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AEC-Q200 & Automotive Reliability: How EV / OBC Magnetics Qualify

Grades, the 18-test list, magnetic-specific concerns, and what buyers should actually ask for

Item	Detail
Document	AEC-Q200 & Automotive Reliability for EV/OBC Magnetics
Scope	Qualification of inductors & transformers for automotive use
Audience	EV/OBC power-electronics design, quality & sourcing engineers
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Reference to AEC-Q200 (latest revision). Values/tests are indicative; the controlling document is the current AEC-Q200 base document.



Summary & key takeaways

Bottom line

AEC-Q200 is the automotive stress-test qualification standard for passive components — including inductors and transformers. It sorts parts into Grade 0–4 by operating temperature and defines the 18 stress tests a magnetic must pass (temperature cycling, humidity, high-temperature operating life, mechanical shock/vibration, ESD, flammability, etc.). Crucial point: AEC-Q200 has no certification body and no official 'certificate' — it is a self-qualification where the supplier runs the tests and issues a qualification report. So ask for the test report + data, not a 'certificate'.

Key takeaways:

- **It's for passive components:** inductors and transformers fall under AEC-Q200 (active devices use Q100/Q101).
- **Pick the Grade first:** choose the Grade by the in-vehicle temperature environment; OBC magnetics are usually Grade 1 (-40...+125°C).
- **18 stress tests:** electrical, environmental, mechanical and process categories, per the AEC-Q200 magnetics test table.
- **Self-qualification:** no certification body, no 'certificate'; the supplier issues a report, the buyer accepts on report + PPAP.
- **Three pillars, all required:** AEC-Q200 (component) + IATF 16949 (QMS) + PPAP/APQP (production approval).
- **Magnetics-specific concerns:** wire insulation thermal class, bobbin/terminals, core cracking & vibration, potting, temperature-rise life, transformer PD.

The single most important clarification If a supplier hands you an 'AEC-Q200 certificate', be wary — the standard has no certifying body. What's credible is a complete qualification test report (tests, conditions, sample size, results, criteria).

1. What AEC-Q200 is — and is not

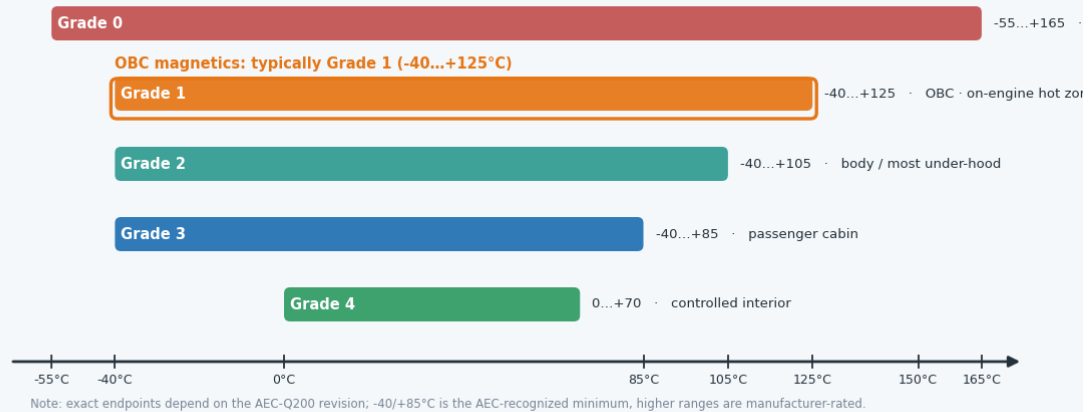
AEC-Q200, 'Stress Test Qualification for Passive Components', is issued by the Automotive Electronics Council (AEC), currently Rev E (2023). It defines which stress tests a passive component (resistor, capacitor, inductor/transformer) must pass to go into a vehicle, under what conditions, and to what criteria.

What it is NOT matters just as much:

- **Not a certificate:** no third-party certifying body; the supplier self-tests, self-declares 'AEC-Q200 Qualified' and issues a report.
- **Not a quality system:** component qualification ≠ factory system; the system is IATF 16949.
- **Not production approval:** passing tests ≠ stable mass production; consistency is governed by PPAP/APQP.

2. Temperature grades: pick the Grade by location

AEC-Q200 sorts parts into Grade 0–4 by operating temperature range — the lower the number, the harsher the requirement. The Grade follows the part's location in the vehicle: closer to heat sources (under-hood, OBC, inverter) means higher temperature and a higher Grade.

Fig. 1 AEC-Q200 temperature grades vs where the part sits in the vehicle


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Fig. 1 — AEC-Q200 grades vs where the part sits (endpoints per the standard revision).

Grade	Temp range (indicative)	Typical location
Grade 0	-55...+165°C	on-engine / extreme heat
Grade 1	-40...+125°C	OBC, inverter, under-hood hot zone
Grade 2	-40...+105°C	body / most under-hood
Grade 3	-40...+85°C	passenger cabin
Grade 4	0...+70°C	controlled interior

Table 1 — Grade vs location (endpoints per AEC-Q200 revision; -40/+85°C is the AEC-recognized minimum)

For OBC magnetics OBCs usually sit in the under-hood/hot zone, so their magnetics are typically designed and validated to Grade 1 (-40...+125°C) — which directly sets wire insulation class, bobbin material and the temperature-rise budget.

3. The 18 stress tests (magnetics table)

AEC-Q200 defines 18 required or conditional tests for magnetic devices. It's clearest grouped into four categories:

Category	Tests	What it stresses
Electrical	Pre/post-stress electrical, electrical characterization	parameter drift before/after stress
Environmental	High-temp storage, temperature cycling, humidity bias, high-temp operating life	thermal shock, moisture, long-term high-temp life
Mechanical	Mechanical shock, vibration, terminal strength, board flex (SMD)	transport/driving vibration, joint & terminal reliability
Process	Resistance to solvents/soldering heat, solderability, flammability, visual, dimensions, ESD	assembly/clean/solder process & safety (flame, ESD)

Table 2 — The 18 magnetics tests grouped in four categories (exact items/conditions per the standard)

How to read a report On a qualification report, check three things: is it the Grade you need (right temperature conditions); do sample size and criteria meet the standard; are all 18 tests covered (any omission explained).

4. Magnetics-specific reliability concerns (beyond the checklist)

Passing the 18 tests is the floor; what really decides an automotive magnetic's life are these points the checklist doesn't spell out but engineering must own:

- **Wire insulation thermal class:** the enamel class (155/180/200°C) must match Grade + temperature rise, or insulation ages under sustained heat.
- **Bobbin / terminal material:** bobbin temperature class, flammability (UL94 V-0), terminal mechanical & solder-heat strength.
- **Core cracking & vibration:** sustained vibration + thermal cycling can crack cores and fail bonding — needs structural and bonding/potting design.
- **Potting / varnish:** for vibration, moisture, PD and buzz suppression; match CTE to avoid thermal-stress cracking.
- **Temperature-rise life:** HTOL is essentially insulation life; rise + ambient must stay within the insulation thermal class.
- **Transformer insulation & PD:** 800 V OBC transformers need reinforced insulation and inter-turn/layer PD control, tested separately.

5. Three pillars: component + system + production approval

Fig. 2 Three pillars of an automotive-grade magnetics supplier

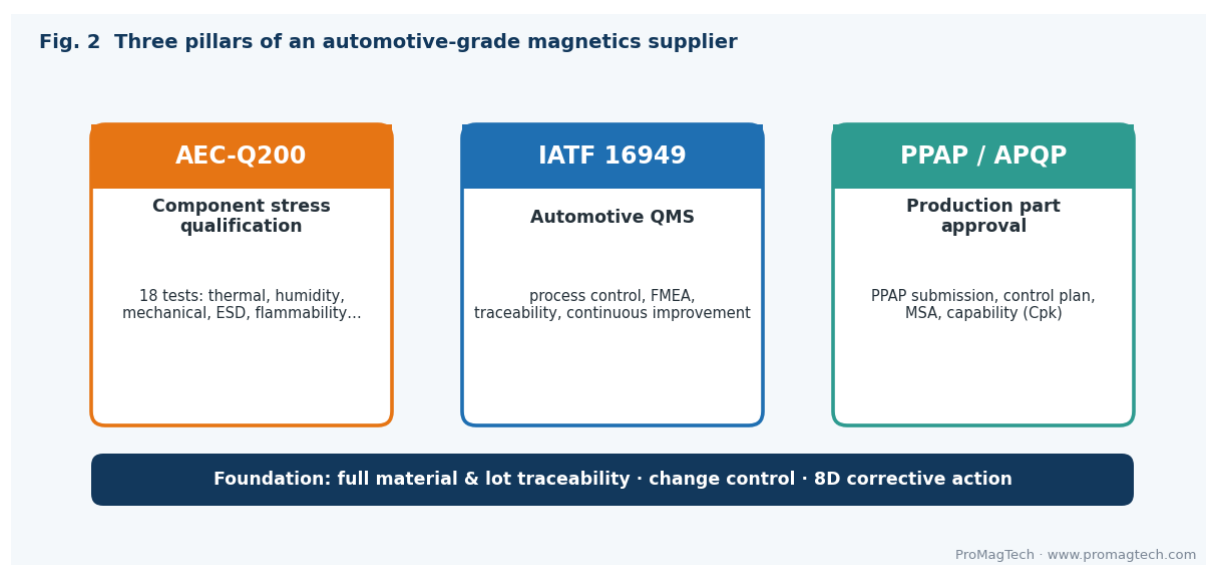


Fig. 2 — Three pillars of an automotive-grade magnetics supplier.

Many buyers watch only AEC-Q200, but stable supply to a carmaker needs all three pillars:

- **AEC-Q200:** component-level stress qualification — proof the part can survive the automotive environment.
- **IATF 16949:** automotive QMS — proof the factory can consistently build good parts (process control, FMEA, traceability).



- **PPAP / APQP:** production part approval — proof this lot matches the sample (control plan, MSA, process capability Cpk).

Foundation The shared foundation is traceability: full material/lot traceability, change control, and 8D corrective action. Without it, the pillars stand on nothing.

6. What buyers/designers should actually ask for

Aligning automotive documentation with a magnetics supplier — ask by this list and you'll ask right the first time:

Ask for	Why / what to check
AEC-Q200 qualification report	check Grade, sample size, criteria, all 18 tests
IATF 16949 certificate	system valid & in date
PPAP package	control plan, PFMEA, MSA, process capability
Material certs (wire/bobbin/potting)	thermal class, UL flammability rating
Temperature-rise / life data	HTOL, measured at the target Grade temperature
Transformer insulation/PD report	reinforced insulation & PD for 800 V
Traceability & change control	lot traceability, change-notice (PCN) process

Table 3 — Automotive magnetics documentation checklist (for sourcing/quality)

7. Common mistakes

- **Asking for an 'AEC-Q200 certificate':** the standard has no certifying body; the correct term is 'qualification report'.
- **Reading the Grade number without the temperature:** endpoints vary by revision; align to the actual conditions.
- **Assuming AEC-Q200 means ready for mass production:** qualification ≠ consistency; PPAP/APQP backs production.
- **Ignoring wire insulation thermal class:** rise + ambient over the insulation class will fail over time.

8. Frequently asked questions (FAQ)

Q Is AEC-Q200 a certification? Is there a certificate?

A No third-party certification and no official certificate. It is a self-qualification: the supplier tests to AEC-Q200 and issues a report. Buyers should request the full test report and data, not a 'certificate'.

Q Do inductors/transformers fall under AEC-Q200 or Q100?

A Under AEC-Q200 (passive components). AEC-Q100/Q101 govern active devices (ICs / discrete semiconductors).

Q Which Grade should OBC magnetics be?

A Usually Grade 1 (-40...+125°C), since OBCs often sit under-hood in a hot zone. The final call follows the vehicle's temperature requirement for that location.

**Q Does passing AEC-Q200 mean I can supply a carmaker?**

A Not by itself. You also need IATF 16949 and PPAP/APQP production approval, plus traceability. All three make a complete automotive supply capability.

Q Where do automotive magnetics most often fail?

A Commonly core cracking and terminal/joint failure under thermal cycling and vibration, and high-temperature operating life (insulation ageing). These are set by structure, potting and wire insulation class.

Q Why is humidity bias (85/85) important?

A Automotive environments are humid; 85°C/85%RH with bias exposes moisture ingress, corrosion and leakage risks — a key long-term reliability screen for magnetics.

Q What automotive support can ProMagTech provide?

A Selecting wire insulation class, bobbin and potting to the target Grade, running temperature-rise/life and insulation/PD validation, and aligning AEC-Q200-direction test data and production documentation.

9. Glossary

- **AEC-Q200** — The AEC's stress-test qualification standard for passive components.
- **Grade 0–4** — Levels by operating temperature range; lower number = harsher.
- **Self-qualification** — The supplier tests to the standard and declares compliance; no third-party body.
- **HTOL** — High-temperature operating life test; essentially an insulation-life test.
- **Humidity bias (85/85)** — 85°C/85%RH moisture test under electrical bias.
- **IATF 16949** — The automotive quality management system standard.
- **PPAP / APQP** — Production Part Approval Process / Advanced Product Quality Planning.
- **Partial discharge (PD)** — Micro-discharge in inter-turn/layer voids at high voltage, degrading insulation.
- **UL94 V-0** — A plastics flammability rating often required for automotive bobbins.

10. Further reading

This guide is part of the ProMagTech 800 V Power Magnetics Selection Reference; related deep-dives:

- [800 V Power Magnetics Selection Reference \(the pillar map\)](#)
- [OBC PFC boost inductor selection \(front-stage magnetic\)](#)
- [800 V OBC CLLC bidirectional transformer selection](#)
- [Southeast Asia EV charger reliability design](#)
- [800 V EV charging systems white paper](#)
- [Choosing a powder core \(material & temperature stability\)](#)

11. About ProMagTech

SHENZHEN PROMAGTECH CO.,LTD (founded 2013, Shenzhen) designs and manufactures flat-wire inductors, planar transformers, common-mode chokes and PFC inductors for 800 V EV



OBC and DC charging, AI-datacenter power, energy-storage PCS, solar inverters and industrial power. We select wire insulation class, bobbin and potting to your target Grade and align AEC-Q200-direction testing and production documentation.

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