Our Everest and Sahara tests provided the perfect environment to confirm the superior integrity of the industry leading HP Ultrium specification. Extreme temperatures, altitude and high winds.

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.

Our Everest and Sahara tests provided the perfect environment to confirm the superior integrity of the industry leading HP Ultrium specification. Extreme temperatures, altitude and high winds. Dramatic and sudden changes in day and night temperatures from 50°C to freezing and back again, every day. If a tape can take the knocks of an Everest ascent and a six-day marathon across the Sahara, it can easily manage regular trips between the data centre and the vault, hundreds of backup/restore cycles and thousands of load/unload cycles.

Of course that's only one cartridge. But every HP Ultrium cartridge has to undergo a similar experience before it's released for sale. The HP Ultrium test programme carries out 170,000 tests lasting 400,000 hours, pushing the technology to its limits in the most extreme conditions of temperature, altitude and humidity. What's more, all HP Ultrium media will also 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 Everest experience alone was enough to prove the point. Retrieving the data from the Sahara sand says it all. Whatever the conditions, HP Ultrium can be relied upon for accurate backup and restore, time and time again, day in, day out.

"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."

'The Sahara marathon has a magic that really gets under your skin. For the people who really suffer, it is a never-to-be-repeated rite of passage that may change a personality completely. For others, it is an experience of such highs and lows, that it makes ordinary life seem diminished by comparison.'

	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.

For more information about HP Storage Media products visit www.hp.com/go/storagemedia

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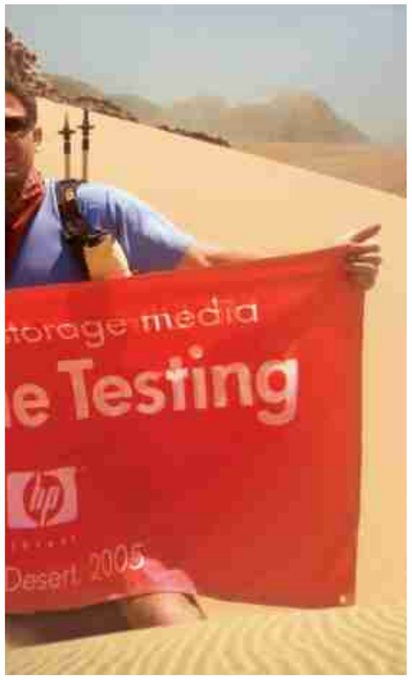

From one extreme to the other

The story of how HP Ultrium cartridges went from -40°C to +56°C without breaking into a sweat.

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Extreme Testing

Everest 2004 – Sahara 2005

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. The following year, Steve Backshall carried the same cartridge off to the other extreme – on a gruelling marathon across the Sahara desert.

-40°C, 160kmph winds - and a 7800 metre climb to the top of the world

"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 on 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. With zero visibility, we just couldn't go on."

As our intrepid heroes battled to overcome the most hostile conditions on the planet, our data was never in doubt. All three men have now completely recovered from their ordeal – and so has our data.

Why do it? Well, for Tom, Ben and Steve it's about pushing oneself to the absolute limits of human endurance to prove it can be done. As someone once said, 'it's because it's there'. Many take up these challenges to raise funds for charity. All share the reward of sheer elation on reaching the target against almost impossible odds.

For HP, the reasons are less compelling, but nevertheless critical to survival. It's about making 100 per cent sure that whatever happens to your business, your data can always recover.

Extreme challenges have a profound effect on human minds and bodies. It changes them forever.

So what happens to material items? If the desert heat is enough to burn out an expensive, high-tech mountaineering watch, what chance does a tape cartridge have?

HP invests millions of dollars in extensive real-life reliability testing in its labs. But there's no substitute for real world experience. If an HP branded Ultrium cartridge can take a brisk climb up the world's highest, most fearsome peak, followed by a searing 230km run in the unforgiving heat and dust of the Sahara, it can probably withstand anything.

So how did it go?

Before starting the ascent of Everest, 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 to the tape during its 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 see what, if any damage had been sustained as a result of the punishing conditions on Everest.

After a well earned rest, the cartridge was ready for its next extreme challenge. On its triumphant return, having finished the marathon an impressive 228th out of 731 participants (thanks to the tenacity of Steve Backshall) - and after the last grain of sand was shaken from the cartridge, the tests were repeated.

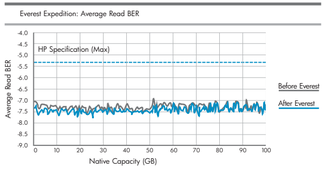
"After six days of unimaginable suffering, the first-aid tent looked more like a war hospital. But the tape came through unscathed"

For mere mortals, extreme challenges mean pain, sickness, fear, sheer exhaustion and, at times, utter despair. For an HP Ultrium tape they apparently mean very little.

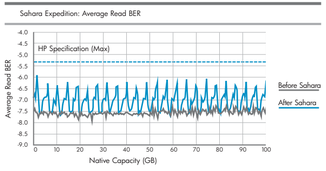
The error rate readings taken before the cartridge left HP on both ventures were, as expected, well within the stringent tolerances of the HP brand specifications. Those that were recorded after the cartridge returned from Everest reassuringly mapped the original almost exactly. The only change was the slight improvement that occurs when a new tape is re-used and the surface of the tape becomes burnished, leading to even closer head-tape spacing.

When the cartridge came back from the Sahara, it was so full of sand, it was hard to imagine how the data could survive. Yes, there was some degradation – but the cartridge still performed within the boundaries of the HP specification and would continue to give optimum backup performance.

The Sahara marathon has a magic that really gets under your skin. For the people who really suffer, it is a never-to-be-repeated rite of passage that may change a personality completely. For others, it is an experience of such highs and lows, that it makes ordinary life seem diminished by comparison.'



Average read error rate of the HP Ultrium 1 cartridge after it returned from Mount Everest with virtually no difference in the performance



Average read error rate of the HP Ultrium 1 cartridge after it returned from the Sahara desert full of sand. There is a definite increase in the error rate but it is still well within the HP brand specification.

+54°C, 160kmph sandstorms - and a 230km race across the desert

"The day had seen us run almost two marathons, the pack on my back was dragging my knuckles towards the ground, and endless sand oozed over the top of my gaiters and into my trainers. As I bent over to spew the last of my water from my stomach into the dust, the competitor ahead disappeared over a dune, leaving me utterly alone, and with still several hours to go to till sleep. This was my lowest moment during the toughest footrace on earth."

"Dropping down from immense sanddunes and into rocky valleys, the breeze would be strangled, and the desert would become a furnace. Temperatures were over 50°C in those scorched vales, and my expensive mountaineering watch burnt out completely, leaving me with no idea how long everything's taking.

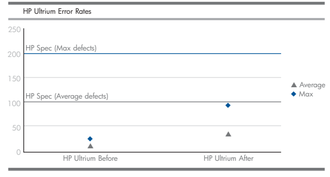
The lower the error rate, the greater the certainty that your data's OK.

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 or read 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.

"After six days of unimaginable suffering, the first-aid tent looked more like a war hospital. But the tape came through unscathed"

Servo patterns are written to the tape during manufacture, and these 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!



Our before-and-after servo defect measurements for the Everest trip 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.

After the Sahara run, there were more servo defects, but these were still well within the HP specification boundaries of an average of less than 100 and a maximum of less than 200 defects per track.

When it comes to HP Ultrium testing, we stop at nothing

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 can 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 or into the furnace of the Sahara desert!