Aluminum electrolytic capacitors

Reliability of Aluminum Electrolytic Capacitors

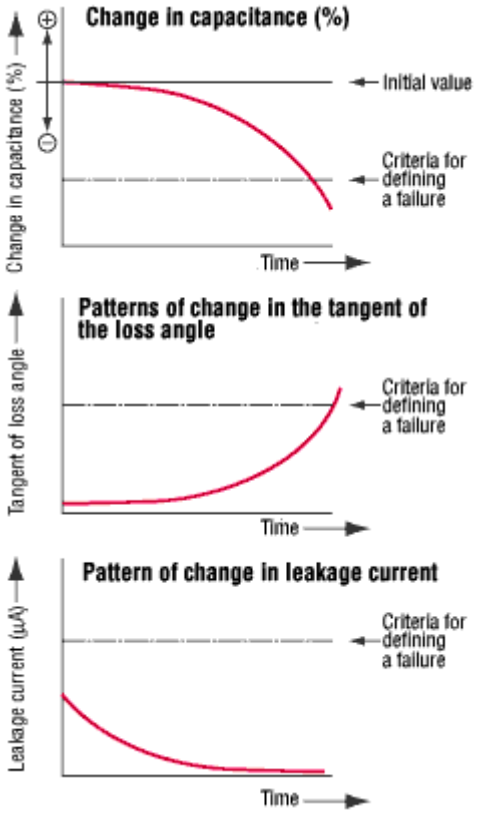
[1] Drift of Aluminum Electrolytic Capacitors Over Time

The aluminum electrolytic capacitor has a limited life span. This occurs because the electrolyte in the element eventually dissipates.

The changes in performance over time can be described as follows:

(1) Eventually, the capacitance begins to drop off.

(2) The tangent of the loss angle begins to increase.
(3) Generally, when voltages are applied, the leakage current begin to drop.
(4) Finally, at the end of the life span, the capacitor enters an open-circuit mode as the dielectric dries up.

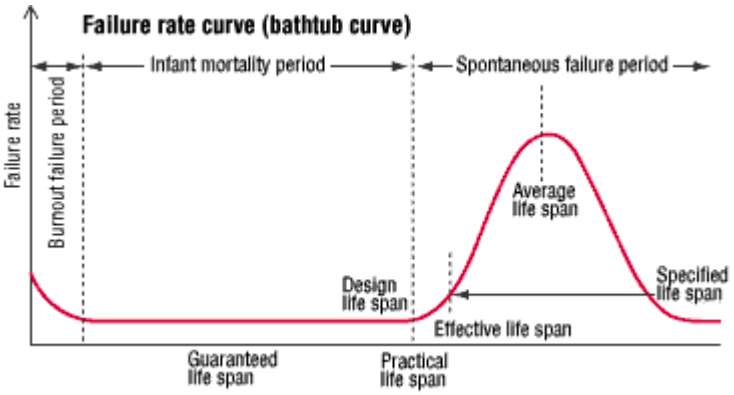


[2] Criteria for Defining Failures in Aluminum Dielectric Capacitors

The criteria for defining failures are established for each individual product series. In general, the standards for establishing the guaranteed life span are as follows:
(1) Changes in capacitance: A failure is defined as a change in capacitance from the initial capacitance level beyond the specified range. The change is generally ±20% to ±30%.
(2) Changes in the tangent of the loss angle: A failure is defined as the component exceeding the specified range. Usually, this range is 1.5 to 3.0 times the initial value.
(3) Change in leakage current: The definition of failure occurs when there is an excess of the specification values.

[3] Definitions of Life Span for the Aluminum Electrolytic Capacitor

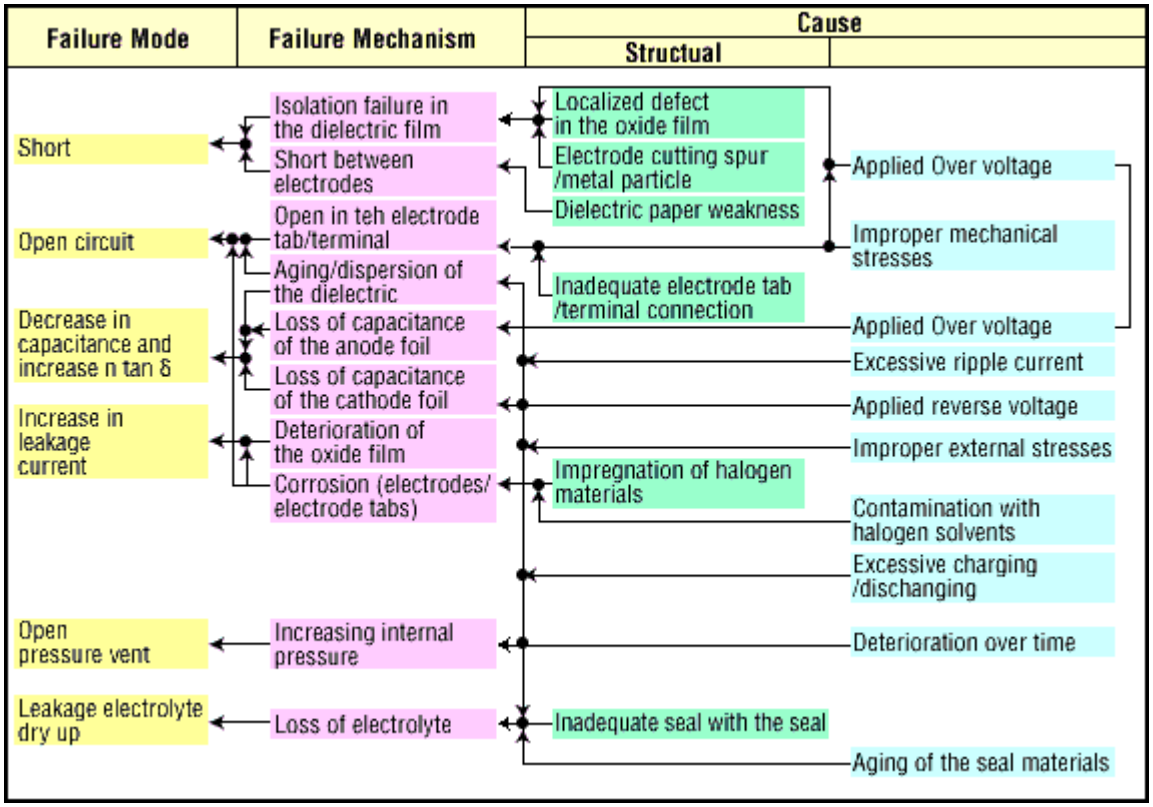
The following five life span definitions of aluminum electrolytic capacitors are used at Elna, Ltd.:
(1) Guaranteed Life Span
The life span that is set in the product transactions. (The period of time where the specified performance will be maintained.)
(2) Design Life Span
A targeted life span specified at the design stage.
(3) Practical Life Span
A precursory period of time where the component enters into the burnout failure phase.
(4) Effective Life Span
The period of time where the capacitor has gone beyond the infant mortality stage and has entered the burnout failure stage. At this stage, the number of failures are less than the specified values.
(5) Average Life Span
The average of the five life spans prior to the burnout failures.



There are five different definitions for "life span." These definitions share a relationship in terms of the length of their life spans: guaranteed life span < design life span < practical life span < effective life span < average life span.

[4] Typical Aluminum Electrolytic Capacitor Failure Modes and Their Causes

The failure mode and cause analysis diagram is shown below:



[5] Various Types of Reliability Data

The reliability data for typical Elna aluminum dielectric capacitors are shown below:

<1> RVK Series: 125°C vertical chip aluminum electrolytic capacitor
(1) Durability (high temperature charge)
(2) High temperature and low temperature characteristics
(3) Frequency characteristic

<2> RYK Series: 125°C horizontal chip aluminum electrolytic capacitor
(1) Durability (high temperature charge)
(2) High temperature and low temperature characteristics
(3) Frequency characteristic

<3> RK Series: 125°C small footprint aluminum electrolytic capacitor
(1) Durability (high temperature charge)
(2) High temperature and low temperature characteristics
(3) Frequency characteristic

<4> RJB Series: 105°C small footprint high reliability low impedance aluminum electrolytic capacitor
(1) Durability (high temperature charge)
(2) High temperature and low temperature characteristics
(3) Frequency characteristic