Saxophone without mouthpiece

Kahl, D.P.

Chapter 5
Saxo-Flute Hybridity

5.1 - Description of Technique - https://youtu.be/y0Z5muhbog8

Saxo-flute hybridity is a technique in which the saxophone is played in a manner similar to a flute or the ney (an ancient Egyptian wind instrument, considered the ancestor of the modern-day flute, still practiced in the world today, especially in folk music traditions of the near and middle East). [Plays an improvisation using the saxo-flute hybridity technique]. Acoustically, this technique is a direct evolution of the air pitch technique. However, unlike the air pitch technique, the performer blows across the open hole of the neck to produce full-bodied pitches. Changes in pitch occur through manipulation of the keywork, while different octaves can be played by adjusting the embouchure and airflow. [Demonstrates.] Sound quality and timbre are influenced by the flexibility of the embouchure, the speed of airflow, and the air pressure. Sometimes, an airy sound may accompany the technique; however, if desired and with practice and experience, this can be minimized. Given that the saxophone is a conical instrument not technically designed for such playing, considerable effort is required to produce the desired effects. Despite this challenge, the technique can be effectively applied to all four main saxophones.

5.2 - Technical Parameters - https://youtu.be/zHGcLtJUadM

Embouchure:
The saxophonist must adopt a new embouchure to execute this technique, closely resembling that used for the flute and the ney. Begin by puckering the lips as if pronouncing the word “pooh.” Position the saxophone neck between the lips, and direct a focused stream of air over the hole in the neckpiece. Adjust the angle of the saxophone neck as needed to achieve the desired sound. [Demonstrates].

Transposition:
The transposition of saxo-flute hybridity closely follows the detuned scale defined in the air pitch technique. However, determining a comprehensive transposition is impossible due to the absence of the mouthpiece.

Range:
As of today, the range of saxo-flute hybridity remains highly limited, in large part due to the lack of training on the part of the saxophonist and to the conical shape of the tube which is not designed to produce sounds in this way. The functional range, which every saxophonist should familiarize themselves with as a basis, spans from C5 to F#5 (G5 on soprano), utilizing the palm keys from D5 upwards. [Demonstrates range on alto]. However, this range may be extended further depending on the performer's comfort and skill level with the technique and embouchure manipulation. Yet, as they explore the lower tessitura of this technique, it becomes more difficult to produce audible pitches.
For more advanced players, the range can be extended by over- or under-blowing the base octave much in the same way that a flutist will overblow to the octave:

- Soprano: The technique can be extended from F#4 to G5.
- Alto: Two octaves are possible. The lower octave ranges from B♭4 to F#5, while the middle octave ranges from D#4 to F#5.
- Tenor: Two octaves are possible. The middle octave ranges from E4 to F#5, while the higher octave ranges from G4 to F#5.
- Baritone: There are four different octaves that the player can execute. In the low octave, the range is B4 to F#5. In the middle octave, the range is C5 to F#5. In the high octave, the range is C5 to F#5. Additionally, by overblowing into this higher octave, one can attain a limited altissimo range of D5 to E♭5.

To hear the full range on each of the four main saxophones, click on the chromatic scale video in the section entitled Demonstration Videos.

Discussion:
Saxo-flute hybridity is a rather new phenomenon in the history of saxophone playing. For this reason, not many saxophonists have either heard them or seen them in written music. Despite this, several contemporary musicians have taken these techniques to heart. Apart from myself, for example Philippe Geiss and Ola Asdahl Rokkones, have made these techniques an integral part of their artistic practice.

My first introduction to saxo-flute hybridity was hearing Geiss perform live. Geiss is a staunch advocate for this technique, especially on sopranino saxophone. It was from his performance that I started to grow curious about this way of playing the saxophone. Here is an excerpt from one of those concerts featuring Geiss as soloist. [Short excerpt of *Calderosaxo* (2012) by Phillipe Geiss plays] In this work, *Caldersaxo* for 12 saxophones and saxophone solo (2012), the soloist is asked to improvise on written out chord progressions in a legato style. In doing so, Geiss weaves a dreamy sound world to the opening of this rhythmically active work.[39]

Another deeply devoted saxophonist to this technique is Ola Asdahl Rokkones. He has developed it for several years, performing his own works or those of Scandinavian composers. Memorable is his work in the mixed ensemble Zwei-Mann-Orchester (two musicians playing various instruments at once) where many techniques are used to create a rich tapestry of sounds. Notable is the use of saxo-flute hybridity in the work *Scener fra et Nabolag* (2015) composed by Lars Skoglund. Here the tenor saxophone, played by Rokkones, is used to create flute sounds in between trumpet sounds from the other musician on the baritone saxophone.

Kientzy is the only author to mention the saxo-flute hybridity technique, briefly in his *Saxologie*. He classifies its sounds as "possessing the qualities of the flute and that of the ney" (Kientzy 2007: 511). Kientzy therefore names it the "saxnay technique." The analogy

[39] Interestingly, many of the supporting musicians are asked to play saxophone without mouthpiece techniques as well.

comes from the position of the lips to the open bocal used to create the characteristic sounds, much in the same way that the ney is performed.

Kientzy falsely claims that the technique is only possible on the higher saxophones (sopranino, soprano, and alto saxophones). However, the ranges for the soprano and alto saxophones are inconsistent with the current possibilities on these instruments. Moreover, the outlined transposition and pitches that are detailed are inconsistent with my own findings on the same saxophones. Below, in the Video Demonstration section, you will find examples of me performing this technique on all four standard saxophones.

5.3 - Performance and Practice - https://youtu.be/TpHacwEZbSA

Dynamic Range:
In general, the dynamic range of saxo-flute hybridity is dependent on several factors, including the saxophonist's comfort with producing these sounds, the type of saxophone being used, the desired octave, and the fingering employed. Typically, dynamics can have a broad range between *ppp* to *fff*. I will demonstrate the two different octaves available on alto saxophone: [Demonstrates].

Articulation:
Articulation is entirely possible while producing saxo-flute hybridity sounds. Saxophonists should shift away from their conventional understanding of playing when approaching this technique. To perform it effectively, put the tongue behind the top teeth at the soft palate and articulate naturally, as if producing the consonant "TOO." It is crucial to control the speed of articulation to execute consistent articulations without losing the base saxo-flute hybridity pitch. [Demonstrates].

Glissandi:
Due to the fragile nature of the sounds produced, saxophonists must approach the saxo-flute hybridity technique delicately. Despite this delicacy, glissandi are inherently possible. Depending on the starting and ending notes of the desired glissando, there are two effective ways to execute it.
Fingered Glissando:
The first technique involves using the keys, which will be familiar to saxophonists as it is commonly used in regular playing. Simply hold a note and slowly depress or open the key preceding or succeeding the base note. [Demonstrates].
Embouchure Glissando:
The second method involves using the embouchure and air to perform a glissando. This approach may present challenges related to maintaining sound stability and endurance in sustaining the new embouchure and air pressure. While holding the base note, direct the airstream either downwards or upwards, depending on the intended direction of the glissando. At the same time, adjust the openness of the throat to match the note being

targeted with the glissando. While this second method requires significant practice, it proves effective in many situations. [Demonstrates].

Vibrato:
Developing vibrato within this technique can greatly enhance expression in the sound. Saxophonists aiming to achieve this effect should study how similar wind instruments – particularly the flute – produce vibrato. Instead of relying on jaw movements, which is common for saxophonists, use the air to create streams of vibrating columns, similar to techniques used by singers or flutists. [Demonstrates]. For further information on flute vibrato development, excellent pedagogical resources such as *The Techniques of Flute Playin*g by Carin Levine and Christina Mitropoulos-Bott, *The Flute Vibrato Book* by Patricia George and Phyllis Avidan Louke, or *Practice Book for the Flute* by Trevor Wye, are available. While my research does not delve into the debate on how vibrato should be performed on the flute, it serves to provide a context for saxophonists to consider and adjust their common vibrato usage.

5.4 - Personal Development - https://youtu.be/aamQ-1ff7Gs

It is crucial for saxophonists to develop muscle memory with the new embouchure and to find the optimal angle for the neckpiece to produce a full-bodied flute sound rather than just an air pitch. [Demonstrates].
Begin by working exclusively with the neckpiece of an alto saxophone. Experiment with different angles and air pressures to achieve the desired sound. Practice repeatedly to find the angle that consistently produces the desired result. [Demonstrates].
Next, before attaching the neck to the saxophone body and introducing keywork, focus on producing pitches at the octave. [Demonstrates]. This will enhance flexibility and familiarize musicians with the new air usage and embouchure manipulation.
Once octaves can be produced consistently and easily, progress to adding keys. Attach the neckpiece to the saxophone body and open the C1 key. Slur between the D with the C1 key and the open C#. Gradually add keys ascending the scale to F#. [Demonstrates]. When comfortable with this, work at the higher octave, gradually adding keys ascending the scale to F# again. [Demonstrates].
To introduce lower pitches, descend from the D. Manipulating the tube while descending may prove to be a challenge at first, but with practice, it is possible to produce lower pitches. [Demonstrates].

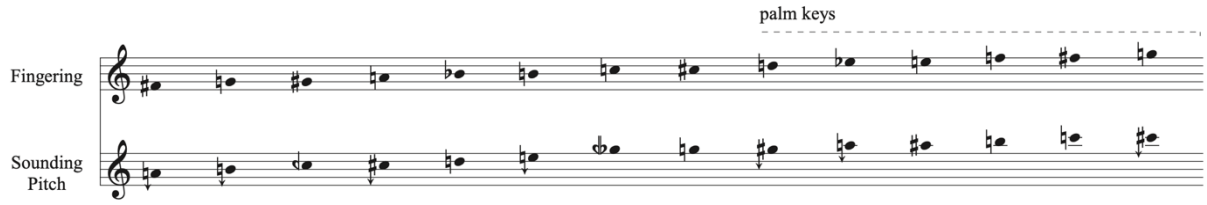
5.5 - Pedagogy - https://youtu.be/pi2EwvfHuJA

If necessary, adjust the neckstrap to the proper height so that the neckpiece is aligned with the mouth. [Demonstrates]. Position the neckpiece halfway between the lips. [Demonstrates]. If performing on soprano saxophone, consider holding the instrument to the right, in a typical flute or ney fashion. [Demonstrates]. Form the “pooh” embouchure with the mouth. [Demonstrates]. Prepare the desired fingering. [Demonstrates]. Breathe

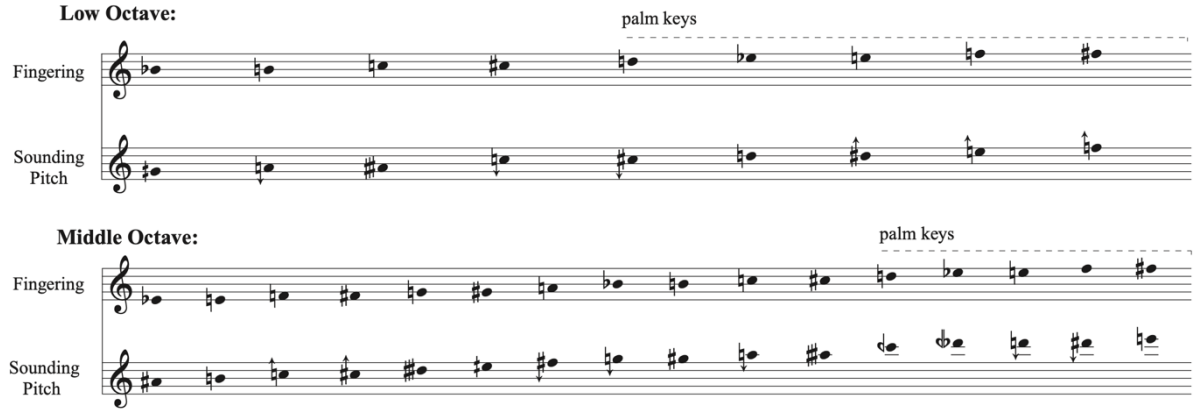
in. [Demonstrates]. Exhale with a fast airstream into the saxophone producing the saxo-flute hybridity technique. [Demonstrates].

5.6 - Transposition Charts for Saxo-Flute Hybridity

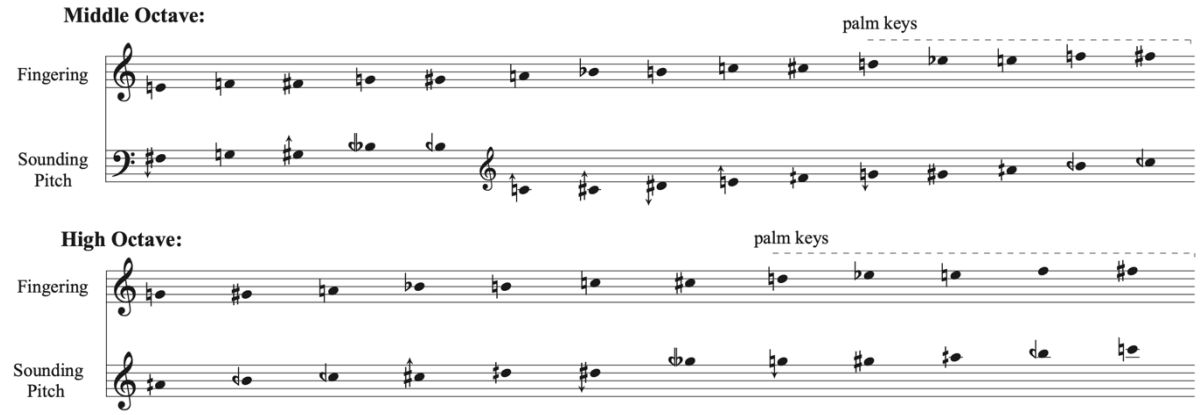
Soprano Saxophone



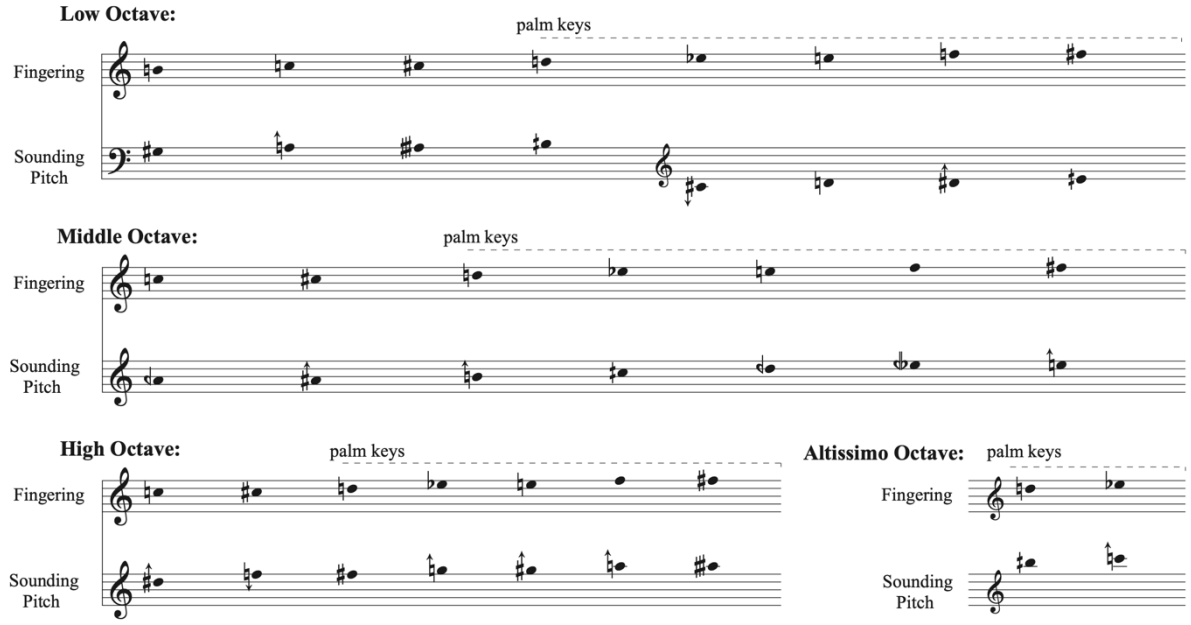
Alto Saxophone



Tenor Saxophone



Baritone Saxophone



5.7 - Demonstration Videos for Saxo-Flute Hybridity

Below, I will demonstrate the saxo-flute hybridity technique on all four main saxophones, show various transitions with the other SWMP techniques, and perform combinations with singing and common practice saxophone playing. Each video is accompanied by a brief text for further elaboration.

Chromatic Scale Played on Soprano, Alto, Tenor, and Baritone Saxophones:
https://youtu.be/BVQQB7Mpsho
Here, I demonstrate the saxo-flute hybridity technique across all four main saxophones. The technique is more challenging to execute fully in the lower tessitura. Saxophonists will need to dedicate considerable time to developing control in the lower registers to achieve optimal results.

Articulations:
https://youtu.be/scpMLyE9jac
Single Tongue:
Saxophonists should shift away from the conventional method of articulation and instead adapt their knowledge of single tongue articulation, with a focus on developing both speed and accuracy while maintaining the specific embouchure required for saxo-flute hybridity. The most essential element is to maintain clarity of sound despite introducing the tongue in order to articulate.
Double Tongue:
Similarly, double tongue articulations can be adapted from common practice techniques. It is important to maintain a rapid tongue speed when alternating between the front and back of the soft palate. The articulation structures I recommend are “TOO KOO” for shorter, more staccato double tonguing, and “DUH GUH” for more legato double tonguing passages.
Flutter Tongue:
As with the air pitch and trumpet sounds techniques, flutter tonguing can be combined with saxo-flute hybridity too. However, with saxo-flute hybridity it is crucial to maintain the correct embouchure and angle of the saxophone; the front rolling “R” may disrupt the airflow too significantly, potentially causing a lapse in sound production. Conversely, the back rolling “R” might be too subtle to be heard clearly without amplification.

Glissandi:
https://youtu.be/WdnYBfB4lBg
Similar to the trumpet sounds technique, glissandi are highly effective in saxo-flute hybridity. The method for producing the required glissando largely depends on the specific pitches involved. Most saxophonists are accustomed to employing various methods to achieve the desired intervals. By combining different fingerings and adjusting the throat opening, a wide range of possibilities exists for creating a smooth and fluid pitch shift.

Vibrato:
https://youtu.be/ZCLv7NXVYGE
Vibrato should be approached similarly to the way singers or flutists practice it. Undulations should be achieved through modulation of the air rather than through the jaw, as is common in traditional saxophone playing. It is advisable to integrate pedagogical methods from flute playing, and to approach vibrato systematically, focusing on gradually increasing speed and consistency.

In Combination with Other SWMP Techniques:
Saxo-Flute Hybridity to Air Pitch:
https://youtu.be/yoNWXABL0fg
Combining saxo-flute hybridity with air pitch is quite logical, as the air pitch technique can be seen as a precursor to saxo-flute hybridity. The pitched sound produced through air pitch serves as a "shadow" of the fully developed sound produced by saxo-flute hybridity. To facilitate a smooth transition, it is advisable to use an air pitch from a playing position that complements the saxo-flute hybridity technique, particularly if the transition needs to be executed quickly.

Saxo-Flute Hybridity to Tongue Ram Technique:
https://youtu.be/A6dR_R9ErB4
The primary challenge in combining saxo-flute hybridity with the tongue ram technique lies in the need to reposition the entire saxophone body and neck. In order to produce the saxo-flute hybridity technique, a saxophonist must adjust the angle of the instrument to blow correctly across the aperture hole of the neckpiece. This contrasts with the embouchure required to produce a successful tongue ram. Although this adjustment can be mastered through dedicated practice, it is advisable to allow the performer a second or two to properly position the saxophone.

Saxo-Flute Hybridity to Trumpet Sounds:
https://youtu.be/FBXgYTjRDf4
Achieving a smooth transition between saxo-flute hybridity and trumpet sounds is challenging due to the significantly different embouchures required, making rapid and fluid succession nearly impossible. Nevertheless, the inherent tonal shift between these techniques can result in striking sonic contrasts. Given the substantial differences in transpositions between the two techniques, performers and composers should refer to the respective fingering charts to achieve consistent sonic results when transitioning from one technique to the other.

In combination with Other Techniques:
Saxo-Flute Hybridity and Singing:
https://youtu.be/40IwcTvDO00
Singing while performing saxo-flute hybridity can be an effective auxiliary technique, enabling the production of multiple pitches simultaneously. The primary challenge lies in maintaining the precise embouchure and angle required for playing the saxo-flute hybridity technique while also singing.

Saxo-Flute Hybridity to Normal Playing:
https://youtu.be/626DGywlNHU
As with all saxophone techniques performed without the mouthpiece, it is possible to combine saxo-flute hybridity with common practice playing. The primary challenge is reattaching the mouthpiece to the neckpiece. Composers should allow saxophonists approximately five to ten seconds to replace the mouthpiece, return to the normal playing position, adjust their neckstrap, and wet the reed. Additionally, they should consider how to address the silence that occurs during the transition between common practice playing and SWMP techniques.

5.8 - Pitch Manual for Saxo-Flute Hybridity

Soprano Saxophone							
Fingering	**Test 1 (Hz)**	**Test 2 (Hz)**	**Test 3 (Hz)**	**Test 4 (Hz)**	**Average (Hz)**	**St Dev (Hz)**	**Musical Notation**
F#4 / G♭4	436.11	437.19	436.24	438.39	**436.9825**	1.05	**A4 minus 12 cents**
G4	X	482.69	496	485.63	**488.1066667**	6.99	**B4 minus 20 cents**
G#4 / A♭4	510.14	512.96	508.33	513.97	**511.35**	2.58	**C5 minus 40 cents**
A4	550.4	550.8	550.77	551.2	**550.7925**	0.33	**C#5 minus 11 cents**
A#4 / B♭4	586.74	592.53	589.81	583.74	**588.205**	3.80	**D5 plus 3 cents**
B4	654.23	655.3	653.02	654.33	**654.22**	0.93	**E5 minus 13 cents**
C5	730.15	722.74	721.38	720.99	**723.815**	4.29	**F#5 minus 38 cents**
C#5 / D♭5	780.34	781.32	780.49	780.46	**780.6525**	0.45	**G5 minus 7 cents**
D5 (with palm keys)	811.94	827.51	826.87	828.38	**823.675**	7.85	**G#5 minus 15 cents**
D#5 / E♭5 (with palm keys)	873.01	869.77	870.96	879.56	**873.325**	4.37	**A5 minus 13 cents**
E5 (with palm keys)	926.99	937.65	929.43	926.18	**930.0625**	5.24	**A#5 minus 4 cents**
F5 (with palm keys)	985.14	985.4	987.43	994.01	**987.995**	4.14	**B5 plus 0 cents**
F#5 / G♭5 (with palm keys)	1035.97	1043.18	1040.27	1049.26	**1042.17**	5.58	**C6 minus 7 cents**
G5 (with palm keys)	1093.91	1108.74	1096.14	1109.11	**1101.975**	8.08	**C#6 minus 11 cents**

Alto Saxophone							
Fingering	**Test 1 (Hz)**	**Test 2 (Hz)**	**Test 3 (Hz)**	**Test 4 (Hz)**	**Average (Hz)**	**St Dev (Hz)**	**Musical Notation**
A#4 / B♭4 - Low Octave	402.44	401.79	401.06	398.47	**400.94**	1.74	**G4 plus 39 cents**
B4 - Low Octave	438.62	435.99	435.54	437.99	**437.035**	1.50	**A4 minus 12 cents**
C5 - Low Octave	476.25	476.27	473.9	475.88	**475.575**	1.13	**A#4 plus 35 cents**
C#5 / D♭5 - Low Octave	519.66	519.03	514.73	520.65	**518.5175**	2.61	**C5 minus 16 cents**
D5 (with palm keys) - Low Octave	547.13	545.22	547.64	548.09	**547.02**	1.26	**C#5 minus 23 cents**
D#5 / E♭5 (with palm keys) - Low Octave	587.95	588.63	589.66	589.05	**588.8225**	0.72	**D5 plus 4 cents**

E5 (with palm keys) - Low Octave	621.06	622.94	627.5	632.18	**625.92**	4.97	**D#5 plus 10 cents**
F5 (with palm keys) - Low Octave	667.21	664.22	665.21	664.45	**665.2725**	1.36	**E5 plus 16 cents**
F#5 / G♭5 (with palm keys) - Low Octave	700.15	710.73	704.31	710.24	**706.3575**	5.06	**F5 plus 19 cents**
D#4 / E♭4 - Mid Octave	466.59	466.65	464.69	463.01	**465.235**	1.74	**A#4 minus 3 cents**
E4 - Mid Octave	493.77	487.97	492.06	488.99	**490.6975**	2.69	**B4 minus 11 cents**
F4 - Mid Octave	528.14	525.99	529.7	528.12	**527.9875**	1.52	**C5 plus 16 cents**
F#4 / G♭4 - Mid Octave	560.85	561.29	556.86	556.52	**558.88**	2.54	**C#5 plus 14 cents**
G4 - Mid Octave	632.77	632.94	632.98	633.86	**633.1375**	0.49	**D#5 plus 30 cents**
G#4 / A♭4 - Mid Octave	675.13	681.5	683.01	675.24	**678.72**	4.13	**E5 plus 50 cents**
A4 - Mid Octave	730.25	732.26	724.36	729.32	**729.0475**	3.36	**F#5 minus 26 cents**
A#4 / B♭4 - Mid Octave	767.29	780.93	778.35	779.75	**776.58**	6.28	**G5 minus 16 cents**
B4 - Mid Octave	829.54	827.76	829.27	830.66	**829.3075**	1.19	**G#5 minus 3 cents**
C5 - Mid Octave	871.73	871.49	876.13	862.15	**870.375**	5.88	**A5 minus 19 cents**
C#5 / D♭5 - Mid Octave	952.58	951.62	950.44	942.51	**949.2875**	4.60	**A#5 plus 31 cents**
D5 (with palm keys) - Mid Octave	1017.1	1020.09	1015.66	1022.94	**1018.9475**	3.24	**C6 minus 46 cents**
D#5 / E♭5 (with palm keys) - Mid Octave	1078.89	1082.02	1089.15	1097.42	**1086.87**	8.24	**C#6 minus 34 cents**
E5 (with palm keys) - Mid Octave	1157.28	1165.98	1160.97	1167.53	**1162.94**	4.70	**D6 minus 17 cents**
F5 (with palm keys) - Mid Octave	1226.2	1223.29	1229.68	1232.34	**1227.8775**	3.96	**D#6 minus 23 cents**
F#5 / G♭5 (with palm keys) - Mid Octave	1310.78	1315.21	1309.93	1322.08	**1314.5**	5.56	**E6 minus 5 cents**

Tenor Saxophone							
Fingering	**Test 1 (Hz)**	**Test 2 (Hz)**	**Test 3 (Hz)**	**Test 4 (Hz)**	**Average (Hz)**	**St Dev (Hz)**	**Musical Notation**
E4 - Mid Octave	182.47	186.43	183.43	183.28	**183.9025**	1.74	**F#3 minus 10 cents**
F4 - Mid Octave	195.56	194.58	195	195.66	**195.2**	0.51	**G3 minus 7 cents**
F#4 / G♭4 - Mid Octave	212.56	209.39	210.57	210.39	**210.7275**	1.33	**G#3 plus 25 cents**
G4 - Mid Octave	229.54	226.46	227.47	226.61	**227.52**	1.42	**A#3 minus 42 cents**

G#4 / A♭4 - Mid Octave	241.13	241.81	242.37	242	**241.8275**	0.52	**B3 minus 36 cents**
A4 - Mid Octave	267.26	260.64	263.57	261.82	**263.3225**	2.89	**C4 plus 11 cents**
A#4 / B♭4 - Mid Octave	283.73	282.1	279.57	280.19	**281.3975**	1.89	**C#4 plus 26 cents**
B4 - Mid Octave	304.05	307.8	306.17	308.4	**306.605**	1.95	**D#4 minus 25 cents**
C5 - Mid Octave	331.93	333	330.91	334.02	**332.465**	1.34	**E4 plus 15 cents**
C#5 / D♭5 - Mid Octave	360.29	358.68	360.46	357.18	**359.1525**	1.54	**F4 plus 49 cents**
D5 (with palm keys) - Mid Octave	387.56	389.09	386.75	383.47	**386.7175**	2.37	**G4 minus 23 cents**
D#5 / E♭5 (with palm keys) - Mid Octave	414.77	416.73	416.97	419.54	**417.0025**	1.96	**G#4 plus 7 cents**
E5 (with palm keys) - Mid Octave	447.27	448.04	449.02	448.01	**448.085**	0.72	**A4 plus 32 cents**
F5 (with palm keys) - Mid Octave	476.89	481.66	489.55	480.53	**482.1575**	5.33	**B4 minus 42 cents**
F#5 / G♭5 (with palm keys) - Mid Octave	509.68	510.12	515.03	512.55	**511.845**	2.47	**C5 minus 38 cents**
G4 - High Octave	448.03	458.27	453.55	451.21	**452.765**	4.31	**A4 plus 50 cents**
G#4 / A♭4 - High Octave	483.12	486.91	485.91	485.48	**485.355**	1.61	**B4 minus 30 cents**
A4 - High Octave	525.41	519.03	520.72	515.27	**520.1075**	4.21	**C5 minus 10 cents**
A#4 / B♭4 - High Octave	556.63	567.63	565.72	564.65	**563.6575**	4.84	**C#5 plus 29 cents**
B4 - High Octave	602.01	601.77	600.13	602.18	**601.5225**	0.94	**D5 plus 41 cents**
C5 - High Octave	X	633.8	631.65	630.41	**631.9533333**	1.72	**D#5 plus 27 cents**
C#5 / D♭5 - High Octave	720.35	724.66	719.24	724.31	**722.14**	2.75	**F#5 minus 42 cents**
D5 (with palm keys) - High Octave	775.56	774.44	771.93	772.74	**773.6675**	1.64	**G5 minus 23 cents**
D#5 / E♭5 (with palm keys) - High Octave	824.44	825.33	826.2	829.73	**826.425**	2.32	**G#5 minus 9 cents**
E5 (with palm keys) - High Octave	890.88	897.76	898.29	902.43	**897.34**	4.79	**A5 plus 34 cents**
F5 (with palm keys) - High Octave	968.93	968.32	971.38	974.26	**970.7225**	2.70	**B5 minus 30 cents**
F#5 / G♭5 (with palm keys) - High Octave	1041.27	1042.13	1044.57	1041.83	**1042.45**	1.46	**C6 minus 7 cents**

Baritone Saxophone							
Fingering	**Test 1 (Hz)**	**Test 2 (Hz)**	**Test 3 (Hz)**	**Test 4 (Hz)**	**Average (Hz)**	**St Dev (Hz)**	**Musical Notation**
B4 - Low Octave	208.76	206.18	205.67	205.92	**206.6325**	1.43	**G#3 minus 9 cents**
C5 - Low Octave	221.7	220.88	223.59	223.99	**222.54**	1.49	**A3 plus 20 cents**
C#5 / D♭5 - Low Octave	237.22	236.8	238.79	236.31	**237.28**	1.07	**A#3 plus 31 cents**
D5 (with palm keys) - Low Octave	252.19	253.15	252.16	254.84	**253.085**	1.26	**B3 plus 43 cents**
D#5 / E♭5 (with palm keys) - Low Octave	272.18	273.72	272.1	273.92	**272.98**	0.97	**C#4 minus 26 cents**
E5 (with palm keys) - Low Octave	292.49	294.17	291.2	292.2	**292.515**	1.23	**D4 minus 7 cents**
F5 (with palm keys) - Low Octave	311.79	314.24	312.69	313.29	**313.0025**	1.03	**D#4 plus 10 cents**
F#5 / G♭5 (with palm keys) - Low Octave	337.45	338.19	339.39	338.18	**338.3025**	0.80	**E4 plus 45 cents**
C5 - Mid Octave	431.73	431.16	428.9	427.54	**429.8325**	1.96	**A4 minus 40 cents**
C#5 / D♭5 - Mid Octave	469.31	472.51	469.84	466.06	**469.43**	2.65	**A#4 plus 12 cents**
D5 (with palm keys) - Mid Octave	501.92	499.23	500.25	501.16	**500.64**	1.16	**B4 plus 24 cents**
D#5 / E♭5 (with palm keys) - Mid Octave	530.94	531.75	535.01	537.63	**533.8325**	3.08	**C5 plus 35 cents**
E5 (with palm keys) - Mid Octave	574.19	574.26	578.79	579.24	**576.62**	2.77	**D5 minus 32 cents**
F5 (with palm keys) - Mid Octave	608.65	611.5	613.1	611.17	**611.105**	1.84	**D#5 minus 31 cents**
F#5 / G♭5 (with palm keys) - Mid Octave	661.23	671.01	672.91	671.04	**669.0475**	5.29	**E5 plus 26 cents**
C5 - High Octave	635.43	631.9	629.46	631.98	**632.1925**	2.45	**D#5 plus 27 cents**
C#5 / D♭5 - High Octave	688.4	693.95	694.96	692.48	**692.4475**	2.88	**F5 minus 15 cents**
D5 (with palm keys) - High Octave	743.2	738.14	739.37	745.88	**741.6475**	3.55	**F#5 plus 4 cents**
D#5 / E♭5 (with palm keys) - High Octave	790.86	783.07	792.1	796.26	**790.5725**	5.51	**G5 plus 14 cents**
E5 (with palm keys) - High Octave	840.19	840.58	838.92	838.92	**839.6525**	0.86	**G#5 plus 19 cents**
F5 (with palm keys) - High Octave	895.75	892.29	895.24	892.2	**893.87**	1.89	**A5 plus 27 cents**
F#5 / G♭5 (with palm keys) - High Octave	947.57	959.62	953.25	961.43	**955.4675**	6.33	**A#5 plus 42 cents**

D5 (with palm keys) - Altissimo Octave	1008.32	1005.88	1007.49	1010.15	**1007.96**	1.78	**B5 plus 35 cents**
D#5 / E♭5 (with palm keys) - Altissimo Octave	1059.27	1063.31	1068.6	1059.56	**1062.685**	4.35	**C6 plus 27 cents**