

Battery End-of-Line Testing 2026

The Test Matrix & RFQ Guide for Pack and Module Lines — NEGUP MACHINE

What the gate does

Battery EOL testing is the 100% end-of-line test on every module and pack. In one automated cycle the station re-reads OCV and AC internal resistance, runs the insulation and HiPot safety tests, verifies BMS communication and protection trips, confirms enclosure sealing, and writes a PASS/FAIL record to MES. The core sequence takes **60–180 seconds** per pack and clears **180–550 packs per shift**; comprehensive stations are quoted from about **USD 16,000**. Market growth of 16.22% a year and the GB 38031-2025 insulation basis of **100 Ω /V** (effective 1 July 2026) have turned this from an option into a legal requirement on export packs.

Table 1 — The 2026 EOL testing market

Worldwide battery EOL tester market	USD 1,420.5M (2025) → 4,068.25M (2032), 16.22% CAGR	PW Consulting, 2026
Asia-Pacific revenue, 2025	USD 828.17M (largest region)	PW Consulting, 2026
Battery pack EOL test bench systems	USD 2.86B (2025) → 3.18B (2026) → 8.67B (2036)	FactMR, 2026
Automated share of EOL testing	58.4% of 2025 revenue (≈USD 1.64B)	Dataintel, 2026
Cycle time: automated vs semi	8–15 min vs 45–90 min per pack	Dataintel, 2026
China single-station PACK EOL cabinets	RMB 2.76B in 2026, +18.2% vs 2024	China Electronic Components Assoc., 2026
Battery charge & discharge testers	USD 1.72B (2025) → 3.37B (2032), 10.10% CAGR	360iResearch, Sep 2026

The gate grows faster than the general test market because pack architectures got more complex while safety expectations hardened.

Table 2 — Ten-stage test matrix with thresholds

1. Scan & traceability	Pack serial ↔ cell batch ↔ BMS firmware	100% binding to MES
2. OCV / AC-IR re-check	Pack and module voltage, AC internal resistance	In recipe window; 0.1 $\mu\Omega$ resolution
3. Insulation resistance	HV bus to chassis, DC 500 V / 1,000 V	$\geq 100 \Omega/V$ (500 Ω/V with AC)
4. Dielectric withstand	HiPot at $2 \times V + 1,000$ V, 60 s	No breakdown; leakage < 10 mA
5. Ground continuity	Chassis bonding path at 25–40 A	≤ 100 m Ω
6. BMS communication	CAN / CAN FD frames vs DBC; DTC read and clear	All signals in range
7. Protection trips	Over/under-voltage, over-current, short, thermal	Contactors open in spec window
8. Charge/discharge function	Short cycle, relay and pre-charge sequencing	Current follows command
9. Leak / sealing	Enclosure 20–40 kPa; coolant 0.4–0.6 MPa	< 20 –50 sccm; < 5 sccm coolant
10. Verdict & archive	PASS/FAIL, raw traces, time stamp	10+ year retention

The two checks cheap suppliers drop are short-circuit trip and communication fault injection — exactly the failures that reach the field.

Table 3 — EOL windows by cell format (real cells)

EOL levels used	Cell sort → module EOL → pack EOL	Module EOL → pack EOL	Pouch module EOL → pack EOL

Insulation test voltage	DC 500 V module / 1,000 V pack	DC 1,000 V pack-to-chassis	DC 500–1,000 V
Dielectric withstand	2×V + 1,000 V, 60 s	2×V + 1,000 V, 60 s	2×V + 1,000 V, 60 s
BMS interface	CAN FD, DBC-mapped	CAN + cell-voltage sampling	CAN / RS-485 + harness
Core sequence time	90–180 s	60–150 s	60–150 s
Aging reference after EOL	Pack aging 24–72 h	Pack aging 48–72 h	Pack aging 24–48 h

Buy a station whose recipe covers all three formats. On mature lines the safety-test rejection rate is 0.1–0.5%; on a new product it has been seen as high as 25%.

RFQ acceptance criteria

Test coverage: every test item listed with its pass threshold and sequence order.

Accuracy: current $\pm 0.01\%$ FS; IR resolution 0.1 $\mu\Omega$; calibration certificates supplied.

Repeatability: Gauge R&R on your own packs; test-to-test drift <2%.

Throughput: packs per shift at your protocol (reference band 180–550 per station).

Safety: door and HVIL interlock, emergency stop, safe discharge to <60 V DC before release.

Data: per-pack record, 10+ year retention, MES/API integration documented.

Changeover: new pack variant via stored recipe in <30 min.

Acceptance: trial run on your packs with documented first-pass yield and Cpk.

NEGUP MACHINE supplies the chain around the gate: the **NG-007 EOL test system** for pack and module end-of-line, the **NG-008 comprehensive tester** for module and protection-board verification, the **NG-009 polarity detection** station upstream, and the **NG-013 grading machine** and **NG-014 pack aging machine** behind them. Tell us your pack voltage class, BMS protocol and shift volume and we size the station to the process rather than to a datasheet.

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