

# Toshiba MK-1122FC, 1990

## Why it's important

The previous disk material, aluminum, was too soft to withstand the physical wear characteristic of the mobile market. Aluminum's replacement by glass further enabled the growth of HDD's into the mobile market.



## Discussion

### **Development Outline:**

In October, 1989, Toshiba started developing HDDs which featured a compact design with high capacity, high performance, low power consumption and high ruggedness for mobile applications. At that time, Conner Peripherals had already announced a 2.5-inch HDD with a single aluminum disk and it was already in the market; therefore, we would set our goal as developing a 40 MB+ HDD with a single disk.

In order to achieve a high capacity HDD, it was essential to use over 100Mbpsi, high areal density. We matched up with a 50 turn thin-film head and glass media with low-roughness and smooth surface to implement 0.1 $\mu$ m head flying height, and it worked. In November 1989, Yamaha, Hoya and Toshiba decided to co-develop the head and media combination. When introducing glass media to the market, there was fear that the disk might be broken while handling, assembling and testing using a punch test, so we conducted a significantly demanding crack check test by using engineering samples and functional samples. As a result, there was no breakage found. Rather, the conclusion told us that glass media was several times stronger than aluminum media in terms of scratch resistance in non-operating conditions. Thus, shock resistance performance level was beyond our expected spec of 100G, which proved glass media's durability, becoming a selling point for glass media HDD.

But then, since glass media had a smaller coefficient of thermal expansion than aluminum

media, we had to change the spindle motor material from aluminum to stainless steel to keep deformation caused by temperature change at a minimum.

We focused on the following to ensure the machine credibility of the HDD:

- Anti HDI ( Head Disk Interference)
- CSS (Contact Start Stop)
- Durability
- Anti-Stiction
- Anti Corrosion

Silicon dioxide, the unique Hoya glass media overcoat, worked so well to ensure the above characteristic features. The only drawback of glass media was that as a challenge inherent in glass media, the edge of outer periphery became “ski-jump” looking configuration; therefore, the head glide property would deteriorate near the outer edge. In order to reduce the “ski-jump” effect, polishing pad and process characteristics when fabricating the glass substrate were improved, and processing conditions were optimized. In addition to the use of glass media, this device adopted the most advanced technology such as, a 50-turn-coil high output thin-film head, sensorless spindle motor, Neodymium magnet voice coil motor, 1-7 RLL Code recording mode, digital sector servo method, etc.

Now, let me summarize above-mentioned history briefly

1. 1989/10 Development design begins
2. 1990/ 3 Fundamental experiment begins by using functional samples
3. 1990/ 8 Device validation begins with functional samples
4. 1991/ 1 Qualification process begins with commercial samples and shipping to specific users
5. 1991/4 Volume production begins

As you can see, Toshiba became a leader in the development of high-capacity 2.5-inch HDD products in rapid succession by upgrading areal density and increasing the number of installed glass disks.

### **Production History on 2.5-inch HDD with Glass Media and New Model:**

April 1991

40MB 1 disk, model volume production began

Approx.15K / Month

October 1991

80MB, 2 disks, model volume production began:

Approx.20K / Month including other models

March 1992

131MB, 2 disks, model volume production began:  
Approx.60K / Month including other models

October 1992

213MB, 2 disks, model volume production began:  
Approx.70K / Month including other models

May 1993

340MB, 3 disks, model volume production began:  
Approx.100K / Month including other models

December 1993

520MB, 4 disks, model volume production began:  
Approx.150K / Month including other models

September 1994

704MB, 5 disks, model volume production began:  
Approx.230K/ Month including other models

### **Shipment Growth:**

FY Shipped Volume - Main Customers

1991 200K units, Internal use, domestic PC maker

1992 780 units, domestic PC maker

1993 1450K units, domestic, Taiwanese and US PC maker

1994 2230K units, PCs worldwide

### **Reference:**

Main Spec on the first 2.5-inch HDD loaded with glass media (MK-1122FC)

Capacity (Formatted) MB	43.0
Number of Disks	1 disk (Glass)
Number of Heads	2
User Cylinders	977
Sectors/Track	43
Bit Density (BPI)	51,891
Track Density (TPI)	2,000
Record Mode	1-7 RLL Code
Revolutions Per Minute (RPM)	3,200

Average Seek Time (ms)	23
Dimensions (mm)	17 x 70 x 100 (HWD)
Weight (gr)	160
Environment	
Vibration (Operating - G)	0.3
Vibration (Non-operating - G)	5
Shock (Operating - G)	5
Shock (Non-operating - G)	100
Number of CSS Cycles	40,000

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**Additional information:**

In 1989, Areal Technology, Inc announced the BP100, a 3.5-inch HDD incorporating glass substrates [1] from Hoya and the product was reported to have begun shipping in early 1990 (maybe even late 1989). But according to Jack Swartz, Areal founder and President, the BP100 never really made it into the market mainly because of problems with its plastic base plate. Areal halted efforts to make and market the BP100 in July 1990 [2]. A 2.5-inch product was disclosed Mar 5, 1990 and the MD-2060 did ship in 1991, contemporaneously with Toshiba. Areal closed in mid-1995.

A number of other manufacturers experimented with glass substrates (e.g., SyQuest) but none are known to have introduced them into commercial HDDs prior to Toshiba.

1 Swartz, J, "New Areal 3½-in. Beats The Heat," *Computer Technology Review*, Feb 1989, p. 25

2 Duffey, B, "Areal Taps CEO, to Stress 2.5-Inch Drives," *Electronic News*, Jul 23, 1990, p. 20

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