

Extended bassoon techniques: Filling the pedagogical gap

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ABSTRACT

This thesis addresses the demands of extended techniques imposed by composers on bassoonists in performing their music. Several factors contribute to the difficulties a bassoonist can experience when using performing extended techniques. The lack of an appropriate learning progression focusing on advanced bassoon playing techniques, the ongoing development of these techniques as well as the absence of a consistent approach to bassoon notation exacerbate this situation.

A qualitative research approach incorporating practice-led research through the personal involvement of the researcher was used. The research design includes the experiences and experimentations of the researcher. Data was collected under controlled conditions. The researcher utilised a consistent approach to notation as well as fingering charts and audio recordings to report the results of the research.

A sound basic understanding of traditional bassoon playing techniques is underscored. A practical teaching approach is taken in the discourse to enable the aspiring bassoonist to master certain techniques, such as circular breathing, tonguing, pitch sliding and the use of multiphonics and microtones. All these technical aspects are illustrated with appropriate examples, exercises and fingering charts to enhance the learning experience.

The practice-led research foregrounds most of the pioneer Bruno Bartolozzi's findings. These and performing some of the works for bassoon by *avant-garde* composers have underscored the absolute requirement of mastering the various extended techniques. The insights gained from the research should provide the aspirant bassoonist with the insight and practical skill to master extended bassoon techniques.

Key words

Bassoon, Bruno Bartolozzi, circular breathing, embouchure, glissando, microtonal, multiphonics, pitch-sliding, portamento, tonguing.

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DEFINITIONS

- Avant-garde* music: Music that is considered to be at the forefront of experimentation or innovation in its field.
- Cent: A unit of pitch based on the equal tempered octave, such that one equal tempered semitone is equal to 100 cents.
- Embouchure: The way in which a player applies his or her mouth to the mouthpiece of a wind instrument, especially as it affects the production of the sound.
- Extended technique: An unconventional, unorthodox, or non-traditional method of playing a musical instrument.
- Glissando: A continuous slide upwards or downwards between two notes.
- Microtone: An interval smaller than a semitone.
- Monophonic: Having a single melodic line without harmonies or melody in counterpoint.
- Multiphonic: An extended technique on a monophonic instrument in which several tones are produced simultaneously.
- Notation: Any system in music used to represent visually music perceived aurally so that it can be played on an instrument through the use of written, printed or otherwise produced symbols.
- Portamento*: A slide from one note to the next in a consecutive movement of the fingers.

Quinquepartite: Divided into or composed of five parts.

Secco: A musical term meaning *dry*.

ABBREVIATIONS

PRMD: Performance-related musculoskeletal disorders.

MOV: Mnemonic for the copying of data from one location to another in the x86 assembly language (x86 assembly languages are used to produce object code for the x86 class of CPU processors).

WAV: An audio file format standard for storing an audio bitstream on personal computers.

CHAPTER 1. INTRODUCTION AND OVERVIEW

1.1. Introduction

The development of the bassoon as a musical instrument has been slow but steady. Originally the bassoon was designed as an accompaniment instrument; as its mechanism became more advanced and additional mechanisms were developed to assist with range extension, and as enhanced reed construction to assist with tuning was introduced, composers started to include solo repertoires for the instrument. When comparing the baroque bassoon to today's modern German system bassoon, it is clear how the instrument has developed from a three-keyed instrument into an instrument consisting of more than 28 keys.

These changes prompted experimentation by bassoonists and thus new techniques were developed to produce specific sounds and timbre, which in turn influenced the inherent characteristics of subsequent bassoon compositions. Although the instrument was originally intended to be a monophonic instrument, experimentation with multiphonic possibilities resulted in the innovation of the bassoon repertoire during the 20th century classical music period.

At the forefront of publishing descriptive explanations of the new compositional techniques for woodwind instruments was Bruno Bartolozzi (1911 - 1980). Bartolozzi was an Italian composer and pioneer of the development of extended techniques for wind instruments. He published his treatise, *New sounds for woodwind* in 1967, which served as an inspiration to composers to conceive new compositions incorporating extended techniques and performance procedures. This led to the introduction of the monophonic and multiphonic possibilities that could not be obtained with standard and traditional techniques (Penazzi 1972:1). Thus, extended techniques for the bassoon became an indispensable tool for the contemporary bassoonist.

As composers started to include extended techniques in their compositions for bassoon, the lack of relevant training and knowledge became challenging to performers. Composers who wrote pieces that include extended techniques would not always include fingering charts or illustrative instructions in the composition. This resulted in major difficulties for the bassoonist who wanted to perform these works, especially if the individual was inexperienced in playing

compositions that include extended bassoon techniques. Examples of contemporary scores for bassoon are illustrated in Appendix D. The scores consist of extracts from *Sequenza XII* (1997) for bassoon composed by Lucio Berio (1925 - 2003) and from *Monolog* (1983) by Isang Yun (1917 - 1995).

Personal experience has taught the researcher that these techniques are neglected by bassoon teachers, especially in South Africa, as extended bassoon techniques are used mostly in *avant-garde* compositions not regularly premiered or performed in South Africa. There is often not a sound understanding of traditional bassoon techniques that makes it almost impossible to master extended techniques required for bassoon playing. Many beginner bassoonists in South Africa cannot afford a well-serviced, decently maintained bassoon, which results in poor basic technique.

Even more problematic is that not all composers are familiar with the system of notation as set out by Bartolozzi. An example of this is illustrated in *Vir 'n Winterdag*, composed by the South African composer, Stefans Grové (1922 - 2014). As a bassoonist my first encounter with extended bassoon techniques was in the work, *Vir 'n Winterdag* by Grové. I was fortunate to have had personal interaction with the composer while preparing to play this work for the UNISA Performer Licentiate in Bassoon in 2010, as well as my second D.Mus. recital (2015) at the University of Pretoria. During the preparation of *Vir 'n Winterdag* I experienced some difficulty in finding the precise fingering charts to accommodate the extended techniques demanded by the composer in this composition. Grové's illustrations in the score are not adequately descriptive; the extended techniques are labelled only x and y respectively. An example can be found in bar 23, as illustrated in Example 1.1.

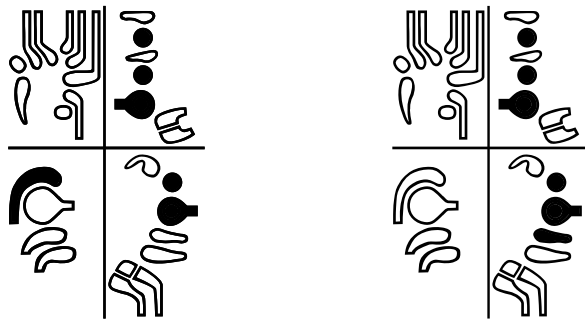
Example 1.1: S. Grové, *Vir 'n Winterdag*, bars 20 - 23

* Wisselgrepe/alternative fingering

The only indication that Grové gives in his composition is to use alternative fingering; however, using alternative fingering alone does not achieve the desired effect. This is because alternative fingering does not change the sound of the specific note as Grové intended. The alternative fingering simply provides a different way to play the same-sounding note. This example demonstrates the complexity of the issues encountered by the bassoonist performing the compositions of modern composers and attempting to achieve the desired effect and impact.

Example 1.2 illustrates the alternative fingering compared to the traditional fingering for A#3 on the German system bassoon. On the left is the traditional fingering for A#3 and on the right the alternative fingering for A#3. Due to the mechanism of the German system bassoon, both the traditional and alternative A#3 fingering open the same-sounding hole, which means that both fingerings produce the same note in terms of pitch and timbre. All illustrations and schematic discussions in this study are based on the traditional German system bassoon fingering design, also known as Heckel fingering.

Example 1.2: Traditional fingering on a German system bassoon for A#3 on the left and alternative fingering for A#3 on the right

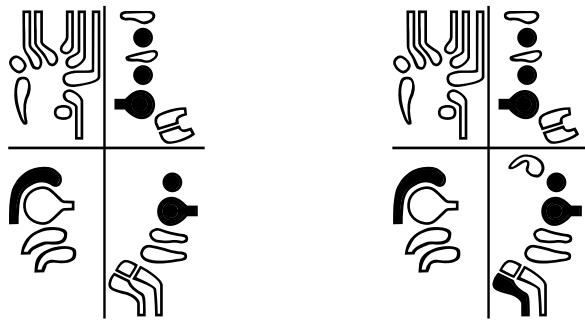


To produce an extra effect or different sound, additional mechanisms must be used to open different-sounding holes and to change the natural harmonic frequency produced by the instrument. In a conversation with Grové (March 2010, LaPat, University of Pretoria, South Africa), he explained how the x and y was supposed to sound, but he could not demonstrate it on the bassoon. He further explained that the piece was “an atmospheric work”. When I demonstrated the quarter-tone effect, he indicated that it was a good representation of his

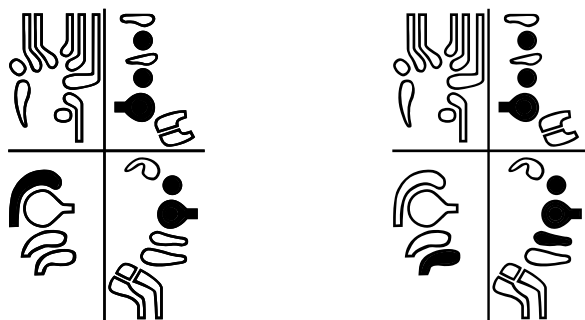
tonal idea. How Grové intended it to sound can be understood by following Bartolozzi's writings, as illustrated in Examples 1.3 and 1.4.

Example 1.3 illustrates the fingering for the back A# (right hand, fifth finger) mechanism and Example 1.4 the fingering for the alternative A# (right hand, first finger) mechanism to open the same tone hole on the modern German bassoon. Example 1.4 also shows the fingering for the alternative mechanism for Bb (right hand, fourth finger). Example 1.4 is not the best fingering approach, but is used as an example to indicate the different options for the same alternative fingering to execute pitch adjustment on A#3.

Example 1.3: Traditional fingering on a German system bassoon for A#3 on the left, pitch adjustable fingering for A#3 on the right using the back A# mechanism

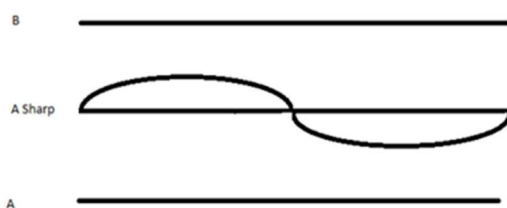


Example 1.4: Traditional fingering on a German system bassoon for A#3 on the left, pitch adjustable fingering for A#3 on the right using the alternative front A# and back Bb mechanism



The extra fingering does not produce the extended bassoon technique known as a multiphonic, but it does adjust the pitch of the note to a quarter-tone effect between A#3 and B3, or as Bartolozzi explained, a “monophonic possibility” (Bartolozzi 1982:50). Example 1.5 is one of many indicating the amplitude of the half-oscillation during the execution of microtones that constitutes part of Bartolozzi’s monophonic possibilities. In this instance it indicates the half-oscillation between B3 and A#3, and A#3 and A3.

Example 1.5: The curve shows the movement of the note by creating a half-oscillation between a quarter-tone and half-tone



Unfortunately Bartolozzi’s original suggestion regarding the incorporation of extended bassoon techniques into a standard woodwind curriculum, or more specifically the bassoon curriculum (Bartolozzi 1982:90), is still met with continued resistance after nearly 50 years. My experience as an ensemble and contemporary bassoonist has been that performers learn extended techniques only when, and if they are required to perform them; this practice results in only a small number of musicians specialising in extended bassoon techniques. It is against this background that I conducted this research as an approach to master and use extended bassoon techniques and address the shortcomings in teaching them.

1.2. Purpose of the study

The purpose of the study is to provide bassoonists with a foundation for understanding and executing extended techniques that are not commonly taught but increasingly needed, as composers are currently producing compositions that demand the use of these techniques. It is essential to understand and have knowledge of extended bassoon techniques to perform advanced contemporary compositions. As Bruno Bartolozzi’s (1982) treatise is a seminal work on extended techniques, it is imperative to study his writings and to evaluate their relevance to the modern German system bassoon. The findings of this study should be beneficial to South African and international students and advanced professional bassoonists alike. The

thesis should also inform both the bassoonist and the composer of the limitations of these techniques for the instrument.

1.3. Research questions

Given the issues relating to performing extended bassoon techniques as discussed, the following main research question was formulated:

How can the pedagogical gap regarding the teaching of extended bassoon techniques be bridged?

Secondary research questions:

- How relevant is Bartolozzi's (1982) treatise on extended bassoon techniques in a contemporary educational context?
- How can experimentation with the execution of extended bassoon techniques aid in establishing a notation system representing various fingering possibilities?

1.4. Research method

This practice-led study followed a qualitative research design with a post-positivist position. Data collection was done by conducting a thematic review of the existing literature. Documenting different fingering possibilities for both multiphonic and monophonic playing was done using the writings of Bartolozzi (1982) as point of departure.

It was also prudent to verify whether Bartolozzi's writings (1982) regarding fingering for extended techniques are still appropriate to the modern German bassoon system. Additional techniques regarding circular breathing as well as tonguing techniques have been experimented with to explore and document appropriate methods to teach them. Chapter 3 describes the methodological process in detail.

1.5. Delimitations of the study

- Due to the construction of the German bassoon fingering system, the findings on monophonic and multiphonic playing are not possible on Baroque, Classical or French system bassoons.
- Fingering charts developed by the researcher should not be regarded as the only options for executing specific monophonic and multiphonic possibilities; they serve as an additional option for the bassoonist or composer desiring to experiment with the techniques.
- This study does not focus on the construction or influence of different reeds as bassoon reeds are a personal preference for each professional bassoonist.

1.6. Outline of the study

Chapter 1 is introductory and includes the background to the study, the research problem, questions, aims and an overview of the research methodology.

Chapter 2 discusses the literature study conducted; it provides an overview of the literature that relates to the historical background and development of extended bassoon techniques. A number of bassoonist and other woodwind players at post-graduate level have explored the topic and this has augmented the available literature.

Chapter 3 presents the methodological procedures used for the research and includes information regarding the research paradigm, design, data collection, data analysis and a brief discussion of the validity and reliability of the research.

Extended modern bassoon playing techniques and their execution are discussed extensively in Chapter 4. The results gained from the research and experimentation are organised alphabetically for ease of reference. In addition, bassoon fingering charts with descriptive explanations are explained and illustrated.

Chapter 5 is the concluding chapter and provides a summary, limitations and recommendations for further research.

CHAPTER 2. LITERATURE REVIEW

2.1. Introduction

The history of the development of the bassoon reflects slow but steady progress. It has been slower than that of most other woodwind instruments, which can probably be ascribed to the intricacies of its mechanical design requirements, as well as it being a comparatively large instrument requiring extensive development of both wood attributes and sound chambering.

Development of the bassoon implies not only the improvement of the mechanical design of the instrument but also the increasing technical ability of the bassoonist as time progresses. During the past three centuries composers have taken advantage of these developments and written music that capitalises on the growing capabilities of the instrument. At the same time they have imposed additional skill requirements on the bassoonist to perform at the required level.

Traditionally music was written for the twelve-pitch octave. During the past century, though, certain composers have begun to include sounds in their compositions that result in a dissolution of tonality, bringing about compositions with no rules, no boundaries and no precedents, enabling the performer to interpret music freely (De Leeuw 2005:20). These compositions challenge the physical limitations of the bassoon. Both the mechanical and musical changes constitute the extended techniques referred to in the title of the research. An important element of 20th century classical music is the continually expanding palette of sounds available for utilisation by composers (Wilson 2011:13). This element challenges the bassoonist to learn how to execute the techniques with a view to producing these sounds.

Composers like John Cage (5 September 1912 – 12 August 1992) became increasingly interested in expanding the spectrum of sounds for traditional orchestral instruments. Extended bassoon techniques found in his 1958 composition, *Concert for Piano and Orchestra*, multiphonics. In this composition the multiphonic chords are referred to as “motor sounds” (Lipp 1982:54). Unfortunately, at the time there was no established record of the bassoon’s technical capabilities and neither was there any regulation, system of notation or exact fingering charts for these extended bassoon techniques. Performers had no instructions and were forced to rely on personal experimentation, while composers had no conventional

references that they could use to acquaint themselves with these techniques (Wilson 2011:13).

New stumbling blocks appeared in the form of problematic fingering for the instrument, compounded by the challenging system of notation used by composers not familiar with the writings of Bruno Bartolozzi (1982). Through his experimentations, Bartolozzi (1982) discovered that woodwind instruments were able to produce a vast array of unusual tones, timbres and effects never before considered possible or even imagined. *New Sounds for Woodwinds*, published by Bartolozzi in 1967, was an attempt to provide a platform to develop consistency in techniques and approaches on how to master these extended techniques.

The publication by Bartolozzi is still regarded as a valid resource for both the composer and woodwind instrumentalist in their continued quest for new sounds, yet not many are familiar with the text of Bartolozzi (1982). As a result of the increasing usage of extended techniques, especially in *avant-garde* music, the compositions are not often performed or even considered by many bassoonists in South Africa. This can be ascribed to a lack of understanding of the intricacies of and concomitant execution of these techniques.

2.2. Bruno Bartolozzi

2.2.1 *New Sounds for Woodwind* by Bruno Bartolozzi

Bartolozzi (1967) investigated the possibility of woodwind instruments achieving a desired effect with different sounds without any physical alteration to the instrument itself. The result was a spectrum of sounds and effects that can be produced by using a variety of different fingering, embouchure tension and positions, air speed and tongue motions. With the help of Sergio Penazzi, Bruno Bartolozzi published his influential treatise *New Sounds for Woodwind* in 1967, a detailed method that provided descriptions and instructions for the performance of extended techniques on woodwind instruments.

Bartolozzi emphasised the fact that new sounds can be achieved when performers deviate from the standard performance techniques that stress the "... purity and beauty of sound obtained through uniformity of timbre ..." (Bartolozzi 1967:5). His book contains several chapters describing non-traditional performance techniques, including suggestions for execution and an approach to notation. Bartolozzi (1967) often stresses the importance of

extended techniques being incorporated into private and conservatory curricula. He argues that dedication is required from the contemporary performer to explore new ways of using techniques that are not bound by traditional rules. This should become a natural practice for those who, in the future, can be initiated from the beginning of their studies into the new techniques which, being nothing other than a consequential development of traditional ones, can only be of benefit to the performers (Bartolozzi 1982:90).

Bartolozzi (1982:90) asserts that it is the experimental musician who directs his or her efforts toward searching for new sounds and away from categorising them as ugly or unpleasant. These extended techniques introduced by Bartolozzi are classified into monophonic and multiphonic possibilities.

2.2.1.1 *Monophonic possibilities*

Bartolozzi (1982:91) describes monophonic possibilities as “[e]mitting the same sound with timbres of considerable diversity, thus permitting the performance of melodies of tone colour with either a single sound or sounds of different pitch”. These can include, but are not limited to, the same notes with different timbres (classified as closed or open, light or dark), effects controlled by the lips, and special monophonic effects such as the following:

- *Portamento*: Discrete continuous movement from one pitch to another through all the intervening pitches (Randel 1999:659).
- *Acciaccatura-portamento*: Combining *portamento* with an ornament consisting of a non-harmonic tone (Randel 1999:3).
- *Glissando*: A continuous or sliding movement from one pitch to another (Randel 1999:342).

2.2.1.2 *Multiphonic possibilities*

Bartolozzi’s research into multiphonic possibilities, which he refers to as “sound amalgams” (1982:42), is the most frequently referred to section of his treatise. He classifies multiphonics as the “generation, at one and the same time, of a number of frequency vibrations in the single air column of an instrument” (Bartolozzi 1982:42). Bartolozzi also discusses the processes of adjusting embouchure, i.e. the placement of the lips and the co-use of facial muscles and the jaw in the playing of wind instruments. In addition, variations in air pressure are required to

produce certain multiphonic sounds; these are supported by illustrations in the fingering charts to indicate the required adjustments (Bartolozzi 1982:42).

2.3. Challenging aspects of extended bassoon techniques

2.3.1 Challenges of bassoon fingering

The most notable problem of the bassoon design that distinguishes the instrument from any other woodwind instrument is its awkward and uncomfortable fingering system. In the essay *Bassoon Fingering Issues*, Burns (2006:1) poses the question, “What other instrument demands so much of the player’s thumbs or requires so many diverse techniques such as using forked fingering, half-holes, and flicking?”

He explains that the left thumb alone is responsible for nine keys and for the right thumb there are four keys, where other woodwind instruments like the flute use only the right thumb to support the instrument. Burns (2006:1) describes the bassoon as “large, heavy and unwieldy!” Many people, including Theobald Boehm (9 April 1794 – 25 November 1881), have tried to redesign the bassoon's fingering without success. Boehm is known for developing the fingering systems for the flute, oboe and clarinet (cited in Burns 2006:1). Brusky (2009:30) explains that the complexity of the fingering system of the instrument, where all 10 fingers are used, may be a factor influencing bassoon performance-related musculoskeletal disorders (PRMD). She further postulates that where other woodwind instruments have the facility to use the right thumb to support the instrument, the bassoonist must carry the weight of the instrument on the left hand while having to use all five fingers of the left hand for its fingering system. PRMD includes any pain, weakness, numbness, tingling and/or other symptoms that interfere with the ability to play an instrument at the level to which the musician is accustomed (Brusky 2009:30).

Moreno (2013:68) discusses how the fingering system of the bassoon has been a problem since the early ages and points out how bassoonists worked with instrument makers to develop new bassoon models with a view to improving the fingering system. These changes included the increase in the number of keys on the bassoon to help improve the tuning of notes that are not often used. Moreno explains how new fingering systems were developed for these new keys and how performers combine old and new fingering to execute the challenges set by composers to “broaden the use of tonalities and chromatic passages” (2013:68). Burns (2006:2) states that a bassoonist must master the fingering techniques of

half-holing and flicking to avoid *cracking*. Cracking is the unpleasant noise that sometimes accompanies a desired note. Some monophonic and multiphonic possibilities require the use of half-holing and flick keys combined with two distinct fingering approaches:

- Forked-fingering is any fingering where a central tone hole is open while the tone holes to each side are covered with a finger from the left hand.
- Cross-fingering is any fingering where an open tone hole is below or above the covered tone hole on the left hand.

It follows that mastery of the basic traditional fingering of the German bassoon system is a prerequisite for the successful execution of extended techniques that include multiple fingering like monophonic and multiphonic possibilities.

2.3.2 Challenges of an approach to a system of notation for extended woodwind techniques

Only a small amount of research has been conducted on a system of notation for extended techniques, especially regarding the bassoon. Unfortunately, not all approaches to notation and illustrations are interchangeable for woodwind instruments. Redgate and Archbold (n.d.:1) underscore the importance of developing a system of notation that can support the practical needs of the performer.

Holliger developed a system of notation for oboe in his *Studie über Mehrklänge* (1979) that has proved to be a good alternative to the development and study of multiphonics. Holliger's (1979) system notates the fingering above the staff and this shows the performer exactly what should be done to produce the required extended technique. It has been noted that this is a system of notation developed by an oboist for oboists and is therefore not particularly composer-friendly (Burgess & Haynes 2004:275). I believe that this is an effective system, but that it cannot be applied to the bassoon, since the fingering for the two instruments differs. The same observation could be made for most of the prominent systems for notating extended techniques presently in use.

Therefore bassoon students should not try to copy fingering notations for another woodwind instrument. Redgate and Archbold (n.d.:1) point out that the most common problem with notating fingering is that it is woodwind instrument specific and a composer needs to be

familiar with an instrument's key-work to be able to include such descriptions above the music staff. Berio (2006:27) worked with the bassoonist Pascal Gallois to help eliminate the notation problem for his composition *Sequenza XII for Bassoon*, demonstrating the importance of composer and dedicatee working together. One can conclude that there are different approaches to the notation for executing extended techniques on different woodwind instruments and that it is of paramount importance for the composer not to experiment with new ideas for a specific instrument without understanding the construction and possibilities of the instrument itself.

2.4. Conclusion

The development of the bassoon may have been inhibited, to an extent, by the complexity of its mechanical design and other factors, such as wood attributes. Composers recognised that the instrument does possess, given the appropriate circumstances, the ability to produce a much wider spectrum of sound than traditionally thought. Thus they started to produce compositions that require the bassoonist to perform works employing techniques not used before. A lack of a standardised system of notation or fingering charts to assist the bassoonist has proved to be a stumbling block as it results in major performance issues.

To a certain extent the work of Bartolozzi (1982) assisted in simplifying many of the complexities when he developed and detailed the use of non-standard performance techniques. Important to the current research is Bartolozzi's absolute insistence that the use of extended techniques be introduced to bassoonists at the beginning of their studies (Bartolozzi, 1982:90). He classified extended techniques into monophonic and multiphonic possibilities, both of which are addressed at length in Chapter 4.

Chapter 2 indicates that while the use of new extended techniques is an exciting and rich field for experimentation, it is still impacted by three problem areas. Firstly, the complexity associated with fingering and the related use of the bassoon's mechanisms and hole design to achieve the desired results; secondly, the lack of a standardised system of notation specifically for the bassoon; and thirdly, exposing composers to the sound qualities and sound producing abilities of the bassoon – the rationale being that greater collaboration between composers and bassoonists should result in a common understanding of the capabilities of the instrument.

CHAPTER 3. RESEARCH METHODOLOGY

3.1. Introduction

This study follows a qualitative research approach with a post-positivist position. Qualitative research is characterised by its aims that relate to understanding aspects of society, and its methods which, in general, generate words (Patton 2002:2). In short, qualitative methods aim to answer questions about the *what*, *how* and *why* of a phenomenon, rather than *how many* or *how much*; the latter would be answered by quantitative methods (Patton 2002:3).

Creswell (2013:7) advances the notion that the knowledge developed by this kind of research is gained through observation and the subsequent measurement of the objective. He continues by stating that a researcher starts with an understanding of a practice and then collects data regarding the possibility of gaining new knowledge of the specific practice. After collecting data, additional revisions and tests are conducted to support or refute the understanding of the practice. Ryan (2006:12) explains that a post-positivist approach emphasises the development of new knowledge by not focusing on known facts only, but also on the theory of the subject and does not separate theory from practice.

In this study the main research focus is on the theoretical and practical gap that I have identified in the learning and execution of extended bassoon techniques in South Africa and on the development of new knowledge to fill this gap. The problems identified regarding learning to master and executing extended techniques are explained by means of descriptive text as well as fingering charts indicating various possibilities on the bassoon.

Practice-led research, as a form of action research, enabled me to apply the performative nature of my discipline to the research to generate new information and knowledge to add to the existing knowledge regarding extended bassoon techniques. According to Redhead (2012:1), practice-led research allows the researcher to understand the purpose and nature of what is studied in and by art disciplines. She postulates that it is used to address the issue of contemporary consciousness in the arts. This methodology enabled me to understand the processes involved in the development of extended techniques and why there is such a disparity between the teaching of accepted bassoon playing and mastering these techniques. Gray (1996:3) clarifies practice-led research:

... research which is initiated in practice, where questions, problems, challenges are identified and formed by the needs of practice and practitioners; and secondly that the research strategy is carried out through practice, using predominantly methodologies and specific methods familiar to us as practitioners.

Walliman (2011:6) explains that action research is conducted by focusing on observation and behavioural data of the theory or practice. As a result of my own bassoon playing, I experimented with the various extended techniques set by Bartolozzi and new extended techniques that are to be found in modern compositions such as Manfred Schoof's *Zwei Impromptus for Bassoon and Piano* (1993) and Sofia Gubaidulina's *Concerto for Bassoon and Low Strings* (1975). This was done to discover and develop more effective ways to learn, practise and perform these extended techniques.

Data collection was done by conducting a thematic review of the available literature concerning the history, experiences, practice and opinions of other scholars, pedagogues and performers on the topic of extended bassoon techniques. An in-depth search was undertaken to explore published literature on the topic. The data includes possible extended techniques experimented with by reputable bassoonists and bassoon pedagogues such as Dag Jensen and Sergio Azzolini. I also reviewed information found in published articles on the topic of extended woodwind techniques. Platforms such as internet blogs, podcasts and discussion boards focusing on problematic areas in the field of extended bassoon techniques were consulted.

Using published sheet music, I documented prefaces to various compositions that incorporate extended bassoon techniques to compare how composers approach the use of notation and indications to explain to the performer how to execute these techniques. The notations are catalogued to assist in determining whether there is a common set or system of notations for extended bassoon techniques or not. The data collected was used to catalogue the literature on extended woodwind techniques and the existing pedagogical and practical problems regarding the execution of these techniques.

Data was also collected through a process of personally executing a wide spectrum of extended techniques, while notating the results observed in a reflective journal. The journal includes difficulties experienced with respect to fingering, embouchure changes, instrument changes and physical changes the human body must adapt to in order to improve the performance. As part of my practice-led research, I experimented on my own bassoon with

the various extended techniques possible for the German system bassoon, as outlined by a pioneer of extended techniques, Bruno Bartolozzi.

I was aided in my observations by recording audio examples on a Moosmann 200 AP Soloist Model, built in 2012 accompanied by a Heckel CC2 bocal. Tuning was set at a constant of A = 440Hz (Hertz). These recordings were used to observe how the sound may differ with varying fingerings for the same note or with the application of some other extended technique. The recordings assisted in identifying and listing possible challenges that I experienced during the process of experimentation. Comparisons were drawn between fingering provided by Bartolozzi and possible improvements to the fingering for performance on the modern German bassoon.

I documented methods not normally associated with standard bassoon techniques. These included changes in embouchure and the effect of the direct application of the bassoonist's teeth on the double reed. All fingering improvements as proposed by Bartolozzi that I experimented with were documented in the reflective journal and included in a detailed fingering chart. This fingering chart should not be regarded as the only option for these possibilities but should be viewed as an additional source of knowledge to be used during the study of a composition that includes extended bassoon techniques.

3.2. Data analysis and interpretation

A thematic analysis of the literature was used to identify common problems experienced by bassoonists regarding the utilisation of extended bassoon techniques. Patton (2002:23) states that a thematic analysis is used to identify a common problem regarding a specific topic as well as the main themes in the data that has been collected. The thematic analysis used in this study was performed in the following sequence:

- Defining and identifying data
- Collecting and storing data
- Data reduction
- Structuring data
- Consolidating and capturing the research findings in appropriate fingering charts and accompanying sound reproductions

Information regarding the topic was collected using various collection techniques. All data was stored and sorted according to a theme-based system. This allowed for the categorisation of sound and techniques in terms of the themes as stated below. The collected data was stored for possible further studies on the topic, including those that will not be used during this study. The data was then scrutinised to determine its relevancy to the identified themes. All data was classified under the sub-categories of the various monophonic and multiphonic alternatives of the lower, middle and upper register of the bassoon. The following themes were used to analyse my findings on extended bassoon techniques:

- Problematic fingering
- Desired fingering
- Undesired sound effect
- Desired sound effect
- Not possible to perform on a German system bassoon
- Possible to perform on a German system bassoon
- Concurrence with the findings of Bartolozzi
- Non-concurrence with the findings of Bartolozzi
- Problematic notation
- An approach to notation that is easy to understand, consistent and that provides an adequate indication of the requirements

My own experimentations through practice-led research, combined with the findings from the literature review, encouraged and created an environment for further experimentation with extended bassoon techniques. These included circular breathing techniques, tonguing techniques, the development of microtones and the use of multiphonic approaches. The detailed results of the experimentation are provided in Appendix B and Appendix C.

3.2.1 Analysing results of circular breathing and extended tonguing techniques

The following problematic areas regarding circular breathing and extended tonguing techniques were identified:

- Incorrect rehearsal techniques
- Loss of interest due to technical complexity
- Duration of the learning process

- Frustration with the inability to master the technique

The identification of these areas led to an online search to acquaint myself with the available literature pertaining to these matters. The search included exploring the catalogues of various libraries of academic institutions and browsing articles, musicology journals, dissertations and theses. The information obtained was analysed to compare the opinions and suggestions of experts. The volume of relevant literature on extended bassoon techniques was found to be very limited compared to that on the development of other instruments. In addition to the experiments that I conducted, information obtained from these sources enabled me to identify examples to illustrate possibilities for learning and executing these techniques.

3.2.2 Analysing data of microtonal techniques

The results for microtonal sounds were obtained through practice-led research on my own bassoon. Due to new compositional techniques used in the 20th century classical music period, microtonal possibilities became very popular for almost every wind instrument. The construction of the bassoon as well as the development of its mechanical system has undergone great changes since the 1960s. Therefore writings on this topic needed to be investigated to determine whether the techniques required to produce any particular tone have changed since the 1960s and if so, whether these were due solely to the development of the instrument itself.

Various possibilities for the execution of techniques to produce microtonal sounds can be found in the writings of Bartolozzi, Dieter Hänchen and Sergio Penazzi. I experimented with each of the fingerings presented by these three authors and the results were catalogued. A fingering chart was constructed in order to notate the results of the experimentation. In addition, each possible alternative indicated by these three authors was recorded using a Zoom professional recording device assisted with a KORG tuner to determine the 50 cent intonation or half semi-tone change precisely. The experimentation pitch was set at a constant A = 440 Hz. A discussion can be found in Chapter 4, Section 4.2.4 on the use and measurement results of the half semi-tone or cent.

After recording each possibility for a specific tone, the different fingerings were examined to determine whether those indicated by the three authors are suitable for playing on the modern German system bassoon. The prime objective of this experimentation was to isolate the ease

of execution regarding the specific tone, as well as ways in which the specific tone can be executed at the correct pitch with the neighbouring tones. The second objective was to obtain a result to indicate a high quality of sound with a precise audible microtonal change in pitch, resulting in either a quarter-tone or quintepartite-tone on each indicated note.

Following the principles of practice-led research, the results were formulated to indicate to the reader different fingering options for each microtonal possibility. These results indicate whether the writings and findings of these composers are still relevant to the modern German system bassoon. By modernising the fingering chart the bassoonist can try out new fingering to ease the execution of a desired tone. The writings of Bartolozzi can be challenging due to the numbered fingering system he employed to indicate his results.

3.2.3 Analysing data of multiphonic techniques

The objective of the section on multiphonics is to illustrate the possibilities of these techniques on the bassoon. Only a select number of multiphonics was experimented with due to the vast spectrum of the instrument's possibilities. The objective was to indicate specific multiphonic options with the use of precise fingering charts as well as the resonant frequency and audible tones for each multiphonic. The multiphonics were individually recorded and analysed by using *Audiosculpt 3*© as the principal multiphonic research tool. *Audiosculpt 3*© is a sound analysis and processing tool that allows the user to analyse the spectral content of a sound and includes a function to display the results via a spectrogram. The spectral content is displayed in both spectrogram as well as in partial tracking analysis. Appendix A illustrates an example of a spectrograph as well as partial tracking of the multiphonic possibility of the middle upper register D on the bassoon. The programme is available from the IRCAM (*L'Ircam Institut de Recherche et Coordination Acoustique/Musique*) Forum by subscription.

Having loaded the recorded bassoon multiphonics as MOV or WAV files (WAV is a Microsoft© and IBM© audio file format standard for storing an audio bitstream on PCs) on *Audiosculpt 3*©, the program indicated the following results:

- Frequencies present when playing a specific tone or multiphonic possibility on the bassoon.
- The strongest frequency in the multiphonic chord.
- The change of frequency when the multiphonic is at a certain dynamic level.

Frequencies indicated on the partial tracking were then compared to the table shown in Appendix A to find the represented tones. The darker lines on the spectrograph indicate the most prominent frequencies and thus the resonant frequency. The lighter lines indicate additional partials resulting in audible tones on the specific note or multiphonic being played. As this program indicates the strongest frequencies present when playing multiphonics, accurate fingering charts could be designed to accommodate specific tones. These fingering charts also show the dynamic levels at which the specific possibilities can be produced. Due to the nature of multiphonics, not all frequencies are at the same dynamic level. Possible audible tones and microtones have been indicated in the charts. The experimentation pitch was set at a constant $A = 440$ Hz.

3.3. Conclusion

Chapter 3 outlines the research design and methodology underpinning this qualitative study that is approached from a positivist position. With the intention of advancing knowledge about the utilisation of extended techniques on the bassoon, practice-led research, as a form of action research, was identified as the appropriate methodology for the study. A thematic literature review was conducted to identify challenges experienced by bassoonists regarding the execution of extended techniques.

Further data collection involved experimenting with various extended techniques as set by Bartolozzi, Hähnchen and Penazzi, and compositions by Schoof and Gubaidulina, among others. These experiments were recorded in a controlled environment using high quality audio equipment. My own German system bassoon was used throughout the experimentation.

A thematic analysis using a set sequence of activities was conducted on the data collected during the experiments. A categorisation exercise was performed to obtain a representative distribution of specific attribute themes, incorporating sub-categories in respect of the various monophonic and multitone alternatives. The latter resulted in a pre-defined set of criteria, measuring conformance with or divergence from the previously set attributes.

Data in respect of microtonal techniques was analysed as part of the experiments conducted using fingering presented by various composers. The data was interpreted in terms of the tone obtained and the results were recorded on fingering charts. Multiphonic techniques were addressed in a similar manner. I indicated that only selected multiphonics were used and

provided the reasons for the decision. Using a similar recording and data gathering approach as for microtonal techniques, an analysis of the various tones was conducted and the results captured onto relevant fingering charts.

The research results and the capturing thereof allowed for ease of interpretation, use and replication. In addition, the fingering charts as well as the electronic storage of the tone results should assist any other researcher or a bassoonist with the required level of skill to replicate and even conduct further experiments.

CHAPTER 4. EXTENDED TECHNIQUES FOR THE MODERN GERMAN SYSTEM BASSOON

4.1. Introduction

Colour became an essential factor in the development of all the arts in the twentieth century. Composers created innovative instrumentation and orchestration to produce new spectrums of colour in their works. Brindle (1975:153) explains that the primary elements of 19th century music such as melody and harmony were no longer the most important compositional features in the twentieth century. Composers moved away from pitch, measured rhythm and form to focus more on timbre and dynamics in their work. These techniques became extensions of the performance techniques used on traditional instruments.

This chapter illustrates and explains my research on selected extended bassoon techniques for the modern German system bassoon. The results include various fingering possibilities for each technique, all having a marginally different effect regarding the pitch and timbre of the sound produced. Tonguing and circular breathing techniques have also been experimented with, and the results regarding the instruction and learning of these, including exercises to obtain the desired results, are explained.

The objective of this chapter is to explain the characteristics and execution of these extended techniques, especially to bassoonists who are not familiar with them. As a result of the number of possible techniques, only the extended techniques most commonly used in *avant-garde* music are discussed. It is not possible to explain every single extended technique, since some of them are created impromptu by instrumentalists to assist the ongoing experimentation by *avant-garde* composers seeking new sound possibilities.

There are a number of extended technique possibilities with various production methods for the bassoon and it must be understood that, due to the construction of the instrument (some instruments are handmade and some fully machine constructed), a specific sound effect is not always possible on every instrument. Two compact discs are included as an audible representation of the various possibilities regarding microtones and multiphonics. Each is clearly indicated with a track number corresponding to the track numbers on the compact discs (Consult Appendix E).

It was once explained to me by a teacher that the first approach to extended techniques is to remember the words of Bartolozzi: “It is the experimental musician who will direct his efforts toward searching for new sounds and away from categorising them as ugly or unpleasant” (Bartolozzi 1982:90).

I believe there are multiple reasons why there is a gap in the instruction and learning of extended techniques for the bassoon. Firstly, for a sound foundation the bassoonist must have a thorough understanding of the traditional techniques required to play the instrument. Secondly, the bassoonist must be prepared to step into the unknown by exploring new possibilities on the instrument and, at the same time, be able to handle negative criticism that may come from teachers, colleagues, peers and others not familiar with extended techniques. Not all extended techniques are regarded as beautiful or aesthetic in Western classical music, and the uninformed might even regard them as ugly or irrelevant.

As a student of the bassoon I have had teachers who disregard the importance of teaching these techniques due to their lack of knowledge of extended techniques. This lack of exposure will most likely stand in the way of a student trying to obtain the desired results and may well result in a loss of interest in, or even the avoidance of a repertoire that includes extended techniques. It is problematic that some bassoon teachers believe that these techniques should only be taught when and if needed. It is true that the primary focus must always be on mastering traditional technique; however, an extended technique such as circular breathing cannot be mastered in a short period of time and may require months or even years for the bassoonist to master. For this reason I agree with Bartolozzi that an introduction to extended techniques should be incorporated into the bassoon student’s curriculum. This process should be initiated during the early stages of training once there is a sound understanding of the standard technique, such as fingering and breathing.

4.2. Extended bassoon techniques

The extended techniques in this chapter are presented in alphabetical order. Descriptive text as well as bassoon fingering charts and music notation is provided to demonstrate the performance of a specific technique. The microtone and multiphonic fingering charts (Consult Appendix B and C) are accompanied by results compiled during experimentation with the fingering of each extended technique. Indications as to the fingering that works best regarding ease of execution and tone production accompany the microtone results. The fingering charts

can be used not only by bassoon teachers but also by composers when they need to indicate a desired effect or sound in a composition.

4.2.1 Circular breathing

Circular breathing is a technique used by both woodwind and brass instrumentalists in the classical repertoire and even more so in the jazz music environment to maintain a seamlessly extended tone or series of tones. Dick (1987:5) states the following:

Circular breathing makes it possible to play the flute (or other wind instrument) continuously while inhaling. This seeming contradiction – exhaling to playing while inhaling to breathe – is accomplished by storing air in the mouth and cheeks and using this air to play while inhaling through the nose.

Dick (1987:5) further notes that although circular breathing may be considered a new development of the 1980s, it is an age-old technique of breathing in several parts of the world, including the Indian province of Rajasthan where musicians perform on Bulgarian *kaval* and *narsh* flutes. This technique is similarly used by glassblowers around the world to maintain continuous air pressure inside the molten glass as it is being shaped.

Learning the technique of circular breathing on the bassoon can be approached on two levels. The first level is to develop the correct embouchure so that a desired quality of tone can be produced while the facial muscles, like the cheeks and corners of the mouth, are moving. The second level is to learn and master the coordination involved to inhale and exhale while simultaneously playing the instrument. Due to the development of a specific embouchure to execute circular breathing perfectly, this technique requires an extended period of time to perfect.

Most important, in my view is that the instrumentalist must learn how to use this technique sensibly, without any disturbance to the musical phrase or line. Prior to starting the technique of circular breathing, it is advisable for the bassoonist who wishes to learn it, first to master traditional diaphragmatic breathing. In my own development as a bassoonist this technique required almost two years to perfect by including technical circular breathing exercises in my daily rehearsal sessions. By restricting the exercises to short 10 to 15 minute rehearsal sessions, fatigue of the embouchure was prevented. Applying a new technique that involves

the development or adjustment of the embouchure can be quite strenuous if done for long periods at a time and should thus be carefully managed.

As a bassoonist I believe that to excel at learning circular breathing on the bassoon, the instrumentalist must:

- include technical exercises on circular breathing in his/her daily rehearsal session for no more than 15 minutes;
- not become discouraged if the sound is less than desirable due to the change in embouchure. This will happen in the beginning stages of learning to use circular breathing. Due to the nature of musicality, all instrumentalists value their perspective of what they regard as their own sound. This sound then becomes what can be termed the *identity* of each individual musician. Focus during the learning stages must always be on creating the original identity sound for the musician;
- stay motivated even if progress is not achieved or is slow as the technique can be challenging. Any progress made with embouchure will be negated if not rehearsed regularly.

Circular breathing should be used as a means to enhance performance practice as well as musicianship. By following the bubble technique, many wind instrumentalists and I have successfully mastered the art of circular breathing. The bubble technique exercise enhances the understanding of the process that the facial muscles and diaphragm experience when having to do circular breathing. My aim is to explain what the focus points in every step of the bubble technique should be. Caution should be exercised when doing circular breathing to avoid hyperventilating when exhaling more air than is inhaled, as this may lead to light-headedness and rapid fatigue.

4.2.1.1 *Bubble technique*

During experimentation with and the learning of circular breathing, I recognised that the approach to this technique is to understand the idea of creating a constant stream of air going through one's nose and filling one's lungs, while simultaneously blowing the double reed with no disruptions to the airflow or airstream going through the bassoon's double reed. Attempting to master circular breathing in the early stages of learning to play an instrument can be intimidating and should be mastered slowly in order not to become discouraged. Using an

easy air bubble technique, the skill of simultaneous exhaling and inhaling can be implemented to achieve the desired effect.

The following steps constitute the foundation for the bubble technique:

- Take a deep breath to fill the lungs with air.
- Puff out the cheeks, filling them with air.
- Blow air from the lungs through a straw into a glass/cup of water. The goal is to sustain the bubbling in the glass with no break in the airstream.
- When it is time to take a breath, expel the air from the cheeks into the straw while simultaneously inhaling through the nose.
- While inhaling through the nose, fill the lungs with air and push the air out again, simultaneously filling the cheeks with stored air.

This technique can be challenging when attempted the first time. To understand and improve the execution of the technique, the cheek muscles, known as the buccinators, need to be exercised; firstly, by forcing the air that is stored in the cheeks through the straw without inhaling at the same time. Focus should be on the movement of the buccinators while pushing the air out of the cheeks, doing this in one slow controlled movement. This may initially result in air being expelled for only a very short period of time. With time and practice the bassoonist should be able to extend the time it takes to expel the air stored in the cheeks without taking a breath.

Secondly, only once the desired movement by the buccinators has been achieved, should simultaneous blowing and breathing be practised. Focus should still be on the movement of the buccinators, moving them slowly while inhaling. A balance should be struck between the relationship of the inhaling with respect to speed and air volume and the release of air from the cheeks. The next step is to switch between stored air in the cheeks and the air in the lungs without applying an uncontrolled break in the air pressure. This uninterrupted switch of air is the most difficult to achieve during circular breathing. Once the instrumentalist has achieved success as far as this process is concerned, he/she should implement the same principles on the bassoon.

4.2.1.2 *Applying circular breathing on the bassoon*

A problem that I experienced in implementing the circular breathing technique on my instrument was pushing out the cheeks while playing. The embouchure technique is based on the German school of bassoon performance practice that I was taught, as are many bassoonists throughout Europe, and requires the cheeks not to be pushed out during bassoon playing, but the jaw to be lowered to open the inside of the mouth (Camden 1962:6).

The first noticeable difference when adjusting the embouchure to store air in the mouth with the cheeks extended outwards is a significant change in intonation and sound quality. At first I experienced that circular breathing was only achieved on those registers of the instrument that provide the appropriate level of resistance. A lower level of resistance on the bassoon can result in difficulty in sustaining a constant airflow with no disruptions. The bassoonist is encouraged to practise the technique on a more resistant register of the bassoon, for example C4 to E \flat 4, focusing on a constant air stream support to maintain the correct pitch while pushing out the cheeks. Only once this can be comfortably executed should the range outward above E \flat 4 and below C4 be practised.

Establishing a continuous sound on the bassoon creates an extreme stamina issue for the facial muscles of the bassoonist. While executing this technique, the buccinators as well as orbicularis oris that supports the adjusted embouchure during playing must enable the lips to stay in contact with, as well as seal, the double reed for much longer than is typically required; this results in accelerated fatigue in these muscles.

Long tones must be practised to enhance the control of, and at the same time reduce fatigue of the embouchure. There are two possible ways of practising this: firstly, by using only air stored inside the mouth with the cheeks inflated, sustaining a single long tone and focusing on the intonation while not inhaling; and secondly, by inflating and deflating the cheeks while sustaining a long note. When implementing the second exercise the intonation will not be stable, but the focus should be on the movement of the buccinators while inhaling. The bassoonist should remember that circular breathing consists of many short, rapid inhalations. Waiting until a breath is needed is to be discouraged, as taking a long breath through the nose can be quite noisy. In addition, this may also result in hyperventilation. The air stored in the cheeks must not be fully depleted before reverting to using the newly inhaled air.

Dick (1987:24) developed a well-designed system for practising long tones on the flute during circular breathing. Although these exercises are in the treble clef, they can be executed on the bassoon at the preferred pitch of the instrumentalist. Much research has been published on the positive effect of long tone exercises. These exercises will not be discussed here, but the objective of performing the exercises is to strengthen the muscles used to control the embouchure, particularly the orbicularis oris muscle, thus improving stability of sound.

Example 4.1: Example of symbols indicating the inflation of cheeks or inhaling through the nose (Dick 1987:24)

The symbol for inflating the cheeks while playing is: *———

This links up with the symbol to inhale through the nose while playing: *——o

The image shows four staves of music in treble clef, 3/4 time, with a dynamic marking of *f-ff*. Each staff contains a sequence of notes, each with a circular breathing symbol above it. The symbols are either a star with a horizontal line (*———) or a star with a horizontal line and a small circle at the end (*——o). A large slur covers the notes on each staff. The second and fourth staves end with a double bar line and the word "rest".

The following exercises were developed during my own learning of and recent experimentation with the circular breathing technique. Metronome markings have been provided at a tempo of a crotchet = 40 beats per minute (BPM). These exercises can be practised on any note or scale where the bassoon register supports the resistance of the reed. In my own experience, the best suitable register for these exercises is between F3 and F4 where the double reed can vibrate freely with enough supported resistance. In the lower register of the bassoon below F3, the double reed vibrates excessively with hardly any resistance. In the upper register above F4, the vibrations of the double reed are very small resulting in great resistance.

Exercise 4.1: Scale in F major over two bars

In Exercise 4.1 the bassoonist fills both lungs and cheeks with air and then plays a one-octave scale, in this case in F major over two bars. When ascending (Bar 1) starting on F3, the bassoonist should exhale from the lungs for the duration of the bar and when descending (Bar 2), he/she should inhale through the nose, while pushing out the stored air from the cheeks, again for the duration of the bar. From Bar 4 the scale is descending from F4. The same principal should be applied as in bars 1 and 2.

Exercise 4.2: Scale in F major over one bar

In Exercise 4.2 the bassoonist fills up the lungs and cheeks with air and then plays a one-octave scale in F major, spanning one bar. Throughout the duration of bar 1 the bassoonist must exhale from the lungs; in bar 2 the scale must be performed up and down while simultaneously inhaling through the nose and pushing the stored air from the cheeks. In bar 4, the scale direction changes, starting on F4 going downwards. These two exercises should not be practised at a fast tempo. The slower the tempo, the better the control over the movement of the embouchure during the release of the air stored in the cheeks. Focus should be on the simultaneous exhaling and inhaling movement to ensure there is no break in airflow.

Exercise 4.3: Scale in thirds in F major over four bars

♩ = 40

Exhale Inhale Exhale Inhale

5

Exhale Inhale Exhale Inhale

Exercise 4.3 is constructed in thirds, being played on a one-octave scale in F major over four bars. In this exercise it is expected of the bassoonist to execute the interval leaps with no break in airflow or speed while doing circular breathing. The exercise is challenging due to the movement of abdominal muscles. These muscles have to be contracted and relaxed to support the intonation of the notes while sustaining a constant airstream. As with the previous two exercises, the tempo should be very slow and focus should be on the simultaneous exhaling and inhaling movement.

Exercise 4.4: Scale in thirds in F major over two bars

Exercise 4.4 consists of two staves of music in bass clef, 4/4 time. The first staff begins with a tempo marking of quarter note = 40. It contains two bars of music, each with a slur over a pair of notes (thirds). The first bar is labeled 'Exhale' and the second bar is labeled 'Inhale'. The second staff begins with a '3' indicating a triplet and also contains two bars of music, each with a slur over a pair of notes. It is also labeled 'Exhale' and 'Inhale'.

Exercise 4.4 is similar to Exercise 4.3, but the scale in thirds is now played over two bars. As before, the focus should be on the simultaneous exhaling and inhaling movement.

Creating dynamic changes during circular breathing can be very challenging, owing to the change of airspeed that is needed to achieve a dynamic effect. Exercise 4.5 indicates that C4 should be started on a low dynamic level, steadily increasing the volume over the two bars, while exhaling from the lungs. From bar 3 the dynamics should decrease while simultaneously inhaling through the nose and releasing the stored air from the cheeks by slowly contracting the buccinators. Air speed should be adjusted and no pressure should be applied to the reed to assist the *decrescendo* on the note. Exercise 4.6 indicates the opposite, but the same action should be followed as in Exercise 4.5.

Exercise 4.5: Long tone on C4, *crescendo, decrescendo*

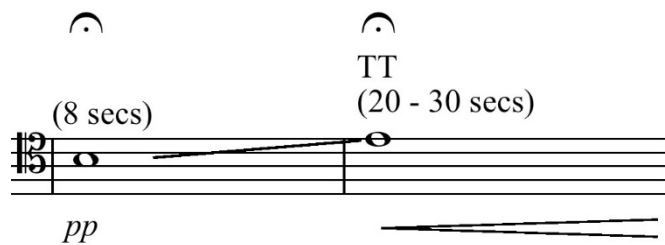
Exercise 4.5 is a single staff in bass clef, 4/4 time, with a tempo marking of quarter note = 40. It shows a long tone on C4 (middle C) with a slur over it across four bars. Below the staff, a diagram shows the 'Exhale' phase increasing in volume over the first two bars and the 'Inhale' phase decreasing in volume over the last two bars.

Exercise 4.6: Long tone on C4, *decrescendo, crescendo*

Exercise 4.6 is a single staff in bass clef, 4/4 time, with a tempo marking of quarter note = 40. It shows a long tone on C4 (middle C) with a slur over it across four bars. Below the staff, a diagram shows the 'Exhale' phase decreasing in volume over the first two bars and the 'Inhale' phase increasing in volume over the last two bars.

Mastery of this technique is not achieved instantly, and the instrumentalist should feel comfortable with circular breathing before implementing it in a performance so as not to disrupt the musical lines of a composition due to uncertainty. A common problem experienced with circular breathing is that breath control can be negatively influenced as a result of performance nerves. Example 4.2, where total control and calm are required during circular breathing, appears at the start of *The 21 Thoughts of Toru in the Well* (2010) by Mark Gaydon. The extended period that transpires during the execution of the written *glissando* from bar 1 to bar 2 (8 seconds) and then the execution of the timbre trill in bar 2 (20 - 30 seconds), ensure the need for stable circular breathing.

Example 4.2: *The 21 Thoughts of Toru in the Well*, bar 1 - 2.



Circular breathing is a fundamental extended technique that can be very time consuming and painstaking to master. With this technique gaining more popularity among contemporary composers, I believe that bassoonists should be introduced to circular breathing at an early stage in the curriculum, once they have gained good understanding of and the ability to employ the traditional breathing techniques.

4.2.2 Advanced extended tonguing techniques

Every wind instrumentalist should master various tonguing techniques that should be part of the wind instrumentalist's capabilities. In this section I explain extended tonguing techniques found in the *avant-garde* repertoire. These techniques can also be found in earlier styles, for example the classical and romantic era.

I am of the opinion that the problem with learning how to execute extended tonguing techniques lies not with the techniques themselves, but is more dependent on the age and playing level at which the bassoonist is introduced to these specific techniques. My own experience as a bassoon teacher has been that extended tonguing techniques on the bassoon

are seldom taught at junior or high school level, due to the exclusion of this technique from both compositional as well as technical material for graded examinations, especially in South Africa.

More commonly used on single reed woodwind instruments and brass instruments, extended tonguing techniques like double-tonguing and triple-tonguing are also used on double reed woodwind instruments in order to articulate faster. Including extended tonguing techniques in this thesis is essential since most students do not learn how to execute these until it is required of them to do so, in which case it may take months or even years to become proficient. The reality is that not all wind instrumentalists can tongue fast and thus have to use alternative tonguing techniques, such as double-tonguing to execute fast passages.

4.2.2.1 *Double-tonguing*

Double-tonguing is an extension of standard single-tonguing that all wind and brass instrumentalists use. Latham (2002:1281) explains that “double-tonguing permits the non-*legato* execution of more rapid passages of music and facilitates the repetition of notes far more rapidly than is possible with single-tonguing”.

Double-tonguing is a technique that is of vital importance to the professional bassoonist, especially the orchestral bassoonist. Orchestral compositions such as Ludwig van Beethoven’s 4th *Symphony* (1806) (Example 4.3) and the *Symphonie Fantastique* by Hector Berlioz (1830) (Example 4.4) are excellent examples of the need for a bassoonist to be able to execute the double-tongue technique perfectly.

Example 4.3: *Symphony no 4, 4th movement, L. van Beethoven*



Example 4.4: *Symphonie Fantastique*, 4th movement, H. Berlioz

It is not uncommon for these to be included in specific excerpt lists when a bassoonist is auditioning for a principal seat in a professional orchestra. However, this chapter does not explain how to execute the double-tonguing required to perform these two excerpts, but an explanation of the execution of the technique itself is provided.

a) Double-tongue execution

Single tonguing is executed by using an articulate *TA*, *TU* or *T* with breath energy. This is done by using the tip of tongue, which needs to move backward and upward and then forward and downward on the bassoon reed. Using double-tonguing as an extension of single-tonguing makes it possible for the instrumentalist to produce another note with the backward stroke of the tongue, increasing the speed at which the instrumentalist can articulate a specific note or run.

The first challenge of double-tonguing is to articulate *Ku* to produce the second note as clearly as the first note of the double-tongue, articulated as *Tu*. The second note is produced by forming the letter *Ku* with supported breath energy and good airspeed to assist the reed vibration. Since the tongue is in contact with the reed when a specific note is tongued by using the letter *Tu*, the reed *speaks* or vibrates more easily than when using the letter *Ku* that originates from the throat. The word *Tuk* provides a good indication in respect of the movement of the tongue when playing two consecutive notes. Saying the word *Kut* turns the tonguing

into the opposite movement. Thus, double-tonguing can be demonstrated by saying *Tu* and *Ku* together, forming the word *Tuku*. The focus must also be on the distance that the tongue travels when tonguing to ensure that the tongue does not move too far away from the reed. In researching this technique, I have found that the closer the tongue is to the double reed when producing the *Ku* stroke with minimal tension, the clearer the sound produced is.

The Art of Wind Playing by Arthur Weisberg (1975) provides valuable advice on learning the art of double-tonguing. Weisberg (1975:54) explains that the instrumentalist must first practise double-tonguing on a single note. Ending each syllable is important; for example, instead of producing only *Tu*, it should be *Tuk*, and *Ku* should be *Kut*. The note should be kept as short as possible. It is essential not to attempt double-tonguing at a fast tempo when learning this technique. Exercises based on the findings by Weisberg (1975) regarding double-tonguing are illustrated and discussed in Exercises 4.7 and 4.8.

Exercise 4.7: Articulation exercise of 16th sounding *Tuk* and *Kut* notes



Exercise 4.7 illustrates the conventional process of the *Tuk* and *Kut* articulation. This is practised by only using the tongue and the throat. Although the tempo is very slow, the length of the notes tongued needs to be as short as possible, creating a *secco* articulation. It is important to keep the same length and intonation for all the consecutive notes. At first, the *Kut* articulation may create the impression of being longer than the *Tuk* articulation. It may be that the instrumentalist is restricting the airstream in his/her throat by trying to force the *Kut* syllable.

To improve and overcome the closing throat effect, the instrumentalist must relax both the orbicularis oris and masseter muscles in the face and pronounce both *TukKut* at a steady tempo without the instrument. The next step is to do the same; this time on the double reed without the instrument, again focusing on pronouncing *Tuk* and *Kut* clearly on the double reed. This exercise should only be done on the bassoon once the instrumentalist feels comfortable with his/her double-tonguing approach regarding the *Tuk* and *Kut* syllables. Double-tonguing in the lower register of the bassoon is challenging and it is advisable to start in a comfortable

register where the resistance of the bassoon reed will assist in creating a stable *Kut* syllable on the second note of the double tongue. The result will sound as indicated in Example 4.5.

Example 4.5: Resulting sound from a stable *Tuk* and *Kut* syllable using double-tonguing



Exercise 4.8: Articulation exercise on the *Kut* syllable



Exercise 4.8 indicates the process to strengthen the execution. To enhance the articulation of the second part of the double-tonguing, the syllable needs to be practised on its own. As with Exercise 4.7, it is important to do so at a slow tempo, focusing on a very short *secco* articulation. The objective should be to execute each *Kut* exactly as the previous one before attempting to maintain a constant tempo.

If the instrumentalist prefers a hard double reed, this exercise can be done by imitating the coughing effect on each *Kut* to ensure that there is enough airflow to allow the double reed to vibrate. The *Kut* syllable is more easily achieved on a medium to soft double reed. Again, the objective for the bassoonist is to achieve a similar sound and length of the notes being tongued. Over time the tempo can be gradually increased once a steady approach to and execution of the above exercises have been achieved. The execution can be illustrated as follows:

Example 4.6: Result of a steady approach to and execution of a similar sound



The second challenge of double-tonguing is the coordination between fingering and articulation. When the metronome has reached a crotchet = 120 BPM in the performance of Exercises 4.7 and 4.8, it is time to start exercising semi-quaver note scales. Exercises 4.9 and 4.10 indicate how a scale, in this case F major, should be practised by starting on either the *Tuk* syllable or the *Kut* syllable.

Exercise 4.9: Double-tonguing exercise on F major scale starting with *Tuk*



Exercise 4.10: Double-tonguing exercise on F major scale starting with *Kut*



At this tempo, a crotchet = 120 BPM, and *Kut* simply become the sounds *Tuku* or *Kutu*, as the ending of the syllable becomes the beginning of the next note only using *Ku* and *Tu*, as in Examples 4.7 and 4.8 respectively.

Example 4.7: Result of sounding double-tonguing at a tempo of a crotchet = 120 BPM in F major starting on *Tu* articulation

♩=120

Tu Ku Tu Ku Tu Ku Tu Ku Tu Ku Tu Ku Tu Ku Tu Ku

Example 4.8: Result of sounding double-tonguing at a tempo of a crotchet = 120 BPM in F major starting on *Ku* articulation

♩=120

Ku Tu Ku Tu Ku Tu Ku Tu Ku Tu Ku Tu Ku Tu Ku Tu

Double-tonguing in the upper and or lowest register of the bassoon is challenging and should be attempted only once the middle register has been perfected. In my own experience while learning the double-tonguing technique, I realised that it is necessary to keep practising this technique, even when it is not being used regularly by primarily focusing on the *Kut* syllable as part of my practice routine.

4.2.2.2 Triple-/Mixed-tonguing

Triple- or mixed-tonguing is an extension of the double-tonguing technique, making it possible for the bassoonist to perform tongued triplets at a fast tempo; for example when performing the *Rondo* section of *Andante and Hungarian Rondo* (1809) by Carl Maria von Weber, as demonstrated in Example 4.9, bar 269 - 314:

Example 4.9: Andante and Hungarian Rondo (1809), Carl Maria von Weber, bars 269 - 314

269 11

281

285

289

293 *tr* *tr* *tr* *tr* *tr*

12

300 *ff*

305

309

UE 18 134 a

In Example 4.9 the bassoonist can use triple-/mixed-tonguing to even and regulate the flow of the consecutive triplets.

a) Triple-tonguing/mixed-tonguing execution

Triple-tonguing is executed by extending the double-tonguing technique with an extra syllable. This technique is also referred to as the mixed-tonguing technique since the instrumentalist can change the order of the *Tu* and *Ku* syllables. For example, saying *Tu, Ku* and then again *Tu* forming the word *Tukutu* or *Tu, Tu* and *Ku* forming the word *Tutuku*. There is no need to say *Tuk* or *Kut*, as was the case when starting double-tonguing exercises, as even at a slow tempo the beginning and ending of the syllables flow into one another, resulting in *Tuku* or *Kutu*. Like double-tonguing, triple-/mixed-tonguing can be practised at a slow tempo in the following sequence as per Exercises 4.11 and 4.12.

Exercise 4.11: Mixed-tonguing exercise using *Tu-Ku-Tu* articulation

$\text{♩} = 40$

Tu Ku Tu Tu Ku Tu Tu Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu

3

Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu

Exercise 4.12: Mixed-tonguing exercise using *Tu-Tu-Ku* articulation

$\text{♩} = 40$

Tu Tu Ku Tu Tu Ku Tu Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu Ku

3

Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu

Care should be taken to focus on keeping a steady tempo while maintaining adequate air support to establish proper intonation. As with double-tonguing, the *Ku* syllable needs to *speak* as clearly as the *Tu* syllable. It is important to ensure that each note sounds identical to all the others before gradually increasing the tempo over time. When the metronome has reached a crotchet = 120 BPM in these exercises, the bassoonist can progress to triple-tonguing triplet semi-quaver note scales, as provided in Exercises 4.13 and 4.14.

Exercise 4.13: Mixed-tonguing exercise using *Tu-Tu-Ku* articulations on an ascending scale in F major

$\text{♩} = 120$

Tu Tu Ku Tu Tu Tu Ku Tu Tu Tu Ku Tu Tu Tu Tu Ku Tu Tu Tu

5

Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu

Exercise 4.14: Mixed-tonguing exercise using *Tu-Ku-Tu* articulations on ascending scale in F major

♩=120

Tu Ku Tu Tu Tu Ku Tu Tu Tu Ku Tu Tu

5

Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu Ku Tu Tu

The bassoonist is encouraged to practise the triple-/mixed-tonguing technique to enhance his/her ability to execute triplet passages that require fast and accurate tonguing. As with most performance practices, I believe that before triple-/mixed-tonguing can be mastered, a thorough understanding of double-tonguing is essential, as it is the foundation for the triple-/mixed-tonguing technique.

4.2.2.3 Flutter-tonguing

The flutter-tonguing technique has been utilised in woodwind compositions since the late 19th century and has become a popular inclusion in music of the 20th and 21st centuries. This technique appears in orchestral compositions by, among others, Richard Strauss (1864 - 1949), Claude Debussy (1862 - 1918), Gustav Mahler (1860 - 1911), and Dmitri Shostakovich (1906 - 1975).

On woodwind instruments, this technique is produced by rolling or trilling the tongue very quickly as in pronouncing *R* in Germanic-based languages. The effect varies according to the instrument and the volume played, ranging from cooing sounds on the recorder to a growling effect used by jazz musicians. Penazzi (1982:60) states that this technique is difficult to achieve on the bassoon due to the performer simultaneously applying pressure on the reed with his/her lips to maintain pitch while rolling or trilling the tongue.

I experienced different problems regarding flutter-tonguing. Although my mother tongue is Afrikaans, most of my bassoon mentors were English-speaking when I started to explore the possibilities of extended techniques. They could not demonstrate this technique to me via the

creation of a rolling *R* on the reed as they did not speak a language where the *R* sound was rolled. The technique was demonstrated by using what they referred to as a *growling* effect in the back of the throat. This can be compared to the action of gargling with a liquid in the back of the throat. I had to take it upon myself to learn the flutter-tonguing technique, creating it by using a rolled *R*.

An example of the flutter-tonguing technique can be found in *Concerto for Bassoon and Low Strings* (1975) by Sofia Gubaidulina, an extract of which is provided in Example 4.10. The technique is indicated by the word *frull* in rehearsal bar 21 of the first movement. *Frull* is an abbreviation of an Italian verb, *frullare*, meaning to flutter.

Example 4.10: *Concerto for Bassoon and Low Strings* (1975), Sofia Gubaidulina, bar 21



a) Flutter-tongue execution

Before blowing on the reed, the bassoonist must first practise perfecting the rolling effect without the instrument or double reed. This can be done by saying the letter *R* while being supported by the abdominal muscles until no air is left. This effect should create a tickling sensation on the palate.

Next, the same rolling of the tongue should be replicated on the double reed. Caution should be taken not to cut the tip of the tongue on the blades of the double reed when first trying to roll the tongue. Once a stable flutter can be executed on the bassoon on one specific note, the bassoonist should progress to the next desired note. To develop a stable flutter tongue, the technique must be practised on long tones similar to any other long tones on the bassoon.

A problem identified with the flutter-tongue technique is that a flat pitch is often noticeable when playing notes that involve flutter-tongue. To perform a stable flutter-tongue on the bassoon, airspeed must be combined with a significant amount of support to maintain the desired pitch and quality of sound while the tongue oscillates. The bassoonist will note that the amount of airspeed necessary to achieve the correct pitch varies greatly among the

registers of the instrument. The higher the tone being played, the more airspeed will be required to achieve the desired effect.

4.2.2.4 Additional extended tonguing techniques

Many new and creative tonguing techniques have been developed by *avant-garde* composers. The following tonguing techniques demonstrate some of these developments. These were used extensively by Lucio Berio in his *Sequenza XII* for bassoon (1995).

a) Double-staccato

The aim of the double-staccato is to slap the double reed as hard as possible with the tongue while still producing a tone that is clear with good intonation. The embouchure must be such that no air escapes from the side of the mouth when aggressively tonguing to ensure good intonation on the tongued note. These notes can be indicated above the music stave as *TK* (Gaydon 2012:33).

b) Water-tonguing

Water-tonguing is achieved by a quick motion of the tongue as with staccato-tonguing, but without touching the double reed. I am of the opinion that composers can use this tonguing technique to illustrate tranquillity in the music. These notes can be indicated above the music stave as *WT* (Gaydon 2012:35).

c) Flap-tonguing

This tonguing technique is executed in the same manner as a regularly articulated note, except that there is little to no amount of air pressure behind the note. Once the note has been played, the tip of the tongue stays in contact with the tip of the double reed to stop the vibrations of the double reed. The result of flap-tonguing can be heard as a percussive effect, consisting of the fundamental pitch of the specific note that is being fingered. Mostly used on single reed instruments, this technique is challenging to use on a double reed instrument as it creates a very soft sound effect. Most flap notes are indicated above the music stave as *Flap* (Gaydon 2012:38).

d) Harmonic-tonguing

Harmonic-tonguing can be challenging as the technique requires the bassoonist to articulate a low register note aggressively with no embouchure pressure to mis-pitch the specific note on purpose. The result sounds like a crack note at first, but is a chord that accentuates the harmonic spectrum of the specific note. This tonguing technique is done by having almost no amount of reed inside of the mouth while giving the note a very hard tongue. Luciano Berio (1925 - 2003) used this technique in multiple passages in his composition *Sequenza XII* for bassoon, indicating the tonguing technique as *HT* above the music staff.

4.2.3 Pitch-sliding

Pitch-sliding techniques for most woodwind and brass instruments have been present since the compositions of Mahler (7 July 1860 – 18 May 1911). As an extended technique, it is important to understand pitch-sliding technique possibilities and the limitations on the bassoon due to the construction of the instrument's mechanism. Although not the most difficult of extended techniques, sufficient practice and precise movement of the fingers are needed to perfect these techniques. Weait (1975:1) explains that there are two musical terms used to elucidate pitch-sliding, namely *portamento* and *glissando*.

4.2.3.1 Portamento

Stowell (Sadie 2001:183) explains that in instrumental music, the term *portamento* refers to the emotional connection between two notes. Weait (1975:1) describes a *portamento* as a gradual and continuous change of pitch from one note to the next. This technique is easily executed on instruments where the sliding of the note is possible in a single movement; for example, on the trombone sustaining a note while extending or pulling in the instrument's slide. On the bassoon this technique can be done by means of the key-glissandi, but is limited to the availability of open tones holes that are not covered by the instrument's mechanisms.

4.2.3.2 Glissando

Stowell (Sadie 2001:13) explains that the term *glissando* indicates that a passage should be executed with a rapid, sliding motion, as can be seen when a harpist or pianist sweeps a fingertip or nail over the relevant strings or keys. This technique is restricted in its use on

woodwind instruments, due to their construction. Limited options are available on the bassoon when performing *glissandi* due to the instrument using both open tone holes as well as tone holes covered by the mechanism of the instrument. Read (1993:33) refers to two possibilities of performing a *glissando* on woodwind instruments, namely *lip-glissando* and *key-glissando*.

a) Lip-glissando

Read (1993:33) explains that to perform a *lip-glissando* on a woodwind or a brass instrument, the performer must either tighten or relax the embouchure to achieve the required effect. Although the technique works well on instruments like the flute or trombone, I believe that it is not sufficient to tighten or relax the lips on the double reed of the bassoon, as it constricts the air that flows through the double reed, limiting the vibrations of the reed itself. The result is a very nasal, soft sound, which is difficult to control, especially in the lower register of the instrument where the reed needs to be capable of vibrating freely with almost no embouchure pressure.

Higher notes, such as those above middle C, are easier to manipulate with the embouchure when executing a pitch-slide than trying to do so in the lower register. The range of the *glissando* is also very limited due to the small range that the double reed can be squeezed (tightening of the embouchure) or relaxed, especially if the performer is using hard reeds. Another common problem with *lip-glissando* is that some notes can be *bent* only upwards and not downwards by varying the embouchure pressure and some only vice versa.

In general, higher notes are easier to bend than lower notes. Sliding pitch by adjusting the embouchure is more challenging at *piano*, or even softer dynamics, when wind pressure cannot be varied as much as with *forte* dynamics.

Due to the restriction of the double reed, I have found that an effective way to execute an ascending *lip-glissando* in scale is to increase the air speed through the double reed while applying embouchure pressure. By doing so, the pitch sliding will sharpen the tone, resulting in an upward *glissando*. Once again, the upward distance in scale is very limited due to the capability of the double reed. Bending the note downwards is achieved by lowering the air speed combined with relaxing the embouchure. Another problem noted was that due to the construction of individual handmade bassoon reeds not being consistent, executions of the *lip-glissando* were different.

b) Key-glissando

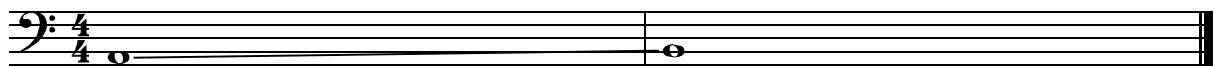
As the name suggests, *key-glissando* is executed by sliding the fingers over the keys of the instrument. Due to the construction of the mechanism on the bassoon – only five open tone holes while the rest are covered by the instruments' mechanism – it is very difficult to execute clear and precise *key-glissandi* on most notes.

An effective way to achieve this is to slide the fingers very slowly in consecutive order either up or down to open and close tone holes. Sliding the fingers from the open tone holes, starting with the lowest fingering results in an upward sliding effect of the tone. Sliding the top finger first back over the tone hole, followed by the fingering below in consecutive order, creates a downward effect on the tone.

Holes covered by the instrument mechanism can produce pitch-slides by opening or closing the key slowly and with precision. These types of *key-glissandi* can be challenging, again due to the construction of the instrument's mechanism. I have found that the following *key-glissandi* are easily playable with accurate movement of the fingers (Examples 4.11 - 4.21).

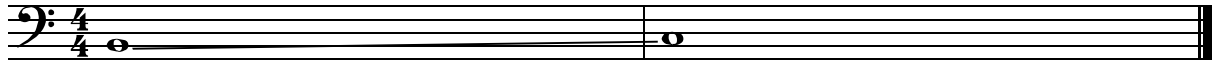
Sliding from A2 to B2 is achieved by sliding the third finger of the right hand (A tone hole) slowly off the tone hole.

Example 4.11: Pitch-sliding from A2 to B2



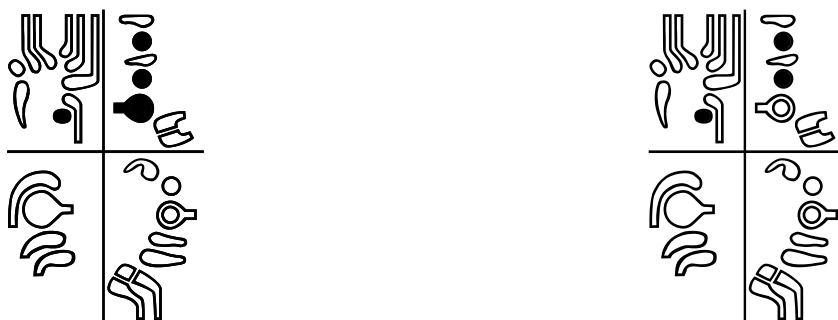
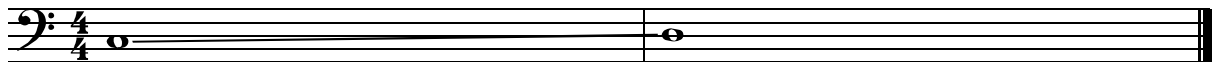
Sliding from B2 to C3 is achieved by sliding the second finger of the right hand (B tone hole) slowly off the tone hole.

Example 4.12: Pitch-sliding from B2 to C3



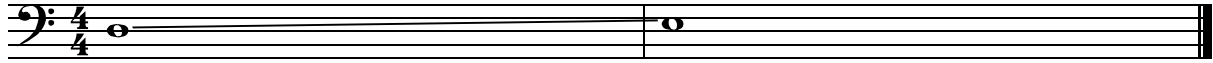
Sliding from C3 to D3 is achieved by sliding the fourth finger of the left hand (C tone hole) slowly off the tone hole.

Example 4.13: Pitch-sliding from C3 to D3



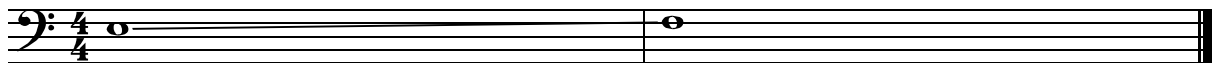
Sliding D3 to E3 is achieved by sliding the third finger of the left hand (D tone hole) slowly off the tone hole. Good air support is needed to keep E3 from going flat in intonation while the third finger is being moved slowly off the tone hole.

Example 4.14: Pitch-sliding from D3 to E3



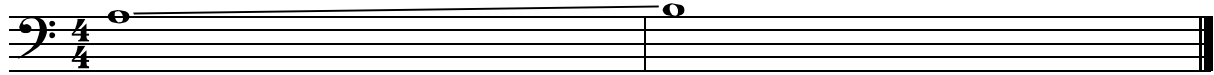
Sliding E3 to F3 is achieved by sliding the second finger of the left hand (E tone hole) slowly off the tone hole.

Example 4.15: Pitch-sliding from E3 to F3



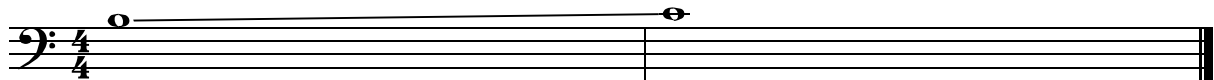
Sliding A3 to B3 is achieved by sliding the third finger of the right hand (A tone hole) slowly off the tone hole.

Example 4.16: Pitch-sliding from A3 to B3



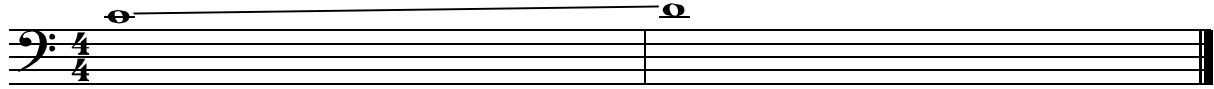
Sliding B3 to C4 is achieved by sliding the second finger of the right hand (B tone hole) slowly off the tone hole.

Example 4.17: Pitch-sliding from B3 to C4



Sliding C4 to D4 is achieved by sliding the fourth finger of the left hand (C tone hole) slowly off the tone hole.

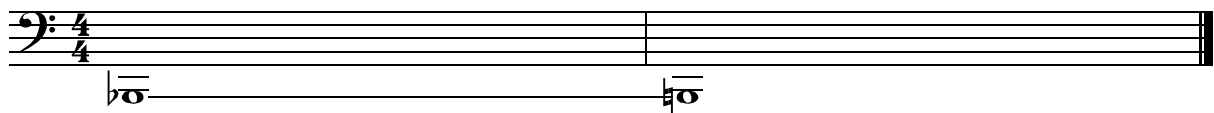
Example 4.18: Pitch-sliding from C4 to D4

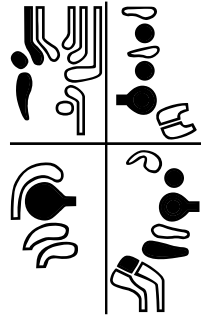
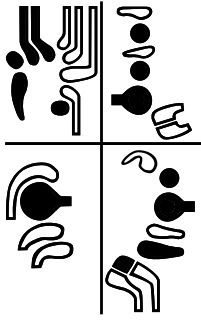


All the above fingerings for the specific notes can be joined to produce a longer *glissando* that may or may not be perfectly smooth. Although not open, tone holes B \flat 1 to B1 and B1 to C2 can create a very warm and effective execution by sliding up or down as slowly as possible:

Sliding B \flat 1 to B1 is achieved by the precise lifting of the bottom B \flat mechanism in a slow movement.

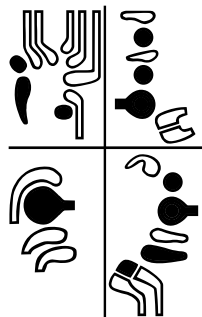
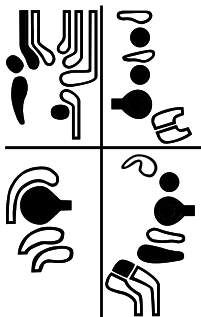
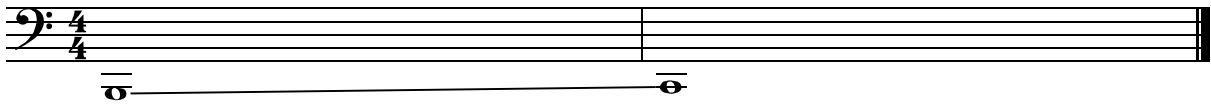
Example 4.19: Pitch-sliding from B \flat 1 to B1





Sliding B1 to C2 is achieved by the precise lifting of the bottom B mechanism in a slow movement.

Example 4.20: Pitch-sliding from B1 to C2



High note finger slides sound beautiful when executed between B4 and C5 as follows:

Sliding B4 to C5 is achieved by sliding the third finger of the left hand (D tone hole) off the instrument. A good amount of support and airstream is required to support the intonation when sliding from B4 to C5.

Example 4.21: Pitch-sliding from B4 to C5

The image shows a musical staff in 3/4 time with a treble clef. A horizontal line with a note head at the beginning and an oval at the end spans across the staff, indicating a pitch slide from B4 to C5. Below the staff are two sets of fingering diagrams. Each set consists of two columns of diagrams: the left column shows the left hand (thumb and fingers) and the right column shows the right hand (thumb and fingers). The diagrams illustrate the fingerings for the starting note (B4) and the ending note (C5), with arrows indicating the movement of fingers during the slide.

The use of *glissandi* is a natural addition to the bassoon's expressive capabilities, yet the possibilities are restricted by the double reed and the instrument's mechanism.

I believe that it is possible to create a convincing musical effect by combining both lip and key-*glissandi*. An example of creating the desired effect by combining lip and key-*glissandi* is illustrated in Example 4.22, bar 42 and bar 55 - 57 of the 2nd movement of *Zwei Impromptus* by Manfred Schoof.

Due to the tempo indication, it is possible for the performer to slide over the open tone holes where possible, combining the sliding with lip-*glissandi* when needed. The waveform symbols in bars 43 - 47 may indicate that the composer allows the performer to stretch the pitch sliding from E2 - E5 over the entire length of the six bars. The indicated 3 on top of the staff does not appear in the piano score, indicating that it may be a printing error and can be ignored with the pitch-sliding.

Example 4.22: *Zwei Impromptus* 2nd movement by Manfred Schoof, bars 42 - 62. Key-glissandi in bar 42 as well as in bars 55 - 57

The image shows a musical score for Manfred Schoof's *Zwei Impromptus*, 2nd movement, bars 42-62. The score is written in bass clef with a 4/4 time signature. It features a key-glissandi in bar 42, marked 'Sehr langsam' with a tempo of quarter note = 48. Bars 50-53 are marked 'pp' and 'Schneller (ad lib.)' with an 'accel.' marking. Bars 54-62 are marked 'Con brio' with a tempo of quarter note = 112. The score includes various musical notations such as triplets, slurs, and dynamic markings like 'f' and 'pp'.

4.2.4 Microtonal system on the bassoon

The microtonal system in music or division of the octave into intervals other than the traditional Western 12-tone chromatic scale, has been used at various times, by various cultures, dating as far back as Ancient Greece (Mathiesen 2001:6). The use of microtones is demonstrated in works like *Three Quarter-Tone Pieces* (1918) by Charles Ives, Bartok's *Violin Concerto No. 2* (1938), and also in works composed by Darius Milhaud during the 1930s and 1940s (Cope 1993:67).

Microtonal compositions became more widespread in the latter half of the 20th century as composers experimented with new sound possibilities in their work. De Vries (2001:14) states that it is possible for microtones to have different tonal systems, ranging from five to 72 pitch divisions per octave. These tonal systems can be divided into three different categories. The first category includes systems that are based on the traditional 12-tone equal temperament system of Western music. These can divide/separate the octave into 24 and 36 notes, as well as other 12-fold divisions.

The second category includes a divisible tone system that separates the octave into different tone numbers, such as nine, 10, 15 and 18. The last category comprises a system that splits the octave into prime number divisions such as two, three, five, seven, 11 and so forth. The system most used by experimental composers is the 24-tone division, also known as quarter-tones from the first category. The term *quarter-tone* is used for tones where the distance

between each tone is one quarter the size of the whole tone of the equal tempered chromatic scale, therefore dividing each semitone of the chromatic scale precisely in half (Latham 2002:1021).

The term *cent* is a logarithmic unit of measure that is applied to musical intervals (Burns 1999:215). In the equal temperament system, 100 cents equal a semi-tone; thus the quarter-tone exists at intervals of 50 cents. I believe that the usage of a chromatic tuner that indicates cents as well as pitch is essential to understand and execute these pitches. For my research I used a KORG tuner, model CA-40 to assist with the analysis of the results. Bartolozzi (1982:26) showed that it is possible for woodwind instruments to produce sounds smaller than one-quarter of a tone, as well as the possibility of divisions of one-eighth of a tone, one-sixth of a tone and one-third of a tone. These tones are obtained by using a well-defined fingering system for each microtone. Due to the complex fingering system of the bassoon, the possibilities to create multiple microtones become endless. For this reason a performer must choose microtone fingering according to pitch, timbre and ease of technical execution. Reinhard (1987:39), composer and bassoonist, explains as follows:

The microtonal bassoon, a bassoon as free as a voice, is an unsuspected musical resource in our midst. It is most often disguised as an instrument of limited pitch availability. A magical transformation takes place when a bassoonist realizes the potential for pitch expressivity and begins developing the necessary techniques.

Reinhard has contributed extensively to the research on microtonal productions. Reinhard (1987:39) points out the following:

Microtonal inflections have long been incorporated into contemporary compositions ... as there is a surge in microtonal compositions, there is already a greater need for sensitive and equipped players.

The lowest octave of the bassoon, which includes the notes of B \flat 1, B1 and C2, compromises fundamental tones and can only be changed with embouchure pressure and air speed, since these tones have only a single fingering or one key combination. From C \sharp 2, additional keys can be added to create quarter-tones. Quarter-tone fingerings increase as one moves up in the registers of the bassoon. Hähnchen (1986:12) explains that while it is possible to create quarter-tones with a flexible embouchure, tones that are indicated as accurately pitched tones should be executed with precise fingering. He adds that it is easier to sharpen notes by a quarter-tone by opening one key beyond the standard fingering.

While it is also easy to flatten any note by means of different fingering, Hähnchen (1986:123) argues that all quarter-tones should be notated as a quarter step above the 12-tone scale note. Through this notation, a clear indication is achieved to indicate the raising of the written note. Being a bassoonist himself, Hähnchen focused on finding a standard system of notation for quarter-tones to improve performance practice.

Composers include approaches to a notation for microtones that have a wide variety of styles and systems, which may result in confusion to any instrumentalist not familiar with the specific composer's style. These may include flags, lines and slashes to indicate the quarter-tone. Some composers will also use words or indicate the quarter-tone as $\frac{1}{4}$ above the note. Problems can become more complex when composers indicate that the quarter-tone should be a flattened standard semi-tone and not notated, as per Hähnchen's (1986) proposals. For example, if the composer writes $A\flat$ and indicates that it should be lowered by a quarter-tone according to Hähnchen's observations, the fingering for a lowered $A\flat$ should then be based on the fingering for a quarter-tone on G.

I am of the opinion that these systems of notation inconsistencies and the difficulties regarding mastering new fingering, combined with accurate tuning, are the major challenges a performer needs to overcome when preparing compositions with microtones. In the following sections the objective is to explain the execution of microtones. I focus on the use of quarter-tones as well as quinqupartite-tones on the German system bassoon. The reader should bear in mind that these fingerings do not produce a perfectly pitched tone, and similar to using traditional fingering, it is important to adjust the embouchure and airspeed to attain the correct pitch. Each individual bassoon is a unique instrument; hence not all fingerings will work perfectly for every instrument and reed combination, but a change in pitch will be noticed. Embouchure and airspeed adjustment can be used to attain the desired effect. Fingering possibilities for microtones on the bassoon sometimes involve the usage of keys that are not standard on every instrument, such as the $E\flat$ trill key and the $A\flat$ to $B\flat$ trill key.

4.2.4.1 Quarter-tones

As mentioned, the quarter-tone is an interval that is half the size of a semitone. The term was used by theorists during the 17th and 18th centuries to signify the distance between a sharp and its enharmonically distinct flat in mean-tone temperaments, for instance $F\sharp$ and $G\flat$ (Haynes 1991:357). In Example 4.23 one can observe the approach to the notation of quarter-

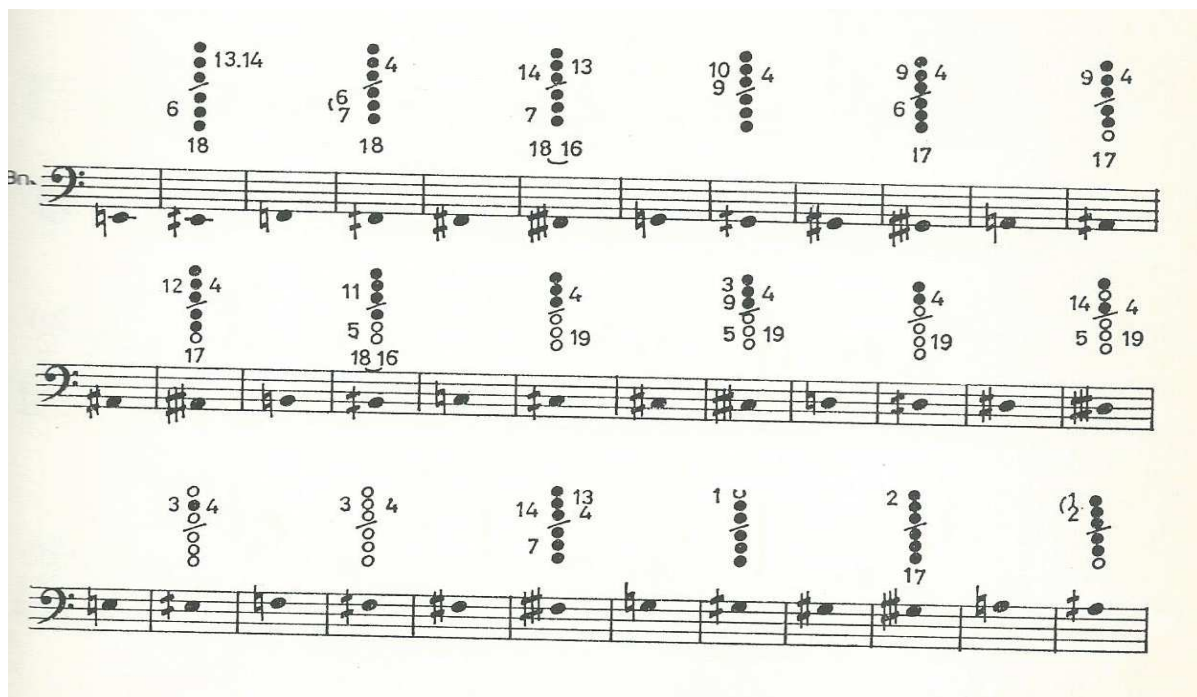
tones from rehearsal number 15 in the second bassoon part of *Duo Sonata for Two Bassoons* (1977) by Gubaidulina. In the second bar of rehearsal number 15, Gubaidulina indicates the quarter-tones as \sharp , going upwards in the following order; F, F \sharp and then F \sharp . In bars 1 and 3 of rehearsal number 15, the quarter-tone on F \sharp is indicated by a double \sharp .

Example 4.23: *Duo Sonata for Two Bassoons* (1977), Sofia Gubaidulina, quarter-tone notations from rehearsal number 15



During my research I encountered a measure of difficulty with the execution of quarter-tones. These included notes not carrying any distinct intonation or being muted by specific fingering. Original charts developed by Bartolozzi (1971:31) and Reinhard (1987:42) can be difficult to understand at first, as they use a number system that can result in ambiguities in the learning process of these specific fingerings, as demonstrated in Examples 4.24 and 4.25.

Example 4.24: Microtonal fingerings by Bruno Bartolozzi (1971:31)



Example 4.25: Microtonal bassoon fingerings by Johnny Reinhard (1987:42)

31-Tone Equal Temperament (based on A=440)

Handwritten musical notation at the top right, showing several notes with complex fingering diagrams above them, including numbers like 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31.

Main body of handwritten musical notation for bassoon, consisting of ten staves. Each staff contains notes with various microtonal fingerings indicated by numbers and symbols above the notes. The notation includes various accidentals (sharps, flats, naturals) and complex fingering diagrams. Some notes have circled numbers or other markings. The notation is dense and covers a wide range of microtonal intervals.

I believe the bassoonist will have a better understanding of how the mechanisms on the instrument interact to change from one microtone to the next if these charts can be modernised.

The modernised charts (Consult Appendix B) are intended to assist any bassoonist with finding appropriate fingering for specific quarter-tones. These were all tested at international pitch standard of A = 440 Hz. The same result was obtained at A = 442 Hz with an adapted (shorter) reed and crook for the higher pitch. It is important for the bassoonist not to change the performance setup of the bassoon to adapt to playing these quarter-tones unless the tuning pitch is higher than the normal pitch of performance.

The fingering charts are based on examples developed by Bartolozzi (1971:31) and Reinhard (1987:42), and fingering designed by Hähnchen, based on the fingering of Penazzi from his *Metodo per Fagotto* (1972). Each chart is labelled as B.B. (Bruno Bartolozzi), J.R. (Johnny Reinhard) or S.P. (Sergio Penazzi). Furthermore, I have included information regarding the execution and results that I have gained through my experimentation with these possibilities on the modern German bassoon. In the fingering chart the quarter-tones are indicated by \sharp , for example, C \sharp 1. By using the equipment as previously stated, the results were formulated according to the following criteria:

- Difficulty of fingering execution; in other words, if the fingering is very different from the standard fingering.
- Stability of tone and adjustments that might be needed regarding loosening or tightening of the embouchure.
- Indication of a definite and clear change in pitch resulting in the desired quarter-tone effect.
- Quality of tone.
- Dynamic levels possible without changing the quality of tone or pitch.

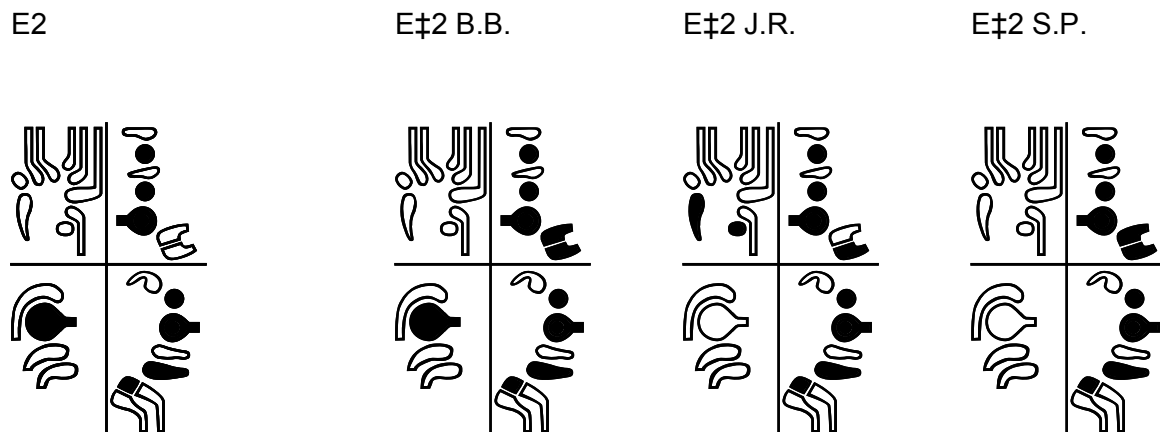
These criteria were chosen due to the fact that the fingering by these three composers was set on instruments not as advanced as today's modern German bassoon. Mechanisms that have been changed on the instrument include the one on the right hand A \flat keys (right hand 1st finger and left hand 5th finger), whereas bassoons made before the 1990s have two mechanisms with two different tone holes (one on the front and one on the back of the instrument). The modern German bassoon has two different mechanisms opening the same tone hole (only one tone hole for specific keys on the back of the instrument). This change in

the mechanism can affect the tonal quality of notes using quarter-tone fingering employing the front A \flat key.

The results of these experimentations were set into a standard fingering chart, as is shown below, illustrating the quarter-tone fingering for E \sharp 2. The charts include precise illustrations via fingering, as well as a descriptive text of how to execute the specific fingering. The complete results for the microtonal system on the bassoon experimented throughout with the same criteria are illustrated in Appendix B.

Example 4.26: E \sharp 2 built on the traditional fingering of E2

E \sharp 2 is built on the traditional fingering of E2:



Quarter-tone	Execution	Result
E \sharp 2 B.B.	<ul style="list-style-type: none"> Close both the C\sharp and D\sharp auxiliary (Both with the left hand, fifth finger) keys. 	<ul style="list-style-type: none"> Embouchure must be tightened. Very clear pitch and timbre change.

E \sharp 2 J.R. *	<ul style="list-style-type: none"> • Lift the bottom E key. • Close the bottom D key and whisper key. 	<ul style="list-style-type: none"> • Extremely clear quarter-tone fingering for E. • Very stable intonation. • Finger does create a muted tone.
E \sharp 2 S.P.	<ul style="list-style-type: none"> • Lift the bottom E key. • Close both the C\sharp and D\sharp auxiliary (Both with the left hand, fifth finger) keys. 	<ul style="list-style-type: none"> • Embouchure must be fully relaxed to execute the desired effect. • Not a very good example for quarter-tone fingering on E. • Intonation very unstable due to relaxed embouchure.

In the above example * is used to indicate the best sounding quarter-tone. The following results were achieved through the set criteria on this specific quarter-tone fingering:

- Difficulty of fingering execution; in other words, if the fingering is very different from the standard fingering:
 - Fingering is easily achieved by closing only two extra keys (bottom D key and C \sharp auxiliary key).
- Stability of tone and adjustments that might be needed regarding loosening or tightening of the embouchure:
 - Tone very stable with no embouchure adjustment needed to achieve the desired effect.
- If there is a definite and clear change in pitch resulting in the desired quarter-tone effect:

- Clear 50 cent pitch change achieved on KORG tuner.
- Quality of tone:
 - Muted tone quality.
- Dynamic levels possible without changing the quality of tone or pitch:
 - Due to the muted tone dynamic, levels are best used at levels of *pianissimo* to *forte*.

Due to the construction of the mechanism on the modern bassoon, no alternative fingering is possible for $B\flat\sharp 1$, $B\sharp 1$ and $C\sharp 2$. If we look at the traditional bassoon fingering of $B\flat 1$, it indicates that the mechanism on the bassoon closes all the holes on the bassoon to produce $B\flat 1$. Releasing mechanisms on the instrument to open any holes above $B\flat$ will result in anything from a muted note to a multiphonic, depending on the mechanism or tone hole that has been opened.

The same applies to $B 1$ and $C 2$. For example, pressing down the $B\flat 1$ mechanism on the bassoon for $C 2$ is possible, but this does not produce any effect other than that of providing an alternative fingering to mute $C 2$. It can thus be concluded that to produce microtones for $B\flat 1$, $B 1$ and $C 1$, the bassoonist must blow sharp, produce a faster airspeed, and if needed, increase pressure from the embouchure, resulting in $B\flat\sharp 1$, $B\sharp 1$ and $C\sharp 1$. Controlling the stability of the microtones on these notes can be challenging if these are to be held for a long period.

4.2.4.2 Bassoon *quinquepartite*-tones

The term *quinquepartite* means to divide into or composed of five parts. In musical terms, the *quinquepartite*-tone distance between pitches is smaller than that of a quarter-tone, dividing a tone into five parts. The sign \wedge indicates 1/5 of a whole step sharper; for example, $C\wedge 3$. The result of $C\wedge 3$ is that the note is a 1/5 of a whole tone above $C 3$. When working with *quinquepartite*-tones it is important to remember that, for example, $C\sharp 3$ is a 1/5 step lower than $D\flat 3$. For example, the *quinquepartite*-tone pattern $C\flat$ to $D\sharp$ can be explained as follows:

C^b, C^b[^], C, C[^], C[#], D^b, D^b[^], D, D[^], D[#].

It is unlikely that it will be expected of a bassoonist to perform *quinquepartite*-tones on B^b1, B1 and C2. Due to the construction of the mechanism on the modern bassoon, no alternative fingering is possible for B^b1, B1 and C2 to produce *quinquepartite*-tones. Alternatively, changes in the airspeed and embouchure can be used, but this will most likely produce an undesired effect. It is important to keep in mind that notes that are referred to in the traditional manner, for example E3, may not be the sounding traditional E3, due to the magnitude of the 1/5 tone shift in sound. Traditional fingering will be indicated where applicable.

4.2.5 Multiphonics

Of all the extended techniques applicable to woodwind and brass instruments, none figures more prominently in the scores of 21st century music than multiphonics. This technique is the result of using particular embouchure combinations, unusual fingering, and auxiliary keys or valves. Bartolozzi (1982:35) explains that multiphonics, also referred to as multitones, are the simultaneous generation of several different frequency vibrations in the single air column of an instrument. These vibrations result in chords of unusual tones with more than one distinct pitch. Of the unlimited number of partials that can exist in a single tone, multiphonics, especially the fingered multiphonic, can enable as well as restrict certain partials.

Campbell (2003:173) clarifies that *partial* refers to one of the component vibrations of a frequency in a complex mixture. He states that a partial tone can be referred to as the fundamental frequency that is the perceived pitch of the sound. Partial can be listed in the following order: the fundamental tone is the first partial; the first overtone the second partial, and so on and so forth. Backus (1977:248) explains that multiphonics on a single or double reed instrument are the result of both the reed and the air column vibrating at frequencies that are not related; thus the vibration of the higher frequency is not a multiple or harmonic of the vibration of the lower frequency. The production of multiphonics can be done using two different actions. The first action relates to lip pressure techniques, and the second to combined fingering techniques.

Multiphonic lip pressure techniques enable the performer to produce different sounding multiphonics by using standard or traditional bassoon fingering, combined with adjustment of the position of the embouchure as well as airspeed to create the desired effect. These kinds

of multiphonic can, on the one hand, be executed by using less or little lip pressure on notes in the higher register of the bassoon, or on the other hand, by using excessive lip pressure on notes in the lower register.

Bartolozzi (1982:37) refers to these techniques using standard fingering capable of producing multiphonics as *polyvalent*. The term *polyvalent* describes fingering that can produce a single tone and, with adjustments to the embouchure as well as airstream, can create a chord/multiphonic without any further fingering adjustments. In my experience, this technique does not always create the desired effect, as it borders on creating microtones rather than an established multiphonic. Trying to execute a multiphonic lip pressure technique in the lower register by using a tight embouchure and fast airstream resulted in a single harmonic, rather than a chord with distinct pitches.

From experience I believe that the second action is the most used technique to produce multiphonics on the bassoon due to its extensive multiphonic possibilities. A variety of multiphonics is possible on the bassoon due to the complexity of the fingering mechanism on the instrument. Fingered multiphonics are usually created through the closing or opening of tone holes while using standard/traditional bassoon fingering, creating two or more possible tube lengths for the use of the production of a tone (Lapina 1977:20).

Hähnchen (1986:123) states that this combined fingering technique can be categorised into nine basic fingerings. He further explains that using notes from the lowest register of the bassoon, opening the smallest possible tone hole that lies an interval of a third or a fourth away from the original fingered low note, creates the basic multiphonic chord. Numerous multiphonics are possible from these nine fingerings by opening additional tone holes upwards on the bore of the bassoon. It is also possible to create additional multiphonics through the use of these nine fingerings, as well as their variants by adjusting the air stream and embouchure pressure, and adding auxiliary keys that lie below the initial fingering on the bore of the instrument. The standard fingering of the low register of the instrument provides numerous opportunities for multiple multiphonics since they require a greater number of keys.

Multiphonic fingering also has the ability to produce a variety of chords of different timbre and texture, depending on the size of the bore and wall thickness of the instrument. Lapina (1977:21), through his experimentation with multiphonic fingering, found that more than 336 different fingerings are possible to produce individual multiphonics on the bassoon without

change or alteration of the standard mechanism setup of the instrument. In his opinion “the reed for playing solo or ensemble literature will produce multi-tones, providing it is a good flexible reed capable of playing the entire range of the bassoon”.

This statement is supported by Hähnchen (1986:123) who emphasises the importance of using a new reed with the correct length Bartolozzi (1967:41) states that it is possible, with every fingering on the bassoon, to achieve three different chords by changing the embouchure on the double reed. During experimentation I could not achieve this result, but noted that several multiphonics with a variety of textures can be produced by simply changing the embouchure and airspeed on specific notes. I produced variations by altering the airspeed, embouchure, and dynamics at which the multiphonic was played. During experimentation with the various possibilities of fingered multiphonics, I catalogued the possibilities that I believe produced the desired effect. Most of these fingerings created what is called the *triple sonority* multiphonic, consisting of three distinctive tones, while others created four or more tones.

4.2.5.1 Approaches to multiphonic notations

Limited research has been conducted on a notation system for extended techniques, especially for the bassoon. As previously mentioned, not all woodwind notation and illustrations are interchangeable among the instruments. There is no standard system for the notation of multiphonics as composers indicate these in a number of ways; for instance with symbols, stacks of partials or desired pitches, or fingering with numerical or letter key designations.

Example 4.27 demonstrates how Schoof illustrates the multiphonics in his composition *Zwei Impromptus* for Bassoon and Piano (1993). Bars 30 - 33 show stacks of partials, and below the stave the composer indicates on which chord the multiphonic must be built. In the preface to his composition the composer gives the right to the performer to experiment with multiple multiphonic options from bar 30 - 32, but from bar 33 - 35 the exact pitched multiphonic needs to be executed.

Example 4.27: *Zwei Impromptus* for Bassoon and Piano (1993) by Manfred Schoof, bars 30 - 35

Some composers indicate multiphonics by providing written instructions for the fingering in the score, or by including written information regarding the execution of the multiphonic in the preface to the composition. The result is a continuous number of new works with new systems that the performer first needs to decipher. It is possible that the composers are unfamiliar with the writings of both Bartolozzi and Penazzi, or that they simply want to provide their own unique approach to notation in each composition.

Bartolozzi and Penazzi's intention was to create a consistent system for notating multiphonics, but not specifically for the bassoon. It has been noted and experienced by many bassoonists that the numbered key system designed by Bartolozzi and Penazzi is confusing to the bassoonist and requires repeated referencing for retention. Hähnchen (1986:124) states, "Without a lucid classification coupled with easy-to-read notation, excessive demands will be made on the performer".

It is important that the bassoon student does not try to copy fingering notations from another woodwind instrument. One can conclude that approaches to the notation for the execution of extended techniques vary among woodwind instruments, but it is of the utmost importance for the composer to indicate a clear path to the specific effect envisaged.

4.2.5.2 *Developing multiphonic tones*

Self-exploration is what I have always understood to be the central tenet in developing a personal musical vocabulary and it is thus a basic responsibility of the creative musician. The development of new sound spectrums for my bassoon, along with honing my musicianship is of paramount importance in my progress as a solo bassoonist. By exploring unconventional techniques I have broadened my own perspective of what the bassoon is capable of.

Multiphonics is a term used by *avant-garde* composers and performers alike to describe a tone where two or more pitches can be heard simultaneously, produced by a monophonic instrument such as woodwind and brass. These pitches can be manipulated by altering the embouchure and air control normally associated with traditional bassoon techniques, resulting in previously unknown acoustic experiences.

Mastering the execution of multiphonics does not happen instantaneously. I believe the individual attracted to multiphonics needs to study the movement of the embouchure and control of the airspeed, as well as experiment with different bassoon setups regarding reeds and bocals. It is also advisable to have followed an intensive aural training programme to be able to hear and control the tonal possibilities created by multiphonics. When an instrumentalist first encounters multiphonics, the horn-like sounds can be very unpleasant. With practice and experience, the ear adapts to certain pitches and the embouchure can instantaneously be adjusted for the desired effect. Most of the multiphonics that I have discovered happened during experimentation in works by *avant-garde* composers, including Manfred Schoof, Luciano Berio and John Cage.

During experimental sessions I kept a record of what works and what does not, applying the gained insights to current music that I am studying. The objective is always to find multiphonics that preserve the aesthetics of the music. Multiphonics should never be forced, but rather used as an element in music to express individuality. I always advise my students to write down any new element that they discover on the bassoon, even when discovered by chance. I have learnt that refining something discovered by chance can assist in developing a new spectrum of sound possibilities not heard before. Designing my own charts is an ever-changing process. This process usually includes the following:

- Different fingering for a specific resonant frequency.
- Possible pitches relating to resonant frequency.
- Embouchure adjustments.
- System of notation possibilities.
- Finding fingering that can be easily executed.

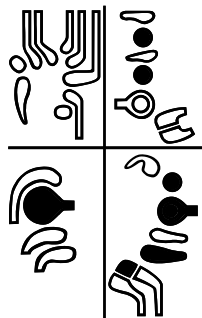
A former teacher taught me to store all information gathered from different approaches and immediately file them, if not used, for future reference. As a result of this wisdom I have created a storing system to document multiphonic possibilities found during experimentation. It is

important to note in the fingering charts that the resonant frequencies are relative to the pitch indicated, and that the blocks indicating audible pitches are approximations and can often be heard as microtones on the given pitch. More audible tones can be heard and notated by way of experimentation.

In creating a multiphonic chord, the first step should be to isolate the resonant frequency through traditional fingering, lifting or closing a key normally a third or fourth higher from the base key. By lifting and closing the keys a monophonic sound can be produced. By adjusting the embouchure and air speed, different textures can be added to the resonant frequency. Additional lifting of the keys will generate new sound possibilities.

My aim is always to find multiphonics that are mechanically easy between multiphonic note shifts, thus assisting in creating interesting harmonic changes. Multiphonics can also be created by using separated left and right hand fingering, called multiphonic cross-fingering. Cross-fingering consists of two different fingerings used at the same time. For example, the left hand employs the fingering for D3 and the right hand the fingering for E2. The fingering chart, Example 4.28 illustrates cross-fingering for multiphonics.

Example 4.28: Fingering chart, cross-fingered multiphonic. Right hand fingers D3, left hand fingers E2



Not all fingerings on the bassoon can be executed as multiphonic cross-fingering due to the construction of the instrument. It is up to the bassoonist to find combinations that work well with his/her personal instrument's setup.

In the above example, the C tone hole is opened to create a *skip* between the traditional fingering of E2 and the multiphonic fingering as indicated. By using these cross-fingerings, the bassoonist can create a wider spectrum of audible tones above the registered frequency. Musicians who understand the overtone background of the bassoon and have refined their aural skills can discover a vast amount of multiphonic possibilities on their own instrument through experimentation. Hearing pitch content in the seemingly noisy sonorities of multiphonics is something that gradually becomes possible through disciplined practice and experience.

4.2.5.3 *Multiphonic fingering chart*

In the multiphonic fingering chart, the system of notation illustrates the results of specific fingering. The registered frequency or fundamental frequency is demonstrated by a semibreve in brackets, as well as audible tones depicted by a diamond shaped note, \diamond . As explained in Chapter 3, multiphonics were recorded and loaded onto *Audiosculpt 3*©. By analysing the spectrogram and using partial tracking analysis it is possible to see the different partials present in a specific multiphonic chord. The darkest line indicates the registered frequency and the lighter lines indicate audible tones as measured in Hz. Frequencies present on the partial tracking were compared to the table as presented in Appendix A to find the represented tones.

The registered frequency is the dominant note of the multiphonic that can be clearly heard when played. The audible tones have been indicated as such to illustrate the various possibilities for each note, since true pitch can be different on each individual instrument. Track numbers on the accompanying compact disc for audible demonstration are provided. Auxiliary keys are indicated to explain which finger on the left or right hand should be used to open and close the bassoon mechanism.

All multiphonics are based on the traditional fingering of specific notes, but it must be understood that the specific fingering for a note, for example C4, does not always mean the registered frequency will be C4. Dynamic levels are indicated since not all multiphonics work with all dynamic ranges. Due to a change in embouchure or airspeed, it is a challenge to make the multiphonic *speak* at certain dynamics.

The results of these experimentations have been set into a standard fingering chart such as the one below illustrating the multiphonic possibilities on B \flat .

Example 4.29: Multiphonic possibilities are developed from the traditional fingering of B \flat 1

The following multiphonic possibilities have been developed from the traditional fingering of B \flat 1.

B \flat - 1 B \flat - 2 B \flat - 3 B \flat - 4

The image displays four examples of multiphonic possibilities on the B \flat 1 note. Each example consists of a musical staff with a bass clef and a fingering diagram below it. The fingering diagrams show the placement of fingers on the keys and the embouchure. The first example (B \flat - 1) shows a specific fingering for the left hand and a corresponding embouchure. The second example (B \flat - 2) shows a different fingering and embouchure. The third example (B \flat - 3) shows another variation. The fourth example (B \flat - 4) shows a final variation.

Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	1	<ul style="list-style-type: none"> Lift E key. Tighten embouchure slightly to start the multiphonic. 	E2	E3, F3, G3, C4 and F4		<i>mf - ff</i>

2	2	<ul style="list-style-type: none"> • Lift both E and F keys. • Open A tone hole. • Multiphonic speaks easily. 	A2 and B2	B2, D3, B3, C4 and D \flat 4	G4 and B4	<i>pp - ff</i>
3	3	<ul style="list-style-type: none"> • Lift E key. • Add B\flat auxiliary (Right hand first) key. • Pitch will change if dynamic is too loud. 	B1	A3 and D2	A \sharp 2, A3, D \sharp 3 and D6	<i>pp - ff</i>
4	4	<ul style="list-style-type: none"> • Lift F key. • Air speed and embouchure tension must be adjusted for the multiphonic to speak. 	B2	F2, B \flat 3 and F4	C3	<i>pp - p</i>

As the potential number of multiphonic possibilities is infinite, only a select few that I have experimented with are included in Appendix C. These examples will assist the bassoonist in creating new sounds as well as enhance the opportunity for creative work by composers who are interested in exploring new sounds on the bassoon. Although composers each use their own system of notation, it is advisable always to provide a clear indication of the desired resonant frequency accompanied by tones that they would like to be audible. The fingering chart in Appendix C should assist the bassoonist in executing the desired multiphonic tones.

4.3. Conclusion

This chapter reflects the results of my practice-led experimentation with a wide range of extended techniques as executed on my own Moosmann 200 soloist model bassoon. Several tonguing techniques are discussed, such as double- and triple-/mixed tonguing, flutter-tonguing, water-tonguing, double staccato, flap-tonguing and harmonic-tonguing. In addition,

other bassoon extended techniques such as various forms of pitch-sliding, microtones and multiphonics are included in the discussion.

Fingering charts and explanatory text are provided for several of the techniques, challenges regarding execution are pointed out, as are the benefits of certain fingering. The exercises set out in this chapter should enable the bassoonist to develop an understanding of the implementation of these techniques with a view to gaining entry into the exciting field of extended techniques and the new sound possibilities that they offer in music making.

CHAPTER 5. SUMMARY AND CONCLUSION

In this research study I set out to investigate the pedagogical gap that exists regarding the lack of training in extended techniques on the bassoon. The challenges that face a bassoonist when confronted with the need to perform extended techniques written into a music composition were investigated. On the one hand there are inconsistencies regarding the music notation representing these techniques and on the other a dearth of training in the execution thereof. The Italian composer Bruno Bartolozzi's seminal work, *New sounds for woodwind* (1982), was used as point of departure for extensive experimentation with a multitude of fingerings for monophonic and multiphonic possibilities on the German system bassoon.

5.1. Summary

Chapter 1 of the study is introductory and includes the background to the study, research questions, aims, delimitations of the study, and an overview of the research methodology. In Chapter 2 the limited pool of available literature that relates to the historical background and development of extended bassoon techniques was discussed. Bartolozzi's treatise was studied to identify how he created a spectrum of new sounds without altering the instrument. The book consists of several chapters describing non-traditional performance techniques on the execution of monophonic and multiphonic possibilities on woodwind instruments. Furthermore, literature regarding fingering and notation challenges have also been consulted. The most notable problem insofar as bassoon design, which distinguishes the instrument from any other woodwind instrument, is its size, creating an uncomfortable fingering system that has been a main focus of improvement over time. These included the increase of the number of keys on the bassoon to help improve the tuning of notes on the instrument. Research into challenges experienced with notation of extended techniques have indicated that there is no set system of notation, resulting in composers creating their own illustrations for these techniques.

In Chapter 3, the characteristics of a qualitative research approach were described as applicable to this study. Practice-led research enabled me to study my creative practice and creative methods, in this case, the various possibilities of the execution of extended techniques on the bassoon, as part of the research design. The selected extended bassoon techniques and the practical execution thereof are extensively discussed in Chapter 4. The literature was analysed according to themes based on common problems experienced by

bassoonists regarding the execution of extended bassoon techniques. Themes that were identified are fingering options, sound effects, systems of notation, and execution possibility of these techniques on the German system bassoon in comparison with the findings of Bartolozzi. Extensive experimentation was conducted along the lines of these themes. During experimentation, the sound resulting from different fingering options for both monophonic and multiphonic possibilities was recorded using a Zoom professional recording device, supplemented by a KORG tuner. The recordings of the various multiphonic possibilities were digitally analysed by using *Audiosculpt 3*©. This software allowed me to analyse the spectral content of a sound and displayed the results via spectrograms. The spectrograms illustrate the frequency per second (Hz) of each partial to create the notation examples that accompanying the fingering charts.

Only fingerings which proved viable on the German system bassoon were subsequently notated and illustrated under the theme 'possible to perform on a German system bassoon'. Results regarding relevancy of these possibilities were formulated according to the following criteria: quality of tone produced, pitch change, stability and difficulty of each fingering possibility, as well as the results of experimentation with quinquartite-tone fingerings were documented in Appendices A, B and C. An audio compact disk representing the sound effects of the multiphonic possibilities were also produced.

5.2. Conclusion

The research conducted during this study supports the main argument, insofar as the existence of a practical and theoretical gap between the learning and execution of extended bassoon techniques in South Africa. Through practice-led experimentation I have found that Barolozzi's original fingering charts are still relevant on the modern German bassoon system, although they can hinder the learning of microtonal possibilities due to their complex numbering systems. The execution of monophonic and multiphonic possibilities is subject to a multitude of options. Thus I have added fingering charts to be used as an additional resource to the existing possibilities. Experiments on multiphonic possibilities, conducted under controlled conditions, have indicated that there are multiple executions for each possibility and resulted in the creation of an extensive range of multiphonics with accompanying fingering charts and notations.

From the result it is evident that the bassoonist who would like to master extended techniques must first have a general knowledge of standard bassoon techniques, especially breathing, embouchure control and tonguing techniques. A good example is the fact that circular breathing is not possible without the mastering of standard breathing first. Standard breathing techniques are implemented in the bubble technique which is used to practise the concept of circular breathing on the bassoon. From experience I have found that the bubble technique is appropriate to teach circular breathing to young bassoonist as it is more easily mastered than other available options. Results have shown that circular breathing is possible with this technique but that it requires time to develop. Unlike standard embouchure control where the embouchure stays the same, many extended techniques require embouchure adjustment, including direct contact with the teeth on the double reed.

Within the context of the ever expanding repertoire including bassoon extended techniques, it is worrying that firstly, an uniform system of notation is still not used by composers and secondly, that sufficient training in the execution of these techniques is lacking. This gap can be overcome when bassoon teachers research the topic of extended techniques and promote these techniques to their students for future research. From the results it is evident that the bassoonist who would like to master extended techniques must first have a general knowledge of standard bassoon techniques, especially breathing and embouchure control. This supports Bartolozzi's belief that extended techniques must be incorporated into the woodwind, in this case bassoon curriculum, once standard techniques have been mastered. It is also valuable for students to study the available literature in order to gain a better understanding of the history and the contemporary application of extended techniques.

Research has shown, as in the case of Berio *Sequenza XII* for the bassoon, that it is most beneficial when the composer and the performer interact to find a solution regarding the system of notation for extended techniques and to document these not just for practical reasons but also for future research. An uniform system of notation, if used by composers across board, will surely encourage training in and the exposure to extended techniques and thus contribute to the use thereof and enhanced performance practise. Results have indicated that, when there is no clear indication regarding the execution of these techniques, misunderstanding can result in a loss of interest in extended techniques. It must be emphasised that limiting factors were evident throughout the research process, such as the dearth of suitable music with sufficiently illustrative text regarding the extended techniques required. This illustrates the timeous undertaking of the research. As the bassoon is not only a mainstay instrument in an orchestra, but also a solo instrument, its attraction needs to be

maintained, nurtured and certainly enhanced. This study will aid both composers, teachers and bassoonists, especially those who wish to experiment with alternate sounds. Continuous experimentation with extended bassoon techniques should be an ongoing enterprise.

5.3. Recommendations for future research

The continued search for new sounds spectrums and innovative fingering approaches requires development and must be experimented with, and incorporated into repertoires. Composers and bassoonists should ideally create a platform to enable them to refine and agree on a system of notation for extended techniques and document these for future performance and research. In addition, the use of appropriate computer software can assist in developing a standardised system of notation. This would be possible as a collaborative research project if the correct coding approaches can be developed by experienced bassoonists, in cooperation with composers. The development of teaching material to enhance the learning experience of the young bassoonist regarding extended techniques is another research opportunity. A study of this nature should continuously be upgraded and extended as new techniques develop.

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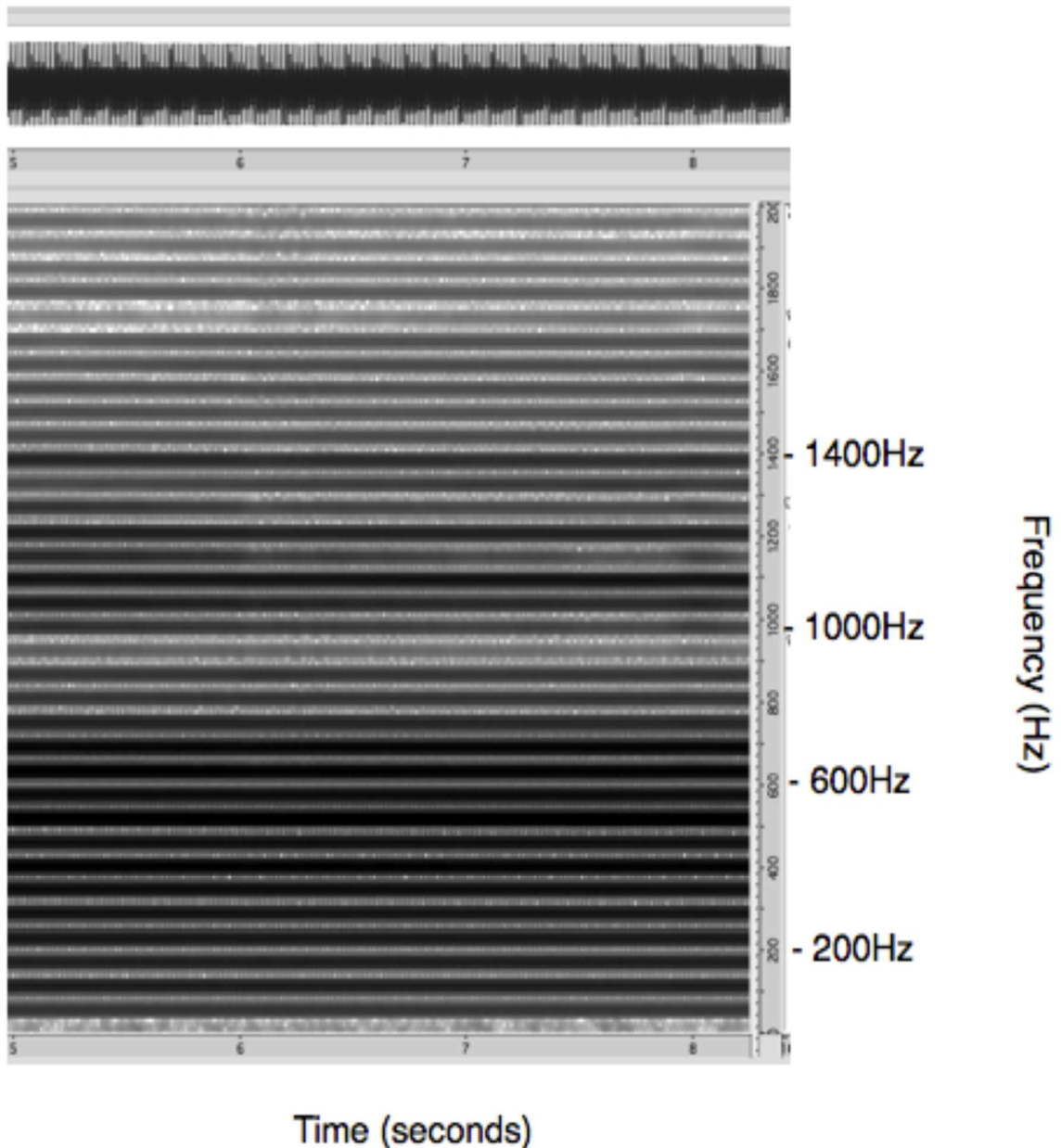
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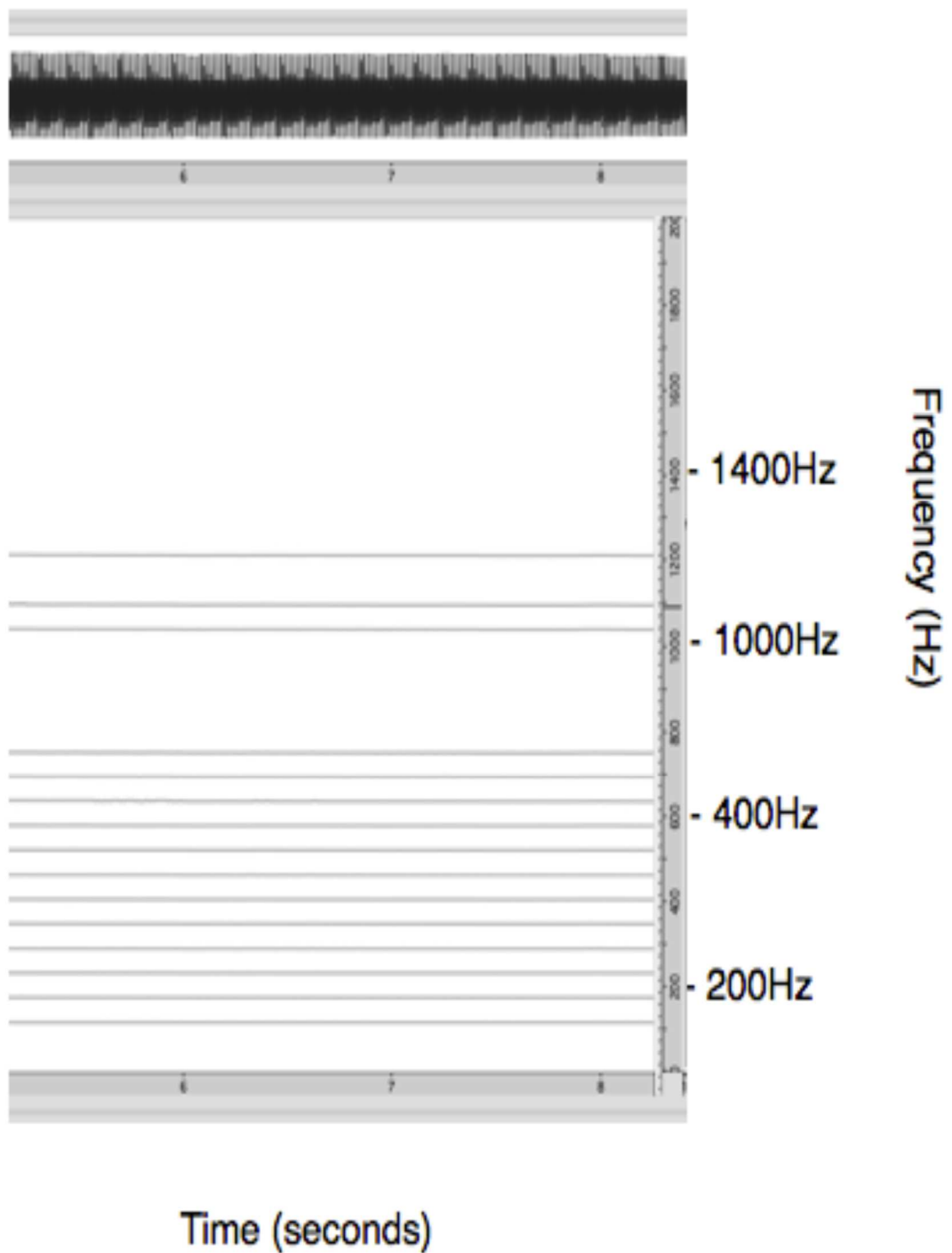
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Appendix A

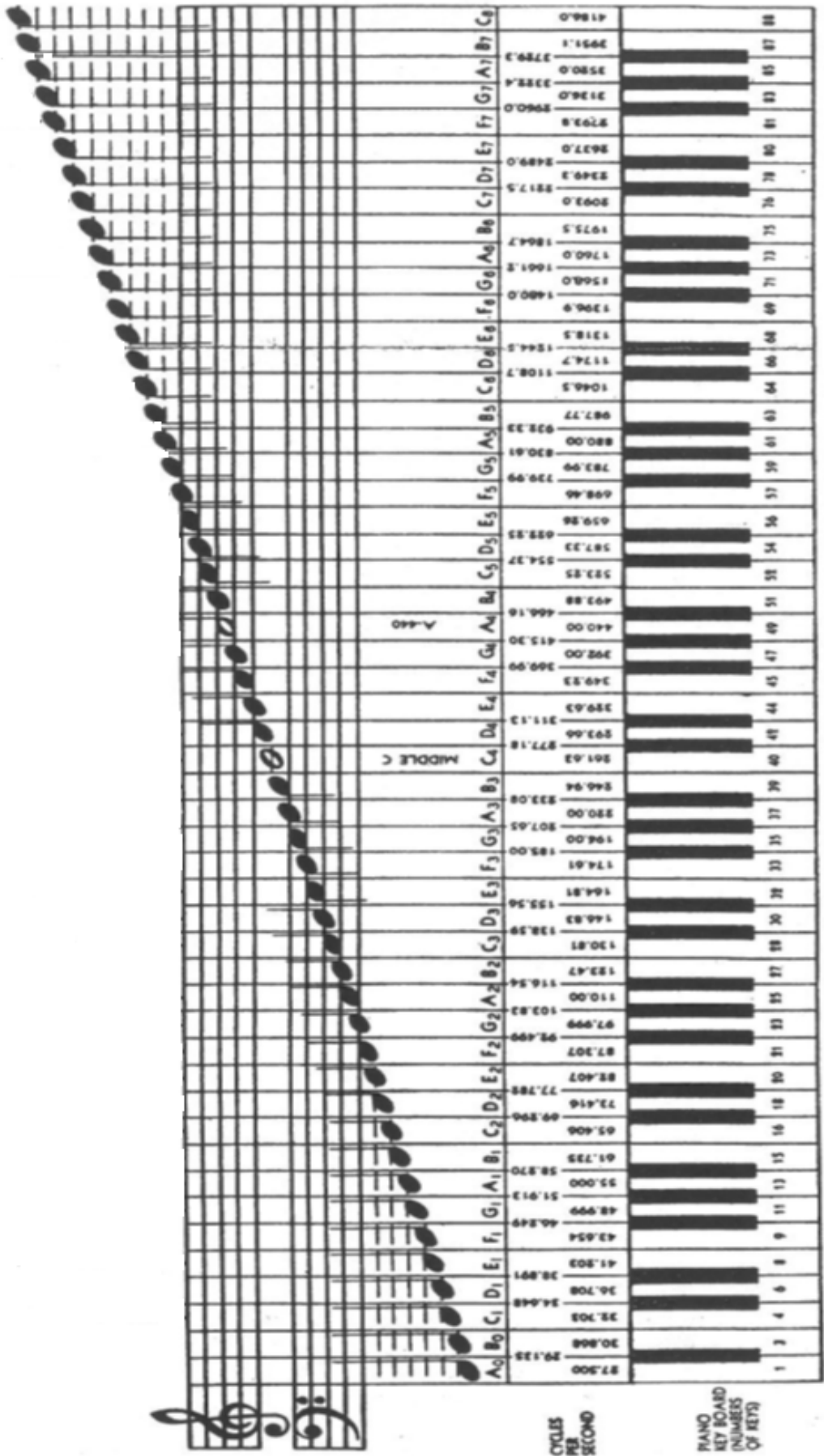
An example of a spectrograph of a multiphonic possibility on the upper middle register D on the bassoon can be seen in the following example:



The darker congested lines (between 200Hz and 600Hz) indicate the most prominent frequencies indicating the resonant frequency of the multiphonic possibility on upper middle register D. The lighter but still dark lines (between 1000Hz and 1400Hz) indicate additional partials resulting in audible tones. In the following picture, the graph shows a complete partial analysis of the multiphonic possibility of the upper middle register D on the bassoon:



From here it is possible to indicate the audible tones as well as the resonant frequency when comparing the cycles per second (Hz) to the following table to identify the additional audible tones on a specific multiphonic possibility. Microtones have not been indicated on the staves' per se but have been indicated in the tables as audible microtones.



Appendix B

Microtonal fingering charts

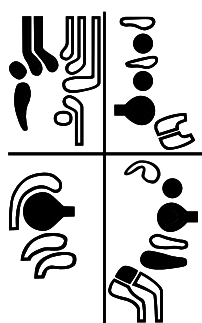
The following fingering charts illustrate the fingering possibilities for both quarter-tone and quinquupartite-tones on the bassoon. Through experimentation I have indicated which quarter-tone produces a clear change in pitch together with the greatest ease of execution. These have been indicated by a * and descriptive text below the table. The three authors for the quarter-tone options have been indicated as follow:

- Bruno Bartolozzi – B.B.
- Johnny Reinhard – J.R.
- Sergio Penazzi – S.P.

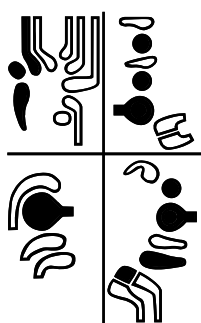
Quarter-tone fingering charts:

B \flat ♯1, B♯1, C♯2 Possibilities

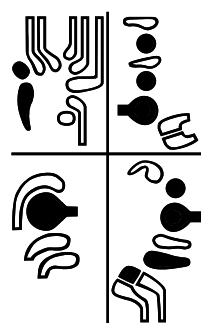
B \flat ♯1



B♯1



C♯2



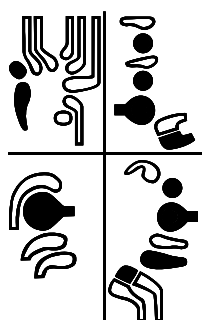
Quarter-tone	Execution	Result
B \flat ♯1	<ul style="list-style-type: none"> • Use traditional B\flat1 fingering. • Tighten embouchure and increase airspeed. 	<ul style="list-style-type: none"> • Sharp intonation, unstable to sustain a long quarter-tone. • Fatigue of the embouchure muscles can influence practicality. • No desired effect.

B \sharp 1	<ul style="list-style-type: none"> • Use traditional B1 fingering. • Tighten embouchure and increase airspeed. 	<ul style="list-style-type: none"> • Sharp intonation, unstable to sustain a long quarter-tone. • Fatigue of the embouchure muscles can influence practicality. • No desired effect.
C \sharp 1	<ul style="list-style-type: none"> • Use traditional C2 fingering. • Tighten embouchure and increase airspeed. 	<ul style="list-style-type: none"> • Sharp intonation, unstable to sustain a long quarter-tone. • Fatigue of the embouchure muscles can influence practicality. • No desired effect.

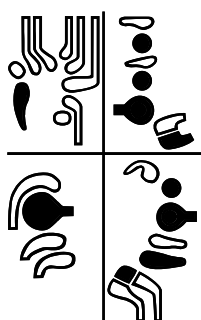
C \sharp 2 Possibilities

C \sharp 2 is developed out of the traditional fingering of C \sharp 2:.

C \sharp 2



C \sharp 2

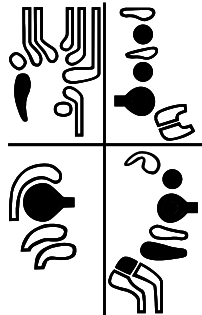


Quarter-tone	Execution	Result
C \sharp 2	<ul style="list-style-type: none"> • Lift the bottom C key. • Embouchure needs to be fully relaxed. 	<ul style="list-style-type: none"> • Very clear pitch change. • Desired effect easily achieved. • Very stable fingering. • Works well across all dynamic levels.

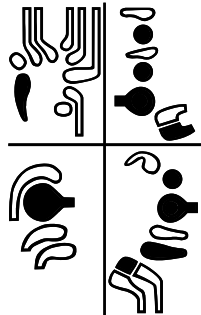
D \sharp 2 Possibilities

D \sharp 2 is developed out of the traditional fingering of D2:

D2



D \sharp 2

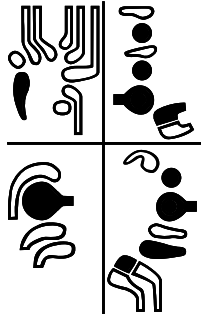


Quarter-tone	Execution	Result
D \sharp 2	<ul style="list-style-type: none"> • Close the C\sharp auxiliary (Left hand, fifth finger) key. • Increase airspeed. 	<ul style="list-style-type: none"> • Very clear pitch change. • Desired effect easily achieved. • Very stable fingering. • Works well across all dynamic levels.

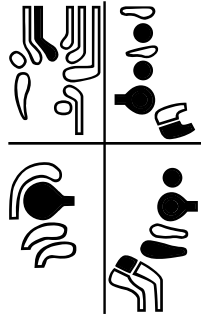
E♭‡2 Possibilities

E♭‡2 is developed out of the traditional fingering of E♭2 as follows:

E♭2



E♭‡2

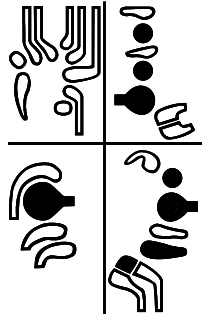


Quarter-tone	Execution	Result
E♭‡2	<ul style="list-style-type: none"> • Lift the bottom D key and close the bottom B♭ key. • Embouchure needs to be fully relaxed. 	<ul style="list-style-type: none"> • Pitched raised but fingering results in uncontrollable oscillation of pitch. • Fingering works when embouchure is fully relaxed but still creates control problems.

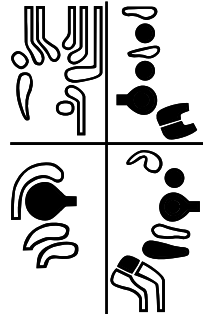
E \sharp 2 Possibilities

E \sharp 2 is built on the traditional fingering of E2:

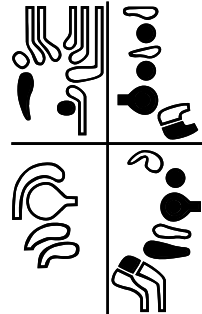
E2



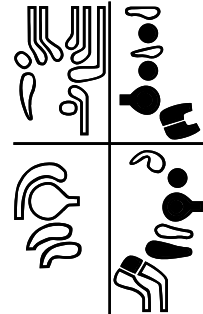
E \sharp 2 B.B.



E \sharp 2 J.R.



E \sharp 2 S.P.

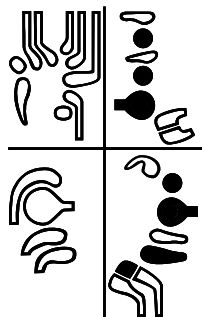


Quarter-tone	Execution	Result
E \sharp 2 B.B.	<ul style="list-style-type: none"> • Close both the C\sharp and D\sharp auxiliary (Both with the left hand, fifth finger) keys. 	<ul style="list-style-type: none"> • Embouchure must be tightened. • Very clear pitch and timbre change.
E \sharp 2 J.R. *	<ul style="list-style-type: none"> • Lift the bottom E key. • Close the bottom D key and whisper key. 	<ul style="list-style-type: none"> • Extremely clear quarter-tone fingering for E. • Very stable intonation. • Finger does create a muted tone.
E \sharp 2 S.P.	<ul style="list-style-type: none"> • Lift the bottom E key. • Close both the C\sharp and D\sharp auxiliary (Both with the left hand, fifth finger) keys. 	<ul style="list-style-type: none"> • Embouchure must be fully relaxed to execute the desired effect. • Not a very good example for quarter-tone fingering on E. • Intonation very unstable due to relaxed embouchure.

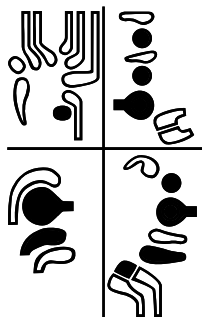
F \sharp 2 Possibilities

F \sharp 2 is developed out of the traditional fingering of F2:.

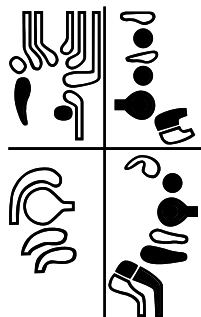
F2



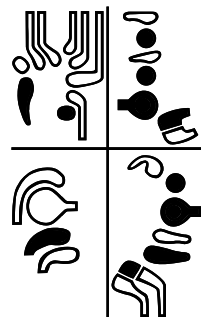
F \sharp 2 B.B.



F \sharp 2 J.R.



F \sharp 2 S.P.

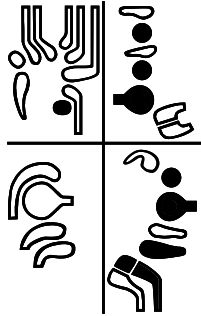


Quarter-tone	Execution	Result
F \sharp 2 B.B. *	<ul style="list-style-type: none"> Close the bottom E key as well as the front F\sharp auxiliary (Right hand, left finger). 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Stable intonation. Easily executed. Dark sound.
F \sharp 2 J.R.	<ul style="list-style-type: none"> Close the bottom D key and D\sharp auxiliary (Left hand, fifth finger) key. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Stable intonation. Easily executed. Bright sound.
F \sharp 2 S.P.	<ul style="list-style-type: none"> Close the bottom D, D\sharp auxiliary (Left hand, fifth finger) and front F\sharp auxiliary (Right hand, first finger) keys. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Same as F\sharp2 J.H. but with front F\sharp auxiliary key.

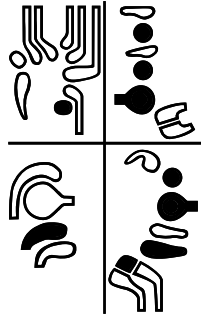
F#2 Possibilities

F#2 is developed on the two traditional fingerings of F2:

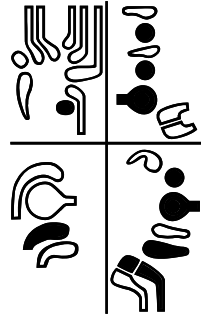
F#2



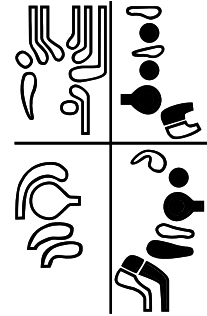
F#2



F#2 B.B.



F#2 J.R.

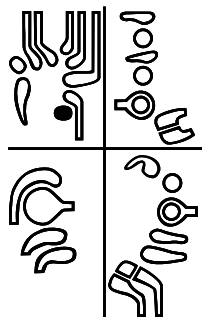


Quarter-tone	Execution	Result
F#2 B.B.	<ul style="list-style-type: none"> Close both the front and back F# auxiliary (Right hand, first and fifth finger) keys. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Very bright sound.
F#2 J.R.	<ul style="list-style-type: none"> Close both the bottom D and D# auxiliary (Left hand, fifth finger) keys. 	<ul style="list-style-type: none"> Embouchure needs to be tightened by a large amount. Very muted sound. Fingering does not work and creates a very flat F#2.

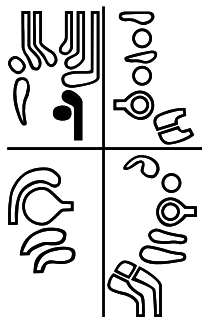
F‡3 Possibilities

F‡3 is built on the traditional fingering of F3:

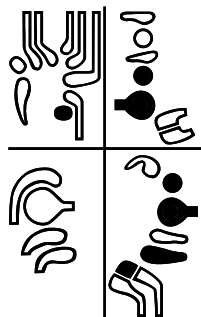
F3



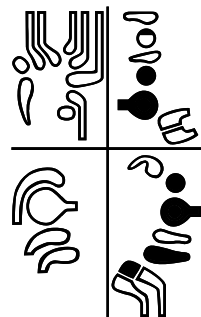
F‡3 B.B.



F‡3 J.R.



F‡3 S.P.

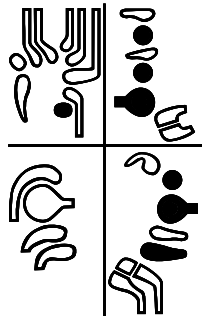


Quarter-tone	Execution	Result
F‡3 B.B.	<ul style="list-style-type: none"> Press down C# flick (Left hand, first finger) key. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Very stable intonation. Easy fingering. No big adjustment of embouchure needed.
F‡3 J.R. *	<ul style="list-style-type: none"> Close D, C, B and A tone holes. Close both G and F keys. 	<ul style="list-style-type: none"> Very clear quarter-tone pitch change. Stable intonation. Fingering is perfect for sustained quarter-tone.
F‡3 S.P.	<ul style="list-style-type: none"> Half hole E tone hole. Close D, C, B and A tone holes. Close both G and F keys. Lift whisper key (Left hand, first finger). 	<ul style="list-style-type: none"> By half holing the E tone hole, intonation can be adjusted to desired effect.

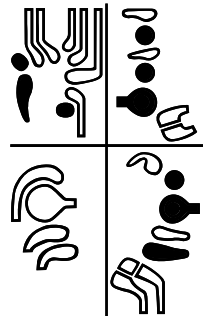
G \sharp 2 Possibilities

G \sharp 2 is developed out of the traditional fingering of G2:

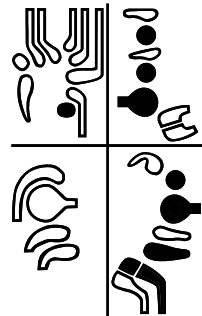
G2



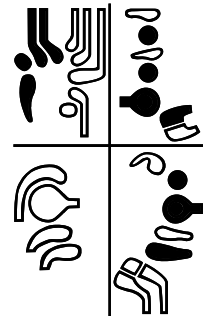
G \sharp 2 B.B.



G \sharp 2 J.R.



G \sharp 2 S.P.

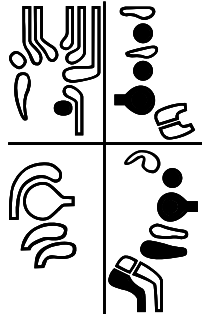


Quarter-tone	Execution	Result
G \sharp 2 B.B.	<ul style="list-style-type: none"> Close both the bottom C and D keys. 	<ul style="list-style-type: none"> Fingerings result in a muted G2 tone. No exact pitch change.
G \sharp 2 J.R.	<ul style="list-style-type: none"> Close the F\sharp auxiliary (Right hand, fifth finger). 	<ul style="list-style-type: none"> Pitch lowers to F\sharp as it is the same fingering..
G \sharp 2 S.P. *	<ul style="list-style-type: none"> Close bottom B\flat, B, C and D keys, also close D\sharp auxiliary (Left hand, fifth finger) key. 	<ul style="list-style-type: none"> Clear pitch change. Fingering is easily executed. Airspeed needs to be increased with embouchure pressure to achieve desired effect.

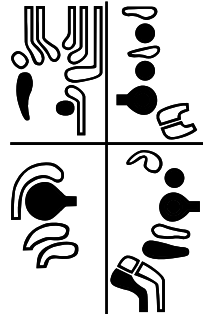
G#12 Possibilities

G#12 is built on the traditional fingering of G2:

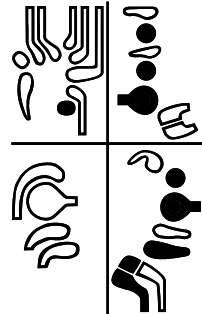
G#2



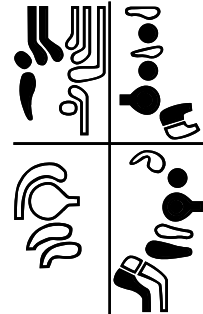
G#12 B.B.



G#12 J.R.



G#12 S.P.

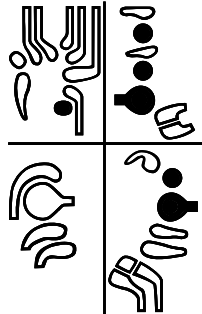


Quarter-tone	Execution	Result
G#12 B.B. *	<ul style="list-style-type: none"> Close bottom D and E keys. 	<ul style="list-style-type: none"> Clear pitch change. Fingering easily executed. Airspeed as well as embouchure pressure needs to be increased till desired effect.
G#12 J.R.	<ul style="list-style-type: none"> Close F key. Use right hand, fifth finger to close both the A\flat auxiliary and F keys. 	<ul style="list-style-type: none"> Slight change in pitch.
G#12 S.P. *	<ul style="list-style-type: none"> Open the A\flat auxiliary (Right hand, fifth finger) key and close bottom B\flat, B, C and D keys. 	<ul style="list-style-type: none"> Clear pitch change. Airspeed as well as embouchure pressure needs to be increased for desired effect. Tone has a nasal quality.

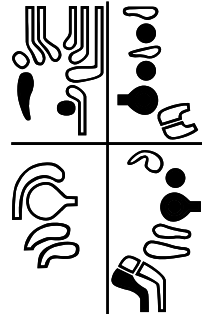
A \sharp 2 Possibilities

A \sharp 2 is built on the traditional fingering of A2:

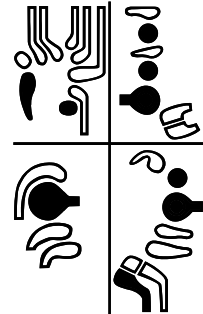
A2



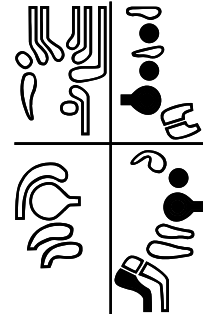
A \sharp 2 B.B.



A \sharp 2 J.R.



A \sharp 2 S.P.

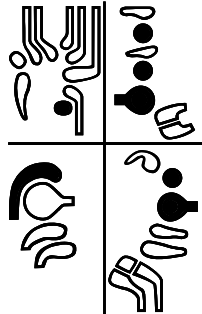


Quarter-tone	Execution	Result
A \sharp 2 B.B.	<ul style="list-style-type: none"> Close bottom D and A\flat auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> Change in pitch is noticeable but not perfectly 50 cent of the semi-tone. Fingering is easily executed.
A \sharp 2 J.R.	<ul style="list-style-type: none"> Close bottom D, E and A\flat auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> With increased embouchure pressure a very good quarter-tone pitch can be created. Intonation can be unstable due to oscillation in the pitch due to embouchure change.
A \sharp 2 S.P.*	<ul style="list-style-type: none"> Close A\flat auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> Good fingering for the specific note. Clear quarter-tone pitch change. Good intonation. Brighter in sound than other two. Fingering is easily executed.

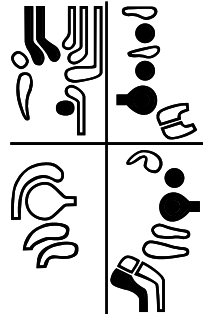
B \flat ‡2 Possibilities

B \flat ‡2 is built on the traditional fingering of B \flat 2:

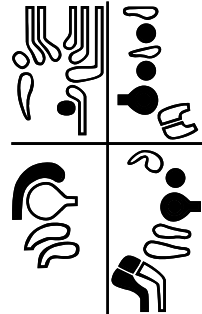
B \flat 2



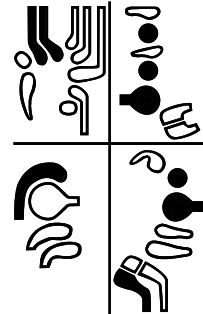
B \flat ‡2 B.B.



B \flat ‡2 J.R.



B \flat ‡2 S.P.

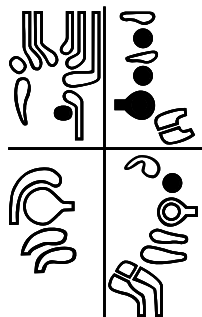


Quarter-tone	Execution	Result
B \flat ‡2 B.B.	<ul style="list-style-type: none"> Lift front B\flat auxiliary (Right hand, first finger). Close bottom B\flat and B and A\flat auxiliary (Right hand, fifth finger) keys. 	<ul style="list-style-type: none"> Result in a very flat pitch more suitable for A‡2.
B \flat ‡2 J.R.	<ul style="list-style-type: none"> Close A\flat auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Fingering is uncomfortable due to pressing down both the A\flat auxiliary and F key.
B \flat ‡2 S.P.*	<ul style="list-style-type: none"> Close bottom B\flat and B and A\flat auxiliary (Right hand, fifth finger) keys. 	<ul style="list-style-type: none"> Good quarter-tone fingering. Intonation clear but can be nasal if too much air is supplied.

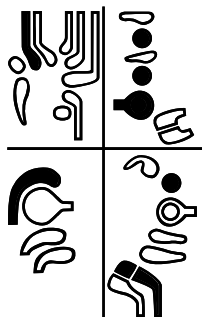
B \sharp 2 Possibilities

B \sharp 2 is built on the traditional fingering of B2:

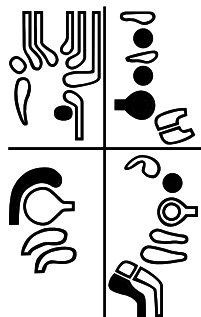
B2



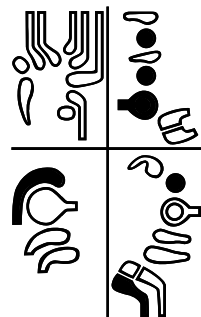
B \sharp 2 B.B.



B \sharp 2 J.R.



B \sharp 2 S.P.

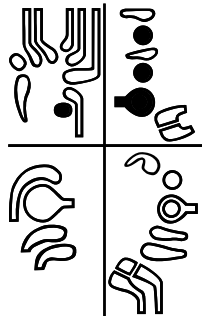


Quarter-tone	Execution	Result
B \sharp 2 B.B.	<ul style="list-style-type: none"> Close the bottom B, B\flat auxiliary (Right hand, first finger), F and back F\sharp auxiliary (Right hand, fifth finger) keys. 	<ul style="list-style-type: none"> Good pitch change. Embouchure needs to be relaxed to find the desired intonation. Tone is unstable due to embouchure changes and oscillation in pitch.
B \sharp 2 J.R.*	<ul style="list-style-type: none"> Close both B\flat auxiliary (Right hand, first finger) and A\flat auxiliary (Right hand, fifth finger) keys. 	<ul style="list-style-type: none"> Very good quarter-tone fingering. Very clear pitch change with stable intonation. Works well across all dynamic levels.
B \sharp 2 S.P. *	<ul style="list-style-type: none"> Lift whisper key. Close both B\flat auxiliary (Right hand, first finger) and A\flat auxiliary (Right hand, fifth finger) keys. 	<ul style="list-style-type: none"> Same as B\sharp2 J.R.

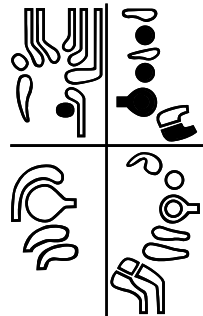
C \sharp 3 Possibilities

C \sharp 3 is built on the traditional fingering of C3:

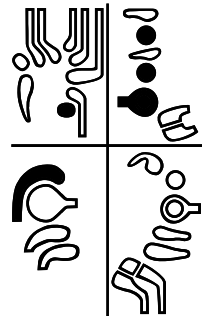
C3



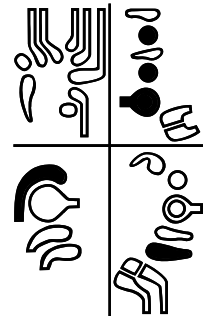
C \sharp 3 B.B.



C \sharp 3 J.R.



C \sharp 3 S.P.

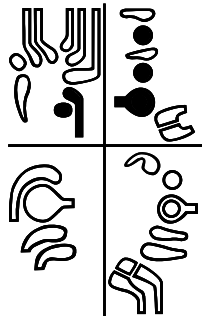


Quarter-tone	Execution	Result
C \sharp 3 B.B.	<ul style="list-style-type: none"> Close the C\sharp auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> Change in pitch but a great deal of air pressure and embouchure pressure is needed to create the quarter-tone lift.
C \sharp 3 J.R.	<ul style="list-style-type: none"> Close the B\flat auxiliary (Right hand, first finger) key. 	<ul style="list-style-type: none"> Clear change in pitch. Embouchure pressure needs to be regulated to create desired quarter-tone.
C \sharp 3 S.P.*	<ul style="list-style-type: none"> Close both the B\flat auxiliary (Right hand, first finger) and G keys. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Extremality good fingering with stable intonation. No embouchure adjustment needed to execute. Can become nasal if airspeed increases.

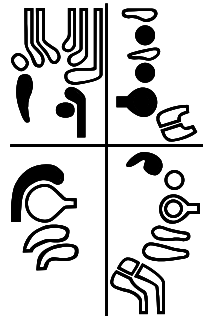
C#3 Possibilities

C#3 is built on the traditional fingering of C#3:

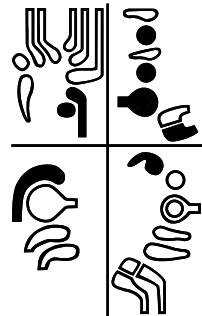
C#3



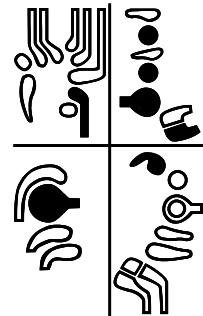
C#3 B.B.



C#3 J.R.



C#3 S.P.

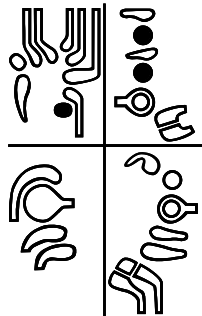


Quarter-tone	Execution	Result
C#3 B.B.*	<ul style="list-style-type: none"> • Close bottom D key. Close B\flat auxiliary key. • Close C trill (Right hand, second finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Intonation stable. • Open bright sound.
C#3 J.R.*	<ul style="list-style-type: none"> • Close B\flat auxiliary and C# auxiliary (Left hand, fifth finger) keys. • Close C trill (Right hand, second finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Intonation stable. • Open dark sound. • Fingering easily executed.
C#3 S.P.*	<ul style="list-style-type: none"> • Close bottom E key. • Close C# auxiliary (Left hand fifth finger) keys. • Close C trill (Right hand, second finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Intonation stable. • Muted tone, good fingering for <i>pianissimo</i> quarter-tone.

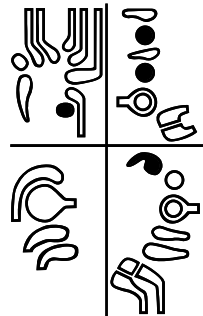
D \sharp 3 Possibilities

D \sharp 3 is built on the traditional fingering of D3:

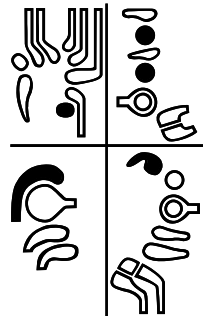
D3



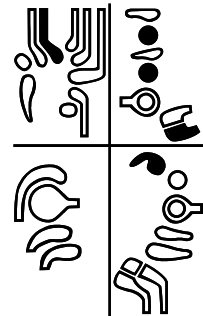
D \sharp 3 B.B.



D \sharp 3 J.R.



D \sharp 3 S.P.

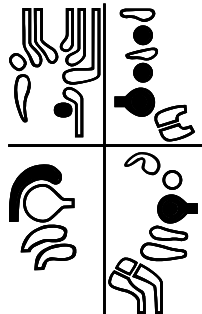


Quarter-tone	Execution	Result
D \sharp 3 B.B.*	<ul style="list-style-type: none"> • Close C trill (Right hand, second finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Stable intonation. • Easily executed with bright clear sound.
D \sharp 3 J.R.	<ul style="list-style-type: none"> • Close C trill (Right hand, second finger) key. • Close B\flat auxiliary key (Right hand, first finger). 	<ul style="list-style-type: none"> • Muted version of the D\sharp3. • More focussed and dark sound.
D \sharp 3 S.P.	<ul style="list-style-type: none"> • Close bottom B\flat key. • Close C trill (Right hand, second finger) key. • Close C\sharp auxiliary (Left hand, fifth finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Stable intonation. • Complexed fingering but will work for long sustained quarter-tone.

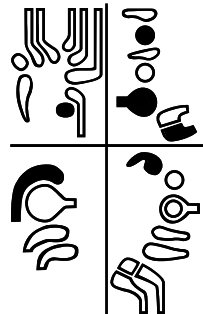
E \flat 3 Possibilities

E \flat 3 is built on the traditional fingering of E \flat 3 as follows:

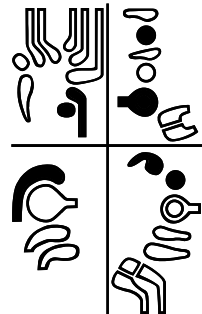
E \flat 3



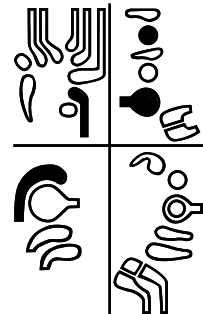
E \flat 3 B.B.



E \flat 3 J.R.



E \flat 3 S.P.

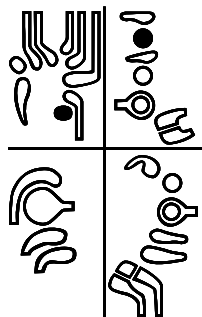


Quarter-tone	Execution	Result
E \flat 3 B.B.*	<ul style="list-style-type: none"> • Open the B tone hole. • Close the C\sharp trill (Right hand, second finger) key. 	<ul style="list-style-type: none"> • Extremely clear quarter-tone pitch change. • Mellow tone when played at <i>pianissimo</i> to <i>mezzo-forte</i> dynamics. • Stable intonation.
E \flat 3 J.R.	<ul style="list-style-type: none"> • Press down the C\sharp flick (Left hand, first finger) key. • Close the C\sharp trill (Right hand, second finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Very open sound. • Difficult to control intonation in soft dynamics. • Complex fingering can be demanding when combined with other fingerings.
E \flat 3 S.P.	<ul style="list-style-type: none"> • Open the B tone hole. • Press down the C\sharp flick (Left hand, first finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Fingering easily executed.

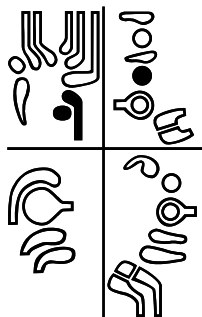
E \sharp 3 Possibilities

E \sharp 3 is built on the traditional fingering of E3:

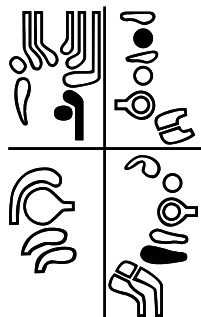
E3



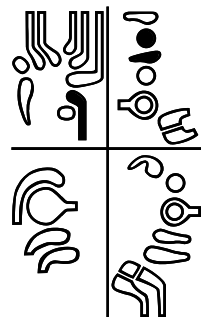
E \sharp 3 B.B.



E \sharp 3 J.R.



E \sharp 3 S.P.

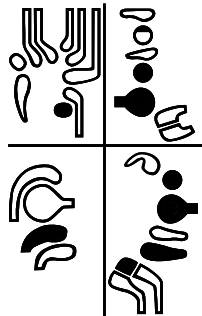


Quarter-tone	Execution	Result
E \sharp 3 B.B.	<ul style="list-style-type: none"> • Open E tone hole. • Close D tone hole. Press down C\sharp flick (Left hand, first finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Intonation stable with a dark tone.
E \sharp 3 J.R.	<ul style="list-style-type: none"> • Close G key. • Press down C\sharp flick (Left hand, first finger) key. 	<ul style="list-style-type: none"> • Same tonal effect as E\sharp3 B.B. • Slightly flatter pitch.
E \sharp 3 S.P.*	<ul style="list-style-type: none"> • Press down C\sharp flick (Left hand, first finger) and E\flat trill (Left hand, third finger) keys. 	<ul style="list-style-type: none"> • Very clear quarter-tone pitch change. • Clear intonation with bright open sound. • Sustained quarter-tones easily executed with this fingering.

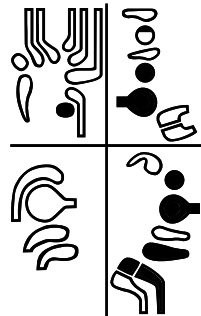
F#3 Possibilities

F#3 is built on the traditional fingering of F#3:

F#3

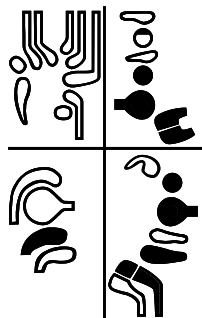


F#3

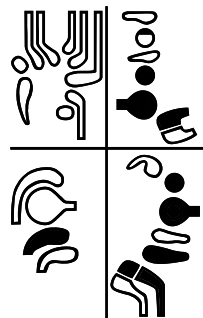


or

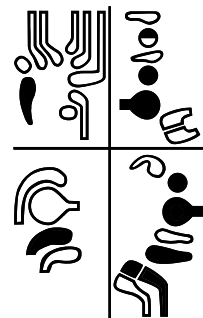
F#3 B.B.



F#3 J.R.



F#3 S.P.



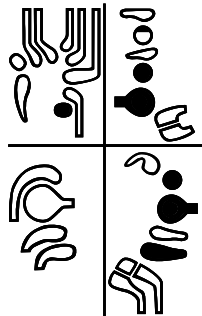
Quarter-tone	Execution	Result
F#3 B.B.	<ul style="list-style-type: none"> Close both bottom C# and D# auxiliary (Left hand, fifth finger) keys. 	<ul style="list-style-type: none"> Very clear quarter-tone pitch change. Beautiful round tone with good intonation. Fingering can be challenging not to roll 5th finger left hand of the rollers of the C# and D# auxiliary key.

F#3 J.R.	<ul style="list-style-type: none"> • Close bottom D# auxiliary (Left hand, fifth finger) key. 	<ul style="list-style-type: none"> • Same as F#3 but with a less resonating sound.
F#3 S.P.	<ul style="list-style-type: none"> • Half hole E tone hole. • Close bottom D key. 	<ul style="list-style-type: none"> • Same as the previous two fingers but with a muted tone. • Perfect for soft quarter-tones.

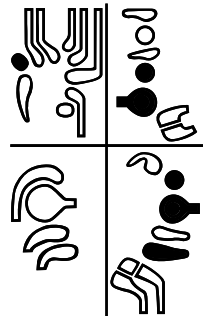
G♯3 Possibilities

G♯3 is built on the traditional fingering of G3:

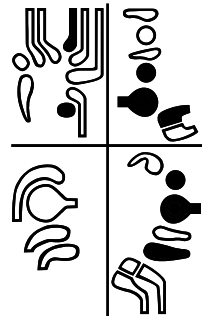
G3



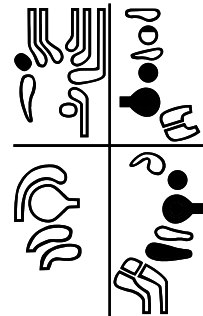
G♯3 B.B.



G♯3 J.R.



G♯3 S.P.

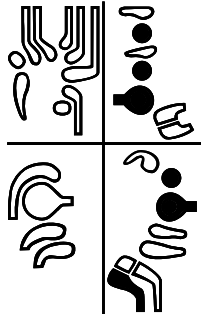


Quarter-tone	Execution	Result
G♯3 B.B.	<ul style="list-style-type: none"> • Open E tone hole. • Close bottom C key. 	<ul style="list-style-type: none"> • Muted nasal sounding quarter-tone. • Fair amount of embouchure pressure needs to be used to create the quarter-tone to influence the pitch.
G♯3 J.R.	<ul style="list-style-type: none"> • Lock whisper key if bassoon has locking mechanism. • Open E tone hole. • Close D♯ auxiliary (Left hand, fifth finger) key. Close D flick (Left hand, first finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change with minimal embouchure adjustments. • Very bright and open sound.
G♯3 S.P.	<ul style="list-style-type: none"> • Close bottom C key. 	<ul style="list-style-type: none"> • Muted nasal sounding quarter-tone. • Fair amount of embouchure pressure needed to create the quarter-tone to influence the pitch.

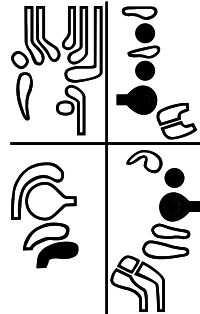
Ab‡3 Possibilities

Ab‡3 is built on the traditional fingering of Ab3:

Ab3

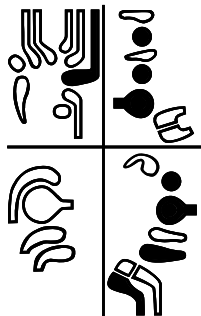


Ab3

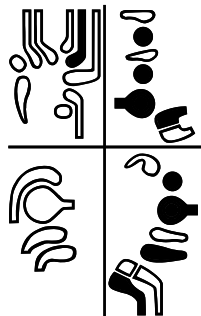


or

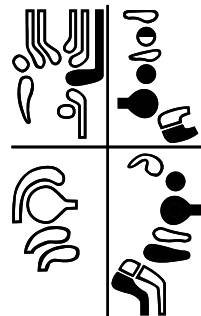
Ab‡3 B.B.



Ab‡3 J.R.



Ab‡3 S.P.



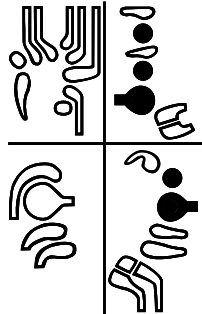
Quarter-tone	Execution	Result
Ab‡3 B.B.	<ul style="list-style-type: none"> Press down A flick (Left hand, first finger) key. 	<ul style="list-style-type: none"> Adjustment of embouchure needed to lift the pitch to the desired quarter-tone.
Ab‡3 J.R.*	<ul style="list-style-type: none"> Press down C flick (Left hand, first finger) key. Close D‡ auxiliary (Left hand, fifth finger) key. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Fingering provides a very stable intonation across all dynamic levels.

<p>A\flat3 S.P.</p>	<ul style="list-style-type: none"> • Press down C flick (Left hand, first finger) key. • Close C\sharp auxiliary (Left hand, fifth finger) key. • Half hole E tone hole. 	<ul style="list-style-type: none"> • Open dark sounded tone with good intonation. • Embouchure adjustment needed to lift the pitch.
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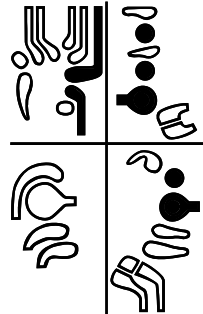
A♯3 Possibilities

A♯3 is built on the traditional fingering of A3:

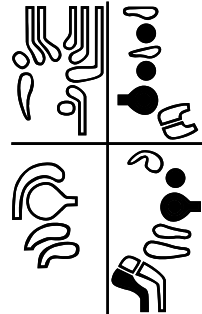
A3



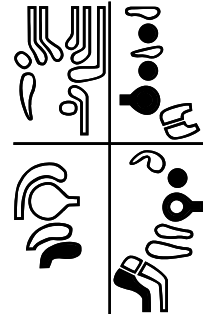
A♯3 B.B.



A♯3 J.R.



A♯3 S.P.

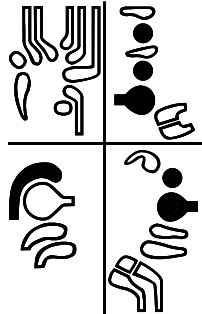


Quarter-tone	Execution	Result
A♯3 B.B.	<ul style="list-style-type: none"> Press down both A and C flick (Left hand, first finger) keys. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Dark tone with good intonation.
A♯3 J.R. *	<ul style="list-style-type: none"> Close A♭ auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> Very clear quarter-tone pitch change. Good fingering for sustained quarter-tone. Works well across all dynamic levels.
A♯3 S.P.	<ul style="list-style-type: none"> Close both front and back A♭ auxiliary (Right hand, first and fifth finger) key. Open A tone hole but the ring mechanism needs to stay closed. 	<ul style="list-style-type: none"> Complexed fingering resulting in oscillation of pitch. Very bright sound and difficult to control.

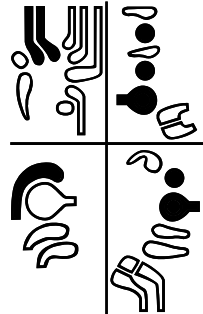
B \flat 3 Possibilities

B \flat 3 is built on the traditional fingering of B \flat 3:

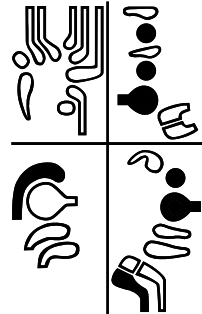
B \flat 3



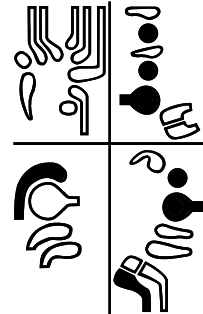
B \flat 3 B.B.



B \flat 3 J.R.



B \flat 3 S.P.

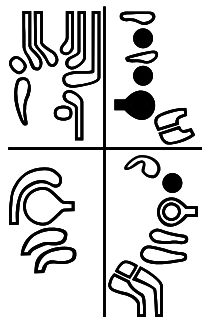


Quarter-tone	Execution	Result
B \flat 3 B.B.*	<ul style="list-style-type: none"> Press down both C and D flick (Left hand, first finger) keys. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Dark rounded tone. Works well with soft dynamics.
B \flat 3 J.R.	<ul style="list-style-type: none"> Close A\flat auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> Very clear quarter-tone pitch change. Embouchure can be relaxed. Brighter tone making this difficult to sustain at soft dynamic levels.
B \flat 3 S.P.	<ul style="list-style-type: none"> Close A\flat auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> Very clear quarter-tone pitch change. Brighter tone making this difficult to sustain at soft dynamic levels.

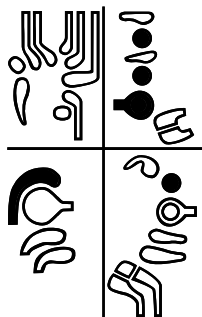
B \sharp 3 Possibilities

B \sharp 3 is built on the traditional fingering of B3:

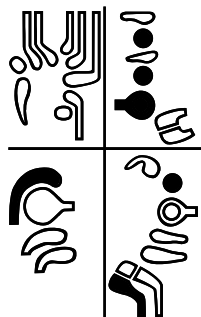
B3



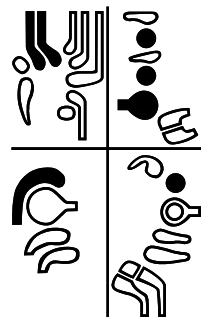
B \sharp 3 B.B.



B \sharp 3 J.R.



B \sharp 3 S.P.

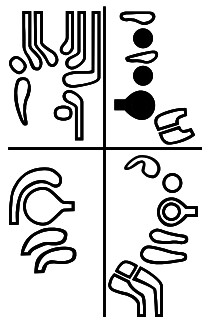


Quarter-tone	Execution	Result
B \sharp 3 B.B.	<ul style="list-style-type: none"> Close B\flat auxiliary (Right hand, first finger) key. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Adjustment of embouchure needed to control intonation. Difficult to sustain a long quarter-tone.
B \sharp 3 J.R. *	<ul style="list-style-type: none"> Close both B\flat auxiliary (Right hand, first finger) and A\flat auxiliary (Right hand, fifth finger) keys. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Full dark sound. Intonation stable resulting in ease with sustaining a long quarter-tone. Works well across all dynamic levels.
B \sharp 3 S.P.	<ul style="list-style-type: none"> Close B\flat auxiliary (Right hand, first finger) key. Press down on both C and D flick (Left hand, first finger) keys. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Adjustment of embouchure needed to control intonation. Difficult to sustain.

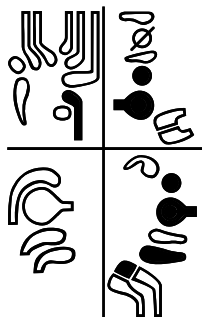
C♯4 Possibilities

C♯4 is built on the traditional fingering of C4:

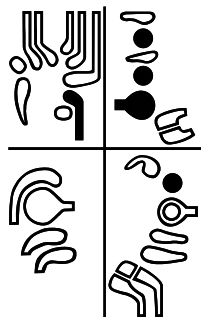
C4



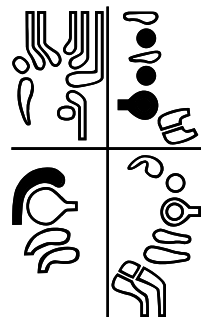
C♯4 B.B.



C♯4 J.R.



C♯4 S.P.

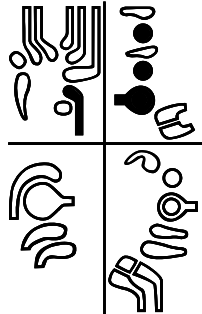


Quarter-tone	Execution	Result
C♯4 B.B.	<ul style="list-style-type: none"> • Press down C# flick (Left hand, first finger) key. • Close D, C, B and A tone holes. • Close both G and F keys. • Finger should hover but not close E tone hole. 	<ul style="list-style-type: none"> • Fingering does not create quarter-tone effect on modern German bassoon.
C♯4 J.R.	<ul style="list-style-type: none"> • Close B tone hole. • Press down C flick (Left hand, first finger). 	<ul style="list-style-type: none"> • Fingering does not create quarter-tone effect on modern German bassoon.
C♯4 S.P. *	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Works well on across all dynamic levels. • Sustained quarter-tone is easily executed with this specific fingering.

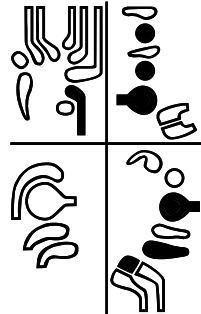
C#4 Possibilities

C#4 is built on the traditional fingering of C#4:

C#4

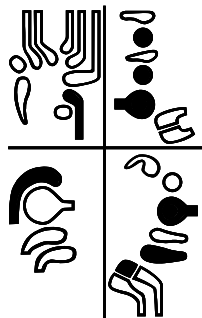


C#4

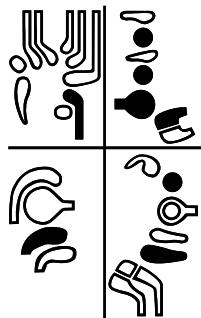


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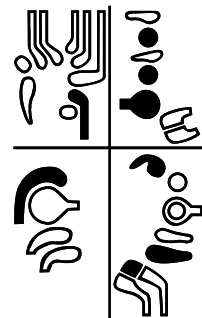
C#4 B.B.



C#4 J.R.



C#4 S.P.



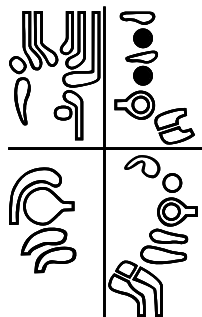
Quarter-tone	Execution	Result
C#4 B.B.*	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. 	<ul style="list-style-type: none"> • Very clear quarter-tone pitch change with good intonation. • Works well across all dynamic levels. • Fingering easily executed.
C#4 J.R.	<ul style="list-style-type: none"> • Close B tone hole. • Open A tone hole. • Open F key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Very bright sounding tone.

	<ul style="list-style-type: none"> • Close both front F# auxiliary and D# auxiliary keys. 	<ul style="list-style-type: none"> • Difficulty in executing a soft quarter-tone. • Difficulty in sustaining a long quarter-tone at soft dynamics. • Complex fingering.
C#4 S.P.	<ul style="list-style-type: none"> • Open B tone hole. • Close Bb auxiliary (Right hand, first finger) as well as the C trill (Right hand, second finger) keys. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Very bright sounding tone. • Difficulty in executing a soft quarter-tone. • Difficulty in sustaining a long quarter-tone at soft dynamics. • Complex fingering.

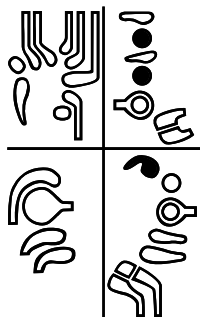
D \sharp 4 Possibilities

D \sharp 4 is built on the traditional fingering of D4:

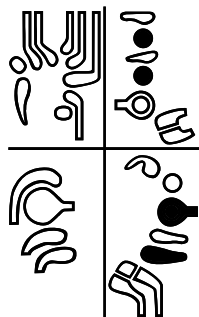
D4



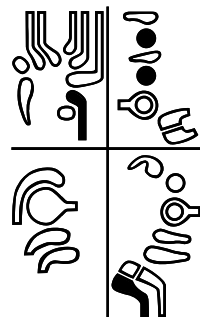
D \sharp 4 B.B.



D \sharp 4 J.R.



D \sharp 4 S.P.

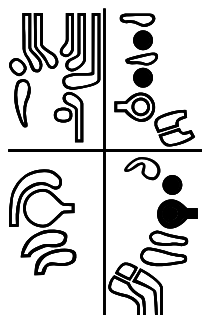


Quarter-tone	Execution	Result
D \sharp 4 B.B.	<ul style="list-style-type: none"> • Close C trill (Right hand, second finger) key. 	<ul style="list-style-type: none"> • Tightening of embouchure and increase of air speed needed to create the desired quarter-tone effect.
D \sharp 4 J.R.*	<ul style="list-style-type: none"> • Close A tone hole and G key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Easily sustainable with good intonation. • Fingering easily executed.
D \sharp 4 S.P.	<ul style="list-style-type: none"> • Press down C\sharp flick (Left hand, first finger) and A\flat auxiliary (Right hand, fifth finger). 	<ul style="list-style-type: none"> • Tone very bright and sharp. • Difficult to control pitch as embouchure needs to be fully relaxed. • Fingering easily executed.

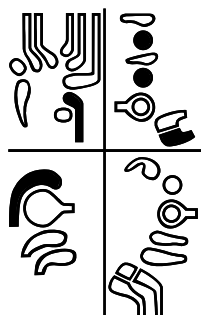
E \flat 4 Possibilities

E \flat 4 is built on the traditional fingering of E \flat 4:

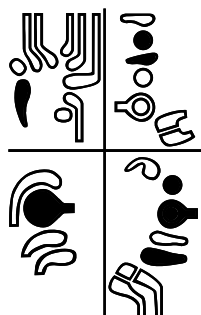
E \flat 4



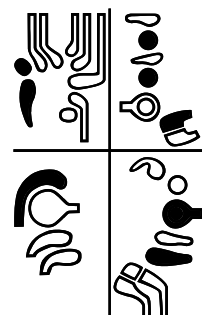
E \flat 4 B.B.



E \flat 4 J.R.



E \flat 4 S.P.

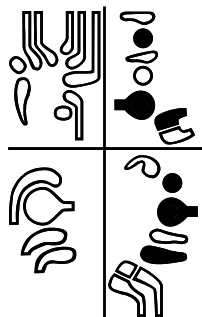


Quarter-tone	Execution	Result
E \flat 4 B.B. *	<ul style="list-style-type: none"> • Open B and A tone holes. • Close both B\flat auxiliary (Right hand, first finger) and bottom C\sharp auxiliary (Left hand, fifth finger) keys. • Press down C\sharp flick (Left hand, first finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change with good intonation. • Dark rounded tone and easily sustainable. • Works across all dynamic levels. • Fingering easily executed.
E \flat 4 J.R.	<ul style="list-style-type: none"> • Close bottom D, E and G keys. • Close E\flat trill (Left hand, third finger) key. • Open D tone hole. 	<ul style="list-style-type: none"> • Fingering does not create the quarter-tone effect on the modern bassoon.
E \flat 4 S.P. *	<ul style="list-style-type: none"> • Close bottom C, D and G keys. • Close B\flat auxiliary (Right hand, first finger) keys. • Close bottom C\sharp auxiliary (Left hand, fifth finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change with good intonation. • Dark rounded tone and easily sustainable. • Works across all dynamic levels. • Muted version of E\flat4 • Fingering easily executed.

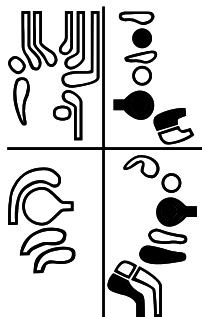
E \sharp 4 Possibilities

E \sharp 4 is built on the traditional fingering of E4:

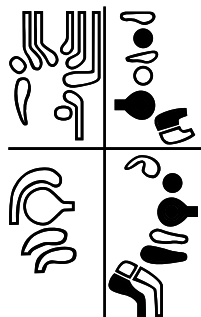
E4



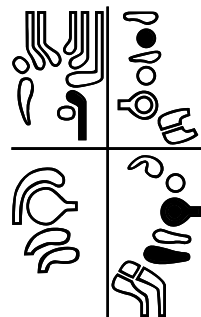
E \sharp 4 B.B.



E \sharp 4 J.R.



E \sharp 4 S.P.

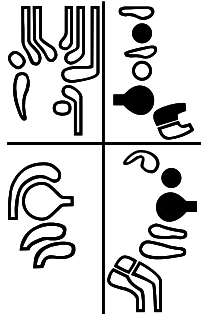


Quarter-tone	Execution	Result
E \sharp 4 B.B.*	<ul style="list-style-type: none"> Open B tone hole. Close A\flat auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> Very clear quarter-tone pitch change. Stable intonation and easily sustained. Works well across all dynamic levels. Fingering easily executed.
E \sharp 4 J.R. *	<ul style="list-style-type: none"> Close A\flat auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> Very clear quarter-tone pitch change. Stable intonation and easily sustained. Fingering easily executed. Works well across all dynamic levels.
E \sharp 4 S.P.	<ul style="list-style-type: none"> Open C and B tone holes. Press down C\sharp flick (Left hand, first finger) key. 	<ul style="list-style-type: none"> Embouchure needs to be relaxed to find the quarter-tone intonation but due to the fingering the tone is very unstable resulting in a 'cracking' sound.

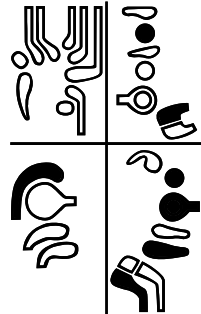
F \sharp 4 Possibilities

F \sharp 4 is built on the traditional fingering of F4:

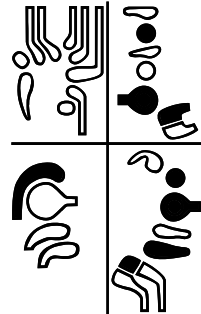
F4



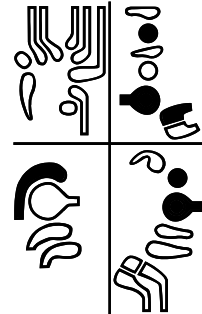
F \sharp 4 B.B.



F \sharp 4 J.R.



F \sharp 4 S.P.

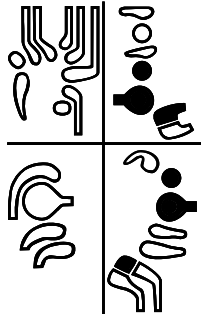


Quarter-tone	Execution	Result
F \sharp 4 B.B.	<ul style="list-style-type: none"> • Close both B\flat (Right hand, first finger) and A\flat auxiliary (Right hand, fifth finger) keys. • Open C tone. • Close G key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Embouchure needs to be adjusted to improve the intonation.
F \sharp 4 J.R.	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. • Close both F and G keys. 	<ul style="list-style-type: none"> • Fingering does not create the desired quarter-tone for the specific note.
F \sharp 4 S.P.*	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change with a dark tone. • Very stable intonation and sustainable across all dynamic levels. • Fingering easily executed.

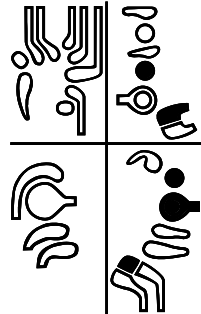
F#4 Possibilities

F#4 is built on the traditional fingering of F#4:

F#4

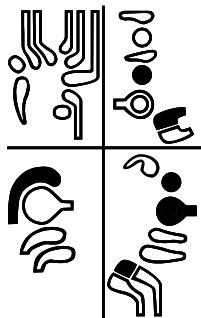


F#4

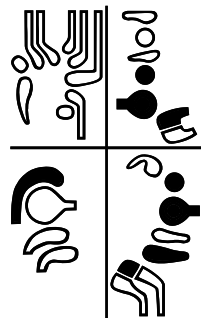


or

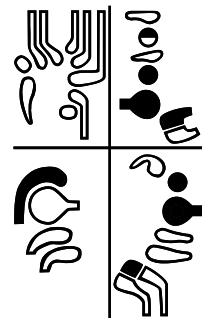
F#4 B.B.



F#4 J.R.



F#4 S.P.



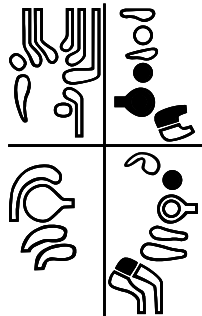
Quarter-tone	Execution	Result
F#4 B.B. *	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger). 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change with good intonation. • Easily sustainable on long quarter-tone. • Darker tone. • Fingering easily executed.
F#4 J.R. *	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger). 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change with good intonation.

	<ul style="list-style-type: none"> • Close G key. 	<ul style="list-style-type: none"> • Easily sustainable on long quarter-tone. • Fingering easily executed.
F#4 S.P. *	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger). • Half hole E tone hole. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change with good intonation. • Easily sustainable on long quarter-tone. • Fingering easily executed.

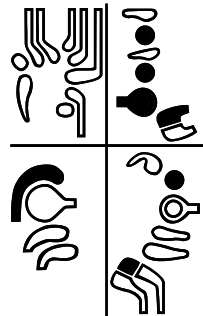
G♯4 Possibilities

G♯4 is built on the traditional fingering of G4:

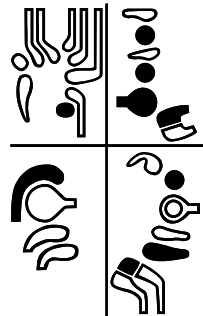
G4



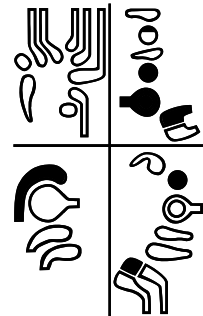
G♯4 B.B.



G♯4 J.R.



G♯4 S.P.

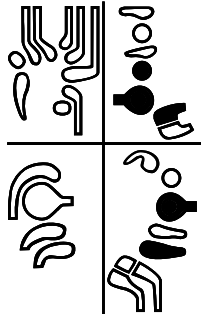


Quarter-tone	Execution	Result
G♯4 B.B.*	<ul style="list-style-type: none"> • Close B♭ auxiliary (Right hand, first finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Good intonation and sustainability on long quarter-tone. • Works across all dynamic levels. • Fingering easily executed.
G♯4 J.R.	<ul style="list-style-type: none"> • Close B♭ auxiliary (Right hand, first finger) key. • Close G key. 	<ul style="list-style-type: none"> • Fingering creates an uneven quarter-tone with oscillation in pitch. • Very difficult to control the tone and pitch.
G♯4 S.P. *	<ul style="list-style-type: none"> • Close B♭ auxiliary (Right hand, first finger) key. • Half hole E tone hole. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Good intonation and sustainability on long quarter-tone. • Works across all dynamic levels.

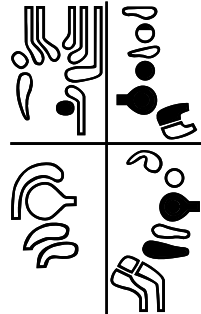
Ab♯4 Possibilities

Ab♯4 is built on the traditional fingering of Ab4:

Ab4

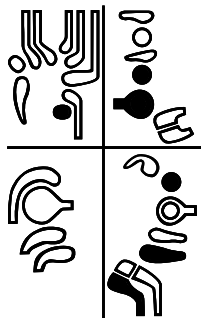


Ab4

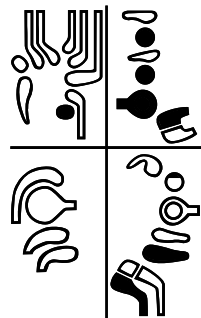


or

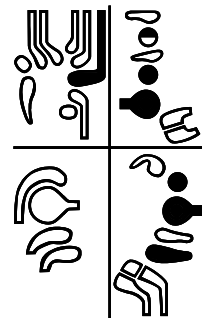
Ab♯4 B.B.



Ab♯4 J.R.



Ab♯4 S.P.



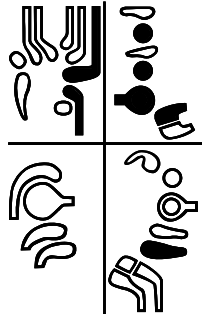
Quarter-tone	Execution	Result
Ab4 B.B.	<ul style="list-style-type: none"> Open both E and A tone hole. Close B tone hole. Close Ab auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change but unstable intonation. Oscillation in pitch due to embouchure adjustment.
Ab4 J.R.*	<ul style="list-style-type: none"> Half hole B tone hole. Close E tone hole. Close Ab auxiliary (Right hand, left hand) key. 	<ul style="list-style-type: none"> Clear quarter-tone pitch change. Good intonation with slightly bright tone.

		<ul style="list-style-type: none"> • Easily sustained and works across all dynamic levels. • Complexed fingering due to half holing of B tone hole.
A \flat 4 S.P.	<ul style="list-style-type: none"> • Half hole E tone hole. • Press down A flick (Left hand, first finger) key. 	<ul style="list-style-type: none"> • Muted version of A\flat4. • Some oscillation in pitch has been experienced. • Fingering easily executed.

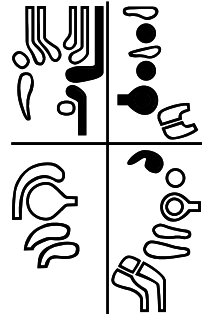
A \sharp 4 Possibilities

A \sharp 4 is built on the traditional fingering of A4:

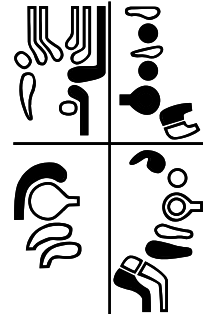
A4



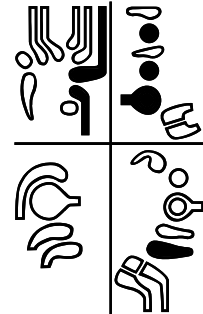
A \sharp 4 B.B.



A \sharp 4 J.R.



A \sharp 4 S.P.

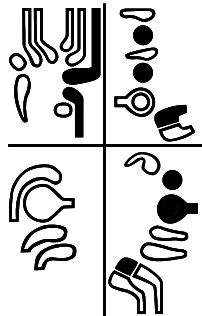


Quarter-tone	Execution	Result
A \sharp 4 B.B.	<ul style="list-style-type: none"> • Close C\sharp trill (Right hand, second finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Rounded sound and easily sustainable. • Difficulty with soft quarter-tone.
A \sharp 4 J.R.*	<ul style="list-style-type: none"> • Close B\flat (Right hand, first finger) and A\flat auxiliary (Right hand, fifth finger) keys. • Close C\sharp trill (Right hand, second finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Rounded sound and easily sustainable. • Works well across all dynamic levels. • Fingering easily executed.
A \sharp 4 S.P.	<ul style="list-style-type: none"> • Use traditional fingering. • Increase air speed and embouchure pressure. 	<ul style="list-style-type: none"> • Intonation unstable due to embouchure and air speed adjustment. • Not ideal for quarter-tone production.

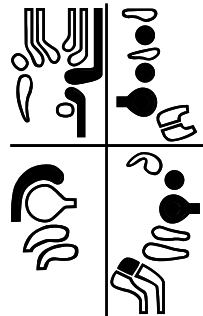
B \flat 4 Possibilities

B \flat 4 is built on the traditional fingering of B \flat 4:

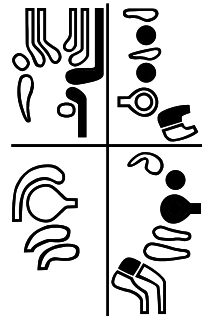
B \flat 4



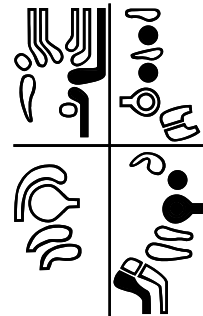
B \flat 4 B.B.



B \flat 4 J.R.



B \flat 4 S.P.

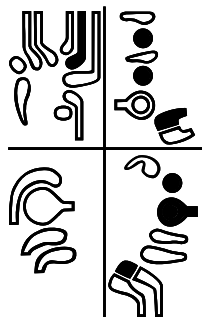


Quarter-tone	Execution	Result
B \flat 4 B.B.*	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. • Close C tone hole. • Open bottom D\sharp auxiliary (Left hand, fifth finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change with very good intonation. • Fingering easily executed. • Works well across all dynamic levels. • Long tone is easily sustainable.
B \flat 4 J.R.	<ul style="list-style-type: none"> • Open C tone hole. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change with very good intonation. • Works well across all dynamic levels. • Long tone is easily sustainable.
B \flat 4 S.P.	<ul style="list-style-type: none"> • Open F key. • Close A\flat auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change with very good intonation. • Works well across all dynamic levels. • Long tone is easily sustainable.

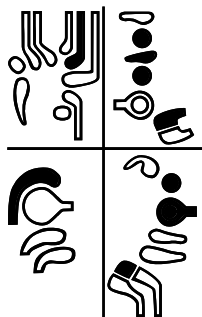
B \sharp 4 Possibilities

B \sharp 4 is built on the traditional fingering of B4:

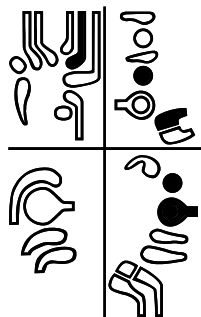
B4



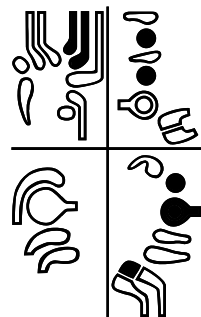
B \sharp 4 B.B.



B \sharp 4 J.R.



B \sharp 4 S.P.

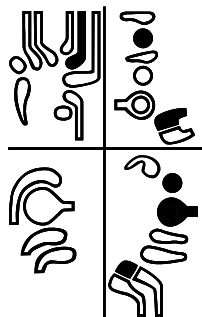


Quarter-tone	Execution	Result
B \sharp 4 B.B.	<ul style="list-style-type: none"> Press down both the E\flat auxiliary (Left hand, third finger) and B\flat auxiliary (Right hand, first finger) keys. 	<ul style="list-style-type: none"> Clear pitch change. Fingering can be tricky on some bassoons where the E\flat key is differently placed.
B \sharp 4 J.R. *	<ul style="list-style-type: none"> Open E tone-hole and lift F key. 	<ul style="list-style-type: none"> Clear pitch change. Clear quarter-tone over all dynamics.
B \sharp 4 S.P.	<ul style="list-style-type: none"> Press down D flick (Left hand, first finger) key. Open bottom D\sharp auxiliary (Left hand, fifth finger) key. 	<ul style="list-style-type: none"> Increased airspeed needed to precisely execute the quarter-tone. I have experienced that the fingering works best when the E tone hole is open and not closed as explained by S.P.

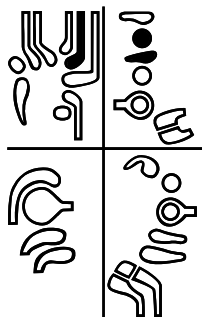
C♯5 Possibilities

C♯5 is built on the traditional fingering of C5:

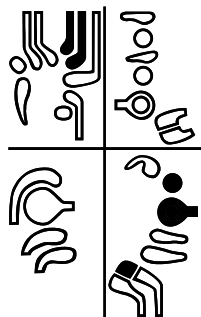
C5



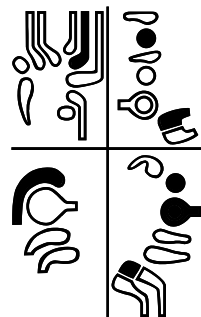
C♯5 B.B.



C♯5 J.R.



C♯5 S.P.



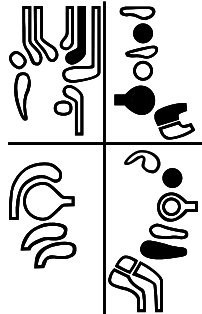
Quarter-tone	Execution	Result
C♯5 B.B.*	<ul style="list-style-type: none"> • Close E♭ trill (Left hand, third finger) key. • Open B and A tone hole. • Open F key. • Open bottom D♯ auxiliary (Left hand, fifth finger). 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Good intonation. • Fingering is easily executed. • The traditional fingering on the right hand can be included to mute the pitch.
C♯5 J.R.	<ul style="list-style-type: none"> • Open E tone hole. • Press down D flick (Left hand, first finger) key. • Open bottom D♯ auxiliary (Left hand, fifth finger). 	<ul style="list-style-type: none"> • Good quarter-tone pitch change. • More airspeed and embouchure pressure needed to raise the pitch. • Good fingering. • Tone has a muted quality. • Not good for extreme dynamics as pitch changes with different airspeeds.

C♯5 S.P.	<ul style="list-style-type: none">• Close B♭ auxiliary (Right hand, first finger) key.	<ul style="list-style-type: none">• Fingering works but increased airspeed and embouchure pressure needed.• Oscillation of pitch as result of increased air pressure.
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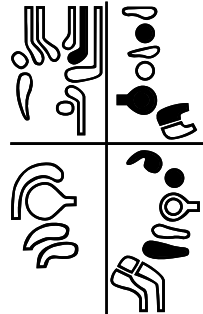
C#±5 Possibilities

C#±5 is built on the traditional fingering of C#5:

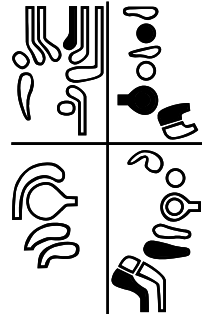
C#5



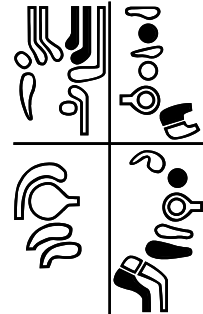
C#±5 B.B.



C#±5 J.R.



C#±5 S.P.

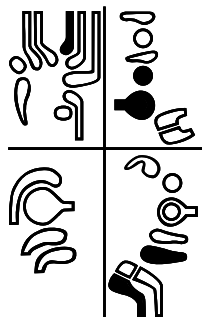


Quarter-tone	Execution	Result
C#±5 B.B.	<ul style="list-style-type: none"> • Close C# trill (Right hand, second finger) key. 	<ul style="list-style-type: none"> • Complexed fingering • Pitch changes after the note 'speaks'. • Not desirable fingering.
C#±5 J.R. *	<ul style="list-style-type: none"> • Open B tone hole. • Close A\flat auxiliary (Right hand, fifth finger) key. • Open C flick key and press down D flick (Left hand, first finger) key. 	<ul style="list-style-type: none"> • Clear quarter-tone pitch change. • Fingering easily executed. • Fingering works well with neighbouring fingerings. • Works well across all dynamics.
C#±5 S.P.	<ul style="list-style-type: none"> • Open C tone hole. • Close A\flat auxiliary (Right hand, fifth finger) key. • Press down D flick (Left hand, first finger) key. 	<ul style="list-style-type: none"> • Great amount of embouchure pressure needed to execute to desired effect. • Tone unstable due to excessive embouchure pressure. • Will work with a much shorter reed.

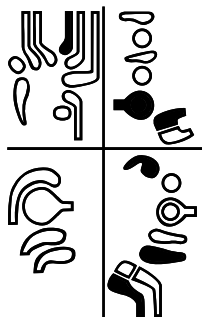
D♯5 Possibilities

D♯5 is built on the traditional fingering of D5:

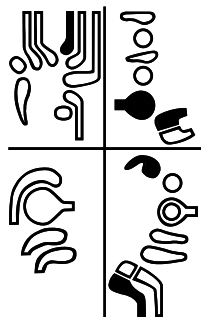
D5



D♯5 B.B.



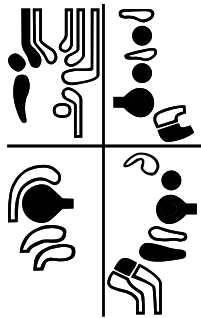
D♯5 J.R.



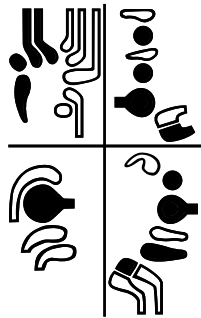
Quarter-tone	Execution	Result
D♯5 B.B. *	<ul style="list-style-type: none"> • Open A, B and D tones hole. • Close C♯ trill (Right hand, second finger) key. • Close G key. • Open F key and close A♭ auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> • Very clear quarter-tone pitch change. • Fingering easily executed. • Works well with neighbouring fingerings • Works well across all dynamic levels.
D♯5 J.R. *	<ul style="list-style-type: none"> • Open A, B and D tones hole. • Close C♯ trill (Right hand, second finger) key. • Open F key and close A♭ auxiliary (Right hand, fifth finger) key. 	<ul style="list-style-type: none"> • Very clear quarter-tone pitch change. • Fingering easily executed • Works well with neighbouring fingerings • Works well across all dynamic levels.

Quintpartite-tone bassoon fingerings charts:

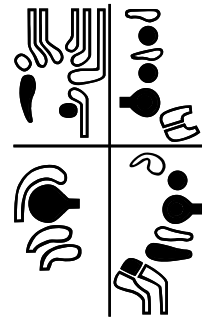
C#2 (Traditional fingering)



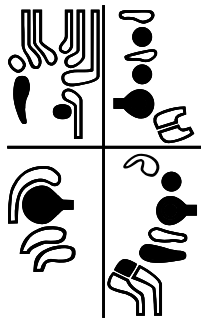
D \flat 2



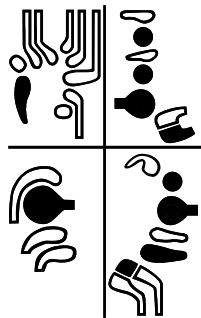
D \flat [^]2



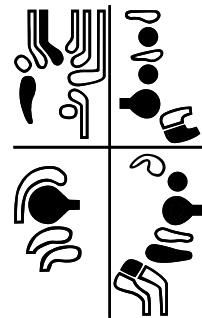
D2 (Traditional fingering)



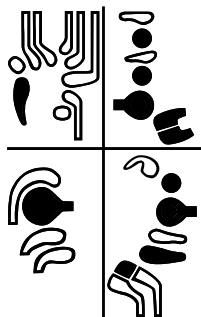
D2[^]



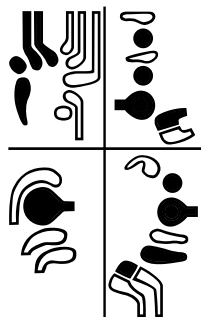
D#2



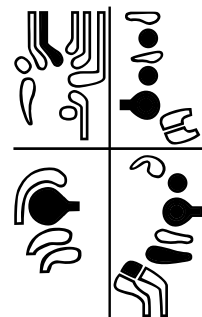
E \flat 2



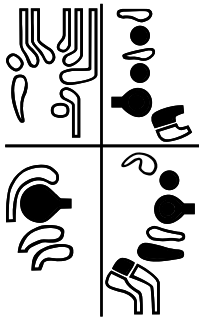
E \flat 2[^] (B,C and D 1/2 closed)



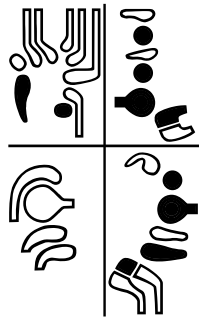
E2



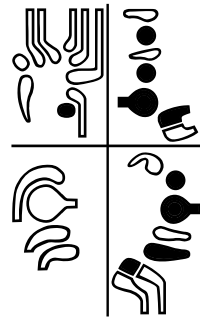
E2^



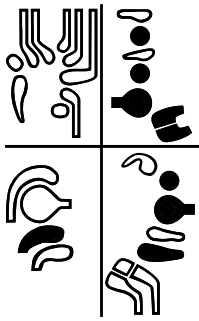
Fb2^



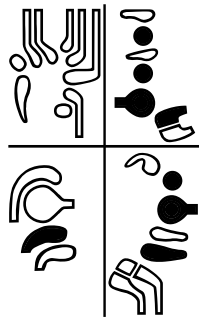
F2



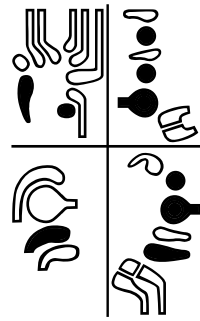
F2^



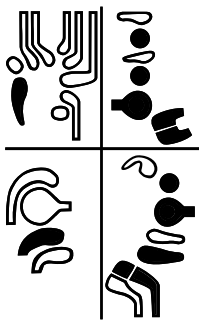
F#2



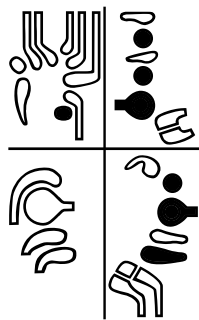
Gb2



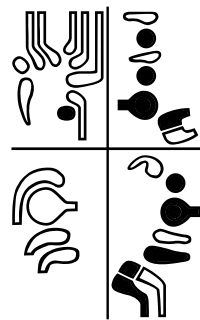
Gb2^



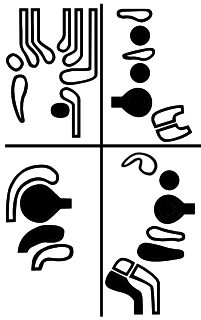
G2 (Traditional fingering)



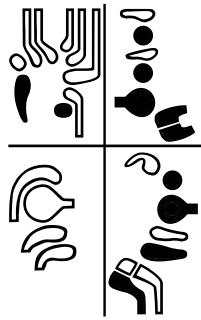
G2^ (Blow flat)



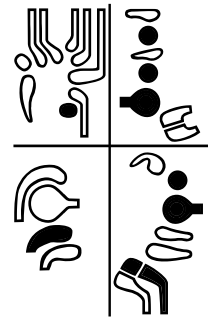
G#2



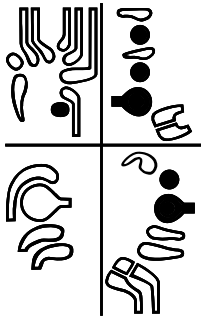
A \flat 2



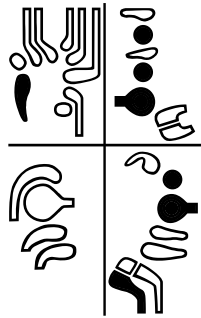
A \flat 2 \wedge



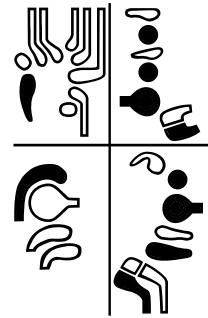
A2 (Traditional fingering)



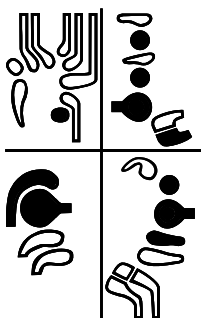
A2 \wedge



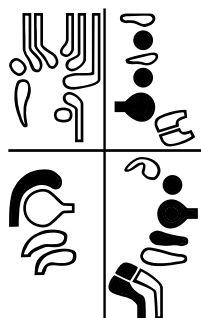
A#2



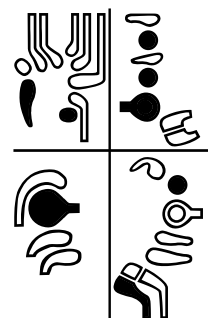
B \flat 2



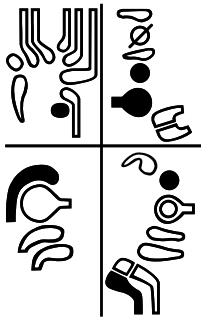
B \flat 2 \wedge



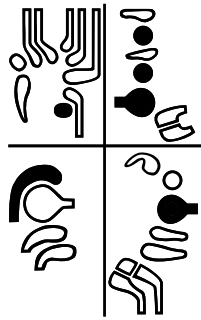
B2



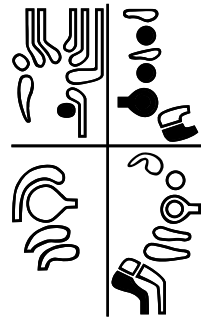
C \flat 3



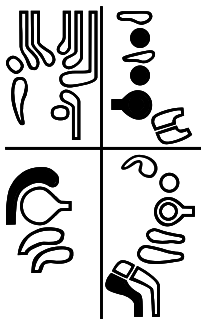
C \flat 3 \wedge



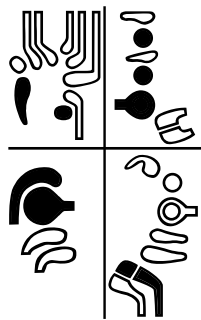
C3



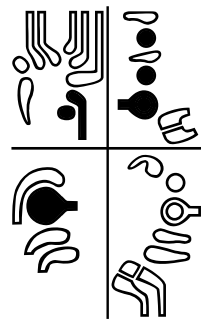
C3 \wedge



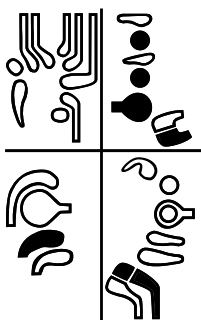
C#3



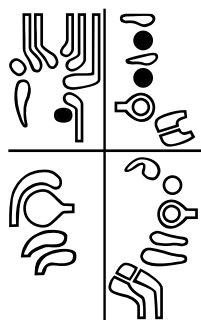
D \flat 3



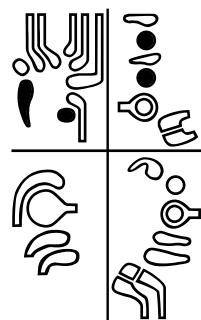
D \flat 3 \wedge



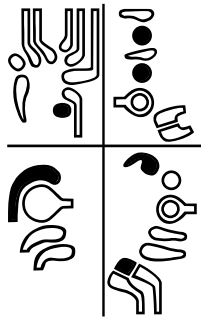
D3 (Traditional fingering)



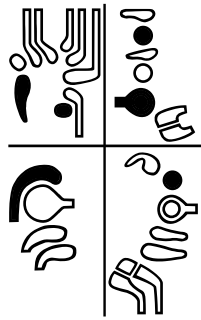
D3 \wedge



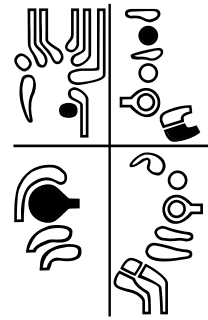
D#3



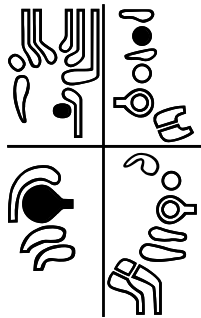
E♭3 (Traditional fingering)



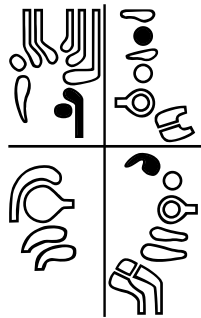
E♭3^



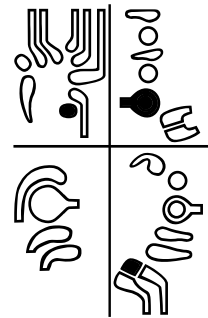
E3



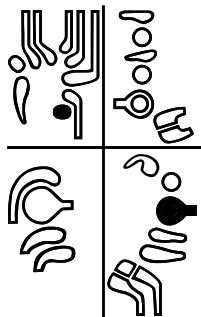
E3^



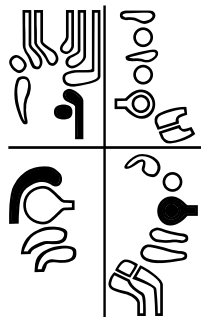
F♭3^



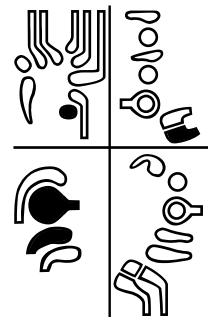
F3



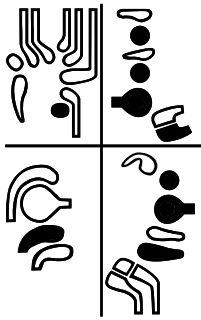
F3^



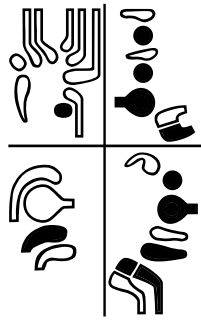
F#3



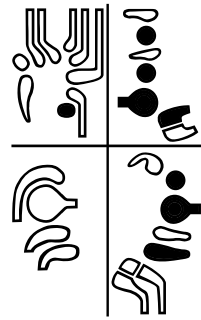
G \flat 3



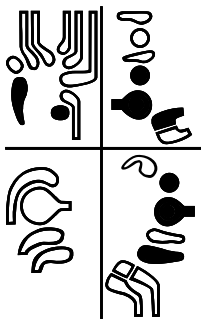
G \flat 3 $^\wedge$



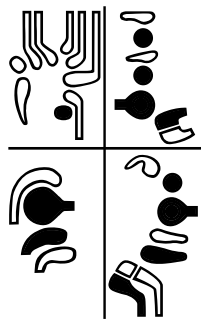
G3



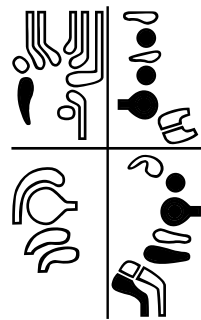
G3 $^\wedge$



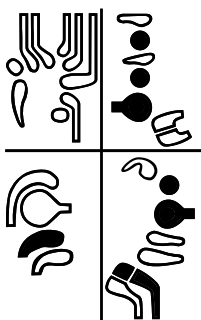
G#3



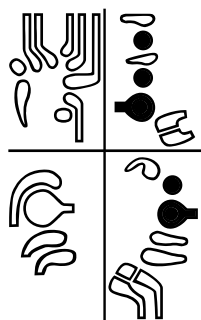
A \flat 3



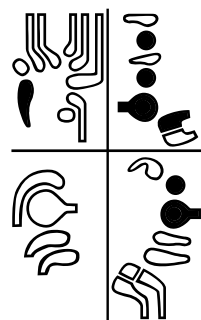
A \flat 3 $^\wedge$



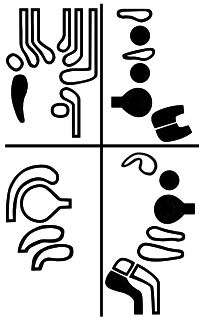
A3 (Traditional fingering)



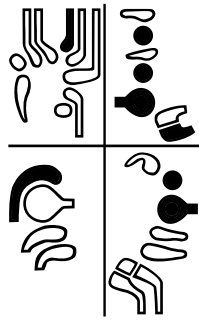
A3 $^\wedge$



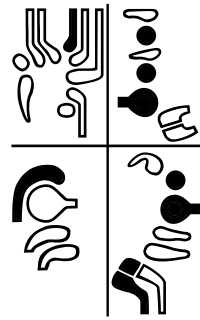
A#3



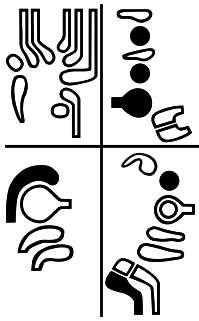
Bb3



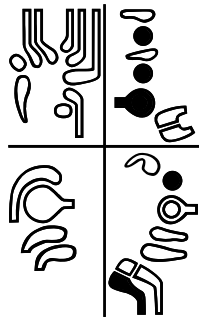
Bb3^



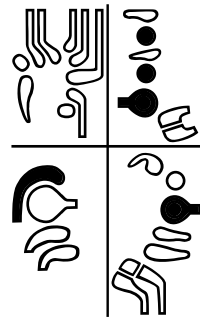
B3



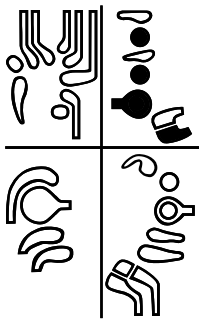
Cb4



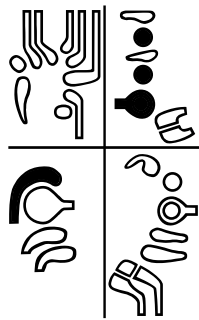
Cb4^



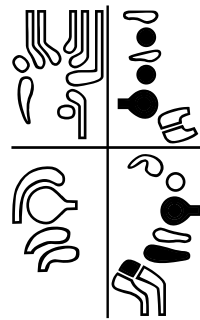
C4



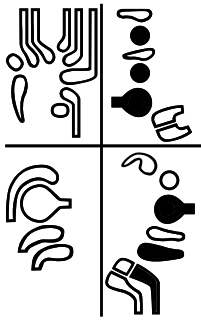
C4^



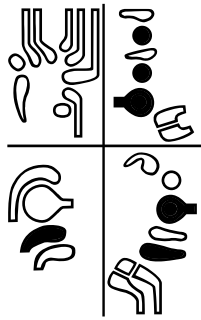
C#4



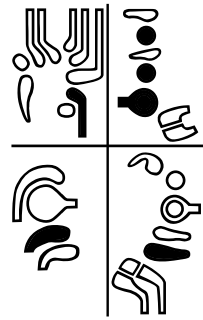
D \flat 4



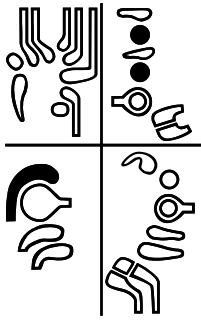
D \flat 4



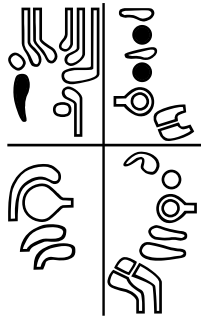
D \flat 4 $^\wedge$



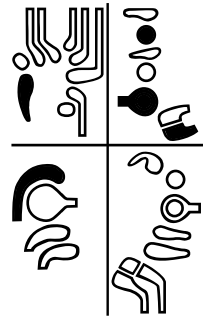
D4



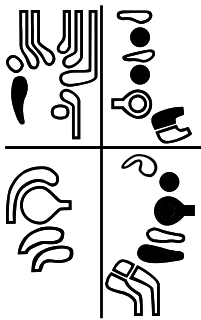
D4 $^\wedge$



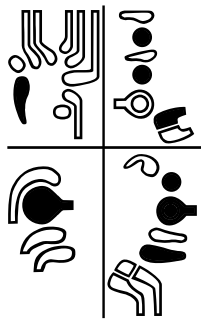
D#4



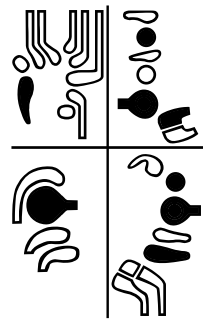
E \flat 4



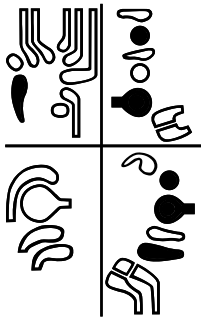
E \flat 4 $^\wedge$



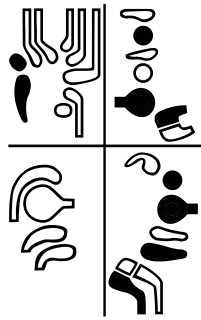
E4



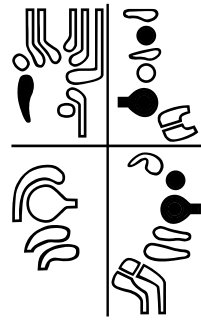
E4^



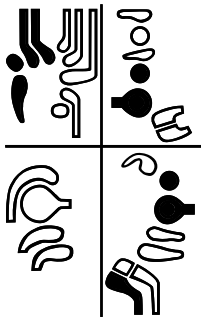
Fb4^



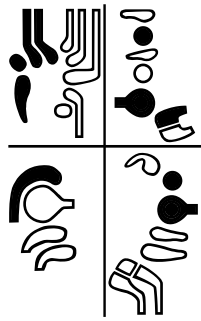
F4



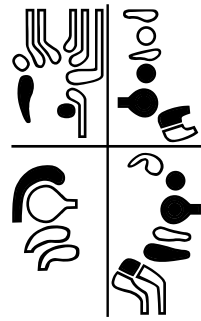
F4^



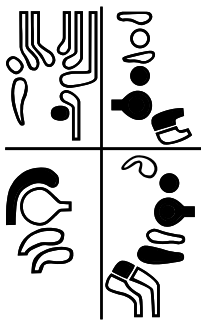
F#4



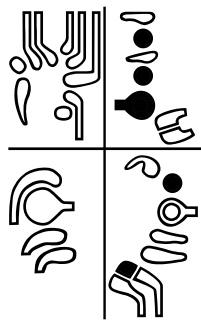
Gb4



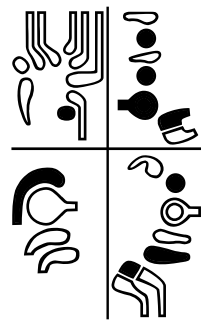
Gb4^



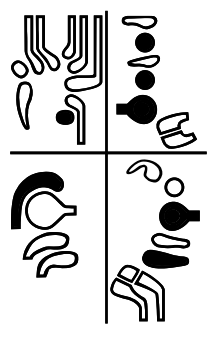
G4



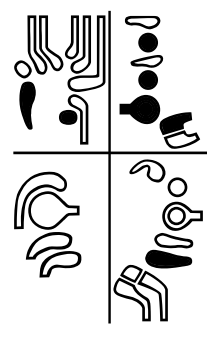
G4^



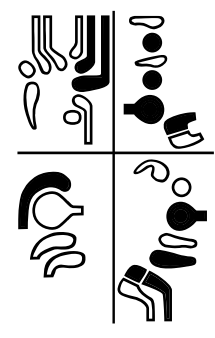
G#4



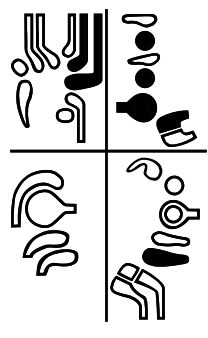
A \flat 4



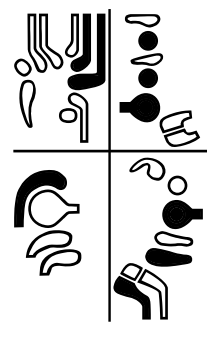
A \flat 4 \wedge



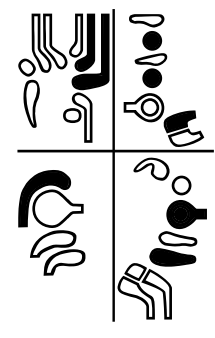
A4 (Traditional fingering)



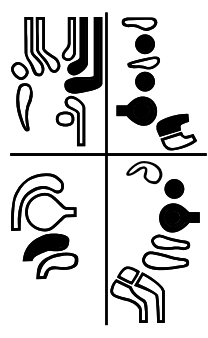
A4 \wedge



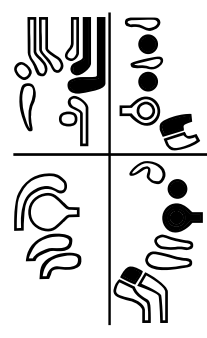
A#4



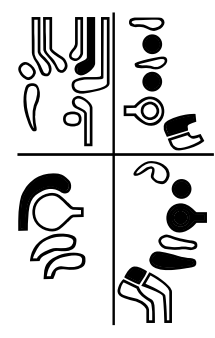
B \flat 4



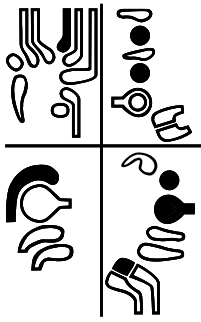
B \flat 4 \wedge



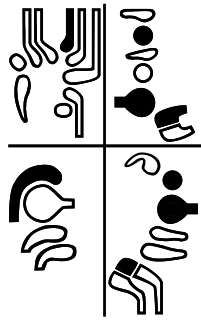
B4



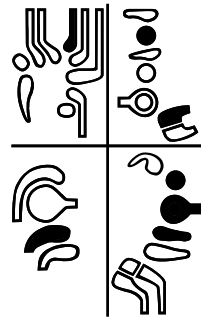
C \flat 5



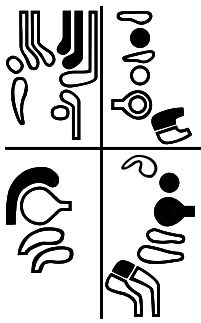
C \flat 5 $^\wedge$



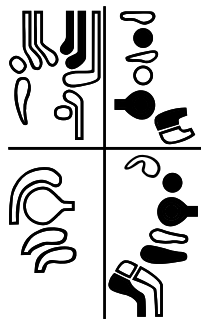
C5



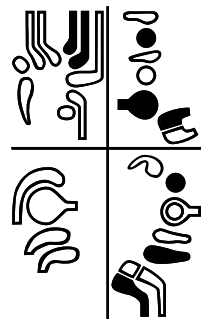
C5 $^\wedge$



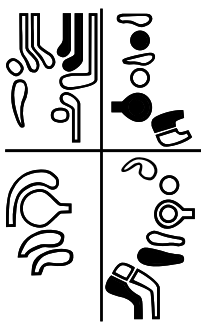
C#5



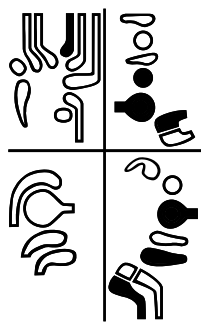
D \flat 5



D \flat 5 $^\wedge$



D5 (Traditional fingering)



Appendix C

Multiphonic Bassoon Fingerings

The following multiphonic bassoon fingering charts indicate:

- Execution of fingering
- Registered frequency
- Audible tones and audible microtones
- Dynamic level at which multiphonics can be executed
- Track number corresponding with Appendix E (Compact discs A and B)

B \flat possibilities

The following multiphonic possibilities are developed out of the traditional fingering of B \flat 1.

B \flat - 1	B \flat - 2	B \flat - 3	B \flat - 4

Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	A1	<ul style="list-style-type: none"> • Lift E key. • Tighten embouchure slightly to start the multiphonic. 	E2	E3, F3, G3, C4 and F4		<i>mf - ff</i>
2	A2	<ul style="list-style-type: none"> • Lift both E and F key. • Open A tone hole. 	A2 and B2	B2, D3, B3, C4	G4 and B4	<i>pp - ff</i>

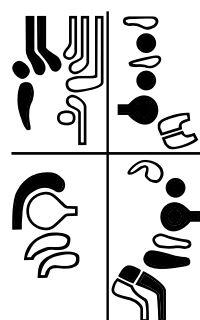
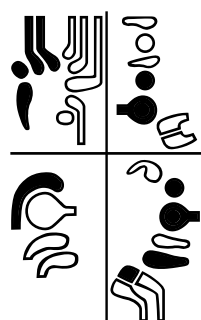
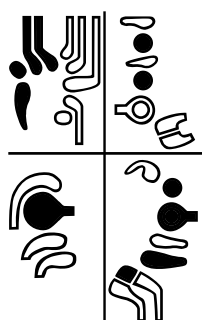
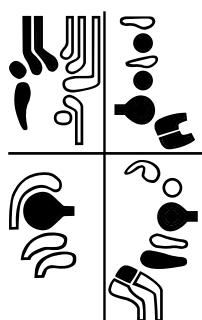
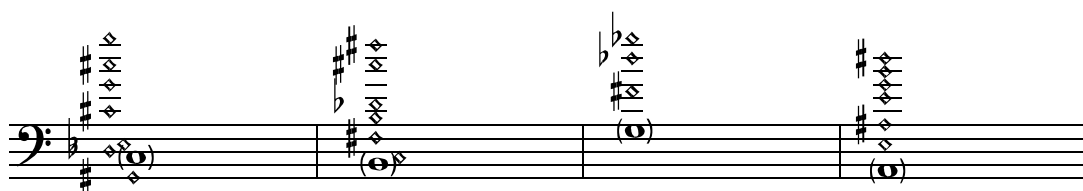
		<ul style="list-style-type: none"> Multiphonic speaks easily. 		and D \flat 4		
3	A3	<ul style="list-style-type: none"> Lift E key. Add B\flat auxiliary (Right hand first) key. Pitch will change if dynamic is too loud. 	B1	A3 and D2	A \sharp 2, A3, D \sharp 3 and D6	<i>pp - ff</i>
4	A4	<ul style="list-style-type: none"> Lift F key. Air speed and embouchure tension must be adjusted for the multiphonic to speak. 	B2	F2, B \flat 3 and F4	C3	<i>pp - p</i>

B \flat - 5

B \flat - 6

B \flat - 7

B \flat - 8



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	A5	<ul style="list-style-type: none"> Open B tone hole. Close bottom C\sharp auxiliary (Left hand, fifth finger) key. A good amount of air speed needs to be provided. 	C3	G \sharp 3, D \flat 3, E \flat 3, C \sharp 4	G4, C \sharp 5 and G5	<i>mf - ff</i>

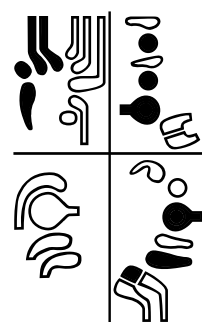
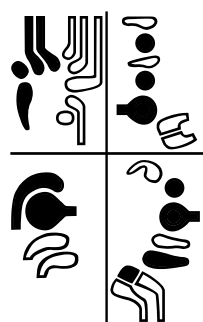
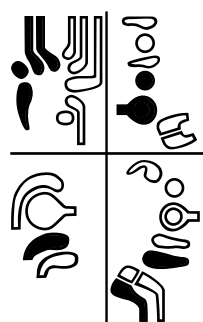
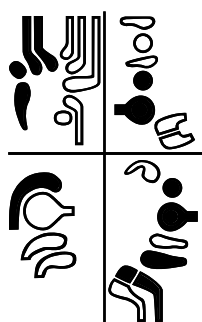
6	A6	<ul style="list-style-type: none"> Open C tone hole. Easily achieved. 	B2	C3, B3, D \flat 4 and C#5	F#3 and F#5	<i>pp - ff</i>
7	A7	<ul style="list-style-type: none"> Open E key. Open E tone hole. Close B\flat auxiliary (Right hand, first finger) key. Embouchure pressure needs to be adjusted till multiphonic speaks. 	G3	F#4	D \flat 5 and F#5	<i>mf - ff</i>
8	A8	<ul style="list-style-type: none"> Open E key. Close F# auxiliary (Right hand, fifth finger) key. 	A2	E3, E4, G4 and B4	A#3 and D#5	<i>mf - ff</i>

B \flat - 9

B \flat - 10

B \flat - 11`

B \flat - 12



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
9	A9	<ul style="list-style-type: none"> Open E key. Close both B\flat auxiliary (Right 	G#2	D#3, G4,	G \flat 4	<i>mf - f</i>

		<p>hand, first finger) and F# auxiliary (Right hand, fifth finger) keys.</p> <ul style="list-style-type: none"> • Open E tone hole. 		B \flat 3, C4 and C5		
10	A10	<ul style="list-style-type: none"> • Open E key. • Close both F# auxiliary (Right hand, first finger) and A\flat auxiliary (Right hand, fifth finger) keys. • Open E, A and B tone holes. • Embouchure pressure must be adjusted. • Multiphonic tones will not work in soft dynamics. 	D3	B2, F#3, D \flat 4 and A \flat 4	C4 and D \flat 5	<i>f - ff</i>
11	A11	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. • First finger needs to press down on both the bottom E and B\flat auxiliary keys. 	D \flat 2	F#2, F#3 and A \flat 4	A2 D4, and D5	<i>p - ff</i>
12	A12	<ul style="list-style-type: none"> • Open E key. • Open B tone hole. • Embouchure must be fully relaxed and just seal the reed sides. • Does not work in soft dynamics. 	B2		F#3, D#4, A \flat 4 and D#5	<i>f - ff</i>

B Possibilities

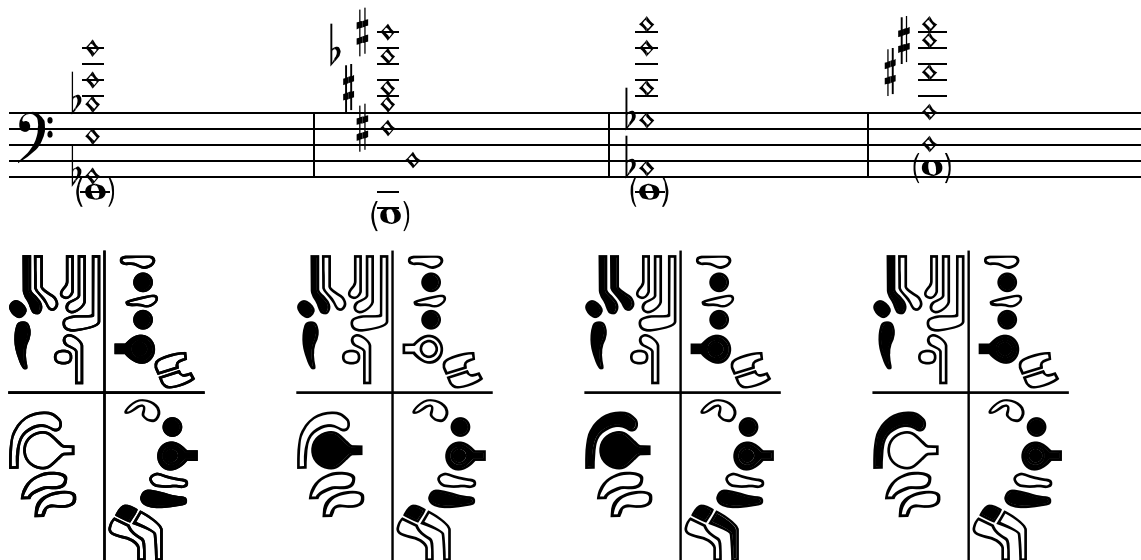
All the following multiphonic possibilities are developed out of the traditional fingering for B1.

B - 1

B - 2

B - 3

B - 4



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	A13	<ul style="list-style-type: none"> Open E key. Good amount of embouchure pressure and airtspeed required. 	E2	G \flat 2 and B \flat 3	E3, E4 and B4	<i>mf - ff</i>
2	A14	<ul style="list-style-type: none"> Open C tone hole. 	B1	F \sharp 3, D \sharp 4, A \flat 4 and D \sharp 5	B2 and B3	<i>pp - ff</i>
3	A15	<ul style="list-style-type: none"> Close B\flat auxiliary (Right hand, first finger) key. First finger needs to press down on both the bottom E and B\flat auxiliary keys. 	E2	A \flat 2 and B4	G \flat 3, D4 and D5	<i>pp - ff</i>
4	A16	<ul style="list-style-type: none"> Open E key. 	A2	A3, F \sharp 4 and C \sharp 5	D3 and E5	<i>pp - ff</i>

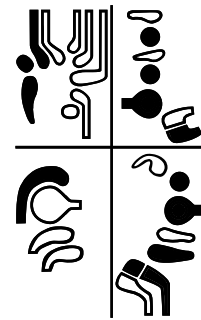
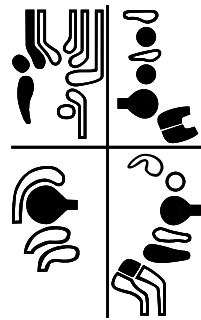
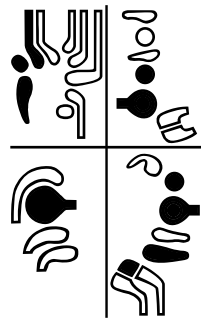
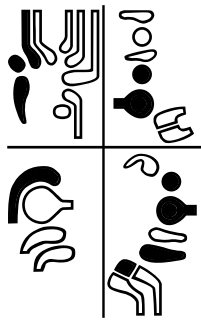
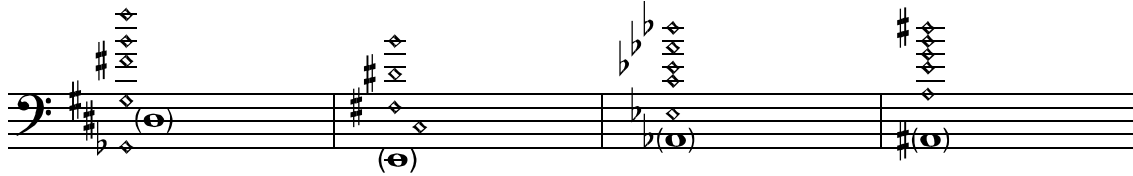
		<ul style="list-style-type: none"> Close B\flat auxiliary (Right hand, first finger) key. 			
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B - 5

B - 6

B - 7

B - 8



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	A17	<ul style="list-style-type: none"> Open E key. Close B\flat auxiliary (Right hand, first finger) key. Open E tone hole. Control over embouchure pressure and air speed is advisable during dynamic changes. 	D#3	G#3 and F#4	G \flat 2, B4 and F5	<i>pp - ff</i>
6	A18	<ul style="list-style-type: none"> Open E tone hole. Focus on air speed control. Do not over blow. 	E \flat 2	C3, F#3, D#4 and B4		<i>pp - mf</i>
7	A19	<ul style="list-style-type: none"> Open B tone hole. 	A \flat 2	E \flat 3, C4, E \flat 4	D \flat 5	<i>pp - p</i>

		<ul style="list-style-type: none"> • Close both bottom C# and D# auxiliary (Left hand, fifth finger) key. 		and A \flat 4		
8	A20	<ul style="list-style-type: none"> • Open E key. • Close B\flat auxiliary (Right hand, first finger), F# auxiliary (Right hand, fifth finger) and bottom C# auxiliary (Left hand fifth finger) keys. • Embouchure pressure needed in soft dynamics. 	A2	D5	A3, E4, G4 and B4	<i>pp - ff</i>

C2 Possibilities:

All the following multiphonic possibilities are developed out of the traditional fingering of C2

C - 1

C - 2

C - 3

C - 4

The image displays four multiphonic possibilities for the C2 note, labeled C-1, C-2, C-3, and C-4. Each possibility is represented by a musical staff in bass clef showing a C2 note with specific fingerings and a corresponding diagram of the saxophone keys and embouchure. The diagrams illustrate the fingerings for the right and left hands and the embouchure pressure and air speed adjustments.

Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	A21	<ul style="list-style-type: none"> Open E tone hole. 	C2	C#3, G#3, C#4, B \flat 4 and C#5		<i>pp - ff</i>
2	A22	<ul style="list-style-type: none"> Open E tone hole. Close both B\flat auxiliary (Right hand, first finger) and F# auxiliary (Right hand, fifth finger) keys. Embouchure pressure and air speed needs to be adjusted till multiphonic is stable. 	E2	D4, F#4 and G \flat 5	A \flat 3, B4 and D5	<i>mf - ff</i>

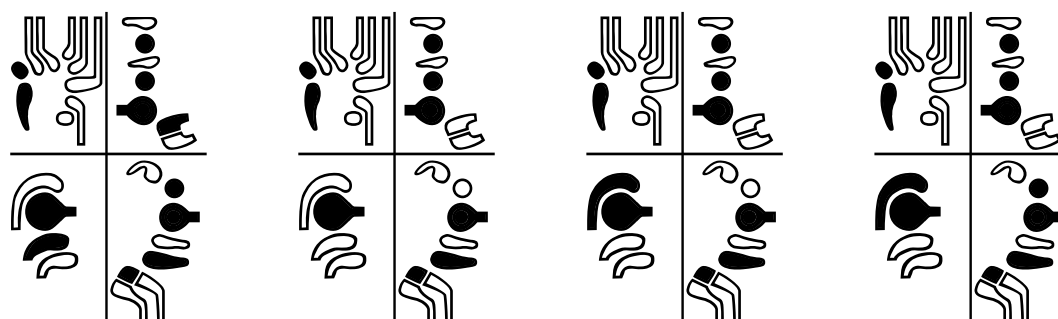
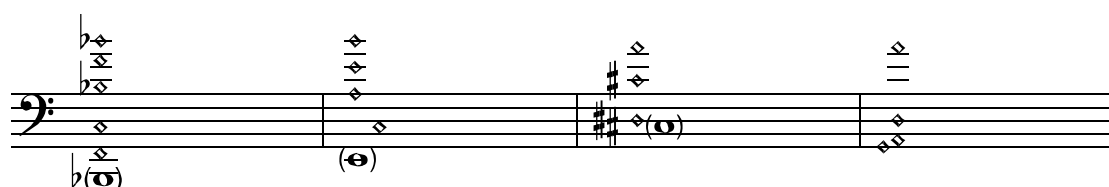
3	A23	<ul style="list-style-type: none"> Close bottom D# auxiliary (Left hand, fifth finger) key. 	D2	D#3, Bb3, D#4 and E4	G4 and B4	<i>mf - ff</i>
4	A24	<ul style="list-style-type: none"> Close Bb auxiliary (Right hand, first finger) key. Embouchure can be slightly relaxed to open the possibility of more audible tones. More tones can be produced in louder dynamics with more air speed. 	F2	D2, G2, Ab2, F3, G3, D4, F#4 and G4	A3 and Bb4	<i>p - ff</i>

C - 5

C - 6

C - 7

C - 8



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	A25	<ul style="list-style-type: none"> Close front F# auxiliary (Right hand, first finger) key. Embouchure pressure needed. 	Bb1	F2, C3 and Bb4	Bb3 and F4	<i>pp - p</i>

6	A26	<ul style="list-style-type: none"> Open B tone hole. 	E2	C2, A3 and B4	G4	<i>p - f</i>
7	A27	<ul style="list-style-type: none"> Open B tone hole. Close B\flat auxiliary (Right hand, first finger) key. 	C3	D \sharp 3, C \sharp 4 and A4		<i>f - ff</i>
8	A28	<ul style="list-style-type: none"> Close B\flat auxiliary (Right hand, first finger) key. 	No registered pitch	G2 and A2	D3 and A4	<i>pp - mf</i>

C# Possibilities

All the following multiphonic possibilities are developed out of the traditional C#2 fingering.

C# - 1 **C# - 2** **C# - 3** **C# - 4**

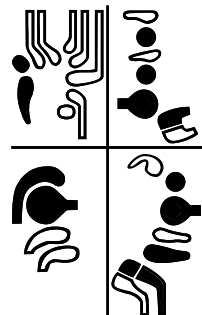
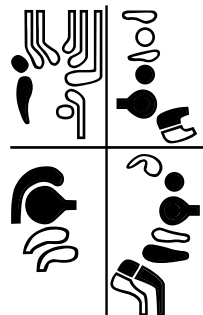
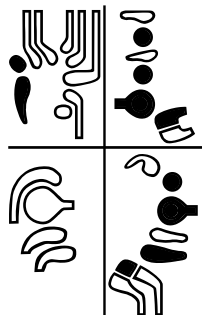
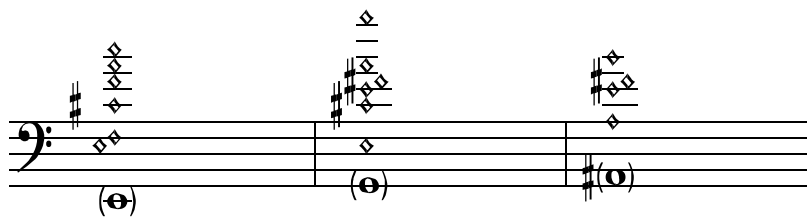
The image displays four multiphonic possibilities for the C#2 fingering. Each possibility is represented by a musical staff in bass clef and a corresponding fingering diagram. The diagrams show the right hand (RH) and left hand (LH) fingerings for each possibility.

Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	A29	<ul style="list-style-type: none"> Close F# auxiliary (Right hand, fifth finger) key. 	F#2	F#3, C#4, F#4 and E5	A4	<i>mf - ff</i>
2	A30	<ul style="list-style-type: none"> Open E key. Close B\flat auxiliary (Right hand, first finger) and F# auxiliary (Right hand, fifth finger) keys. Close bottom D# key. 	C2	A#2, C4, G4 and C5	E5	<i>pp - ff</i>
3	A31	<ul style="list-style-type: none"> Close B\flat auxiliary (Right hand, first finger) key. Close bottom D# key. 	G#2	F#4	E3, A \flat 3 and B \flat 4	<i>p - f</i>
4	A32	<ul style="list-style-type: none"> Close bottom D# key. 	F2	C3, A3, C4 and F4	B4	<i>mf - ff</i>

C# - 5

C# - 6

C# - 7



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	A33	<ul style="list-style-type: none"> Lift E key. Close bottom D# key. 	E2	F3, C#4 and C5	A4	<i>f - ff</i>
6	A34	<ul style="list-style-type: none"> Open E tone hole. Close B\flat auxiliary (Right hand, first finger) key. Use right hand, first finger to close both the auxiliary as well as the E key. Close bottom D# key. Close F# auxiliary (Right hand, fifth finger) key. 	G2	A3, C#4, E4 and C5	F#4, A4 and G5	<i>p - mf</i>
7	A35	<ul style="list-style-type: none"> Close B\flat auxiliary (Right hand, first finger) key. Use righty hand, first finger to close both the auxiliary as well as the E key. Close bottom D# key. 	A#2	A3 and F#4	E4 and B4	<i>mf - f</i>

		<ul style="list-style-type: none">• Close F# auxiliary (Right hand, fifth finger) key.				
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D Possibilities

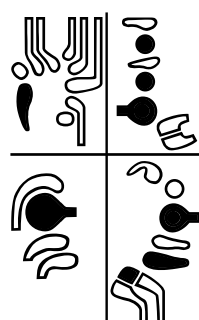
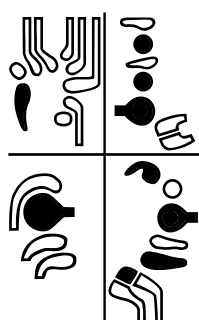
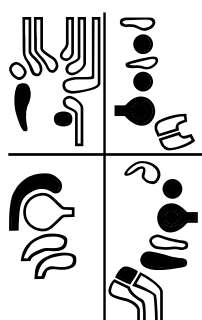
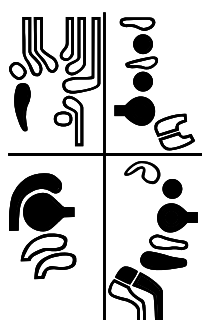
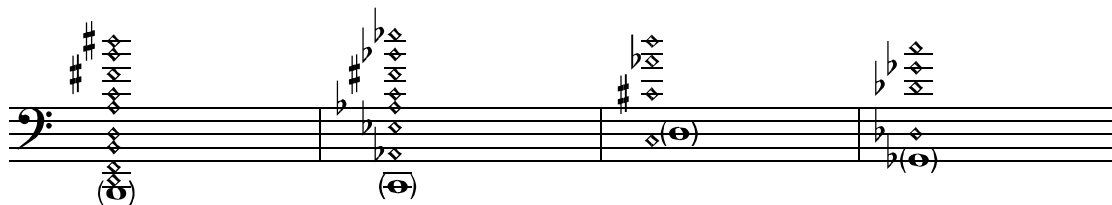
All the following multiphonic possibilities are developed out of the traditional D2 fingering.

D - 1

D - 2

D - 3

D - 4

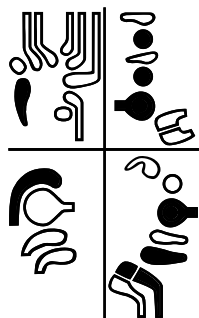
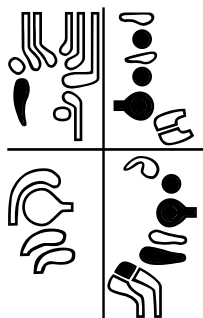
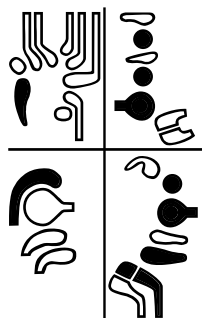
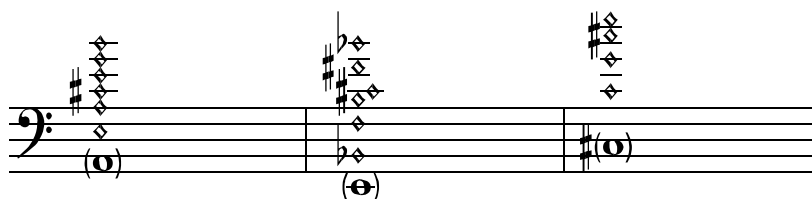


Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	A36	<ul style="list-style-type: none"> Close both B\flat auxiliary (Right hand, first finger) and F\sharp auxiliary (Right hand, fifth finger) keys. 	B1	D2, F2, B2, D3, A3, C4, F \sharp 4, B4 and D \sharp 5		<i>p - ff</i>
2	A37	<ul style="list-style-type: none"> Open E key. Close B\flat auxiliary (Right hand, first finger) key. 	C2	E \flat 3, C4, F \sharp 4 and E \flat 5	A \flat 2, A \flat 3 and B \flat 4	<i>mf - f</i>
3	A38	<ul style="list-style-type: none"> Open B tone hole. Close C\sharp trill (Right hand, second finger) key. 	D3	C3 and C \sharp 4	A \flat 4 and D5	<i>pp - ff</i>
4	A39	<ul style="list-style-type: none"> Open B tone hole. 	G \flat 2	G \flat 4	D \flat 3, D \flat 4 and C5	<i>p - mf</i>

D - 5

D - 6

D - 7



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	A40	<ul style="list-style-type: none"> Open E key. Close both B\flat auxiliary (Right hand, first finger) and F\sharp auxiliary (Right hand, fifth finger) keys. Airspeed should be controlled to create a balanced multiphonic. 	A2	E3, A3, C \sharp 4, E4, G4, and B4		<i>pp - p</i>
6	A41	<ul style="list-style-type: none"> Open E key. 	E2	C4, F \sharp 4 and B \flat 4	B \flat 2, F3 and B3	<i>mf - ff</i>
7	A42	<ul style="list-style-type: none"> Open both E key and B tone hole. Close both B\flat auxiliary (Right hand, first finger) and F\sharp auxiliary (Right hand, fifth finger) keys. 	C \sharp 3		C4, G4, C \sharp 5 and E5	<i>p - f</i>

E \flat Possibilities

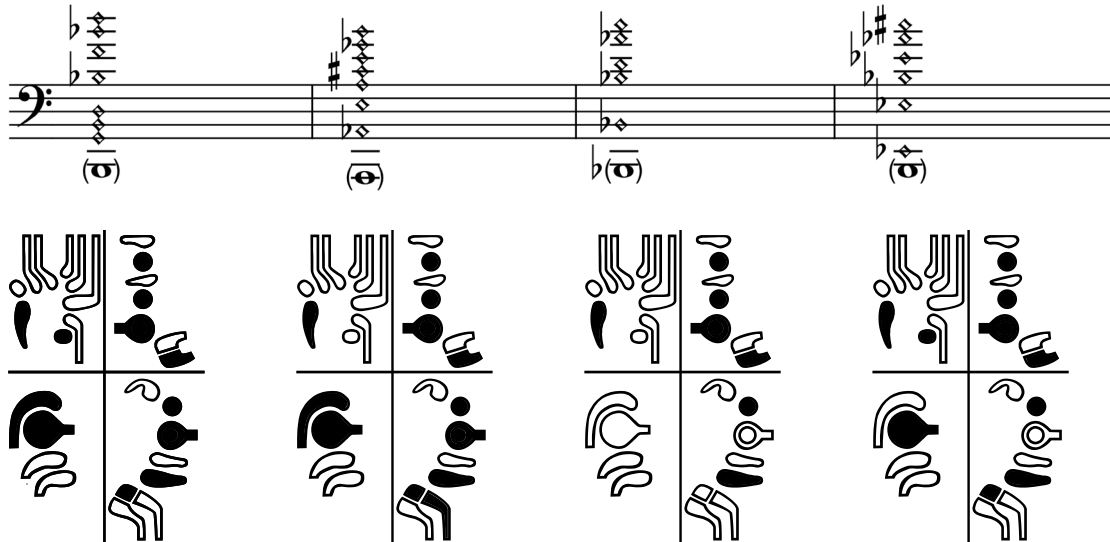
All the following multiphonic possibilities are developed out of the traditional fingering of E \flat 2.

E \flat - 1

E \flat - 2

E \flat - 3

E \flat - 4



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	A43	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. • First finger needs to close both the B\flat and E key 	B1	G2, B2, D3, B \flat 3, F4 and D5	B \flat 4	<i>pp - ff</i>
2	A44	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. • First finger needs to close both the B\flat and E key. • Close the F\sharp auxiliary (Right hand, fifth finger) key. 	A1	E3, A3, E4 and B4	A \flat 2, C \sharp 4 and G \flat 4	<i>pp - ff</i>
3	A45	<ul style="list-style-type: none"> • Open the E key. • Close the G key. 	B \flat 1	D4, A \flat 4 and C5	B \flat 2 and B \flat 3	<i>pp - ff</i>
4	A46	<ul style="list-style-type: none"> • Close both the F and G keys. 	B1	E \flat 2, E \flat 3,		<i>pp - ff</i>

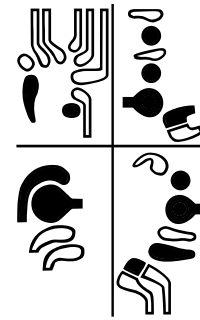
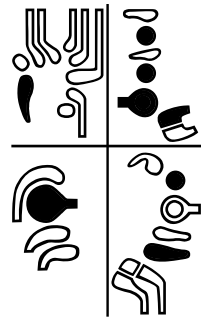
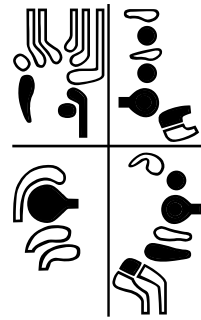
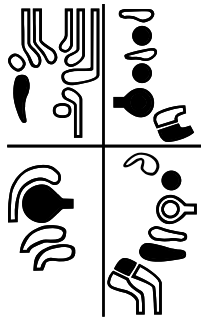
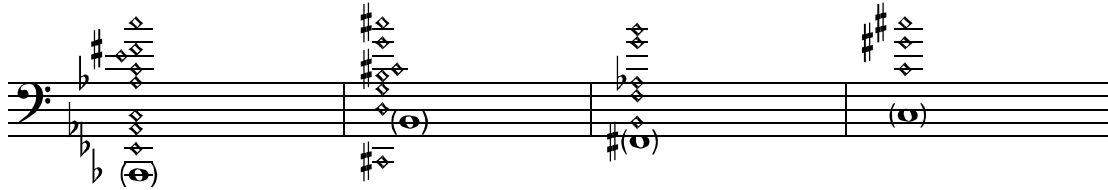
				B \flat 3, E \flat 4, A \flat 4 and C \sharp 5	
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E \flat - 5

E \flat - 6

E \flat - 7

E \flat - 8



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	A47	<ul style="list-style-type: none"> Open A tone hole. 	A \flat 1	E \flat 2, A \flat 2, C3, A \flat 3, C4, E4, F \sharp 4, and C5		<i>mf - ff</i>
6	A48	<ul style="list-style-type: none"> Close C\sharp flick (Left hand, first finger) key. 	B2	C \sharp 2, D3, B3 and C \sharp 4	G4 and C \sharp 5	<i>mf - ff</i>

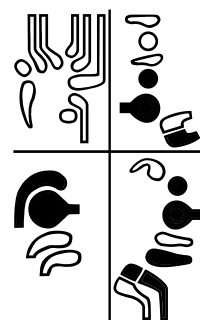
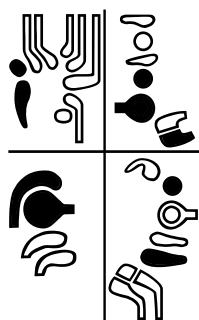
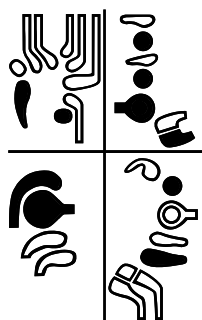
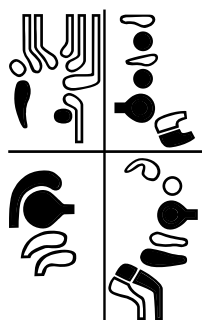
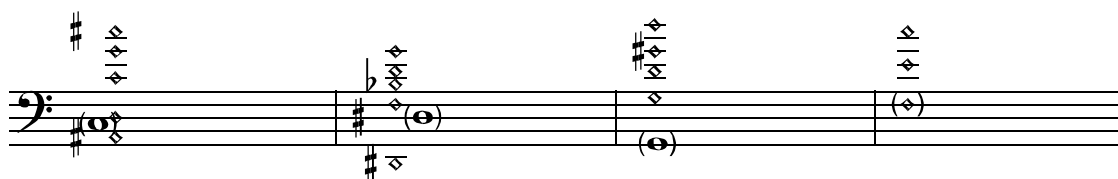
7	A49	<ul style="list-style-type: none"> Open F key. 	F#2	B2 and B4	F3, A \flat 3 and G4	<i>mf - ff</i>
8	A50	<ul style="list-style-type: none"> Close B\flat auxiliary (Right hand, first finger) key. First finger needs to close both the B\flat and E key. 	C3	C4, G#4 and C#5		<i>p - f</i>

E \flat - 9

E \flat - 10

E \flat - 11

E \flat - 12



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
9	A51	<ul style="list-style-type: none"> Open B tone hole. Close B\flat auxiliary (Right hand, first finger) key. 	C3	A#2, D3, C4 and C#5	G4	<i>p - ff</i>
10	A52	<ul style="list-style-type: none"> Open A tone hole. Close B\flat auxiliary (Right hand, first finger) key. 	D#3	D#2, F3 and D4	B \flat 3 and G4	<i>mf - ff</i>
11	A53	<ul style="list-style-type: none"> Open both A and E tone holes. 	G2	G3, G#4 and D5	D4	<i>mf - ff</i>

		<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. 				
12	A54	<ul style="list-style-type: none"> • Open E tone hole. • Close B\flat auxiliary (Right hand, first finger) key. 	No registered frequency	C5	F3 and E4	<i>mf - ff</i>

E Possibilities

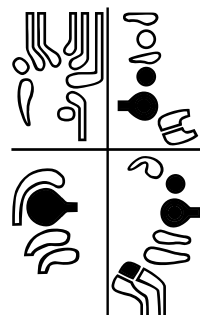
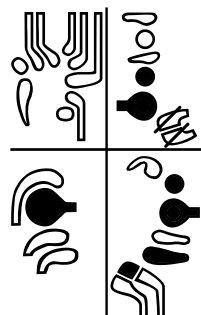
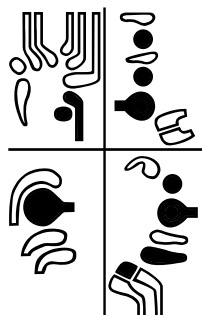
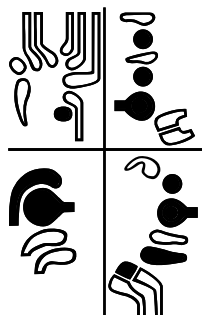
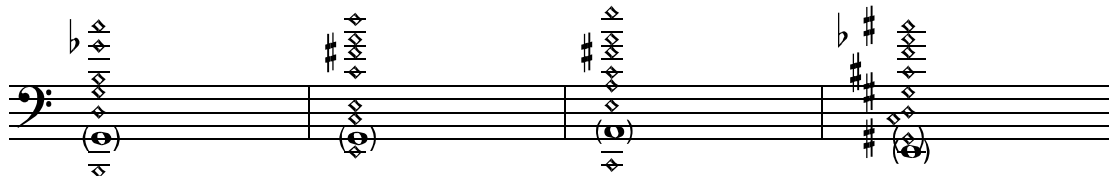
All the following multiphonic possibilities are developed out of the traditional fingering of E2.

E - 1

E - 2

E - 3

E - 4



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	A55	<ul style="list-style-type: none"> Close B\flat auxiliary (Right hand, first finger) key. 	G2	B1, G3, B3, G \flat 4 and C5	D3	<i>pp - mf</i>
2	A56	<ul style="list-style-type: none"> Hold down C\sharp flick (Left hand, first finger) key. 	G2	E2, C3, E3, F \sharp 4, A4 and D5	C4	<i>pp - ff</i>
3	A57	<ul style="list-style-type: none"> Open E tone hole. Close both bottom C\sharp and D\sharp auxiliary (Right hand, fifth finger) keys only halfway. 	A2	C2, E3, A3 F \sharp 4, A4 and E5	C4	<i>p - mf</i>
4	A58	<ul style="list-style-type: none"> Open both E tone hole and G key. 	E2 and G2	D3, G \sharp 3, C \sharp 4, F4, A \flat 4	C3	<i>f - ff</i>

				and C#5		
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E - 5

E - 6

E - 7

E - 8

The image displays four musical exercises, E-5 through E-8, arranged horizontally. Each exercise consists of a musical staff in bass clef and a corresponding fingering diagram below it. The fingering diagrams are split into two columns, representing the left and right hands, with various symbols indicating finger placement and movement.

Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	A59	<ul style="list-style-type: none"> Open E tone hole. 	G2	E3, C4, E4, G4, B4		<i>p - f</i>
6	A60	<ul style="list-style-type: none"> Open D tone hole. 	B \flat 2	C#4, E4, G4 and B4	E3	<i>p - f</i>
7	A61	<ul style="list-style-type: none"> Open B tone hole. 	E2	B3, F4, A \flat 4 and D5	F3	<i>p - f</i>
8	A62	<ul style="list-style-type: none"> Open F key. 	E2	A \flat 2, G3, B3 and C4	E3 and F \flat 4	<i>pp - mf</i>

F Possibilities

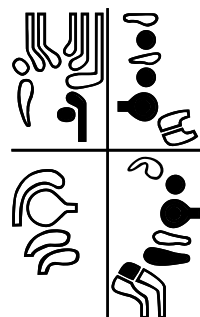
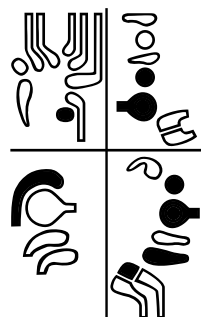
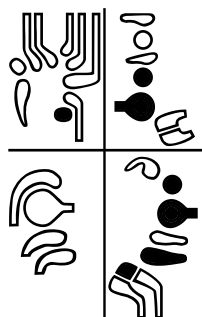
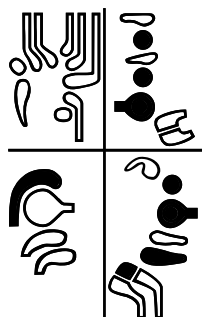
All the following multiphonic possibilities are developed out of the traditional fingering of F2.

F - 1

F - 2

F - 3

F - 4



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	A63	<ul style="list-style-type: none"> Close B\flat auxiliary (Right hand, first finger) key. 	A2	D \sharp 2, D \sharp 3, D \sharp 4, G \flat 4 and B \flat 4	A \flat 3	<i>pp - ff</i>
2	A64	<ul style="list-style-type: none"> Open E tone hole. 	A2	A1, E2, E3, C \sharp 4, G4 and D5	E4	<i>pp - ff</i>
3	A65	<ul style="list-style-type: none"> Open E tone hole. Close B\flat auxiliary (Right hand, first finger) key. 	A \flat 2	C \sharp 2, C \sharp 3, C \sharp 4, A4 and C \sharp 5	E3 and E4	<i>pp - ff</i>

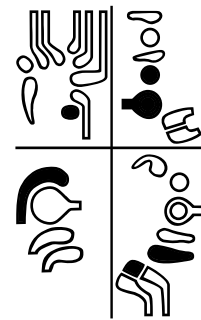
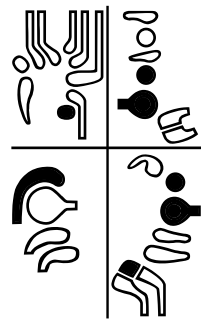
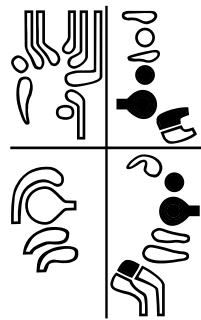
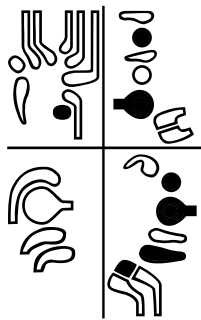
4	A66	<ul style="list-style-type: none"> Hold down C# trill (Left hand, first finger) key. 	G#2	C#2, G3, Bb3, F#4 and A4	E3, C4 and C#5	<i>pp - ff</i>
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F - 5

F - 6

F - 7

F - 8



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	A67	<ul style="list-style-type: none"> Open D tone hole. 	B2	E2, E3, G#3, B3, D4, A#4 and D5		<i>pp - p</i>
6	A68	<ul style="list-style-type: none"> Open E tone hole. Close bottom D# key. 	D2	F#2, B2, D3, F#3, A3, D4 and F#4	Db5	<i>pp - p</i>

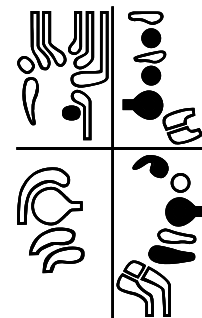
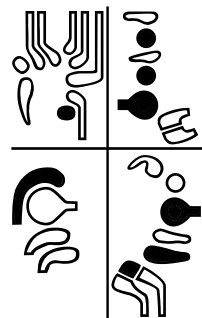
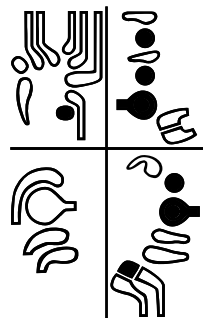
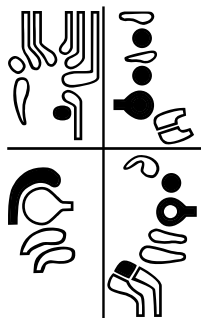
7	A69	<ul style="list-style-type: none"> • Open E tone hole. • Close B\flat auxiliary (Right hand, first finger) key. 	A \sharp 2	B \flat 1, D2, D3, F \sharp 3, A3, D4 and G4	D5	<i>p - ff</i>
8	A70	<ul style="list-style-type: none"> • Open both E and A tone holes. • Close B\flat auxiliary (Right hand, first finger) key. 	E \flat 2	D \flat 2, E \flat 3, B \flat 3, E \flat 4, G4 and B \flat 4	G3	<i>pp - p</i>

F - 9

F - 10

F - 11

F - 12



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
9	A71	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand first finger) key. • Open A tone hole while keeping the A mechanism around the tone hole closed. 	B \flat 2	A2, C3 and A3	F4, B \flat 4 and D5	<i>mf - ff</i>

10	A72	<ul style="list-style-type: none"> • Open G key. 	A2	G2, A3, B \flat 3 and E4	A4 and E5	<i>f - ff</i>
11	A73	<ul style="list-style-type: none"> • Open B tone hole. • Close B\flat auxiliary (Right hand, first finger) key. 	B2	C4, G4 and E5	C3 and B4	<i>f - ff</i>
12	A74	<ul style="list-style-type: none"> • Open both B tone hole and F key. • Hold down C\sharp trill (Right hand, second finger) key. 	C \sharp 3		D3, D \flat 4, A4 and D \flat 5	<i>mf - ff</i>

F# Possibilities

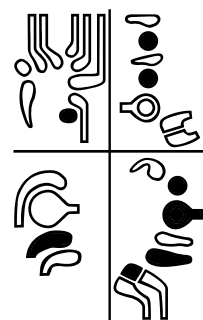
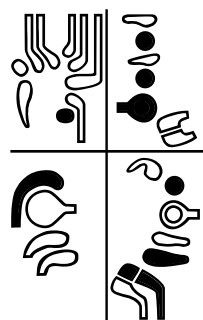
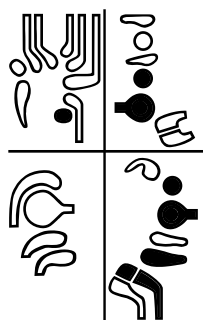
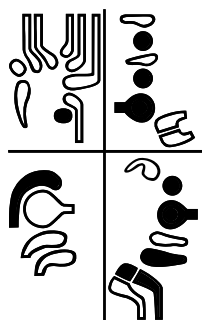
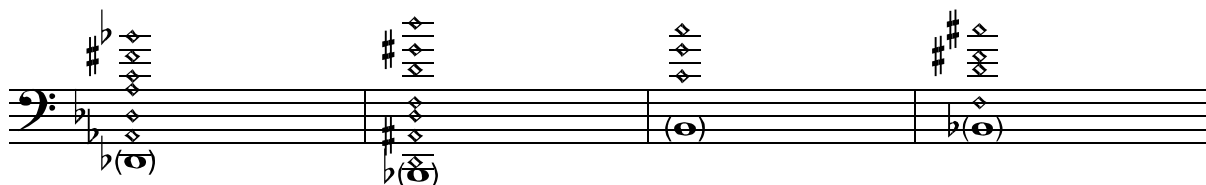
All the following multiphonic possibilities are developed out of the traditional fingering of F#2.

F# - 1

F# - 2

F# - 3

F# - 4



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	A75	<ul style="list-style-type: none"> Close B\flat auxiliary (Right hand, first finger) key. 	D \flat 2	A3 and F#4	A \flat 2, D \flat 3, C4 and B \flat 4	<i>mf - ff</i>
2	A76	<ul style="list-style-type: none"> Open E tone hole. 	B \flat 1	D2, A#2, D3, F3, D4, G#4 and D5		<i>p - ff</i>
3	A77	<ul style="list-style-type: none"> Open A tone hole. Close B\flat auxiliary (Right hand, first finger) key. 	B2	C4, G4 and C5		<i>p - ff</i>
4	A78	<ul style="list-style-type: none"> Open C tone hole Close A\flat auxiliary (Right hand, first finger) key. 	B \flat 2	D4 and C#5	F3 and F#4	<i>mf - f</i>

G2 Possibilities

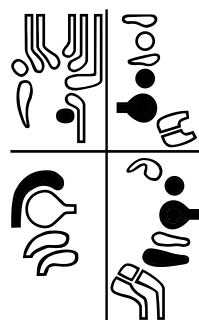
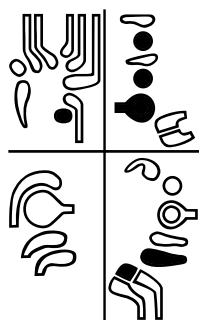
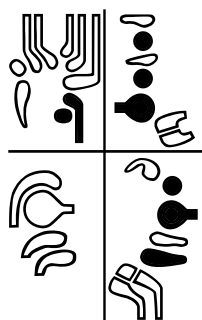
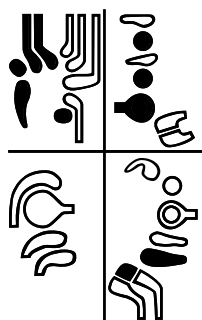
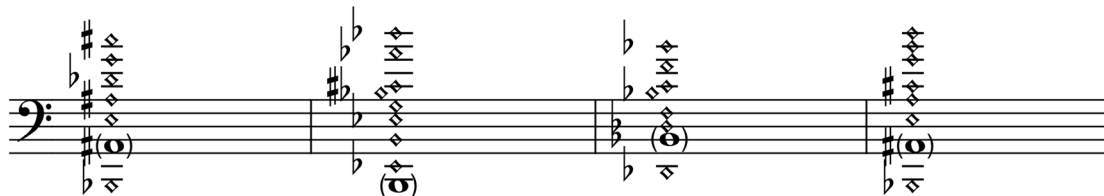
All the following multiphonic possibilities are developed out of the traditional fingering of G2.

G - 1

G - 2

G - 3

G - 4



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	A79	<ul style="list-style-type: none"> Close bottom B\flat, B, C, D and F key. Open both A and B tone holes. 	A \sharp 2	B \flat 1, E3, A \sharp 3 and C \sharp 5	D \flat 4 and G4	<i>pp - ff</i>
2	A80	<ul style="list-style-type: none"> Hold down C\sharp flick (Left hand, first finger) key. 	B1	E \flat 2, B2, E \flat 3, G3, B \flat 3, C \sharp 4 and A \flat 4	D \flat 5	<i>pp - ff</i>
3	A81	<ul style="list-style-type: none"> Open both A and B tone holes. 	B \flat 2	D \flat 2, D \flat 3,	F3	<i>pp - ff</i>

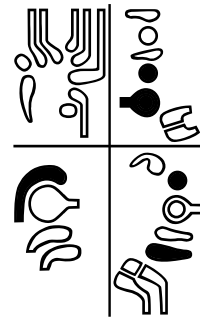
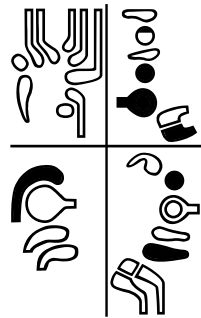
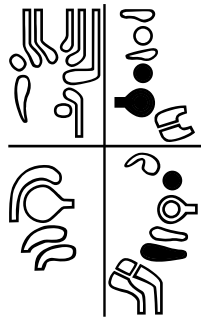
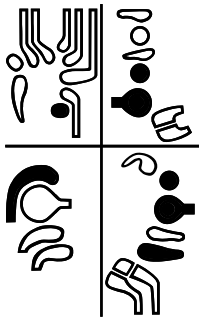
		<ul style="list-style-type: none"> Close F key. 		B \flat 3, C4, F4 and B \flat 5		
4	A82	<ul style="list-style-type: none"> Open both F key and E tone hole. Close B\flat auxiliary (Right hand, first finger) key. 	A \sharp 2	B \flat 1, E3, A3, C \sharp 4, G4, B4 and D5		<i>mf - ff</i>

G - 5

G - 6

G - 7

G - 8



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	A83	<ul style="list-style-type: none"> Open E tone hole. Close B\flat auxiliary (Right hand, first finger) key. 	E \flat 3	E \flat 2, B2, E \flat 4, B \flat 4 and D \flat 5	G3 and G4	<i>pp - mf</i>

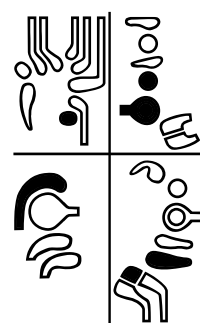
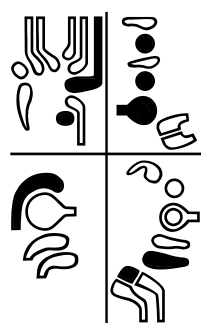
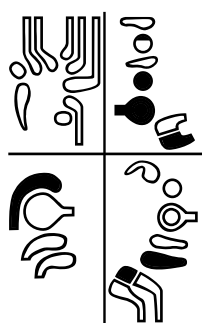
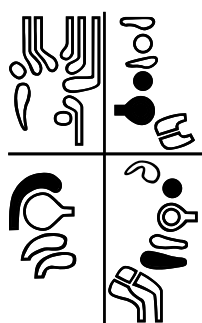
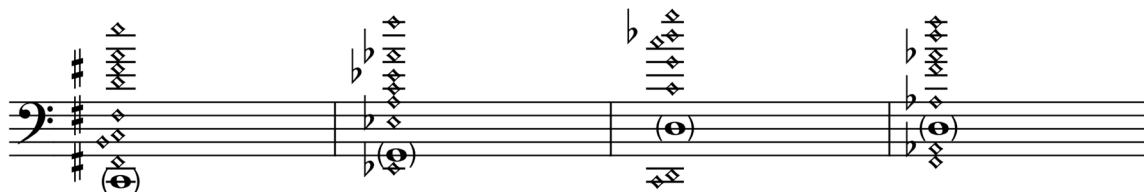
6	A84	<ul style="list-style-type: none"> Open both E and A tone holes. 	G2	C5	E2, D3, G3, B3, D4, G4 and G5	<i>pp - mf</i>
7	A85	<ul style="list-style-type: none"> Open A tone hole. Half close E tone hole. Close both B\flat auxiliary (Right hand, first finger) and bottom C\sharp keys. 	E \flat 3	D2, B2, B \flat 3, E \flat 4, A \flat 4, B \flat and D5	G3	<i>f - ff</i>
8	A86	<ul style="list-style-type: none"> Open both E and A tone holes. Close B\flat auxiliary (Right hand, first finger) key. 	E3	D \sharp 2, B2, G \sharp 3, B3, E4, A \flat 4 and C \sharp 5	G5	<i>f - ff</i>

G - 9

G - 10

G - 11

G - 12



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
9	A87	<ul style="list-style-type: none"> Open both E and A tone holes. 	C2	F \sharp 2, B2, C3,	E5	<i>p - mf</i>

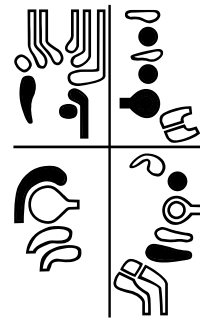
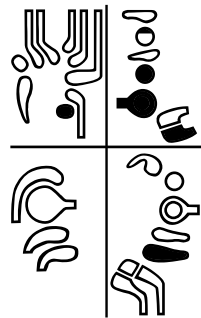
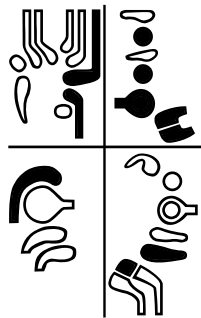
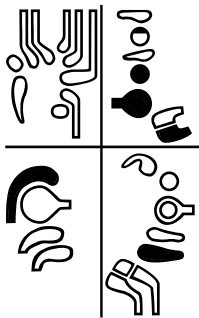
		<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. 		F \sharp 3, D4, F \sharp 4 and A4		
10	A88	<ul style="list-style-type: none"> • Open both A and B tone holes. • Half close E tone hole. • Close B\flat auxiliary (Right hand, first finger), bottom C\sharp and F key. 	G2	E \flat 2, E \flat 3, A3, C4, E \flat 4 and F5	A \flat 4	<i>p - mf</i>
11	A89	<ul style="list-style-type: none"> • Lock whisper key. • Open both A and B tone holes. Hold down A flick (Left hand, first finger) key. Close both B\flat auxiliary (Right hand, first finger) and F key. 	D3	C2, D2, C4, G4, C5, D \flat 5 and G5	G4 and G5	<i>mf - ff</i>
12	A90	<ul style="list-style-type: none"> • Open E, A and B tone holes. • Close both B\flat auxiliary (Right hand, first finger) and F keys. 	D3	F2, A \flat 2, F4, D5 and F5	A \flat 3 and A \flat 4	<i>p - mf</i>

G - 13

G - 14

G - 15

G - 16



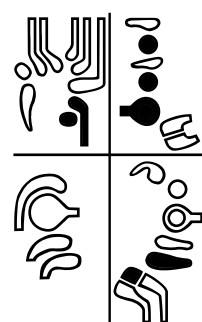
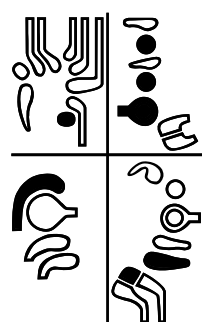
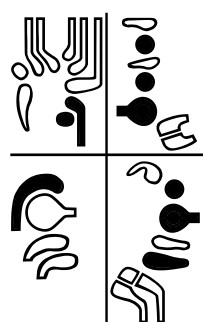
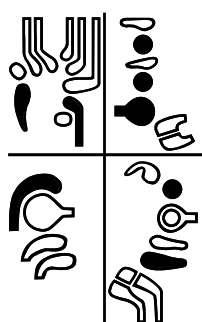
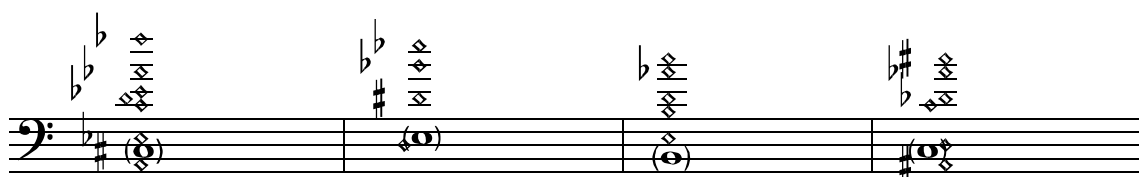
Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
13	A91	<ul style="list-style-type: none"> Open A and B tone holes. Half close E tone hole. Close both B\flat auxiliary (Right hand, first finger) and bottom C\sharp key. 	G2	B1, D \sharp 3, F \sharp 3, D \flat 5 and E5	B3, E \flat 4 and G4	<i>p - f</i>
14	A92	<ul style="list-style-type: none"> Open A and B tone holes. Hold down both A and C\sharp flick (Left hand, first finger) keys. Close B\flat auxiliary (Right hand, first finger) and both bottom C\sharp and D\sharp keys. 	A2	C \sharp 4, G \flat 4, C5 and F \sharp 5	D3 and A \flat 4	<i>p - ff</i>
15	A93	<ul style="list-style-type: none"> Open both A and B tone holes. Half close E tone hole. Close bottom C\sharp key. 	B2	G4, B4, C5 and G5	A \flat 2, D \flat 3, B3 and C4	<i>mf - ff</i>
16	A94	<ul style="list-style-type: none"> Open A tone hole. Hold down C\sharp flick (Left hand, first finger) key. Close both B\flat auxiliary (Right hand, first finger) and D keys. 	B2	A2, D3, G4, C5 and G \sharp 5	B3 and D4	<i>mf - ff</i>

G - 17

G - 18

G - 19

G - 20



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
17	A95	<ul style="list-style-type: none"> • Open A tone hole. Hold down C# flick (Left hand, first finger) key. • Close both B\flat auxiliary (Right hand, first finger) and D keys. 	C#3	A2, E \flat 3, D4 and E \flat 4	C4, A \flat 4 and F \flat 5	<i>f - ff</i>
18	A96	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. • Hold down C# flick (Left hand, first finger) key. 	E3	D3 and D#4	B \flat 4 and E \flat 5	<i>f - ff</i>
19	A97	<ul style="list-style-type: none"> • Open both A and B tone holes. • Close both B\flat auxiliary (Right hand, first finger) and F keys. 	B2	B3, D4, A \flat 4 and C5	E3	<i>mf - ff</i>
20	A98	<ul style="list-style-type: none"> • Open both A and B tone holes. Hold down C# flick (Left hand, first finger) and close F key. 	C3	A#2, D3, A \flat 4 and C#5	C4 and D \flat 4	<i>mf - ff</i>

A \flat Possibilities

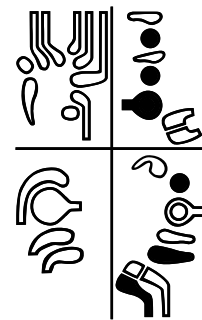
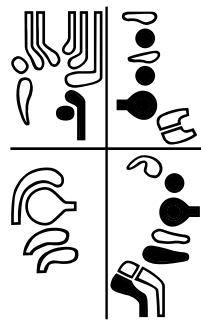
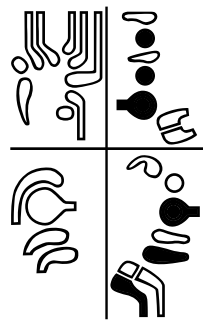
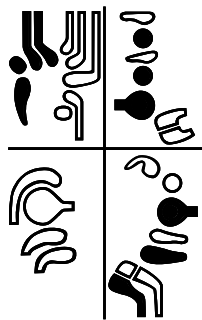
All the following multiphonic possibilities are developed out of the traditional fingering of A \flat 2.

A \flat - 1

A \flat - 2

A \flat - 3

A \flat - 4



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	A99	<ul style="list-style-type: none"> • Close B\flat, B, C and D keys. • Open B tone hole. 	A#2	B \flat 1, D2, D3, A#3 and G#4	F3, D4 and C5	<i>pp - ff</i>
2	B1	<ul style="list-style-type: none"> • Open B tone hole. 	B2	B1, D#2, F#2, E \flat 3, F#3, B3, E \flat 4, G#4	E5	<i>pp - ff</i>

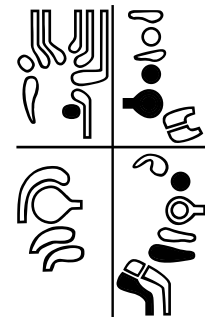
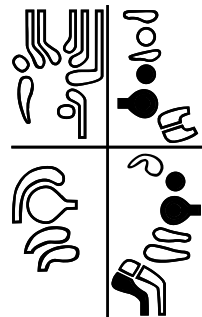
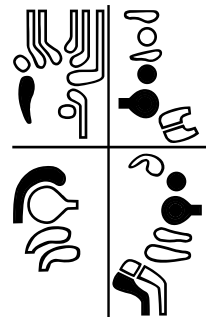
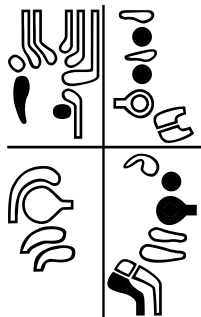
				and C#5		
3	B2	<ul style="list-style-type: none"> Hold down C# flick (Left hand first finger) key. 	B \flat 2	B1, D2, D3, B3 and C#5	F3, D4, A4 and D5	<i>f - ff</i>
4	B3	<ul style="list-style-type: none"> Open A tone hole. 	F#2	B1, B2, F#3, B3, F#4 and E5	D4, G4 and C5	<i>f - ff</i>

A \flat - 5

A \flat - 6

A \flat - 7

A \flat - 8



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	B4	<ul style="list-style-type: none"> Close D key. Open both G key and C tone hole. 	C3	C2, E2, G2, E3, G3, C3, E4, A#4, C5 and D5		<i>mf - ff</i>

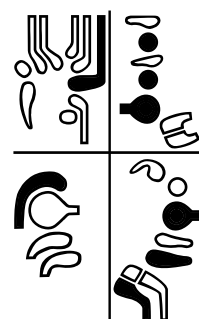
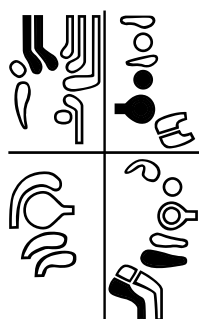
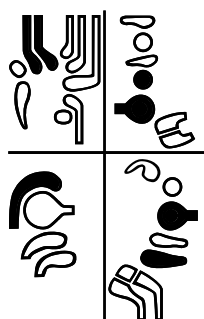
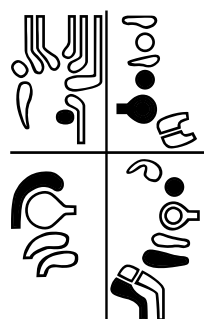
6	B5	<ul style="list-style-type: none"> • Close both B\flat auxiliary (right hand, first finger) and D keys. • Open both G key and E tone hole. 	D \flat 2	A \flat 2, A \flat 3, F4, B4 and D \flat 5	D \flat 3, D \flat 4 and A \flat 4	<i>mf - ff</i>
7	B6	<ul style="list-style-type: none"> • Open both G key and E tone hole. 	C#3	C#2, A \flat 2, F3, C#4 and B4	F4 and C5	<i>mf - ff</i>
8	B7	<ul style="list-style-type: none"> • Open both A and E tone holes. 	B \flat 1	E \flat 2, B2,		<i>f - ff</i>

A \flat - 9

A \flat - 10

A \flat - 11

A \flat - 12



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
9	B8	<ul style="list-style-type: none"> • Open both A and E tone holes. • Close B\flat auxiliary (Right hand, first finger) key. 	E \flat 3	B1, E \flat 2, A#2, G#3,	C4 and D5	<i>pp - p</i>

				F#5 and Ab4		
10	B9	<ul style="list-style-type: none"> • Close B\flat and B key. • Close B\flat auxiliary (Right hand, first finger) key. • Open both B and E tone holes as well as A\flat auxiliary (Right hand, fifth finger) key. 	D \flat 2	E \flat 2, G#2, E \flat 3, G#3, E4, A \flat 4 and D5	C4	<i>pp - p</i>
11	B10	<ul style="list-style-type: none"> • Close B\flat and B keys. • Open A, B and E tone holes. 	B	C#2, E \flat 2, E \flat 3, G \flat 3, E \flat 4, A4, C#5 and D5	C4	<i>pp - mf</i>
12	B11	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. • Hold down A flick (Left hand, first finger) key. • Open B tone hole. 	C2	F2, A \flat 2, F#3, B3, F#4, A4, B4 and F5	A \flat 3	<i>pp - mf</i>

A Possibilities

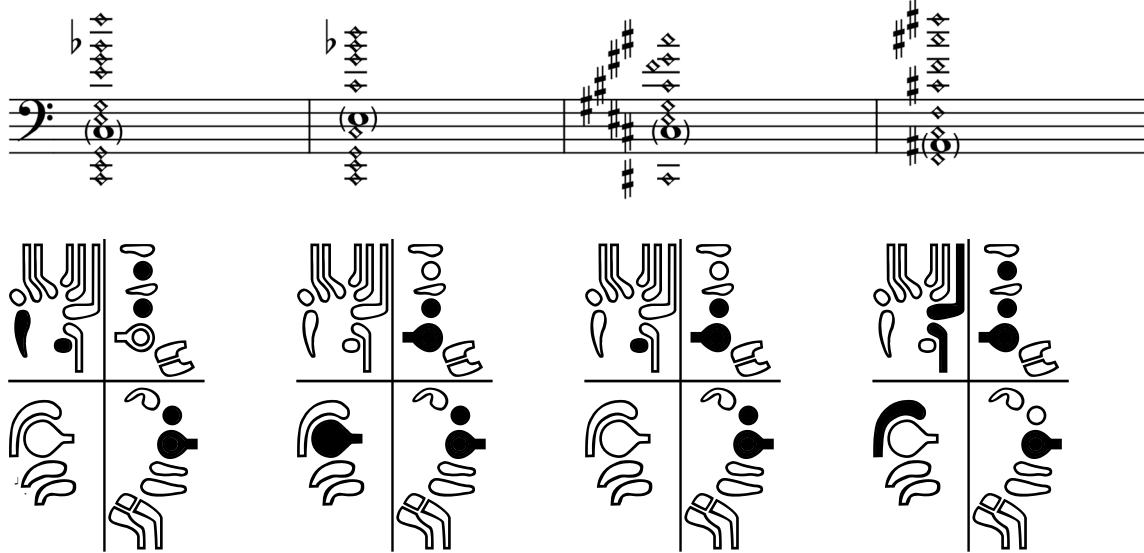
All the following multiphonic possibilities are developed out of the traditional fingering of A.

A - 1

A - 2

A - 3

A - 4



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	B12	<ul style="list-style-type: none"> • Close D key. • Open C tone hole. 	C3	C2, E2, E3, G3, E4 and B \flat 4	G4 and F5	<i>pp - ff</i>
2	B13	<ul style="list-style-type: none"> • Close E Key. • Open E tone hole. 	E3	C2, E3, G2, C4, G4, B \flat 4 and D5	C3	<i>pp - ff</i>
3	B14	<ul style="list-style-type: none"> • Open E tone hole. 	C#3	C#2, G#3, C#4, F#4, G#4 and C#5	E3	<i>mf - ff</i>

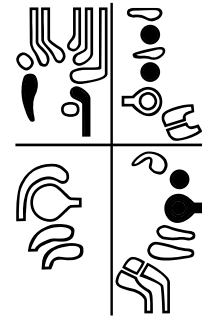
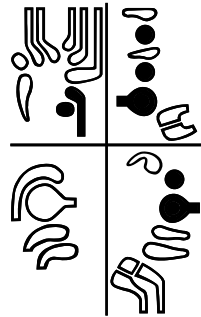
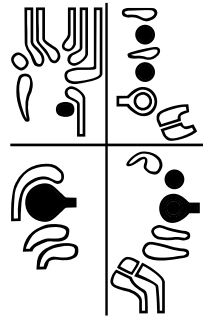
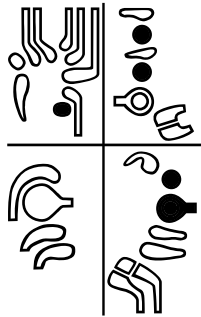
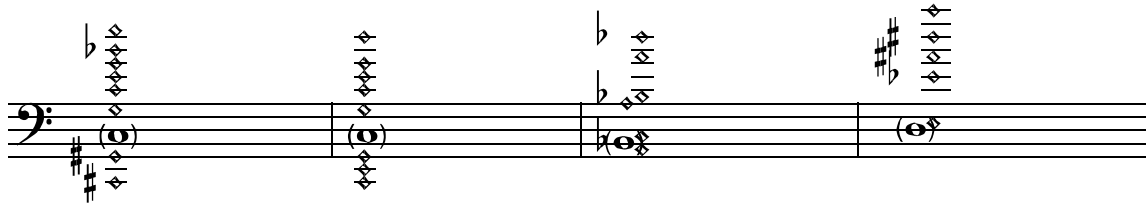
4	B15	<ul style="list-style-type: none"> • Open B tone hole. • Hold down both C# and C flick (Left hand, first finger) keys. 	A#2	F2, C3, C#4 and C#5	F2, F3, F4 and F#5	<i>p - mf</i>
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A - 5

A - 6

A - 7

A - 8



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	B16	<ul style="list-style-type: none"> • Open C tone hole. 	C3	C#2, G#2, C4, E4, G4 and Bb4	G3 and E5	<i>mf - ff</i>
6	B17	<ul style="list-style-type: none"> • Open C tone hole. • Close E key. 	C3	C2, E2, G2, G3, C4, E4, G4, and D5		<i>f - ff</i>

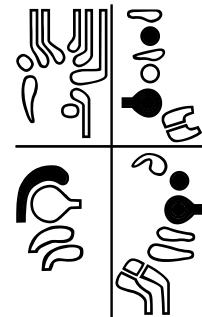
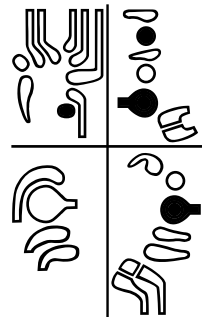
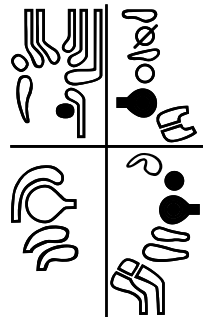
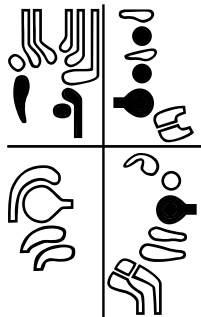
7	B18	<ul style="list-style-type: none"> Hold down C# flick (Left hand, first finger) key. 	B \flat 2	A2, A3 and A4	C3 B \flat 3, and D \flat 5	<i>f - ff</i>
8	B19	<ul style="list-style-type: none"> Open C tone hole. Close D key. Hold down C# flick (Left hand, first finger) key. 	D3	E3, A#4, D#5 and A5	E \flat 4	<i>f - ff</i>

A - 9

A - 10

A - 11

A - 12

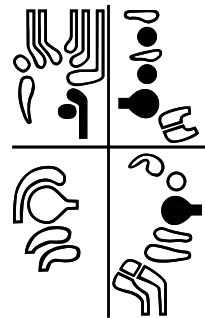
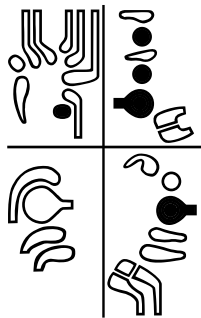
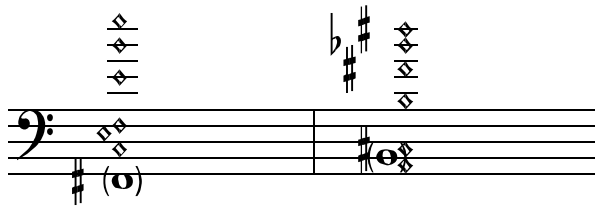


Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
9	B20	<ul style="list-style-type: none"> Close D key. Open B tone hole. Hold down C# flick (Left hand, first finger) key. 	B \flat 2	G2, D \flat 2, A3, E4 and A4	D \flat 5 and G \flat 5	<i>f - ff</i>
10	B21	<ul style="list-style-type: none"> Open both D and E tone hole. E tone hole can be half holed to improve stability. 	B \flat 2	D#3, E4, B4, E5 and G#5	F3	<i>f - ff</i>

11	B22	<ul style="list-style-type: none"> Open both B and D tone holes. 	G#2	F#2, D#3, C#4, A4, B4, E5 and G#5	F3	<i>p - f</i>
12	B23	<ul style="list-style-type: none"> Open D tone hole. Close B\flat auxiliary (Right hand, first finger) key. 	E \flat 3	D3, C4, D \flat 4, B4 and G#5	E5	<i>p - f</i>

A - 13

A - 14



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
13	B24	<ul style="list-style-type: none"> Open B tone hole. 	F#2	C3, F3, E4, B4 and E5	E3	<i>f - ff</i>

14	B25	<ul style="list-style-type: none"> • Open B tone hole. • Hold down C# flick (Left hand, first finger) key. 	B2	A2, C3, B3, F#4 and Bb4	D#5	<i>f - ff</i>
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B \flat Possibilities (Middle register)

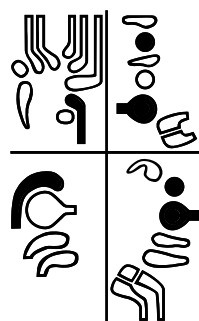
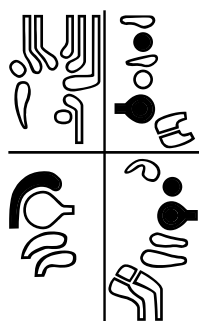
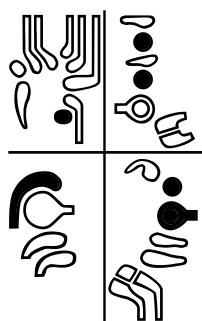
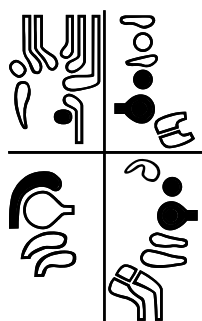
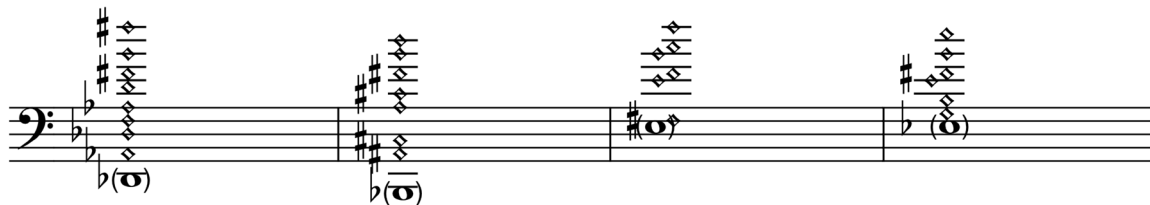
All the following multiphonic possibilities are developed out of the traditional fingering of B \flat 3.

B \flat - 1

B \flat - 2

B \flat - 3

B \flat - 4



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	B26	<ul style="list-style-type: none"> Open E tone hole. 	D \flat 2	A \flat 2, D \flat 3, A \flat 3, F \sharp 4, B4 and F \sharp 5	F3 and D4	<i>pp - ff</i>
2	B27	<ul style="list-style-type: none"> Open C tone hole. 	B \flat 2	A \sharp 2, C \sharp 3, C \sharp 4, F \sharp 4, B4 and D4	A3	<i>f - ff</i>
3	B28	<ul style="list-style-type: none"> Open D tone hole. 	E3	E4, F4, B4, C5 and F5		<i>f - ff</i>

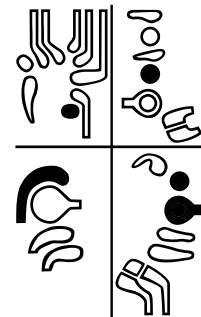
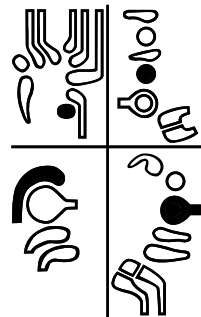
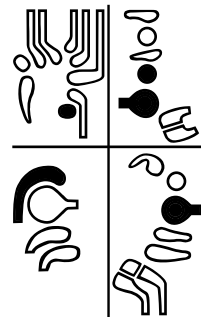
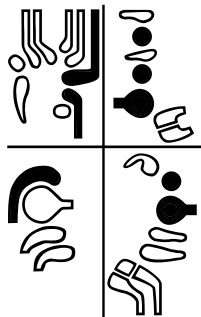
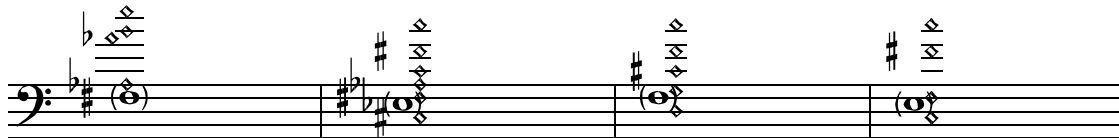
4	B29	<ul style="list-style-type: none"> • Open D tone hole. • Hold down C# flick (Left hand, first finger) key. • Increase embouchure pressure. 	E \flat 3	F#4 and B4	G3, B3, E4 and E5	<i>ff</i>
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B \flat - 5

B \flat - 6

B \flat - 7

B \flat - 8



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	B30	<ul style="list-style-type: none"> • Hold down both C# and A flick (Left hand, first finger) keys. 	F#3	A \flat 3 and B4	A \flat 3 and E5	<i>pp - p</i>
6	B31	<ul style="list-style-type: none"> • Open both B and E tone holes. 	E \flat 3	C#3, F#3, A \flat 3, C4, F#4 and C5		<i>pp - p</i>
7	B32	<ul style="list-style-type: none"> • Open B, C and E tone holes. 	F3	D3, G3, C#4, F4 and C5		<i>pp - p</i>

8	B33	<ul style="list-style-type: none"> Open both C and E tone holes. 	E3	C3, F3, F#4 and C5	C3, F3, F#4 and C5	<i>pp - f</i>
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B Possibilities (Middle register)

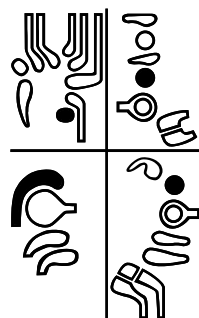
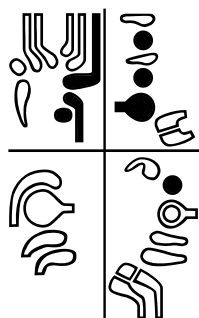
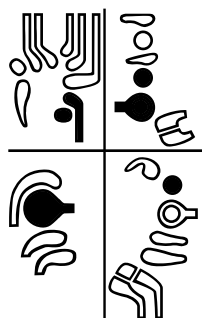
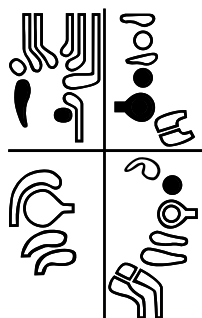
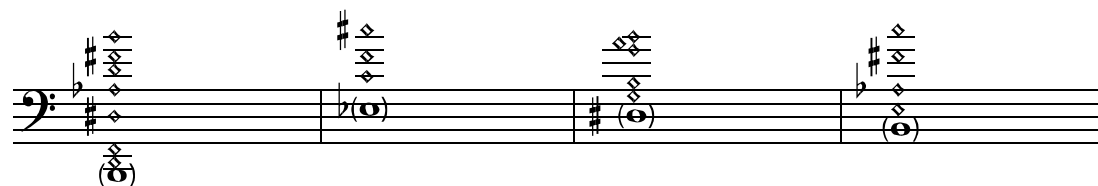
All the following multiphonic possibilities are developed out of the traditional fingering of B3.

B - 1

B - 2

B - 3

B - 4



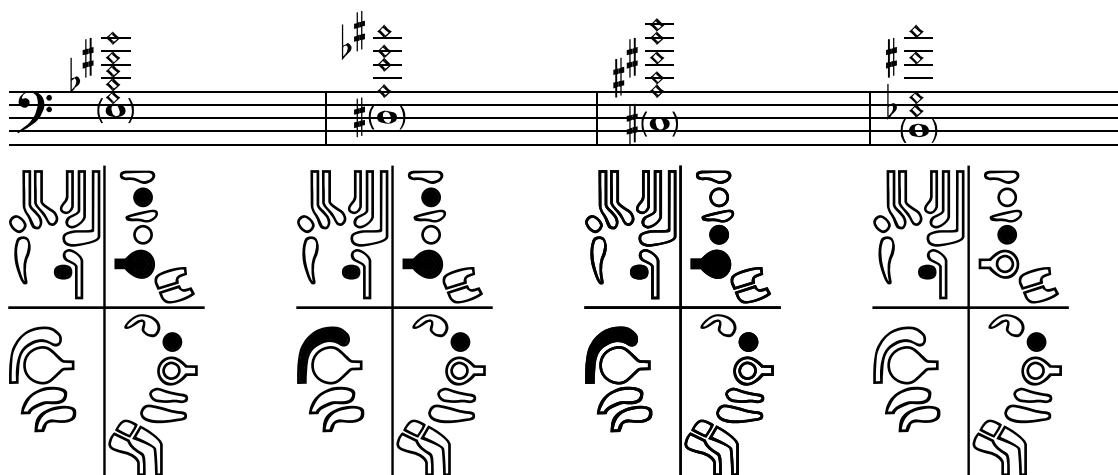
Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	B34	<ul style="list-style-type: none"> Open E tone hole. Close D key. 	B1	D2, F2 and D#3	A \flat 3, D4, F#4 and B4	<i>pp - ff</i>
2	B35	<ul style="list-style-type: none"> Open E tone hole. Close E key. Hold down C# flick (Left hand, first finger) key. 	E \flat 3	C4, F4 and C#5		<i>pp - ff</i>
3	B36	<ul style="list-style-type: none"> Lock whisper key. Hold down both C# and A flick (Left hand, first finger) keys. 	D#3	G3, B3, G4, A4, and B4		<i>pp - ff</i>
4	B37	<ul style="list-style-type: none"> Open C and E tone holes. Close B\flat auxiliary (Right hand, first finger) key. 	B2	E3, A \flat 3 and F#4	C5	<i>mf - pp</i>

B - 5

B - 6

B - 7

B - 8



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	B38	<ul style="list-style-type: none"> Open D tone hole. 	E3	G3, B \flat 3 and F \sharp 4	D4 and B4	<i>mf - ff</i>
6	B39	<ul style="list-style-type: none"> Open D tone hole. Close B\flat auxiliary (Right hand, first finger) key. 	D \sharp 3	A3 and E4	G \flat 4 and C \sharp 5	<i>f - ff</i>
7	B40	<ul style="list-style-type: none"> Open E tone hole. Close B\flat auxiliary (Right hand, first finger) key. 	C \sharp 3	C \sharp 4, F \sharp 4, B4 and D5	A3	<i>f - ff</i>
8	B41	<ul style="list-style-type: none"> Open both C and E tone holes. 	B2	G3, F \sharp 4 and C5	E \flat 3	<i>f - ff</i>

C Possibilities (Upper middle register)

All the following multiphonic possibilities are developed out of the traditional fingering of C4.

C - 1
C - 2
C - 3
C - 4

The image shows four examples of multiphonic possibilities, labeled C-1 through C-4. Each example consists of a musical staff with a bass clef and a fingering diagram below it. The fingering diagrams are divided into two parts: the left hand (top) and the right hand (bottom). The diagrams use various symbols to represent fingerings, such as numbers 1-5, dots, and arrows, indicating which keys are held down or released during the performance of each multiphonic.

Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	B42	<ul style="list-style-type: none"> Open A, B and E tone holes. Close B\flat auxiliary (Right hand, first finger) as well as F and G keys. 	B2	B1, D \flat 2, A3, C \sharp 4, G \sharp 4 and C \sharp 5	D3	<i>pp - ff</i>
2	B43	<ul style="list-style-type: none"> Open B tone hole. Close B\flat auxiliary (Right hand, first finger) key. Hold down A flick (left hand, first finger) key. 	D3	G2, G3, G4, A4 and B4	B \flat 3	<i>pp - ff</i>
3	B44	<ul style="list-style-type: none"> Open B tone hole. Hold down both C\sharp and A flick (Left hand, first finger) keys. 	F \sharp 3	B2, A4 and G5	B3 and E \flat 4	<i>pp - ff</i>

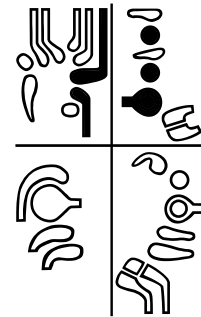
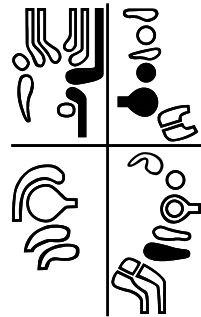
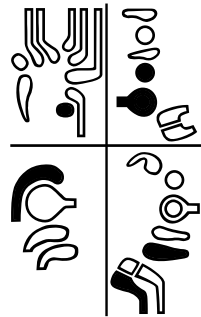
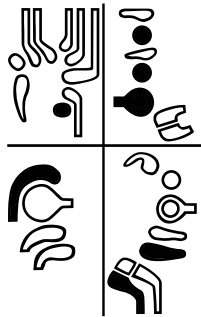
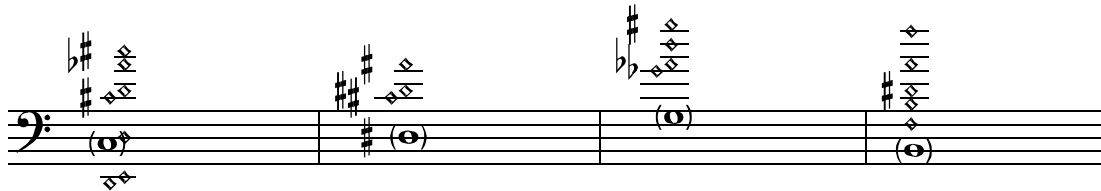
4	B45	<ul style="list-style-type: none"> • Open B tone hole. • Close E key. Hold down both C# and A flick (Left hand, first finger) keys. 	C#2, C3	F#2, C4, F#4, A4 and G5	Gb3	<i>mf - f</i>
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C - 5

C - 6

C - 7

C - 8



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	B46	<ul style="list-style-type: none"> • Close both G and A\flat keys. • Close B\flat auxiliary (Right hand, first finger) key. 	C3	E2, C#4 and C#5	D2, D3, D4 and A \flat 4 and C#5	<i>mf - ff</i>
6	B47	<ul style="list-style-type: none"> • Close both G and A\flat keys. • Open E tone hole. • Close B\flat auxiliary (Right hand, first finger) key. 	D#3	C#3, D#3 and A#4		<i>mf - ff</i>
7	B48	<ul style="list-style-type: none"> • Open E tone hole. • Close G key. • Hold down both C# and A flick (Left hand, first finger) keys. 	G3	D5	G \flat 4, A \flat 4 and G#5	<i>f - ff</i>

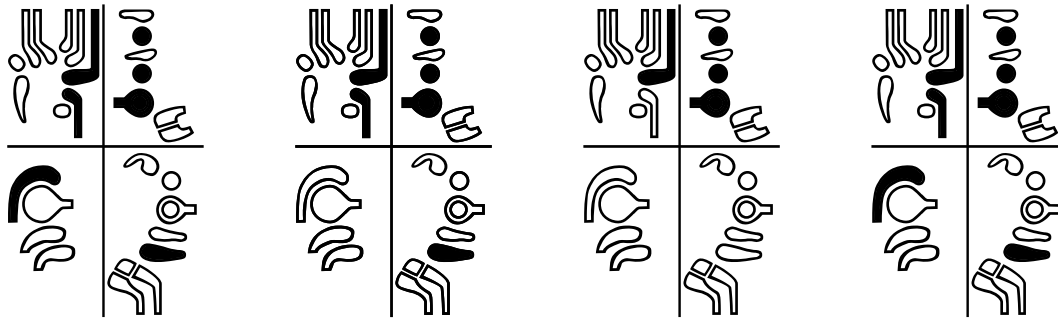
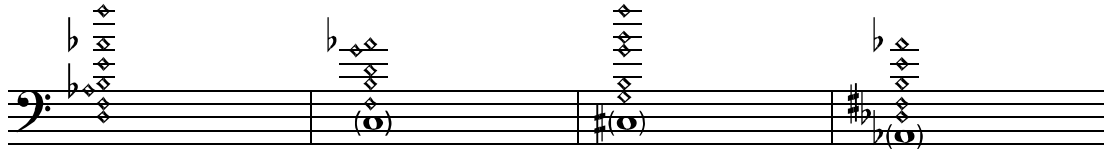
8	B49	<ul style="list-style-type: none"> Hold down both C# and A flick (Left hand, first finger) keys. 	B2	F3, B3, D#4, A4 and F5		<i>mf - ff</i>
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C - 9

C - 10

C - 11

C - 12



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
9	B50	<ul style="list-style-type: none"> Close both B\flat auxiliary (Right hand, first finger) and G keys. Hold down both C# and A flick (Left hand, first finger) keys. 	No registered frequency	E4 and F5	D3, F3, A \flat 3, B3 and A \flat 4	<i>f - ff</i>
10	B51	<ul style="list-style-type: none"> Close G key. Hold down both C# and A flick (Left hand, first finger) keys. 	C3	B3, D4, and G4	F3 and A \flat 4	<i>f - ff</i>
11	B52	<ul style="list-style-type: none"> Hold down A flick (Left hand, first finger) key. 	C#3	G3, B3, G4, B4 and F5		<i>pp - p</i>

12	B53	<ul style="list-style-type: none"> • Open E tone hole. • Close both B\flat auxiliary (Right hand, first finger) and G keys. • Hold down both C\sharp and A flick (Left hand, first finger) keys. 	A \flat 2	F \sharp 3	D \flat 3, B3, E4 and A \flat 4	<i>p - f</i>
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D possibilities (Upper middle register)

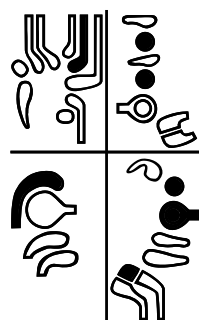
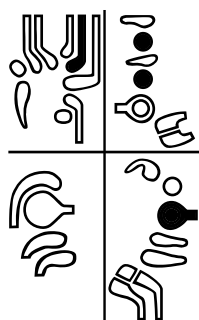
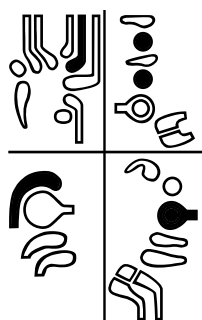
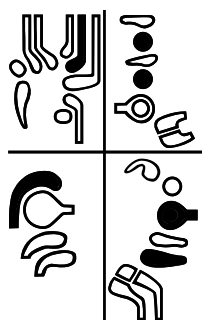
The following multiphonic possibilities are developed out of the traditional fingerings of D4.

D - 1

D - 2

D - 3

D - 4



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
1	B54	<ul style="list-style-type: none"> Close B\flat auxiliary (Right hand, first finger) key as well as G key and A tone hole Hold down C flick (Left hand, first finger) key. 	B \flat 1	F2, B2, C3, F3, F4, A4, C5 and E \flat 5	C4	<i>pp - ff</i>
2	B55	<ul style="list-style-type: none"> Close B\flat auxiliary (Right hand, first finger) key. Close A tone hole. Hold down C flick (Left hand, first finger) key. 	F2	D3, F \sharp 3, C \sharp 4, F \sharp 4, B \flat 5 and F \sharp 5		<i>pp - ff</i>
3	B56	<ul style="list-style-type: none"> Close A tone hole. Hold down C flick (Left hand, first finger) key. 	F \sharp 2	A \sharp 2, C \sharp 3, F \sharp 3, C \sharp 4,		<i>pp - ff</i>

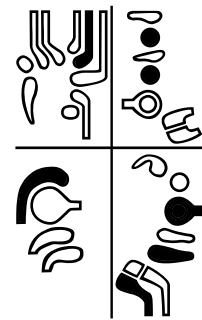
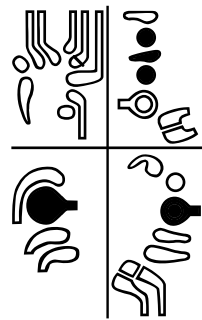
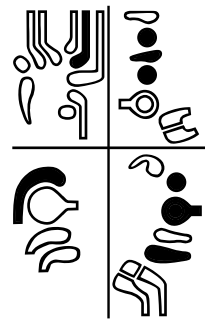
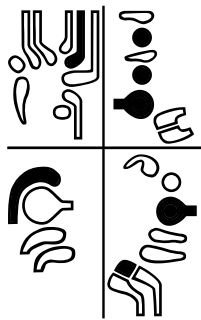
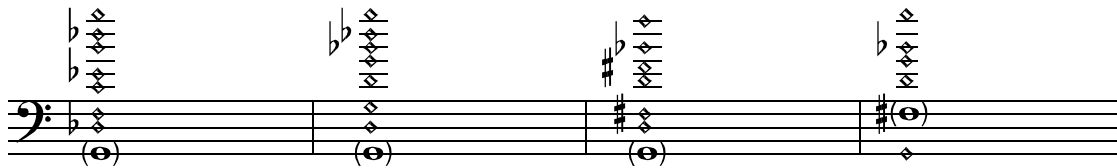
				F#4, Bb4 and F5		
4	B57	<ul style="list-style-type: none"> • Close both B\flat auxiliary (Right hand, first finger) and F keys. • Close A and B tone holes. Hold down C flick (left hand, first finger) key. 	B2	A3, B \flat 3 and F#5	B \flat 4	<i>pp - ff</i>

D - 5

D - 6

D - 7

D - 8



Nr	Track number	Execution	Registered frequency	Audible tones	Audible microtones	Dynamic level
5	B58	<ul style="list-style-type: none"> • Close both B\flat auxiliary (Right hand, first finger) and F keys. • Open B tone hole. Hold down C flick (Left hand, first finger) key. 	G2	G4, B \flat 4 and G5	D \flat 3, F3, C4 and E \flat 4	<i>mf - ff</i>
6	B59	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. 	G2	D3, G2, D4, B \flat 4 and G5	G4 and D \flat 5	<i>mf - ff</i>

		<ul style="list-style-type: none"> • Open C tone hole. Close E\flat trill (Left hand, second finger) key. • Hold down C flick (Left hand, first finger) key. 				
7	B60	<ul style="list-style-type: none"> • Close B\flat auxiliary (Right hand, first finger) key. • Open B and C tone holes. • Close E\flat trill (Left hand, second finger) key. • Hold down C flick (Left hand, first finger) key. 	G2	D3, F \sharp 3, F \sharp 4, and F5	D4 and B \flat 4	<i>pp - ff</i>
8	B61	<ul style="list-style-type: none"> • Close both B\flat auxiliary (Right hand, first finger) and A\flat auxiliary (Right hand, fifth finger) keys. • Close A tone hole. • Close G key. • Hold down C flick (Left hand, first finger) key. 	F \sharp 3	G2, G4, B \flat 4 and G5	D4	<i>f - ff</i>

MONOLOG für Fagott

Isang Yun (1983/84)

ca. 52

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18

20

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* ♯ = 1/4-Ton Erhöhung

Uraufführung: 3. Februar 1985 Nizza (Alexandre Ouzounoff) Spieldauer circa 11 Minuten.

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Appendix E
