

A Brief Chronology of HALT and HASS

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When I was a freshman at UCLA back in 1960, we had a lab session which used a very old Tinius Olson tensile test machine. We studied an S/N diagram for some variety of steel and ran a few tests to verify some of the low cycle fatigue data in our course notes. We learned that using a higher stress would create failures in fewer cycles. This experience would much later allow me to develop the HALT (Highly Accelerated Life Testing) and HASS (Highly Accelerated Stress Screening) techniques to their current state. Please note that many different stresses behave as do tensile loadings and, in general, higher stress creates failures in an exponentially compressed number of cycles or in less time.

When I got out of college and went to work in the aerospace industry, I suggested overtesting (in time) of a non-deliverable engineering model and was told to “keep your radical ideas to yourself if you want to keep your job!” Well, so much for the application of the basics of mechanical engineering in the aerospace business. Undaunted though, five years later I got my chance to apply Ruggedized Design or overstressing to find the weaknesses in a product during the design phase and did so successfully on the Multi-Spectral Scanner for the Earth Resources Technology Satellite. So far as I know, none of that series ever had a field failure, so the overstress testing worked well in finding and fixing design weaknesses way back in 1969.

My first exposure to Environmental Stress Screening (ESS) came in 1979 when I was working as a consultant on Air Force and Navy jobs and was required to utilize NAVMAT-P9492 which was a guideline to ESS. Unfortunately, many just used the document as a MIL-SPEC. Many ESS mistakes were made as there is no single stress regimen that is good for all products. I spoke personally with Will Willoughby and he fully realized this. One of his favorite statements was “Stimulate, don’t simulate!” How correct he was. I carefully read the document and then proceeded to use the thermal and vibration stresses together, added electrical stresses and increased the stress levels in order to get some time compression. We fully monitored the Unit Under Test (UUT) as much as possible. I called this Enhanced Environmental Stress Screening (EESS) and taught it for a few years before changing to HALT and HASS, which are just improved versions of Design Ruggedization and EESS respectively. Every time that I used EESS on a product, I found design defects, so Ruggedized Design was very successfully implemented on a few military programs way back in 1979. A competing company using the same pre-ruggedization design did not do any ruggedization and so could not develop an ESS profile that could screen out enough defects and still leave enough life left so that the Mean Time Before Failure (MTBF) test could be passed. That company lost their half of the contract and my employer got it. Monopoly makes for profit and we had it in spades!

It became necessary to prove that my radical ideas of EESS did not ‘damage’ good hardware and so I developed “Proof of Screen” which demonstrated that the screens were effective and left enough life in the product for customer use. Note that determining how much life has been removed completely misses the point yet is much discussed at some conferences even today. The correct

question is “Is there enough life left?” Consider this – when you look at the gas gauge in your car is it to see how much you have used or how much is left?

In 1979 the company for which I was working as a consultant purchased the first two production all-axis pneumatic shaker and thermal cycling systems on my recommendation. Using those systems, I then found four design defects that the classical shakers had not been able to expose even when operating at maximum test levels for one week in each axis. This new system was clearly a giant advance ahead of the electro-dynamic shakers typically used for this application. This is discovery testing and not compliance testing. As a result of my lengthy study on the behavior of the shaker and publication of many papers, the chamber manufacturer hired me in 1983 to design a better shaker. The end product was a flexible honeycomb shaker table which I believe is still in production at this time.

In 1989, I founded QualMark Corporation (I have not been associated with them since 1995) and coined the terms HALT and HASS. These techniques developed rapidly with the introduction of Precipitation and Detection Screens™, RapidHALT™, HyperHALT™ and Modulated Excitation™. Precipitation screens are normally above operational levels, if possible, in order to gain severe time compression. Detection screens are run within operational levels in order to detect precipitated defects, RapidHALT combines all stresses right from the start and steps them all together. HyperHALT is a time compressed RapidHALT with larger step sizes in order to speed up the process. Modulated Excitation combines combinations of stresses to find the combination which allows detection of precipitated defects.¹ Each of these named advances was a big step forward in effectiveness, lowering of costs and shortening the time necessary to perform the techniques. The techniques and equipment of today make the efforts of the 1970s look obsolete and slow by comparison, but then, that was over 30 years ago.

In 2004, I founded HALT & HASS Systems Corporation so that I could develop a HALT chamber that required less power and liquid nitrogen, provided faster thermal cycling and much larger vibration dynamic range. Detection screens were improved due to the very low level of vibration of which the system was capable.

A further advance called the Hybrid™ combines various types of shakers to allow excitation from very low frequencies to very high frequencies to be simultaneously applied in all six axes. One variation is fully controllable up to about 200 Hz and is pneumatic in nature above that. Of course, thermal cycling is simultaneously applied. Other advances in equipment are on the horizon and so the techniques and equipment continue to be developed some 38 years after their first application.

We are clearly in the midst of a paradigm shift from compliance testing to discovery testing of major proportions. Come on in – the water is fine!

1. HALT and HASS, *The New Quality and Reliability Paradigm*, published by Hobbs Engineering Corporation, www.hobbssengr.com.

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