Technical White Paper

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Mean Time Between Failure for the Iomega® REV™ Drive

The Estimated MTBF for the Iomega REV Drive is an Impressive 400,000 Hours


iomega
REV

Introduction

Iomega's revolutionary Removable Rigid Disk (RRD) technology provides the speed, reliability, and ease-of-use of a hard drive with the portability and expandability of tape and optical media. While based on standard hard drive components, the removable Iomega RRD disk contains only the magnetic media and spindle hub and motor for greater durability – all the sensitive drive heads and electronics remain in the drive itself. Both the drive and disks are sealed by a unique shutter mechanism designed to keep the heads and media in a virtual "clean room" environment. Advanced air filtration, automatic head cleaning, and robust two-stage error correction are employed to ensure high data integrity and reliability.

The Iomega® REV™ 35GB/90GB* drive system is the first of the company's RRD-based family of products. With its high speed, capacity, and removable media, the Iomega REV products are the ideal solution for desktop and server-level backup as well as high-capacity, portable storage applications.

MTBF is often used as a common measure of reliability for data storage products. This paper outlines the methodology used by Iomega to estimate the mean time between failure (MTBF) metric for the Iomega REV drive. Iomega believes that the new REV technology will achieve a 400,000 hour estimated MTBF, which indicates that REV drives will deliver the kind of outstanding reliability and piece-of-mind that consumers and corporations alike expect from a primary backup solution.

Mean Time Between Failure (MTBF)

Mean Time Between Failure (MTBF) is an indication of the average amount of time that will pass between random failures on a given type of drive. It is generally defined as the number of hours under observation divided by the number of failures. If the product is in use or "powered-on" all the time, then the MTBF is equivalent to number of hours in a year (8,760 hours) divided by the annual failure rate (AFR):

$$MTBF = \frac{\left(24\ \frac{hr}{day}\right)\cdot\left(365\ \frac{day}{year}\right)}{AFR}$$

Because the estimates for Iomega REV products have been done in advance of actual product completion, some assumptions and approximations were needed (i.e., a "theoretical" MTBF). Historical data on other types of products are one way to estimate this preliminary type

* Compressed capacity assuming 2.6:1 data compression with "high" compression on Iomega Automatic Backup Pro software. Capacity may vary and is data and software dependent.

of MTBF. Later on in the product's life cycle, actual field returns are analyzed to provide an "operational" MTBF.

In order to correctly understand the MTBF calculations, it is important to take into consideration the product's useful service life and typical usage patterns. Service life traditionally represents the typical length of time before which the drive enters the period where failures occur due to components wearing out. Typical usage is usually an estimate of how often, or in what manner, the product will be used. MTBF is not a measure of the time to wear out the drive. Instead, MTBF is more an indication of reliability given the various failures that occur somewhat randomly over the time of the service life.

Iomega REV Drive Service Life and Usage

The Iomega REV drive's service life is anticipated to be five years (not to be confused with the warranty period). This estimate is based on historical information regarding Iomega's other data storage products. The design and engineering phases of this product have assumed this anticipated service life.

The postulated operational usage of the product begins by assuming the typical duration of time an Iomega REV drive is used per day. The assumption is that daily use is three full disk writes per day, at a sustained transfer rate of 14 MB/s. This scenario could encompass a backup every eight hours for a three-shift day, or three backups on a typical one-shift workday. Under such a scenario, the Iomega REV drive is operational for 2.08 hours per day:

$$\frac{\left(3.35 \cdot 10^{9}\ bytes\right)}{\left(14 \cdot 10^{6}\ \frac{bytes}{\sec}\right)} = 2.08\ \frac{hours}{day}$$

Using 260 working days per year with the three full disk writes per working day, the annual drive mechanical usage rate (the percentage of time per year the drive is actually transferring data) is 6.18 percent:

$$\frac{\left(2.08\ \frac{hours}{day}\right) \cdot \left(260\ \frac{working\ days}{year}\right)}{\left(24\ \frac{hours}{day}\right) \cdot \left(365\ \frac{days}{year}\right)} = 6.18\%$$

To be conservative, the drive mechanical usage rate is rounded up to 10 percent.

Assume that for the year, the drive electronics are always left "powered-on" (i.e., the electronic usage is 100 percent). If only two disks are used during this service life, then the cartridge use would be one-half of the mechanical usage or five percent. In this scenario, assuming seven to eight disk insertions per week (i.e., one disk change each day plus two

to three additional insertions to restore small file information), the number of disk insertions into the drive falls between 1,820 and 2,080 over the anticipated five years of service life:

$$\left(7\ \frac{insertions}{week}\right)\cdot\left(52\ \frac{weeks}{year}\right)\cdot 5\ years = 1{,}820\ insertions$$

$$\left(8\ \frac{insertions}{week}\right)\cdot\left(52\ \frac{weeks}{year}\right)\cdot 5\ years = 2{,}080\ insertions.$$

Therefore, 2,000 is a reasonable assumption for the number of insertions per drive, with half that for each cartridge (again, using only two cartridges during the service life).

Iomega REV Drive MTBF Estimate

One approach to developing the MTBF for an Iomega REV drive is to use similar products as a basis for estimation. Hard disk drive (HDD) manufacturers list their MTBF numbers between 300,000 and 1.2 million hours, with the majority typically toward the upper end of that range. Since the Iomega REV drive is indeed an HDD-type product, some justification exists to assume that this device could have an MTBF in this range.

However, it would be hard to justify that the MTBF for HDDs could directly translate to the Iomega REV drive as the latter's removability adds an extra layer of complexity to the device. Therefore, historical field-return and failure rate data for other similar Iomega products have been used to estimate the MTBF for the Iomega REV drive. In reviewing the data on other Iomega products, it is noted that typical PC Manufacturer returns are less than one-third of the retail return rate and within that return rate, only one-third or less are actually defective. The majority of these returns have no defect found. In addition, on one product similar to the REV drive, the return rate dropped roughly by a factor of two from early production to later production (from 5.51 percent to 2.28 percent over approximately three years).

For purposes of this analysis, the Iomega REV drive retail return rate is assumed to begin at nine percent. This estimated rate appears conservative in that it is about twice as high as a recently introduced similar product. However, as the Iomega REV device is a new mechanical and electrical platform, this higher rate appears more cautious and a responsible assumption. A behavior similar to the aforementioned example, where the retail return rate dropped from 5.51 percent to 2.28 percent over a three-year period, is assumed for the Iomega REV drive. This retail return rate reduction is equivalent to 58.6 percent over the three years:

$$\frac{(2.28\% - 5.51\%)}{5.51\%} = -58.6\% \quad .$$

By assuming a straight-line reduction in return rate over time, the reduction over 18 months (that is, half the three-year period) is half that rate, or 29.3 percent. If this reduction is applied to the initial admittedly conservative Iomega REV drive retail return rate of nine percent, over 18 months that rate drops to 6.37 percent:

$$9\% \times (1 - 29.3\%) = 6.37\%$$

If the true defective units for retail sales run about one-third of this 6.37 percent return rate, then the retail annual failure rate (AFR) would be 2.12 percent. Using AFR equals 2.12 percent gives approximately 413K hours as the retail MTBF:

$$MTBF_{Retail} = \frac{\left(24\ \frac{hours}{day}\right) \cdot \left(365\ \frac{days}{year}\right)}{AFR_{Retail}} = \frac{8{,}760\ \frac{hours}{year}}{2.12\ \frac{\%}{year}} = 413{,}208\ hours$$

The PC Manufacturer return rate could be about one-third the 6.37 percent retail return rate, or about 2.12 percent. If the defectives returned from PC Manufacturers run higher as a percentage than retail (assume about 60 percent rather than 33 percent), then the OEM MTBF is about 690,000 hours, as follows:

$$MTBF_{OEM} = \frac{\left(24\ \frac{hours}{day}\right) \cdot \left(365\ \frac{days}{year}\right)}{AFR_{Retail} \times 60\%} = \frac{8760\ \frac{hours}{year}}{\left(2.12\ \frac{\%}{year}\right) \times 60\%} = 688{,}679\ hours$$

Therefore, conservatively using the lower number, an MTBF (18 months after introduction) of approximately 400,000 hours is estimated for the Iomega REV drive.

Conclusion

The Iomega RRD technology has been designed to ensure optimal reliability, data availability and system resiliency. As demonstrated in this paper, the MTBF for REV drives is estimated to be 400,000 hours. This impressive reliability metric shows that REV drives, which are the first products to incorporate the Iomega RRD technology, are an ideal solution for protecting information assets and backing up vital corporate data.

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