

Reference Guide Product Review Series

Mid-Sized Tape Backup Drives DAT 72, DLT VS160, VXA-2

An Independent Head-To-Head Analysis From Reference Guide Testing Laboratories

By Joel Shore and Curtis Franklin

Key Findings

Reference Guide Testing Laboratories examined three external single-cartridge tape drives, each using a different tape format and read/write technology: a DAT 72 from Hewlett-Packard (36 GB capacity, uncompressed), DLT VS160 from Quantum (80 GB), and VXA-2 Packet Drive from Exabyte (80 GB). Drives were each subjected to a series of identical comparative backup and restore tests. A reliability torture test of each drive was also undertaken. Comparative acquisition costs were calculated and indexed.

Quantum Corp.'s DLT VS160 drive is fastest, but has a high acquisition cost, which, in our view, is not justified by its only somewhat faster speed. It failed to restore a tape exposed to harsh environmental conditions and it is the only drive that does not ship with a blank tape in the box. The DAT 72 drive from Hewlett-Packard Co. has the least expensive tapes but its slow speed and limited 36 GB capacity renders it the least attractive of the three drives examined.

In our opinion, the VXA-2 Packet Drive from Exabyte Corp. is the superior overall value. Equal in capacity to the Quantum DLT VS160 drive but with a significantly lower acquisition cost, the VXA-2 stands alone for its singular – and remarkable – ability to restore files from tapes exposed to tortuous environmental conditions. The VXA-2 Packet Drive's unique method of storing data in small, individually addressed packets and its ability to adjust continuously the speed of tape movement in accordance with the rate of incoming data, adds a layer of operational and data-restore reliability present in neither the DLT VS160 or DAT 72 products.

DAT 72 Overview

The successor to the DDS-4 tape format, DAT 72 is not called DDS-5 due to licensing issues with Sony Corp., trademark holder of the DDS (Digital Data Storage) name. Nevertheless, DAT 72 tape drives offer both read and write backward compatibility with previous-generation DDS-3 and DDS-4 tapes. A DAT 72 cartridge holds 36 GB of uncompressed data, or 72 GB with 2:1 data compression enabled.

The limited capacity of DAT 72 is curious. If there are organizations installing servers with only 36 GB of disk space, Reference Guide is unaware of them. Even desktop PCs commonly ship with 80 GB hard drives.

DAT 72 employs helical scan technology, similar to a home VCR. The read/write heads reside within a small metal drum that spins at high velocity. Mounted at an angle to the tape, this scheme lays down tightly spaced short diagonal tracks. Data is written and recorded in groups, where each group is a logical collection of data records physically recorded as 22 frames, each frame containing two tracks. DAT 72 is a semi-open format: data written on any DAT 72 tape drive may be interchanged directly with DAT 72 tape drives from other vendors.

A one-button disaster recovery (OBDR) feature places the tape drive into a special mode that enables it to act as a bootable CD device, allowing it to restore the operating system and reboot the server or workstation. The media used is 170 meters in length and 4mm in width.

The product tested by Reference Guide Testing Laboratories for this review was the Hewlett-Packard StorageWorks DAT 72e external tape drive, HP part No. Q1523A.

DLT VS160 Overview

Digital Linear Tape VS160 tape drives are descended from technology developed for the minicomputer industry by the former Digital Equipment Corp.

DLT tape drives do not employ helical-scan technology. Instead, they write data to the tape in a serpentine linear pattern as continuous tracks running parallel to the tape's

Exabyte

VXA-2 Packet Drive external

Capacity

160 GB compressed
80 GB uncompressed

Price

\$1,199; blank tape, \$97

In the box

Software CD-ROM, documentation,
multinational power cord, blank tape,
cleaning tape, SCSI cable, terminator

Exabyte Corp.
www.exabyte.com

Hewlett-Packard

StorageWorks DAT 72e external

Capacity

72 GB compressed
36 GB uncompressed

Price

\$1,297; blank tape, \$25

In the box

Software CD-ROM, documentation,
power cord, SCSI cable, terminator,
blank tape, cleaning tape

Hewlett-Packard Co.
www.hp.com

Quantum

DLT VS160e external

Capacity

160 GB compressed
80 GB uncompressed

Price

\$1,849; blank tape, \$81

In the box

Power cord (USA), power cord (U.K.),
SCSI Cable, terminator, documenta-
tion, cleaning tape

Quantum Corp.
www.quantum.com

edges. Each track runs the full length of the tape. When the end of the tape is reached, the recording head is repositioned to a new track. The drive then continues to record with the tape moving in the opposite direction. This process of recording parallel tracks in alternating directions is repeated until the tape's capacity is reached. Unlike conventional dual-reel cartridge designs, the square-shaped DLTape cartridges contain only one reel; the tape end is drawn out and wound around a permanent take-up reel built into the drive. DLTape is a trademark of Quantum Corp.

Drives based on the DLT VS160 format are backward read compatible with DLT1 and VS80 cartridges. They cannot write to those cartridges, nor are they compatible with other DLT generations such as DLT 7000 and DLT 8000. The DLT VS160 product tested for this review was the Quantum Technology DLT VS160, Quantum part No. BH2BA-YF.

VXA-2 Packet Drive Overview

VXA-2 employs a unique approach to data handling: packet technology is used to write data to and read data from the tape. Though the hardware is helical scan, VXA-2 chops files into small digital packets, similar to network or Internet technology.

Since packets each contain a unique address, they can be read from the tape in any order then reassembled in the drive's buffer according to each packet's address. Whereas traditional technology must trace each continuous data track sequentially in its entirety to be successful, that is not required with VXA-2's small, discrete packets. What does that mean? Exact head-to-tape alignment, so critical for other technologies (especially if a tape recorded on one drive is to be restored from another), is not an issue with VXA-2.

VXA-2 technology further differentiates itself by being the only one among those reviewed to employ a four-level Reed-Solomon error-correction scheme. Doing so allows data often to be restored from partially damaged tapes. This capability was proven to be a clear advantage for Exabyte during the torture test phase of this comparative review.

Product Overview

	DAT 72 HP	VS160 Quantum	VXA-2 Exabyte
Drive Capacity, Uncompressed (GB)	36	80	80
Transfer Rate (MB per second)	3	8	6
Mean Time Between Failure (hours)	400,000	250,000	300,000

Source: Exabyte, HP, Quantum Web sites

VXA-2 offers Variable Speed Operation, enabling the drive to adjust the speed of tape movement, matching it to the data-transfer rate of the computer furnishing the data. This continuous on-the-fly speed adjustment allows the drive to eliminate back-and-forth tape movement (“backhitching”), reducing wear and tear on both the tape and the drive hardware. The goal of VSO is to enhance performance, improve hardware reliability, extend useful tape life, and achieve a high degree of data integrity.

The product tested for this review was the Exabyte VXA-2 external packet tape drive, Exabyte part No. 115.00500. VXA is a trademark of Ecrix Corp., which was acquired by Exabyte in Nov. 2001.

Transfer Speed Tests

All drives were tested under identical conditions, using the same data stream and SCSI controller card. Tests were conducted with data compression disabled. The Quantum DLT VS160 drive, rated by the manufacturer at 8 MB per second was, as expected, the fastest of the three drives. Rated at 3 MB per second, the HP DAT72 drive was indeed the slowest. The Exabyte VXA-2 Packet Drive, rated at 6 MB per second, was, not surprisingly, a bit slower than the Quantum, and significantly faster than the HP. The Exabyte and Quantum drives were a bit slower performing a full restore in comparison to their respective times for a full backup of the same data stream. The HP drive maintained an identical, albeit slower, data-transfer speed for both backup and restore operations.

With respect to each tape drive measuring up to its manufacturer’s published data-transfer speeds, only the HP product, though slowest overall, surpassed that benchmark; it did so for backup and restore operations.

The Exabyte and Quantum drives both met their respective published specifications for backups and both came within a whisker of their published specs for restore operations.

Transfer Speed Lab Results Backup and Restore Without Data Compression

Hours, minutes, seconds in h:mm:ss format; faster is better	DAT 72 HP	VS160 Quantum	VXA-2 Exabyte
Full Backup	3:05:35	1:12:43	1:31:46
Full Backup with Verify	3:06:08	1:15:41	1:36:19
Full Restore	3:06:04	1:17:41	1:38:20
Single Directory Restore	0:02:17	0:03:42	0:03:08
Data-Transfer Speed (MB/sec.)			
Full Backup	3.14	7.99	6.34
Full Restore	3.14	7.48	5.95
Mfgr.’s rated speed	3.0	8.0	6.0

Full backup/restore: 35,012,988,962 bytes in 150,405 files stored in 10,029 directories
Single directory restore: 422,629 bytes in 6 files

In our opinion, the \$1,199 Exabyte VXA-2 drive achieves a superior balance of price, capacity, and speed, yielding the best value (\$199.83 per rated MB/sec.). It outdistanced the faster but more expensive \$1,849 DLT VS160 Quantum drive \$432.33 per rated MB/sec.) and edged out the slower and lower capacity \$1,297 HP DAT 72 drive (\$231.13 per rated MB/sec.). If speed without regard to price is the key factor in making a purchase decision, the Quantum DLT VS160 is an obvious choice, but for reliability and value the Exabyte VXA-2 Packet Drive is the best overall solution.

Torture Test Results

Even in the best of conditions, tapes encounter everyday challenges: dust and debris, heat and humidity, shock and vibration. Add an occasional disaster and the importance of data reliability becomes evident. A drive that can backup data but which is unable to restore it is of little value. Disaster recovery often requires that a drive mount and perform a successful restore operation by reading tapes that have been exposed to severe environmental conditions or physically damaged.

To test a simulated environmental disaster, unwrapped tape cartridges containing data from Test Protocol #1 were submerged in tap water for two minutes then placed overnight in a freezer at a temperature of 0° F (-17° C). Upon removal from the freezer, tapes were placed on paper towels for 20 minutes in a room with an ambient temperature of 67° F (19° C). This allowed condensation to form and dissipate. Each tape was inserted into its drive and mounted. A single-directory restore operation was then performed.

Only the Exabyte VXA-2 Packet Drive was able to perform and complete the disaster-recovery restore operation on the first attempt. The HP DAT 72 drive completed the operation, but required three tries to do so. After numerous attempts, the Quantum VS160 drive was never able to mount the tape successfully; the restore operation could not be performed. Even after six additional hours of warm-up time, the Quantum drive was still not able to mount the tape. Exabyte makes usually bold claims regarding the reliability of its Packet Technology. This test corroborated those claims.

Reference Guide Acquisition Index™

The Reference Guide Acquisition Index provides a relative measure of day-of-purchase product capability in terms of aggregate capacity and dollars spent. It is not a measure of product performance.

Comparative Product Review: Mid-Sized Single-Cartridge Tape Drives

The index is based on a real-world scenario: the purchase of each vendor's drive along with five extra tapes. Taking several factors into consideration, including the wide range of drive prices, and differing tape-cartridge capacities and price per MB, Reference Guide Testing Labs calculate an index showing the relative dollar-outlay value.

Exabyte scored highest, followed by Quantum and HP. Normalizing Exabyte's acquisition index to 1.0, Quantum's index dropped to 0.57 with HP finishing third at 0.49.

The Exabyte VXA-2 Packet Drive was tops, delivering an aggregate capacity of 480 GB (including the 80 GB tape packaged with the drive) along with the least expensive of the three drives. Calculated cost per aggregate GB was fully 47 percent less than HP (\$3.51 vs. \$6.58).

The HP was hurt by the low 36 GB capacity of its DAT 72 tapes, yielding an aggregate capacity of just 216 GB (including the 36 GB tape packaged with the drive) and leading to the highest calculated cost per GB.

Quantum's index suffered doubly: Its drive is the most expensive (\$650 more than Exabyte for the same capacity), yet for some reason it does not come packaged with a starter tape cartridge. (Had the Quantum drive included a starter tape, its index would have improved slightly, to 0.68, still held down by the drive's high price.)

Test Platform

A server from Dell Inc. was used for testing. It was equipped with dual 2.4GHz Intel Xeon processors, 1 GB of RAM, PERC4/Di ROMB (RAID on Motherboard), two 18-GB Ultra320 disk drives configured to RAID 1, four 73-GB Ultra320 disk drives configured to RAID 0, redundant power and cooling supplies, an embedded gigabit network interface card, and an embedded remote access option.

Microsoft Corp.'s Windows 2000 Small Business Server was used with all service packs and security updates applied. To ensure that

Acquisition Index Comparison Drive and Five Cartridges

	DAT 72 HP	VS160 Quantum	VXA-2 Exabyte
Index (Normalized to 1.0, higher is better)	0.49	0.57	1.0
Tape Drive			
Purchase Price	\$1,297	\$1,849	\$1,199
Tape cartridges included	1	0	1
Additional Tapes Purchased			
Price each	\$25	\$81	\$97
Aggregate Total (drive and tapes)			
Price	\$1,422	\$2,254	\$1,684
GBytes	216	400	480
Cost per GB	\$6.58	\$5.64	\$3.51

Source: Pricing data from CDW Inc. Web site, 10/1/2003
Calculations based on uncompressed capacities

test results would not be skewed by spurious network traffic, the server was placed on an isolated network segment. No other software was running during testing.

Each tape drive was installed using its included driver software. Prior to testing, each manufacturer's Web site was consulted; if an updated driver was available, it was downloaded and installed.

Test Methodology

All testing for this Reference Guide comparative product review was performed on a server running the Windows 2000 Small Business Server operating system. The backup and restore application used was the Backup facility included in the operating system. Elapsed times for backup and restore operations were obtained from the log files generated by the application.

Tapes were loaded and mounted via the Windows 2000 system administration console. Drives and individual tapes were mounted then added to the backup pool inside the administration console.

All backup tests were performed first, with no changes to the hard drive, file system, or SCSI interface between each backup. This ensured that each drive would back up exactly the same disk image. A new, factory-sealed tape cartridge was used for each test.

Restore tests were performed after the completion of all back-up tests. Prior to each full restore test, the server's logical hard drive was reformatted, ensuring an empty slate for each test. The logical drive was not reformatted before individual folder restore tests.

Data used for backup and restore operations consisted of an assortment of file types, including typical office productivity files, images, MPEG-3 video files, music, executable programs, and system files.

All tests were performed with hardware compression disabled. In addition, the "Replace All Files" option was selected, all security and archive information was retained, and links restored. Indexing was turned on for all systems and tests.

Reference Guide Testing Labs is an independent organization dedicated to the development and publication of high-quality, impartial analyses of business technology solutions and consumer-electronics products.

*Reference Guide*TM
P.O. Box 725 • Southborough, MA 01772
info@rgtl.net • (508) 397-5550