



Aluminum Electrolytic Capacitors

Quality and environment

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Corporate goals

Our aim is to play a leading role among the world's most competitive companies in the sector of electronic components. This aim is shared by the EPCOS quality and environment management system:

1 EPCOS quality system

1.1 Extract from the EPCOS quality policy

- The quality of our products and services represents a key constituent of our corporate strategy, whose principal aim is customer satisfaction.
- Our quality management system is continuously oriented to the international standards that stipulate the highest requirements.

1.2 Quality management system

The quality management system to ISO/TS 16949:2002 is applied throughout the company and is used to implement the EPCOS quality policy. The implications include:

- As a rule, product and process developments follow the rules of APQP¹⁾,
- Quality tools such as FMEA²⁾, DoE³⁾ and SPC⁴⁾ minimize risks and ensure continuous improvements in conjunction with regular internal audits and QM reviews.

1.3 Certification

The EPCOS quality management system forms the basis for the company certification to ISO 9001:2000 and ISO/TS 16949:2002 that comprises the EPCOS plants and sales organizations. The company certificates are posted on the EPCOS Internet (www.epcos.com/quality).

1.4 Production sequence and quality assurance

The divisions implement the corporate quality management guidelines in procedural and work instructions referred to products and processes.

The following example shows quality assurance applied to the production sequence of aluminum electrolytic capacitors.

1) APQP= Advanced Product Quality Planning

2) FMEA= Failure Modes and Effects Analysis

3) DoE= Design of Experiments

4) SPC= Statistical Process Control

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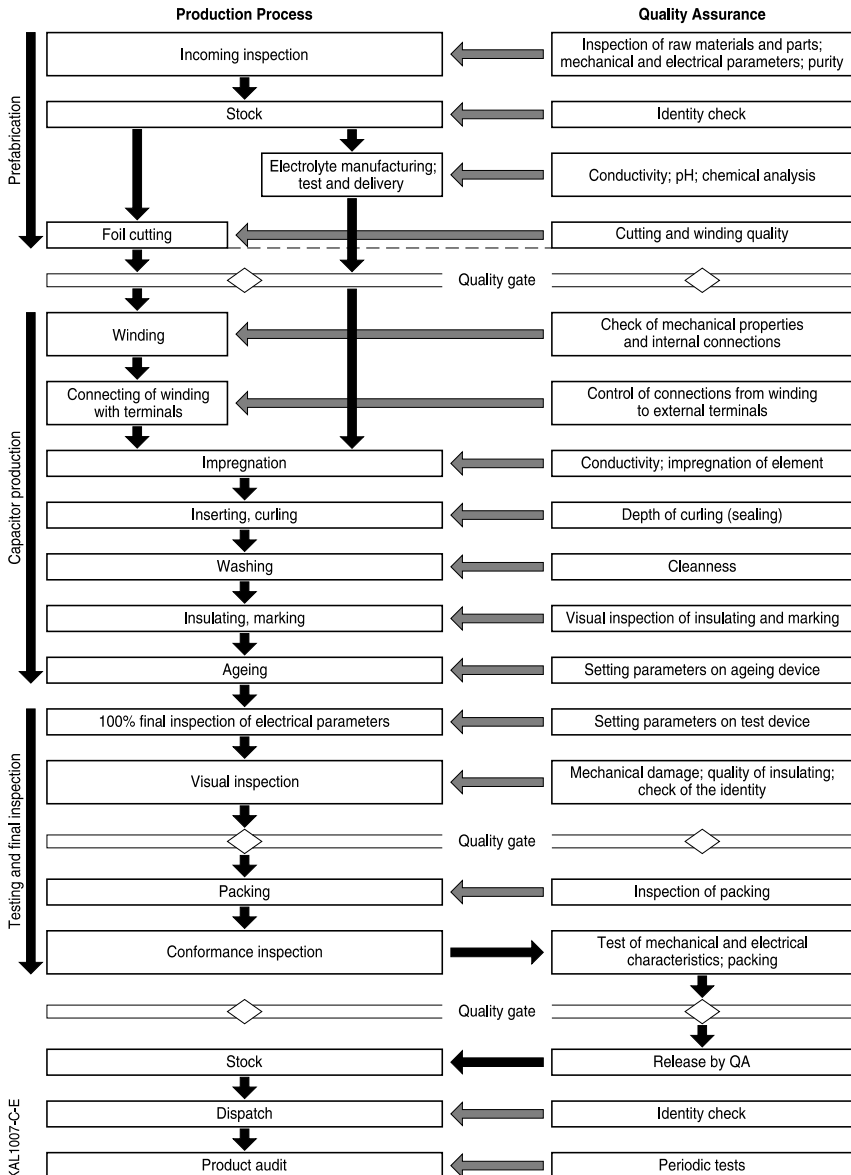


Figure 1
Quality assurance in the production process

1.5 Delivery quality

“Delivery quality” means compliance with the agreed data at the time of delivery.

1.6 Failure criteria

A component is defective if one of its features does not correspond to the specification of the data sheet or an agreed delivery specification.

1.7 Incoming goods inspection at the customer

We recommend the use of a random sampling plan according to ISO 2859-1 (contents compliant with MIL STD 105 D and IEC 60410) for incoming goods inspection.

The test methods to be used are laid down in the relevant standards. Deviations must be agreed by the customer and the supplier.

1.8 Duration of use

The service life in terms of reliability is the time period during which random failures occur, i.e. the range in the product operating life in which the failure rate remains largely constant (early failures and end of operating life excepted). The value depends strongly on conditions of use.

1.8.1 Failure rate (long-term failure rate)

The failure rate is defined as the failure percentage divided by a specified operating period. The failure rate is expressed in fit (failures in 10^9 component hours) or as percentage of failures in 1000 hours.

$$1 \text{ fit} = 1 \cdot 10^{-9} / \text{h} \text{ (fit = failure in time)}$$

Example of a failure rate λ_{test} determined by a useful life test:

- | | |
|--------------------------------|-------------------------|
| 1. Number of components tested | $N = 8000$ |
| 2. Operating hours | $t_b = 25000 \text{ h}$ |
| 3. Number of failures | $n = 2$ |

$$\lambda_{\text{test}} = \frac{n}{N} \cdot \frac{1}{t_b} = \frac{2}{8000} \cdot \frac{1}{25000 \text{ h}} = 10 \text{ fit} = 0.001 \% / 1000 \text{ h}$$

Failure rate specifications must include failure criteria, operating conditions and ambient conditions.

Usually the failure rate of components, when plotted against time, shows a characteristic curve with the following three periods:

I: early failure period, II: useful period, III: wear-out failure period

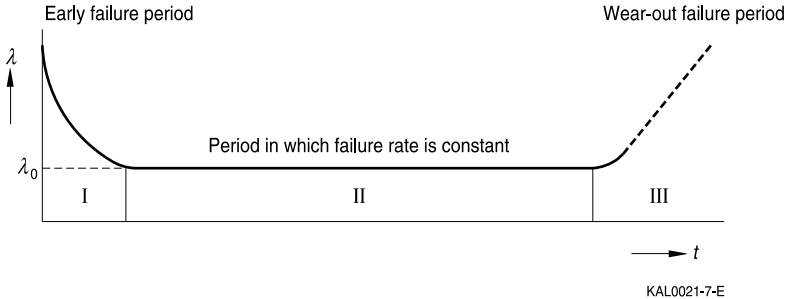


Figure 2
Failure rates

Unless otherwise specified, the failure rate refers to the useful period (II). During this period, an approximately constant failure rate λ_0 can be assumed.

1.8.2 Conversion factors for failure rates

The conversion factors for different load conditions can be derived from EN 61709.

1.9 Traceability

At all stages of production, components are identified by papers accompanying each batch. The completion of manufacturing and testing steps are confirmed and documented. This ensures the traceability of a batch.

After shipment, traceability is ensured by a code on the packing.

1.10 Electrical and mechanical properties

The measuring conditions can be found in the chapter "General technical information". The product data and relevant tolerance limits are defined in the respective data sheets.

1.11 Dimensions

The dimensional drawings in the individual data sheets are definitive for the dimensions.

1.12 Finish

Assessment of the finish of aluminum electrolytic capacitors is performed to EPCOS finish specifications. These are based on IEC 60384-4.

1.13 AQL values

The AQL (AQL = acceptable quality level) figures are based on a random sampling plan to DIN ISO 2859-1 (contents compliant with MIL STD 105D and IEC 60410).

The sampling instructions of this standard are such that a delivered lot will be accepted with a probability of $\geq 90\%$ if the percentage of non-conformancies does not exceed the stated AQL figure. As a rule, the percentage of non-conformancies in deliveries from EPCOS is significantly below the AQL figure. The acceptance value we apply to inoperatives, i.e. unusable components is $c = 0$.

1.13.1 Classification of inoperatives / non-conformancies

A non-conformancy exists if a component characteristic fails to meet the data sheet specifications or an agreed delivery specification. Inoperatives are totally unusable components (to CECC).

Inoperatives

- Wrong or missing marking
(when specified, and provided the consequence can be misapplication)
- Missing or useless terminals
- Broken or missing encapsulation (if encapsulation is specified)
- Short or open circuits
Capacitance outside three times the application tolerance
- Marking: polarity, if missing
- Leakage current more than 10 times the limiting value or $100 \geq \mu\text{A}$; whichever is greater
- Impedance outside three times limit value
- Alternating orientation of taped components
- Mixing with other component types

Non-conformancies

- non-conformancies in electrical characteristics
(electrical characteristics outside of specified limits)
- non-conformancies in mechanical properties
(e.g. wrong dimensions, damaged case, illegible marking, bent terminals).

1.13.2 AQL figures

The following AQL figures apply the non-conformancies listed above:

| | |
|--|-------|
| – inoperatives (electrical and mechanical) | 0.065 |
| – sum of electrical non-conformancies | 0.25 |
| – sum of mechanical non-conformancies | 0.25 |

1.14 Conditions of use

EPCOS products may only be used in line with the technical specifications and installation instructions and must comply with the state of the art. Non-observance of limits, operating conditions or handling guidelines can lead to disturbances in the circuit and other undesirable consequences such as a higher failure rate.

In this connection, please note the “Important notes” on page 2.

Should you have any application-referred questions, please contact our experts, who will be pleased to advise you.

1.15 Customer complaints

If a fault occurs in a product despite careful manufacture and testing, please contact your local sales organization. They will register your complaint as an RMA⁵⁾ process and forward it to the relevant technical departments for rapid handling.

EPCOS treats technical complaints according to the 8D⁶⁾ methodology; i.e. with the use of interdisciplinary teams who aim to implement rapid countermeasures and sustained corrections and answer all complaints with an 8D report.

In order to be able to deal quickly and smoothly with complaints, the following data are helpful:

- Number of components subject to complaint or returned
- Fault description
- How and when was the fault detected?
- Logistics data (date code, delivery note no.)
- Operating conditions
- Operating duration up to occurrence of the fault
- Measurement parameters in the case of divergent technical data

In the event of transport damage, we would ask you to describe this in more detail and if required to mark it so that it can be distinguished from any further damage sustained during the return shipment. The original package should also be checked and any damage to be described. In order to avoid further damage, the original packaging should also be used for the return shipment.

In case of receiving a damaged delivery, please document this damage with a signature of the forwarding company on the delivery papers.

5) RMA = Return of Material Authorization

6) 8D = 8 disciplines

2 Environmental management system

2.1 Environmental policy

Our fundamental commitment to environmental protection is laid down in the EPCOS environmental policy.

EPCOS defines the following environmental protection principles:

- Above and beyond statutory and administrative requirements, we are continuously working to minimize the burden on the environment and to reduce consumption of energy and natural resources.
- We are taking all precautions necessary to protect our environment against damage.
- Potential impact on the environment is assessed and incorporated in product and process planning at the earliest possible stage.
- Our environmental management system ensures that our environmental protection principles are effectively put into practice. The technical and organizational procedures required are regularly monitored and updated.
- Each employee is required to act in an environmentally conscious manner. It is the constant duty of management to increase and encourage awareness of responsibility at all levels.
- We work with our business partners to promote conformity with similar objectives. We supply our customers with information on ways to minimize any potentially adverse environmental impacts of our products. We work in a spirit of cooperation with the relevant authorities.
- We inform the public of the impact on the environment caused by the company and our activities related to the environment.

2.2 Environmental management system

The EPCOS ISO 14001 based environmental management system is applied company wide for implementing the EPCOS environmental policy. It is posted on the EPCOS Intranet and is thus accessible to all employees.

2.3 Certification

The EPCOS Group operates an environmental management system that conforms to the requirements of ISO 14001 and is mandatory for all plants. The company certificate is posted on the EPCOS internet:

(www.epcos.com/environmental_management).

2.4 RoHS

The term “RoHS-compatible” shall mean the following:

The components described as “RoHS-compatible” are compatible with the requirements of the regulations listed below (“Regulations”) and with the requirements of the provisions which will result from transformation of the Regulations into national law to the extent such provisions reflect the Regulations:

- Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment ("Directive 2002/95/EC");
- Commission Decision of 18 August 2005 amending Directive 2002/95/EC (2005/618/EC);
- and all Commission Decision amending the Annex to Directive 2002/95/EC (e.g. 2005/717/EC, 2005/747/EC, 2006/310/EC, 2006/690 ... 692/EC, etc.).

2.5 REACH

According to Art. 33 we are obliged to inform our customers immediately or on request a consumer within 45 days if we get knowledge that a Substance of Very High Concern (SVHC) contained in a product or its packaging with more than 0,1%/w. Provided this substance is published by the European Chemical Agency via the candidates list. Respective information is provided via www.epcos.com/reach (Link: REACH Candidates List and Information according REACH Art. 33, concerning EPCOS Products)

2.6 Banned and hazardous substances in components

As a manufacturer of passive components, we develop our products on the basis of sustainability. In order to guarantee a standardized procedure for EPCOS worldwide, a material compliance management and a mandatory list of banned and declarable substances and substances of special interest (EPCOS BAD-SL) are part of our environmental and/or quality management system. The planning and development instructions include regulations and guidelines that aim to identify environmental aspects and to optimize products and processes with respect to material use and environmental compliance, to design them with sparing use of resources and to substitute hazardous substances as far as possible.

Consideration of the environmental aspects is checked and recorded in the design reviews: the environmental officer provides support in the assessment of the environmental impacts of a development project.

2.7 Material data sheets for product families

EPCOS posts material data sheets on the Internet (www.epcos.com/material) that show typical compositions of product groups by selected representatives. The materials are listed with their percentage weight distribution referred to the respective component.

As per IEC 61906 PAS, all materials with a weight percentage exceeding 0.1 are listed. All specifications are typical data and may vary slightly within a product group or production lot. The material data sheets do not represent guaranteed properties, but are merely given for purposes of information.

Please note in this connection the "Important notes" on page 2.

2.8 Disposal

All Aluminum Electrolytic Capacitors can be disposed off, reused or recycled. However as disposal is regulated by national law, the respective national provisions have to be observed.