

HP LTO3 Ultrium data cartridges comparative brand testing white paper



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Introduction

IT managers may not be able to see the difference, but our tests prove that users of HP LTO3 Ultrium data cartridges could obtain twice the data capacity per backup and significantly greater reliability, with up to three times as many continuously successful backup and restore cycles from HP branded LTO3 Ultrium data cartridges. If you think that an HP LTO3 Ultrium cartridge may cost a little more than a competing brand, the reality is that it may actually be nearly 50% less.

Are all LTO Ultrium tapes created equal?

The logo specification says they are. But our tests tell a different story.

The HP testing program for LTO Ultrium drives and media is well publicized. Exhaustive laboratory tests go well beyond the requirements of the LTO Ultrium logo specification. Further testing in extreme climatic conditions have demonstrated the reliability of HP LTO Ultrium media, where data has been fully recovered from tapes that have withstood the world's most extreme environments.

But is an HP LTO Ultrium tape really any more reliable than other brands? Our test engineers took four LTO3 Ultrium RW cartridges—two from HP and two from another leading brand—and tested them in four HP StorageWorks Ultrium 960 drives (Figure 1). They were tested in a controlled environment of 74°F and relative humidity of 15%.

For the first stage of the test procedure (Figure 2), we put the cartridges through 100 continual full-volume, 400-GB native capacity, backup and restore cycles (that is, 200 full-volume operations in total) and measured the bit error rate (BER) every 2 GB throughout the process.

Figure 1.

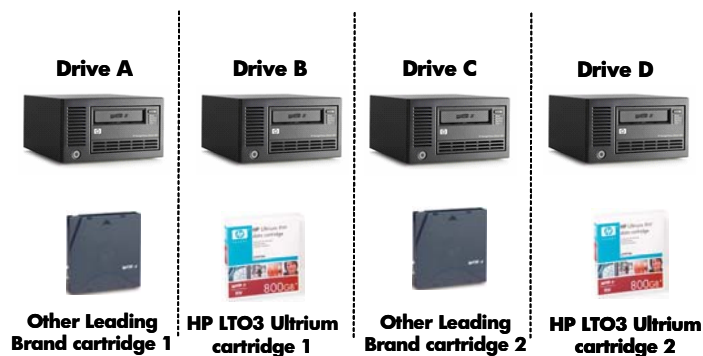


Figure 2.



Data error rates provide the most informative measure of performance and are related to how the tape is manufactured, in particular, the quality of the coating, the signal characteristics of the tape, and the surface roughness. The higher the error rates, the harder the drive has to work to verify that data is being saved (or restored) properly. If the signal becomes distorted and noisy, you end up with a high error rate. In the worst case, error rate levels ultimately reach a point where the drive cannot cope with correcting mistakes and data may be lost altogether.

Would the performance of the drive influence the performance of the media?

As a result of the HP long-term development and co-invention of leading tape storage solutions, we have developed proprietary software, for the HP drives, which when operated using this software acts like a powerful tape microscope and allows us to analyze the performance of the backup and restore cycles in far more detail than would otherwise be possible using off the shelf backup applications.

To try to ensure that the results of our testing procedure were not overly influenced by the performance of individual drives, we exchanged the HP LTO3 Ultrium cartridge 1 in Drive A with the Other Leading Brand cartridge 1 in Drive B and the HP LTO3 Ultrium cartridge 2 in Drive C with the Other Leading Brand cartridge 2 in Drive D (Figure 3) for the second stage of our tests.

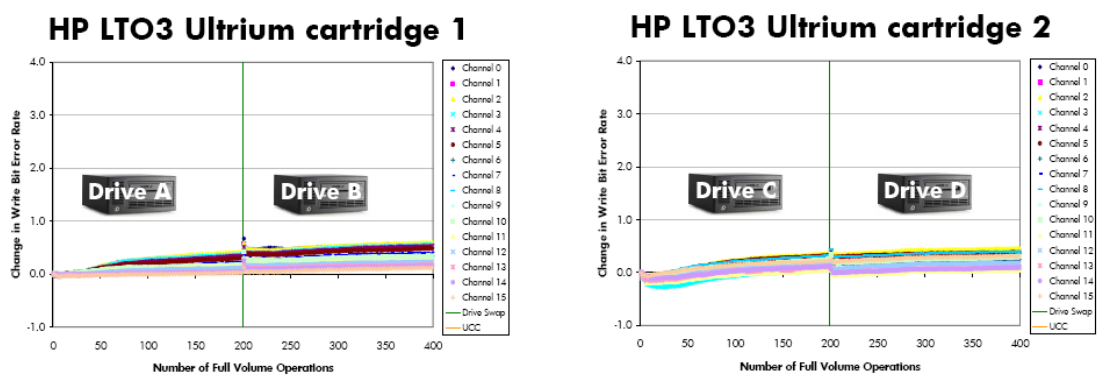
Figure 3.



In the second stage of our tests, the cartridges were once again tested throughout 100 continual full-volume, 400-GB native capacity, backup and restore cycles and the bit error rate was again measured every 2 GB throughout the process. This brought the total number of backup and restore cycles throughout the entire test to 400 (200 full-volume backup cycles and 200 full-volume restore cycles). The average error rates were then calculated for each full volume and any variation in performance during the course of the tests could then be easily determined by observing any change in error rate.

What did our tests reveal for the HP LTO3 Ultrium cartridges?

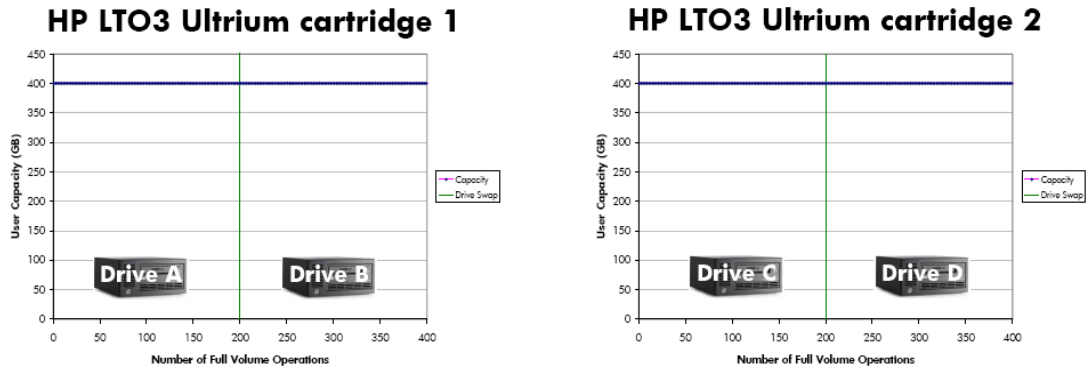
Figure 4.



The results for each of the two HP LTO3 Ultrium cartridges, in each of the drives in which they were tested, showed consistently low and stable error rates throughout the 200 continual backup and 200 continual restore cycles (Figure 4).

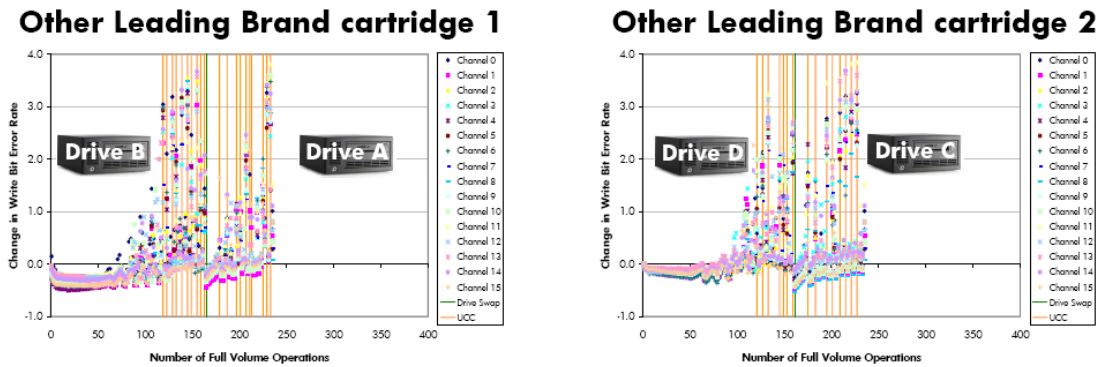
We also measured the amount of the data backed up each cycle to ensure the cartridge was continually providing a full 400 GB of data, the maximum available. The results prove that, after writing 80,000 GB of data, the HP cartridges were still providing optimum performance and maximum capacity without risk of data loss (Figure 5).

Figure 5.



What did our tests reveal for the Other Leading Brand cartridges?

Figure 6.

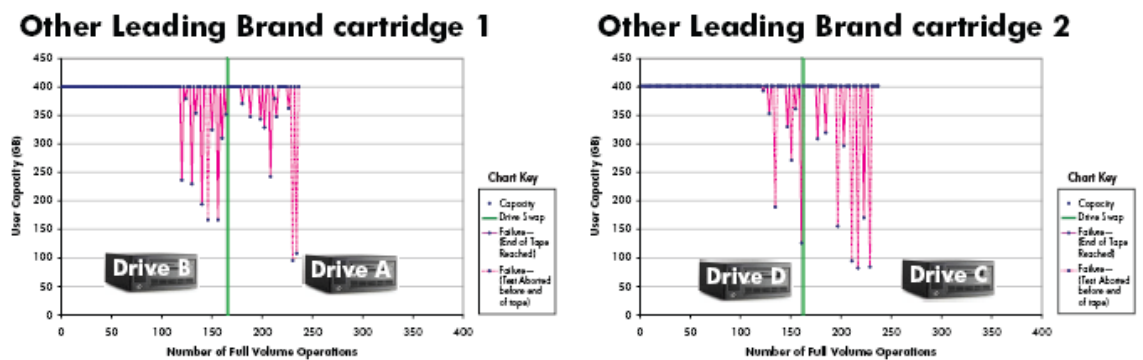


The results for each of the two Other Leading Brand cartridges, in each of the drives in which they were tested, were equally as consistent but showed a very different picture. After just 30 full backup and 30 restore cycles, less than a third of the way through the first stage of the test, performance began to degrade. After no more than 60 continual backup and 60 restore cycles, the error rates were so high, on both cartridges, that it was no longer possible to complete a full 400-GB backup operation.

Two different types of failures occurred in our tests and these failures were directly related to the poor error rate performance. Both failure types meant that it was not possible to back up the maximum 400 GB of data. The first type of failure (indicated by the solid lines in Figure 7) occurred as a result of reaching the end of the tape before completing the full capacity 400-GB backup operation. That is, numerous repeated attempts to write some of the original data were necessary, which resulted in using more tape with the Other Leading Brand cartridges, than was required when using the HP brand cartridges. The second type of failure (indicated by the dashed lines in Figure 7) was also related to the poor error rate performance of the Other Leading Brand cartridges. However, this type of failure was due to it no longer being possible to verify the accuracy of the written data even after repeated attempts, causing the drive to fail and abort the backup operation completely.

Both types of failures meant a cleaning cartridge needed to be inserted before the test procedure could continue. Each of the orange vertical lines in the preceding charts (Figure 6) indicates the point at which a cleaning cartridge needed to be inserted for the test to continue (that is, when it was not possible to write 400 GB during a backup operation).

Figure 7.



The available capacity also deteriorated with sometimes as little as 50% of the total capacity being utilized before the end of the tape was reached (Figure 7). Neither of the Other Leading Brand cartridges completed the full 100 backup and 100 restore cycles in either of the drives in which they were tested.

What do high error rates mean in the real world?

From an engineering perspective, error rates indicate how much margin there is before failure. In other words, did the backup and restore only just complete successfully, or did it complete with lots of margin.

High error rates can lead to:

- More frequent use of a cleaning cartridge.
- Reduced cartridge capacity, so you have to buy more cartridges to back up the same amount of data.
- Lower transfer rates (that is, poorer performance) because the drive will repeatedly attempt to re-write or re-read the same user data until it has been able to successfully verify that the written or restored data is 100% accurate.
- Failed backup and restore operations because there are too many errors to correct. You lose your data.

Proprietary test software from HP enables us to measure the error rate in great detail, as shown in Figures 4 and 6. However, this level of detail is rarely visible during a normal backup and restore procedure and IT managers are generally unaware of how close to failure their backup and restore may have come or that they may be only getting 50% of the quoted capacity of the cartridge.

Why does HP LTO Ultrium media produce such low and stable error rates?

The main reason is that HP LTO Ultrium media is designed and manufactured to optimize both media and drive performance. What matters is the performance of the whole solution, not just one half of it.

There is no visible difference between one tape and another, and the LTO Ultrium specification is unequivocal in the standards required to bear the logo, so in theory all LTO Ultrium media should produce optimum results under test. HP has learned, however, that subtle differences in media (for example, lubricant design, binder composition, particle selection) and manufacture (coating, drying, burnishing, slitting, servo writing) produce vastly different performance in real-life situations.

For more information

http://www.hp.com/products1/storage/products/storagemedia/tape_ultrium/index.html?jumpid=reg_R1002
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