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January 17, 2005
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Hard Disk Solution Sets: Addressing Emerging Requirements

The increasing need for low-cost, high-capacity storage for mobile devices is creating a growing market for sub-1 inch disk drives. These drives are targeted for portable consumer electronics including MP3 players, digital cameras, handheld digital video players and cell phones. Samsung unveiled the first cell phone containing a hard drive last year: a 1.5 Gb disk 1 inch in diameter with a 350 MP3 song capacity.



Figure 1. Toshiba's 0.85-inch drive

The production of these miniature disk drives has created many disk manufacturing process challenges. Most of the current hard disk production equipment was originally designed for 95mm (3.74 inch) disks, which continues to be the dominant form factor. Much of this equipment has been adapted to work with smaller disks (down 2.5 inch) by simply scaling the disk handling devices and process heads. By running the smaller form factors on the same lines, the disk manufacturers avoided the major expense of building new production lines and maintained the flexibility to switch between disk sizes as needed. It also allowed them to leverage existing deposition

processes by using the same process chamber. Even though this solution resulted in higher material usage and larger equipment footprints, it was still very cost effective when compared to the large investment for new equipment.

With the introduction of sub-1 inch disks, we have reached the point where converting the existing equipment may no longer be the lowest cost solution. In many cases, scaling the mechanisms is no longer feasible or reliable. Figure 2 shows several of the common disk sizes currently in production. The 0.85-inch disk actually fits in the center hole of the 95mm disk. In some cases, the existing mechanism may not be precise or gentle enough to handle the miniature disks. The disks are light enough to float away when immersed in a cleaning tank. Even sensing the disks can be a challenge.

The sub-1 inch disks are primarily used for consumer applications where cost is critical. For batch processes, material cost and throughput are direct functions of the batch size. For instance, the cost of sputtering the expensive magnetic layers on the disk is fixed for a particular chamber size regardless of the quantity of disks being sputtered. Six times as many 1" disks can fit inside the footprint of a 95mm disk, theoretically increasing throughput and reducing



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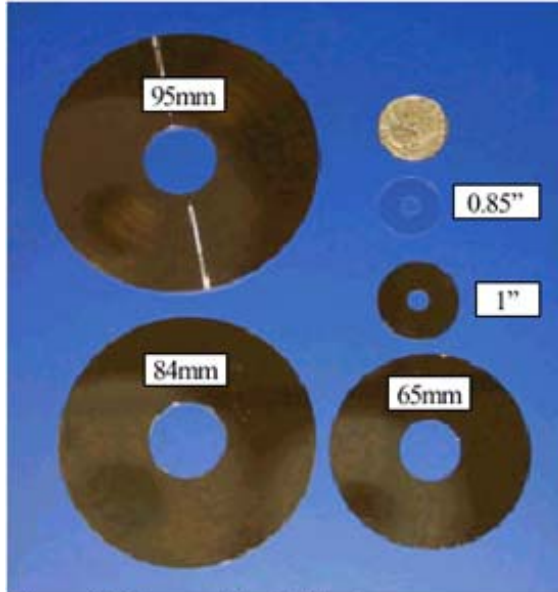


Figure 2. Common hard disk sizes

OD gripping) has been possible with minimum impact to the controls and software. A system to load multiple 0.85-inch disks in place of a single 95mm disk for large increases in throughput has also been developed.

material cost by a factor of six. The trick is to design a carrier for the small disks and load six times as many disks in the same interval.

The same economies of scale do not apply for single disk processes. Here, the process time decreases due to the small surface area of the disk and the cycle time becomes dominated by disk handling. These systems may have to be completely redesigned to balance throughput with the batch processes.

Owens Design has developed several solutions for 0.85" [media handling](#) that can be customized for existing customer tools. These [handling solutions](#) include ID grippers, mandrel, spindles, and vacuum cups as well as OD grippers and saddles. In some cases, retrofitting existing equipment with alternative mechanisms (e.g. changing from ID to

OD gripping) has been possible with minimum impact to the controls and software. A system to load multiple 0.85-inch disks in place of a single 95mm disk for large increases in throughput has also been developed.

Sub-1 inch disk drives have become one of the fastest growing segments of the data industry. Capacity increases and cost reduction will continue to open up even more market opportunities. Achieving the necessary cost reductions in manufacturing of sub-1 inch hard disks will require innovative approaches to disk handling, not simply scaling existing methods. Those manufacturers that make the first move to dedicated small form factor equipment will be best positioned to capitalize on this segment's tremendous potential.

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