Table 3. Survey of measurements on woodwinds

d_1 = inner diameter of main tube (mm).
l_G = distance to tip of reed or to centre of embouchure-hole (mm).
d_H = hole diameter or its smallest value (mm). For oval holes, smallest and largest values are given.
l_H = minimum hole length (mm).
h = mean distance of cup to hole end, in opened position (mm).

R_0 = radius of curvature of bended part of the bore.
\+ denotes undercutting of a hole.
= in the h-column, denotes that the hole is not covered by a key
. denotes no hole present.
( ) tube diameters between brackets are estimates obtained via volume-measurements.

A. FLUTES

Gemeinhardt		Reiner		Hofinger		Kohlert		Selmer		Gaillard		Hammig		Old piccolo		old flute	
d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G
17	26	16.8	20	16.6	63	16.5	61	16.9	40.8	16.9	23	10.85	7.1	10.35	7	18.8	0
16.2	16	17.0	12	17.0	28	16.9	23.5	17.2	25.8	17.0	13	10.85	64.1	10.35	61	18.8	132
16.65	14	17.5	19.9	17.6	22	17.8	26.5	17.8	19	17.3	7	10.7	64.1	11.2	61	15.2	340
17.0	24	17.4	20	17.7	32	17.9	36.5	17.9	29	17.5	17	10.5	73.4	11.2	67	13.5	452
18.0	34	17.8	30	17.9	42	18.1	46.5	18.1	39	17.65	27	10.25	83.1	10.0	67	11.2	583
18.1	44	17.9	40	17.9	52	18.3	56.5	18.2	49	17.85	37	10.0	99.7	9.75	72.5		
18.3	54	18.0	49.4	18.1	62	18.4	66.5	18.3	59	17.95	47	9.75	111.4	9.5	83.1		
18.45	64	18.0	50	18.2	72	18.6	76.5	18.5	69	18.05	57	9.5	122.5	9.25	97.5		
18.55	74	18.25	60	18.3	82	18.8	86.5	18.6	79	18.25	67	9.25	139.0	9.0	109.1		
18.60	84	18.4	70	18.4	92	18.8	96.5	18.7	89	18.4	77	9.0	151.9	8.75	124.7		
18.65	94	18.5	78.2	18.5	102	19.0	106.5	18.9	99	18.5	87	8.75	166.6	8.5	134.8		
18.8	104	18.55	80	18.95	152	18.8	156.5	19.0	109	18.65	97	8.5	176.8	8.25	145.7		
18.85	114	18.68	90	19.05	465	18.9	156.5	18.9	159	18.95	107	8.25	193.6	8.0	155.8		
18.9	154	18.75	100	18.9	594.4	18.9	599.7	18.9	604	18.95	601	8.0	204.7	7.75	172.6		
18.9	603	18.8	110									7.75	224.6	7.5	189.7		
		19	160									7.75	240.9	7.25	207.1		
		19	596.4									8.0	247.4	7.3	262.5		
												8.25	251.3				
												8.5	254.3				
												8.75	256.6				
												9.0	258.6				
												9.2	259.6				

hole			Gemeinhardt				Reiner				Hofinger				Kohlert[a]			Selmer [a]			Gaillard [a]		
no		function	d_H	l_H	h	l_G	d_H	l_H	h	l_G	d_H	l_H	h	l_G	d_H	l_H	l_G	d_H	l_H	l_G	d_H	l_H	l_G
		emb.	10.3 12.2	5	=	0	10.4 12.2	5.7	=	0	10.2 12.2	4.3	=	0	10.6 12.0	5	0	10.5 12.5	4.5	0	10.3 12.2	?	0
16			7.7	2	1.1	199.0	7.2	2.2	1.5	196.7	7.8	2	2.5	190.9	7.3	2	195.9	7.3	1.5	200.1	7.7	2	199.5
15			7.7	2	1.1	215.0	8.0	2.0	1.5	211.1	7.8	2	2.5	206.1	7.3	2	212.4	7.3	1.5	215.9	7.7	2	216.6
14A			–	–	–	–	8.0	2.0	2	228.9	–	–	–	–	–	–	–	–	–	–	–	–	–
14		C–C#	7.5	2	1.7	234.0	7.2	2.0	1.5	231.4	7.2	2	3	229.2	6.9	2	230.2	6.7	2	233.9	7.0	2	233.0
13		B–C	13.6	3	2.7	265.0	12.7	1.6	2.8	261.5	12.4	3	3	258.8	13.8	3	262.4	13.1	3	265.9	12.5	3	262.0
12		A#–B	13.8	3	1.8	285.0	13.6	1.4	2.8	282.4	13.8	3	2	280.4	13.4	3	283.9	13.1	3	285.8	13.0	3	284.5
11		A–A#	13.8	3	1.8	305.5	13.6	1.4	2.8	302.9	13.8	3	2	301.2	13.4	3	302.9	13.1	3	307.1	13.0	3	305.2
10	+8	G–A	13.8	3	2.1	328.5	13.6	1.4	2.8	325.9	13.2	3	3	323.8	13.3	3	326.4	13.1	3	329.1	13.0	3	328.5
9		G–G#	13.8	3	2.1	351.0	13.4	1.4	1.8	348.3	12.8	3	2.5	344.4	13.2	3	349.1	13.1	3	353.5	12.5	3	349.5
8			13.8	3	2.1	351.0	13.6	1.4	2.8	348.4	13.2	3	3	347.4	13.3	3	348.9	13.1	3	353.5	13.0	3	352.0
7	+4	F#–G	14.4	3	2.2	376.0	14.0	1.4	3.7	372.7	13.8	3	2.5	370.7	14.0	3	373.7	14.1	3	378.2	14.0	3	374.0
6		F–F#	14.4	3	2.2	401.5	14.0	1.4	3.7	397.7	13.8	3	3	397.6	14.0	3	399.7	14.1	3	403.0	14.0	3	401.5
5		E–F	14.4	3	2.2	428.5	14.0	1.4	3.7	425.0	13.8	3	3.2	426.2	14.0	3	425.2	14.1	3	431.2	14.0	3	430.5
4		D#–E	14.4	3	2.2	458.0	14.0	1.4	3.7	455.2	13.8	3	3	453.6	14.0	3	455.2	14.1	3	460.5	13.8	3	458.0
3		D–D#	15.3	3.5	1.7	492.0	15.2	1.5	2.8	486.2	15.5	5	3.8	487.8	14.8	3.5	489.7	15.1	3	493.4	15.5	3.5	492.0
2		C#–D	15.3	3.5	3	526.0	15.3	1.5	3.5	519.6	15.4	4.5	3.5	518.8	14.8	3.5	522.2	15.1	3	525.9	15.5	3.5	523.5
1		C–C#	15.3	3.5	2	560.5	15.3	1.5	3.5	553.3	15.4	4.5	3.5	553.2	14.8	3.5	557.2	15.1	3	560.6	15.5	3.5	558.0

a) h was not measured

hole			Hammig			
no			d_H	l_H	h	l_G
		emb	8.6 10.3	5	=	0
15			4.7	3.0	2.2	96.1
14			4.7	2.8	2.2	105.9
13		C – C#	4.2	3.1	2.0	111.2
12	+11	B – C	4.2	2.8	1.5	122.1
11			4.3	2.7	1.5	132.2
10		A# – B	5.0	2.7	1.8	132.1
9		A – A#	5.8	2.6	1.8	143.7
8	+ 7	G – A	6.1	2.6	2.1	156.0
7			6.0	2.5	2.1	166.7
6		G – G#	6.0	2.4	2.1	167.6
5	+ 2	F# – G	6.5	2.2	1.8	179.5
4		F – F#	6.6	2.1	1.8	191.6
3		E – F	7.0	2.0	1.8	207.1
2		D# – E	7.0	1.6	2.0	223.0
1		D – D#	7.8 8.2	1.3	1.8	236.1

hole		old piccolo			
no		d_H	l_H	h	l_G
	emb	8.6 9.7	4.5	=	0
13		4.8	3.8	3	87.9
12	B – C#	4.8	4.3	=	115.3
11	B – C	3.9*	4.0	2	122.3
10	A – B	5.0	4.5	=	132.3
9	A – A#	4.0*	4.0	2.5	140.3
8	G – A	4.5	4.6	=	148.8
7	G – G#	3.8	4.0	1.7	162.1
6	F# – G	4.7	4.5	=	175.5
5	F – F#	5.0	4.4	=	192.5
4	E – F	4.5	4.0	2.5	202.5
3	E – F	4.5	4.0	2.5	202.5
2	D – E	4.4	4.7	=	212.8
1	D – D#	5.0	3.7	2.5	235.3

hole		old flute		
no		d_H	l_H[b)]	l_G
	emb	10.9 12.2	?	0
13	B – C#	7.1	4.3	220
12	B – C	6.1	4.3	235
11	A – B	9.1	4.3	253
10	A – A#	4.8	4.3	270
9	E – A	7.1	4.3	288
8	G – E#	4.6	4.3	312
7	F# – G	7.6	4.3	349
6	F – F#	10.2	4.3	382
5	E – F	7.6	4.3	400
4	D – E	5.6	4.3	420
3	D – D#	11.7	4.3	474
2	C# – D	11.2	4.3	505
1	C – C#	10.2	4.3	540

b) estimated

B. CLARINETS

Dolnet				S.M.L.			
d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G
mouth-piece	a)	18.0	550	mouth-piece	b)	16.0	503
		19.0	559			16.5	516
		20.0	566			17.0	527
(0)	0	21.0	570	(0)	0	18.0	543
14.0	44.1	22.0	573	13.5	36	20.0	563
14.25	47.6	21.5	577	14	39.5	22.0	575
14.5	66.6	22.0	580	14.25	59.5	24.0	582
14.75	84.6	24.0	588	14.75	76.5	26.0	590
15.0	89.6	26.0	595	15.0	83.7	28.0	597
tube		28.0	601	15.1	88.5	30.0	609
1.8	89.6	30.0	607			34.0	614
14.8	450	32.0	613	tube		36.0	619
15.0	473	34.0	618	15.1	88.5	38.0	624
15.25	486	38.0	627	15.1	430	40.0	629
15.5	498	40.0	632	15.25	467	42.0	634
15.75	510	46.0	645	15.5	487	49.0	649
16.0	522	53.0	650	15.75	496	58.0	666
17.0	539	59.0	663				
17.5	546	60.0	664				

a) mouthpiece volume = 10.5 ± 0.1 cm^3
b) mouthpiece volume = 11.0 ± 0.1 cm^3

hole			Dolnet				S.M.L.			
no			d_H	l_H	h	l_G	d_H	l_H	h	l_G
24		G – G#	3.0	12.5	1.8	155	3.1	12.5	3.2	155.0
23		G# – A	4.5+	7.0	2.2	169	5.3	6.5	3	167.0
22		G – G#	6.2+	6.5	2	194	5.9	6.4	1.5	194.8
21		F# – G	5.3+	7.0	2	204	5.5	6.7	2.5	203.5
20		F – F#	5.0+	7.0	2.7	215	5.4	6.5	5	214.5
19	+18	D# – F	4.6+	5.5	2.3	231	5.2	5.0	2.8	230.8
18		D – E	7.8	10.5	=	238.5	7.7	11.0	=	241.0
17		D# – E	5.0+	7.0	2.0	243	5.4	6.7	3	243.5
16		D – D#	5.0+	9.3	=	253	5.4	8.4	=	254.2
15	+14	C – D	5.0+	7.0	2	272	5.4	6.8	2.8	271.8
14	+11	G# – C#	6.4++	9.3	=	286	7.0	8.2	=	287.0
13		C – C#	6.0	7.0	2.5	288.5	6.0	6.6	2.8	288.8
12		C – C#	6.0	6.5	2	290	6.0	6.6	2.2	288.8
11		A# – C	7.1++	7.3	=	308	8.3	6.8	=	309.0
10		A# – B	5.1++	7.3	3	321.5	5.3	6.5	3	320.0
9	+ 8	G# – A#	7.8+	6.3	2	347	8.5	6.0	3.1	350.2
8		G – A	8.7+	9.0	=	363	8.7	8.0	=	366.0
7		G# – A	8.0+	6.3	2	369	8.0	6.5	3	368.5
6		G – G#	7.8+	9.0	=	387	8.7	7.7	=	391.5
5		F – G	9.1+	9.0	=	410	9.3	7.7	=	414.0
4		F – F#	10.0+	5.3	3.2	442	11.4	5.5	3	445.2
3		E – F	12.4+	5.3	3	470	12.2	5.5	3	470.0
2		D# – E	11.0+	5.3	4	502	12.4	5.0	3.5	503.5
1		D – D#	12.3+	5.0	4	540	11.4	4.8	3.5	537.5

C. OBOES

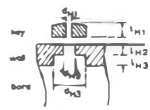
Monnig							
d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G
reed + staple	c)	5.0	99.6	10.5	311.8	16.25	537.0
		5.25	109.5	10.75	325.0	16.5	537.9
(0.75)	0	5.5	118.4	11.0	366.2	16.75	539.8
(2.4)	24.0	5.75	128.0	11.25	345.5	17.0	541.5
3.3	37.5	6.0	138.2	11.5	356.8	18.0	546.4
3.5	40.5	6.5	157.3	12.0	377.5	20.0	554.5
3.7	44.9	7.0	175.6	12.5	398.2	22.0	563.2
4.0	49.0	7.5	195.6	13.0	418.0	24.0	570.2
4.2	53.6	8.0	215.2	13.5	437.5	26.0	579.8
4.5	58.2	8.5	238.5	14.0	457.8	28.0	588.4
4.8	66.0	9.0	260.5	14.5	477.0	30.0	596.5
tube		9.25	271.8	15.0	506.5	32.0	606.0
4.0	66.0	9.5	282.0	15.25	528.0	34.0	615.2
4.2	74.0	9.75	288.5	15.5	531.1	36.0	623.5
4.5	82.2	10.0	294.5	15.75	533.6	38.0	630.8
4.75	92.2	10.25	301.8	16.0	535.6	38.1	632.0

c) volume of reed + staple = 580 ± 30 mm^3

Buffet							
d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G
reed + stapel	c)	4.75	91.8	10.25	299.6	15.8	534.6
		5.0	98.0	10.5	307.4	16.25	547.1
(0.75)	0	5.25	106.0	10.75	320.8	16.5	552.4
2.4	24.0	5.5	114.8	11.0	333.1	16.75	555.2
3.3	37.5	5.75	124.2	11.25	344.6	17.0	557.9
3.5	40.5	6.0	133.0	11.5	355.8	18.0	564.6
3.7	44.9	6.5	151.0	12.0	377.2	19.0	570.1
4.0	49.0	7.0	171.7	12.5	400.2	20.0	574.4
4.2	53.6	7.5	193.6	13.0	419.6	22.0	581.9
4.5	58.2	8.0	214.2	13.5	440.7	24.0	588.1
4.8	66.0	8.5	237.5	14.0	460.8	26.0	596.1
		9.0	257.7	14.5	480.8	28.0	603.1
tube		9.25	270.0	15.0	498.7	30.0	611.7
4.0	66.0	9.5	282.8	15.25	509.4	32.0	620.3
4.2	75.0	9.75	291.6	15.5	522.4	34.0	629.5
4.5	84.0	10.0	294.6	15.75	529.2	37.0	644.3

hole			Monnig			
no			d_H	l_H	h	l_G
22			0.3	7?	1	73
21			0.3	7?	1	129
20		C – D	3.1	6	1	158
19		B – C#	3.0	6	1	170
18			4.2	6	?	182
17	+ 16	A# – C	3.6	6	1	201
16		A – B	4.8	8.5	=	213
15	+ 13	F# – A#	4.2	6	1.3	230
14		A – A#	4.2	6	3	230
13		G – A	4.7	8.5	=	246
12		G – G#	5.0+	6	1.7	275
11		F# – G	7.0+	5.5	1.5	304
10	+ 9	E – F#	4.6	6	1.5	321
9		D# – F	5.6+	6	=	337
8		E – F	7.3+	6	1.5	351
7		D – E	6.7+	8.5	=	365
6		D – D#	7.6	5.5	1.5	401
5		(D – D#)	8.5++	4.8	1.7?	403
4		C – D	9.7	4.5	1.7	431
3		C – C#	7.6+	5.4	1.5	463
2		B – C	9.8	4.5	1.5	499
1		A# – B	10.8	4.5	1.6	539

hole			Buffet							
			hole in key		outside		inside		h	l_G
no			d_{H1}	l_{H1}	d_{H2}	l_{H2}	d_{H3}	l_{H3}		
22					0.5	7?			1	74
21					0.5	7?			1	130
20		C – D			3.2	7.2			1	161.8
19		B – C#			3.2	7.2			2	171.8
18			2	4	6	2	2.7	4.5	2	181.9
17	+ 16	A# – C			2.8	7.0			1.1	199.3
16		A – B	3	4	6.2	2	3.8	3.8	1.2	212.4
15	+ 14	F# – A#			3.8	6.4			1.2	229.3
14		G – A	2.5	4	6.4	2	3.6	4.4	1.4	246.1
13		G – G#			4.8	7.0			1.7	275.9
12		F# – G			8.4	2	6.2	4.2	2.2	303.6
11	+ 10	E – F#			3.7	5.5			1.5	319.5
10		D# – F			8.4	1.8	5.8	4.4	2.5	337.2
9		E – F			6.4	6.6			1.5	349.7
8		D – E	4.8	7.5	8.4	1.8	5.9	4.6	1.2	368.6
7		D – D#			5.7	6.4			3.5	404.3
6		(D – D#)			7.2	6.8			2.0	405.3
5		C – D			9.7	5.7			2.2	435.8
4		C – C#			7.1	6.3			2	469.2
3		B – C			10.4	5.4			2.5	502.3
2	– 1	A# – B			11.3	5			2.2	544.2
1		A#			4.4	6.8			1.5	568.4



D. SAXOPHONES

Schenkelaars tenor				Racso tenor				Schenkelaars alto				Selmer soprano				Schenkelaars soprano				Solotone soprano			
d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G	d_1	l_G
mouth-piece [a]		38.0	542	mouth-piece [c]		35.6	498	mouth-piece [e]		29.0	364	mouth-piece [g]		24.0	277	mouth-piece [h]				mouth-piece [j]		26.0	294
		39.5	570			38.2	546			30.0	382			25.0	294							27.0	310
(3)	0	40.4	586	(3.5)	0	40.1	572	(8)	0	31.0	399	(8)	0	26.0	311	(1.6)	0			(8)	0	28.0	328
12.75	50.5	41.8	615	(16.4)	50	42.1	620	12.0	44.3	32.0	416	8.0	33	27.0	327	14.5	27	25.0	299	10.3	41	29.0	346
17	64	42.5	623	16.25	55	45.1	672	15.5	48.9	33.0	434	13.3	33	28.0	344	14.5	61	26.0	314	14.0	43	30.0	365
17.5	102.5	44.2	663	16.5	70.5	48.8	732	15.75	59.7	34.0	452	13.5	57.5	29.0	360	tube		27.0	332.5	14.2	61	31.0	383
17.7	117	45.2	673	16.75	94.5	50.4	762	16.0	68.7	35.0	469	13.5	71	30.0	373	6.8	36	28.0	344.5	14.3	66	32.0	400
		46.7	707	16.8	100.5	53.8	834	16.25	75.4	36.0	487	tube		31.0	393	6.8	53	29.0	358.5	tube		33.0	418
crook		47.8	725			55.1	872	16.5	84.7	37.0	503	9.2	46	32.0	408	10.2	53	30.0	374	9.5	54	34.0	436
12.0	72	49.6	758	crook		59.0	940	16.75	92.3	38.0	522	9.2	61.5	33.0	422	11.7	66.5	31.0	388	11.4	76	35.0	453
12.3	97	50.1	769	13.0	64	59.6	965	17.0	99.5	40.0	557	10.0	61.5	34.0	437	13.0	83	32.0	402.5	13.0	100	36.0	471
13.5	122	52.1	809	14.7	120	65.1	1045			42.0	592	12.5	100	35.0	452	13.5	92	33.0	418.5	15.0	124	37.0	485
15.3	147	53.6	834	16.6	150	65.6	1075			42.7	608	13.0	108	36.0	468	14.0	100	34.0	432	16.5	144	38.0	501
17.3	172	55.3	866	19.2	188	67.1	1100	crook		44.4	639	13.5	117	38.0	500	14.5	108	35.0	447	18.5	174	39.0	519
19.4	197	56.4	887	21.6	228	68.6	1150	11.8	70	45.0	646	14.0	125	40.0	534	15.0	121	36.0	463	19.0	183	40.0	536
21.4	222	59.1	932	25.1	268	71.1	1218	12.0	93	47.8	690	14.5	135	42.0	565	15.6	134	37.0	477	20.0	198	42.0	560
23.5	247	60.3	945	25.7	300	74.6	1280	13.1	110	47.0	692	15.0	143	39.6	527	16.4	147.5	38.0	491.5	21.0	214	46.5	598
24.6	276	62.1	995	25.7	323	81.6	1328	14.5	130	49.4	732	15.5	147	40.6	543	17.2	156	39.0	508.5	22.0	230	51.5	629
26.0	300	63.9	1035	tube		87.6	1378	16.6	154	51.6	770	16.0	151	42.6	569	18.0	175.5	40.0	522	23.0	245	52.0	633
26.0	325	66.1	1080	26.6	323	91.6	1408	18.3	178	53.6	802	19.0	193	44.6	599	19.0	190.5	41.7	551	24.0	260	93.0	651
tube		67.2	1146	27.1	336	108.6	1448	20.4	202	58.0	859	20.0	209	46.6	641	20.0	208.5	42.0	555	25.0	277		
26.5	325	69.6	1175	28.4	369	164.0	1467	22.0	227	57.7	864	21.0	225	48.6	665	21.0	226.5	44.6	589				
28.0	361	72.5	1220	31.8	430			22.0	248	59.6	907	22.0	247	50.0	671	22.0	243.5	47.1	627				
29.8	488	74.1	1245	33.6	462			tube		60.6	921	23.0	259	90.0	689	23.0	259	50.6	656				
30.0	399	80.1	1298					22.4	248	65.4	967					24.0	282	54.0	668				
31.1	416	82.5	1326					23.0	258	68.4	996							64.0	678				
32.0	430	86.3	1358					24.0	276	70.4	1021							101.4	686				
34.0	466	89	1388					25.0	293	80.0	1043												
35.2	488	93	1423					26.0	314	81.6	1046												
36.0	504	151	1441					27.0	329	123.0	1062												
								28.0	347														

a) volume = 20.4 ± 0.1 cm³. b) R_0 = 48 mm. c) volume = 16.0 ± 0.1 cm³. d) R_0 = 45 mm. e) volume = 14.9 ± 0.1 cm³ f) R_0 = 42 mm. g) volume = 7.0 ± 0.1 cm³ h) volume = 7.4 ± 0.1 cm.³ j) volume = 6.7 ± 0.1 cm.³

hole			tenor								soprano [k]											
			Schenkelaars				Racso				Selmer				Schenkelaars				Solotone			
no			d_H	l_H	h	l_G	d_H	l_H	h	l_G	d_H	l_H	h	l_G	d_H	l_H	h	l_G	d_H	l_H	h	l_G
24			2.5+	5	2	177	1.7+	3.7	3	164	1.3+	5	3	93	1.6+	5.5	5	72	1.5+	6	2	84.5
23			3.0+	9	2	363	2.3+	4.7	2	342	2.2+	6	2	174	2.3+	6.4	1.2	157	1.5+	6	3.5	169
22		D–D#	12.5	2.2	2.5	354	15.0	3.2	4	360	6.5	2	2.5	172	5.5	2.5	2	153	–	–	–	–
21		C#–D	13.0	2.2	4.5	380	15.0	2.7	3	386	6.5	2	3	183	5.4	2.5	3	164	–	–	–	–
20		C–C#	13.5	2.2	4	408	15.2	3.2	4	417	6.5	2	3	194	5.5	2.5	2	175	5.1	2.8	3.5	188
19		B–C	15.5	2.2	3	444	17.8	3.6	4	448	6.5	2	3	205	5.5	3	2	187.5	5.1	2.8	3.5	199
18	+17	A–B	11.5	2.2	5	465	12.5	2.5	3	471	8.0	1.7	4	218	5.2	2.5	3.5	197.5	6.5	3	3	210
17		G–A#	24.4	2.2	5	506	26.0	2.5	3	513	12.8	1.7	4.8	234	12.0	2.5	3.5	215	12.0	3	3	227
16		A–A#	23.1	2.2	3	525	25.0	4	4	533	10.8	1.8	3	242.5	11.0	2.5	4	224.5	9.0	3	3	230
15	+14	G–A	21.8	2.2	5	558	25.0	2.5	3	559	9.2	1.6	3.5	256.5	8.3	2.5	3.5	236	11.0	3	3	247.5
14	+12	E–G#	23.5	2.5	5	601	23.8	2.2	5	603	10.8	1.7	4	276.5	12.0	2.5	4	257	–	–	–	–
13		G–G#	21.0	2.5	4	600	22.0	2.8	4	602	10.8	1.8	3	279.5	11.0	3	4	263.5	11.0	3	3.5	273.5
12		F–G	30.2	2.5	5	645	32.4	2.5	4	652	19.0	1.8	4.5	306.5	18.0	2.5	4	288	16.0	3	4	299
11		F–F#	25.0	2.5	5	693	24.6	3.7	3	695	14.3	1.8	5	328	14.0	1.5	3.5	311	14.0	3	3	323
10	+ 9	D#–F	25.0	2.5	5	744	24.8	2.7	3	745	19.5	1.8	5	352	14.2	2.5	3.5	335.5	14.8	3	4	347.5
9		D–E	33.6	2.6	5	791	33.5	2.7	3	792	22.0	1.8	5	379	21.3	2.5	3.5	363.5	20.5	3	4	377
8		D#–E	25.4	2.5	5	786	–	–	–	–	17.2	2	3.5	381.5	16.3	3.5	4	362.5	–	–	–	–
7		D–D#	26.4	2.6	5	850	30.5	3	4	851	20.0	1.9	5	408	18.5	2.5	4	391.5	18.8	3	4.5	403.5
6		C–D	39.5	2.6	5	910	38.0	2.5	4	912	24.5	2	5	439.5	24.3	2.5	4	421	25.0	3	4.5	433.5
5		C–C#	30.6	3.5	5	967	29.5	3.5	4	980	20.5	2	4	474	19.8	3.5	4.5	454.5	21.0	3	3.5	468.5
4		A#–C	36.8	3.0	9	1032	34.0	4.5	6	1028	29.0	2	4.5	508	27.4	3.5	3.5	489.5	27.0	3	4	502.5
3		A#–B	33.1	3.0	3	1118	35.0	4	5	1127	28.0	2	5	542	25.0	3.5	3.5	527.5	25.0	3	3	540.5
2		A–A#	42.0	3.5	7	1197	43.4	5	10	1204	31.5	2.7	6	582	29.0	3.2	3	570	29.0	3	4	580
1		G#–A	41.3	3.5	7	1269	43.2	5	10	1283	31.5	2.7	8	624	30.6	3	3	612.5	–	–	–	–

hole			Schenkelaars alto			
no			d_H	l_H	h	l_G
24			2.5+	4.9	2	131
23			2.5+	7.4	2	265
22		G–G#	12.3	2.3	4	276
21		F#–G	12.2	2.3	5	291
20		F–F#	12.2	2.3	3	305
19		E–F	12.2	2.3	2.5	324
18	+17	D–E	9.3	2.3	4	344
17		C–D#	20.2	2.3	4	364
16		D–D#	18.8	2.3	2	375.5
15	+14	C–D	14.8	2.3	4.5	398.5
14	+12	A–C#	20.9	2.3	4.5	434.5
13		C–C#	19.0	2.3	3	437.5
12		A#–C	25.0	2.3	5	468.5
11		A#–B	20.9	2.3	3.5	503.5
10	+ 9	G#–A#	21.0	2.3	4.5	537.5
9		G–A	29.6	2.3	4.5	576
8		G#–A	19.3	2.3	4	569
7		G–G#	25.0	2.3	4.5	623.5
6		F–G	34.8	2.3	5	667.5
5		F–F#	31.8	2.5	4	712
4		D#–F	34.1	2.5	9	757
3		D#–E	30.7	2.5	4	835
2		D–D#	38.2	2.2	8.5	886
1		C#–D	39.0	2.2	8.5	944

k) On soprano saxophones, the key mechanism is such that high B on the second register is formed with hole 18 *closed*, holes 16 and 17 being open. On the Selmer, besides that, the key on hole 18 is perforated with a hole of diameter 4 mm and length 6 mm; the last hole can be closed on low register by a second key hanging 4 mm above the perforated first key.

Table 4. Data on Musical Scales.

A. Frequency of musical notes, expressed in hertz (number of complete oscillations per second)

European notation	C''	C'	C	c	c'	c''	c'''	c''''	c'''''
American notation	C_0	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8
C	16.3516	32.7032	65.4064	130.813	261.626	523.251	1046.50	2093.00	4186.01
	17.3239	34.6478	69.2957	138.591	277.183	554.365	1108.73	2217.46	4434.92
D	18.3540	36.7081	3.4162	146.832	293.665	587.330	1174.66	2349.32	4698.64
	19.4454	38.8909	77.7817	155.564	311.127	622.254	1244.51	2489.02	4978.03
E	20.6017	41.2034	82.4069	164.814	329.628	659.255	1318.51	2637.02	5274.04
F	21.8268	43.6535	87.3071	174.614	349.228	698.457	1396.91	2793.83	5587.65
	23.1247	46.2493	92.4986	184.997	369.994	739.989	1479.98	2959.96	5919.91
G	24.4997	48.9994	97.9989	195.998	391.995	783.991	1567.98	3135.96	6271.93
	25.9565	51.9131	103.8262	207.652	415.305	830.609	1661.22	3322.44	6644.88
A	27.5000	55.0000	110.0000	220.000	440.000	880.000	1760.00	3520.00	7040.00
	29.1352	58.2705	116.5409	233.082	466.164	932.328	1864.66	3729.31	7458.62
B	30.8677	61.7354	123.4708	246.942	493.883	987.767	1975.53	3951.07	7902.13

B. Period or reciprocal of frequency, in millisecond

	C_0	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8
C	61.1561	30.5781	15.2890	7.64451	3.82226	1.91113	0.955564	0.477782	0.238891
	57.7237	28.8618	14.4309	7.21546	3.60773	1.80386	0.901932	0.450966	0.225483
D	54.4839	27.2419	13.6210	6.81049	3.40524	1.70262	0.851311	0.425655	0.212828
	51.4259	25.7130	12.8565	6.42824	3.21412	1.60706	0.803530	0.401765	0.200883
E	48.5396	24.2698	12.1349	6.06745	3.03373	1.51686	0.758432	0.379216	0.189608
F	45.8153	22.9077	11.4538	5.72691	2.86346	1.43173	0.715864	0.357932	0.178966
	43.2439	21.6219	10.8110	5.40549	2.70274	1.35137	0.675686	0.337843	0.168922
G	40.8168	20.4084	10.2042	5.10210	2.55105	1.27553	0.637763	0.318881	0.159441
	38.5259	19.2630	9.6315	4.81574	2.40787	1.20394	0.601968	0.300984	0.150492
A	36.3636	18.1818	9.0909	4.54545	2.27273	1.13636	0.568182	0.284091	0.142046
	34.3227	17.1614	8.5807	4.29034	2.14517	1.07258	0.536292	0.268146	0.134073
B	32.3963	16.1982	8.0991	4.04954	2.02477	1.01238	0.506193	0.253096	0.126548

C. Acoustical length for a sound velocity of 346 m/s (in mm)

Clarinets	C_0	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8
Others	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
C	5290.00	2645.00	1322.50	661.250	330.625	165.313	82.6563	41.3281	20.6641
	4993.10	2496.55	1248.27	624.137	312.069	156.034	78.0172	39.0086	19.5043
D	4712.86	2356.43	1178.21	589.107	294.554	147.277	73.6384	36.8192	18.4096
	4448.34	2224.17	1112.09	556.043	278.022	139.011	69.5054	34.7527	17.3763
E	4198.68	2099.34	1049.67	524.835	262.417	131.209	65.6043	32.8022	16.4011
F	3963.02	1981.51	990.76	495.378	247.689	123.845	61.9223	30.9611	15.4806
	3740.60	1870.30	935.15	467.575	233.787	116.894	58.4468	29.2234	14.6117
G	3530.65	1765.33	882.66	441.332	220.666	110.333	55.1665	27.5832	13.7916
	3332.49	1666.25	833.12	416.562	208.281	104.140	52.0702	26.0351	13.0176
A	3145.45	1572.73	786.36	393.182	196.591	98.296	49.1477	24.7739	12.2869
	2968.91	1484.46	742.23	371.114	185.557	92.779	46.3893	23.1946	11.5973
B	2802.28	1401.14	700.57	350.285	175.143	87.571	43.7856	21.8928	10.9464

Table 5.

Relative frequency shift $g = \Delta f / f$ as a function of the number of semitones ν.

ν	g	ν	g
− 1	−0.056126	1	0.059463
− 2	−0.109101	2	0.122462
− 3	−0.159104	3	0.189207
− 4	−0.206299	4	0.259921
− 5	−0.250846	5	0.334840
− 6	−0.292893	6	0.414214
− 7	−0.332580	7	0.498307
− 8	−0.370040	8	0.587401
− 9	−0.405396	9	0.681793
−10	−0.438769	10	0.781797
−11	−0.470268	11	0.887749
−12	−0.500000	12	1.000000

Table 6. Data of closed side-holes

Co-ordinates (L_a, y_a) and (L_b, y_b) of the terminal points of the best straight line through the points $y = \Sigma V_H / S_1$ as a function of the acoustical length L.

Dimensions in mm. ϵ is the penetration factor.

	y_a	L_a	y_b	L_b	ϵ
flute	0	310	20.8	650	0.5
piccolo	0	150	18	290	0.11
clarinet	0	200	40	580	0.13
tenor sax	0	580	32	1666	0.5
alto sax	0	440	34	1248	0.5
soprano sax	0	320	25	833	0.5
oboe	0	275	44	730	0.07
bassoon	0	925	62	2140	0.2
	62	2140	68	3100	0.04