IV. APPENDICES

Layouts, Measures and Tools

A. Measures for common steel pan models

This appendix describes some commonly used steel pan models, together with data on note sizes, sinking depths, side lengths, etc. The measures have been gathered from instruments built in Sweden by the tuners Rudy Smith and Lawrence Mayers and during a research trip to Trinidad in March 1990. Some measures for the lower pans are still missing. As different tuners use different measures, the measures given here are to be seen as guideline examples.

DEFINITION OF MEASURES

This section contains a description of how to apply the measures in appendix A. Please note that the length of the outer notes, denoted "along the rim", is measured using a flexed ruler held against the rim. It is easier and more precise to follow the rim than to use a straight ruler when checking the length of the outer notes. The sum of the note measures along the rim should equal the circumference. The inner diameter of a regular drum is 567 mm, which means that the circumference is $567 * \pi = 1780$ mm ($\pi = 3.14$). A good way to make sure that the measures are correct is to take a measuring-tape, mark the lengths of the outer notes clockwise, and then paste it to the inside of the rim before marking the notes.

The lengths of the radial grooves (the ones going from the rim towards the centre) are measured all the way up to the rim, even if the groove stops about 40-50 mm from the rim. This is because the whole length is a more exact measure.

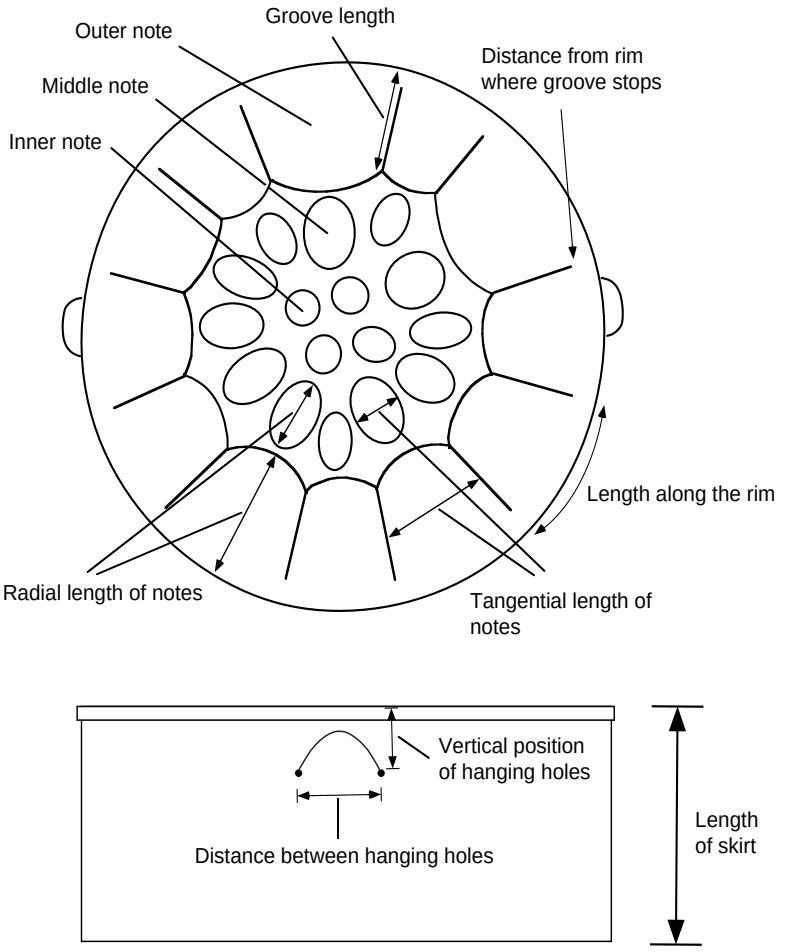


Fig. A.1 Definition of measures.

The outer notes that have a rounded inner border will extend a bit beyond the length of the groove. The length from the rim to the inner groove is given by the radial length of the outer note, see fig. A.1.

The tangential lengths of the outer notes are given for comparison purposes and possible future theoretical calculations of note sizes only. These are not suitable to be used for pan making.

Conversion table – mm to inches

All measures in this handbook are given in millimetres (mm). I have chosen this unit because it is metric and well accepted in technical and scientific literature. As the tradition of steel pan making is based on inches, a conversion table and a conversion diagram is provided here. An inch equals 25.4 mm.

Inches	Millimetres	Centimetres	Meters
0.04	1	0.1	0.001
0.4	10	1	0.01
1	25.4	2.54	0.0254
39	1000	100	1

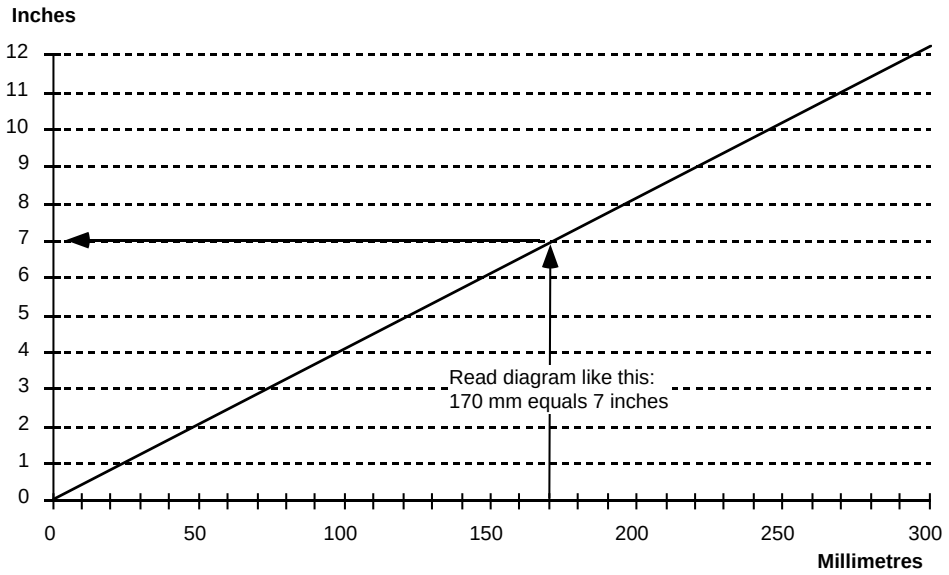


Fig. A.2 Conversion diagram between millimetres and inches.

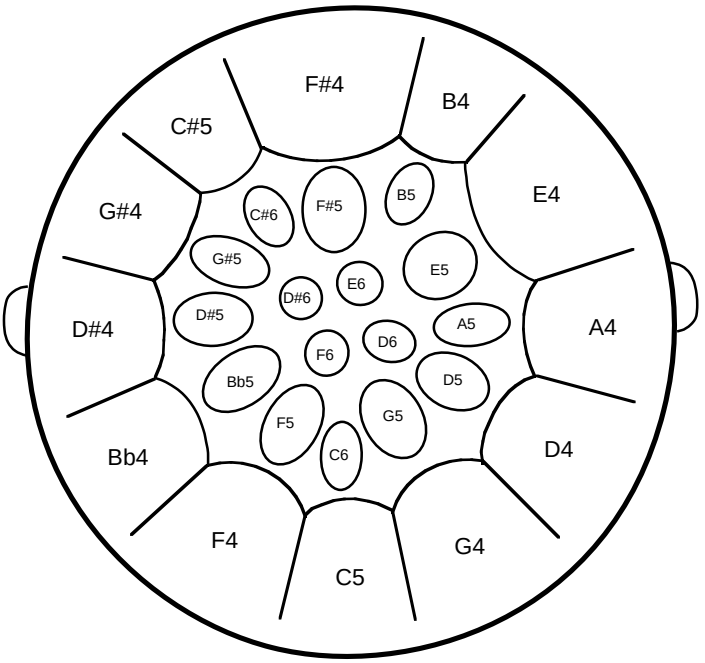
TENOR (SOPRANO)

The reason for naming the highest pan of the steelband "tenor" is historical: In the early days, the lead melody was played on a pan with less than ten notes. These notes were bigger than on todays tenors and the pitch was in the tenor range – therefore it was suitable to call the pan a tenor.

As the instrument developed, more notes were put into the tenor to increase its range. The new notes had to be made smaller, thus putting the pan in a higher tonal range. But the name "tenor" prevailed. Today it would be more proper to call it a soprano, which is also the usual case outside Trinidad.

The early tenors (ping-pongs) still had some of their lower notes, such as F# in the middle section, but eventually all the lower notes were moved to the outer ring with the corresponding octaves just inside them. The first "fifths-and-fourths" tenor pans, created by pioneer tuner Anthony Williams, were "spider web" pans with the notes close together and the intersections shaped as a spider-web-like pattern. In 1963 Herman Johnson changed the design by moving the inner notes apart to reduce the acoustic coupling of adjacent notes.

Overview of the Tenor pan



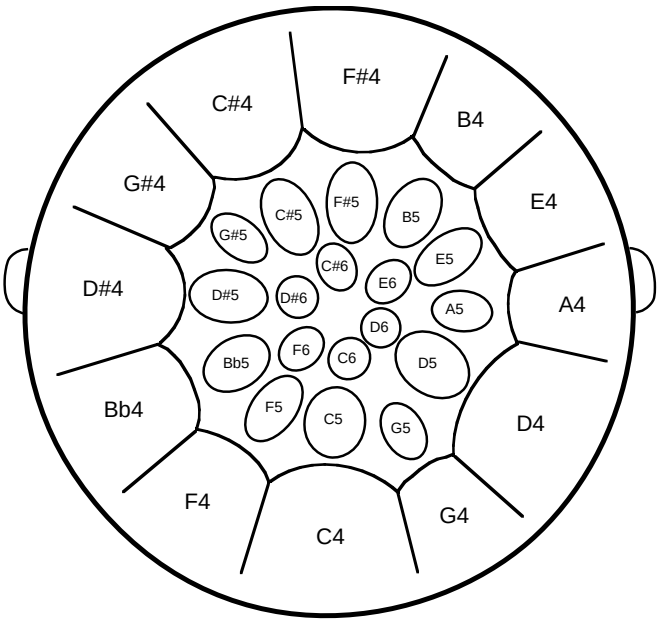
Due to the new ingenious layout according to the circle of fifths, the tenor is the pan that has come the longest way towards a standardization. As seen from the layout figure, all the lower notes are arranged according to the circle of fifths around the rim, with the corresponding octave notes in a similar circle inside. In this way the harmonics of the octave, the fifth and the fourth, will surround each note and help up the harmonic spectrum of the tone.

The size of the lower notes limits the tonal range of the tenor down to D4. During the later development, the tuners have tried to increase the range downwards by making the outer tenor notes smaller. This has resulted in a new tenor model that incorporates a low C4 and a C#4, instead of the C5 and C#5 usually found in the outer ring.

The layout of the low tenor is the same as the ordinary tenor. The C and the C# in the outer ring are made bigger and the rest of the notes a bit smaller. This is accomplished by shifting the pan so that the previous lowest D4 and D#4 become the new C4 and C#4, respectively.

It seems as this tenor has exactly the same measures as the higher one, but you tune each note two semitones lower and then shift it around so that the bottom C4 (former D4) faces the player. This means that every note will be a bit smaller and that two notes has to be added at the top if the range upwards is to be retained. As the pan develops further this model will presumably get more common.

Overview of the Low Tenor pan



Special crafting techniques

For the 8" (200 mm) sinking of tenors it is sufficient to use the sinking hammer down to 7 1/2" (190 mm) = 95% of final depth. The rest of the sinking is done during the smoothing and the backing.

The holes for the supporting strings can be put either as a single hole in the rim or as a pair 50 mm down the side, spaced about 50 mm. The pan will probably ring a little more if the strings are attached to the rim (because there is no damping of the side).

Measures for the Tenor pan

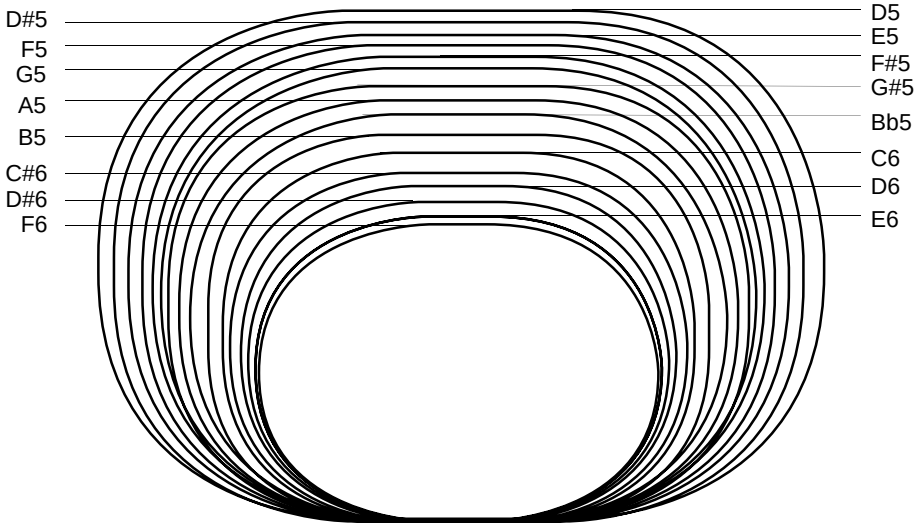
The measured tenor pans were made by Lawrence Mayers in 1990.

Notes		**Drum**			**Groove**		
Number of notes	Tonal Range	Depth of playing surface [mm]	Length of side [mm]	Hole pos. from rim [mm]	Width [mm]	Radial length [mm]	End from rim [mm]
28	D4-F6	200	140	In rim	4.5-5	130	40

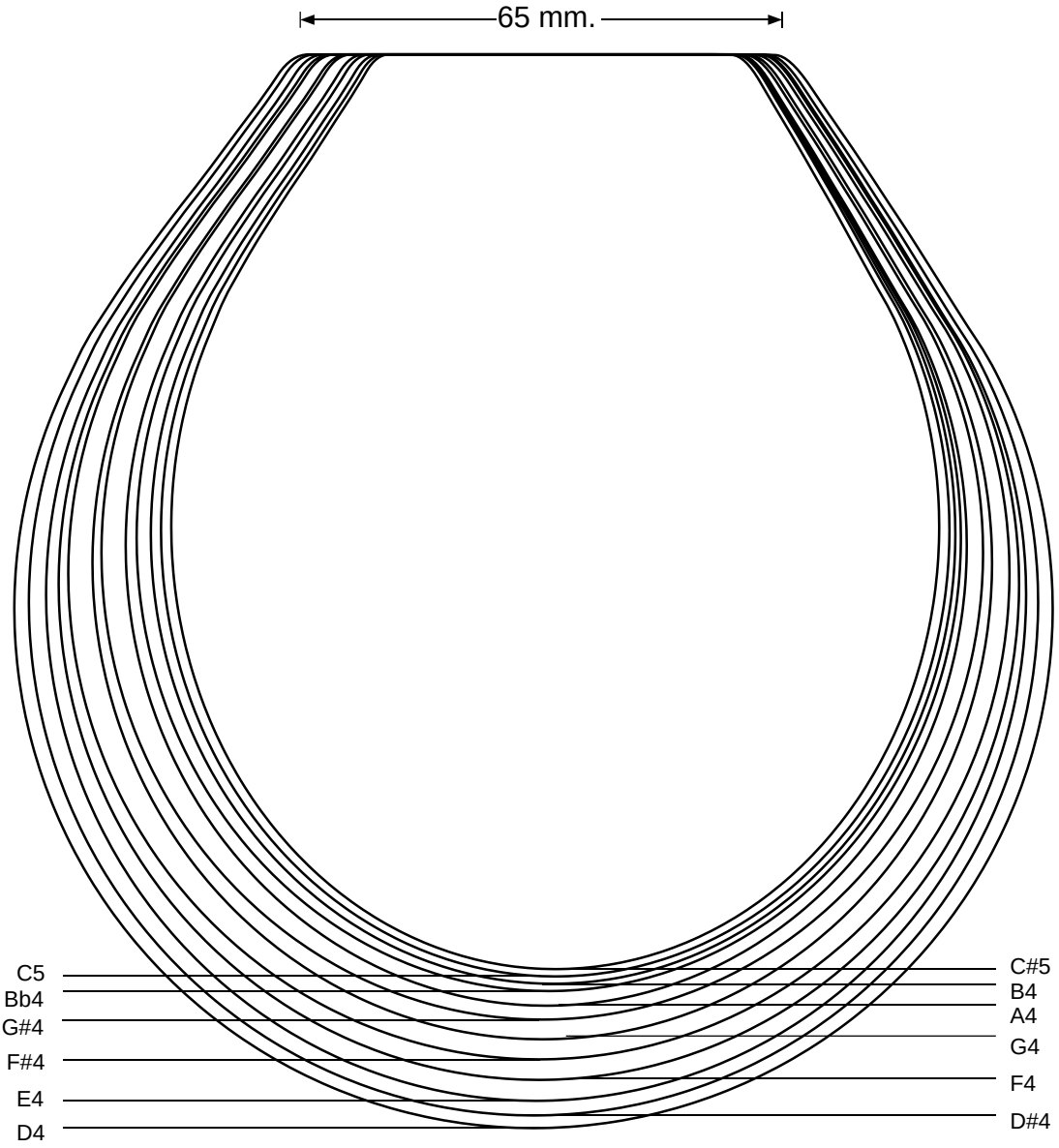
MEASURES FOR TENOR PAN NOTES

Note	Position	Radial length	Tangential length	Length along rim
D4	Outer	150	155	180
D#4	Outer	150	153	175
E4	Outer	145	144	165
F4	Outer	145	135	160
F#4	Outer	142	133	155
G4	Outer	143	128	150
G#4	Outer	138	128	150
A4	Outer	140	120	140
Bb4	Outer	138	115	135
B4	Outer	140	106	125
C5	Outer	135	101	120
C#5	Outer	135	98	120
D5	Middle	100	70	
D#5	Middle	100	70	
E5	Middle	91	67	
F5	Middle	85	65	
F#5	Middle	86	65	
G5	Middle	82	63	
G#5	Middle	76	58	
A5	Middle	77	57	
Bb5	Middle	69	52	
B5	Middle	65	50	
C6	Middle	60	47	
C#6	Inner	59	48	
D6	Inner	60	45	
D#6	Inner	58	48	
E6	Inner	55	41	
F6	Inner	55	41	

Templates for Tenor inner notes



Templates for Tenor outer notes



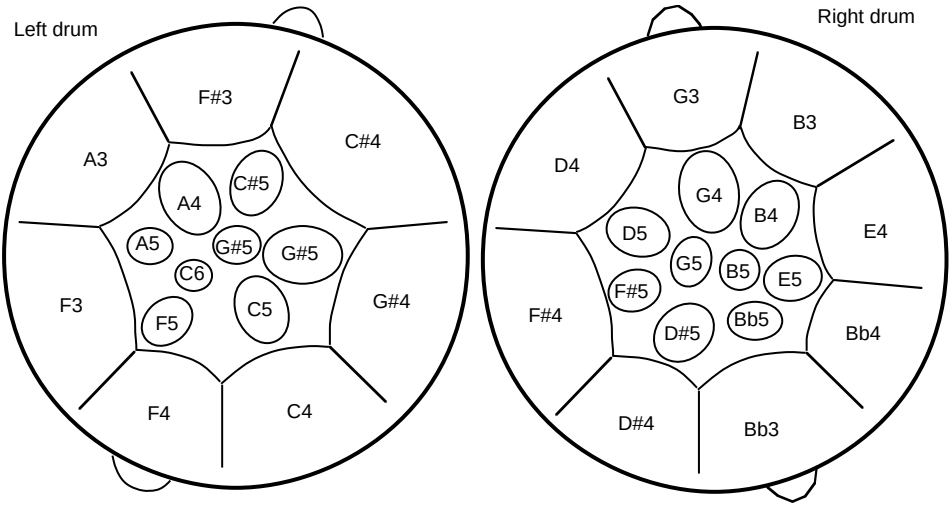
DOUBLE TENOR (ALTO)

The double tenor pan has a tonal range of two and a half octaves, distributed over two drums with 15-17 notes in each. The layout of the double tenor pan seems to consider playing convenience and tonal range more than acoustical matters. Since the notes are separated by a double groove there might be less need for a harmonic arrangement of the notes than in other steel pan models.

The regular Trinidadian way to hang the double tenor is to use two stands with their supporting arms in line with each other. This has the advantage that double tenors and tenors can be used in the same stands in the steelband set-ups. But it will also mean that both drums will hang at a slight angle, tilted with the back end lower. If you want to play fast this will be a disadvantage, because you have to lift your hands rather high when you move them from one drum to another.

To speed up the playing Rudy Smith and other solo players have turned their stands with the supporting arms almost in parallel with each other. In this way the drums will be tilted towards the point between the drums where the player is standing. Thus the lowest part will be facing the place where you want to move the sticks between the drums while playing. This will presumably be a more common styling in the future. Therefore, the pan shown in the layout figure is a regular (as far as I know) Trinidad double tenor, but it is rotated according to Rudy Smith styling for ease in playing.

Overview of the Double Tenor pan



Special crafting techniques

The notes on a regular Trinidad double tenor are separated by two grooves at a distance of 10 mm. According to some tuners there is no need for this nowadays; they are just there for good "looks". Presumably, there was an acoustic need for them earlier, and then people got used to the look. If this extra distance was to be removed, even more notes could be packed into the double tenor pan. This is presumably what will happen in the future.

The straight inner border of the outer notes on a double tenor in Trinidad style also seems to be just for "looks". The acoustically active dent is shaped in the same way as for the rest of the pans. Making this inner border rounded would presumably make the pan easier to tune and reduce the acoustic interference between the notes.

Measures for the Double Tenor pan

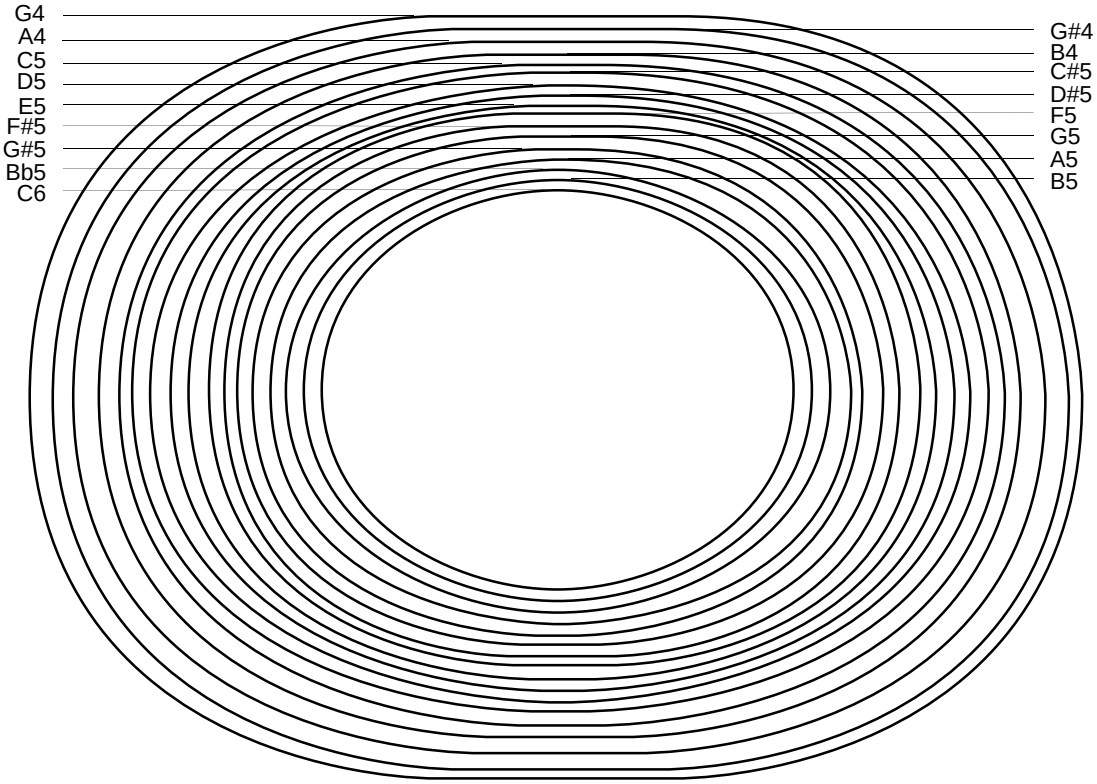
The measured double tenor pan was made by Rudy Smith in 1988. (Smiths left hand set-up was converted to Trinidad right hand style according to tuner Lawrence Mayers.) The measured pan had the inner borders of the outer notes rounded off in the same way as double seconds, etc. The normal distance between the grooves of adjacent notes in the outer ring is 10 mm.

Notes		**Drum**			**Groove**		
Number of notes	Tonal Range	Depth of playing surface [mm]	Length of side [mm]	Hole pos. from rim [mm]	Width [mm]	Radial length [mm]	End from rim [mm]
32	F3-C6	180-195	240	50	2 * 6	130	50

MEASURES FOR DOUBLE TENOR NOTES

Note	Position	Radial length	Tangential length	Length along rim
F3	Outer left	155	230	270
F#3	Outer left	155	230	265
G3	Outer right	150	225	270
G#3	Outer left	150	225	255
A3	Outer left	150	220	255
Bb3	Outer right	147	210	235
B3	Outer right	145	200	230
C4	Outer left	150	200	225
C#4	Outer left	150	195	215
D4	Outer right	147	187	210
D#4	Outer right	140	175	205
E4	Outer right	147	175	200
F4	Outer left	145	170	185
F#4	Outer right	140	165	185
G4	Middle right	145	103	
G#4	Middle left	140	103	
A4	Middle left	139	97	
Bb4	Outer right	140	120	150
B4	Middle right	125	90	
C5	Middle left	115	90	
C#5	Middle left	111	85	
D5	Middle right	110	84	
D#5	Middle right	105	80	
E5	Middle right	97	77	
F5	Middle left	96	74	
F#5	Middle right	95	72	
G5	Inner right	85	65	
G#5	Middle left	82	63	
A5	Middle left	75	58	
Bb5	Middle right	73	60	
B5	Inner right	71	55	
C6	Inner left	65	55	

Templates for Double Tenor inner notes



DOUBLE SECOND (TENOR)

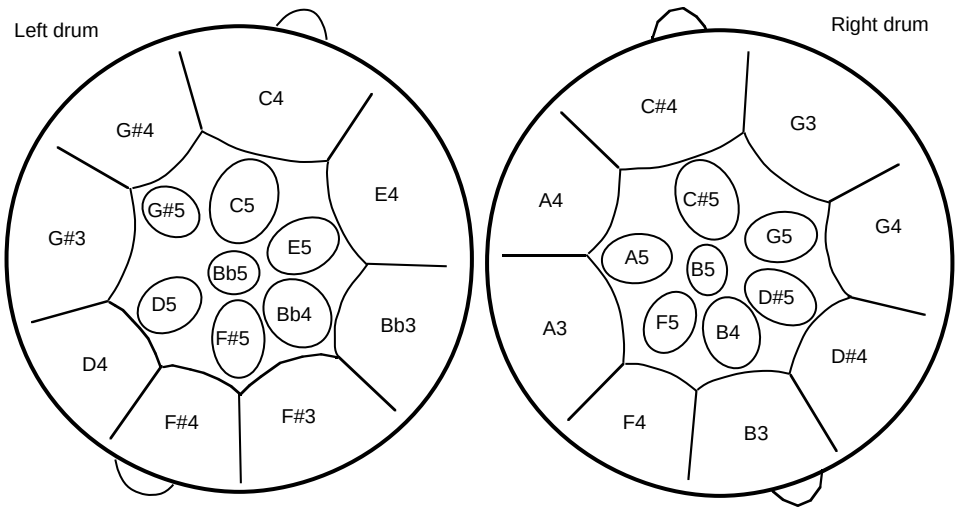
The double second pan consists of two drums with 15 notes in each. The tonal range is almost two and a half octaves in the same range as the double tenor pan. The sound of the double second is, though, a little deeper than the double tenor due to its longer side.

The note layout of the double second seems to be more consistent than for the double tenor. On a chromatic scale, the notes are positioned in drums left-right-left-etc., which means that the most dissonant intervals – the small seconds – are distributed over two drums. The smallest intervals residing in the same drum – the large seconds – are spaced as far apart as possible. For instance, C and D are almost at opposite sides of the left drum.

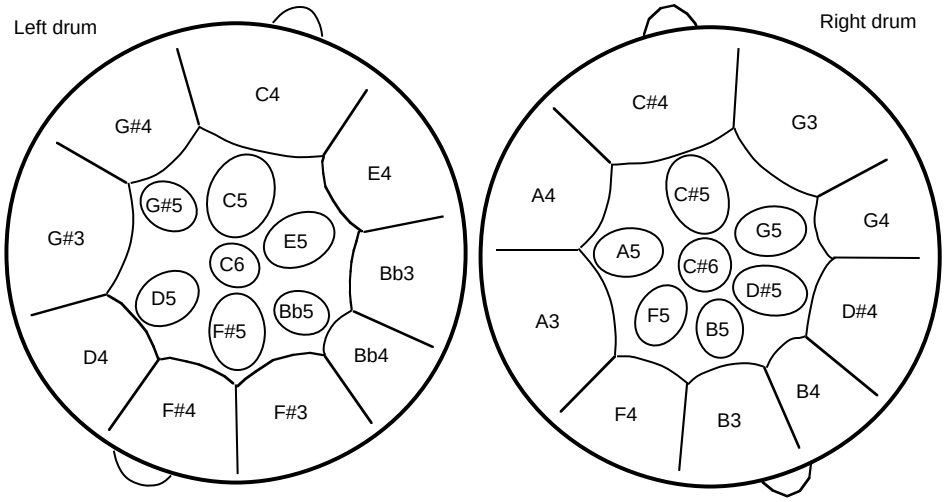
For the positioning of the drums while playing, the same reasoning as for the double tenor is valid. It is easier to play fast if the stands are turned so that the lowest ends of the tilted drums are facing the player. Therefore, the layout is shown in this fashion.

According to some sources there is a special "Ellie Manette styling" of the double second, ranging from the ordinary low F#3 up to C#6, that is; two semitones higher than the usual. This is accomplished by making each note a little smaller and moving Bb4 in the left drum and B4 in the right drum from a middle position to the outer ring, making space for the extra two top notes. The outer ring of notes will then contain nine notes in each drum, again a result of the efforts to make the notes successively smaller.

Overview of the Double Second pan



Overview of Double Second pan, Ellie Mannette styling



Double second pan according to Ellie Manette's styling. Note the Bb4 and B4 moved to the outer ring and the extra C6 and C#6.

Measures for the Double Second pan

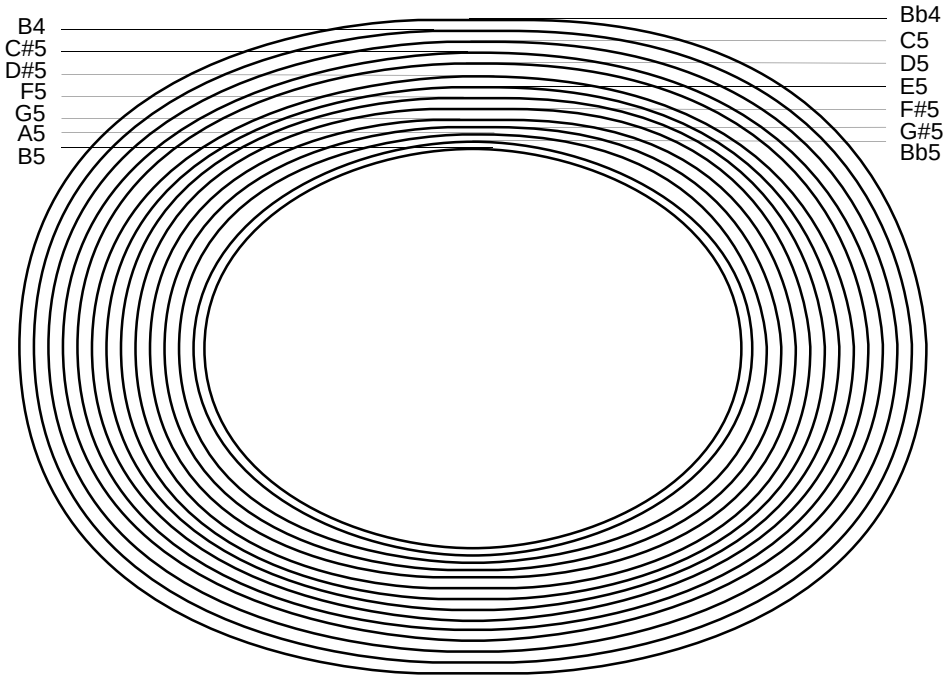
The left drum of the measured pan was made by Lawrence Mayers during a research project of summer 1989. Measures for right drum were extrapolated by the author, together with some data from a double second built by Rudy Smith 1988.

Notes		**Drum**			**Groove**		
Number of notes	Tonal Range	Depth of playing surface [mm]	Length of side [mm]	Hole pos. from rim [mm]	Width [mm]	Radial length [mm]	End from rim [mm]
30	F#3-B5	160-165	215	50	5	125	47

Measures for Double Second notes

Note	Position	Radial length	Tangential length	Length along rim
F#3	Outer left	162	235	290
G3	Outer right	160	210	290
G#3	Outer left	160	202	250
A3	Outer right	158	210	250
Bb3	Outer left	158	210	250
B3	Outer right	155	200	245
C4	Outer left	153	200	245
C#4	Outer right	152	180	210
D4	Outer left	150	162	205
D#4	Outer right	148	155	190
E4	Outer left	145	150	185
F4	Outer right	145	147	185
F#4	Outer left	145	143	185
G4	Outer right	140	135	175
G#4	Outer left	140	130	165
A4	Outer right	135	115	165
Bb4	Middle left	125	90	
B4	Middle right	118	85	
C5	Middle left	112	80	
C#5	Middle right	112	77	
D5	Middle left	113	72	
D#5	Middle right	100	70	
E5	Middle left	92	67	
F5	Middle right	85	64	
F#5	Middle left	80	60	
G5	Middle right	78	60	
G#5	Middle left	76	61	
A5	Middle right	75	58	
Bb5	Inner left	74	55	
B5	Inner right	74	55	

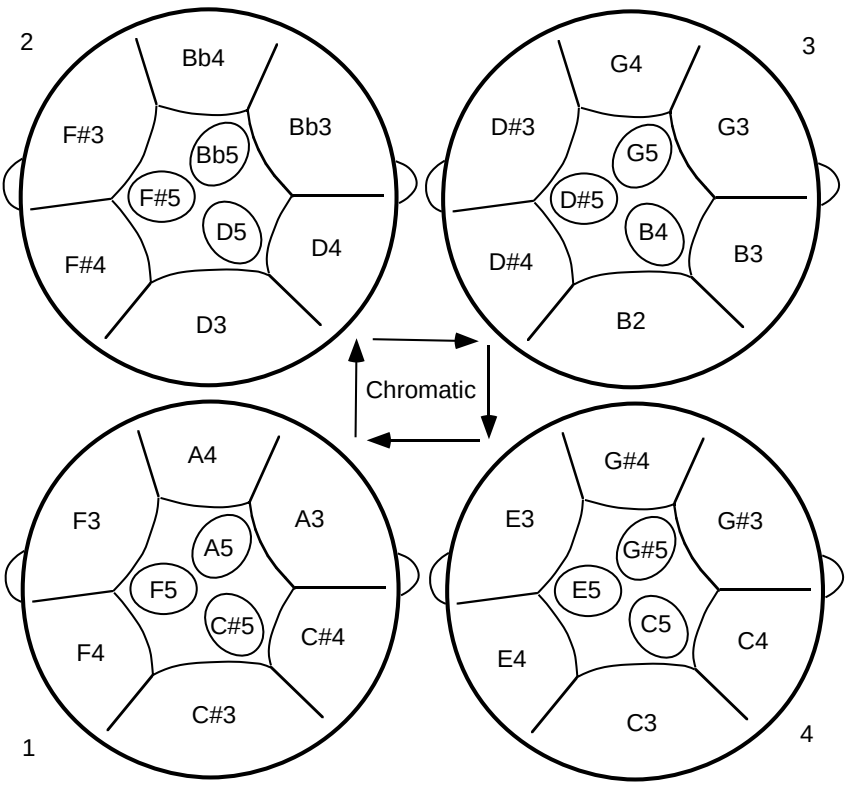
Templates for Double Second inner notes



QUADROPHONIC PAN

The recently invented quadrophonic pan covers the largest tonal range of all regular steel pans. The four drums accommodate altogether 36 notes, ranging from B2 to Bb5. The notes are distributed over the drums in a chromatic sequence from left to right, drums numbered 1 to 4 (see figure), beginning with B2 in drum 3. In this way, the smallest tonal interval residing in the same drum will be a major third. The notes in this interval are placed beside each other, resulting in one major chord for each drum: C# maj, D maj, D# maj, and E maj, left to right.

Overview of the Quadrophonic pan



Measures for the Quadrophonic pan

Data for the quadrophonic pan was gathered during a research trip to Trinidad in March 1990. Some measurements are still missing, especially the note sizes. The measurements given here are extrapolated from the same notes in guitar pans and double seconds. There is

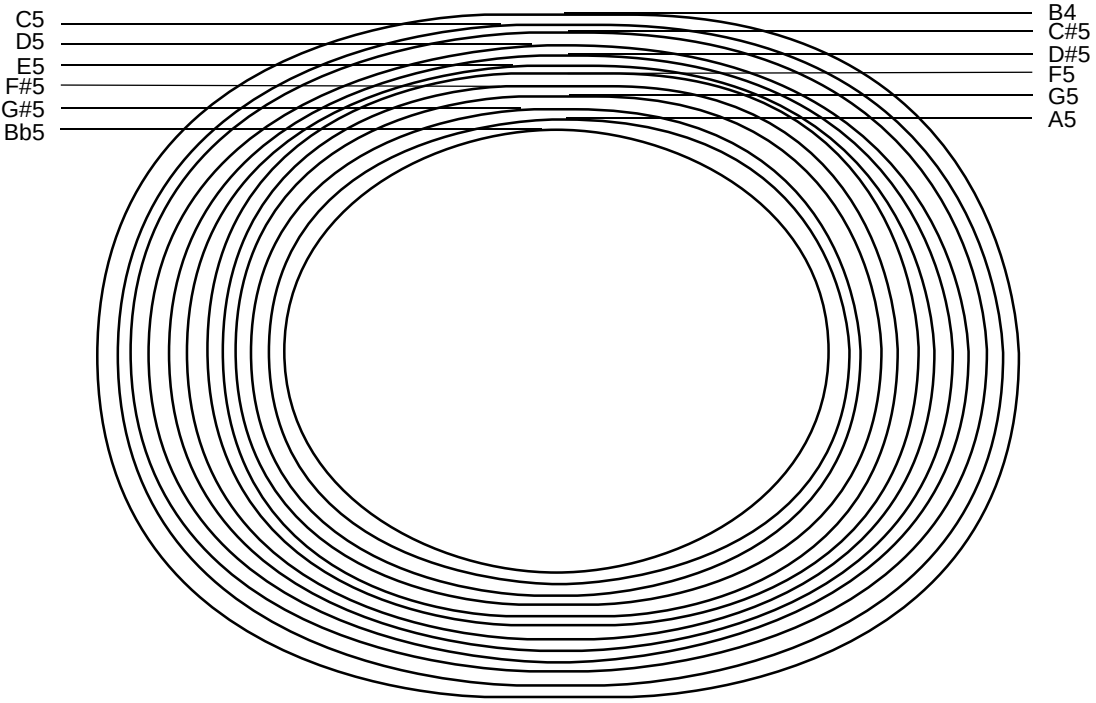
no existing pan with these note sizes, but the real measures should not deviate too far from what is given here. Tangential measures for outer notes are not given, because these are not relevant for panmaking.

Notes		**Drum**			**Groove**		
Number of notes	Tonal Range	Depth of playing surface [mm]	Length of side [mm]	Hole pos. from rim [mm]	Width [mm]	Radial length [mm]	End from rim [mm]
36	B2-Bb5	150	280	60	2 * 5	130	50

Measures for Quadrophonic pan notes

Note	Position	Radial length	Tangential length	Length along rim
B2	Outer 3	175		380
C3	Outer 4	175		380
C#3	Outer 1	175		380
D3	Outer 2	175		380
D#3	Outer 3	170		340
E3	Outer 4	170		340
F3	Outer 1	170		340
F#3	Outer 2	170		340
G3	Outer 3	165		300
G#3	Outer 4	165		300
A3	Outer 1	165		300
Bb3	Outer 2	165		300
B3	Outer 3	160		270
C4	Outer 4	160		270
C#4	Outer 1	160		270
D4	Outer 2	160		270
D#4	Outer 3	155		230
E4	Outer 4	155		230
F4	Outer 1	155		230
F#4	Outer 2	155		230
G4	Outer 3	150		200
G#4	Outer 4	150		200
A4	Outer 1	150		200
Bb4	Outer 2	150		200
B4	Inner 3	128	94	
C5	Inner 4	123	90	
C#5	Inner 1	118	86	
D5	Inner 2	112	82	
D#5	Inner 3	108	78	
E5	Inner 4	102	74	
F5	Inner 1	97	70	
F#5	Inner 2	92	66	
G5	Inner 3	88	64	
G#5	Inner 4	83	62	
A5	Inner 1	78	60	
Bb5	Inner 2	75	60	

Templates for Quadrophonic pan inner notes

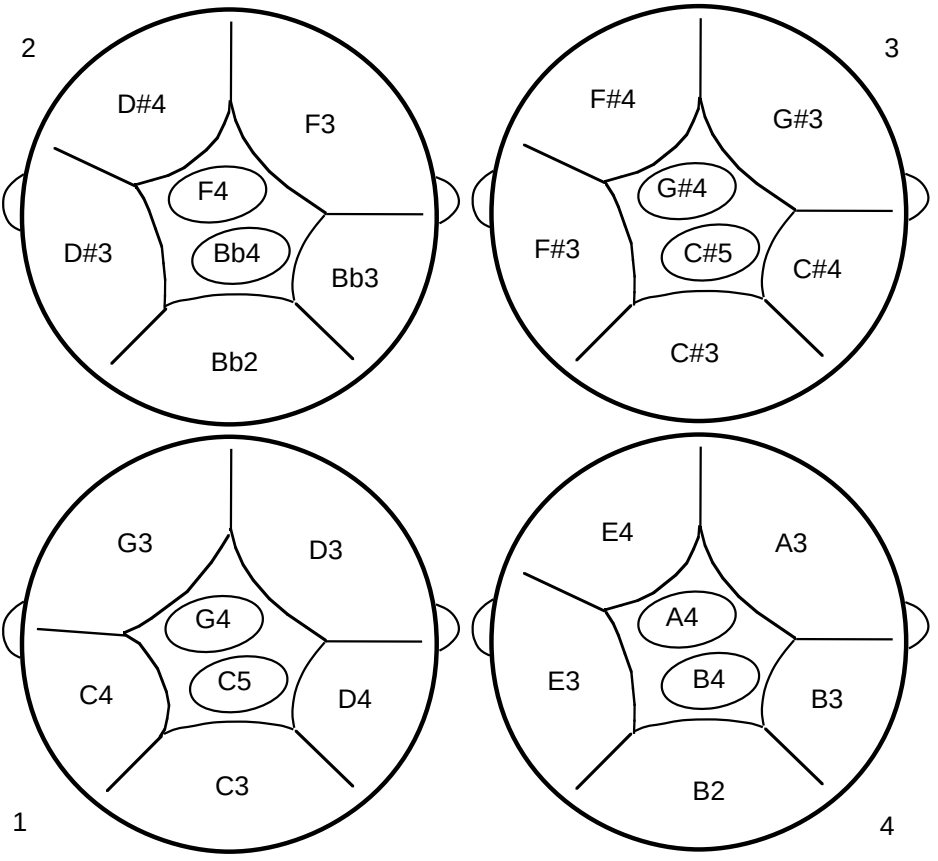


FOUR PAN

The four pan consists of four drums, cut at half their lengths, with seven notes in each. The musical range is just above two octaves, from Bb2 up to C#5. The four pan has the same musical function as the old double guitar, i.e., mainly to play chords in the rhythm section, but its larger tonal range makes it more suited to fill in melodic lines. As the pan instrument develops, I belive we will see the four pan successively replace the ordinary guitar pan.

Unfortunately, the layout of the notes in the four pan is not as well structured as for the quadrophonic pan. A chromatic scale from the lowest note Bb2 and one octave upwards will follow the drum sequence 2-4-1-3-1-2-4-2-3-1-3-4-2 (see figure). There seems to be no reason why the layout of the four pan not could be chromatically sequenced in drums 1-2-3-4 as the quadrophonic pan, resulting in a major chord in each drum. Maybe we will see this happen in the future.

Overview of the Four pan



Measures for the Four pan

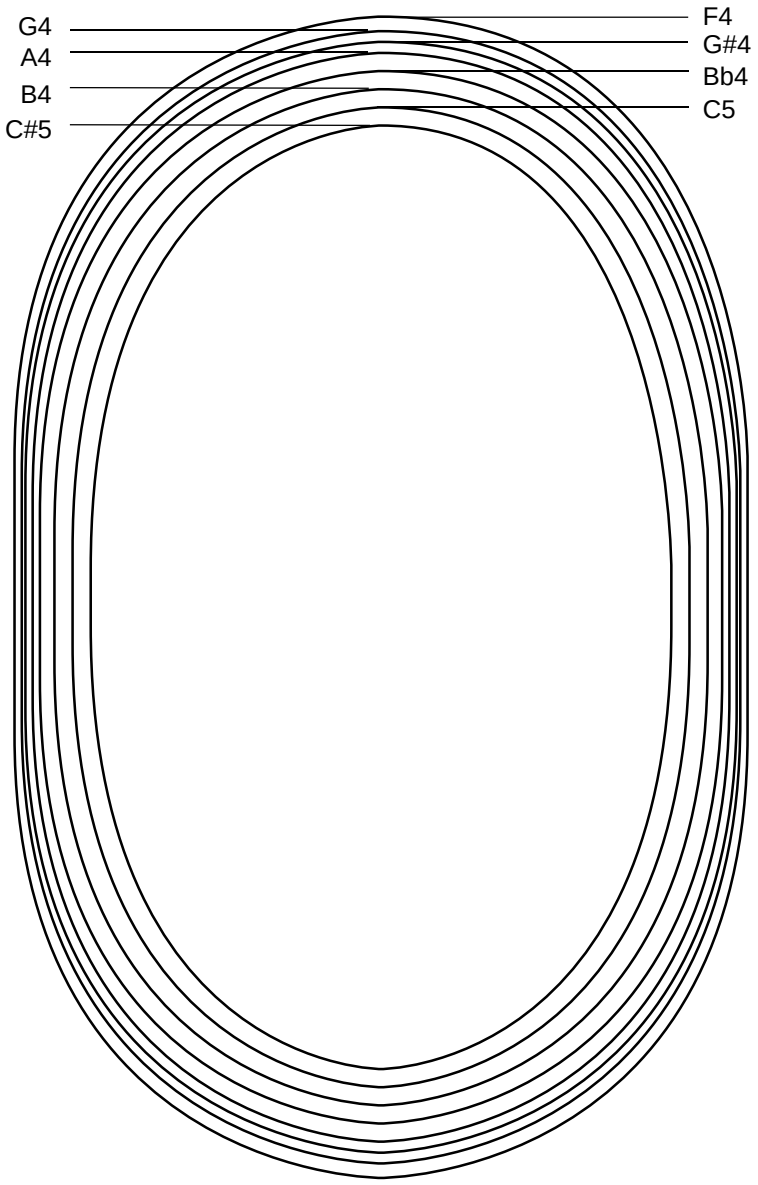
Data for the four pan was gathered during a research trip to Trinidad in March 1990. Some data is still missing, especially measures for the note sizes. The note sizes given here have not been measured, but are extrapolated from the same notes in guitar pans and double seconds. There is no existing pan with these notes, but their real sizes should not deviate too far from what is given here. Tangential measures for outer notes have not been calculated, because these are not relevant for panmaking.

Notes		**Drum**			**Groove**		
Number of notes	Tonal Range	Depth of playing surface [mm]	Length of side [mm]	Hole pos. from rim [mm]	Width [mm]	Radial length [mm]	End from rim [mm]
28	Bb2-C#5	145	550	80	6	130	50

MEASURES FOR FOUR PAN NOTES

Note	Position	Radial length	Tangential length	Length along rim
Bb2	Outer 2	200		400
B2	Outer 4	200		420
C3	Outer 1	200		420
C#3	Outer 3	200		420
D3	Outer 1	190		390
D#3	Outer 2	190		380
E3	Outer 4	190		390
F3	Outer 2	190		390
F#3	Outer 3	180		380
G3	Outer 1	180		360
G#3	Outer 3	180		370
A3	Outer 4	180		360
Bb3	Outer 2	170		320
B3	Outer 4	170		320
C4	Outer 1	170		320
C#4	Outer 3	170		320
D4	Outer 1	160		290
D#4	Outer 2	160		290
E4	Outer 4	160		290
F4	Inner 2	102	160	
F#4	Outer 3	160		290
G4	Inner 1	100	156	
G#4	Inner 3	99	152	
A4	Inner 4	98	148	
Bb4	Inner 1	95	144	
B4	Inner 4	90	140	
C5	Inner 1	86	135	
C#5	Inner 3	80	130	

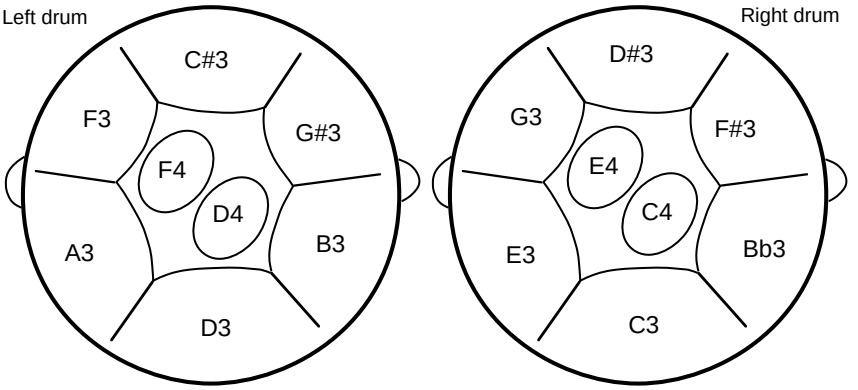
Templates for Four pan inner notes



DOUBLE GUITAR PAN

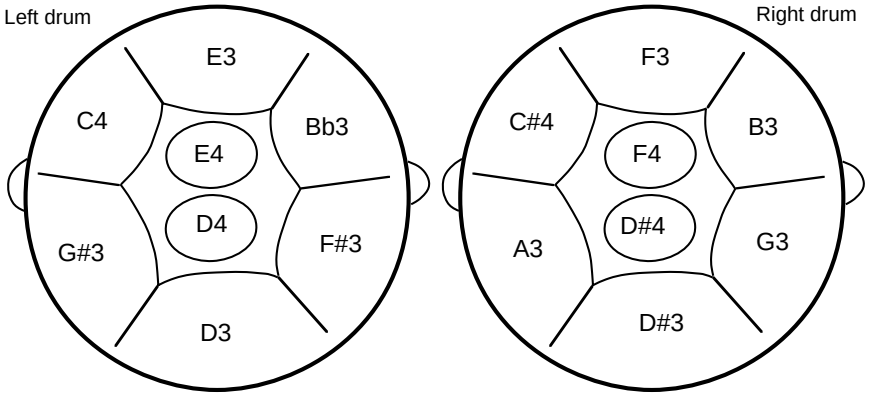
The double guitar pan consists of two drums, cut to half their lengths, with eight notes in each. The tonal range just above one octave, from D3 to F4. The guitar pan is mostly used as a rhythm instrument, playing chords, in the same way as an ordinary guitar in an orchestra. The common Trinidad layout, called "Invader style", is somewhat peculiar, as it goes from C3 up to F4, but lacks the C#4 and the D#4 in the upper octave. This makes it difficult to do musical arrangements for this instrument.

Overview of Double Guitar pan, Invader style



I have chosen to present an alternative guitar pan designed by tuner Rudy Smith, as this covers a full tonal range from D3 to F4. The layout of the Smith Guitar Pan is designed with notes consequently in drums left-right-left on a chromatic scale in the same way as the double

Overview of Double Guitar pan, Rudy Smith style



second pan. There are just four octave intervals and the higher notes reside right inside their lower octave counterpart.

Special crafting techniques

While sinking the guitar pan; do not work closer to the rim than 70 mm. This is done to leave material for the outer notes and get the right shape of the sunk basin.

Measures for the Double Guitar pan

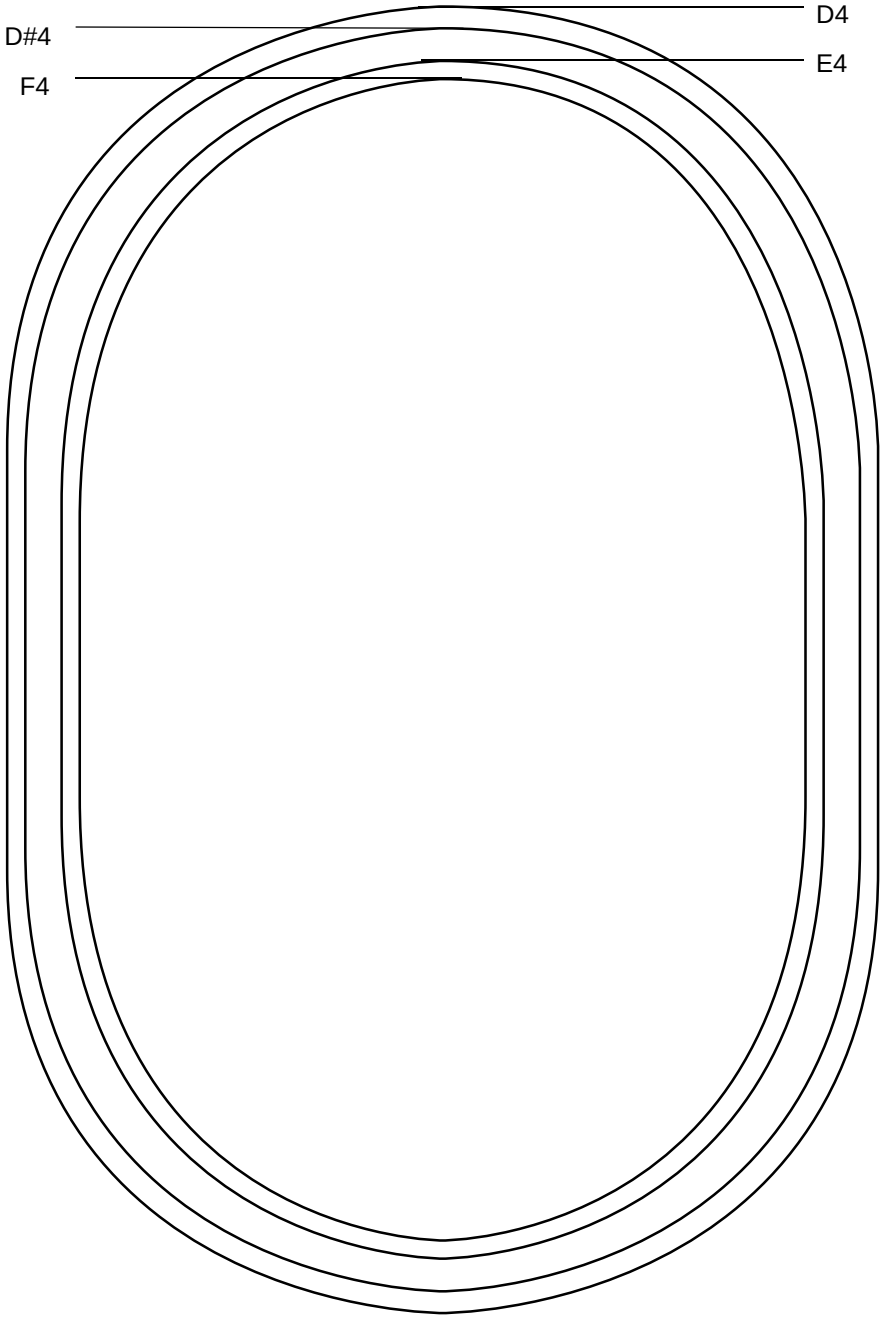
The measured guitar pan was made in Sweden by Rudy Smith 1988.

Notes		**Drum**			**Groove**		
Number of notes	Tonal Range	Depth of playing surface [mm]	Length of side [mm]	Hole pos. from rim [mm]	Width [mm]	Radial length [mm]	End from rim [mm]
16	D3-F4	140	460	80	6	135	50

MEASURES FOR DOUBLE GUITAR PAN NOTES

Note	Position	Radial length	Tangential length	Length along rim
D3	Outer left	180	260	345
D#3	Outer right	175	260	335
E3	Outer left	170	250	330
F3	Outer right	175	250	330
F#3	Outer left	170	240	310
G3	Outer right	170	240	300
G#3	Outer left	165	230	285
A3	Outer right	170	225	285
Bb3	Outer left	160	210	250
B3	Outer right	160	205	250
C4	Outer left	160	195	240
C#4	Outer right	160	190	245
D4	Middle left	120	180	
D#4	Middle right	125	180	
E4	Middle left	105	165	
F4	Middle right	100	165	

Templates for Double Guitar pan inner notes

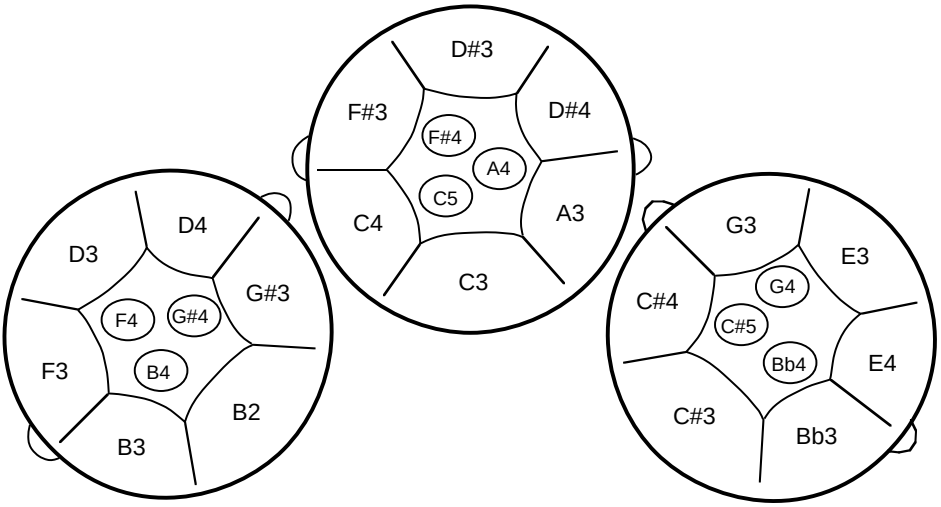


TRIPLE CELLO (BARITONE)

The triple cello pan is made out of three drums cut at approximately half their length. Each drum has eight or nine notes, with two or three of them in a middle position. The cello is mostly used for lower chords and bass riffs, filling in the bass line.

The notes are chromatically distributed, left to right from drum 1 to 2 to 3. Since the set-up consists of three drums, this layout procedure means that every third semitone will be put in the same drum. This makes the harmonic intervals of the notes in each drum form a diminished chord: B dim, C dim, and C# dim, left to right.

Overview of the Triple Cello pan



Measures for the Triple Cello pan

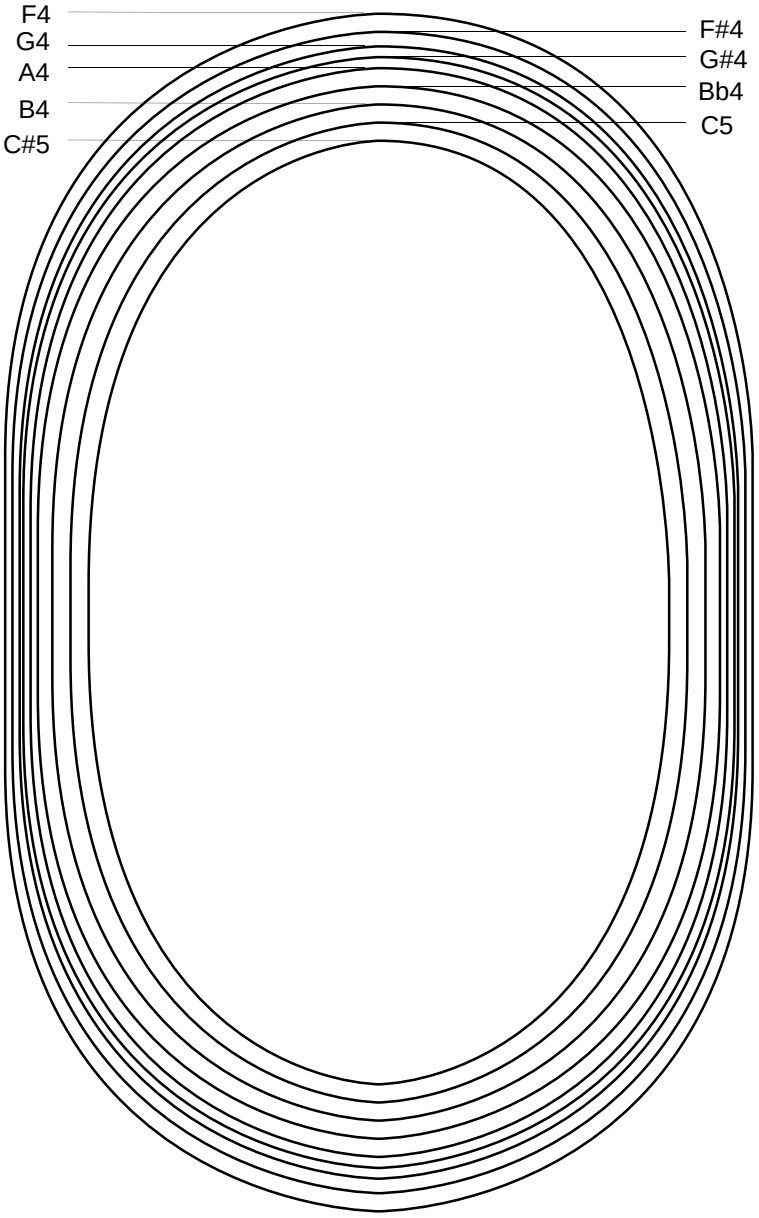
The measured cello pan was made in Sweden by Rudy Smith 1988. The layout of the pan has been extended with three extra upper notes according to a sketch from a folder in the CD-album "Steel Bands of Trinidad and Tobago", 1987.

Notes		**Drum**			**Groove**		
Number of notes	Tonal Range	Depth of playing surface [mm]	Length of side [mm]	Hole pos. from rim [mm]	Width [mm]	Radial length [mm]	End from rim [mm]
27	B2-C#5	130-160	450	50	5	135	50

MEASURES FOR TRIPLE CELLO PAN NOTES

Note	Position	Radial length	Tangential length	Length along rim
B2	Outer 1	177	290	360
C3	Outer 2	175	290	360
C#3	Outer 3	175	300	360
D3	Outer 1	175	265	335
D#3	Outer 2	175	265	335
E3	Outer 3	175	265	330
F3	Outer 1	170	245	305
F#3	Outer 2	170	245	300
G3	Outer 3	170	240	300
G#3	Outer 1	170	230	285
A3	Outer 2	165	235	285
Bb3	Outer 3	170	230	285
B3	Outer 1	170	195	240
C4	Outer 2	185	195	235
C#4	Outer 3	165	195	235
D4	Outer 1	160	180	215
D#4	Outer 2	160	182	215
E4	Outer 3	160	186	215
F4	Inner 1	103	163	
F#4	Inner 2	103	165	
G4	Inner 3	130	156	
G#4	Inner 1	98	152	
A4	Inner 2	98	152	
Bb4	Inner 3	94	145	
B4	Inner 1	90	140	
C5	Inner 2	85	135	
C#5	Inner 3	80	130	

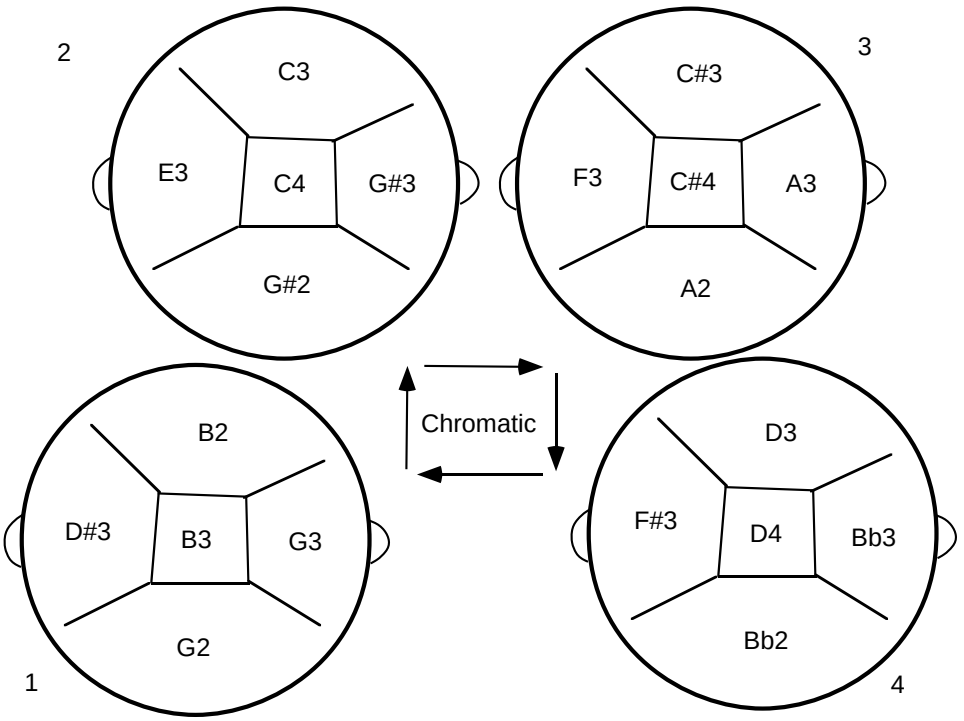
Templates for Triple Cello inner notes



TENOR BASS

The tenor bass consists of four drums cut at two thirds of their length (62 cm). Each drum contains five notes. The tonal range is one and a half octaves, from G2 to D4. The notes are distributed systematically left to right on drums 1-2-3-4 on a chromatic scale (see figure). This will result in each drum ringing in major chords as with the quadrophonic pan.

OVERVIEW OF THE TENOR BASS PAN



Special crafting techniques

No separate sinking is done on the basses. The surface is lowered at the same time as the pan is backed. It is important that the borders (the grooves) of the notes have a straight slope (not convex or concave) down towards the middle. The width of the groove is usually a bit broader than on the higher pans, but it seems to work with the same width.

During the softening part of the tuning of basses, a club-like wooden wedge is used to raise the notes, see fig. B.12. This wedge has a long handle to make it easier to reach down to the note surface inside the drum.

Measures for the Tenor Bass pan

The tenor bass was measured during a research trip to Trinidad 1990.

Notes		Drum			Groove		
Number of notes	Tonal Range	Depth of playing surface [mm]	Length of side [mm]	Hole pos. from rim [mm]	Width [mm]	Radial length [mm]	End from rim [mm]
20	G2-D4	100	620	80-100	6-7	300	60

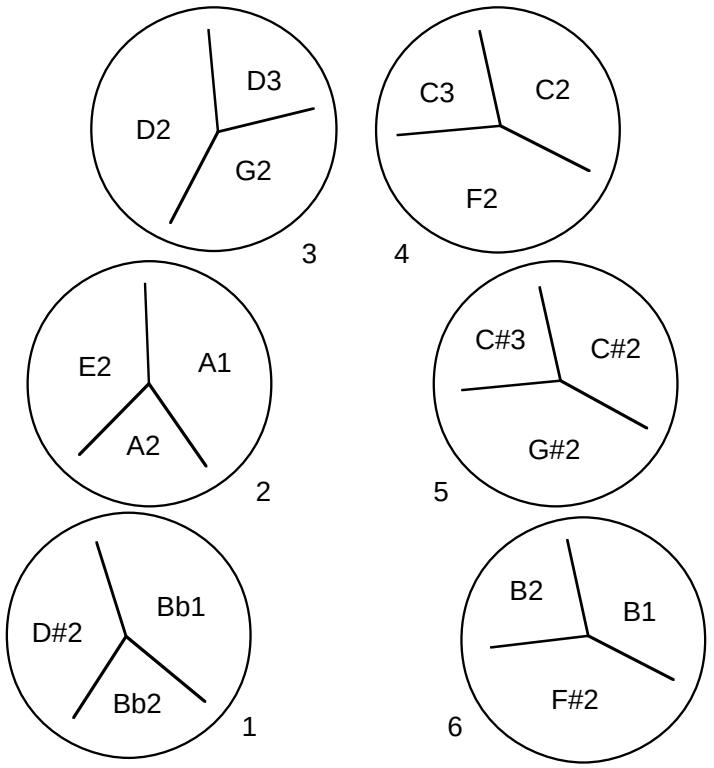
MEASURES FOR TENOR BASS PAN NOTES

Note	Drum	Radial length	Tangential length	Length along rim
G2	1	255	395	570
G#2	2	245	390	570
A2	3	240	400	560
Bb2	4	240	400	560
B2	1	230	350	500
C3	2	230	350	490
C#3	3	230	340	480
D3	4	230	340	480
D#3	1	220	300	390
E3	2	220	280	390
F3	3	220	290	390
F#3	4	220	290	390
G3	1	205	230	300
G#3	2	210	230	300
A3	3	200	230	300
Bb3	4	205	230	300
B3	inner 1	200	200	
C4	inner 2	200	200	
C#4	inner 3	200	200	
D4	inner 4	200	200	

SIX BASS

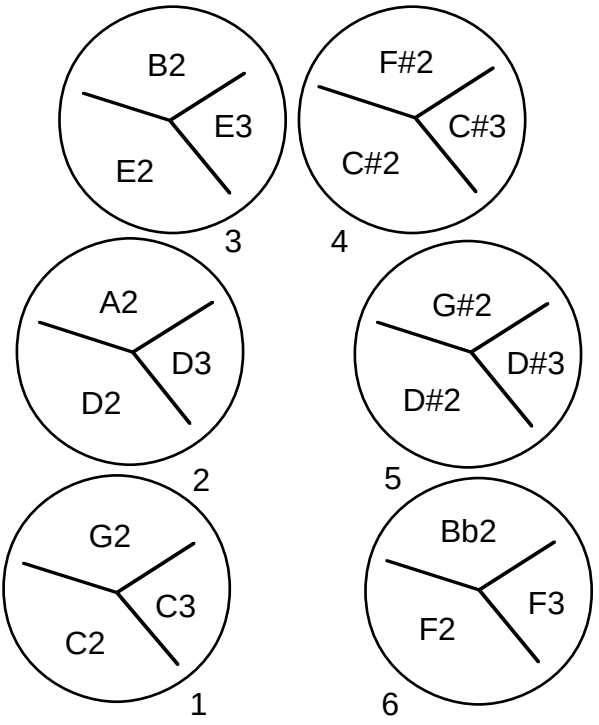
The six bass is made out of six whole drums with three notes in each. The tonal range is 18 notes, starting from A1. The Trinidad layout of the six bass is designed to put notes with fourth or fifth intervals in the same drum as often as possible. This is done to make the notes support the harmonical spectra of each other. But it will result in the notes being distributed quite "arbitrarily" over the drums, see the layout figure.

Overview of Six Bass, Trinidad style



The tuner Clifford Alexis uses an alternative layout that presumably seeks to combine the goals of putting harmonic intervals in the same drum and a logical structuring of the notes. The result is a six bass that has intervals of fifths in the three first drums and fourths in the last three.

Overview of Six Bass, Clifford Alexis style



Special crafting techniques

No separate sinking is done on the basses. The surface is lowered at the same time as the pan is backed. A six bass is sunk down to 9 cm in the middle. It is important that the borders of the notes have a straight slope (not curved) down towards the middle. To raise the notes of a bass a special tool is often used; a paddle-like wooden stick that is long enough to reach down to the bottom of the drum, see fig. B.12.

Measures for the Six Bass

The measured six bass was made by Rudy Smith in 1990. The position for the lowest note is left out and the measures for the highest note are extrapolated, due to the difference in range between Smith's and Alexis' layouts. Position of notes is given according to Clifford Alexis' scheme.

Notes		**Drum**			**Groove**		
Number of notes	Tonal Range	Depth of playing surface [mm]	Length of side [mm]	Hole pos. from rim [mm]	Width [mm]	Radial length [mm]	End from rim [mm]
18	C2-F3	90	883	100-150	5-6	210-230	60

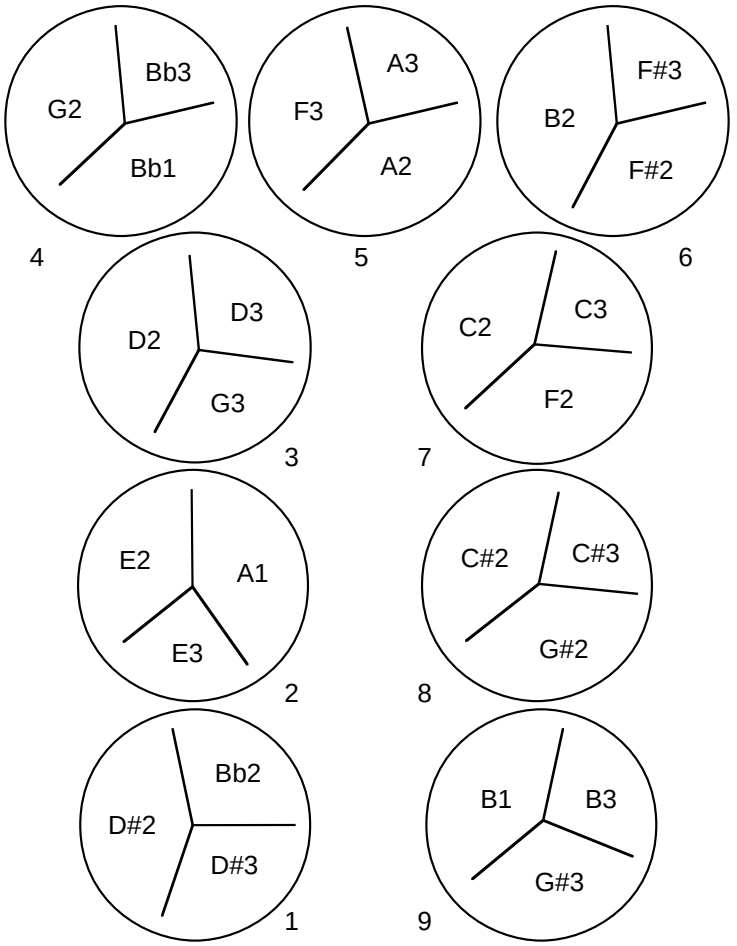
MEASURES FOR SIX BASS NOTES

Note	Drum	Radial length	Tangential length	Length along rim
B1		275	450	650
C2	1	275	440	650
C#2	4	270	430	640
D2	2	270	430	650
D#2	5	280	420	660
E2	3	265	450	640
F2	6	260	430	620
F#2	4	265	460	620
G2	1	265	430	630
G#2	5	270	430	630
A2	2	260	410	610
Bb2	6	260	430	610
B2	3	240	360	470
C3	1	240	370	470
C#3	4	235	360	470
D3	2	240	360	470
D#3	5	240	360	480
E3	3	240	360	470
F3	6	240	360	470

NINE BASS

The nine bass is the lowest regular instrument of the steelband. The nine drums accommodate altogether 27 notes, ranging from A1 to B3. To get a set-up of nine drums to be playable, three of the drums have been hung in a tilted position in front of the player.

Overview of the Nine Bass



Special crafting techniques

No separate sinking is done on the basses. The surface is lowered at the same time as the pan is backed. A nine bass is sunk down to 9 cm in the middle. It is important that the borders of the notes have a straight slope (not curved) down towards the middle. To raise the notes of a bass a special tool is often used; a paddle-like wooden stick that is long enough to reach down to the bottom of the drum, see fig. B.12.

Measures for the Nine Bass

No nine bass has yet been available for measurements, but to give a brief idea of the measures for a nine bass, data from the six bass and the tenor bass have been compiled.

Notes		Drum			Groove		
Number of notes	Tonal Range	Depth of playing surface [mm]	Length of side [mm]	Hole pos. from rim [mm]	Width [mm]	Radial length [mm]	End from rim [mm]
27	A1-B3	90	883	100-150	6	210-230	60

Measures for Nine Bass notes

Note	Drum	Radial length	Tangential length	Length along rim
A1	2	275		650
Bb1	4	275		650
B1	9	275		650
C2	7	275		650
C#2	8	270		640
D2	3	270		650
D#2	1	280		660
E2	2	260		640
F2	7	260		620
F#2	6	265		620
G2	4	265		630
G#2	8	270		630
A2	5	270		610
Bb2	1	260		610
B2	6	240		470
C3	7	240		470
C#3	8	235		470
D3	3	240		470
D#3	1	240		480
E3	2	240		470
F3	5	240		470
F#3	6	210		300
G3	3	205		300
G#3	9	200		300
A3	5	200		300
Bb3	4	200		300
B3	9	200		300

NOTE SIZES

To get an overview of how the note size is related to the pitch of the note, I have compiled note-size data from all measured pans (except the nine bass) into one diagram.

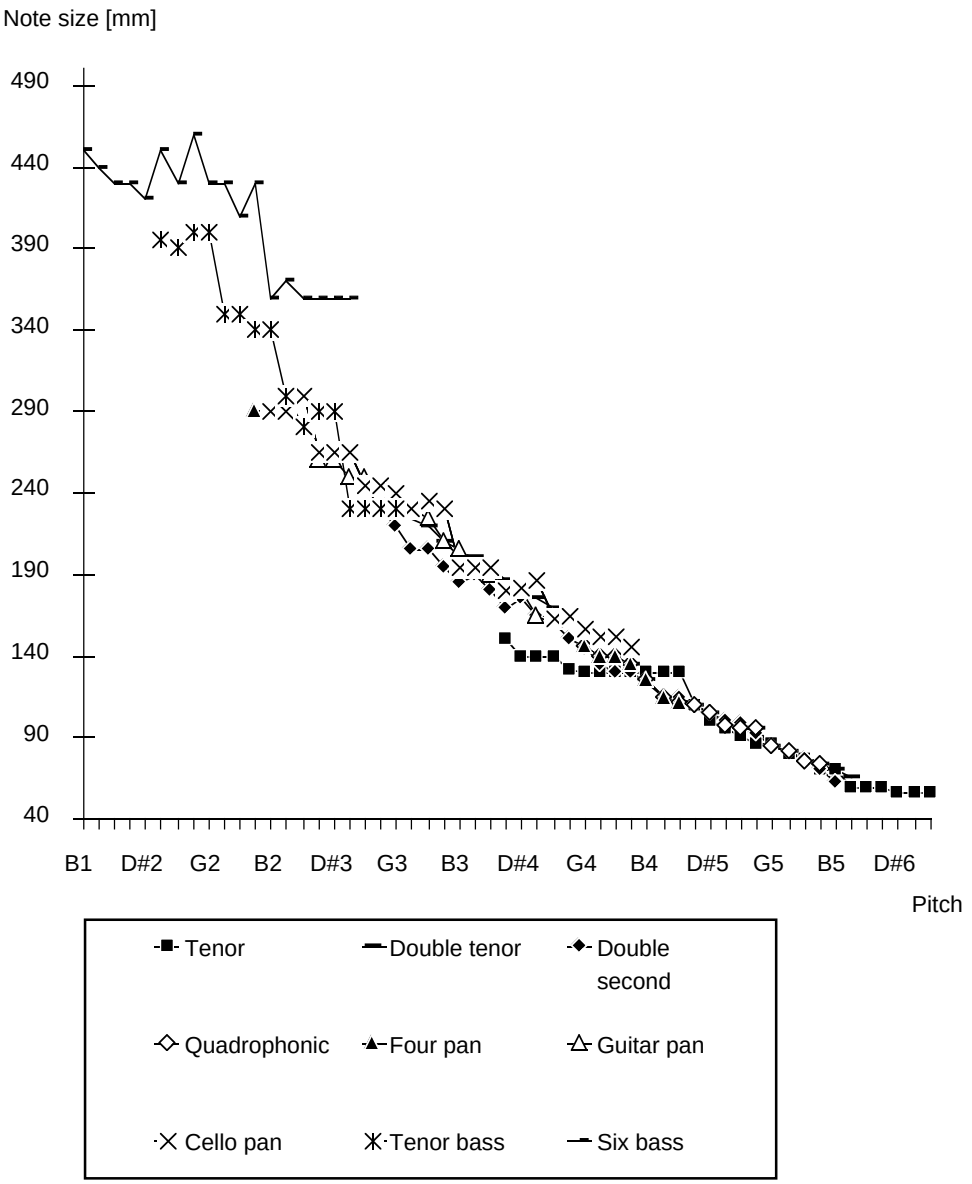


Fig. A.3 Diagram relating note size to pitch.

TEMPLATES FOR SINKING

The shape of the overall sink is of vital importance for the later backing and tuning. The main idea is to make the surface between the notes concave spherical in shape. But, in order to make the notes in the outer circle raise properly during the later backing, there must be a deviation from the concave shape near the rim. The surface should be straight or slightly convex here, resembling the final shape of the outer notes.

When the pan is backed, the surface between the outer notes should be lowered down to form a uniform spherical shape. Since the outer notes of the lower tuned pans are bigger and higher, the height of the convex part near the rim has to be higher in a degree corresponding to the height of the final note dents.

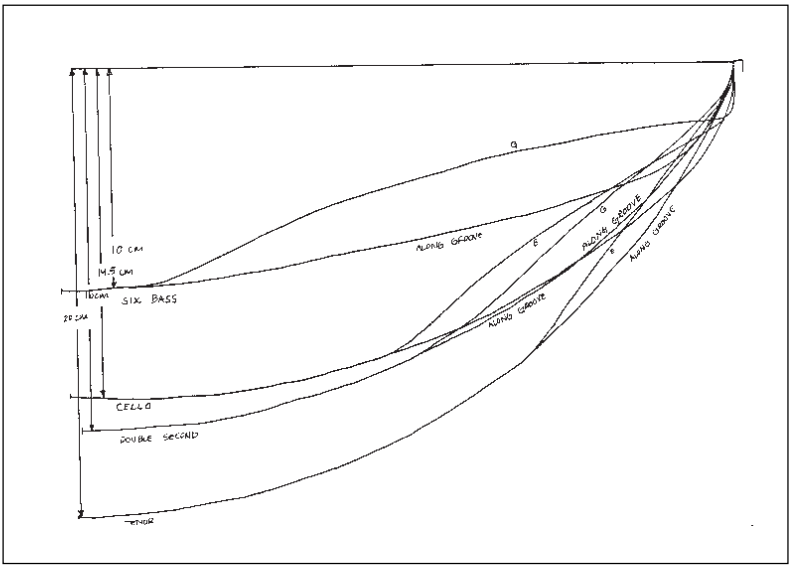
The template graphs given in fig. A.4 and A.5 have a special design. The pattern for each pan involves two shapes: one for the shape of the surface *between* the notes of the finished pan and one showing the shape measured *through* the highest note. The shape to be used during the sinking phase is the higher one, because at this stage material should be left to form the notes later. This template is the most important one.

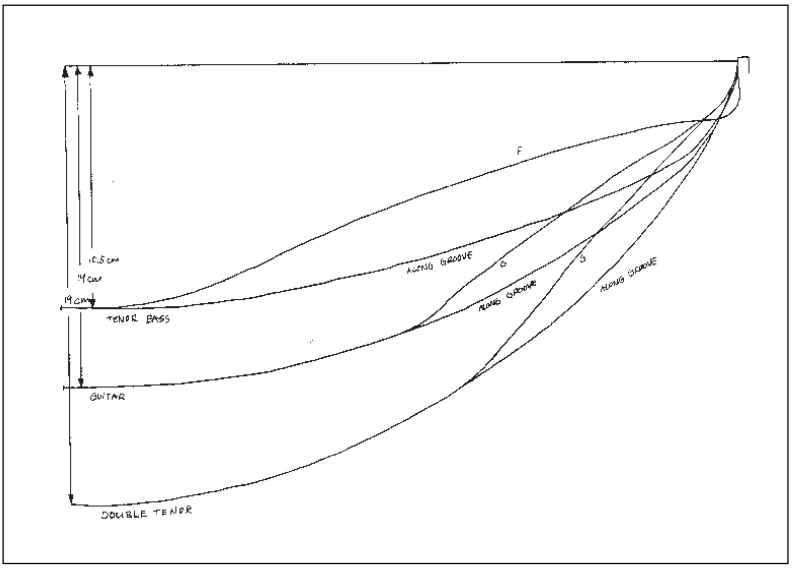
The second shape is given to show what the overall shape should be after backing, grooving and levelling. This template can be used after the backing to check that the surface between the notes has an even, spherical shape.

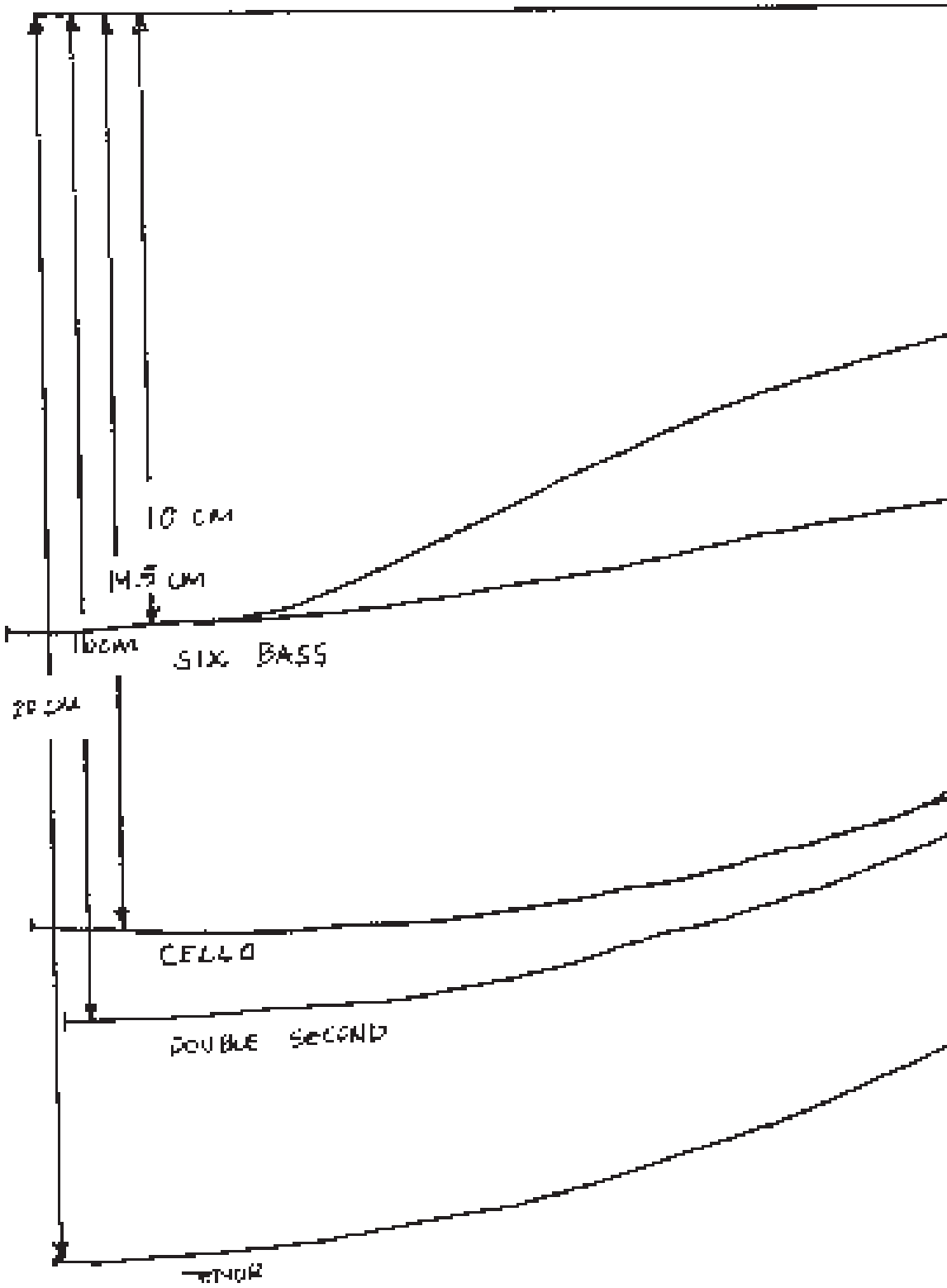
The best way to make sinking templates out of the patterns below is to copy the page twice for each pattern. Then take one of the copies and turn it back to front, to form a left and right side of the template. Paste the left and right shapes together, carefully adjusting them to match the correct depth of the basin for the intended pan. The next thing is to paste the template to some stiff material that can serve as a guiding template during the sinking.

The straight lines at the top of the patterns should not be included in the template, they are there just to serve as a reference to the vertical outer side of the drum. These lines should be vertical when you paste the left and right parts together. Last, cut the template after the shape lines.

Outline of sinking templates






10 CM
14.5 CM
SIX BASS
CELLO
DOUBLE SECOND

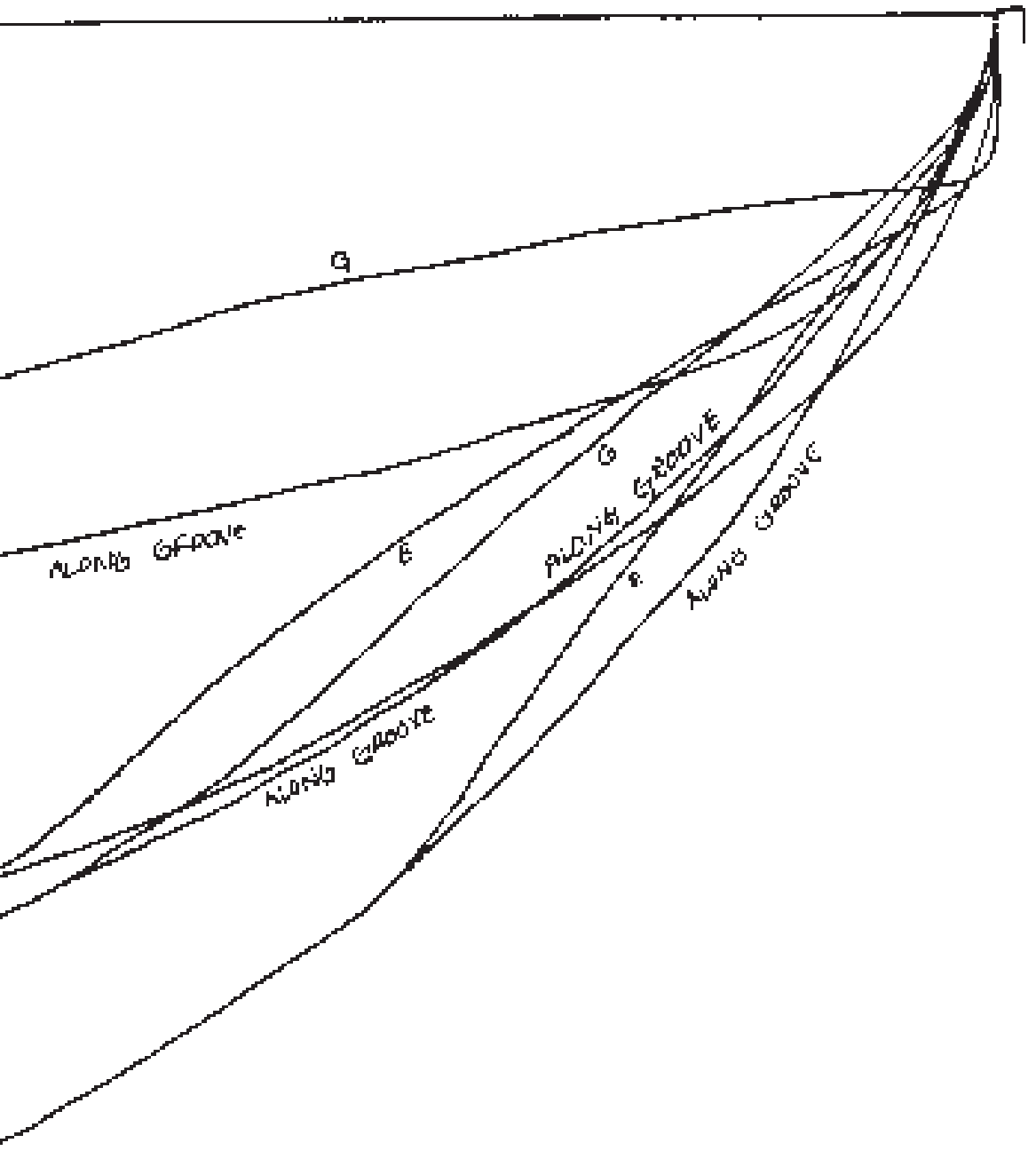
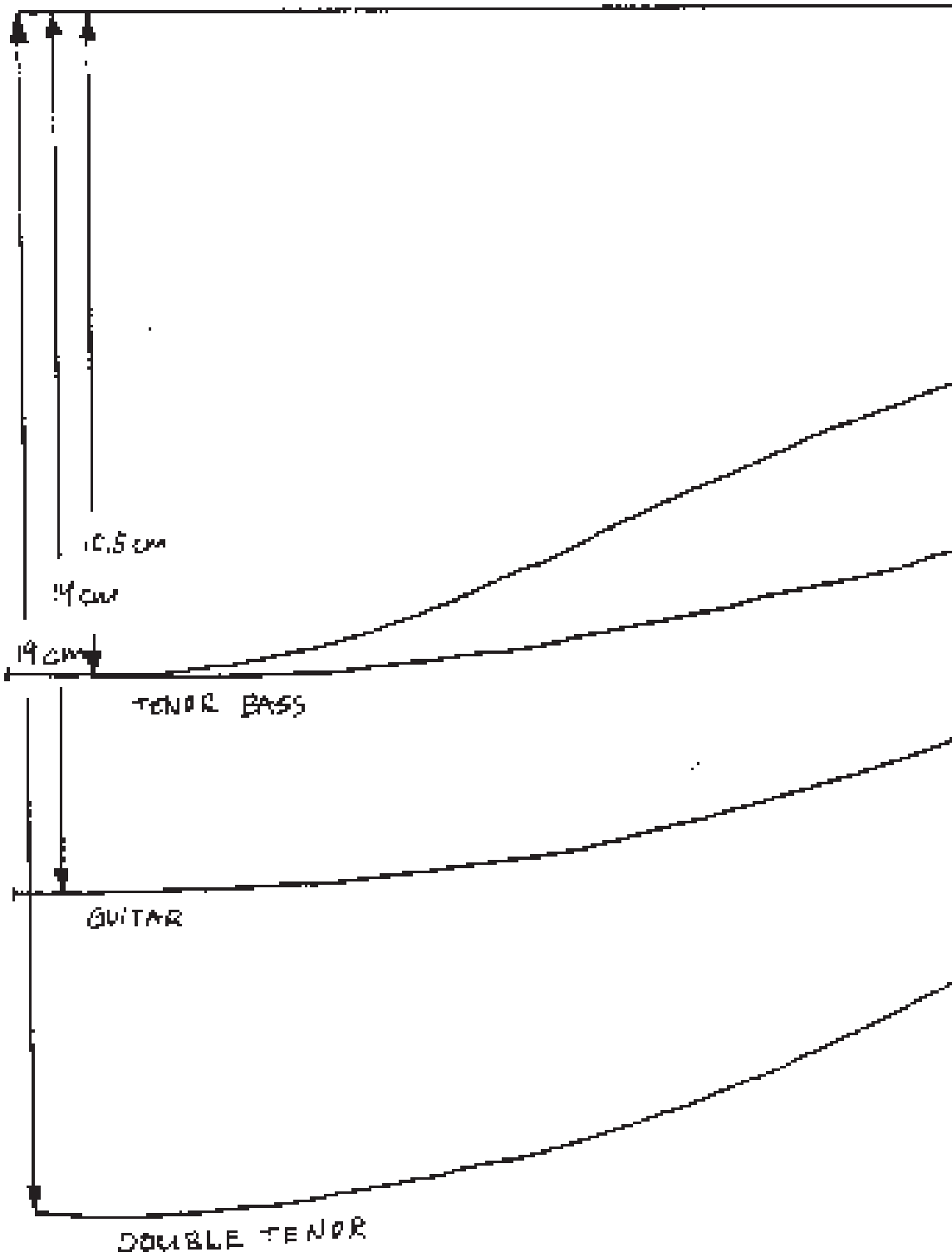


Fig. A.4 Sinking templates for tenor, double second, cello and six bass. Full scale right side. Cross-section of the surface along the groove and through the most convex note for each pan. *Drawing by Johan Larsson.*


12.5 cm
14 cm
19 cm
TENOR BASS
GUITAR
DOUBLE TENOR

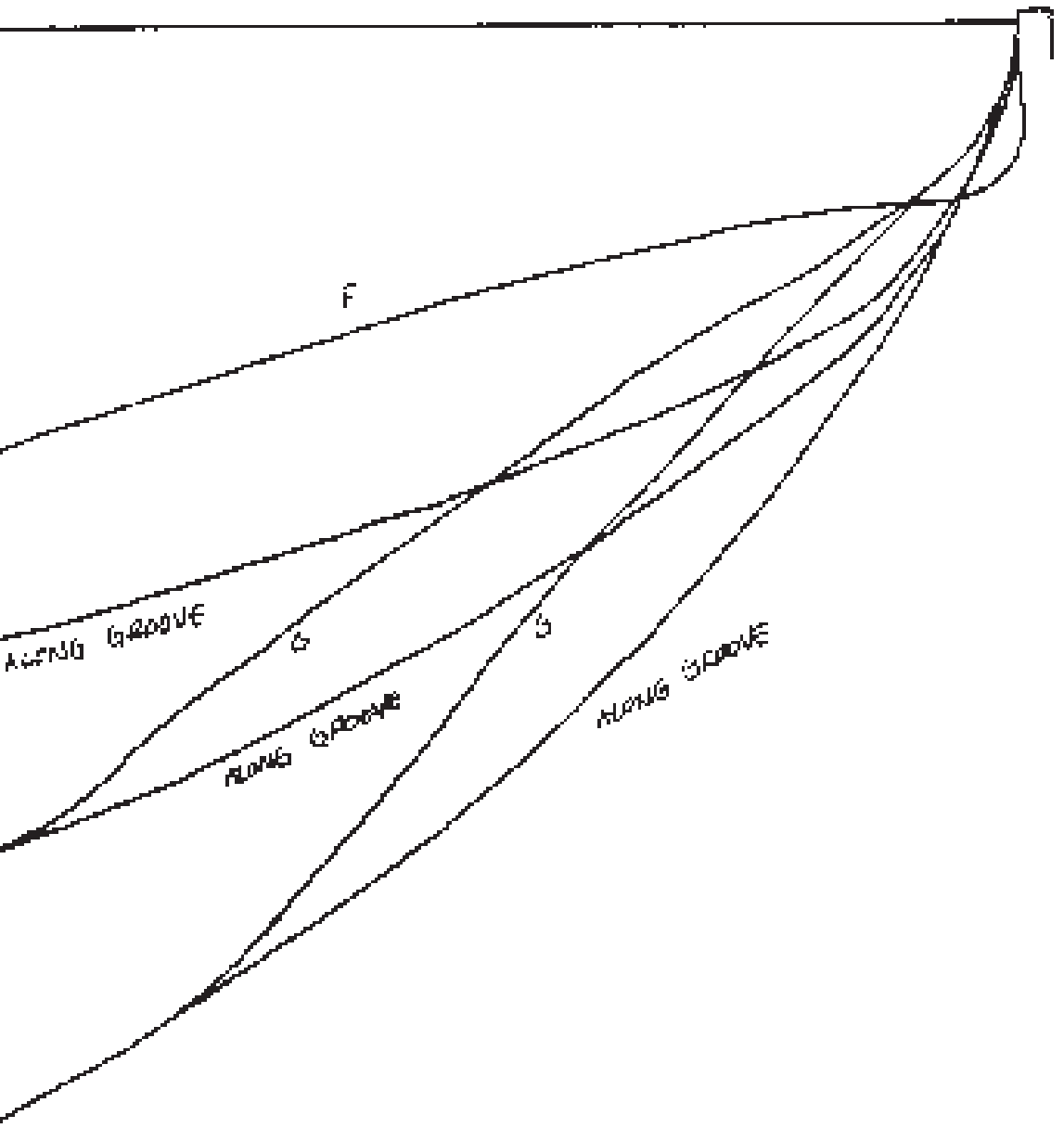


Fig. A.5 Sinking templates for double tenor, guitar and tenor bass. Full scale right side. Cross-section of the surface along the groove and through the most convex note for each pan. *Drawing by Johan Larsson.*

B. Tools for pan making

LIST OF TOOLS

This is a short list of the panmaking tools in the order you will need them:

Sinking

- Sinking sledge-hammer or a shot-put
- Protecting gloves
- Something to protect your ears from the noise
- Ruler and pencil – to mark sinking circles
- A compass – to make circles

Backing

- Backing sledge-hammer
- Smoothing hammer with a soft plastic head

Marking

- Flexible ruler – to measure the notes along the surface and the rim
- Note templates
- Pen, preferably an overhead marker to stick to the drum surface

Grooving

- Punch
- Grooving hammer

Cutting

- Marking stick or ruler
- Electric hacksaw or cutlass
- Plate shears and a file – for trimming

Tempering

- Fireplace of some kind
- Clock – for timing
- Brush, soap and water – to clean the pan

Tuning

- Tuning hammers
- Bending iron and a cutlass – to raise the outer notes, or
- Wooden wedges – specially shaped to raise the outer notes
- Wooden stick to raise the notes of basses.
- Tuning stick
- Padded stand or a truck tyre – to put the pan on while tuning
- A tuned instrument – as reference while tuning
- Drill – to make holes for strings
- Electronic tuning device – for fine tuning
- A sticky or magnetic sheet – to damp interfering notes

Fig. B.1 Main part of the tools needed for panmaking.

SINKING SLEDGE-HAMMER

The sinking sledge-hammer is a small 2.5-3 kg. sledge-hammer with the handle cut-off at approximately 22 cm. The handle is cut off to enable you to reach down in the sink with the head perpendicular to the concave surface. The end of the handle is cut at an angle to make it longer, so you can work with both hands, see figure B.2. The head must be well rounded off, preferably with a convex shape that matches the concave surface of the sunk pan.

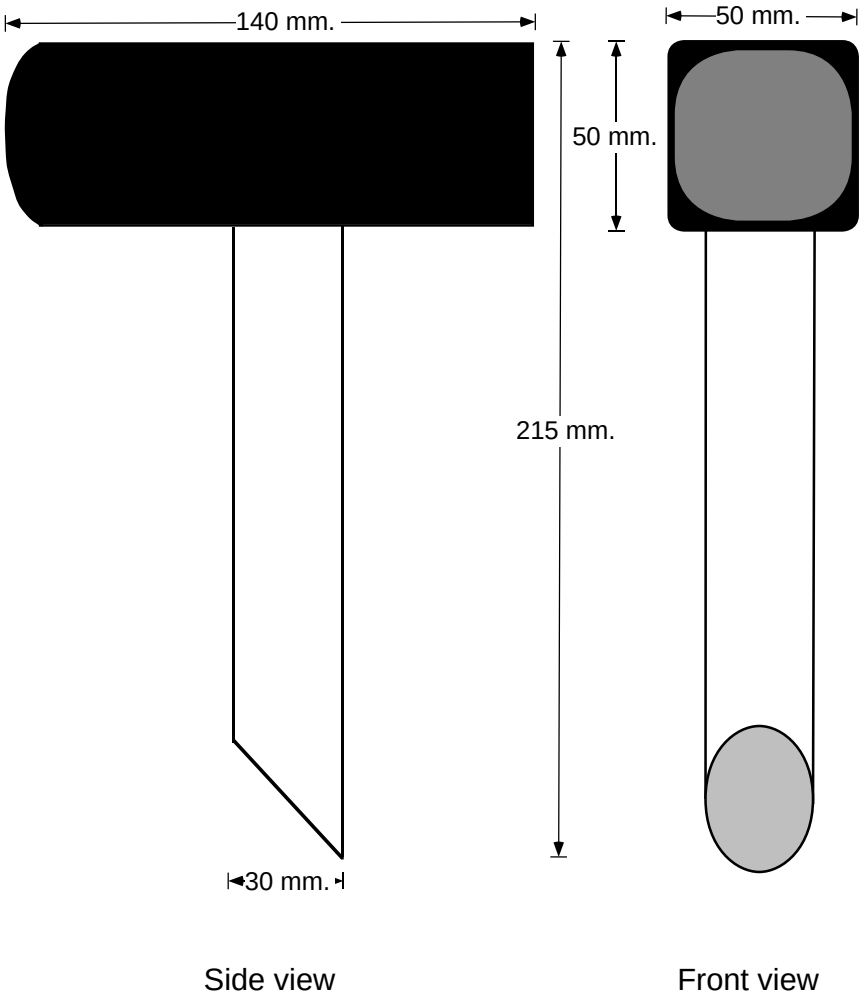


Fig. B.2 Sinking hammer seen from side and front, 50% of actual size.

SHOT-PUT

A common tool for the sinking work is a shot-put (or a cannon ball) of smooth, solid iron. The weight should be about 5 kg and the diameter approx. 11 cm, see fig. B.3. As in the case with the hammer, it is very important that the surface is smooth. A raw surface of cast iron will make marks in the metal that may cause cracks later.

Fig. B.3 Shot-put.

BACKING HAMMER

The backing hammer is almost the same rounded-off sledge-hammer as the sinking hammer, but the handle here is shortened down to 16 cm, to make it possible reach down and work on the notes in the sunk pan. The weight should be 2-2.5 kg and the head has to be well rounded off and very smooth.

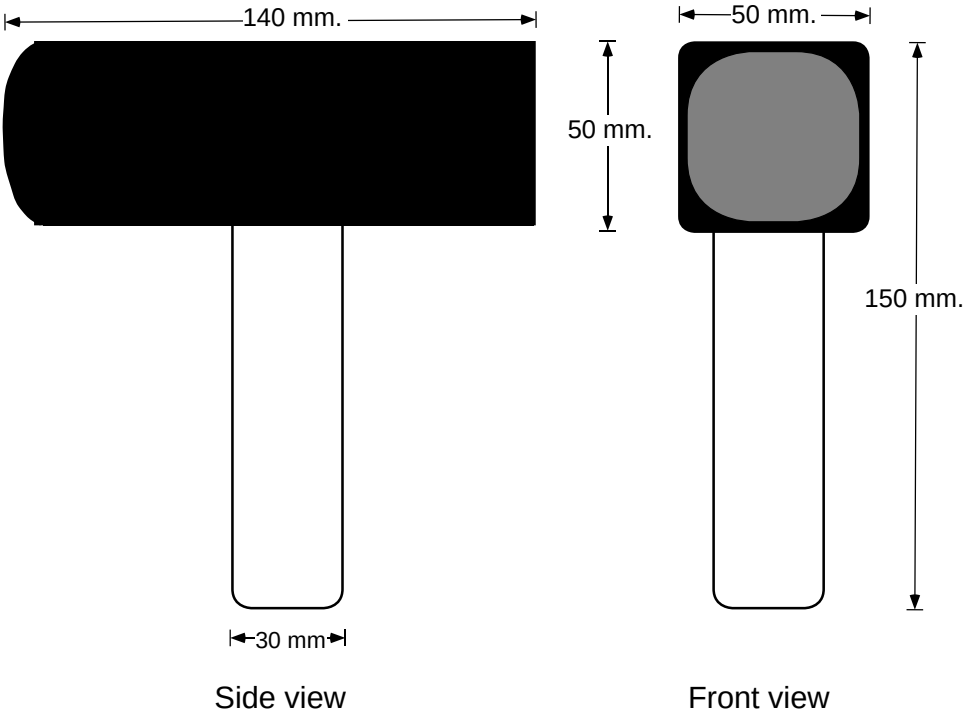


Fig. B.4 Backing hammer seen from side and front, 50% of actual size.

PUNCH

The punch used for grooving should be approximately 10 cm long and have a head diameter of 4-7 mm. The best way to make an appropriate punch is to take an ordinary nail-punch and cut it down to the right length. The head diameter is usually smaller for the higher pans and larger for basses and other low pans. Some tuners also use different punches for different notes in the same pan – for example 4 mm for inner notes and 5.5 mm for outer notes.

It is important that the punch is short enough so you can rest your hand on the surface while using it and still have good control over the upper end. The head should have a rather sharp edge to make distinct marks in the metal.

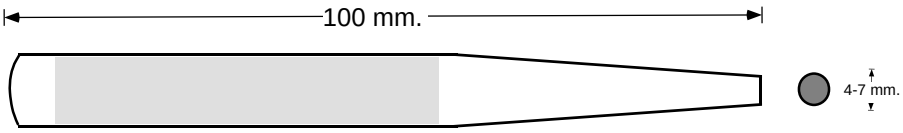


Fig. B.5 Punch seen from side and front, actual size.

GROOVING HAMMER

The grooving hammer is an ordinary hammer, weight about 0.5 kg, with a cut handle. The length of the handle is preferably 18-19 cm. It is very important that the head is tightly fastened to the handle, so choose a hammer of good quality. If the head jolts it will be difficult to control the strokes.

SMOOTHING HAMMER

If you do any separate smoothing, a suitable smoothing hammer is a small club with soft plastic heads. The handle should be cut of at the same length as the backing hammer, i.e., approx. 17 cm. This hammer is also usable for the tuning of medium-sized notes. The weight should be approx. 0.3 kg.

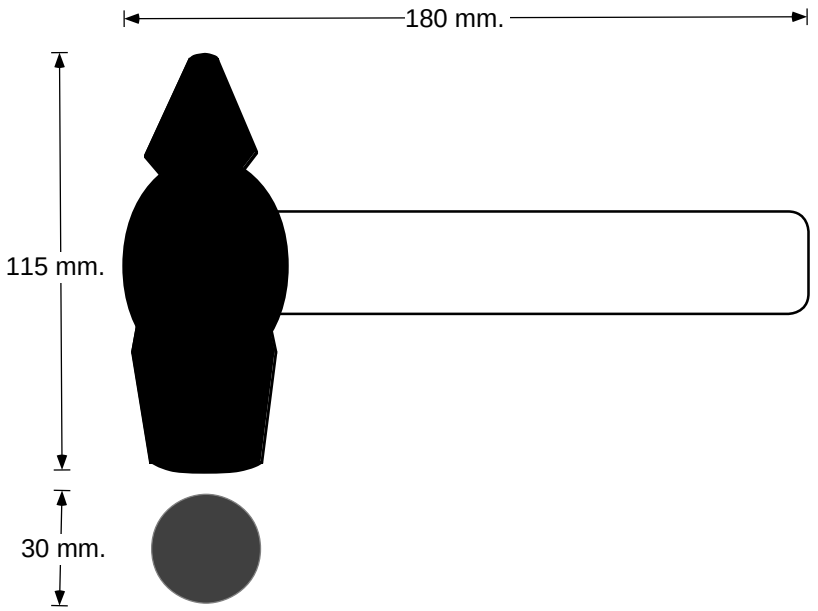


Fig. B.6 Grooving hammer seen from side and head front. 50% of actual size.

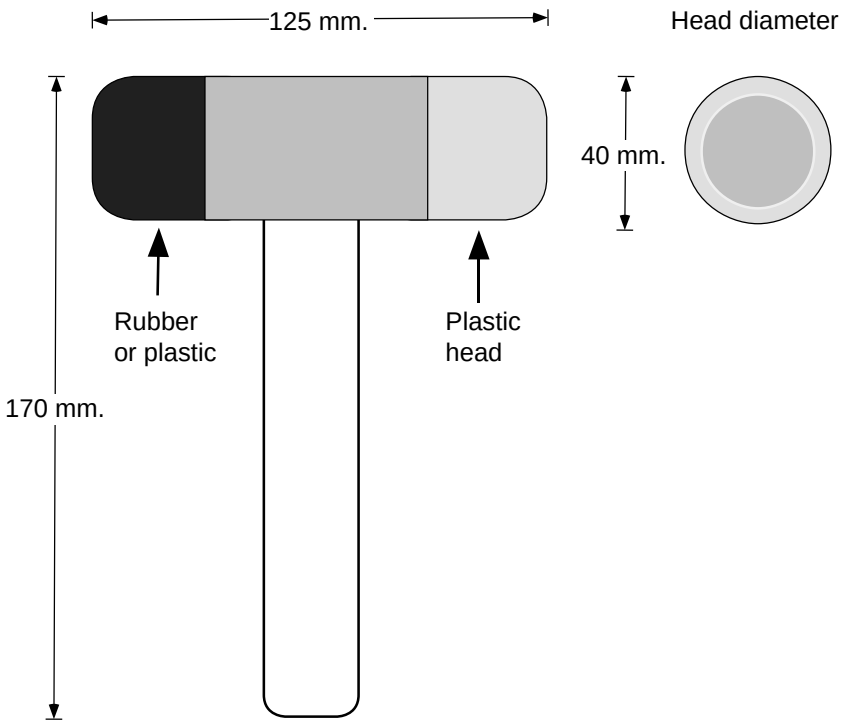


Fig. B.7 Smoothing / tuning hammer seen from side and head front. 50% of actual size.

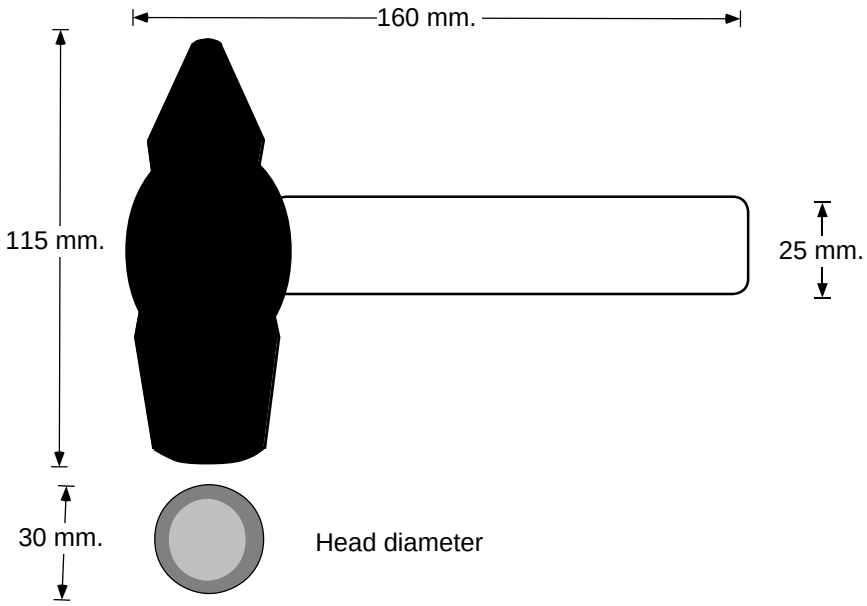


Fig. B.8 Tuning hammer for small notes.

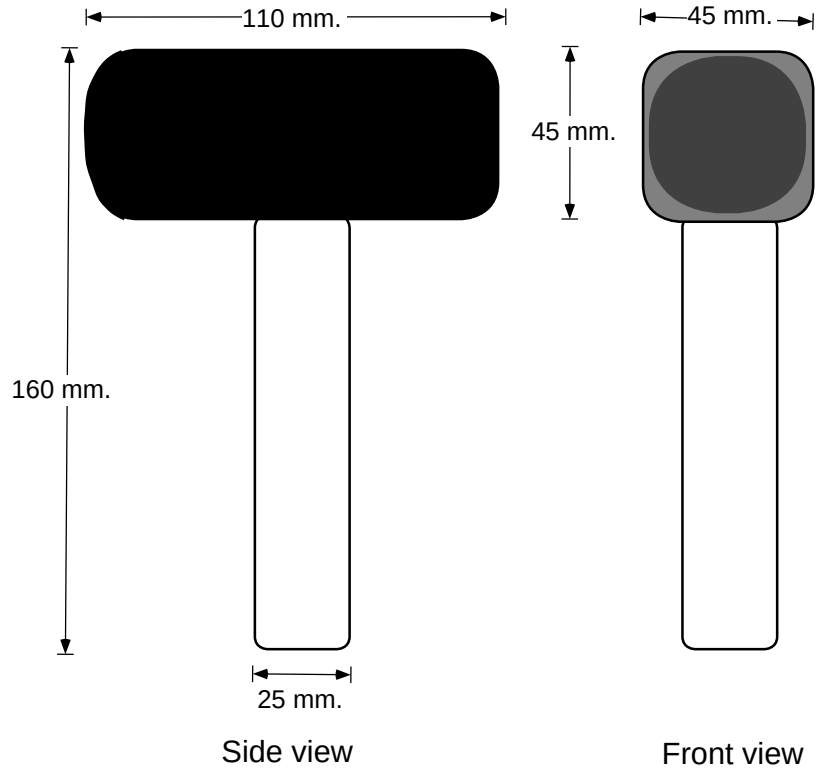


Fig. B.9 Tuning hammer for large notes.

Fig. B.10 A collection of hammers used by tuner Lawrence Mayers. Left to right: Small tuning/smoothing hammer, large tuning hammer, punch together with grooving hammer (also used for tuning of the smallest notes), backing hammer and shot-put. *Photograph by Linus Torell.*

TUNING HAMMERS

The hammers covering the needs for the tuning of the whole range of steel pans should preferably be a set of three; a small steel hammer for the smallest notes in tenors and double tenors, the plastic smoothing club, described as smoothing hammer above, for the medium sized notes, and a large, 1.5 kg hammer for the large notes of guitars and basses. The small steel hammer may actually be the same hammer as the one you do the grooving with, but the head should be smoothed if it is used for tuning.

BENDING IRON

When you tune the outer notes of tenors, double tenors and double seconds it can be difficult to hit on the inside of the pan with the tuning hammer, because of the great slope of the sink. To raise the outer notes a bending iron can be used instead of the hammer.

The bending iron looks similar to an ordinary crowbar. It is important that the iron has the right shape and is well rounded off at the top to avoid marks in the side of the pan. Sometimes the blade of a cutlass is used to protect the skirt while bending with the iron. The length of the iron should be about 35 cm.

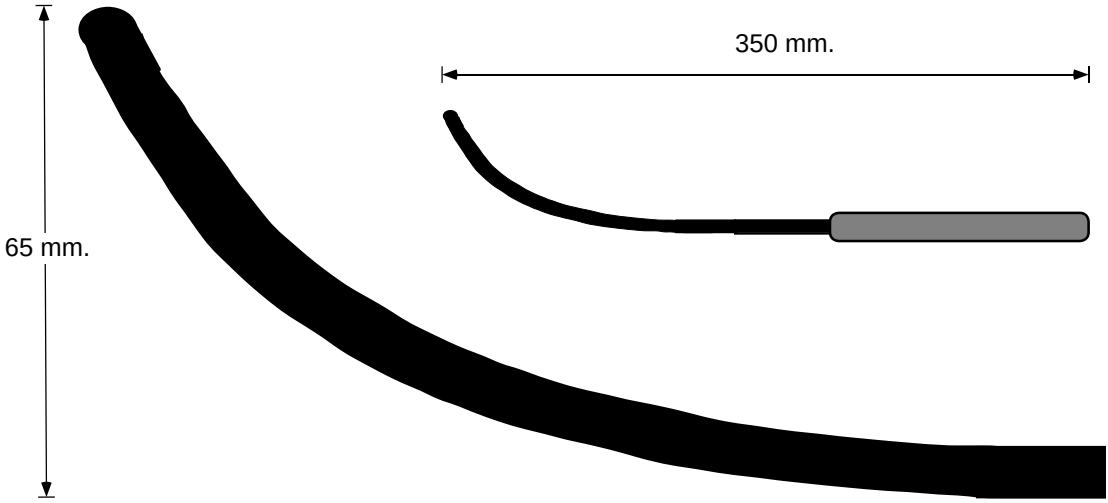


Fig. B.11 Shape of the curved part of the bending iron. Actual size.

WEDGES TO RAISE NOTES

Instead of an iron, wooden wedges can be used to raise outer notes. This is done by resting the wedge against the skirt and then hammering on the top of it to force the surface to re-shape.

TUNING STICK

The tuning stick is usually an ordinary stick used for the pan to be tuned. But sometimes it can be beneficial to use a stick that is a bit harder and heavier than the ordinary one. A harder stick will generate more harmonics and make it easier to tune. The extra weight makes it possible to check the pitch stability of the notes and even to do minor adjustments of the pitch with hard strokes. This means that the stick has to be heavier than any stick used while playing and the test or tuning stroke has to be harder than any playing stroke, otherwise the pan will later go out of tune while playing.

For the lower pans you will need a soft, ordinary stick so as not to get confused by the large amount of harmonics produced by a hard stick.

TUNING DEVICE

When you get to the later part of the tuning, an electronic tuning device is needed determine the exact pitch of the note. There are several good tuning devices on the market, but when you chose one, you should make sure that it has a tonal working range that is large

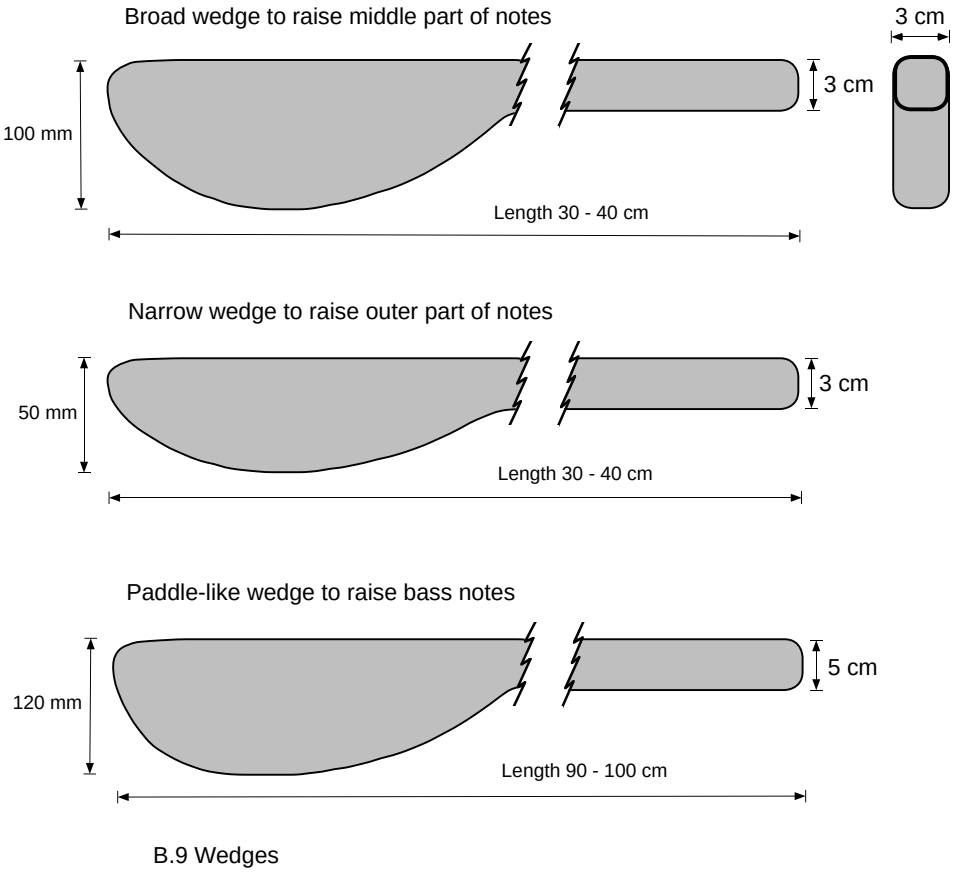


Fig. B.12 Wooden wedges used to raise notes.

enough to cover the whole steel pan ensemble. The notes in the bass range will cause most problems.

Devices for tuning of pianos will be sufficient as the piano covers a tonal range that is bigger than the steel pan ensemble. Devices designed for the tuning of guitars are usually no good, because the range is too small and it usually has pre-sets for the pitches of the guitar strings.

Tuner Rudy Smith uses a KORG DT-1 tuning device, and I use a KORG DT-2 (1991). This small tuning device covers the whole steel pan range and it is good at calculating the pitches, but it is rather expensive.

C. Measures for sticks

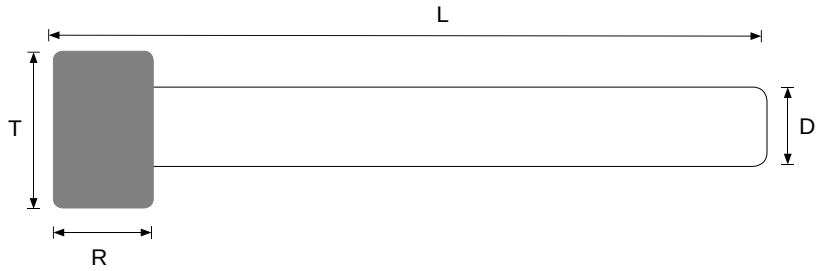


Fig. C.1 Definition of stick measures.

Steelpan model	L – Length	S – Stick diam.	T – Tip diam.	R – Rubber length
Tenor	150-180	11-13	15-17	15-20
Double tenor	170-200	11-13	18-20	15-20
Double second	170-200	11-13	19-22	18-25
Quadrophonic pan	180-220	12-14	20-24	20-25
Four pan	180-220	12-14	22-28	25-30
Double guitar	180-220	12-14	24-30	25-30
Triple cello	200-240	12-14	24-30	25-30
Tenor bass	300-350	12-15	ball, diam. 60-70	
Six bass	300-350	12-15	ball, diam. 60-70	
Nine bass	300-350	12-15	ball, diam. 60-70	

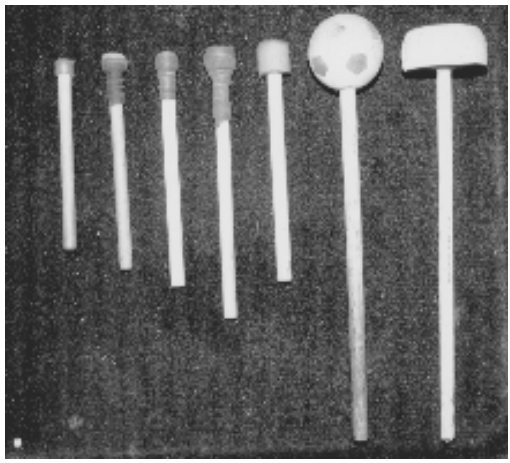


Fig. C.2 Examples of sticks of various types.

D. Steel drums for panmaking

Drums used for steel pan making are ordinary 55-gallon drums according to the standard ASA MH 2.1 or 2.2. The exact measures (according to the Swedish standard SIS 846201) are the following: internal diameter 571 mm, external diameter 595 mm (23 inches), height 840 mm (24.8 inches). The volume is 208 litres, which equals 45.8 Imperial gallons or 55 U.S. gallons, respectively.

The metal in the bottom is usually 1.0 or 1.2 mm thick. Below is a list of combinations of metal thickness in top/bottom and side and the corresponding weight of the drum. The weight might be used as a clue to the thickness of the metal.

THICKNESS <-> WEIGHT TABLE

Thickness side	Thickness top / bottom	Approx. weight
0.8 mm	1.0 mm	15 kg
1.0 mm	1.0 mm	18 kg
1.0 mm	1.2 mm	19 kg
1.2 mm	1.2 mm	22 kg

The best steel pans are probably made from drums with 1.2 mm steel in the bottom and 1.0 mm in the side, that is; 18/20 gauge. The bottom should not be less than 1.2 mm thick. A side that is 1.2 mm thick instead of 1.0 mm makes the pan a bit heavier but is acoustically acceptable.

CONVERSION TABLE; MM <–> GAUGE:

mm	gauge
1.0 mm	20 gauge
1.2 mm	18 gauge
1.4 mm	17 gauge

E. Definitions of vocabulary

THE INSTRUMENT

In this book I have chosen to use the term *Steel Pan*, or just *Pan* for short, referring to the whole instrument, regardless of whether it consists of one or several steel *drums* . A proposed Trinidad & Tobago standard also suggests that the instrument is called Steel Pan.

Outside Trinidad the name "Steel Drum" is often used. It is now due time that this name is eradicated, since it mainly refers to the raw material of the pan, thus implying that performance is made on raw, un-crafted drums. In recognition of the highly developed handicraft work in tuning, the notion that the pan is crafted can be stressed by consistently using the term steel pan for the instrument.

The proposed Trinidad & Tobago standard also suggests a short and precise *definition* of the instrument that is to be called steel pan (Ad Hoc Spec. Comm., 1989):

"A percussion instrument in the idiophone class, traditionally made from the unstoppered end and part of the wall of a metallic drum. The metallic playing surface is concaved with a skirt attached. The playing surface is divided into convex section by grooves, channels and/or bores; each section is a note tuned into a definite pitch. The convex sections are struck with pan sticks to produce musical tones."

NAMES OF THE STEEL PAN MODELS

The naming of the various pan models is a bit problematic. New names are introduced together with new or altered pan models. During

Trinidad common name	Trinidad proposed standard	Range name
Tenor	High tenor	Soprano
	Low tenor	C soprano
Double tenor	Double tenor	Alto
Double second	Double second	Tenor
Quadrophonic pan	Quadrophonic pan	
Four pan	Quadruple pan	
Guitar	Double guitar	
	Triple guitar	
Cello	Triple cello	Baritone
Tenor bass	Tenor bass	
Six bass	Low bass	
Nine bass		

later years, a standard set of pans has evolved and their names have been relatively fixed. A Trinidad standard of naming is now being proposed, but there are still some problems with the changing models.

Outside Trinidad, the names of the higher pans have sometimes been changed in an adaptation to the classical music nomenclature. The table above can be used as a "translation scheme" between the various names.

The reason for the confusion of the naming in the upper range of the steel pan family seems to be the following: In the early days of the pan the lead pan was a single drum with 8 to 10 notes, playing in the tenor range. As the tenor evolved, more notes were put in and the pitch was raised but the name remained the same.

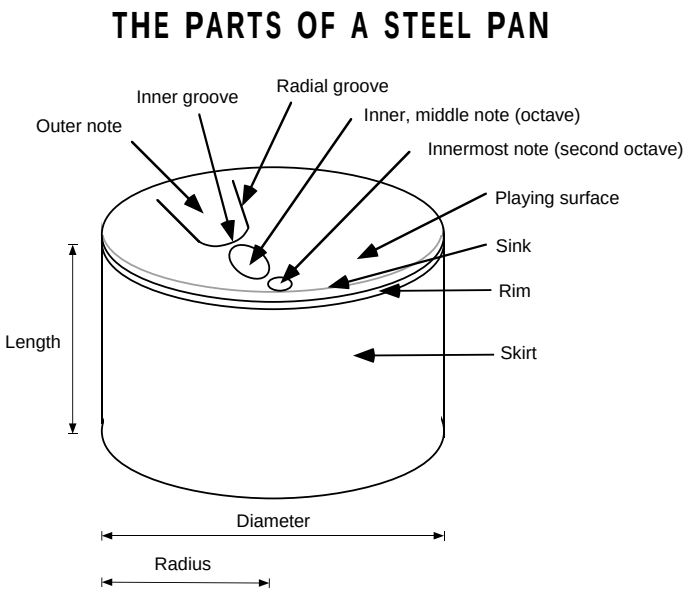


Fig. E.1 The parts of a steel pan.

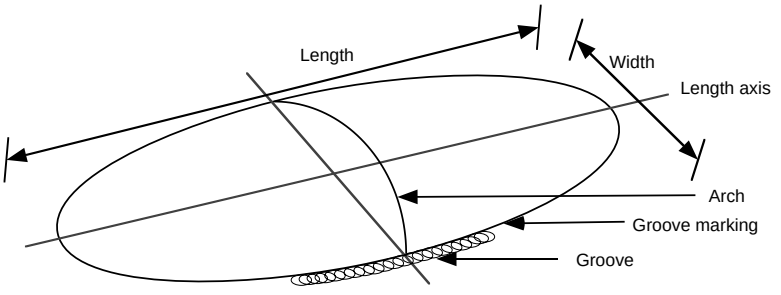


Fig. E.2 The parts of a note.

TECHNICAL TERMS

Arch The term *arch* is used to denote the vertical shape of a note dent.

Channel The area of the playing surface that is used to separate notes.

Concave Curved downwards, when seen from the top of the pan.

Convex Curved upwards, when seen from the top of the pan.

Dent The word *dent* is in this book used to describe the acoustically active areas of the steel pan. The notes are always convex, seen from the top of the pan, and could also be described using the synonymous words; bulge, dome or swelling. I have chosen to use the more technical word "dent", even if the regular use of it mostly refers to unintended, concave shapes.

Drum In this text, the word *drum* is used to denote the raw-material or the parts of a pan. This means that one *pan* can consist of several drums.

Groove An engraved line or indentation that marks the separation of notes.

Note A convex section tuned to a specific pitch.

Radial A direction along the radius of the drum, i.e., from the centre and outwards towards the rim or vice versa. Inner notes are usually oriented radially, i.e., with their length axis pointing towards the centre of the drum.

Skirt The wall of the steel drum, which acts as a resonator in the pan.

Tangential A direction along the *tangent* of the rim, i.e., following a straight line perpendicular to the radius. Outer notes are usually oriented tangentially, i.e., with their length axis pointing along the rim.

F. Names and addresses

This appendix lists some useful addresses to tuners, organisations and companies related to the steel pan.

PROFESSIONAL TUNERS

When you have tried to make your pan, failed and want a professional to do a better job for you, here is a list to make use of. This is an embryo to a list of professional tuners. Right now it contains only a few names and addresses. If you know the name and the address of a professional tuner, please report it to me, and he will be included in the next edition of the handbook.

Here are the addresses to the three tuners who have been involved in the research preceding the production of this book:

Rudy Smith, Parmagade 35, DK-2300 Copenhagen, DENMARK.

Lawrence 'Egar' Mayers, Sparrow Drive, Simeon Road, Petit Valley, TRINIDAD & TOBAGO

Denzil Fernandez, 5 Bank Hill Road, St. Francois Valley Road, Belmont, Port-of-Spain, TRINIDAD & TOBAGO

The names following below is an alphabetical list of respected tuners in Trinidad & Tobago that I have heard of, but of whose addresses I only have been able to get Jimmi Phillip's yet. It should be possible to reach the rest of the tuners through Pan Trinbago (see address below).

Jimmi Phillip, Pan Workshop, Caroni Savannah Road, Charaguanas. TRINIDAD & TOBAGO

Stephen Aaron, Clifford Alfred, Patric Arnold, Wallace Austin, Leslie Bernard, Herman Brown, Felix Clark, Leo Coker, Joseph Collymore, Michael Cupidore, Vernon Dennis, Lennox Fortune, Lloyd Gay, Reynold Gillies, Roland Harrigin, Rolan Inniss, David Isaac, James Jackman, Norman James, Albert John, Michael John, Alwin

Jordan, Andrew Joseph, Bertram Kellman, Lennox Lewis, Michael Lindsay, Carlton Lynch, Vernon Manette, Bertrand Marshall, Andrew Morris, Lincoln Noel, Kenrick Parmell, Edward Peters, Augustus Peterson, Michael Phillips, Kelvin St. Rose, Youis Smith, Frank Stanisclaus, Aaron Thomas, Bertram Thomas, Leroy Thomas, Wilfred Thompson, Calvin Whyte, Patrick Worrell, and Barry Yates

ORGANISATIONS

Pan Trinbago – Steelband Association of Trinidad and Tobago
47 Edward Street
Port of Spain
TRINIDAD & TOBAGO
Assistant secretary: Mr. Richard Forteau

CARIRI – Carribean Industrial Research Institute
Tunapuna Post Office
TRINIDAD & TOBAGO

Trinidad and Tobago Bureau of Standards
Century Drive
Trincity Industrial Estate
Macoya, Tunapuna
P.O. Box 467
TRINIDAD & TOBAGO
Phone: 662-4482

COMPANIES

MIC – Metal Industries Company Ltd.
Company working with industrial maufacturing of steel pans.

Metal Industries Company Ltd.
Century Drive, Trincity
TRINIDAD & TOBAGO
Phone: 809 663-1274; 663-1279; 663-1269; 663-8479
Fax: 809 663-6055

Lincoln Enterprises Ltd.
A company selling steel pans and acessories.

Lincoln Enterprises Ltd.
68 Ariapita Avenue
Woodbrook
Port-of Spain
TRINIDAD & TOBAGO
Phone: 625-5806; 674-7131