RELIABILITY TESTING

FOR SERVER SYSTEM

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RELIABILITY TEST

RELIABILITY TEST

WHAT IS RELIABILITY?

The probability that a piece of equipment operating under specified conditions will perform satisfactorily for a given period of time.

WHY IS RELIABILITY SO IMPORTANT TO US?

Reliability is related to weaknesses or faults in infant mortalities, weaknesses in random failures or natural wearout of electronics devices, components, boards or systems.

HOW DO WE MEASURE THE RELIABILITY OF A PRODUCT?

To ensure that product reliability meets customer expectations, engineers must establish the desired product lifetime and performance during the concept phase.

TYPICAL TYPES OF RELIABILITY TESTS

The following are the examples of typical reliability tests for server systems:

STOREGE TEST is performed to determine the effect on devices of long-term storage at different temperature and humidity without any electrical stresses applied.

CYCLING TEST is performed to determine the ability of a device to withstand at high and low temperature/humidity extremes.

RDT (Reliability Demonstration Test) is a process of demonstrating the reliability of a product. RDT's are usually performed at the system level and is typically set up as a success test.

HALT (Highly Accelerated Life Test) is primarily a margin discovery process. Throughout the HALT process, the intent is to subject the product to stimuli well beyond the expected field environments to determine the operating and destruct limits of the product.

VIBRATION TEST is performed to determine the effects of mechanical vibration within a specified frequency range on semiconductor devices.

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STORAGE TEST

STORAGE TEST

HIGH/LOW TEMPERATURE STORAGE (HTS/LTS) TEST

PURPOSE: The purpose of HTS is to assess the long-term reliability of devices under high temperature conditions while that of Stabilization bake is merely to serve as part of a screening sequence or as a preconditioning treatment prior to the conduct of other tests. HTS is effective for the reliability testing of samples in terms of mechanisms accelerated by temperature only, e.g., oxidation, bond and lead finish intermetallic growths, etc. Low Temperature Storage (LTS) is also performed for the same purpose as HTS but is different in that it is performed at low temperature conditions.

METHOD: The devices must be allowed to reach the specified temperature before the duration starts counting. HTS may be conducted basically at -45/70°C and for various purposes by changing temperature and time conditions.

REFERENCE DOCUMENTS: JESD22-A103 “High Temperature Storage Life, ”JESD22-A119 “Low Temperature Storage Life

TYPES OF STORAGE TESTS

	Cold Storage	Hot Storage	High Temp/Humidity
Temperature	-40°C	70°C	85°C
Humidity	0%	50%	85%
Duration	72 Hours	72 Hours	72 Hours
References	JESD22-A119	JESD22-A119	JESD22-A103

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CYCLING TEST

CYCLING TEST

POWER AND TEMPERATURE CYCLING TEST

PURPOSE: The power and temperature cycling test is performed to determine the ability of a device to withstand alternate exposures at high and low temperature extremes and simultaneously the operating biases are periodically applied and removed. It is intended to simulate worst case conditions encountered in application environments. The power and temperature cycling test is considered destructive and is only intended for device qualification.

METHOD: This test method applies to semiconductor devices that are subjected to temperature excursions and required to power on and off for five minutes during all temperatures. Transition time between temperature extremes should be enough long so that all test samples may reach specified temperature (which is reached when bias is not applied).

REFERENCE DOCUMENTS: JESD22-A105 “Power and Temperature Cycling”, JESD22-A104 “Temperature Cycling”

TYPES OF CYCLING TESTS

	Power Cycling (Max Workload)	Thermal Cycling (Max Workload)	Thermal Cycling (Non-Operating)
Temperature	45°C	-5 to 45°C Cycling	-40 to 100°C Cycling
Humidity	95%	0 to 95% Cycling	0 to 95% Cycling
Duration	128 Hours	128 Hours	168 Hours
References	JESD22-A105	JESD22-A105	JESD22-A104

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RDT
(Reliability Demonstration Test)

RDT (Reliability Demonstration Test)

RDT (RELIABILITY DEMONSTRATION TEST)

PURPOSE: Reliability Demonstration testing (RDT) is an efficient way to test whether the product will attain a specified reliability for a given life. RDT can utilize HALT & ALT data to provide useful life data. Whilst HALT is a product improvement process, RDT is an excellent tool for extracting statistically representative life data through the use of acceleration factors.

METHOD: Acceleration factors can be determined in a variety of ways, each using mathematical formulas based on the stress applied. Some of the acceleration stresses include: [1] steady state elevated temperature; [2] temperature cycling; [3] power cycling; [4] humidity; [5] temperature and humidity; [6] vibration; [7] electrical stress, etc.

REFERENCE DOCUMENTS: MIL-HDBK-781A “Reliability Test Methods”, IEC-1123 “Reliability Testing - Compliance Test Plans for Success Ratio”

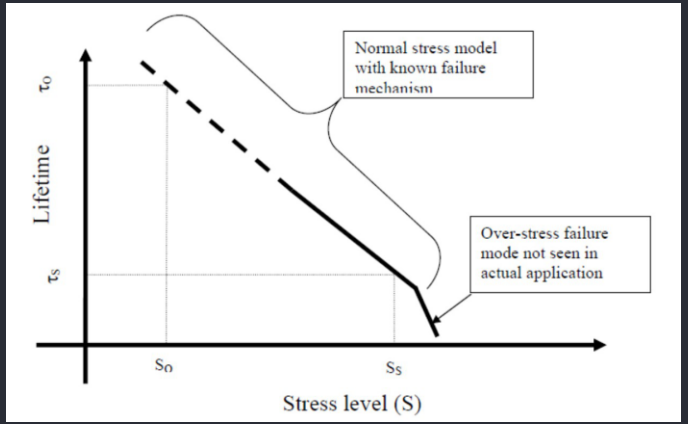
TYPES OF RDTs

There is no fixed RDT for electronic products. When designing a RDT, we have to consider many aspects, such as *actual use*, *operating environment* and *life-span* of the product. The essential elements of RDTs include [1] *acceleration factors*, [2] *acceleration stress*, [3] *sample size*, [4] *test duration*.

The following is an RDT's example for server systems:

Temperature: 25 °C / Humidity: 0 %
Workload: 100 %
Sample Size: 100 Units

Acceleration Factor: Temperature
Acceleration Stress: Ramp up by 5 °C every 4 hours
Test Duration: 48 Hours



By increasing the level of stress, we can simulate the *real life-span of a product*.
Increased stress must be with ascended *linearly*,
The failures caused by over stress tests will not happen in actual use.

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HALT

(Highly Accelerated Life Test)

HALT (Highly Accelerated Life Test)

HALT (HIGHLY ACCELERATED LIFE TEST)

PURPOSE: Highly Accelerated Life Test (HALT) is a completely different concept of test from conventional reliability tests. This test is performed at the product design step to find design weakness and reduce return rates by applying improved design to the product. This is not a concept of simulating field environment but accelerating weak point at low and high temperature conditions or random vibration to find weakness as fast as possible.

METHOD: This test consists of designer's selecting critical parameters and monitoring characteristics according to sequence. If any failure appears, product margins are secured by finding failure points and improvements. Above all, test plans should be established by agreement between designer and investigator, accurate test (where target parameters can be corrected) be performed, and cause analysis be performed at the event of problems.

REFERENCE DOCUMENTS: IPC-9592 "Requirements for Power Conversion Devices for the Computer and Telecommunications Industries"

TYPES OF HALTs

	UOL	LOL	VOL	Combined
Strat Temp	40°C	0°C	25°C	LOL to UOL 5 Cycles
Temp Ramp Rate	Ramp up by 10°C	Ramp down by 10°C	None	Ramp up/down by 5°C
Strart Vibration	None	None	5 – 2000 Hz 5 Grms	5 – 2000 Hz 1 Grms
Vibration Ramp Rate	None	None	Ramp up by 5 Grms	Ramp up by 1 Grms

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VIBRATION TEST

VIBRATION TEST

VIBRATION TEST

PURPOSE: Vibration Tests are tests performed to determine the effects of mechanical vibration within a specified frequency range on semiconductor devices. There are two military standards that are widely used for this purpose: [1] The Vibration Fatigue Test (Mil-Std-993 Method 2005); [2] The Variable Frequency Vibration Test (Mil-Std-883 Method 2007)

METHOD: In The vibration fatigue test (Method 2005), the sample is firmly fastened on the vibration platform with its leads adequately secured. The variable frequency vibration test (Method 2007) requires the same testing apparatus as the vibration fatigue test and its preparation process is similar to that of vibration fatigue test.

REFERENCE DOCUMENTS: ISTA 2A “Partial Simulation Performance Tests: Packaged-Products weighing 150 lb (68 kg) or Less”, ASTM D4169 “Standard Practice for Performance Testing of Shipping Containers and Systems”

TYPES OF VIBRATION TESTS

	Sine Wave (Operating)	Sine Wave (Non-Operating)	Random (Operating)	Random (Non-Operating)
Frequency	5 - 100 - 5 Hz	5 to 500 Hz	5 to 500 Hz	5 to 500 Hz
Acceleration or PSD	1.0 G	2.0 G	0.002 g^2/Hz	0.001 g^2/Hz
Velocity or RMS	0.25 Octave/Min	1.0 Octave/Min	1.0 Grms	2.22 Grms
Duration	X/Y/Z Axes 30 Min Each	X/Y/Z Axes 60 Min Each	X/Y/Z Axes 60 Min Each	X/Y/Z Axes 30 Min Each

THANKS!