

WHITE PAPER

AIT Technology Sets New Standards for Data Storage Reliability

Presented By

SONY[®]

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INTRODUCTION

Because of their low cost per megabyte, tape drives have long been the choice for backing up important data. However, as the capacity of desktop and server hard drives continues to expand, performance demands placed on backup systems also increase. Today's file management systems must provide rapid access to enormous quantities of diverse data types, including corporate, library, multimedia, and e-commerce—all with a high degree of reliability. Requirements as these are stretching the limits of conventional, midrange tape drive backup systems. Until recently, medium-size companies with maxed-out drive systems had the choice of going with costly disk storage or vaulting important files.

The technical breakthrough came in 1996 with the development of Sony's affordable Advanced Intelligent Tape (AIT) system, an innovative design ideally suited for real-time multimedia data acquisition, midrange storage management, unattended backup, and transportable storage applications. The AIT format delivers the largest media capacity, greatest data transfer rates, and fastest media load and file access times of any other midrange storage solution. In addition to these superior performance specifications, the AIT format offers the highest reliability in its class.

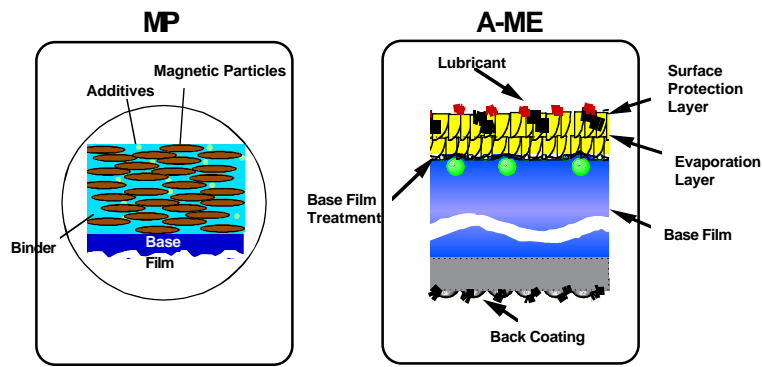
This white paper explores the technologies and innovations that have produced the exceptional reliability of the AIT system, from format to tape drive, and concludes with a sampling of data-critical storage management applications and users that now rely on AIT technology.

EXCLUSIVE USE OF ADVANCED METAL EVAPORATED TAPE – NO BUILDUP, NO PERIODIC CLEANING

Unlike conventional metal particle media, Sony's AME 8mm tape contains no non-magnetic binder material to clog heads or produce other media-related drive contamination (Figure 1). The magnetic recording layer of AME tape contains pure evaporated cobalt, sealed with a super durable diamond-like carbon coating, and protective lubricant. The coating limits wear on both media and head. As further protection against tape-drive contamination, AIT drives accept only Sony AME tape. Both factors enable Sony to specify that AIT drive systems require "no periodic cleaning." Also, the durability of the media is complemented by an extremely robust 3.2" cartridge with an aluminum base plate that defies warping, even under the heaviest duty-cycle environments.

Although a competing system developed by Exabyte has a similar media formulation, its head design and high tape tension produce enough buildup to require periodic cleaning. Also, when older metal particle tapes are used in the read-only mode in this system, a cleaning cycle is required to “re-contour” the recording head for use with a metal evaporative tape. This is an abrasive process that substantially shortens the life of the recording head.

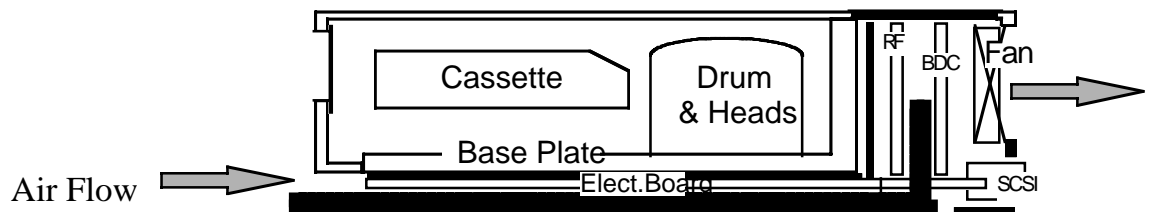
Figure 1



| INNOVATIVE COOLING – REDUCING AIRBORNE CONTAMINATION

Another factor that keeps tape heads in the AIT drive free of contamination is a cooling system that eliminates or significantly reduces (depending on the environment) airborne contamination from entering the sensitive tape path and head/tape interface (Figure 2). A variable duty-cycle fan in the drive pulls cool air only between the base plate and heat-producing printed circuit boards. The directed air flow prevents buildup of debris that could affect system reliability and data integrity. If the temperature of the operating environment reaches a particular threshold, a special fan in the rear of the drive automatically provides additional cooling.

Figure 2



ACTIVE HEAD CLEANER – ELIMINATING THE NEED TO CLEAN THE TAPES

If head contamination does occur, a cleaning mechanism automatically activates when a special sensor detects a certain threshold of soft errors (ECC, rereads, rewrites). Depending on the working environment, the active head cleaner can eliminate or greatly reduce the need for cleaning tapes and the operational problems associated with them.

TAPE LOADING AND HANDLING

In all tape drives, a sequence of mechanical actions pulls the tape from the cartridge, spools it through the tape path and onto the read/write head. In the AIT drive, however, the tape loading method offers greater reliability than that used in DLT and other drives. The DLT system, for example, spools a 1/2 inch tape from a single-hub cartridge to the drive take-up reel, a factor that accounts for the DLT drive being comparatively larger than the AIT or other drives with dual hub cartridges. If a DLT cartridge is dropped or mishandled, the tape can go slack, or the leader can fail to engage, leaving the cartridge unusable. Either way, the consequence can mean lost data.

In contrast, the AIT tape loading method is basically the same as that used by VCRs, camcorders, and video editing systems. This proven design results in a more robust cartridge, less susceptible to dropping and rough handling.

AUTO TRACKING, FOLLOWING SYSTEM – PROVIDING GREATER ACCURACY AND STABILITY

The AIT Auto Tracking Following System provides a closed-loop, self-adjusting path for highly accurate tape tracking. The system uses three embedded servo bursts, one each at the beginning, middle, and end of the tape track, to keep the tape perfectly centered on the read/write head. Any off-track position—which can result in tape flutter, data gaps, the loss of load points and thrashing—is immediately corrected. Tracking accuracy is further enhanced by Sony's use of an advanced Partial Response, Maximum Likelihood (PRML) encoding scheme. Used regularly in hard disk recording technology, PRML enables data to be recorded at a much higher frequency than that used in linear scan technology, further assuring the stability required for high-density recording.

HEAD DESIGN ENSURES SUPERIOR RELIABILITY, LONG DRIVE AND MEDIA LIFE

To ensure the tape is held firmly against the head assembly, tape tension must be enough to produce accurate read-write responses yet minimize head wear and buildup from tape debris. Head design, tape tension, media composition and method of cleaning—all affect the drive system and media reliability. Sony AIT drives feature a Metal-In-Gap (MIG) tape head with a unique geometry enabling it to maintain 50% less tape tension than that of competing technologies. The result is a head life of 50,000 hours. Collectively, these design factors give AIT systems an industry-leading, mean time between failure (MTBF) of 200,000 hours.

Comparative Tape Tensions (grams)

Sony IT-2	Quantum DLT 4000	Quantum DLT 7000	Exabyte Mammoth
4-15	133	133	4-15

AIT RELIABILITY TESTS

To determine AIT suitability for high, duty-cycle environments, Spectra Logic recently tested the system at its tape-drive “proving ground.” In all, 8,000 individual read/write/interchange tests and 80,000 load/unload tests were conducted on 16 production Sony AIT drives and 20 AME tape cartridges, in a typical office environment. Each read/write test included reading or writing 30Mb of data per cartridge. The results: zero failures. Average soft-error rates (rewrites, rereads and ECC) were 0.12% and did not exceed 0.5 % during any test, including interchange—well below the 1% to 3% soft-error rate for conventional, midrange tape drives. In addition, the drives required no cleaning or maintenance throughout the tests.

The Spectra Logic Report¹ states that Sony’s AIT drive and AME media exhibited the highest reliability of any other tape drive tested at Spectra Logic Corporation, confirming the suitability of AIT for high, duty-cycle environments. (Test report available from Spectra Logic.) The report also supports Sony’s average reliability specifications (before failure) for AIT major components and sub-assemblies.

Avg. media uses: greater than 30,000
Media archival: greater than 30 years
Average head life: minimum 50,000 recording head contact hours
Media drum wraps: 100,000 times
Tape repositioning: 1,000,000 cycles

CRITICAL APPLICATIONS POINT OUT AIT RELIABILITY

Today, AIT-based solutions are used in a variety of data-critical, storage management applications, including medical and document imaging, seismic information, video banking, satellite imagery, telemetry, weather, petroleum research and operations, and data warehousing. They are used as Scalar libraries in ADIC's new 220, 480, and 1000 series systems. ADIC's AMASS storage management solution supports AIT across multiple operating systems, such as the Solaris, AIX, HP UX, IRIX, Digital UNIX, and Siemens Reliant UNIX. AIT is the backup and restore solution for Unisys Windows NT Aquanta ES2000 and ES5000 series servers, and the tape storage system for the Survivors of the Shoah Visual History Foundation Archive. Reliability is one of the main reasons why AIT was selected for these and many other data-critical applications.

AIT Users

Now in its second generation, AIT technology is being adopted by users of large-scale data storage systems, developers and manufacturers of backup software, tape library hardware, and high-end mass-storage peripherals. Their growing numbers attest to the reliability of AIT technology. Customers and end-users currently include:

ADIC	Hitachi	Shell
ADDS	LaCie	Shoah Visual History Foundation Archive
Cybernetics	MediaLogic	Spectra Logic
Cypress Technologies	Qualstar	Stor
DotHill	Quantum	TapeLabs
Ford	Seagate	Transitional Technology
		Unisys

"AIT Technology Sets New Standards for Data Storage Reliability" is one in a series of white papers detailing various important technical aspects of the AIT tape format. Additionally, Sony has commissioned NSTL, a nationally recognized independent IS systems test laboratory, to perform a comprehensive series of performance benchmark tests on a variety of competing data storage formats. The NSTL Test Report, additional technical white papers, and a variety of end-user application case studies are available through the AIT Forum Web site, www.aittape.com, Sony's AIT Web site, www.sony.com/AITtechnology, or by calling (800) 475-4379.

¹ "Spectra 10000S\AIT TreeFrog Sony AIT Qualification Report," Spectra Logic Corporation, March 1997, revised April, 1999. Available from Spectra Logic in PDF format. For further information on Certified AIT Media, e-mail media@spectralogic.com, or call (303) 449-6400.