ILLINOIS CAPACITOR, INC.
3757 W. Touhy Ave., Lincolnwood, IL 60712 • (847) 675-1760 • Fax (847) 673-2850 • www.illcap.com

Aluminum Electrolytic Capacitors

Reliability

MTBF (Mean time between failures) is the most commonly used reliability rating used today. Aluminum electrolytic capacitors do not failure in a manner where MTBF can be used accurately. Instead of using MTBF we use load life rating.

In aluminum electrolytic capacitors as they are used the capacitors slowly degrade over time and once a capacitor has degraded beyond a specified amount the capacitor is considered to be a failure. Most capacitors are considered a failure when the capacitance has changed by 20 to 25% of its initial value.

Aluminum electrolytic Capacitors load life's ratings are generally expressed between 1000 and 10000 hours at there rated voltage and temperature rating. This means that the capacitance of the capacitor will not change by more than the amount indicated under the load life rating when the capacitor is operated at its rated voltage and maximum temperature rating. Although the life expectancies appear be a short amount of time the following can increase them.

When the capacitor is operated at temperatures other than the maximum rated temperature for the capacitor the expected life of the capacitor will increase. The rate of increase in expected operating life is for the life to double for every 10°C decrease in temperature.

The above is expressed mathematically as:

$L2=L1*(Vr/Vo)*2^{x}$ Where L2= life expected at ambient temperature.

L1= Load life rating of the capacitor.

Vr= Rated voltage of the capacitor.

Vo= applied voltage

X=(Tm-Ta-Tr)/10

Tm= maximum rated temperature of the capacitor.

Ta= ambient temperature.

Tr= temperature rise due to ripple current

Reducing the amount of voltage applied to the capacitor can also increase the expected life of the capacitor. The expected life can be increased by the ratio of applied voltage to rated voltage for the capacitor. The expected life by voltage derating is limited to a 2:1 ratio even if the ratio is more than 50% of the rated voltage of the capacitor.

By de-rating, the life expectancies beyond 15 years can be achieved. When life expectancies exceed 15 years the expected life of the capacitor should be limited to 15 years mainly due to the sealing materials will deteriorate over time.

The life of the capacitor can be reduced if the amount of ripple current becomes excessive causing the capacitor heat up from its ESR. Care should be taken to limit the temperature rise (Tr) due to the ripple current and ESR to a maximum of 10°C above the ambient temperature the capacitor is operating in.

It should be evident that a 10°C temperature rise due to the ESR will reduce the expected life is half.

Other factors that can reduce the expected life of a capacitor are:

- High leakage current.
- Frequent charge and discharge cycles.
- Excessive reverse voltage.
- Application of voltages greater than the rated voltage of the capacitor.
- AC voltage exceeding the limits of the capacitor.
- Operation at temperatures exceeding the maximum temperature rating for the capacitor.