Sambuca — Shop Packet (Print Edition)

Build target: SAM-13-ROOT — 650 mm boat-shaped arched harp, 13 strings, G-major. **Status:** private review (pending three release gates). **Packet version:** instrument-maker-v4, generated 2026-05-16.

> *This is the printable shop packet. Take it to the bench. Cross-reference back to the live files in the repo when in doubt.*

File map (one-page reference)

File	Purpose	Take to bench?
`design.md`	Design intent, fingerprint, soundhole strategy, cultural provenance	reference only
`reverse-engineering.md`	Source-material analysis	reference only
`family-spec.csv`	5-variant table	reference only
`risks.md`	Red-team risk register with verification tests	check before each stage
`bom.csv`	Make/buy materials and hardware	yes — ordering
`sourcing.csv`	Candidate suppliers, planning prices	yes — ordering
`cut-list.csv`	Rough and final dimensions for every cut	**yes — bench**
`validation.csv`	Dimensional, tension, acoustic, joint, safety, cultural checks	**yes — bench**
`assembly-manual.md`	12-stage build sequence with hold points	**yes — bench**
`supplier-rfq.md`	RFQ drafts to send out	yes — ordering
`drawing-brief.md`	Drawing-package spec	reference only
`cad/SAM-000_master-equations.txt`	Global equations (source of truth)	reference only
`cnc/cnc-plan.md`	Pre-CAM operation plan per part	**yes — bench**
`wolfram/sambuca-acoustics-starter.wl`	Acoustic study notebook	reference only
`photo-shotlist.md`	Capture list across the build	each stage
`harness/README.md`	SAM-19 + SAM-25 harness design	only for those variants
`capstone-deck.pptx`	Capstone presentation	not in shop
`site/index.html`	Build-log site (private until release)	not in shop

Design intent (one paragraph)

Modern parametric family-scalable boat-shaped arched harp that preserves the Sumerian visual fingerprint (gold-flared cap, 13 bulb pegs with cord wraps, J-curve neck, multi-strip lapis band, brass collar, bow-end inlay panel, two stern stub feet) while delivering modern playability (geared tuners hidden behind decorative caps, calibrated fluorocarbon + wound-nylon string set at 65–80 kgf, keel-port soundhole projecting forward toward the listener, CNC-machined hull/neck/inlay, kanawa-tsugi stand). Build target SAM-13-ROOT; four siblings (SAM-19-MID, SAM-25-CONCERT, SAM-13-AE, SAM-13-MULE) derive from the same MasterLayout via `body_length_mm` and `string_count`.

Cultural provenance — for the public-release language

Inspired by the Sumerian boat-shaped arched harp from BM 121198 (Royal Cemetery at Ur, c. 2600 BC, ~4500 years old, public domain). Not a reproduction, not a recreation of any specific surviving artifact, not a claim of cultural authority over any modern living tradition. The Hellenistic Greek *sambykē* (σαμβύκη) etymological link is historically contested; the build uses the term while acknowledging the uncertainty.

Family-spec summary

ID	Body length	Strings	Tuning	Total tension	Harness
SAM-13-ROOT	650 mm	13	G3 → E5	65–80 kgf	none
SAM-19-MID	850 mm	19	D3 → G5	~100 kgf est.	low-back belt
SAM-25-CONCERT	1050 mm	25	A2 → A5	~120 kgf est.	sax harness
SAM-13-AE	650 mm	13	G3 → E5	65–80 kgf	none + piezo
SAM-13-MULE	650 mm	13	G3 → E5 (reduced T)	40–50 kgf	none

Wood pairing (locked)

Component	Species
Hull (and stand)	Walnut — FAS quartersawn 8/4
Soundboard	Western red cedar — quartersawn AAA 3 mm (Wolfram-sweep 2.5–4.0)
Neck	Sapele — three 12 mm laminates around a curved form
String-holder strip	Walnut or hard maple
Bracing	Cedar (matches soundboard movement)

BOM summary (SAM-13-ROOT)

See full `bom.csv` for all 44 lines and per-variant deltas. Headline cost: planning estimate **$530–1300 USD** for SAM-13-ROOT, prices not live-verified.

Highest-risk supply items:

- **BOM-018** PVD-gold-tone brass bulb caps (13) — custom part, longest lead. Parallel two-shop search.
- **BOM-017** Geared guitar tuners (13) — mock-fit one sample before bulk order to verify `neck_depth_mm` clearance.
- **BOM-007** Bow-end inlay panel (mother-of-pearl or composite) — three-candidate sample compare before commit.

Sourcing summary

Spec-first table in `sourcing.csv`. Three candidate suppliers per line. **No live prices verified — confirm before ordering.**

Order in this sequence to fit the 6–10 week build:

1. Week 1: PVD bulb caps (3–5 week lead) + walnut hull stock (2–4 weeks).
2. Week 2: sapele neck stock, cedar soundboard, tuners (mock-fit first).
3. Week 3: brass collar tube, eyebolts, string sets (after Wolfram sweep).
4. Week 4: inlay materials.

Cut-list (build-target subset)

Full table in `cut-list.csv`. Highlights:

Cut ID	Part	Final dims	Material	Notes
CUT-001a or CUT-001b	Hull	650 × 150 × 150 mm, wall 6 mm	Walnut	A: CNC-from-block. B: stave-laminated. Pick one.
CUT-009 + CUT-011	Neck blank	~810 mm arc, 38 × 38–50 mm cross-section	Sapele 3-laminate	Glue → cure 48 hr → CNC sweep
CUT-005	Soundboard	650 × 150 × 3 mm	Cedar QSAAA	Final after sanding
CUT-007	String-holder strip	120 × 10 × 4 mm	Walnut or maple	Glued **after voicing** on MULE
CUT-018	Keel port	80 × 50 mm oval, 15° forward tilt	(cut from hull)	Stage 6
CUT-014	Brass collar	60 mm tall, ~1 mm wall	Brass tube	Aged or polished per R-F-02
CUT-023	Multi-strip lapis inlay pocket	5 × 1.5 mm strips + 4 × 0.8 mm spacers	(route in soundboard)	0.8 mm end mill
CUT-026	Bow-end inlay panel pocket	100 × 60 × 1.5 mm	(route in soundboard)	Per `bow_panel_x_from_stern_mm`

Drawing brief callout

Minimum drawings required for the Fall 2026 capstone (see `drawing-brief.md` for the full 22-sheet list):

- Sheet 01 — Overview front
- Sheet 02 — Overview side (shows bow lift + keel port)
- Sheet 10 — Soundboard inlay program
- Sheet 18 — Family overview

Source of truth: `cad/SAM-000_master-equations.txt`. SVGs are generated from SolidWorks once the rebuild per `cad/SW-MIGRATION-CHECKLIST.md` clears.

Assembly stages (one-line summary each)

#	Stage	Hold?	Critical risk
0	Pre-build (sourcing, fixtures, tuner mock-fit)	yes — R-X-04 mock-fit before cutting stock	—
1	Hull (Path A or Path B)	yes — wall thickness verified	R-S-04
2	Neck blank (laminate + CNC sweep)	yes — scarf cut clean	R-S-01
3	Soundboard (3 mm cedar, fan brace, inlay pockets cut not filled)	yes	R-F-01
4	Hull seam scarf + brass collar	**yes — V-J-01 at 24h and 48h**	R-S-01
5	Soundboard installation + inlay filling	yes	—
6	Keel port cut	yes — V-S-03 decision	R-S-03
7	Stand (CNC-curve + kanawa-tsugi)	parallel	—
8	Tuners + cord wraps + bulb caps	yes — fingerprint complete	—
9	String-holder strip + prototype voicing on MULE	**yes — V-A-05 voicing decision**	R-A-01
10	MULE 30-day hold + ROOT gradual stringing	**GATE — V-S-01 + V-T-02**	R-S-01 + R-S-04
11	Final voicing + acoustic measurement	yes — V-A-01	R-A-01
12	Documentation + brand integration	yes — V-C-01 + V-B-01	R-C-01

> *Full manual at `assembly-manual.md`. Read it before starting.*

Validation / tuning sheet (printable)

Full table in `validation.csv`. Bench-side highlights:

Dimensional checks (V-D-01 through V-D-14)

- [ ] Body length 650 ± 2 mm
- [ ] Body width 150 ± 2 mm
- [ ] Body depth 140–170 mm
- [ ] Instrument height 810 ± 5 mm
- [ ] Hull-wall thickness 6 ± 0.5 mm at midship, bow, stern
- [ ] Neck arc 710 ± 5 mm
- [ ] Brass collar 60 ± 1 mm
- [ ] String-holder strip 120 × 10 × 4 mm
- [ ] Tie-through holes 13, ±0.3 mm spacing, Φ1.5 mm
- [ ] Multi-strip lapis band 11–13 mm total width
- [ ] Bow-end inlay panel 100 × 60 × 1.5 mm pocket
- [ ] Keel port 80 × 50 mm, 12–18° forward tilt

Structural checks (V-S-01 through V-S-05)

- [ ] SAM-13-MULE 30-day neck-deflection ≤ 2 mm at gold cap
- [ ] Brass collar gap monitor ≤ 0.3 mm over a season
- [ ] Soundboard pull-test holds 2× service load
- [ ] Stern eyebolt holds 30 kgf for 60 s (SAM-19/25/AE only)
- [ ] Keel-port keel deflection ≤ 1.5× unported case

Tension checks (V-T-01 through V-T-04)

- [ ] MULE total 40–50 kgf
- [ ] ROOT total 65–80 kgf (calibrated)
- [ ] ROOT 30-day tension drift < 10%

Acoustic checks (V-A-01 through V-A-05)

- [ ] SPL at 1 m within ±6 dB of Wolfram prediction
- [ ] Coupled cavity-plate pair signature (two peaks split 30–80 Hz)
- [ ] Tuning drift < ±10 cents per string at 24 hr
- [ ] Keel-port Helmholtz 128–158 Hz
- [ ] String-holder strip position locked after voicing

Cultural + brand gates (V-C-01 through V-B-02)

- [ ] Cultural-advisor sign-off on provenance language
- [ ] Every BM 121198 and cylinder-seal image credited
- [ ] Heifer Zephyr placement option locked

Supplier-RFQ summary

Send these RFQs in week 1. Full drafts in `supplier-rfq.md`.

RFQ	To	Items
RFQ-1	Wood supplier	Walnut hull stock, walnut 12/4 base, cedar soundboard (2.5 + 3.0 mm), sapele neck stock, cherry brace stock, holly/maple spacer veneer
RFQ-2	Brass/stainless supplier	Brass tube for collar (×2 for spare), stainless dowel pins, stainless eyebolts, brass rod for cap turning
RFQ-3	String supplier	Set A (G-major calibrated, 13 strings), Set B (A-major drop-in), Set C (MULE reduced tension)
RFQ-4	Tuner supplier + PVD finisher	13 compact-housing geared tuners + 13 PVD-gold-tone bulb caps (custom-machined or sourced)
RFQ-5	Inlay supplier	Dyed-blue veneer (5 strips × 3 m), holly/maple spacer, MOP/shell composite panel (3 samples for compare), brand inlay stock
RFQ-6	Harness supplier	Low-back belt + locking hook (SAM-19), sax harness + locking hook (SAM-25)
RFQ-7	Electronics supplier	Under-strip piezo + 1/4" jack + wiring (SAM-13-AE only)

Visual BOM brief

One-page visual BOM lives in `visual-bom-brief.md` plus the rendered visual (placeholder until the photo set is captured). Print last, when the SAM-13-ROOT is finished and photographed.

Appendix — risks worth a second look before each stage

- **R-S-01 Neck cantilever failure** — *the* single highest risk. Hold the MULE for the full 30 days before stringing the ROOT.
- **R-S-04 Soundboard collapse** — pull-test the string-holder-strip glue line on scrap cedar before mounting the production strip.
- **R-S-05 Eyebolt pull-through** — only matters for SAM-19/25/AE, but it's a safety gate when it does.
- **R-A-01 Quiet voice on SAM-13-ROOT** — the small 3.8 L cavity is the chronic concern. Wolfram-sweep before committing soundboard thickness; iterate on MULE.
- **R-C-01 Cultural-advisor review** — public-release gate. Submit the provenance language early; don't wait until Stage 12.
- **R-X-03 PVD bulb caps** — longest-lead supply item. Order in week 1.

Public-release gate checklist (final page)

- [ ] V-S-01 SAM-13-MULE neck-deflection 30-day hold passed
- [ ] V-T-02 SAM-13-ROOT calibrated-tension target hit (65–80 kgf)
- [ ] V-C-01 Cultural-provenance advisor review signed off
- [ ] V-B-01 Heifer Zephyr placement option locked (A soundboard or B stand)
- [ ] R-S-05 SAM-25 eyebolt pull-test passed (if SAM-25 in release scope)
- [ ] All `validation.csv` cultural-category rows closed (V-C-01, V-C-02, V-C-03)
- [ ] `site/index.html` private-review banner removed
- [ ] `README.md` updated to public-release language
- [ ] License files in place (CERN-OHL-W-2.0 for design, CC-BY-4.0 for content)

Tony Koop · Heifer Zephyr · Sambuca SAM-13-ROOT · Fall 2026 capstone · private review