ACCELERATED STRESS AND LIFE TESTING

Accelerated stress testing or Accelerated Life Testing Techniques are based on the SN curve. The S-N curves stands for " Stress and Number of Cycles to Failure". A typical S_N curve is shown in figure 1.

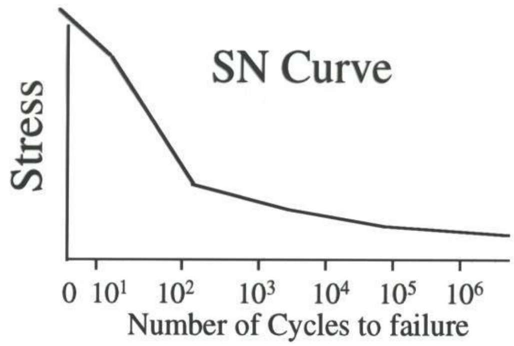

Figure 1

Higher stress magnitudes when applied to a material or a product will result in shorter time to failure as compared to lower stress magnitudes which will result in a longer time to failure. The art and science of selecting an appropriate stress and stress magnitude to establish the key failure modes and mechanisms inherent in a product and predict useful of the product in a relatively short period of test time is "Accelerated Stress Tests" or Accelerated Fatigue Life Tests".

A basic relationship that is used to predict useful life of product under mechanical stress is governed by the relationship $\mathbf{F_d = NS^b}$

Where N is the number of cycles to failure

S is the mechanical stress

b is a fatigue exponent derived from the empirical test data or material properties

And F_d is the cumulative fatigue damage.

Failures due to fatigue damage are cumulative, ir-reversible, and accumulate linearly. The accumulated damage caused by each stress application consumes a percentage of the total life expended is summed over all stress conditions. When the cumulative sum reaches total value of one, the failure occurs and the fatigue end of life could be predicted with great accuracy.

Failures in electronic equipment and semiconductor devices could be due to several reasons for example in fatigue of component-device lead, fatigue of a solder joint, or delamination in between layers of printed circuit boards or barrel Vias cracking. Failures in mechanical structures could be due to stress concentration leading to propagated crack fatigue in metal, membrane ruptures in pump, gear and transmission breakdown in automobile, or aircraft engines.

These fatigue damage could be due to any one or combinations of cyclic stresses from the portfolio of stresses as shown in figure 2.

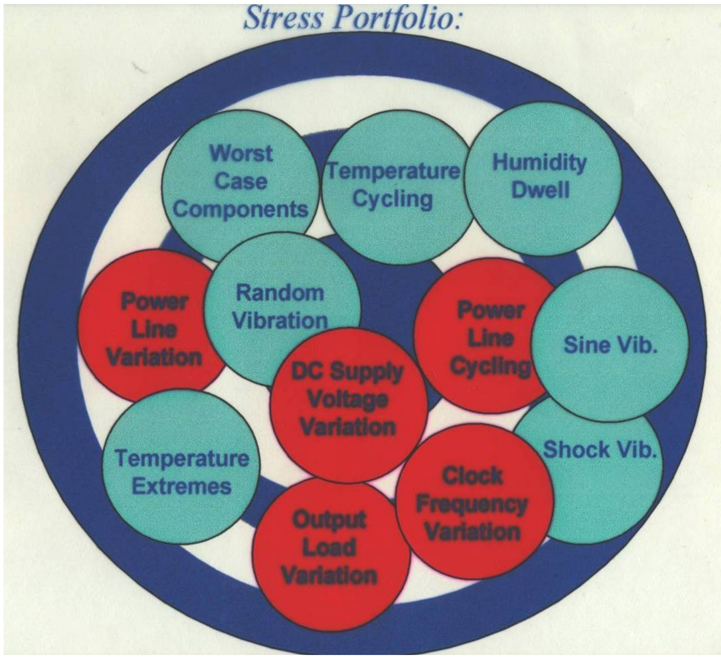

Figure 2

Mechanical fatigue for example could occur due to mechanical stresses caused by high or low temperature, rate of change of temperature, vibration, sinusoidal or random shock, humidity, or contamination causing oxidation or corrosion resulting in failure due to loss of strength.

The proper selection of cyclical stress type and magnitude and correct test setup leads to meaningful life data that could be used to improve the design of the product, select better material or composite material, optimize the assembly and manufacturing process to achieve higher process control parameters, and or built a robust product with inherent design margins and reliability-quality.

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