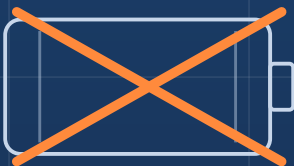


PRODUCTION - GRADE

BATTERY SWAP LIST

Seven common batteries that cause dead products, refused shipments, and real fires. And the production-grade swaps to use instead, plus the document request to send your supplier.



COMMON BATTERY
FAILS IN PRODUCTION



PRODUCTION-GRADE
USE THIS INSTEAD

PREPARED BY
JOHN TEEL

DOC NO.
BAT-07

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Production-Grade Battery Swap List

Swap these seven batteries before your product goes into production.

Every battery in this countdown works perfectly on your bench, and that is exactly what makes each one dangerous. A cell that runs your prototype for weeks can still brown out under load, leak inside the enclosure, get your shipment refused by a freight forwarder, or physically hurt the person holding your product. Unlike most component mistakes, a bad battery choice carries real liability, and your company is the one holding it.

Each entry below explains why the battery breaks down in a real product and gives you the replacement that actually holds up, along with the chemistry to move to and the manufacturers to trust. The list follows the same countdown as the video, starting with a battery that simply wastes your money and ending with one that can stop your product from shipping at all.

The Swap List at a Glance

#	IF YOUR DESIGN USES	START YOUR SEARCH WITH	THE CORE PROBLEM
7	9V alkaline	Two AA cells, or a 1S LiPo	Energy cost, wasted voltage
6	Alkaline AA / AAA under load	Low self-discharge NiMH, Li-FeS2	Voltage sag and leakage
5	Coin cells beyond tiny loads	AA lithium primary cells	Collapse and Reese's Law
4	A sealed-in battery	A screw-secured battery door	EU market lockout in 2027
3	Unprotected 18650 cells	Protected cells, packs with a BMS	Fire risk and counterfeits
2	Bare LiPo pouch cells	Protected pouch cell + charge IC	Puncture, thermal runaway
1	Uncertified lithium packs	Packs with UN38.3 and IEC 62133	Blocked shipping, liability

Every replacement above has detail and alternates in its full entry, and the document request on page 9 covers all of them, so keep reading before you lock in a battery.

#7

The 9V Alkaline

PRIMARY POWER

WHY IT FAILS IN A PRODUCT

- It looks efficient, but a 9V alkaline only holds around 500 to 600 mAh, so you pay three to four times more per unit of energy than you would with a couple of AA cells.
- Your electronics almost certainly run at 3.3V or 5V, and dropping 9V down with a simple linear regulator throws away about two thirds of your energy as heat.
- A switching regulator fixes the efficiency, but it adds cost, parts, and noise to solve a problem you created by picking the wrong battery.
- The snap connector is a mechanical weak point, because those thin wires flex every time the battery is changed until one finally breaks off inside the enclosure.

SWAP IT FOR

REPLACEMENT PART	WHY THIS PART
Two AA cells in series	Two AA cells give you around 3V, which many microcontrollers and sensors will run on directly with no regulator at all.
1S LiPo plus a charger IC	A single-cell lithium polymer battery with a charger IC is a better fit for almost any modern product that recharges.
A small linear or boost stage	When you do need a regulator, dropping 3V to 1.8V with a cheap linear part, or boosting up to 3.3V, is a much smaller job than stepping down from 9V.

Cost check

Per unit of energy, a 9V alkaline costs three to four times more than a pair of AA cells, and it usually forces an extra regulator stage into the design on top of that.

#6

Alkalines in High-Drain Products

HIGH-DRAIN PRODUCTS

WHY IT FAILS IN A PRODUCT

- Internal resistance eats into the voltage the second your product starts drawing power, so a fresh cell that sits at 1.5V doing nothing sags toward 1.1V under a heavy load.
- That resistance keeps climbing as the cell drains, so the product browns out and resets while plenty of capacity still sits inside, and your customer is convinced they got a bad pack of cells.
- Alkaline performance drops off badly near freezing, which rules the chemistry out for most outdoor products.
- Cells left in a device too long leak potassium hydroxide, which corrodes your contacts and destroys the product from the inside, and the customer blames you rather than the battery brand.

SWAP IT FOR

REPLACEMENT PART	WHY THIS PART
Low self-discharge NiMH cells	These handle real current without the sag, and they hold their charge on the shelf. Just design your voltage range around 1.2V per cell instead of 1.5V.
Lithium iron disulfide (L91 class)	These cells handle heavy current and extreme cold far better than any alkaline will, in the same 1.5V AA format your design already expects.

The AA format itself is fine. It is the alkaline chemistry inside it that gives out the moment your product leans on it.

#5

Coin Cells Beyond Tiny Loads

COMPACT PRODUCTS

WHY IT FAILS IN A PRODUCT

- The 225 mAh on a CR2032 datasheet only holds up if you sip current out of it very slowly, meaning a few hundred microamps or less.
- Internal resistance sits in the tens of ohms when the cell is fresh and climbs into the hundreds as it drains, so a 10 to 15 mA radio burst collapses the voltage and resets your microcontroller.
- In the field you get maybe a third of the rated capacity, and the product dies early for reasons that never showed up on your bench.
- Reese's Law now requires any consumer product with a button or coin cell to keep that battery in a compartment children cannot open, with specific warnings on the product, the packaging, and the manual.

SWAP IT FOR

REPLACEMENT PART	WHY THIS PART
AA-sized lithium primary cells	Stepping up to a AA-sized lithium cell gives you the pulse current capability that radios and sensors actually demand.
A small rechargeable cell	A compact lithium polymer cell with proper charging rides through transmit bursts without the voltage collapse.
A bulk capacitor, as a patch only	A capacitor across the cell helps ride out current spikes, but it is a patch on a battery that was never sized for the job.

A federal safety law, not a suggestion

Reese's Law passed in 2022 in the US, so the child-resistant compartment and the warning labels are enclosure design requirements and certification items. Plan for them from the first mechanical drawing.

#4

Sealed-In Batteries

BATTERY ACCESS

WHY IT FAILS IN A PRODUCT

- Article 11 of the EU Batteries Regulation requires portable batteries to be readily removable and replaceable by the end user, and it applies from February 18th, 2027.
- A portable battery under the rule is anything sealed into a product and weighing 5 kg or less, which covers a glued-in lithium polymer pouch exactly the same as a coin cell.
- Replacement has to work with commercially available tools, so adhesives that need heat or solvents are out, and you must stock replacement batteries for five years after the last unit ships.
- This is not a component you can swap later. It is an enclosure decision, a tooling decision, and a contact and layout decision, all made at the start and brutally expensive to reverse once you have cut steel.

SWAP IT FOR

REPLACEMENT PART	WHY THIS PART
A battery door held by a screw	A screwdriver counts as a commercially available tool and reusable fasteners are allowed, so one screw satisfies Article 11 and the coin cell rule at the same time.
A standard replaceable format	Choose a cell your customer can actually buy at a store, and design the contacts to survive cells being jammed in backwards.
A confirmed exemption	Wearables like smartwatches and fitness trackers, plus electric toys, joined the exemption list recently, but confirm your category with a compliance expert before you commit to tooling.

A lesson I learned the hard way

I sealed the coin cells inside my own product to keep the cost down, and the complaints never stopped. I eventually recorded a video showing customers how to fully disassemble a unit that was never meant to be opened. Today that same decision would also lock the product out of the EU.

#3

Unprotected 18650 Cells

CYLINDRICAL LITHIUM

WHY IT FAILS IN A PRODUCT

- An unprotected cell has no circuitry between the chemistry and your customer, so nothing stops an over-discharge, an overcharge, or a dead short across the terminals.
- Taking a lithium ion cell below about 2.5V causes permanent internal damage that can turn into a short weeks later, long after the unit shipped.
- A shorted 18650 can dump 10 A or more into whatever happens to be touching it, and customers will find every failure mode, from cells installed backwards to a spare tossed loose in a bag with keys.
- Online marketplaces are full of rewrapped counterfeits advertising 9,900 mAh, while the best real cells top out around 3,500 mAh.

SWAP IT FOR

REPLACEMENT PART	WHY THIS PART
Protected 18650 cells	A protected cell puts over-voltage, under-voltage, and short circuit protection right at the battery, between the chemistry and everything else.
A pack with a real BMS	A proper battery management system handles charging, discharging, and cell balancing, which is everything a bare cell leaves up to chance.
Top-tier cells, authorized channels	Samsung, LG, Molicel, and EVE make the cells worth building on, and buying through authorized distribution is how you keep counterfeits out of your product.

If the wrapper promises more than about 3,500 mAh from an 18650, the label is lying, and everything else about that cell is now in question too.

#2

Bare LiPo Pouch Cells

POUCH LITHIUM

WHY IT FAILS IN A PRODUCT

- RC-style pouch cells ship with no protection circuit on purpose, because hobby users want every last amp and accept the risk themselves. Your customer never agreed to any of that, and your name is the one on the box.
- The pouch is soft aluminum laminate, so a screw boss pressing into it, a pinched corner during assembly, or a drop onto a hard floor can puncture the cell.
- A punctured or overcharged lithium polymer cell does not just stop working. It swells, vents, and can go into thermal runaway.

SWAP IT FOR

REPLACEMENT PART	WHY THIS PART
A protected pouch cell	Buy cells with the protection board already attached, usually at the top of the pouch under the semi-transparent yellow tape, from a supplier who hands over datasheets and test reports without being chased.
A proper charge IC	Use a charger that does constant current and constant voltage charging with a hard 4.2V limit, and add temperature monitoring so charging stops when the cell is too hot or too cold.
Mechanical design around the cell	Leave a small gap for swelling as the cell ages, and keep anything sharp or rigid away from the pouch.

A cell that is perfectly reasonable in an RC plane, where the owner accepts the risk, has no place inside a product you sell.

#1

Uncertified Lithium Packs

PACKS AND SHIPPING

WHY IT FAILS IN A PRODUCT

- UN38.3 is the transport safety standard for lithium batteries, and it is a set of eight tests covering altitude, thermal cycling, vibration, shock, external short circuit, crush, overcharge, and forced discharge.
- Without that test summary in your hands, your freight forwarder will not accept the shipment, and you cannot legally move those batteries by air.
- IEC 62133 is the battery safety standard your product certification leans on, and you cannot get there with a cell you cannot trace back to an actual manufacturer.
- If one of your products burns down a customer's house and you cannot produce a single document about the battery inside it, your company is the one holding all of the liability.

SWAP IT FOR

REPLACEMENT PART	WHY THIS PART
Established pack manufacturers	Buy from suppliers who hand you the full documentation package before any money moves, because that willingness is itself a screening test.
The three documents to demand	Ask for the UN38.3 test summary, the full cell datasheet, and the IEC 62133 report before you pay anyone. The letter on the next page asks for all three, and more.

The red flag

If a supplier gets vague the moment you ask for documents, walk away. A vendor who cannot produce paperwork before the sale will not produce it after a field failure.

The Supplier Document Request

Copy this into an email before you send a battery vendor any money.

Fill in the brackets, send it, and treat the reply as part of your evaluation. A supplier who returns every document quickly, for the exact model and revision you were quoted, has just passed a test that matters more than any spec sheet. Do not issue a purchase order until everything on this list is in your hands.

Subject: Documentation request for [cell or pack model number]

Hello [supplier name],

We are evaluating your [cell or pack model number] for use in a commercial product. Before we issue a purchase order, we need the following documentation for the exact model and revision quoted:

1. The complete cell datasheet, including discharge curves at multiple currents and temperatures, cycle life data, and mechanical drawings with tolerances.
2. The UN38.3 test summary for this exact cell or pack.
3. The IEC 62133 test report from an accredited laboratory.
4. The safety data sheet for shipping and handling.
5. The name of the cell manufacturer and the country of origin, if you are not the manufacturer yourself.
6. Your specified charge voltage, maximum charge current, discharge cutoff voltage, and the allowed temperature ranges for charging and discharging.
7. Confirmation of how long this model will remain in production, and how much notice we would receive before any change or discontinuation.

We treat these documents as a condition of purchase. If any item is not available for this model, please tell us now so we can evaluate alternatives.

Thank you,
[your name]
[your company]

If the reply is vague, incomplete, or slow, you have learned something more valuable than any datasheet. Move on to a supplier who treats documentation as normal, because the good ones do.

Before You Commit to Any Battery

Every battery in this countdown fails in its own way, but the same habits catch all of them. Check one spec, buy from names that can prove themselves, and make the paperwork a condition of the sale.

The One Spec to Check

Pull the discharge curves and read the real capacity at your actual load current and your real operating temperature. The number printed on the label assumes a tiny, gentle load at room temperature, and your product does not draw power that way. Internal resistance turns that gap into early resets and dead units, and it explains the 9V that costs a fortune per milliamp hour, the AA that browns out half full, the coin cell that dies at a third of its rating, and the counterfeit 18650 that was never going to deliver at all. If the datasheet does not include discharge curves at multiple currents and temperatures, it is not a production part.

Chemistries and Names to Trust

IF YOU NEED	MOVE TO	NAMES TO START WITH
Replaceable cells under load	Low self-discharge NiMH	Panasonic Eneloop
Heavy current or extreme cold	Lithium iron disulfide	Energizer Ultimate Lithium (L91)
True microamp standby loads	Lithium coin cells (CR series)	Panasonic, Murata, Renata
Rechargeable cylindrical cells	Lithium ion, 18650 or 21700	Samsung, LG, Molicel, EVE
Slim rechargeable products	Protected lithium polymer	Suppliers with full UN38.3 and IEC 62133 documentation

Get a second opinion before you wire money to a battery supplier.

Battery and supplier questions like these are an everyday conversation inside the Hardware Academy, where you can get feedback on your specific design and your specific vendors from engineers who have taken real products through production.

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