Staldophone - an extended overtone tenor saxophone

by Hans Ulrich Stalder.
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Preamble

When it comes to playing with the Staldophone, it is largely based on the tenor saxophone. The Staldophone, however, requires playing overtones. This requires an adapted learning method. Instead of around 22 buttons and pushers, the Staldophone only has ten buttons (peeling the onion). With these few keys and only one cross-fingering in the lowest register, all tones can be generated over several octaves in semitone steps. The buttons, their holders and the whole mechanism, as well as the thumb rests, are attached to a separate holder construction. Therefore, the horn can be constructed from the lyre holder to the C-tone hole without superstructures. This allows the horn to vibrate freely over the entire distance, which significantly improves the sound. All superstructures and attachments are made of lightweight construction using carbon fibre reinforced plastic.

The advantages of the Staldophone at a glance.

- The Staldophone has a singing sound rich in overtones.
- The Staldophone is a very lightweight instrument.
- The Staldophone only needs 12 fingerings (about 90 for the Saxophone).
- The Staldophone only needs a simple mechanism.
- The Staldophone enables a good price due to the simplified production.

Terminology

Various saxophone explanations make no difference between valves and keys. In this documentation keys are assigned to the fingers and valves cover the tone holes. Push-buttons are not assigned to a finger.

Exclusion of liability / disclaimer see last page.

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Preface

After an intensive whiskey training, I thought about which musical instrument would complement my whiskey drink. I got into the saxophone intuitively. On January 17th, 2020 I became the proud owner of a 20 year old tenor saxophone, Yamaha YTS-32, almost unused.

Whisky Bowmore, Islay,
only slightly smoky

As a result, I bought a saxophone course and decided to be a good student. In parallel to practising, I dealt with the physics of the saxophone (I already know a little about music). The insights gained in the process gave me chills and forced me to change direction in the curriculum.

The conclusion regarding physics and music theory is:

In theory, the saxophone cannot be played at all!

The findings made are justified as follows. Please note beforehand - the saxophone is a covered pipe (closed one side) and has a movement node at the closed end, so the tone sounds an octave lower. The noted note is therefore already positioned like the first overtone and is referred to as the second partial tone. In addition, according to classical physics, the measured length of the tenor saxophone at 144 centimetres should be 133 Hertz (all approximate numbers, because everything is not that simple). But reality is 103 Hertz. This corresponds to an acoustic length of 166 centimetres, and this makes the tenor saxophone to a B instrument. It is of course assumed that the B is a Bb and not an H, therefore corresponds to an A# and as the lowest note of the horn sounds as an Ab, which also sounds like a G#, except for the downward scale, then it stays with the Ab.

Anyone who no longer understands anything has understood it.

The aforementioned physical peculiarity is explained by the conical shape of the horn. But this form has another disadvantage, namely that at most a single hole in the horn can be right in tune. If you also take into account the tempered tuning, this hole is also wrong in any key and pitch. This means that you have to bend every note played with the embouchure at the mouthpiece. With the top tones, a dozen different fingerings on the tenor saxophone are not uncommon, which arouses the suspicion that it doesn't really matter what you are touching. The horn also has the octave hole (the thumb overblown button) that only occurs once, but physically should actually occur per tone. Fortunately, this sturgeon hole is not needed by good players. Now it is time to turn the disadvantages caused by the conical shape of the horn for the better.

So if you have to bend every tone by ear anyway, it always makes sense to choose the tone with the most beautiful sound, namely the one in the overtone range. So I put my saxophone course aside and concentrated on playing overtones. This is also the idea behind the horn described below. This forces you to play overtones, namely by omitting all unneeded keys that are not needed for overtone play.

By the way, there are also practice saxophones without keys (Keyless Overtone Saxophone). But these have too many restrictions. There is also at least one with only overload loads. An example is available on the following website:
http://www.ramponecazzani.com/

PS. In this document, the reference numbers in brackets refer to the following documentation on the Internet:
http://www.clarissono.de/pluginAppObj_85_01/SaxophonTerminologie.pdf

Construction description

Horn overview

Almost icon image

From the lyre holder to the lower horn bow, there are no attachment points that could impair the free swinging of the tube. Neither the valve mechanism, the thumb button, the strap eyelet nor the thumb hook are in direct contact with the horn. All these parts are attached to a device running parallel to the horn, which also extends from the lyre holder to the lower horn bow. In addition, the upper part of the horn from the lyre holder to the G key, which covers the A tone hole (12), is even tone hole free. This pipe section can have different wall thicknesses and thus vary the overall sound of the instrument, therefore from rather dead-sounding to a bright sound.

Obviously, the part casing increases the instrument diameter. So that the instrument can still be held comfortably, the thumb rests are not placed on the casing. but represented by a plastic frame hole in the casing. Similarly, the buttons are also on the same level as the casing in corresponding recesses.

The tone holes

The Staldophone manages with only 10 tone holes (since the D# tone hole is omitted). In contrast to the saxophone, the tone holes are not drawn flat at the top, but only slightly everted in the curve itself. It should be noted in the picture on the right that the top edge is not actually flat, but rather rounded like the pipe at this point. As a result, the tone holes cause only little vibration resistance. Furthermore, the tone holes are arranged somewhat offset to one another. Since the horn can be constructed from the lyre holder to the C-tone hole without any superstructures, the C-tone hole is still positioned in the freely swinging stretched tube part (as mentioned without D# tone hole). This slightly changes the proportions compared to the tenor saxophone.

The valve flaps

The valves are also made of lightweight carbon fiber reinforced plastic. When closed, the valves with the inside of the horn form a round, continuous, open area. Another special feature of the valves is when opened, assume an inclined position, namely directed towards the tone hole. The lower valve surface has the same curve as the inner tube. The valve itself is held open by a steel spring. If the associated key is pressed, the valve is pulled towards the pipe, possibly with a little distance to the pipe (see section Keyboard).

The bracket construction

The bracket construction runs on the back from the lyre holder to the lower horn bow and sweeps up to about a third of the horn circumference. This means that at a distance of around 25 millimetres from the horn, a fiber composite panel, which is open wherever possible, accommodates all superstructures and attachments. The entire key mechanism is placed between the horn and the bracket construction.

Playing on the Staldophone

The keyboard

First of all, a little detour to the keyboard of the normal saxophone. The year is 1842, we are standing in Mr. Sax's workshop and watching his face when he noticed that his left hand has too few fingers. The result was then the dreaded little finger table (affectionately called "Pinky Table") with the four handles and a hardly manageable mechanism behind it.

With the Staldophone you could redesign the key assignment with the fingers that have become free. But this is certainly not in the spirit of successful saxophone players. For this reason, only one exception was made for finger assignment, but this ultimately means that nine keys are required. You can also consider keeping the little finger table, which can be switched from Saxophone mode to Staldophone mode. This would certainly suit the "old" saxophone player.

The buttons on the index, middle and ring fingers are provided with an outer half-ring. In addition, when pressed, this half-ring means that the button (adjustable) is halfway up against the mounting structure, i.e. the tone holes do not close completely. This is helpful if an overtone does not respond immediately or to get to the next overtone. It is to be tried out which key is suitable in each case.

Seen from top to bottom, the G key, which covers the A tone hole (12), is the first key and is pressed as before with the ring finger of the left hand. It should be noted that all overblown and trill buttons are omitted.

Note the German notation: Low-H key = Low B key and Low B key = Low Bb key (long live the monk who caused this confusion).

Because the keys and valves are made of carbon fiber reinforced plastic, less mass (wight) is moved when playing. Therefore, the G sharp key (13a) can be dispensed with, which was only attached in order to move less mass. As before, the low B key (22a) can also be used for the G sharp.

The fingers of the left hand are thus assigned as follows:

- The index finger is free and can be used as desired, for example as an Alesis PercPad control with a push button (see Saxofon Bongo Extension written in German);
- The middle finger operates the low B key (23a) - this relieves the little finger;
- The ring finger operates the G key (12) - as before;
- The little finger operates the C sharp key (21a) as well as the low H key (22a) - as before [so that the low B key sounds like this, the low H key (22a) must also be pressed].

On the keys of the right hand, the D# key can be dispensed with [tenor saxophone use cross-fingering E / C + H (22a)]. As already mentioned, the side buttons are also omitted. Since the keys H and B are not linked on the Staldophone, the cross-fingerings E / C + B (23a) can be used on the D#1.

Since the valves are positioned inside the tube and are only held open by steel springs, they can be closed by using a cable - which in turn means less weight. This means that there is only one cord connection from the keys to the valves. Another effect of this technique is that the Staldophone becomes a percussion instrument when the keys are played strong.

The music

Where there are several possibilities to play the same tone in the overtone range, the tone with the longest tube is to be chosen (provided the player can play this tone cleanly and the intonation allows it).

In order to hear the difference between overtone playing and normal playing, for example Ludwig van Beethoven's "Freude schöner Götterfunken" can be played. To do this, start with e2 on the tenor saxophone. Then play once with normal fingerings and once with f2 and g2 with the B or C fingering.

The approach

When it comes to approach, I lean towards Archie Shepp's style. Copycats should make sure that the ligature of the mouthpiece stays outside of the mouth.

Archie Shepp

Explanations of the fingering chart

For the following fingering designation, I am based on the standard fingering of the saxophone in the first octave.

In the meantime I have learned that you have to be patient with learning to play overtones. Like humans, every saxophone has its own characteristics. Individual overtones are difficult to address straight away. That depends not only on the player's condition of the day, but also on the temperature and humidity (some saxophone players even bring the moon phases into play …)

General information on the Staldophone fingering chart.

The standard fingerings for saxophones are used up to a, with the exception of Db->cross-fingering.

Originally using Mouthpiece Yamaha 4C Tenorsax Standard (phenolic resin),
small track opening 1.6mm, track length medium (20mm), middle chamber.

10/28/2020: mouthpiece replaced by Vandoren V16 T6 (ebonite / rubber),
Vintage sound, track opening 2.5mm, track length long (27mm), middle chamber: round.
I am currently using a saxophone reed Vandoren Java green Bb SR2725, thickness 2.5.

The basic tone of the present tone scale is the tempered tuning of the piano. The desired overtone is again the tempered tuning of the piano. The staldophone, like the tenor saxophone, is a transposing instrument. This means that the sounding tone is 14 semitones (major ninth) lower than the notated tone of the tenor saxophone. The starting point for calculating the overtone is therefore the sounding tone.

The first column is the tone designation as it is notated in the treble clef.
The second column is the tone name of the sounding tone.
The third column corresponds to the tempered tone from the piano.

It is true that the staldophone, as well as the tenor saxophone, can be played purely. For the sake of simplicity, however, this list is based on the tempered tuning. Otherwise, the frequencies of the pure tuning would have to be listed for each key to be played, and the associated frequencies of the overtones would have to be represented by these again. The result would be an unmanageable compilation that would not help in practice. Ultimately, the musician has to bend the notes played by ear anyway.

Staldophone fingering chart – will be updated from time to time.

The finger positions of the lowest notes of the tenor saxophone are meant, sometimes supplemented with more precise details. This list is based on the German notation. The grip images in the shaded fields are my preferred alternative. PT_n = partial tone.

Date 12/15/2020

Tone		Piano	Keynote -Variant 1		Keynote -Variant 2		Keynote -Variant 3	
Notated	**Physic.**	**Hz**	**Grip**	**Hz**	**Grip**	**Hz**	**Grip**	**Hz**
ais	Gis	103.8	B / PT 1	103.8				
h	A	110	H / PT 1	110				
c1	Ais	116.5	C / PT1	116.5				
cis1	H	123.4	Cis / PT1	123.4				
d1	c	130.8	D / PT1	130.8				
dis1	cis	138.6	E $^{D\ offen}$C^{+}H	138.6				
e1	d	146.8	E / PT1	146.8				
f1	dis	155.5	F / PT1	155.5				
fis1	e	164.8	Fis / PT1	164.8				
g1	f	174.6	G / PT1	174.6				
gis1	fis	185	Gis / PT1	185				
a1	g	196	A / PT1	196				
This is where the overtone range for the Staldophone begins (left grip column).								
ais1	gis	207.6	B / PT2	207.6				
h1	a	220	H / PT2	220				
c2	ais	233	C / PT2	233				
cis2	h	246.9	Cis / PT2	246.8				
d2	c1	261.6	D / PT2	221.6				
dis2	cis1	277.2	E $^{D\ offen}$C	277.2				
e2	d1	293.6	E / PT2	293.6				
f2	dis1	311.1	B / PT3	311.4	F / PT2	311		
fis2	e1	329.6	H / PT3	330	Fis / PT2	329.6		
g2	f1	349.2	C / PT3	349.5	G / PT2	349.2		
gis2	fis1	370	Cis / PT3	370	Gis / PT2	370		
a2	g1	392	D / PT3	292.4	A / PT2	392		
ais2	gis1	415.3	B / PT4	415.2				
h2	a1	440	H / PT4	440	E / PT3	440.4		

Tone		Piano	Keynote -Variant 1		Keynote -Variant 2		Keynote -Variant 3	
Notated	**Physic.**	**Hz**	**Grip**	**Hz**	**Grip**	**Hz**	**Grip**	**Hz**
c3	ais1	466.2	C / PT4	466	F / PT3	466.5		
cis3	h1	493.9	Cis / PT4	493.6	Fis / PT3	494.4		
d3	c2	523.2	D / PT4	523.2	G / PT3	523.8		
dis3	cis2	554.3	H / PT5	↑ 550	Gis / PT3	555		
e3	d2	587.3	E / PT4	587.2	A / PT3	588		
f3	dis2	622.2	B / PT6	622.8	F / PT4	622		
fis3	e2	659.2	H / PT6	660	Fis / PT4	659.2		
g3	f2	698.4	C / PT6	699	G / PT4	698.4		
gis3	fis2	740	Cis / PT6	740.4	Gis / PT4	740		
a3	g2	784	D / PT6	784.8	A / PT4	784		
ais3	gis2	830.6	B / PT8	830.4	Cis / PT3	831.5	Fis / PT5	↑ 824
h3	a2	880	H / PT8	880	E / PT6	880.8		
c4	ais2	932.3	C / PT8	932	F / PT6	933		
cis4	h2	987.7	Cis / PT8	987.2	H / PT9	↓ 990	Fis / PT6	988.8
d4	c3	1046.5	D / PT8	1046.4	G / PT6	1047.6		
dis4	cis3	1108.7	Cis / PT9	↓ 1110.6	Gis / PT6	1110		
e4	d3	1174.6	E / PT8	1174.4	A / PT6	1176		
f4	dis3	1244.5	B / PT12	1245.6	F / PT8	1244		
fis4	e3	1318.5	Fis / PT8	1318.4				
g4	f3	1396.9	G / PT8	1396.8				
gis4	fis3	1479.9	Cis / PT12	1480.8	Gis / PT8	1480		
a4	g3	1567.9	A / PT8	1568				
ais4	gis3	1661.2	B / PT16	1660.8				
h4	a3	1760	E / PT12	1761.6				
c5	ais3	1864.6	F / PT12	↓1866				
cis5	h3	1975.5	Cis / PT16	1974.4				

Instructions for Instrument Builders

AN ACOUSTIC ANALYSIS OF SINGLE-REED WOODWIND INSTRUMENTS WITH AN EMPHASIS ON DESIGN AND PERFORMANCE ISSUES AND DIGITAL WAVEGUIDE MODELING TECHNIQUES

A dissertation submitted to the department of music and the committee on graduate studies of Stanford university in partial fulfilment of the requirements for the degree of
doctor of philosophy

Gary Paul Scavone
March 1997

Single-Reed Woodwind Acoustic Principles - Chapter 1- Tone-holes - 1.4.3

ftp://ccrma-ftp.stanford.edu/pub/Publications/Theses/GaryScavoneThesis/thesis.pdf

Epilogue

As already mentioned, the Staldophone is not suitable for beginners. The same applies to smoky whiskey (mainly comes from the island of Islay). But if you still don't want to do without Scottish whiskey, the Auchentosham Virgin Oak is recommended. As the name suggests, matured in virgin oak barrels, this gives the whiskey a pleasant note of vanilla in the nose. But be careful, with drinking comes the disenchantment – Uh?


Auchentoshan distillery

Addendum 2020 / 2021

Tenor saxophone conversion to Staldophone

The purpose of this modification is that only playing overtones can be used and the fingers (grips) can be practised. The modification does not destroy anything substantial on the instrument, so it can be dismantled without any problems.

Unfortunately, the sound advantages of the Staldophone do not yet come into play here. The instrument does not sound nicer, on the contrary, the multiple cable ties also tighten the instrument. With the original Staldophone, the instrument would also have much less weight. Practising the overtones is also more difficult because the key mechanism is not yet equipped with the half-opening mechanism.

The only advantage is the bongo extension switch, which can now be operated with the exposed index finger of the left hand and is therefore independent of the playing music.

For me the conversion still made sense, so I can already play like on the Staldophone - and if I should ever raise the money to have a Staldophone built, I'm already prepared!

As mentioned already, note the German notation: Low-H key = Low B key and Low B key = Low Bb key (Hang the monk who caused this confusion).

The following work was carried out:

- First, all valve pads were treated with valve balm;
- Beginning with the B-valve (8) and above it, all open valves were closed with cable ties;
- The lower B-button (23a) plus the connecting bar (to 21a) have been removed from the small finger table;
- The key follower of the low-H pusher (22a), on the lower side of the little finger table, was bent away so that the c sharp pusher (21a) is not taken along (the bending point was previously heated selectively), then the axis was oiled;
- The two hole covers, the valve of the H button (7) and the valve of the B button (8), attached and fixed with cable ties;
- The additional low-B driver (see picture) was glued to the valve (12) so that the low-B lever is depressed when actuated.

Hole covers (7 + 8) blanks.

Bend the key follower away from the lower H-button (22a).

Dismantling parts Hole covers (7 + 8).

Ready for installation.

Carrier

Carrier connection.

Carrier glued to valve.

Bongo Switch

Cable ties - over and over again!

Addendum January 2021

Dismantling the Staldophone to the Tenorsaxophone

Dismantling to the original state

Since no changes were made to the substance, dismantling is easy. Parts to be completed are in the saxophone case.

- Unplug all cable ties - everything that loosens now is dismantling waste;
- Carefully remove the two additional hole covers, the valve from the H button (7) and the valve from the B button (8) from the holes (use a knife to loosen the adhesive on the Saxophone protuberance);
- Remove the glued-on deep-B catch from the valve (12); if necessary, remove the valve and polish away the glue residue by machine;
- The key follower from the low-H button (22a) on the lower side of the small finger table must be bent back into its original position (heat the bending point beforehand selectively);
- The small finger table is to be completed with the low B-handle (23a) plus connecting web (to 21a);
- All pivot bearings must be oiled;
- Replace defective valve upholstery;
- The tenor saxophone must be checked for leaks and mechanical functionality;
- Cable tie traces and oil residues must be removed with a suitable polish.

Limited dismantling - the original bongo extension will be reactivated

It must be clarified with every cable tie whether it belongs to the bongo extension facility or not. For this, the document Saxophone Bongo Extension is to be consulted. The additional third bongo extension switch on button (2a) must be disconnected from the upper bongo switch (unsoldered) and the two cables of the bongo extension switch soldered on again.

Staldofon construction information

The prototype is primarily built using only known materials, preferably in the simplest version. That means, apart from the cables and pulleys, only gold-lacquered brass is used (with the use of carbon fibre reinforced plastic for the bracket construction, the development can become enormously expensive).

Since the mounting structure has to be provided with the largest possible holes, a good compromise is to be found between stability and permeability when using brass.

Exclusion of liability / disclaimer

This instrument is purely theoretical. No legal responsibility or liability of any kind can be assumed for incorrect information and its consequences. Subject to changes.

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