



Technology Paper

## Establishing Industry Endurance Standards for Solid State Storage

### Overview

Similar to traditional hard disk drives (HDDs), solid state drives (SSDs) are manufactured today using numerous technologies and specifications that enable different degrees of performance, reliability and endurance. While HDDs use standard methods for determining overall reliability ratings based on Mean Time Between Failures (MTBF) or Annualized Failure Rates (AFR), SSDs are just now establishing a standardization process. Testing with a validated format is critical for any OEM provider of enterprise servers or client-based systems that will integrate SSDs.

The JEDEC Solid State Technology Association, working together with industry leaders, has established a set of standards for client and enterprise SSDs. These requirements and test methods are found within the JEDEC JESD218 and JESD219 standards developed by the JC-64.8 subcommittee and are focused on SSD endurance.

### Introduction: The Need for Standards

The category of solid state storage (SSS) is one of the most promising and exciting technology areas discussed today. Over the past several years, numerous solid state makers have placed offerings to the marketplace, making strong performance, reliability and endurance claims. The bold positioning of these solutions seemed to indicate that they would become the storage standard and quickly replace hard drive technology, which has been part of the computing industry for over 50 years.

Regardless of the solid state hype, the market is still small when compared to HDDs. According to IDC, solid state drive shipments reached 11 million units last year while the HDD industry shipped a total of 590 million units.

# Establishing Industry Endurance Standards for Solid State Storage



Why haven't SSDs taken off? Besides pricing and supply concerns, many within the storage industry believe the answer is largely due to the lack of established standards. A standard for SSD endurance validation in particular is a critical requirement of any OEM system maker. Developing standards for SSD endurance provides the confidence needed for OEMs to conduct qualification cycles for product integration. Ultimately, the adoption and communication of standards enables both consumer and CIO confidence to drive the market.

## JEDEC Standards Arrive

JEDEC is the leading developer of standards for the solid-state industry. With over 3000 participants from nearly 300 companies, various standards work is brought together under 50 JEDEC committees to meet the needs of every segment of the industry—manufacturers and consumers alike.

JEDEC JESD218 and JESD219 address the standards needed to distinguish SSD endurance in both enterprise and client application classes. *Enterprise* and *client* are the two fundamental classes which serve as the building blocks for present and future solid state standard development. Both standards documents are available for free download at [http://www.jedec.org/standards-documents/results/taxonomy%3A2506?order=field\\_doc\\_full\\_number\\_value&sort=asc](http://www.jedec.org/standards-documents/results/taxonomy%3A2506?order=field_doc_full_number_value&sort=asc). These standards define specific requirements for each application class, describe a test methodology and create an SSD endurance rating that provides a standard comparison for SSD endurance based on application class.

## Enterprise and Client Classes Defined

Since workloads vary with storage depending on their application environment, enterprise and client class categories have different needs that must be met according to the standard. The client class is derived from a single-drive environment, with an emphasis on notebook applications. The enterprise class is based on a multi-drive environment, with an emphasis on random access and mixed workloads.

In addition to different daily usage and temperature environments, specific power-off long-term data retention and UBER (unrecoverable bit error ratio) requirements must be met for each class. The enterprise class requires operation typical of a server in use 24 hours per day.

## SSD Endurance Rating

JESD218 defines an endurance rating in terms of the amount of data an SSD can write, or TBW (terabytes written). For determining TBW, JESD218 states:

The SSD manufacturer shall establish an endurance rating for an SSD that represents the maximum number of terabytes that may be written by a host to the SSD, using the workload specified for the application class, such that the following conditions are satisfied:

- The SSD maintains its advertised user capacity.
- The SSD maintains the required UBER for its application class.
- The SSD meets the required functional failure requirement (FFR) for its application class.
- The SSD retains data with power off for the required time for its application class.
- The SSD maintains its advertised user capacity.

The SSD maintains the required UBER for its application class. *The SSD endurance rating class requirements are shown in Table 1.*

# Establishing Industry Endurance Standards for Solid State Storage



## For More Information

To learn more about JEDEC JC-64.8, visit [www.jedec.org](http://www.jedec.org).

## Test Workload Methodology

JESD218 looks at a number of factors to determine the overall TBW rating. A key element is the verification of the endurance rating conducted over time at different operating temperatures. With the direct method, SSDs are stressed to their full endurance rating (TBW) using the agreed-upon workload. If the TBW cannot be achieved within a reasonable amount of time (1000 hours), extrapolation methods are described to allow the SSD manufacturer to verify the endurance rating. *Requirements in Table 2 apply to both methods.*

## Conclusion

JEDEC's JC-64.8 subcommittee offers a platform for much-needed solid state standards development. By providing these standards, delivering a test path, and distinguishing between enterprise and client, OEMs, customers and the industry as a whole will be better served as they look to adopt SSS into their storage mix.

Table 1. SSD Endurance Classes and Requirements

Application Class	Workload (see JESD219)	Active Use (power on)	Retention Use (power off)	Functional Failure Requirement (FFR)	UBER Requirement
Client	Client	40°C (8hrs/day)	30°C (1 year)	≤ 3%	≤ 10% <sup>-15</sup>
Enterprise	Enterprise	55°C (24hrs/day)	40°C (3 months)	≤ 3%	≤ 10% <sup>-16</sup>

Table 2. Endurance and Retention Times and Temperatures by Drive Class

Class	Active Use Temperature	Retention Use Temperature	Retention Use Time	Endurance Stress Temperature <sup>1</sup>	High Temperature Retention Stress Temperature
Client	40°C (8 hrs/day)	30°C	1 year	Ramped approach: Low: $T \leq 25^\circ\text{C}$ High: $40^\circ\text{C} \leq T \leq T_{\text{max}}$ Split-flow approach: Low: $T \leq 25^\circ\text{C}$ High: $40^\circ\text{C} \leq T \leq T_{\text{max}}$	96 hrs / $T \geq 66^\circ\text{C}$ or 500 hrs / $T \geq 52^\circ\text{C}$
Enterprise	55°C (24 hrs/day)	40°C	3 months	Ramped approach: Low: $T \leq 25^\circ\text{C}$ High: $60^\circ\text{C} \leq T \leq T_{\text{max}}$ Split-flow approach: Low: $T \leq 25^\circ\text{C}$ High: $60^\circ\text{C} \leq T \leq T_{\text{max}}$	96 hrs / $T \geq 66^\circ\text{C}$ or 500 hrs / $T \geq 52^\circ\text{C}$

©2010 JEDEC, reproduced with permission

<sup>1</sup>  $T_{\text{max}}$  values are available in Table 4 of the JESD218 standards document at [www.jedec.org/standards-documents/results/taxonomy%3A2506?order=field\\_doc\\_full\\_number\\_value&sort=asc](http://www.jedec.org/standards-documents/results/taxonomy%3A2506?order=field_doc_full_number_value&sort=asc).

AMERICAS Seagate Technology LLC 920 Disc Drive, Scotts Valley, California 95066, United States, 831-438-6550  
 ASIA/PACIFIC Seagate Singapore International Headquarters Pte. Ltd. 7000 Ang Mo Kio Avenue 5, Singapore 569877, 65-6485-3888  
 EUROPE, MIDDLE EAST AND AFRICA Seagate Technology SAS 16-18 rue du Dôme, 92100 Boulogne-Billancourt, France, 33 1-4186 10 00