Understanding IATF 16949 and AEC-Q200 Quality Management Systems

What is IATF 16949?

IATF 16949 is a global manufacturing quality management system standard for the automotive industry. It is a process-oriented quality management system that focuses on continual improvement, defect prevention, and reduction of variation and waste in the supply chain. The goal is to meet customer requirements efficiently and effectively.

IATF 16949:2016 incorporates the structure and requirements of the ISO 9001:2015 quality management system standard with additional automotive requirements. It was developed by the International Automotive Task Force (IATF) with support from AIAG. This standard requires certification by a 3rd party auditor (Registrar/CB/Certification Body).

These are the key areas of focus for IATF 16949:

- Continuous improvement
- Defect prevention
- Reducing waste
- Product safety
- Risk management
- Contingency planning
- Requirements for embedded software
- Change and warranty management
- Management of sub-tier suppliers

Registration to IATF 16949 is not only beneficial but a requirement for any company wanting to supply its products to the automotive industry. Companies registered to this technical specification are required to develop their suppliers' quality management systems with the goal of the supplier conforming to IATF 16949.

What is AEC-Q200?

The AEC-Q200 qualification is the global standard for stress resistance that all passive electronic components must meet if they are intended for use within the automotive industry. Parts are deemed to be AEC-Q200 qualified if they have passed the stringent testing as outlined within the standards. All the automotive standards can be found and downloaded using the link below. Including qualifications that apply to passive electronic components AEC-Q100 and AEC-Q101.

Starting in the early 1980s, electronic technology was becoming more common and part of our everyday life. The boom of consumer electronics meant that automotive companies were no longer the highest priority for component suppliers. This made it

difficult for the automotive industry to specify parts to the strict standards required by the automotive environment.

The idea for a standard was originally proposed by Gerald Servais of Delco Electronics (General Motors) and Jerry Jennings (Chrysler) at a meeting of the JEDEC, the global leader for the creation of microelectronics standards. Further conversation resulted in the founding of the AEC Council by of Gerald Servais, Jerry Jennings, Robert Knoell (Ford), and Earl Fischer (Ford). This group published the precursor of the standards we know today.

The overall aim of these standards is to set a benchmark for temperature and pressure resistance and to ensure the consistency of safety specifications of passive components required for the automotive industry. The creation of these standards removes guesswork for a lot of engineers – as they no longer need to determine the individual specifications for many components.

The following table is taken from the current standards as an example:

Grade	Temperature Range	Component Type	Typical Application
0	-50°C ~ +150°C	Flat chip ceramic resistors, X8R ceramic capacitors	All automotive
1	-40°C ~ +125°C	Capacitor networks, resistors, inductors, transformers, thermistors, resonators, crystals, and varistors, all other ceramic and tantalum capacitors	Most under the hood
2	-40°C ~ +105°C	Aluminum electrolytic capacitors	Passenger compartment hotspots
3	-40°C ~ +85°C	Film capacitors, ferrites, R/R-C networks, and trimmer capacitors	Most passenger compartment
4	0°C ~ +70°C		Non-automotive

The standards themselves should always be your first point of reference for this question, but we've included a summary here to try and help explain some of the intricacies.

AEC-Q200 Rev. D splits the level of qualification required for different parts of the industry into five grades, numbered 0 – 4. To meet a specific qualification grade, the part must undergo stress testing up to the highest temperature included within that grade. Grade 0 is the most stringent, requiring testing throughout the -50°C ~ +150°C temperature range. Components graded to this level can be used in any application throughout the automotive industry regardless of location within the vehicle. The level of testing required then decreases through the grades. Grade 1 parts which are suitable for most under hood uses are required to be tested through the -40°C ~ +125°C temperature range. Grade 2 parts are less stringently tested and are suitable for use in

hot spots within the passenger compartments. Grade 3 is used within most of the passenger compartment. Lastly, there is grade 4 which is the qualification grade used for non-automotive parts.

All component suppliers will have slightly different test procedures, but at ECS Inc. International the automotive qualified parts we supply are tested to ensure they are within strict limits. Our testing process includes subjecting a sample of the parts to rigorous rounds of testing. Below are some examples of the types of testing these parts undergo before they are deemed AEC-Q200 qualified:

- A round of stringent electrical testing, followed by a stress test, and then a further round of testing to ensure the electrical integrity of the component.
- The temperature resistance of the part is tested by exposing the samples to the maximum temperature within the required testing range for a prolonged period. This is then followed by temperature cycling throughout the entire temperature range, and then a further round of measurement to determine the resistance of the parts.
- Moisture resistance is tested by exposing the part to a high degree of humidity for a prolonged period.
- The operational life of the component is checked to ensure it passes the required benchmark. A reliability prediction is used to estimate the failure rate or Mean Time Between Failures (MTBF) which predicts a product's reliability.
- The resistance of the component to solvents is tested. The goal is to ensure that solvents do not cause deleterious, electrical, or mechanical damage, or the deterioration of materials and finishes.
- Mechanical shock and vibration resistance are checked by exposing the components to high levels of g-force for prolonged periods of time and by cycling the parts through periods of vibration.
- The solderability of the parts and their resistance to soldering heat is also checked to ensure they are fully operable which involves exposing the components to extremely high temperatures.
- The board flex and terminal strength of the components are also checked to ensure compliance with the standard. This determines the ability of the surface mounted component terminations and seals to withstand bending, flexing, and pulling during board assembly and use.
- Finally, the parts undergo a strict visual inspection and a check to ensure their physical characteristics meet the required specifications.

There's a lot of testing that goes into qualifying a part to AEC-Q200 specifications which adds peace of mind about the integrity of the part which ultimately makes for a safer product.

The future of AEC-Q200 products looks dynamic. As more modern cars incorporate ever increasing amounts of electronic technology, the need for standards to be applied to the components they require is ever greater.

The AEC Council hosts an annual workshop each spring where industry leaders meet to discuss the standard and its application to new and developing technology.

For a full list of AEC-Q200 qualified ECS Inc. parts. Please visit our website https://ecsxtal.com/

For an in-depth look at the IATF 16949 standards, there is a book available for purchase here.