Reliability

Given an operating condition and expected life, the reliability of an Itelcond capacitor can be defined as the probability that it will operate correctly. The expected life is the period of time in which a capacitor reaches the maximum accepted values of modification of its electrical parameters.

Naturally it is impossible to predict exactly when a capacitor will fail and so probability theory is used. To forecast the probability that a capacitor will operate correctly, MIL-STD-690 specifications with a "confidence level" of 60% is utilised. Reliability is linked to capacitor temperature, applied voltage and time in use.

Reliability as a function of time, Rel (time), is normally expressed as Rel (time) = $e^{-\lambda t}$ where Rel (time) is the probability that the capacitor will work correctly and λ is the failure rate.

The failure rate of many electronic components follows a characteristic 'bath tub' pattern as shown in figure 17.

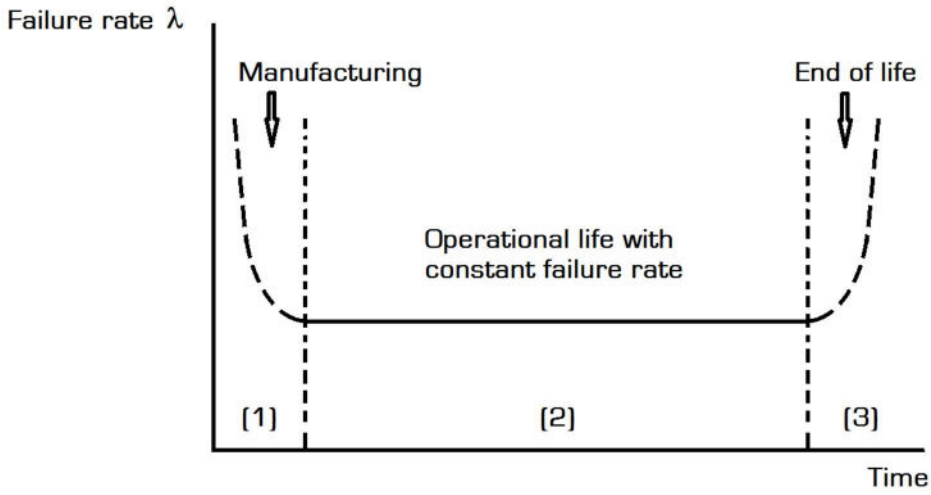

Figure 17

(1) is the period during manufacturing.
(2) is the operational life, where the failure rate is invariably constant.
(3) is where the end of life has been reached. The failure rate will rapidly increase.

The failure rate, λ , is defined as $1x10^{-9}$ failures per hour, and is also known as Failure in Time, or FIT, and is also expressed as a percentage of failures per 1000 hours.

For example, 10FIT = $1x10^{-8}$ failures per hour = 0.01%/1000 hours.

Years of experience have shown that values could be considered, during the intrinsic failure period of a typical bathtub statistical curve. The values of FIT are typical at 60°C.

ITELCOND series	Voltage	FIT	ITELCOND series	Voltage	FIT
AR,AY	<150 Vdc	40	AZK	<150 Vdc	50
	≥150 Vdc	70		≥150 Vdc	80
AS	<150 Vdc	45	ATK	<150 Vdc	40
	≥150 Vdc	45		≥150 Vdc	70
AP	ALL VOLTAGES	45	ACC	ALL VOLTAGES	50
AF	ALL VOLTAGES	45	AZC	<150 Vdc	50
AT	ALL VOLTAGES	20		≥150 Vdc	80
			ATC	<150 Vdc	40
AKS	<150 Vdc	50		≥150 Vdc	70

Figure 18

Figure 19 shows a typical FIT vs temperature graph.

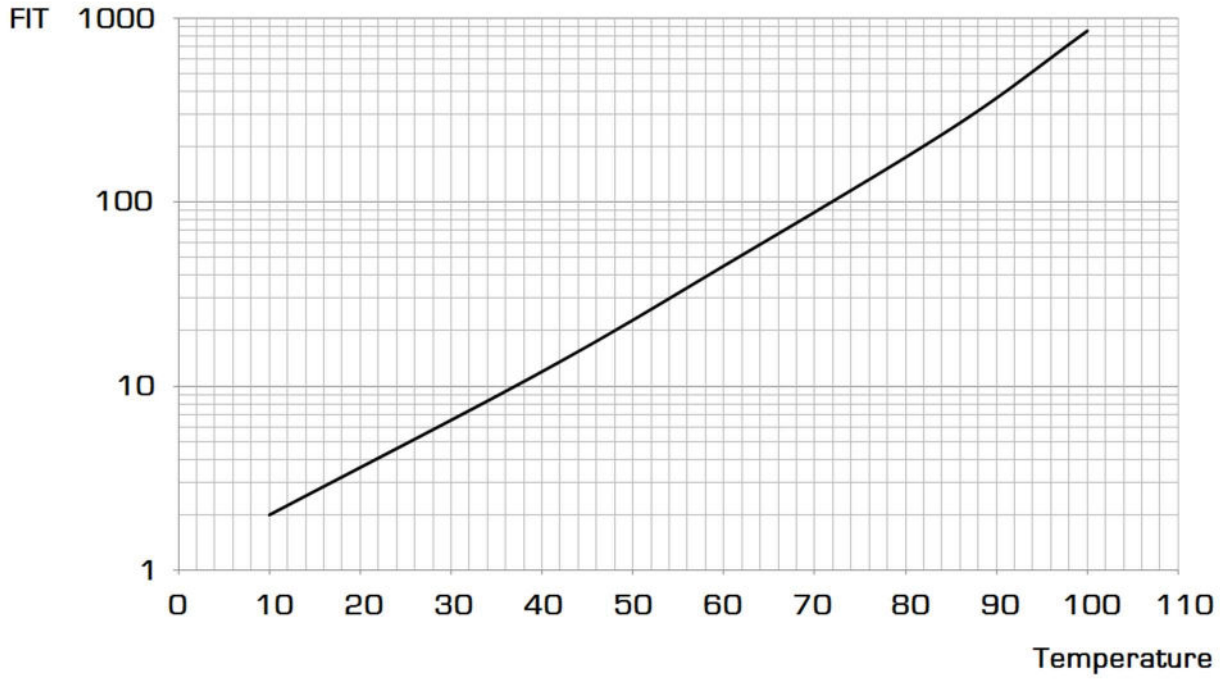

Figure 19

Applied voltage in relation to the capacitor rated voltage also has an effect on reliability. Figure 20 shows the effect of having the applied voltage less than the rated voltage as a percentage.

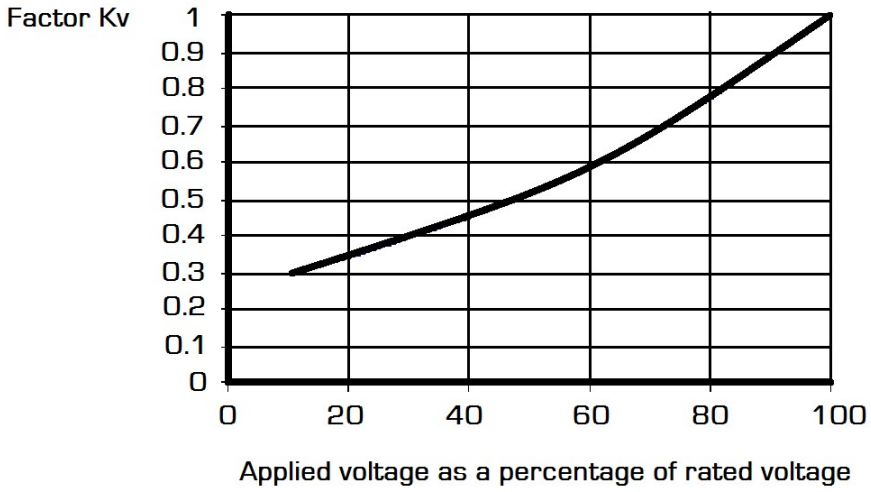

Figure 20

The failure rate during the operational life, λop, is the FIT value from figure 17 multiplied by the Kv value from figure 20:

λop,= FIT x Kv

The mean time before failures (MTBF) is the inverse of the failure rate: MTBF = 1 / λop