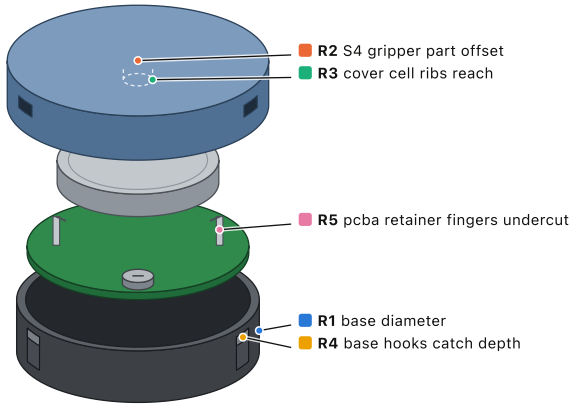
Synthetic coin-cell tracker puck: where the next build loses units

S4 (press cover) scraps 151 of the 172 units the line loses out of 5,000. The largest risk, no-engage / loose at S4, falls from 70 to 1 unit when base diameter goes from 29.80 ±0.08 mm to 29.88 ±0.08 mm.

SIMULATED UNCALIBRATED SYNTHETIC PART ASSUMPTION Engine output on a synthetic product; nothing is measured. ASSUMPTION marks equipment values and drawn shapes.



SYNTHETIC PART ASSUMPTION Drawn to scale from the spec's nominal dimensions. Labels mark the feature each fix changes. Hook and rib shapes are ASSUMPTIONS.

1 Line summary SIMULATED UNCALIBRATED SYNTHETIC PART

Units run	First-pass yield	Yield after retries	Bottleneck
5,000	**96.30%**	**96.56%**	**S2**
seed 42, S1 to S5	185 fail first pass	13 recovered by retry	462/h, assumed timing

S1 0 lost — Place board → **S2** 0 lost bottleneck — Drive screws → **S3** 1 lost — Insert cell → **S4** 151 lost — Press cover → **S5** 20 lost — Inspect gap, power test

ASSUMPTION Illustrative plan from the bench layout, station spacing to scale, footprints not. 24 pallets at 12 m/min. Losses are after retries.

2 Failing stations, ranked by units lost SIMULATED UNCALIBRATED SYNTHETIC PART

Rank	Station	Units lost after retries	Of units run	Risks: failure class, units lost (range over seeds 42 to 46)
1	**S4** press cover	151	3.02%	R1 No-engage / loose **70** (55 to 70) R2 Jam / misalignment **61** (54 to 63) R3 Stack interference **20** (15 to 20)
2	**S5** inspect gap, power test	20	0.40%	R4 Gap uneven **20** (18 to 39)
3	**S3** insert cell	1	0.02%	R5 Cell not seated **1** (0 to 1)

3 Risks, cause and fix

The cause is the engine's model of the failure. The fix is the tested change that leaves the most good units, for the first build to confirm. Station errors are 3 sigma.

R1 S4 No-engage / loose

70 units lost (1.40%); 55 to 70 over seeds SIMULATED UNCALIBRATED SYNTHETIC PART

Cause. A hook misses its window, engages too little, has too much axial play, or the press stops before it snaps.

Top drivers	Input	First-pass units with this failure → driver held at nominal	Direction
base diameter	29.80 ±0.08 mm SYNTHETIC	70 → 5	larger is safer
cover inner diameter	30.10 ±0.08 mm SYNTHETIC	70 → 6	smaller is safer
base hooks undercut	0.45 ±0.04 mm SYNTHETIC	70 → 26	spread only

Fix. Best of 7 what-if reruns: move the nominal of **base diameter**, 29.80 ±0.08 mm to **29.88 ±0.08 mm** SYNTHETIC +74 good units.

Tied: cover inner diameter, 30.10 ±0.08 mm to 30.02 ±0.08 mm, leaves as many.

Rerun this failure 70 → **1** all lost at S4 151 → **75** first pass 96.30% → **97.78%** after retries 96.56% → **98.04%**

Trade-off. The same rerun loses more units to hook overstrain (crack risk) at S4 (+2); gap uneven at S5 (+2). Check these before choosing this fix.

First build. Measure hook-face diameter and window position on first shots; record press curves. Owner: design and tooling supplier ASSUMPTION

R2 S4 Jam / misalignment

61 units lost (1.22%); 54 to 63 over seeds SIMULATED UNCALIBRATED SYNTHETIC PART

Cause. The cover's lead-in does not capture the base, or a hook lands outside its window along the rim.

Top drivers	Input	First-pass units with this failure → driver held at nominal	Direction
S4 gripper part offset	±0.10 mm ASSUMPTION	61 → 3	smaller is safer
S4 gripper rotation offset	±0.30 deg ASSUMPTION	61 → 9	spread only
pallet locating error	±0.05 mm ASSUMPTION	61 → 32	smaller is safer

Fix. Best of 2 what-if reruns: specify **S4 gripper part offset**, ±0.10 mm to **±0.05 mm** ASSUMPTION +48 good units.

Rerun this failure 61 → **13** all lost at S4 151 → **103** first pass 96.30% → **97.26%** after retries 96.56% → **97.52%**

First build. Measure cover pose on the gripper and base pose on the pallet separately. Owner: manufacturing engineering ASSUMPTION

R3 S4 Stack interference 20 units lost (0.40%); 15 to 20 over seeds SIMULATED UNCALIBRATED SYNTHETIC PART

Cause. A cover rib presses on the stack below it (cell or board) by more than its allowed crush, so the cover cannot seat.

Top drivers	Input	First-pass units with this failure → driver held at nominal	Direction
cell height	2.9 to 3.2 mm TYPICAL	20 → 0	smaller is safer
pcba thickness	1.00 ±0.08 mm ASSUMPTION	20 → 1	smaller is safer
cover cell ribs reach	1.60 ±0.04 mm SYNTHETIC	20 → 12	smaller is safer

Fix. Best of 4 what-if reruns: move the nominal of **cover cell ribs reach**, 1.60 ±0.04 mm to **1.56 ±0.04 mm** SYNTHETIC +25 good units.

Rerun this failure 20 → **0** all lost at S4 151 → **131** first pass 96.30% → **96.80%** after retries 96.56% → **97.06%**

First build. Measure the seated board and cell stack and the rib reach on first-shot covers. Owner: mechanical design ASSUMPTION

R4 S5 Gap uneven 20 units lost (0.40%); 18 to 39 over seeds SIMULATED UNCALIBRATED SYNTHETIC PART

Cause. The camera's cover-to-base gap varies around the part by more than the spread limit.

Top drivers	Input	First-pass units with this failure → driver held at nominal	Direction
base hooks catch depth	2.20 ±0.06 mm SYNTHETIC	29 → 6	spread only
cover windows latch depth	2.30 ±0.06 mm SYNTHETIC	29 → 6	spread only
S4 gripper pick loss	1 in 1,000 units HYPOTHESIS	29 → 23	smaller is safer

29 units show this failure on the first pass, some alongside another; 20 are lost to it after retries, each lost unit counted once under its main failure.

Fix. Best of 3 what-if reruns: tighten the tolerance of **base hooks catch depth**, 2.20 ±0.06 mm to **2.20 ±0.03 mm** SYNTHETIC +21 good units.

Rerun this failure 20 → **0** all lost at S5 20 → **0** first pass 96.30% → **96.72%** after retries 96.56% → **96.98%**

First build. Measure the gap at each hook on samples, compare with the camera, and gauge it. Owner: quality and design ASSUMPTION

- **R5 S3 cell not seated**, 1 unit lost (0 to 1 over seeds): fewer than 5 units lost, below the search threshold, so no fix was searched. The retainer fingers do not snap over the cell's top edge. First build: check the retainer fingers snap over inserted cells; measure contact force.

4 All fixes in one rerun SIMULATED UNCALIBRATED SYNTHETIC PART

Risk	Change	To approve it before tooling ASSUMPTION
R1	base diameter, 29.80 ±0.08 mm to 29.88 ±0.08 mm	A tool-change quote and plan for the new nominal, then a dimensional check
R2	S4 gripper part offset, ±0.10 mm to ±0.05 mm	A capability run that measures the station's real spread
R3	cover cell ribs reach, 1.60 ±0.04 mm to 1.56 ±0.04 mm	A tool-change quote and plan for the new nominal, then a dimensional check
R4	base hooks catch depth, 2.20 ±0.06 mm to 2.20 ±0.03 mm	Supplier capability at the tighter tolerance, and a gauge study

First-pass yield	Yield after retries	Good units (+158; one at a time they sum to +168)	Units still lost, by failure
96.30% → **99.46%**	96.56% → **99.72%**	4,828 → **4,986**	S4 jam / misalignment **13**, S3 cell not seated **1**

5 What the model does not cover, and where it is uncertain

- **Uncalibrated.** No value here is measured; 5 of the 12 drivers in the tables are ASSUMPTION or HYPOTHESIS values. Counts are not a forecast, and the ranking and direction of each change hold only under these assumptions until a real build calibrates the stations.
- **Sampling.** Over seeds 42 to 46, first-pass yield runs 96.14% to 96.74% and after retries 96.50% to 96.96%; S4 loses the most at 5 of 5 seeds, and R1 is the largest risk at 3 of 5. Ranges are spreads over these baseline seeds, not confidence intervals.
- **Inspection error.** On the first pass the S5 inspect gap camera rejected 5 units whose true gap met both limits and passed 4 whose true gap did not. Its repeatability is an ASSUMPTION until a gauge study.
- **One change at a time.** Each fix is a rerun with one change; fixes interact, so plan with the combined rerun. Candidates follow fixed rules (a nominal moved half or one tolerance toward margin, a halved tolerance or station error), so a better fix may lie outside them.
- **Physics and timing.** Analytic models only; the MuJoCo contact cross-check does not cover these operations yet. The engine is a CPU Monte Carlo (NumPy) with SimPy line flow. Cycle times, transport and retries are ASSUMPTIONS, so the bottleneck and 462 good units per hour are not a forecast.
- **Not modeled.** For this product, re-driving into formed threads, antenna and RF performance, cosmetic defects, drop, water ingress, cell aging. For any product, flex cables, adhesives, foams, cosmetics, reliability, firmware, supply and operator error.

Generated by `uv run python -m virtual_build.risk_report --spec specs/tracker_puck.yaml --out examples/build-risk-report` from engine commit a65ef230a3b1, spec `specs/tracker_puck.yaml` digest 800e67cef127. Every number is read from the engine runs in the companion JSON, which also holds each change for `vb compare`; `tests/test_risk_report.py` regenerates this page and fails if it drifts. Simulated, uncalibrated, synthetic part. In a blind backtest a page like this is locked before the real failures are opened. Not a physical calibration, a certification or a reason to skip a real build.