Saxophone without mouthpiece

Kahl, D.P.

Chapter 4
Trumpet Sounds

4.1 - Description of Technique - https://youtu.be/3Aa94ht86Ws

When a saxophonist wants to play the trumpet sounds technique, the lips should vibrate against the open hole of the saxophone neckpiece to produce a characteristic brass sound. [Plays an improvisation using the trumpet sounds technique]. Sound is made by blowing a thin stream of air through the instrument while the lips produce a buzz which resonates through the instrument in the same way that a brass instrument is played. [Demonstrates]. Pitch is affected by the harmonic partial selected and determined by the strength and flexibility of the saxophonist's embouchure and, of course, fingerings.

4.2 - Technical Parameters - https://youtu.be/a0WEp-GyZF4

Proper Embouchure:
Saxophonists must be able to lightly press their lips together while still allowing a thin stream of air to pass through the opening of the embouchure. The characteristic buzzing sound of the typical brass player embouchure is desired. The lips are lightly pressed against the aperture of the saxophone. [Demonstrates]. The pressure level is pivotal to create a just and in-tune intonation. Practice with a tuner is encouraged at the beginning stages.

Something that should be avoided is placing the neckpiece aperture hole off-center to the lips. [Demonstrates]. This alters the pitch and pressure balance of the technique. While Weiss and Netti advocate for the opposite in their method to “protect against cramping in the lips” (Weiss and Netti 2010: 148), through my own practice, and working with other saxophonists, I have found that diligent embouchure exercises and training of this technique allow a saxophonist to gain the endurance to produce this technique without many issues.

Transposition:
As with all saxophone techniques that exclude the mouthpiece, it is infeasible to establish a universal transposition applicable to each saxophone. Nevertheless, a transposition chart for each type of saxophone – soprano, alto, tenor, and baritone – is provided below the primary video.

Range:
Trumpet sounds have a variable and large range, depending largely on the flexibility of the saxophonist's embouchure, the development of the buzzing technique used to create this sound, and the specific saxophone being played. In general, the trumpet sounds technique spans from B♭3 to B♭5. One will find that the octave key causes little change when oscillating between C#5 and D5. However, since there is little change, one might find it helpful to use the octave key with the desired fingering as a guide and for comfort.

Below, I specify the written range for each saxophone:

- On soprano saxophone, the range is B♭3 to G5.
- On alto saxophone, the range is B♭3 to B♭5.
- On tenor saxophone, the range is B♭3 to C6.
- On baritone saxophone, the range is A3 to A5. There are multiple harmonic partials possible to achieve with the same fingerings. Due to this, in the D5 to A5 range, there are disparate notes that a saxophonist is capable of producing depending on whether they utilize the primary or secondary octave.

The ranges specified are suggestions based on my own personal experience and development of this technique. Since the trumpet sounds technique requires flexibility and training of the lips, it is possible that theses ranges could be extended and developed further in the future. To hear the full range on each of the four main saxophones, click on the chromatic scale video in the section entitled Demonstration Videos.

Speed and Precision:
When discussing trumpet sounds and employing this technique in contemporary compositions, it is important to consider how quickly one can execute this technique. Depending on the required precision and stability of pitch, a saxophonist can perform the technique with some fluidity. However, achieving this level of proficiency will require diligent practice and repetition. The velocity parameter is directly linked to the saxophonist's comfort level with the buzzing embouchure. This type of embouchure manipulation is quite distinct from any technique taught within common saxophone pedagogy. As a result, saxophonists will need to train their lips to build endurance in maintaining this embouchure. Without the necessary endurance, the integrity of pitch and precision may suffer. Additionally, one may have the impulse to play faster than the embouchure allows, as the key mechanisms to vary pitch remain the same as the knowledge of common practice playing. [Demonstrates various playing speeds].

Several authors discuss the speed and precision of trumpet sounds. Kientzy suggests that the technique's speed is limited and that, when a few leaps are indeed necessary, it is “nearly essential that they be composed using partials from the same row” (Kientzy 2007: 428). While Kientzy's idea is understandable given the difficulty of the technique and the embouchure required, it immediately limits the compositional possibilities. With dedicated practice, an understanding of the resultant pitches of desired notes, and embouchure work, saxophonists can fluently play different partials from different rows, making the technique more versatile. [Demonstrates].

Londeix and Charrier are vaguer, stating that while performing this technique, “legato and staccato may be played fairly swiftly throughout the entire range of the saxophone” (Londeix 1989: 69). While this is not untrue, one should be aware of the possibility of losing pitch precision when combining staccato playing with speed. In my own practice, I

am comfortable performing sixteenth-notes at around MM=120. Any faster, and I risk losing precision and clarity of pitch.

I recommend composers to consider and develop material with a brass player in mind. While large leaps are not impossible, they are challenging for saxophonists who are not accustomed to buzzing their lips. For this reason, I encourage composers to collaborate with performers to determine what is comfortable and achievable for them.

Sound Quality and Brass Mouthpiece Addition:
The quality of sound produced by the trumpet sounds technique is characteristically brass-like, although it lacks the complexity of harmonics typical of brass instruments. Weiss and Netti comment on this, stating that playing trumpet sounds on saxophones possess "a sound weak in overtone content" (Weiss and Netti 2010: 147). They further mention that, depending on the instrument, the sound can resemble that of a bass or alto flute, or that of a wooden trumpet (Weiss and Netti 2010: 147). When I perform this technique in concerts, audience members often describe the trumpet sounds as having a tone quality like that of an alto horn or alto flute - somber and hollow. Various authors use suggestive adjectives to describe the sound as primitive and modest (Kientzy 2007: 428), sad, mournful, and muffled (Londeix 1989: 68), or crude and primordial (Weiss and Netti 2010: 147).

One of the most controversial elements of the trumpet sounds technique is the question whether the saxophonist should integrate the use of a bespoke tube, hose, brass mouthpiece, etc., to aid in the sound production. Two reasons have been discussed in favor of using such aids.
The first one is to uphold the integrity of the pitch of the common practice saxophone by elongating the tube to where the mouthpiece would generally be placed. Among those who make this claim, Weiss and Netti advocate this method for longer passages of trumpet sounds playing (Weiss and Netti 2010: 147). Similarly, Kientzy claims that by adding a tube of the same length and volume as the saxophone mouthpiece, the pitch of the instrument is "restored" (Kientzy 2007: 429). While elongating the tube may affect the intonation of the saxophone, there is no evidence that the trumpet sounds will automatically be tuned to the same transposition as the common practice saxophone. The pitches are still somewhat detuned from their common practice fingerings, likely due to the regular shape of the tube as opposed to the irregular shape of a saxophone mouthpiece chamber.

Secondly, saxophonists must make the artistic and technical decision whether to use a brass mouthpiece to produce trumpet sounds. This decision might also require the approval of the composer, if they are available to discuss such artistic choices. The advantages of using a brass mouthpiece include the potential of a more resonant, full, and warmer sound, as well as improved precision in identifying and placing pitches. However, there are also drawbacks: the metal often rubs against the inside of the saxophone tube,

causing unwanted scraping marks and micro-indentations inside the neckpiece. Additionally, the technical limitations of the saxophonist as a brass player might become more apparent, as trained brass players spend years refining their embouchure. When a saxophonist opts to use a brass mouthpiece, there is an expectation that they will perform at a level comparable to professional brass players. However, saxophonists may always lag behind in this regard due to the specialized training and experience required in brass instrument technique. Therefore, this decision should be made proactively by the saxophonist to align with the needs of the work, practice, and the composer's intentions.

While I consider the trumpet sounds technique to offer limitless artistic possibilities, I advise composers to exercise caution if they intend to treat it akin to virtuosic trumpet writing. Saxophonists must develop their lip buzzing embouchure and ensure confidence in placing pitches accurately across the instrument's range, spanning various octaves.[37]

4.3 - Performance and Practice - https://youtu.be/7IDE1hp8rc4

To properly execute the trumpet sounds technique, a saxophonist should first familiarize themselves with the brass embouchure. Begin with the lips. Bring them together as if forming a kiss. [Demonstrates]. With the lips loosely clamped shut, focus a stream of air through the lips, vibrating them against each other. [Demonstrates]. One should not need to force the lips or the air too much to create this sound. Before introducing the saxophone neck and body, one must be able to create this typical sound with ease.

However, there are many other ways to consider the vibrating lips embouchure. In *Hello! Mr. Sax,* Londeix and Charrier briefly discuss and quote French brass pedagogue Michel Ricquier concerning trumpet embouchure. Ricquier refers to the trumpet embouchure as forming the "mask." He states: "Close the mouth, then slightly separate the jaws, without opening or drawing back the lips, as if you were going to pass your tongue over your lips to moisten them. When the tongue has enough room to pass between the teeth, tighten the lips against each other so that only a tiny stream of air can pass between the lips when you blow" (Londeix 1989: 68). By thinking about the new embouchure in this way, a model is given to refer to.

Another model is presented by American trumpet player and pedagogue Andy Kozar. In his book *Response*, he advocates for an approach whittled down to the following steps: start with the air first, breathe in the vowel "hope"; find a simple buzzing embouchure that does not force any tension in the lips; then, produce a focused sound and find the center of pitch (Kozar 2022: 4-6). This model is simple and easy to follow, allowing the performer to focus on the main aspects of proper tone production. When reproducing this method on the saxophone, one should develop the concepts of tone and embouchure from

[37] Adding a brass mouthpiece to the neckpiece of the saxophone is a next step and, for now, outside this dissertation's scope.

the basics, ensuring they have a balanced air-first approach and not to use too much pressure while buzzing.[38]

Once this embouchure is achieved, rehearse with just the mouth. This will build ease, flexibility, and, most importantly, endurance with this new type of embouchure. My favorite types of exercises are long tones and single articulations. Do these exercises for about ten minutes before moving on to the neck of the saxophone. [Demonstrates].

Next, introduce solely the neckpiece. As is also common in common practice playing, I like to do only neck exercises to continue to work on the embouchure and the experience of the saxophone neck against my lips. The neck poses several challenges for anyone who buzzes their lips against it. First, the edges of the neck can be somewhat sharp as they are not designed to be in contact with the human skin. Second, one should avoid forcefully pressing the neckpiece into the lips. This will hurt and ultimately leave the saxophonist unable to play until the lips heal. Bring the neckpiece gently to the center of the lips and vibrate the lips against it. [Demonstrates]. It is recommended to incorporate exercises that enhance familiarity, flexibility, and endurance in this configuration.

Given the multitude of possible pitches, it is advisable to have the target pitches in mind before attempting to play them. The pitch manual provided on this page will be beneficial for this exercise. When approaching trumpet sounds for the first time in an unfamiliar score, I often find it helpful to sing the part before attempting to play it on the saxophone. In this way, I have an aural reference before using the saxophone; Weiss and Netti encourage the same (Weiss and Netti 2010: 148).

Dynamic Range:
Trumpet sounds can be played across a dynamic range from *pianissimo* to *fortissimo*, depending on the range of the instrument. It is nearly impossible to play in the lower tessitura of the instrument outside of the *piano* to *mezzo-piano* range. However, in the highest ranges, it is almost impossible to do the opposite, relying on a solid *mezzo-forte* to *fortissimo* range. [Demonstrates].

Articulations:
Single Tongue:
While buzzing the lips, the tongue should be directed towards the center of the lips to momentarily interrupt the airflow. Despite the absence of the mouthpiece, the tonguing remains largely similar to standard playing techniques. [Demonstrates].
Double Tongue:
Double tonguing is also possible and somewhat easier compared to common practice playing when the mouthpiece is not present. One will want to think of the tongue as

[38] There are many other articles, methods, and pedagogies that detail the complexity of brass embouchure. To interact with all these methods would be a dissertation on its own. For the sake of focus, I will not provide too many examples but will reference other documents for saxophonists to read while working on embouchure.

having a rebound action. The first articulation is a single tongue where the tongue is aimed toward the center of the lips. Immediately after, retract the tongue slightly and force the back of the tongue up to articulate on the soft palate. Repeat this procedure over and over in the desired rhythm and tempo. What I like to think about is a "Too-Koo" articulation, which mirrors what the tongue must do in order to double tongue. [Demonstrates].

Flutter Tongue:

Flutter tonguing can be easily combined with trumpet sounds. For saxophonists who can perform the flutter tongue technique with the mouthpiece, they simply need to get used to the sensation of fluttering without the resistance of the mouthpiece while buzzing their lips. This should not be too difficult. Performers and composers should be aware that adding the flutter tongue technique will increase the dynamic output of the trumpet sounds. Additionally, flutter tonguing might affect the pitch center of the sound. [Demonstrates].

Glissandi:

Much like in common practice brass playing, glissandi are possible when performing the trumpet sounds technique. This can be achieved by slowly altering between fingerings, manipulating the embouchure, or a combination of both. The manipulation of the embouchure can occur through several different means: adjusting the strength or weakness of the lips on the neckpiece, altering how close the neckpiece is to the vibrating lips, or adjusting the openness of the throat. A fair amount of trial and error will be necessary to determine which method will work best on the respective saxophone and desired pitch sets. [Demonstrates].

Barrissement:

The barrissement technique is a subset technique that involves the over pressurization of the trumpet sound embouchure. [Demonstrates]. "Barrissement" in French means the roar of an elephant, aptly named due to the evocative sound it produces. When the amount of air forced into the saxophone neckpiece saturates the sound, a roar-like effect is achieved. The amount of pitched content is nearly equal to the amount of air, as the air being forced through the lips and neckpiece is hyper-pressurized. The pitch is very difficult to control since the air itself is out of control. Despite the typical lack of control, desired pitches can be achieved through diligent practice. One should take caution when performing this technique, as the amount of pressure exerted by the lips is extraordinary and can lead to cramps and headaches if overperformed. The pressure can be released by often taking rests when practicing. Found throughout the literature for SWMP, this technique is often used in pieces that do not require precision of pitch but rather a textured and colorful sound world.

4.4 - Personal Development - https://youtu.be/di-GONYpy2I

Extremes in tessitura can be challenging depending on the saxophone used. For example, it is very difficult to produce sounds lower than a low C on tenor and baritone saxophone without first starting slightly higher in range, whereas this difficulty is not as apparent with the alto and soprano saxophones. Like all techniques, mindful practice is essential to mastery.

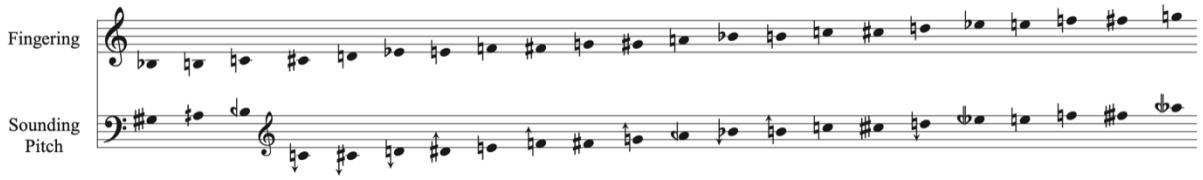
What I like to do when I need to play very precise trumpet sounds and be exact with pitch is to pull out my old method books and play the simple melodies there. Working through these exercises allows me to focus on the sound, accuracy of pitch, and development of embouchure strength.

4.5 - Pedagogy - https://youtu.be/hlE7rcureco

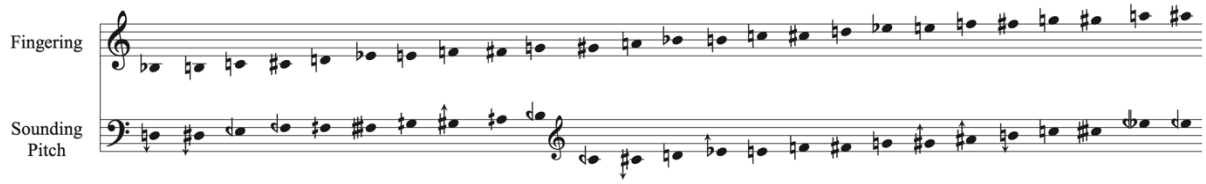
Position the center of the neckpiece of the saxophone to the center of the lips. [Demonstrates]. Choose the correct and desired fingering. [Demonstrates]. Form the buzzing embouchure by lightly pressing the lips together, creating a kissing shape with the mouth while keeping the top and bottom teeth slightly spaced apart inside the oral cavity. [Demonstrates]. Hear the desired pitch in the mind's ear before blowing. Breathe in. [Demonstrates]. And, blow a focused stream of air through the lips and into the neckpiece producing a successful trumpet sound through the saxophone. [Demonstrates].

4.6 - Transposition Charts for Trumpet Sounds

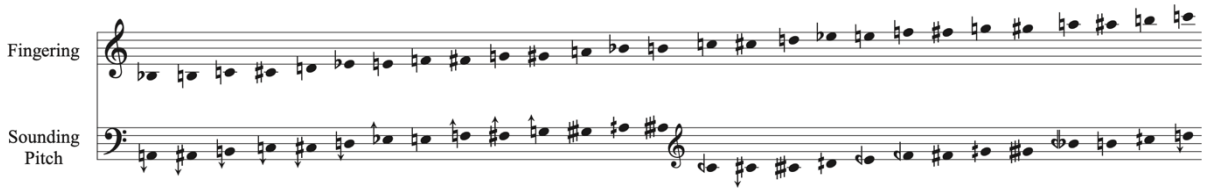
Soprano Saxophone



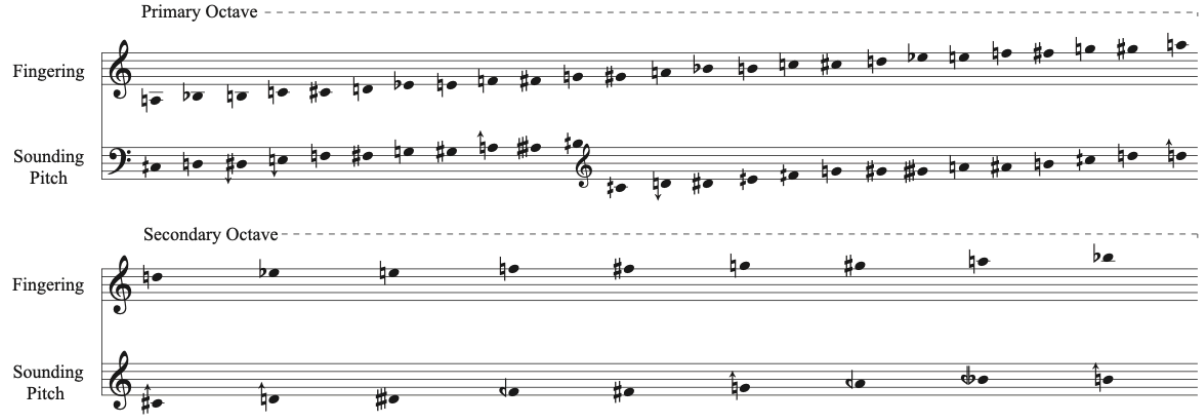
Alto Saxophone



Tenor Saxophone



Baritone Saxophone



4.7 - Demonstration Videos for Trumpet Sounds

Below, I will demonstrate the trumpet sounds technique on all four main saxophones, show 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/5xtt0epuDoQ
In this section, I demonstrate the full range of possible notes on all four standard saxophones. It is important to note that at the extremes of tessitura, producing pitches with precision and exactitude becomes increasingly challenging. In many cases, it is advisable to begin from a more accessible starting point and gradually work higher or lower to achieve the desired pitches.

The ranges presented here reflect what was achievable for me at the time of recording the Pitch Manual in March 2022. However, each player may have a functional range that extends beyond the indicated limits, depending on their familiarity and comfort with the trumpet sounds technique.

Barrissement Technique:
https://youtu.be/aFxG3n6KjHM
Alternating between regular trumpet sounds and the barrissement technique is both possible and highly effective in creating distinct sound worlds. However, composers should be mindful that a player's endurance may be compromised by rapid shifts between these two techniques. It is also important to note the potential risk of injury when performing extended passages using the barrissement technique, due to the over-pressurization of air. To prevent damage to the embouchure, it is advisable to take breaks and rest when experiencing headaches or excessive cramping in the lips.

Articulations:
https://youtu.be/509W_iOB7Ms
Single Tongue:
Single tonguing articulation within the context of trumpet sounds technique should be adapted from common practice playing, with the key difference being the reduced resistance inside the mouth due to the absence of the mouthpiece. Composers are encouraged to collaborate with saxophonists to determine the maximum speed at which they can single tongue while maintaining the trumpet sound embouchure. When the speed increases, clarity often becomes a challenge; therefore it is, important to find a balance between articulation speed and sound quality.
Double Tongue:
Similarly, a saxophonist should adapt their knowledge of double tonguing from common practice technique. Most saxophonists will be familiar with the “TOO KOO” or “DUH GUH”

approach to double tonguing. At slower speeds, the back of the tongue may interfere with the pitch and sound quality. To minimize this, the tongue should be moved quickly into position, striking the back of the soft palate and interrupting the airflow to create the double tongue articulation. This quick movement will help maintain clarity and sound quality.

Flutter Tongue:

The flutter tongue technique can be applied while performing trumpet sounds, and it can be produced in two ways: the front rolling "R" and the back rolling "R." The front rolling "R" creates a more aggressive attack, which naturally increases the dynamic intensity. In contrast, the back rolling "R" produces a more intimate sound, although it can be difficult to hear in certain contexts.

Glissandi:

https://youtu.be/-loEVta0-FE

There are multiple ways to produce glissandi effects using the trumpet sounds technique. Saxophonists may need to incorporate a combination of different techniques depending on the desired starting and target notes. By manipulating the embouchure, adjusting the opening of the throat, altering fingerings, and varying the distance between the lips and the saxophone neckpiece, one can achieve a range of glissandi effects. These various methods offer flexibility and options for creating smooth, continuous pitch shifts.

In Combination with Other SWMP Techniques:

Trumpet Sounds to Tongue Rams:

https://youtu.be/C8ViRu5lJsA

The trumpet sounds technique can be seamlessly integrated with the tongue ram technique. While the pitch of the tongue ram closely matches that of trumpet sounds, there are subtle differences in the same fingerings. To aid in developing the trumpet sound pitch, a saxophonist can use the tongue ram as a close reference for the fundamental pitch of the trumpet sound. Swift transitions between these two techniques are feasible and can be effectively utilized in performance.

Trumpet Sounds to Air Pitch:

https://youtu.be/BdsCX4aOSFQ

Trumpet sounds can be easily combined with the air pitch technique, though the resultant pitches will differ even when similar fingerings are used. If a composer wishes to blend these techniques, it is recommended to instruct the saxophonist to perform the air pitch technique with a "straight on" playing position. There is an inherent dynamic inconsistency between these two techniques, which the saxophonist must address through dynamic scaling or which the composer can utilize creatively. The speed of transition between the techniques can be quite rapid, depending on the distance between the neckpiece and the saxophonist's mouth while performing the air pitch technique. This close distance may allow for a seamless transition between the two techniques.

Trumpet Sounds to Saxo-Flute Hybridity:
https://youtu.be/9GyjNTGh9W0
Creating a smooth transition between trumpet sounds and saxo-flute hybridity is challenging. Due to the drastically different embouchures required for each technique, making fluid and rapid succession is nearly impossible. However, the inherent change in tone quality between these techniques can create striking sonic shifts in both compositions and improvisations. Since the transpositions between the two techniques differ significantly, saxophonists and composers should consult the respective fingering charts to achieve similar sonic results when transitioning from one fingering to the next.

In Combination with Other Techniques:
Trumpet Sounds and Growl/Singing:
https://youtu.be/Ftjl4pBEPuU
Playing trumpet sounds and singing simultaneously is feasible. However, the balance between the trumpet sounds and the singing voice may require adjustment based on the dynamic level demanded. Often, the singing voice can become quite harsh due to the interaction of lip buzzing and vocal production. This unique combination can be employed to create harmonies with a typically monophonic instrument, enriching the overall texture and expanding sonic possibilities.

Trumpet Sounds to Normal Playing:
https://youtu.be/DtRJY4BrIsw
Combining any SWMP techniques with traditional playing using the mouthpiece is possible, though there are a few important considerations to keep in mind.

Firstly, the transition time required to reattach the mouthpiece is significant. Allow the saxophonist approximately five to ten seconds to pick up the mouthpiece, properly place it on the instrument, adjust the neckstrap if necessary, and prepare to play with the mouthpiece again. This delay can also be used creatively, for example to generate musical drama through silence or by emphasizing the physical act of removing or replacing the mouthpiece. Alternatively, a composer may choose to fill this transition with different musical material or techniques.

Secondly, there is the possibility of the mouthpiece making noise as it rubs against the cork of the neckpiece. While applying cork grease before performing can mitigate this noise, it is not a guaranteed solution. Composers might also consider incorporating this rubbing sound into their compositions.

The third factor to consider is the tuning of the instrument after reattaching the mouthpiece. While this is typically not a major issue since experienced saxophonists will intuitively know where to place the mouthpiece to play in tune, it is important to acknowledge that this intuition is not foolproof. If precise tuning is critical, composers should include a designated moment in the piece for the saxophonist to retune.

4.8 - Pitch Manual for Trumpet Sounds

Soprano Saxophone							
Fingering	**Test 1 (Hz)**	**Test 2 (Hz)**	**Test 3 (Hz)**	**Test 4 (Hz)**	**Average (Hz)**	**St Dev (Hz)**	**Musical Notation**
A#3 / Bb3	209.63	210.7	211.15	215.03	**211.6275**	2.36	**G#3 plus 33 cents**
B3	220.65	224.63	226.65	227.06	**224.7475**	2.93	**A3 plus 37 cents**
C4	240.08	241.63	242.34	244.92	**242.2425**	2.02	**B3 minus 33 cents**
C#4 / Db4	259.14	259.37	259.26	259.68	**259.3625**	0.23	**C4 minus 15 cents**
D4	272.31	273.13	275.99	273.88	**273.8275**	1.58	**C#4 minus 21 cents**
D#4 / Eb4	293.68	291.58	292.52	289.72	**291.875**	1.67	**D4 minus 11 cents**
E4	310.4	313.92	313.76	313.78	**312.965**	1.71	**D#4 plus 10 cents**
F4	328.69	331.35	330.21	329.45	**329.925**	1.13	**E4 plus 2 cents**
F#4 / Gb4	347.43	355.52	354.67	354.26	**352.97**	3.73	**F4 plus 18 cents**
G4	369.88	368.01	371.34	371.64	**370.2175**	1.66	**F#4 plus 1 cent**
G#4 / Ab4	400.82	393.59	396.77	399.67	**397.7125**	3.23	**G4 plus 25 cents**
A4	427.23	432.16	434.5	432.47	**431.59**	3.09	**A4 minus 33 cents**
A#4 / Bb4	456.24	462.08	463.66	466.05	**462.0075**	4.18	**A#4 minus 16 cents**
B4	502.54	504.6	500.22	501.23	**502.1475**	1.89	**B4 plus 29 cents**
C5	519.34	530.96	524.49	523.56	**524.5875**	4.80	**C5 plus 4 cents**
C#5 / Db5	564.11	569.28	560.66	565.02	**564.7675**	3.55	**C#5 plus 32 cents**
D5	576	577.77	579.76	576.99	**577.63**	1.59	**D5 minus 29 cents**
D#5 / Eb5	599.86	606.22	606.52	608.23	**605.2075**	3.67	**D#5 minus 48 cents**
E5	658.69	659.9	651.89	657.87	**657.0875**	3.56	**E5 minus 6 cents**
F5	694.21	698.1	700.28	703.63	**699.055**	3.95	**F5 plus 1 cent**
F#5 / Gb5	753.18	754.69	754.65	753.16	**753.92**	0.87	**F#5 plus 32 cents**
G5	824.28	826.58	810.24	807.19	**817.0725**	9.78	**G#5 minus 28 cents**

Alto Saxophone							
Fingering	**Test 1 (Hz)**	**Test 2 (Hz)**	**Test 3 (Hz)**	**Test 4 (Hz)**	**Average (Hz)**	**St Dev (Hz)**	**Musical Notation**
A#3 / B♭3	143.19	145.08	144.93	144.33	**144.3825**	0.86	**D3 minus 29 cents**
B3	154.08	154.06	154.52	154.04	**154.175**	0.23	**D#3 minus 16 cents**
C4	161.42	161.56	162.19	161.08	**161.5625**	0.46	**E3 minus 34 cents**
C#4 / D♭4	169.43	170.9	170.75	169.72	**170.2**	0.73	**F3 minus 44 cents**
D4	178.65	179.38	179.26	181.45	**179.685**	1.22	**F3 plus 50 cents**
D#4 / E♭4	186.9	188.9	190.25	190.42	**189.1175**	1.63	**F#3 plus 38 cents**
E4	198.57	200.41	200.36	200.56	**199.975**	0.94	**G3 plus 35 cents**
F4	210.39	209.36	211.68	212.52	**210.9875**	1.39	**G#3 plus 28 cents**
F#4 / G♭4	223.71	224.38	225	225.82	**224.7275**	0.90	**A3 plus 37 cents**
G4	239.22	240.84	241.5	243.76	**241.33**	1.88	**B3 minus 40 cents**
G#4 / A♭4	257.89	252.47	254.96	257.86	**255.795**	2.61	**C4 minus 39 cents**
A4	275.29	273.37	275.95	277.74	**275.5875**	1.80	**C#4 minus 10 cents**
A#4 / B♭4	292.63	291.18	291.73	294.15	**292.4225**	1.30	**D4 minus 7 cents**
B4	313.26	314.9	316.75	313.83	**314.685**	1.54	**D#4 plus 20 cents**
C5	326.61	324.04	335.96	336.72	**330.8325**	6.45	**E4 plus 6 cents**
C#5 / D♭5	353.06	348.5	350.41	347.84	**349.9525**	2.34	**F4 plus 4 cents**
D5	370.32	371.71	371.98	372.56	**371.6425**	0.95	**F#4 plus 8 cents**
D#5 / E♭5	393.2	394.13	395.34	391.74	**393.6025**	1.52	**G4 plus 7 cents**
E5	415.55	420.18	422.24	422.24	**420.0525**	3.15	**G#4 plus 20 cents**
F5	442.02	455.05	459.12	459.28	**453.8675**	8.14	**A#4 minus 46 cents**
F#5 / G♭5	487.75	487.22	489.48	490.82	**488.8175**	1.65	**B4 minus 18 cents**
G5	522.07	526.75	525.91	527.71	**525.61**	2.47	**C5 plus 8 cents**
G#5 / A♭5	571.86	566.98	567.47	567.78	**568.5225**	2.25	**C#5 plus 44 cents**
A5	606.01	612.96	608.07	612.23	**609.8175**	3.33	**D#5 minus 35 cents**
A#5 / B♭5	644.57	644.55	640.9	648.21	**644.5575**	2.98	**E5 minus 39 cents**

Tenor Saxophone							
Fingering	**Test 1 (Hz)**	**Test 2 (Hz)**	**Test 3 (Hz)**	**Test 4 (Hz)**	**Average (Hz)**	**St Dev (Hz)**	**Musical Notation**
A#3 / B♭3	107.73	107.45	108.72	108.8	**108.175**	0.69	**A2 minus 29 cents**
B3	115.19	114.37	117.88	114.71	**115.5375**	1.60	**A#2 minus 15 cents**
C4	122.18	122.48	122.94	122.17	**122.4425**	0.36	**B2 minus 14 cents**
C#4 / D♭4	130.01	129.45	129.13	128.4	**129.2475**	0.67	**C3 minus 21 cents**
D4	137.93	137.89	136.59	138.12	**137.6325**	0.70	**C#3 minus 12 cents**
D#4 / E♭4	147.28	143.76	145.79	145.33	**145.54**	1.45	**D3 minus 15 cents**
E4	156.43	158.72	158.36	158.74	**158.0625**	1.10	**D#3 plus 28 cents**
F4	164.62	163.6	165.76	166.87	**165.2125**	1.41	**E3 plus 4 cents**
F#4 / G♭4	174.07	176.12	176.7	178.35	**176.31**	1.77	**F3 plus 17 cents**
G4	185.41	187.66	185.83	185.78	**186.17**	1.01	**F#3 plus 11 cents**
G#4 / A♭4	195.72	198.19	199.56	200.29	**198.44**	2.01	**G3 plus 21 cents**
A4	212.37	213.13	210.79	213.08	**212.3425**	1.09	**G#3 plus 39 cents**
A#4 / B♭4	224.2	223.91	225.91	226.02	**225.01**	1.11	**A3 plus 39 cents**
B4	237.44	237.94	236.52	238.89	**237.6975**	0.99	**A#3 plus 34 cents**
C5	254.16	255.08	255.13	258.68	**255.7625**	2.00	**C4 minus 39 cents**
C#5 / D♭5	272.43	272.43	272.33	273.49	**272.67**	0.55	**C#4 minus 28 cents**
D5	282.66	283.67	284.78	284.36	**283.8675**	0.93	**C#4 plus 41 cents**
D#5 / E♭5	298.81	300	300.25	300.48	**299.885**	0.74	**D4 plus 36 cents**
E5	321.74	322.4	319.14	322.12	**321.35**	1.50	**E4 minus 44 cents**
F5	341.16	341.63	340.37	342.61	**341.4425**	0.94	**F4 minus 39 cents**
F#5 / G♭5	370.78	369.77	366.95	366.55	**368.5125**	2.08	**F#4 minus 7 cents**
G5	396.3	398.31	400.36	397.34	**398.0775**	1.73	**G4 plus 27 cents**
G#5 / A♭5	424.43	422.36	424	423.32	**423.5275**	0.90	**G#4 plus 34 cents**
A5	457.18	454.68	453.71	455.56	**455.2825**	1.47	**A#4 minus 41 cents**

A#5 / B♭5	483.4	494.09	494.53	495.37	**491.8475**	5.66	**B4 minus 7 cents**
B5	532.17	530.43	528.48	554.35	**536.3575**	12.09	**C5 plus 43 cents**
C6	583.5	581.8	581.98	580.68	**581.99**	1.16	**D5 minus 16 cents**

Baritone Saxophone							
Fingering	**Test 1 (Hz)**	**Test 2 (Hz)**	**Test 3 (Hz)**	**Test 4 (Hz)**	**Average (Hz)**	**St Dev (Hz)**	**Musical Notation**
A3 - 1°	133.45	132.7	135.2	136.47	**134.455**	1.70	**C3 plus 48 cents**
A#3 / B♭3 - 1°	147.75	147.13	146.79	142.48	**146.0375**	2.40	**D3 minus 9 cents**
B3- 1°	153.06	153.51	151.98	155.88	**153.6075**	1.65	**D#3 minus 22 cents**
C4 - 1°	162.01	162.67	162.4	162.66	**162.435**	0.31	**E3 minus 25 cents**
C#4 / D♭4 - 1°	174.78	173.31	174.52	174.97	**174.395**	0.75	**F3 minus 2 cents**
D4 - 1°	183.41	185.08	185.15	185.82	**184.865**	1.03	**F#3 minus 1 cent**
D#4 / E♭4 - 1°	194.83	194.84	196.26	194.84	**195.1925**	0.71	**G3 minus 7 cents**
E4 - 1°	205.35	203.27	209.34	209.05	**206.7525**	2.95	**G#3 minus 8 cents**
F4 - 1°	218.31	221.67	222.25	223.17	**221.35**	2.12	**A3 plus 11 cents**
F#4 / G♭4 - 1°	236.35	238.69	238.18	240.15	**238.3425**	1.57	**A#3 plus 39 cents**
G4 - 1°	251.44	252.89	253.6	252.22	**252.5375**	0.92	**B3 plus 39 cents**
G#4 / A♭4 - 1°	268	270.46	270.79	271.96	**270.3025**	1.66	**C#4 minus 44 cents**
A4 - 1°	288.87	287.92	290.03	292.59	**289.8525**	2.02	**D4 minus 23 cents**
A#4 / B♭4 - 1°	306.97	309.44	309.62	312.33	**309.59**	2.19	**D#4 minus 9 cents**
B4 - 1°	336.54	335.76	336.7	335.04	**336.01**	0.77	**E4 plus 33 cents**
C5 - 1°	355.31	357.36	358.31	361.71	**358.1725**	2.67	**F4 plus 44 cents**
C#5 / D♭5 - 1°	390.35	390.27	393.6	393.98	**392.05**	2.02	**G4 plus 0 cents**
D5 - 1°	416.46	414.05	413.81	415.43	**414.9375**	1.24	**G#4 minus 2 cents**
D#5 / E♭5 - 1°	418.04	418.66	421.94	421.69	**420.0825**	2.02	**G#4 plus 20 cents**
E5 - 1°	441.15	442.53	437.79	442.35	**440.955**	2.20	**A4 plus 4 cents**
F5 - 1°	477.46	477.43	477.07	478.17	**477.5325**	0.46	**A#4 plus 42 cents**

F#5 / G♭5 - 1°	495.52	497.72	496.86	494.92	**496.255**	1.27	**B4 plus 8 cents**
G5 - 1°	537.64	537.84	538.91	540.67	**538.765**	1.39	**C#5 minus 49 cents**
G#5 / A♭5 - 1°	586.37	586.65	589.99	588.65	**587.915**	1.72	**D5 plus 2 cents**
A5 - 1°	597.98	590.98	598.06	598.36	**596.345**	3.58	**D5 plus 26 cents**
D5 - 2°	278.57	279.92	281	281.21	**280.175**	1.21	**C#4 plus 19 cents**
D#5 / E♭5 - 2°	292.22	298.25	298.78	298.82	**297.0175**	3.21	**D4 plus 20 cents**
E5 - 2°	317.48	319.31	319.54	320.85	**319.295**	1.39	**D#4 plus 45 cents**
F5 - 2°	337.88	341.62	342.25	343.54	**341.3225**	2.43	**F4 minus 40 cents**
F#5 / G♭5 - 2°	367.36	366.7	368.75	371.8	**368.6525**	2.27	**F#4 minus 6 cents**
G5 - 2°	393.76	397.65	398.16	398.54	**397.0275**	2.21	**G4 plus 22 cents**
G#5 / A♭5 - 2°	428.87	429.08	429.55	429.18	**429.17**	0.28	**A4 minus 43 cents**
A5 - 2°	459.76	456.67	457.03	456.85	**457.5775**	1.46	**A#4 minus 32 cents**
A#/B♭ 5 - 2°	501.15	501.2	493.18	497.25	**498.195**	3.82	**B4 plus 15 cents**