General introduction

Rated capacitance
The capacitance value for which the capacitor has been designed and which is usually indicated upon it.

Tolerance on rated capacitance
Preferred values of tolerance on rated capacitance are:
-20/+20%, -10/+20%, -10/+30%, -10/+50%, -10/+10%

Rated voltage
The maximum direct voltage, or peak value of pulse voltage which may be applied continuously to a capacitor at any temperature within operating temperature range.

Ripple voltage
An alternating voltage may be applied, provided that the peak voltage resulting from the alternating voltage, when superimposed on the direct voltage, does not exceed the value of rated voltage or fall under 0V and that the ripple current is not exceeded.

Surge voltage
The maximum instantaneous voltage which may be applied to the terminations of the capacitor for a specified time at any temperature with the operating temperature range.

Rated voltage (VDC)	4	6.3	10	16	25	35
Surge voltage (VDC)	5	8	13	20	32	44

Rated voltage (VDC)	40	50	63	80	100	160
Surge voltage (VDC)	50	63	79	100	125	200

Rated voltage (VDC)	200	250	275	315	350	375
Surge voltage (VDC)	250	300	316	365	400	425

Rated voltage (VDC)	400	420	450	500	550	600
Surge voltage (VDC)	450	470	500	550	600	650

Equivalent series resistance (ESR)
The ESR of an equivalent circuit having capacitance, inductance and resistance in series measured with alternating current of approximately sinusoidal waveform at a specified frequency.

$$ESR = \frac{\tan\delta}{2\pi fC}$$

where,
f = measurement frequency (120Hz)
C = measurement capacitance (F)

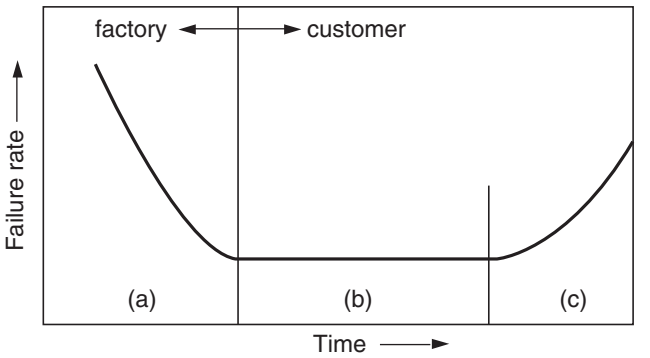
Dissipation factor (tanδ)
The power loss of the capacitor divided by the reactive power of the capacitor at a sinusoidal voltage of specified frequency.

Leakage current
Leakage current flows through a capacitor when DC voltage is applied in correct polarity. It is dependent on voltage, temperature and time.

Ripple current
Any pulsating voltage (or ripple voltage superimposed on DC bias) across a capacitor results in an alternating current through the capacitor. Because of ohmic and dielectric losses in the capacitor, this alternating current produced an increase of temperature in the capacitor cell. The capacitor should be used within specified permissible ripple current in each standard products table.
In other condition of ambient temperature and frequency, ripple current multiplied by following multiplier can be applied as maximum permissible ripple current.

Failure rate

The failure rate of an aluminum electrolytic capacitor follows a bathtub curve.



(a) initial failure period (infant mortility)
(b) random failure period (useful life period)
(c) wear-out failure period

Expected life - ***(* for reference)***

Temperature, humidity, ripple current and atmospheric pressure etc. have influence on the life of aluminum electrolytic capacitors. Among them, temperature has the greatest effect on life of capacitors. The relationship between ambient temperature and life of capacitor can be explained to so-called ARRHENIUS equation, generally the life of capacitor is reduced approximately by one-half for each temperature increase of 10˚C. The life acceleration equation computes as shown below.

$$L = Ls \times 2^{\frac{Ts - (T+\Delta T)}{10}}$$

L : Lifetime of capacitor to be estimated (Hour)
Ls : Base life time of capacitor (Hour)
Ts : Maximum operating temperature shown in catalog (˚C)
T : Ambient temperature (˚C)
ΔT : An increase temperature produced by internal heating due to actual operating ripple current. (˚C)

Expected life chart - ***(* for reference)***