

TideCrux 100 and 300

Harbour inspection ROV with a faired hull and a bent-tube cage. Brief and reveal, requirement status, screening calculations, design-intent evidence, feature coverage, parts and drawings, ParaCrux Toolbox hardware, the 2D electrical system, the frame bend schedule, standards, design and manufacturing review, verification and the change from 100 m to 300 m.

1 / 1 / 11 Rev A requirements pass / fail / unproved	1 / 1 / 12 Rev B requirements pass / fail / unproved	16 + 6 parts built without rebuild errors (Rev A + parts Rev B owns)	11 of 11 build stages run; 7 ParaCrux Toolbox items
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TideCrux 100 (Rev A), SOLIDWORKS render of the built assembly out\renders\TC-100-isometric.png

Status. Work in progress, prepared by an AI agent driving SOLIDWORKS 2026 through its API in a lab demonstration. Not checked or approved. Screening calculations with stated assumptions: not a coded pressure-vessel assessment, structural qualification, pressure test or sea trial. Bought-in parts are envelope models. Sections whose evidence has not been produced yet say PENDING rather than guessing.

1. Brief and reveal

Fictional brief: a port authority dive team wants a two-person-portable ROV. It inspects quay walls, pile caps and moorings down to 100 m in tidal current. It must carry a tilting HD camera behind a port, two lights, a depth sensor and a replaceable battery. It must trim neutral after a payload swap, and a technician must be able to service it on deck without special tools.

The reveal (Rev B): "Re-rate it to 300 m and add a one-function gripper. Keep the frame footprint, battery and electronics tray." Screening calculations predict the following failures and changes:

What the 300 m reveal breaks (screening prediction)

Item	100 m (Rev A)	300 m (Rev B)	Consequence the agent must find and explain
NPS 4 Sch 10 6061-T6 housing, 300 mm long	Collapse margin 8.2×	2.75× , below the proposed 3× rule	Fails narrowly. Choose Sch 40, which doubles tube mass (0.86 → 1.66 kg), or a shorter unsupported length. Evaluate the second option rather than assume it
Flat acrylic camera port, 40 mm radius	≥15.9 mm thick	≥27.6 mm thick	Impractical. Switch to a hemispherical dome, with membrane thickness ≥9.4 mm at a 50 mm radius. Dome buckling and seat design remain open
Aluminium end cap, 54 mm radius, 0.6 ligament efficiency	≥5.4 mm	≥9.3 mm	Stress does not govern at Rev A, so gland and thread engagement set the thickness. At Rev B, stress and extrusion gap begin to matter
Radial O-ring gland, 3.53 mm section	21 % squeeze, 75 % fill	Same geometry, ~3 MPa	Re-check the extrusion gap. Consider 90 Shore A or back-up rings
Buoyancy foam	2.6 L at an assumed 200 kg/m³	5.7 L at an assumed 400 kg/m³ deep grade	Foam volume more than doubles. Envelope, CB height and frame clearance must be re-checked
Dry mass	11.5 kg	14.9 kg	0.1 kg under the proposed 15 kg deck-handling limit. Flag it, don't hide it

As with the drone, a narrow failure that the agent explains is the story. A uniformly scaled model is not.

Revision parameters in the frozen design

Parameter	Rev A (100)	Rev B (300)	
name	TideCrux 100	TideCrux 300	changed
depth_m	100	300	changed
housing_wall	3.05	6.02	changed
housing_schedule	NPS 4 Sch 10	NPS 4 Sch 40	changed
dome_t	6.0	10.0	changed
foam_density	200	400	changed
gripper	False	True	changed

Every other value in tools/design.py is shared by both revisions. tools/design.py REVS

Concept renders

SOLIDWORKS renders from the concept spikes that the frozen design was approved from. They are not the delivered Rev A parts; renders of the built parts and assemblies are in section 6.



cage front spikes\cage\cage-front.png



cage right spikes\cage\cage-right.png



cage top spikes\cage\cage-top.png



style dimetric spikes\style\style-dimetric.png



style front spikes\style\style-front.png



style isometric spikes\style\style-isometric.png

2. Requirement status

Status is taken from the evidence, not from intent. **Unproved** means the verification named in the brief has not produced evidence yet, even where a screening calculation looks favourable.

ID	Requirement	Result and evidence	Method	Rev A	Rev B
R01	Frame envelope $\leq 460 \times 350 \times 270$ mm, excluding tether termination	frozen design: frame $525 \times 525 \times 232$ mm from the side-frame corner, rail and skid parameters (tube OD added); cage spike measured $525 \times 525 \times 232$ mm The 460×350 mm proposal is revision 0; the revision-3 cage is wider and longer. Needs re-baselining or a smaller cage (operator decision).	design parameters; CAD envelope when verify runs	FAIL	FAIL
R02	Dry mass in air ≤ 12 kg (Rev A), ≤ 15 kg (Rev B)	A: CAD 6.82 kg for 59 modelled components + 0.21 kg of required foam (not modelled). B: CAD 7.64 kg for 60 modelled components + 1.04 kg of required foam (not modelled). Screening ledger with allocations 11.5 kg (A), 14.9 kg (B) The CAD has no battery, electronics, penetrators, harness, foam or ballast, so it cannot prove the limit; Rev B screening is 0.1 kg under 15 kg: flagged, not hidden.	CAD mass ledger with supplier overrides	UNPROVED	UNPROVED
R03	Rated depth 100 m. Test pressure $1.25 \times$ rated	rated 1.006 MPa / test 1.257 MPa (A); 3.017 MPa / 3.771 MPa (B) No pressure test in this demo.	calculation; hydrostatic test not performed	UNPROVED	UNPROVED
R04	Housing elastic collapse $\geq 3 \times$ rated pressure. Hoop stress at test pressure $\leq \frac{2}{3}$ Rp0.2	Sch 10 8.2x, hoop 23.6 MPa (A). Rev B: Sch 10 2.75x fails the 3x rule; Sch 40 15.2x Screening passes the chosen schedules; acceptance needs the FEA buckling study.	Windenburg-Trilling screening; FEA buckling with imperfection pending	UNPROVED	UNPROVED
R05	Every static seal has two O-rings, or one O-ring plus a face seal. Glands sized to ISO 3601-2 or supplier handbook (squeeze, fill, stretch, extrusion gap). $15-20^\circ$ lead-in chamfers. Sealing surfaces $Ra \leq 0.8 \mu\text{m}$	gland screening: squeeze 21.0 %, fill 74.6 %. CAD: 2 caps with two radial glands each, lead-in chamfer present, 4 O-rings at designed squeeze in the assembly. Chamfer angle and Ra callouts not yet evidenced	gland table, drawing callouts, feature audit	UNPROVED	UNPROVED

R06	Net buoyancy +0.10 to +0.20 kg. CB above CG by ≥ 25 mm for passive righting	A: net -0.73 kg without foam; 1.07 L of 200 kg/m ³ foam needed for +0.15 kg (foam not modelled); CB not computed. B: net -1.47 kg without foam; 2.59 L of 400 kg/m ³ foam needed for +0.15 kg (foam not modelled); CB not computed	CAD mass/CoM + displaced-volume body	UNPROVED	UNPROVED
R07	Hold station in 0.5 m/s current with 30 m of exposed Ø8 mm tether. 1 m/s forward with 1.5× thrust margin	needs 24.0 N per vectored thruster at 1 m/s; 17.1 N in current (tether 36.9 N) Thrusters are envelope models.	drag screening; supplier thrust curve not yet cited	UNPROVED	UNPROVED
R08	Camera tilt $\pm 90^\circ$ behind the port with no vignetting or collision. Lights clear of the field of view	no tilt mechanism or view-cone check yet	motion sweep, view-cone check	UNPROVED	UNPROVED
R09	Galvanic compatibility: anodised 6061 with A4 (316) fasteners isolated by inserts or anti-seize. No bare dissimilar contacts in the wetted zone	library fasteners are A4, A4-70; insert holes and isolation not yet modelled	material/finish matrix, BOM check	UNPROVED	UNPROVED
R10	Tool-free battery swap on deck. Each penetrator replaceable without opening the other housing	no evidence yet; the frozen design puts the 4S sled inside the main housing (no separate battery housing), so the swap route needs review	assembly sequence and access check	UNPROVED	UNPROVED
R11	Lift handle withstands 2× dry weight. Handle stress screened at 53 MPa for Rev B	rev-0 16x2 handle screened at 53.1 MPa for 292 N (allowable 160 MPa); the revision-3 design lifts by the cage, not yet screened	calculation; FEA of handle and frame	UNPROVED	UNPROVED
R12	Feature standard: every part passes the modelling-practice audit (see below). Every departure from a rule is recorded with a reason	A: 16 parts, 38/38 sketches fully defined, 0 Fixed relations, 0 findings; seeded negative caught; 6/6 HL-01 cut reviews dispositioned. B (changed parts): 6 parts, 10/10 sketches fully defined, 0 Fixed relations, 0 findings; seeded negative caught; 2/2 HL-01 cut reviews dispositioned Rev B audits the parts the change owns; common parts are covered by the Rev A audit.	audit_features.py (stage 08)	PASS	PASS
R13	Drawings conform to the selected drawing standard (see decision D2). Every hole callout comes from Hole Wizard data	6 Rev A and 2 Rev B drawing PDFs; 2 layout warning(s) logged (('fit warning', 'view outlines overlap', 'Drawing View3', 'Drawing View4')); no drawing audit yet	drawing audit and review	UNPROVED	UNPROVED
R14	Rev B (300 m + gripper) rebuilds from the same parameters with no broken mates or references, and every R-check is rerun	change stage regenerated 6 parts and referenced 11 common parts; equation check matches ("housing_wall" = 6.02); Rev B assembly 0 unexpected interferences; feature audit rerun; components are placed at documented positions rather than mated, so 'no broken mates' is not tested Not every R-check has been rerun: R02-R11 still need their acceptance evidence.	change report	N/A	UNPROVED

Requirement wording from the scope document's revision-0 brief (origin/main (revision 3)); every number in it is a proposal for discussion, not a cited class rule.

3. Screening calculations

Source: paracrux/ExecPlans/Research/2026-10-01-underwater-rov-sizing.json (reproducible script alongside). Status as written by the script: *Illustrative screening; no CAD, FEA, coded pressure assessment, pressure test or sea trial*. Assumptions: $\rho_{\text{sea}} = 1025 \text{ kg/m}^3$; 6061-T6 E = 68,900 N/mm², $\nu = 0.33$, $R_{p0.2} = 240 \text{ N/mm}^2$; proof factor 1.25; collapse factor 3; allowable $\frac{2}{3} R_{p0.2} = 160 \text{ N/mm}^2$ at test pressure; housing OD 114.3 mm, unsupported length 300 mm.

Pressure (R03)

$p = \rho \cdot g \cdot h$ (gauge); test = 1.25 × rated.

Revision	Depth	Rated	Test
A	100 m	1.006 MPa	1.257 MPa
B	300 m	3.017 MPa	3.771 MPa

Housing collapse (R04): NPS 4 6061-T6, Windenburg-Trilling

$p_{cr} = 2.42 \cdot E \cdot (t/D)^{2.5} / [(1-\nu^2)^{0.75} \cdot (L/D - 0.45 \cdot (t/D)^{0.5})]$ for a perfect cylinder with the ends held round; hoop $\sigma = p_{test} \cdot D / 2t$.

Rev	Schedule	t (mm)	Tube mass (kg)	p_{cr} (MPa)	Margin on rated	Hoop at test (MPa)	Screen
A	Sch 5	2.11	0.60	3.3	3.27x	34.0	PASS
A	Sch 10	3.05	0.86	8.3	8.24x	23.6	PASS
A	Sch 40	6.02	1.66	45.9	45.65x	11.9	PASS
A	Sch 80	8.56	2.30	111.5	110.93x	8.4	PASS
B	Sch 5	2.11	0.60	3.3	1.09x	102.1	FAIL
B	Sch 10	3.05	0.86	8.3	2.75x	70.7	FAIL
B	Sch 40	6.02	1.66	45.9	15.22x	35.8	PASS
B	Sch 80	8.56	2.30	111.5	36.98x	25.2	PASS

Frozen design check. The same formula at the design's housing length from design.py (computed here, not in the sizing script). The tube is shorter than the 300 mm screening length, so the screening is conservative.

Revision	Schedule	t (mm)	L (mm)	p_{cr} (MPa)	Margin	Screen
TideCrux 100	NPS 4 Sch 10	3.05	240	10.4	10.4x	PASS
TideCrux 300	NPS 4 Sch 40	6.02	240	58.0	19.2x	PASS

Imperfection, end-cap restraint and thermal effects are not included: acceptance needs an FEA linear-buckling study with an imperfection (decision D4).

End cap and camera port

Item	Rev A	Rev B	Note
Flat end cap, r = 54.1 mm, ligament 0.6	$t \geq 5.4 \text{ mm}$	$t \geq 9.3 \text{ mm}$	12 mm cap deflects 0.045 mm at Rev B test. stress is not the governing case: thread engagement, gland geometry and penetrator spot faces set thickness

Flat acrylic port, r = 40 mm	t ≥ 15.9 mm	t ≥ 27.6 mm	Impractical at 300 m: switch to a dome
Hemispherical dome, r = 50 mm (membrane)	t ≥ 3.1 mm (design 6.0 mm)	t ≥ 9.4 mm (design 10.0 mm)	dome membrane only; dome buckling and seat design unassessed; ASME PVHO-1 is guidance, not claimed

O-ring gland (R05)

Squeeze = (cs – depth)/cs; fill = (π/4·cs²)/(depth·width). Section 3.53 mm, depth 2.79 mm, width 4.7 mm: **squeeze 21.0 %, fill 74.6 %** PASS against static squeeze 15-30 %, fill ≤ 85 %; confirm against ISO 3601-2 / supplier handbook; extrusion gap from chart at Rev B pressure. Design values in design.py (cs 3.53, depth 2.79, width 4.7 mm) give squeeze 21.0 % and fill 74.6 %. At Rev B (~3 MPa) the extrusion gap needs re-checking; consider 90 Shore A or back-up rings.

Drag and tether (R07)

$F = \frac{1}{2} \cdot \rho \cdot C_d \cdot A \cdot v^2$; hull C_d 1.0 on 0.0884 m²; tether C_d 1.2 on 30 m × Ø8 mm; four vectored thrusters at 45°.

Case	Hull drag	Tether drag	Total	Per vectored thruster
1 m/s forward	45.3 N	-	45.3 N	16.0 N (24.0 N with 1.5x margin)
0.5 m/s current, 30 m tether	11.3 N	36.9 N	48.2 N	17.1 N

The tether drag is over three times the hull drag in current: tether diameter is a design variable.

Buoyancy and foam (R02, R06)

$V_{\text{foam}} = (W_{\text{water}} + \text{reserve}) / (\rho_{\text{sea}} - \rho_{\text{foam}})$, reserve 0.15 kg, from an allocation ledger (not CAD masses).

Case	Dry, no foam (kg)	Displaced (L)	In water (kg)	Foam p (kg/m ³)	Foam (L)	Total dry (kg)
Rev A, shallow foam	11.00	8.76	2.02	200	2.63	11.53
Rev B, 300 m foam	12.60	8.96	3.41	400	5.70	14.87
Rev B if shallow foam kept (rejected: not rated for 300 m)	12.60	8.96	3.41	200	4.32	13.46

Lift handle (R11)

16 × 2 6061 tube, 200 mm span, centre load 2 × Rev B dry weight = 292 N; $I = 2199 \text{ mm}^4$; $\sigma = M \cdot c / I = \mathbf{53.1 \text{ N/mm}^2}$ against $\frac{2}{3} R_{p0.2} = 160 \text{ N/mm}^2$. The revision-3 design lifts by the bent-tube cage instead; that load case has not been screened.

4. Design-intent modelling

Rules (BUILD-PLAN, global modelling practice SK-01 to SK-10): every sketch fully defined with centrelines, relations and **named driving dimensions** from the origin and datums; **no Fixed relations**; Hole Wizard for hardware holes, each located by named dimensions in its position sketch; patterns and mirrors for repeats; features named by intent. Definition status is read back from SOLIDWORKS after each sketch closes (GetConstrainedStatus) and logged; an under-defined sketch is a finding, never patched with a Fixed relation.

Stage summary (latest run of each stage)

#	Stage	Rev	Latest run	Time	Steps ok	Sketches fully defined	Named dims	Geometry events	Status
01	hull	100	2026-10-02 03:10:49	348.5 s	21 / 21	15 / 15	101	37	DONE rec
02	frame	100	2026-10-02 03:16:43	49.1 s	9 / 9	2 / 2	10	4	DONE rec
03	housings	100	2026-10-02 03:17:36	68.8 s	15 / 15	7 / 7	27	17	DONE rec
04	chassis	100	2026-10-02 03:18:49	40.8 s	8 / 8	4 / 4	11	11	DONE rec
05	details	100	2026-10-02 03:19:34	113.0 s	10 / 10	14 / 14	36	31	DONE rec
06	hardware	100	2026-10-02 03:21:32	31.0 s	7 / 7	0 / 0	0	7	DONE rec
07	assembly	100	2026-10-02 03:33:08	147.7 s	3 / 3	0 / 0	0	59	DONE rec
07	assembly	300	2026-10-02 03:29:01	167.1 s	3 / 3	0 / 0	0	60	DONE rec
08	audit	100	2026-10-02 03:24:51	44.1 s	17 / 17	0 / 0	0	0	DONE rec
08	audit	300	2026-10-02 03:36:10	19.6 s	7 / 7	0 / 0	0	0	DONE
09	drawings	100	2026-10-02 03:25:37	80.9 s	7 / 7	0 / 0	0	24	DONE rec
09	drawings	300	2026-10-02 03:31:56	21.9 s	2 / 2	0 / 0	0	8	DONE rec
10	change	300	2026-10-02 03:27:04	112.0 s	19 / 19	11 / 11	45	26	DONE rec
11	exports	100	2026-10-02 03:32:22	35.7 s	6 / 6	0 / 0	0	1	DONE rec
11	exports	300	2026-10-02 03:35:42	17.7 s	6 / 6	0 / 0	0	1	DONE

Fixed relations. Counted by the feature audit in every audited part: Rev A 0 Fixed relations in 38 sketches (38 fully defined); Rev B 0 Fixed relations in 10 sketches (10 fully defined). The audit's seeded negative part (one under-defined sketch, one Fixed relation, default names) is flagged, which shows the census can see a Fixed relation when one exists. `out/audit-100.json` · `out/audit-300.json`

Hole Wizard positions

Hole Wizard places a hole where the face is picked; each hole's position sketch is then located by named dimensions (or a relation to a datum) so the hole moves with the design. Positions logged by the stages:

Stage	Position sketch	Hole Wizard step	Definition	Located by
01 rev 100	Boss tapped hole position	Hole Wizard M3x0.5 tapped holes in bosses (one located, mirrored twice)	PASS fully defined	boss_x = 90.0, boss_z = 100.0
03 rev 100	Penetrator port position	Hole Wizard M10x1.5 penetrator port (on PCD by dimension)	PASS fully defined	port_x (relation to a datum), port_pcd_radius = 32.0
04 rev 100	Clamp hole position	-	PASS fully defined	clamp_x, clamp_screw_z

05 rev 100	Counterbore position	-	PASS fully defined	screw_pitch
10 rev 300	Penetrator port position	Hole Wizard M10x1.5 penetrator port (on PCD by dimension)	PASS fully defined	port_x (relation to a datum), port_pcd_radius = 32.0

Stage 01 hull, rev 100 `out\stages\01-hull-100-rec.json`

Sketch	Definition	Named driving dimensions
Station 1 section	PASS fully defined	9: S1_w0, S1_h0, S1_w2, S1_w3, S1_h3, S1_w4, S1_h4, S1_w5, S1_h5
Station 2 section	PASS fully defined	10: S2_w0, S2_h0, S2_w2, S2_h2, S2_w3, S2_h3, S2_w4, S2_h4, S2_w5, S2_h5
Station 3 section	PASS fully defined	10: S3_w0, S3_h0, S3_w2, S3_h2, S3_w3, S3_h3, S3_w4, S3_h4, S3_w5, S3_h5
Station 4 section	PASS fully defined	10: S4_w0, S4_h0, S4_w2, S4_h2, S4_w3, S4_h3, S4_w4, S4_h4, S4_w5, S4_h5
Station 5 section	PASS fully defined	10: S5_w0, S5_h0, S5_w2, S5_h2, S5_w3, S5_h3, S5_w4, S5_h4, S5_w5, S5_h5
Station 6 section	PASS fully defined	9: S6_w0, S6_h0, S6_w2, S6_h2, S6_w3, S6_w4, S6_h4, S6_w5, S6_h5
Sponson outline	PASS fully defined	9: SP_axis, SP_w0, SP_z0, SP_w1, SP_z1, SP_w2, SP_z2, SP_w3, SP_z3
Visor outline	PASS fully defined	6: VIS_w0, VIS_h0, VIS_w2, VIS_h2, VIS_w3, VIS_h3
Tunnel sketch	PASS fully defined	3: TUN_dia, TUN_spacing, TUN_v
Deck hatch outline	PASS fully defined	8: HAT_w0, HAT_h0, HAT_w2, HAT_h2, HAT_w3, HAT_h3, HAT_w4, HAT_h4
Camera bore sketch	PASS fully defined	2: CAM_dia, CAM_v
Light bore sketch	PASS fully defined	3: LGT_dia, LGT_spacing, LGT_v
Vent slot sketch	PASS fully defined	4: VNT_w0, VNT_z0, VNT_w1, VNT_z1
Boss sketch	PASS fully defined	6: BF_dia, BF_spacing, BF_v, BR_dia, BR_spacing, BR_v
Boss tapped hole position	PASS fully defined	2: boss_x, boss_z

Stage 02 frame, rev 100 `out\stages\02-frame-100-rec.json`

Sketch	Definition	Named driving dimensions
Bend path (3D sketch)	PASS fully defined	9: skid_drop, rail_rise, hug_half_width, hug_half_length, corner_half_width, corner_half_length, bend_clr, tube_od, tube_wall
Member path	PASS fully defined	1: span

Global variables (equations): skid_drop = 97.0, rail_rise = 110.0, hug_half_width = 190.0, hug_half_length = 110.0, corner_half_width = 250.0, corner_half_length = 250.0, bend_clr = 65.0, tube_od = 25.0, tube_wall =

Stage 03 housings, rev 100 out\stages\03-housings-100-rec.json

Sketch	Definition	Named driving dimensions
Tube section	PASS fully defined	2: OD_dia, ID_dia
Cap profile	PASS fully defined	9: flange_r, flange_t, plug_r, CAP_z3, gland_root_r, CAP_z4, CAP_z5, CAP_z6, plug_end
Penetrator port position	PASS fully defined	1: port_pcd_radius
Cap profile	PASS fully defined	9: flange_r, flange_t, plug_r, CAP_z3, gland_root_r, CAP_z4, CAP_z5, CAP_z6, plug_end
Dome bore sketch	PASS fully defined	1: BORE_dia
Dome profile	PASS fully defined	3: dome_ro, dome_ri, skirt
O-ring section	PASS fully defined	2: CS_dia, CS_v

Stage 04 chassis, rev 100 out\stages\04-chassis-100-rec.json

Sketch	Definition	Named driving dimensions
Tray profile	PASS fully defined	3: TRAY_width, TRAY_height, TRAY_base
Clamp hole position	PASS fully defined	2: clamp_x, clamp_screw_z
Saddle outline	PASS fully defined	4: SAD_w0, SAD_h0, SAD_w2, SAD_h2
Cradle sketch	PASS fully defined	2: CRADLE_dia, CRADLE_v

Stage 05 details, rev 100 out\stages\05-details-100-rec.json

Sketch	Definition	Named driving dimensions
Clamp block outline	PASS fully defined	4: CLB_w0, CLB_h0, CLB_w2, CLB_h2
Cradle outline	PASS fully defined	2: cradle_r, cradle_top
Counterbore position	PASS fully defined	1: screw_pitch
Collar outline	PASS fully defined	2: COL_OD_dia, COL_ID_dia
Tab outline	PASS fully defined	4: TAB_w0, TAB_z0, TAB_w1, TAB_z1
Duct seat	PASS fully defined	2: SEAT_dia, SEAT_u
Collar split outline	PASS fully defined	4: SPL_w0, SPL_h0, SPL_w2, SPL_h2
Hub outline	PASS fully defined	1: HUB_dia
Spoke outline	PASS fully defined	4: SPK_w0, SPK_z0, SPK_w1, SPK_z1
Duct section	PASS fully defined	2: DUCT_OD_dia, DUCT_ID_dia
Pod section	PASS fully defined	1: POD_dia
Blade outline	PASS fully defined	4: BLD_w0, BLD_z0, BLD_w1, BLD_z1
Light section	PASS fully defined	1: LIGHT_dia

Camera body outline	PASS fully defined	4: CAMB_w0, CAMB_h0, CAMB_w2, CAMB_h2
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Stage 10 change, rev 300

out\stages\10-change-300-rec.json

Sketch	Definition	Named driving dimensions
Tube section	PASS fully defined	2: OD_dia, ID_dia
Cap profile	PASS fully defined	9: flange_r, flange_t, plug_r, CAP_z3, gland_root_r, CAP_z4, CAP_z5, CAP_z6, plug_end
Penetrator port position	PASS fully defined	1: port_pcd_radius
Cap profile	PASS fully defined	9: flange_r, flange_t, plug_r, CAP_z3, gland_root_r, CAP_z4, CAP_z5, CAP_z6, plug_end
Dome bore sketch	PASS fully defined	1: BORE_dia
Dome profile	PASS fully defined	3: dome_ro, dome_ri, skirt
O-ring section	PASS fully defined	2: CS_dia, CS_v
Mount outline	PASS fully defined	5: GMT_axis, GMT_w0, GMT_z0, GMT_w1, GMT_z1
Mount bore sketch	PASS fully defined	3: MBORE_dia, MBORE_u, MBORE_v
Body section	PASS fully defined	2: BODY_dia, BODY_v
Jaw outline	PASS fully defined	8: JAW_w0, JAW_h0, JAW_w2, JAW_h2, JAW_w3, JAW_h3, JAW_w4, JAW_h4

Feature counts per part

Part	Rev	Features	Volume (mm³)	Rebuild errors	Built
TC-101	A	64	1,034,898.3	none	2026-10-02 03:16:38
TC-201	A	19	195,122.8	none	2026-10-02 03:17:23
TC-202	A	21	51,157.7	none	2026-10-02 03:17:32
TC-301	A	19	255,835.6	none	2026-10-02 03:17:46
TC-302	A	23	285,934.2	none	2026-10-02 03:18:06
TC-303	A	23	117,090.1	none	2026-10-02 03:18:25
TC-304	A	19	97,565.3	none	2026-10-02 03:18:35
TC-B10	A	20	3,263.7	none	2026-10-02 03:18:45
TC-401	A	38	79,423.9	none	2026-10-02 03:19:13
TC-402	A	21	50,752.7	none	2026-10-02 03:19:30
TC-501	A	23	43,779.6	none	2026-10-02 03:19:57
TC-502	A	25	31,091.3	none	2026-10-02 03:20:25
TC-503	A	23	8,561.0	none	2026-10-02 03:20:45
TC-B01	A	25	143,609.9	none	2026-10-02 03:21:06

TC-B02	A	19	8,042.5	none	2026-10-02 03:21:15
TC-B03	A	19	38,880.0	none	2026-10-02 03:21:27
TC-301	B	19	491,480.0	none	2026-10-02 03:27:15
TC-302	B	23	266,805.8	none	2026-10-02 03:27:38
TC-303	B	23	97,961.7	none	2026-10-02 03:27:57
TC-304	B	19	150,377.6	none	2026-10-02 03:28:07
TC-B10	B	20	3,081.1	none	2026-10-02 03:28:17
TC-701	B	27	84,062.9	none	2026-10-02 03:28:53

Build history

Every run is appended to the build log, never overwritten. Failed runs are where the build found its own problems; each was fixed in the builder and the stage re-run.

Stage	Rev	Runs	Recorded	Failed runs	What failed	Latest
01 hull	100	7	1	1	mirror vents to port	DONE
02 frame	100	10	6	1	3D bend path, thin circular sweep 25x2, TC-201 saved (Side frame, bent tube 25x2 EN AW-6060 T66)	DONE
03 housings	100	7	1	0	-	DONE
04 chassis	100	10	1	3	sheet-metal base flange from open U profile, Hole Wizard M5 clearance; Hole Wizard M5 clearance	DONE
05 details	100	6	1	0	-	DONE
06 hardware	100	6	3	0	-	DONE
07 assembly	100	10	2	3	interference detection	DONE
07 assembly	300	5	1	2	interference detection	DONE
08 audit	100	8	1	1	seeded negative part is flagged	DONE
08 audit	300	4	0	0	-	DONE
09 drawings	100	6	1	1	TC-401 flat pattern DXF	DONE
09 drawings	300	4	1	0	-	DONE
10 change	300	3	1	0	-	DONE
11 exports	100	2	1	0	-	DONE
11 exports	300	2	0	0	-	DONE

5. Feature coverage

Each feature type must earn its place on a real part (PR-02). **Used** = a successful build step in a stage log; **attempted** = only failed steps so far; **spike only** = proven in a G0/style spike but not yet in the vehicle build; **planned** = in the build plan, not yet run. The audit column counts SOLIDWORKS feature types found by the feature audit across the Rev A parts and the parts Rev B owns.

Feature	Where it earns its place (scope)	Vehicle build evidence	Audit	Spike evidence	Status
Loft	Hydrodynamic top foam block with faired nose Plan: stage 01 hull	TC-101: loft through 6 station sections	Blend 1	fairing: loft; style: hull loft	USED
Extrude / cut	Plan: stage 01 hull, 05 details	TC-101: visor recess; TC-101: thruster tunnels (through all, symmetric); TC-101: tunnel rim blends; TC-101: raised deck hatch; TC-101: camera bore; +10 more	Extrusion 10, ICE 21	cage: saddle clamp (HW counterbore + mirror); cage: tunnel spider (circular pattern x3); fairing: drafted bosses x4 up to skin; +13	USED
Mirror	Port/starboard frame plates, symmetric thruster mounts Plan: stage 01 hull, 04 chassis, 05 details	TC-101: mirror sponson to port; TC-101: mirror vents to port; TC-101: Hole Wizard M3x0.5 tapped holes in bosses (one located, mirrored twice); TC-401: mirror front/rear; TC-401: mirror port/starboard; +1 more	MirrorPattern 7	cage: saddle clamp (HW counterbore + mirror); style: mirror sponson to port; style: mirror vents to port	USED
Linear / fill pattern	Frame lightening holes, foam cavity drainage Plan: stage 03 housings, 04 chassis	TC-101: vent linear pattern x4; TC-302: circular pattern x8 (equal spacing); TC-401: linear pattern x2 at clamp screw pitch; TC-302: circular pattern x8 (equal spacing)	LPattern 2	cage: tunnel spider (circular pattern x3); endcap: circular pattern x4; style: vent linear pattern x6	USED
Circular pattern	Penetrator bolt circle (count driven by a named dimension), flange bolts, thruster guard slots Plan: stage 03 housings, 05 details	TC-302: circular pattern x8 (equal spacing); TC-503: spider: seed spoke + symmetric circular pattern (120/180/240); TC-302: circular pattern x8 (equal spacing)	CirPattern 4	cage: tunnel spider (circular pattern x3); endcap: circular pattern x4	USED
Shell	Moulded thruster guard, foam skin cover Plan: stage 01 hull	TC-101: shell, open underneath; TC-304: revolve: hemispherical shell + seating skirt; TC-304: revolve: hemispherical shell + seating skirt	Shell 1	fairing: shell 3 mm, open underneath; style: shell open underneath	USED
Draft	Moulded thruster guard and cast ballast puck: 1–2° draft, ribs at 50–60 % of wall Plan: stage 01 hull	TC-101: drafted sponson; TC-101: drafted bosses to the skin	-	fairing: drafted bosses x4 up to skin; fairing: drafted rib (failed); style: drafted sponson	USED

Rib	Moulded thruster guard and cast ballast puck: 1–2° draft, ribs at 50–60 % of wall	-	-	fairing: drafted rib (failed)	PLANNED
Fillet / chamfer	Internal pocket corner radii, O-ring lead-in chamfers, burr-free sealing edges Plan: stage 02 frame, 03 housings	TC-101: blend Crease blends R4; TC-101: blend Nose rim blend R6; TC-101: blend Tail rim blend R6; TC-101: blend Sponson edge blends R5; TC-101: blend Sponson root blends R8; +7 more	Fillet 6, Chamfer 4	endcap: lead-in chamfer; fairing: blend Longitudinal blends R6; fairing: blend Nose blend R10; +8	USED
Revolve	End caps, port flange, dome, penetrator bosses, thruster hub adapters Plan: stage 03 housings	TC-302: revolve: flange + plug + two radial glands; TC-303: revolve: flange + plug + two radial glands; TC-304: revolve: hemispherical shell + seating skirt; TC-B10: O-ring torus (revolve about reference axis); TC-302: revolve: flange + plug + two radial glands; +3 more	Revolution 8	endcap: revolve	USED
Hole Wizard	End-cap penetrator holes (M10 × 1.5, spot face for the face seal). Flange bolts (ISO 4762 counterbore). Frame clearance holes (ISO 273 medium) Plan: stage 01 hull, 03 housings, 04 chassis, 09 drawings	TC-101: Hole Wizard M3x0.5 tapped holes in bosses (one located, mirrored twice); TC-302: Hole Wizard M10x1.5 penetrator port (on PCD by dimension); TC-401: Hole Wizard M5 clearance; TC-302: Hole Wizard M10x1.5 penetrator port (on PCD by dimension)	HoleWzrd 5	endcap: Hole Wizard M10x1.5 tapped; fairing: Hole Wizard pilot in boss (failed); timing: HoleWizard5 #1 tap M5; +4	USED
Cosmetic thread	Every tapped hole and externally threaded turned part	-	-	-	PLANNED
3D sketch	Plan: stage 02 frame	TC-201: 3D bend path	-	cage: 3D side frame (8 bends); harness: 3D spline	USED
Sweep	Bent lift-handle tube with a standard bend radius. Tether strain-relief boot. Harness envelopes Plan: stage 02 frame	TC-201: thin circular sweep 25x2	Sweep 1	fairing: fallback thin circular sweep; harness: circular-profile sweep	USED
Helix	Battery hatch latch spring (compression spring, bought-in where possible)	-	-	-	PLANNED
Structural member (weldment profile)	Plan: stage 02 frame	TC-202: ParaCrux structural member 25x2.0	WeldMemberFeat 1	fairing: structural member CHS 33.7x3.2 (ParaCrux EN) (failed)	USED

Sheet metal	Camera tilt bracket and light brackets in 1.5 mm 316 stainless. Bend radius and K-factor from the gauge table Plan: stage 04 chassis, 09 drawings	TC-401: sheet-metal base flange from open U profile; stage 09: TC-401 flat pattern DXF (1:1)	SMBaseFlange 1	-	USED
Equations / global variables	Depth rating → catalogue choice (pipe schedule, foam grade, port type), not continuous scaling Plan: stage 02 frame, 03 housings, 10 change	TC-201: global variables (frame design logic); TC-201: fillet radii linked to bend_clr (equations); TC-301: tube NPS 4 Sch 10 extruded mid-plane (equations); TC-301: tube NPS 4 Sch 40 extruded mid-plane (equations); stage 10: equation edit == regenerated part (TC-301)	63 equations	-	USED
Reference geometry	Waterline plane, CG/CB points, thrust axes, gland datums	TC-B10: O-ring torus (revolve about reference axis); TC-B10: O-ring torus (revolve about reference axis)	-	endcap: reference axis; timing: FullyDefineSketch with datums	USED
Configurations / design table	Rev A/B. Housing length. O-ring durometer. Ballast count	-	-	-	PLANNED
Combine / displaced volume	Derived wetted-envelope part for CB and displacement	-	-	-	PLANNED
Assembly, mates, interference	Subassemblies, limit-angle mate for camera tilt, flexible tilt subassembly, exploded views, interference detection, mate references on the thrusters Plan: stage 06 hardware, 07 assembly	stage 07: interference detection; stage 07: interference detection; stage 11: assembly STEP AP214; stage 11: assembly STEP AP214	-	cage: concept assembly; harness: interference; scale: assembly + fixed plate; +2	USED

Justified non-use is part of the demo. The scope's revision-0 note ("weldments are not used") is superseded by revision 3: straight cross members are ParaCrux structural members (bolted, for the cut list) and the bent side frames are swept tube parts, as a tube bender would make them. Cosmetic threads, helix, configurations and the displaced-volume body are not yet in the build; they are reported as planned, not claimed.

6. Parts list

Rev A (TideCrux 100)

PN	Description	Material (library)	Mass (g)	Volume (mm³)	Density (g/cm³)	Rev	Status
TC-101	Fairing, moulded PC+ABS	PC+ABS – Bayblend T65 XF ParaCrux Materials	1,169.4	1,034,898.3	1.13	A	BUILT
TC-201	Side frame, bent tube 25x2 EN AW-6060 T66	EN AW-6060 T66 ParaCrux Materials	526.8	195,122.8	2.70	A	BUILT
TC-202	Cross member, tube 25x2.0 (ParaCrux EN 755)	EN AW-6060 T66 ParaCrux Materials	51.2	51,157.7	1.00	A	BUILT
TC-301	Main housing tube, NPS 4 Sch 10 6061-T6	EN AW-6061 T6 ParaCrux Materials	690.8	255,835.6	2.70	A	BUILT
TC-302	Rear end cap, 6061-T6, 8 penetrator ports	EN AW-6061 T6 ParaCrux Materials	772.0	285,934.2	2.70	A	BUILT
TC-303	Front dome flange, 6061-T6	EN AW-6061 T6 ParaCrux Materials	316.1	117,090.1	2.70	A	BUILT
TC-304	Camera dome, cast PMMA, 6 mm wall	PMMA (cast) ParaCrux Materials	116.1	97,565.3	1.19	A	BUILT
TC-B10	O-ring 106.2 x 3.53 NBR 70 (ISO 3601)	Rubber SOLIDWORKS Materials	3.3	3,263.7	1.01	A	BUILT
TC-401	Chassis tray, sheet metal 3 mm 6061-T6	EN AW-6061 T6 ParaCrux Materials	214.4	79,423.9	2.70	A	BUILT
TC-402	Housing saddle, POM-C	POM-C ParaCrux Materials	71.6	50,752.7	1.41	A	BUILT
TC-501	Saddle clamp, 6061-T6 anodised orange	EN AW-6061 T6 ParaCrux Materials	118.2	43,779.6	2.70	A	BUILT
TC-502	Thruster post bracket, 6061-T6	EN AW-6061 T6 ParaCrux Materials	83.9	31,091.3	2.70	A	BUILT
TC-503	Tunnel spider, 6061-T6	EN AW-6061 T6 ParaCrux Materials	23.1	8,561.0	2.70	A	BUILT
TC-B01	Thruster, bought-in (envelope model)	POM-C ParaCrux Materials	202.5	143,609.9	1.41	A	BUILT
TC-B02	LED light module, bought-in (envelope)	EN AW-6061 T6 ParaCrux Materials	21.7	8,042.5	2.70	A	BUILT
TC-B03	Camera module, bought-in (envelope)	POM-C ParaCrux Materials	54.8	38,880.0	1.41	A	BUILT

16 of 16 part numbers built; CAD mass of these parts 4435.9 g, one of each (volume × material density; no supplier overrides yet). The density column is mass ÷ volume and shows that the intended material is applied; the stage logs' material_ok flag is the return of a void API call and is not evidence either way. cad/TC-100/parts.json · out/stages/*.json

Rev B (TideCrux 300): parts the change owns; every other part is referenced from Rev A

PN	Description	Material (library)	Mass (g)	Volume (mm³)	Density (g/cm³)	Rev	Status
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TC-301	Main housing tube, NPS 4 Sch 40 6061-T6	EN AW-6061 T6 ParaCrux Materials	1,327.0	491,480.0	2.70	B	BUILT
TC-302	Rear end cap, 6061-T6, 8 penetrator ports	EN AW-6061 T6 ParaCrux Materials	720.4	266,805.8	2.70	B	BUILT
TC-303	Front dome flange, 6061-T6	EN AW-6061 T6 ParaCrux Materials	264.5	97,961.7	2.70	B	BUILT
TC-304	Camera dome, cast PMMA, 10 mm wall	PMMA (cast) ParaCrux Materials	178.9	150,377.6	1.19	B	BUILT
TC-B10	O-ring 100.2 x 3.53 NBR 70 (ISO 3601)	Rubber SOLIDWORKS Materials	3.1	3,081.1	1.01	B	BUILT
TC-701	Gripper module, bought-in (envelope), on the front cross member	EN AW-6061 T6 ParaCrux Materials	227.0	84,062.9	2.70	B	BUILT

6 of 6 part numbers built; CAD mass of these parts 2720.9 g, one of each (volume × material density; no supplier overrides yet). The density column is mass ÷ volume and shows that the intended material is applied; the stage logs' material_ok flag is the return of a void API call and is not evidence either way. cad/TC-300/parts.json · out/stages/*.json

Common parts referenced by TC-300 from TC-100: TC-101, TC-201, TC-202, TC-401, TC-402, TC-501, TC-502, TC-503, TC-B01, TC-B02, TC-B03. out/change-300.json

SOLIDWORKS renders: assemblies



TC-100-front out\renders\TC-100-front.png



TC-100-isometric out\renders\TC-100-isometric.png



TC-100-top out\renders\TC-100-top.png



TC-300-front out\renders\TC-300-front.png

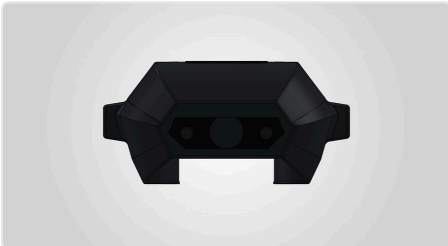


TC-300-isometric out\renders\TC-300-isometric.png



TC-300-top out\renders\TC-300-top.png

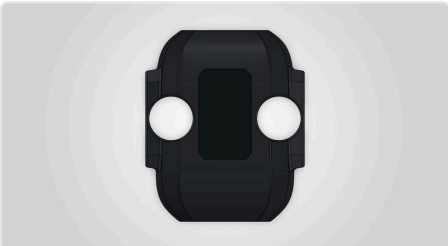
SOLIDWORKS renders: parts



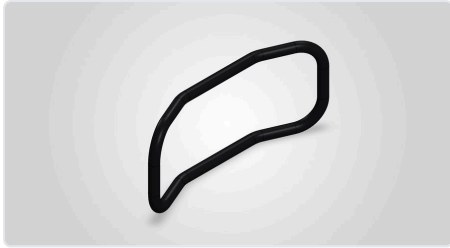
TC-101-100-front out\renders\TC-101-100-front.png



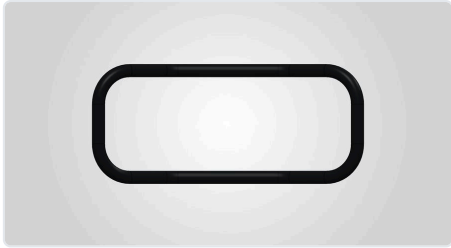
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TC-101-100-top out\renders\TC-101-100-top.png



TC-201-100-isometric out\renders\TC-201-100-isometric.png



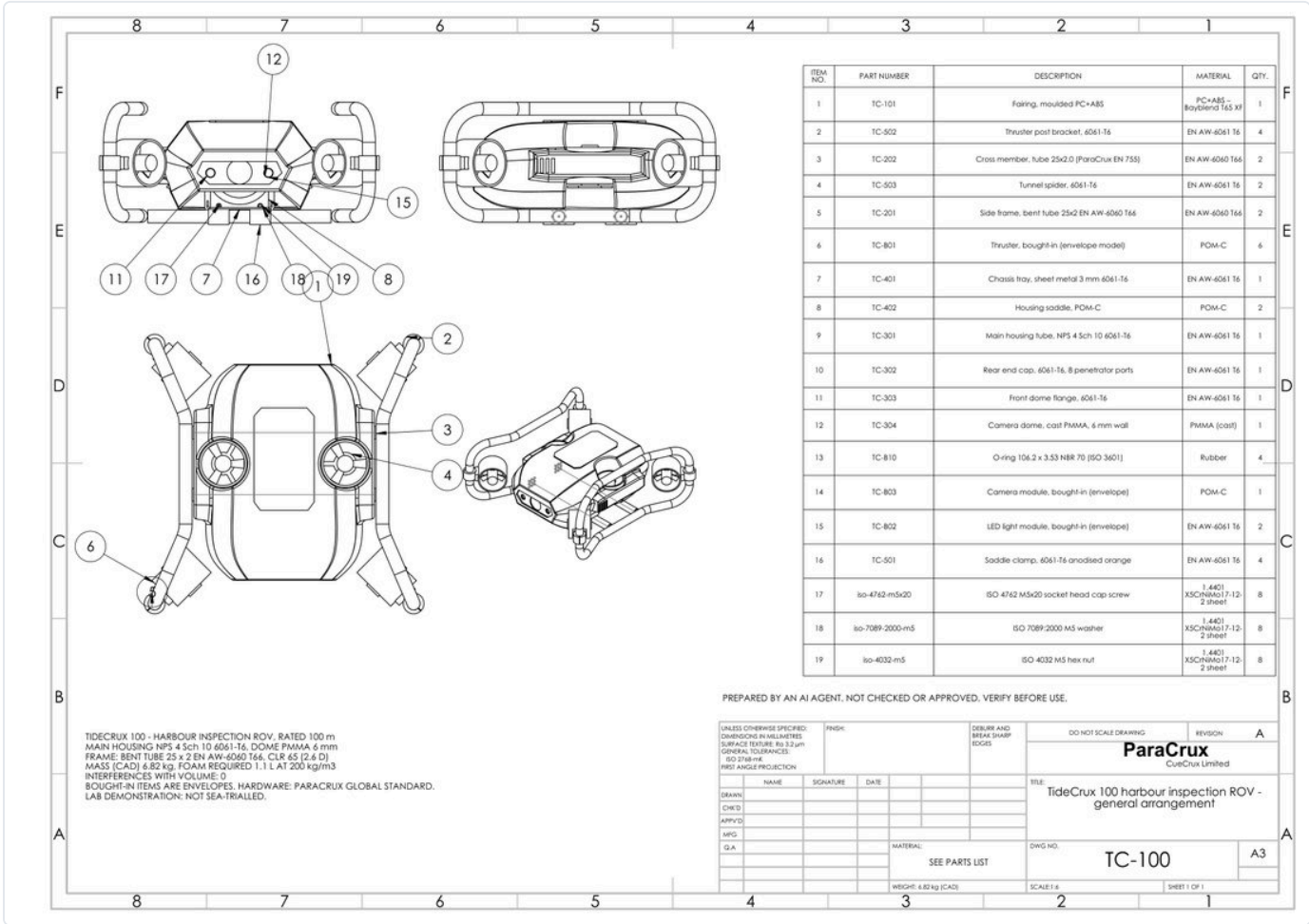
TC-201-100-right out\renders\TC-201-100-right.png



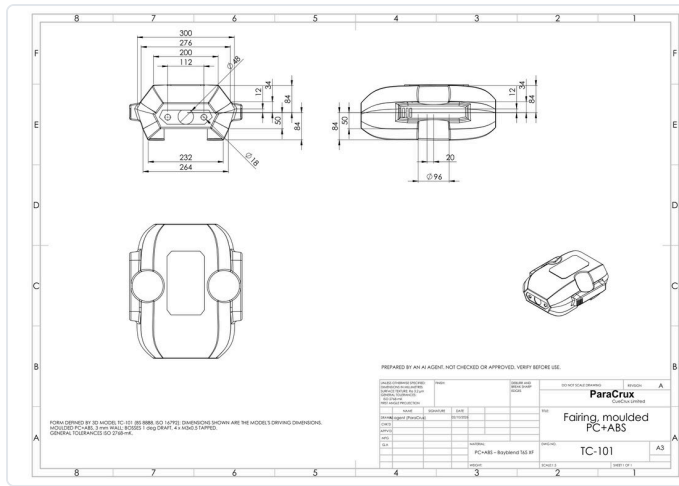
TC-201-100-top out\renders\TC-201-100-top.png

Drawings (BS 8888 sheets, SOLIDWORKS)

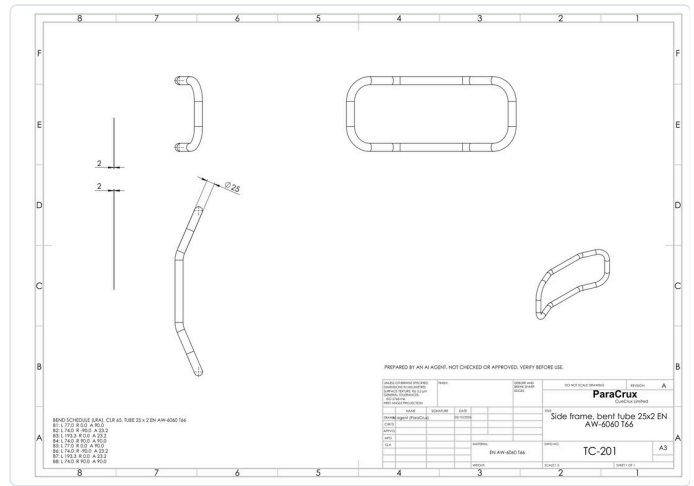
Rev A: 6 sheets. Layout warnings logged by the drawing stage: ('fit warning', 'view outlines overlap', 'Drawing View3', 'Drawing View4').



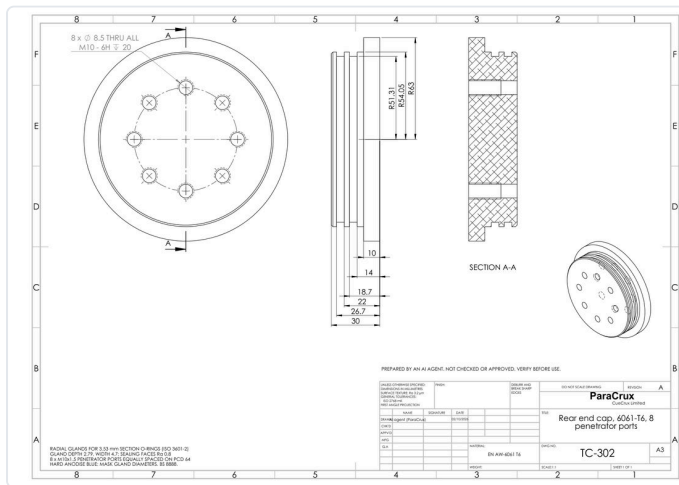
TC-100-GA cad\TC-100\drawings\TC-100-GA.pdf (re-rasterised from PDF)



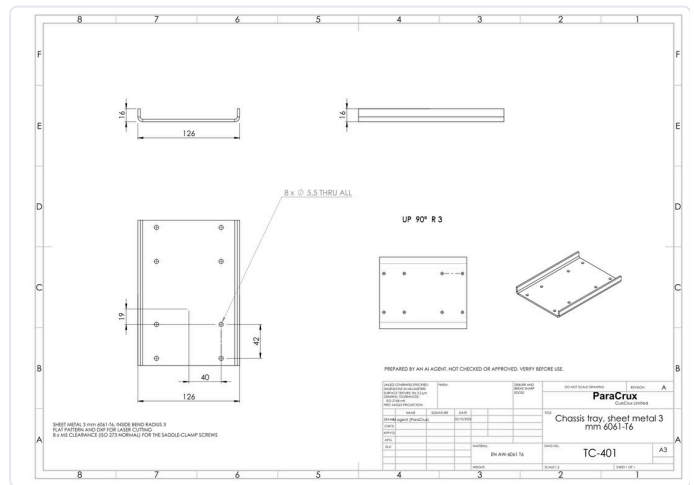
TC-101 cad\TC-100\drawings\TC-101.pdf (re-rasterised from PDF)



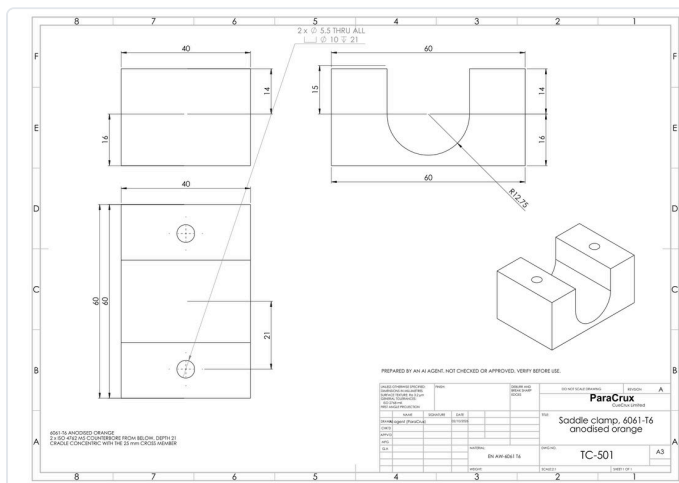
TC-201 cad\TC-100\drawings\TC-201.pdf (re-rasterised from PDF)



TC-302 cad\TC-100\drawings\TC-302.pdf (re-rasterised from PDF)



TC-401 cad\TC-100\drawings\TC-401.pdf (re-rasterised from PDF)



TC-501 cad\TC-100\drawings\TC-501.pdf (re-rasterised from PDF)

Manufacturing data: TC-401-flat.DXF (1:1 flat pattern).

Drawings are SOLIDWORKS output; they have not been audited against BS 8888 (R13 stays unproved). Rev B drawings (2 sheets) are in section 12.

Exports

TC-100: 21 files in the manifest. exports/TC-100/manifest.json

File	Size
TC-100.STEP	4952 KB
TC-100-BOM.csv	2 KB
TC-101.STEP	4157 KB
TC-201.STEP	148 KB
TC-202.STEP	14 KB
TC-301.STEP	14 KB
TC-302.STEP	83 KB
TC-303.STEP	54 KB
TC-304.STEP	22 KB
TC-401.STEP	82 KB
TC-402.STEP	13 KB
TC-501.STEP	44 KB
TC-502.STEP	31 KB
TC-503.STEP	37 KB
TC-B01.STEP	51 KB
TC-B02.STEP	9 KB
TC-B03.STEP	13 KB
TC-B10.STEP	11 KB
TC-201-bend-schedule.csv	0 KB
TC-401-flat.DXF	67 KB
TC-100.glb	2753 KB

TC-100 BOM (19 lines, 59 components, 6.814 kg) [exports\TC-100\TC-100-BOM.csv](#)

part	description	material	qty	mass_g_each	mass_g_total	source
TC-101	Fairing, moulded PC+ABS	PC+ABS – Bayblend T65 XF	1	1169.4	1169.4	TC-100
TC-201	Side frame, bent tube 25x2 EN AW-6060 T66	EN AW-6060 T66	2	526.8	1053.6	TC-100
TC-202	Cross member, tube 25x2.0 (ParaCrux EN 755)	EN AW-6060 T66	2	51.2	102.4	TC-100
TC-301	Main housing tube, NPS 4 Sch 10 6061-T6	EN AW-6061 T6	1	690.8	690.8	TC-100
TC-302	Rear end cap, 6061-T6, 8 penetrator ports	EN AW-6061 T6	1	772.0	772.0	TC-100
TC-303	Front dome flange, 6061-T6	EN AW-6061 T6	1	316.1	316.1	TC-100
TC-304	Camera dome, cast PMMA, 6 mm wall	PMMA (cast)	1	116.1	116.1	TC-100
TC-401	Chassis tray, sheet metal 3 mm 6061-T6	EN AW-6061 T6	1	214.4	214.4	TC-100
TC-402	Housing saddle, POM-C	POM-C	2	71.6	143.2	TC-100
TC-501	Saddle clamp, 6061-T6 anodised orange	EN AW-6061 T6	4	118.2	472.8	TC-100
TC-502	Thruster post bracket, 6061-T6	EN AW-6061 T6	4	83.9	335.6	TC-100
TC-503	Tunnel spider, 6061-T6	EN AW-6061 T6	2	23.1	46.2	TC-100

TC-B01	Thruster, bought-in (envelope model)	POM-C	6	202.5	1215.0	TC-100
TC-B02	LED light module, bought-in (envelope)	EN AW-6061 T6	2	21.7	43.4	TC-100
TC-B03	Camera module, bought-in (envelope)	POM-C	1	54.8	54.8	TC-100
TC-B10	O-ring 106.2 x 3.53 NBR 70 (ISO 3601)	Rubber	4	3.3	13.2	TC-100
iso-4032-m5	ISO 4032 M5 hex nut	1.4401 X5CrNiMo17-12-2 sheet	8	1.3	10.4	hardware
iso-4762-m5x20	ISO 4762 M5x20 socket head cap screw	1.4401 X5CrNiMo17-12-2 sheet	8	5.1	40.8	hardware
iso-7089-2000-m5	ISO 7089:2000 M5 washer	1.4401 X5CrNiMo17-12-2 sheet	8	0.5	4.0	hardware

TC-300: 11 files in the manifest. `exports/TC-300/manifest.json`

File	Size
TC-300.STEP	5024 KB
TC-300-BOM.csv	2 KB
TC-301.STEP	14 KB
TC-302.STEP	83 KB
TC-303.STEP	54 KB
TC-304.STEP	22 KB
TC-701.STEP	68 KB
TC-B10.STEP	11 KB
TC-201-bend-schedule.csv	0 KB
TC-401-flat.DXF	67 KB
TC-300.glb	2766 KB

TC-300 BOM (20 lines, 60 components, 7.636 kg) `exports\TC-300\TC-300-BOM.csv`

part	description	material	qty	mass_g_each	mass_g_total	source
TC-101	Fairing, moulded PC+ABS	PC+ABS – Bayblend T65 XF	1	1169.4	1169.4	TC-100 (common)
TC-201	Side frame, bent tube 25x2 EN AW-6060 T66	EN AW-6060 T66	2	526.8	1053.6	TC-100 (common)
TC-202	Cross member, tube 25x2.0 (ParaCrux EN 755)	EN AW-6060 T66	2	51.2	102.4	TC-100 (common)
TC-301	Main housing tube, NPS 4 Sch 40 6061-T6	EN AW-6061 T6	1	1327.0	1327.0	TC-300
TC-302	Rear end cap, 6061-T6, 8 penetrator ports	EN AW-6061 T6	1	720.4	720.4	TC-300
TC-303	Front dome flange, 6061-T6	EN AW-6061 T6	1	264.5	264.5	TC-300
TC-304	Camera dome, cast PMMA, 10 mm wall	PMMA (cast)	1	178.9	178.9	TC-300
TC-401	Chassis tray, sheet metal 3 mm 6061-T6	EN AW-6061 T6	1	214.4	214.4	TC-100 (common)
TC-402	Housing saddle, POM-C	POM-C	2	71.6	143.2	TC-100 (common)
TC-501	Saddle clamp, 6061-T6 anodised orange	EN AW-6061 T6	4	118.2	472.8	TC-100 (common)

TC-502	Thruster post bracket, 6061-T6	EN AW-6061 T6	4	83.9	335.6	TC-100 (common)
TC-503	Tunnel spider, 6061-T6	EN AW-6061 T6	2	23.1	46.2	TC-100 (common)
TC-701	Gripper module, bought-in (envelope), on the front cross member	EN AW-6061 T6	1	227.0	227.0	TC-300
TC-B01	Thruster, bought-in (envelope model)	POM-C	6	202.5	1215.0	TC-100 (common)
TC-B02	LED light module, bought-in (envelope)	EN AW-6061 T6	2	21.7	43.4	TC-100 (common)
TC-B03	Camera module, bought-in (envelope)	POM-C	1	54.8	54.8	TC-100 (common)
TC-B10	O-ring 100.2 x 3.53 NBR 70 (ISO 3601)	Rubber	4	3.1	12.4	TC-300
iso-4032-m5	ISO 4032 M5 hex nut	1.4401 X5CrNiMo17-12-2 sheet	8	1.3	10.4	hardware
iso-4762-m5x20	ISO 4762 M5x20 socket head cap screw	1.4401 X5CrNiMo17-12-2 sheet	8	5.1	40.8	hardware
iso-7089-2000-m5	ISO 7089:2000 M5 washer	1.4401 X5CrNiMo17-12-2 sheet	8	0.5	4.0	hardware

Appearances (ParaCrux appearance library, .p2m)

Appearance	ID	Roughness	Metallic	Used for (design.py)	Fidelity
 Moulded charcoal PC/ABS	paracrux.plastic.pcabs.charcoal.v1	0.55	0	fairing	authored-preset
 Safety orange ABS	paracrux.plastic.abs.orange.v1	0.38	0	clamp, prop	authored-preset
 Clear acrylic (PMMA)	paracrux.plastic.acrylic.clear.v1	0.02	0	dome	authored-preset
 Yellow syntactic foam	paracrux.composite.syntactic.yellow.v1	0.85	0	foam	authored-preset
 Black anodised aluminium	paracrux.aluminium.anodised.black.v1	0.4	1	tube, housing	authored-preset
 Blue anodised aluminium	paracrux.aluminium.anodised.blue.v1	0.38	1	cap	authored-preset
 Bead-blasted aluminium	paracrux.aluminium.beadblast.v1	0.64	1	-	authored-preset
 Brushed stainless steel	paracrux.steel.brushed.v1	0.32	1	steel	authored-preset
 Textured black ABS	paracrux.plastic.abs.black.v1	0.58	0	thruster	authored-preset
 Black EPDM rubber	paracrux.rubber.epdm.v1	0.88	0	-	authored-preset
 Cool white LED	paracrux.light.cool.v1	0.4	0	-	authored-preset
 Gunmetal	paracrux.steel.gunmetal.v1	0.35	1	-	authored-preset

Values are authored appearance choices, not measured material data. SOLIDWORKS roughness is not PBR roughness.
appearances/manifest.json

Referenced by design.py but not in the exported set: paracrux.composite.carbon.twill.v1,
paracrux.plastic.gloss.black.v1.

TideCrux ROV appearances (ParaCrux presets, exported as .p2m)



Moulded charcoal PC/ABS NEW
paracrux.plastic.pcabs.charcoal.v1
sRGB 46,49,54 r 0.55 m 0 op 1
Moulded charcoal PC ABS.p2m
p2m_sw_shader: defaultplastic



Safety orange ABS NEW
paracrux.plastic.abs.orange.v1
sRGB 236,108,22 r 0.38 m 0 op 1
Safety orange ABS.p2m
p2m_sw_shader: defaultplastic



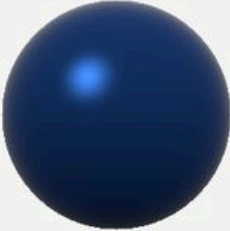
Clear acrylic (PMMA) NEW
paracrux.plastic.acrylic.clear.v1
sRGB 242,245,246 r 0.02 m 0 op 0.15
Clear acrylic (PMMA).p2m
p2m_sw_shader: clearglass



Yellow syntactic foam NEW
paracrux.composite.syntactic.yellow.v1
sRGB 232,186,38 r 0.85 m 0 op 1
Yellow syntactic foam.p2m
p2m_sw_shader: defaultplastic



Black anodised aluminium
paracrux.aluminium.anodised.black.v1
sRGB 30,31,34 r 0.4 m 1 op 1
Black anodised aluminium.p2m
p2m_sw_shader: satinfinishstainlesssteel



Blue anodised aluminium
paracrux.aluminium.anodised.blue.v1
sRGB 40,86,160 r 0.38 m 1 op 1
Blue anodised aluminium.p2m
p2m_sw_shader: satinfinishstainlesssteel



Bead-blasted aluminium
paracrux.aluminium.beadblast.v1
sRGB 171,180,188 r 0.64 m 1 op 1
Bead-blasted aluminium.p2m
p2m_sw_shader: mattesteel



Brushed stainless steel
paracrux.steel.brushed.v1
sRGB 169,180,190 r 0.32 m 1 op 1
Brushed stainless steel.p2m
p2m_sw_shader: brushedsteel



Textured black ABS
paracrux.plastic.abs.black.v1
sRGB 39,42,46 r 0.58 m 0 op 1
Textured black ABS.p2m
p2m_sw_shader: defaultplastic



Black EPDM rubber
paracrux.rubber.epdm.v1
sRGB 24,27,29 r 0.88 m 0 op 1
Black EPDM rubber.p2m
p2m_sw_shader: defaultplastic



Cool white LED
paracrux.light.cool.v1
sRGB 220,236,255 r 0.4 m 0 op 1
Cool white LED.p2m
p2m_sw_shader: defaultplastic



Gunmetal
paracrux.steel.gunmetal.v1
sRGB 72,76,82 r 0.35 m 1 op 1
Gunmetal.p2m
p2m_sw_shader: satinfinishstainlesssteel

Appearance swatches appearances\swatches.png

7a. Hardware from the ParaCrux Toolbox

All TideCrux fasteners come from the ParaCrux Global Standard library: release **rov-fastener-set-2026-10**, approved candidate hash 678325be21f74e4ab87c9307f2fe48282321e6e209b9869392bafc95bbd50089 (recorded at approval; the hash is not stored beside the items). Item records name their release as: rov-fastener-set-2026-10. Geometry is generated by the ParaCrux hardware generator; SOLIDWORKS parts are made on this machine from the published STEP, so no SOLIDWORKS-authored bytes are distributed.

Item	Label	Standard (edition)	Size	Grade	Sources	Generator	Volume (mm ³)	Mass (g)	SLDPRT (stage 06)
iso-4032-m4	ISO 4032 M4 hex nut	ISO 4032 (edition not stated by sources)	M4	A4-70	2	hardware-native-4	95.6	0.76	95.58 mm ³ = generator
iso-4032-m5	ISO 4032 M5 hex nut	ISO 4032 (edition not stated by sources)	M5	A4-70	2	hardware-native-4	168.2	1.35	168.22 mm ³ = generator
iso-4762-m3x8	ISO 4762 M3x8 socket head cap screw	ISO 4762 (edition not stated by sources)	M3 x 8	A4-70	4	hardware-native-4	120.8	0.97	120.79 mm ³ = generator
iso-4762-m4x12	ISO 4762 M4x12 socket head cap screw	ISO 4762 (edition not stated by sources)	M4 x 12	A4-70	4	hardware-native-4	289.1	2.31	289.15 mm ³ = generator
iso-4762-m5x20	ISO 4762 M5x20 socket head cap screw	ISO 4762 (edition not stated by sources)	M5 x 20	A4-70	4	hardware-native-4	641.8	5.13	641.78 mm ³ = generator
iso-7089-2000-m5	ISO 7089:2000 M5 washer	ISO 7089 (2000)		A4	2	hardware-native-4	56.5	0.45	56.48 mm ³ = generator
iso-7380-1-m5x10	ISO 7380-1 M5x10 button head screw	ISO 7380-1 (edition not stated by sources)	M5 x 10	A4-70	4	hardware-native-4	307.4	2.46	307.39 mm ³ = generator

Generator limitations (as stated by the generator): Simplified envelope; threads are not modelled. Edge chamfers are not modelled. Mass is envelope mass, not procurement mass. Simplified envelope; threads are not modelled. Hexagon corner chamfers and washer faces are not modelled (tapered revolve cuts are not supported by the kernel). Mass is envelope mass, not procurement mass.

Stage 06 converted 7 items to SLDPRT in cad/hardware/, each with its library document hash. cad/hardware/parts.json · out/stages/06-hardware-100.json

T6 proving run: library STEP to SOLIDWORKS

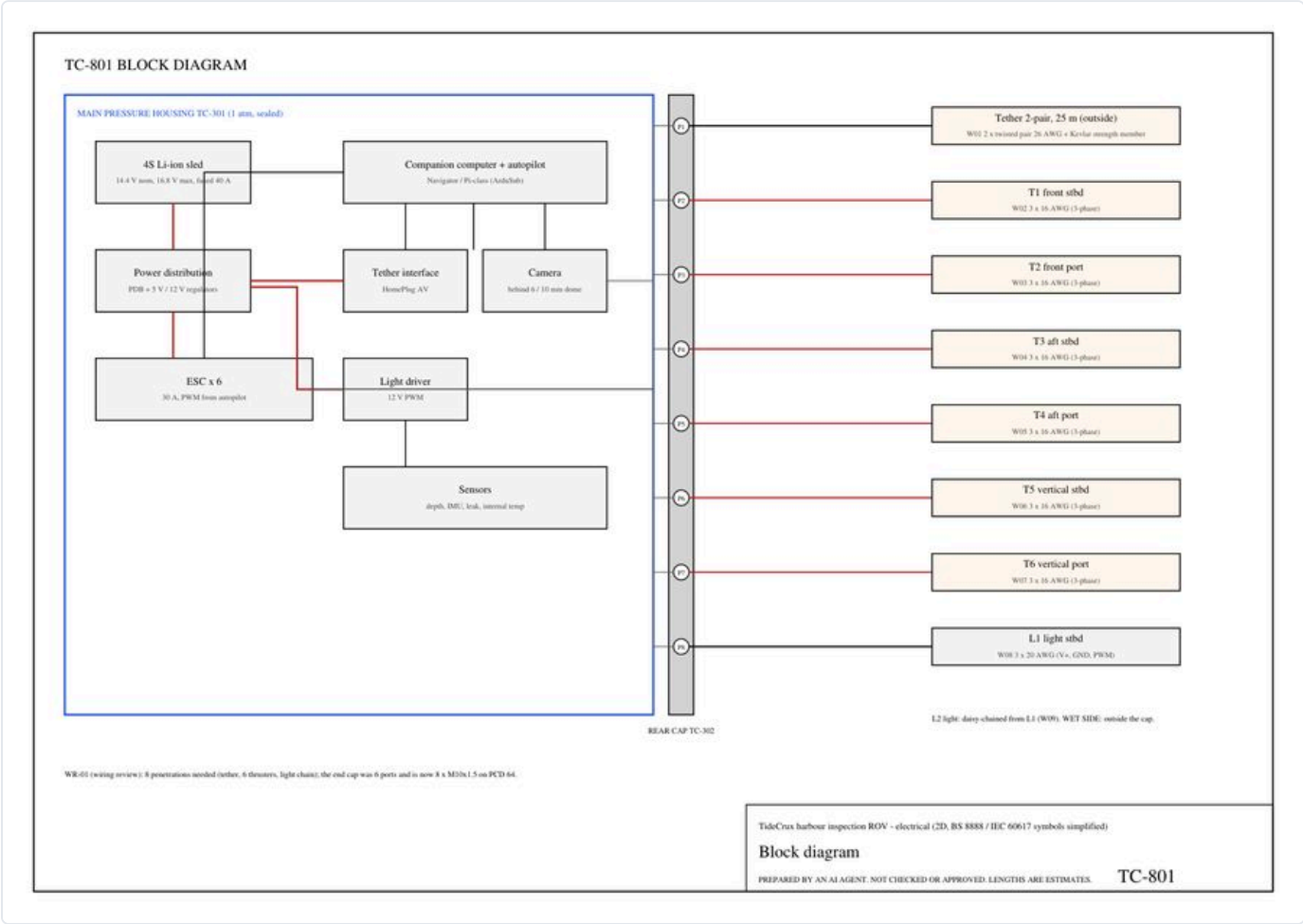
Item	Action	Volume rel. error	Mate reference	Material set	Message
iso-7089-2000-m6	written	4.4e-16	ParaCrux fastener	no	Material "acerinox-acx250-1-4401" is not in the ParaCrux material library, so SolidWorks has no material to as
iso-4762-m5x12	written	0.0e+00	ParaCrux fastener	yes	
iso-7380-1-m5x10	written	2.2e-16	ParaCrux fastener	yes	

Run 2026-10-01T20:24:25.8425101+01:00, overall ok = True. out/t6-solidworks-hardware.json

A further folder hardware-v4/ holds 23 items; this record cites only the approved hardware-std/ release.

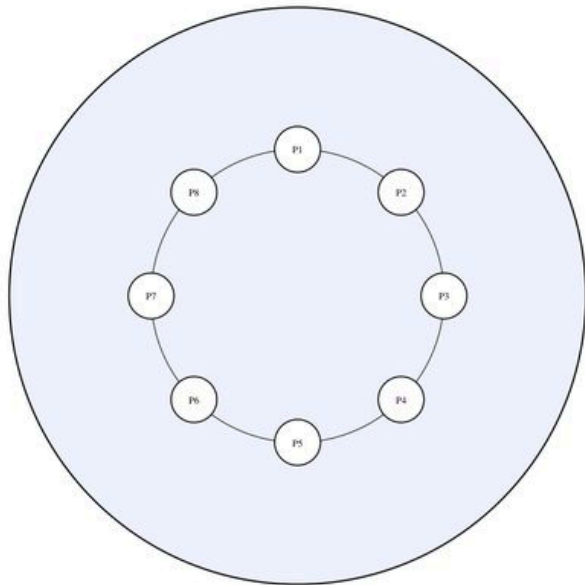
7b. Electrical system (2D, by ruling)

By the revision-2 ruling there is no 3D routing or harness: wiring is drawn the way electrical schematics are, from one wire-list source. Connectors and penetrators are physical parts on the end cap; wires, ties and labels are not modelled. **Lengths are estimates:** straight-line distances between ports plus declared service-loop and routing allowances, not routed lengths.



TC-801 system block diagram deliverables\wiring\TC-801-block.png

TC-803 REAR CAP PORT MAP AND HARNESS (VIEW FROM BEHIND)



WIRE LIST (TC-802)

WIRE	PORT	FROM	TO	CONDUCTORS	L mm
W01	P1	Tether interface J1	Tether 2 pair, 25 m	2 x twisted pair 26 AWG	550
W02	P2	ESC1	T1 front stbd	3 x 16 AWG (3-phase)	700
W03	P3	ESC2	T2 front port	3 x 16 AWG (3-phase)	650
W04	P4	ESC3	T3 aft stbd	3 x 16 AWG (3-phase)	450
W05	P5	ESC4	T4 aft port	3 x 16 AWG (3-phase)	450
W06	P6	ESC5	T5 vertical stbd	3 x 16 AWG (3-phase)	400
W07	P7	ESC6	T6 vertical port	3 x 16 AWG (3-phase)	400
W08	P8	Light driver	L1 light stbd	3 x 20 AWG (V+, GND, PWM)	600
W09	-	L1 light stbd	L2 light port	3 x 20 AWG (V+, GND, PWM)	300

NOTES

1. PENETRATORS: M10x1.5 WireLink class, O-ring face seal on the cap's outer face.
2. THRUSTER CABLES: manufacturer's PU-jacketed 3-core; cut to length + 150 mm service loop at the cap.
3. ROUTE: along the side-frame tubes, retained with stainless P-clips at $\approx$ 150 mm pitch; no strain on penetrators.
4. LENGTHS: estimated from design py positions ($\times$ 1.25 routing factor + 150 loops, rounded up to 50 mm).
5. Put all wire side terminations; continuity + insulation test (500 V DC, $>$ 100 MOhm) before sealing.

TideCrux harbour inspection ROV - electrical (2D, BS 8888 / IEC 60617 symbols simplified)

Rear cap port map, harness and wire list

PREPARED BY AN AI AGENT. NOT CHECKED OR APPROVED. LENGTHS ARE ESTIMATES.

TC-803

TC-803 flat harness drawing deliverables\wiring\TC-803-harness.png

TC-802 wire list deliverables\wiring\TC-802-wire-list.csv

wire	port	from	to	conductors	signal	length_mm
W01	P1	Tether interface J1 (inside)	Tether 2-pair, 25 m (outside)	2 x twisted pair 26 AWG + Kevlar strength member	Ethernet over HomePlug (Fathom-X class)	25000 (tether) + 550
W02	P2	ESC1 (inside)	T1 front stbd	3 x 16 AWG (3-phase), PU jacket	BLDC phases A/B/C, 16.8 V max	700
W03	P3	ESC2 (inside)	T2 front port	3 x 16 AWG (3-phase), PU jacket	BLDC phases A/B/C, 16.8 V max	650
W04	P4	ESC3 (inside)	T3 aft stbd	3 x 16 AWG (3-phase), PU jacket	BLDC phases A/B/C, 16.8 V max	450
W05	P5	ESC4 (inside)	T4 aft port	3 x 16 AWG (3-phase), PU jacket	BLDC phases A/B/C, 16.8 V max	450
W06	P6	ESC5 (inside)	T5 vertical stbd	3 x 16 AWG (3-phase), PU jacket	BLDC phases A/B/C, 16.8 V max	400
W07	P7	ESC6 (inside)	T6 vertical port	3 x 16 AWG (3-phase), PU jacket	BLDC phases A/B/C, 16.8 V max	400
W08	P8	Light driver (inside)	L1 light stbd	3 x 20 AWG (V+, GND, PWM)	12 V + PWM dimming	600
W09	- (L1 pass-through)	L1 light stbd	L2 light port	3 x 20 AWG (V+, GND, PWM)	daisy chain	300

9 wires; penetrator ports used: P1, P2, P3, P4, P5, P6, P7, P8 (8 of 8 on the rear cap) PASS. Vehicle-side cut-length estimate 4.50 m excluding the tether. See finding WR-01.

8. Frame bend schedule (TC-201)

Tube 25.0 × 2.0 mm EN AW-6060 T66, centreline bend radius (CLR) 65 mm = 2.6 D. LRA convention: L = straight before the bend, R = rotation of the bend plane from the previous bend, A = bend angle. One side frame is a closed loop of eight bends; port and starboard are the same part.

Bend	L straight (mm)	R rotation (deg)	A bend (deg)	Arc (mm)
1	77.0	0.0	90.0	102.1
2	74.0	-90.0	23.2	26.3
3	193.3	0.0	23.2	26.3
4	74.0	90.0	90.0	102.1
5	77.0	0.0	90.0	102.1
6	74.0	-90.0	23.2	26.3
7	193.3	0.0	23.2	26.3
8	74.0	90.0	90.0	102.1

Cut length **1,350.2 mm**; shortest straight between bends **74.0 mm** (3.0 D). `cad/TC-100/parts.json` (TC-201)

Exported bend schedule `exports\TC-100\TC-201-bend-schedule.csv`: 8 bends, matches the part cache.

Frame iteration history (concept job runs)

Run	Bends	Min straight (mm)	Cut length (mm)	Swept volume (mm³)	$\pi r^2 L$ check (mm³)	Concept interferences	Job output
2026-10-01 23:01	7	37.7	1,321.9	191,003.1	191,032.1	2	job-230103-365f62.out
2026-10-01 23:29	8	70.0	1,336.2	193,099.6	193,098.6	0	job-232726-732dbf.out
2026-10-01 23:31	8	70.0	1,336.2	193,099.6	193,098.6	0	job-233019-66da8a.out
2026-10-01 23:35	8	73.0	1,326.9	191,771.5	191,754.6	8	job-233500-404f44.out
2026-10-01 23:39	6	74.0	1,326.3	191,668.9	191,667.9	6	job-233820-648127.out
2026-10-02 00:05	6	74.0	1,326.3	191,668.9	191,667.9	16	job-000338-2cbd82.out
2026-10-02 00:27	8	74.0	1,350.2	195,122.8	195,121.8	0	job-002725-10d4a7.out
2026-10-02 00:38	8	74.0	1,350.2	195,122.8	195,121.8	16	job-003536-773ee9.out
2026-10-02 00:40	8	74.0	1,350.2	195,122.8	195,121.8	4	job-003908-d24e3a.out
2026-10-02 00:42	8	74.0	1,350.2	195,122.8	195,121.8	0	job-004107-b0f778.out

2026-10-02 00:44	8	74.0	1,350.2	195,122.8	195,121.8	0	job-004303- f924cf.out
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Every concept run of the side-frame path through the SOLIDWORKS job server, oldest first. The shortest straight (37.7 mm, 7-bend iteration) is manufacturing finding MR-01.

9. Standards register

Pressure methods are reference methods: the demo does not claim class approval or code compliance.
Drawing standard per decision D2: BS 8888 / ISO GPS.

Area	Standard / method	Used for
O-ring seals	ISO 3601-1 (sizes), ISO 3601-2 (housing dimensions); AS568 equivalence; supplier handbook for extrusion gap	Gland geometry, squeeze/fill/stretch table
External pressure	ASME BPVC VIII-1 UG-28 method and Windenburg–Trilling screening; DNV-RU-UWT as a reference for underwater vehicles	Housing schedule selection. FEA buckling study scope
Acrylic ports	ASME PVHO-1 as guidance only. The ROV is unmanned	Port/dome thickness ratios, seat geometry
Threads and fasteners	ISO 261/965 (metric threads), ISO 4762, ISO 7380, ISO 7089, ISO 273 clearance, ISO 3506-1 A4-70	Hole Wizard data, fastener selection
Corrosion and finish	Hard anodise (ISO 10074 / MIL-A-8625 Type III); galvanic series	R09 matrix, finish notes
Ingress	IEC 60529 IPX8 is only a label. The hydrostatic test is the evidence	Requirement wording
Drawings	BS 8888 (ISO GPS: ISO 128, 129-1, 1101, 5459, 2768-1/-2, 21920-1, 7200, 6410) <i>or</i> ASME Y14.5-2018	Every SLDDRW, GD&T on gland bores and the end-cap datum system
Modelling practice	Global modelling practice v1 (SK, HL, PT, FT, MF rules)	<code>audit_features.py</code>

origin/main (revision 3) : Design and drawing standards register

10. Design and manufacturing review findings

The formal DFM/DFA gate is held after the Rev A baseline passes its engineering checks and before drawings are released; no drawing is released while a **must fix** is open. The log below holds the findings made during the spikes, the build and the wiring and change reviews; the formal DFM/DFA review itself is **PENDING**. At least one finding must change the design: MR-01, WR-01 and CH-01 did. Status is re-derived from the evidence on every run.

Manufacturing and modelling findings

ID	Part / area	Finding	Decision and result	Status
MR-01 MUST FIX	TC-201 side frame Tube bending	An earlier 7-bend frame iteration had a 37.7 mm straight between bends (1.5 D on the 25 mm tube); shorter than the clamp length a rotary-draw bender needs between bends (about 2 D is a common shop minimum; bender supplier to confirm); its concept assembly also showed 2 interferences. jobs\job-230103-365f62.out (2026-10-01 23:01); cad/TC-100/parts.json	Bend points moved: 8-bend loop with the top runs mirroring the bottom runs After: Rev A TC-201: 8 bends, min straight 74.0 mm, cut length 1321.9 -> 1350.2 mm Decided by: agent (concept iteration); design frozen 2026-10-02 (owner review)	CLOSED
MR-02 MUST FIX	TC-101 fairing Moulded part	Shell versus decoration: a 3 mm hatch boss standing 2 mm proud collapsed the inward shell offset (found by suppression bisect). Convex blends below the wall (R3 on 3 mm) also failed the shell. scope rev 3 styling pass; out/stages/01-hull-100.json	Decorative bosses after the shell; convex blends larger than the wall (R4) After: Rev A hull build shells before the hatch Decided by: agent	CLOSED
MR-03 SHOULD FIX	TC-101 fairing Moulded part	Crowned surface: a flat-plane hatch boss on the crowned deck left islands (the hatch rendered as two panels). scope rev 3; tools/design.py	Offset-from-surface end condition or a separate hatch part; hatch narrowed to +/-58 mm to clear the tunnel rims After: design.py DECK_HATCH (2026-10-02) Decided by: agent	OPEN
MR-04 SHOULD FIX	TC-101, TC-302, TC-401, TC-501 Hole Wizard	Placement: Hole Wizard puts the hole where the face is picked (a face alone gives the face centre), so a hole is not positioned by design intent until its position sketch is dimensioned. The 2.5 mm drill-size string was refused (M3 tapped used). The first Hole Wizard call took 134 s (database load). out/spike-endcap.json; out/spike-fairing.json; out/stages/*.json	Locate every hole's position sketch by named dimensions (hw_locate); warn Hole Wizard up before recording After: 5 of 5 logged hole positions fully defined by named dimensions (section 4) Decided by: agent	CLOSED
MR-05 MUST FIX	TC-502 post bracket Hole Wizard	M4 clearance holes for the thruster strap are missing on the bracket tab: the cage spike logged the step ok with holes = False, and the Rev A bracket still has no Hole Wizard feature. out/spike-cage.json; out/audit-100.json	Open After: feature audit: TC-502 Hole Wizard features = 0 Decided by: -	OPEN

MR-06 SHOULD FIX	All parts Modelling practice (FT-02)	A sketch sharing its feature's name leaves the feature with its default name (Cut-Extrude3), breaking FT-02 and later select-by-name. scope rev 3 styling pass; out/audit-100.json	Sketch names distinct from feature names After: feature audit default names: 0 Decided by: agent	CLOSED
MR-07 MUST FIX	All parts Build method	A whole-body edge scan through COM on the blended hull hung SOLIDWORKS for about 16 minutes before it crashed. scope rev 3 styling pass	Take edges from the creating feature's own faces After: grouped blends in stage 01 select from feature faces Decided by: agent	CLOSED
MR-08 SHOULD FIX	TC-202 / TC-501 Assembly (DFA)	Front cross members at z = +95 landed off the chassis tray and in the tunnel outflow (z -68..28). tools/design.py (2026-10-02)	Cross members moved under the chassis tray, clear of the tunnel outflow After: CROSS_Z = +40, -80 mm Decided by: agent	CLOSED
MR-09 MUST FIX	TC-201 side frame Modelling practice (SK-01)	First design-intent build of the bend path (bend points dimensioned to planes from global variables) returned 'no solution'; the sweep had zero volume and the part saved with Equations and sketch errors. out/BUILD-LOG.md; out/stages/02-frame-100.json; cad/TC-100/parts.json	Rebuild the path with the same named variables until it solves; never fall back to Fixed points After: latest build 195,122.8 mm ³ , rebuild errors: none Decided by: agent	CLOSED
MR-10 NOTE	TC-101 fairing Moulded part	Hatch edge chamfer selection from the feature's faces picked skin edges too; the drafted rib returns null through the API. out/spike-style.json; out/spike-fairing.json	Open (styling) After: - Decided by: -	OPEN

Design-review findings (wiring, change impact, materials, layout)

ID	Part / area	Finding	Decision and result	Status
WR-01 MUST FIX	TC-302 rear end cap Wiring review	The rear cap needed 8 penetrations (tether, 6 thrusters, light chain) but had 6 ports. tools/design.py HOUSING (WR-01 note); deliverables/wiring/TC-802-wire-list.csv; out/stages/03-housings-100.json	8 x M10x1.5 on PCD 64 After: 24.5 mm between port centres; wire list uses 8 ports; cap built with 'circular pattern x8 (equal spacing)' Decided by: agent (wiring review)	CLOSED
CH-01 MUST FIX	TC-304 dome / TC-B03 camera Change impact (Rev B)	The 10 mm Rev B dome clipped the camera envelope. Interference detection caught it (2 failed Rev B assembly run(s) in the build log). out/BUILD-LOG.md; out/verify-300.json; tools/asm_tc.py (CH-01 rule)	Camera station derived from the dome inner radius with 2 mm sphere clearance, not a fixed offset After: Rev B assembly: 0 unexpected interferences Decided by: agent (change check)	CLOSED
MAT-GAP-01 SHOULD FIX	TC-B10 O-rings Material library	The ParaCrux material library has no elastomers (NBR/FKM), so the O-rings cannot take a ParaCrux material. cad/TC-100/parts.json; cad/TC-300/parts.json; tools/design.py	Stock SOLIDWORKS 'Rubber' until the library adds elastomers After: TC-B10 material: Rubber (SOLIDWORKS Materials) Decided by: agent	OPEN

LR-01 SHOULD FIX	TC-401 chassis tray Layout	The tray must stay clear of the vertical-thruster tunnels. tools/parts_chassis.py TRAY; tools/design.py	Tray narrowed to 126 mm After: tray half-width 63 mm against the tunnel rim at about x = 67 mm Decided by: agent	CLOSED
LR-02 SHOULD FIX	TC-501 saddle clamps Layout	Each 40 mm clamp must land fully under the tray. tools/design.py CLAMP	Clamps at x = +/-40 mm After: clamp outer edge at x = 60 mm, inside the tray half-width of 63 mm Decided by: agent	CLOSED
LR-03 SHOULD FIX	TC-402 saddles Load path	Housing loads should pass straight down: housing, saddle, tray, clamp, tube. tools/asm_tc.py	Saddles placed at the cross-member stations After: assembly places TC-402 at CROSS_Z Decided by: agent	CLOSED
LR-04 SHOULD FIX	TC-402 saddle / TC-401 tray Layout	The saddle must sit on the flat of the tray, not on its bend radius. tools/parts_chassis.py TRAY, SADDLE	Saddle half-width 56 mm After: 1.0 mm clear of the inside bend (tray half-width - wall - bend radius - saddle half-width) Decided by: agent	CLOSED

Expected by the scope, still to confirm (not findings)

- Fastener sizes and drive types can be consolidated.
- Corner radii in the HDPE plates need opening up to the router tool.
- Gland bores need masking from anodise, or a stated pre-finish size.
- The flange screw count is set by sealing pressure, not stress.
- Some tray standoffs can merge into a machined spacer.

Review areas

Review area	What is checked	Tool / evidence
Machined parts (end caps, flanges, tray)	Setups and fixturing; tool access and reach-to-diameter; internal corner radius vs cutter (MF-02); thin walls and ligaments; hole depth vs drill; thread depth vs tap; datum strategy matching the setups	DFMXpress run per part (installed, API status to confirm), plus a reviewer table per part
Anodised aluminium	Masking of sealing bores and threads; coating build-up allowance on gland diameters; galvanic isolation after finishing	Finish note and masking callout on the drawing; adjusted pre-finish dimensions
HDPE plates	Router tool radius in DXF corners; thermal expansion and stress relief; holes vs plate edge; screw retention in PE (through-bolt vs threaded insert)	DXF check script; fastener joint table
Sheet metal brackets	Minimum flange length, bend relief, hole-to-bend distance, grain/bend direction, standard gauge and bend radius	SW sheet-metal flat-pattern checks, DXF
Moulded and cast parts	Draft on all pulled faces; uniform wall; rib ratio; gate/parting line feasibility; undercuts	SW draft analysis, thickness analysis
Tolerances and cost	Tolerances tighter than function needs; stack-up on the end-cap/tube/O-ring fit; ISO 2768 class choice	Stack-up sheet for the gland fit; flagged tight tolerances
Assembly (DFA)	Part count; fastener rationalisation (unique sizes and drive types); tool access and torque-wrench clearance; O-ring installation without twisting or passing threads; error-proofing of thruster orientation and connector keys; assembly order with the harness in place	DFA scorecard (part count, fastener types, operations); assembly sequence trial using SW exploded steps

Wiring manufacture	Crimp contact and tooling commonality; harness build on a nail board; label legibility; potting or overmould process for penetrator pigtails	Harness drawing review
Make/buy and supply	Stock availability (MF-01); single-source vendor items; lead-time risks; spare parts	Procurement BOM with supplier and alternate columns
Cost (optional)	Rough part cost per process for the top 10 manufactured parts	SW Costing if licensed and API-reachable; otherwise a transparent rate x time sheet, labelled as an estimate

11. Verification

Each check renders here as soon as its evidence file exists; the state column says what exists, not what passed.

Check	Evidence	Produced by	State
Mass, CG, buoyancy, interference	out/verify-*.json	stage 07 assembly	PRESENT
Feature-standard audit (SK/HL/PT/FT/MF, seeded negative)	out/audit-*.json	stage 08	PRESENT
Drawings	cad/TC-*/drawings/*.pdf	stage 09	PRESENT
Rev B change record and equation check	out/change-*.json	stage 10	PRESENT
Exports (STEP, glb, BOM, bend CSV)	exports/TC-*/manifest.json	stage 11	PRESENT
Bend schedule check	out/bend-*.json	-	PENDING
Drawing audit to BS 8888	-	not built	PENDING
FEA linear buckling with imperfection (housing)	-	decision D4	PENDING
Hydrostatic proof test (1.26 / 3.77 MPa)	-	not in this demo	UNPROVED
Tank trim and buoyancy check	-	not in this demo	UNPROVED

Mass, CG and buoyancy (CAD)

Quantity	Rev A	Rev B
Components	59	60
CAD mass	6.815 kg	7.637 kg
CG (x, y, z)	-0, -11.4, -14.1 mm	-0, -14, -9 mm
Material volume	3.718 L	4.052 L
Displaced volume	5.935 L	6.019 L
Net buoyancy without foam	-0.731 kg	-1.467 kg
Foam density	200 kg/m ³	400 kg/m ³
Foam for +0.15 kg	1.07 L	2.59 L

Interference detection

Rev	Components	Volume (mm ³)	Class	Reason
100	TC-301-1 / TC-B10-2	509.4	expected	O-ring radial squeeze 21% (designed)
100	TC-301-1 / TC-B10-4	509.4	expected	O-ring radial squeeze 21% (designed)
100	TC-301-1 / TC-B10-3	509.4	expected	O-ring radial squeeze 21% (designed)
100	TC-301-1 / TC-B10-1	509.4	expected	O-ring radial squeeze 21% (designed)
300	TC-301-1 / TC-B10-1	481.6	expected	O-ring radial squeeze 21% (designed)
300	TC-301-1 / TC-B10-3	481.6	expected	O-ring radial squeeze 21% (designed)
300	TC-301-1 / TC-B10-4	481.6	expected	O-ring radial squeeze 21% (designed)
300	TC-301-1 / TC-B10-2	481.6	expected	O-ring radial squeeze 21% (designed)

Expected interferences are the designed O-ring squeeze; any other interference fails the check. out/verify-100.json · out/verify-300.json

The CAD mass covers modelled components only: no foam, battery, electronics, penetrators, harness or ballast. CB is not yet computed, so R06 stays unproved.

Feature-standard audit, Rev A [out/audit-100.json](#) · [out/audit-100.md](#)

16 parts, 38/38 sketches fully defined, 0 Fixed relations.

Part	Sketches defined	Fixed	Default names	Hole Wizard	Patterns	Mirrors	Equations	Findings
TC-101	14/14	0	0	1	1	4	0	none
TC-201	1/1	0	0	0	0	0	41	none
TC-202	1/1	0	0	0	0	0	2	none
TC-301	1/1	0	0	0	0	0	6	none
TC-302	1/1	0	0	1	1	0	0	none
TC-303	2/2	0	0	0	0	0	0	none
TC-304	1/1	0	0	0	0	0	4	none
TC-401	1/1	0	0	1	1	2	0	none
TC-402	2/2	0	0	0	0	0	0	none
TC-501	2/2	0	0	1	0	1	0	none
TC-502	4/4	0	0	0	0	0	0	none
TC-503	2/2	0	0	0	1	0	0	none
TC-B01	3/3	0	0	0	1	0	0	none
TC-B02	1/1	0	0	0	0	0	0	none
TC-B03	1/1	0	0	0	0	0	0	none
TC-B10	1/1	0	0	0	0	0	0	none

HL-01 reviews (circular cuts that are not Hole Wizard holes):

Part	Cut	Disposition
TC-101	Thruster tunnels	flow opening for the vertical thrusters (not a fastener hole)
TC-101	Camera window bore	optical opening behind the visor
TC-101	Light bores	optical openings for the LED modules
TC-303	Dome bore	optical opening for the camera dome
TC-402	Housing cradle	saddle seat concentric with the housing (not a hole)
TC-502	Duct seat cut	thruster duct seat (not a fastener hole)

Seeded negative part PASS flagged with: SK-01 sketches not fully defined: Sketch1; USER RULE Fixed relations used: 1; FT-02 default names: Sketch1, Boss-Extrude1, Sketch2, Cut-Extrude1.

Feature-standard audit, Rev B [out/audit-300.json](#) · [out/audit-300.md](#)

6 parts, 10/10 sketches fully defined, 0 Fixed relations.

Part	Sketches defined	Fixed	Default names	Hole Wizard	Patterns	Mirrors	Equations	Findings
TC-301	1/1	0	0	0	0	0	6	none
TC-302	1/1	0	0	1	1	0	0	none

TC-303	2/2	0	0	0	0	0	0	none
TC-304	1/1	0	0	0	0	0	4	none
TC-701	4/4	0	0	0	0	0	0	none
TC-B10	1/1	0	0	0	0	0	0	none

HL-01 reviews (circular cuts that are not Hole Wizard holes):

Part	Cut	Disposition
TC-303	Dome bore	optical opening for the camera dome
TC-701	Mount bore (on the cross member)	gripper mount bores onto the 25 mm cross member (not a fastener hole)

Seeded negative part PASS flagged with: SK-01 sketches not fully defined: Sketch1; USER RULE Fixed relations used: 1; FT-02 default names: Sketch1, Boss-Extrude1, Sketch2, Cut-Extrude1.

12. Revision B change summary

Change request: re-rate TideCrux 100 to 300 m and add a one-function gripper; keep the frame footprint, battery and electronics tray. The design changes only through catalogue choices recorded in `design.py` REVS.

Parameter	Rev A	Rev B	Reason (screening)
depth_m	100	300	change request
housing_wall	3.05	6.02	follows the schedule
housing_schedule	NPS 4 Sch 10	NPS 4 Sch 40	Sch 10 margin $2.75x < 3x$; Sch 40 15.2x
dome_t	6.0	10.0	dome membrane needs ≥ 9.4 mm at Rev B; a flat port would need 27.6 mm
foam_density	200	400	shallow foam not rated for 300 m; deep grade needs 5.70 L (screening)
gripper	False	True	change request

out/change-300.json

Equation check PASS

Editing one global, "housing_wall" = 6.02, on the Rev A tube gives 491,480.0 mm³; the regenerated Rev B TC-301 is 491,480.0 mm³. They match exactly: the change is carried by the design's own equations, not by remodelling.

Regenerated parts

Part	Rev A volume (mm ³)	Rev B volume (mm ³)	Rev A mass (g)	Rev B mass (g)	Δ mass (g)	Rev B errors
TC-301	255,835.6	491,480.0	690.8	1,327.0	+636.2	none
TC-302	285,934.2	266,805.8	772.0	720.4	-51.6	none
TC-303	117,090.1	97,961.7	316.1	264.5	-51.6	none
TC-304	97,565.3	150,377.6	116.1	178.9	+62.8	none
TC-B10	3,263.7	3,081.1	3.3	3.1	-0.2	none
TC-701	new	84,062.9	-	227.0	new part	none

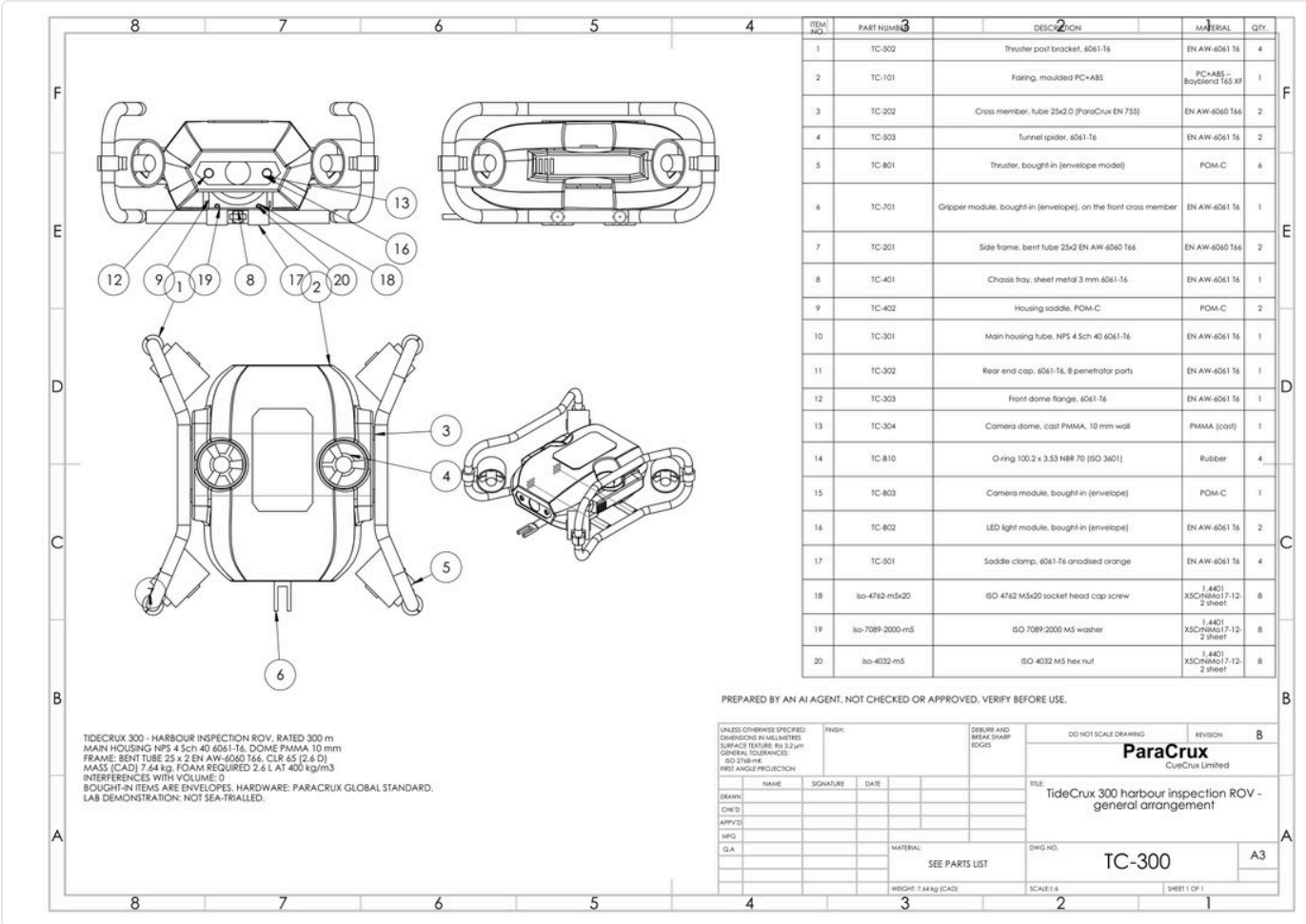
11 common parts are referenced from TC-100 unchanged: TC-101, TC-201, TC-202, TC-401, TC-402, TC-501, TC-502, TC-503, TC-B01, TC-B02, TC-B03. out/change-300.json · cad/TC-300/parts.json

Note on the end caps. The scope expected thicker caps at Rev B; the Rev B caps are lighter, because the plug follows the smaller Sch 40 bore while the flange stays 10.0 mm. The screening minimum at Rev B is 9.3 mm, so the unchanged flange passes screening; stress, thread engagement and the extrusion gap at Rev B still need checking.

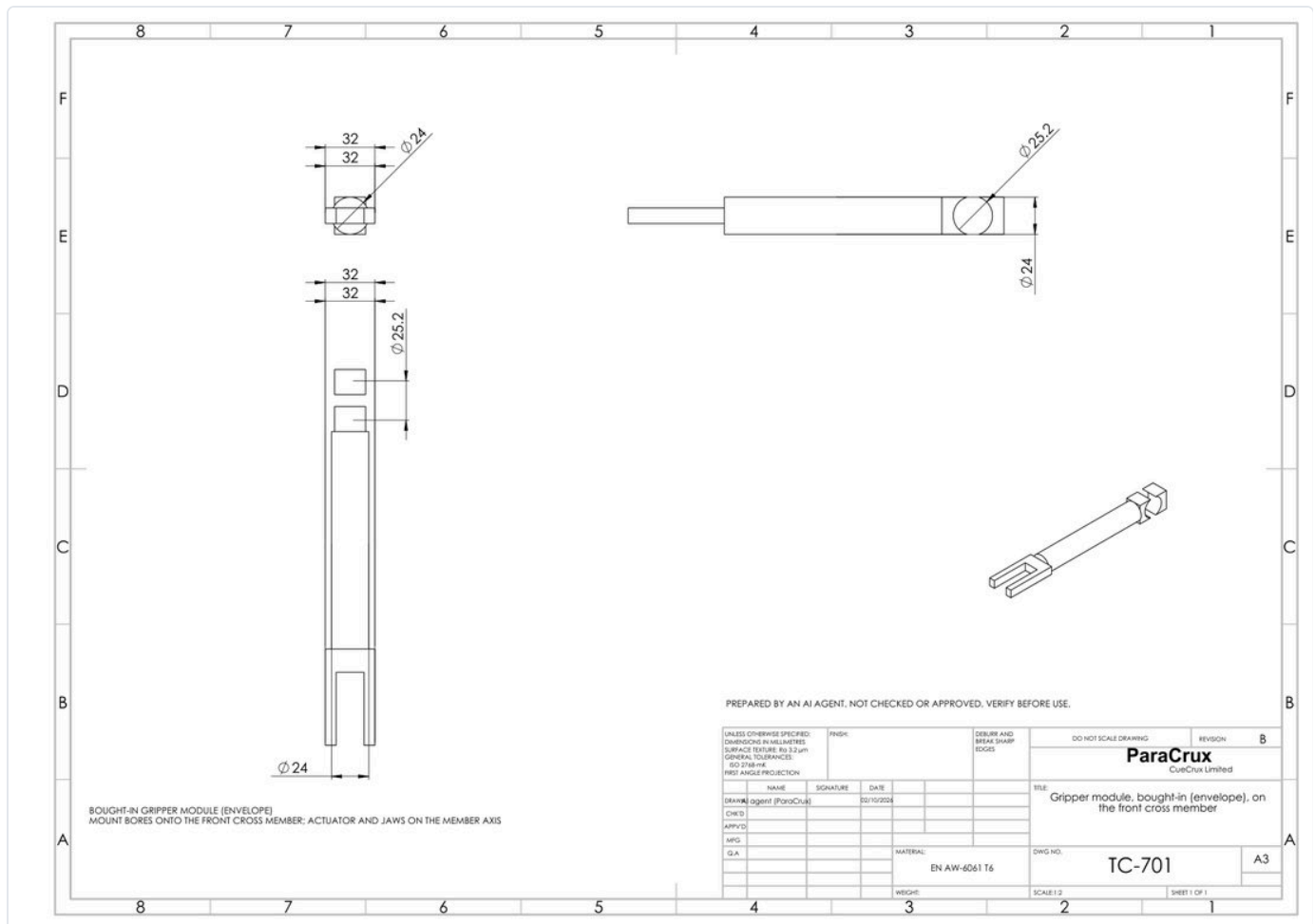
Assembly: Rev B has 60 components (Rev A 59); CAD mass 7.637 kg (+0.822 kg); foam needed 2.59 L at 400 kg/m³ (Rev A 1.07 L at 200 kg/m³); 0 unexpected interferences. The 10 mm dome first clipped the camera: 2 Rev B assembly run(s) failed interference detection before the fix (finding CH-01).

Feature audit on the changed parts: 6 parts, 10/10 sketches fully defined, 0 Fixed relations, 0 findings (section 11).

Rev B drawings



TC-300-GA cad\TC-300\drawings\TC-300-GA.pdf (re-rasterised from PDF)



TC-701 cad\TC-300\drawings\TC-701.pdf (re-rasterised from PDF)



TC-300-front out\renders\TC-300-front.png



TC-300-isometric out\renders\TC-300-isometric.png

Still to do for Rev B

- Every R-check rerun with acceptance evidence (R02-R11 are unproved for both revisions).
- Manufacturing review repeated on the changed items (Sch 40 tube, dome seat, thicker caps, gripper mount, foam grade): PENDING
- HL-01 disposition of the TC-701 mount bore, if the audit still lists it as unreviewed.

13. Limitations and honesty notes

- **Lab route.** The CAD is built by an AI agent driving SOLIDWORKS 2026 through its API (COM job server). Sketches and features are created by API calls, not by a person in PropertyManagers. This record does not demonstrate native ParaCrux assembly parity.
- **No physical tests.** No hydrostatic proof test, tank trim check, thruster test or sea trial has been performed. Every pressure, buoyancy, drag and stress figure is a screening calculation with stated assumptions; the FEA buckling study is pending.
- **Envelope models.** Thrusters, lights, camera and gripper are envelope models from nominal dimensions, not supplier CAD. Library fasteners, as their generator states: Simplified envelope; threads are not modelled. Hexagon corner chamfers and washer faces are not modelled (tapered revolve cuts are not supported by the kernel). Mass is envelope mass, not procurement mass.
- **Incomplete mass.** The CAD mass has no foam, battery, electronics, penetrators, harness or ballast, so R02 and R06 cannot be proved from it.
- **CAM gate.** CAM is out of this demo (revision 2 ruling). The CAM add-in loads and returns an API object, but no toolpath or G-code has been generated.
- **Routing gate.** SOLIDWORKS Routing is not installed (G0a), so there is no 3D harness. Wiring is a 2D block diagram, wire list and flat harness drawing; cut lengths are estimates (straight-line port distances plus declared allowances), not routed lengths.
- **M4 bracket hole still open.** The thruster-strap M4 clearance holes on the TC-502 post bracket have not been built (MR-05); the feature audit finds no Hole Wizard feature on the part.
- **Assembly placement.** Components are placed at documented positions rather than mated, so mate-error checks (R14's 'no broken mates') are not exercised.
- **Material library gap.** O-rings use stock SOLIDWORKS 'Rubber' (MAT-GAP-01); the stage logs' `material_ok` flag is the return of a void API call and is not evidence.
- **Requirements are proposals.** R01-R14 are revision-0 proposals for discussion, not cited class rules. R01 conflicts with the revision-3 cage and needs re-baselining.
- **Work in progress.** This record is regenerated from whatever evidence exists. Missing evidence is shown as pending, and a status is never upgraded without its evidence file. A stage step's *ok* flag is the builder's own judgement; the feature audit and the verification files, not the step log, are the acceptance evidence.

Appendix A. Capability spike evidence (G0 and styling)

File	Run	Steps ok	Failed steps
spike-addins.json	2026-10-01 18:24	3 / 3	none
spike-cage.json	2026-10-02 00:44	7 / 7	none
spike-endcap-log.json	2026-10-01 18:14	-	none
spike-endcap.json	2026-10-01 18:14	11 / 11	none
spike-fairing.json	2026-10-01 21:16	12 / 15	Hole Wizard pilot in boss; drafted rib; structural member CHS 33.7x3.2 (ParaCrux EN)
spike-hardware.json	2026-10-01 18:22	2 / 2	none
spike-harness.json	2026-10-01 18:21	6 / 6	none
spike-scale.json	2026-10-01 18:19	13 / 13	none
spike-style.json	2026-10-02 00:27	20 / 21	hatch edge chamfer 0.8
spike-timing.json	2026-10-01 18:15	7 / 7	none

G0 conclusions (scope)

Gate	Result	Evidence and consequence
G0a Routing	Not available. Premium covers Routing, but the add-in is not installed: only the interop DLL, help and data are present, <code>GetRouteManager()</code> returns null, and no Routing add-in is registered	Adding it is an operator action (modify the SOLIDWORKS installation). The fallback is proven: 3D-sketch spline through clip points, then a circular-profile sweep with no profile sketch. Swept volume matches $\pi r^2 L$ to 0.02 %. Length (409.4 mm) and minimum bend radius (124 mm against a 36 mm limit) are measured from the curve. Cable ties are placed at a 60 mm pitch along the tangent, with 0.0 mm centreline offset. One trap: <code>AddComponent5</code> places a component by its bounding box, so always set <code>Transform2</code> ; the first try put the cable 100+ mm away and the interference check passed falsely
G0b Live viewport	Pass. <code>ffmpeg</code> <code>gdigrab</code> recorded the live viewport and <code>FeatureManager</code> while the end cap built (<code>video/g0b-181206.mp4</code>). The display was kept awake with <code>SetThreadExecutionState</code> plus a monitor-on broadcast before SW started	The SW window maximises across the 7680×2100 monitor. The film run must place SW in a fixed 16:9 window (2560×1440 or 3840×2160)

G0c Scale	Pass. 1,201 components with graphics on. 100 fasteners inserted and mated to real hole faces: 0.38 s insertion plus 0.16 s per mate, 0 failures. 1,100 batch-inserted with AddComponent s3 in 12.4 s. Rebuild 1.8 s, 36 view rotations 0.6 s, save 1.9 s, reopen 2.6 s	Projected SW time for the full build is about 1–1.5 hours: ~2,500 features at ~0.6 s, ~1,200 insertions and mates at ~0.7 s, ~50 sheets. Real assemblies have ~150 unique files rather than one, so re-measure on the first real subassembly
G0d Fasteners	Pass, via the ParaCrux library. crux-hardware.exe (managed-library release build) generated the approved ISO 7089 M6 washer and a spike-only ISO 4762 M5×12 as STEP. SOLIDWORKS imported each as one body with volume and mass matching the generator exactly . The material was assigned from the registered "ParaCrux Materials" database (1.4401), and the library stamp was written as custom properties. About 2.5 s per part	Current library geometry is an envelope: no socket, threads, chamfers or radii. Imported parts have no named axis, planes or mate reference. Both are closed by the Toolbox track below
G0e Production tools	CAM: the add-in loads and returns an API object, but toolpath generation is unproven. Inspection: the add-in loads but exposes no automation object through SOLIDWORKS	CAM G-code remains optional pending a toolpath spike. The inspection plan uses ballooned drawings plus a generated characteristic table
Other	Hole Wizard's first call took 134 s (database load); later calls take ~0.5 s. FullyDefineSketch returned 0 and left sketches under-defined, even with explicit datums	Warm up Hole Wizard before recording. Keep explicit relations and named dimensions, which SK-02 and SK-04 want anyway

Appendix B. Evidence inventory

Every input this run read, with its state. Re-run `python tools/record_doc.py` to pick up new evidence.

Group	Input	Path	State	Detail
Scope	Demo scope (R01-R14, matrices, registers)	origin\main\paracrux\ExecPlans\Research\2026-10-01-underwater-rov-demo-scope.md	PRESENT	revision 3
Calculations	Sizing calculations (sizing.json)	D:\ParaCrux\paracrux\ExecPlans\Research\2026-10-01-underwater-rov-sizing.json	PRESENT	2026-10-01 17:49
Design	Frozen design (design.py)	tools\design.py	PRESENT	2026-10-02 02:27
Design	BUILD-PLAN.md	BUILD-PLAN.md	PRESENT	2026-10-02 02:26
Stage logs	out\BUILD-LOG.md	out\BUILD-LOG.md	PRESENT	2026-10-02 03:36
Stage logs	out\stages\01-hull-100-rec.json	out\stages\01-hull-100-rec.json	PRESENT	2026-10-02 03:16
Stage logs	out\stages\01-hull-100.json	out\stages\01-hull-100.json	PRESENT	2026-10-02 02:48
Stage logs	out\stages\02-frame-100-rec.json	out\stages\02-frame-100-rec.json	PRESENT	2026-10-02 03:17
Stage logs	out\stages\02-frame-100.json	out\stages\02-frame-100.json	PRESENT	2026-10-02 02:48
Stage logs	out\stages\03-housings-100-rec.json	out\stages\03-housings-100-rec.json	PRESENT	2026-10-02 03:18

Stage logs	out\stages\03-housings-100.json	out\stages\03-housings-100.json	PRESENT	2026-10-02 02:49
Stage logs	out\stages\04-chassis-100-rec.json	out\stages\04-chassis-100-rec.json	PRESENT	2026-10-02 03:19
Stage logs	out\stages\04-chassis-100.json	out\stages\04-chassis-100.json	PRESENT	2026-10-02 02:49
Stage logs	out\stages\05-details-100-rec.json	out\stages\05-details-100-rec.json	PRESENT	2026-10-02 03:21
Stage logs	out\stages\05-details-100.json	out\stages\05-details-100.json	PRESENT	2026-10-02 02:50
Stage logs	out\stages\06-hardware-100-rec.json	out\stages\06-hardware-100-rec.json	PRESENT	2026-10-02 03:22
Stage logs	out\stages\06-hardware-100.json	out\stages\06-hardware-100.json	PRESENT	2026-10-02 02:50
Stage logs	out\stages\07-assembly-100-rec.json	out\stages\07-assembly-100-rec.json	PRESENT	2026-10-02 03:35
Stage logs	out\stages\07-assembly-100.json	out\stages\07-assembly-100.json	PRESENT	2026-10-02 02:51
Stage logs	out\stages\07-assembly-300-rec.json	out\stages\07-assembly-300-rec.json	PRESENT	2026-10-02 03:31
Stage logs	out\stages\07-assembly-300.json	out\stages\07-assembly-300.json	PRESENT	2026-10-02 02:55
Stage logs	out\stages\08-audit-100-rec.json	out\stages\08-audit-100-rec.json	PRESENT	2026-10-02 03:25
Stage logs	out\stages\08-audit-100.json	out\stages\08-audit-100.json	PRESENT	2026-10-02 02:52
Stage logs	out\stages\08-audit-300.json	out\stages\08-audit-300.json	PRESENT	2026-10-02 03:36
Stage logs	out\stages\09-drawings-100-rec.json	out\stages\09-drawings-100-rec.json	PRESENT	2026-10-02 03:26
Stage logs	out\stages\09-drawings-100.json	out\stages\09-drawings-100.json	PRESENT	2026-10-02 02:58
Stage logs	out\stages\09-drawings-300-rec.json	out\stages\09-drawings-300-rec.json	PRESENT	2026-10-02 03:32
Stage logs	out\stages\09-drawings-300.json	out\stages\09-drawings-300.json	PRESENT	2026-10-02 02:56
Stage logs	out\stages\10-change-300-rec.json	out\stages\10-change-300-rec.json	PRESENT	2026-10-02 03:28
Stage logs	out\stages\10-change-300.json	out\stages\10-change-300.json	PRESENT	2026-10-02 02:54
Stage logs	out\stages\11-exports-100-rec.json	out\stages\11-exports-100-rec.json	PRESENT	2026-10-02 03:32
Stage logs	out\stages\11-exports-100.json	out\stages\11-exports-100.json	PRESENT	2026-10-02 02:56
Stage logs	out\stages\11-exports-300.json	out\stages\11-exports-300.json	PRESENT	2026-10-02 03:35
Part cache	cad\TC-100\parts.json	cad\TC-100\parts.json	PRESENT	2026-10-02 03:21

Part cache	cad/TC-300/parts.json	cad\TC-300\parts.json	PRESENT	2026-10-02 03:28
Part cache	cad/hardware/parts.json	cad\hardware\parts.json	PRESENT	2026-10-02 03:22
Verification	out\verify-100.json	out\verify-100.json	PRESENT	2026-10-02 03:35
Verification	out\verify-300.json	out\verify-300.json	PRESENT	2026-10-02 03:31
Verification	out\audit-100.json	out\audit-100.json	PRESENT	2026-10-02 03:25
Verification	out\audit-300.json	out\audit-300.json	PRESENT	2026-10-02 03:36
Verification	out/bend-*.json (bend check)	out\bend-*.json	PENDING	not yet produced
Verification	out/review-*.json (manufacturing review log)	out\review-*.json	PENDING	not yet produced
Verification	out\change-300.json	out\change-300.json	PRESENT	2026-10-02 03:28
Spikes (G0)	out\spike-addins.json	out\spike-addins.json	PRESENT	2026-10-01 18:24
Spikes (G0)	out\spike-cage.json	out\spike-cage.json	PRESENT	2026-10-02 00:44
Spikes (G0)	out\spike-endcap-log.json	out\spike-endcap-log.json	PRESENT	2026-10-01 18:14
Spikes (G0)	out\spike-endcap.json	out\spike-endcap.json	PRESENT	2026-10-01 18:14
Spikes (G0)	out\spike-fairing.json	out\spike-fairing.json	PRESENT	2026-10-01 21:16
Spikes (G0)	out\spike-hardware.json	out\spike-hardware.json	PRESENT	2026-10-01 18:22
Spikes (G0)	out\spike-harness.json	out\spike-harness.json	PRESENT	2026-10-01 18:21
Spikes (G0)	out\spike-scale.json	out\spike-scale.json	PRESENT	2026-10-01 18:19
Spikes (G0)	out\spike-style.json	out\spike-style.json	PRESENT	2026-10-02 00:27
Spikes (G0)	out\spike-timing.json	out\spike-timing.json	PRESENT	2026-10-01 18:15
Hardware	hardware-std\iso-4032-m4.item.json	hardware-std\iso-4032-m4.item.json	PRESENT	2026-10-02 01:27
Hardware	hardware-std\iso-4032-m4\generation.json	hardware-std\iso-4032-m4\generation.json	PRESENT	2026-10-02 01:27
Hardware	hardware-std\iso-4032-m5.item.json	hardware-std\iso-4032-m5.item.json	PRESENT	2026-10-02 01:27
Hardware	hardware-std\iso-4032-m5\generation.json	hardware-std\iso-4032-m5\generation.json	PRESENT	2026-10-02 01:27
Hardware	hardware-std\iso-4762-m3x8.item.json	hardware-std\iso-4762-m3x8.item.json	PRESENT	2026-10-02 01:27

Hardware	hardware-std\iso-4762-m3x8\generation.json	hardware-std\iso-4762-m3x8\generation.json	PRESENT	2026-10-02 01:27
Hardware	hardware-std\iso-4762-m4x12.item.json	hardware-std\iso-4762-m4x12.item.json	PRESENT	2026-10-02 01:27
Hardware	hardware-std\iso-4762-m4x12\generation.json	hardware-std\iso-4762-m4x12\generation.json	PRESENT	2026-10-02 01:27
Hardware	hardware-std\iso-4762-m5x20.item.json	hardware-std\iso-4762-m5x20.item.json	PRESENT	2026-10-02 01:27
Hardware	hardware-std\iso-4762-m5x20\generation.json	hardware-std\iso-4762-m5x20\generation.json	PRESENT	2026-10-02 01:27
Hardware	hardware-std\iso-7089-2000-m5.item.json	hardware-std\iso-7089-2000-m5.item.json	PRESENT	2026-10-02 01:27
Hardware	hardware-std\iso-7089-2000-m5\generation.json	hardware-std\iso-7089-2000-m5\generation.json	PRESENT	2026-10-02 01:27
Hardware	hardware-std\iso-7380-1-m5x10.item.json	hardware-std\iso-7380-1-m5x10.item.json	PRESENT	2026-10-02 01:27
Hardware	hardware-std\iso-7380-1-m5x10\generation.json	hardware-std\iso-7380-1-m5x10\generation.json	PRESENT	2026-10-02 01:27
Hardware	T6 SOLIDWORKS hardware conversion	out\t6-solidworks-hardware.json	PRESENT	2026-10-01 20:25
Appearances	appearances\manifest.json	appearances\manifest.json	PRESENT	2026-10-01 21:34
Appearances	appearances\swatches.png	appearances\swatches.png	PRESENT	2026-10-01 21:35
Renders	out/renders/*.png (SOLIDWORKS part images)	out\renders	PRESENT	16 images
Renders	spikes/cage, spikes/style concept renders	spikes	PRESENT	20 images
Spikes (G0)	Earlier frame iteration (job output)	jobs\job-230103-365f62.out	PRESENT	2026-10-01 23:01
Verification	out/audit-100.md (HL-01 dispositions)	out\audit-100.md	PRESENT	2026-10-02 03:25
Verification	out/audit-300.md (HL-01 dispositions)	out\audit-300.md	PRESENT	2026-10-02 03:36
Drawings	cad\TC-100\drawings/*.pdf	cad\TC-100\drawings	PRESENT	6 PDFs
Drawings	cad\TC-300\drawings/*.pdf	cad\TC-300\drawings	PRESENT	2 PDFs
Exports	exports\TC-100\manifest.json	exports\TC-100\manifest.json	PRESENT	2026-10-02 03:32
Exports	exports\TC-100\TC-100-BOM.csv	exports\TC-100\TC-100-BOM.csv	PRESENT	2026-10-02 03:32
Exports	exports\TC-100\TC-201-bend-schedule.csv	exports\TC-100\TC-201-bend-schedule.csv	PRESENT	2026-10-02 03:32
Exports	exports\TC-300\manifest.json	exports\TC-300\manifest.json	PRESENT	2026-10-02 03:35
Exports	exports\TC-300\TC-300-BOM.csv	exports\TC-300\TC-300-BOM.csv	PRESENT	2026-10-02 03:35
Electrical	TC-801 block diagram	deliverables\wiring\TC-801-block.png	PRESENT	2026-10-02 02:29

Electrical	TC-803 harness drawing	deliverables\wiring\TC-803-harness.png	PRESENT	2026-10-02 02:29
Electrical	TC-802 wire list	deliverables\wiring\TC-802-wire-list.csv	PRESENT	2026-10-02 02:29