

Siku (Zampoña)

Print Packet — Build Reference · v4.3 · 2026-05-08

Quick Reference

Parameter	Value
Tube length formula	$L_{\text{calc}} = 13552 / (4 \times f_{\text{hz}}) - 0.82 \times \text{bore_ID}$
Trim allowance	$L_{\text{cut}} = L_{\text{calc}} + 3/16" (0.1875")$
Speed of sound	13,552 in/s at 68°F
Tuning standard	A4 = 440 Hz, equal temperament
End correction	$0.82 \times \text{bore_ID}$ (empirical)
Pipe type	Stopped cylindrical; odd harmonics only (1f, 3f, 5f...)

Toyo — Bass · G3 root · bore 0.750" · OD 1.000"

Frame width: 13.750" · Pocket pitch: 1.063" C-C · Pocket width: 0.995"

Tube ID	Rank	Note	Hz	L_calc (in)	L_cut (in)
T-A1	Arka	G3	196.00	22.459	22.646
T-I1	Ira	A3	220.00	19.958	20.146
T-A2	Arka	B3	246.94	17.742	17.929
T-I2	Ira	C4	261.63	16.709	16.896
T-A3	Arka	D4	293.66	14.820	15.007
T-I3	Ira	E4	329.63	13.139	13.327
T-A4	Arka	F4	349.23	12.378	12.565
T-I4	Ira	G4	392.00	10.979	11.166
T-A5	Arka	A4	440.00	9.629	9.817
T-I5	Ira	B4	493.88	8.546	8.733
T-A6	Arka	C5	523.25	8.054	8.242
T-I6	Ira	D5	587.33	7.128	7.315
T-A7	Arka	E5	659.26	6.267	6.455

Zanka — Tenor · C4 root · bore 0.625" · OD 0.821" ← PRIMARY BUILD

Frame width: 11.423" · Pocket pitch: 0.884" C-C · Pocket width: 0.816"

Tube ID	Rank	Note	Hz	L_calc (in)	L_cut (in)
Z-A1	Arka	G3	196.00	16.961	17.148
Z-I1	Ira	A3	220.00	15.076	15.264
Z-A2	Arka	B3	246.94	13.395	13.582
Z-I2	Ira	C4	261.63	12.620	12.807
Z-A3	Arka	D4	293.66	11.157	11.344
Z-I3	Ira	E4	329.63	9.878	10.065
Z-A4	Arka	F4	349.23	9.292	9.479
Z-I4	Ira	G4	392.00	8.231	8.418
Z-A5	Arka	A4	440.00	7.188	7.375
Z-I5	Ira	B4	493.88	6.447	6.635
Z-A6	Arka	C5	523.25	6.060	6.247
Z-I6	Ira	D5	587.33	5.328	5.516
Z-A7	Arka	E5	659.26	4.627	4.814

Malta — Alto · G4 root · bore 0.500" · OD 0.658"

Frame width: 9.304" · Pocket pitch: 0.721" C-C · Pocket width: 0.653"

Tube ID	Rank	Note	Hz	L_calc (in)	L_cut (in)
M-A1	Arka	G4	392.00	7.565	7.752
M-I1	Ira	A4	440.00	6.728	6.915
M-A2	Arka	B4	493.88	5.971	6.158
M-I2	Ira	C5	523.25	5.638	5.826
M-A3	Arka	D5	587.33	4.978	5.165
M-I3	Ira	E5	659.26	4.389	4.576
M-A4	Arka	F5	698.46	4.144	4.332
M-I4	Ira	G5	783.99	3.624	3.811
M-A5	Arka	A5	880.00	3.214	3.401
M-I5	Ira	B5	987.77	2.823	3.010
M-A6	Arka	C6	1046.50	2.669	2.857
M-I6	Ira	D6	1174.66	2.339	2.526
M-A7	Arka	E6	1318.51	2.074	2.261

Chili — Soprano · A4 root · bore 0.375" · OD 0.493"

Frame width: 7.159" · Pocket pitch: 0.556" C-C · Pocket width: 0.488"

Tube ID	Rank	Note	Hz	L_calc (in)	L_cut (in)
C-A1	Arka	A4	440.00	7.565	7.752
C-I1	Ira	B4	493.88	6.728	6.915
C-A2	Arka	C#5	554.37	5.971	6.158
C-I2	Ira	D5	587.33	5.638	5.826
C-A3	Arka	E5	659.26	4.978	5.165
C-I3	Ira	F#5	739.99	4.389	4.576
C-A4	Arka	G5	783.99	4.144	4.332
C-I4	Ira	A5	880.00	3.624	3.811
C-A5	Arka	B5	987.77	3.214	3.401
C-I5	Ira	C#6	1108.73	2.823	3.010
C-A6	Arka	D6	1174.66	2.669	2.857
C-I6	Ira	E6	1318.51	2.339	2.526
C-A7	Arka	F#6	1479.98	1.982	2.170

WARNING: C-A7 (F#6, L_cut = 2.170") is at the practical playability limit. Prototype before committing production stock. Consider building Chili as 11 tubes (omit C-A7 and C-I6). See risks.md AC-04.

CNC Rail Pocket Parameters

Member	OD (in)	Pocket Width	Pocket Depth	Pocket Pitch	First Center	# Pockets
Toyo	1.000	0.995	0.333	1.063	0.500	13
Zanka	0.821	0.816	0.274	0.884	0.411	13
Malta	0.658	0.653	0.219	0.721	0.329	13
Chili	0.493	0.488	0.164	0.556	0.247	13

Pocket depth = OD/3 · Pocket pitch = OD + 1/16" · Z0 = top of stock

Sealing Stand Parameters

Member	Plug Depth	Stand Hole Diam.	Stand Size	Material
Toyo	3/8"	1.010"	6" x 14"	3/4" plywood
Zanka	3/8"	0.831"	5" x 12"	3/4" plywood
Malta	1/4"	0.668"	4" x 10"	1/2" plywood
Chili	1/4"	0.503"	3" x 8"	1/2" plywood

Pour beeswax at 160°F. Allow 30 min cure. Stand hole = tube OD + 0.010" clearance.

Tuning Acceptance Criteria

Metric	Criterion
Pitch tolerance	±5 cents of target frequency
Maximum trim	No more than 3/16" below L_calc (scrap if exceeded)
Environment	Tune and trim at same temperature
Reference	A4 = 440 Hz on calibrated chromatic tuner

Assembly Checklist (Zanka)

- [] Bore ID verified within +0.000" / -0.010" of target for all tubes
- [] All 13 tubes cut to L_cut lengths from this packet; labeled with tube ID and note name
- [] Story stick built and verified against cut-list.csv before first cut
- [] Sealing stand built (13 holes at 0.831" dia, spaced 0.884" C-C)
- [] Beeswax plugs poured (3/8" depth) and fully cured (30 min minimum)
- [] First-pass tuning complete; all deviations recorded in validation.csv
- [] Frame rails milled; first pocket width verified with calipers before batch routing
- [] Dry-fit assembly confirmed; all 13 tubes seat in pockets without forcing
- [] Cord binding complete; 3+ wraps per tube; square-knot finish at both rail ends

- [] Final tuning: all 13 tubes within ± 5 cents of target; validation.csv updated
- [] Rails finished with Danish oil; bamboo tubes wiped with tung oil
- [] Photos taken per photo-shotlist.md

Tube lengths above are L_cut values (include 3/16" trim allowance). Never cut shorter than L_calc. Keep validation.csv open during the build and record measured_hz after each tuning pass. See resources.md before writing any public-facing documentation about this instrument.

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