U01 design rationale and evidence record

Revision R2 | 5 October 2026 | Local technical working record

U01 combines the fan hood, transition duct and guard into one printed part. The objective is easier assembly while keeping the fan replaceable.

The user reported difficult access when fastening the previous separate upper parts. The present change addresses that reported assembly problem. It does not establish a new measured print failure.

Current configuration	Selection / evidence
Print one part	U01_ONE_PIECE_MK4S_PLA.3mf; quantity 1. STL and G-code are alternative representations, not extra parts. [E05, E10]
Retain existing parts	B01 body, S05R panel, H01/H02 hood clamps and PCB clamps. [E04, E07]
Replace / remove	Replace S06/S07/S08 with U01. Remove four H20 sleeves and four duct-joint fastener stacks. [E05]
Material / machine	PLA; MK4S standard 0.4 mm nozzle, not the high-flow profile. [E11]
Selected slice	5 h 53 min 38 s; 95.79 g total estimated filament. These are estimates, not elapsed production time or weighed mass. [E10]
Release boundary	Digitally checked prototype. Actual U01 print completion, support removal, fit and cooling remain Pending.

Confirmed: the user identified the green Nano and orange A4988 installation region as correct. Exact coordinates, heights and connector envelopes were not measured. [E18]

This revision updates theory, calculations, decision traceability and evidence. It does not change the selected STL, 3MF, G-code or cloud-controlled records.

Report map: requirements and history; design decisions; mechanical calculations; manufacturing; airflow and thermal method; structural limits; verification; evidence index.

1. Requirements and inherited configuration

Separate user requirements, selected dimensions and unverified physical results.

ID / requirement	Design response	Evidence boundary
R01: PLA and existing MK4S	Ordinary 0.4 mm PLA project; four perimeters and 15% gyroid.	User material choice; actual embedded profile read back. [E10-E11]
R02: box must rest on a table	Retain B01 flat-base layout and side inlet.	Inherited body geometry; whole-machine installation is separate. [E23]
R03: underside wiring clearance	Retain current nominal 60 mm floor-to-PCB underside clearance.	Earlier 42 mm is historical. Current 60 mm is nominal; 53 mm remains locally above the organiser. [E22-E23]
R04: support with Nano corner open	Retain bottom/right edge support, left 30 x 5 mm and upper-right 10 x 5 mm support intent.	Photo orientation: Nano upper-left, PCB landscape. Real solder-joint clearance is Pending. [E22]
R05: connector and inspection access	Retain DC/LED and Nano access, and 92 x 42 mm right service window with nominal 15 mm sill.	These are B01/S05R inherited features. U01 does not newly add them. [E22-E23]
R06: reduce assembly effort	Fuse three upper parts and eliminate separate duct joints.	User assembly complaint drives the change. No measured time-saving claim. [E04-E05]
R07: allow fan replacement	Provide open-bottom loading channel and accessible nuts.	Continuous frame sweep and tool-envelope checks. Physical fit remains Pending. [E06-E07]
R08: use available screw lengths	Four M3 x 20 for fan; retain two M3 x 25 hood screws.	Nominal stack checked; actual head/washer dimensions require inspection. [E05]
R09: ventilate the electronics region	Retain side fan and transition into the confirmed Nano/A4988 region.	Region confirmed; concentrated cooling and component temperatures not validated. [E18-E20]

Requirement coverage is not acceptance. A green CAD result only addresses its specified envelope, transform, clearance or toolpath calculation.

2. Change chronology and failure evidence

Keep distinct events distinct. Documentation updates do not rewrite actual completion dates.

Event	Evidence and inference	Decision / status
Earlier connector access complaints	User reported blocked Arduino interfaces, inadequate underside wiring space and absent DC/LED access.	Body/panel revisions added access and clearance. Their fitted success is not established by U01. [E22-E23]
Earlier coordinate-direction error	The 2 October record identifies photo-to-CAD handedness mapping error. The slicer rotation itself was not a reflection.	Historical design error and correction; separate from the later display error. [E22]
Stopped original Plate A	User reported clamp/sleeve detachment or nozzle contact after several layers. B01 remained unfinished when the plate stopped.	Reported physical failure. Bed contamination, adhesion and nozzle contact remain hypotheses without measured attribution. [E22]
Within-layer ordering concern	The user confirmed other objects were still on their first layer.	Starting one object last within a layer does not establish sequential-object printing or root cause. [E22]
Separate upper assembly difficult	User accepted fan screws but found hood/duct/guard fastening uncomfortable.	U01 integrates the upper module. Old successful parts are not retrospectively marked failed. [E05]
5 October static image wrong	Independent rays intersect U01 before the old Nano/A4988 references. Painter sorting drew surfaces in the wrong order.	Confirmed rendering failure. Replaced with WebGL depth-buffer images; CAD unchanged. [E19]
Subsequent region confirmation	User answered yes to the green Nano/orange A4988 region in the corrected view.	Closes regional interpretation only. No new millimetre measurement or thermal result. [E18-E20]

Historical records remain available. Later corrections explicitly supersede the affected interpretation instead of silently deleting its evidence.

3. Design decisions and alternatives

Why this geometry was selected, and what each choice costs.

Decision	Reason / selected solution	Trade-off and verification
D01: fuse upper parts	Remove four duct joints and four loose H20 sleeves. Preserve the lid and two hood clamps.	One connected solid checked. Internal support removal becomes less direct. [E06-E07]
D02: bottom-loaded fan	A permanently integrated guard prevents ordinary frontal insertion. Use an open-bottom frame channel.	Conservative 40.5 x 40.5 x 10.5 mm frame swept continuously. Actual wire routing remains unmeasured. [E02-E07]
D03: direct fan clamping	Use four guard access holes so screws and washers bear on the actual fan frame.	A clearance channel alone does not clamp the fan. Four M3 x 20 screws remain necessary. [E05-E07]
D04: external nut loading	Side-entry captive nut pockets avoid reaching inside the fused duct.	Ordinary hex nuts only. Printed bridge sag and actual anti-rotation still require inspection. [E06-E07]
D05: retain interfaces	Keep existing B01/S05R/H01/H02 contact geometry and assembly coordinates.	Avoids unnecessary reprinting. Protected-region checks do not verify an unknown physical print. [E07]
D06: roof-down printing	Select broader model contact and lower height than guard-down printing.	Reduces support estimate but still requires internal duct support. [E12-E15]
D07: local support blockers	Keep support out of four nut entrances while retaining support below the lower nut cages.	The wide blocker candidate was rejected because necessary cage-start support disappeared. [E12-E14]
D08: retain airflow orientation	Corrected view and user confirmation place electronics in the existing hood region.	No basis to flip the hood solely because of the old image. Bypass remains; no cooling guarantee. [E18-E20]

No printed snap latch was introduced. This revision follows the user preference for simpler assembly with conventional fan fasteners.

4. Fan fit and dimensional allowances

Nominal calculations with explicit hardware and print uncertainty. [E02-E07, E17]

The manufacturer drawing gives nominal 40 mm square frame size, 10 mm thickness, 32 mm hole pitch and four 4.3 mm mounting holes.

A conservative 40.5 x 40.5 x 10.5 mm envelope is used. Frame and pitch callouts do not provide full independent GD&T.

Calculation	Result	Interpretation
Centred lateral allowance: (42 - 40.5) / 2	0.75 mm per side	Slot X12.9 to 54.9; nominal slot-to-maximum-frame clearance; print error excluded.
Thickness allowance: 11.4 - 10.5	0.90 mm	Channel Y142.6 to 154.0. Do not confuse this with the older 10.5 mm gap.
Top allowance: 101.25 - 100.75	0.50 mm	Centred maximum frame, front face fixed in the model.
Minimum fan-hole diameter: 4.3 - 0.3	4.00 mm	Nominal M3 shaft gives (4.0 - 3.0) / 2 = 0.50 mm radial clearance.
Centred pitch offset: 0.3 / 2	0.15 mm per axis	Diagonal offset is sqrt(2) x 0.15 = 0.212 mm if both axes vary together.
Pitch-only nominal margin: 0.50 - 0.212	0.288 mm	Excludes printed-axis error, screw tolerance and unspecified hole-position errors.

The insertion check sweeps the entire maximum frame volume, rather than checking only its final position. Withdrawal of 45.5 mm was also checked. [E07]

These results establish nominal geometric feasibility. They do not predict PLA shrinkage, surface ridges, insertion force or actual cable bend radius.

The manufacturer shows a lead exit but does not dimension its precise position or connector envelope. The bottom opening and lower side reliefs preserve routing access.

Use actual hardware measurements before attributing a tight fit to design, printing or assembly orientation.

5. Screw stack, nut retention and hardware

Metal threads provide adjustment; the printed cage locates the nut. [E05-E07, E17]

```
Head bearing Y = 142.6 + fan thickness + washer thickness

Screw tip Y = head bearing Y - 20; nut extends from Y136.6 to Y139.0
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Fan thickness	Head bearing Y	Tip Y	Beyond full nut
10.0 mm	153.1 mm	133.1 mm	3.5 mm
10.5 mm	153.6 mm	133.6 mm	3.0 mm

The assumed washer is 0.5 mm thick, 7 mm outside diameter and 3.2 mm inside diameter. The ordinary M3 nut is 5.5 mm across flats and 2.4 mm thick.

A 25 mm screw moves the tip another 5 mm inward. It is not substituted for the selected 20 mm fan screw.

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Nut corner diameter = 5.5 / cos(30 degrees) = 6.351 mm
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The pocket is 6.1 mm across flats with a 5.9 mm entrance and 2.8 mm axial depth. The depth allowance is 2.8 - 2.4 = 0.4 mm.

At zero rotation, the nut fits the tested entry path. Rotated nut envelopes intersect the pocket at the tested 15 and 30 degree cases. [E07]

These intersections support geometric anti-rotation intent. They do not measure holding torque, layer strength or resistance to repeated tightening.

Location	Bolts	Nuts / washers
Fan to U01	4 x M3 x 20	4 / 4
H01/H02 hood clamps	2 x M3 x 25	2 / 2
S05R cover	3 x M3 x 20	3 / 3
PCB clamps	4 x M3 x 20	4 / 4
Complete controller	11 x M3 x 20; 2 x M3 x 25	13 / 13

Counts exclude bucket and machine-mounting hardware. The manufacturer recommends M4 fan mounting; this M3-through-bolt choice is a project-specific adaptation.

The manufacturer torque recommendation is not a validated torque for printed PLA. Actual clamping, frame rocking and plastic deformation remain inspection items.

6. Manufacturing decision and reproducibility

Roof down is selected from actual slices, not appearance alone. [E10-E15, E17]

Variant	Height / contact section	Estimated support	Estimated total / time
Roof down, initial	63.1 mm / 5030.55 mm2	15.35 g	96.34 g / 5h 56m 6s
Guard down, comparison	108.0 mm / 1276.52 mm2	40.46 g	122.83 g / 5h 55m 33s
Roof down, selected blockers	63.1 mm / same source geometry	14.79 g	95.79 g / 5h 53m 38s

Contact areas are solid-model sections at print Z0.1 mm, excluding support and brim. The selected orientation has approximately 3.94 times the model contact section.

Contact area is not an adhesion test. The previous small-part detachment does not establish that a larger contact area guarantees success.

The final project uses 0.20 mm layers, four perimeters, 15% gyroid and a 6 mm brim. Both first-layer speed settings are 20 mm/s.

PLA temperatures are 230 degrees C for the first layer and 220 degrees C thereafter, with a 60 degrees C bed. These are saved project settings.

The project contains one printable ModelPart and one non-printing SupportBlocker volume containing four disconnected regions. It is not a second component.

Final support-path inspection finds zero support/interface centreline segments inside all four nut regions. Necessary support below the lower cages remains. [E13-E14]

Use the configured 3MF. Loading the bare STL with generic support settings can recreate support inside the nut slots.

Internal duct support must be removed in small pieces through the hood underside before fitting the fan. The integral grille prevents straight extraction through the fan bore.

The earlier 60 x 15.3 mm throat description was a restricted upper window. The revised geometric check also finds an open 60 x 25 mm rectangle at specified seam stations. [E17]

No unbroken support block is assumed to pass through that rectangle. Tool access and geometry are not proof of practical support-removal success.

7. Air path, openings and corrected interpretation

Region confirmed; exact component envelopes and airflow remain unmeasured. [E16-E20]

The intended path runs from the side fan through the transition, then past the Nano and A4988 region towards the front outlet slots.

A conservative 2 mm diameter path probe at X40, Z84 reaches the rear of the driver reference region. It clears the checked enclosure and Nano reference geometry.

Section / calculation	Geometric area	Scope
60 x 15.3 mm historical upper window	918 mm2	Restricted Z77.7 to 93 window; not the complete throat.
60 x 25 mm seam rectangle	1500 mm2	X3.9 to 63.9, Z68 to 93 at the tested Y stations.
Fan-face bore section	1169.38 mm2	Actual polygonal mesh section near Y141; excludes real fan hub/blades.
Guard projection within bore	734.62 mm2	Net projected opening; about 62.8% of the sampled bore section.
Four front outlet slots: 4 x 12 x 25	1200 mm2	Nominal open rectangle probes; not a flow measurement.
USB-side opening: 34.1 x 17.9	610.39 mm2	Conservative open rectangle and potential early bypass.
Roof to driver reference: 114.6 - 88.6	26 mm gap	Inherited reference height; not measured from the user hardware.

No listed area is claimed as the globally minimum system area. Sample windows, area projections and connected flow domains answer different questions.

Upper space and lateral openings allow flow to bypass the driver. Real wires, connectors, fan hub and blade geometry are not fully represented.

The enclosure reaches the user-confirmed region. It does not force all incoming air across the actual A4988 package or a particular heatsink.

This distinction prevents an untested ventilation prototype from being described as validated direct-impingement cooling.

8. Fluid and thermal calculation method

Use a fan operating point and measured heat load before predicting installed cooling. [E21]

The exact fan specification gives 12 V DC, 40 mA rated current, 0.48 W rated consumption and 0.58 W maximum consumption. [E21]

```
Free-air endpoint: 7.0 CFM = 3.3036 L/s = 11.8931 m3/h

Shutoff endpoint: 0.12 inH2O = approximately 29.8907 Pa

Operating point: Delta p_fan(Q) = Delta p_system(Q)

Example path model: Delta p_system = sum[(f L / Dh + K) rho v^2 / 2]; v = Q_branch / A
```

The duct is an open network with several outlets. Its branch flows differ. Each branch needs pressure consistency and conservation of mass.

Loss coefficients, roughness, bend effects, wiring blockage and branch-flow fractions have not been identified. A single assumed loss coefficient would not certify this geometry.

Maximum static pressure is specified at zero flow. Free-air flow is specified at nearly zero pressure. They are different endpoints, not one simultaneous operating point.

```
Bulk-air energy balance: P_to_air = rho cp Q_air Delta T_air
```

This steady-state estimate describes mean air warming. It does not predict A4988 junction temperature, local convective coefficient or heatsink temperature.

```
Sensitivity example only: rho = 1.20 kg/m3, cp = 1005 J/(kg K), Delta T_air = 10 K

Q_air = P_to_air / 12060 m3/s = 0.2985 P_to_air m3/h, with P_to_air in watts
```

For an illustrative 5 W transferred to air, the result is 1.493 m3/h. Neither 5 W nor a 10 K rise is a measured project result or approved target.

The heat load must include relevant electronics losses. Motor electrical input is not automatically heat dissipated inside this box.

```
A4988 current-limit relation: I_trip,max = V_REF / (8 R_S) [manufacturer datasheet]
```

Actual sense resistance, reference voltage, current waveform, supply voltage and duty cycle remain unknown. Do not calculate a current limit from an assumed module resistor.

The A4988 datasheet specifies a 150 degrees C maximum junction rating and 165 degrees C typical thermal shutdown. Its 32 K/W thermal resistance uses a specified test PCB. [E21]

These manufacturer limits and the test-board thermal resistance are not operating targets or validated properties of the user module.

Chip thermal shutdown is a protective function, not the accepted operating target. Surface temperature cannot be substituted directly for semiconductor junction temperature.

A later guide vane should follow measured component and connector heights. It would change flow resistance and require a new geometry and thermal assessment.

9. Material, stiffness and assembly trade-offs

State what has been calculated and what cannot yet be substantiated.

```
Volume change = 83195.158 - 78311.242 = 4883.916 mm3

Relative increase = 4883.916 / 78311.242 x 100 = 6.2365%
```

This compares U01 with the three previous solid meshes only. It excludes four removed H20 sleeves and removed or shortened metal hardware. [E17]

Including four removed H20 sleeves, the previous printed solids total 79215.572 mm3. U01 increases this comparison by 3979.586 mm3, or 5.0237%. [E17]

The change prioritises assembly access, not minimum solid volume. Hollow infill makes solid mesh volume unsuitable as a weighed-print mass estimate.

Compared with the guard-down candidate, final U01 saves 27.04 g estimated filament and 1 minute 55 seconds. Compared with historical separate-part slices, it adds 16.28 g. [E17]

The historical separate-part comparison excludes H20 and uses different job starts and settings. It is not a controlled before-and-after production test.

The selected G-code estimates 80.463 g in part deposition, 14.789 g in support and 0.480 g in brim/skirt. Start/custom extrusion explains the remaining small total. [E10]

PLA grade, moisture, actual extrusion and layer bonding have not been characterised. Do not attach a numerical structural factor of safety to this dataset.

```
Possible bearing estimate: sigma_bearing = clamp force / effective bearing area

Approximate screw relation: T = K F d; K and a validated PLA clamp-load limit are unknown
here
```

These equations identify missing test inputs. They are not a numerical clamp-load proof. The chosen torque must not be inferred from a metal-joint rule.

Roof-down printing changes the orientation of the layer interfaces relative to local loads. Four perimeters and support settings are manufacturing choices, not strength certificates.

The side nut cage may resist rotation geometrically but still deform, creep or delaminate. Inspect repeated installation and operating-temperature exposure.

A larger integrated part removes alignment operations but concentrates replacement cost. Damage to its grille or nut cage may require replacing the entire U01.

The removable fan preserves service access. The fixed grille increases support-cleaning effort. These are explicit design trade-offs, not omitted disadvantages.

10. Digital verification and corrected images

Digital pass statements remain tied to the exact source and checked scope.

Evidence	Result	Does not establish
Generator QA [E06]	59 listed checks passed; single connected positive-volume watertight model.	Actual printed strength or manufacturing accuracy.
Independent geometry QA [E07]	122 checks passed, including retained interfaces, frame/nut sweeps and tool envelopes.	122 independent physical tests or a reliability probability.
STL to native 3MF [E11]	Symmetric difference 0.029763 mm3; maximum bounds change about 0.00000190 mm.	Perfect bitwise mesh identity; 12 degenerate facets were removed on import.
Native model types [E11]	One printable model plus non-printing blocker.	That a bare STL preserves the selected support settings.
Bed and path envelope [E11]	Bounds fit MK4S, including actual arcs and 0.3 mm bead margin.	Actual adhesion or uninterrupted machine operation.
Orientation [E05, E17]	Rotation determinant +1 with translation; no reflection.	That every historical photo-to-CAD model was correct.
Corrected display [E19]	Actual mesh ray occlusion explains the wrong old image; WebGL replaces it.	Physical fan direction or thermal performance.
Region confirmation [E18-E20]	User confirms intended electronics region in the corrected view.	Measured placement, connector fit or 26 mm actual upper gap.

Print-file hashes are unchanged by this documentation update. Their exact identities appear in the evidence index and the release manifest.

The historical diagnosis correctly records what was uncertain at that earlier point. The later confirmation supersedes only its unresolved-region status.

11. Physical verification and evidence collection

Proposed checks; no observations or pass signatures are pre-filled.

Check / purpose	Record	Outcome rule / boundary
V01: identify the build	File hash, printer/nozzle, PLA brand, plate, start/end times and photos.	Record completion and defects; do not replace actual elapsed time with slicer estimate.
V02: clean support	Access path, tool, time, residues, bridge sag and wall/grille damage.	No loose fragments or interference in the operating fan/duct. Actual result Pending.
V03: fan and fastener fit	Frame/head/washer/nut sizes; loading route; clamp stability; wire clearance.	Fit without forcing, no frame rocking or visible PLA distortion.
V04: connector and wire access	USB, DC, LED visibility, motor interface and representative cable routing.	Inspect powered-off clearance, insulation and strain relief before operation.
V05: flow direction / bypass	Fan orientation arrow, fan supply, flow indicator at inlet/outlet and near driver region.	Keep indicators secured away from blades. Qualitative indication is not calibrated volume flow.
V06: thermal behaviour	Ambient, sensor type/location, driver/module identity, V_REF, R_S, current, duty and temperature-time series.	Set project operating limits before acceptance. Do not use thermal shutdown as a target.
V07: comparable test	Same wiring/load/ambient and initial temperatures for the selected configurations.	Change one factor; report sensor uncertainty and repetitions. Stop if the agreed limit or abnormal behaviour occurs.
V08: repeated service	Count fan removals, nut rotation, cracks, loosening and permanent deformation.	Operating/load limits and repeat-cycle target require agreement before formal acceptance.

For each run, distinguish Pending, Blocked and Failed. Blocked means a required input or safe setup is missing; Failed requires an executed check and criterion.

An example stabilisation rule could be less than 1 degree C change over five minutes. This is a proposed method, not an approved criterion or observed result.

Photographs support configuration identity and visible condition. They cannot alone establish internal temperatures, preload or flow rate.

The companion CSV provides blank measured-value fields. User reports, digital results and measured observations must remain separate.

12. Reproduction and decision closure

A reviewer can follow requirement -> decision -> calculation -> artifact -> verification.

Open the evidence index first. Every indexed file has a role, source path, byte count and SHA-256. External references identify their issuer and page where available.

For portable reproduction, use REPLAY_CALCULATIONS.py with CALCULATION_REPLAY_INPUTS.zip and the recorded dependencies. See REPLAY_README.md for the exact command.

The archive freezes all calculation inputs, including historical comparison G-code. Those historical files are evidence only, not additional manufacturing instructions.

REPRODUCE_CALCULATIONS.py remains the original local reproduction script. Replay verifies source hashes and writes fresh results separately without regenerating print geometry.

Re-run support-path checks only if the selected 3MF or slice changes. Re-slicing another printer requires that printer profile and a fresh path review.

A fresh archive replay verified 39 payload hashes and reproduced 497 numerical or Boolean fields within stated tolerances, with no differences. [E24]

The documentation renderer builds this PDF, the English source record and local HTML from the same section data. Source evidence is preserved independently.

Decision now supported	Status
Print scope: U01 once; reuse the specified existing parts	Confirmed configuration choice; physical result Pending.
Frame path and nominal screw engagement are geometrically feasible	Confirmed digital scope for the indexed files.
The corrected view covers the intended Nano/A4988 region	User-confirmed region; exact geometry unmeasured.
Upper assembly should require fewer alignment/fastening operations	Reasoned design benefit; assembly time not measured.
U01 supplies effective concentrated cooling to A4988	Not established. Geometry allows bypass; no thermal result.
The design is physically accepted or ready for uncontrolled thermal load	Not established by this evidence record.

A future modification should state its trigger, affected requirements, alternatives and revalidation scope. A successful slice alone is not a closed engineering decision.

This record remains local. The audit handover receives the corrected evidence and open-item boundaries. Cloud publication and formal acceptance are separate actions.

Appendix A. Evidence locator

Full SHA-256 values and clickable paths are in EVIDENCE_INDEX.json and the HTML record.

ID / source	File / interpretation
E01 - User request excerpts	analysis/evidence-update-20261005/USER_REQUIREMENTS_RECORD.json Verbatim current-task excerpts; no independently assigned event timestamps. SHA-256 prefix: b3a42ee7fd42def5
E02 - Manufacturer specification	evidence/SUNON_MF40101V2-1000U-G99_D04111080G-01_Ed1_OFFICIAL.pdf Model/specification identified internally; mechanical drawing p6. SHA-256 prefix: 940900b63532cf92
E03 - Manufacturer extraction	evidence/FAN_MECHANICAL_EVIDENCE.json Dimensions, callout interpretation, source SHA and unmeasured cable details. SHA-256 prefix: 020b0f0325c6ebe1
E04 - Parametric geometry source	source/build_integrated_upper.py Geometry intent and nominal generator checks. SHA-256 prefix: cd1a2cc69489d4b7
E05 - Geometry/configuration manifest	INTEGRATED_UPPER_MANIFEST.json Assembly and print identities; dimensions, transforms and BOM. SHA-256 prefix: 34b02100b4216048
E06 - Generator geometry QA	qa/GEOMETRY_QA.json 59 listed checks; digital only. SHA-256 prefix: 025a3baafe489bab
E07 - Independent geometry QA	analysis/INDEPENDENT_GEOMETRY_REVIEW.json 122 listed checks; scope and limits preserved. SHA-256 prefix: c370aceea2629136
E10 - Selected slice report	PRINT_THIS/SLICE_REPORT.json Selected native project and G-code identities, estimates and settings. SHA-256 prefix: 4bc876dffa37cb4a

These are evidence identities, not a physical acceptance signature. Historical records retain their original scope and dates.

Appendix B. Evidence locator

Full SHA-256 values and clickable paths are in EVIDENCE_INDEX.json and the HTML record.

ID / source	File / interpretation
E11 - Final native/project/path QA	qa/FINAL_PROJECT_QA.json Model conversion, profile, placement and toolpath limits. SHA-256 prefix: 0a1cab6076c22d74
E12 - Print orientation and support review	analysis/print_review/INDEPENDENT_PRINT_REVIEW.md Historical candidates and final selected configuration are distinguished. SHA-256 prefix: bdf1ecc37c1ca291
E13 - Final support decision	analysis/print_review/FINAL_DECISION.json Final project hash, zero slot support, retained cage-start support. SHA-256 prefix: 74cf5492a40aabdc
E14 - Final nut support-path check	analysis/print_review/NUT_SUPPORT_ca1c531febc7.json Actual final G-code support-centreline inspection. SHA-256 prefix: 89faf93fb19a815c
E15 - Orientation contact comparison	analysis/print_review/INPUT_HASHES_AND_FIRST_LAYER.json Model contact sections, source identities and initial estimates. SHA-256 prefix: 3d2920a91ced6eeb
E16 - Historical bounded airway sections	analysis/AIRWAY_SECTIONS.json 918 mm2 is a restricted probe, not the whole throat. SHA-256 prefix: d26337716c5a5f8d
E17 - Independently reproduced calculations	analysis/evidence-update-20261005/CALCULATIONS_REPRODUCED.json Formulae, input hashes, mesh probes and scope. SHA-256 prefix: e1dff4e82dd28849
E18 - User region confirmation	AIRFLOW_TARGET_CLARIFICATION.json User confirms region, not exact measured position or cooling. SHA-256 prefix: 5148c71b052a857e

These are evidence identities, not a physical acceptance signature. Historical records retain their original scope and dates.

Appendix C. Evidence locator

Full SHA-256 values and clickable paths are in EVIDENCE_INDEX.json and the HTML record.

ID / source	File / interpretation
E19 - Historical image diagnosis	analysis/evidence-update-20261005/sources/STATIC_RENDERING_DIAGNOSIS.json Preserved pre-confirmation diagnosis; subsequent E18 governs region status. SHA-256 prefix: 13f31ea495824594
E20 - Regional path review	analysis/REGION_CONFIRMATION_AIR_PATH_REVIEW.json Geometric reachability and bypass limitations. SHA-256 prefix: bd8488eb3e7d609d
E21 - Thermal theory primary sources	analysis/evidence-update-20261005/THERMAL_THEORY_SOURCES.json SUNON exact specification pp3-6; selection guide pp2-4; Allegro A4988 Rev8 pp2,4,5,9. Copies and URLs indexed. SHA-256 prefix: c30ed75948085211
E22 - Historical decision and failure traceability	analysis/evidence-update-20261005/TRACEABILITY_REVIEW.json Inherited body features, failure attribution and chronology. SHA-256 prefix: d1b08b1ea34bdc12
E23 - Inherited body handover	analysis/evidence-update-20261005/sources/B01_HANDOVER.json 60 mm current nominal space and existing access features. SHA-256 prefix: d7d70e42f6d12462
E24 - Portable archive replay verification	analysis/evidence-update-20261005/REPLAY_SMOKE_TEST/REPLAY_VERIFICATION.json 39 payload hashes; 497 numeric/Boolean fields compared within tolerances; no differences. SHA-256 prefix: 0de768b23587701e

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