DATAFORTH®

Signal Conditioner Life

MTBF of Signal Conditioners (and anything else)

In order to understand MTBF (Mean Time Between Failures) it is best to start with something else, something for which it is easier to develop an intuitive feel. This other concept is failure rate, which is not surprisingly the average (mean) rate at which things fail. A “thing” could be a component, a signal conditioner, or a whole system. Some things, rocks for example are accepted to have very low failure rates while others, British sports cars, for example are expected to have relatively high failure rates.

It is generally accepted among reliability specialists that a thing’s failure rate isn’t constant, but generally goes through three phases over a thing’s lifetime. In the first phase the failure rate is relatively high, but decreases over time, this is called the “infant mortality” phase. In the second phase the failure rate is low and essentially constant, this is called the “constant failure rate” phase. In the third phase the failure rate begins increasing again, often quite rapidly, this is called the “wearout” phase. The reliability specialists noticed that when plotted as a function of time the failure rate resembled a familiar bathroom appliance, they called it a “bathtub” curve. The units of failure rate are failures per unit of “thing-time”; e.g. failures per machine-hour. Signal conditioners, being electronic, are usually measured in “power on hours” (POH).

What, you may ask, does all this have to do with MTBF? MTBF is THE INVERSE OF THE FAILURE RATE IN THE CONSTANT FAILURE RATE PHASE. Nothing more and nothing less. The units of MTBF are units of “thing-time” per failure; e.g. signal conditioner power-on-hours per failure but the “thing” part and the “per failure” part are almost always omitted to enhance the mystique and confusion and to make MTBF appear to have the units of “time” which it doesn’t. We will bow to the convention of speaking of MTBF in hours or years but we all know what we really mean.

What does MTBF have to do with lifetime? Nothing at all! It is not at all unusual for things to have MTBF’s which significantly exceed their lifetime as defined by wearout in fact, you know many such things. A “thirty-something” American (well within his constant failure rate phase) has a failure (death) rate of about 1.1 deaths per 1000 person-years and, therefore, has an MTBF of 900 years (of course its really 900 person-years per death). Even the best ones however, wear out long before that.

This example points out one other important characteristic of MTBF,it is an ensemble characteristic which applies to populations (i.e. “lots”) of things. For many systems of interest today the required failure rates are so low that the MTBF substantially exceeds the lifetime. The key implication of this essential characteristic of MTBF is that it can only be determined from populations and it should only be applied to populations.