions over a two-and-a-half-day period — one in the evening of the first day and one morning and one evening session on the following two days. Each session involved working through the scores Skordis had written, playing the material he had composed, and demonstrating new ideas that emerged. After the session, Skordis would edit and revise the score for the next one.

Session 1 began with a discussion of the form of the composition. The three movements each focus on a particular musical idea and represent the Balinese concept Tri Hita Karana, reflecting the three reasons for prosperity. The "Tri" movement (harmony with God) is a ritual ceremony, using singing and the voice, changing the sung pitch with fingerings, and colour-fingerings. The "Hita" movement (harmony among people) depicts a

[253] See video *1089 Shaking Contrabass Clarinet* in Audio Examples.

frenzied intensity and lack of harmony. The “Karana” movement (harmony with nature) is the release with soft harmonics.

The first movement began playing in the lowest register of the instrument and singing two octaves higher. Singing was comfortable for my voice range, however we tried passages in varying registers to determine what worked best. In my collaborations with Mark Dyer, we found the relationships of the sung and played octaves to be an important factor in the way the instrument responded. In this case, the singing caused no significant interference to the played pitch, but could be an important consideration for a contrabass clarinettist with a different vocal range, and the effectiveness of the piece. Skordis also changes the vowels to be sung while changing fingerings. After experimenting with different vowels and combinations, we decided that “eh” and “o” gave the most varied results and should be used for the piece.

We found another interesting discovery during the vowel experimentation in the passage in Figure 97. The upper stave is sung and the bottom stave changes fingers. Normally, the D4 in the bottom stave would change the sung pitch from B♭ to A, however when using the vowel “oo,” the pitch would change up to a B. This only occurred when changing the fingers from E♭4 to D as shown — using the D fingering while singing “oo” on its own, or changing to the D from another fingering did not have this effect. At the end of the stave, Skordis notates a flutter-tongue while singing. The tongue must stay low so that it can still roll, so vowels used must be low like “oh” or “ah” and not high, like “eh or “ee.”

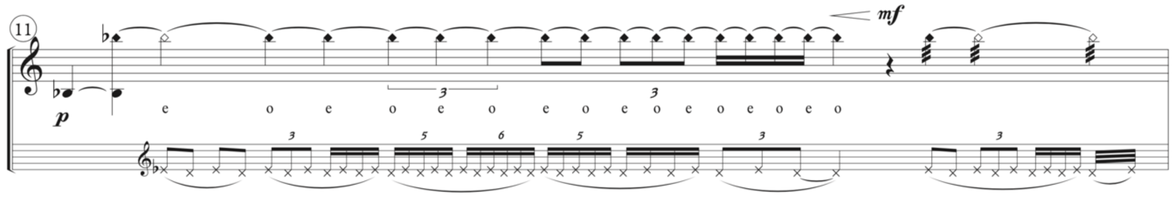


Figure 97. Skordis, "Tri...Hita...Karana" first draft.

Figure 98 illustrates the ritual motif used in the first movement. It lies entirely within range to overblow the throat tones rather than switching to the altissimo register. It more easily produces a dyad with the perfect 12th below it than other ranges. I suggested that I play this motif with the fundamental, which became part of the later versions of the score (Figure 99).

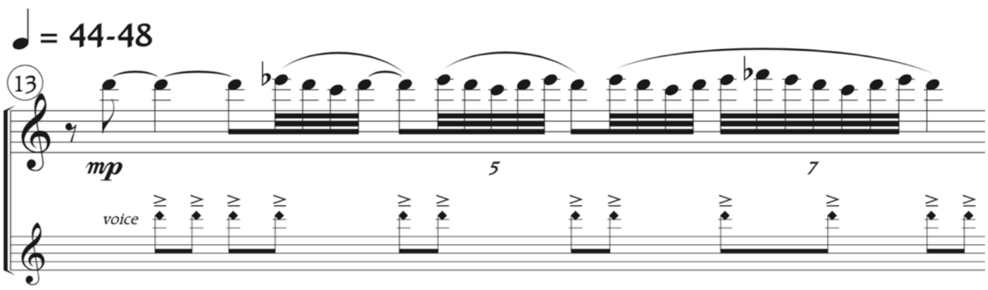


Figure 98. Skordis, "Tri...Hita...Karana" Ritual motif, first draft.

Figure 99. Skordis, "Tri...Hita...Karana" Ritual motif, final version.

The bottom stave in Figure 99 notates a rhythm to be played by stomping the feet, using ideas that were discussed in our initial meetings of physical and theatrical performance. The two notes E3 and F3 indicate the left and right foot. Figure 100 shows both feet stomping together, however since I perform standing this could require jumping so the decision was made to replace it with alternating feet. Rehearsal mark 18 gives instructions to play a bass clarinet mouthpiece at the same time as the contrabass clarinet melody and foot stomping. This was difficult to manoeuvre and did not have the desired result, but Skordis wanted a drone effect in this section. I suggested that by playing the melody as a Type 1 multiphonic, the high partials could create a drone effect, and later scores use this idea instead.

Figure 100. Skordis, "Tri...Hita...Karana" foot stomping and drone.

In Session 2, we worked on the third movement (Figure 101), which focuses on soft multiphonics and harmonics. The multiphonics used were taken from the fingering chart I previously provided. Skordis uses fingerings that have multiple overtone possibilities, keeping the fundamentals and moving through the upper partials. The movement's tempo had to remain flexible because some partials required more time to emerge due to their resistance and response, or because I need to find them in the texture and adjust my embouchure to allow them to sound. Once I have found them, they are easier to return to but difficult to produce out of context. He composed long lines, so the question of breathing arose. Circular breathing through multiphonics is challenging and impossible with very delicate ones; however, taking a breath and restarting the pitches I had just been playing was often possible.

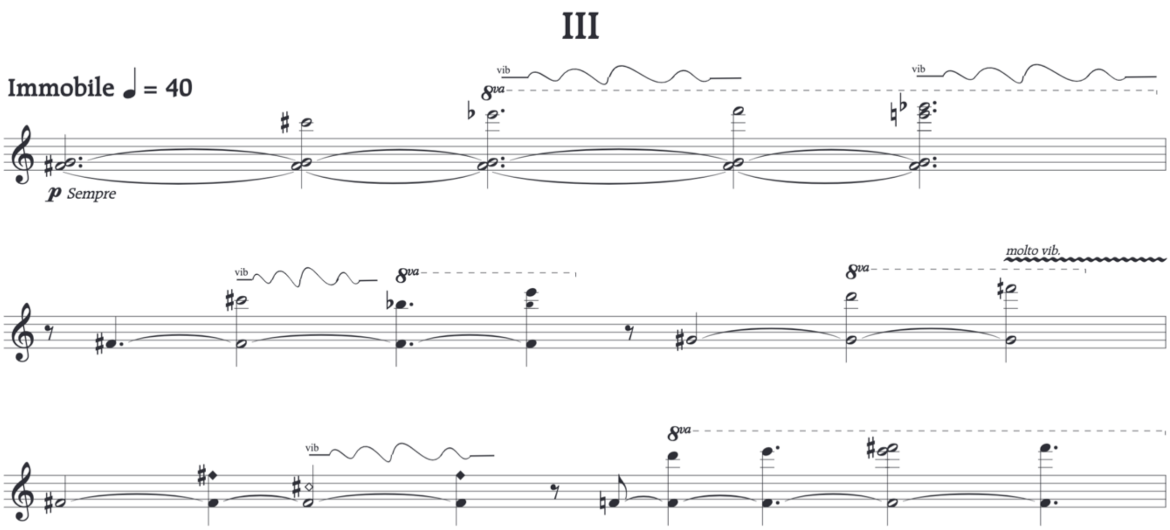


Figure 101. Skordis, "Tri...Hita...Karana" Third Movement, first draft.

The movement ends with three soft multiphonic tremolos. The chosen tremolos in the first draft (Figure 102) did not have the desired effect, so I began to experiment with different fingerings and voicing until we found some that responded well and maintained the character of the music, and ordered them in a sequence to create the cadence Skordis was happy with (Figure 103).

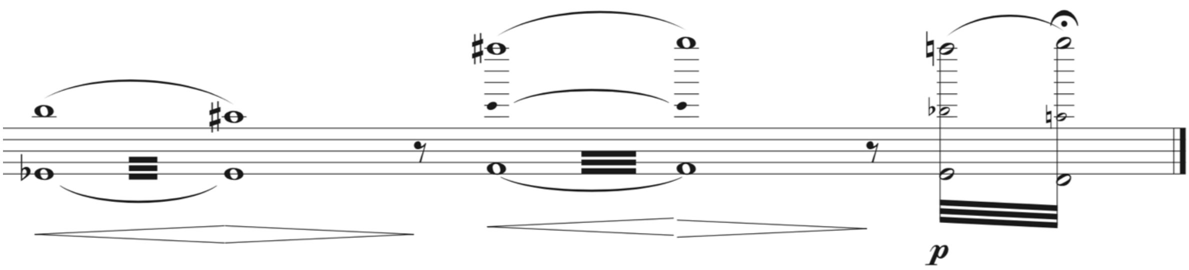


Figure 102. Skordis, "Tri...Hita...Karana", end of third movement, first draft.

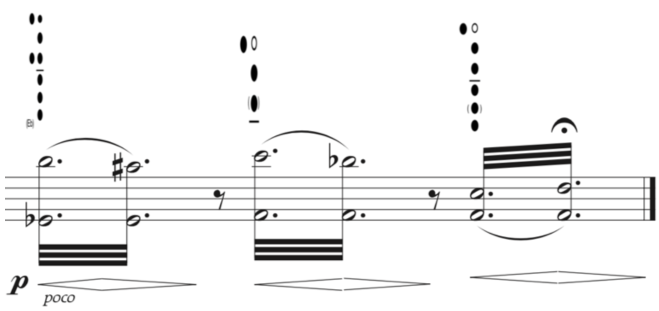


Figure 103. Skordis, "Tri...Hita...Karana", end of third movement, final version.

Session 3 began by playing through the first and third movements with the changes Skordis made after our previous session. An interesting effect developed from the sung fingerings passage shown in Figure 104. By trilling my fingers, the pitch can change much faster than I would ordinarily be able to sing.

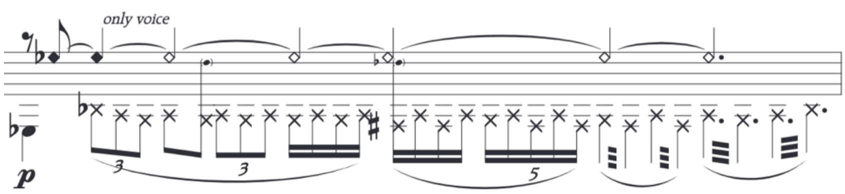


Figure 104. Skordis, "Tri...Hita...Karana", sung fingerings.

The multiphonic progression beginning on F♯4 seen in the second system in Figure 101 was jumping out, uncontrolled, and with a harsh character as I added the higher partials. I found that by adding extra keys, I could change the resistance to produce another harmonic while maintaining control of the sound (Figure 105). This meant making a slight change in the pitches, but the effect was preferable.

Figure 105. Skordis, "Tri...Hita...Karana", multiphonic fingering changes.

During a break in our rehearsal, I had started improvising and played a C3 with the register key. Adding the register key produces the pitch a 12th above. However, the response is different in the extended range of the instrument and creates a multiphonic with a nice texture. By releasing the key, I was able to produce the register shift Grisey used throughout *Nout*. Later in our rehearsal, Skordis changed the passage in Figure 106 to use the texture created from C3 instead of E♭3, and changed the notation to reflect the idea as Grisey used it.

Figure 106. Skordis, "Tri...Hita...Karana", third movement, 3rd draft.

Figure 107. Skordis, "Tri...Hita...Karana", third movement, final draft.

The register shift idea was repeated towards the end of the movement when Skordis asked if a multiphonic could be played from the G5 in Figure 108 that would introduce a lower note (Figure 109). The preceding F6 and E6 are notated as harmonics. Harmonics are fundamental to the way the clarinet produces notes, so there is no difference in how I produce these notes, unlike how they are used on stringed instrument, however the harmonic notation indicates the sound's character.

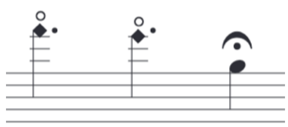


Figure 108. Skordis, "Tri...Hita...Karana", third movement, 3rd draft.

Figure 109. Skordis, "Tri...Hita...Karana", third movement, final draft.

In the second movement, Skordis wrote a fast, ascending passage into the extreme altissimo range. Although it is possible to play all the notes, performing runs at this speed in this range is not practical. However, this range is where the partials are close together and can change easily with the embouchure, so later scores indicate to play this *quasi gliss*.

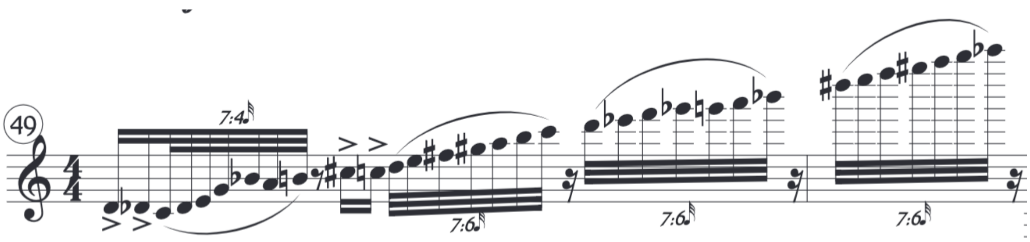


Figure 110. Skordis, "Tri...Hita...Karana", second movement, third draft.

The second movement's essence is frenzy and speed, and Skordis asked for recommendations to demonstrate this. I suggested keeping the passages in the lower register and not below G3, as the little-finger keys respond more slowly. Allowing freedom in finger movement by notating gestures and ideas rather than specific notes also facilitates speed. I also demonstrated double trills to introduce speed into the texture with a rapid machine-gun-like sound.

In our fourth session, we spent more time exploring double trills and all the possible note combinations and keys which could be double-trilled. All the fingerings could also be overblown and their harmonics double-trilled; however, some of the harmonic pitch combinations did not produce two separate notes but rather colour-trills. Skordis also wanted to hear the difference between double trills and flutter-tongue and changing back and forth between them and he rewrote the movement to feature the double trill technique (Figure 111).

Figure 111. Skordis, "Tri...Hita...Karana", double trills.

A second type of double trill involves trilling two fingers on different pads to create a sequence of three or four notes. After demonstrating this and how it can shift into other registers, Skordis added it in the slow movement (Figure 112).

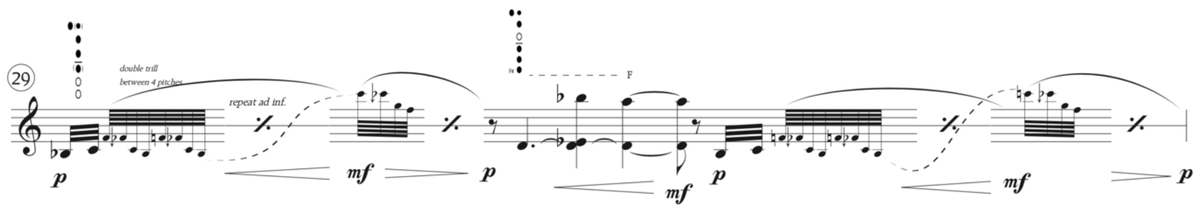


Figure 112. Skordis, "Tri...Hita...Karana", type 2 double trill.

Our fifth session reviewed all three movements, starting with the new version of the fast movement. Skordis wrote a double trill with a Type 1 multiphonic, as seen in example a) of Figure 113. The double trill created perforations in the multiphonic, producing a rapid bisbigliando effect. However, trilling from F3-G3 was not as effective and changed to the B♭3-C4 seen in example b).

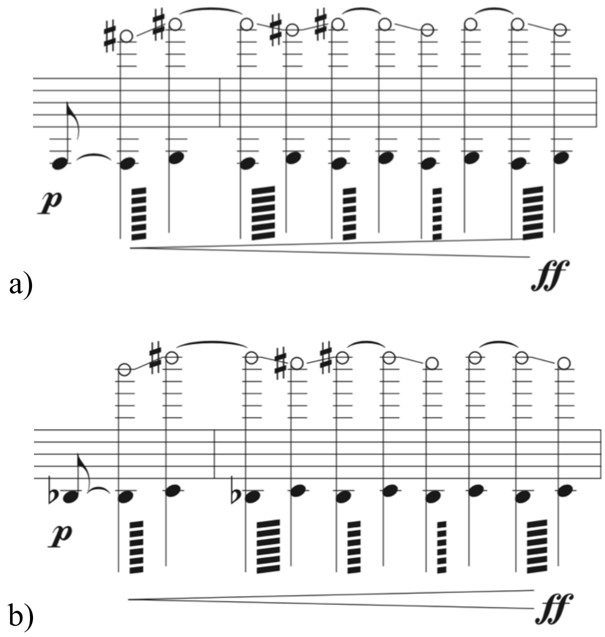


Figure 113. Skordis, "Tri...Hita...Karana", double trill with multiphonic.

I received the final score a few days later, and I used it for the premiere performance. The planned premiere was to be in the United States in the summer of 2020, however, due to the Covid-19 pandemic, it was cancelled, and the premiere was postponed until October, with two consecutive concerts in Denmark. Both performances were video recorded for Skordis to view, with my additional feedback. I felt the piece was effective and had a good response from the audience; however, it was very exhausting and physically demanding, so the third movement’s soft, delicate multiphonics were very difficult to control. I found myself running out of breath too quickly and did not always play the intended overtones due to fatigue. Skordis made some significant changes to the form and structure:

- The soft movement and the fast double trill movement were swapped so that piece ends loud rather than soft.
- The opening of the first movement was removed and inserted into the beginning of the soft movement.
- Other passages in the first movement were removed to trim the length.

- Screaming while playing was removed from the repeated section at the end of the first movement and only plays once as the final gesture.
- Growls were replaced with flutter tongue in the middle section of the double trill movement.
- A breath mark was added between the double trills and the flutter tongue notes and in the alternating 6/8 and 5/8 bars to help better distinguish the rhythmic differences.

The most significant of these changes for me was the swap of the second and third movements as it facilitates a better live performance.

Thanos Chrysakis – Dark Light and Milieu Interieur II

Musical Recordings: 2007 Thanos Chrysakis- Dark Light

2008 Thanos Chrysakis- Milieu Interieur II

Thanos Chrysakis gave me a list of various dyad multiphonics to find while working on *Dark Light*. The requested dyads were to be clear, pure-sounding tones without buzzing or extra harmonics and included:

- Twelve dyads with the low note in the lowest register of the instrument
- Twelve dyads with the low note in the middle register of the instrument
- Ten dyad trills
- Six dyad trills with the lower notes the same but the higher note changes

To this list I also added:

- Dyad trills with the higher note the same but the lower note changes

These parameters forced me to look for possibilities that I may not have sought out on my own and provided inspiration while constructing the multiphonic fingering charts. The dyads in the low register were difficult because of a lack of fingering choices. Most of the options in this range are Type 1 multiphonics which are very rich in tones and not dyads. It is possible to produce very wide dyads from the low register, with the higher note in the upper altissimo range, but these can be harsher timbres rather than the pure tones Chrysakis requested. Finding dyads in the middle register was easier, as this is where many of the possibilities are.

Discovering dyad trills required combinations with both a fingering conducive to trilling and containing notes that speak when trilled. Since multiphonics can be fragile, the disruptions caused by the trill can cause it to stop responding. Trills where the higher note changes need a fingering that is conducive to trilling and retains the fundamental. The difficulty is that there is only one fingering for the fundamental in most cases, so a trill must use a fingering which is a colour fingering for the fundamental, but allows the upper harmonics to easily change. Trills retaining the upper note while the lower notes changes require dyads using fundamentals containing the same note within their harmonic series. This is most easily achieved when the upper note is high within the series, where the pitches are close together and shared amongst more fundamentals.

Dark Light uses a number of techniques such as bisbigliando, breath pulsations, pulse smorzato, tone oscillations, air sounds, flutter tongue, singing, multiphonics and harmonic glissando, quarter- and micro-tones, and vibrato. Figure 114 demonstrates Chrysakis' use of multiphonics that emerge from their bottom note. He uses this idea and multiphonics that emerge from their top note often in compositions, prompting me to include these possibilities as descriptors on the fingering charts. The piece begins with a G3 accelerando-ritardando.[254] A short figure follows, ending on F4, which becomes the fundamental of a multiphonic. Another short figure follows, ending on a C5 held until the next multiphonic emerges, then played *smorzato*. The final, longer rhythmic figure ends on F♯4 that immediately becomes a multiphonic with *poco vibrato* and breath pulsations before changing the upper harmonic.

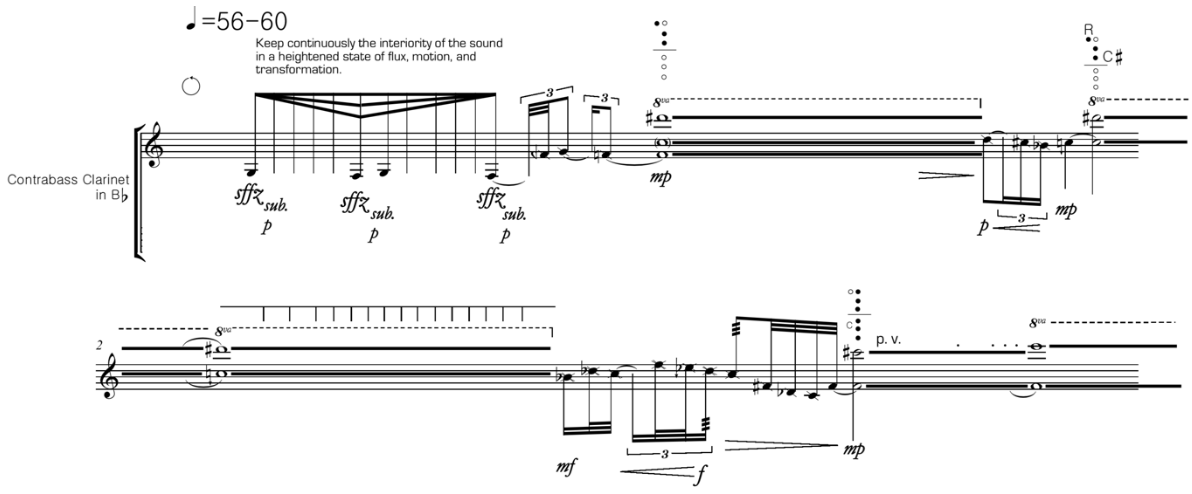


Figure 114. Thanos Chrysakis, "Dark Light", p. 1.

I also worked with Chrysakis to amend a previously composed work, *Milieu Interieur II,* originally for another contrabass clarinettist with a different instrument, a low-E♭ straight Leblanc model. The work had never been performed so Chrysakis gave it to me; however, I struggled with many of the multiphonics originally written. Chrysakis and I worked together to modify this work to perform on my low-C curved Leblanc instrument. The piece uses similar techniques as *Dark Light*, with long, held multiphonics, sometimes decorated with breath pulsations or *smorzato*. Chrysakis also uses perfect 12th register shifts, the motif used by Grisey in *Nout.*[255]

---

254 The accelerando-ritardando is notated with beams emerging from a quaver into a semidemiquaver and back.

255 See the discussion of Grisey's *Nout* movement in Chapter 1 (p. 35).

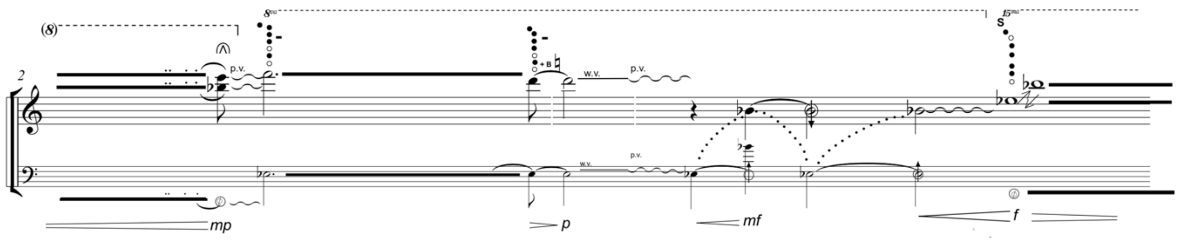


Figure 115. Thanos Chrysakis, "Milieu Interieur II" bar 2.

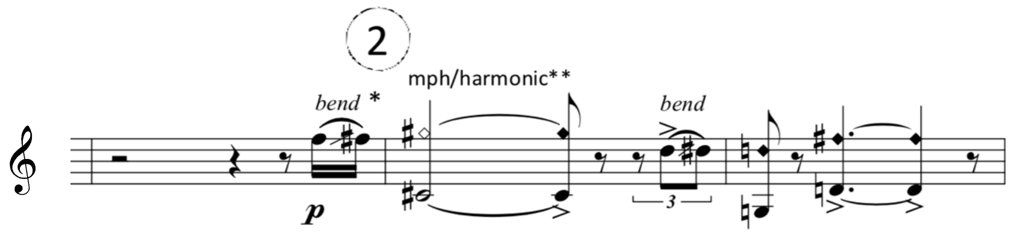
Niels Christian Rasmussen – *Gestalten*

Musical Recordings: 2009 Niels Christian Rasmussen- Gestalten

Niels Christian Rasmussen is a composer in Denmark and part of the Snow Mask Composers Group. They invited me to play a solo contrabass clarinet concert in Aalborg,[256] and Rasmussen would compose a new piece. Due to the distance, we could not work together in-person but did so remotely via email and video calls, with final adjustments in-person during rehearsals in the days before the concert. I began by sending him an initial document describing various techniques, preliminary fingering charts, and examples to formulate compositional ideas. Before our first video meeting, Rasmussen sent musical fragments to discuss so I could offer insight into using them. The final piece, *Gestalten*, is in three sections with an electronic accompaniment. Each section focuses on a musical idea- multiphonics, slap tongue, and air sounds with multiphonics.

The multiphonics in the first section were written freely, with the fundamental and proposed harmonics, but with instructions that other harmonics can be chosen as long as the piece's character remains "silent and dark". This allowed me to find those that work best in the piece for the sound and response.

[256] 11 November 2018, Utzon Centre, Aalborg, Denmark.



bend* (a quartertone)
The second note shall not be played, it only tells the direction of the bending.

multiphonic/harmonic**
The notes indicate proposals (thirds or fitfhs) to be 'highlightened' with the fundamental.
Feel free to choose other harmonics, just that you watch the caracther to be silent and dark.

Figure 116. Niels Chr. Rasmussen "Gestalten", bb. 7-10 and instructions for multiphonics.

The slap tongues in the second section are always at a *piano* dynamic in a moderately quick rhythmic figure, with indication there should be pitch. A light tone-slap attack accomplishes this. The second section also uses extreme vibrato with some clarion register notes.

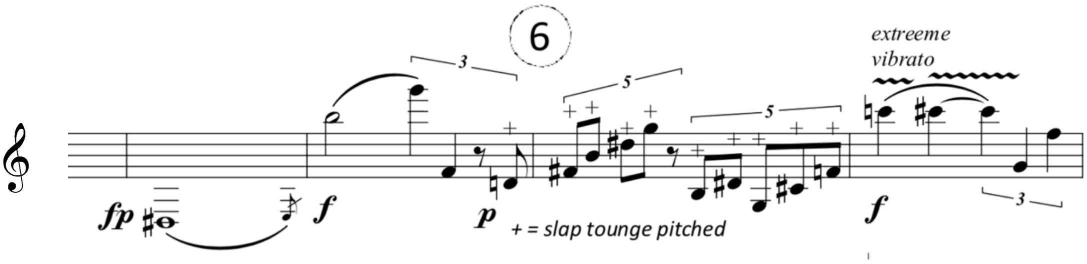
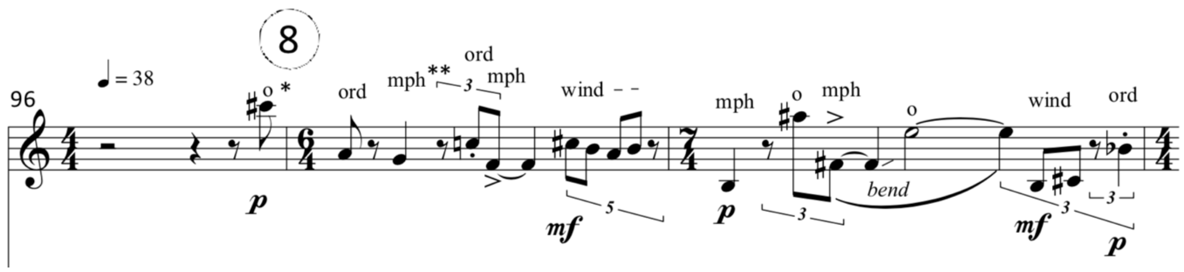


Figure 117. Niels Chr. Rasmussen "Gestalten" bb. 38-41.

The third section uses freely chosen multiphonics based on the given fundamental again, with instructions to keep the character light and "not too screaming." The notation "wind" is as much a notation of character as technique. I was asked to play the phrases as if it were a winter wind outside a window, which I interpreted with an air and subtone timbre, allowing the ends of phrases to decrescendo and trail off.



* o = flautando

** mph. = multiphonic. Choose freely which multiphonic that works best. The character shall be light, but not too screaming. The written note is the fundamental.

Figure 118. Niels Chr. Rasmussen "Gestalten", bb. 96-98 and instructions for multiphonics.

The electronic part consists of sounds and motifs that maintain a pulse; however, I sometimes had trouble identifying it. For the first performance, I had written timecodes into my score to ensure we aligned in the right places, but I did not feel proper cohesion between my playing and the electronics. Rasmussen modified the electronic's balance for the next performance and edited the score, but I still did not feel it was clear enough to follow. After a few email exchanges, he had edited the score sufficiently with enough information from the electronic accompaniment that I was confident of not losing my place during a performance.

<u>Elspeth Brooke – hillside detail sometimes textures</u>

Musical Recordings: 2010 Elspeth Brooke- hillside detail sometimes textures (video)

Elspeth Brooke brought a stack of Post-It Notes to our session to try folding different ways to place behind the reed. The idea was to try to achieve a muted sound, which was mostly unsuccessful. The most muting effect was when the paper was closest to the tip of the reed, but it was difficult to make it stay there. The paper also became wet and unusable very quickly. My idea was to try papers with different thicknesses, such as business cards and train tickets. At one point, I found a position where the paper caught the airstream and created a very interesting flapping sound, but I could not find precisely the right place and the correct type of paper to recreate this with consistent results.

Figure 119. Paper behind reed.

We tried covering the bell with Post-It Notes, which only really affects low C3, and C♯3 created a slight buzzing sound. How the paper vibrates can depend on the size of the Post-It Note. The size we used was a square, approximately five centimetres. Four squares were required to cover the Leblanc bell, leaving a hole in the middle, with the square's interior side allowed to flap. The bells of Eppelsheim and Selmer instruments are larger. With larger Post-It Notes, the same design is achievable on an Eppelsheim; however, the Selmer bell is too large for adequate coverage. Sticking squares end-to-end to reach closer to the centre of the Selmer bell proved ineffective. The most interesting effect was at quiet dynamics; playing too loudly overpowered the sound from the paper. Adding more squares increases the number of flapping sides, creating more buzz. Using the register key also allows overtones to buzz, but the higher the note, the more negligible the effect. Brooke used this idea in an ensemble piece sketch in a workshop. The limitation within a piece of music, like all instrument preparations, is having the necessary time to prepare. The technique was removed from later sketches.

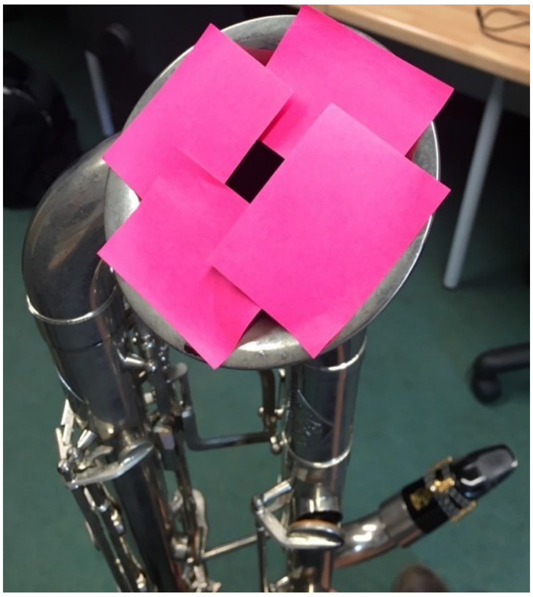


Figure 120, Post-It Notes on bell.

Brooke composed *hillside detail sometimes textures* for contrabass clarinet and video as the result of our sessions. The piece does not use any of the preparations. Instead, it uses other techniques we tried, such as:

- air effects (half-tone/half-air; blowing low-pitched air rhythmically through the mouthpiece; blowing high-pitched air at the mouthpiece, outside of the mouth)
- colour trills
- flutter tongue
- altissimo

The piece uses musical material derived from the video, assigning musical gestures to elements seen on the screen, such as relative distances, proportional measurements, and camera angles.

Notation Key

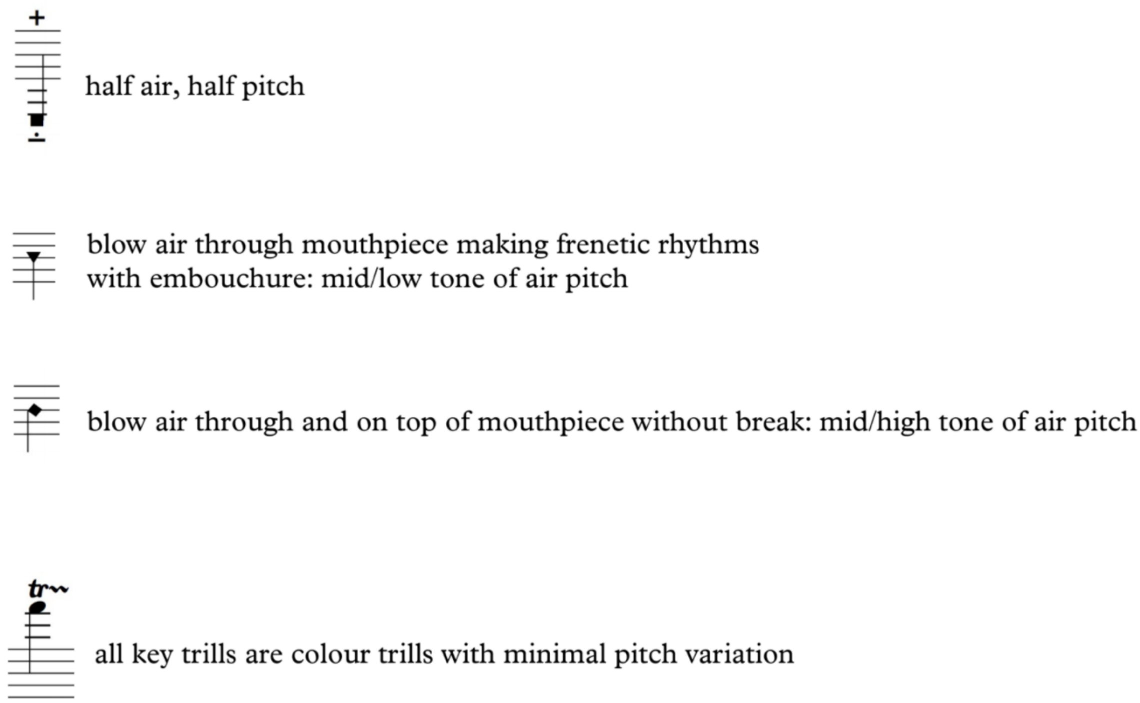


Figure 121. Elspeth Brooke "hillside detail sometimes textures" notation key.

Shaun Davies

Audio Examples: 1091-1092 Shaun Davies

Instrument preparation was also a technique I workshopped with Shaun Davies, mainly involving aluminium foil. We covered the bell of a Leblanc with foil and sealed it with tape to achieve a rattling effect. As with other forms of muting, this was most effective on lower notes. We found that from E3 at a loud dynamic, there would be some activation of the foil; from E♭3, an even lower dynamic would activate it.[257] From D3, anything above pianissimo would cause the foil to vibrate, and C♯3 was extremely rattly, triggering the foil before much pitch even emitted. The lowest C3 caused the instrument to overblow because

[257] See *1092 Aluminium Foil on Bell* in Audio Examples.

the foil stopped the pipe, not allowing the air to expel; however, puncturing holes for the air to vent enables the note to sound without overblowing. In further experiments of my own, I found the quality of the foil and the tightness of the seal affected the response. Crumpled foil did not respond as much, and using a rubber band rather than tape created a looser seal, also changing the response. Blowing through the instrument alone without vibrating the reed had no effect; the sound waves are necessary for the foil to respond.

Another idea was to seal off the pad on the instrument's bottom bow with foil and tape and place the bow in a container of water. Placing the bow of a foil-covered bass clarinet bell in water like this has an effect, but there was no result with the Leblanc contrabass clarinet. However, this gave me the idea to remove the mouthpiece and neck to play into the water.[258] There was not much effect, so I attached the foil-covered bell. The result of this prepared, deconstructed instrument alone was as expected — the pitch produced from the neck attached to the bell distorted with the foil's rattling. Placing the foil-covered end in the water produced a higher-pitched metallic sound. When some air escaped through unsealed parts in the foil, it simultaneously produced bubbles, adding to the sound texture. Removing the foil and placing the bell directly into the water had the most interesting effects. A sinewave-like sound was created, sometimes punctuated with a metallic distortion or pulsation caused by bubbles, depending on the bell's angle to the water. Overblowing the pitch was also possible. Due to the curve of the neck, this technique required standing in an awkward position. It would also be possible with an Eppelsheim, using the first section of the neck attached to the bell, but not with a Selmer neck.

[258] See video *1091 Leblanc in Water* in Audio Examples.

Figure 122. Leblanc mouthpiece, neck, and bell in water.

Further investigation of rattling sounds led to dropping balls of paper into the instrument's bottom, hoping that they would bounce inside while playing. This had no effect, so they were removed and replaced with small foil balls, which also had no effect, partly because the moisture caused them to stick to the side of the instrument. We brainstormed other ways of accomplishing the desired result and arrived at the idea of using a mesh material across the bore of the instrument between two joints to create a platform for the objects to rest on, in the direct path of the airstream. I stretched sheer tights between the bell and foot joint of a Leblanc. The paper balls did bounce around the inside of the bell but not produce enough of an audible effect; however, the foil balls did. I also tried small metal balls, but they were too heavy for the air to move. I expanded the idea further by covering the bell so that the foil balls had something else to bounce against to create more sound and keep them from being blown out of the instrument. I used different materials, including foil and paper and plastic bags. Covering the end of the bell has the same effect on C3 as previously seen, causing the instrument to overblow. The material used to cover reacted more than the foil balls inside, so there was no beneficial effect gained by combining these ideas.

An object with interesting results was a table-tennis ball. When dropped inside the bell, the ball stops when the bell-flare tapers so it does not fall further into the instrument. The pressure from the airstream of the lowest notes causes the ball to rattle inside at varying degrees relative to the amount of air blown. If the air is too strong, the ball can be blown out the bell of a Leblanc or Eppelsheim; however, it is not a concern with the large-belled Selmer. The end of the bell can be covered with a material to keep the ball inside, which adds its own vibrations to the sound texture. Further experimentation with different materials to cover the bell and objects inside will undoubtedly yield other results.

Improvisations

Musical Recordings: 2000-2024 Improvisations (video)

Due to the Covid-19 pandemic of 2020, I postponed some of my planned ensemble activities. I took the opportunity of having possession of three different contrabass clarinets to record improvisation trios with myself. The recording process was in four phases over ten days and produced four sets of trio recordings. In the first nine days, I recorded one contrabass clarinet per day, cycling through the three (Eppelsheim-Selmer-Leblanc) as seen in Table 4.

Table 4. Improvisation trio recordings ten-day schedule.

		Trio 1	Trio 2	Trio 3	Trio 4
Phase 1 Solos	Day 1	Eppelsheim			
	Day 2		Selmer		
	Day 3			Leblanc	
Phase 2 Duos	Day 4		Eppelsheim		
	Day 5			Selmer	
	Day 6	Leblanc			
Phase 3 Trios	Day 7			Eppelsheim	
	Day 8	Selmer			
	Day 9		Leblanc		
Phase 4	Day 10				Leblanc Selmer Eppelsheim

Phase 1 was solo recordings. In Phase 2, I added a second instrument to the Phase 1 solos to create duos, and Phase 3 added a third instrument to the Phase 2 duos, each phase responding to the improvisations already recorded. In Phase 1, I began each session playing an open improvisation without any specific direction but utilising various techniques. After this open improvisation, I recorded a series of shorter improvisations, each focusing on a specific technique. Recording one instrument per day allowed time between improvisations; I would not clearly remember what I had played the day before, attempting to keep the improvisation fresh and relying on my creativity and the idiosyncrasies of each contrabass clarinet to guide my playing.

With each consecutive phase, sufficient time had passed, and other improvisations played in-between, that I would not remember the previous phase improvisation. I would be reactive rather than anticipative with the new improvisation to simulate a live situation better. This method could not truly simulate live playing because it will always be reactive and not interactive. However, cycling through the instruments allows each to lead the initial improvisation, and each possible instrument combination and order exists through the phased layering process. On Day 10, I recorded one more open improvisation trio, but all three contrabass clarinets consecutively.

The goal of these recordings was not to analyse my improvisations on each instrument, but rather to hear the three contrabass clarinets played together for a better understanding of their comparative sound characteristics and response to the various techniques. Through improvisation, I could focus on demonstrating individual techniques and musical ideas that may not have been explored in the pieces developed through the composer collaborations.

The following list is a selection from the improvisations that highlight using various techniques. The improvisations focus on textural playing and response to the other instruments.

- *Selmer Improvisation*- open improvisation started on Day 2 with the Selmer contrabass clarinet and uses microtones, colour trills, multiphonics, subtones, staccato and tone slap tongue, and singing with fingerings.
- *Slap Tongues*- demonstrates the different type of slaps, the varying dynamics possible, and the speed they can be articulate.
- *Double Trills*- features the dense texture produced by this rapid technique with pitches, colour fingerings, and multiphonics.
- *Singing and Playing*- begins by illustrating the distorted multiphonics that can occur due to the difference-tones between a sung and played pitch. Sung fingerings using differing vowel sounds are also heard when singing into the instrument without playing.
- *Singing Without Mouthpiece*- further explores the sung fingerings, focusing only on the singing and without playing. It combines with double trills and flutter-tongues, showing the unique textures created with this technique.

- *Tongue on Reed*- demonstrates the muted sound throughout the lower and upper registers in both legato passages and as a rhythmic effect.
- *Colour Fingerings*- also uses the technique in rhythmic passages throughout the range of the instrument.
- *Air and Vocal Sounds*- uses varying methods of blowing at and through the instrument. The improvisation begins without using the reed but adds pitches with air in the timbre. Flutter-tongues, growls, and guttural vocal sounds are also used.
- *Multiphonics*- employs various possibilities, including Type 1 and Type 2 multiphonics, soft and loud dynamics, and wide and close intervals. They combine with *bisbigliandi* and multiphonic trills. A Type 1 multiphonic sequence is heard and a sequence comprised of a bassline with wide, high, and soft partials above it.
- *Keyclicks and Finger Pops*- highlights the rhythmic pitches obtained by swiftly closing the pads and the metallic textures created by the keys rattling. When actuating the reed in the second half of the piece, the effect of finger pops combined with played pitches is heard.
- *Altissimo and Quarter Tones*- begins with glissandi through the pitches in the extreme upper register. At times, the lower partials and fundamentals emerge from altissimo notes to form multiphonics. Colour-fingerings and bisbigliandi are used as textural elements.
- *Deconstruction*- focuses on the use of the neck and mouthpiece only, sometimes combining the bell. Moving the hand back-and-forth at the end of the tube creates a wah-wah effect. Slap-tongue, flutter-tongue, harmonics, and multiphonics are combined, expanding the sound palette.
- *Alternate Mouthpieces*- explores different means of sound production, including Acme siren, tuba mouthpiece, duck and bird calls, whistles, and kazoos. The

contrabass clarinet becomes a resonator and combines with singing, growling flutter-tongue, and colour-fingerings.

- *Day 10 Improvisation*- the result of the final day of improvising. It starts with a dense texture of loud multiphonics, which remain for much of the improvisation. The piece intensifies with multiphonic trills and slap-tongues, before subduing into pulsing multiphonics with strong beating effects. The multiphonics crescendo with trills and slap-tongue into another dense, gritty cloud. A second release leads to altissimo, air sounds, and slap tongues on a bed of soft multiphonics. The dynamic increases a final time with altissimo notes, multiphonics, and trills, and the improvisation ends with a final fragile, long multiphonic.

These recordings emphasise that each contrabass clarinet is capable of performing the various techniques, despite their design differences. There are nuanced variations in the sound, but the primary differences are in the response from the instrument and physicality of performing the techniques, known by the performer rather than the listener.

Chapter 5: Conclusion

This research has looked at the history, design, and sounds of the contrabass clarinet, focusing on the differences between the low-C models by the manufacturers Leblanc, Selmer, and Eppelsheim. The study of playing techniques has focused on those that are unique to the contrabass clarinet, those that respond differently to other clarinet family members, or those that are newly discovered. Collaboration with composers has yielded new compositions for the contrabass clarinet and developed new techniques and ways of writing for them. In particular, substantial developments have been in:

- the analysis of multiphonics and the creation of their fingering charts
- devising a system to represent all colour-fingering combinations
- altissimo, quarter-tone, and double-trill fingering charts
- the creation and study of compound multiphonics
- the discovery of singing with fingerings

We have seen that the contrabass clarinet's design went through several stages of development during its creation. Unlike other clarinet family members, the instruments today are still not standardised in shape or keywork, and it is apparent that these differences affect how the instruments respond to contemporary techniques. These are most evident with pitch-based content, necessitating different fingerings on each instrument to play the same notes. The altissimo register and quarter-tones are particularly affected.

Multiphonics have shown to be the most problematic, as the pitch content is often not the same between instruments. Approximately 100 multiphonics were recorded and analysed for each contrabass clarinet, using the same fingerings. Only 35 of those were considered cross-compatible based on their pitches. Within the cross-compatible multiphonics, there are still some variations in response and sound. A multiphonic which is stable and has a wide dynamic range on one of the contrabass clarinets may be unstable with limited dynamics on another. The timbres of a multiphonic on each instrument can also be different. The individual charts depict considerable information regarding pitch content in an attempt to illustrate the sound visually. Multiphonics notated with many internal pitches will be dense, and those with clusters of many high overtones will sound harsh. However, because all the overtones do not play at the same dynamic, it is impossible to judge the multiphonic's true sound without listening to the individual examples in the provided recordings.

Individual player setup is also a significant factor in the response of multiphonics. Due to the range of mouthpiece and reed preferences by each player, it is impossible to account for every different setup. I have found some multiphonics respond best with lighter reeds, and others require the extra resistance of a harder reed to produce the desired pitches or timbre. These differences can often be attributed to the means of production of the multiphonic, and whether it requires overblowing or underblowing. I also experienced differences in response when using a different reed of similar strength. Further study could be done into the multiphonics to catalogue them by resistance type, but as it was not the intent of this research to focus solely on multiphonics, this was beyond the scope at this time. Tuning can also be variable with multiphonics due to setup, with quarter-tone differences within the overtones not unlikely.

For composers wishing to use multiphonics in their compositions, a certain amount of flexibility is necessary. Expecting another player to achieve the exact sound and tuning as the provided recorded examples is unrealistic. Therefore, it is best to choose a particular aspect of a multiphonic as its reason for inclusion, such as the bottom and top pitches with less regard for the internal ones, or a wide interval, or timbral characteristic such as dense, sparse, harsh, or clear. Composers with the good fortune to have a contrabass clarinettist to work with can use these charts as a guide for more specific multiphonic writing, with the player's ability to test them. We have seen that remote collaborations are now possible thanks to the currently available technology, enabling working methods that were not as feasible before. This will allow further expansion of collaborative networks, and I encourage all composers to seek out contrabass clarinettists for collaborations when working with complex sound material.

Non-pitch-based techniques are less affected by the differences between the contrabass clarinets. However, some techniques produce different results on the contrabass clarinet in general compared to the smaller clarinets, either due to the register the contrabass clarinet is in, how it responds, or the instrument's physical size.

The development of the colour-fingering combination grids allows one to assess every possible fingering combination. The system is complex, but I believe it has broader potential for representing possible finger combinations on woodwind instruments and could be used in the methodical study of finger movements. For example, if a composer wanted to write a series of colour-fingerings, they could determine which fingers can move to which keys using the grids. They could also be applied to multiphonic fingerings or for trill and tremolo possibilities.

Through a reciprocal process, my collaborative process with composers successfully generated new works, discovered new techniques, and explored new uses of them. The composers helped and inspired me to investigate different sound possibilities and techniques. I influenced the compositions through demonstrations of techniques, and the results of some collaborations influenced the others. Chrysakis' request for specific multiphonics pushed me to search for particular fingerings, which were then given to other composers to use in their compositions. His use of multiphonics that emerge from either the bottom or top note led me to analyse this possibility in every multiphonic as data to include on the fingering charts. The replication of particular sound textures for Ma led to discovering a series of technique combinations. Working with Dyer included an in-depth exploration of singing while playing, developing compound multiphonics, and discovering the effects of singing through the instrument while using particular fingerings. This discovery led me to investigate the technique further and create fingering charts for it, which were then used by Skordis in his composition. Skordis also extensively used double trills after I demonstrated them to him.

The area of compound multiphonics has the potential for further research. In working with Dyer, our attention was on how the singing while playing multiphonics technique responded for me. A study of compound multiphonics performed by players with various vocal ranges would yield more data to provide a more defined understanding of how to use them in composition.

The discovery of singing with fingerings was a unique product of the collaborative process and one that may not have occurred without it. My initial tests of the technique on a bass clarinet and alto saxophone indicate that it also works on these instruments, although it did not work on a soprano clarinet. Further research is needed to determine the full effects on other woodwind instruments. This technique also requires further testing within varying vocal ranges.

The trio improvisations stress that, despite the design differences, the three contrabass clarinets more or less sound the same. The primary differences are known by the player more than the listener and relate to response and feel. Composers should not use differences in sound as a reason to write for a specific contrabass clarinet. Players rarely have multiple contrabass clarinets to choose from, and specifying one will limit the composition's playability. A reason a composer might specify an instrument is due to design aspects, such as a Leblanc's lack of a low C/C♯ linkage, or a Selmer or Eppelsheim's full set of trill keys. Although I have my own preferences for which contrabass clarinet I like to use in particular settings and for particular works, it is not my intention to state that one is better than the other. A player will adapt to the setting with the instrument they have and with which they are comfortable. With the material presented in this research, players should have an easier time using whichever instrument they have to perform a composition.

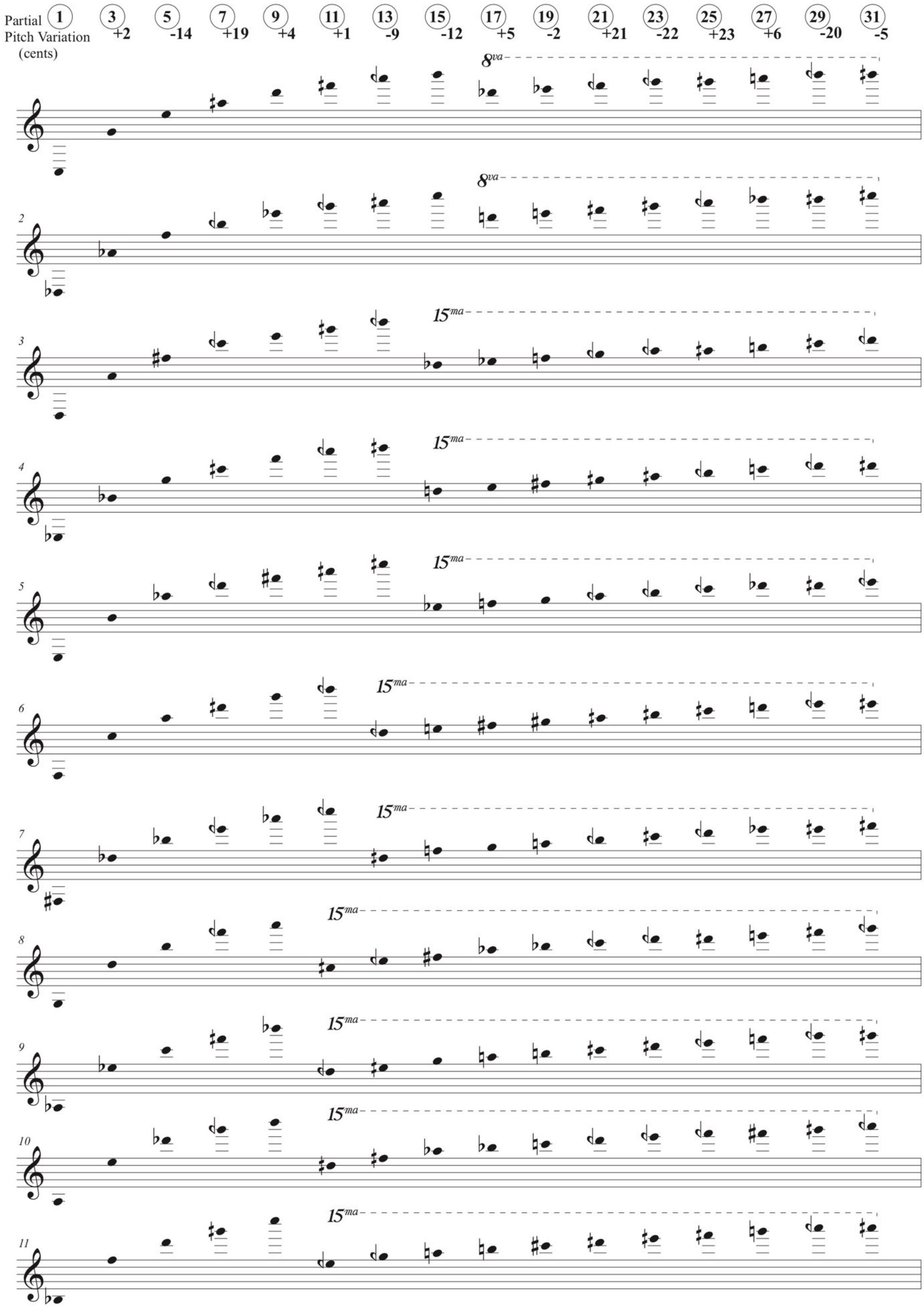
The continued promotion of the contrabass clarinet is necessary to produce a new generation of players, without which composers will not write for the instrument. The production of new instruments is also vital, particularly as the most-used low-C contrabass clarinet, Leblanc, is no longer manufactured. This is an area I feel is worth researching further, as the Leblanc is the preferred instrument by many players for practical reasons, but it is not without its problems. The development of a replacement instrument as equally practical but addressing these problems in an updated and improved contrabass clarinet would be a welcomed addition to the contrabass clarinet world.

Appendix

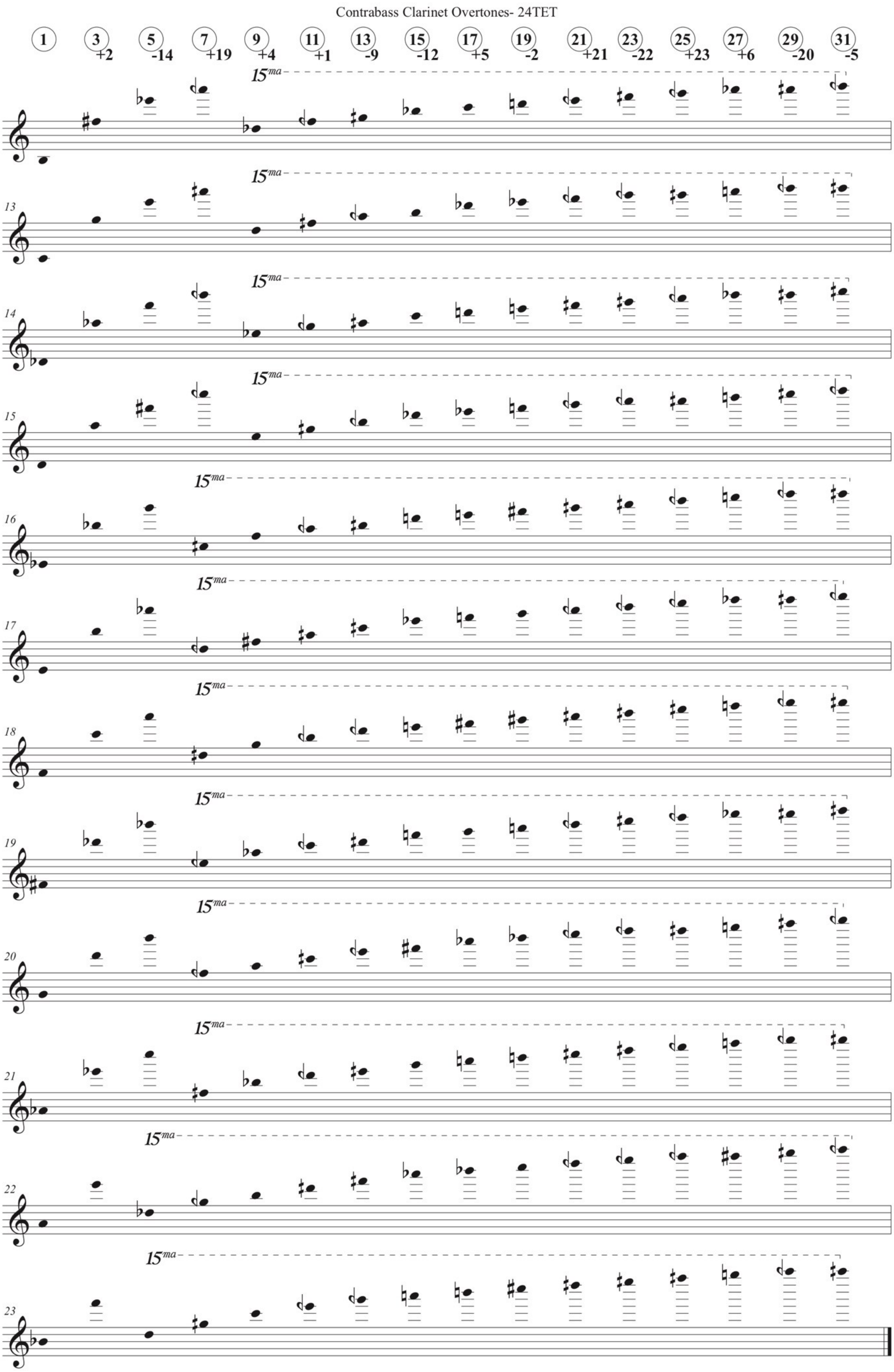
Contrabass Clarinet Natural Overtones

This chart shows the natural overtone series for all the fundamental pitches of a contrabass clarinet, C3-B♭4 up to the 31st partial. The pitches are notated in quarter-tones, and the Pitch Variation indicates the how many cents it deviates from the quarter-tone (50 cents per quarter-tone). Tuning on a contrabass clarinet is very flexible, so this should be used as a guide only. The information is useful for understanding and finding fingerings for multiphonics and the altissimo range.

Contrabass Clarinet Overtones

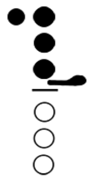


Appendix - Contrabass Clarinet Natural Overtones

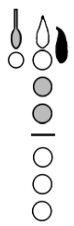


Fingering Charts with Altissimo Quarter-Tones

These fingering charts follow the standard convention of notation; black keys should be depressed, and white keys left undepressed. In the example below, the keys for LT, L1, L2, L3, and C♯4 are depressed. The right-hand keys are left open.



An addition to these fingerings is the use of grey. Adding a grey-coloured key may be helpful for tuning or response, depending on the player. In this example, the G♯ key must be used, but adding the Register Key, L2, or L3 may tune better. Any combination of grey keys may be used as needed.



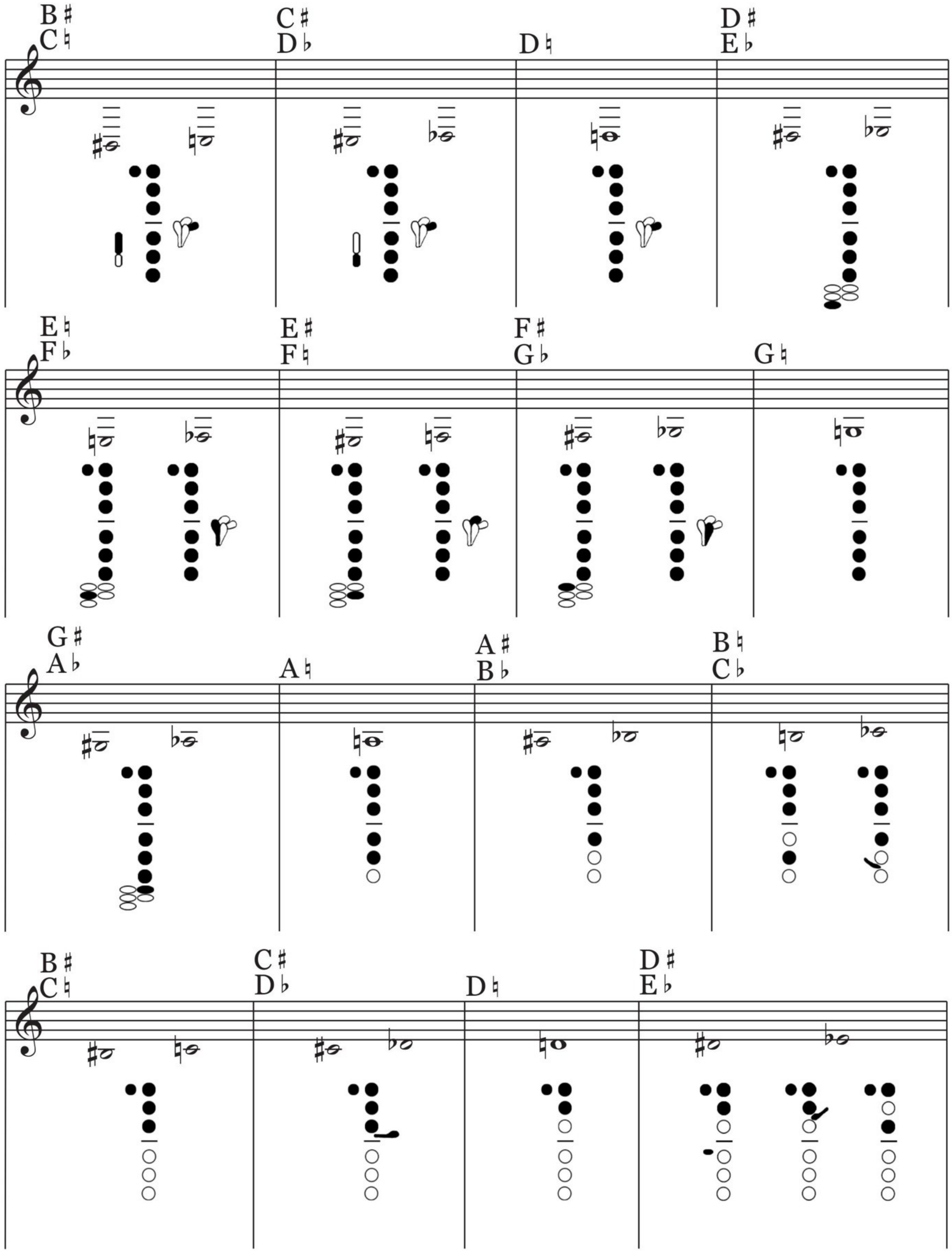
Tuning in the altissimo register of the contrabass clarinet is very flexible. The quarter-tone fingerings presented here are relative to each other, but due to individual players and setups, it may be necessary to shift to an adjacent fingering for a particular pitch.

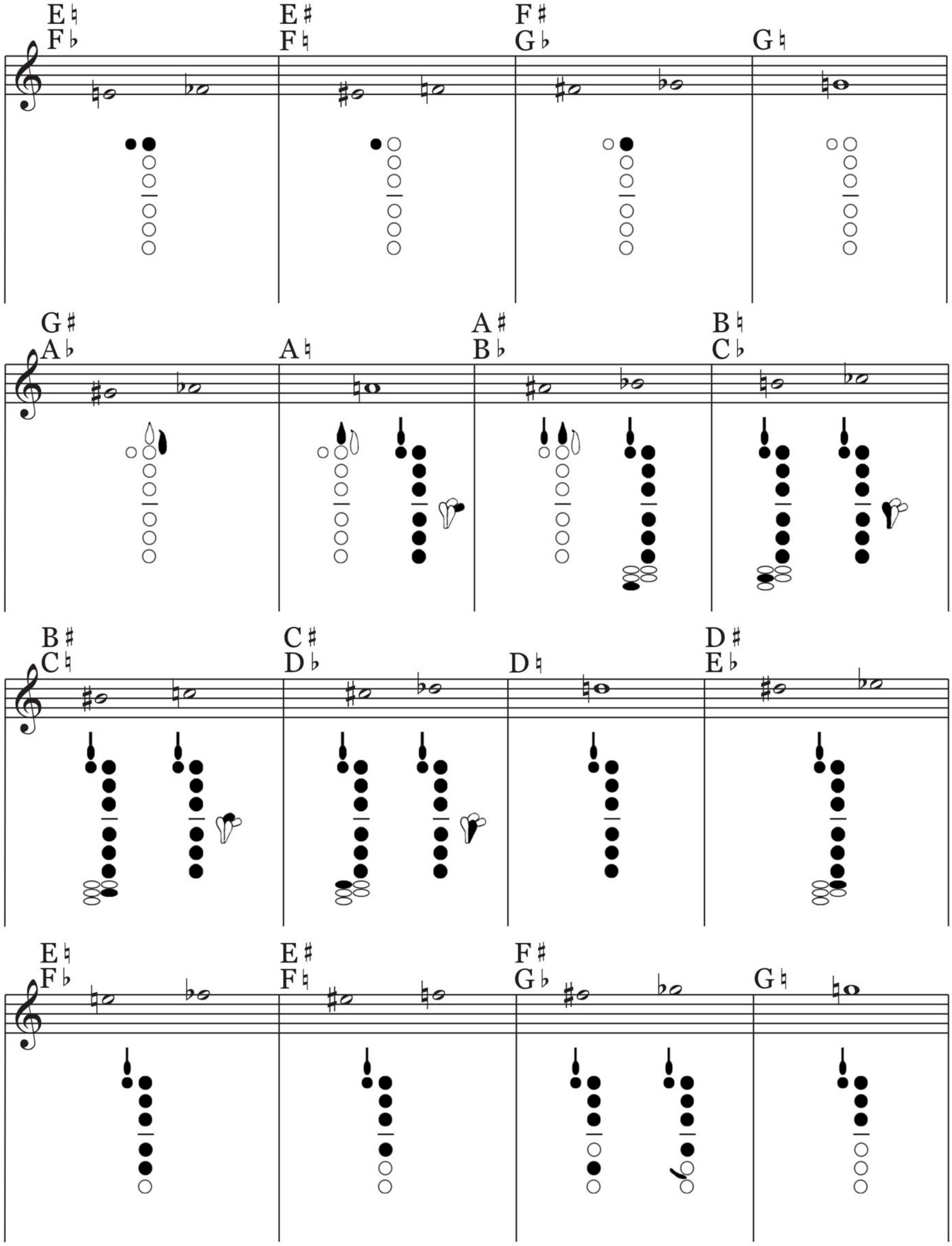
Leblanc

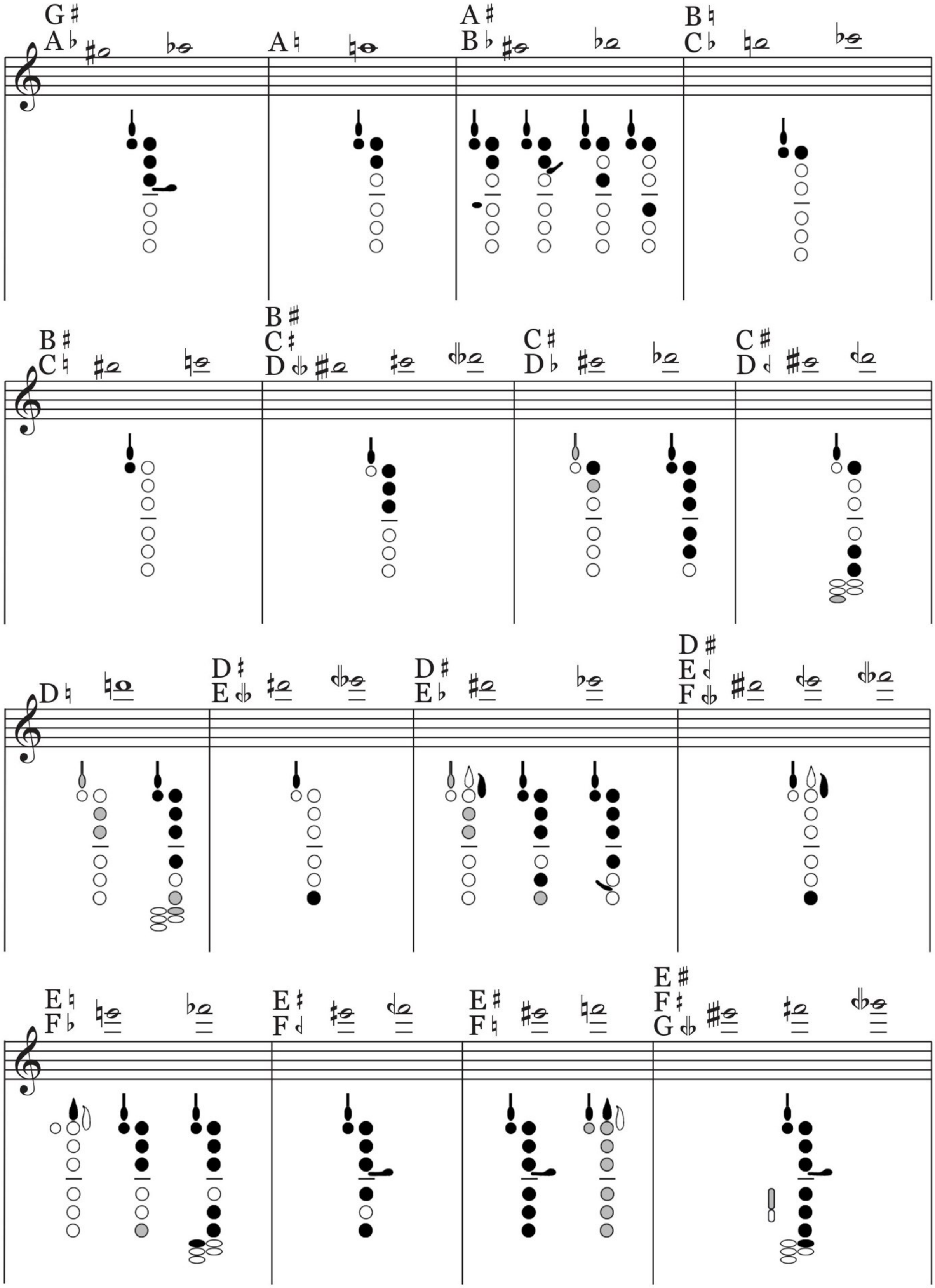
Quarter-tone Altissimo

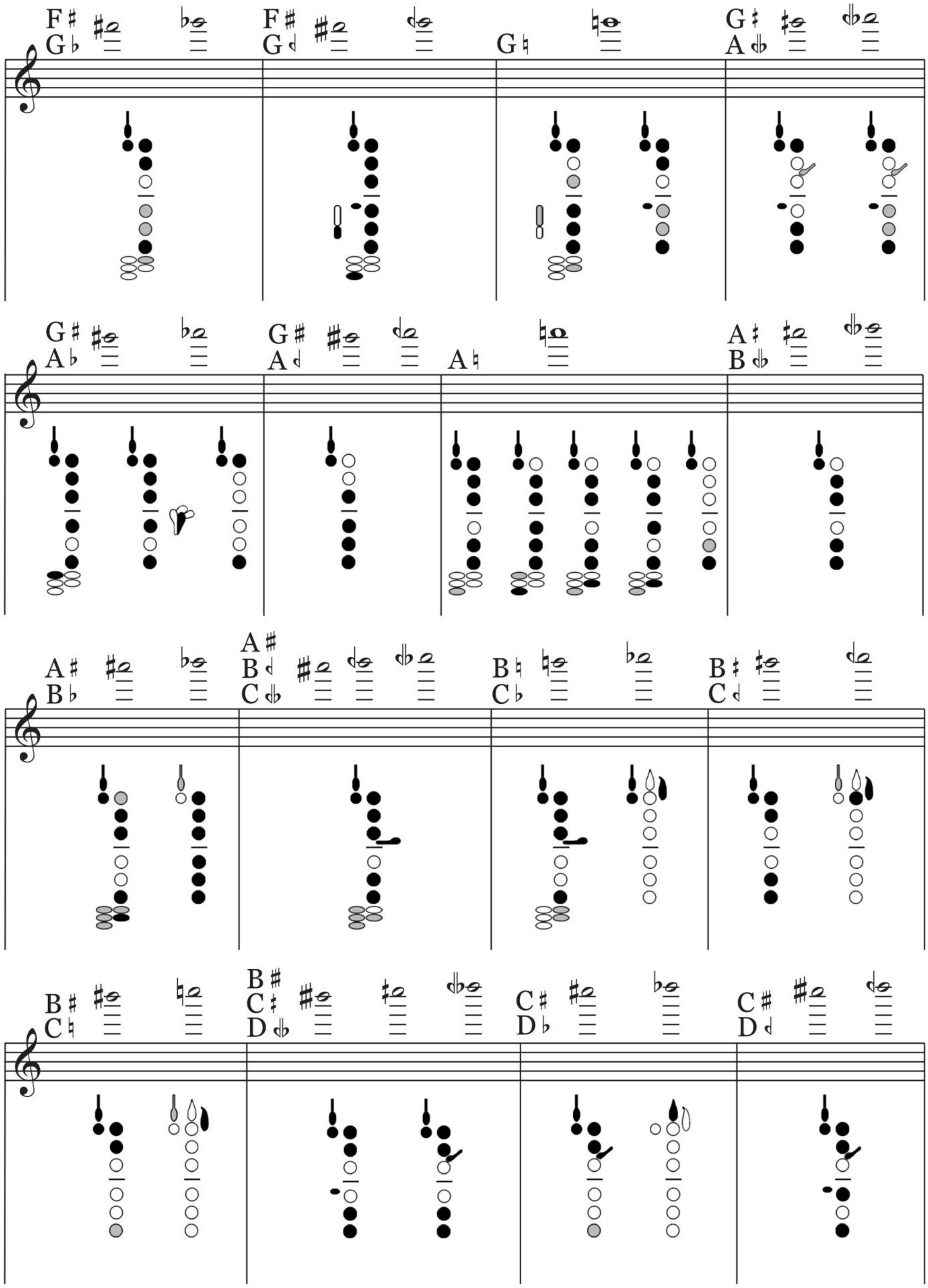
Fingering Charts

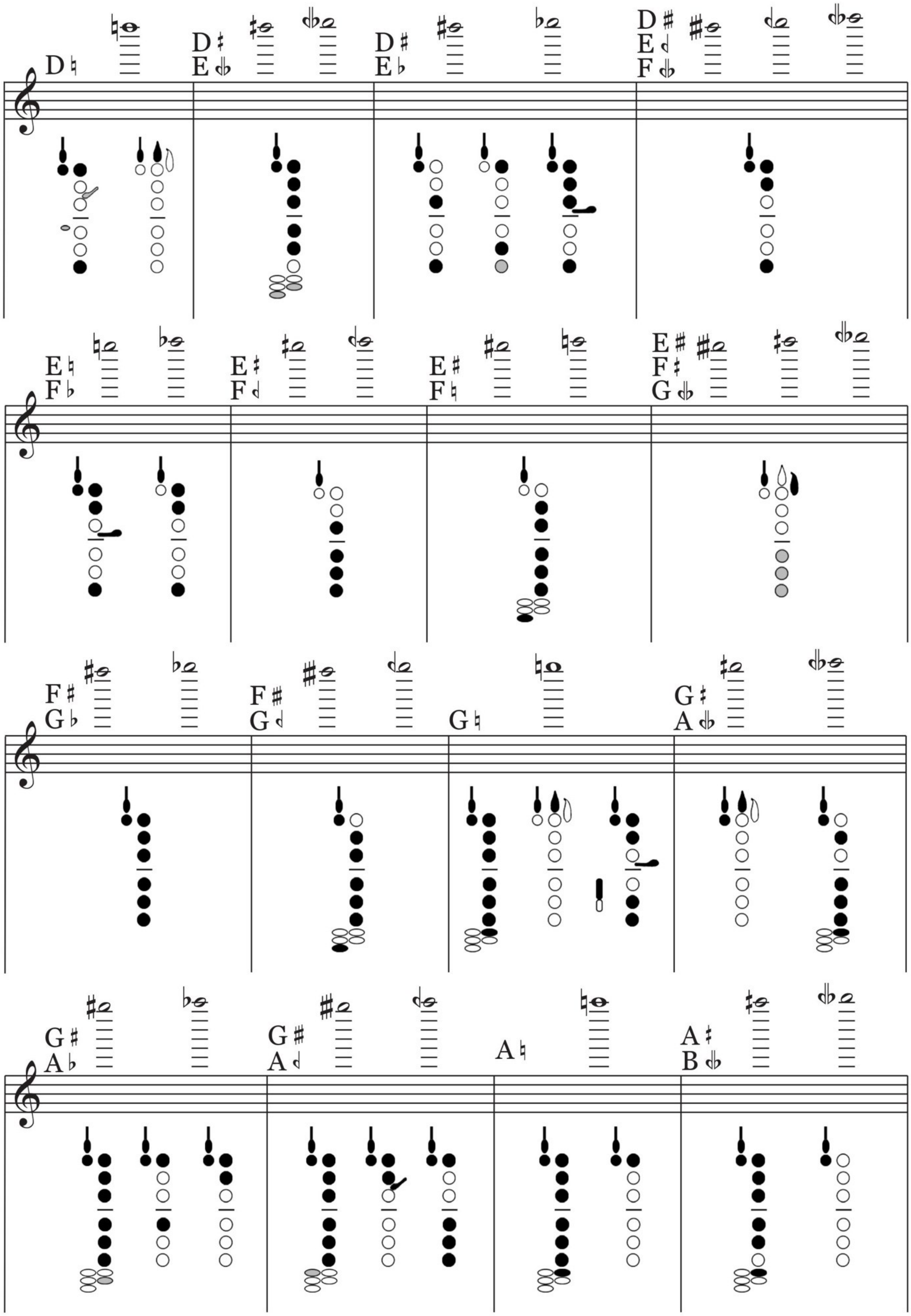
Leblanc Contrabass Clarinet
Quarter-Tone Altissimo Fingering Chart

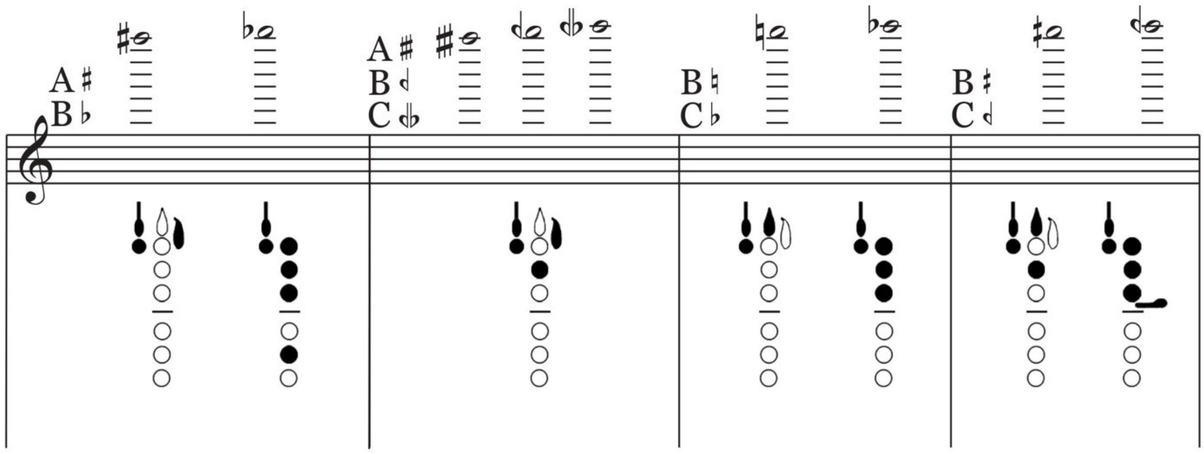


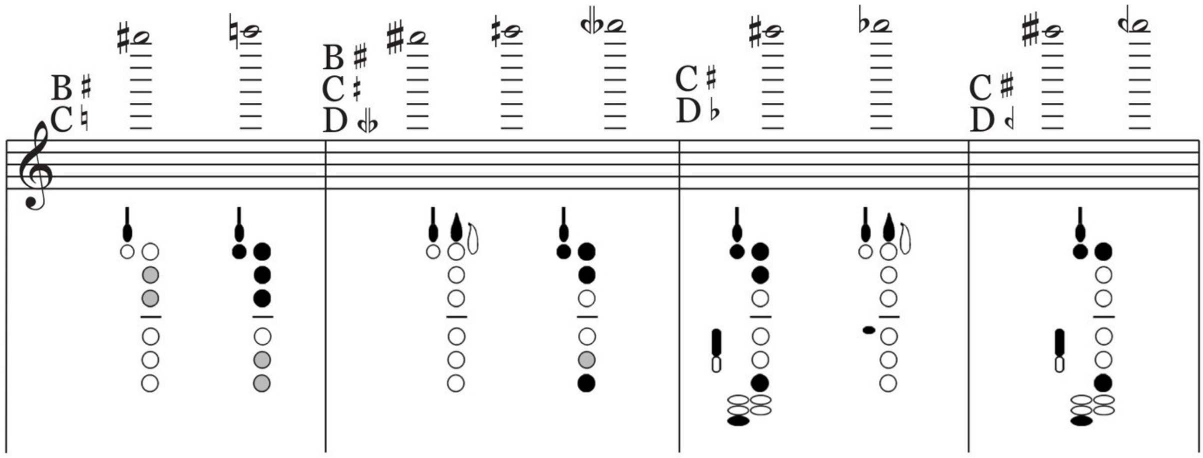

E♮
F♭
E♯
F♮
F♯
G♭
G♮
G♯
A♭
A♮
A♯
B♭
B♮
C♭
B♯
C♮
C♯
D♭
D♮
D♯
E♭
E♮
F♭
E♯
F♮
F♯
G♭
G♮

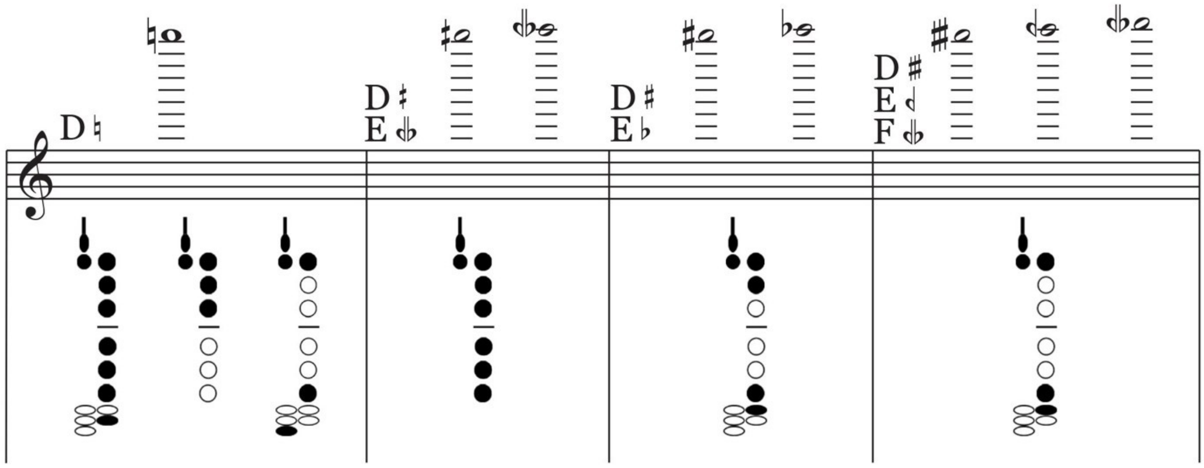

G♯ A♭
A♮
A♯ B♭
B♮ C♭
B♯ C♮
B♯ C𝄲 D𝄫
C♯ D♭
C♯ D𝄳
D♮
D𝄲 E𝄫
D♯ E♭
D♯ E𝄳 F𝄫
E♮ F♭
E𝄲 F𝄳
E♯ F♮
E♯ F𝄲 G𝄫


F♯ G♭
F♯ G𝄳
G♮
G𝄲 A𝄳♭
G♯ A♭
G♯ A𝄳
A♮
A𝄲 B𝄳♭
A♯ B♭
A♯ B𝄳 C𝄳♭
B♮ C♭
B𝄲 C𝄳
B♯ C♮
B♯ C𝄲 D𝄳♭
C♯ D♭
C♯ D𝄳


D♮
D‡ E𝄳♭
D♯ E♭
D♯ E𝄳 F𝄳♭
E♮ F♭
E‡ F𝄳
E♯ F♮
E♯ F‡ G𝄳♭
F♯ G♭
F♯ G𝄳
G♮
G‡ A𝄳♭
G♯ A♭
G♯ A𝄳
A♮
A‡ B𝄳♭


A♯
B♭
A♯
B𝄳
C𝄫
B♮
C♭
B𝄲
C𝄳


B♯
C♮
B♯
C𝄲
D𝄫
C♯
D♭
C♯
D𝄳

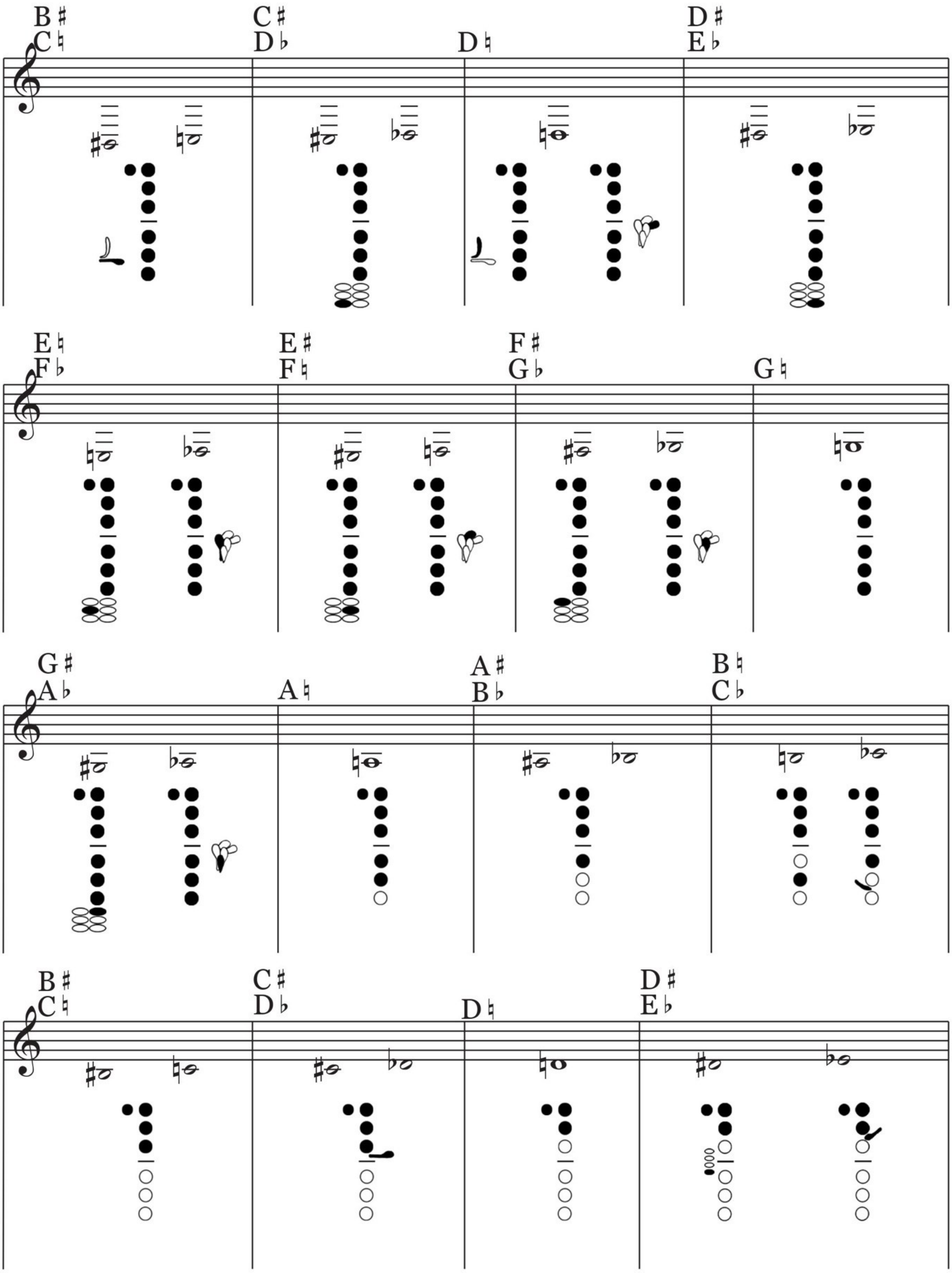

D♮
D𝄲
E𝄫
D♯
E♭
D♯
E𝄳
F𝄫

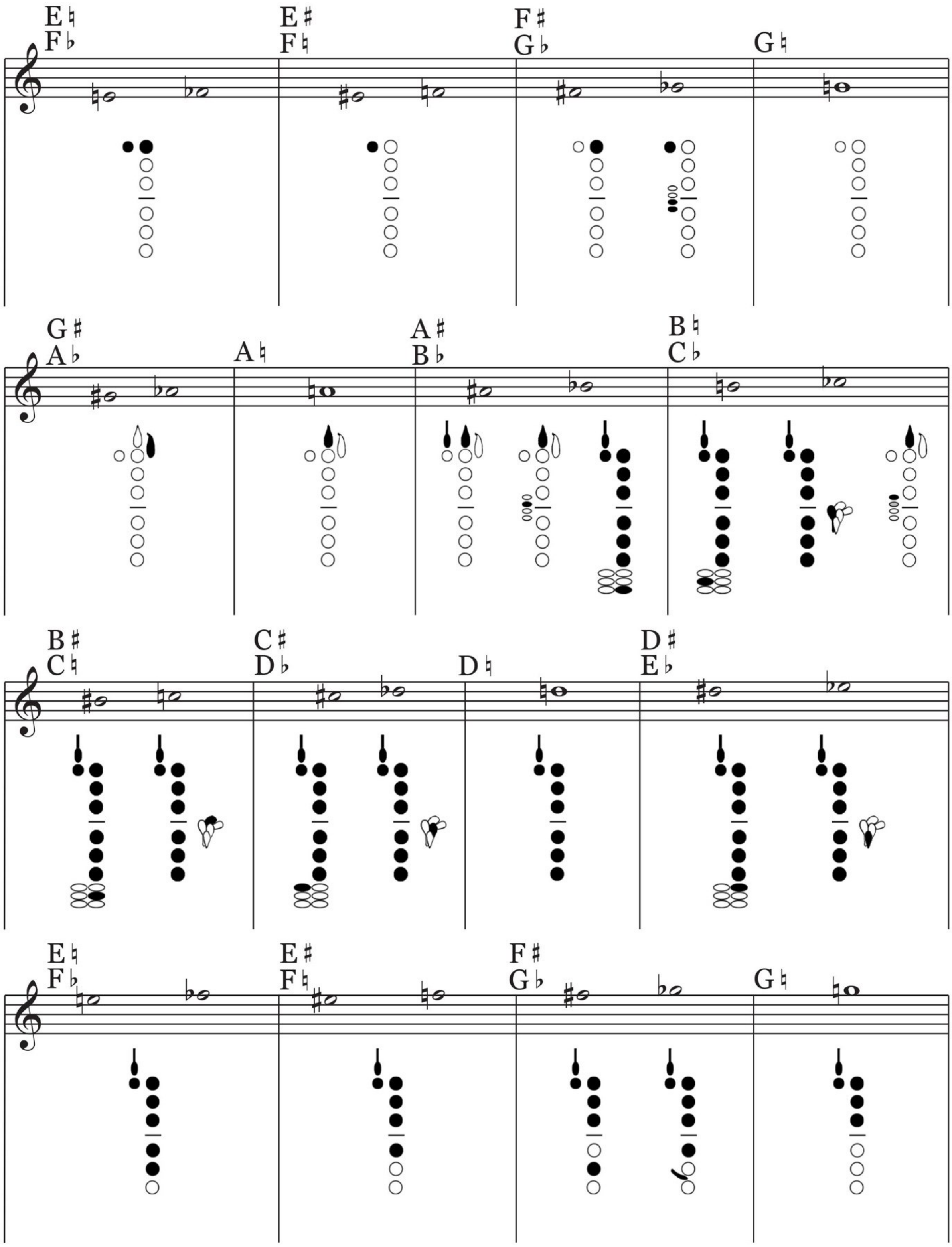
Selmer

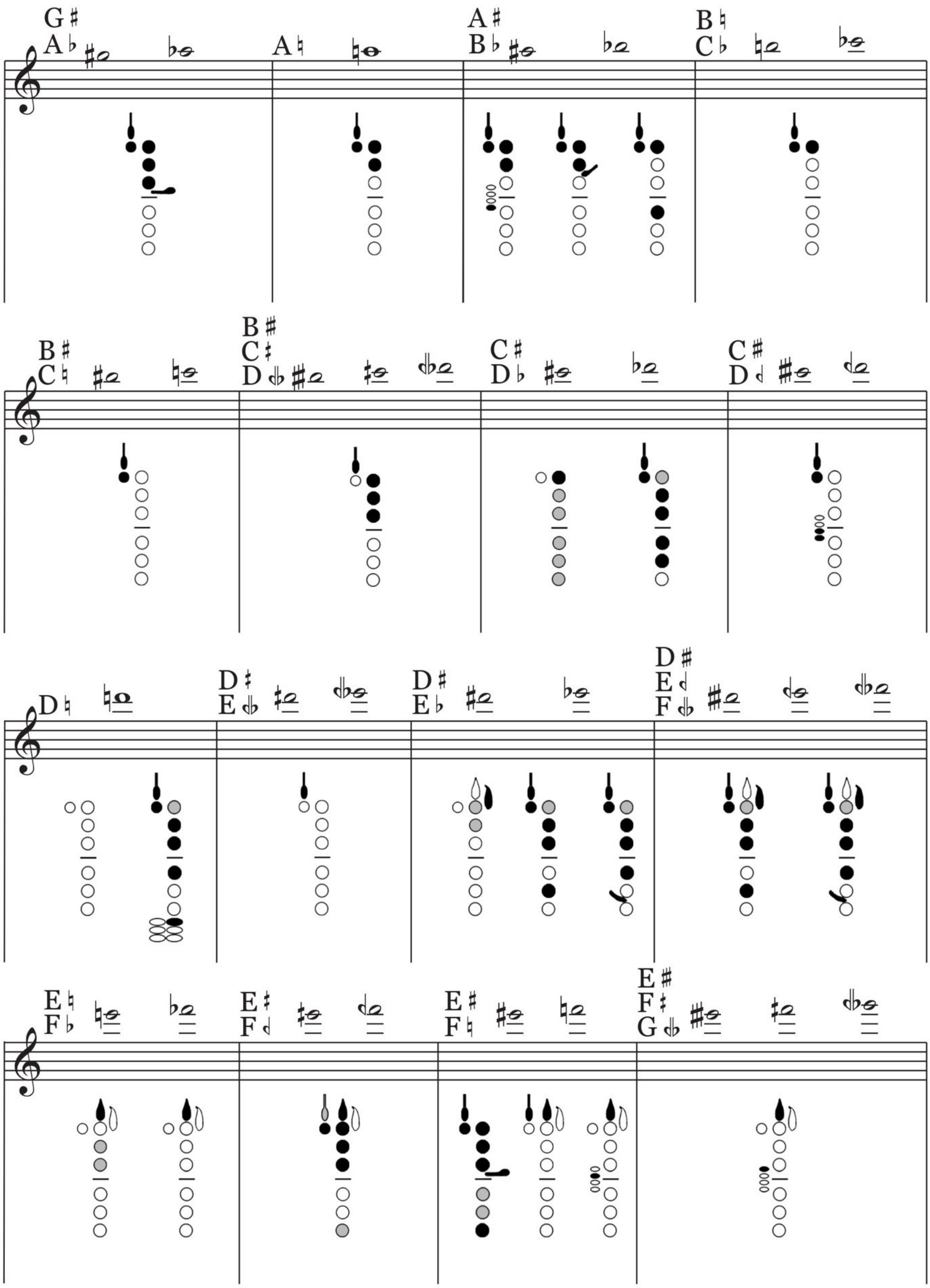
Quarter-tone Altissimo

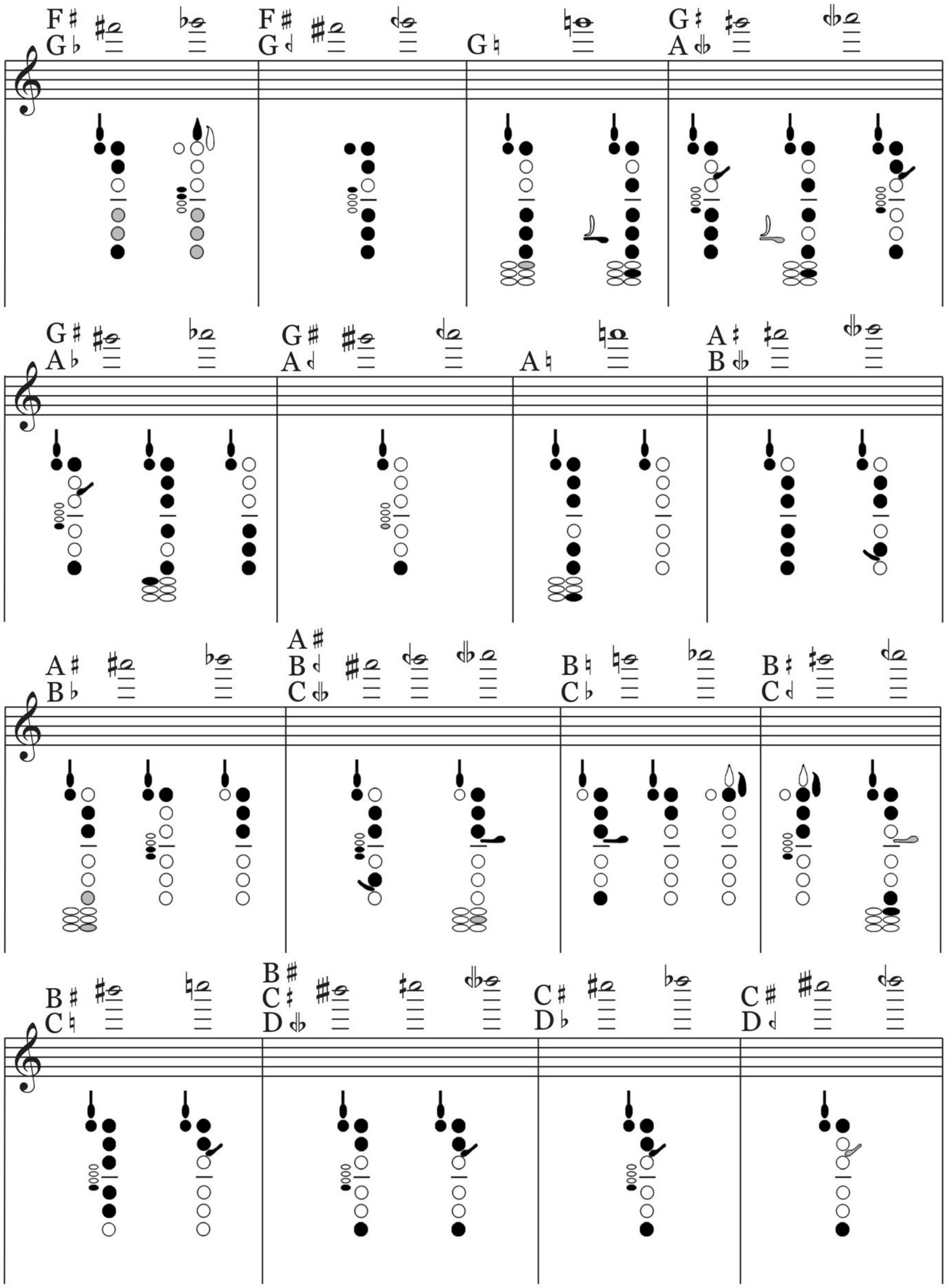
Fingering Charts

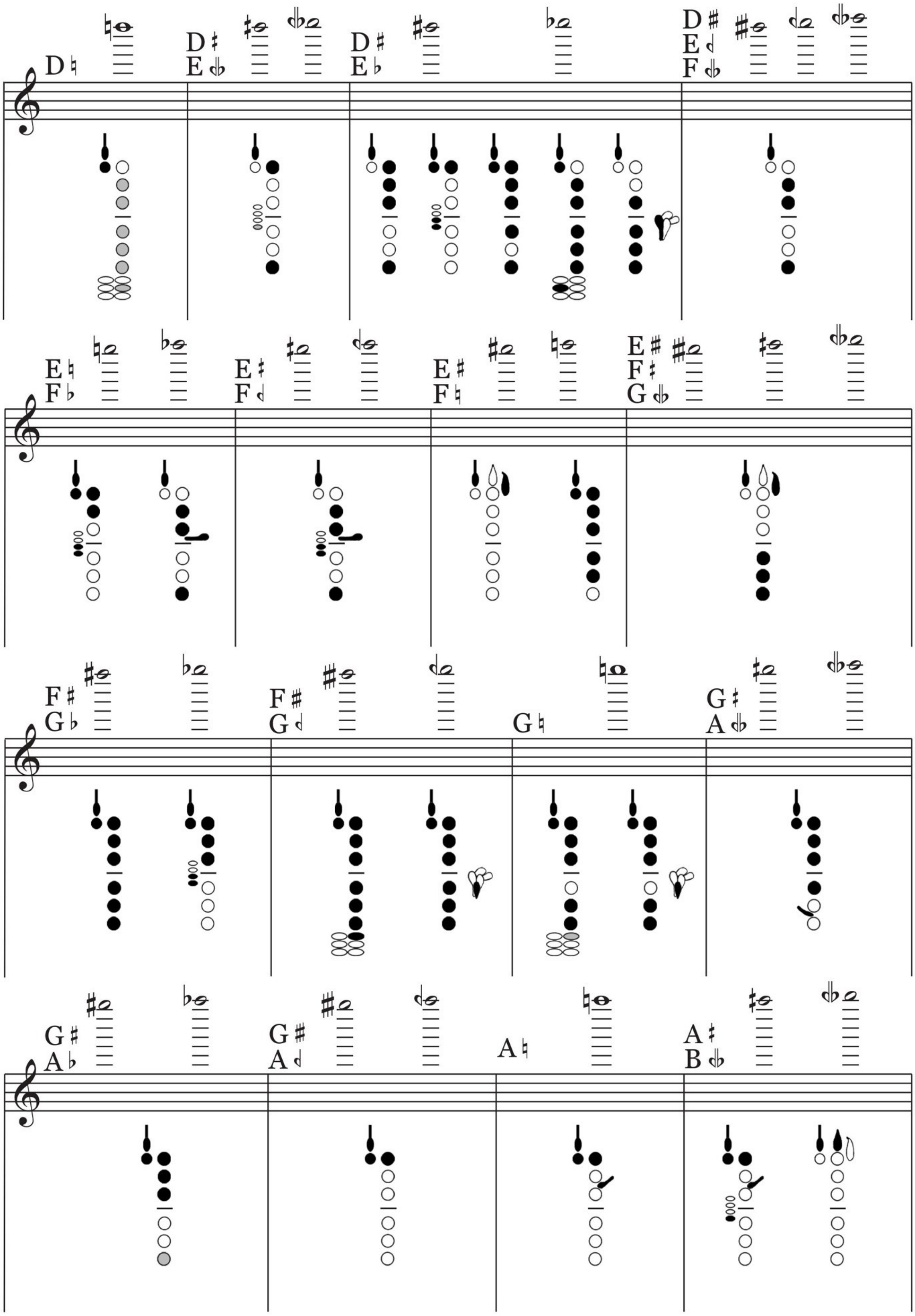
Selmer Contrabass Clarinet
Quarter-Tone Altissimo Fingering Chart

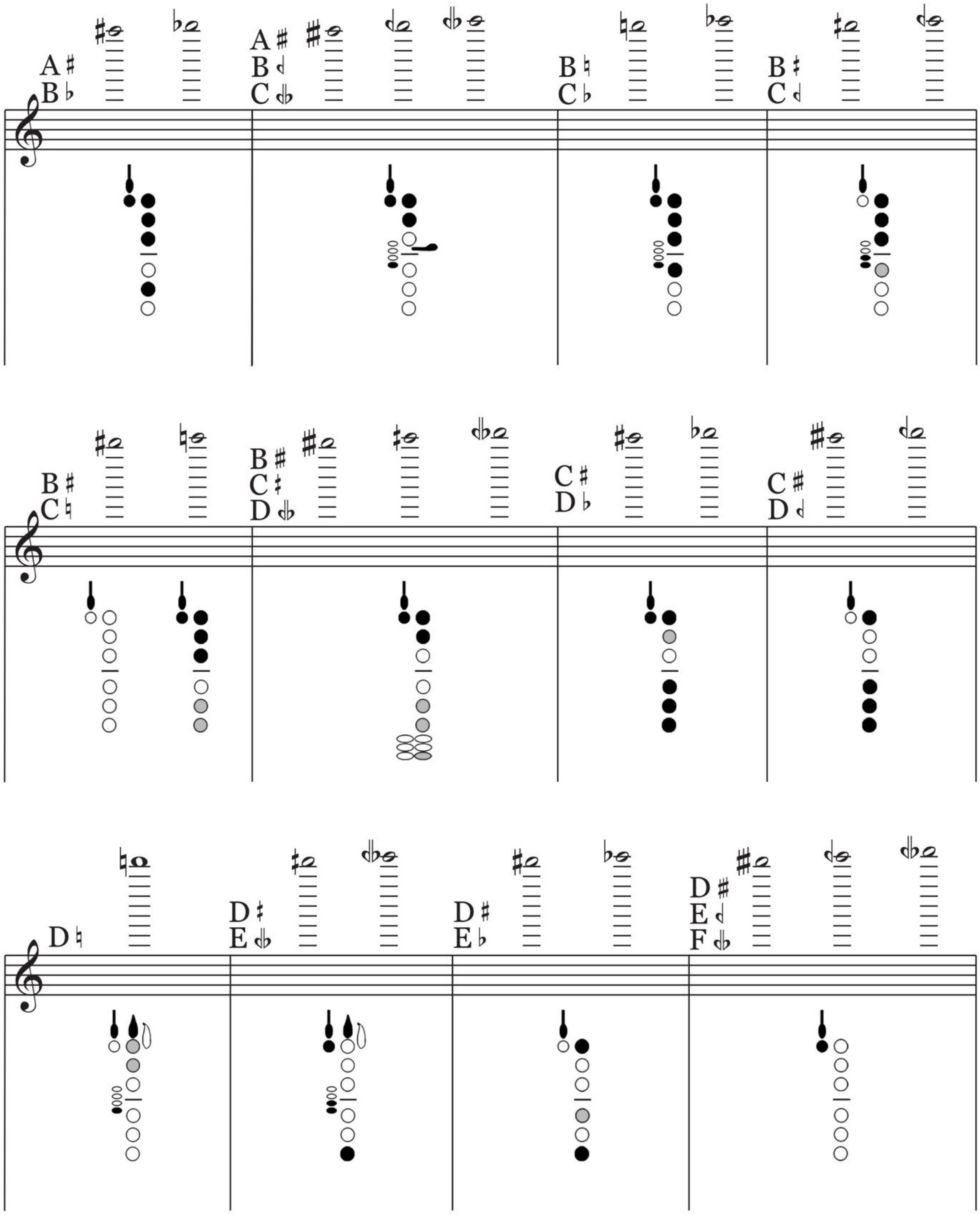


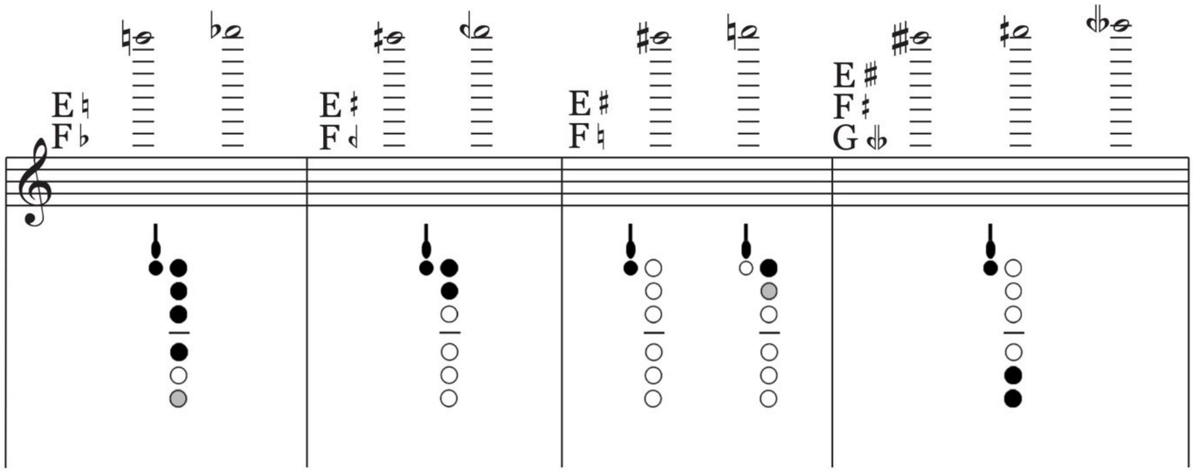

E♮
F♭
E♯
F♮
F♯
G♭
G♮
G♯
A♭
A♮
A♯
B♭
B♮
C♭
B♯
C♮
C♯
D♭
D♮
D♯
E♭
E♮
F♭
E♯
F♮
F♯
G♭
G♮

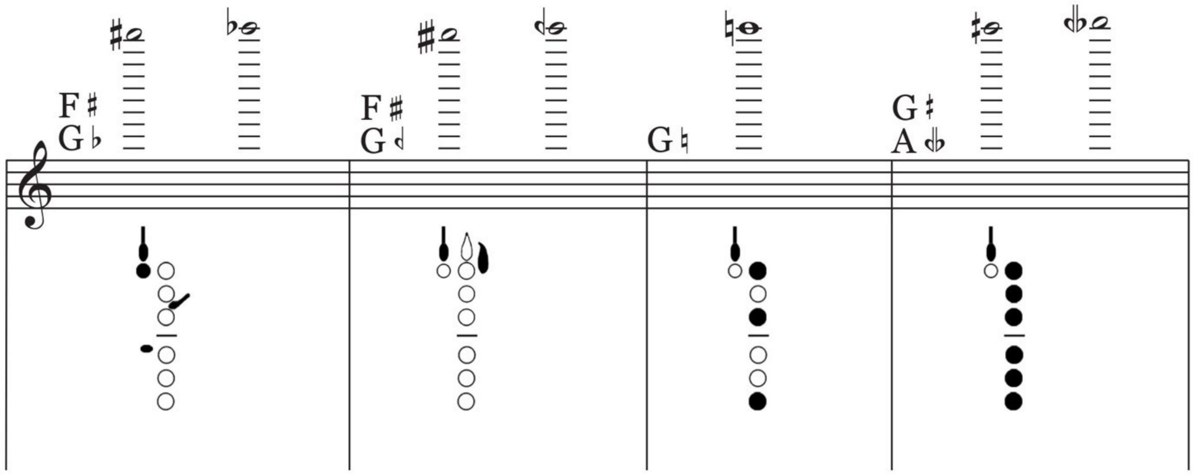

G♯
A♭
A♮
A♯
B♭
B♮
C♭
B♯
C♮
B♯
C♯
D𝄳
C♯
D♭
C♯
D𝄳
D♮
D♯
E𝄳
D♯
E♭
D♯
E𝄳
F𝄳
E♮
F♭
E♯
F𝄳
E♯
F♮
E♯
F♯
G𝄳

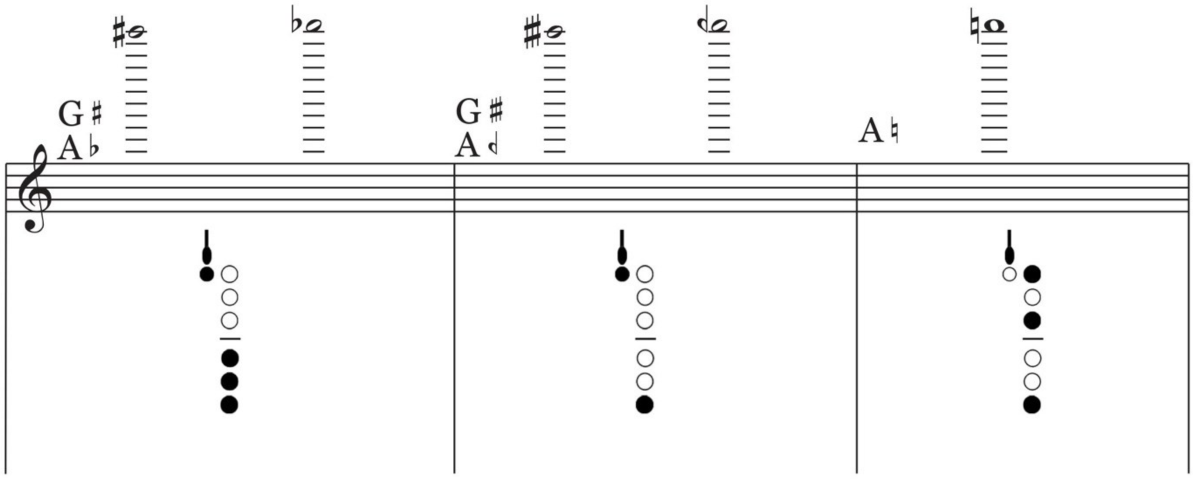

F♯ G♭
F♯ G𝄳
G♮
G𝄲 A𝄳♭
G♯ A♭
G♯ A𝄳
A♮
A𝄲 B𝄳♭
A♯ B♭
A♯ B𝄳 C𝄳♭
B♮ C♭
B𝄲 C𝄳
B♯ C♮
B♯ C𝄲 D𝄳♭
C♯ D♭
C♯ D𝄳




A♯ B♭
A♯ B𝄳 C𝄫
B♮ C♭
B𝄲 C𝄳
B♯ C♮
B♯ C𝄲 D𝄫
C♯ D♭
C♯ D𝄳
D♮
D𝄲 E𝄫
D♯ E♭
D♯ E𝄳 F𝄫


E♮
F♭
E𝄲
F𝄳
E♯
F♮
E♯
F𝄲
G𝄫


F♯
G♭
F♯
G𝄳
G♮
G𝄲
A𝄫

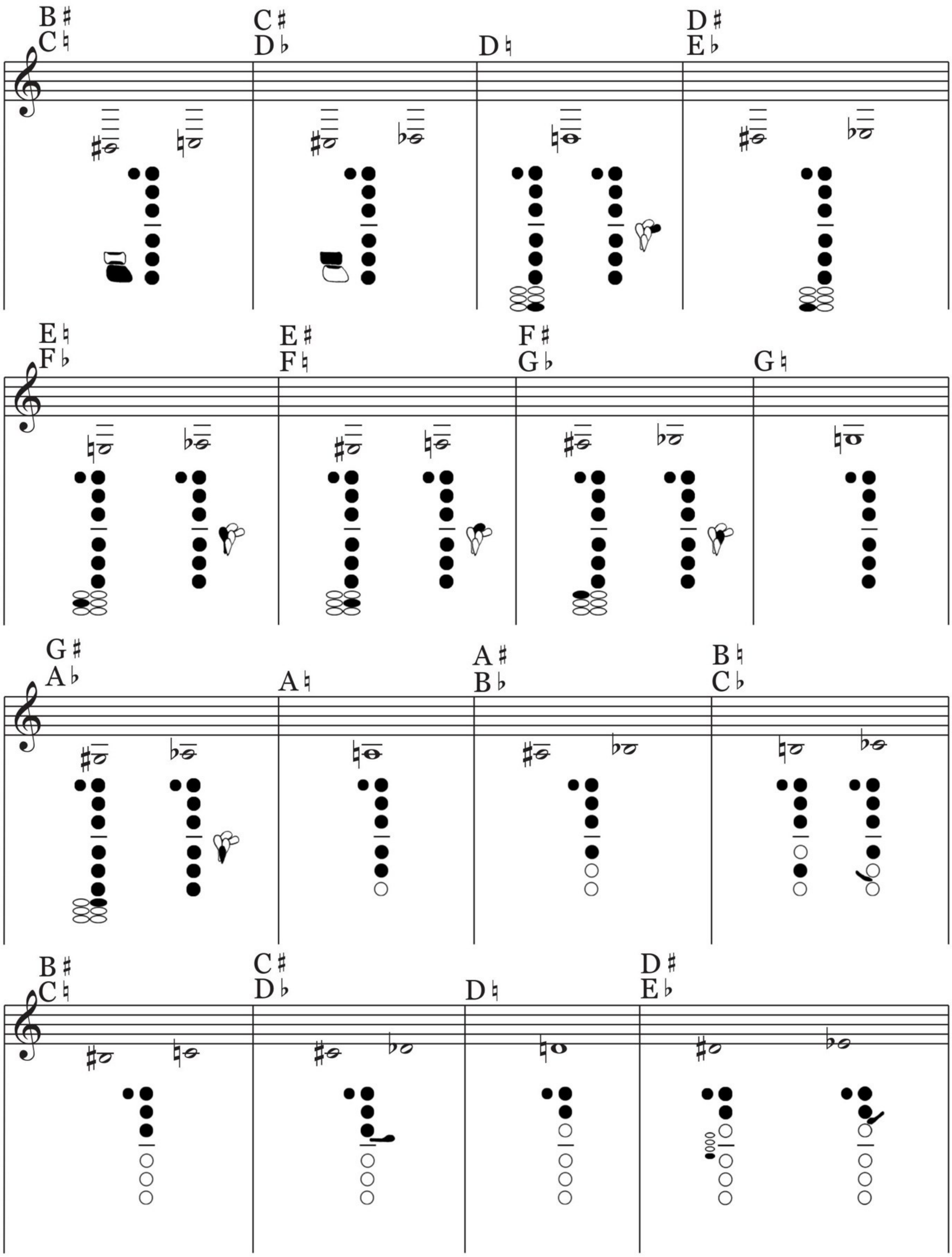

G♯
A♭
G♯
A𝄳
A♮

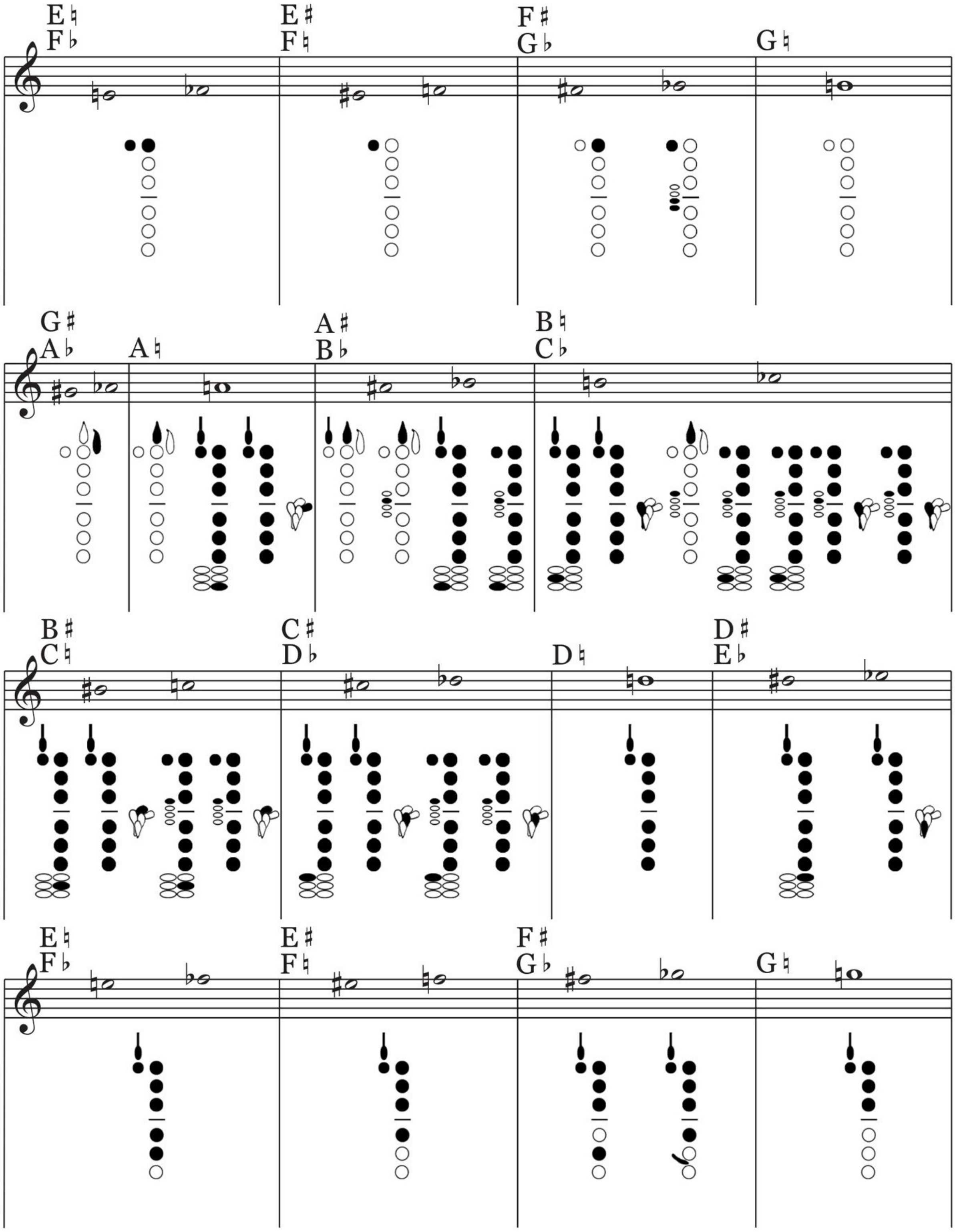
Eppelsheim

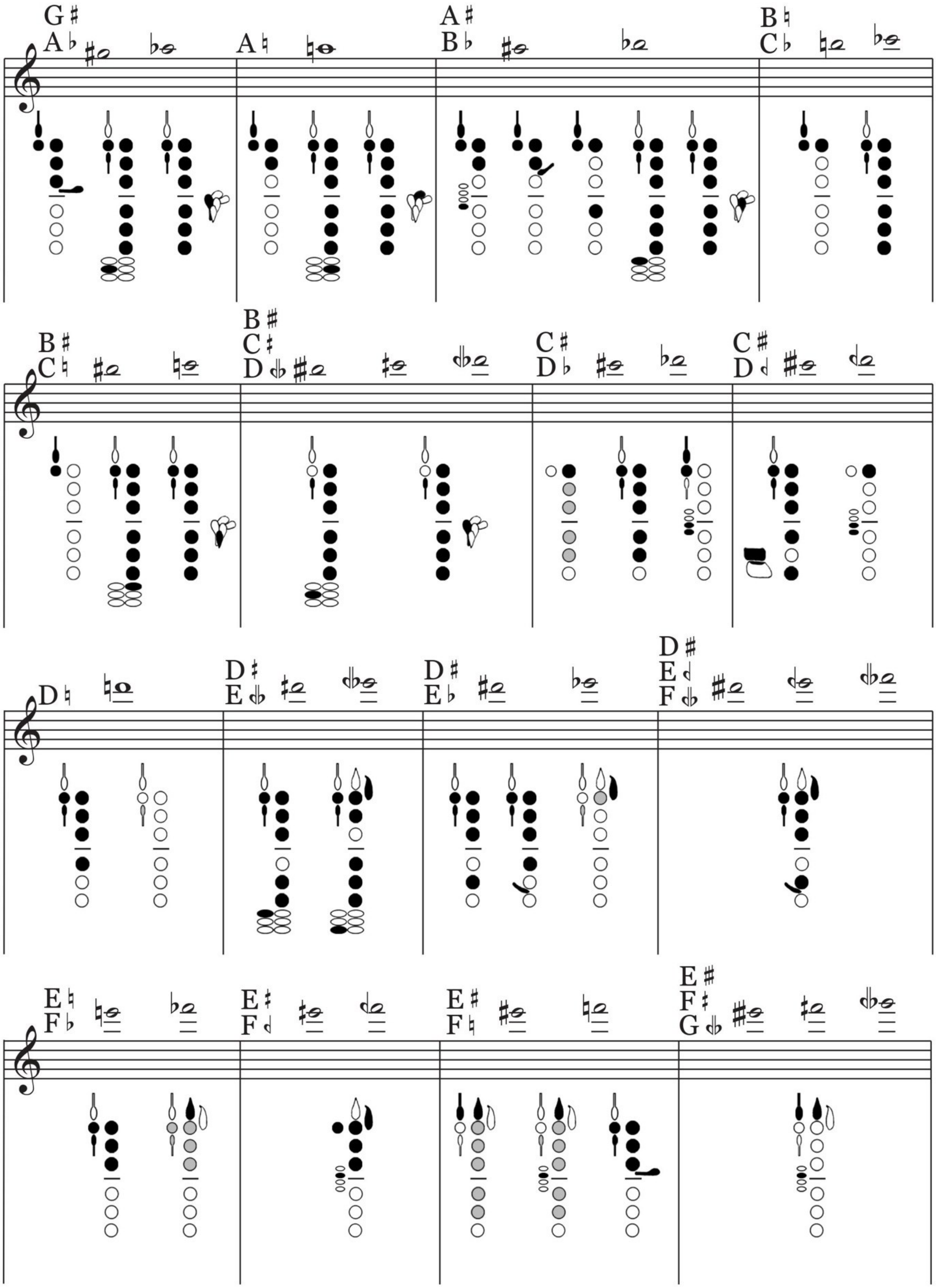
Quarter-tone Altissimo

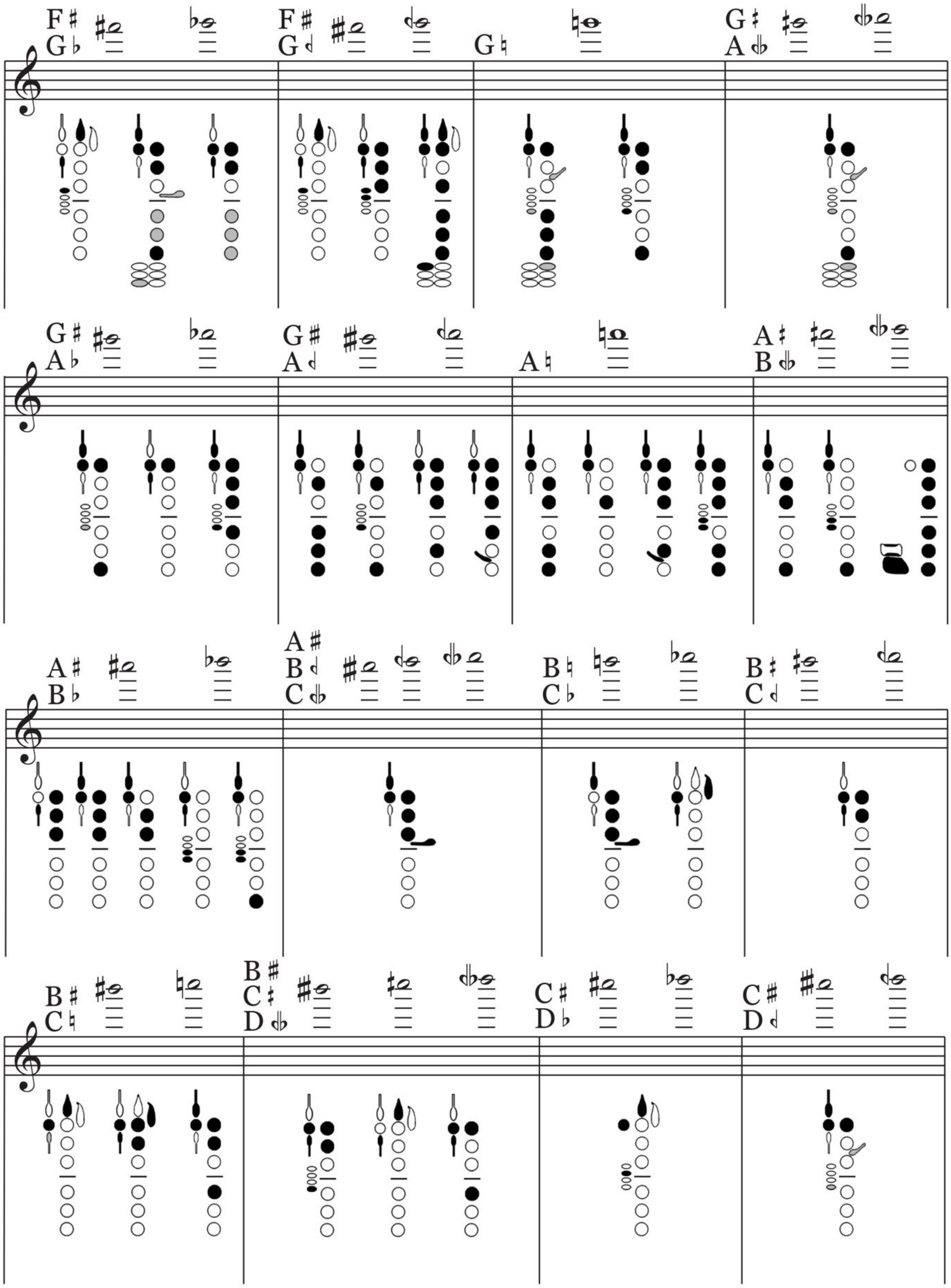
Fingering Charts

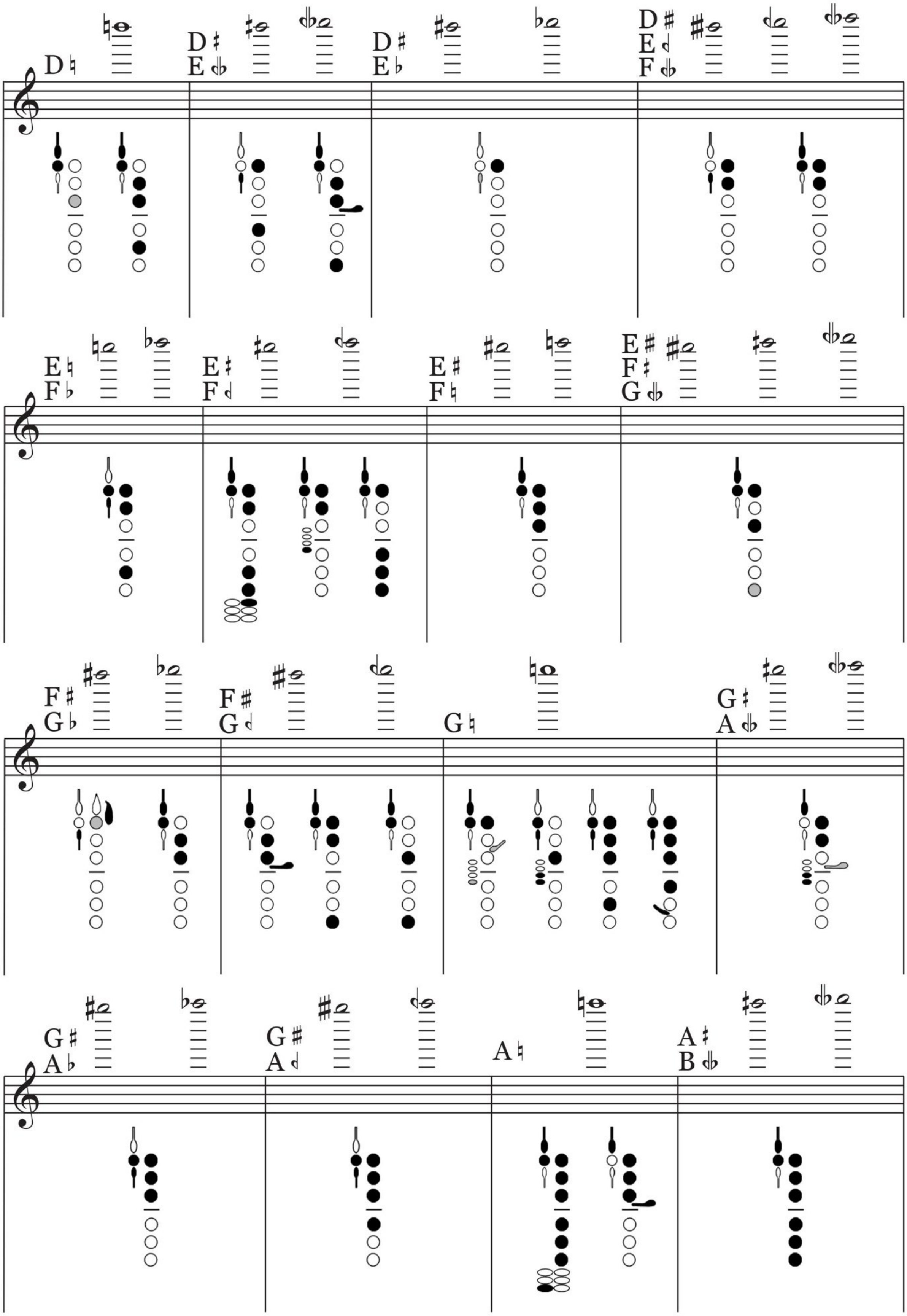
Eppelsheim Contrabass Clarinet Quarter-Tone Altissimo Fingering Chart

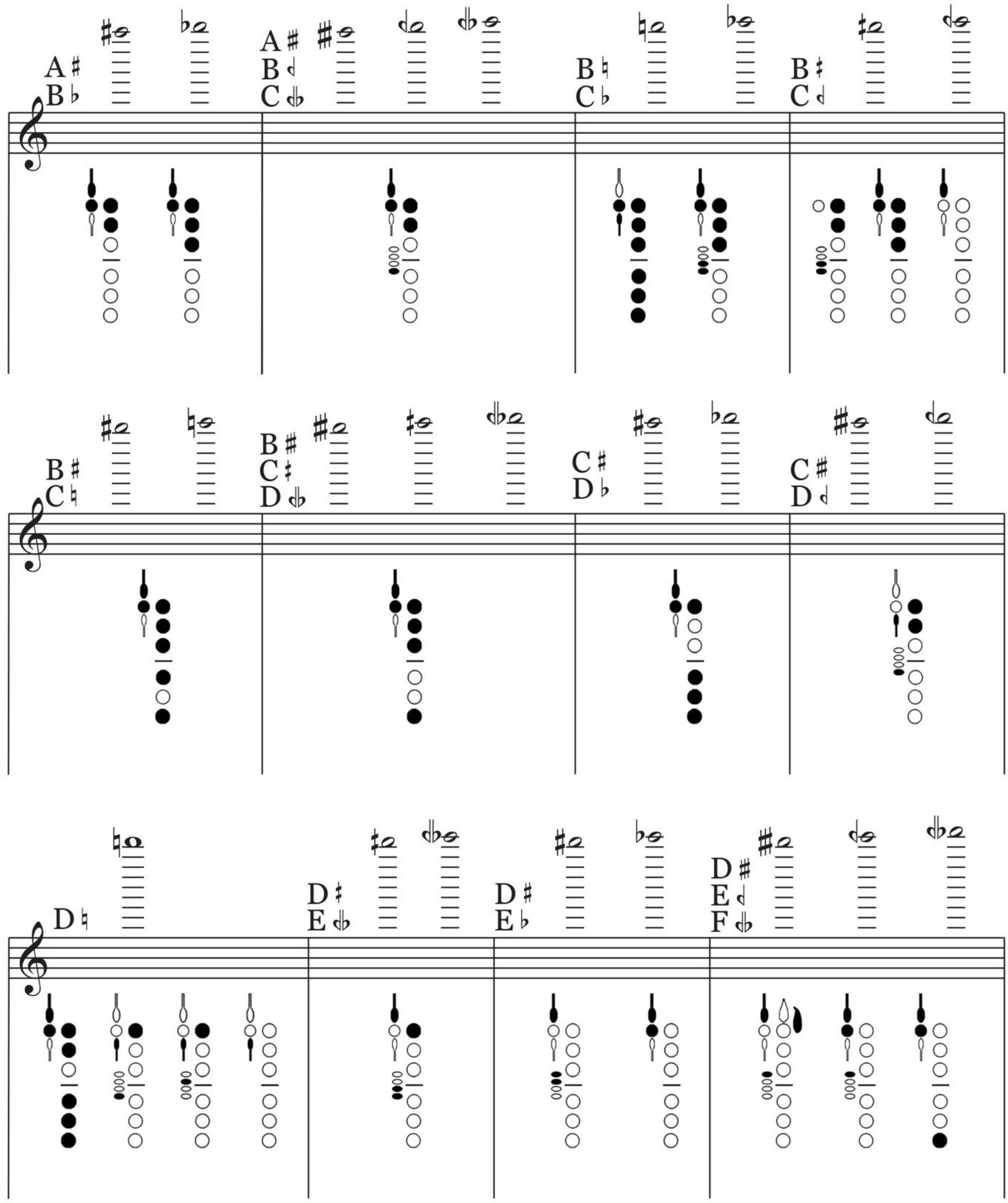


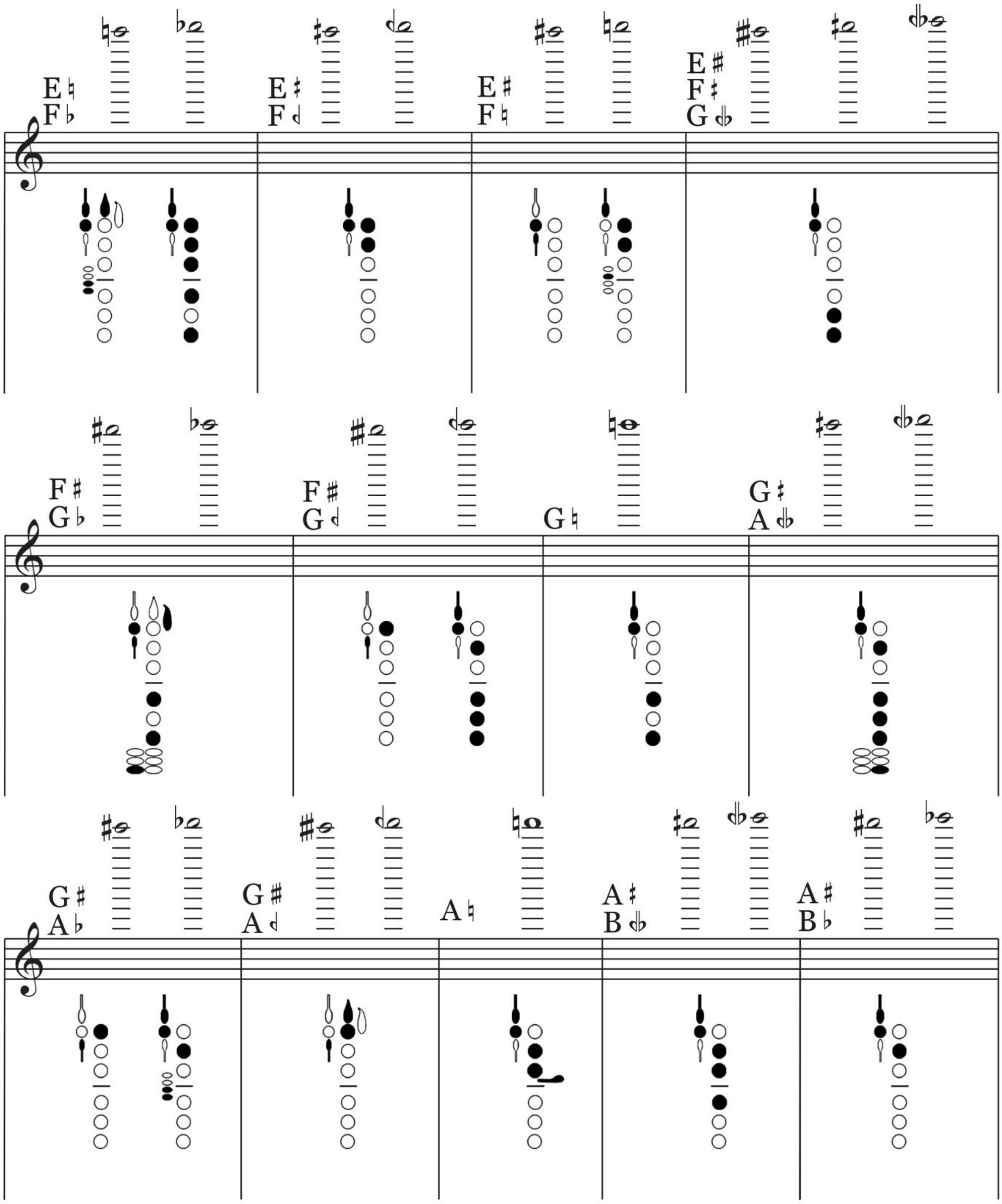

E♮
F♭
E♯
F♮
F♯
G♭
G♮
G♯
A♭
A♮
A♯
B♭
B♮
C♭
B♯
C♮
C♯
D♭
D♮
D♯
E♭
E♮
F♭
E♯
F♮
F♯
G♭
G♮


G♯ A♭
A♮
A♯ B♭
B♮ C♭
B♯ C♮
B♯ C𝄲 D𝄫
C♯ D♭
C♯ D𝄳
D♮
D𝄲 E𝄫
D♯ E♭
D♯ E𝄳 F𝄫
E♮ F♭
E𝄲 F𝄳
E♯ F♮
E♯ F𝄲 G𝄫


F♯ G♭
F♯ G𝄳
G♮
G𝄲 A𝄳♭
G♯ A♭
G♯ A𝄳
A♮
A𝄲 B𝄳♭
A♯ B♭
A♯ B𝄳 C𝄳♭
B♮ C♭
B𝄲 C𝄳
B♯ C♮
B♯ C𝄲 D𝄳♭
C♯ D♭
C♯ D𝄳




A♯ B♭
A♯ B𝄳 C𝄫
B♮ C♭
B𝄲 C𝄳
B♯ C♮
B♯ C𝄲 D𝄫
C♯ D♭
C♯ D𝄳
D♮
D𝄲 E𝄫
D♯ E♭
D♯ E𝄳 F𝄫


E ♮
F ♭
E 𝄲
F 𝄳
E ♯
F ♮
E ♯
F 𝄲
G 𝄭
F ♯
G ♭
F ♯
G 𝄳
G ♮
G 𝄲
A 𝄭
G ♯
A ♭
G ♯
A 𝄳
A ♮
A 𝄲
B 𝄭
A ♯
B ♭

Appendix

Multiphonics Fingering Charts

Audio Examples: 0001-0829

Each bar represents a single sound, often in two clusters due to range.

Many fingerings have multiple sets of overtones that can be achieved. Each fingering is designated by number, and the different sets of overtones by letter.

Each set of overtones has descriptors regarding its response.

- *Stability*: (scale of 1 to 3)
    - 1 (Fragile) multiphonics can easily break apart into constituent notes or squeaks. They require more precision and control from the player to maintain.
    - 2 (Somewhat stable)- multiphonics are more stable, but can break if not careful.
    - 3 (Very stable)- multiphonics are reliable, speak easily, and are easily controlled.
- *Attack dynamic*: the dynamic range in which the multiphonic can start.
- *Attack immediacy*: (scale of 1 to 3)
    - 1 (Slow) attacks require more time to develop into the multiphonic. These should be written as longer notes.
    - 2 (Medium) attacks respond more quickly, but not immediately.
    - 3 (Fast) attacks respond immediately. These can be used in shorter and more rhythmic passages.
- *Crescendo range*: the dynamic range the multiphonic can crescendo and decrescendo within.
- *OTs inc with dyn*: (Overtones increase with dynamics): Yes or No. Indicates whether more upper harmonics are added to the texture as the dynamic level increases. More upper harmonics contribute to a brighter, harsher sound at louder volumes.
- *Emerge from bottom note*: Yes, No, or a dynamic range. Indicates whether the fundamental pitch can be played as a single note and the multiphonic evolve

up from it. *Yes* means it is possible from all dynamics, whereas a dynamic range means the fundamental is limited to being played within this range.

- *Emerge from top note*: Yes or No. Indicates whether the top pitch of the multiphonic can be played as a single note and the multiphonic evolve down from it.
- *Comments*: Other particular notes about the multiphonic. One used several times is "Internal Oscillating", and notated with indicating strong frequency beatings.

Two files for each multiphonic can be found in the Audio Examples folder, the recording used for spectral analysis (Multiphonic) and a recording demonstrating each descriptor (Multiphonic Examples). Each recording is labelled with a number and letter corresponding to the fingerings and set of overtones found on the charts.

Leblanc

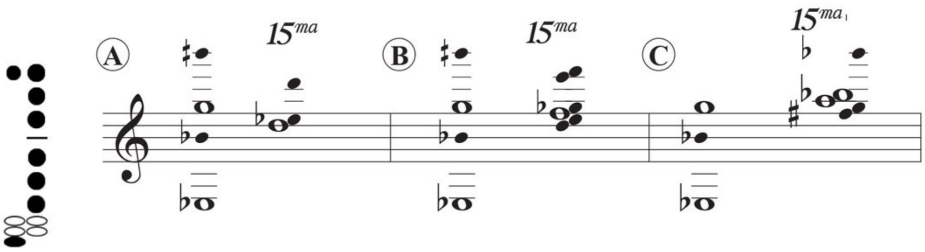
Multiphonics

Fingering Charts

Audio Examples 0001-0216

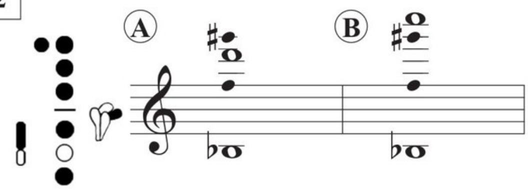
Leblanc Contrabass Clarinet Multiphonics

1



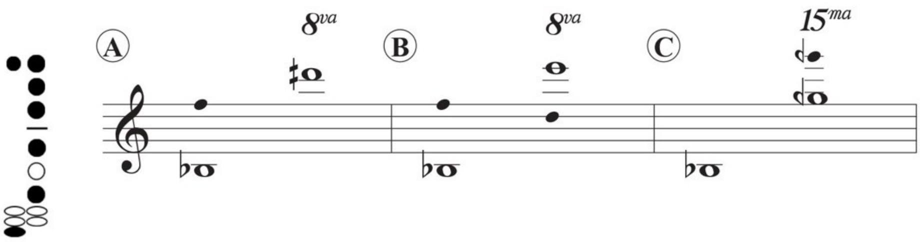
	A	B	C
Stability	3	3	3
Attack dynamic	***pp–ff***	***pp–ff***	***pp–ff***
Attack immediacy	3	3	3
Crescendo range	***pp–ff***	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

2



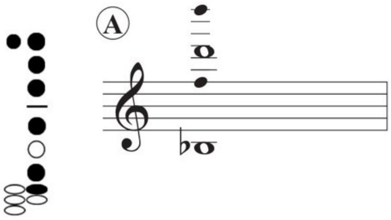
	A	B
Stability	3	3
Attack dynamic	***pp–f***	***pp–f***
Attack immediacy	3	3
Crescendo range	***pp–f***	***pp–f***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

3



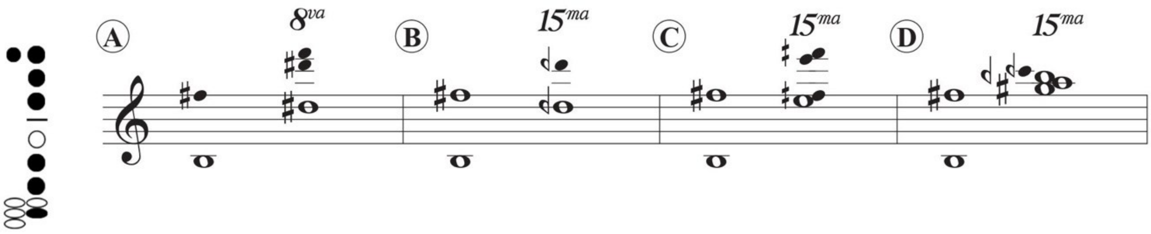
	A	B	C
Stability	2	3	3
Attack dynamic	***pp–mf***	***pp–f***	***pp–ff***
Attack immediacy	1	3	3
Crescendo range	***pp–mf***	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

4



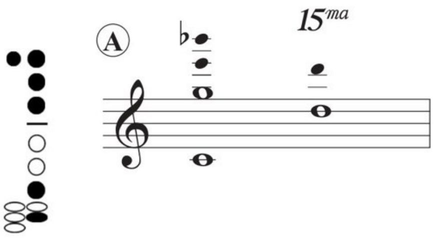
	A
Stability	2
Attack dynamic	***pp*–*p***
Attack immediacy	3
Crescendo range	***pp*–*p***
OTs inc.with dyn.	no
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

5



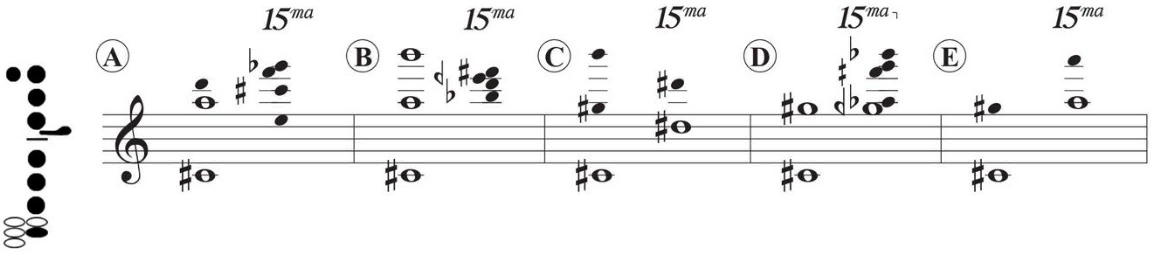
	A	B	C	D
Stability	3	3	3	2
Attack dynamic	***pp*–*f***	***pp*–*ff***	***pp*–*ff***	***pp*–*ff***
Attack immediacy	3	3	3	2
Crescendo range	***pp*–*ff***	***pp*–*ff***	***pp*–*ff***	***pp*–*ff***
OTs inc.with dyn.	yes	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes
Comments	F♯6 emerges more with louder dynamics			

6



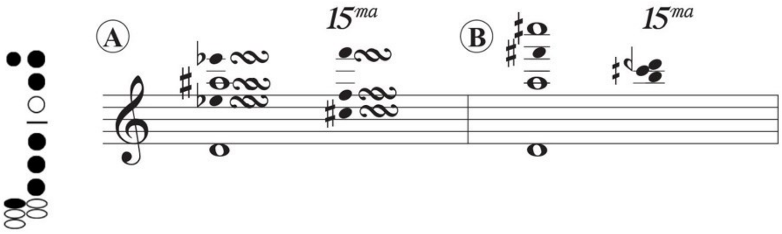
	A
Stability	3
Attack dynamic	***pp*–*ff***
Attack immediacy	2
Crescendo range	***pp*–*ff***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

7



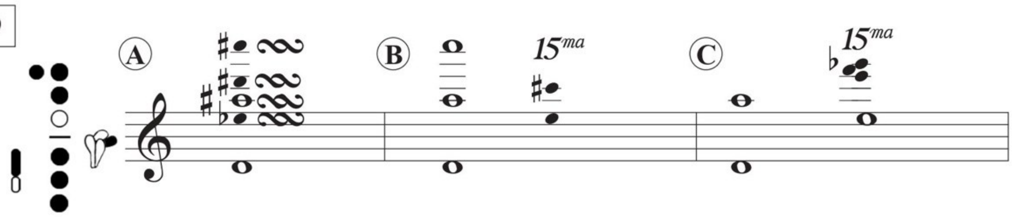
	A	B	C	D	E
Stability	2	3	3	3	2
Attack dynamic	*pp–mf*	*pp–ff*	*pp–ff*	*pp–ff*	*pp–ff*
Attack immediacy	2	3	3	3	3
Crescendo range	*pp–mf*	*pp–ff*	*pp–ff*	*pp–ff*	*pp–ff*
OTs inc.with dyn.	yes	yes	yes	yes	yes
Emerge from bottom note	no	no	no	no	no
Emerge from top note	yes	yes	yes	yes	yes
Comments	increased air pressure causes more beatings	increased air pressure causes more beatings			

8



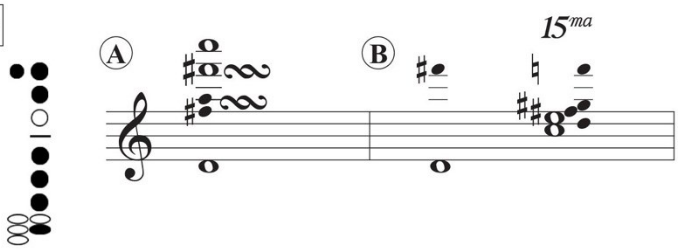
	A	B
Stability	3	3
Attack dynamic	*p–f*	*pp–ff*
Attack immediacy	2	3
Crescendo range	*p–f*	*pp–ff*
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

9



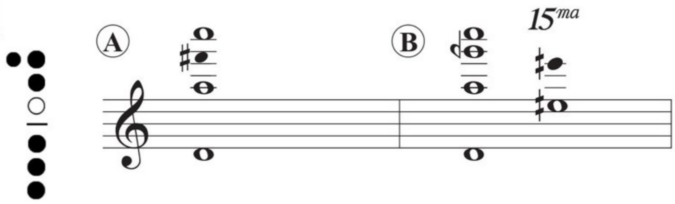
	A	B	C
Stability	2	3	2
Attack dynamic	*mp–f*	*pp–ff*	*pp–ff*
Attack immediacy	2	3	3
Crescendo range	*mp–f*	*pp–ff*	*pp–ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments	Internal oscillating		

10



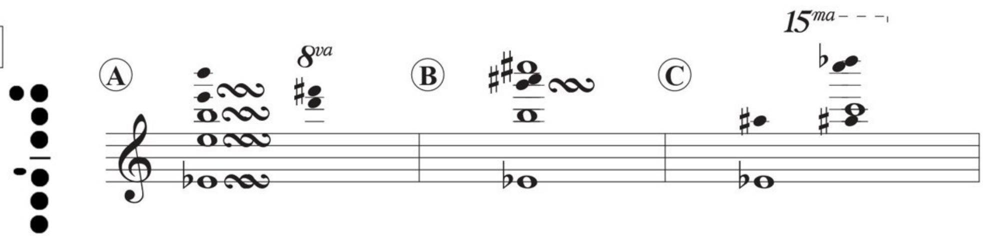
Stability	2	3
Attack dynamic	***pp–ff***	***pp–ff***
Attack immediacy	2	3
Crescendo range	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments	Internal oscillating	

11



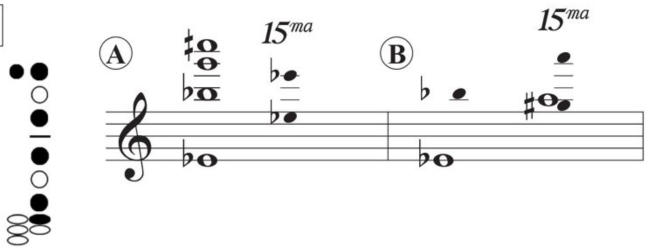
Stability	3	3
Attack dynamic	***pp–ff***	***pp–ff***
Attack immediacy	3	3
Crescendo range	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

12



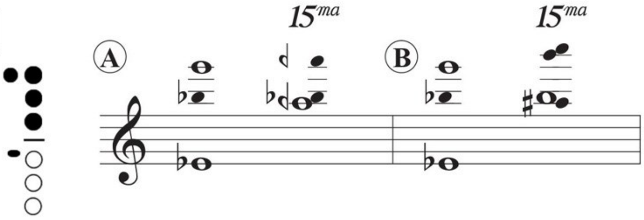
Stability	2	3	2
Attack dynamic	***pp–f***	***pp–ff***	***pp–f***
Attack immediacy	3	3	3
Crescendo range	***pp–f***	***pp–ff***	***pp–f***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments	Internal oscillating	Internal oscillating	

13



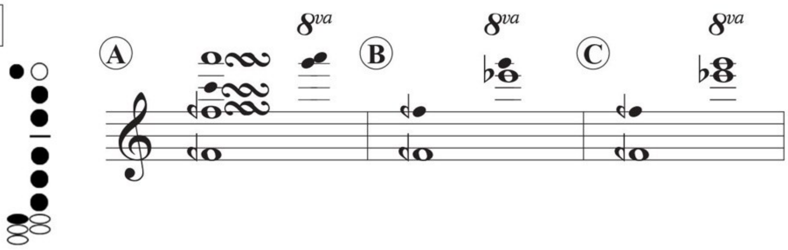
	A	B
Stability	2	2
Attack dynamic	*pp–ff*	*pp–ff*
Attack immediacy	2	2
Crescendo range	*pp–ff*	*pp–ff*
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

14



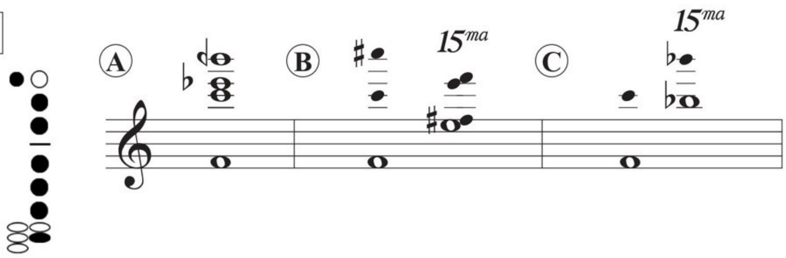
	A	B
Stability	2	2
Attack dynamic	*pp–ff*	*pp–f*
Attack immediacy	2	3
Crescendo range	*pp–ff*	*pp–f*
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

15



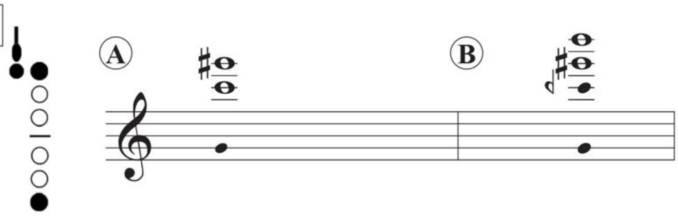
	A	B	C
Stability	2	2	2
Attack dynamic	*pp–mp*	*pp–mf*	*pp–ff*
Attack immediacy	2	2	2
Crescendo range	*pp–mp*	*pp–mf*	*pp–ff*
OTs inc.with dyn.	no	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments	Internal oscillating		

16



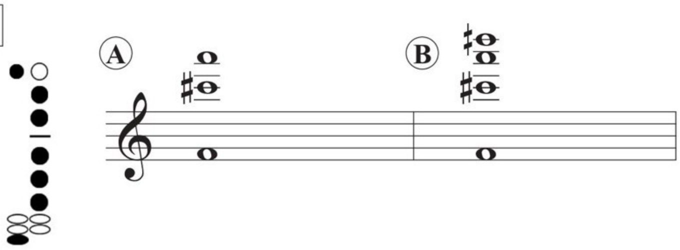
Stability	2	2	2
Attack dynamic	*pp–mf*	*pp–f*	*pp–f*
Attack immediacy	1	3	3
Crescendo range	*pp–mf*	*pp–mf*	*pp–f*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

17



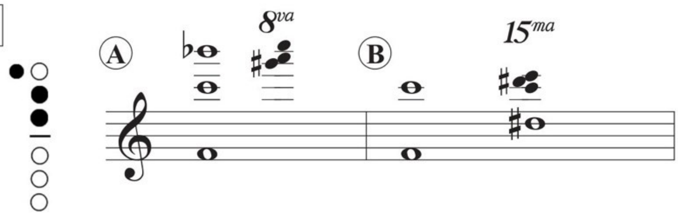
Stability	1	2
Attack dynamic	*pp–mp*	*pp–mp*
Attack immediacy	2	2
Crescendo range	*pp–mp*	*pp–p*
OTs inc.with dyn.	no	no
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

18



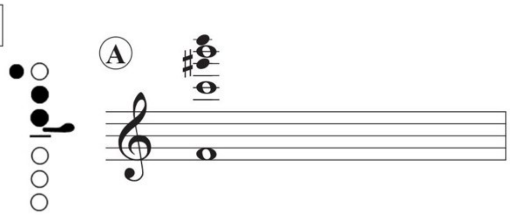
Stability	2	2
Attack dynamic	*pp–mp*	*pp–ff*
Attack immediacy	3	2
Crescendo range	*pp–mp*	*pp–ff*
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

19



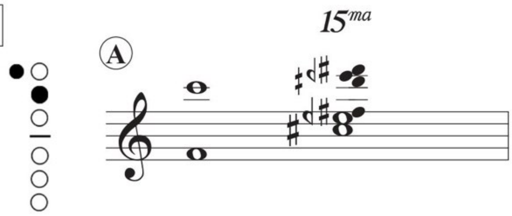
Stability	3	3
Attack dynamic	***pp–ff***	***pp–ff***
Attack immediacy	3	3
Crescendo range	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

20



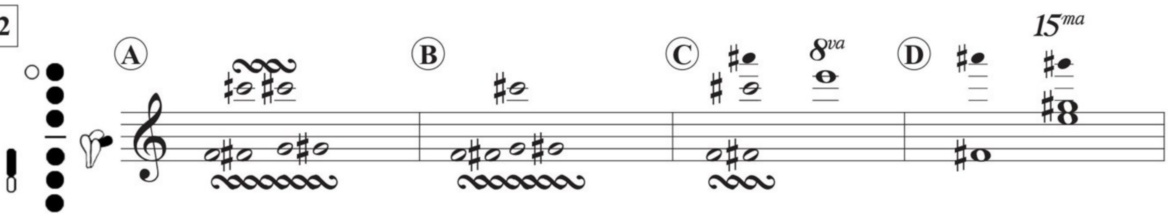
Stability	2
Attack dynamic	***pp–mf***
Attack immediacy	2
Crescendo range	***pp–mf***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	*G♯6 and D7 emerge more with louder dynamics*

21



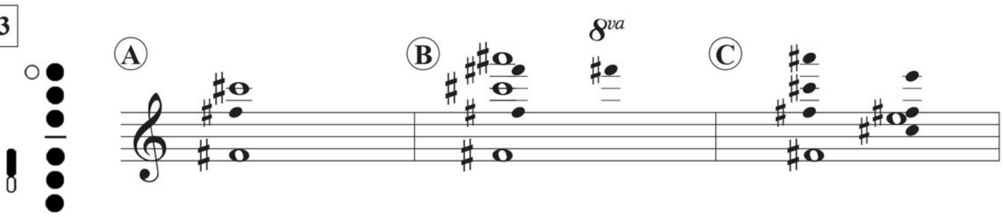
Stability	3
Attack dynamic	***pp–ff***
Attack immediacy	3
Crescendo range	***pp–ff***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

22



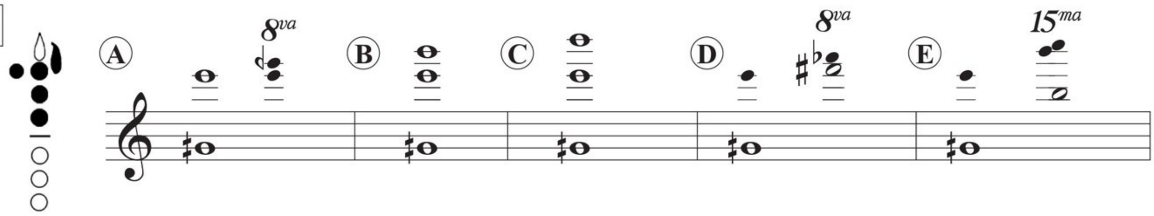
	A	B	C	D
Stability	1	1	1	1
Attack dynamic	*pp*	*pp*	*pp–p*	*pp–mf*
Attack immediacy	1	1	1	2
Crescendo range	no	no	no	*pp–mf*
OTs inc.with dyn.	no	no	no	yes
Emerge from bottom note	no	no	no	no
Emerge from top note	no	no	no	yes
Comments	Internal oscillating	Internal oscillating	Internal oscillating	

23



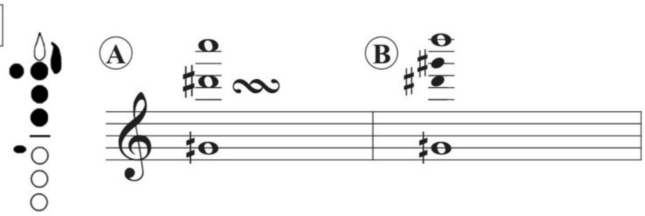
	A	B	C
Stability	1	2	3
Attack dynamic	*pp–p*	*pp–mf*	*pp–ff*
Attack immediacy	2	2	3
Crescendo range	*pp–p*	*pp–mf*	*pp–ff*
OTs inc.with dyn.	no	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			*A♯6 and C♯7 emerge at louder dynamics*

24



	A	B	C	D	E
Stability	3	1	3	3	2
Attack dynamic	*pp–ff*	*pp–p*	*pp–mf*	*pp–mf*	*pp–ff*
Attack immediacy	3	2	3	3	3
Crescendo range	*pp–ff*	*pp–p*	*pp–mf*	*pp–mf*	*pp–ff*
OTs inc.with dyn.	yes	no	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes	yes
Comments					

25

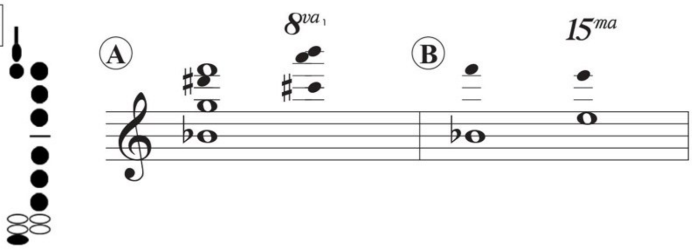


Stability	2	2
Attack dynamic	***pp–mf***	***pp–mf***
Attack immediacy	2	2
Crescendo range	***pp–mf***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments	Internal oscillating	

26

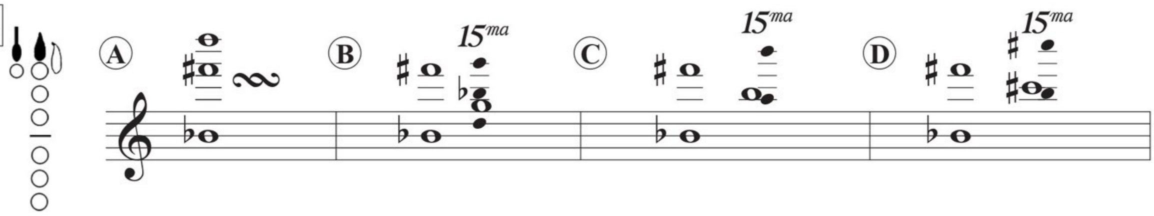
Stability	3
Attack dynamic	***pp–ff***
Attack immediacy	3
Crescendo range	***pp–ff***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

27



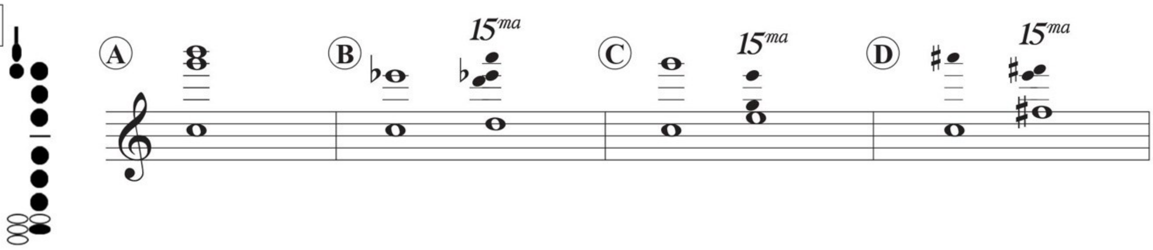
Stability	2	3
Attack dynamic	***pp–ff***	***pp–ff***
Attack immediacy	2	3
Crescendo range	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments	Requires high resistance	

28

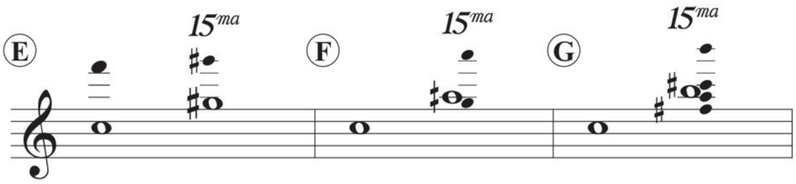


	A	B	C	D
Stability	2	2	2	2
Attack dynamic	*pp–f*	*pp–ff*	*pp–ff*	*pp–ff*
Attack immediacy	2	3	3	3
Crescendo range	*pp–f*	*pp–ff*	*pp–ff*	*pp–ff*
OTs inc.with dyn.	yes	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes
Comments	Internal oscillating			

29

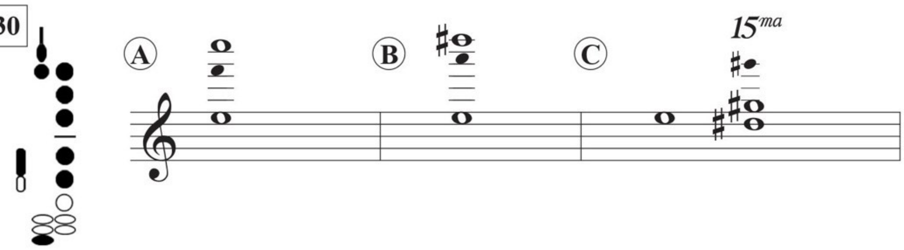


	A	B	C	D
Stability	2	3	3	2
Attack dynamic	*pp–ff*	*pp–ff*	*pp–ff*	*pp–ff*
Attack immediacy	2	3	3	2
Crescendo range	*pp–ff*	*pp–ff*	*pp–ff*	*pp–ff*
OTs inc.with dyn.	yes	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes
Comments				



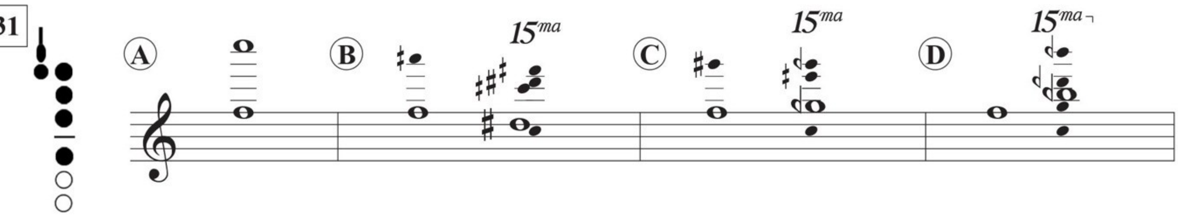
	E	F	G
Stability	2	2	2
Attack dynamic	*pp–ff*	*pp–ff*	*pp–ff*
Attack immediacy	2	2	2
Crescendo range	*pp–ff*	*pp–ff*	*pp–ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

30



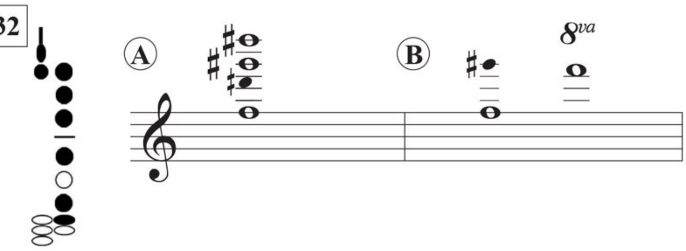
Stability	2	2	2
Attack dynamic	***pp–ff***	***pp–ff***	***pp–f***
Attack immediacy	2	2	2
Crescendo range	***pp–ff***	***pp–ff***	***pp–f***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			D#7 emerges at higher dynamic

31



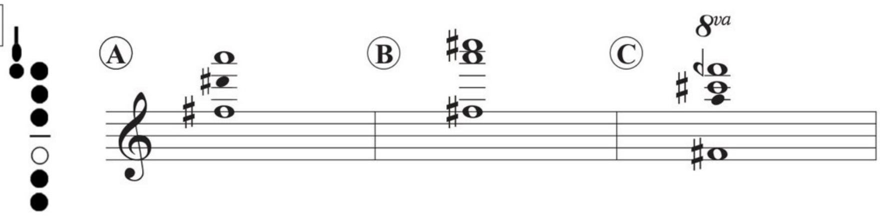
Stability	2	2	3	2
Attack dynamic	***pp–ff***	***pp–mf***	***pp–ff***	***pp–ff***
Attack immediacy	2	3	3	2
Crescendo range	***pp–ff***	***pp–mf***	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes
Comments				

32



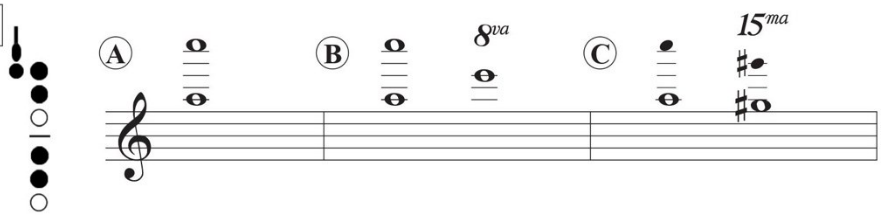
Stability	2	3
Attack dynamic	***pp–mf***	***pp–ff***
Attack immediacy	3	3
Crescendo range	***pp–mf***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

33



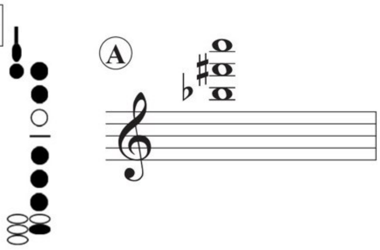
Stability	2	2	2
Attack dynamic	***pp*–*mf***	***pp*–*mf***	***pp*–*ff***
Attack immediacy	2	3	2
Crescendo range	***pp*–*mf***	***pp*–*mf***	***pp*–*ff***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

34



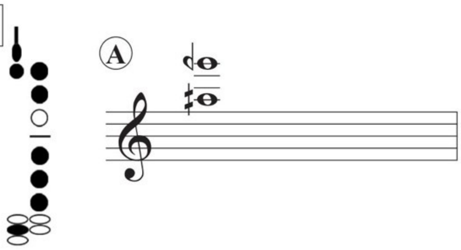
Stability	2	1	2
Attack dynamic	***pp*–*mf***	***pp*–*mp***	***pp*–*mf***
Attack immediacy	3	2	2
Crescendo range	***pp*–*mf***	***pp*–*mp***	***pp*–*mf***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

35



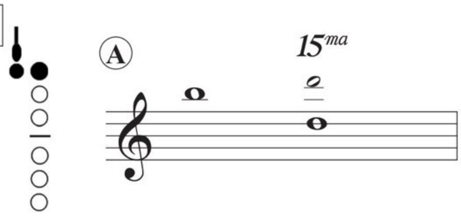
Stability	1
Attack dynamic	***pp*–*mp***
Attack immediacy	2
Crescendo range	***pp*–*mp***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

36



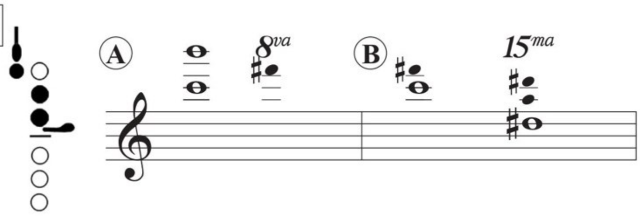
Stability	1
Attack dynamic	***pp*–*p***
Attack immediacy	2
Crescendo range	***pp*–*p***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

37



Stability	2
Attack dynamic	***pp*–*mf***
Attack immediacy	3
Crescendo range	***pp*–*mf***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

38

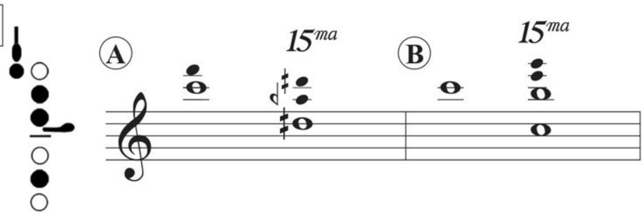


Stability	2	2
Attack dynamic	***pp*–*mf***	***pp*–*ff***
Attack immediacy	3	2
Crescendo range	***pp*–*mf***	***pp*–*ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments	Oscillations at higher dynamics	

39

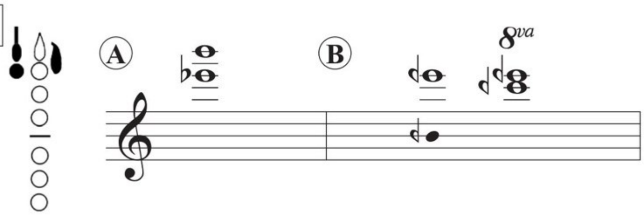
Stability	3
Attack dynamic	***pp–ff***
Attack immediacy	2
Crescendo range	***pp–ff***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

40



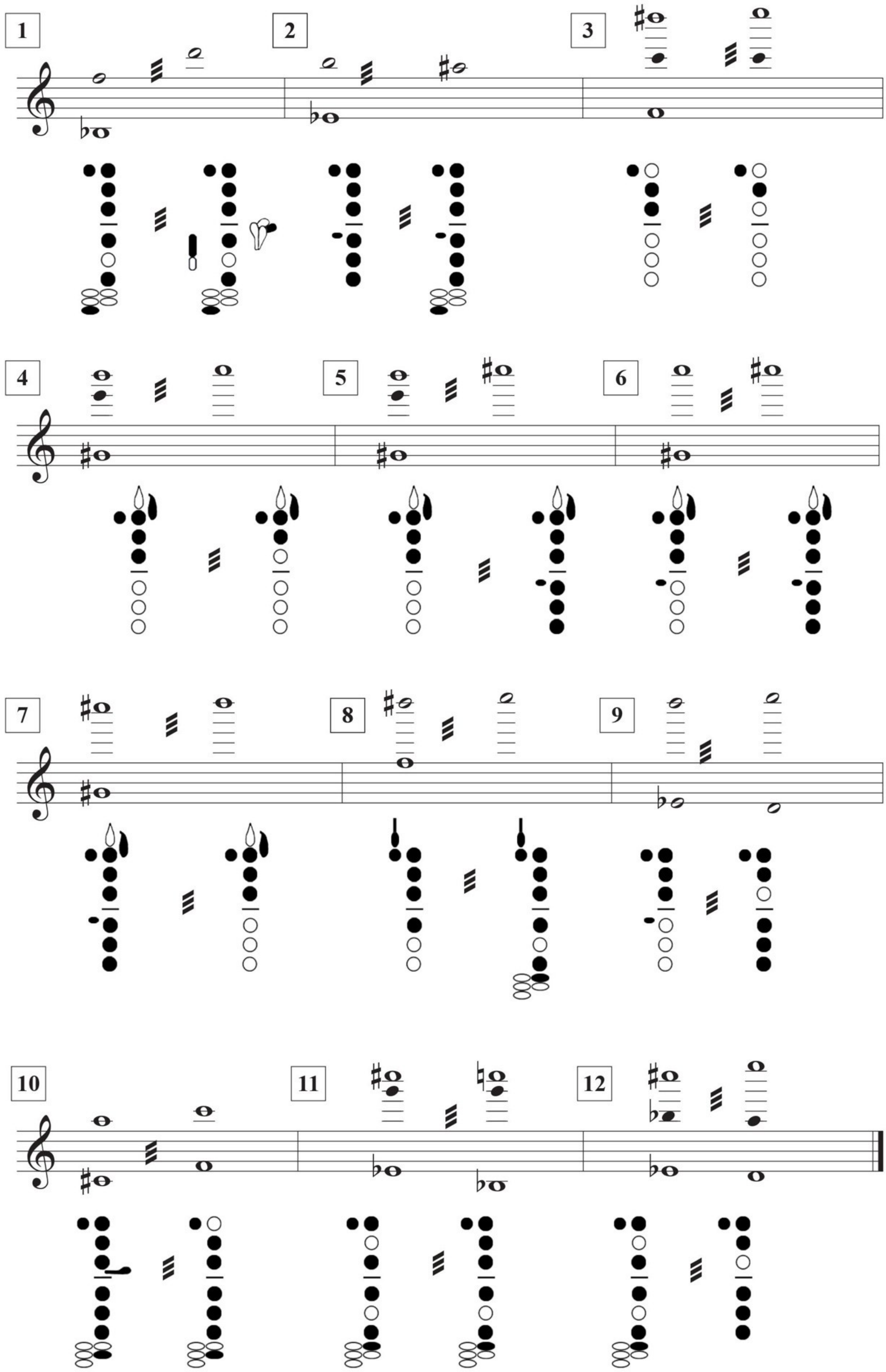
Stability	2	2
Attack dynamic	***pp–ff***	***pp–f***
Attack immediacy	2	2
Crescendo range	***pp–ff***	***pp–f***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

41



Stability	1	1
Attack dynamic	***pp***	***pp***
Attack immediacy	1	1
Crescendo range	no	no
OTs inc.with dyn.	no	no
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

Multiphonic Tremolos



Selmer

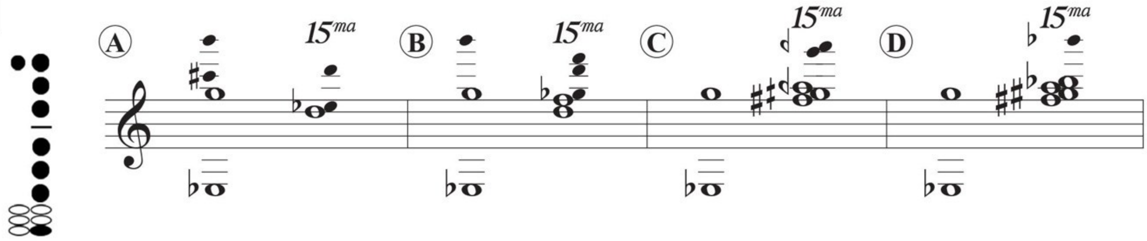
Multiphonics

Fingering Charts

Audio Examples 0217-0398

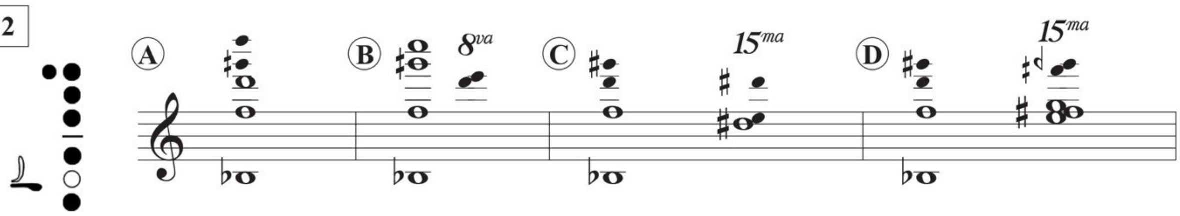
Selmer Contrabass Clarinet Multiphonics

1



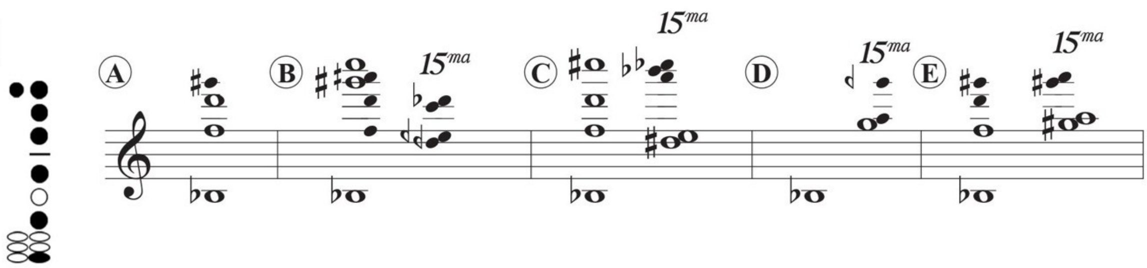
	A	B	C	D
Stability	2	2	2	3
Attack dynamic	***pp–ff***	***pp–ff***	***pp–mf***	***pp–ff***
Attack immediacy	3	3	2	3
Crescendo range	***pp–ff***	***pp–ff***	***pp–mf***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes
Comments	Difficult to maintain top pitch at higher dynamics	Difficult to maintain top pitch at higher dynamics	Difficult to maintain top pitch at higher dynamics	

2



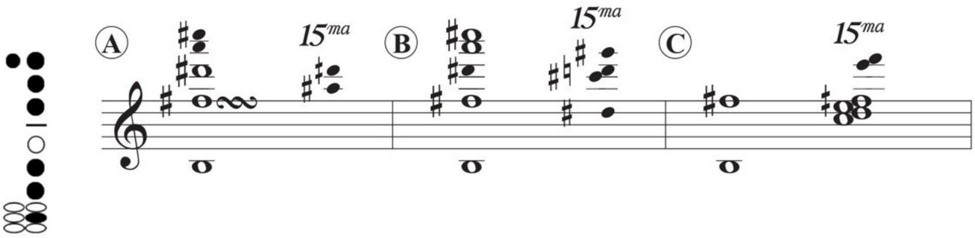
	A	B	C	D
Stability	2	2	2	2
Attack dynamic	***pp–mf***	***pp–mf***	***pp–mf***	***pp–ff***
Attack immediacy	2	2	2	3
Crescendo range	***pp–mf***	***pp–mf***	***pp–mf***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes
Comments				

3

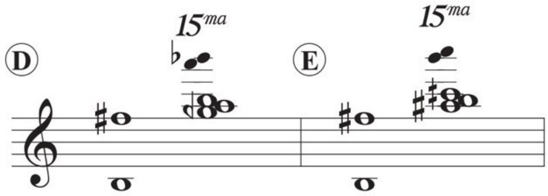


	A	B	C	D	E
Stability	1	2	2	3	2
Attack dynamic	***pp–ff***	***pp–ff***	***pp–ff***	***pp–ff***	***pp–ff***
Attack immediacy	2	2	2	2	2
Crescendo range	***pp–ff***	***pp–ff***	***pp–ff***	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes	yes	yes
Emerge from bottom note	no	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes	yes
Comments					

4

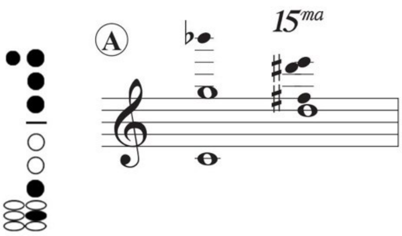


	A	B	C
Stability	2	3	3
Attack dynamic	*pp–ff*	*pp–ff*	*pp–ff*
Attack immediacy	3	2	3
Crescendo range	*pp–ff*	*pp–ff*	*pp–ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			



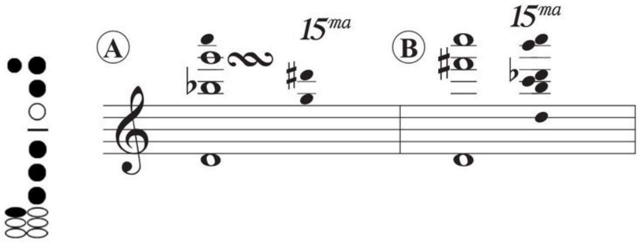
	D	E
Stability	3	2
Attack dynamic	*pp–ff*	*pp–ff*
Attack immediacy	3	2
Crescendo range	*pp–ff*	*pp–ff*
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

5



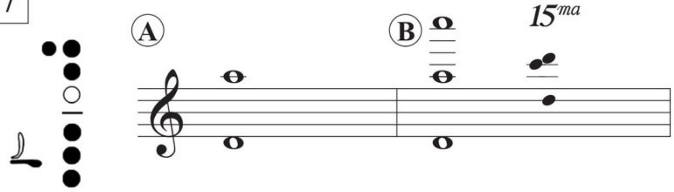
	A
Stability	2
Attack dynamic	*pp–ff*
Attack immediacy	3
Crescendo range	*pp–ff*
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

6



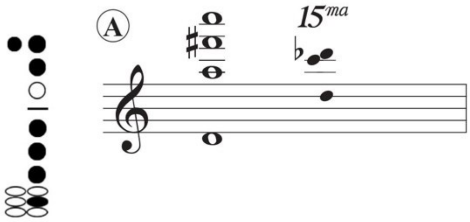
	A	B
Stability	3	3
Attack dynamic	***pp–ff***	***pp–ff***
Attack immediacy	2	3
Crescendo range	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	no	yes
Emerge from top note	yes	yes
Comments	Internal oscillating	

7



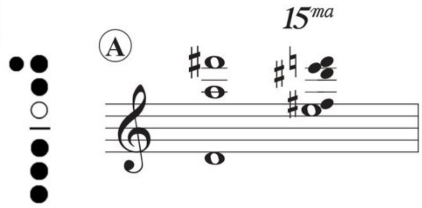
	A	B
Stability	2	3
Attack dynamic	***pp–mp***	***pp–ff***
Attack immediacy	2	3
Crescendo range	***pp–mp***	***pp–ff***
OTs inc.with dyn.	no	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

8



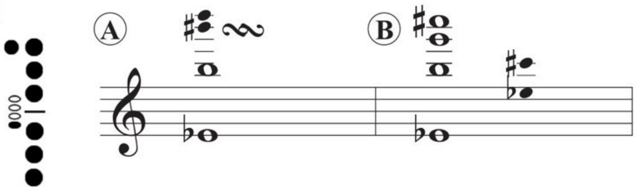
	A
Stability	3
Attack dynamic	***pp–ff***
Attack immediacy	3
Crescendo range	***pp–ff***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

9



Stability	2
Attack dynamic	*pp–ff*
Attack immediacy	2
Crescendo range	*pp–ff*
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

10

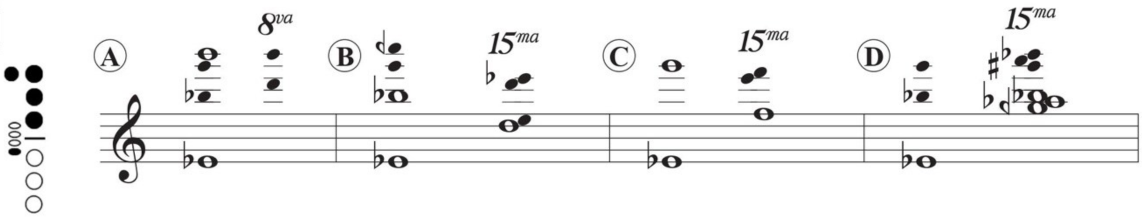


Stability	3	2
Attack dynamic	*pp–ff*	*pp–f*
Attack immediacy	3	2
Crescendo range	*pp–ff*	*pp–f*
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

11

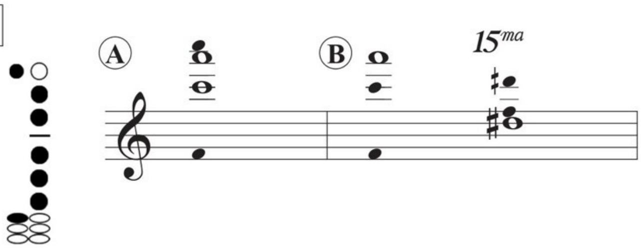
Stability	3
Attack dynamic	*pp–ff*
Attack immediacy	3
Crescendo range	*pp–ff*
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

12



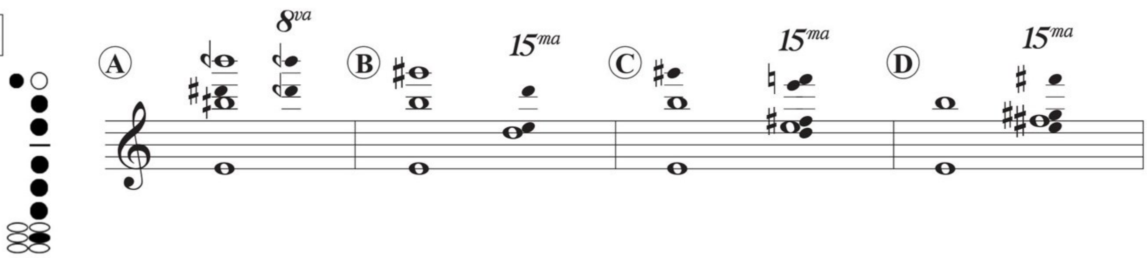
	A	B	C	D
Stability	2	2	3	2
Attack dynamic	*pp–mf*	*pp–f*	*pp–ff*	*pp–ff*
Attack immediacy	2	2	3	3
Crescendo range	*pp–mf*	*pp–f*	*pp–ff*	*pp–ff*
OTs inc.with dyn.	yes	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	no
Comments				

13



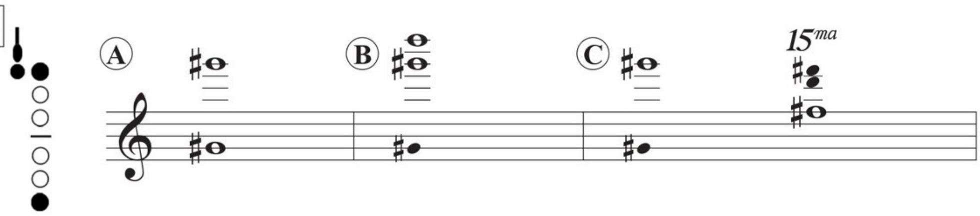
	A	B
Stability	2	2
Attack dynamic	*pp–p*	*pp–mf*
Attack immediacy	3	2
Crescendo range	*pp–p*	*pp–mf*
OTs inc.with dyn.	no	yes
Emerge from bottom note	yes	no
Emerge from top note	no	yes
Comments		

14



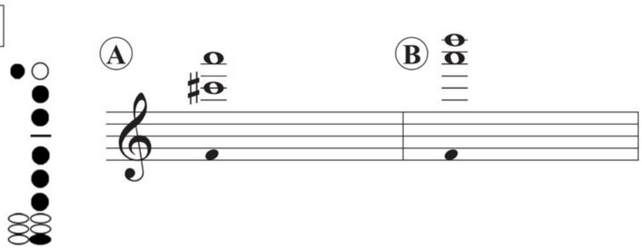
	A	B	C	D
Stability	2	2	3	2
Attack dynamic	*pp–f*	*pp–mf*	*pp–ff*	*pp–mf*
Attack immediacy	2	2	3	2
Crescendo range	*pp–f*	*pp–mf*	*pp–ff*	*pp–mf*
OTs inc.with dyn.	yes	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes
Comments				

15



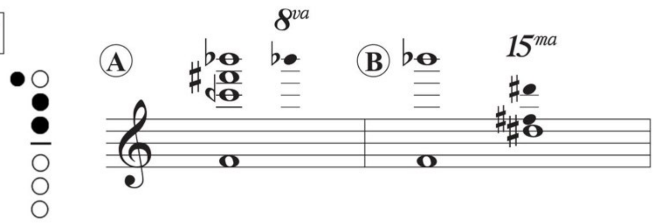
	A	B	C
Stability	3	1	2
Attack dynamic	***pp–f***	***pp–mp***	***pp–ff***
Attack immediacy	3	2	3
Crescendo range	***pp–f***	***pp–mp***	***pp–ff***
OTs inc.with dyn.	yes	no	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

16



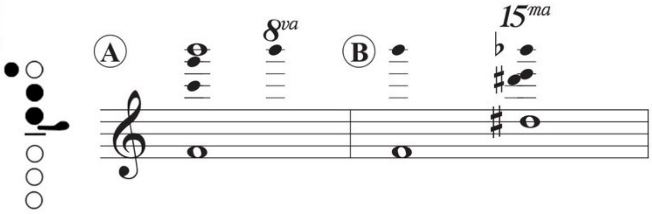
	A	B
Stability	2	2
Attack dynamic	***pp–f***	***pp–f***
Attack immediacy	3	2
Crescendo range	***pp–f***	***pp–f***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

17



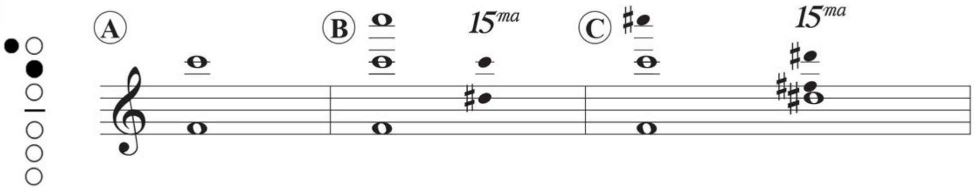
	A	B
Stability	3	2
Attack dynamic	***pp–ff***	***pp–f***
Attack immediacy	3	3
Crescendo range	***pp–ff***	***pp–f***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments	F♯6 emerges at louder dynamics	

18



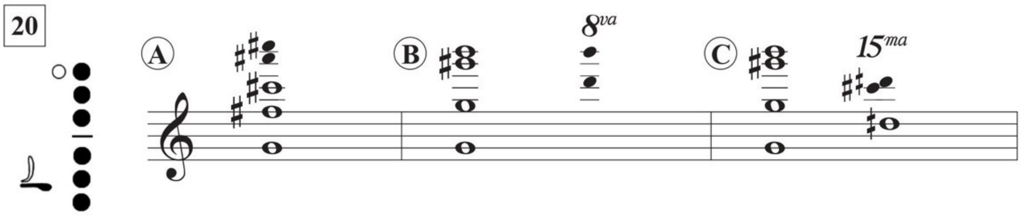
Stability	3	3
Attack dynamic	*pp–ff*	*pp–ff*
Attack immediacy	3	3
Crescendo range	*pp–ff*	*pp–ff*
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

19

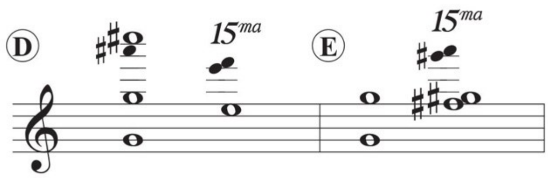


Stability	1	2	3
Attack dynamic	*pp–p*	*pp–mf*	*pp–ff*
Attack immediacy	2	2	3
Crescendo range	*pp–p*	*pp–mf*	*pp–ff*
OTs inc.with dyn.	no	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

20

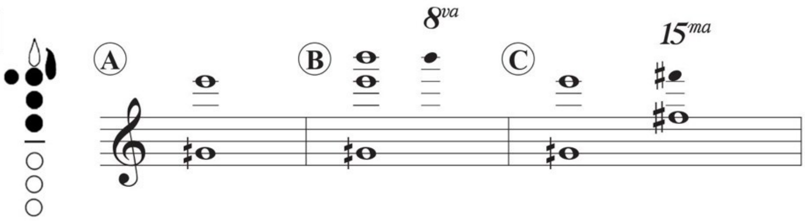


Stability	1	1	1
Attack dynamic	*pp–p*	*pp–p*	*pp–mf*
Attack immediacy	2	1	2
Crescendo range	*pp–p*	*pp–p*	*pp–mf*
OTs inc.with dyn.	no	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			



Stability	2	2
Attack dynamic	***pp–ff***	***pp–ff***
Attack immediacy	2	2
Crescendo range	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

21



Stability	3	1	3
Attack dynamic	***pp–ff***	***pp–f***	***pp–ff***
Attack immediacy	2	2	2
Crescendo range	***pp–ff***	***pp–f***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

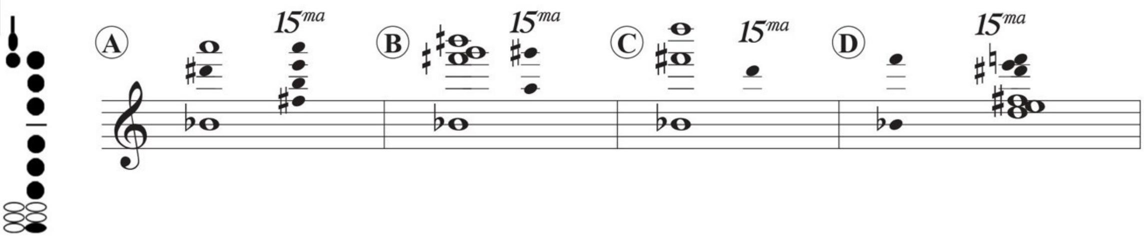
22

Stability	2
Attack dynamic	***pp–f***
Attack immediacy	3
Crescendo range	***pp–f***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

23

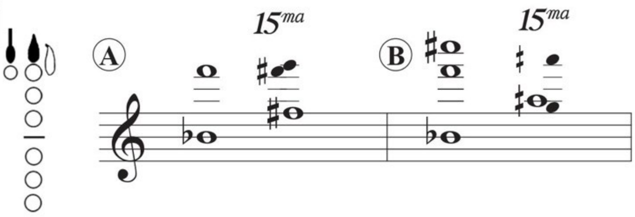
	A
Stability	3
Attack dynamic	*pp–ff*
Attack immediacy	3
Crescendo range	*pp–ff*
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

24



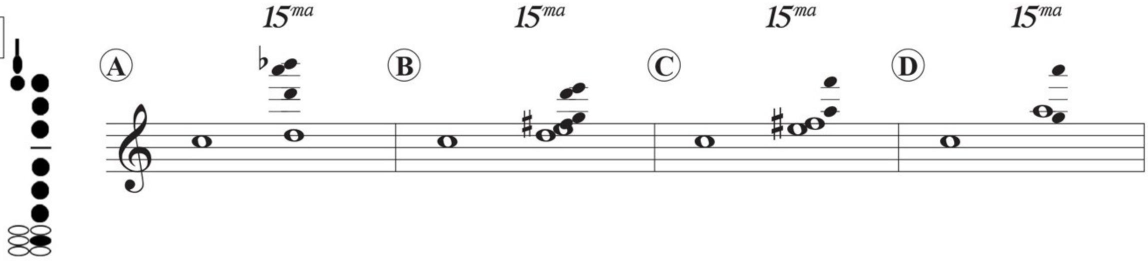
	A	B	C	D
Stability	2	2	3	2
Attack dynamic	*pp–ff*	*pp–mf*	*pp–ff*	*pp–ff*
Attack immediacy	2	2	2	2
Crescendo range	*pp–ff*	*pp–mf*	*pp–ff*	*pp–ff*
OTs inc.with dyn.	yes	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	no
Comments				

25



	A	B
Stability	2	3
Attack dynamic	*pp–ff*	*pp–mf*
Attack immediacy	2	2
Crescendo range	*pp–ff*	*pp–ff*
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

26

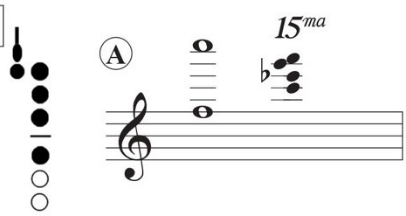


Stability	3	3	2	2
Attack dynamic	***pp–ff***	***pp–ff***	***pp–ff***	***pp–ff***
Attack immediacy	2	2	2	2
Crescendo range	***pp–ff***	***pp–ff***	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes
Emerge from top note	yes	yes	no	no
Comments				

27

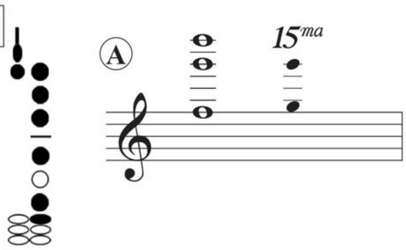
Stability	2
Attack dynamic	***mp–ff***
Attack immediacy	2
Crescendo range	***mp–ff***
OTs inc.with dyn.	yes
Emerge from bottom note	no
Emerge from top note	yes
Comments	

28



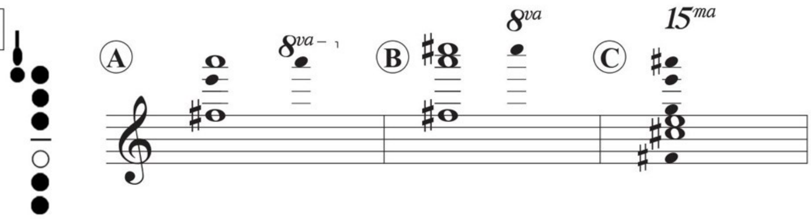
Stability	3
Attack dynamic	***pp–ff***
Attack immediacy	3
Crescendo range	***pp–ff***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

29



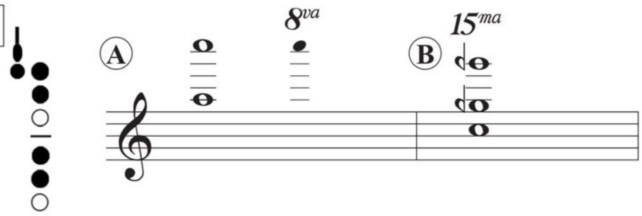
	A
Stability	3
Attack dynamic	***pp–ff***
Attack immediacy	3
Crescendo range	***pp–ff***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

30



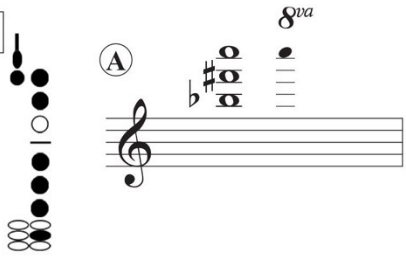
	A	B	C
Stability	3	2	2
Attack dynamic	***pp–mf***	***pp–f***	***pp–ff***
Attack immediacy	3	2	2
Crescendo range	***pp–mf***	***pp–f***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

31



	A	B
Stability	3	1
Attack dynamic	***pp–f***	***pp–mf***
Attack immediacy	3	1
Crescendo range	***pp–f***	***pp–mf***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

32

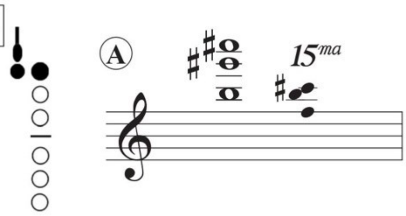


Stability	1
Attack dynamic	***pp – mp***
Attack immediacy	1
Crescendo range	***pp – mp***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

33

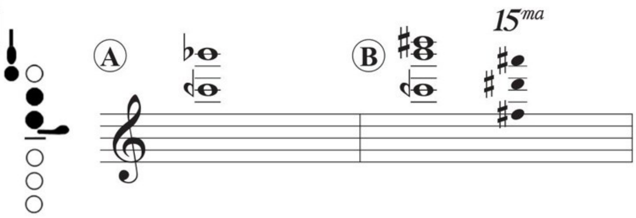
Stability	1
Attack dynamic	***pp – p***
Attack immediacy	2
Crescendo range	***pp – p***
OTs inc.with dyn.	no
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

34



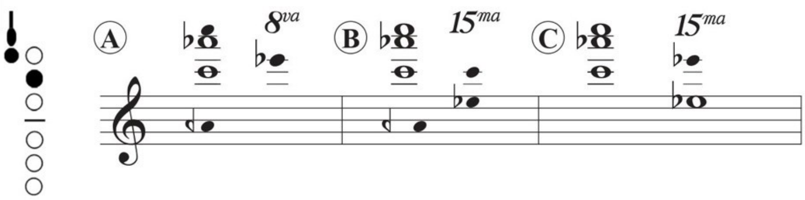
Stability	2
Attack dynamic	***pp – mp***
Attack immediacy	1
Crescendo range	***pp – mp***
OTs inc.with dyn.	yes
Emerge from bottom note	no
Emerge from top note	yes
Comments	

35



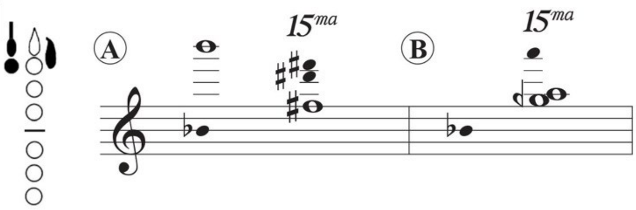
	A	B
Stability	2	2
Attack dynamic	***pp–mp***	***pp–ff***
Attack immediacy	2	2
Crescendo range	***pp–mp***	***pp–ff***
OTs inc.with dyn.	no	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

36



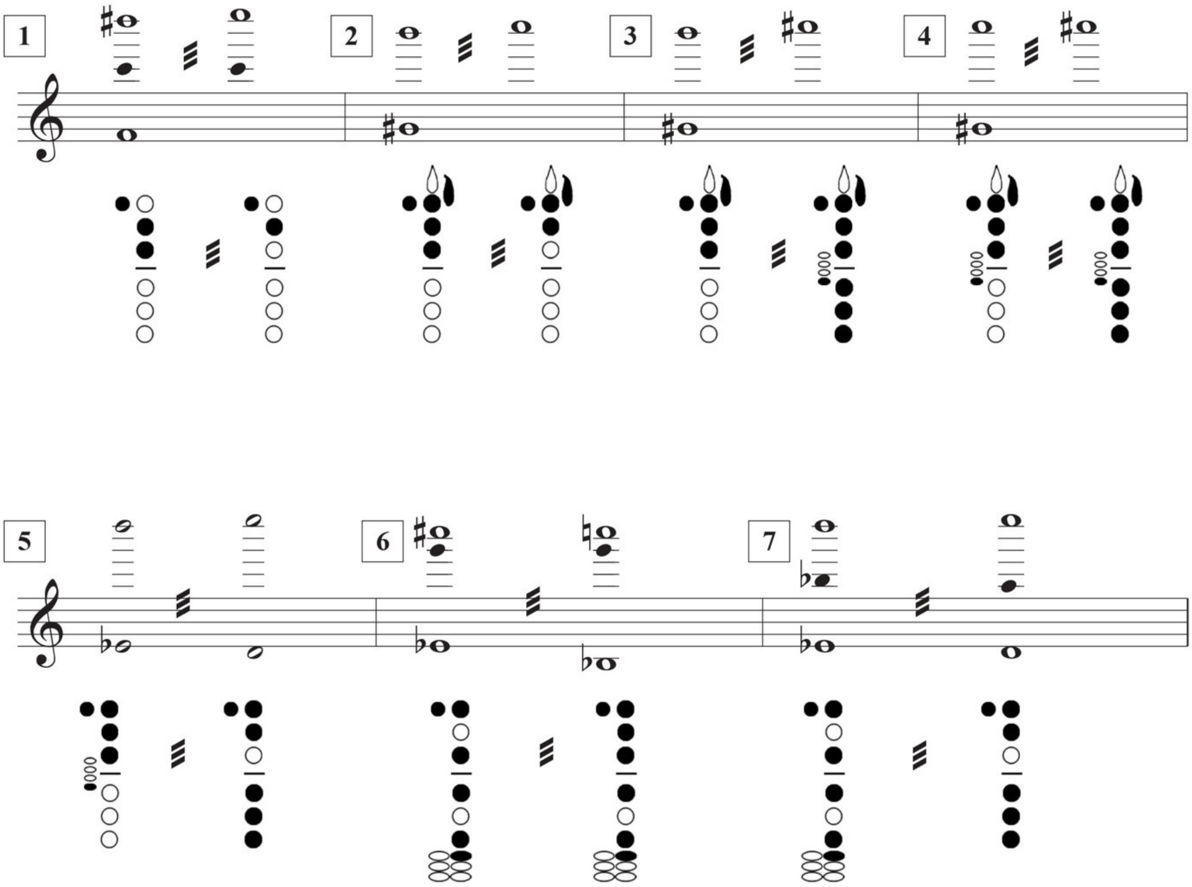
	A	B	C
Stability	1	1	2
Attack dynamic	***pp–p***	***pp–mp***	***pp–mp***
Attack immediacy	1	1	2
Crescendo range	***pp–p***	no	***pp–mp***
OTs inc.with dyn.	no	no	no
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

37



	A	B
Stability	2	1
Attack dynamic	***pp–ff***	***pp–mp***
Attack immediacy	2	1
Crescendo range	***pp–ff***	***pp–mp***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

Multiphonic Tremolos



Eppelsheim

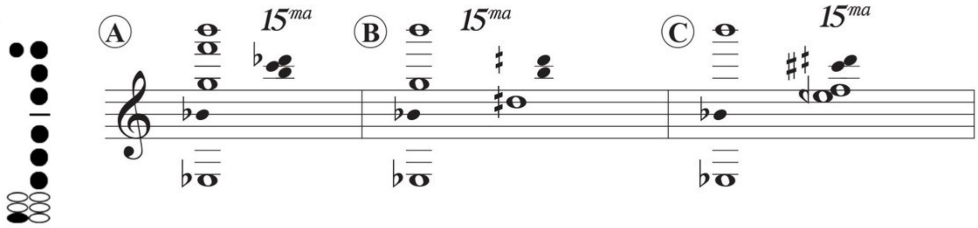
Multiphonic

Fingering Charts

Audio Examples 0399-0598

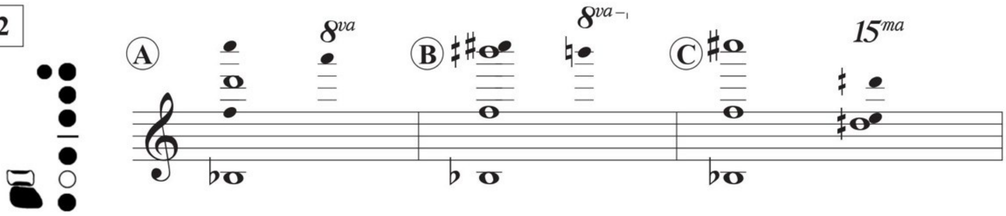
Eppelsheim Contrabass Clarinet Multiphonics

1

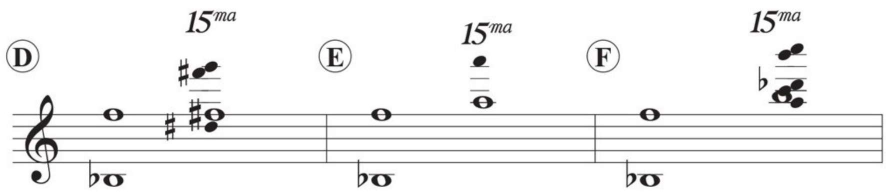


Stability	3	3	2
Attack dynamic	pp–ff	pp–ff	pp–ff
Attack immediacy	3	3	3
Crescendo range	pp–ff	pp–ff	pp–ff
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

2

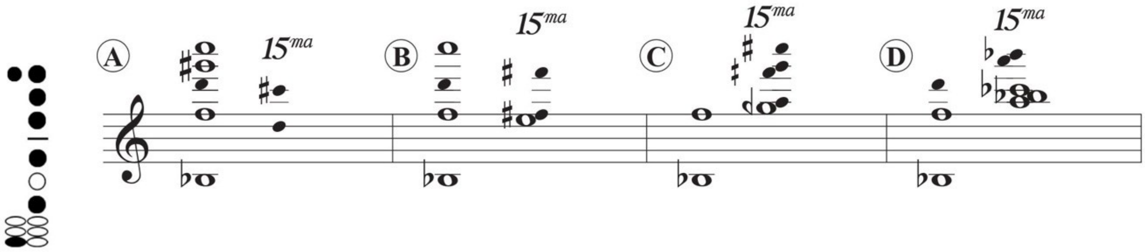


Stability	3	3	3
Attack dynamic	pp–ff	pp–mp	pp–ff
Attack immediacy	3	3	3
Crescendo range	pp–ff	pp–mf	pp–ff
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments	F5 emerges at louder dynamic		



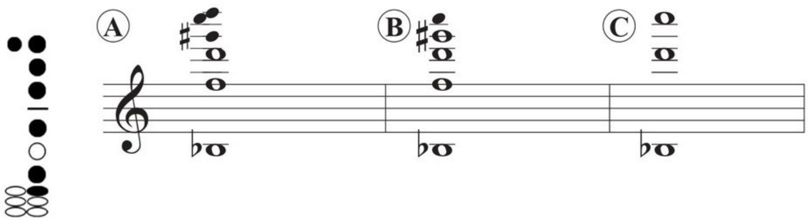
Stability	2	2	2
Attack dynamic	pp–ff	p	pp–ff
Attack immediacy	2	2	2
Crescendo range	pp–f	pp–p	pp–ff
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	no	yes	yes
Emerge from top note	yes	yes	yes
Comments			

3



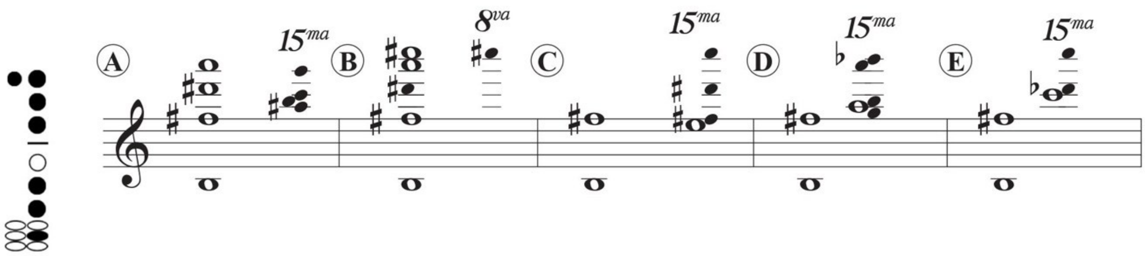
Stability	3	2	3	2
Attack dynamic	***pp–ff***	***mp–mf***	***p–f***	***pp–mp***
Attack immediacy	2	2	3	2
Crescendo range	***pp–ff***	***mp–f***	***pp–ff***	***pp–f***
OTs inc.with dyn.	yes	no	yes	no
Emerge from bottom note	yes	no	yes	yes
Emerge from top note	yes	yes	yes	yes
Comments				

4



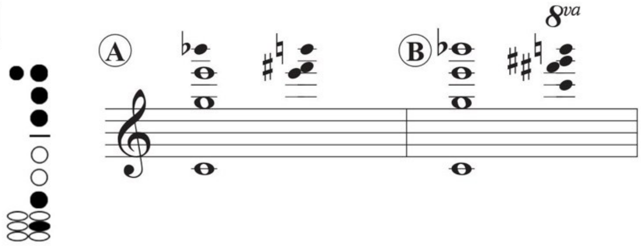
Stability	2	2	3
Attack dynamic	***mp–f***	***mf–f***	***pp–ff***
Attack immediacy	3	2	3
Crescendo range	***pp–f***	***mf–ff***	***pp–ff***
OTs inc.with dyn.	yes	no	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

5



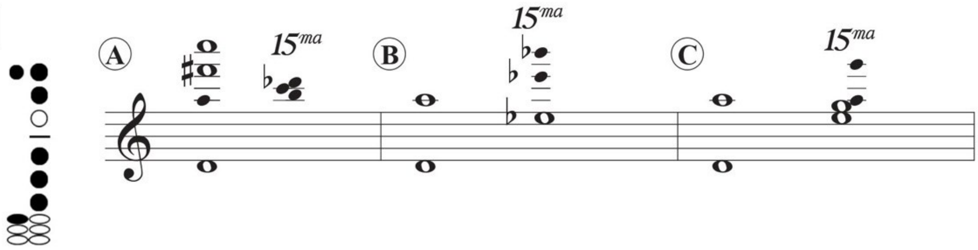
Stability	2	3	2	2	2
Attack dynamic	***pp–ff***	***pp–ff***	***p–mf***	***pp–f***	***pp–ff***
Attack immediacy	2	3	2	3	3
Crescendo range	***pp–ff***	***pp–ff***	***pp–f***	***pp–f***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes	yes
Comments					

6



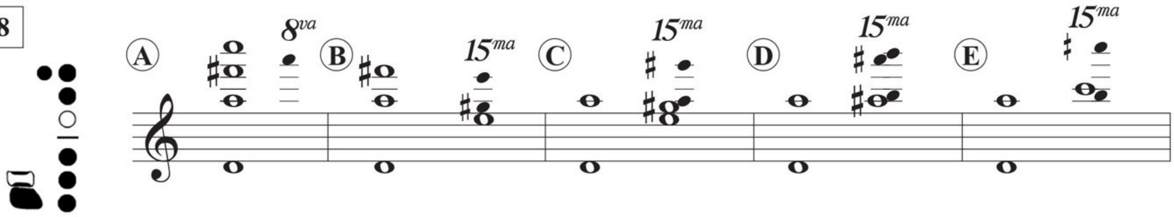
Stability	2	2
Attack dynamic	***pp–mp***	***pp–ff***
Attack immediacy	2	3
Crescendo range	***pp–f***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

7



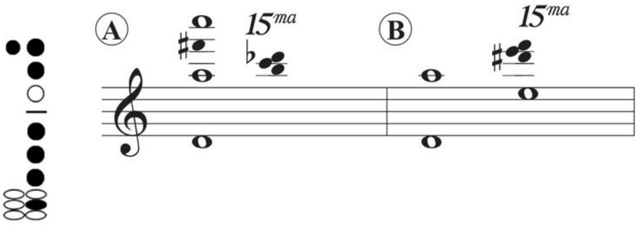
Stability	3	3	2
Attack dynamic	***pp–ff***	***pp–f***	***pp–f***
Attack immediacy	3	3	2
Crescendo range	***pp–ff***	***pp–f***	***pp–f***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

8



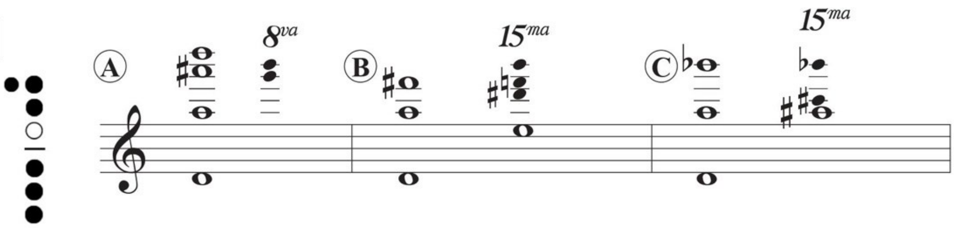
Stability	3	3	1	2	2
Attack dynamic	***pp–ff***	***pp–ff***	***mf***	***pp–ff***	***pp–f***
Attack immediacy	3	3	1	2	2
Crescendo range	***pp–ff***	***pp–ff***	no	***pp–ff***	***pp–mf***
OTs inc.with dyn.	yes	yes	no	yes	yes
Emerge from bottom note	yes	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes	yes
Comments					

9



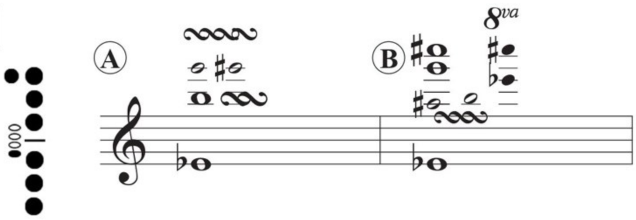
Stability	3	3
Attack dynamic	***pp–ff***	***pp–ff***
Attack immediacy	3	3
Crescendo range	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

10



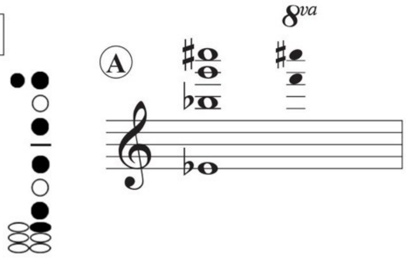
Stability	2	2	2
Attack dynamic	***pp–ff***	***pp–ff***	***pp–ff***
Attack immediacy	2	2	2
Crescendo range	***pp–ff***	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

11



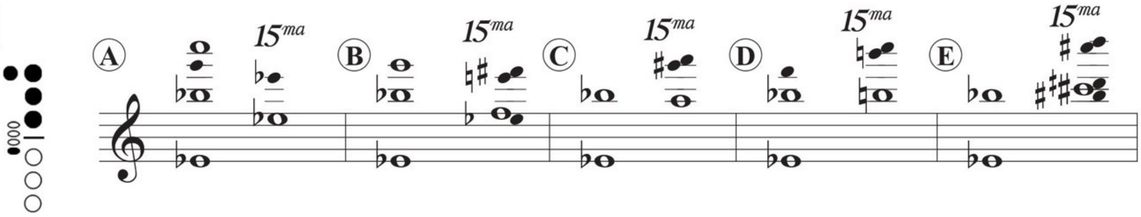
Stability	1	3
Attack dynamic	***pp–p***	***pp–ff***
Attack immediacy	2	3
Crescendo range	***pp–p***	***pp–ff***
OTs inc.with dyn.	no	yes
Emerge from bottom note	yes	yes
Emerge from top note	no	yes
Comments	Internal oscillating	Internal oscillating

12



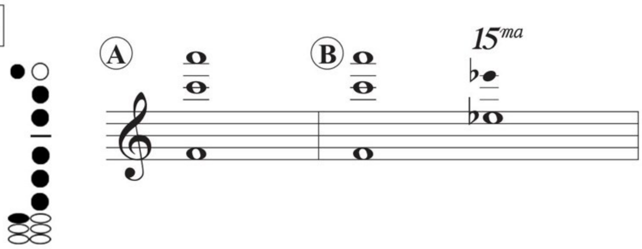
	A
Stability	3
Attack dynamic	***pp–ff***
Attack immediacy	3
Crescendo range	***pp–ff***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

13



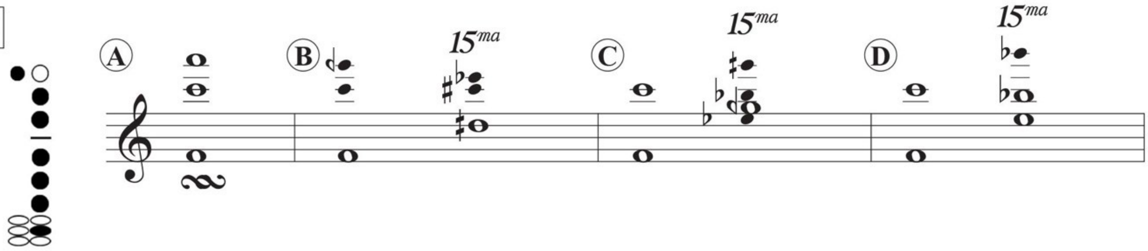
	A	B	C	D	E
Stability	2	3	2	2	2
Attack dynamic	***pp–mp***	***pp–ff***	***pp–ff***	***mf–ff***	***pp–ff***
Attack immediacy	2	3	2	2	1
Crescendo range	***pp–mp***	***pp–ff***	***pp–ff***	***mf–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes	yes
Comments					

14



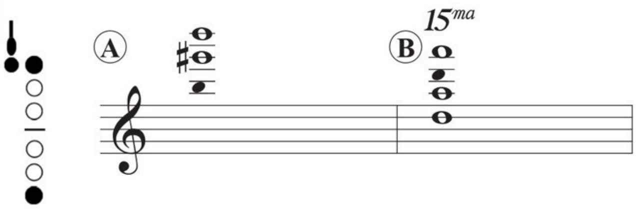
	A	B
Stability	2	3
Attack dynamic	***pp–p***	***pp–ff***
Attack immediacy	3	3
Crescendo range	***pp–p***	***pp–ff***
OTs inc.with dyn.	no	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

15



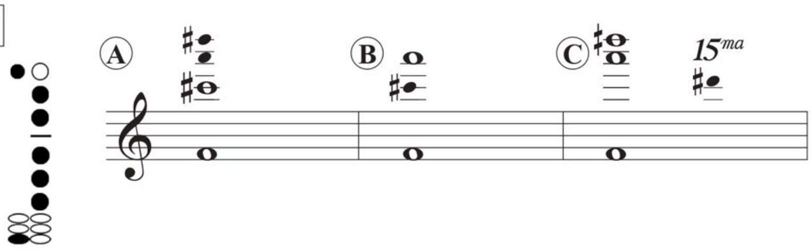
Stability	3	3	2	2
Attack dynamic	*pp–p*	*pp–mf*	*pp–mp*	*pp–ff*
Attack immediacy	2	3	2	2
Crescendo range	*pp–p*	*pp–mf*	*pp–f*	*pp–ff*
OTs inc.with dyn.	no	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes
Comments	Internal oscillating			

16



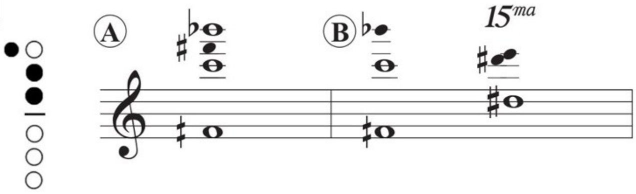
Stability	2	1
Attack dynamic	*pp–p*	*pp–mf*
Attack immediacy	2	1
Crescendo range	*pp–p*	*pp–mf*
OTs inc.with dyn.	no	no
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

17



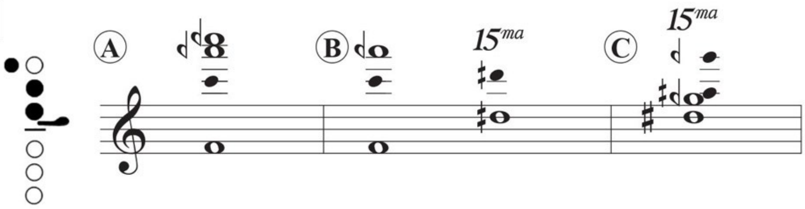
Stability	1	2	2
Attack dynamic	*pp*	*pp–mp*	*pp–mf*
Attack immediacy	1	2	3
Crescendo range	no	*pp–mp*	*pp–mf*
OTs inc.with dyn.	no	no	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

18



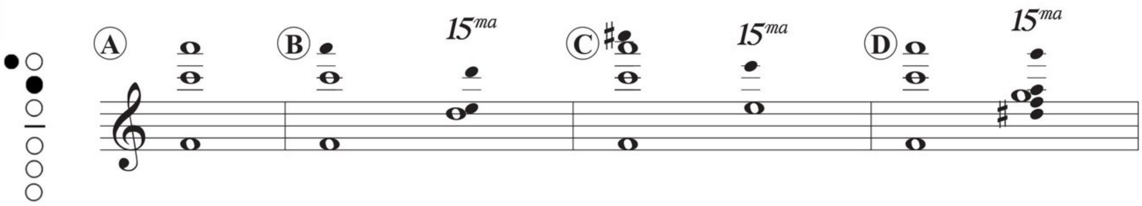
Stability	2	2
Attack dynamic	***pp–f***	***pp–f***
Attack immediacy	2	2
Crescendo range	***pp–f***	***pp–f***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

19



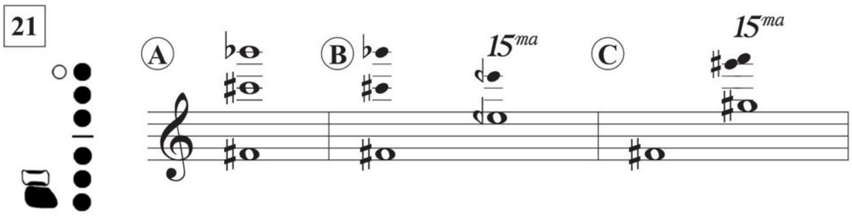
Stability	1	3	2
Attack dynamic	***pp–mp***	***pp–ff***	***pp–mf***
Attack immediacy	1	3	3
Crescendo range	***pp–mp***	***pp–ff***	***pp–mf***
OTs inc.with dyn.	no	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	no	yes	yes
Comments			

20



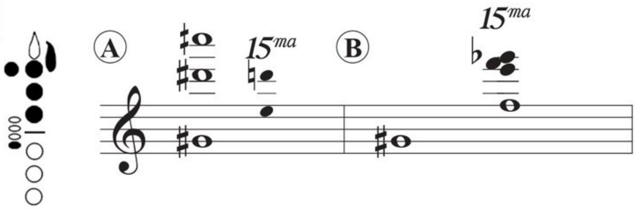
Stability	2	2	1	2
Attack dynamic	***pp–mf***	***pp–mf***	***pp–mp***	***pp–ff***
Attack immediacy	2	2	2	2
Crescendo range	***pp–mf***	***pp–mf***	***pp–mp***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes	yes
Emerge from bottom note	yes	yes	yes	yes
Emerge from top note	yes	yes	yes	yes
Comments				

21



	A	B	C
Stability	3	3	1
Attack dynamic	***pp–mf***	***pp–f***	***pp***
Attack immediacy	2	3	1
Crescendo range	***pp–mf***	***pp–f***	***pp–mp***
OTs inc.with dyn.	no	yes	no
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

22

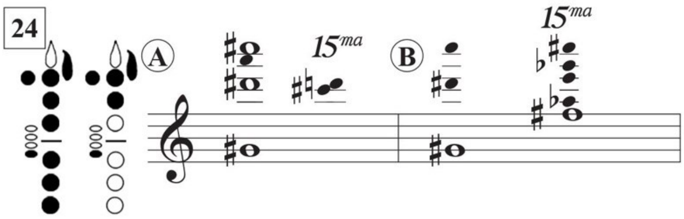


	A	B
Stability	3	3
Attack dynamic	***pp–ff***	***pp–ff***
Attack immediacy	3	2
Crescendo range	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

23

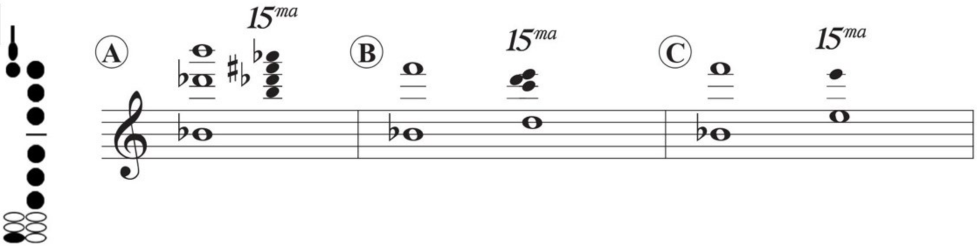
	A
Stability	3
Attack dynamic	***pp–ff***
Attack immediacy	3
Crescendo range	***pp–ff***
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

24



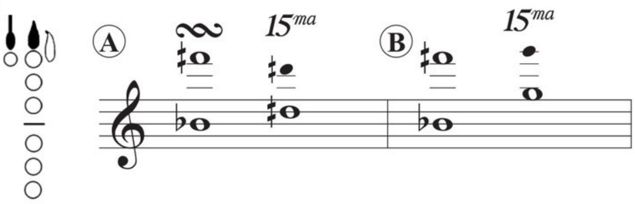
Stability	3	2
Attack dynamic	***pp–ff***	***pp–ff***
Attack immediacy	3	2
Crescendo range	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

25



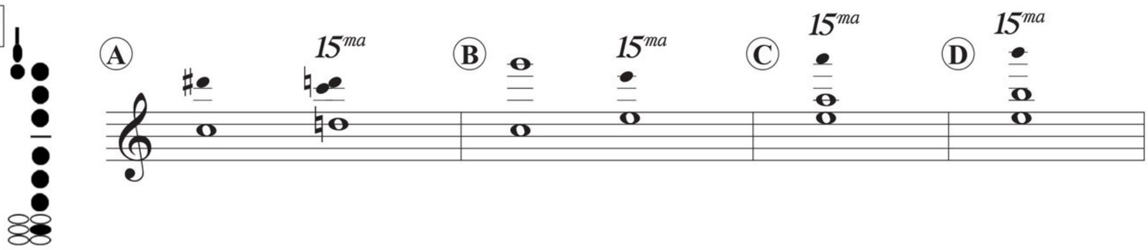
Stability	2	3	1
Attack dynamic	***pp–mf***	***pp–ff***	***pp–f***
Attack immediacy	2	2	1
Crescendo range	***pp–mf***	***pp–ff***	***pp–f***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

26



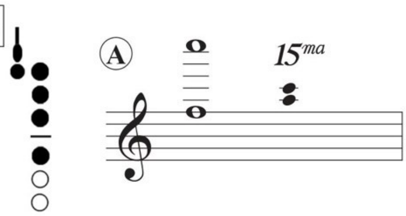
Stability	3	2
Attack dynamic	***pp–ff***	***pp–ff***
Attack immediacy	3	2
Crescendo range	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

27



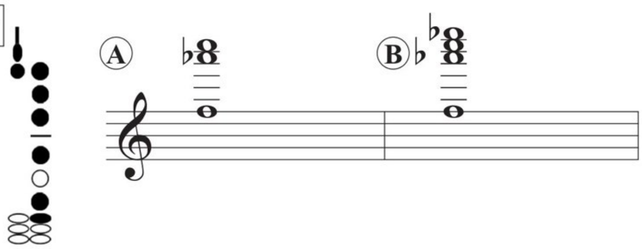
	A	B	C	D
Stability	2	2	1	1
Attack dynamic	*pp–ff*	*pp–ff*	*pp*	*pp–mp*
Attack immediacy	2	2	1	1
Crescendo range	*pp–ff*	*pp–ff*	no	*pp–mp*
OTs inc.with dyn.	yes	yes	no	no
Emerge from bottom note	yes	yes	no	no
Emerge from top note	yes	yes	no	no
Comments				

28



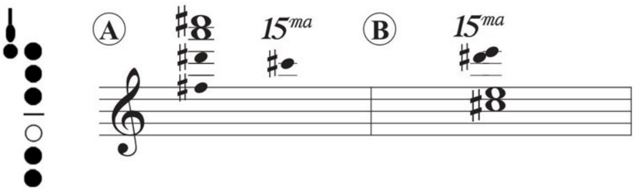
	A
Stability	3
Attack dynamic	*pp–ff*
Attack immediacy	3
Crescendo range	*pp–ff*
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

29



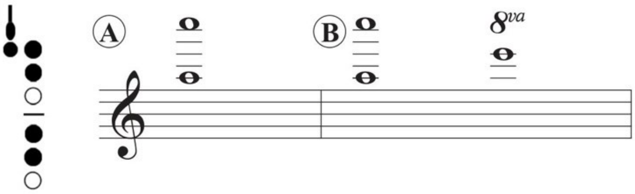
	A	B
Stability	1	1
Attack dynamic	*pp–p*	*pp–p*
Attack immediacy	2	1
Crescendo range	*pp–p*	*pp–p*
OTs inc.with dyn.	no	no
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

30



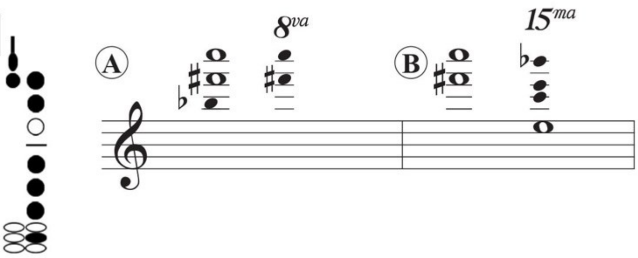
Stability	1	1
Attack dynamic	***pp–p***	***pp–mp***
Attack immediacy	1	1
Crescendo range	***pp–p***	***pp–p***
OTs inc.with dyn.	no	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

31



Stability	3	2
Attack dynamic	***pp–ff***	***pp–ff***
Attack immediacy	3	3
Crescendo range	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

32

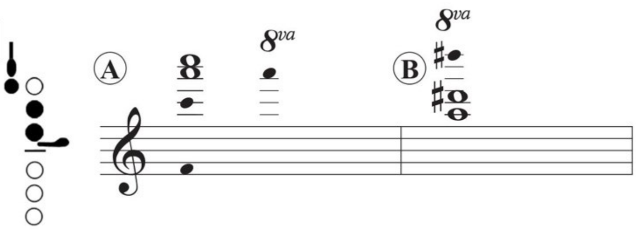


Stability	1	1
Attack dynamic	***pp–f***	***pp–f***
Attack immediacy	2	2
Crescendo range	***pp–f***	***pp–f***
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	no	yes
Comments		

33

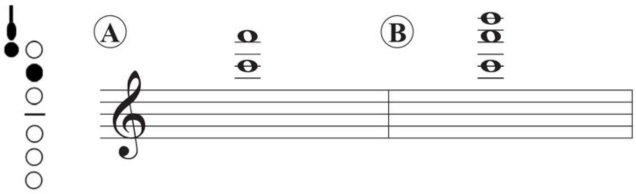
Stability	3
Attack dynamic	*pp–mf*
Attack immediacy	3
Crescendo range	*pp–mf*
OTs inc.with dyn.	yes
Emerge from bottom note	yes
Emerge from top note	yes
Comments	

34

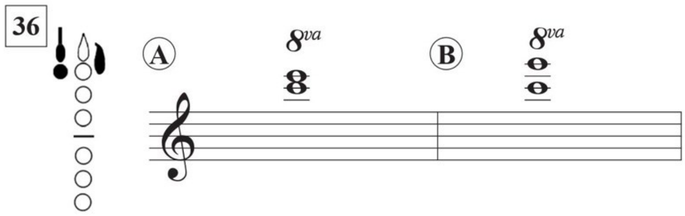


Stability	1	1
Attack dynamic	*p*	*pp–mp*
Attack immediacy	1	1
Crescendo range	no	*pp–mp*
OTs inc.with dyn.	no	yes
Emerge from bottom note	yes	yes
Emerge from top note	no	yes
Comments		

35

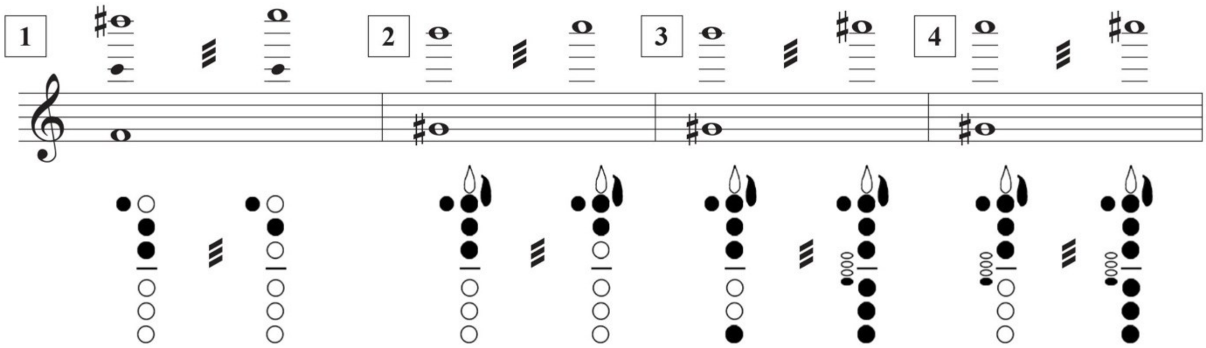


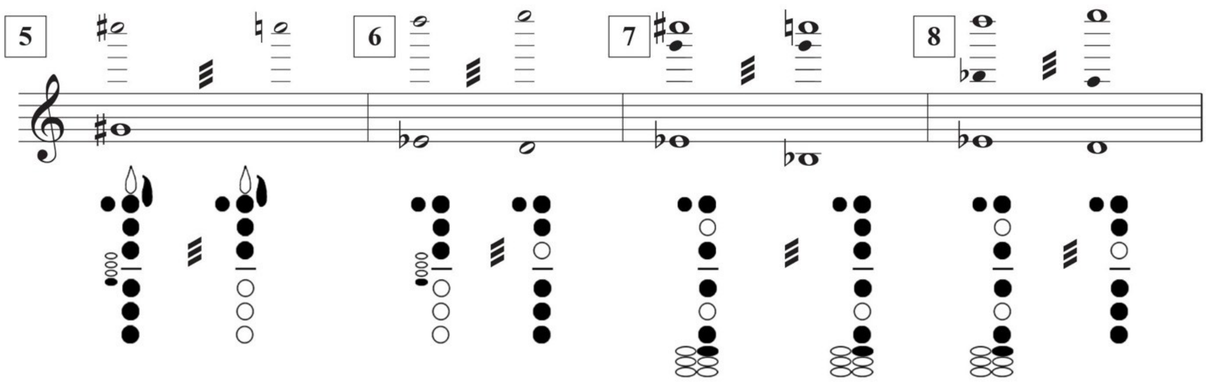
Stability	2	2
Attack dynamic	*pp–mf*	*pp–mf*
Attack immediacy	2	2
Crescendo range	*pp–mf*	*pp–mf*
OTs inc.with dyn.	yes	yes
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		



	A	B
Stability	1	1
Attack dynamic	***p***	***pp–mf***
Attack immediacy	1	1
Crescendo range	no	***pp–mf***
OTs inc.with dyn.	no	no
Emerge from bottom note	yes	yes
Emerge from top note	yes	yes
Comments		

Multiphonic Tremolos





Cross-Compatible

The Cross-Compatible Contrabass Clarinet Multiphonics chart collates from the individual fingering charts. Several changes have been made to create a single chart applicable to all three instruments.

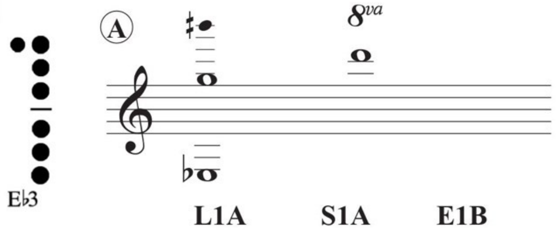
- Rather than an illustration for the little-finger and right-thumb keys, the letter name for the key is used.
- The pitch content of each multiphonic takes an average from the three instruments. The pitches used here appear in at least two of the instruments. Focus was placed on the primary pitches; however, secondary pitches that were present in at least two contrabass clarinets were also included.
- A three-part label indicates which multiphonic from the individual charts are being used. The label consists of:
    - Letter- L(eblanc), S(elmer), or E(ppelsheim)
    - Number- Corresponding to the original fingering number
    - Letter- Corresponding to the set of overtones for the fingering

  For example, S13B is Selmer, 13th fingering, B set of overtones
- The response descriptors for each multiphonic vary between the instruments, so each were included.

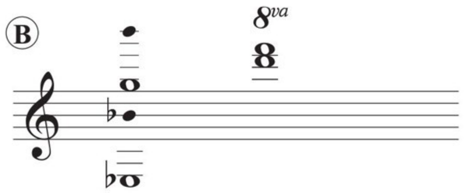
Audio Examples 0599-0829

Cross-Compatible Contrabass Clarinet Multiphonics

1

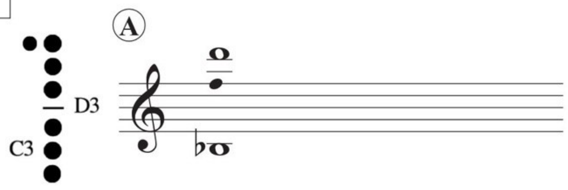


	L1A	S1A	E1B
Stability	3	2	3
Attack dynamic	***pp–ff***	***pp–ff***	***pp–ff***
Attack immediacy	3	3	3
Crescendo range	***pp–ff***	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments		Difficult to maintain top pitch at higher dynamics	

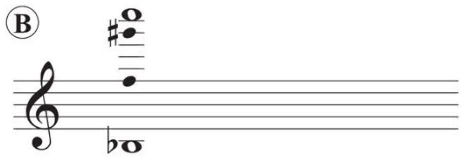


	L1B	S1B	E1C
Stability	3	2	2
Attack dynamic	***pp–ff***	***pp–ff***	***pp–ff***
Attack immediacy	3	3	3
Crescendo range	***pp–ff***	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments		Difficult to maintain top pitch at higher dynamics	

2

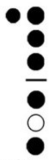


	L2A	S2A	E2A
Stability	3	2	3
Attack dynamic	***pp–f***	***pp–mf***	***pp–ff***
Attack immediacy	3	2	3
Crescendo range	***pp–f***	***pp–mf***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			F5 emerges at louder dynamic

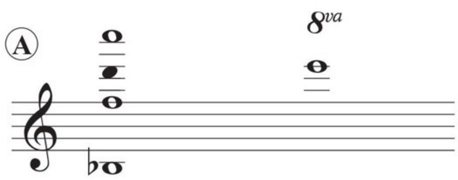


	L2B	S2B	E2B
Stability	3	2	3
Attack dynamic	***pp–f***	***pp–mf***	***pp–mp***
Attack immediacy	3	2	3
Crescendo range	***pp–f***	***pp–mf***	***pp–mf***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

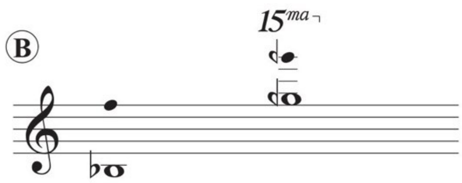
3



E♭3

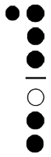


	L3B	S3C	E3B
Stability	3	2	2
Attack dynamic	***pp–f***	***pp–ff***	***mp–mf***
Attack immediacy	3	2	2
Crescendo range	***pp–ff***	***pp–ff***	***mp–f***
OTs inc.with dyn.	yes	yes	no
Emerge from bottom note	yes	yes	no
Emerge from top note	yes	yes	yes
Comments			



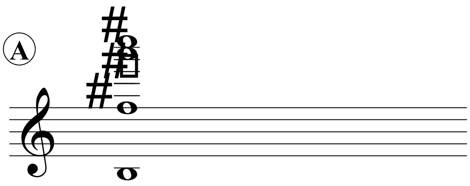
	L3C	S3D	E3C
Stability	3	3	3
Attack dynamic	***pp–ff***	***pp–ff***	***p–f***
Attack immediacy	3	2	3
Crescendo range	***pp–ff***	***pp–ff***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

4



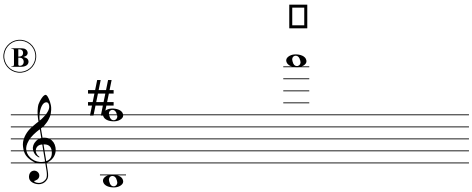
F3

A



	L5B	S4B	E5B
Stability	3	3	3
Attack dynamic	*pp-ff*	*pp-ff*	*pp-ff*
Attack immediacy	3	2	3
Crescendo range	*pp-ff*	*pp-ff*	*pp-ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

B

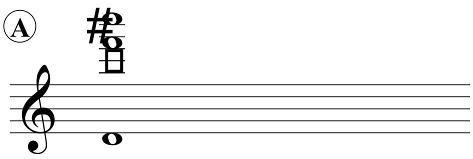


	L5D	S4D	E5D
Stability	2	3	2
Attack dynamic	*pp-ff*	*pp-ff*	*pp-f*
Attack immediacy	2	3	3
Crescendo range	*pp-ff*	*pp-ff*	*pp-f*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

5

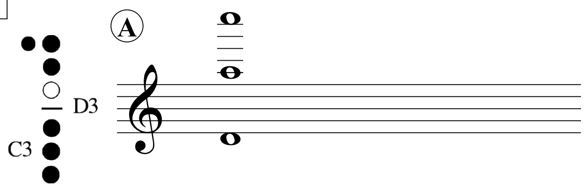
F♯3

A



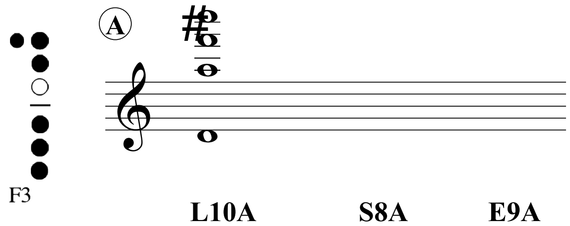
	L8B	S6B	E7A
Stability	3	3	3
Attack dynamic	*pp-ff*	*pp-ff*	*pp-ff*
Attack immediacy	3	3	3
Crescendo range	*pp-ff*	*pp-ff*	*pp-ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

6



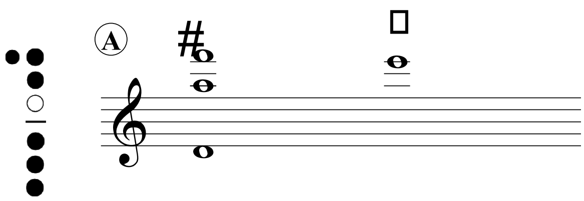
	L9B	S7B	E8A
Stability	3	3	3
Attack dynamic	*pp-ff*	*pp-ff*	*pp-ff*
Attack immediacy	3	3	3
Crescendo range	*pp-ff*	*pp-ff*	*pp-ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

7



	L10A	S8A	E9A
Stability	2	3	3
Attack dynamic	*pp-ff*	*pp-ff*	*pp-ff*
Attack immediacy	2	3	3
Crescendo range	*pp-ff*	*pp-ff*	*pp-ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments	Internal oscillating		

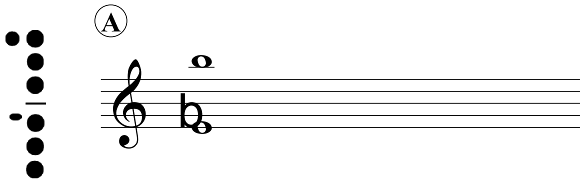
8



	L11B	S9A	E10B
Stability	3	2	2
Attack dynamic	*pp-ff*	*pp-ff*	*pp-ff*
Attack immediacy	3	2	2
Crescendo range	*pp-ff*	*pp-ff*	*pp-ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

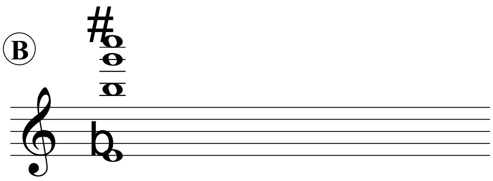
9

(A)



	L12A	S10A	E11A
Stability	2	3	1
Attack dynamic	*pp-f*	*pp-ff*	*pp-p*
Attack immediacy	3	3	2
Crescendo range	*pp-f*	*pp-ff*	*pp-p*
OTs inc.with dyn.	yes	yes	no
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	no
Comments	Internal oscillating		Internal oscillating

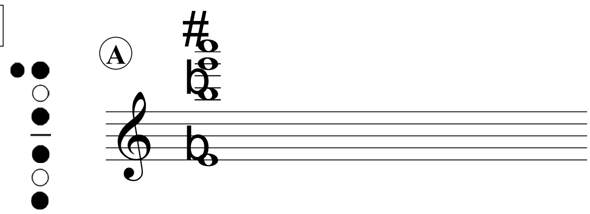
(B)



	L12B	S10B	E11B
Stability	3	2	3
Attack dynamic	*pp-ff*	*pp-f*	*pp-ff*
Attack immediacy	3	2	3
Crescendo range	*pp-ff*	*pp-f*	*pp-ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments	Internal oscillating		Internal oscillating

10

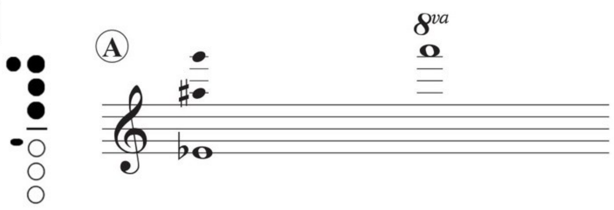
(A)



A♭3

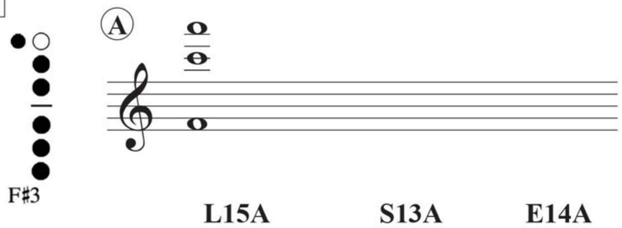
	L13A	S11A	E12A
Stability	2	3	3
Attack dynamic	*pp-ff*	*pp-ff*	*pp-ff*
Attack immediacy	2	3	3
Crescendo range	*pp-ff*	*pp-ff*	*pp-ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

11

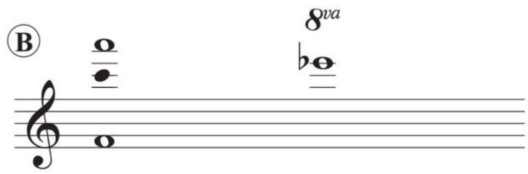


	L14A	S12D	E13C
Stability	2	2	2
Attack dynamic	*pp–ff*	*pp–ff*	*pp–ff*
Attack immediacy	2	3	2
Crescendo range	*pp–ff*	*pp–ff*	*pp–ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	no	yes
Comments			

12

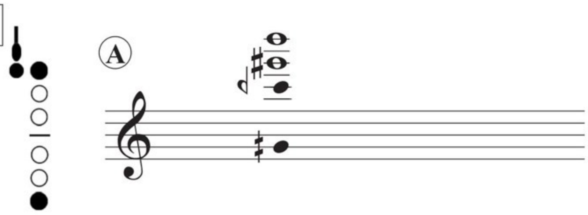


	L15A	S13A	E14A
Stability	2	2	2
Attack dynamic	*pp–mp*	*pp–p*	*pp–p*
Attack immediacy	2	3	3
Crescendo range	*pp–mp*	*pp–p*	*pp–p*
OTs inc.with dyn.	no	no	no
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	no	yes
Comments	Internal oscillating		



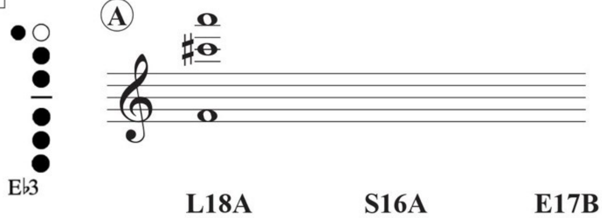
	L15B	S13B	E14B
Stability	2	2	3
Attack dynamic	*pp–mf*	*pp–mf*	*pp–ff*
Attack immediacy	2	2	3
Crescendo range	*pp–mf*	*pp–mf*	*pp–ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	no	yes
Emerge from top note	yes	yes	yes
Comments			

13



	L17B	S15B	E16A
Stability	1	1	2
Attack dynamic	*pp*–*mp*	*pp*–*mp*	*pp*–*p*
Attack immediacy	2	2	2
Crescendo range	*pp*–*mp*	*pp*–*mp*	*pp*–*p*
OTs inc.with dyn.	no	no	no
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

14

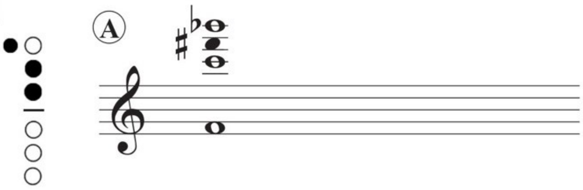


	L18A	S16A	E17B
Stability	2	2	2
Attack dynamic	*pp*–*mp*	*pp*–*f*	*pp*–*mp*
Attack immediacy	3	3	2
Crescendo range	*pp*–*mp*	*pp*–*f*	*pp*–*mp*
OTs inc.with dyn.	yes	yes	no
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

	L18B	S16B	E17C
Stability	2	2	2
Attack dynamic	*pp*–*ff*	*pp*–*f*	*pp*–*mf*
Attack immediacy	2	2	3
Crescendo range	*pp*–*ff*	*pp*–*f*	*pp*–*mf*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

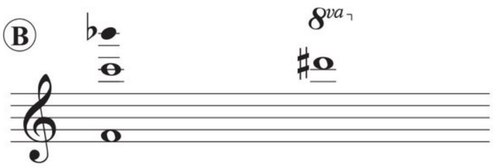
15

A



	L19A	S17A	E18A
Stability	3	3	2
Attack dynamic	*pp–ff*	*pp–ff*	*pp–f*
Attack immediacy	3	3	2
Crescendo range	*pp–ff*	*pp–ff*	*pp–f*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments		F♯6 emerges at louder dynamics	

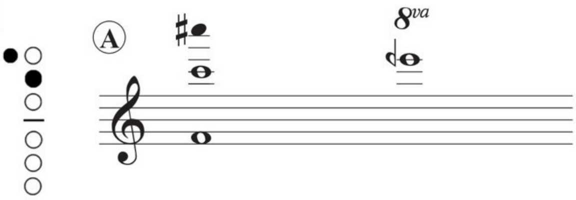
B



	L19B	S17B	E18B
Stability	3	2	2
Attack dynamic	*pp–ff*	*pp–f*	*pp–f*
Attack immediacy	3	3	2
Crescendo range	*pp–ff*	*pp–f*	*pp–f*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

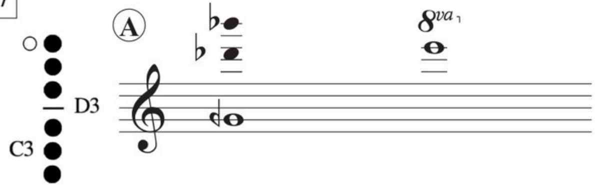
16

A

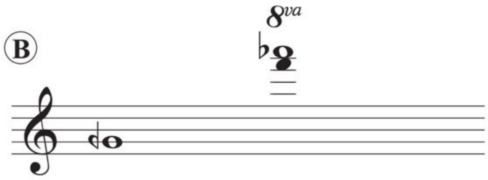


	L21A	S19C	E20C
Stability	3	3	1
Attack dynamic	*pp–ff*	*pp–ff*	*pp–mp*
Attack immediacy	3	3	2
Crescendo range	*pp–ff*	*pp–ff*	*pp–mp*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

17

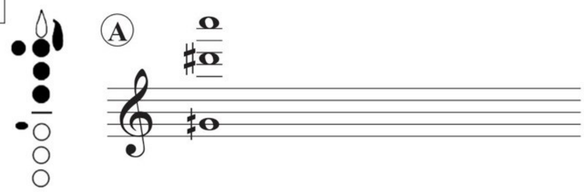


	L22C	S20D	E21B
Stability	1	2	3
Attack dynamic	***pp–p***	***pp–ff***	***pp–f***
Attack immediacy	1	2	3
Crescendo range	no	***pp–ff***	***pp–f***
OTs inc.with dyn.	no	yes	yes
Emerge from bottom note	no	yes	yes
Emerge from top note	no	yes	yes
Comments	Internal oscillating		



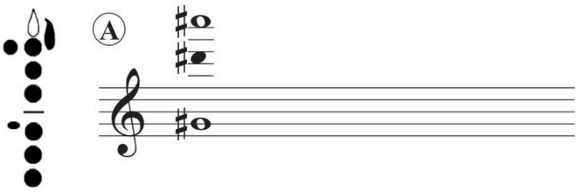
	L22D	S20E	E21C
Stability	1	2	1
Attack dynamic	***pp–mf***	***pp–ff***	***pp***
Attack immediacy	2	2	1
Crescendo range	***pp–mf***	***pp–ff***	***pp–mp***
OTs inc.with dyn.	yes	yes	no
Emerge from bottom note	no	yes	yes
Emerge from top note	yes	yes	yes
Comments			

18



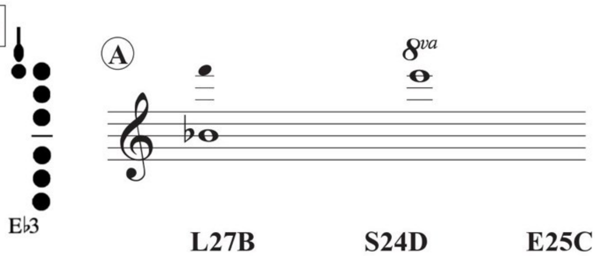
	L25A	S22A	E22A
Stability	2	2	3
Attack dynamic	***pp–mf***	***pp–f***	***pp–ff***
Attack immediacy	2	3	3
Crescendo range	***pp–mf***	***pp–f***	***pp–ff***
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments	Internal oscillating		

19



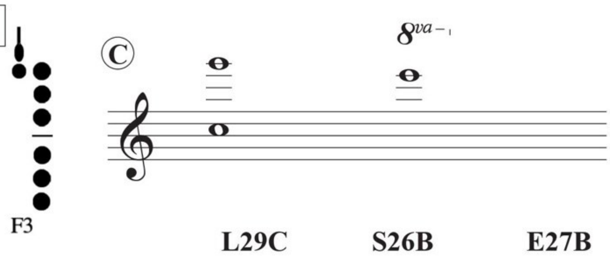
	L26A	S23A	E24A
Stability	3	3	3
Attack dynamic	*pp*–*ff*	*pp*–*ff*	*pp*–*ff*
Attack immediacy	3	3	3
Crescendo range	*pp*–*ff*	*pp*–*ff*	*pp*–*ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

20



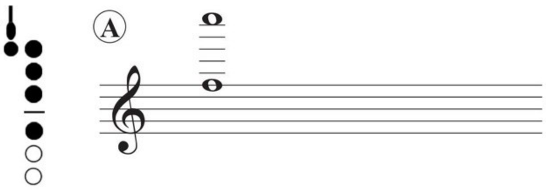
	L27B	S24D	E25C
Stability	3	2	1
Attack dynamic	*pp*–*ff*	*pp*–*ff*	*pp*–*f*
Attack immediacy	3	2	1
Crescendo range	*pp*–*ff*	*pp*–*ff*	*pp*–*f*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	no	yes
Comments			

21



	L29C	S26B	E27B
Stability	3	3	2
Attack dynamic	*pp*–*ff*	*pp*–*ff*	*pp*–*ff*
Attack immediacy	3	2	2
Crescendo range	*pp*–*ff*	*pp*–*ff*	*pp*–*ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

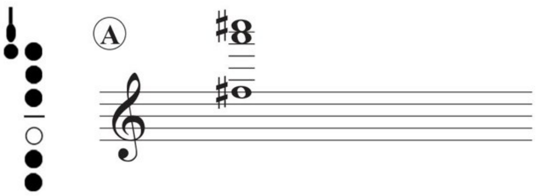
22



(A)

	L31A	S28A	E28A
Stability	2	3	3
Attack dynamic	*pp*–*ff*	*pp*–*ff*	*pp*–*ff*
Attack immediacy	2	3	3
Crescendo range	*pp*–*ff*	*pp*–*ff*	*pp*–*ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

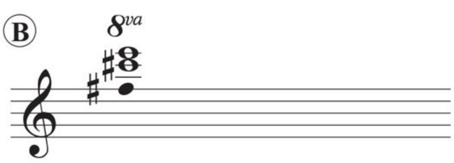
23



(A)

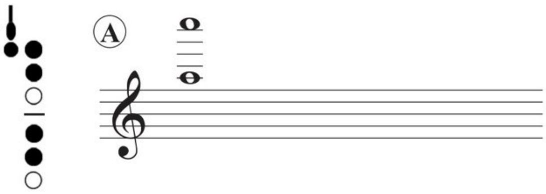
	L33B	S30B	E30A
Stability	2	2	1
Attack dynamic	*pp*–*mf*	*pp*–*f*	*pp*–*p*
Attack immediacy	3	2	1
Crescendo range	*pp*–*mf*	*pp*–*f*	*pp*–*p*
OTs inc.with dyn.	yes	yes	no
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

(B)



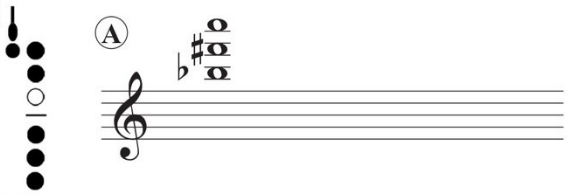
	L33C	S30C	E30B
Stability	2	2	1
Attack dynamic	*pp*–*ff*	*pp*–*ff*	*pp*–*mp*
Attack immediacy	2	2	1
Crescendo range	*pp*–*ff*	*pp*–*ff*	*pp*–*p*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

24



	L34A	S31A	E31A
Stability	2	3	3
Attack dynamic	*pp–mf*	*pp–f*	*pp–ff*
Attack immediacy	3	3	3
Crescendo range	*pp–mf*	*pp–f*	*pp–ff*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	yes
Comments			

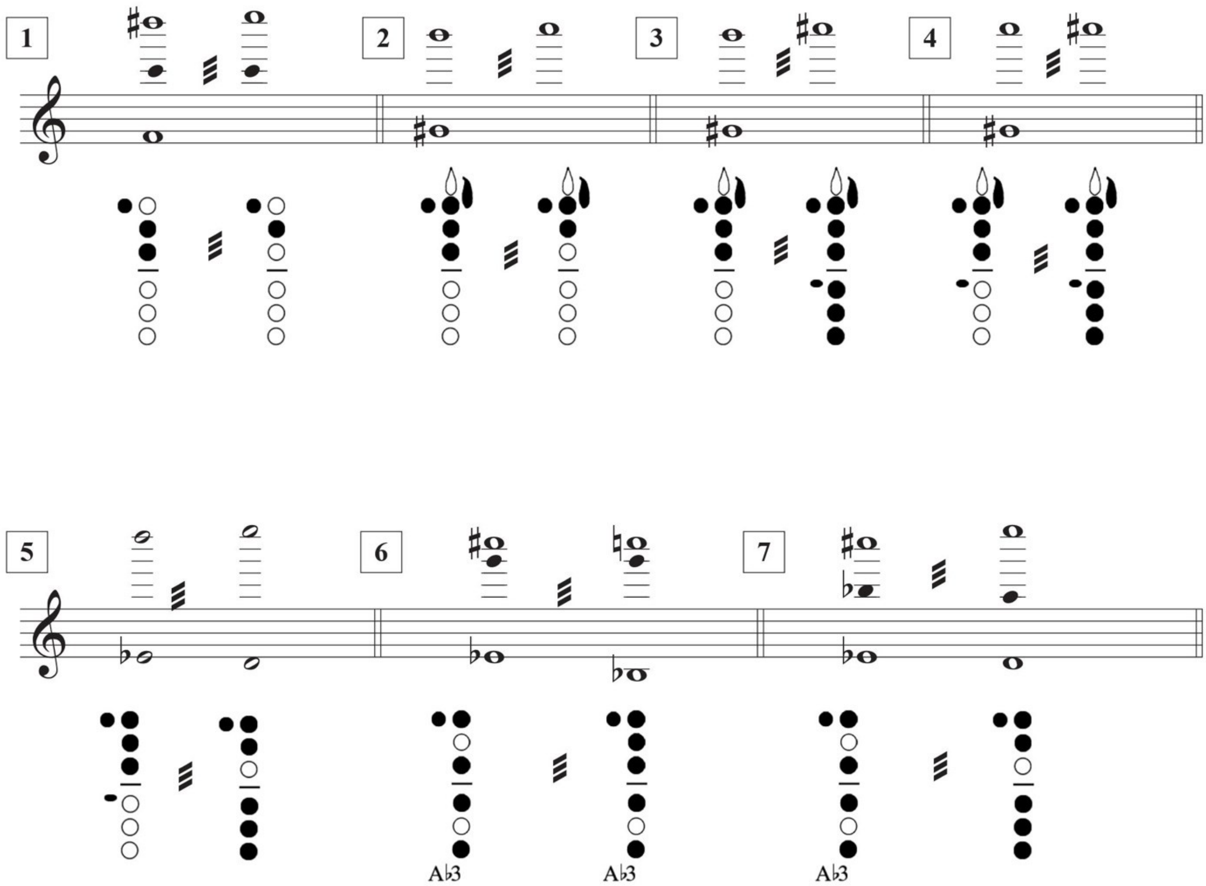
25



F3

	L35A	S32A	E32A
Stability	1	1	1
Attack dynamic	*pp–mp*	*pp–mp*	*pp–f*
Attack immediacy	2	1	2
Crescendo range	*pp–mp*	*pp–mp*	*pp–f*
OTs inc.with dyn.	yes	yes	yes
Emerge from bottom note	yes	yes	yes
Emerge from top note	yes	yes	no
Comments			

Multiphonic Tremolos



Colour Fingering Combinations Charts

Audio Examples 0830-0936

Colour-Coding

- Red borders indicate key groups. Only one key within each red border can be used at a time.
- Black boxes indicate keys for the base note
- Blue boxes indicate colour fingering keys and combinations.
- Green boxes indicate alternate keys. Only one or the other can be used at a time.
- Yellow boxes indicate disallowed combinations.
- Tan boxes indicate incomplete combinations. Extra keys are required, combined with another tan box if in the same column, otherwise any other colour-fingering.

Character-Coding (applies to like-coloured boxes)

- Boxes without any characters can be used with any other boxes, with or without characters
- 1 Numbered boxes used in combination must be like-numbers
- Z Lettered boxes used in combination must be like-letters
- / Symbolled boxes used in combination must be like-symbols

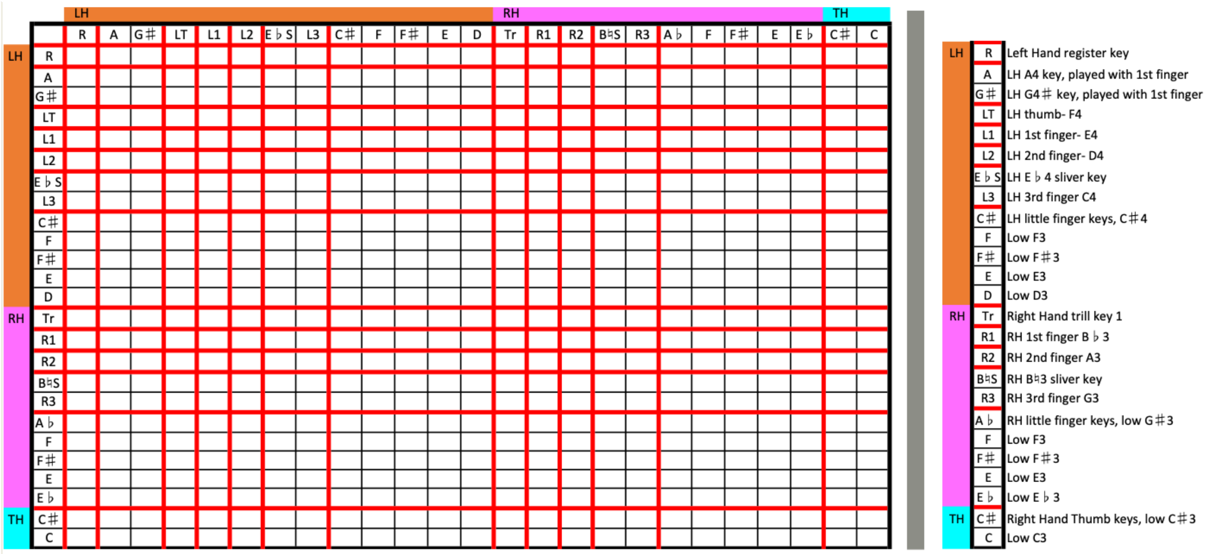


Figure 123. Colour-fingerings combinations grid

The X and Y axis of the grid represents every key on the contrabass clarinet. Each red box indicates keys operated by the same finger. Only one key within each red box group can be used at a time.

A black grid square indicates a key used to produce the normal note, marked in the box where the same key meets on the X-Y axis. E♭3 uses the left-hand thumb (LT), first (L1), second (L2), and third (L3) finger, and the right-hand first (R1), second (R2), third (R3) finger, and E♭ key (See

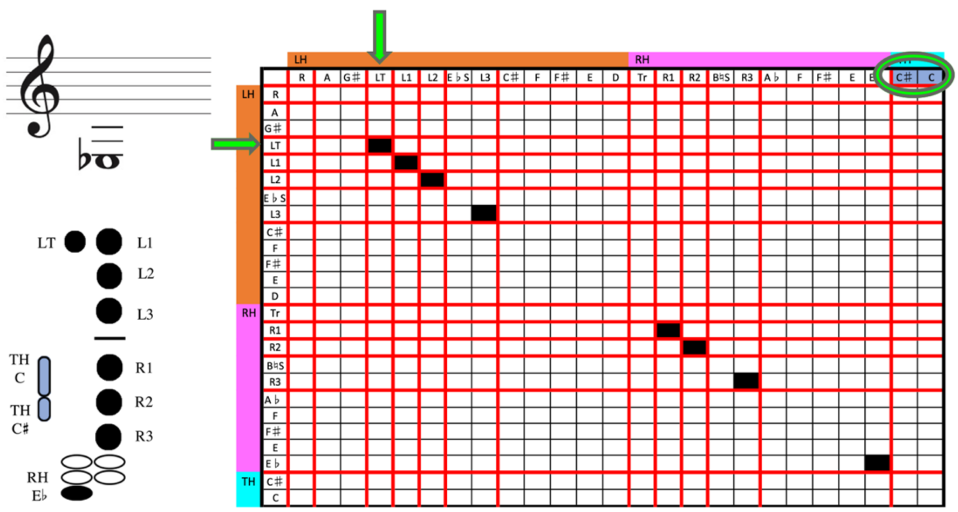


Figure 124).

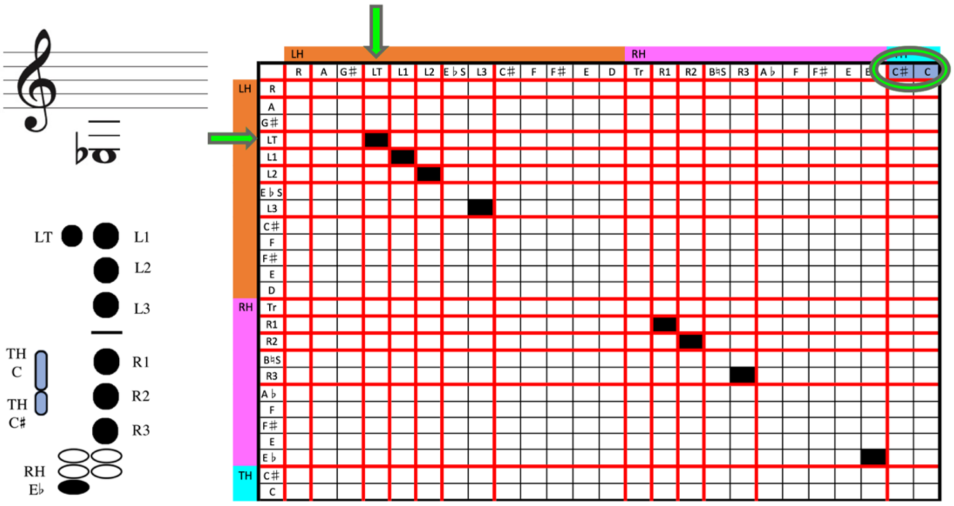
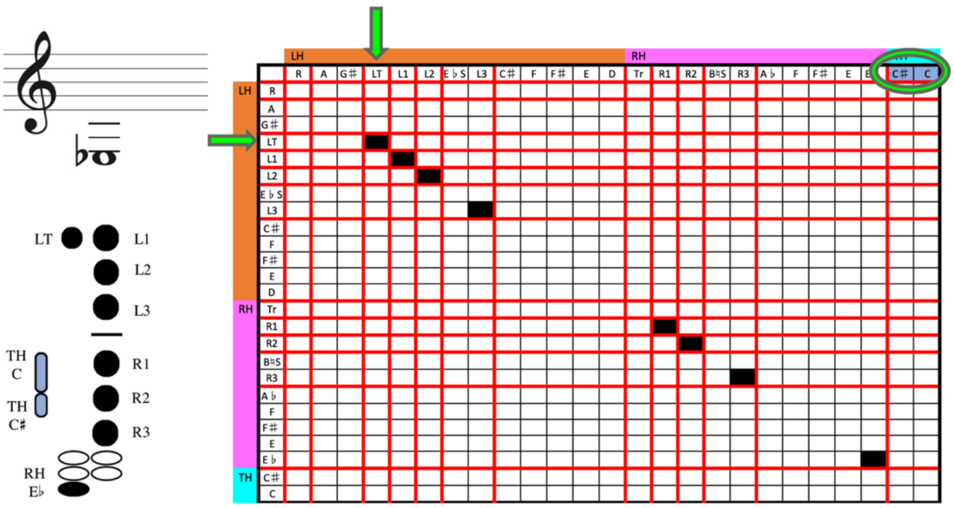


Figure 124. One colour-key added.

- One Colour-Key (



- Figure 124)

A blue-coloured column name is a key that can be added as a colour-fingering.

TH C♯ and C are the available colour-fingerings for E♭3.

They are both within the same red-box group, so they cannot form a combination.

- Two Colour-Keys Combination (Figure 125)

A blue box down a column indicates a colour-key combination with the key named in the corresponding row.

The colour keys for A♭3 are:

- LH F, F♯, E, and D. They are within the same red box group and cannot combine with each other.
- TH C♯ and C. They are within the same red box group and cannot combine with each other.

Example 1: In the LH F column, there are blue boxes in the rows TH C♯ and C. LH F can combine with one of these at a time. A combination of LH F and TH C can be made.

Example 2: In the TH C♯ column, there are blue boxes for LH F, F♯, E, and D. TH C♯ can combine with one of these at a time. A combination of TH C♯ and LH E can be made.

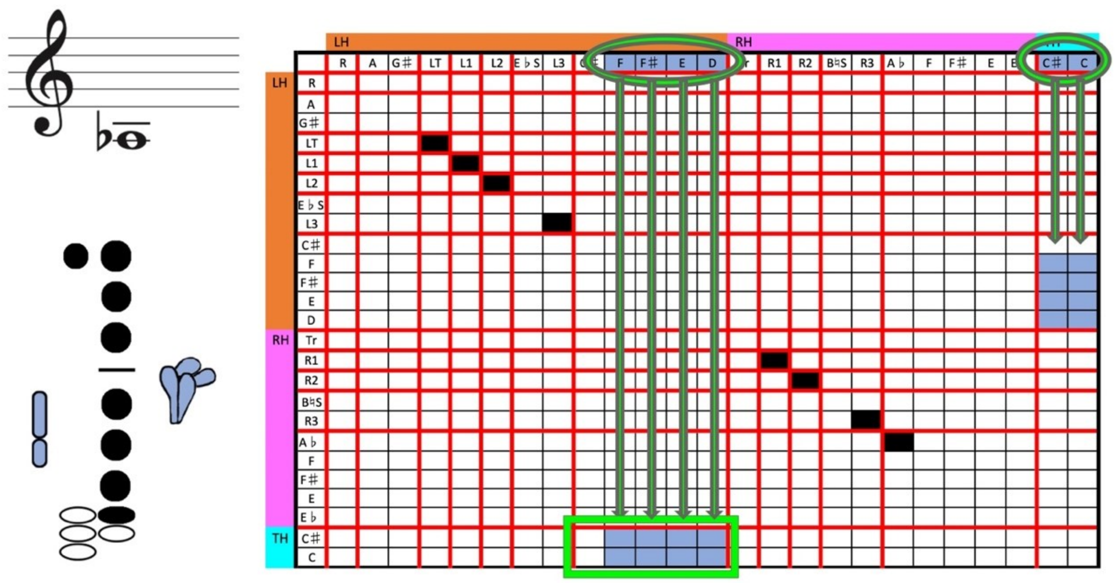


Figure 125. Two colour-keys added.

- <u>More than Two Colour-Keys Combination</u> (Figure 126)

  If there are multiple blue boxes in the column, the key can combine with each of the corresponding rows, provided they are within separate red boxes.

  The C♯4 grid shows there are ten possible colour-keys (R2, B♮ S, R3, A♭, F, F♯, E, E♭, C♯, C). They are situated within four separate red boxes, so combinations with up to four keys are possible.

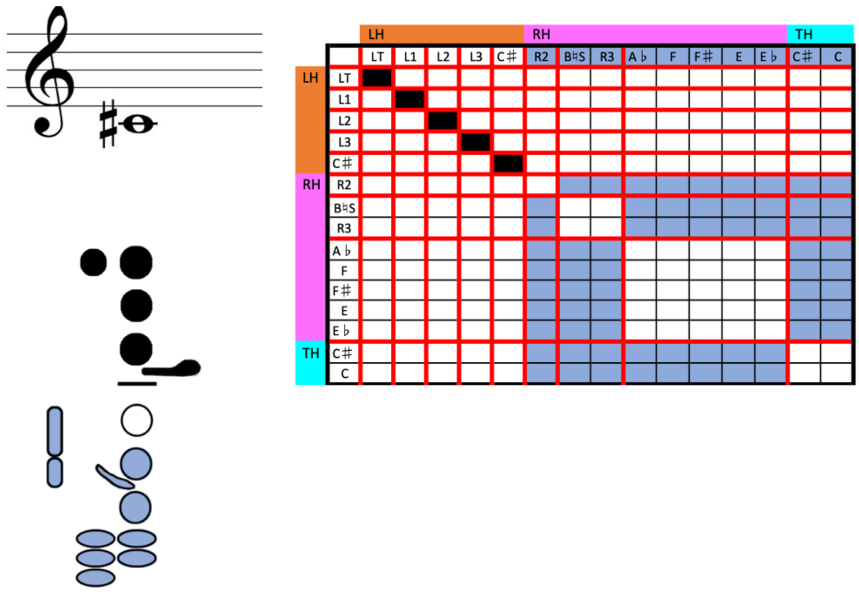


Figure 126. More than two colour-keys added.

Example 3: R2's column shows it can combine with:

- B♮S or R3
- RH A♭, F, F♯, E, or E♭
- TH C or C♯

Only one key from each group can be used simultaneously, but any combination from two, three, or four groups can combine together, such as R2 with R3, RH F♯, and TH C (Figure 127).

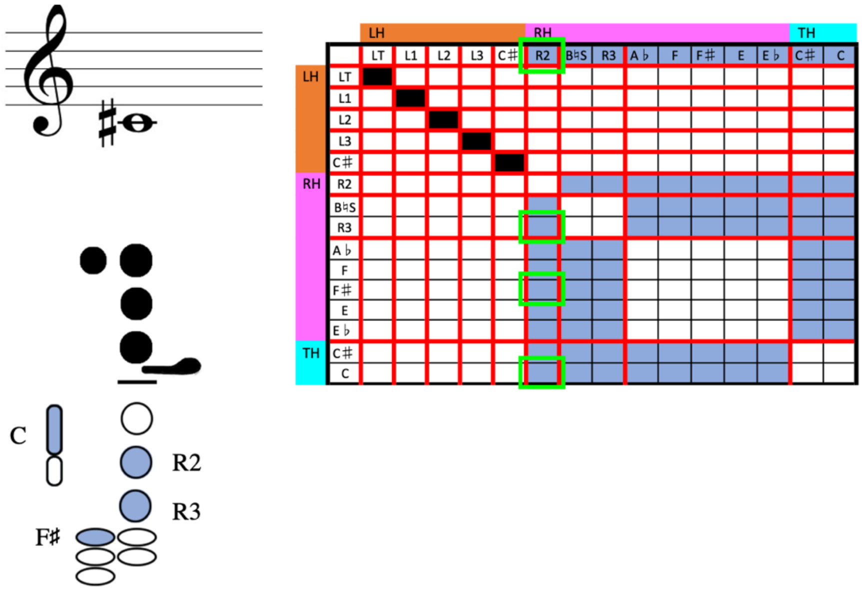


Figure 127. C♯4 with four colour-keys – R2, R3, LH F♯, TH C

- <u>Alternate Keys</u> (Figure 128)

  A green box is an alternate fingering. Only one or the other green key is used at a time. Which is used can affect the available colour-fingerings.

  In Figure 128, the F♯ key can be pressed by either the left or right hand.

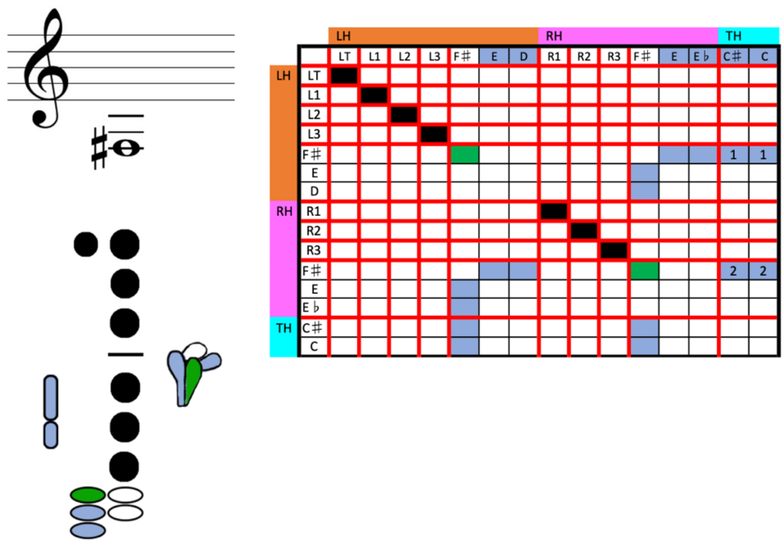


Figure 128. Alternate keys.

When LH F♯ is used, RH E♭ is an available colour-fingering (different red boxes).

When RH F♯ is used, LH D is available (Figure 129).

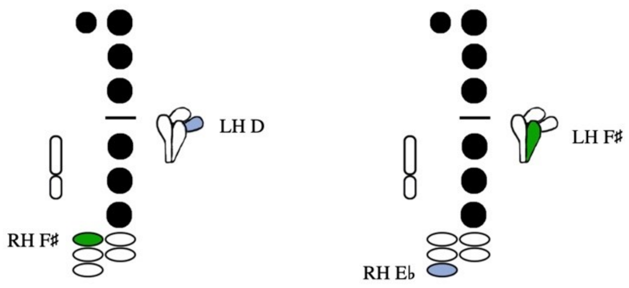


Figure 129. F♯3 alternate keys.

- <u>Duplicate keys- Numbered and Lettered Boxes</u> (Figure 130)

Character-coding indicates relationships of some alternate fingering keys that are doubled on the left and right sides, for example F, F♯, and E. Each side closes the same pad so they cannot be used together. Some keys also have a linkage that automatically closes other pads and cannot be used together.

Numbers indicate which keys can combine.

- A numbered box can only combine with another numbered-box if it has a like-number.
- A numbered box can combine freely with non-numbered boxes.

The colour-fingerings for A3 are:

- LH F, F♯, E, and D
- RH A♭, F, F♯, E, and E♭
- TH C♯ and C

Example 4: TH C can combine with LH F♯ and RH E♭, as they each have the number "1".

Example 5: Thumb C can combine with LH D and RH F♯, as they each have the number "2".

Example 6: TH C and LH F ("3") cannot combine with a RH key, as there is no other numbered-box with a corresponding "3".

Example 7: TH C and RH A♭ can combine with any LH key, as RH A♭ does not have a number.

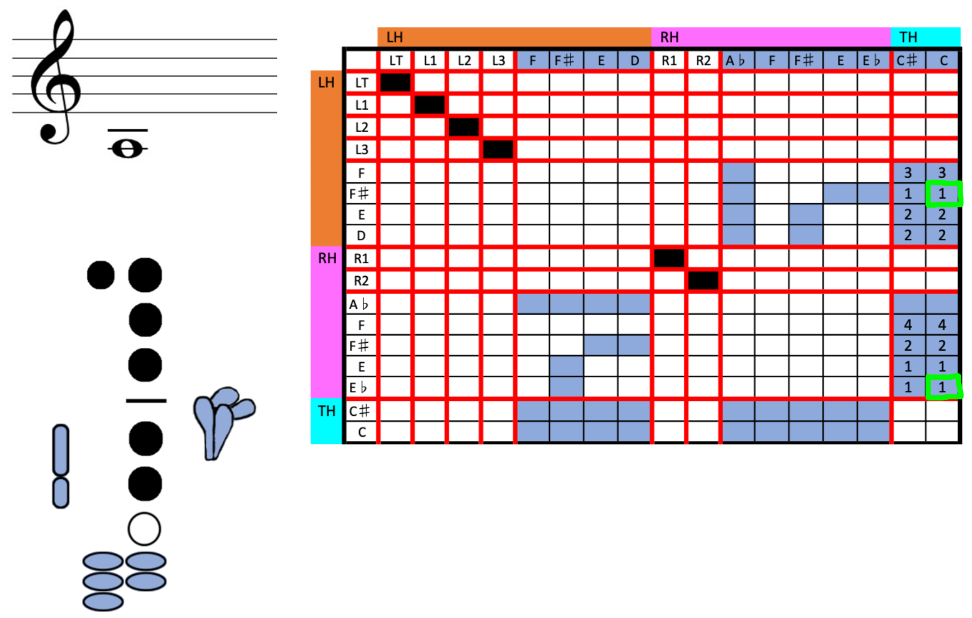


Figure 130. Duplicate keys numbering system.

Letters indicate further relationships (Figure 131).

- A lettered box can only combine with another lettered box if they have like-letters.
- A lettered box can be used freely with boxes with other characters or with non-charactered boxes.

Example 8:

- The R3-LH A♭ and R3-RH F♯ combinations both have a “Z”.
- R3-LH A♭-RH F♯ can form a three-key combination.
- R3-LH A♭ can combine with RH F, E, E♭, or D because they have numbers, not letters.

Example 9:

- C♯3-RH A♭ can combine with LH F♯ because they have “Y”.
- C♯3-RH A♭ can combine with R3 because it has no character.
- C♯3, RH A♭, LH F♯, and R3 can form a four-key combination.

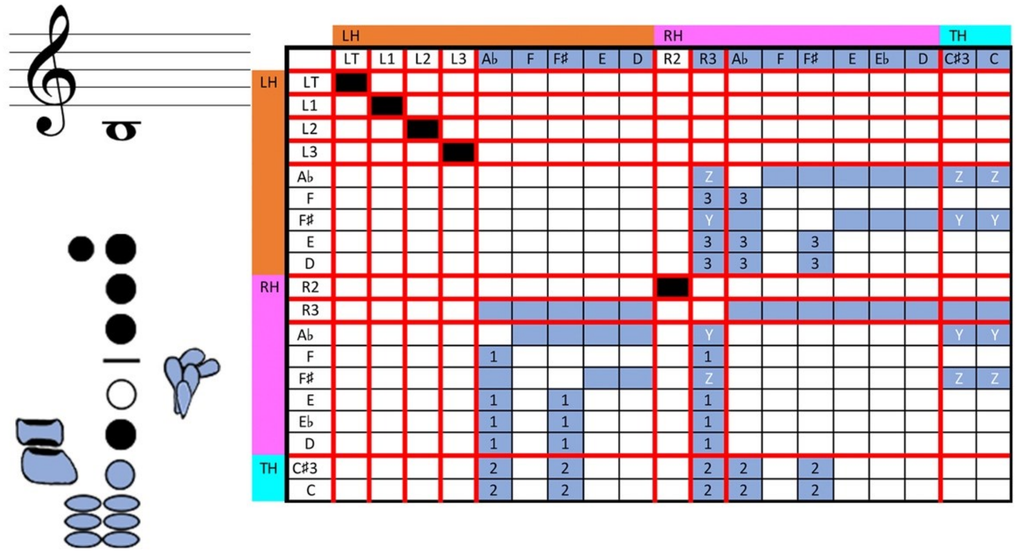


Figure 131. Additional character set- letters.

- Disallowed Combinations (Figure 132)
  - Yellow boxes can only combine with other yellow boxes with like-symbols.
  - A yellow box with multiple symbols can combine with another box if it contains the other box's first symbol.
  - Yellow boxes can combine with other-colour boxes as per other guidelines.

Example 10:
  - The L2-R combination has the symbols %/*.
  - The L2-L3 combination has the symbols *%@.
  - Both combination boxes contain the other combination's first symbol, so they can combine into a three-key combination.

Example 11:
  - The L2-R3 combination has the symbols @*/.
  - L2-R does not have @.
  - L2, R3, and R cannot form a three-key combination.
  - L2-L3 does have @, so L2, L3, and R3 can form a three-key combination.

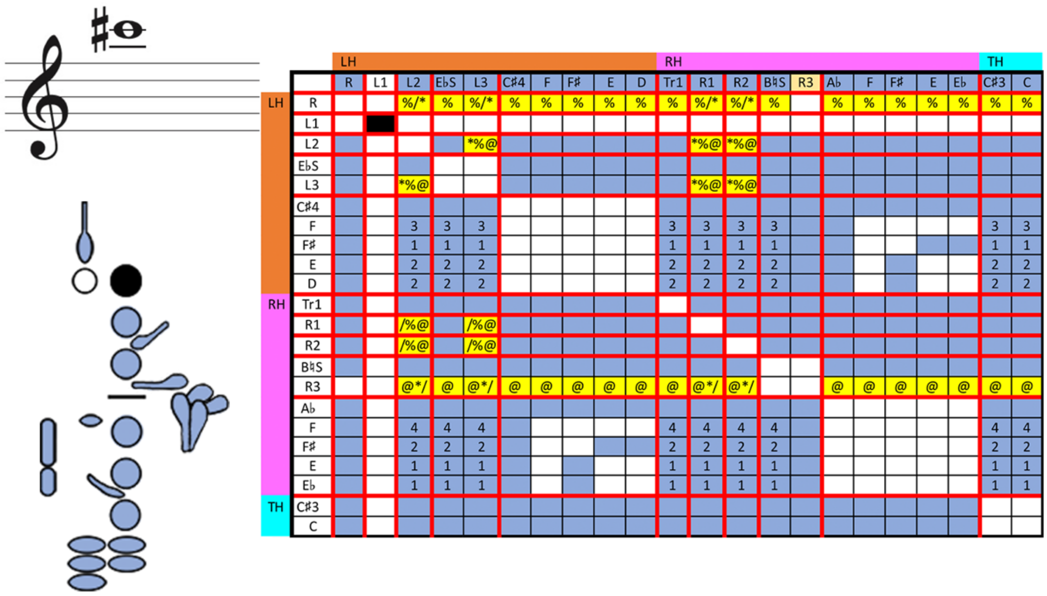


Figure 132. Disallowed combinations.

- Incomplete Combinations (Figure 133)
  - A tan column name or combination box must combine with other tan boxes in the column.
  - If there is no other tan box it must combine with another colour-key, as per other guidelines.

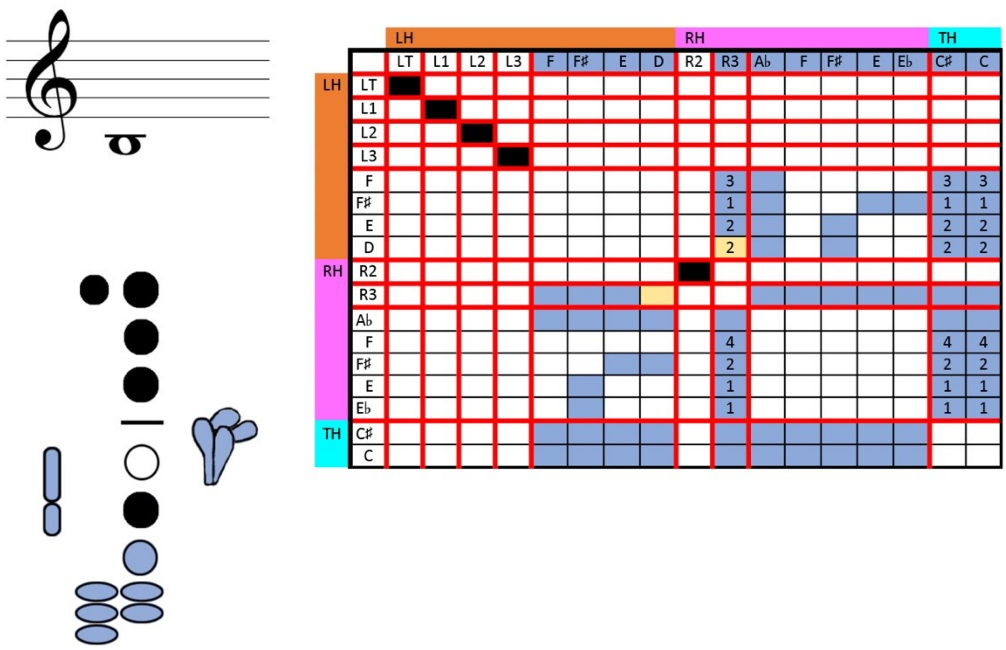


Figure 133. Incomplete combinations.

Example 12:

- The R3-D combination is tan. There is no other tax box in the column, so it must combine with another colour-fingering.
- The “2” still applies to the Duplicate Keys rule.
- R3-D can combine with F♯ (“2”), or A♭, C♯, or C (no number).

- Dynamics

  Some general guidelines apply to colour-fingering dynamics:
  - Colour-fingering changes are less noticeable at soft dynamics.
  - Colour-fingering changes are more noticeable at louder dynamics.
  - Keys closest to the last open hole create the most change.
  - Keys that close pads have more effect than those that open them.
  - Low C3 on Selmer and Eppelsheim and Low D3 on Leblanc have a greater effect because they close several pads at once.

These are just guidelines and do not apply to every note, so each fingering grid includes additional dynamics information regarding which single colour-keys are:

Most effective at *p*
Least effective at *f*

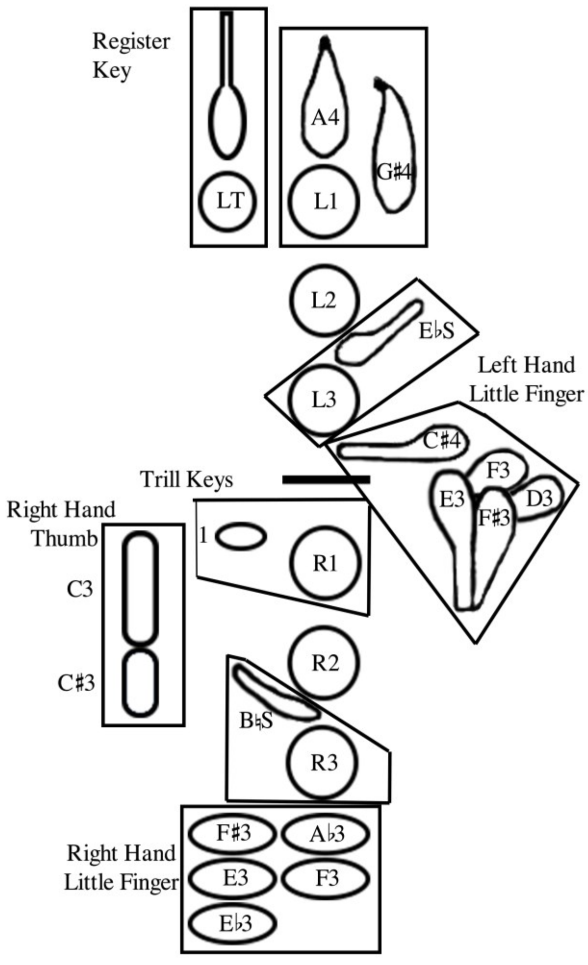
The included diagrams represent the fingering for each note with the available single colour-keys. The grids provide information for combining the colour-keys and are not meant for use in a score. A composer wishing to illustrate a specific colour-key combination is advised to use a diagram format such as Figure 127.

Leblanc

Colour-Fingering Combinations Grids

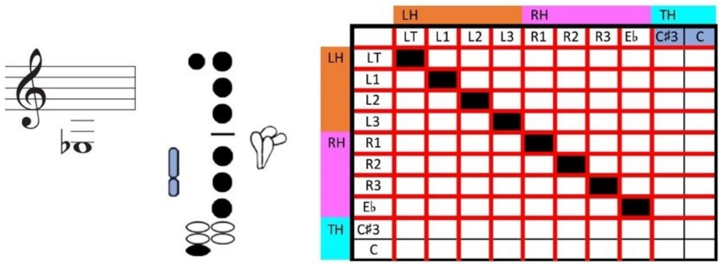
Audio Examples 0830-0869

LH	R	Left Hand register key
	A	LH A4 key, played with 1st finger
	G♯	LH G4♯ key, played with 1st finger
	LT	LH thumb- F4
	L1	LH 1st finger- E4
	L2	LH 2nd finger- D4
	E♭S	LH E♭ sliver key
	L3	LH 3rd finger C4
	C♯4	LH little finger keys, C♯4
	F	Low F3
	F♯	Low F♯3
	E	Low E3
	D	Low D3
RH	Tr1	Right Hand trill key 1
	R1	RH 1st finger B♭3
	R2	RH 2nd finger A3
	B♮S	RH B♮3 sliver key
	R3	RH 3rd finger G3
	A♭	RH little finger keys, low A♭3
	F	Low F3
	F♯	Low F♯3
	E	Low E3
	E♭	Low E♭3
TH	C♯3	Right Hand Thumb keys, low C♯3
	C	Low C3



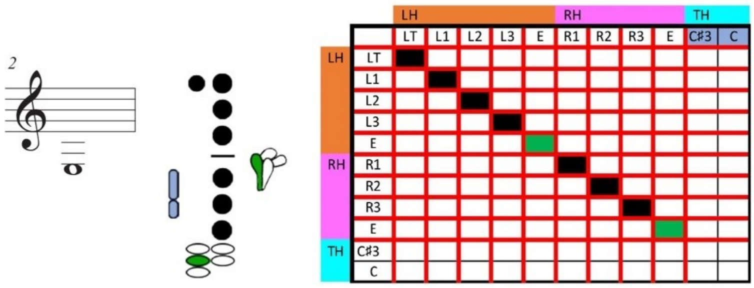
Appendix

Leblanc Contrabass Clarinet
Colour-Fingering Combinations



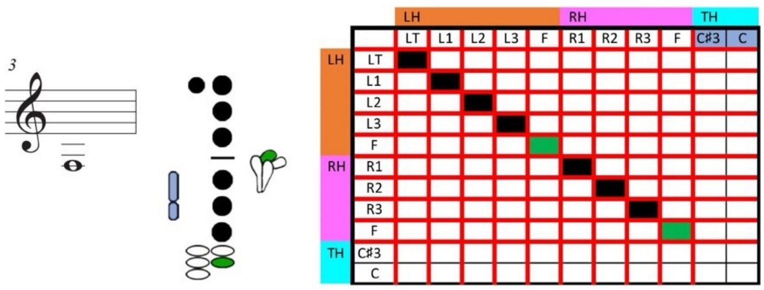
Most effective at *p*: All

Least effective at *f*:



Most effective at *p*: All

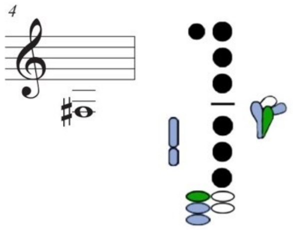
Least effective at *f*:

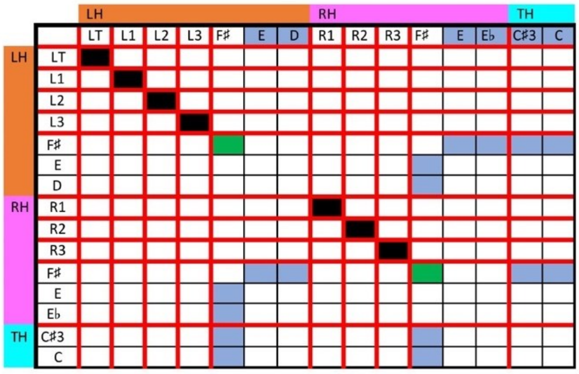


Most effective at *p*: All

Least effective at *f*:

4

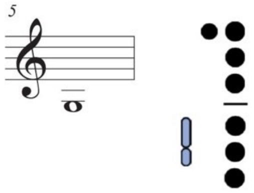


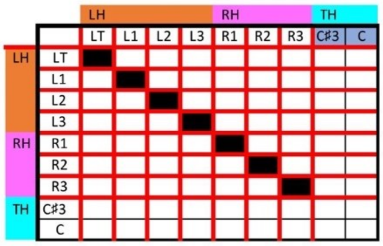


Most effective at *p*: All

Least effective at *f*:

5

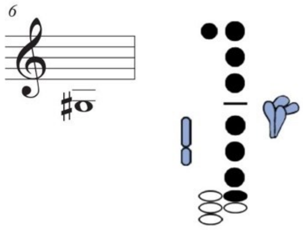


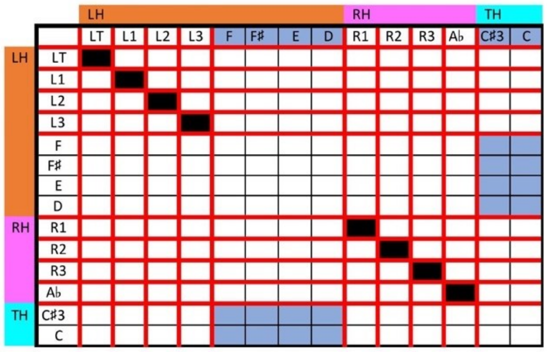


Most effective at *p*: All

Least effective at *f*:

6

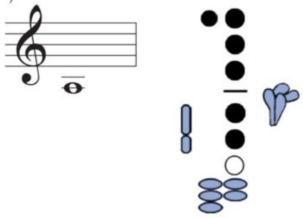


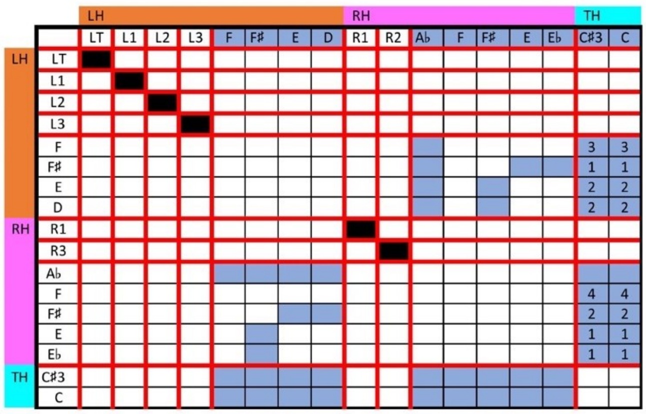


Most effective at *p*: All

Least effective at *f*:

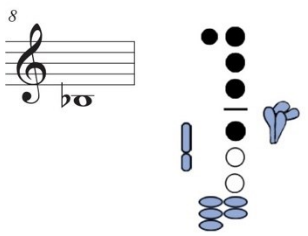
7

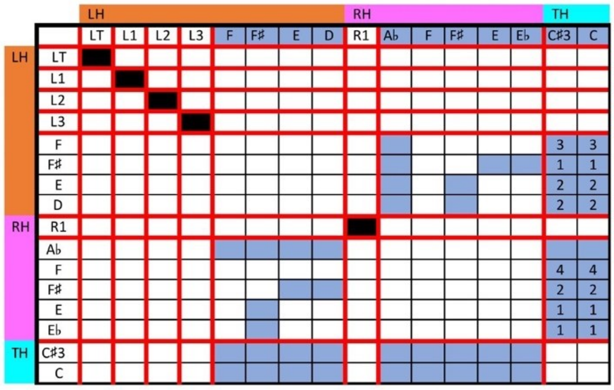




Most effective at *p*: All

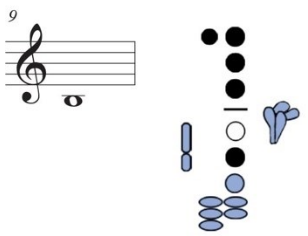
Least effective at *f*:

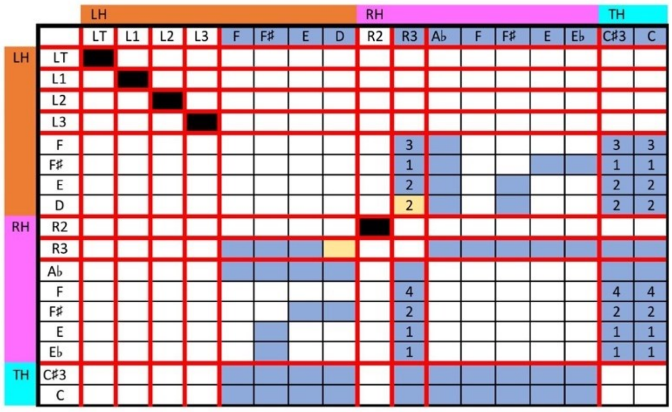




Most effective at *p*: All

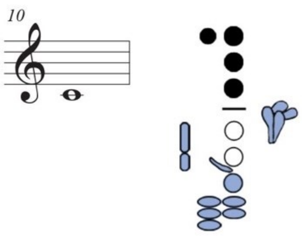
Least effective at *f*:

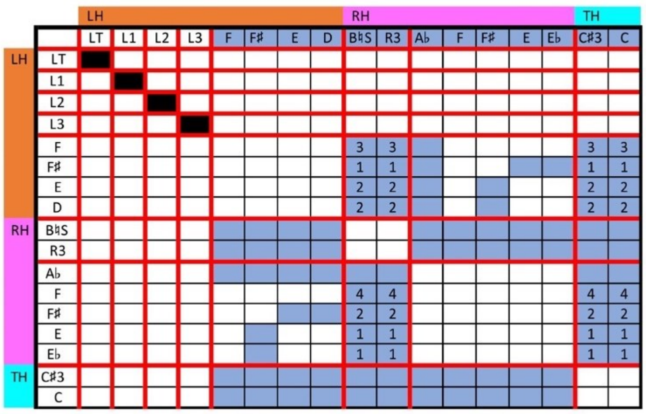




Most effective at *p*: All

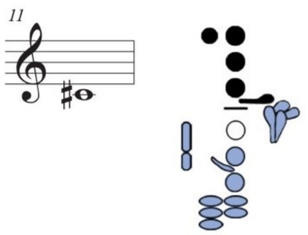
Least effective at *f*:

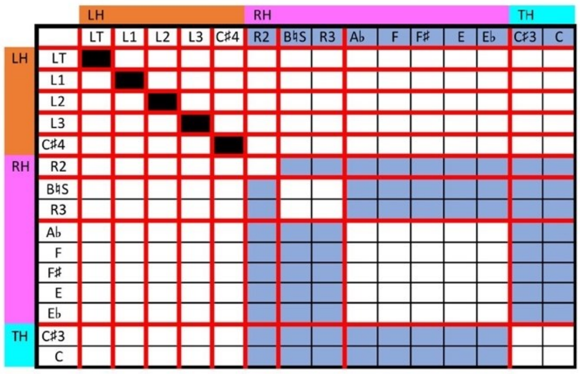




Most effective at *p*: E, F♯, E♭, D

Least effective at *f*:

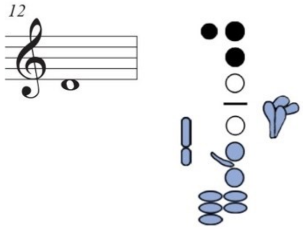


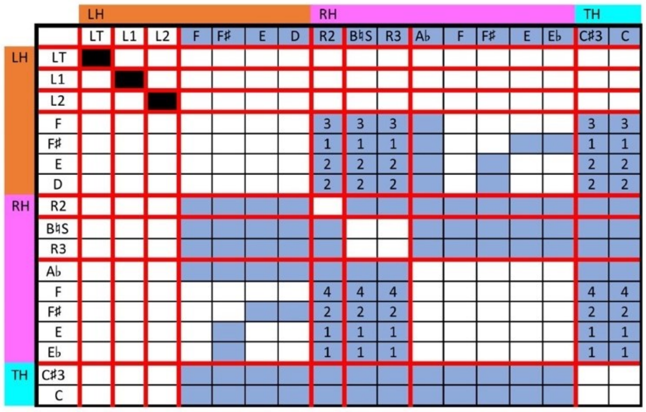


Most effective at *p*: R2

Least effective at *f*:

12

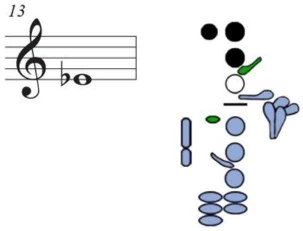


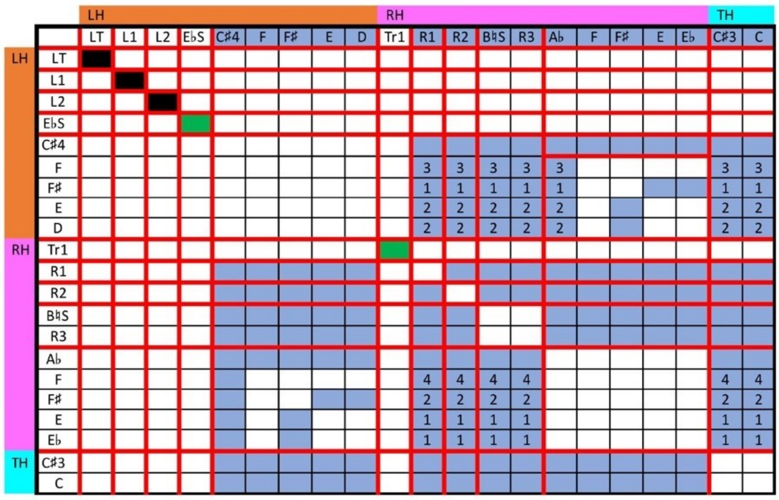


Most effective at *p*: R2, E♭, D

Least effective at *f*: R3

13

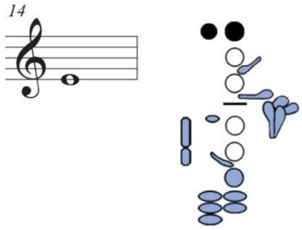


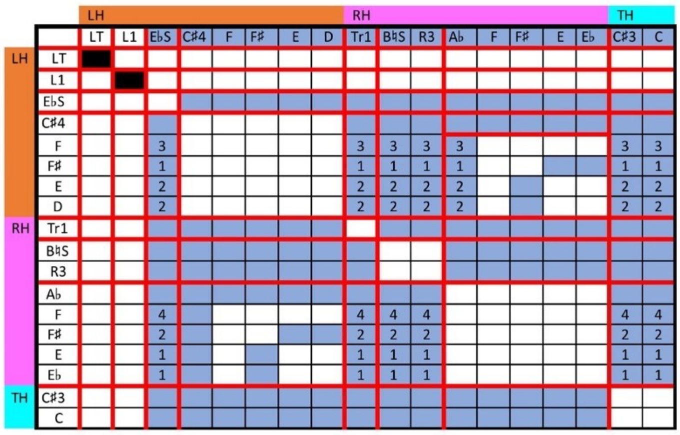


Most effective at *p*: R1, R2, D

Least effective at *f*:

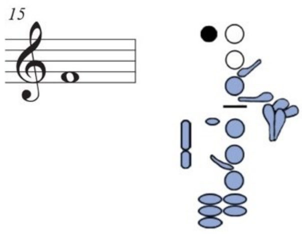
14

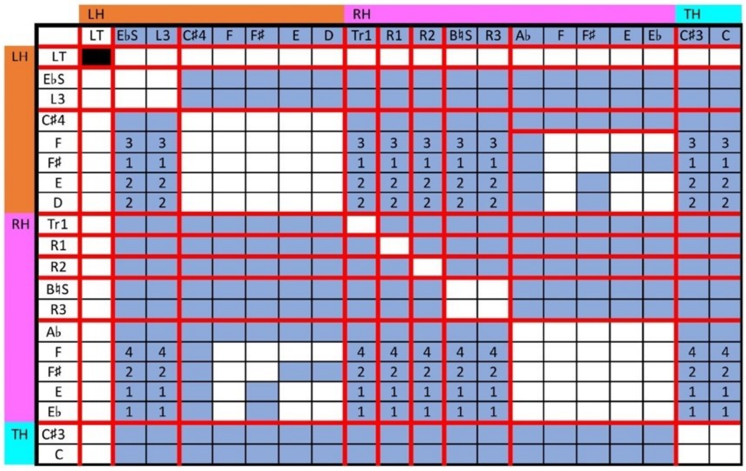




Most effective at *p*: E♭S, Tr1, D

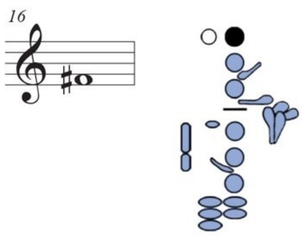
Least effective at *f*:

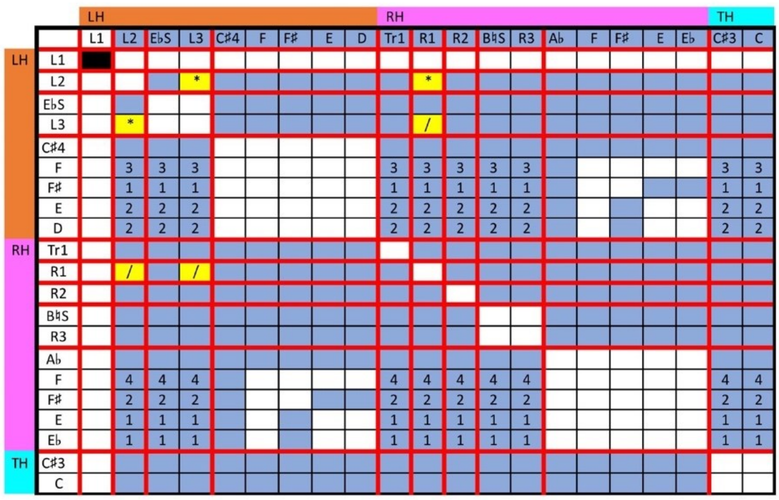




Most effective at *p*: D

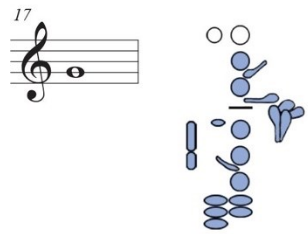
Least effective at *f*:

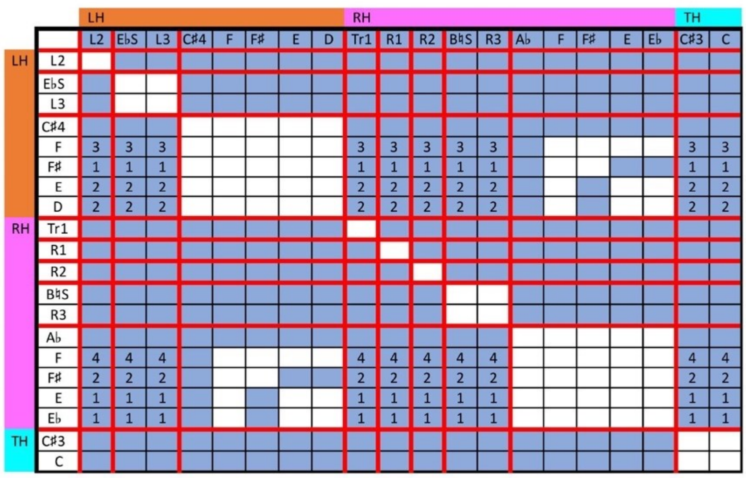




Most effective at *p*: L2, L3, R1, R2, E♭, D

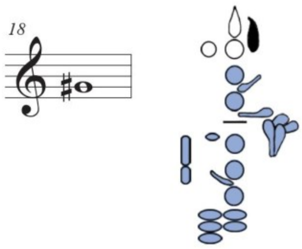
Least effective at *f*: E♭S, Tr1, B♮S





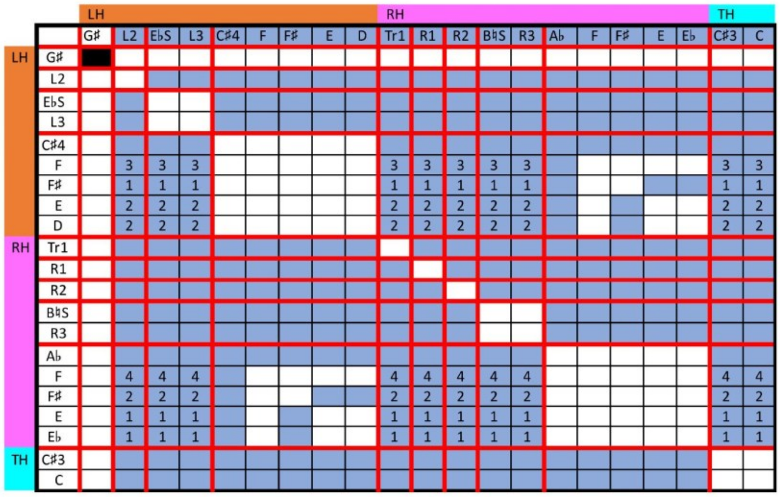
Most effective at *p*: L2, L3, R1, R2

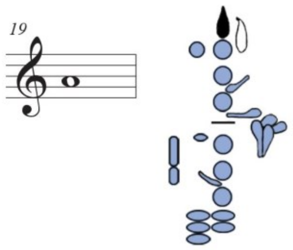
Least effective at *f*: E♭S, C♯4, Tr1, A♭, F, F♯



Most effective at *p*: None

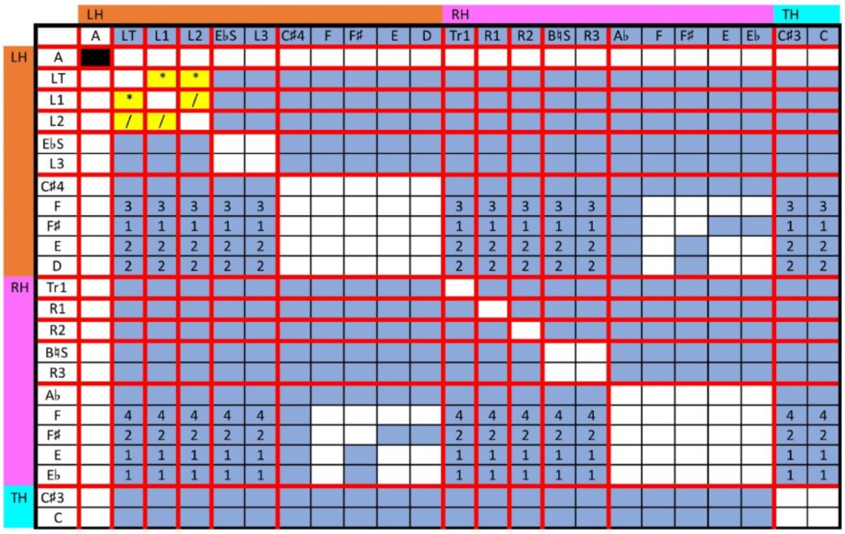
Least effective at *f*: C♯4, R3, A♭, F, C♯3, C

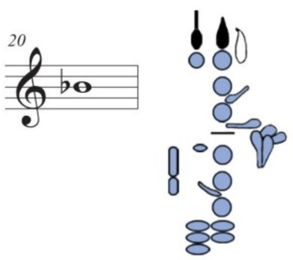




Most effective at *p*: LT, L1, L2, L3, R1, R2

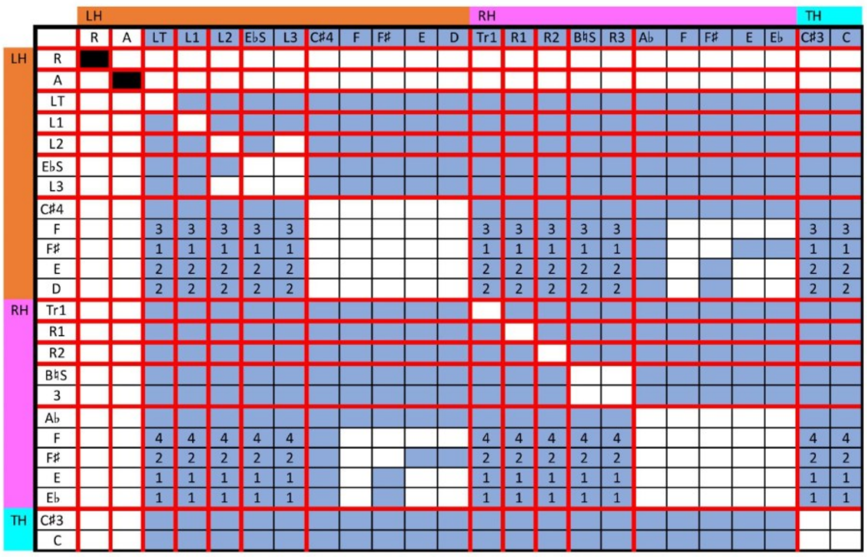
Least effective at *f*: E♭S, C♯4, Tr1, R3

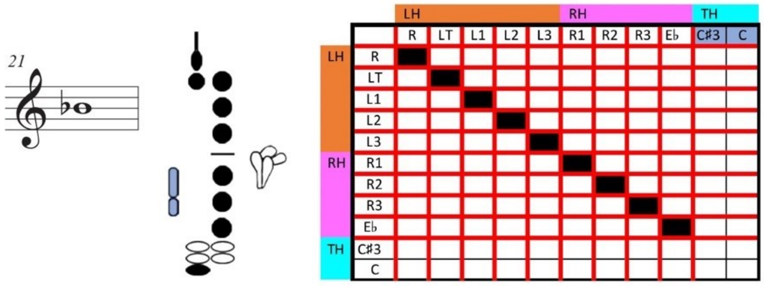




Most effective at *p*: LT, L1, L2, E♭, D

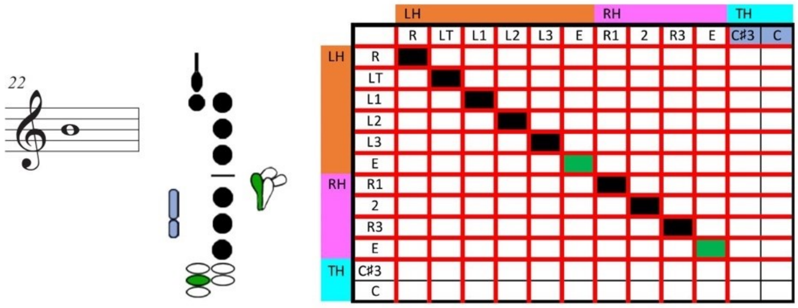
Least effective at *f*: E♭S, C♯4,
Tr1, B♮S, R3





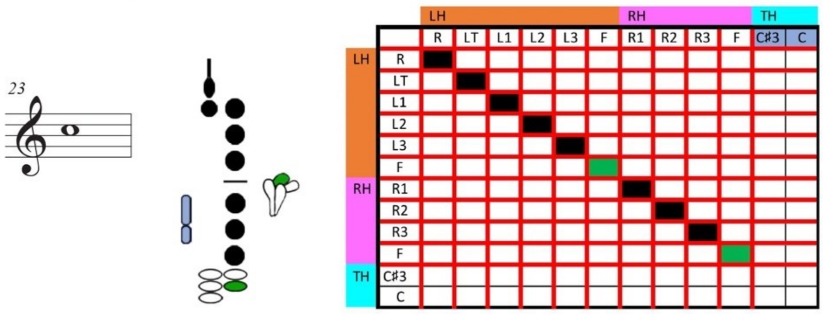
Most effective at *p*: All

Least effective at *f*:



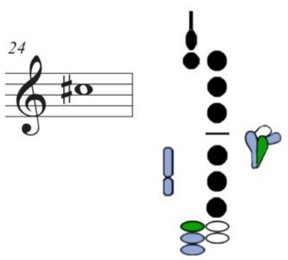
Most effective at *p*: All

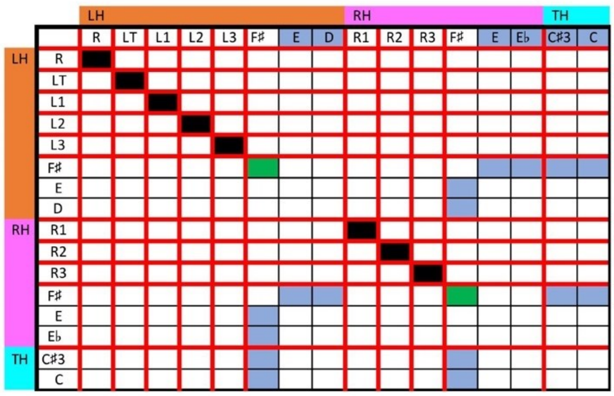
Least effective at *f*:



Most effective at *p*: All

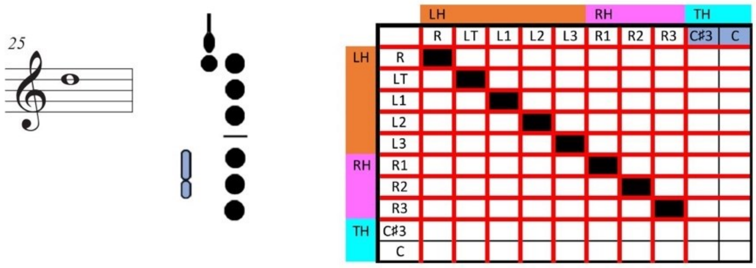
Least effective at *f*:





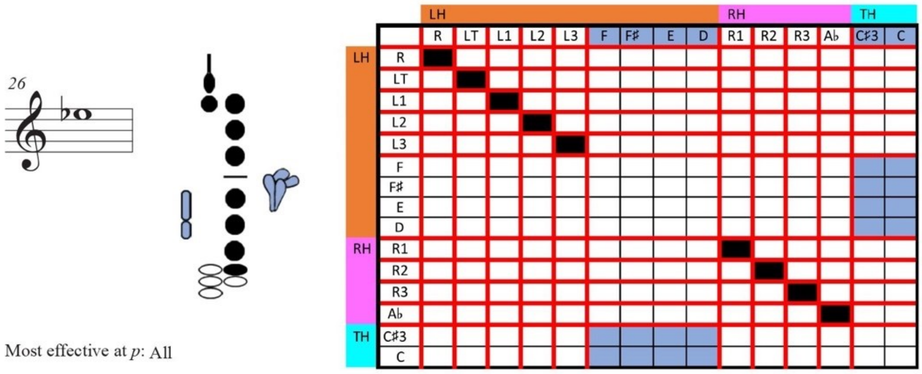
Most effective at *p*: All

Least effective at *f*:



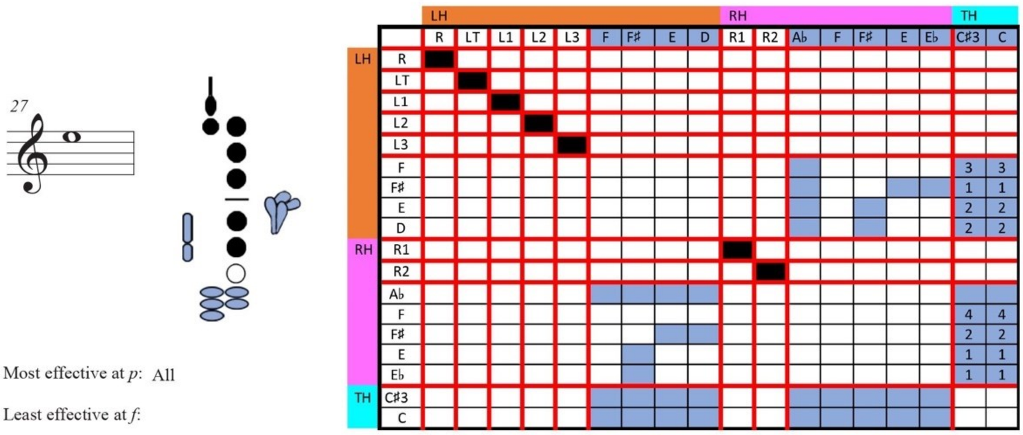
Most effective at *p*: All

Least effective at *f*:



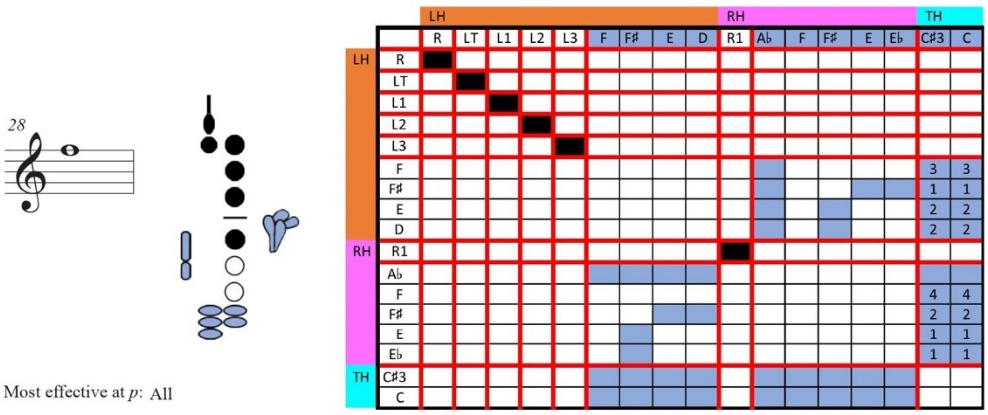
Most effective at *p*: All

Least effective at *f*:



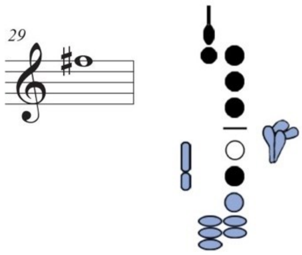
Most effective at *p*: All

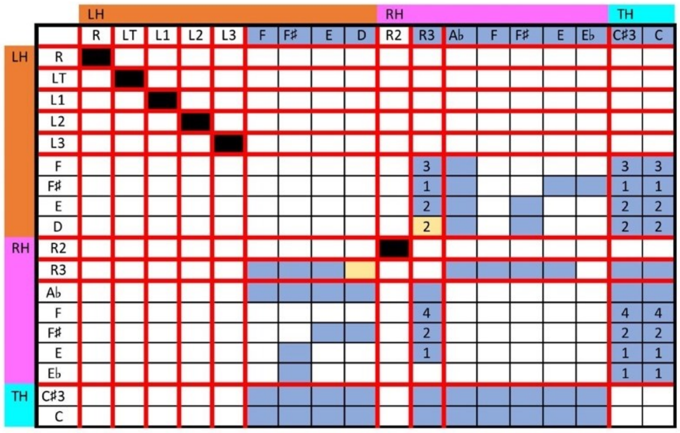
Least effective at *f*:



Most effective at *p*: All

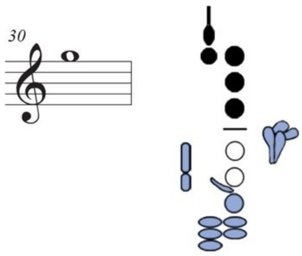
Least effective at *f*:

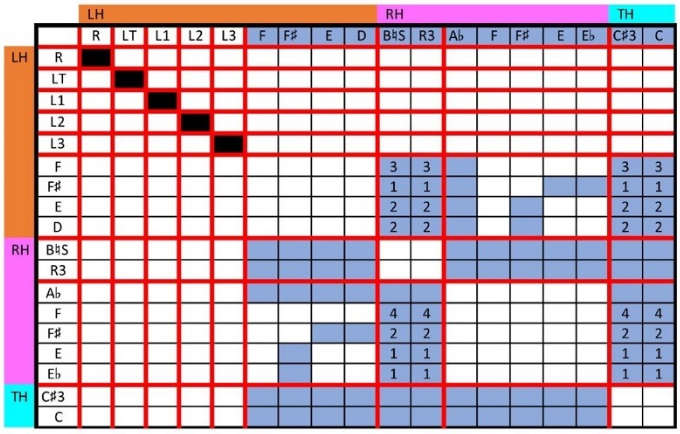




Most effective at *p*: All

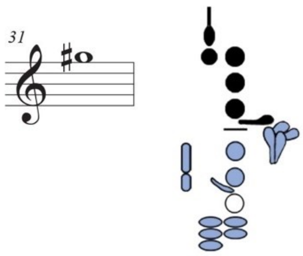
Least effective at *f*:

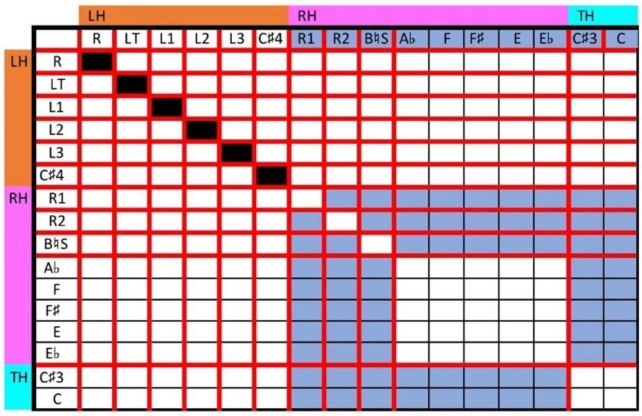




Most effective at *p*: All

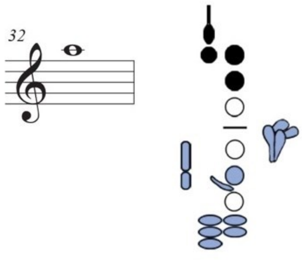
Least effective at *f*:

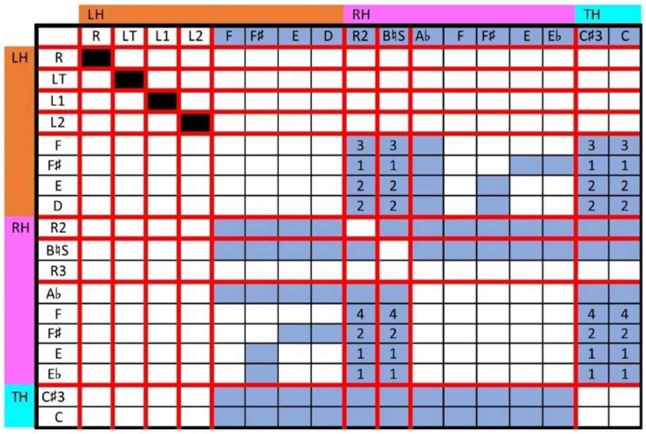




Most effective at *p*: R1, R2, F♯, E, E♭

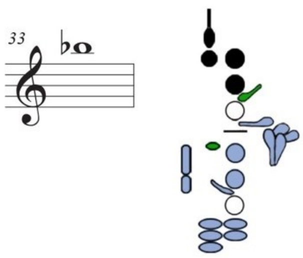
Least effective at *f*: B♮S

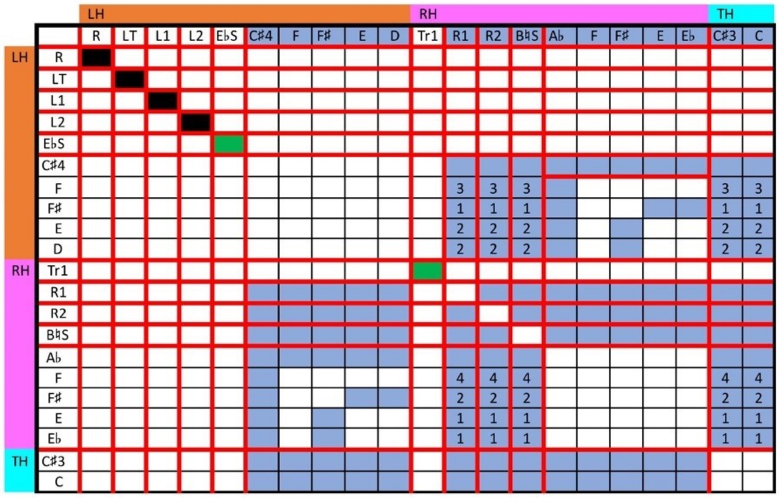




Most effective at *p*: R2, F♯, E, E♭, D

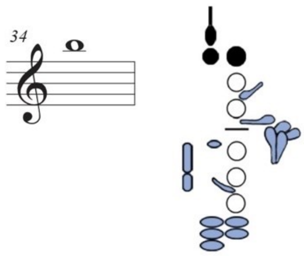
Least effective at *f*: C♯3

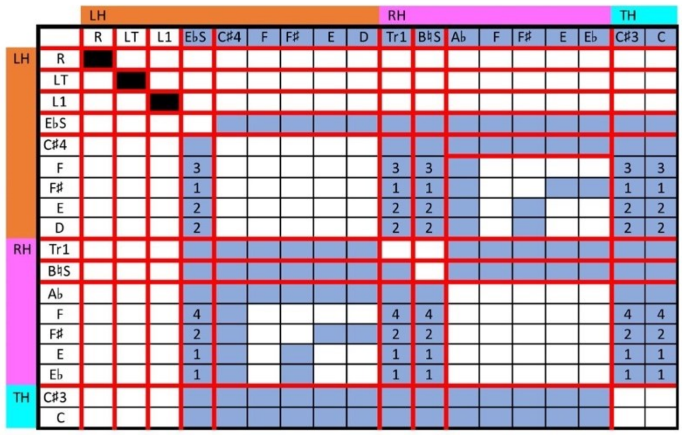




Most effective at *p*: R1, R2, C♯4,
A♭, F♯, E, E♭, D

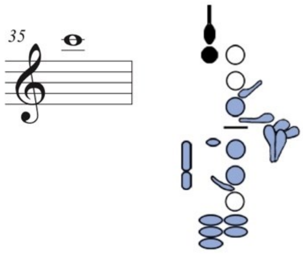
Least effective at *f*: B♮S





Most effective at *p*: B♮S, A♭, F♯, D

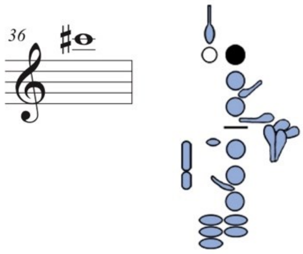
Least effective at *f*: C♯3, C



		LH									RH									TH	
		R	LT	E♭S	L3	C♯4	F	F♯	E	D	Tr1	R1	R2	B♮S	A♭	F	F♯	E	E♭	C♯3	C
LH	R																				
	LT																				
	E♭S																				
	L3																				
	C♯4																				
	F			3	3						3	3	3	3						3	3
	F♯			1	1						1	1	1	1						1	1
	E			2	2						2	2	2	2						2	2
	D			2	2						2	2	2	2						2	2
RH	Tr1																				
	R1																				
	R2																				
	B♮S																				
	A♭																				
	F			4	4						4	4	4	4						4	4
	F♯			2	2						2	2	2	2						2	2
	E			1	1						1	1	1	1						1	1
	E♭			1	1						1	1	1	1						1	1
TH	C♯3																				
	C																				

Most effective at *p*: L3, R1, R2

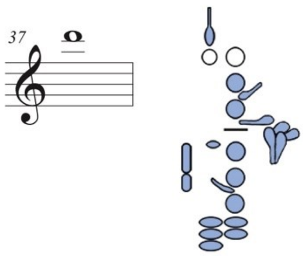
Least effective at *f*: B♮S, C♯3, C



		LH										RH										TH	
		R	L1	L2	E♭S	L3	C♯4	F	F♯	E	D	Tr1	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	C
LH	R			%/*	%	%/*	%	%	%	%	%	%	%/*	%/*	%		%	%	%	%	%	%	%
	L1																						
	L2					*%@							*%@	*%@									
	E♭S																						
	L3			*%@									*%@	*%@									
	C♯4																						
	F			3	3	3						3	3	3	3							3	3
	F♯			1	1	1						1	1	1	1							1	1
	E			2	2	2						2	2	2	2							2	2
	D			2	2	2						2	2	2	2							2	2
RH	Tr1																						
	R1			/%@		/%@																	
	R2			/%@		/%@																	
	B♮S																						
	R3			@*/	@	@*/	@	@	@	@	@	@	@*/	@*/			@	@	@	@	@	@	@
	A♭																						
	F			4	4	4						4	4	4	4							4	4
	F♯			2	2	2						2	2	2	2							2	2
	E			1	1	1						1	1	1	1							1	1
	E♭			1	1	1						1	1	1	1							1	1
TH	C♯3																						
	C																						

Most effective at *p*: R, L2, L3, R1, R2, A♭, F♯, D

Least effective at *f*: R, E♭S, Tr1, B♮S, R3, C♯3

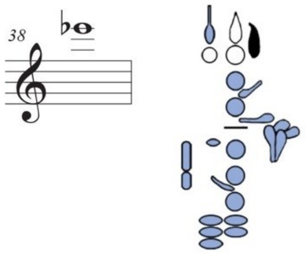


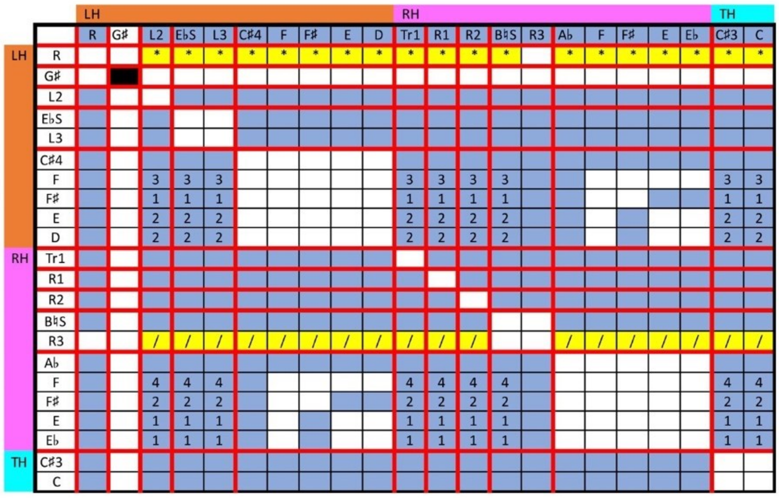
		LH									RH										TH	
		R	L2	E♭S	L3	C♯4	F	F♯	E	D	Tr1	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	C
LH	R		*	*	*	*	*	*	*	*	*	*	*			*	*	*	*	*	*	*
	L2																					
	E♭S																					
	L3																					
	C♯4																					
	F		3	3	3						3	3	3	3							3	3
	F♯		1	1	1						1	1	1	1							1	1
	E		2	2	2						2	2	2	2							2	2
	D		2	2	2						2	2	2	2							2	2
RH	Tr1																					
	R1																					
	R2																					
	B♮S																					
	R3		/	/	/	/	/	/	/	/	/	/	/			/	/	/	/	/	/	/
	A♭																					
	F		4	4	4						4	4	4	4							4	4
	F♯		2	2	2						2	2	2	2							2	2
	E		1	1	1						1	1	1	1							1	1
	E♭		1	1	1						1	1	1	1							1	1
TH	C♯3																					
	C																					

Most effective at *p*: R, L2, L3, R1, R2

Least effective at *f*: R, E♭S, C♯4, Tr1, B♮S, R3, F, C♯3

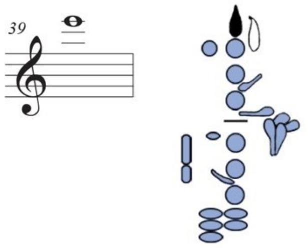
38

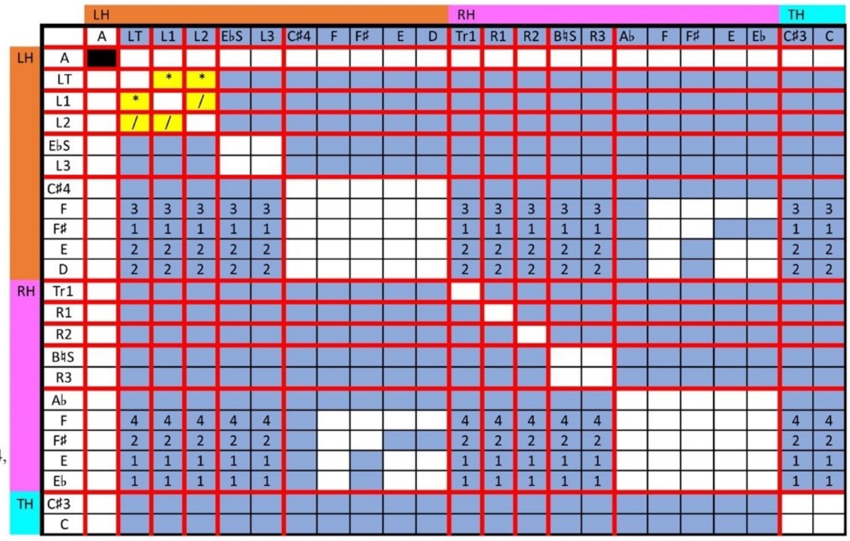




Most effective at *p*: L2, L3, R1, R2, B♮S, E♭, D
Least effective at *f*: R3

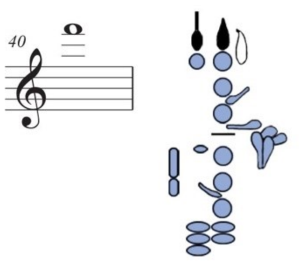
39

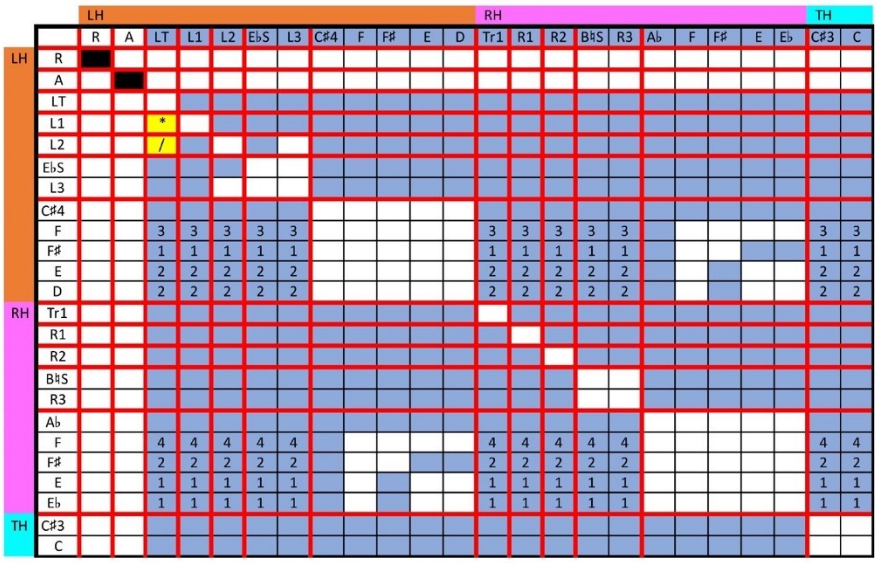




Most effective at *p*: LT, L1, L2, E♭S, L3, C♯4, R1, R2, D
Least effective at *f*: R3, C♯3, C

40





Most effective at *p*: LT, L1, L2, D

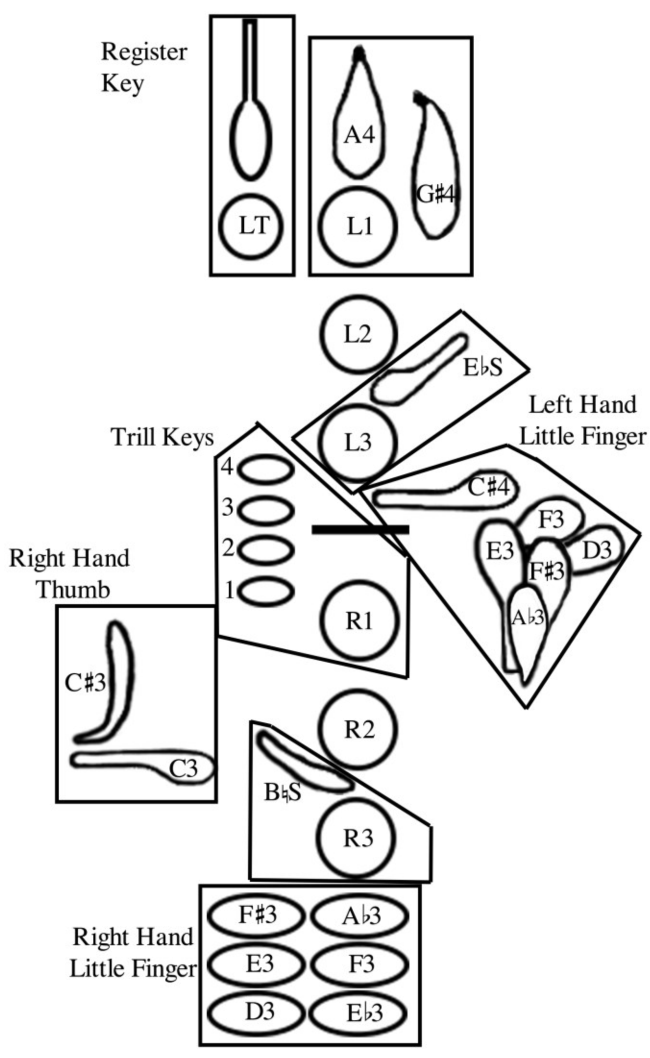
Least effective at *f*: C♯4, R3, A♭, C♯3, C

Selmer

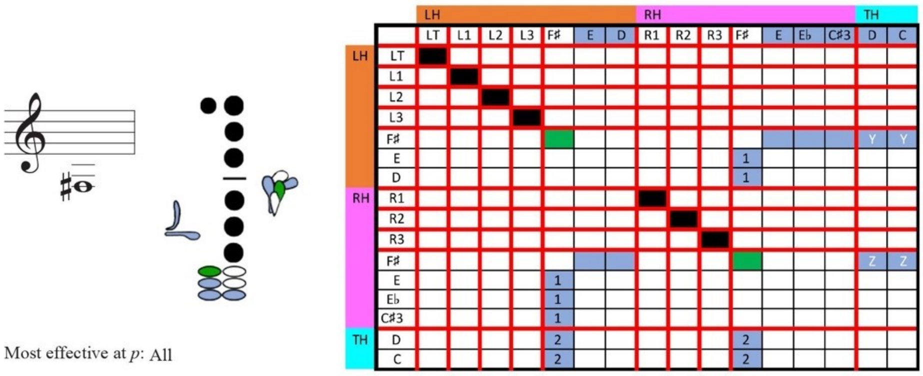
Colour-Fingering Combinations Grids

Audio Examples 0870-0904

LH	R	Left Hand register key
	AR	Altissimo register Key
	A	LH A4 key, played with 1st finger
	G♯	LH G4♯ key, played with 1st finger
	LT	LH thumb- F4
	L1	LH 1st finger- E4
	L1	LH 2nd finger- D4
	L2	LH E♭ sliver key
	L3	LH 3rd finger C4
	C♯4	LH little finger keys, C♯4
	A♭	Low G♯3
	F	Low F3
	F♯	Low F♯3
	E	Low E3
	D	Low D3
RH	Tr4	Right Hand trill key 4
	Tr3	Right Hand trill key 3
	Tr2	Right Hand trill key 2
	Tr1	Right Hand trill key 1
	R1	RH 1st finger B♭3
	R2	RH 2nd finger A3
	B♮S	RH B♮3 sliver key
	R3	RH 3rd finger G3
	A♭	RH little finger keys, low G♯3
	F	Low F3
	F♯	Low F♯3
	E	Low E3
	E♭	Low E♭3
	C♯3	Low D3
TH	D	Right Hand Thumb keys, low C♯3
	C	Low C3

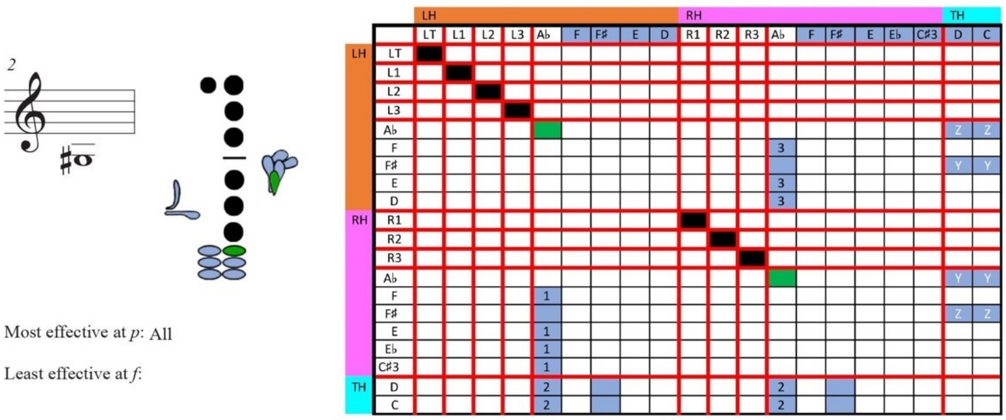


Selmer Contrabass Clarinet
Colour-Fingering Combinations



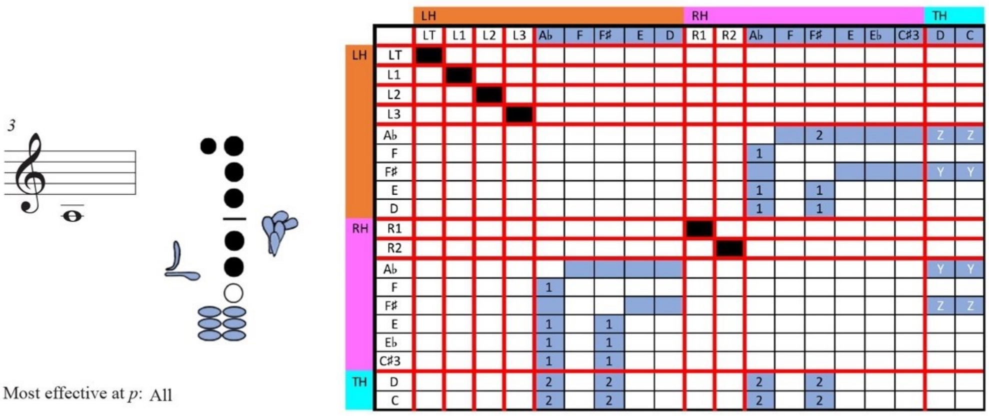
Most effective at *p*: All

Least effective at *f*:



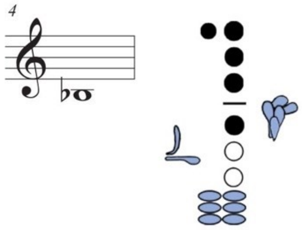
Most effective at *p*: All

Least effective at *f*:



Most effective at *p*: All

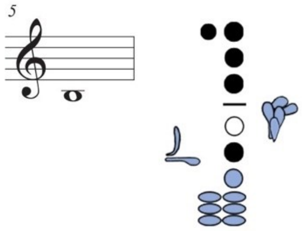
Least effective at *f*:



Most effective at *p*: All

Least effective at *f*:

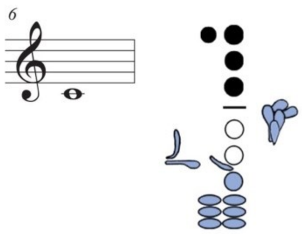
		LH									RH								TH	
		LT	L1	L2	L3	A♭	F	F♯	E	D	R1	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	LT																			
	L1																			
	L2																			
	L3																			
	A♭											Z							Z	Z
	F											3	3							
	F♯											Y							Y	Y
	E											3	3		1					
	D											3	3		1					
RH	R1																			
	R3																			
	A♭											Y							Y	Y
	F					1						1								
	F♯											Z							Z	Z
	E					1		1				1								
	E♭					1		1				1								
	C♯3					1		1				1								
TH	D					2		2				2	2		2					
	C					2		2				2	2		2					



Most effective at *p*:

Least effective at *f*:

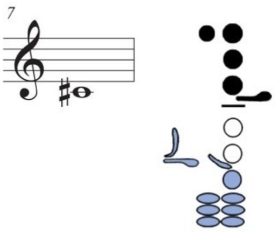
		LH									RH								TH	
		LT	L1	L2	L3	A♭	F	F♯	E	D	R2	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	LT																			
	L1																			
	L2																			
	L3																			
	A♭											Z							Z	Z
	F											3	3							
	F♯											Y							Y	Y
	E											3	3		3					
	D											3	3		3					
RH	R2																			
	R3																			
	A♭											Y							Y	Y
	F					1						1								
	F♯											Z							Z	Z
	E					1		1				1								
	E♭					1		1				1								
	C♯3					1		1				1								
TH	D					2		2				2	2		2					
	C					2		2				2	2		2					



Most effective at *p*: B ♮ S, D, C♯3

Least effective at *f*:

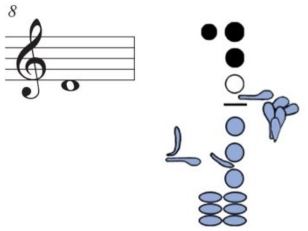
		LH									RH								TH	
		LT	L1	L2	L3	A♭	F	F♯	E	D	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	LT																			
	L1																			
	L2																			
	L3																			
	A♭										Z	Z							Z	Z
	F										3	3	3							
	F♯										Y	Y							Y	Y
	E										3	3	3		3					
	D										3	3	3		3					
RH	B♮S																			
	R3																			
	A♭										Y	Y							Y	Y
	F					1					1	1								
	F♯										Z	Z							Z	Z
	E					1		1			1	1								
	E♭					1		1			1	1								
	C♯3					1		1			1	1								
TH	D					2		2			2	2	2		2					
	C					2		2			2	2	2		2					



Most effective at *p*:All need R3

Least effective at *f*:

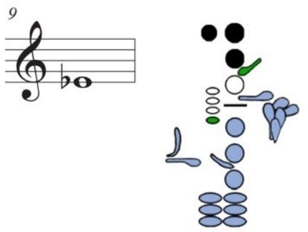
		LH					RH								TH	
		LT	L1	L2	L3	C♯4	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	LT															
	L1															
	L2															
	L3															
	C♯4															
RH	B♮S															
	R3															
	A♭															
	F						1	1								
	F♯															
	E						1	1								
	E♭						1	1								
	C♯3						1	1								
TH	D						2	2								
	C						2	2								



		LH									RH										TH	
		LT	L1	L2	C♯4	A♭	F	F♯	E	D	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	LT																					
	L1																					
	L2																					
	C♯4												*	*	*	*	*	*	*	*	*	*
	A♭										Z	Z	Z	Z							Z	Z
	F										3	3	3	3	3							
	F♯										Y	Y	Y	Y							Y	Y
	E										3	3	3	3	3		3					
	D										3	3	3	3	3		3					
RH	R1												/	/	/	/	/	/	/	/	/	/
	R2												/	/	/	/	/	/	/	/	/	/
	B♮S																					
	R3																					
	A♭										Y	Y	Y	Y							Y	Y
	F				1	1					1	1	1	1								
	F♯										Z	Z	Z	Z							Z	Z
	E				1	1		1			1	1	1	1								
	E♭				1	1		1			1	1	1	1								
	C♯3				1	1		1			1	1	1	1								
TH	D				2	2		2			2	2	2	2	2		2					
	C				2	2		2			2	2	2	2	2		2					

Most effective at *p*: C♯4, R1, R2

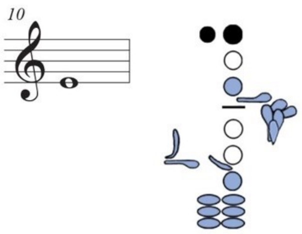
Least effective at *f*:



		LH										RH											TH	
		LT	L1	L2	E♭S	C♯4	A♭	F	F♯	E	D	Tr1	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	LT																							
	L1																							
	L2																							
	E♭S																							
	C♯4														*	*	*	*	*	*	*	*	*	*
	A♭												Z	Z	Z	Z							Z	Z
	F												3	3	3	3	3							
	F♯												Y	Y	Y	Y							Y	Y
	E												3	3	3	3	3		3					
	D												3	3	3	3	3		3					
RH	Tr1																							
	R1														/	/	/	/	/	/	/	/	/	/
	R2														/	/	/	/	/	/	/	/	/	/
	B♮S																							
	R3																							
	A♭												Y	Y	Y	Y							Y	Y
	F					1	1						1	1	1	1								
	F♯												Z	Z	Z	Z							Z	Z
	E					1	1		1				1	1	1	1								
	E♭					1	1		1				1	1	1	1								
	C♯3					1	1		1				1	1	1	1								
TH	D					2	2		2				2	2	2	2	2		2					
	C					2	2		2				2	2	2	2	2		2					

Most effective at *p*: R1, R2

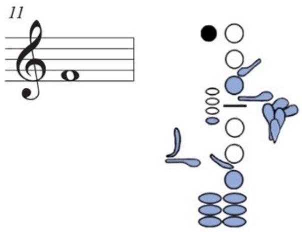
Least effective at *f*:



		LH									RH								TH	
		LT	L1	L3	C♯4	A♭	F	F♯	E	D	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	LT																			
	L1																			
	L3																			
	C♯4																			
	A♭										Z	Z							Z	Z
	F										3	3	3							
	F♯										Y	Y							Y	Y
	E										3	3	3		3					
	D										3	3	3		3					
RH	B♮S																			
	R3																			
	A♭										Y	Y							Y	Y
	F				1	1					1	1								
	F♯										Z	Z							Z	Z
	E				1	1		1			1	1								
	E♭				1	1		1			1	1								
	C♯3				1	1		1			1	1								
TH	D				2	2		2			2	2	2		2					
	C				2	2		2			2	2	2		2					

Most effective at *p*: L3, C♯4

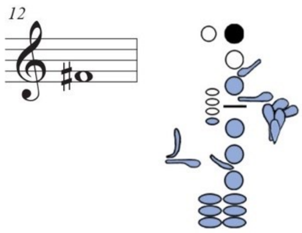
Least effective at *f*: F



Most effective at *p*: L3

Least effective at *f*: F, F♯

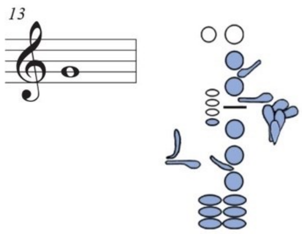
		LT	E♭S	L3	C♯4	A♭	F	F♯	E	D	Tr1	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
		LH									RH									TH	
LH	LT																				
	E♭S																				
	L3																				
	C♯4																				
	A♭		Z	Z							Z	Z	Z							Z	Z
	F		3	3							3	3	3	3							
	F♯		Y	Y							Y	Y	Y							Y	Y
	E		3	3							3	3	3	3		3					
	D		3	3							3	3	3	3		3					
RH	Tr1																				
	B♮S																				
	R3																				
	A♭		Y	Y							Y	Y	Y							Y	Y
	F		1	1	1	1					1	1	1								
	F♯		Z	Z							Z	Z	Z							Z	Z
	E		1	1	1	1		1			1	1	1								
	E♭		1	1	1	1		1			1	1	1								
	C♯3		1	1	1	1		1			1	1	1								
TH	D		2	2	2	2		2			2	2	2	2		2					
	C		2	2	2	2		2			2	2	2	2		2					



Most effective at *p*: L3, R1, R2

Least effective at *f*: F, F♯

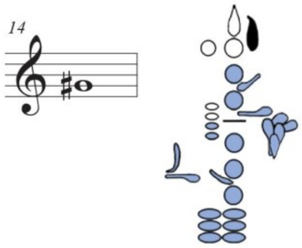
		L1	E♭S	L3	C♯4	A♭	F	F♯	E	D	Tr1	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
		LH									RH											TH	
LH	L1																						
	E♭S																						
	L3																						
	C♯4		*	*							*			*	*	*	*	*	*	*	*	*	*
	A♭		Z	Z							Z	Z	Z	Z	Z							Z	Z
	F		3	3							3	3	3	3	3	3							
	F♯		Y	Y							Y	Y	Y	Y	Y							Y	Y
	E		3	3							3	3	3	3	3	3		3					
	D		3	3							3	3	3	3	3	3		3					
RH	Tr1																						
	R1		/	/							/			/	/	/	/	/	/	/	/	/	/
	R2		/	/							/			/	/	/	/	/	/	/	/	/	/
	B♮S																						
	R3																						
	A♭		Y	Y							Y	Y	Y	Y	Y							Y	Y
	F		1	1	1	1					1	1	1	1	1								
	F♯		Z	Z							Z	Z	Z	Z	Z							Z	Z
	E		1	1	1	1		1			1	1	1	1	1								
	E♭		1	1	1	1		1			1	1	1	1	1								
	C♯3		1	1	1	1		1			1	1	1	1	1								
TH	D		2	2	2	2		2			2	2	2	2	2	2		2					
	C		2	2	2	2		2			2	2	2	2	2	2		2					



Most effective at *p*: L2, L3, C♯4, R1, R2

Least effective at *f*: F, F♯

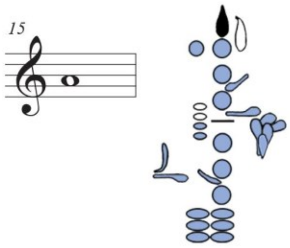
		L2	E♭S	L3	C♯4	A♭	F	F♯	E	D	Tr1	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
		LH									RH											TH	
LH	L2																						
	E♭S																						
	L3																						
	C♯4	*	*	*							*			*	*	*	*	*	*	*	*	*	*
	A♭	Z	Z	Z							Z	Z	Z	Z	Z							Z	Z
	F	3	3	3							3	3	3	3	3	3							
	F♯	Y	Y	Y							Y	Y	Y	Y	Y							Y	Y
	E	3	3	3							3	3	3	3	3	3		3					
	D	3	3	3							3	3	3	3	3	3		3					
RH	Tr1																						
	R1	/	/	/							/			/	/	/	/	/	/	/	/	/	/
	R2	/	/	/							/			/	/	/	/	/	/	/	/	/	/
	B♮S																						
	R3																						
	A♭	Y	Y	Y							Y	Y	Y	Y	Y							Y	Y
	F	1	1	1	1	1					1	1	1	1	1								
	F♯	Z	Z	Z							Z	Z	Z	Z	Z							Z	Z
	E	1	1	1	1	1		1			1	1	1	1	1								
	E♭	1	1	1	1	1		1			1	1	1	1	1								
	C♯3	1	1	1	1	1		1			1	1	1	1	1								
TH	D	2	2	2	2	2		2			2	2	2	2	2	2		2					
	C	2	2	2	2	2		2			2	2	2	2	2	2		2					



Most effective at *p*: L2, L3

Least effective at *f*: F, F♯

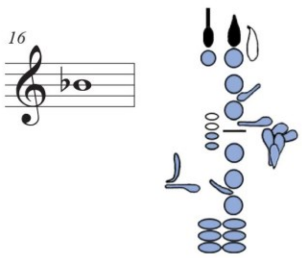
		LH										RH												TH	
		G♯	L2	E♭S	L3	C♯4	A♭	F	F♯	E	D	Tr1	Tr2	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	G♯																								
	L2																								
	E♭S																								
	L3																								
	C♯4		*	*	*							*			*	*	*	*	*	*	*	*	*	*	
	A♭		Z	Z	Z							Z	Z	Z	Z	Z	Z							Z	Z
	F		3	3	3							3	3	3	3	3	3	3							
	F♯		Y	Y	Y							Y	Y	Y	Y	Y	Y							Y	Y
	E		3	3	3							3	3	3	3	3	3	3		3					
	D		3	3	3							3	3	3	3	3	3	3		3					
RH	Tr1																								
	Tr2																								
	R1		/	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	R2		/	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	B♮S																								
	R3																								
	A♭		Y	Y	Y							Y	Y	Y	Y	Y	Y							Y	Y
	F		1	1	1	1	1					1	1	1	1	1	1								
	F♯		Z	Z	Z							Z	Z	Z	Z	Z	Z							Z	Z
	E		1	1	1	1	1		1			1	1	1	1	1	1								
	E♭		1	1	1	1	1		1			1	1	1	1	1	1								
	C♯3		1	1	1	1	1		1			1	1	1	1	1	1								
TH	D		2	2	2	2	2		2			2	2	2	2	2	2	2		2					
	C		2	2	2	2	2		2			2	2	2	2	2	2	2		2					



Most effective at *p*: LT, L2, R1, R2

Least effective at *f*: Tr1, E♭S, F, F♯, E

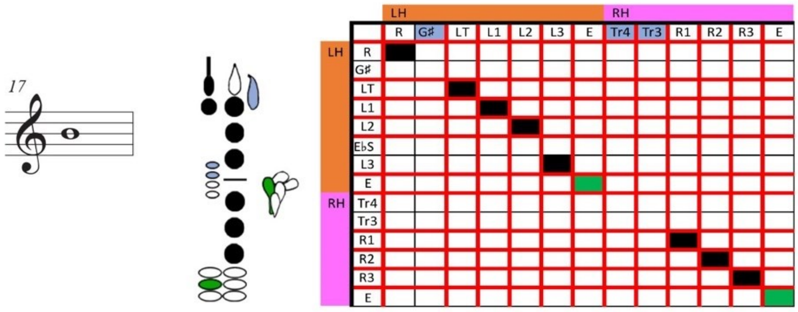
		LH												RH												TH	
		A	LT	L1	L2	E♭S	L3	C♯4	A♭	F	F♯	E	D	Tr1	Tr2	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	R																										
	A																										
	LT																										
	L1																										
	L2																										
	E♭S																										
	L3																										
	C♯4		*	*	*	*	*							*	*			*	*	*	*	*	*	*	*	*	*
	A♭		Z	Z	Z	Z	Z							Z	Z	Z	Z	Z	Z							Z	Z
	F		3	3	3	3	3							3	3	3	3	3	3	3							
	F♯		Y	Y	Y	Y	Y							Y	Y	Y	Y	Y	Y							Y	Y
	E		3	3	3	3	3							3	3	3	3	3	3	3		3					
	D		3	3	3	3	3							3	3	3	3	3	3	3		3					
RH	Tr1																										
	Tr2																										
	R1		/	/	/	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	R2		/	/	/	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	B♮S																										
	R3																										
	A♭		Y	Y	Y	Y	Y							Y	Y	Y	Y	Y	Y							Y	Y
	F		1	1	1	1	1	1	1					1	1	1	1	1	1								
	F♯		Z	Z	Z	Z	Z							Z	Z	Z	Z	Z	Z							Z	Z
	E		1	1	1	1	1	1	1		1			1	1	1	1	1	1								
	E♭		1	1	1	1	1	1	1		1			1	1	1	1	1	1								
	C♯3		1	1	1	1	1	1	1		1			1	1	1	1	1	1								
TH	D		2	2	2	2	2	2	2		2			2	2	2	2	2	2	2		2					
	C		2	2	2	2	2	2	2		2			2	2	2	2	2	2	2		2					



Most effective at *p*: R1

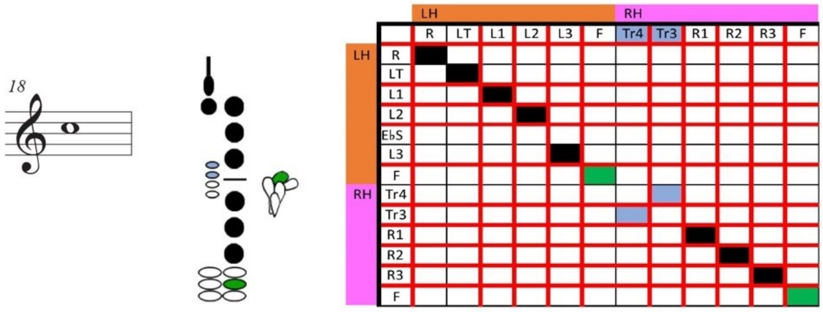
Least effective at *f*: Tr1, E♭S, F, F♯

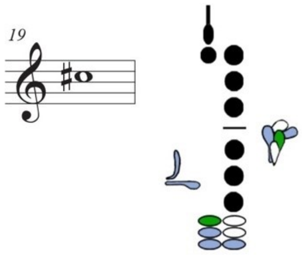
		LH													RH												TH	
		R	A	LT	L1	L2	E♭S	L3	C♯4	A♭	F	F♯	E	D	Tr1	Tr2	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	R																											
	A																											
	LT																											
	L1																											
	L2																											
	E♭S																											
	L3																											
	C♯4			*	*	*	*	*							*	*			*	*	*	*	*	*	*	*	*	*
	A♭			Z	Z	Z	Z	Z							Z	Z	Z	Z	Z	Z							Z	Z
	F			3	3	3	3	3							3	3	3	3	3	3	3							
	F♯			Y	Y	Y	Y	Y							Y	Y	Y	Y	Y	Y							Y	Y
	E			3	3	3	3	3							3	3	3	3	3	3	3		3					
	D			3	3	3	3	3							3	3	3	3	3	3	3		3					
RH	Tr1																											
	Tr2																											
	R1			/	/	/	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	R2			/	/	/	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	B♮S																											
	R3																											
	A♭			Y	Y	Y	Y	Y							Y	Y	Y	Y	Y	Y							Y	Y
	F			1	1	1	1	1	1	1					1	1	1	1	1	1								
	F♯			Z	Z	Z	Z	Z							Z	Z	Z	Z	Z	Z							Z	Z
	E			1	1	1	1	1	1	1		1			1	1	1	1	1	1								
	E♭			1	1	1	1	1	1	1		1			1	1	1	1	1	1								
	C♯3			1	1	1	1	1	1	1		1			1	1	1	1	1	1								
TH	D			2	2	2	2	2	2	2		2			2	2	2	2	2	2	2		2					
	C			2	2	2	2	2	2	2		2			2	2	2	2	2	2	2		2					

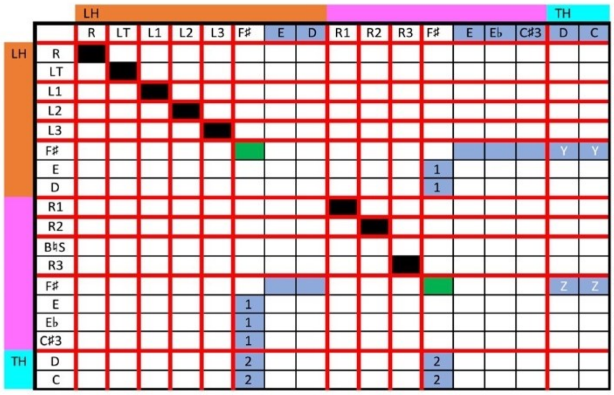


Most effective at *p*: All

Least effective at *f*:





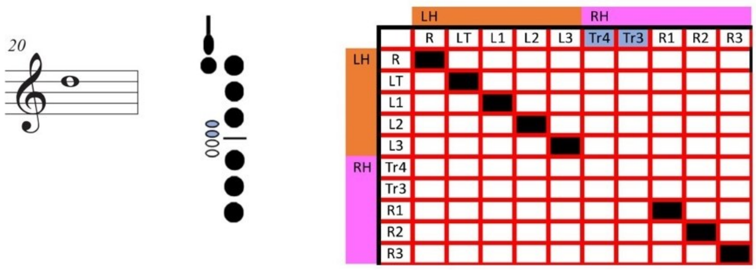


Most effective at *p*: All

Least effective at *f*:

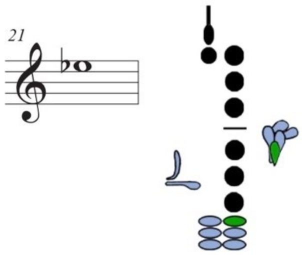
Most effective at *p*: All

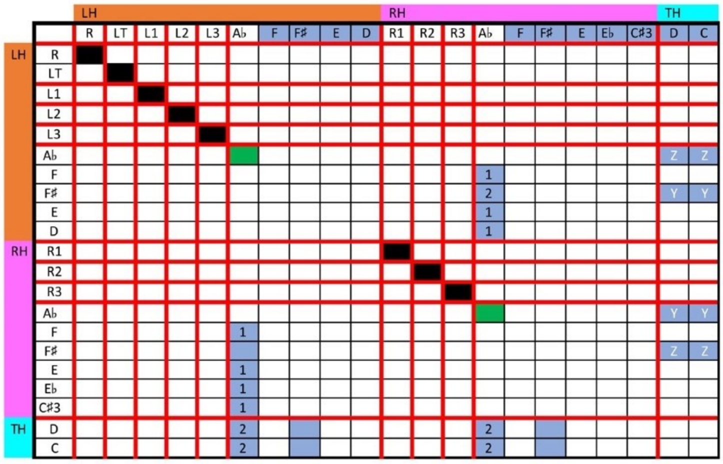
Least effective at *f*:



Most effective at *p*: All

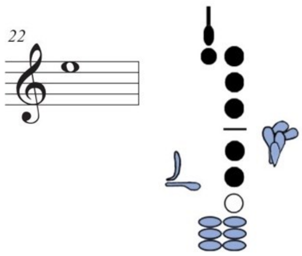
Least effective at *f*:

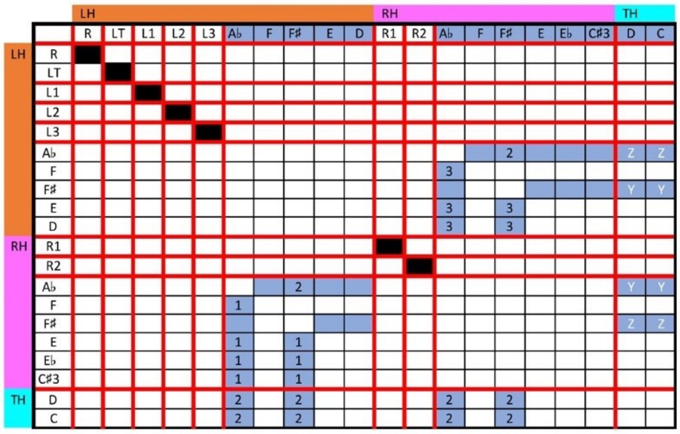




Most effective at *p*: All

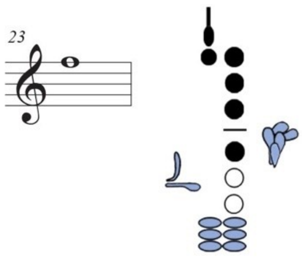
Least effective at *f*:

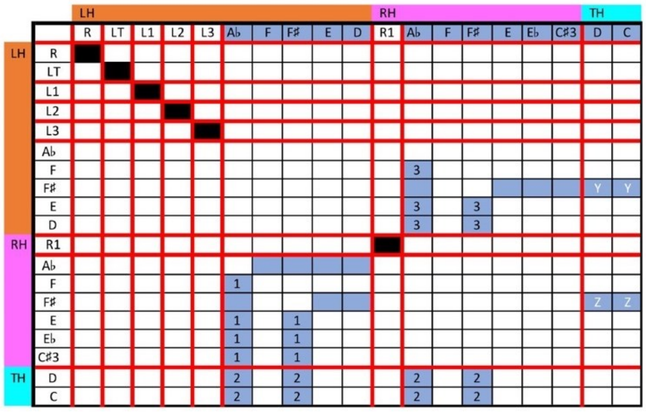




Most effective at *p*: All

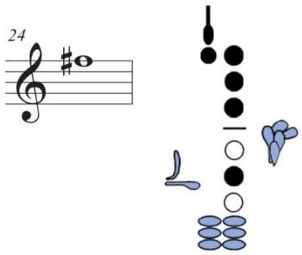
Least effective at *f*:

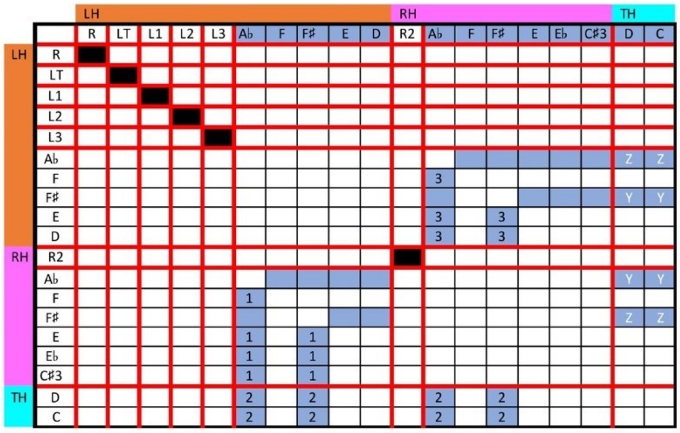




Most effective at *p*: All

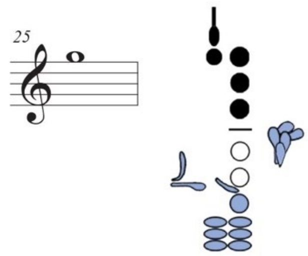
Least effective at *f*:

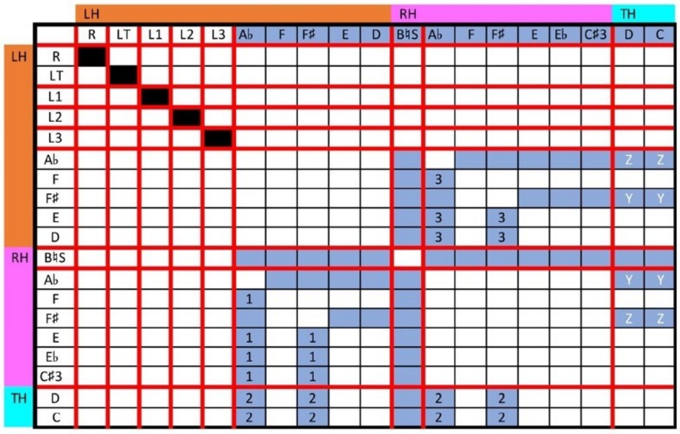




Most effective at *p*: All

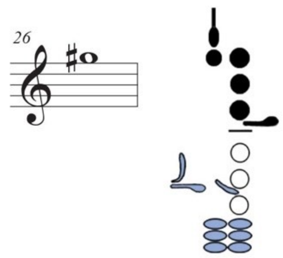
Least effective at *f*:

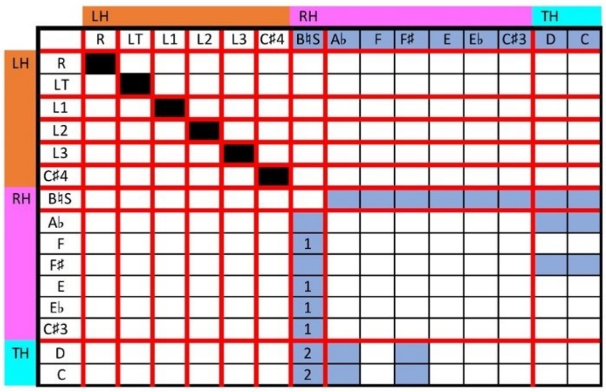




Most effective at *p*: B ♮ S, A ♭, F♯, C

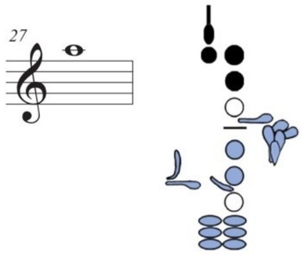
Least effective at *f*:





Most effective at *p*: E ♭, D, C♯3, C

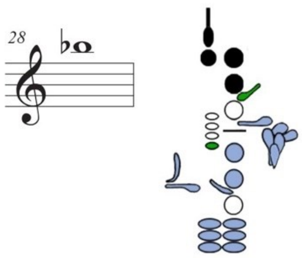
Least effective at *f*: F, F♯



Most effective at *p*: R1, R2, E♭, D, C♯3, C

Least effective at *f*: F, F♯

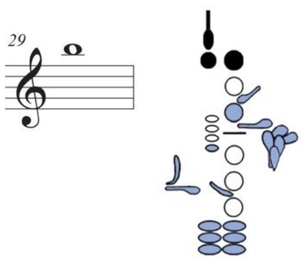
		LH										RH									TH	
		R	LT	L1	L2	C♯4	A♭	F	F♯	E	D	R1	R2	B♮S	A♭	F	F♯	E	E♭	C♯3	D	C
LH	R																					
	LT																					
	L1																					
	L2																					
	C♯4													*	*	*	*	*	*	*	*	*
	A♭											Z	Z	Z							Z	Z
	F											3	3	3	3							
	F♯											Y	Y	Y							Y	Y
	E											3	3	3	3		3					
	D											3	3	3	3		3					
RH	R1													/	/	/	/	/	/	/	/	/
	R2													/	/	/	/	/	/	/	/	/
	B♮S																					
	A♭											Y	Y	Y							Y	Y
	F					1	1					1	1	1								
	F♯											Z	Z	Z							Z	Z
	E					1	1		1			1	1	1								
	E♭					1	1		1			1	1	1								
	C♯3					1	1		1			1	1	1								
TH	D					2	2		2			2	2	2	2		2					
	C					2	2		2			2	2	2	2		2					



Most effective at *p*: R1, R2, E♭, D, C♯3, C

Least effective at *f*: B♮S, A♭, F

		LH											RH										TH	
		R	LT	L1	L2	E♭S	C♯4	A♭	F	F♯	E	D	Tr1	R1	R2	B♮S	A♭	F	F♯	E	E♭	C♯3	D	C
LH	R																							
	LT																							
	L1																							
	L2																							
	E♭S																							
	C♯4															*	*	*	*	*	*	*	*	*
	A♭													Z	Z	Z							Z	Z
	F													3	3	3	3							
	F♯													Y	Y	Y							Y	Y
	E													3	3	3	3		3					
	D													3	3	3	3		3					
RH	Tr1																							
	R1															/	/	/	/	/	/	/	/	/
	R2															/	/	/	/	/	/	/	/	/
	B♮S																							
	A♭													Y	Y	Y							Y	Y
	F						1	1						1	1	1								
	F♯													Z	Z	Z							Z	Z
	E						1	1		1				1	1	1								
	E♭						1	1		1				1	1	1								
	C♯3						1	1		1				1	1	1								
TH	D						2	2		2				2	2	2	2		2					
	C						2	2		2				2	2	2	2		2					

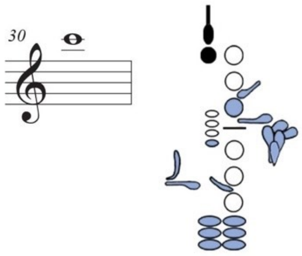


Most effective at *p*: All

Least effective at *f*:

		LH											RH								TH	
		R	LT	L1	E♭S	L3	C♯4	A♭	F	F♯	E	D	Tr1	B♮S	A♭	F	F♯	E	E♭	C♯3	D	C
LH	R																					
	LT																					
	L1																					
	E♭S						*	*	*	*	*	*		*	*	*	*	*	*	*		
	L3																					
	C♯4																					
	A♭				Z	Z							Z	Z							Z	Z
	F				3	3							3	3	3							
	F♯				Y	Y							Y	Y							Y	Y
	E				3	3							3	3	3		3					
	D				3	3							3	3	3		3					
RH	Tr1						/	/	/	/	/	/		/	/	/	/	/	/	/		
	B♮S																					
	A♭				Y	Y							Y	Y							Y	Y
	F				1	1	1	1					1	1								
	F♯				Z	Z							Z	Z							Z	Z
	E				1	1	1	1		1			1	1								
	E♭				1	1	1	1		1			1	1								
	C♯3				1	1	1	1		1			1	1								
TH	D				2	2	2	2		2			2	2	2		2					
	C				2	2	2	2		2			2	2	2		2					

30

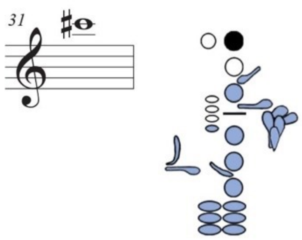


Most effective at *p*: L3, C♯4

Least effective at *f*:

		LH										RH								TH	
		R	LT	E♭S	L3	C♯4	A♭	F	F♯	E	D	Tr1	B♮S	A♭	F	F♯	E	E♭	C♯3	D	C
LH	R																				
	LT																				
	E♭S																				
	L3																				
	C♯4																				
	A♭			Z	Z							Z	Z							Z	Z
	F			3	3							3	3	3							
	F♯			Y	Y							Y	Y							Y	Y
	E			3	3							3	3	3		3					
	D			3	3							3	3	3		3					
RH	Tr1																				
	B♮S																				
	A♭			Y	Y	Y						Y	Y							Y	Y
	F			1	1	1	1					1	1								
	F♯			Z	Z	Z						Z	Z							Z	Z
	E			1	1	1	1		1			1	1								
	E♭			1	1	1	1		1			1	1								
	C♯3			1	1	1	1		1			1	1								
TH	D			2	2	2	2		2			2	2	2		2					
	C			2	2	2	2		2			2	2	2		2					

31

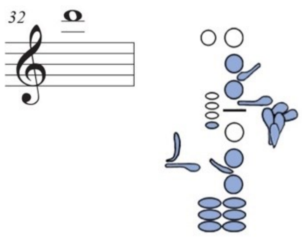


Most effective at *p*: L3, C♯4, R1, R2, C♯3, C

Least effective at *f*: F, F♯

		LH									RH											TH	
		L1	E♭S	L3	C♯4	A♭	F	F♯	E	D	Tr1	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	L1																						
	E♭S																						
	L3					*	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*
	C♯4		*	*							*			*	*	*	*	*	*	*	*	*	*
	A♭			Z							Z	Z	Z	Z	Z							Z	Z
	F			3							3	3	3	3	3	3							
	F♯			Y							Y	Y	Y	Y	Y							Y	Y
	E			3							3	3	3	3	3	3		3					
	D			3							3	3	3	3	3	3		3					
RH	Tr1																						
	R1		/			/	/	/	/	/	/			/	/	/	/	/	/	/	/	/	/
	R2		/	/		/	/	/	/	/	/	/		/	/	/	/	/	/	/	/	/	/
	B♮S																						
	R3																						
	A♭			Y							Y	Y	Y	Y	Y							Y	Y
	F			1		1					1	1	1	1	1								
	F♯			Z							Z	Z	Z	Z	Z							Z	Z
	E			1		1		1			1	1	1	1	1								
	E♭			1		1		1			1	1	1	1	1								
	C♯3			1		1		1			1	1	1	1	1								
TH	D			2		2		2			2	2	2	2	2	2		2					
	C			2		2		2			2	2	2	2	2	2		2					

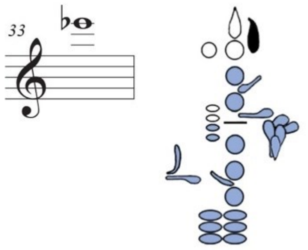
32



Most effective at *p*: L2, L3, C♯4, R2, C♯3, C

Least effective at *f*: B ♮ S

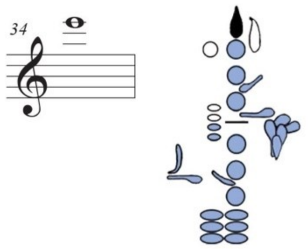
		LH									RH										TH	
		L2	E♭S	L3	C♯4	A♭	F	F♯	E	D	Tr1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	L2																					
	E♭S																					
	L3																					
	C♯4	*	*	*							*		*	*	*	*	*	*	*	*	*	*
	A♭	Z		Z							Z	Z	Z	Z							Z	Z
	F	3		3							3	3	3	3	3							
	F♯	Y		Y							Y	Y	Y	Y							Y	Y
	E	3		3							3	3	3	3	3		3					
	D	3		3							3	3	3	3	3		3					
RH	Tr1																					
	R2	/	/	/							/		/	/	/	/	/	/	/	/	/	/
	B♮S																					
	R3																					
	A♭	Y	Y	Y							Y	Y	Y	Y							Y	Y
	F	1	1	1	1	1					1	1	1	1								
	F♯	Z	Z	Z							Z	Z	Z	Z							Z	Z
	E	1	1	1	1	1		1			1	1	1	1								
	E♭	1	1	1	1	1		1			1	1	1	1								
	C♯3	1	1	1	1	1		1			1	1	1	1								
TH	D	2	2	2	2	2		2			2	2	2	2	2		2					
	C	2	2	2	2	2		2			2	2	2	2	2		2					



Most effective at *p*: L2, L3, R1, R2, C♯3, C

Least effective at *f*: C♯4, F, F♯

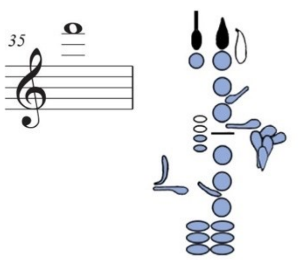
		LH										RH												TH	
		G♯	L2	E♭S	L3	C♯4	A♭	F	F♯	E	D	Tr1	Tr2	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	G♯																								
	L2																								
	E♭S																								
	L3																								
	C♯4		*	*	*							*	*			*	*	*	*	*	*	*	*	*	*
	G♯		Z	Z	Z							Z	Z	Z	Z	Z	Z							Z	Z
	F		3	3	3							3	4	3	3	3	3	3							
	F♯		Y	Y	Y							Y	Y	Y	Y	Y	Y							Y	Y
	E		3	3	3							3	3	3	3	3	3	3		3					
	D		3	3	3							3	3	3	3	3	3	3		3					
RH	Tr1																								
	Tr2																								
	R1		/	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	R2		/	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	B♮S																								
	R3																								
	A♭		Y	Y	Y	Y						Y	Y	Y	Y	Y	Y							Y	Y
	F		1	1	1	1	1					1	2	1	1	1	1								
	F♯		Z	Z	Z							Z	Z	Z	Z	Z	Z							Z	Z
	E		1	1	1	1	1		1			1	1	1	1	1	1								
	E♭		1	1	1	1	1		1			1	1	1	1	1	1								
	C♯3		1	1	1	1	1		1			1	1	1	1	1	1								
TH	D		2	2	2	2	2		2			2	2	2	2	2	2	2		2					
	C		2	2	2	2	2		2			2	2	2	2	2	2	2		2					



Most effective at *p*: C♯4, R1, R2, B♮S, A♭, F♯, C♯3, C

Least effective at *f*: L1, L2, R3, F, E

		LH											RH												TH	
		A	L1	L2	E♭S	L3	C♯4	A♭	F	F♯	E	D	Tr1	Tr2	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	A																									
	L1																									
	L2																									
	E♭S																									
	L3																									
	C♯4		*	*	*	*							*	*			*	*	*	*	*	*	*	*	*	*
	A♭		Z	Z	Z	Z							Z	Z	Z	Z	Z	Z							Z	Z
	F		3	3	3	3							3	3	3	3	3	3	3							
	F♯		Y	Y	Y	Y							Y	Y	Y	Y	Y	Y							Y	Y
	E		3	3	3	3							3	3	3	3	3	3	3		3					
	D		3	3	3	3							3	3	3	3	3	3	3		3					
RH	Tr1																									
	Tr2																									
	R1		/	/	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	R2		/	/	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	B♮S																									
	R3																									
	A♭		Y	Y	Y	Y							Y		Y	Y	Y	Y							Y	Y
	F		1	1	1	1	1	1					1		1	1	1	1								
	F♯		Z	Z	Z	Z							Z		Z	Z	Z	Z							Z	Z
	E		1	1	1	1	1	1		1			1		1	1	1	1								
	E♭		1	1	1	1	1	1		1			1		1	1	1	1								
	C♯3		1	1	1	1	1	1		1			1		1	1	1	1								
TH	D		2	2	2	2	2	2		2			2		2	2	2	2	2		2					
	C		2	2	2	2	2	2		2			2		2	2	2	2	2		2					



Most effective at *p*: C♯4, R1, R2, E, A♭, D, C♯3, C

Least effective at *f*: F, F#

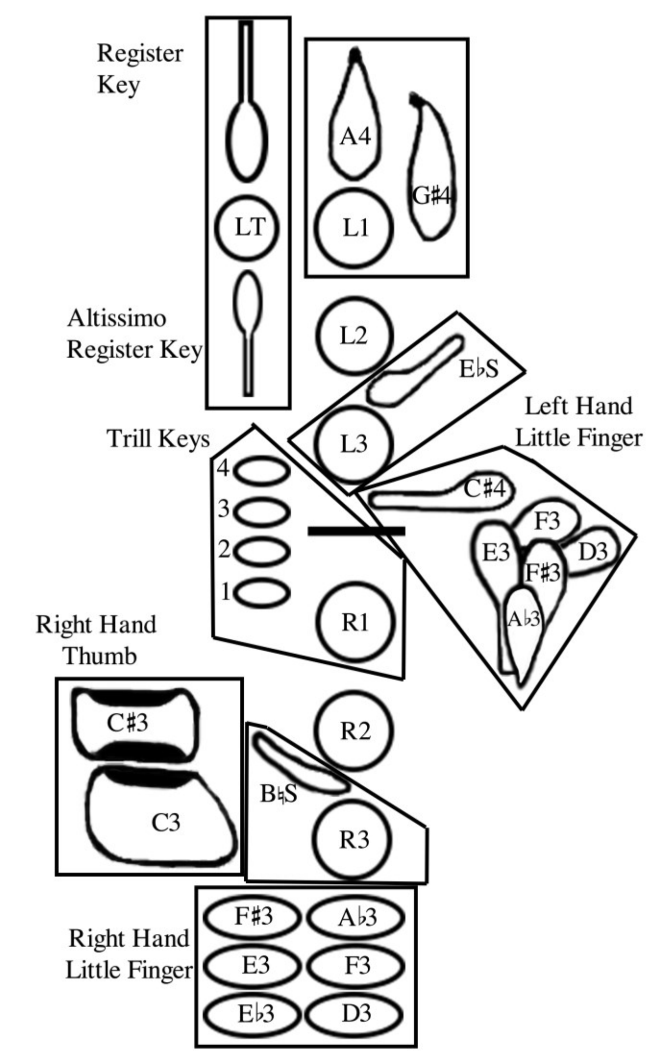
		LH													RH												TH	
		R	A	LT	L1	L2	E♭S	L3	C♯4	A♭	F	F♯	E	D	Tr1	Tr2	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	C♯3	D	C
LH	R																											
	A																											
	LT																											
	L1																											
	L2																											
	E♭S																											
	L3																											
	C♯4			*	*	*	*	*							*	*			*	*	*	*	*	*	*	*	*	*
	A♭				Z	Z	Z	Z							Z	Z	Z	Z	Z	Z							Z	Z
	F				3	3	3	3							3	3	3	3	3	3	3							
	F♯				Y	Y	Y	Y							Y	Y	Y	Y	Y	Y							Y	Y
	E				3	3	3	3							3	3	3	3	3	3	3		3					
	D				3	3	3	3							3	3	3	3	3	3	3		3					
RH	Tr1																											
	Tr2																											
	R1			/	/	/	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	R2			/	/	/	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	B♮S																											
	R3																											
	A♭			Y	Y	Y	Y	Y							Y	Y	Y	Y	Y	Y							Y	Y
	F			1	1	1	1	1	1	1					1	1	1	1	1	1								
	F♯			Z	Z	Z	Z	Z							Z	Z	Z	Z	Z	Z							Z	Z
	E			1	1	1	1	1	1	1		1			1	1	1	1	1	1								
	E♭			1	1	1	1	1	1	1		1			1	1	1	1	1	1								
	C♯3			1	1	1	1	1	1	1		1			1	1	1	1	1	1								
TH	D			2	2	2	2	2	2	2		2			2	2	2	2	2	2	2		2					
	C			2	2	2	2	2	2	2		2			2	2	2	2	2	2	2		2					

Eppelsheim

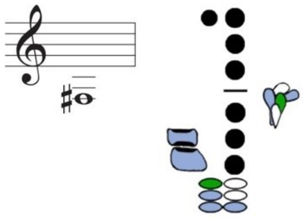
Colour-Fingering Combination Grids

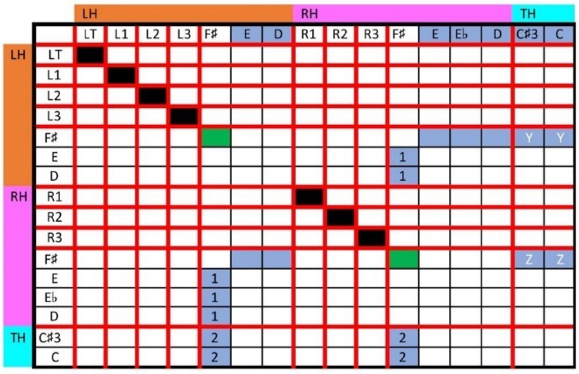
Audio Examples 0905-0936

LH	R	Left Hand register key
	AR	Altissimo register Key
	A	LH A4 key, played with 1st finger
	G♯	LH G4♯ key, played with 1st finger
	LT	LH thumb- F4
	L1	LH 1st finger- E4
	L2	LH 2nd finger- D4
	E♭S	LH E♭4 sliver key
	L3	LH 3rd finger C4
	C♯4	LH little finger keys, C♯4
	A♭	Low A♭3
	F	Low F3
	F♯	Low F♯3
	E	Low E3
	D	Low D3
RH	Tr4	Right Hand trill key 4
	Tr3	Right Hand trill key 3
	Tr2	Right Hand trill key 2
	Tr1	Right Hand trill key 1
	R1	RH 1st finger B♭3
	R2	RH 2nd finger A3
	B♮S	RH B♮3 sliver key
	R3	RH 3rd finger G3
	A♭	RH little finger keys, low A♭3
	F	Low F3
	F♯	Low F♯3
	E	Low E3
	E♭	Low E♭3
	D	Low D3
TH	C♯3	Right Hand Thumb keys, low C♯3
	C	Low C3



Eppelsheim Contrabass Clarinet Colour-Fingering Combinations

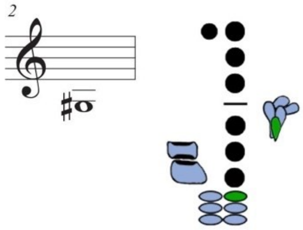


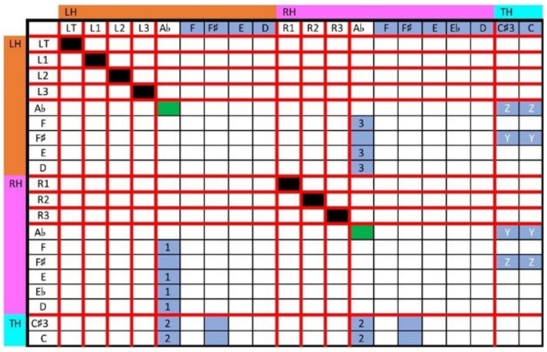


Most effective at *p*: All

Least effective at *f*:

2

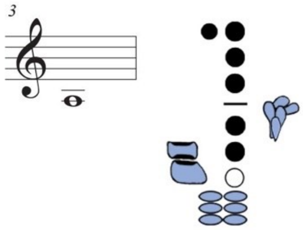


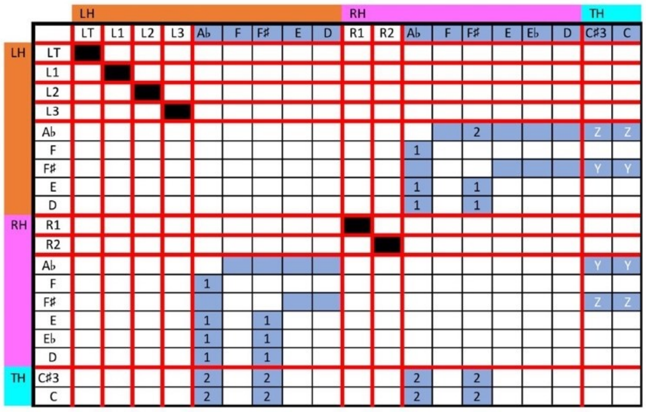


Most effective at *p*: All

Least effective at *f*:

3

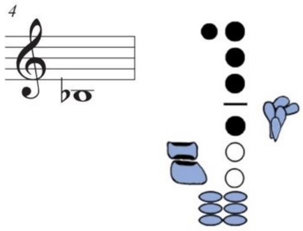


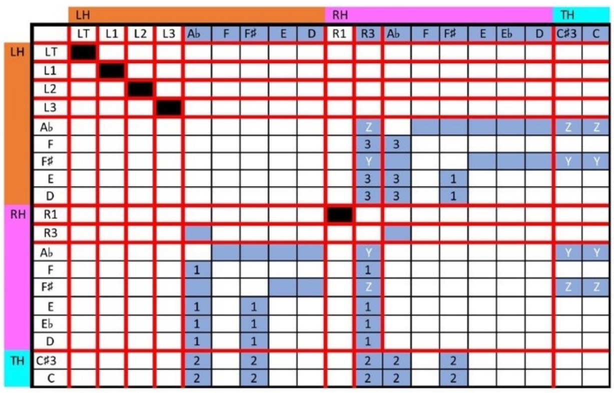


Most effective at *p*: All

Least effective at *f*:

4

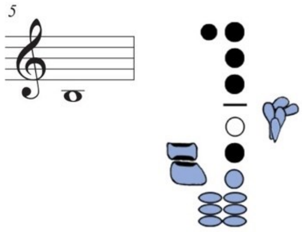




Most effective at *p*: All

Least effective at *f*:

5

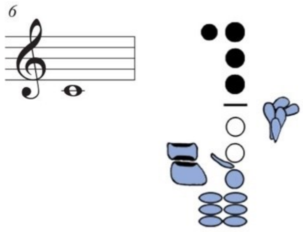


Most effective at *p*: All

Least effective at *f*:

		LH									RH								TH	
		LT	L1	L2	L3	A♭	F	F♯	E	D	R2	R3	A♭	F	F♯	E	E♭	D	C♯3	C
LH	LT																			
	L1																			
	L2																			
	L3																			
	A♭											Z							Z	Z
	F											3	3							
	F♯											Y							Y	Y
	E											3	3		3					
	D											3	3		3					
RH	R2																			
	R3																			
	A♭											Y							Y	Y
	F					1						1								
	F♯											Z							Z	Z
	E					1		1				1								
	E♭					1		1				1								
	D					1		1				1								
TH	C♯3					2		2				2	2		2					
	C					2		2				2	2		2					

6

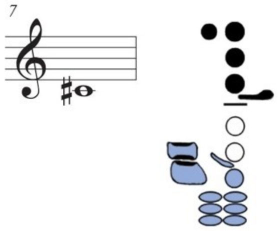


Most effective at *p*: E ♭, D, C♯3, C

Least effective at *f*: B ♮ S

		LH									RH								TH	
		LT	L1	L2	L3	A♭	F	F♯	E	D	B♮S	R3	A♭	F	F♯	E	E♭	D	C♯3	C
LH	LT																			
	L1																			
	L2																			
	L3																			
	A♭										Z	Z							Z	Z
	F										3	3	3							
	F♯										Y	Y							Y	Y
	E										3	3	3		3					
	D										3	3	3		3					
RH	B♮S																			
	R3																			
	A♭										Y	Y							Y	Y
	F					1					1	1								
	F♯										Z	Z							Z	Z
	E					1		1			1	1								
	E♭					1		1			1	1								
	D					1		1			1	1								
TH	C♯3					2		2			2	2	2		2					
	C					2		2			2	2	2		2					

7

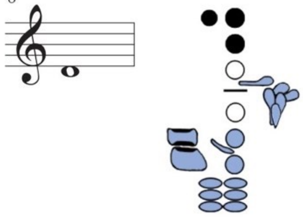


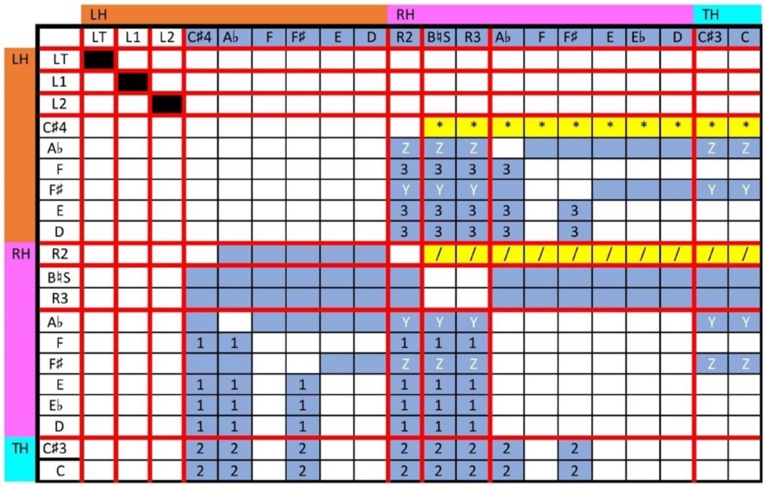
Most effective at *p*: C♯3, C

Least effective at *f*: F

		LH					RH								TH	
		LT	L1	L2	L3	C♯4	B♮S	R3	A♭	F	F♯	E	E♭	D	C♯3	C
LH	LT															
	L1															
	L2															
	L3															
	C♯4															
RH	B♮S															
	R3															
	A♭															
	F						1	1								
	F♯															
	E						1	1								
	E♭						1	1								
	D						1	1								
TH	C♯3						2	2								
	C						2	2								

8

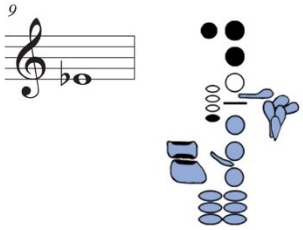


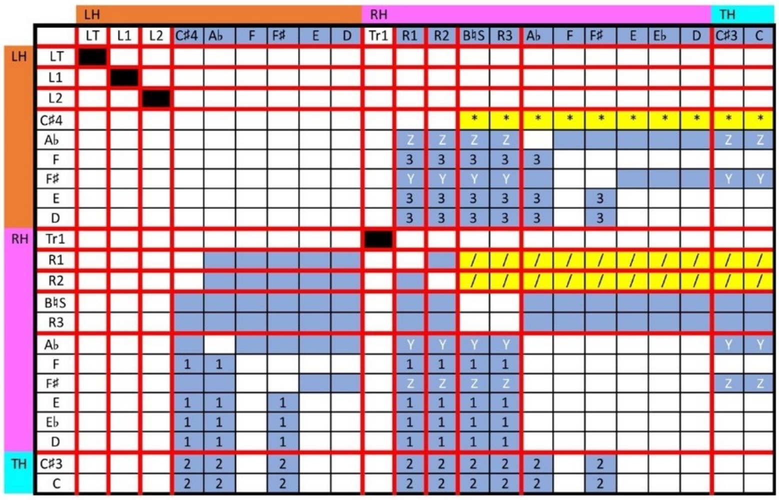


Most effective at *p*: C♯4, R2, E♭, D

Least effective at *f*: F, F♯

9

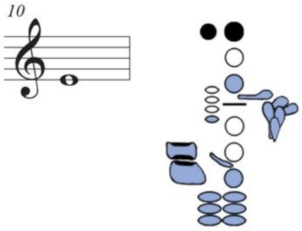


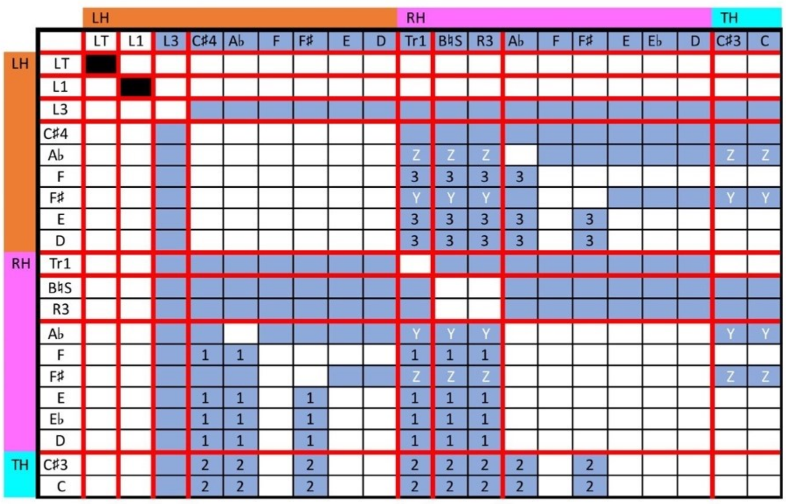


Most effective at *p*: R1, R2, B♮S

Least effective at *f*: A♭, F

10

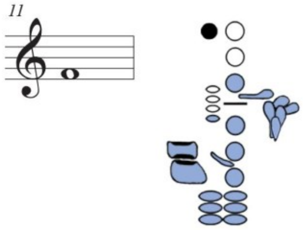




Most effective at *p*: L3, C♯4

Least effective at *f*: F, F♯

11

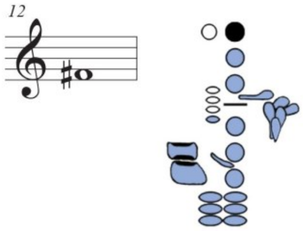


Most effective at *p*: L3, R1, R2

Least effective at *f*: A♭, F, F♯, Tr1, B♮S, R3

		LH								RH											TH	
		LT	L3	C♯4	A♭	F	F♯	E	D	Tr1	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	D	C♯3	C
LH	LT																					
	L3																					
	C♯4									*	*	*	*	*	*	*	*	*	*	*	*	*
	A♭		Z							Z	Z	Z	Z	Z							Z	Z
	F		3							3	3	3	3	3	3							
	F♯		Y							Y	Y	Y	Y	Y							Y	Y
	E		3							3	3	3	3	3	3		3					
	D		3							3	3	3	3	3	3		3					
RH	Tr1																					
	R1									/		/	/	/	/	/	/	/	/	/	/	/
	R2									/	/		/	/	/	/	/	/	/	/	/	/
	B♮S																					
	R3																					
	A♭		Y							Y	Y	Y	Y	Y							Y	Y
	F		1	1	1					1	1	1	1	1								
	F♯		Z							Z	Z	Z	Z	Z							Z	Z
	E		1	1	1		1			1	1	1	1	1								
	E♭		1	1	1		1			1	1	1	1	1								
	D		1	1	1		1			1	1	1	1	1								
TH	C♯3		2	2	2		2			2	2	2	2	2	2		2					
	C		2	2	2		2			2	2	2	2	2	2		2					

12

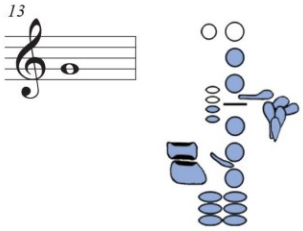


Most effective at *p*: L2, L3, R1, R2

Least effective at *f*: A♭, F

		LH									RH											TH	
		L1	L2	L3	C♯4	A♭	F	F♯	E	D	Tr1	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	D	C♯3	C
LH	L1																						
	L2																						
	L3																						
	C♯4		*	*							*			*	*	*	*	*	*	*	*	*	*
	A♭		Z	Z							Z	Z	Z	Z	Z							Z	Z
	F		3	3							3	3	3	3	3	3							
	F♯		Y	Y							Y	Y	Y	Y	Y							Y	Y
	E		3	3							3	3	3	3	3	3		3					
	D		3	3							3	3	3	3	3	3		3					
RH	Tr1																						
	R1		/	/							/			/	/	/	/	/	/	/	/	/	/
	R2		/	/							/			/	/	/	/	/	/	/	/	/	/
	B♮S																						
	R3																						
	A♭		Y	Y							Y	Y	Y	Y	Y							Y	Y
	F		1	1	1	1					1	1	1	1	1								
	F♯		Z	Z							Z	Z	Z	Z	Z							Z	Z
	E		1	1	1	1		1			1	1	1	1	1								
	E♭		1	1	1	1		1			1	1	1	1	1								
	D		1	1	1	1		1			1	1	1	1	1								
TH	C♯3		2	2	2	2		2			2	2	2	2	2	2		2					
	C		2	2	2	2		2			2	2	2	2	2	2		2					

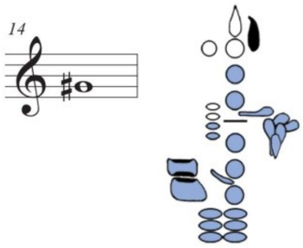
13

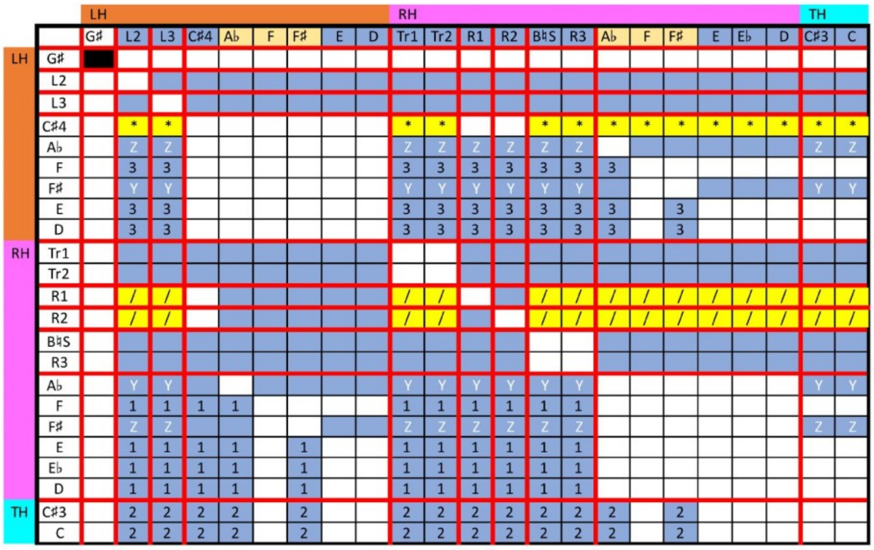


Most effective at *p*: L2, R1, R2

Least effective at *f*: L3, Tr1, F, F♯

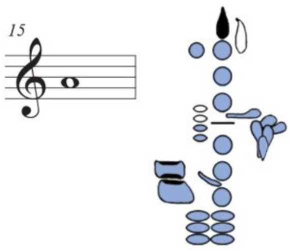
										RH												TH	
		L2	L3	C♯4	A♭	F	F♯	E	D	Tr1	Tr2	R1	R2	B♮S	R3	A♭	F	F♯	E	E♭	D	C♯3	C
	L2																						
	L3																						
	C♯4	*	*							*	*			*	*	*	*	*	*	*	*	*	*
	A♭	Z	Z							Z	Z	Z	Z	Z	Z							Z	Z
	F	3	3							3	3	3	3	3	3	3							
	F♯	Y	Y							Y	Y	Y	Y	Y	Y							Y	Y
	E	3	3							3	3	3	3	3	3	3		3					
	D	3	3							3	3	3	3	3	3	3		3					
RH	Tr1																						
	Tr2																						
	R1	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	R2	/	/							/	/			/	/	/	/	/	/	/	/	/	/
	B♮S																						
	R3																						
	A♭	Y	Y							Y	Y	Y	Y	Y	Y							Y	Y
	F	1	1	1	1					1	1	1	1	1	1								
	F♯	Z	Z							Z	Z	Z	Z	Z	Z							Z	Z
	E	1	1	1	1		1			1	1	1	1	1	1								
	E♭	1	1	1	1		1			1	1	1	1	1	1								
	D	1	1	1	1		1			1	1	1	1	1	1								
TH	C♯3	2	2	2	2		2			2	2	2	2	2	2	2		2					
	C	2	2	2	2		2			2	2	2	2	2	2	2		2					

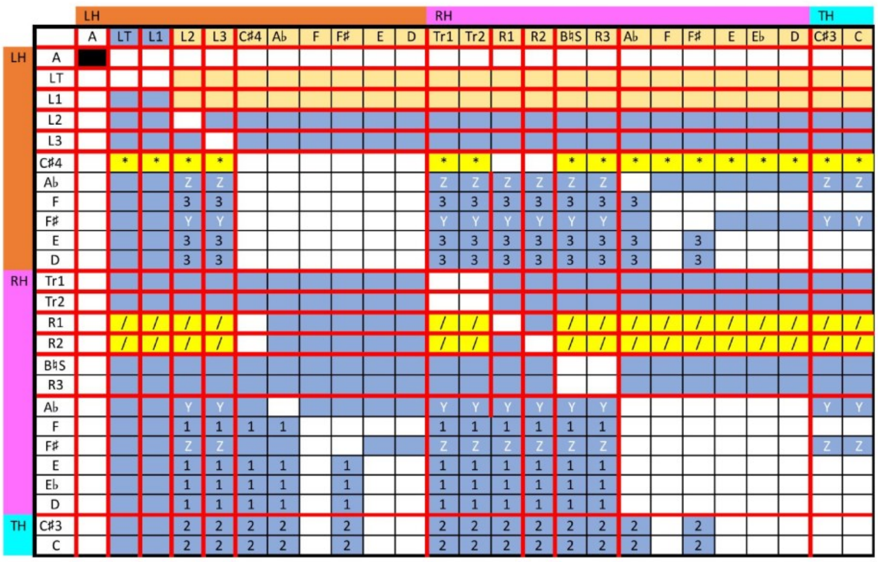




Most effective at *p*: None

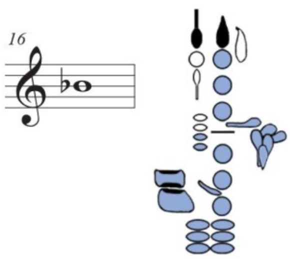
Least effective at *f*: B ♮ S, A ♭

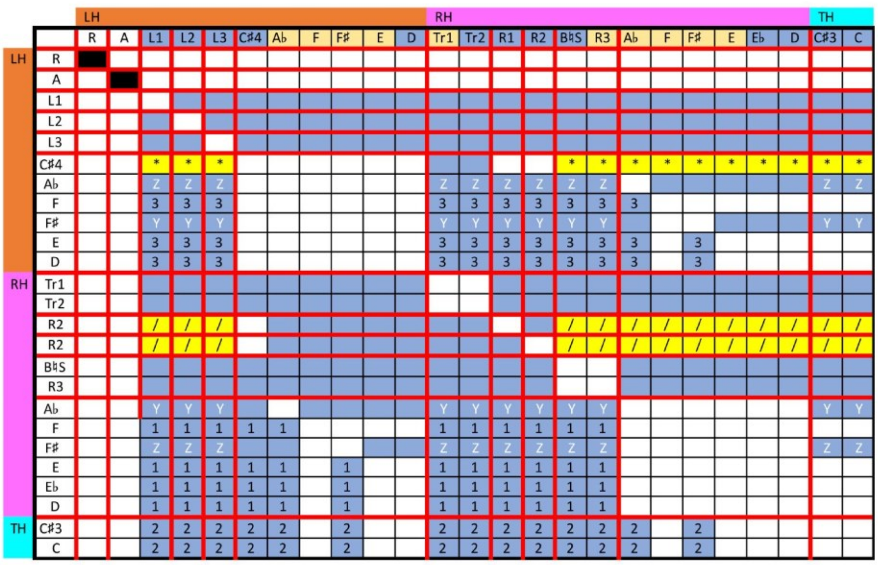




Most effective at *p*: LT

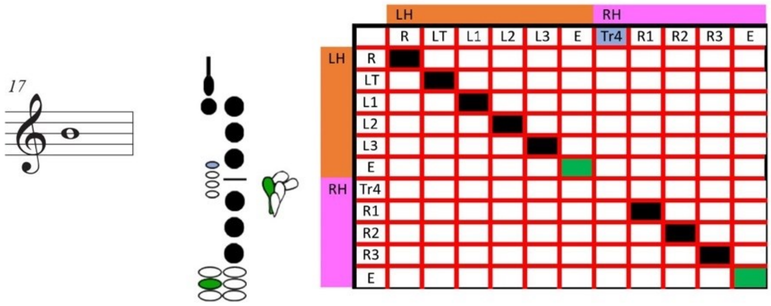
Least effective at *f*: B ♮ S, A ♭





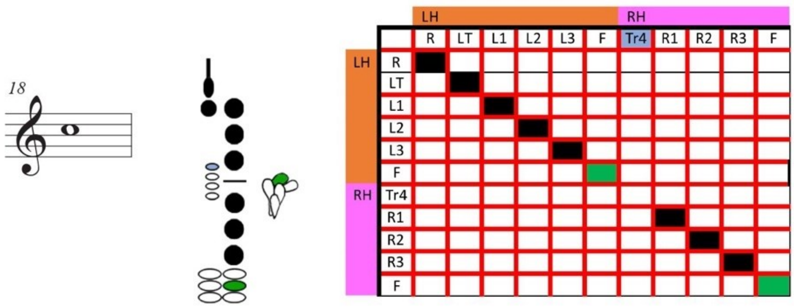
Most effective at *p*: None

Least effective at *f*: Tr2, A ♭ , F, F♯



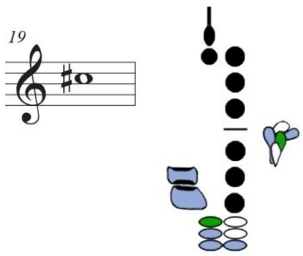
Most effective at *p*: All

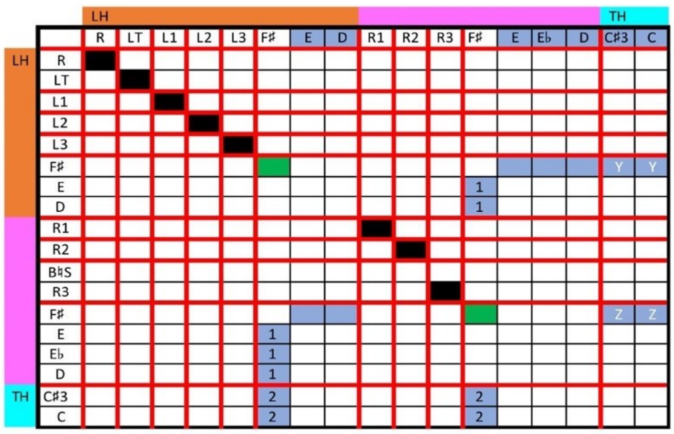
Least effective at *f*:



Most effective at *p*: All

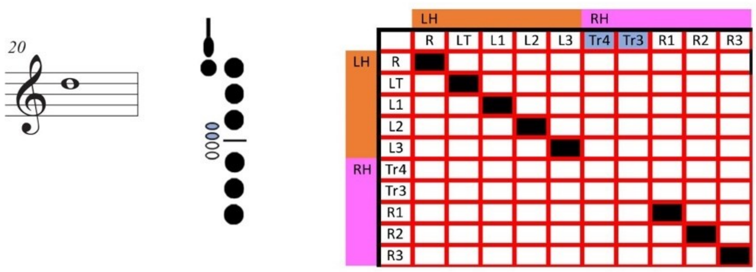
Least effective at *f*:





Most effective at *p*: All

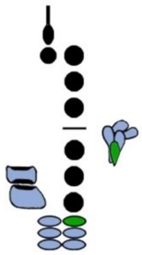
Least effective at *f*:



Most effective at *p*: All

Least effective at *f*:

21

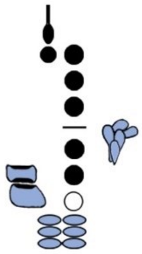


Most effective at *p*: All

Least effective at *f*:

		LH										RH									TH	
		R	LT	L1	L2	L3	A♭	F	F♯	E	D	R1	R2	R3	A♭	F	F♯	E	E♭	D	C♯3	C
LH	R																					
	LT																					
	L1																					
	L2																					
	L3																					
	A♭																				Z	Z
	F														1							
	F♯														2						Y	Y
	E														1							
	D														1							
RH	R1																					
	R2																					
	R3																					
	A♭																				Y	Y
	F						1															
	F♯						2														Z	Z
	E						1															
	E♭						1															
	D						1															
TH	C♯3						2								2							
	C						2								2							

22

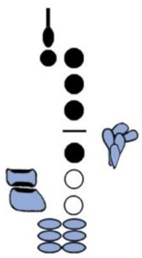


Most effective at *p*: All

Least effective at *f*:

		LH										RH								TH	
		R	LT	L1	L2	L3	A♭	F	F♯	E	D	R1	R2	A♭	F	F♯	E	E♭	D	C♯3	C
LH	R																				
	LT																				
	L1																				
	L2																				
	L3																				
	A♭															2				Z	Z
	F													3							
	F♯																			Y	Y
	E													3		3					
	D													3		3					
RH	R1																				
	R2																				
	A♭								2											Y	Y
	F						1														
	F♯																			Z	Z
	E						1		1												
	E♭						1		1												
	D						1		1												
TH	C♯3						2		2					2		2					
	C						2		2					2		2					

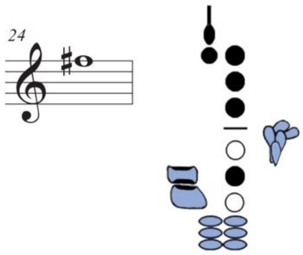
23

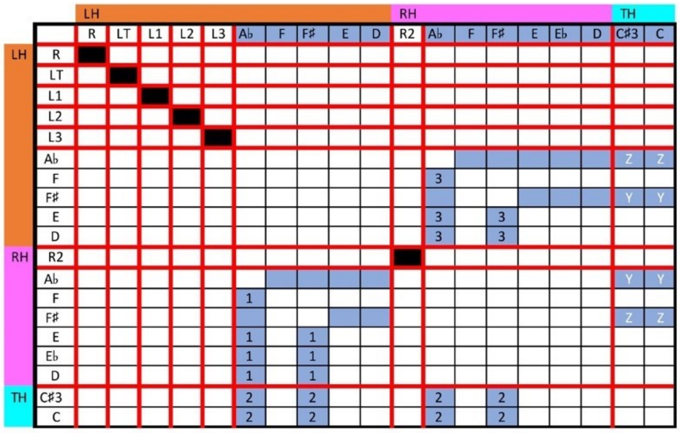


Most effective at *p*: All

Least effective at *f*:

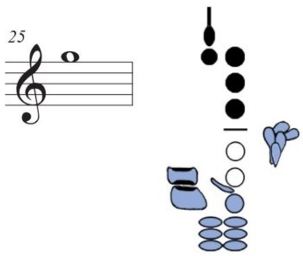
		LH										RH							TH	
		R	LT	L1	L2	L3	A♭	F	F♯	E	D	R1	A♭	F	F♯	E	E♭	D	C♯3	C
LH	R																			
	LT																			
	L1																			
	L2																			
	L3																			
	A♭																			
	F												3							
	F♯																		Y	Y
	E												3		3					
	D												3		3					
RH	R1																			
	A♭																			
	F						1													
	F♯																		Z	Z
	E						1		1											
	E♭						1		1											
	D						1		1											
TH	C♯3						2		2				2		2					
	C						2		2				2		2					

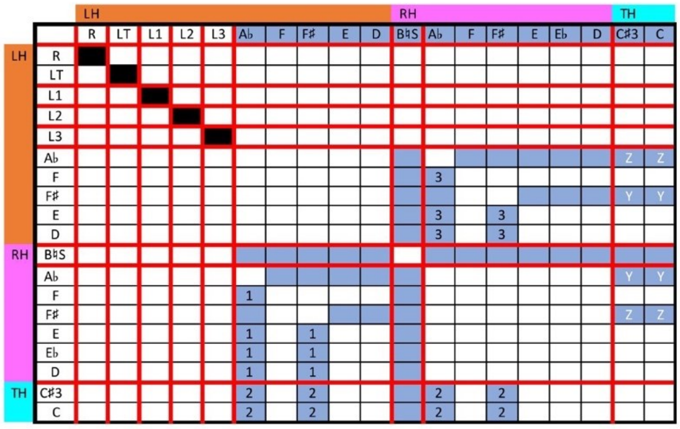




Most effective at *p*: All

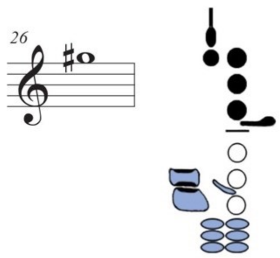
Least effective at *f*:

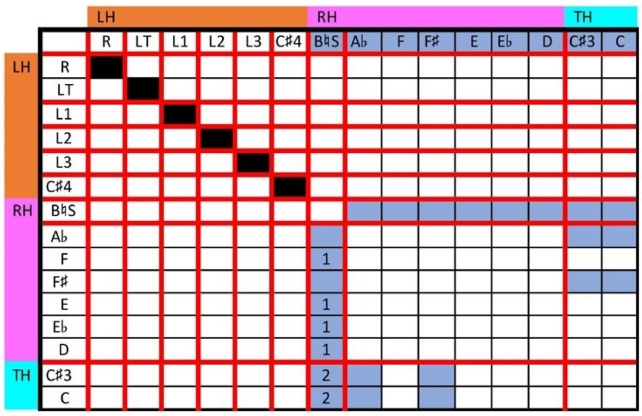




Most effective at *p*: E♭, D, C♯3, C

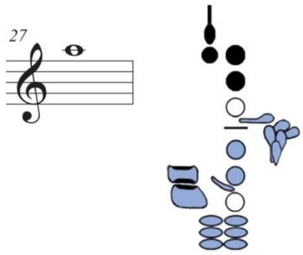
Least effective at *f*: B♮S





Most effective at *p*: E♭, D, C♯3, C

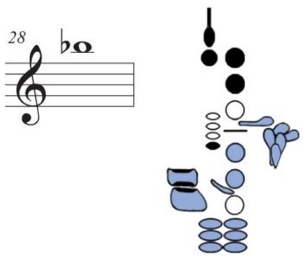
Least effective at *f*: F, F♯



Most effective at *p*: R1, R2, E♭, D, C♯3, C

Least effective at *f*: F, F♯

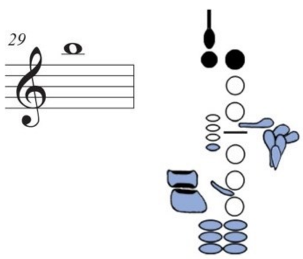
		LH										RH									TH	
		R	LT	L1	L2	C♯4	A♭	F	F♯	E	D	R1	R2	B♮S	A♭	F	F♯	E	E♭	D	C♯3	C
LH	R																					
	LT																					
	L1																					
	L2																					
	C♯4													*	*	*	*	*	*	*	*	*
	A♭											Z	Z	Z							Z	Z
	F											3	3	3	3							
	F♯											Y	Y	Y							Y	Y
	E											3	3	3	3		3					
	D											3	3	3	3		3					
RH	R1													/	/	/	/	/	/	/	/	/
	R2													/	/	/	/	/	/	/	/	/
	B♮S																					
	A♭											Y	Y	Y							Y	Y
	F					1	1					1	1	1								
	F♯											Z	Z	Z							Z	Z
	E					1	1		1			1	1	1								
	E♭					1	1		1			1	1	1								
	D					1	1		1			1	1	1								
TH	C♯3					2	2		2			2	2	2	2		2					
	C					2	2		2			2	2	2	2		2					



Most effective at *p*: R1, R2, E♭, D, C♯3, C

Least effective at *f*: B♮S, A♭, F

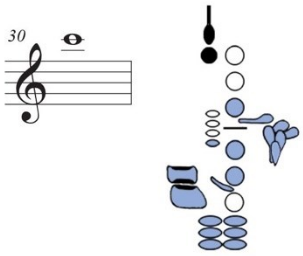
		LH										RH										TH	
		R	LT	L1	L2	C♯4	A♭	F	F♯	E	D	Tr1	R1	R2	B♮S	A♭	F	F♯	E	E♭	D	C♯3	C
LH	R																						
	LT																						
	L1																						
	L2																						
	C♯4														*	*	*	*	*	*	*	*	*
	A♭												Z	Z	Z							Z	Z
	F												3	3	3	3							
	F♯												Y	Y	Y							Y	Y
	E												3	3	3	3		3					
	D												3	3	3	3		3					
RH	Tr1																						
	R1														/	/	/	/	/	/	/	/	/
	R2														/	/	/	/	/	/	/	/	/
	B♮S																						
	A♭												Y	Y	Y							Y	Y
	F					1	1						1	1	1								
	F♯												Z	Z	Z							Z	Z
	E					1	1		1				1	1	1								
	E♭					1	1		1				1	1	1								
	D					1	1		1				1	1	1								
TH	C♯3					2	2		2				2	2	2	2		2					
	C					2	2		2				2	2	2	2		2					

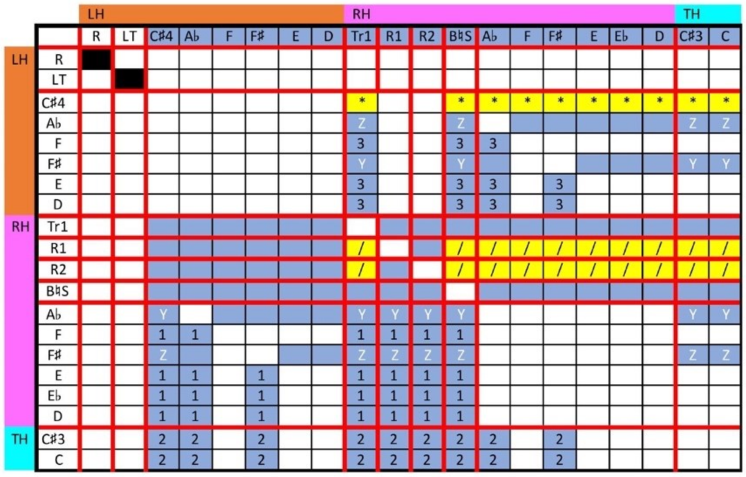


Most effective at *p*: C♯3, C

Least effective at *f*: A♭, F♯

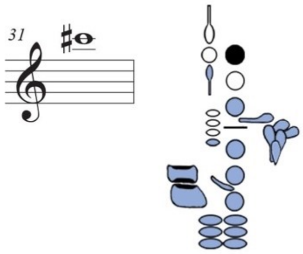
		LH									RH								TH	
		R	LT	L1	C♯4	A♭	F	F♯	E	D	Tr1	B♮S	A♭	F	F♯	E	E♭	D	C♯3	C
LH	R																			
	LT																			
	L1																			
	C♯4																			
	A♭										Z	Z							Z	Z
	F										3	3	3							
	F♯										Y	Y							Y	Y
	E										3	3	3		3					
	D										3	3	3		3					
RH	Tr1																			
	B♮S																			
	A♭										Y	Y							Y	Y
	F				1	1					1	1								
	F♯										Z	Z							Z	Z
	E				1	1		1			1	1								
	E♭				1	1		1			1	1								
	D				1	1		1			1	1								
TH	C♯3				2	2		2			2	2	2		2					
	C				2	2		2			2	2	2		2					

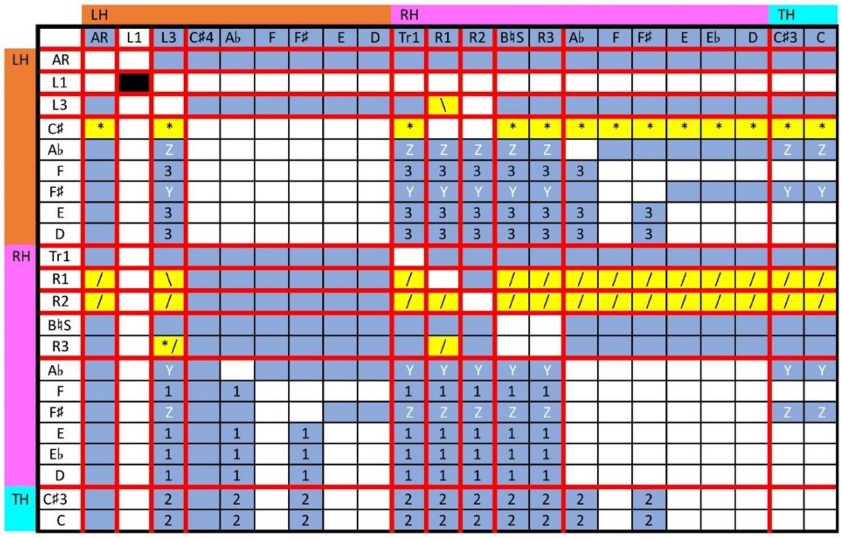




Most effective at *p*: E♭, D, C♯3, C

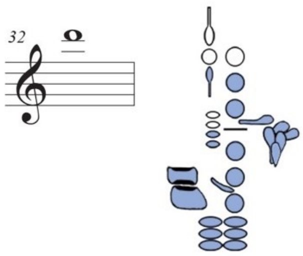
Least effective at *f*: F♯

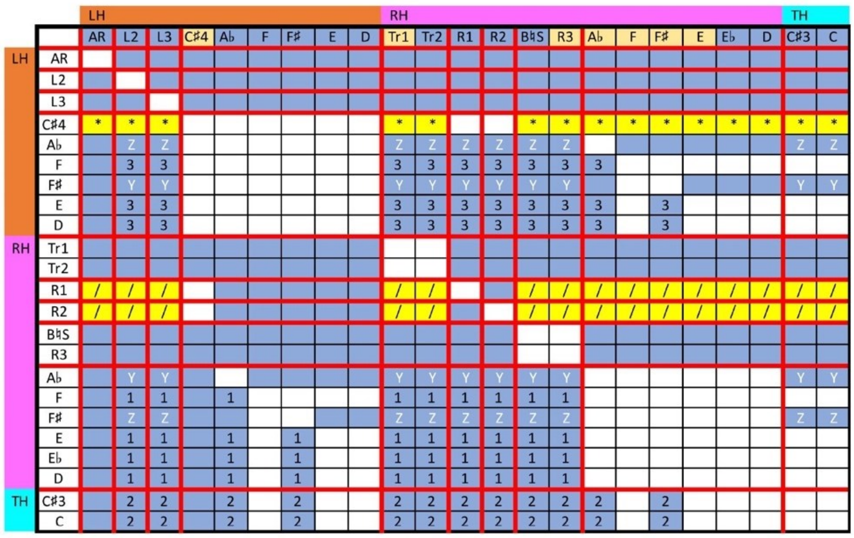




Most effective at *p*: AR

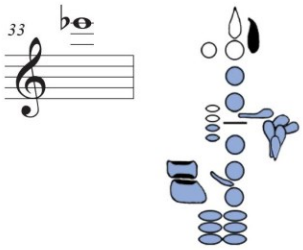
Least effective at *f*: L3, C♯4, R1, R2, C♯3, C





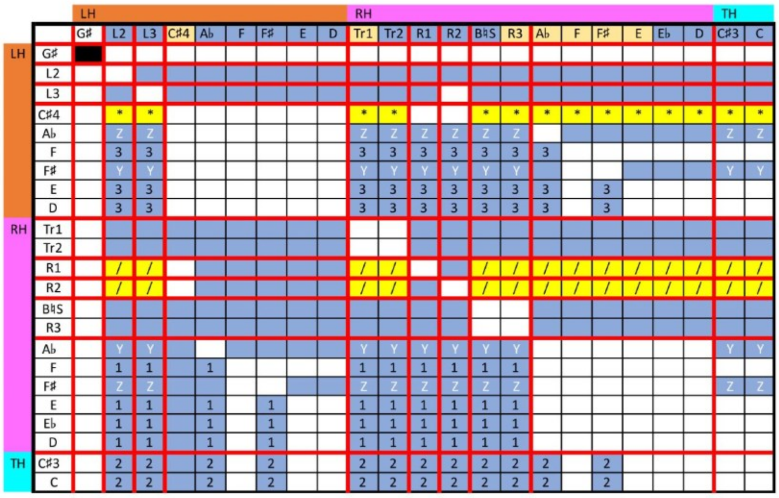
Most effective at *p*: AR, L2, R1, R2, C♯3, C

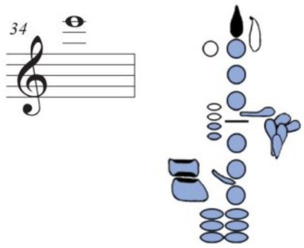
Least effective at *f*: R3, F, F♯



Most effective at *p*: L2, L3, R1, R2, C♯3, C

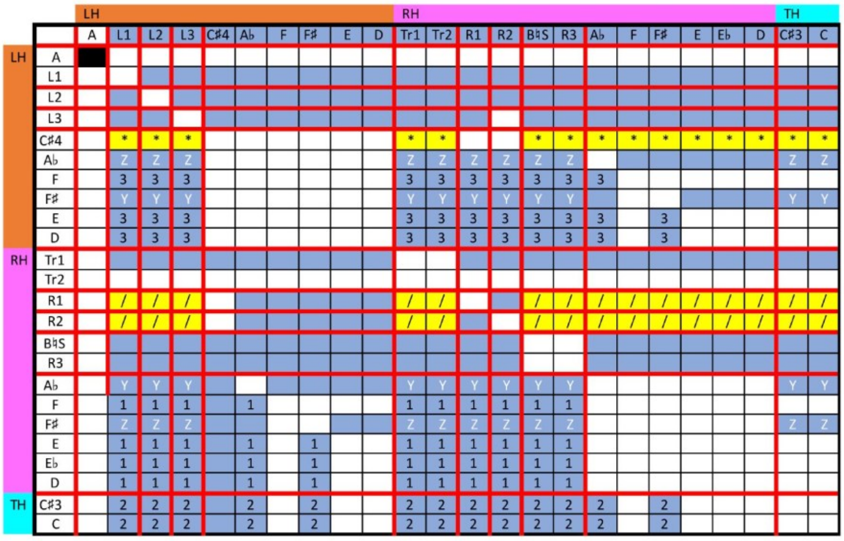
Least effective at *f*: C♯4, B♮S, A♭

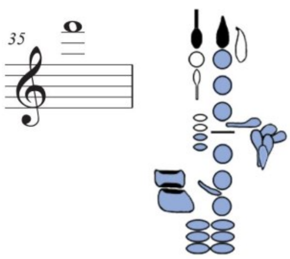




Most effective at *p*: L1, L2, Tr2, R1, R2

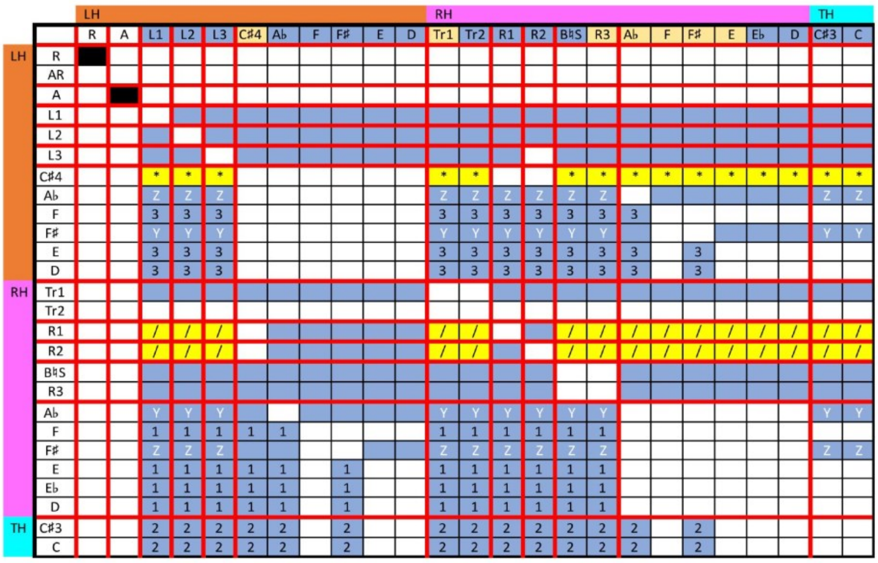
Least effective at *f*: C♯4, B♮S, A♭, F, F♯





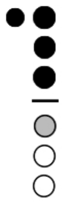
Most effective at *p*: L1, L2, R1, R2, C♯3, C

Least effective at *f*: C♯4, A♭, F, F♯, E



Double Trills Fingering Charts

Audio Examples 0936-1024



The grey-coloured key indicates the one to be double-trilled.

Each fingering has a series of overtones that can be played from that same fingering.

The double trill fingering charts use these additional accidentals to indicate a change in pitch that is not a full quarter-tone. Tuning can be relative:

♯↑ - A bit higher than sharp

♯↓ - A bit lower than sharp

♮↑ - A bit higher than natural

♮↓ - A bit lower than natural

♭↑ - A bit higher than flat

♭↓ - A bit lower than flat

+ Double trill using alternate keys in the lowest register. The keys operate the same pad, and are slower to respond.

* Double trill can happen on the key or directly on the pad the key closes. Sometimes the pad is easier to use due to ergonomics, because there is a greater surface area, or because it is easier to reach in a musical passage.

** The key is difficult or awkward to reach, although possible. Not recommended to use in fast passages.

Leblanc

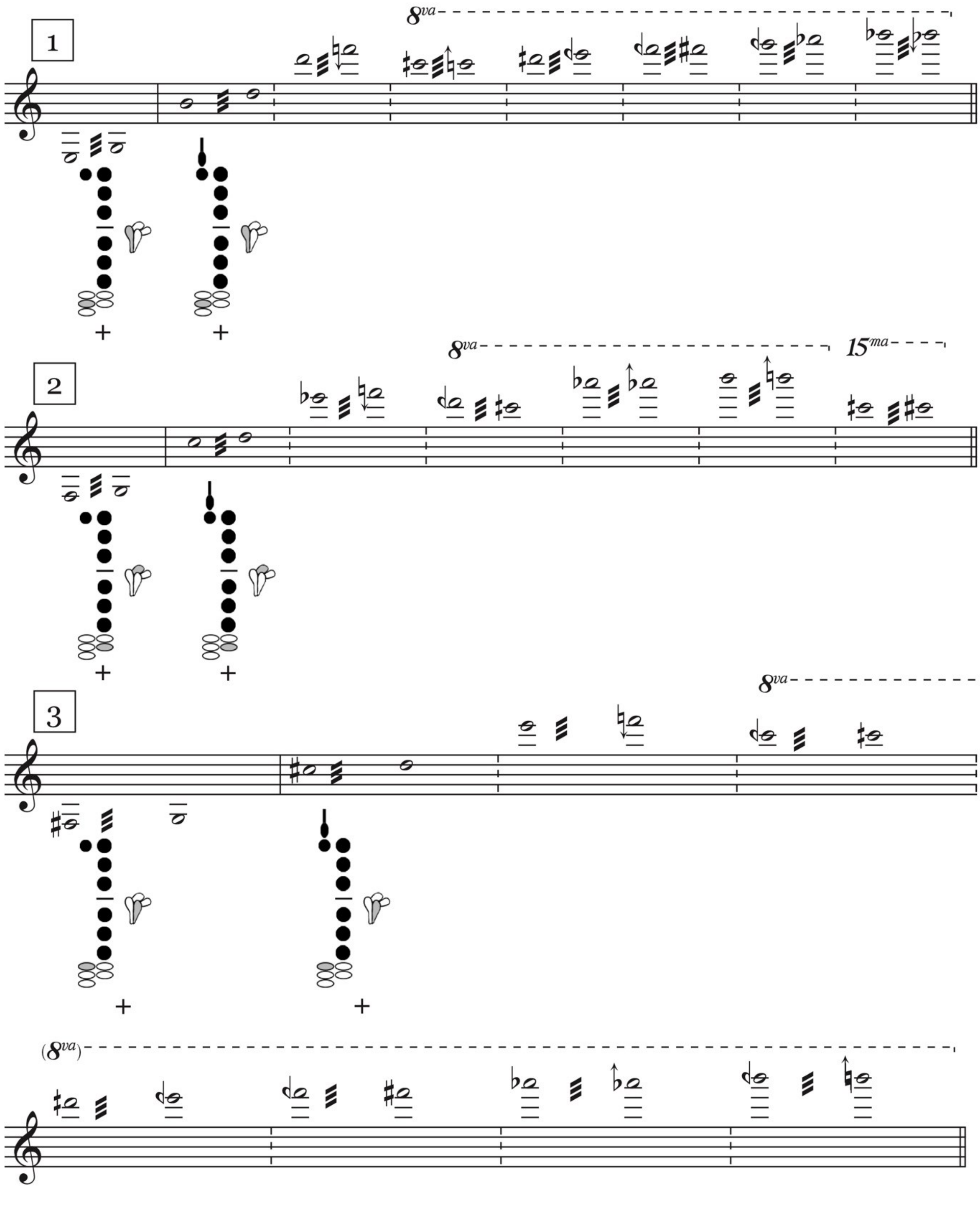
Double Trill

Fingering Charts

Audio Examples 0936-0963

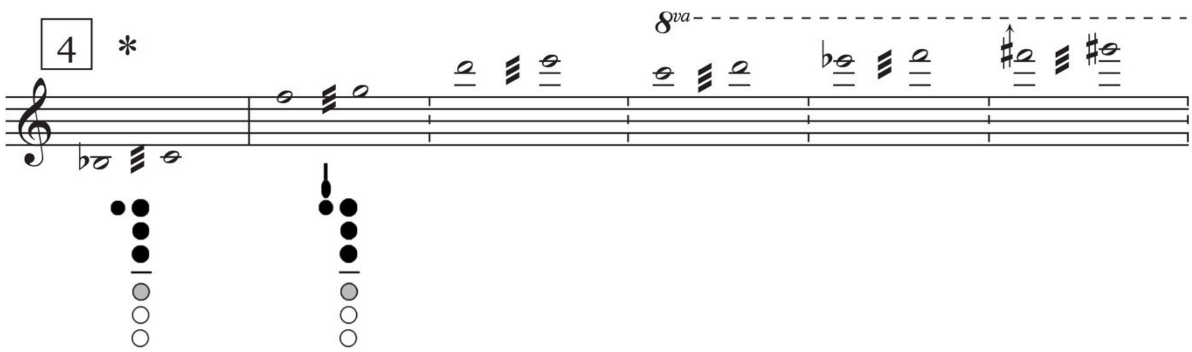
Leblanc Contrabass Clarinet
Double Trills Fingering Chart

TYPE 1- Two Finger trill between two notes

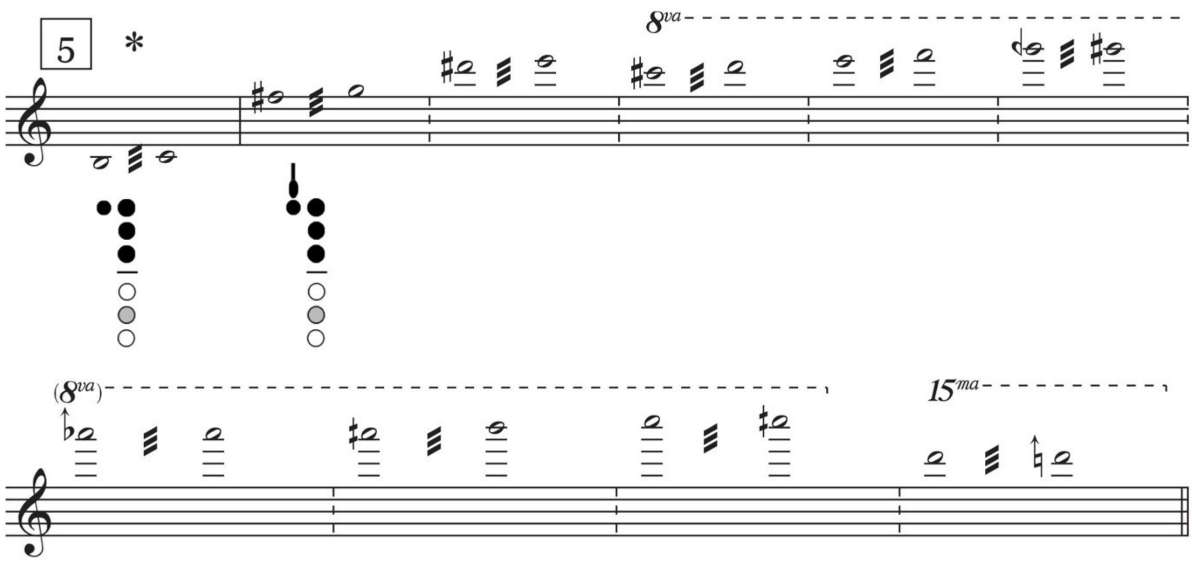


+ Keys open same pad, so response is slower

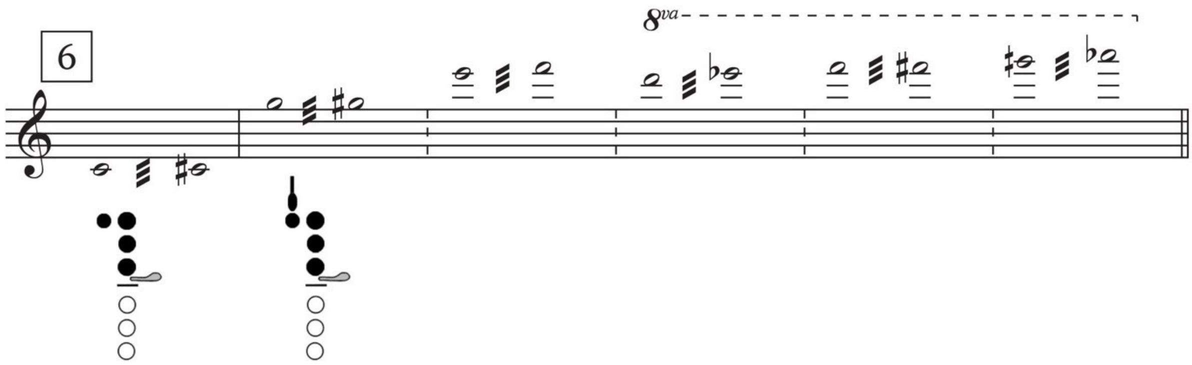
4 *



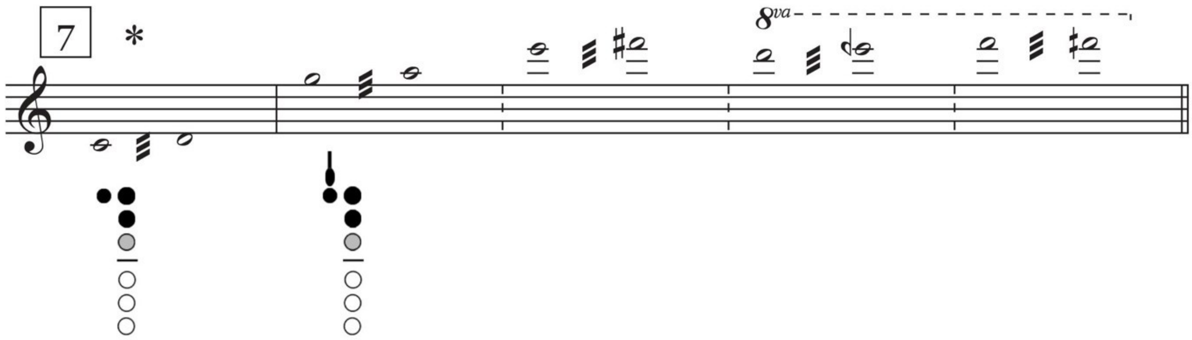
5 *

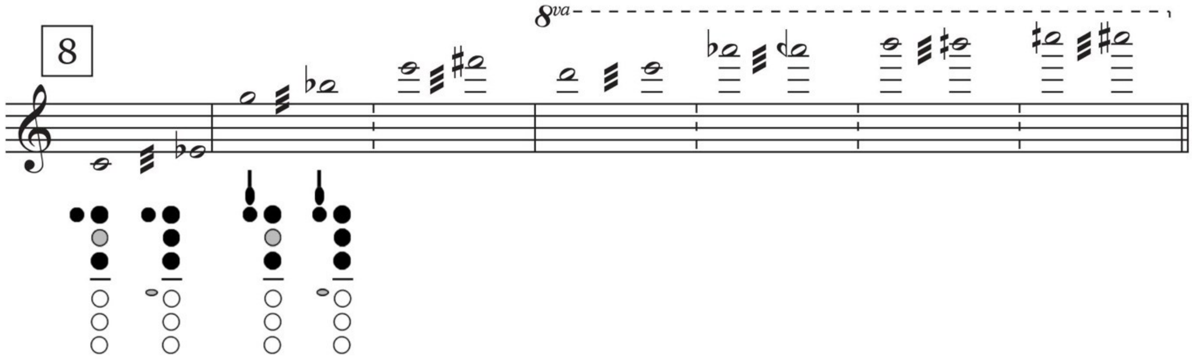


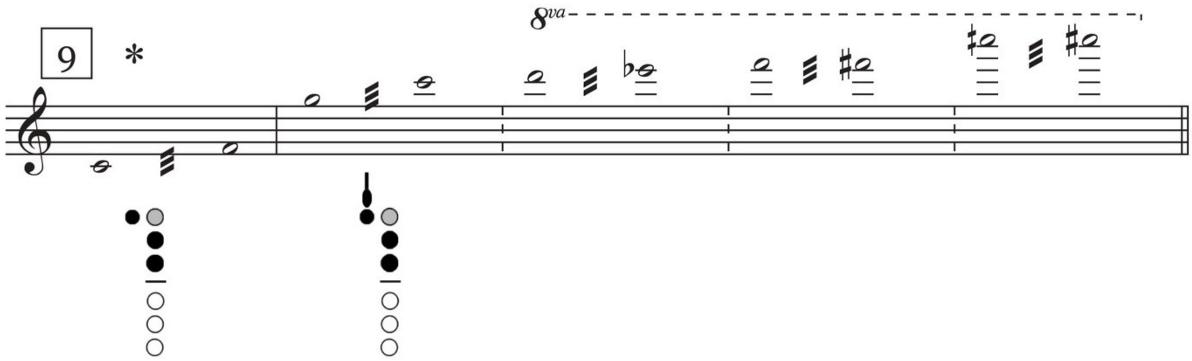
6

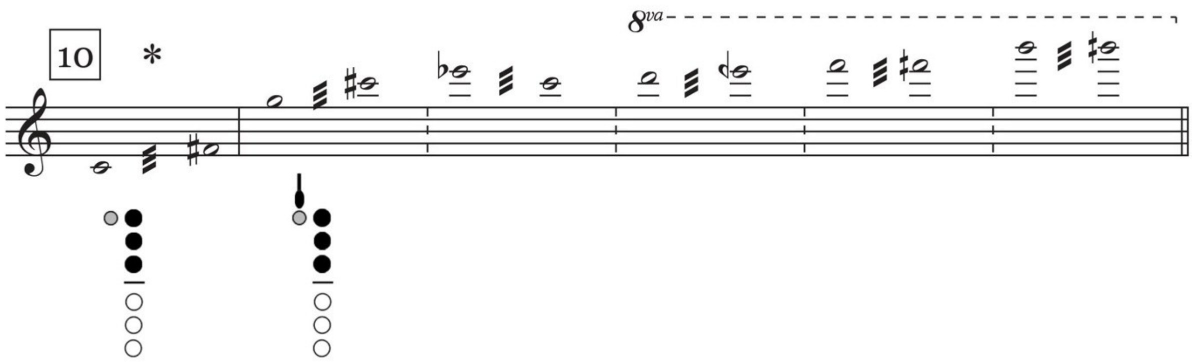


* Can trill directly on pad or touchpiece


7
*
8va

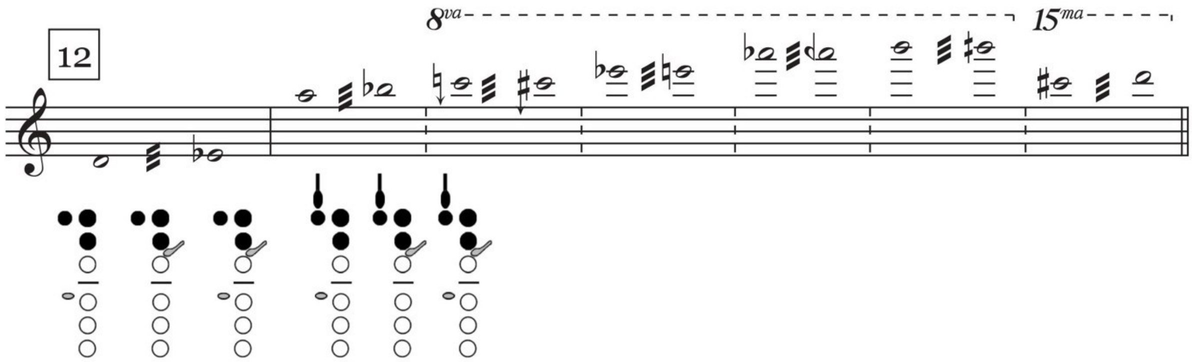

8
8va


9
*
8va

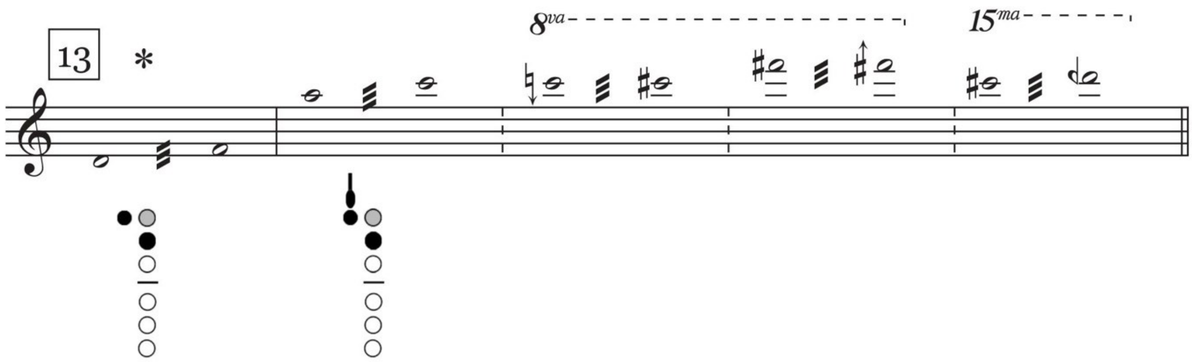

10
*
8va

11 *

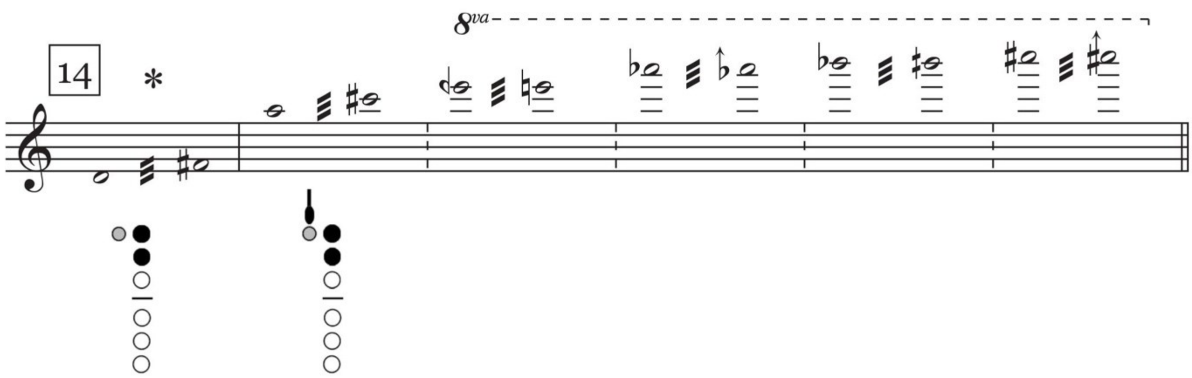
12



13 *

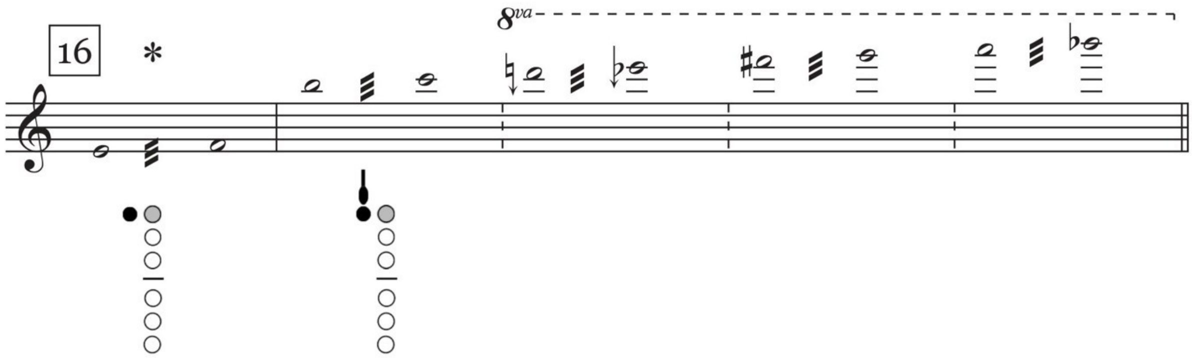


14 *

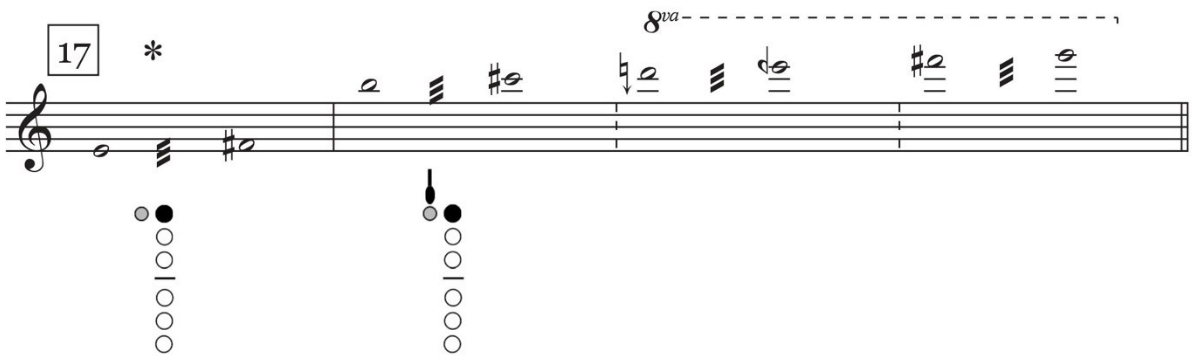


15

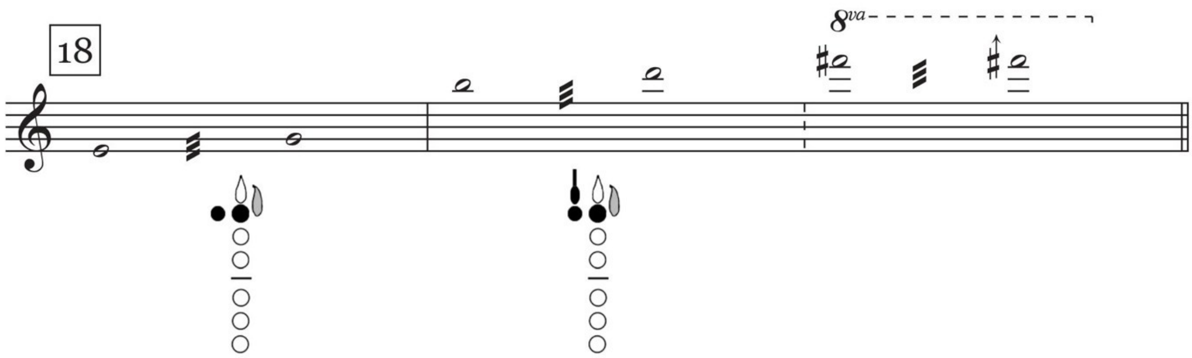
16

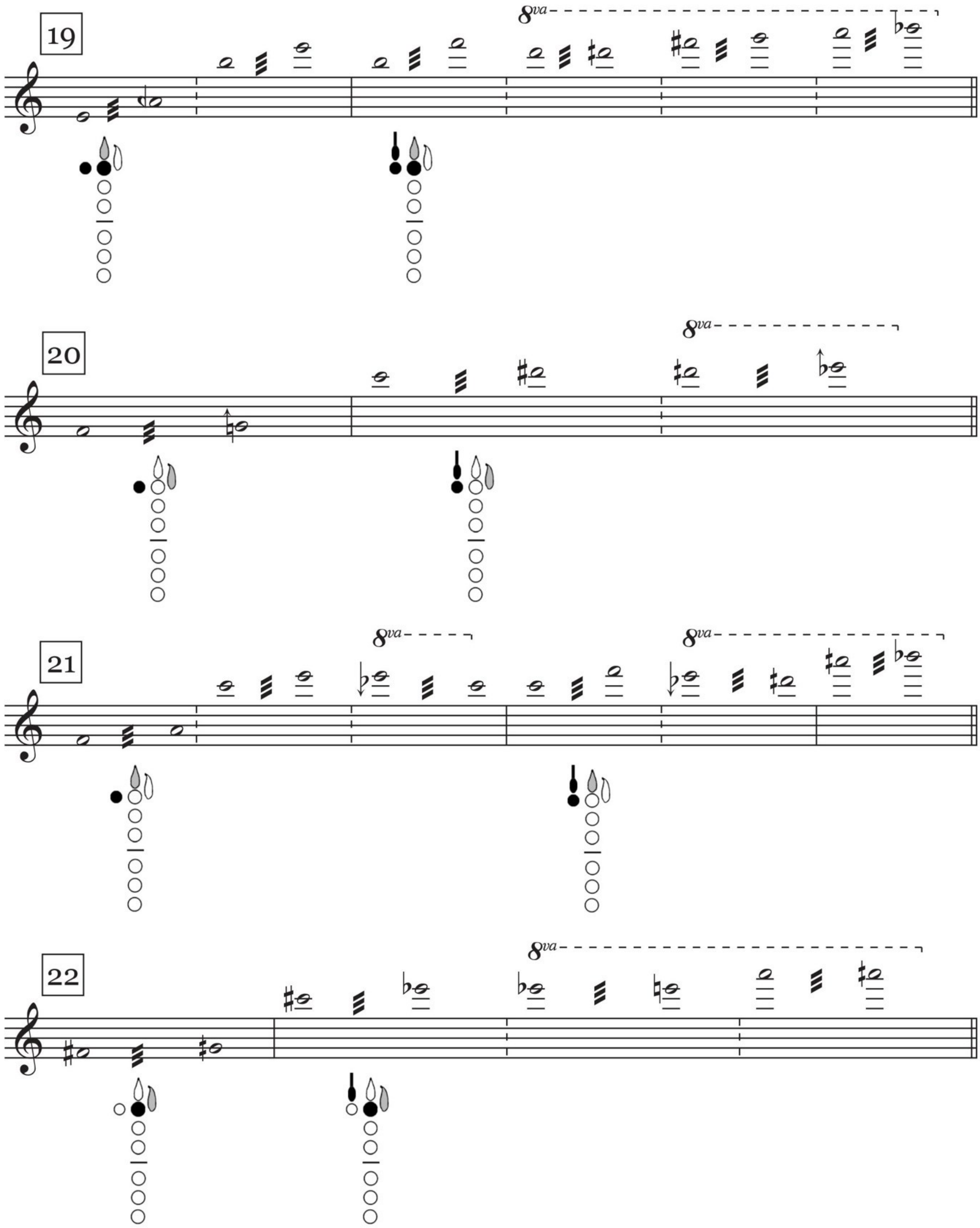


17

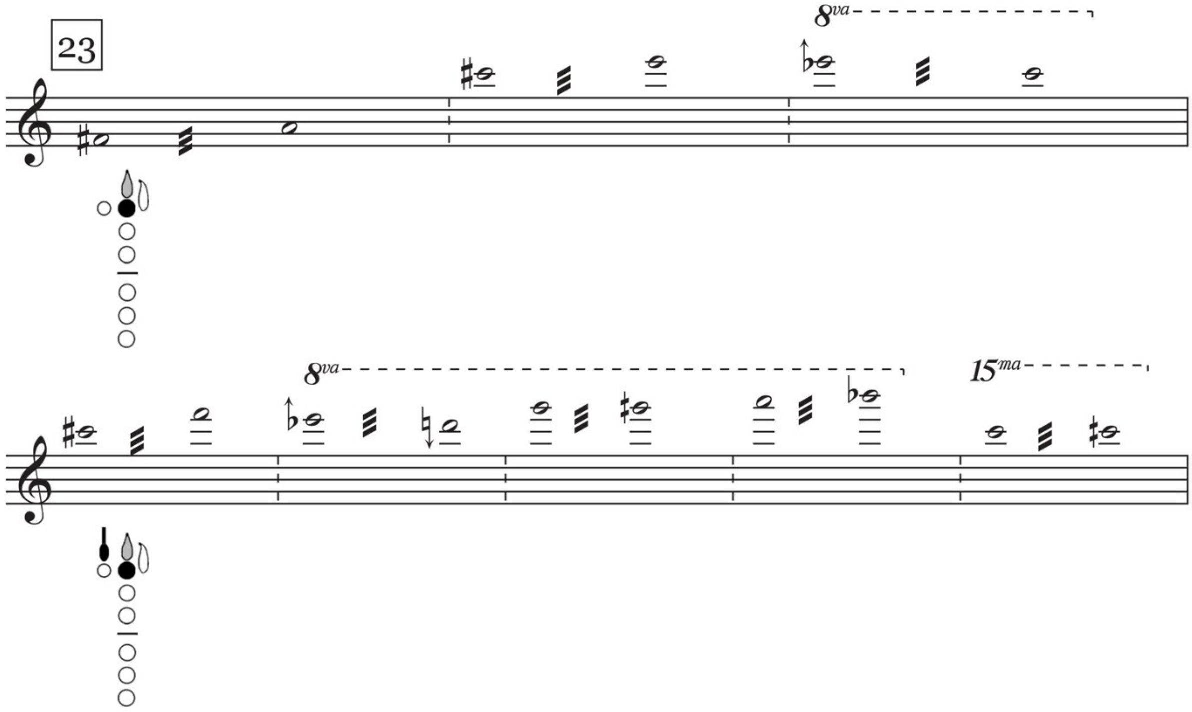


18

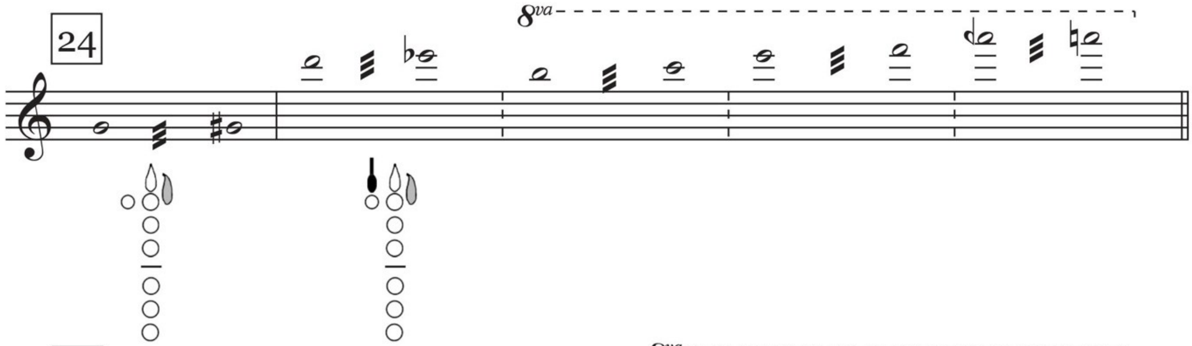



19
8va
20
8va
21
8va
8va
22
8va

23

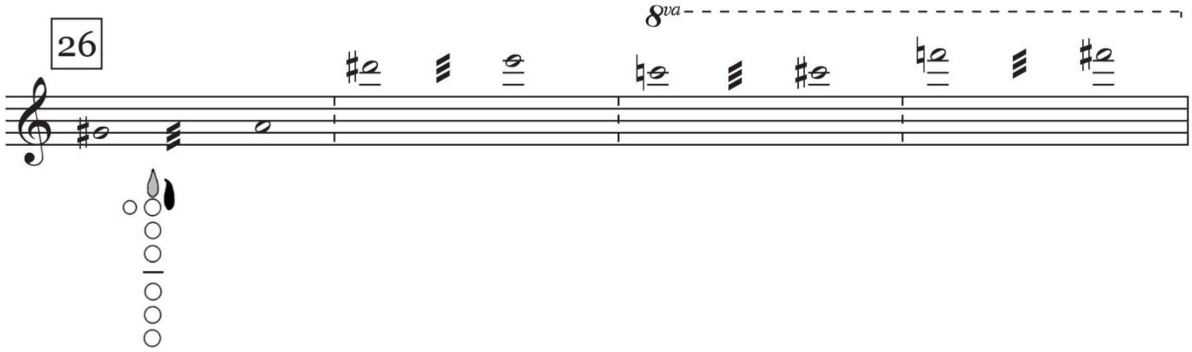


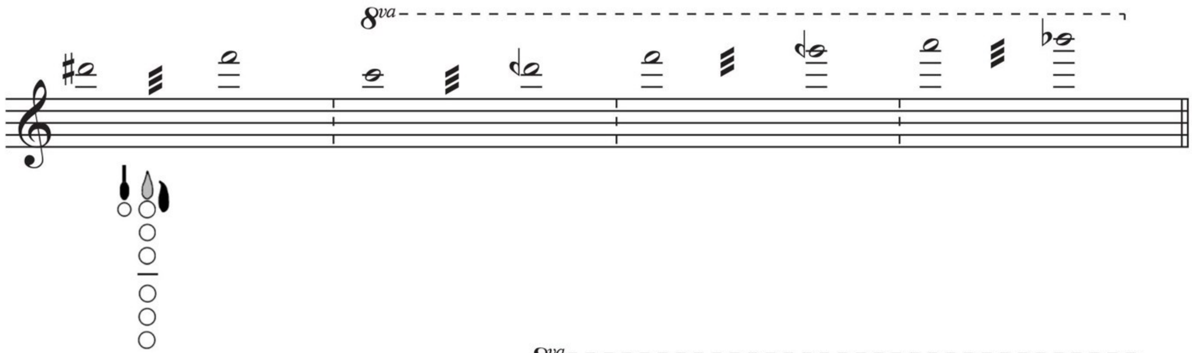
24



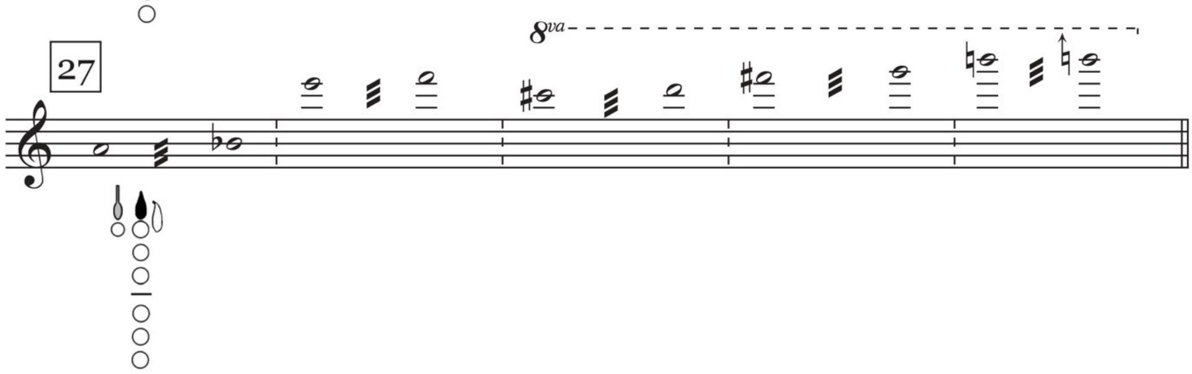
25

26





27



Selmer

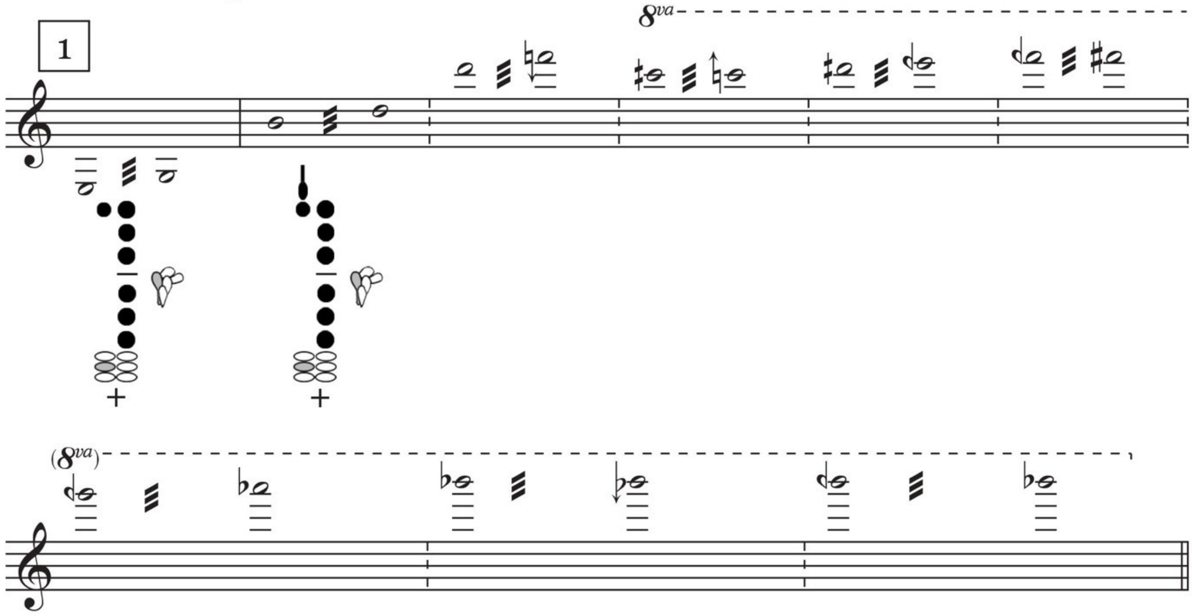
Double Trills

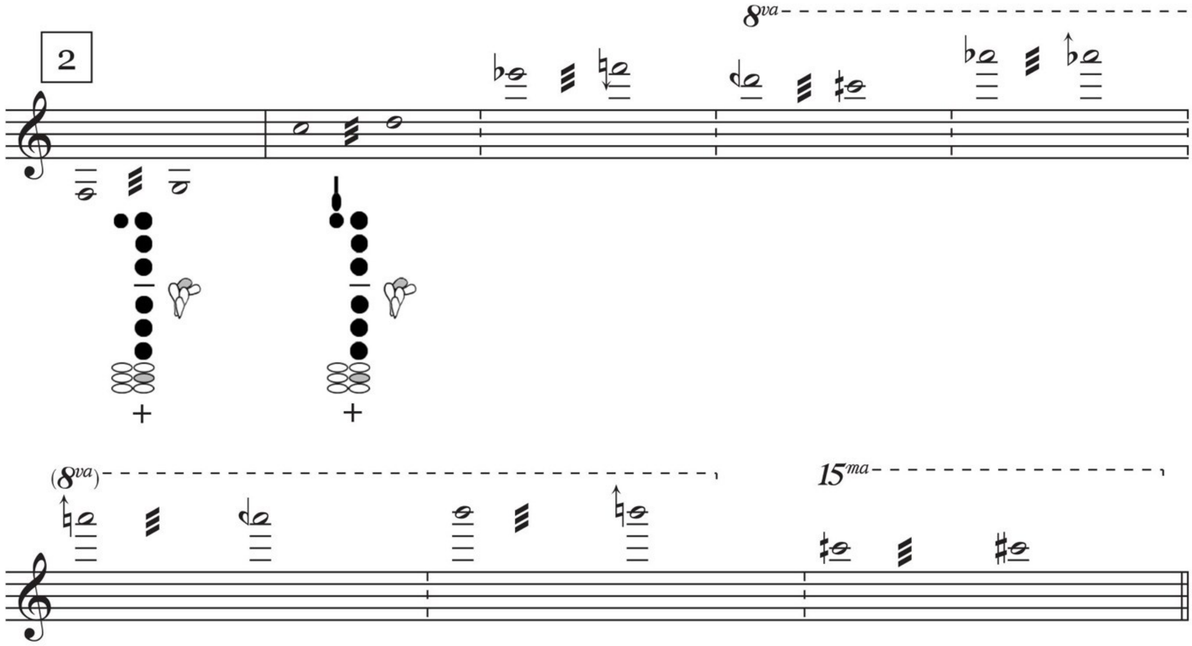
Fingering Charts

Audio Examples 0964-0995

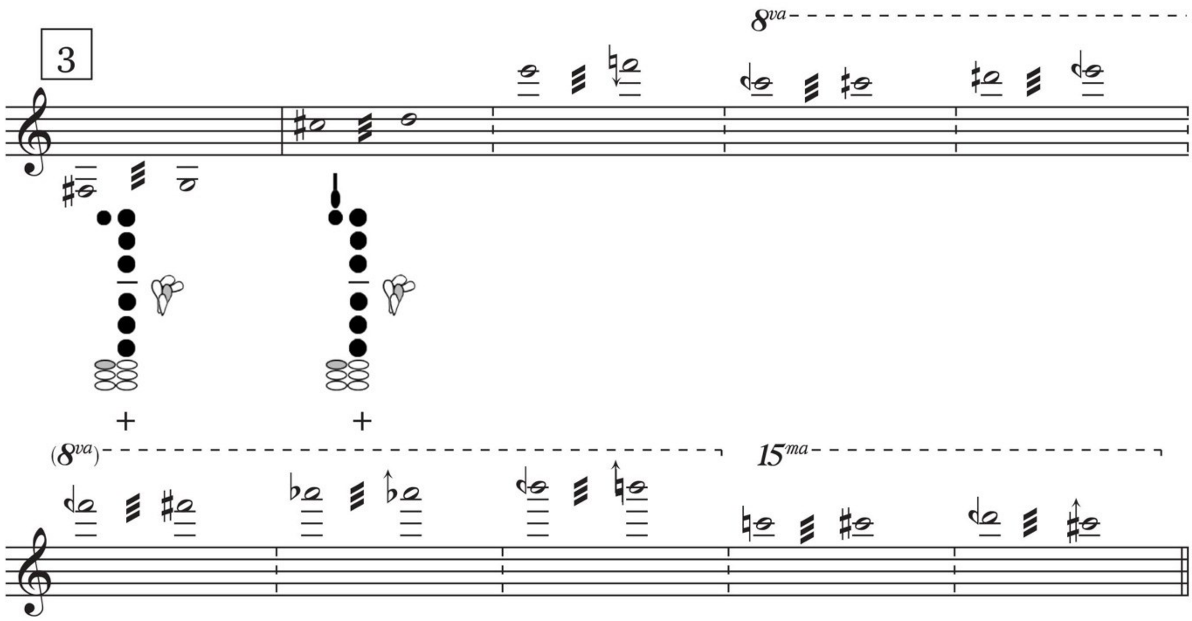
Selmer Contrabass Clarinet
Double Trills Fingering Chart

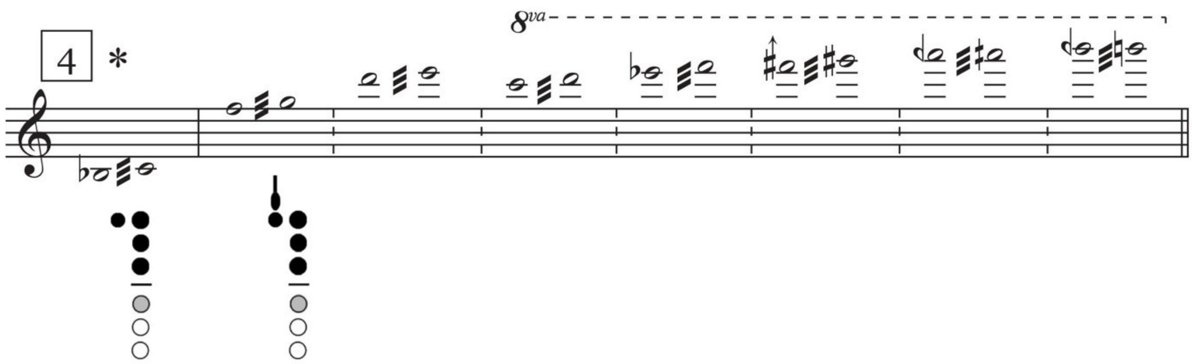
TYPE 1- Two Finger trill between two notes

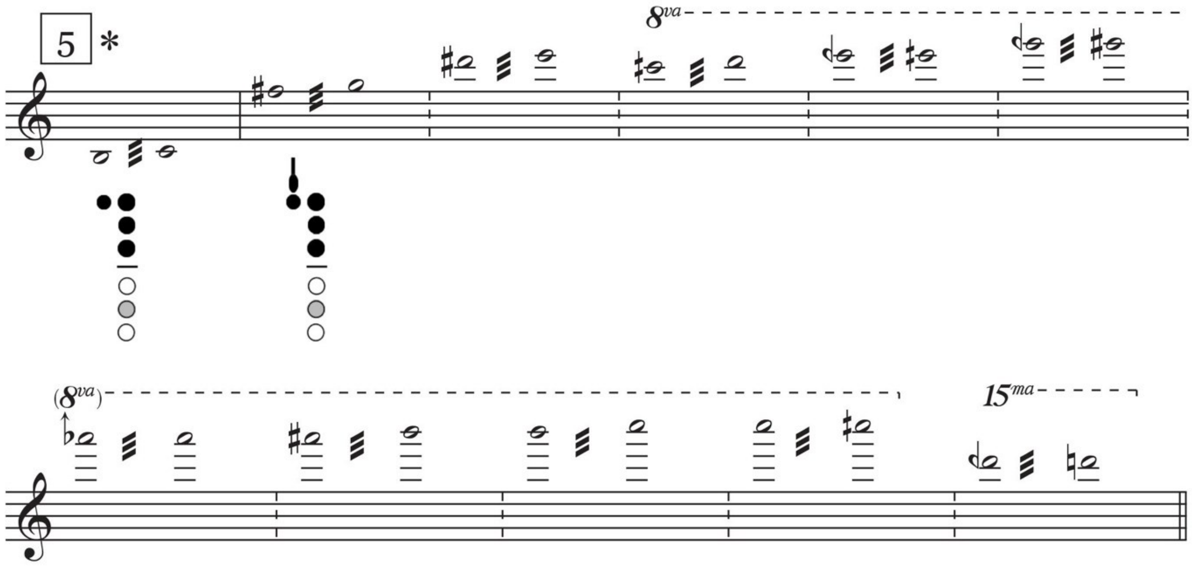




+ Keys open same pad, so response is slower

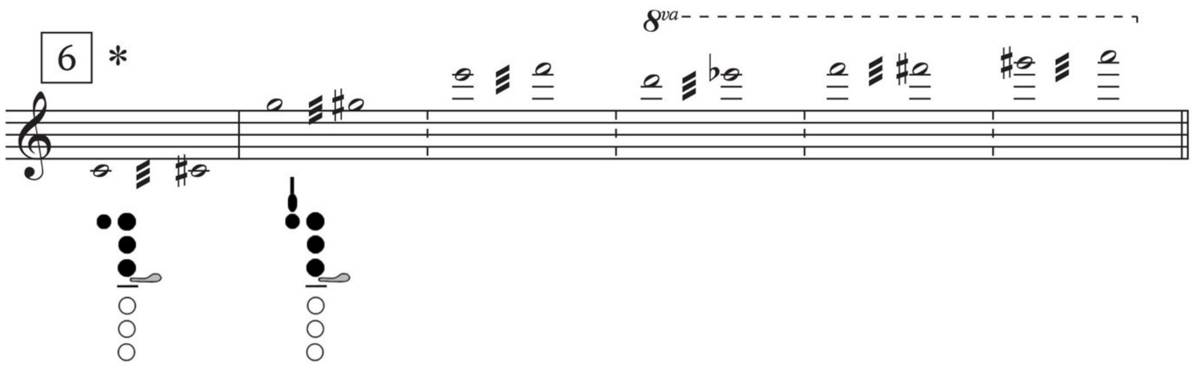






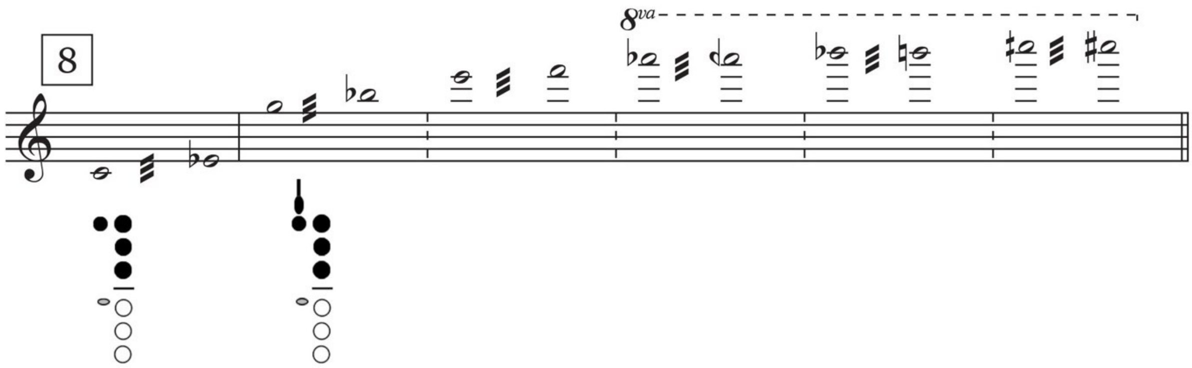
* Can trill directly on pad or touchpiece

6 *

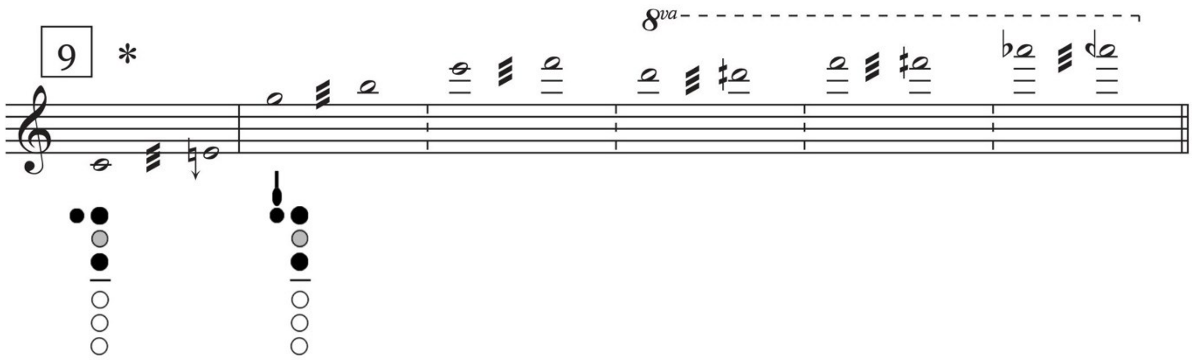


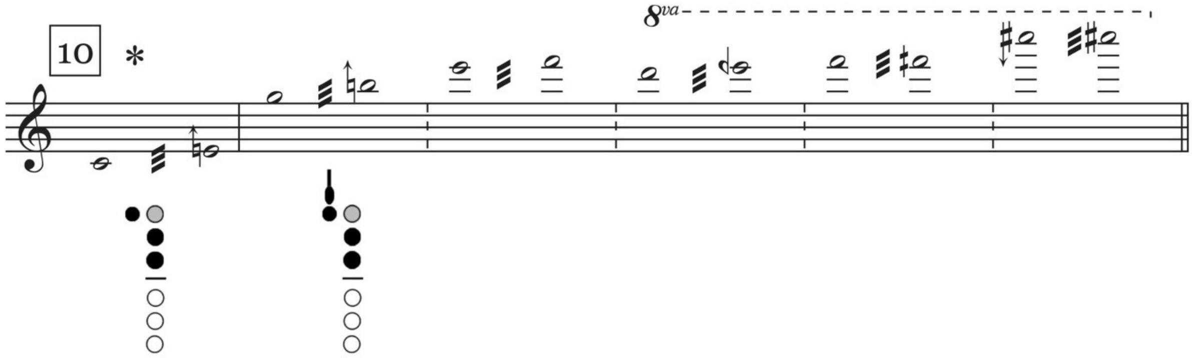
7 *

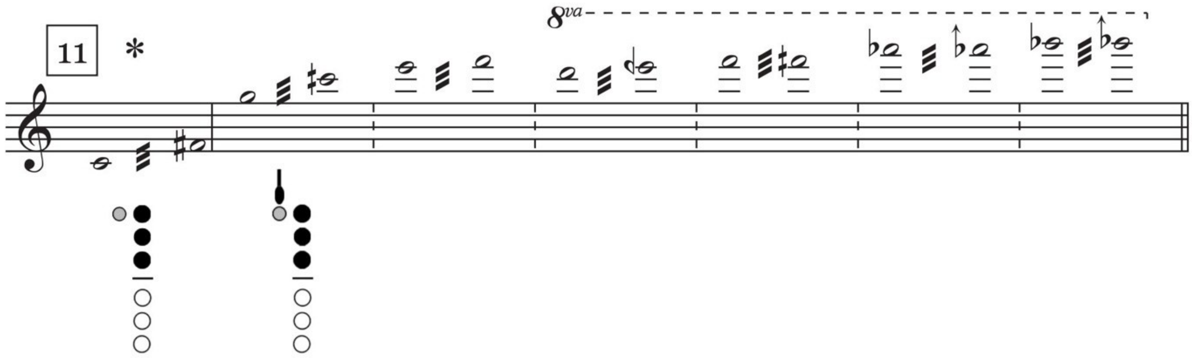
8

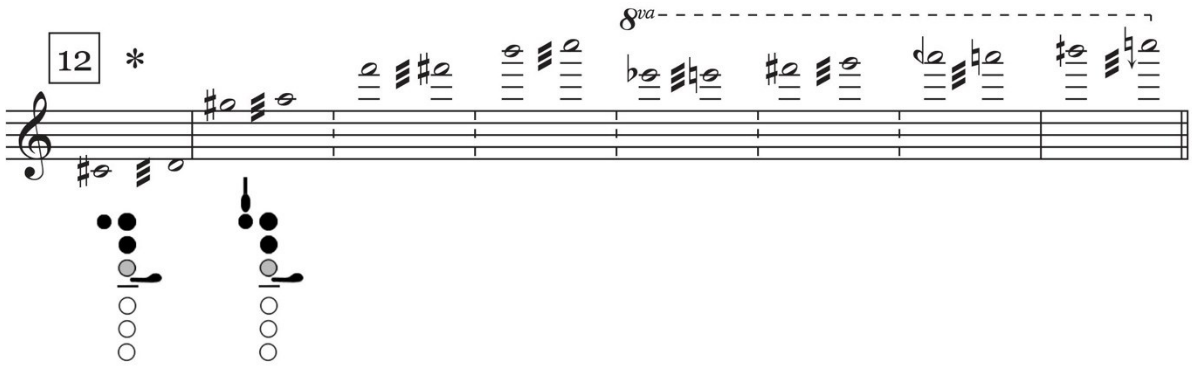


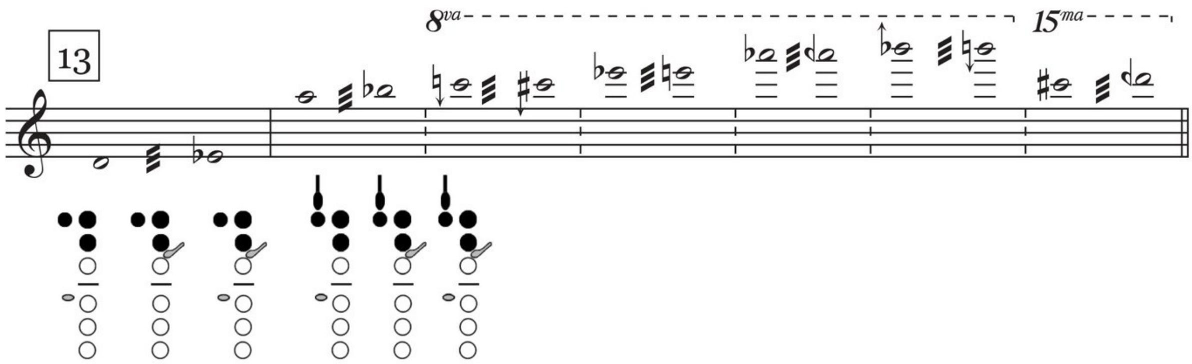
9 *



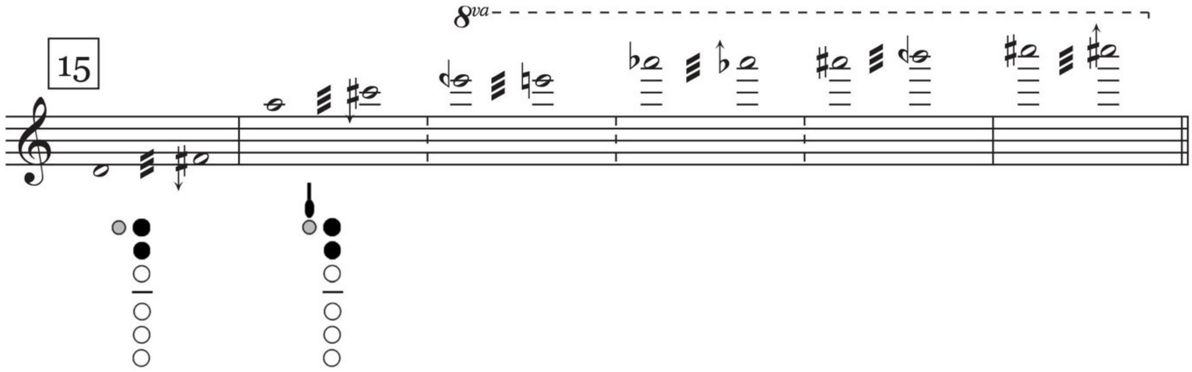

10
*
8va


11
*
8va

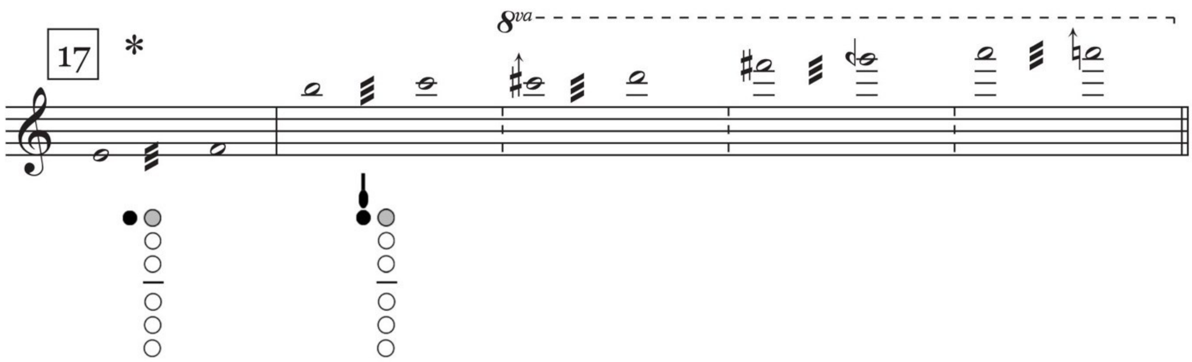

12
*
8va


13
8va
15ma


14
*
8va
15ma

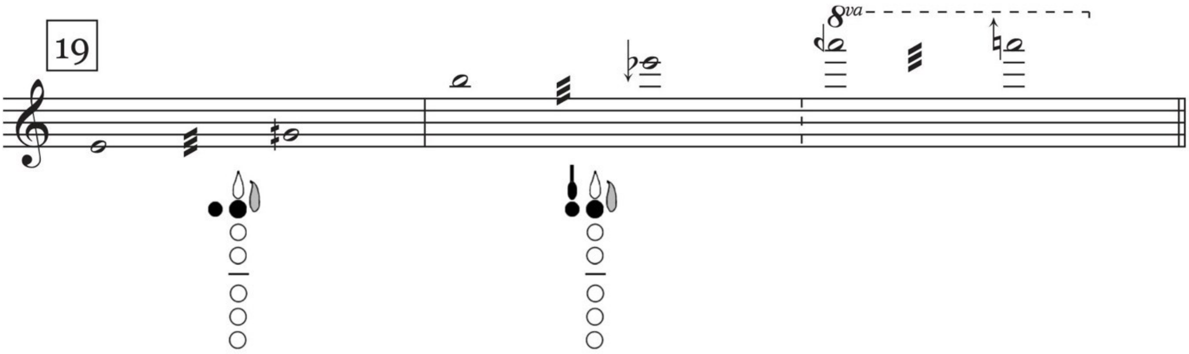

15
8va


16
*
8va
15ma


17
*
8va

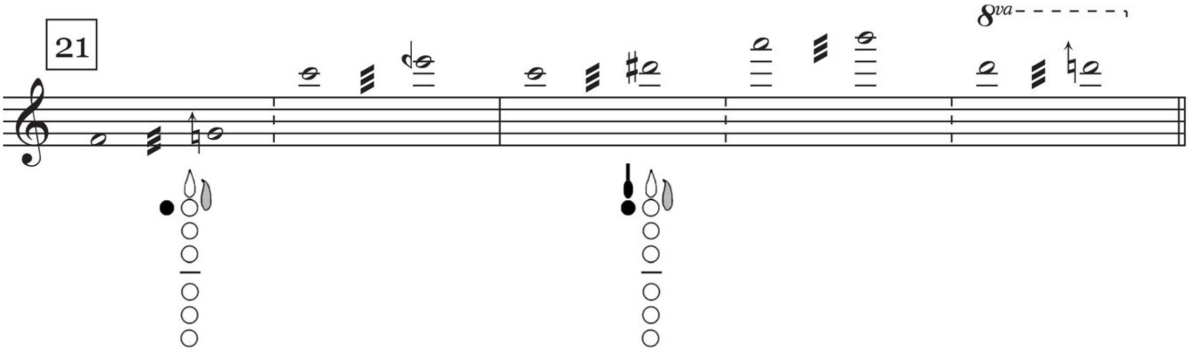
18

19

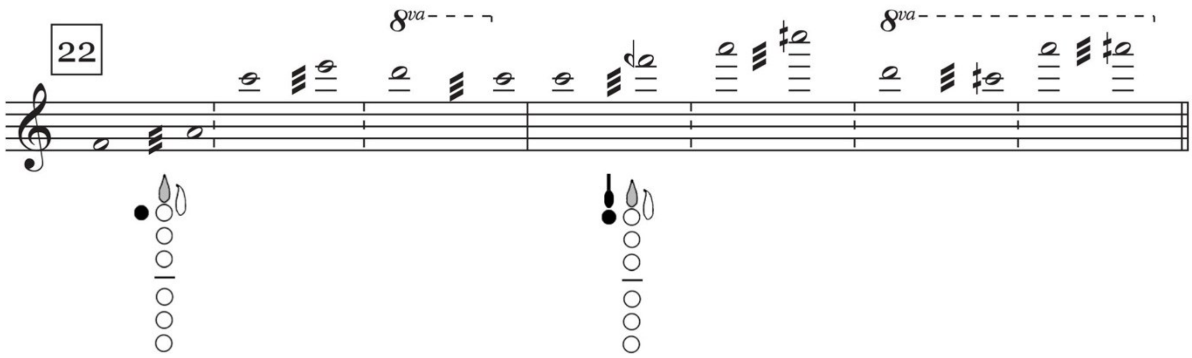


20

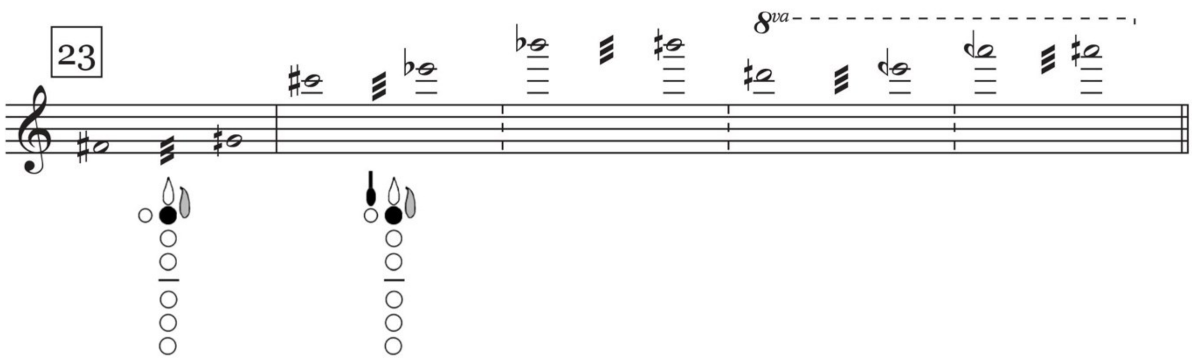
21



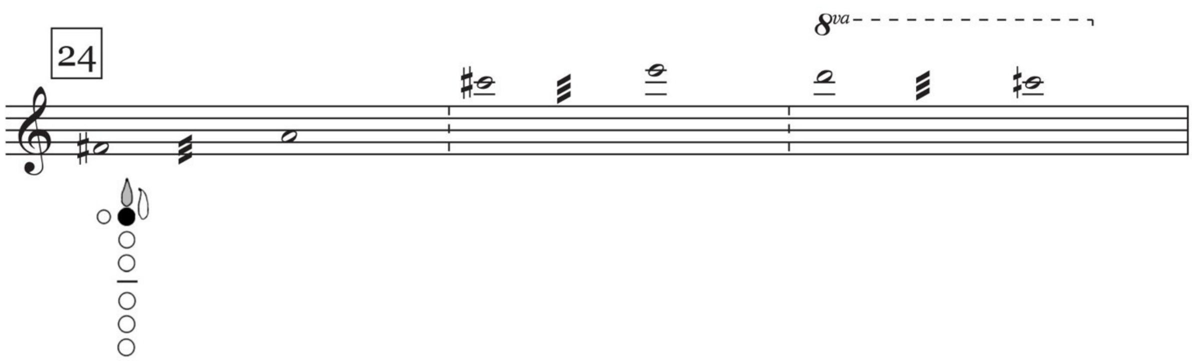
22

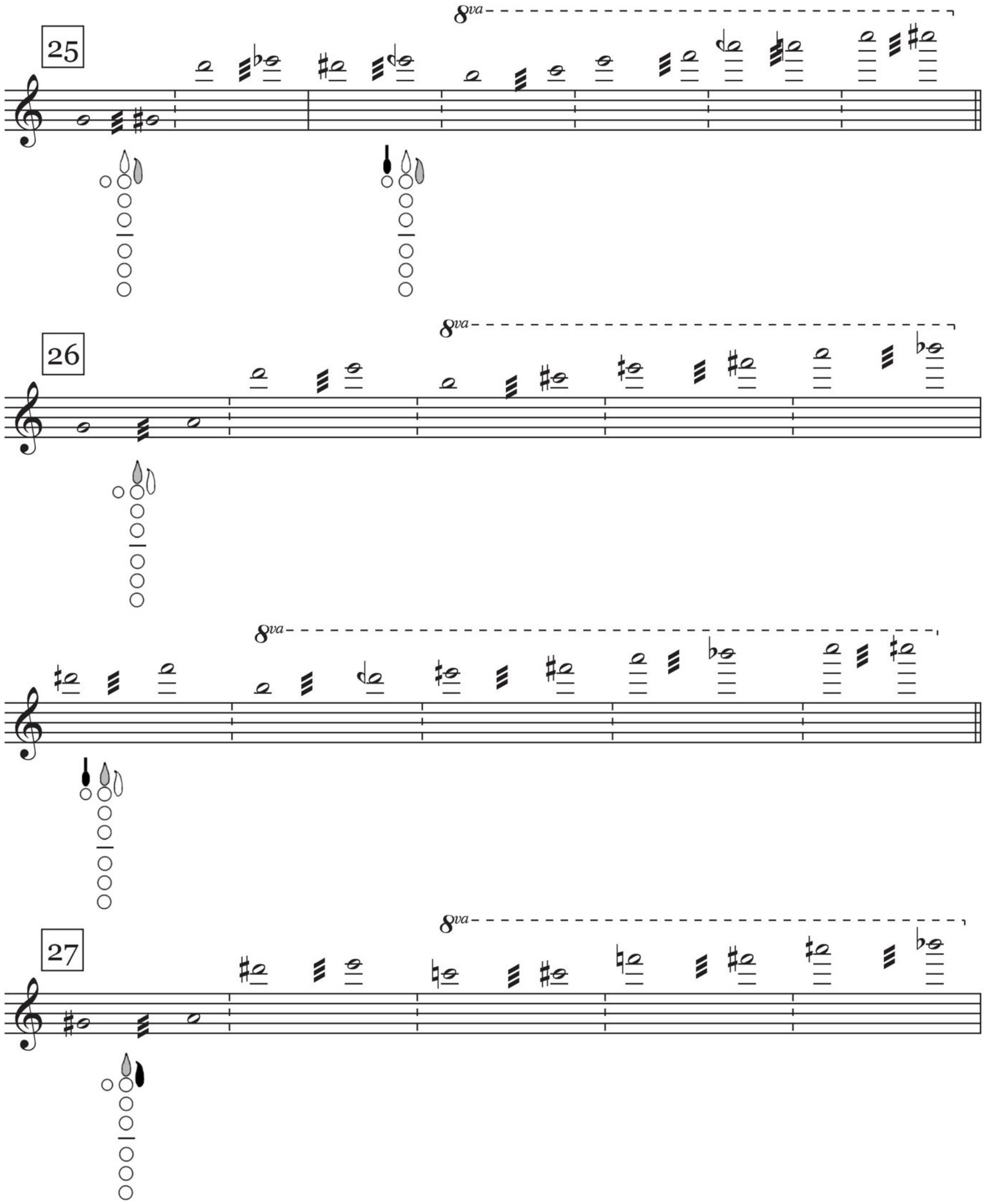


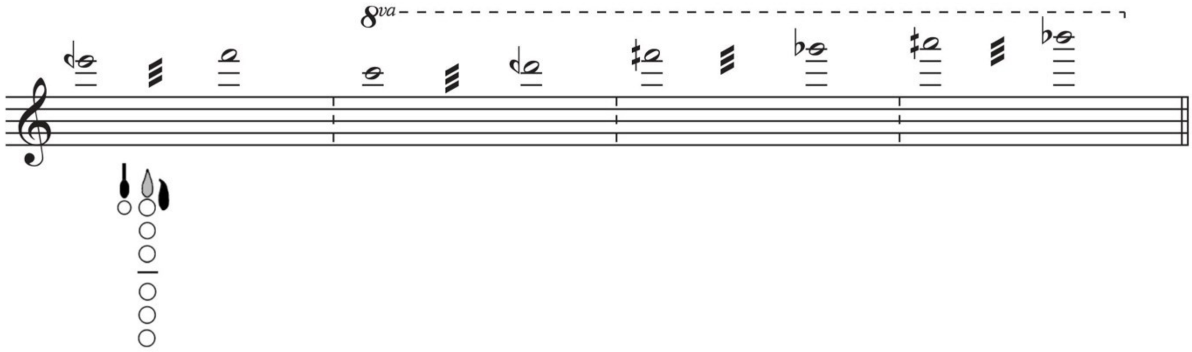
23



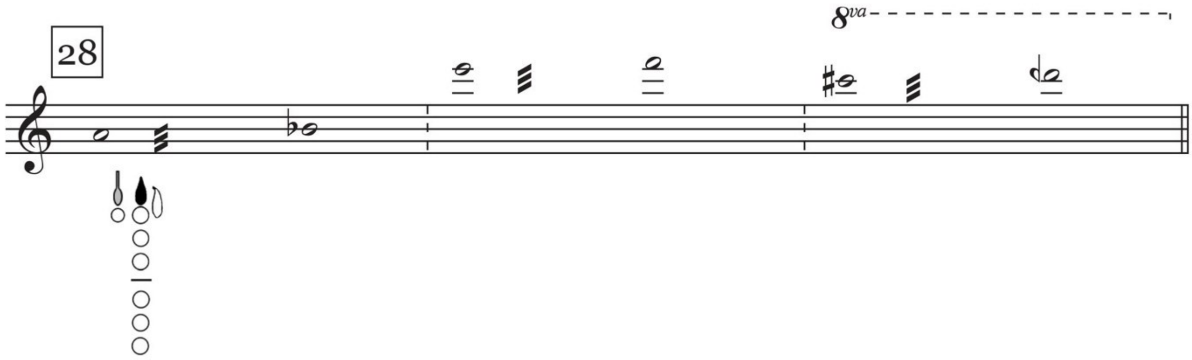
24



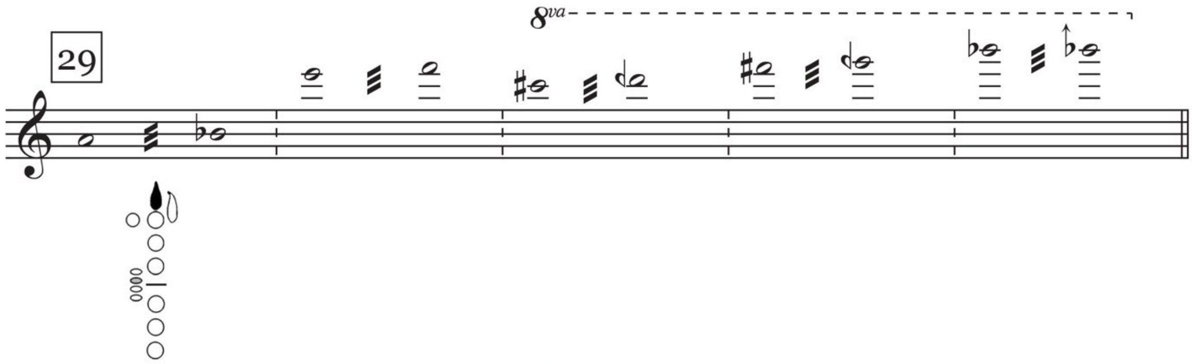

25
8va
26
8va
8va
27
8va



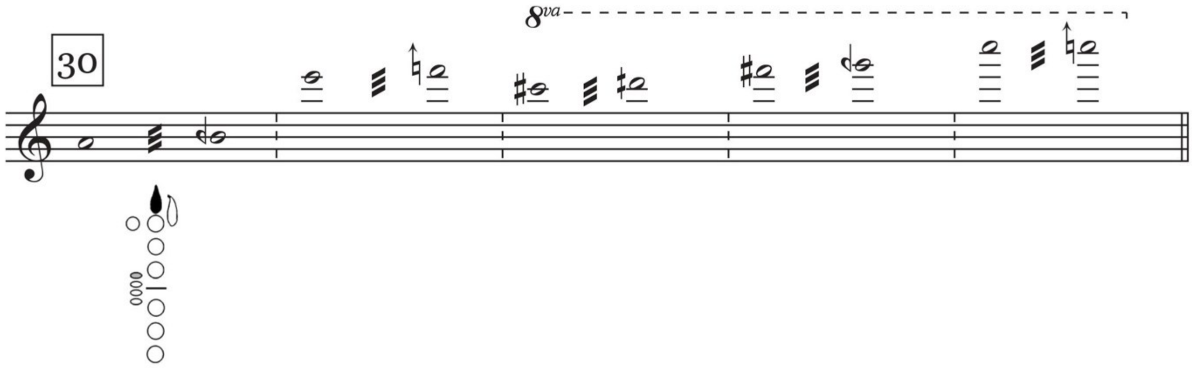
28



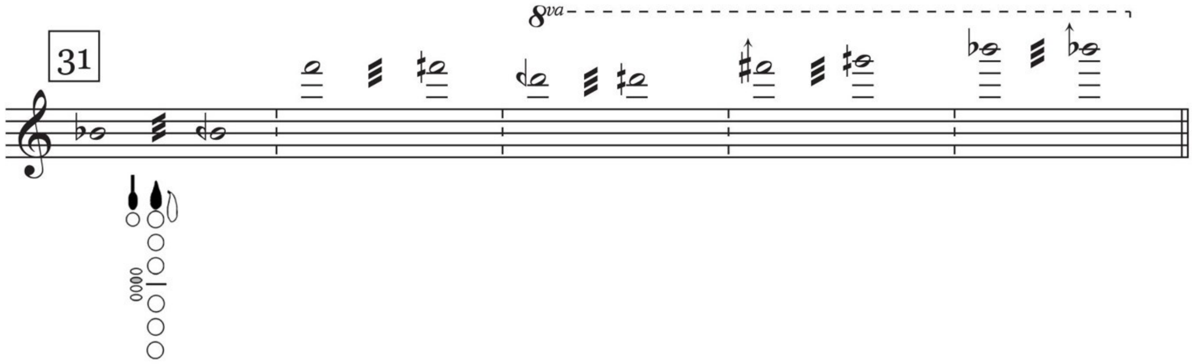
29



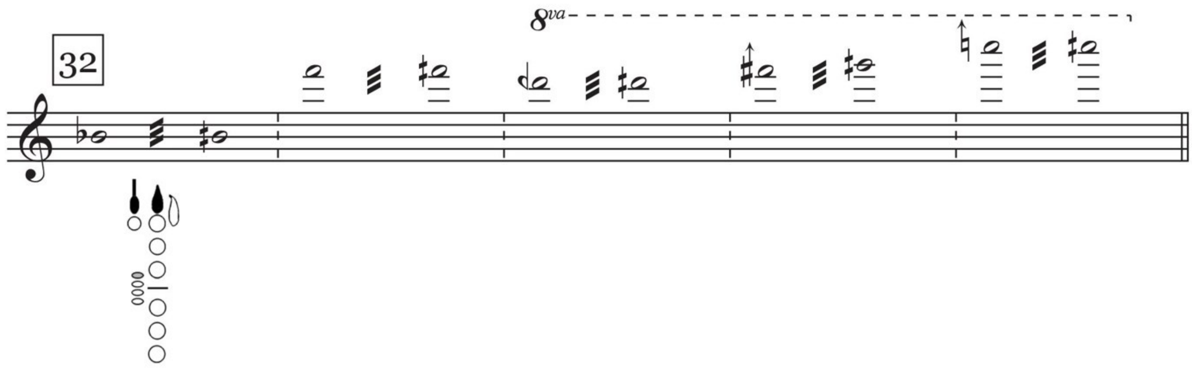
30



31



32



Eppelsheim

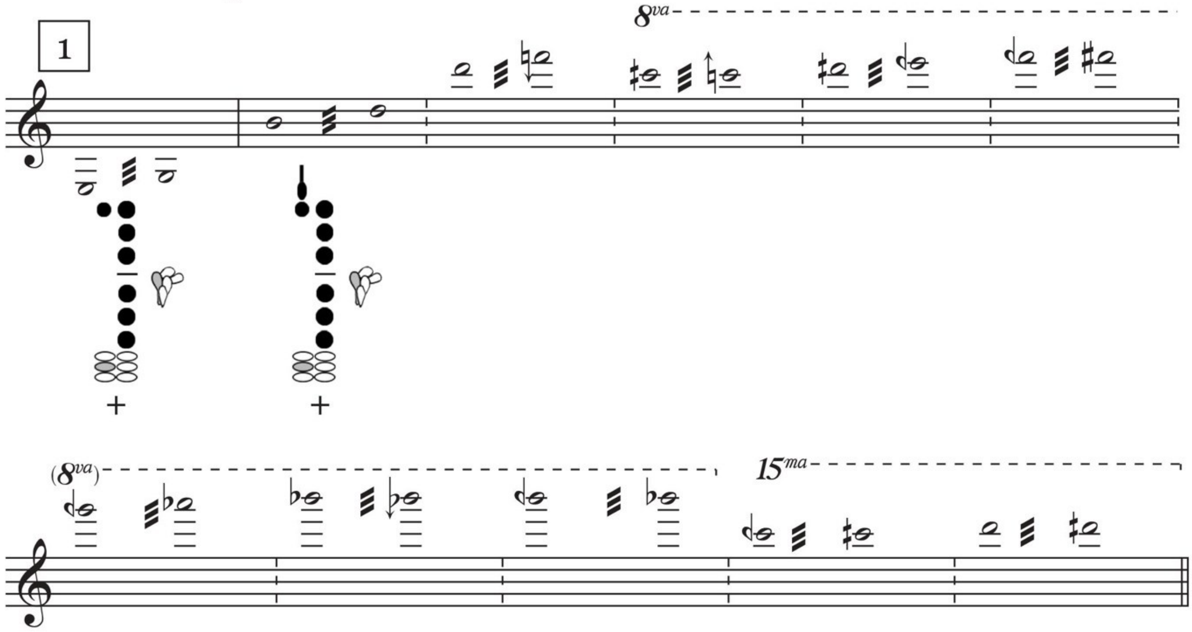
Double Trills

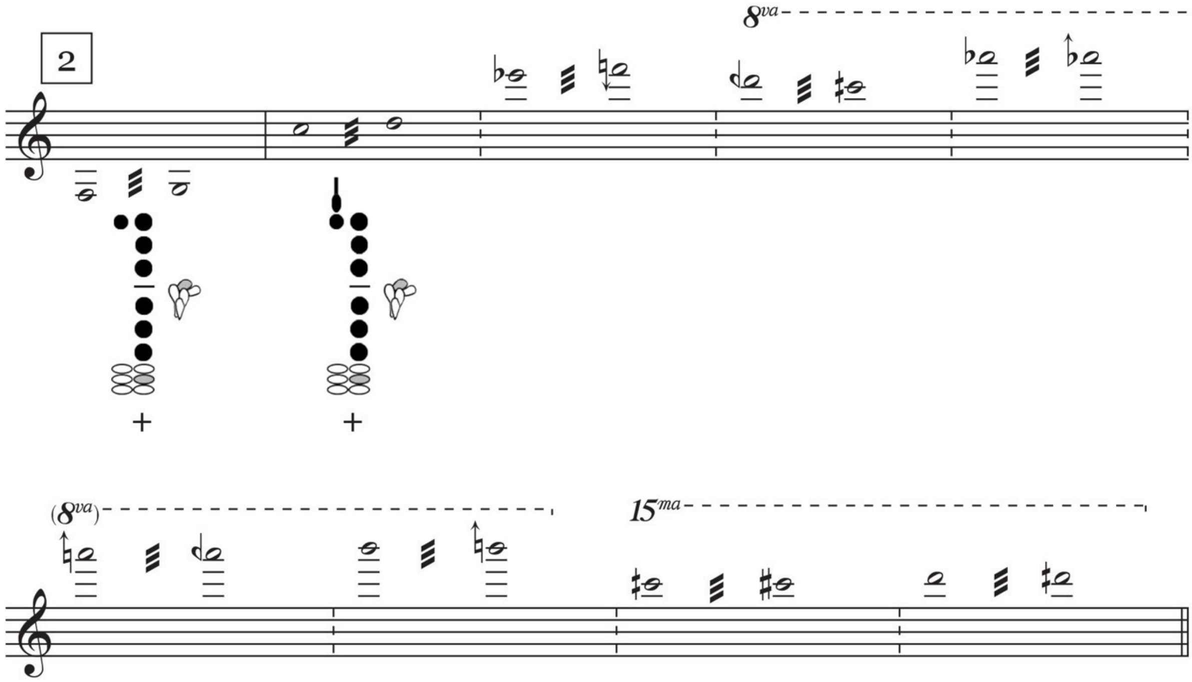
Fingering Charts

Audio Examples 0996-1024

Eppelsheim Contrabass Clarinet Double Trills Fingering Chart

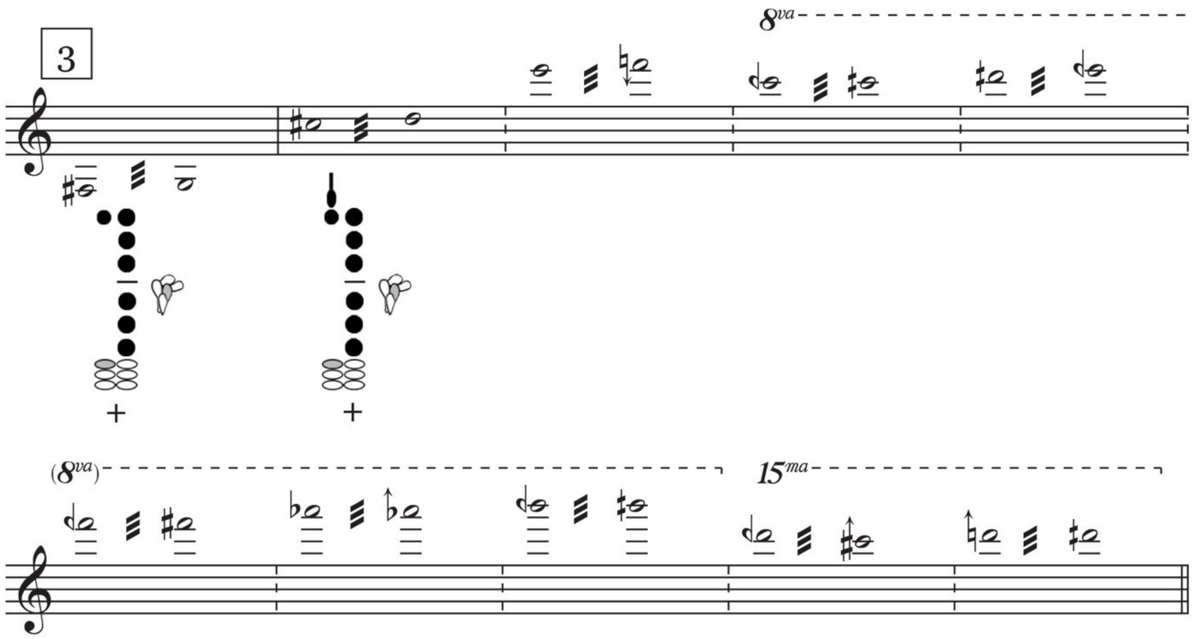
TYPE 1- Two Finger trill between two notes



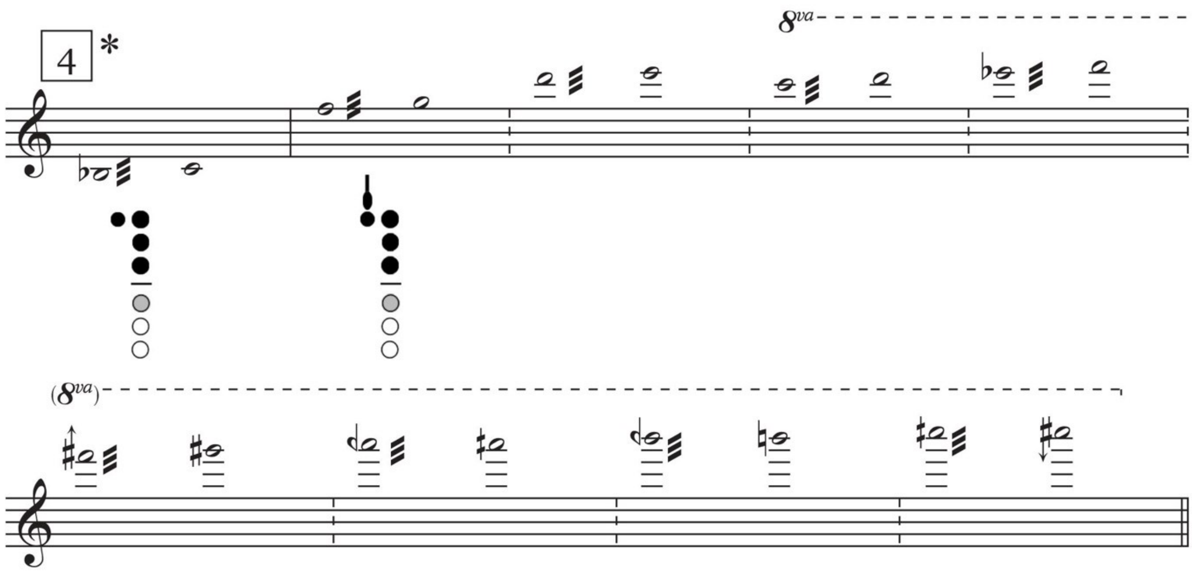


+ Keys open same pad, so response is slower

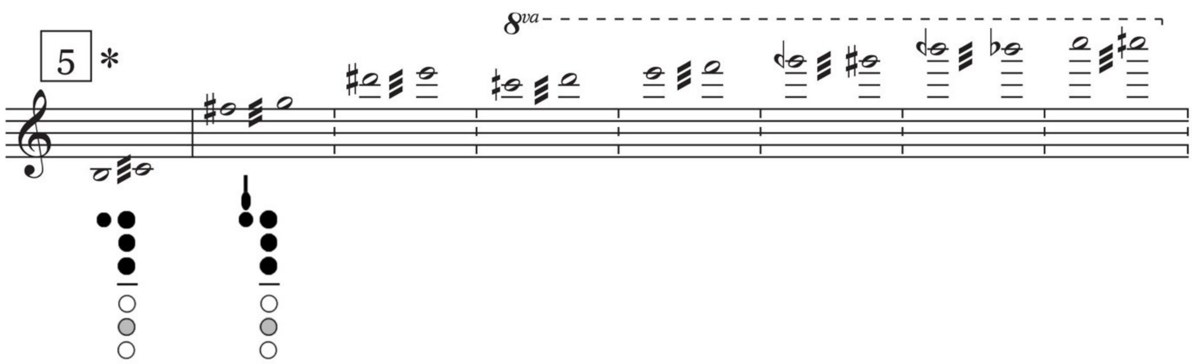
3



4 *

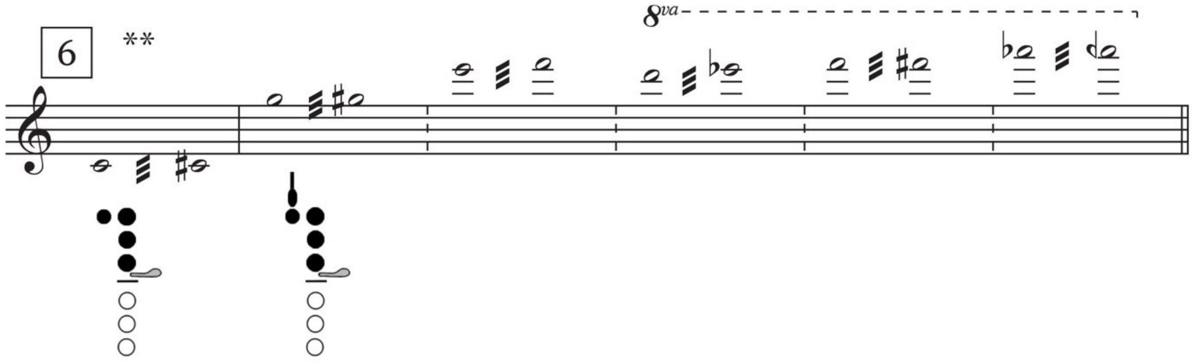


5 *

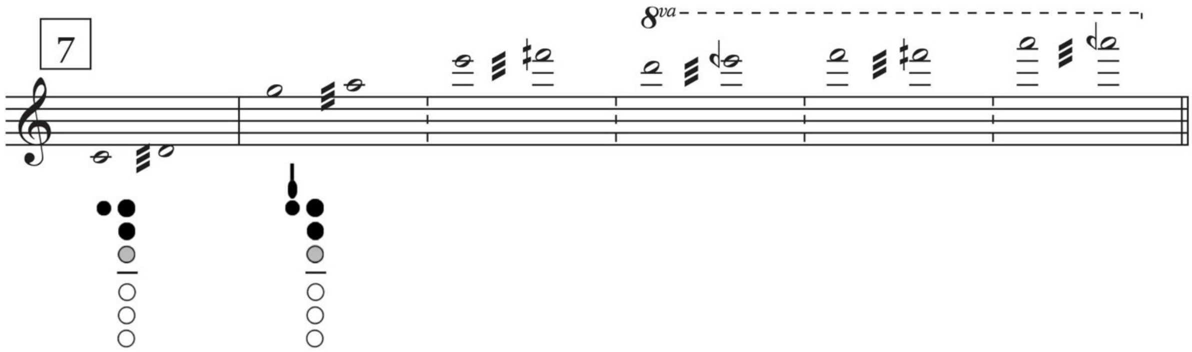


* Can trill directly on pad or touchpiece

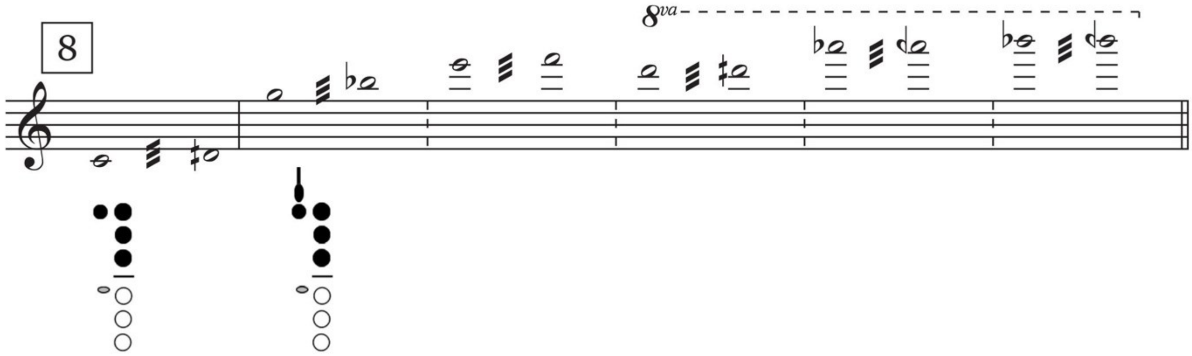
6



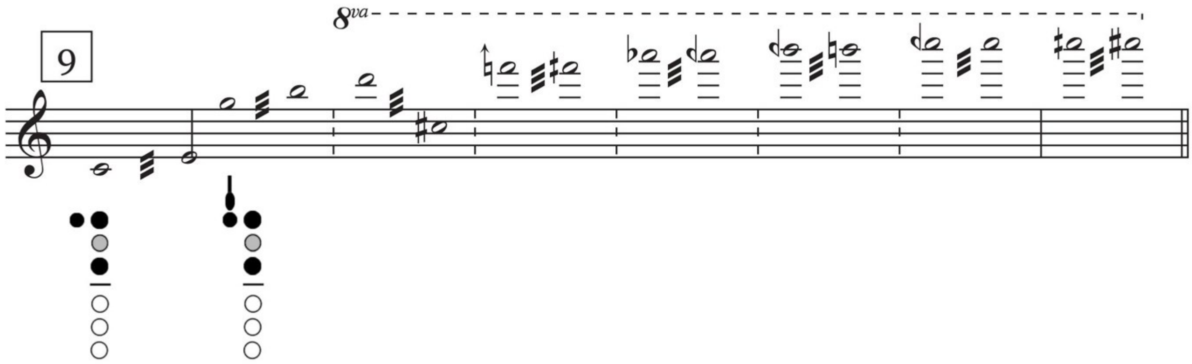
7



8

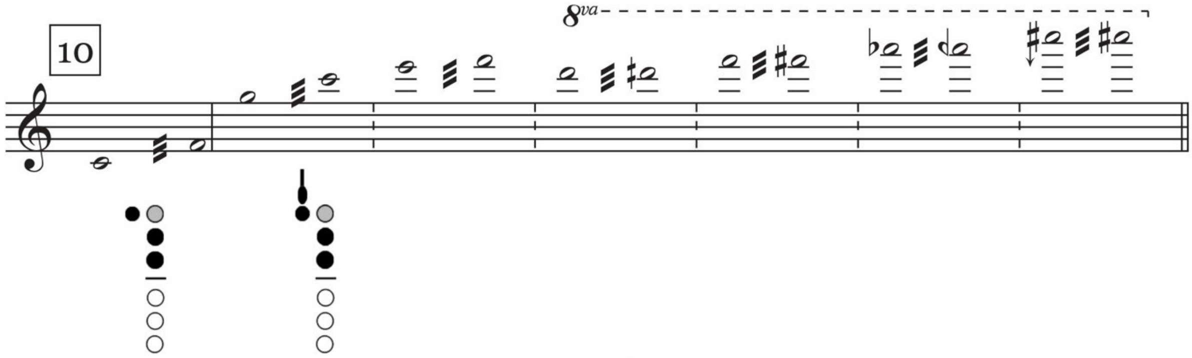


9



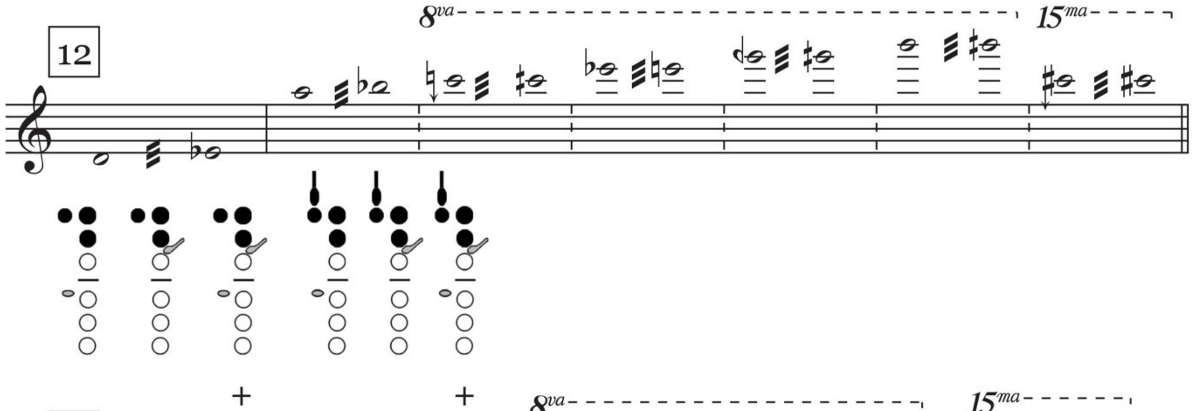
** Awkward to reach or trill

10



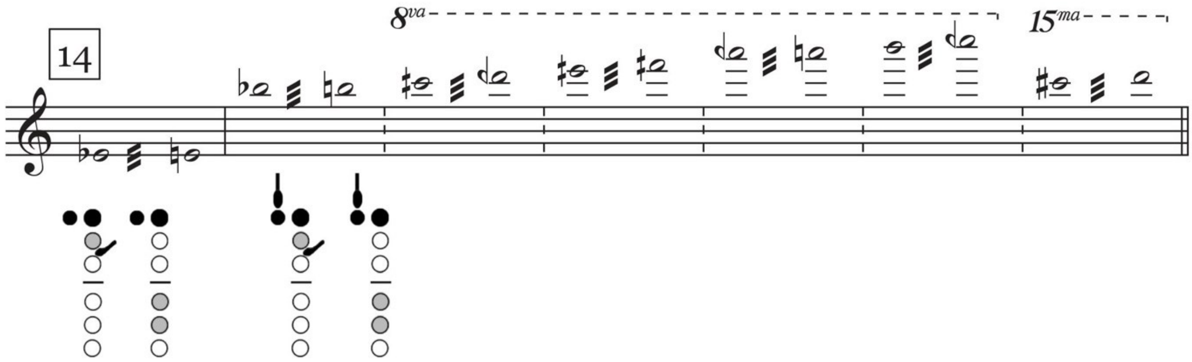
11

12

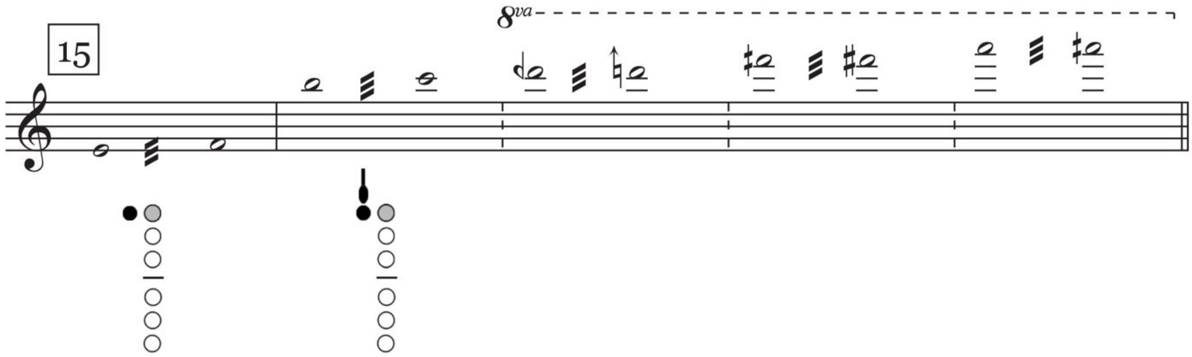


13

14

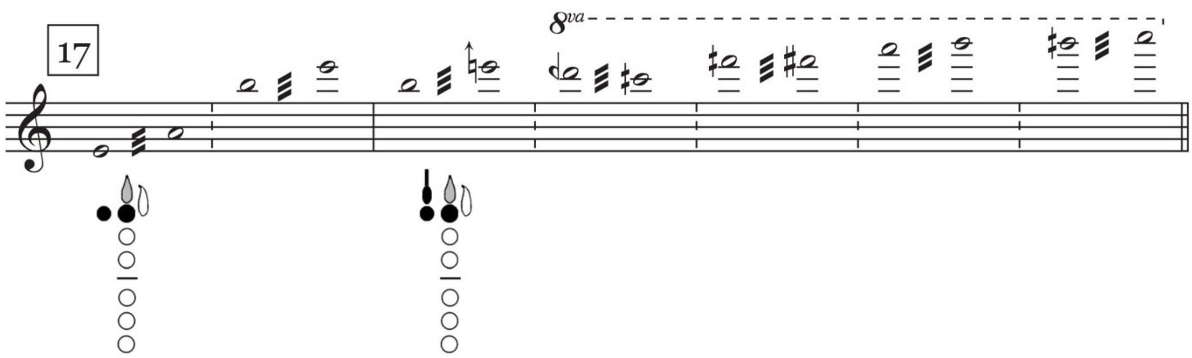


15

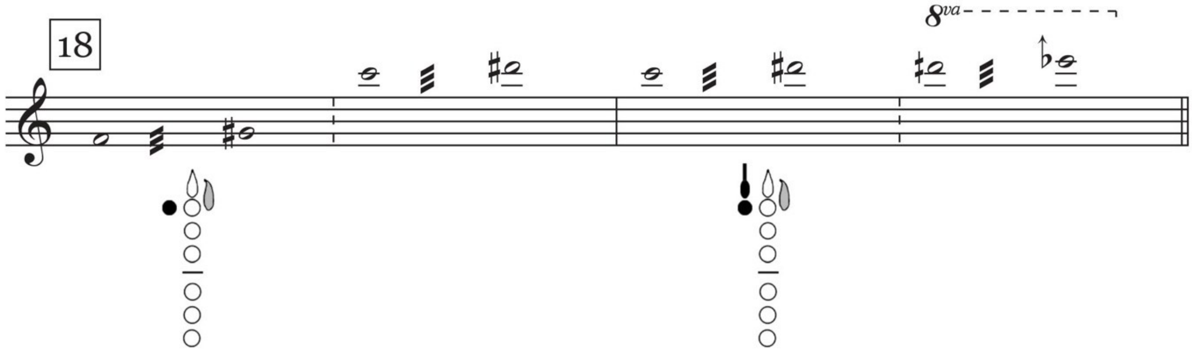


16

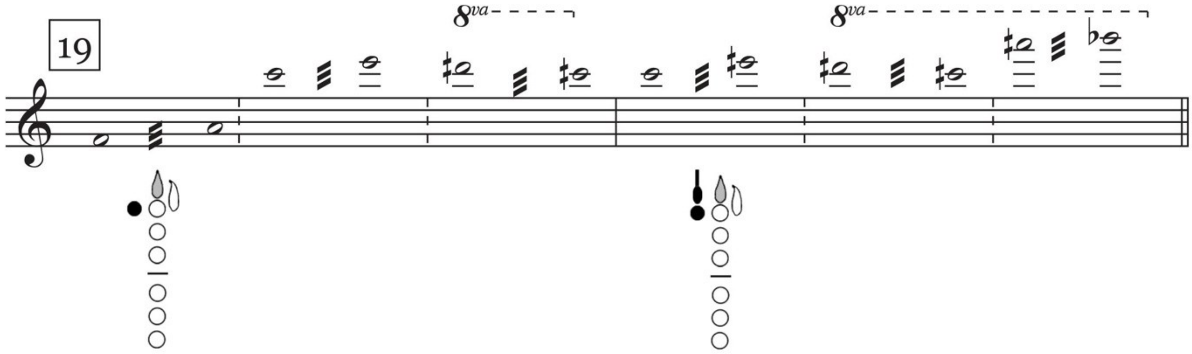
17



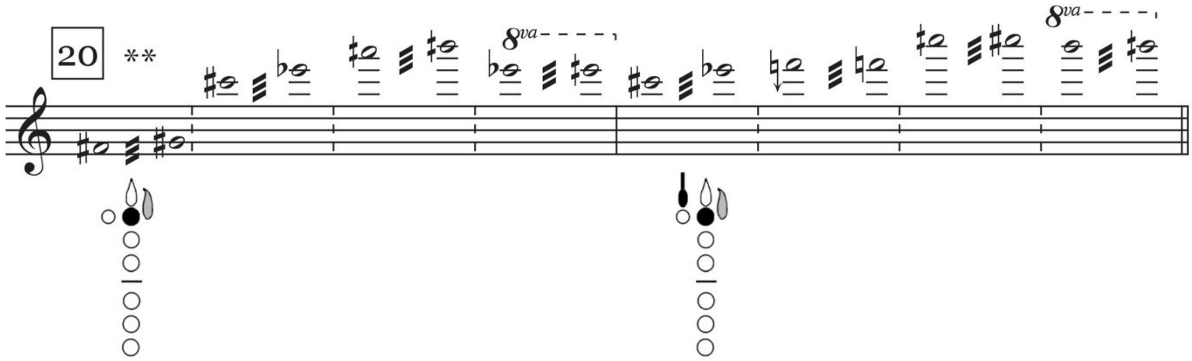
18



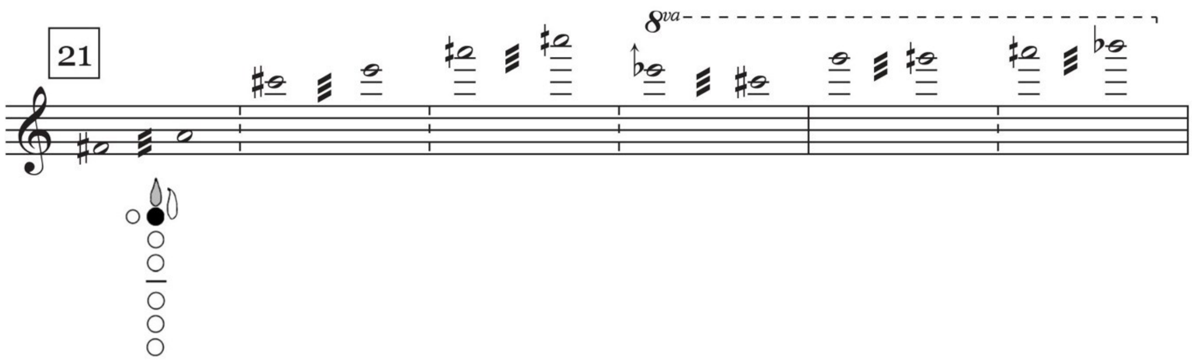
19

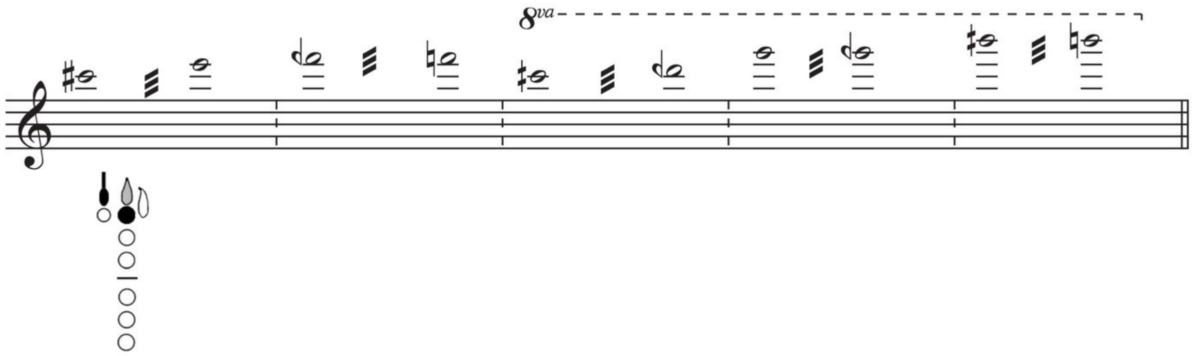


20 **

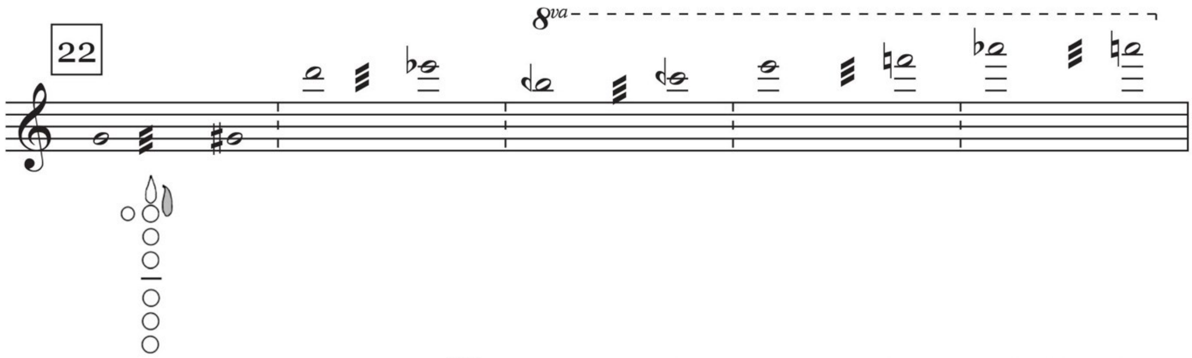


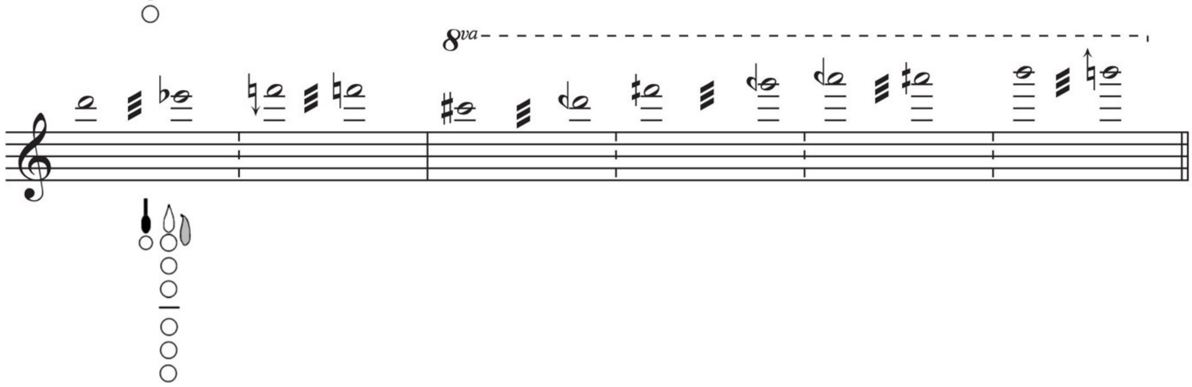
21



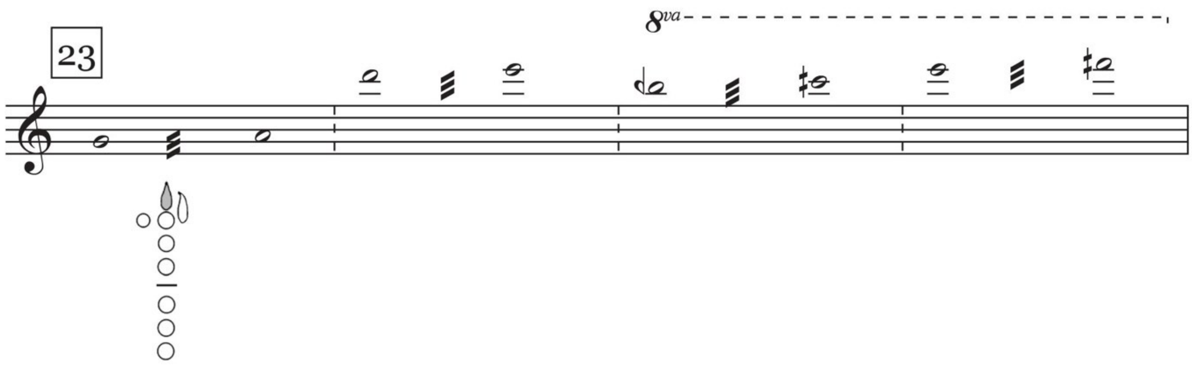


22

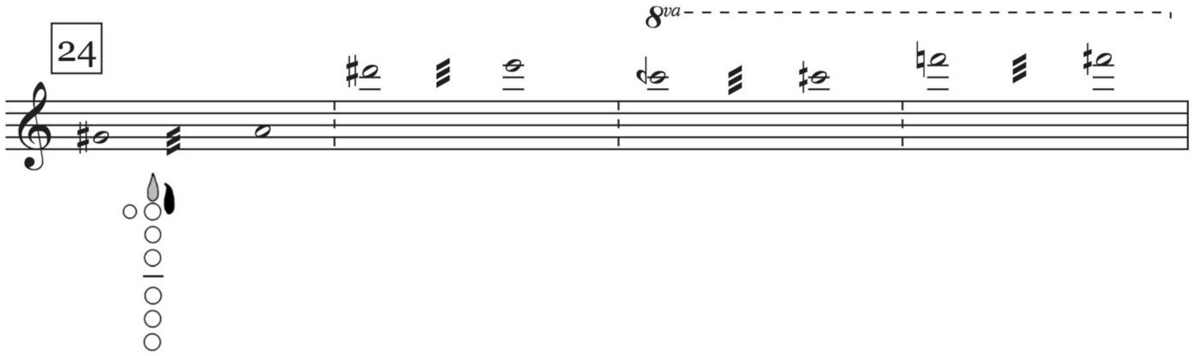




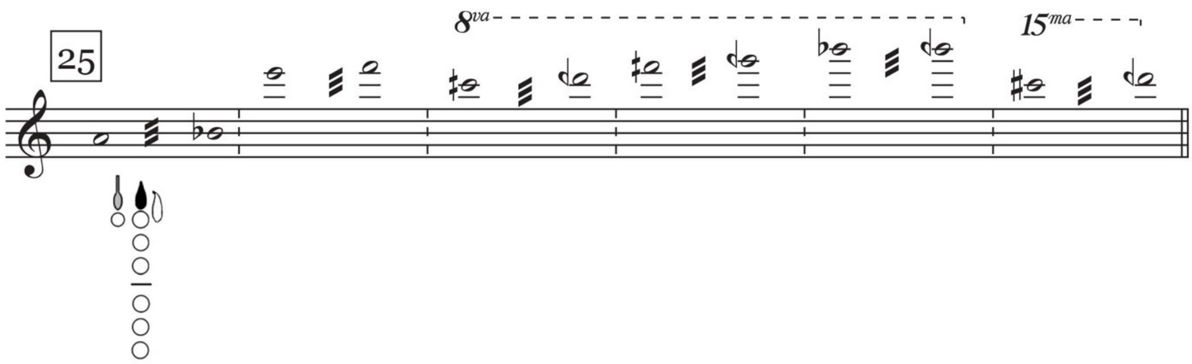
23

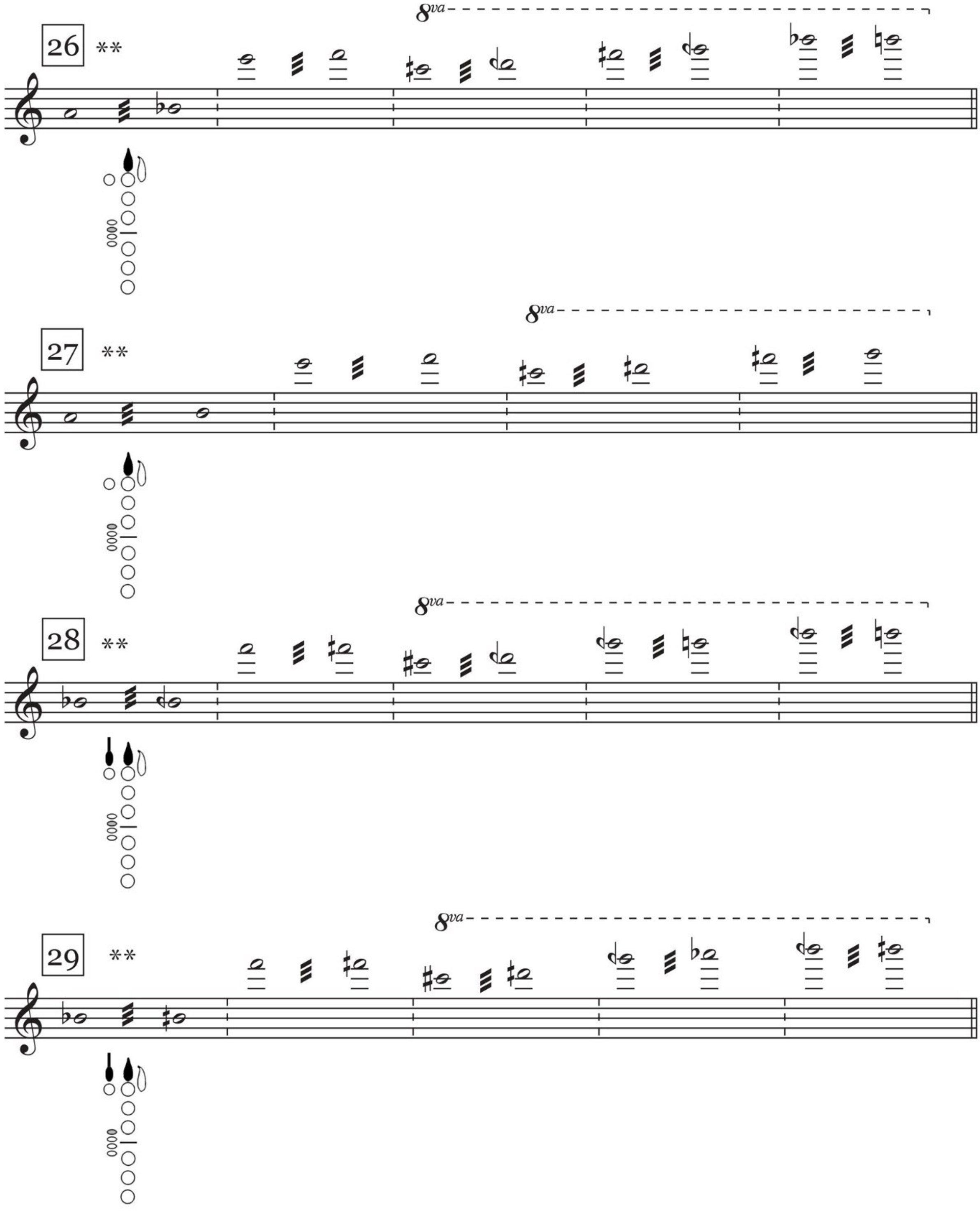


24



25



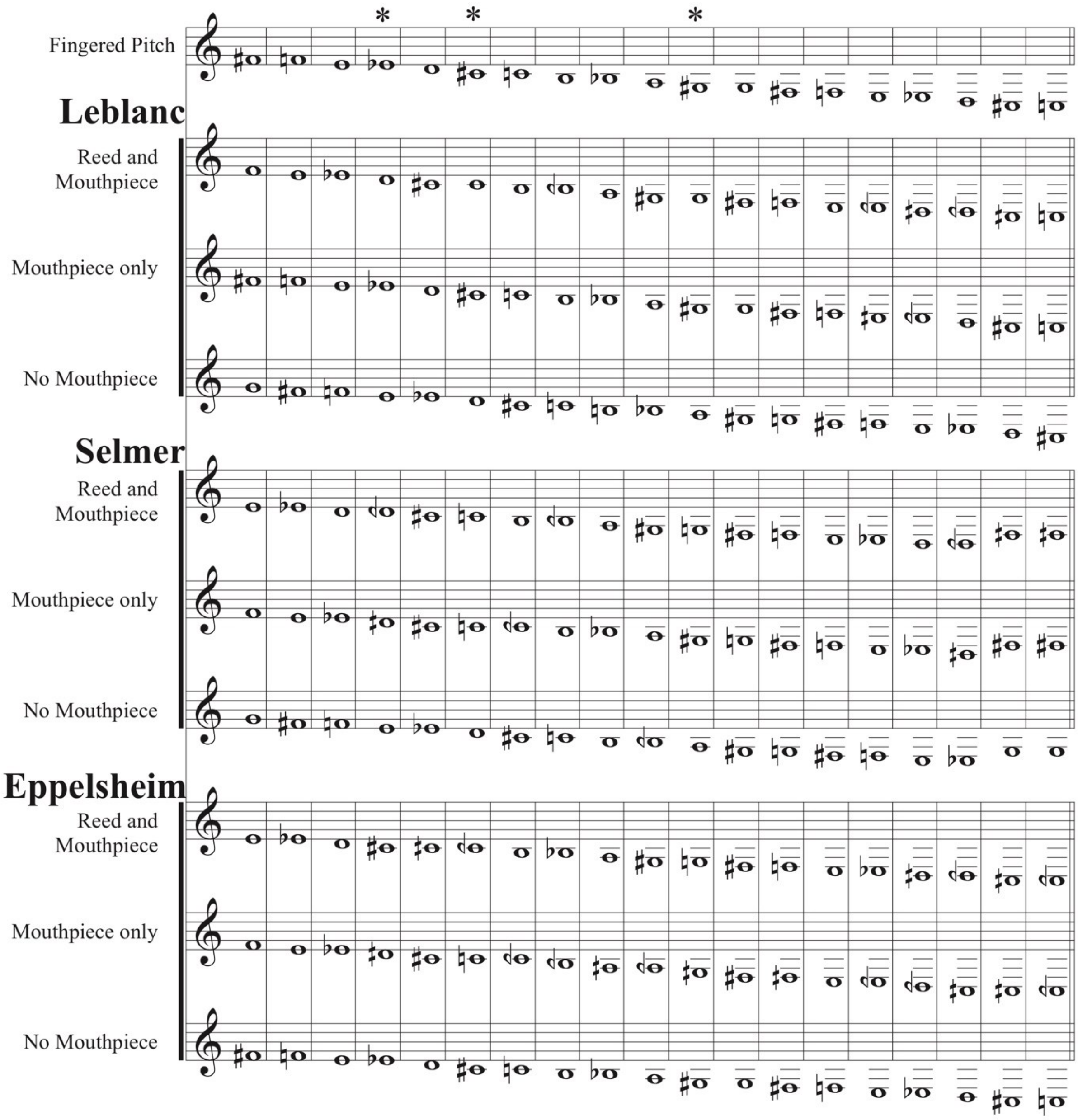

8va
26 **
8va
27 **
8va
28 **
8va
29 **

Finger pops

Audio Examples 1077-1078

Fingerings with a * indicate keys that open. Pressing only the key that opens will not create the pop effect, and other pads that do close must pressed at the same time.

Finger Pops



* Pad opens. Must be used with other pads that close.

Audio Examples

- 0001-0829 Multiphonics
    - Multiphonic (Analysis File)
    - Multiphonic Examples
        - Differing dynamics (soft, medium, loud)
        - Crescendo
        - Emerge from bottom note
        - Emerge from top note
    - 001-0216 Leblanc
    - 0217-0398 Selmer
    - 0399-0598 Eppelsheim
    - 0599-0829 Cross-Compatible
- 0830-0869 Colour-Fingerings
    - 0830-0869 Leblanc
    - 0870-0904 Selmer
    - 0905-0936 Eppelsheim
- 0936-1024 Double Trills
    - 0936-0963 Leblanc
    - 0964-0995 Selmer
    - 0996-1024 Eppelsheim
- 1025-1073 Slap tongues
    - 1025-1036 Leblanc
        - Instrument C3-C6
            - 1025 Tone forte
            - 1026 Tone piano
            - 1027 Subtone
            - 1028 Staccato forte
            - 1029 Staccato piano
            - 1030 Fast
            - 1031 Open Slap
            - 1032 Reed Slap

    - Mouthpiece and neck only
        - 1033 Tone forte-piano-subtone
        - 1034 Staccato forte-piano
        - 1035 Fast
        - 1036 Open
        - 1037 Reed Slap
- 1037-1049 Selmer
    - Instrument C3-C6
        - 1037 Tone forte
        - 1038 Tone piano
        - 1039 Subtone
        - 1040 Staccato forte
        - 1041 Staccato piano
        - 1042 Fast
        - 1043 Open Slap
        - 1044 Reed Slap
    - Mouthpiece and neck only
        - 1045 Tone forte-piano-subtone
        - 1046 Staccato forte-piano
        - 1047 Fast
        - 1048 Open
        - 1049 Reed Slap
- 1050-1067 Eppelsheim
    - Instrument C3-C6
        - 1050 Tone forte
        - 1051 Tone piano
        - 1052 Subtone
        - 1053 Staccato forte
        - 1054 Staccato piano
        - 1055 Fast
        - 1056 Open Slap
        - 1057 Reed Slap
    - Mouthpiece and Full neck only

        - 1058 Tone forte-piano-subtone
        - 1059 Staccato forte-piano
        - 1060 Fast
        - 1061 Open
        - 1062 Reed Slap
      - Mouthpiece and Upper neck only
        - 1063 Tone forte-piano-subtone
        - 1064 Staccato forte-piano
        - 1065 Fast
        - 1066 Open
        - 1067 Reed Slap
  - 1068-1072 Mouthpiece only
    - 1068 Tone forte-piano-subtone
    - 1069 Staccato forte-piano
    - 1071 Fast
    - 1071 Open
    - 1072 Reed Slap
  - 1073 Visual Demonstration of Open Slap (video)
- 1074-1076 Sung Fingerings
  - 1074 Leblanc D6
  - 1075 Selmer A5
  - 1076 Eppelsheim E♭5
- 1077-1078 Finger Pops
  - 1077 Eppelsheim, Scale, No Mouthpiece
  - 1078 Eppelsheim, Example, No Reed
- 1079 Palm Ram
  - Scale Up- Palm ram on and hold
  - Scale Down- Palm ram on and off
- 1080-1087 Bofan Ma, Sound Textures Simulations
  - 1080 200gsm paper with page falling into stand
  - 1081 Paperclips
  - 1082 Metal Plate

- 1083 Tin Foil-Plastics-BubbleWrap- Dry
- 1084 An iPad with Millions of Scratches
- 1085 A Super aged, thick, solid, sound-proof wooden door
- 1086 Page falling into stand
- 1087 Environmental noise from alternating current with mics and speakers, white noise

- 1088-1089 Andys Skordis
  - 1088 Multiple Clarinets (video)
  - 1089 Shaking Contrabass Clarinet (video)
- 1090 Mark Dyer
  - Speaker in Contrabass Clarinet
- 1091-1092 Shaun Davies
  - 1091 Leblanc Neck and Bell in Water
  - 1092 Aluminium Foil on Bell

Musical Recordings

2000 Mark Dyer – *Droning Falsities (for ones's self)*

2001 Bofan Ma – *offset iv* (video)

2002 Oğuz Büyükberber – *Sketchbook*

2003 Aled Smith – *vus* (video)

2004 -2006 Andys Skordis *Tri…Hita…Karana*

2007 Thanos Chrysakis – *Dark Light*

2008 Thanos Chrysakis – *Milieu Interieur II*

2009 Niels Christian Rasmussen – *Gestalten*

2010 Elspeth Brooke – *hillside detail sometimes textures*

2011-2024 Improvisations

- 2011 01 Selmer Improvisations
- 2012 02 Slap Tongues
- 2013 03 Double Trills
- 2014 04 Singing and Playing
- 2015 05 Singing Without Mouthpiece
- 2016 06 Tongue on Reed
- 2017 07 Colour-Fingerings
- 2018 08 Air and Vocal Sounds
- 2019 09 Multiphonics
- 2020 10 Keyclicks and Finger Pops
- 2021 11 Altissimo and Quarter-tones
- 2022 12 Deconstruction
- 2023 13 Alternate Mouthpieces
- 2024 14 Day 10 Improvisation

Bibliography

Aber, Thomas Carr. "A History of the Bass Clarinet as an Orchestra and Solo Instrument in the Nineteenth and Early Twentieth Centuries and an Annotated, Chronological List of Solo Repertoire for the Bass Clarinet from before 1945." Dissertation, UMI, 1990.

Adler, Samuel. "Individual Woodwinds - Contrabass Clarinet." In *The Study of Orchestration*, 3rd ed., 216. New York, NY: W.W. Norton and Co., 2002.

"All Events - Proms 1912." BBC Music Events. Accessed October 2, 2020. https://www.bbc.co.uk/events/rfg2fx/series.

Altenburg, Wilh. "Adolphe Sax Und Seine Verdienste Um Den Instrumentenbau." *Zeitschrift Für Instrumentenbau* 32 (Band 1911-1912), no. 27, June 27, 1912.

Altenburg, Wilh. "Die Contrabass-Klarinette Von Fontaine-Besson Und Poncelet's Klarinett-Concerte." *Zeitschrift Für Instrumentenbau* 19 (Band 1898-1899), no. 5, November 11, 1898.

"Alto, Bass & Contra Clarinets." Martin Freres Company. Accessed November 9, 2021. https://martinfreres.net/clarinetcatalog/low-clarinets/.

Anderson, Colin. "Leopold Stokowski's Symphony." *Classical Source*, (May 7, 2009). https://www.classicalsource.com/concert/leopold-stokowskis-symphony/.

Andre, Mark. "iv 7." Leipzig, London, New York: Henry Litolff's Verlag / C.F. Peters, 2008.

Ayres, Thomas A. “Arranging for the Clarinet Choir.” In *Woodwind Anthology: a Compendium of Woodwind Articles from the Instrumentalist* 2, 2:51–53. Northfield, IL: Instrumentalist Co., 1999.

B., L. “Courrier Théatral Et Artistique.” *La Depeche*. April 15, 1899.

Baines, Anthony. “The Woodwind Today: The Clarinet.” In *Woodwind Instruments and Their History*, 3rd ed., 130–31. Mineola, NY: Dover, 1991.

Baines, Christopher. “Communications Relating to the GSJ's Fiftieth Anniversary.” *The Galpin Society Journal* 50 (March 1997): 313–14.

Barrett, Richard. *Interference for Solo Contrabass Clarinet/(Male Voice)/Pedal Bass Drum, with Amplification*. London: United Music Publishers, Ltd., 2000.

Beers, Jack. “B♭ Contrabass Clarinets [Cover Image].” *Etude: The Music Magazine*, August 1955.

Berlioz, Hector, and Richard Strauss. *Instrumentationslehre, Von Hector Berlioz. Ergänzt Und Rev. Von Richard Strauss*. 2. Vol. 2. Leipzig: C.F. Peters, 1905.

Berz, William. “Three Early Works for Band by H. Owen Reed.” *Journal of the Wind Association for Symphonic Bands and Ensembles (WASBE)* 10 (2003): 95–105. https://doi.org/https://wasbe.org/wp-content/uploads/2018/02/WASBE_10_2003_Three-Early-Works-for-Band-by-H.-Owen-Reed.pdf.

Borch, Rolf. *Contrabass Clarinet: Orchestral Excerpts and a Brief History*. Oslo: Norwegian Academy of Music, 2015.

Büyükberber, Oğuz. *Spiral : A Personal Approach for Generating Pitch Content for Improvisation/Composition*. Rijswijk: Stichting Donemus Beheer, 2019.

Cage, John. *4'33"*. Edition Peters, n.d.

Cailliet, Lucien. *Le Pionnier (The Pioneer), Solo for B♭ Contrabass Clarinet and Piano*. Kenosha, WI: Leblanc Publishing Inc., 1962.

Callaway, Ann. *Contraption*. Manuscript, 1991.

Casa Museo Spada. "Musica Da Banda Item J.93." Casa Museo Spada English Version. Accessed December 18, 2020. http://casamuseospadaen.blogspot.com/2017/01/blog-post_10.html.

Casembroot, J L. "Het Orkest Van Fervaal." *Caecilia; Algemeen Muzikaal Tijdschrift Van Nederland* 55, no. 10, May 15, 1898.

Casembroot, J. L. "Nieuwe Speeltuigen." *Caecilia; Algemeen Muzikaal Tijdschrift Van Nederland* 55, no. 11, June 1, 1898.

Chrysakis, Thanos. *Dark Light.* Aural Terrains: Aural Terrains, March 2017.

"Clarinet." Howarth of London, makers of fine oboes, woodwind specialists. Accessed March 13, 2021. https://howarthlondon.com/instruments.aspx?family=810&brand=9.

"Clarinets." Wurlitzer Clarinets. Accessed December 12, 2020. https://wurlitzerklarinetten.de/clarinets/?lang=en.

"Cover Photo." *'Rohrblatt*, March 1995.

Daan Manneke. *Gesti*. Vinyl recording. *Ruimten*. Attacca, 1982.

Dempster, Stuart. *The Modern Trombone: A Definition of Its Idioms*. Athens, OH: Accura Music, Inc, 1994.

Denco, Raphaël. *Décombres, Pour Clarinette Contrebass & Électronique*. Paris: Maison Ona, 2017.

Dethou Léon. *Traité D'instrumentation appliqué Aux Orchestres D'instruments à Vent*. Paris: E. Collet, 1873.

Deutsch, Bernd Richard. *Orcus, Für Kontrabasskarinette* 2007/08. Berlin: Boosey & Hawkes – Bote & Bock, 2016.

D'Indy, Vincent. *Fervaal*. Paris: A. Durand et Fils, 1895.

Donatoni, Franco. *Ombra: Due Pezzi per Clarinetto Contrabasso*. Milano: Ricordi, 1984.

Druckenbrod, Andrew. "Obituary: Donald McCathren / Clarinetist, Band Leader and Duquesne Professor." *Pittsburgh Post Gazette*, November 25, 2004. https://www.post-gazette.com/news/obituaries/2004/11/25/Obituary-Donald-McCathren-Clarinetist-band-leader-and-Duquesne-professor/stories/200411250123.

Ensemble Alternance. *Ombra*. CD. *Franco Donatoni – Spiri, Eco, Ombra, Diario, Lame*. Harmonic Records , 1986.

Estrin, Mitchell. “The Klezmer Clarinet.” Dansr, November 29, 2017. https://www.dansr.com/vandoren/resources/the-klezmer-clarinet.

Florida Bandmasters Association. “2010 Solo/Ensemble Music List.” Florida Bandmasters Association, 2010.

Foag Klarinetten. *Foag E♭ Contra Clarinet in Black Laquered Metal to E♭*. December 24, 2019. Photograph. *Facebook.* https://www.facebook.com/Foag.Klarinetten/photos/p.2185572288418082/2185572288418082/?type=3.

Foag Klarinetten. *Foag E♭ Contra Clarinet in Brass to C*. September 2, 2019. Photograph. *Facebook.* https://www.facebook.com/Foag.Klarinetten/photos/a.1411953349113317/2099061590402486.

Foag, Martin. Email, September 13, 2020.

Forsyth, Cecil. “The Pedal Clarinet.” In *Orchestration*, 286. London: MacMillan and Co., 1914.

G. Leblanc Corporation. *"Contra" Clarinets*. Kenosha, WI: G. Leblanc Corporation, 1963.

G. Leblanc Corporation. “The All Metal Contra Bass Clarinet in B♭,” n.d.

Gee, Harry R. “French Clarinetists in America.” *The Clarinet* 8, no. 4 (1981): 20–22.

Gleissberg, Gabi. “Goldene Meister Mit Goldenen Händen.” *Freie Presse*. December 8, 2010. https://www.freiepresse.de/goldene-meister-mit-goldenen-h-nden-artikel7543001.

Globokar, Vinko. *Discours IV, Für Drei Klarinettisten*. Frankfurt, New York, London: Henry Litolff's Verlag / C.F. Peters, 1984.

Grisey, Gérard. *Anubis, Nout: Deux Pièces Pour Clarinette Contrebasse En Si Bémol*. Milan: Casa Ricordi, 1983.

The Group for Contemporary Music, Harvey Sollberger, conductor. *Donald Martino / Milton Babbitt – Triple Concerto / Arie Da Capo*. Vinyl recording. Nonesuch, 1980.

H&A Selmer, Inc. *Selmer Band Instruments*. Elkhart, IN: H&A Selmer, Inc., 1953.

H&A Selmer, Inc. *Selmer Band Instruments*. Elkhart, IN: H&A Selmer, Inc., 1964.

H&A Selmer, Inc. "The New Selmer E♭ Contrabass Clarinet." *The Reed Section*, 1931.

H&A Selmer, Inc. *You'll Play Better with a Selmer*. Elkhart, IN: H&A Selmer, Inc., 1951.

H., P. "De La Musique Militaire." Essay. In *Revue Britannique: Ou Choix D'articles Traduits Des Meilleurs écrits périodiques De La Grande-Bretagne* 2, edited by Pichot Amédée, 2:432. 6. Paris: La Revue, 1846.

HalLeonard.com. "Le Pionnier (The Pioneer) - Contra Bass Clarinet or Bass Clarinet." Accessed September 29, 2020. https://www.halleonard.com/product/3774832/le-pionnier-the-pioneer.

Heim, Norman. "The Clarinet Choir Phenomenon." In *Woodwind Anthology: a Compendium of Woodwind Articles from the Instrumentalist* 2, 2:311–15. Northfield, IL: Instrumentalist Co., 1999.

Henri Selmer Paris. “Contralto Clarinet | Henri SELMER Paris.” Henri Selmer Paris, June 27, 2019. https://www.selmer.fr/en/product-sheet/contralto-clarinet.

Henri Selmer Paris. *Instruments De Musique*. Paris: Henri Selmer Paris, 1963.

Henri-Selmer. “Contralto Clarinet.” Henri SELMER Paris. Accessed March 12, 2021. https://www.selmer.fr/en/product-sheet/contralto-clarinet.

Hoeprich, Eric. *The Clarinet*. New Haven and London: Yale Univ. Press, 2008.

“Introduction to Vocal Effects.” CVT Research Site, August 11, 2016. https://cvtresearch.com/effects/introduction-to-effects/.

“Io, Frammento Dal Prometeo.” FONDAZIONE ARCHIVIO LUIGI NONO ONLUS, February 7, 2017. http://www.luiginono.it/en/works/io-frammento-dal-prometeo/.

Ircam. “Audiosculpt.” Computer software, 2013. http://anasynth.ircam.fr/home/english/software/audiosculpt.

Jones, Brian D. “The E♭ Contra-Alto Clarinet: Misunderstood and Overlooked.” In *Woodwind Anthology: a Compendium of Woodwind Articles from the Instrumentalist* 2, 2:466–76. Northfield, IL: Instrumentalist Co., 1999.

Jordan, Douglas M. *Alfred Reed: a Bio-Bibliography*. Westport, CT: Greenwood Press, 1999.

Karski, Dominik. *The Outward Impulse*. Musicaneo, 2007.

KevinGoebbels. *The Hoffnung Symphony Orchestra*. Photograph. *Discogs*. Accessed December 2, 2020. https://www.discogs.com/artist/1974080-The-Hoffnung-Symphony-Orchestra.

Knussen, Oliver. "Hums and Songs of Winnie the Pooh." London: Faber Music, 1990.

Koechlin, Charles. "Clarinette." In *Traité De L'orchestration En Quatre Volumes, Vol. 1*, 35. Paris: Éditions Max Eschig, 1954.

Landré, Guillaume. *Concertante per Clarinetto Contrabasso Ed Orchestra*. Amsterdam: Donemus, 1960.

Lavignac, Albert, and Lionel de la Laurencie. "Des Instruments A Vent." Essay. In *Encyclopédie De La Musique Et Dictionnaire Du Conservatoire* 2 Technique, Esthétique et Pédagogie, 2 Technique, Esthétique et Pédagogie:1417. Paris: Delagrave, 1927.

Lawrence, Morris. "The E♭ Contrabass Clarinet." Essay. In *Woodwind Anthology: a Compendium of Woodwind Articles from the Instrumentalist* 2, 2:193–94. Northfield, IL: Instrumentalist Co., 1999.

Leblanc Léon, Emanuele Marconi, Biteau Élodie, Nicole Chenesseau, Bernard Groulier, and Leon Pascucci. *Léon Leblanc 1900-2000: Un Homme, Un siècle: a Man, a Century*. La Couture-Boussey: Le Musée des instruments à vent, 2020.

Lerstad, Terje. *Tacet 5'33": John Cage in Memorium, Op. 199*. National Library of Norway, 1994.

Lerstad, Terje. *Toccata, for Kontrabassklarinett Solo, Op. 183*. Norway: National Library of Norway, 1986.

Lerstad, Terje. *Try Stykker for Kontrabassklarinett, Op. 101*. National Library of Norway, 1976.

Linton Mfg. Co., Inc. *Linton Prestige Woodwinds*. USA, 1967.

Lori Freedman. *Excess*. CD. Collection QB, 2019.

Macgillivray, James A. "Recent Advances in Woodwind Fingering Systems." *The Galpin Society Journal* 12 (1959): 70.

Manneke, Daan. "Gesti, for Bass Clarinet." Amsterdam: Donemus, 1979.

Martino, Donald. *Triple Concerto*. Newton, MA: Dantalian, 1978.

McCathren, Donald E. *The Teacher's Guide to the Alto, Bass and Contrabass Clarinets*. Elkhart, IN: Selmer, 1965.

McClellan, Bobby. "Thread: Ridenour Contrabass Clarinet," 2016. https://forum.saxontheweb.net/showthread.php?120862-Ridenour-contrabass-clarinet.

Molinari, Ernesto, Jochen Seggelke, Daniel Debrunner, Daniel Heiniger, and Simon Schnider. "Contrabass Clarinet Unlimited: Eine Sensorisch-Dynamische Kontrabassklarinette." *Dissonance* 126 (June 2014): 22–29.

Monnet, Marc. *Le Cirque*. Paris: Editions Salabert, 1990.

Montorier, J. “Annuaire Des Artistes Et De L'enseignement Dramatique Et Musical.” Paris: Sociétés de Orphéoniques, 1894. p. 380. https://gallica.bnf.fr/ark:/12148/bpt6k124042w/f391.image

Morgan, John. “The History of the Clarinet Choir.” In *Woodwind Anthology: a Compendium of Woodwind Articles from the Instrumentalist* 2, 2:127–29. Northfield, IL: Instrumentalist Co., 1999.

Myers, Arnold. *Catalogue of the Sir Nicholas Shackleton Collection*. Edinburgh: Edinburgh University Collection of Historic Musical Instruments, 2007.

Müller, Nora-Louise. *The Bohlen-Pierce Clarinet: Theoretical Aspects and Contemporary Applications*. Norderstedt: BoD - Books on Demand, 2020.

Newton, Bret. *Band Orchestration*. 2. 2nd ed. Vol. 2. Newton Press, 2019.

Payne, Tim. “The Contrabass Clarinets.” In *The Versatile Clarinet*, edited by Roger Heaton, 101–8. New York, NY: Routledge, 2006.

Pfatschbacher, Friedrich, and Nicholas Cox. “The Clarinet Choir: Development of the Clarinet Choir.” In *The Clarinet Choir: a Special Form of Ensemble Conquers the World's Concert Platforms*, 13–14. Hamburg, Germany: Tredition, 2017.

Pike, Donna June. “The Clarinet Choir.” Thesis, Ouachita Baptist University, 1969. https://scholarlycommons.obu.edu/honors_theses/585. Honors Thesis

Pimentel, Bret. “Naming the Low E♭ (Contrabass? Contra-Alto?) Clarinet.” Web log. *Bret Pimentel, Woodwinds* (blog), September 6, 2017. https://bretpimentel.com/naming-the-low-e-flat-contrabass-contra-alto-clarinet/.

Piston, Walter. “The Clarinet.” Essay. In *Orchestration*, 163–84. London: Victor Gollanzc LTD, 1969.

“Prestige Contra Alto.” Buffet Crampon. Accessed November 28, 2020. https://www.buffet-crampon.com/en/instruments/clarinets/prestige-contra-alto/.

“Radio Buitenland 12 Oktober 1960.” *Vrije Geluiden* 33, no. 41, October 8, 1960.

Reed, Alfred. *Afro, from Five Dances for Five Clarinets, for B♭ or E♭ Contrabass Clarinet and Piano*. New York, NY: Marks Music Corporation, 1966.

Reed, Alfred. *Contest Solos for the Clarinet Family*. Vinyl recording. Roxas Associates, n.d.

Reed, Alfred. *Scherzo Fantastique, for B♭ or E♭ Contrabass Clarinet and Piano*. New York, NY: Marks Music Corporation, 1966.

Reed, Alfred. *The Balanced Clarinet Choir*. Kenosha, WI: G. Leblanc Corporation, 1955.

Reed, H. Owen. *La Fiesta Mexicana (A Mexican Folk Song Symphony for Concert.)*. Melville, NY: Belwin Mills, 1954.

Rehfeldt, Phillip. *New Directions for Clarinet*. Berkeley and Los Angeles, CA: University of California Press, 1994.

Rendall, Francis Geoffrey. “Chapter 12: The Contrabass Clarinet.” In *The Clarinet, Some Notes upon Its History and Construction*, 158–62. London: Williams and Norgate, 1954.

Rendall, Francis Geoffrey., and Philip Bate. “Chapter 12: The Contrabass Clarinet.” In *The Clarinet: Some Notes upon Its History and Construction*, 3rd ed., 149–53. London: E. Benn, 1978.

Revelli, William D. “The Balanced Clarinet Choir.” Essay. In *Woodwind Anthology: a Compendium of Woodwind Articles from the Instrumentalist*, 27. Northfield, IL: Instrumentalist Co., 1999.

Rice, Albert R. “Bass, Contra Bass, and Contra Alto Clarinets.” Essay. In *From the Clarinet D'amour to the Contra Bass: a History of Large Size Clarinets, 1740-1860*, 325–88. New York, NY: Oxford University Press, 2009.

Rice, Albert R. “The E-Flat Contra Alto Clarinet by Maldura (1881) and the Contra Bass Clarinets by Besson (1890).” *Journal of the American Musical Instrument Society* XLII (2016): 161–96.

Ridenour Clarinet Products. “About Tom Ridenour.” Accessed September 9, 2020. https://www.ridenourclarinetproducts.com/about-tom-ridenour.html.

Ripa. “Clarinetti.” Accessed September 13, 2020. https://www.ripamusic.com/categoria/legni/clarinetti/?product_orderby=price.

Robin, Yann. “Art of Metal II.” Paris: Editions Jobert, 2007.

Rousselet, William, and Denis Watel. *Larigot No. XXIV Spécial: Le Livre D'Or De La Clarinette Française*. 2nd ed. Paris, France: ACIMV c/o M.B. Kampmann, 2013.

Ruth, Jeremy Larkham. "Humming and Singing While Playing in Clarinet Performance: An Evidence Based Method for Performers and Resource for Composers." Dissertation, Arizona State University, 2019.

Saint-Marie, A. Pierre. *Méthode Pour La Clarinette-Basse, à L'Usage Des Artistes Clarinettistes*. Paris: Evette & Schaeffer, 1898.

Saint-Saëns, Camille. *Henry VIII*. Manuscript, 1882.

The Selmer Co. *Band Instrument Price List Area A January 1, 1985*. Elkhart, IN: The Selmer Co., 1985.

The Selmer Co. *Price List Area A January 1979*. Elkhart, IN, 1979.

The Selmer Co. *What to Look for When You Choose Your New Woodwind Mouthpiece*. Elkhart, IN: The Selmer Co., 1978.

"Selmer." Conn-Selmer, Inc. Accessed November 28, 2020. https://www.conn-selmer.com/en-us/our-brands/selmer.

Sextour de Clarinettes de Paris. *The Clarinet, Volume 2 LS 1077*. Vinyl recording. London, n.d.

Smeyers, David. "The Hespos Phenomenon: A Performer's Point of View." *Contact* 33 (1988): 17–19.

Sparnaay, Harry. *The Bass Clarinet: a Personal History*. Translated by Annelie de Man and Paul Roe. 3rd ed. Barcelona: Periferia Sheet Music, 2017.

Taylor, Rhonda Janette. Dissertation. *Gérard Grisey's Anubis Et Nout: A Historical and Analytical Perspective*. Dissertation, University of Arizona, 2005. http://hdl.handle.net/10150/194938.

Vessella, Alessandro, and Alamiro Giampieri. *Studi D'istrumentazione per Banda*. Milano: G. Ricordi & Co., 1955.

Vincent Bach. *Buescher Band Instruments*. Elkhart, IN: Vincent Bach, 1971.

Vinko Globokar. *Echanges / Res/As/Ex/Ins-Pirer / Discours IV*. Vinyl recording. Deutsche Harmonia Mundi, 1978.

Waln, George E. "The Clarinet Choir." In *Woodwind Anthology: a Compendium of Woodwind Articles from the Instrumentalist* 2, 2:43–44. Northfield, IL: Instrumentalist Co., 1999.

Watts, Sarah. *Spectral Immersions: a Comprehensive Guide to the Theory and Practice of Bass Clarinet Multiphonics*. Ruisbroek-Puurs: Metropolis Music, 2015.

Weerts, Richard K. "The Contrabass Clarinet in the Modern Symphonic Band." In *Woodwind Anthology: a Compendium of Woodwind Articles from the Instrumentalist* 2, 2:110–11. Northfield, IL: Instrumentalist Co., 1999.

Weiss, Marcus, and Giorgio Netti. *The Techniques of Saxophone Playing - Die Spieltechnik Des Saxophons*. 4th ed. Kassel: Bärenreiter-Verlag Karl Vötterle GmbH & Co. KG, 2018.

Wiley, Roland John. *Tchaikovsky's Ballets: Swan Lake, Sleeping Beauty, Nutcracker*. Oxford: Clarendon Press, 1985.

Wilhelm Heckel GmbH. "Instruments- Clarinet," December 16, 2018. https://heckel.de/en/chronicle/instruments/.

The Woodlawn Senior High School Concert Band. *Woodwinds Brasswinds Percussion*. Vinyl recording, 1962.