



SanDisk SSD: A More Reliable Alternative to the Laptop HDD

How SanDisk solid state drive compares with the hard disk drive in independent testing

Hard Disk Drive Failure Rates

Perhaps more than any single factor, the failure rate of the hard disk drive (HDD) has helped pave the way for the flash-based solid state drive (SSD) as a HDD replacement inside corporate notebook computers.

Recent data from some of the industry's most reliable sources addresses issues with HDDs:

"According to Gartner Dataquest's research, the motherboards and hard drives in notebooks account for the largest number of hardware failures (tying for first place, with each ranging between 25% and 45% of total failures)"¹

"The mean time to failure (MTTF) of those drives, as specified in their datasheets, ranges from 1,000,000 to 1,500,000 hours, suggesting a nominal annual failure rate of at most 0.88%. We find that in the field, annual disk replacement rates typically exceed 1%, with 2-4% common and up to 13% observed on some systems. We also find evidence, based on records of disk replacements in the field, that failure rate is not constant with age, and that, rather than a significant infant mortality effect, we see a significant early onset of wear-out degradation."²

"Our annualized failure rates were generally higher than those reported by vendors, and more consistent with other user experience studies."³

SanDisk SSD Durability

In contrast, durability is at the top of the list of SanDisk SSD benefits. With no spinning disks or read/write head arms that must move over these disks to locate files, the SSD is immune from the most common HDD failure, a head crash, which can lead to partial and even total data loss. It is much less likely to fail in outdoor temperatures and conditions of vibration and shock when, for instance, the notebook computer accidentally falls.

SanDisk performed vibration testing in an independent lab on the SanDisk SSD 5000 and a popular HDD, using the HD Tach benchmark. The results, represented in Figure 1 and Figure 2, clearly show the benefits of SanDisk SSD over the HDD when vibration is applied during a sequential read operation.

¹ Gartner, Inc. "Dataquest Insight: Expect PCs to Impact the NAND Flash Market After 2008," Joseph Unsworth, 15 December 2006

²Computer Sciences Dept., Carnegie Mellon University, "Disk failures in the real world: What does an MTTF of 1,000,000 hours mean to you?", Bianca Schroeder, Garth A. Gibson. Paper presented at FAST'07: 5th USENIX Conference on File and Storage Technologies, San Jose, CA, Feb. 2007.

³Google Inc., "Failure Trends in a Large Disk Drive Population," Eduardo Pinheiro, Wolf-Dietrich Weber and Luiz Andr e Barroso. Paper presented at FAST'07: 5th USENIX Conference on File and Storage Technologies, San Jose, CA, Feb. 2007.

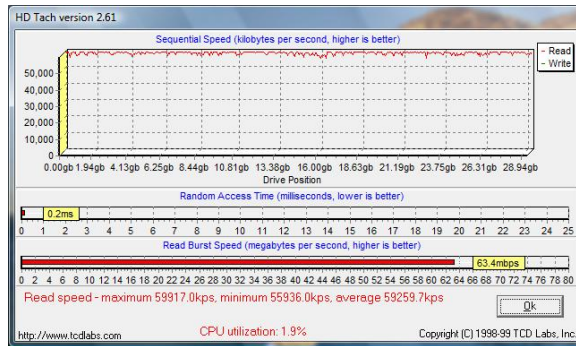


Figure 1: SanDisk SSD Sequential Read Performance Starts High and Stays High⁴

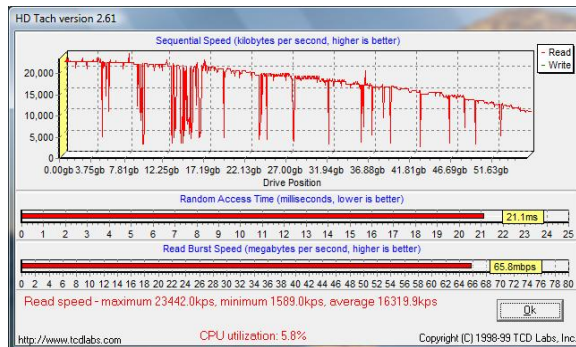


Figure 2: HDD Sequential Read Performance Starts Low, Spikes Even Lower, and Degrades Over Time⁴

SanDisk SSD Long-Term Cost Benefits

What does all of this mean for corporate notebooks? Although the initial cost of the SSD is higher than the HDD, the flash-based SSD reduces costs associated with ongoing use as compared with the HDD for these reasons:

- SanDisk SSD reduces tangible costs associated with HDD failures. HDD head crashes, for instance, add IT labor costs to recover lost data and can result in productivity loss due to downtime.
- SanDisk SSD is predicted to reduce failure probability by three-and-one-half times compared to standard HDDs.⁵ During extreme impact testing performed by Dell, the SSD was so durable that the surrounding notebook hardware broke before the SSD.⁶
- Downtime as a result of the relatively high HDD failure rate can result in intangible costs such as loss of business opportunities.

This document contains certain forward-looking statements, including expectations for new product introductions, specifications, applications, markets and pricing that are based on our current expectations and involve numerous risks and uncertainties that may cause these forward-looking statements to be inaccurate. Risks that may cause these forward-looking statements to be inaccurate include, among others: our products may not perform as expected, and the other risks detailed from time-to-time under the caption "Risk Factors" and elsewhere in our Securities and Exchange Commission filings and reports, including, but not limited to, Form 10-K and our quarterly reports on Form 10-Q. We do not intend to update the information contained in this press release.

⁴ Testing performed internally at SanDisk using HD Tach, version 2.61 benchmark on SanDisk SSD SATA 5000 2.5", 32GB and HDD MHV2080BH, 5400 rpm, 80GB, SATA

⁵ Based on mean time to failure (MTTF) calculations of 2M hours for SSD vs. 550K hours for standard HDD by Dell Labs using Telcordia methodology.

⁶ Based on SanDisk Environmental testing March 2007 comparing 32GB SSD vs. Std. 1.8-inch Dell HDD operational specifications