

# Prototype test plan template

Reference structure for defining what each prototype round must prove, the test methods used, the standards referenced, and the decisions each result feeds.

REVISION <b>2.0</b>	ISSUED <b>May 2026</b>	OWNER <b>Ideambox engineering</b>	COMPANION <b>PDF reference</b>
------------------------	---------------------------	--	-----------------------------------

## ABSTRACT

A prototype that does not answer a written question is a model, not a test. This document is the structure for committing those questions, test methods, and decision criteria to writing before the prototype is built.

Section 1 covers prototype-type selection. Section 2 covers test definition with referenced standards. Section 3 covers execution and review discipline. Section 4 covers the decision framework for the next investment.

## PROTOTYPE TYPES – MATCHED TO THE QUESTION

01 · APPEARANCE

### Appearance model

Form, finish, ergonomics.  
Machined or 3D-printed, painted, no internals.  
Cost: low · Time: 1-2 wk

02 · ARCHITECTURE

### Architecture proto

Internal layout, fit, routing.  
Boards, battery, antenna, connectors fit-check.  
Cost: low · Time: 1-2 wk

03 · ELECTRONICS RIG

### Electronics proof

Circuit works at all.  
Breadboard or dev board, hand-soldered.  
Cost: low · Time: 1-3 wk

04 · FUNCTIONAL

### Functional proto

Integrated system works.  
Real PCB + enclosure + firmware. Iterate 2x.  
Cost: mid · Time: 4-8 wk

05 · SUPPLIER SAMPLE

### Supplier sample

Actual factory + process.  
Surfaces tolerance, finish, assembly issues.  
Cost: mid · Time: 4-6 wk

06 · PILOT

### Pilot-production

Production line + tooling.  
Built by production operators. Pre-MP gate.  
Cost: high · Time: 3-6 wk

SIX PROTOTYPE TYPES MATCHED TO THE QUESTION. PICK THE CHEAPEST THAT CAN ANSWER IT; SEQUENCE FROM CHEAPEST TO MOST EXPENSIVE.

## CONTENTS

1. Choose the prototype type
2. Define the tests
3. Run and review
4. Decide what comes next

## 1. Choose the prototype type

---

Different prototypes answer different questions, and each one costs differently. Pick before drawing or ordering anything.

### 1.1 Six prototype types

#	TYPE	PROVES	COST	TIME
1	Appearance model	Form, finish, ergonomics	\$200–2 000	1–2 wk
2	Architecture proto	Internal layout, fit	\$500–3 000	1–2 wk
3	Electronics proof	Circuit works at all	\$500–5 000	1–3 wk
4	Functional proto	Integrated system works	\$5–30k	4–8 wk
5	Supplier sample	Actual factory + process	\$1–10k	4–6 wk
6	Pilot-production unit	Production line + tooling	\$10–50k	3–6 wk

### 1.2 Sequencing principle

- **One prototype, one or two questions**

Do not stack. If a test fails, you won't know which assumption was wrong.

---

- **Cheapest first**

A foam-board appearance model can answer ergonomics that a \$40 k functional prototype cannot answer any better.

---

- **Don't skip stages**

Architecture before functional; functional before tooling; tooling before pilot. Skipping costs more than running.

## 2. Define the tests

A test is only useful if it has a method, a pass criterion, and a decision tied to the result. Write all three before building.

### 2.1 Per-test definition (template)

ID	T-XXX sequential, traceable to spec sheet revision
Question	What the prototype must answer (one sentence)
Standard	Referenced standard (ISO/IEC/ASTM/MIL-STD) if applicable
Method	How the question is measured (equipment, conditions, duration)
Sample count	One unit shows a bug; one unit cannot show absence of a bug
Acceptance	A number, range, or binary (e.g. "Drop survives 1.2 m x 6 faces, no functional defect")
Measurement tools	Calipers, force gauge, oscilloscope, thermal camera, environmental chamber
Failure modes	Specific failure signatures to watch for
Design action	What changes in CAD, BoM, firmware, or process if this fails

### 2.2 Standard environmental test methods

TEST	STANDARD	NOTES
Free fall drop	IEC 60068-2-32	Drop height per product class
Tumble (rolling drop)	IEC 60068-2-31	Wearables, handhelds
Mechanical shock	IEC 60068-2-27	Half-sine pulse, multiple axes
Vibration (sinusoidal)	IEC 60068-2-6	Resonance + dwell
Vibration (random)	IEC 60068-2-64	Transport, vehicle mount
Cold storage	IEC 60068-2-1	-20 °C, -40 °C standard
Dry heat storage	IEC 60068-2-2	+70 °C, +85 °C standard
Damp heat (steady)	IEC 60068-2-78	+40 °C, 93 % RH, 96 h
Damp heat (cyclic)	IEC 60068-2-30	Cycling 25–55 °C, 93 % RH
Salt mist	IEC 60068-2-11 / ASTM B117	Corrosion, 5 % NaCl
Water spray (IP code)	IEC 60529	IPX3-X9K per spec
Dust (IP code)	IEC 60529	IP5X-6X
UV exposure	ISO 4892-2	Plastic colour stability
MIL-STD-810	MIL-STD-810H	US military environmental
RTCA DO-160	DO-160G	Aviation equipment

### 2.3 Drop test heights by product class

CLASS	HEIGHT	SURFACES	STANDARD
Tabletop / kitchen	0.76 m (30")	Hardwood, vinyl	IEC 60068-2-32
Handheld consumer	1.0 m (40")	Concrete	Internal carrier specs
Outdoor consumer	1.2 m (48")	Concrete	IEC 60068-2-32
Rugged industrial	1.5 m (60")	Steel + concrete	MIL-STD-810H 516.8
Mobile phone	1.0 m, 6 face + 4 edge + 4 corner	Concrete	Carrier requirement
Wearable / fitness	1.0–1.5 m + tumble	Concrete	IEC 60068-2-31

### 2.4 Calibration and controls

- **Calibrate against the spec, not the previous prototype**  
Each test is judged against the brief.
- **Document equipment with calibration certificate**  
Date, traceability, accuracy. NIST/UKAS–traceable preferred.
- **Record environmental conditions during test**  
T, RH, supply voltage, anything that can move the result.
- **Photograph the setup before starting**  
Settles disputes 6 months later.

#### WATCH OUT – PASS/FAIL HIDES DATA

Tests that report only PASS / FAIL without a numeric reading lose information. Always record the measurement, not just whether it crossed the threshold. A "PASS" at 0.05 mm under the limit looks identical to a "PASS" at 0.5 mm under — but the first one is about to fail at temperature, and the second one is robust.

The trend across a sample set tells you more than any single binary result.

### 3. Run and review

Most prototype rounds fail because results aren't captured rigorously enough to act on. Treat the record as the deliverable.

#### 3.1 During the round

– **Run tests in the planned order**

Don't reorder by convenience; the order is usually riskiest-first.

– **Record every reading**

Even ones that obviously pass. Trends across a batch tell you more than individual results.

– **Photograph failure modes**

A blurry phone photo today is worth a long memory-based discussion later.

– **Stop when a destructive test is reached**

Or save those for last on units you no longer need intact.

#### 3.2 Test report template

```
`` Test ID: T-007 Question: Does the latch survive 500 open-close cycles? Standard: IEC 60068-2-79 (vibration), section adapted Method: Automated cycler, 30 cycles/min, ambient Sample size: n = 5 (units 003, 007, 011, 014, 019) Acceptance: Latch force after 500 cycles ≥ 80% of initial Result: Unit 003: 100% → 88% (pass) Unit 007: 100% → 92% (pass) Unit 011: 100% → 76% (fail; investigate) Unit 014: 100% → 84% (pass) Unit 019: 100% → 91% (pass) Mean: 86%; n=5; 4/5 pass; 1 outlier Disposition: Inspect unit 011 latch geometry; possibly material flaw or insertion variance. Re-run with n=10 if material change. ``
```

#### 3.3 MTBF / MTTF estimation

For reliability claims, you need multiple units × multiple hours.

```
`` MTBF (Mean Time Between Failures) = total operating hours / number of failures MTTF (Mean Time To Failure) – same formula; used for non-repairable items ``
```

**Worked example:** 10 units, run continuously, 3 failures over 90 days = 21 600 unit-hours / 3 failures = **7 200 hours MTBF (~10 months)**. To claim 50 000 h MTBF (~5.7 years), you'd need either: (a) 10 units × 5 000 hours each with no failures, or (b) much larger sample. Reliability claims need real data, not extrapolation.

#### 3.4 Review meeting

– **Walk the test list end-to-end**

Every line gets pass / fail / inconclusive. Inconclusive means re-test, not "ignore".

– **Decide the design action before moving on**

For each failed test, agree on the change and the owner. Open questions go on a parking list, dated.

– **Update the brief**

If the test result invalidates a brief assumption, update the brief now, not later.

#### 3.5 What to write down

OUTPUT	PURPOSE	GOES TO
Per-question summary	Question, result, measurement, action	Test report
Design change list	What changes in CAD/BoM/firmware	ECN queue
Cost + time spent	This round's actuals	Next-round planning
Open issues	What we still don't know	Parking list

## 4. Decide what comes next

The point of a prototype round is to enable a decision. Make the decision explicit before scheduling the next round.

### 4.1 Before the next investment, confirm

– **What changed**

In CAD, PCB, BoM, firmware, assembly process, supplier choice.

– **What needs to be re-tested**

Any change to a part touched by a previous test re-opens that test.

– **What's ready to move forward**

Decide explicitly which areas are stable enough for supplier quotation, certification samples, tooling, or pilot production.

### 4.2 Gate criteria for common transitions

FROM → TO	GATE CRITERIA
Architecture → Functional	Layout and clearances stable, no overlaps, cable routing feasible, antenna position fixed
Functional → Tooling	Certification-sensitive electronics frozen, mechanical tolerances realistic, BoM stable 4–6 weeks
Tooling → Pilot	First-off-tool samples meet spec, cycle time validated, gate locations confirmed
Pilot → Mass production	Process repeatable on line, yield meets threshold (typically 90 %+ first-pass), open issues documented with dispositions

### 4.3 Common round budgets

ROUND	TYPICAL COST	TYPICAL TIME
Concept models (foam, 3D print)	\$500–2 000	1–2 weeks
Architecture proto	\$1–5 k	2–3 weeks
Functional prototype iteration	\$5–25 k	4–8 weeks
Engineering samples (off-tool)	\$2–10 k	4–6 weeks
Pre-production samples (DV / PV)	\$5–20 k	3–4 weeks
Pilot production	\$10–50 k	4–6 weeks

**RULE OF THUMB.** if you can't write a clear answer to "what does this prototype prove?", build a cheaper one first. The cost of a wasted prototype round is almost always higher than the cost of one extra meeting to define it.