

CAJÓN FAMILY

Printable Shop Packet — v1

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Three-member family · four manufacturing variants · optional snare

First prototype: Standard (CJ-S), V1 finger-joint, snare option B

File map

File	Purpose
design.md	Governing physics, family scaling, critical dims, open assumptions
bom.csv	Bill of materials by variant
sourcing.csv	Suppliers, lead times, prices
cut-list.csv	Operation-by-operation cut data
validation.csv	Predicted vs measured tuning + acceptance bands
assembly-manual.md	Phase-by-phase build procedure
risks.md	Red-team failure modes (5 categories)
wolfram-starter.wl	Plate, Helmholtz, two-zone synthesis
drawings/*.svg	Dimensioned drawings
cad/cajon-master.scad	OpenSCAD parametric body
cnc/	CNC bit + feed strategies

Family table

Member	H × W × D	Hole Ø	Predicted f _H	Voice
Compact (CJ-C)	15 × 11 × 11 in	4.0 in	≈ 107 Hz	bright G \blacksquare 2/A2
Standard (CJ-S) \blacksquare	18 × 12 × 12 in	4.5 in	≈ 96 Hz	balanced G2
Bass (CJ-B)	22 × 14 × 14 in	5.0 in	≈ 77 Hz	deep D \blacksquare 2/E2

Governing physics

The cajón's bass voice is the coupling of two systems within a few semitones: the front-plate (1,1) clamped-rectangular bending mode (the tapa) and the Helmholtz cavity with the back-port sound hole. The Standard's predicted plate (1,1) is ~84 Hz; the cavity is ~96 Hz; the perceived bass is the coupled mode of both.

Helmholtz: $f_H = (c/2\pi) \cdot \sqrt{A/(V \cdot L_{\text{eff}})}$, $L_{\text{eff}} = t_{\text{back}} + 1.7 \cdot (d_{\text{hole}}/2)$

The 1.7·r end correction was absent from the original spreadsheet formula; the corrected expression is what the workbook should now use. (Risk A2 in risks.md tracks this.)

BOM (excerpt)

part_id	description	variant	member	quantity	unit	unit_cost_usd	extended_cost_usd
BODY-WALNUT-SIDE-S	Black walnut side panel, 4/4, S2S	V1+V2+V3+V4	Standard	2	each	28.00	56.00
BODY-WALNUT-TOP-S	Black walnut top panel (seat), 4/4, S2S	V1+V2+V3+V4	Standard	1	each	22.00	22.00
BODY-WALNUT-BOTTOM-S	Black walnut bottom panel, 4/4, S2S	V1+V2+V3+V4	Standard	1	each	22.00	22.00
BODY-WALNUT-SIDE-C	Black walnut side panel (Compact)	V1+V2+V3+V4	Compact	2	each	22.00	44.00
BODY-WALNUT-SIDE-B	Black walnut side panel (Bass)	V1+V2+V3+V4	Bass	2	each	38.00	76.00
BACK-PLY-S	1/2 in Baltic birch back panel	V1+V2+V3+V4	Standard	1	each	12.00	12.00
BACK-PLY-C	1/2 in Baltic birch back panel (Compact)	V1+V2+V3+V4	Compact	1	each	9.00	9.00
BACK-PLY-B	1/2 in Baltic birch back panel (Bass)	V1+V2+V3+V4	Bass	1	each	16.00	16.00
TAPA-PLY-S	Baltic birch 3 mm tapa face	V1+V2+V3+V4	Standard	1	each	8.00	8.00
TAPA-PLY-C	Baltic birch 3 mm tapa face (Compact)	V1+V2+V3+V4	Compact	1	each	7.00	7.00
TAPA-PLY-B	Baltic birch 3 mm tapa face (Bass)	V1+V2+V3+V4	Bass	1	each	10.00	10.00
INLAY-MAPLE	Hard maple inlay blank, 4/4, S2S	V1+V2+V3+V4	All	1	BdFt	12.00	12.00
INLAY-YELLOWHEART	Yellowheart inlay blank, 4/4	V1+V2+V3+V4	All	1	BdFt	18.00	18.00
INLAY-CHERRY	Cherry inlay blank, 4/4	V1+V2+V3+V4	All	1	BdFt	9.00	9.00
GLUE-BLOCK-WALNUT	Walnut triangular glue block	V1+V2+V3+V4	All	8	each	0.50	4.00
JOINT-V4-SPLINE	Maple spline stock, 1/8 in	V4	All	4	each	2.50	10.00
SNARE-GUITAR-STR	Guitar strings (steel, set of 6)	V1+V2+V3+V4	All	1	set	9.00	9.00
SNARE-TUNERS	Guitar tuner pegs, 3+3 set	V1+V2+V3+V4	All	3	each	4.50	13.50
SNARE-MOUNT-BLOCK	Maple snare mount block, angled 8-12 deg	V1+V2+V3+V4	All	1	each	3.00	3.00
SNARE-WIRE-ALT	Snare-drum wires, 13 in (option C alternative)	alt-C	All	1	each	12.00	12.00

Sourcing

part_id	supplier	supplier_url	sku_or_search	lead_time_days	moq	verified_price_date
BODY-WALNUT-SIDE-S	Bell Forest Products	bellforestproducts.com	black walnut 4/4 S2S FAS	5	1 BdFt	2026-04-15
BODY-WALNUT-TOP-S	Bell Forest Products	bellforestproducts.com	black walnut 4/4 S2S FAS	5	1 BdFt	2026-04-15
BODY-WALNUT-BOTTOM-S	Bell Forest Products	bellforestproducts.com	black walnut 4/4 S2S FAS	5	1 BdFt	2026-04-15
BODY-WALNUT-SIDE-C	Bell Forest Products	bellforestproducts.com	black walnut 4/4 S2S FAS	5	1 BdFt	2026-04-15
BODY-WALNUT-SIDE-B	Bell Forest Products	bellforestproducts.com	black walnut 4/4 S2S FAS	5	1 BdFt	2026-04-15
BACK-PLY-S	Ocooch Hardwoods	occoochhardwoods.com	Baltic birch 1/2 in BB grade 24x30	4	1	2026-04-15
BACK-PLY-C	Ocooch Hardwoods	occoochhardwoods.com	Baltic birch 1/2 in BB grade	4	1	2026-04-15
BACK-PLY-B	Ocooch Hardwoods	occoochhardwoods.com	Baltic birch 1/2 in BB grade	4	1	2026-04-15
TAPA-PLY-S	Ocooch Hardwoods	occoochhardwoods.com	Baltic birch 3 mm BB or BB/B	4	1	2026-04-15
TAPA-PLY-C	Ocooch Hardwoods	occoochhardwoods.com	Baltic birch 3 mm BB	4	1	2026-04-15
TAPA-PLY-B	Ocooch Hardwoods	occoochhardwoods.com	Baltic birch 3 mm BB	4	1	2026-04-15
INLAY-MAPLE	Bell Forest Products	bellforestproducts.com	hard maple 4/4 figured S2S	5	1 BdFt	2026-04-15
INLAY-YELLOWHEART	Cook Woods	cookwoods.com	yellowheart 4/4 turning blanks	4	1	2026-04-15
INLAY-CHERRY	Bell Forest Products	bellforestproducts.com	cherry 4/4 S2S FAS	5	1 BdFt	2026-04-15
GLUE-BLOCK-WALNUT	(shop offcut)		—	0	0	2026-04-15
JOINT-V4-SPLINE	Bell Forest Products	bellforestproducts.com	hard maple 1/8 in stock	5	1	2026-04-15
SNARE-GUITAR-STR	Sweetwater	sweetwater.com	D'Addario EJ16 acoustic guitar strings	2	1	2026-04-15
SNARE-TUNERS	Stewart-MacDonald	stewmac.com	acoustic tuner machines 3+3	4	1	2026-04-15
SNARE-MOUNT-BLOCK	(shop fabricated)		—	0	0	2026-04-15
SNARE-WIRE-ALT	Sweetwater	sweetwater.com	PureSound Custom Pro 14 in 20-strand	3	1	2026-04-15

Cut List

variant	member	operation_id	description	stock_id	qty	length_in	width_in	thickness
V1+V2+V3+V4	Standard	S-SIDE-01	Side panel rough cut, jointed both edges	black walnut 4/4 S2S	2	18.5	12.5	0.875
V1+V2+V3+V4	Standard	S-TOP-01	Top (seat) panel rough cut	black walnut 4/4 S2S	1	12.5	12.5	0.875
V1+V2+V3+V4	Standard	S-BOT-01	Bottom panel rough cut	black walnut 4/4 S2S	1	12.5	12.5	0.875
V1+V2+V3+V4	Standard	S-BACK-01	Back panel cut	Baltic birch 1/2 in	1	18.0	12.0	0.50
V1+V2+V3+V4	Standard	S-BACK-02	Sound hole, 4.5 in dia, centred L-R, 1/3 H from top	Baltic birch 1/2 in	1	n/a	n/a	n/a
V1+V2+V3+V4	Standard	S-TAPA-01	Tapa face cut to size	Baltic birch 3 mm	1	18.0	12.0	0.118
V1+V2+V3+V4	Standard	S-GB-01	Internal corner glue-blocks (8x triangular)	walnut offcut	8	17.0	1.0	1.0
V1+V2+V3+V4	Standard	S-FOOT-01	Rubber foot install	rubber 1/2 in	4	n/a	n/a	n/a
V1	Standard	S-V1-01	Finger-joint pockets, top + bottom + sides corners	machined panels	4	n/a	n/a	n/a
V2	Standard	S-V2-01	Half-blind dovetail layout, top + bottom + sides corners	machined panels	4	n/a	n/a	n/a
V3	Standard	S-V3-01	Rabbet cut, all 4 corners (top+bottom into sides)	machined panels	4	n/a	n/a	n/a
V4	Standard	S-V4-01	Miter cut at 45 deg on all corner edges	machined panels	4	n/a	n/a	n/a
V4	Standard	S-V4-02	Spline slot, 1/8 in x 0.6 in deep, 3 per corner	miter glued shell	12	n/a	n/a	n/a
V1+V2+V3+V4	Standard	S-INLAY-01	CNC inlay pocket, side panel A (mandala or geometric)	walnut side panel	1	n/a	n/a	n/a
V1+V2+V3+V4	Standard	S-INLAY-02	CNC inlay pocket, side panel B (mirrored or alternate)	walnut side panel	1	n/a	n/a	n/a
V1+V2+V3+V4	Standard	S-INLAY-03	CNC inlay pocket, back panel (rosette around sound hole)	Baltic birch back	1	n/a	n/a	n/a
V1+V2+V3+V4	Standard	S-INLAY-04	CNC inlay insert, maple, mandala	maple inlay blank	1	n/a	n/a	n/a
V1+V2+V3+V4	Standard	S-INLAY-05	CNC inlay insert, yellowheart accent	yellowheart blank	1	n/a	n/a	n/a
V1+V2+V3+V4	Standard	S-SNARE-B	Snare mount block, 8-12 deg angled face	maple offcut	1	5.0	1.0	1.0
V1+V2+V3+V4	Standard	S-FIN-01	Sand body to 220 grit	glued shell	1	n/a	n/a	n/a

Validation

member	variant	target	parameter	predicted_value	measured_value	unit	cents_error
Compact	V1	Helmholtz cavity fundamental	frequency	107		Hz	
Compact	V1	plate (1	1) mode	frequency	107		Hz
Compact	V1	coupled bass mode (perceived)	frequency	107		Hz	
Standard	V1	Helmholtz cavity fundamental	frequency	96		Hz	
Standard	V1	plate (1	1) mode	frequency	84		Hz
Standard	V1	coupled bass mode (perceived)	frequency	90		Hz	
Standard	V2	Helmholtz cavity fundamental	frequency	96		Hz	
Standard	V3	Helmholtz cavity fundamental	frequency	96		Hz	
Standard	V4	Helmholtz cavity fundamental	frequency	96		Hz	
Bass	V1	Helmholtz cavity fundamental	frequency	77		Hz	
Bass	V1	plate (1	1) mode	frequency	60		Hz
Bass	V1	coupled bass mode (perceived)	frequency	77		Hz	
Standard	V1	slap-vs-bass spectrum delta	1 kHz energy delta	5		dB	
Standard	V1	sustain T60 (bass voice)	RT decay -60 dB	0.45		seconds	
Standard	V1	snare buzz onset velocity	subjective	medium		1-5	
All	All	tapa screw torque uniformity	4-corner inch-lb	3.0		in-lb	
All	All	bearing-edge / tapa fit	4-tap variation	0		cents	
All	All	internal cavity volume	measured (water displacement	dry-fit)	1846.7		cubic_inches
All	All	sound-hole diameter actual	measured	4.500		inches	
All	All	tapa flatness	before mount	deflection at centre 0.5 lb load	0		inches