Hitachi Deskstar 7K400 Mechanical Enhancements

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Inspire the Next

Evolution, accelerated

Hitachi hard drives are at the forefront of miniature engineering. Their technical supremacy is the result of thousands of incremental improvements, implemented by our engineers during decades of development. Now, a series of mechanical features have been incorporated in the highly evolved Deskstar 7K400.

The next generation

Hitachi has a long tradition of enhancing each generation of disk drive. The latest model, the Deskstar 7K400, contains several design features that help to protect customer data while enabling increased capacity and maintaining performance.

These features provide quick access to and protection of user's valuable data.

The features include:

- A new spindle motor
- The Rotational Vibration Safeguard
- The load/unload ramp
- An anti-rebound actuator latch, protecting the data area

They're small changes, but they make a big difference.

Spindle motor

The new spindle motor is designed for extended operation. The motor has a fixed shaft that provides added stability to the five media disks. This is achieved by securing the shaft at both the top and the bottom.

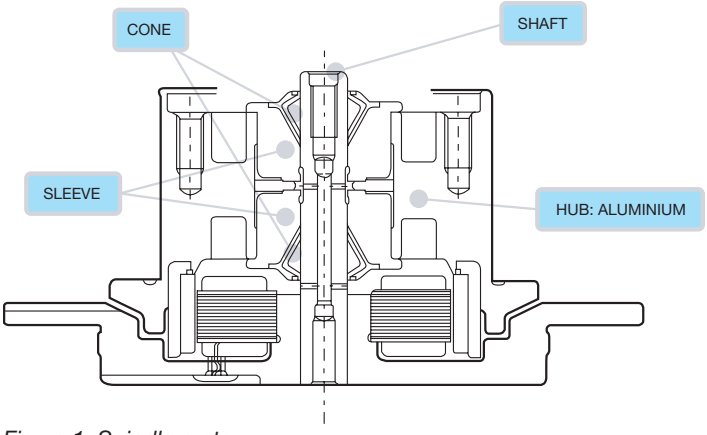


Figure 1: Spindle motor

The spindle motor better accommodates the five disks of the 7K400. This includes two disks more than in previous generations.

As has been the case for several generations now, the motor uses a fluid bearing. The fluid bearing ensures quiet operation and better shock protection than a steel ball bearing.

Rotational vibration safeguard

Excessive external disturbances (vibration) can cause a disk drive head to unexpectedly move off track. When this situation occurs, the drive's performance is impaired, since the head must reposition itself before reading or writing can resume.

Extreme rotational vibration can occur in multi-drive configurations. One of the target applications of the Deskstar 7K400 is in multi-drive arrays, so it has been specifically designed to withstand the most severe disturbances.

The Rotational Vibration Safeguard (RVS) protects the drive from excessive disturbance. Two vibration sensors are mounted on the circuit board. If these sensors feel a vibration rippling through the drive, they can feed forward a signal to the actuator that controls the head's position. The actuator can then prepare to compensate for the disturbance, counteracting it with an equal and opposite force. In this way, the effects of external vibration are minimized, providing optimum performance.

The following bar charts (Figure 2.1 and 2.2) show how a system performs by simulating business and high-end machine operations. Testing was done using VeriTest's Benchmark tests—WinBench Business and WinBench High-end. In each case, tests were completed with and without RVS, under stable and vibrating conditions.

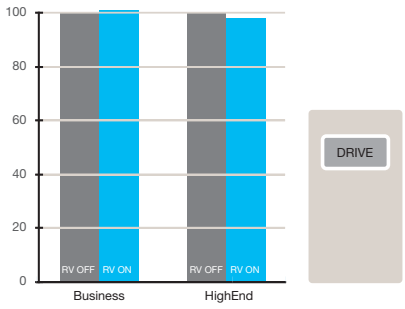


Figure 2.1: System level benchmark comparison with RVS enabled and disabled—NO SHAKER

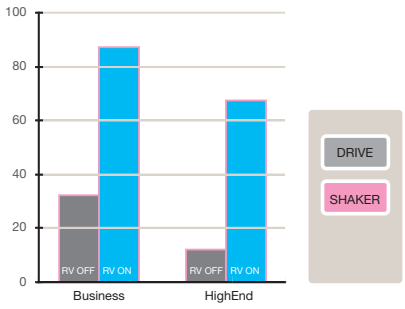


Figure 2.2: System level benchmark comparison with RVS enabled and disabled—WITH SHAKER

Figure 2.2—showing performance during vibration—is the most interesting. In the simulation, we shook the high-end machine so hard that, without RVS, it could only score 15% in our performance tests. However, the moment RVS was switched on, the score shot up to almost 70%. In the business machine, the improvement was just as significant, boosting performance from 30% to almost 90%.

These statistics confirm that Hitachi's RVS system constitutes a major step forward in hard drive technology. Unnecessary rotations of the disks are avoided and, by sensing vibrations before they hit, RVS gives users more reliable performance.

Load/unload ramp

Ever-increasing areal densities require an ever-decreasing space between the head and the disk, which can be achieved only with a virtually perfect, ultra smooth disk.

In the past, most disk drives have operated using the Contact Start-Stop (CSS) mode, in which the heads come to rest on the disk surface when the drive is turned off. During start-up, the heads slide along the disk surface until the disks are spinning sufficiently fast. In order to prevent adhesion of the heads to the surface, disk surfaces have been deliberately textured using a precision process.

While such a technique was once satisfactory, today's higher areal densities require a level of disk surface perfection incompatible with the texturing needed for CSS.

One solution to this texturing problem has come with the advancement of load/unload technology (see Figure 3). The Deskstar 7K400 is the fifth generation of Deskstar products to use this data protection technology.

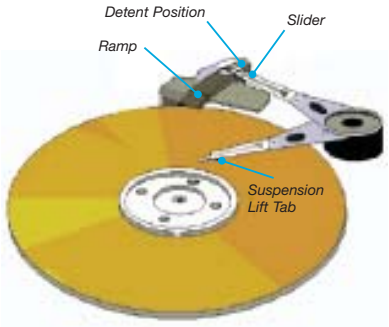


Figure 3: Load/unload ramp technology. Heads parked on ramp when disk stops.

In drives that use a load/unload system, a lifting mechanism removes each head from the disk surface prior to power-down and returns the heads to the disk surface only after a sufficient rotation rate has been reached on the next start-up. As a result, head-to-disk contact (and any other head-to-disk interaction) is significantly reduced, and disk damage from such contact is virtually eliminated.

With load/unload technology, several systems work together to ensure that the heads never land on stationary disks. For instance, a load/unload ramp mechanism lifts the heads from each disk's surface when the actuator travels beyond the disk's outer diameter, parking the heads outside the disk stack. To prevent disk surface contact during loading, the descent speed of the heads is reduced.

In the event of power loss to the drive, a retract system moves the heads to the parking position without using external power. A high-efficiency retract circuit draws energy from the spinning disks, directing it to the actuator. This mechanism moves the actuator to the parked position while the disks are spinning down.

By continuously monitoring spindle speed, power supply voltage, and microprocessor status, a fault-tolerant feature designed into the electronics and microcode prevents the heads from landing on the disks and potentially causing disk damage.

Load/unload technology improves reliability, enables increased areal density and drive capacity, and offers greater robustness to handle shock. In addition, the energy savings and lower wear provided by load/unload technology can prove invaluable in reducing overall maintenance costs and extending drive lifetime.

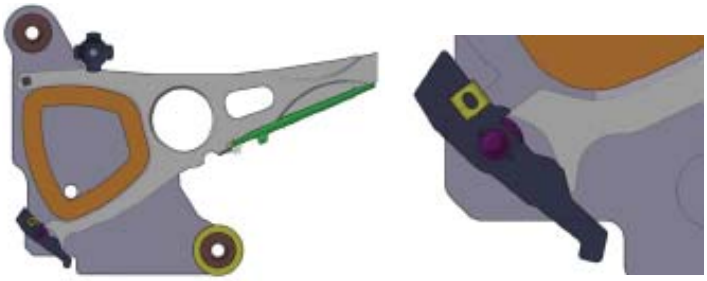
Anti-rebound actuator latch

This feature was first seen in Hitachi's Ultrastar drives, and is now being introduced to the Deskstar for the first time.

The actuator latch protects user data in two ways:

1. The anti-rebound latch ensures that the heads remain on the ramp during nonoperation. This protects user data in the event of a severe shock, which might otherwise knock the heads off of the ramp and onto the disk surface.
2. The data area is also protected by the latch during operation. In the event of an accidental power-down, the heads are mechanically prevented from rebounding onto the media after landing on the ramp. This action keeps the heads from bouncing on the disks and possibly damaging user data.

Together, these enhancements make the Deskstar 7K400 one of the most finely crafted hard drives in the world. It is the latest in a long line of industry-leading products from Hitachi, once again driving forward the evolutionary progress of technology.



Actuator latch *Close-up of latch*

Figure 4: Actuator latch

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