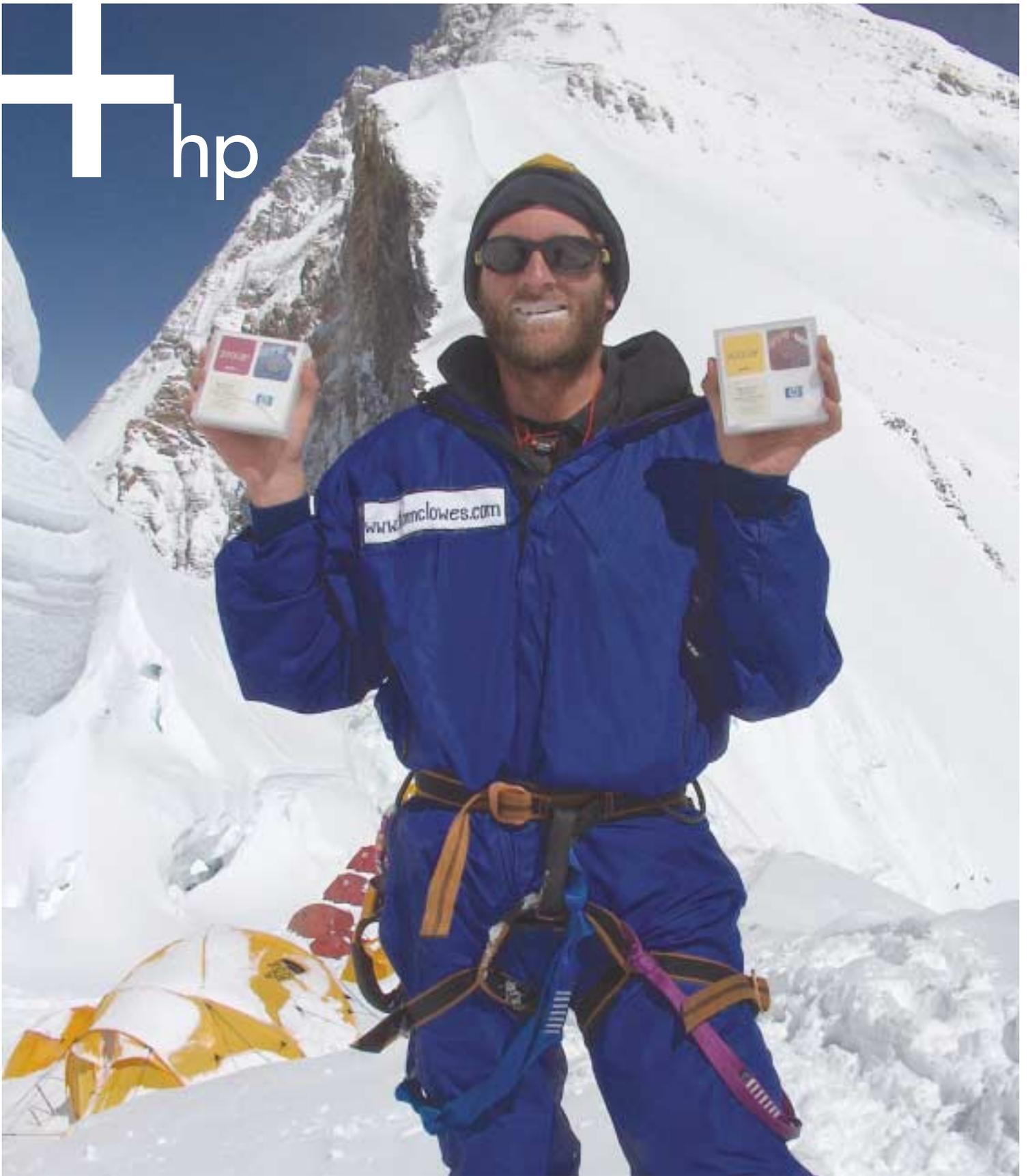




hp



When it comes to HP Ultrium testing, the sky's the limit



Extreme Testing Everest, Spring 2004



In Spring 2004 an HP Ultrium 1 data cartridge accompanied Tom Clowes and his brother Ben on their attempt to become the first British brothers to climb Mount Everest. Would they all make it up to the summit, and back again, all in one piece?

Changes in temperature, altitude and humidity can have a profound effect not only on human minds and bodies, but also on tape condition, and potentially business survival. Increased error rates jeopardise back ups, and back up disruption jeopardises business continuity. So supporting Tom and Ben was a chance for HP not only to do some good, and help two intrepid climbers realise their dream, but also to prove, once and for all, that when we say 'tested to extremes', we mean exactly that.

Reaching the summit of Mount Everest was the ultimate challenge for two young men driven to push themselves to the limits of human endurance. Right from the start, it was all up hill. It takes years of careful planning, hard work and enthusiasm to start climbing a mountain.

Just as the brothers reached High Camp at 7,800 metres, the weather closed in. *"It was so cold up there that we didn't venture outside the tent for two days. Our breath froze into tiny crystals and the wind - gusting at up to 100mph - shook the tent so violently, it looked as if we had a blizzard going right inside the tent. Once the sun went down, temperatures plummeted to -40°C with wind chill. And we weren't always dry, even inside the sleeping bags. These were the worst conditions either of us had experienced - especially with the altitude. It took twenty minutes to get our boots on, another ten to put on crampons. Everything was an effort. We climbed up a bit to see if it would clear higher up, but visibility was zero. At times we wondered what on earth had possessed us to come to Everest, at others we thought how lucky we were to see what most people never get to see. The views up there are the best in the world."*

So how did they manage to get those fantastic photographs?

"The pictures make it look easy," says Tom. "In fact, taking photographs at High Camp was almost impossible. The HP Photosmart 945 digital camera didn't mind the cold, but we had to keep the batteries warm, inside our hand warmers. Every time we took a picture, we had to take off our big mittens, take out the camera, load the batteries, get out the cartridge and the flag, and set up the shot. All at 7,800m and sub-zero temperatures in a howling gale."

But for one HP Ultrium data cartridge, the trip was a complete success.

HP invests millions of dollars in extensive real-life reliability testing in its labs. But the real test is what actually happens in the real world. If HP branded Ultrium cartridges could withstand the

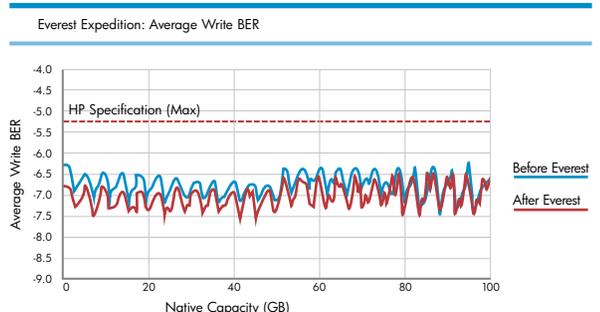
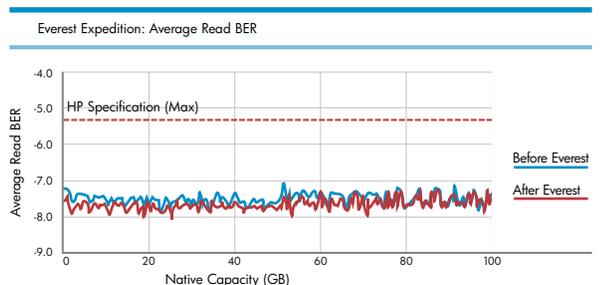
extreme climatic and handling conditions of the world's highest, most fearsome peak, they could withstand anything.

100mph winds, -40°C and 7,800 metres above sea level. How did the data cope?

Before starting the ascent, the data cartridge was fully loaded with 100GB of data using an HP StorageWorks Ultrium 230 drive. Write and read error rates were measured and the servocode (that is pre-written during tape manufacture) was checked for servo defects.

On its return, the read error rate of the data stored on the cartridge was tested again, in the same HP StorageWorks Ultrium 230 drive, to measure any changes that may have occurred to the tape due to the punishing conditions on Everest. Data was once more written to the cartridge to test for any change in the write error rate.

The charts below show the average read and write error rates before and after the expedition.



The error rate readings taken before the cartridge left HP are, as expected, well within the tolerances of the HP brand specifications. Those that were recorded after the cartridge returned, reassuringly map the original almost exactly. The only change is the slight improvement that occurs when a new tape is re-used and the surface of the tape becomes burnished.



Forget transfer rates.
What really matters is the data error rate.

Data error rates are determined by the quality of the tape coating and the performance of the drive. Poor error rates mean the drive has to work harder to verify that data is being written properly. Backup slows down and, in the worst case, you may not be able to restore your data.

Each time data is written to a tape, there is an error rate associated with it. For HP branded Ultrium cartridges we test to ensure a low, flat, stable error rate to provide the best possible backup performance.

Did the tape suffer any physical damage?

During manufacture, the tape is passed through a servo writer to add the servo markers that help to keep the drive head accurately positioned during reading and writing operations. Writing data to 384 tracks using 8 recording channels at 30MB/sec is not easy and any errors in the servo code could result in backup failure!

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HP's specifications go well beyond requirements for the LTO logo, which only test for 100% compatibility.

Media manufacture is a complex business involving a series of precision processes, where HP relies on its suppliers to follow the quality control procedures for HP-branded media. Suppliers frequently change processes, components and geographic location to improve their efficiency - changes which often have an adverse impact on the product. Even something as innocuous as a leaking factory roof can spoil the purity of the ingredients.

And once a cartridge is packaged and shipped off to the store, who knows where it could end up? Someone might even be mad enough to take it to the top of Everest!

We never assume anything. All tapes are not the same and there is no guarantee that even a single brand of tape will always perform in the same way. So we test for absolutely every obstacle that a tape could encounter. However improbable.

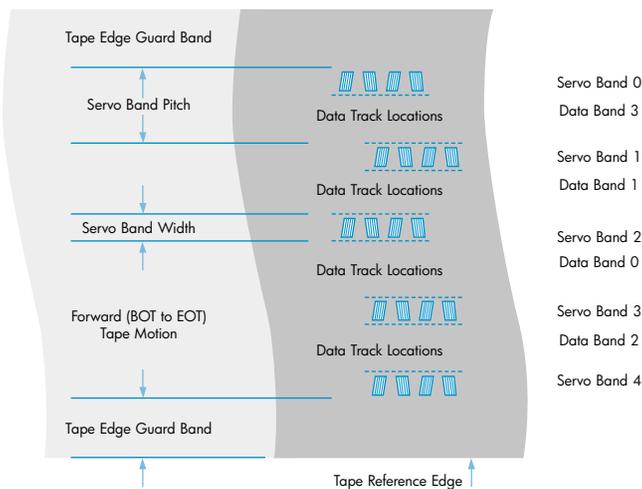
Could a cartridge written in the heat of an Australian summer survive a New York winter or Hong Kong monsoon? Will it continue to perform to the spec, no matter how many times it's dropped and knocked as it travels back and forth from the data centre to the vault? Will it remain stable and reliable for the whole of its life, no matter how many times it's loaded in and out of the drive? After hundreds of backup/restore cycles in a busy and dynamic 24x7 e-commerce network, can data still be accurately retrieved from the tape?

All HP Ultrium media undergo an exhaustive battery of procedures that relate directly to how the product is used in the workplace, when actual data and businesses are at stake. We use hundreds of drives and media to be sure our results are consistent for any combination, rather than a narrower, custom test on just one drive and cartridge.

The HP Ultrium test programme carried out 170,000 tests lasting 400,000 hours in 2002, pushing the technology to its limits in the most extreme conditions of temperature, altitude and humidity.

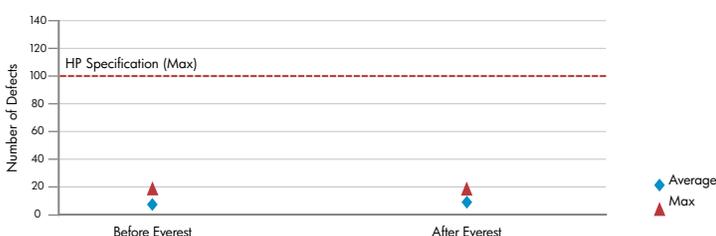
If that doesn't prove it, then the Everest experience surely does. Whatever the conditions, HP Ultrium can be relied upon for accurate backup and restore, time and time again, day in, day out.

Positioning of Servo Bands



The HP brand specification stipulates that an HP Ultrium data cartridge must show fewer than 100 servo defects per servo track. Our before and after servo defect measurements showed an average and maximum defect result of less than 20, with virtually no difference between the two measurements. Servo band 0 at the top and servo band 4 at the bottom of the tape are those most at risk from tape edge damage, but even after all that the tape has been through, it was as good as new.

Everest Expedition: Servo Defects



For more details visit
www.hp.com/go/storagemedia

	Industry standard format	HP standard format	The pay off
Standard performance	To guarantee interchange between all Ultrium drives, 30 cartridges must be tested for initial format compliance every year.	To qualify for the HP brand, 600 cartridges from three separate manufacturing batches will be tested, and followed up with routine, quality monitoring. We give the same interchange guarantee, to a minimum consistent level of quality.	Consistent quality is assured for every HP Ultrium data cartridge, regardless of the drive it's used on.
Environmental interchange	Limited interchange tests using one cartridge on one drive under one or more environmental conditions.	HP demands successful interchange in conditions ranging from 10°C to 29°C and 10% to 80% relative humidity.	In passing these tests, we know that the drive and media will stand up to continuous pressure in all conditions, not just the controlled environment of a data centre.
Drop testing	Cartridges can come in for some fairly rough treatment. But there is no drop test specified in the LTO spec.	In our labs, the cartridges get more than their fair share of knocks. We drop them half a metre onto a concrete floor, time and time again, on each of their six faces, 12 sides and eight corners. We test them alone, in the library case and in their packaging.	HP Ultrium data cartridges cope easily with the toughest daily use and transport without sustaining any damage to the casing, tape or mechanism.
Load/unload	Frequent load/unload cycles put both the tape and the drive under pressure. But there is no such test specified in the LTO spec.	We run 20,000 automated mechanism cycles to prove reliability of the leader pin assembly. The tape will not break under expected wear and tear, thus avoiding repeat backup or drive damage.	The cartridge leader mechanism is robust enough to ensure effective, reliable performance when subjected to intensive load/unload activity.
Locate/rewind/append	Two-thirds of the tape is run through the drive 250 times in 29°C and 80% relative humidity.	Even the Ultrium logo's demanding locate/rewind/append test is not challenging enough to qualify the media for HP branding. Our test, in similar conditions, requires 2,000 passes.	Reliable performance is assured even under the most extreme daily conditions.
Thermal aging	Archive tapes are stored at a constant temperature that is often different from the operating environment. The LTO spec has no test for this.	Our test maintains the cartridge at 60°C for at least 100 hours; and conditions it to the operating environment for at least 24 hours before conducting full read/write passes.	The tape and all cartridge components will perform reliably despite continuous exposure to a constant temperature.
Ship and store	A simple test checks whether a cartridge can be shipped, stored and used once. Only one cartridge on one drive will be tested.	We run five test-bed drives in an environmental chamber to test cartridges after they have been stored for two days at 10°C, 10% relative humidity, and a further two days at 49°C, 15% relative humidity.	HP Ultrium data cartridges can tolerate radical changes in environment, including transport to and from climatic extremes.
Shoeshine	A data cartridge is written, rewound and read thousands of times during its life, and yet the industry LTO spec does not verify how many times this can be done before data becomes unreliable.	Our 'shoeshine' test simulates excessive repositioning or error recovery on a short section of tape as happens in libraries where media is in constant use. The data is recorded, the tape is rewound, and the data is read and error checked. 40,000 times on the same 3-metre length of tape.	HP Ultrium data cartridges will withstand very intensive use, even when restricted to a small section of tape. This qualification is particularly important for libraries where media are frequently loaded or unloaded by the operating system.