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Technology**Paper**

From: Desktop Product Marketing
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Seagate's G-Force Protection for Desktop Drives (U series, Medalist, and Barracuda ATA)

Introduction

Seagate Technology® is one of the largest providers of desktop disc drives in the world. In fact, 10 of the top 12 desktop PC makers choose Seagate drives. They rely on Seagate's proven quality and reliability, as well as the excellent performance and recent time-to-market improvements demonstrated by Seagate. For example, Compaq recently stated, "We recognize Seagate as a top performer because they provide us with high-quality, innovative products that meet our standards for performance, reliability and compatibility."

Seagate's innovative designs continue to improve drive reliability to save customers the cost, inconvenience, and potential data loss that can result from handling damage. Seagate now leads the industry with a desktop drive nonoperating shock specification of up to 350 Gs for a 2 millisecond shock duration. This specification has more than doubled over the last two years. Design enhancements help minimize handling damage caused by the accidental bumps and knocks a drive may undergo during shipping and installation. This increased G-force protection is no accident. It is the result of careful design analysis and product enhancements that are intended to make Seagate disc drives as robust as possible.

G-Force Explanation

When a drive is bumped, knocked or dropped accidentally, the shock is measured not only in strength of the shock (Gs), but also in duration of the shock (how long those Gs are experienced by the drive). The typical surfaces found in an installation or shipping environment usually produce shock durations of 2 to 12 milliseconds when a drive is knocked over. Shorter duration shocks (less than 2 milliseconds) are rarer, and can be much higher—hundreds or thousands of Gs—without causing major damage to the disc drive.

The most difficult shock a drive can withstand reliably lasts about 2 milliseconds in duration. This is why the industry standard nonoperating shock specification is set at 2 milliseconds. **Seagate has the highest desktop disc nonoperating shock specification in the industry—350 Gs at 2 milliseconds for U8 drives and 300 Gs for 7,200-RPM Barracuda® ATA drives.** These specifications exceed all desktop competitors' specifications.

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Seagate's G-Force Protection for Desktop
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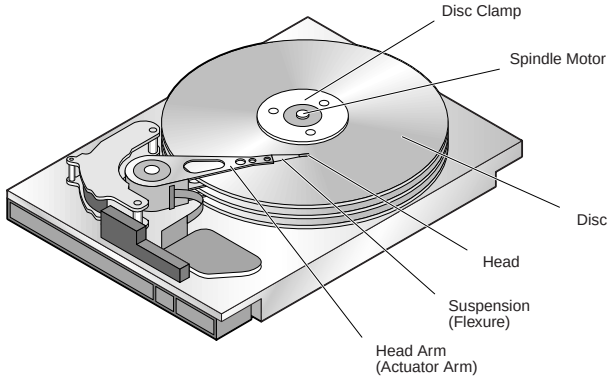
G-Force Protection for Desktop Drives

Seagate desktop disc drives have been specifically designed to meet higher nonoperating shock specifications. Enhancements have been made to the entire drive system, including:

- Head/disc system
- Spindle motor
- Disc clamp/code

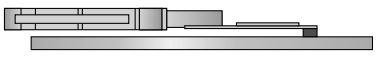


Head/Disc System Enhancements

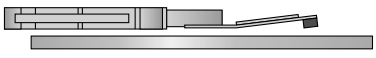
When a shock event occurs—for example, if the drive is knocked over during installation or accidentally dropped—it is important for the heads to stay in contact with the disc to prevent "head slap" damage and for no other contact to occur between the disc and the head arms. Seagate has performed extensive modeling to arms, suspensions, heads, and discs to identify and eliminate potentially harmful resonances and keep all parts of the system synchronized during a shock event. Design enhancements are part of every desktop drive Seagate makes and include such specific measures as:

- Reduced mass and size of head to reduce head slap
- Replaced head wires with Flex on Suspension (FOS) to help control head attitude
- Tuned head, suspension, head arm and disc to eliminate harmful resonances
- Added snubbers to prevent contact between disc and head arm
- Maximized clearance between head arm and disc to prevent contact
- Maximized clearance between suspension and disc to prevent contact

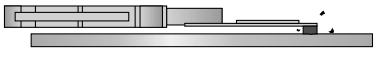
System Enhancements Prevent Head Slap



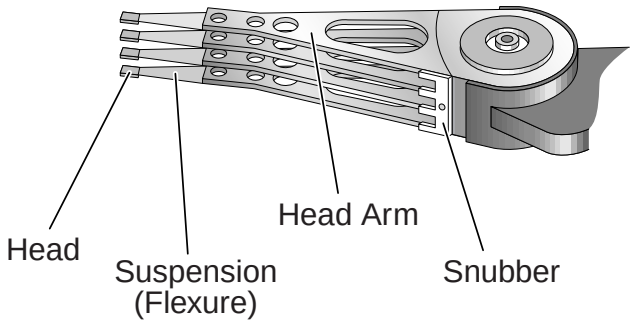
Head, flexure and arm at normal position on disc



Shock event occurs, causing head to lift off the disc.

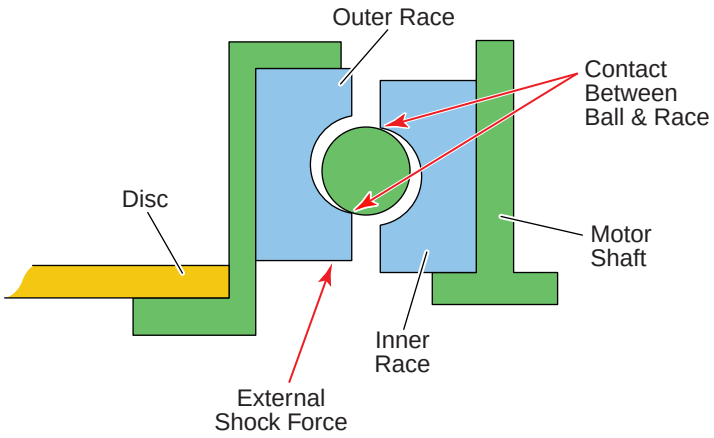


Head slaps the disc, causing damage and leaving particles on the disc.



Spindle Motor Enhancements

The spindle motor, which spins the discs within the drive, is a ball bearing motor. Damage to the balls and the races in the bearing can occur when a shock event causes a ball and race to knock against each other too hard, which can result in material deformation. When a ball bearing sustains damage, it causes the motor to vibrate more and can eventually lead to failure. It can also cause the acoustic noise levels to rise, since the balls are no longer spinning smoothly in the races. Seagate's desktop disc motor design incorporates ball bearings using one of the largest ball diameters in the industry. This increases the contact area between the ball and the race, which minimizes the potential for motor bearing damage.



Disc Clamp/Code Enhancements

Discs are held in place using a disc clamp to keep them from slipping off-center during a shock event. If a disc does slip, it can cause additional vibration, more acoustic noise and reduced performance as the servo system works harder to keep the heads over the proper track. The clamp used in each Seagate desktop disc drive family is designed and tuned to keep the discs from slipping in a shock event, making disc slip a rare occurrence. However, in the unlikely event that a small amount of slip occurs during a particularly hard shock, Seagate's enhanced microcode keeps the heads centered over the tracks and allows the drive to continue reading and writing accurately. This helps prevent data loss and allows the drive to continue the reliable service our customers require and expect.

Customer Satisfaction

Seagate's desktop disc drives provide the superior reliability and ruggedness required to keep customers' costs down, their system reliability up and *their* customers happy. Here are some of their recent statements attesting to the importance of Seagate's exceptional disc drive quality:

- eMachines: "Seagate's superior product reliability has undoubtedly contributed to eMachines' dramatically low return rate, less than half the industry average," stated Stephen A. Dukker, President and CEO of eMachines, Inc.

- Compaq: In singling out Seagate for its Outstanding Supplier Award, Compaq recognized "Seagate as a top performer because they provide us with high-quality, innovative products that meet our standards for performance, reliability and compatibility… Seagate has made a significant contribution to Compaq's business, supplying drives used in our… popular Presario and DeskPro product lines."
- Acer: "With a super-reliable drive like Seagate's U4, we can confidently offer systems that will stand up to the challenges of daily, intensive use," said Haydn Hsieh, senior vice president and general manager, Computer and Consumer Products B.U., Acer Inc.

Summary

Seagate desktop disc drives are designed and built to withstand the bumps and knocks that can occur when a drive is shipped, handled and installed. Reducing handling damage means lower return rates, higher reliability, fewer disc crashes and lower cost of ownership. Seagate's continuous improvements have more than doubled the desktop disc nonoperating shock specification over the last two years, with a current nonoperating shock specification of up to 350 Gs (2 milliseconds duration). All components and systems in Seagate's drives are continually optimized to provide unparalleled reliability. Seagate's customers continue to acknowledge the benefits to their business and operations.