MTTF AND L10 CALCULATION

The life expectancy of a fan motor is limited by the following:

- The temperature of the motor (i.e. Ambient temperature plus Temp. Rise of the motor), (for every 10℃ increase of Temp. its life is decreased by 50%).
- The running speed of the motor (for every 19% increase of speed, its life is decreased by 25%).
- Metal fatigue of the bearing system used (e.g. The maximum bearing life is 70000 hrs when the fan is running at 6000RPM as shown in the example below).
- By the life of the electrolytic capacitor whose value is decreased by 50% with every 10℃ of temperature increase.

Below is a sample of MTBF calculation of model C6025X12BPCB2x-5.
The calculation is based on tested sample C6025X12B-5, C6025Y12B-5, C6025X24B-5 (these models use the same size, use the same bearing system and are tested at the same time at 70℃ oven).

Elevated Test Temp.Ts (℃)	Typical Temp to run for L10 hrs: Tuse (℃)	Accelataion Factor Af	Units under test (N)	Poisson Distribution X², Factor Br;c	Actual, Non statistical oven 'no fail' data at 70 C	For MODEL: C6025X12BPCB2x-5			70K @ 6000RPM @ 30C	RPM= 6000
70	40	8	30	2.303	32952	=test hrs	Max.Life of bearing due to metal fatigue:	830	@ RPM 6000 max life :	70000 hrs
$Af=2^{[(Ts-Tuse)/10]}$	Arrhenius Acceleration factor			Speed Effect:		Speed Acceleration Factor=AS=$1.1^{((Smeas.-Starget)/(Smeas.*0.1))}$ (i.e. for every 10% speed decrease, the life increases by 10%) = inversly proportional according to the bearing metal fatigue equation				
MTTF=7*L10 as per Weibull Distribution				Tested: Model samples of same size, bearing type & normalized speed and at the same oven temperature						
Br;c=2.303 as per Poisson distribution factor				C6025X12B-5	C6025X12B-5			C6025X12B-5		
MTTF=no fail test hrs*(Af/1.036)/[(Br;c)/N]^0.91=			2630903	& L10 at 40 =	375843	USE Actual MTTF oven Data			Oven Data Date:	

MTBF, MTTF & L10 vs T(℃) ambient

Legend: MTTF, MTBF, For MODEL: C6025X12BPCB2x-5, L10

MTTF values (blue): 5261806, 2630903, 1315452, 657726, 328863, 164431, 82216, 41108
L10 values (red): 751687, 375843, 187922, 93961, 46980, 23490, 11745, 5873
For MODEL (green): 70,000, 70,000, 69,294, 34,647, 17,324, 8,662, 4,331, 2,165

X-axis: Ambient Temperature (℃): 30, 40, 50, 60, 70, 80, 90, 100
Y-axis: MTBF, MTTF hours & L10 hours

(Actual MTTF data are zero failure or minimum MTBF Data)				25-Jan-21
MTTF & L10 (non-statictical, ACTUAL 32952 test hrs)				
MTTF	Ta℃	L10	Af	L10 (Limit)
5261806	30	751687	16	70000
2630903	40	375843	8	70000
1315452	50	187922	4	70000
657726	60	93961	2	70000
328863	70	46980	1	46980
164431	80	23490	0.5	23490
82216	90	11745	0.25	11745
41108	100	5873	0.125	5873

NOTES:

DEFINITIONS

MTBF= (TTF1+TTF2+····+TTFN)/N- test stopped when all samples failed	
MTBF=Mean Time Between Failures (bearing limit)	39254 hours
Actual 6025-7 NO Failure Test Time @ 70℃ @ 6185 RPM	32952 hours
L10: time period, the fan shown above will survive and run with 90% confidence. MTTF = 7*L10	