Life Time of Fan

Fan life can be measured using different techniques or methods. There are various stressors to shorten testing time such as heat, humidity, temperature, vibration, and load. Usually, engineers in the industry use High Temperature Operational Life Test Conditions to measures fan life by assuming certain conditions of fan life distribution. Then, High Temperature Operational Life (MTBF) is calculated based on temperature acceleration method and Testing is usually conducted under 70-80℃

MTBF or the mean time between failures is the average time between fans fail. Failure is defined as one of the following: 1) fan does not work, 2) RPM is 15% of origin, and 3) rated current is 15% of origin. Usually, a test batch of samples is taken to ensure that the probability test is reliable.

1. Acceleration Factor Calculation

The Arrhenius equation below is used to model the relation between increased temperature and the acceleration of the aging of a product as compared to its normal operational temperature.

$$A_f = e^{\wedge}\left(\frac{Ea}{k} \left\{ \frac{1}{T_s} - \frac{1}{T_t} \right\} \right)$$

A_f = acceleration factor

Ea = activation energy in electon-volts (eV) = 0.53 eV

K = Boltzmann's constant = 8.617 x 10^{5} eV/T_k

T_s = Temperature of noemal operation, in degrees Kelvin

T_t = Temperature of operation during test, in degrees Kelvin

T_k = Kelvin Temperature

e = 2.71828 (mathematical constant)

2. Mean time between failures (MTBF)

The MTBF formula using a Chi-squared distribution is:

$$MTBF = \frac{2 \cdot (N \cdot T) \cdot A_f}{X\ [\alpha,(2(n+1))]}$$

Where:

MTBF = Mean time between failures

N is the Number of elements

T = Total test time

Af = Acceleration factor from Arrenhius equation

α = 0.1 (Confidence level of 90%)

n = number of failures (used to calculate degrees of freedom)

$X^2[\alpha,(2(n+1))]$ = Chi-squared distribution function