

An Introduction To Modern Storage Devices

There are many ways of storing information and data for use with modern computer systems and new developments are constantly being made. Many changes have occurred since the first personal computers were developed, allowing a lot more information to be stored, and on storage devices which are generally a lot smaller and easier to handle than methods of storage previously used.

In the past two or three years, there has been a massive change in the emphasis that has been placed on certain storage devices. Whereas 3.5" floppy discs were practically the only commercially available storage medium available to the public there are now many more on offer. The biggest change has perhaps been that writeable and rewriteable CD's are now widely available to the public. For many people, CD-R's have now replaced the use of floppy discs, as they offer an inexpensive way of storing large amounts of data. A typical floppy disc stores 1.44 Mb's of data, whereas a CD-R stores 650 Mb and both offer a similarly priced product.

Some examples of modern storage mediums are:

- Mini Disc
- Tape Drive
- MP3 Card
- Hard Disk Drives
- CD ROM
- Zip Disk
- DVD

The major advances in the ability to store larger amounts of data is not only desirable, but essential as computers become more complex each day. As computing technology develops, much more complex information can be stored requiring much more storage space. An example of such information is audio and video, which can now be stored at a very high quality. Although audio uses a lot of storage space, it should be noted that as storage devices have improved, so has the facility to "compress" files. The most notable method of audio compression in previous years has been the "MP3" or "MPEG" file which allows superb sound quality whilst maintaining a relatively low file size (usually around 4 or 5 Mb's dependant on desired sound quality)

Hard Disk Drives

What Is A Hard Disk Drive?

A hard disk drive is generally the main storage device used in a PC system and is a fairly essential part. It is generally contained inside the computer, although can be contained in a “box” which can be inserted and removed from the PC tower. This is useful as it allows other hard disk drives to be inserted and therefore more information to be stored. A picture of a hard disk drive can be seen below. Please note that this one has had the cover removed. The cover would normally form an airtight seal around the hard disk drum.



Hard disk drives began storing only a small amount of data, but now they are available to hold a huge amount of information, up to around 73 GB (Gigabytes) of data.

The physical size of the hard disk is common throughout most PC systems, usually 4” wide for a standard PC (although it’s actually called 3.5”). These are known as slimline disks and are 1” in height.

There can sometimes be a slight problem with hard disks when they generate a fairly large amount of heat. This is usually solved by the use of a cooling mechanism such as a fan. The problem of overheating has now generally been solved in modern hard disks.

The History Of The Hard Disk

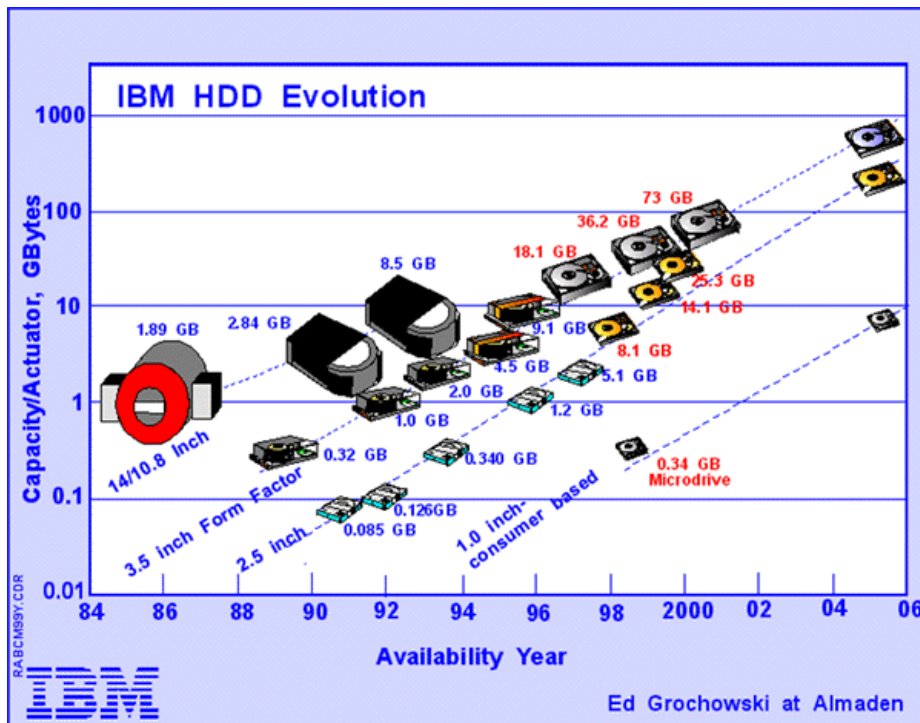
The earliest "true" hard disks had the heads of the hard disk in contact with the surface of the disk. Unfortunately, manufacturing techniques were not nearly as sophisticated as they are now, and it was not possible to get the disk's surface as smooth as would be necessary to allow the head to slide smoothly over the surface of the disk at high speed while in contact with it. Over a period of time, the heads of the disk wore out, as did the magnetic coating on the disk surface. These therefore needed to be replaced.

In the 1950s IBM engineers realised that with the proper design the heads could be suspended above the surface of the disk rather than making contact. They read the bits as they passed underneath.

The first production hard disk was the IBM 305 RAMAC (Random Access Method of Accounting and Control), introduced on September 13, 1956. It stored 5 million characters, (but a "character" in those days was only seven bits, not eight) on 50 disks, each 24 inches in diameter! The data transfer rate of this first drive was an impressive 8,800 bytes per second.

In 1973, the IBM model 3340 disk drive was introduced. This unit had two separate spindles, one permanent and the other removable, each with a capacity of 30 MB. For this reason the disk was sometimes referred to as the "30-30". This led to it being nicknamed the "Winchester", after the "30-30" Winchester rifle. It used the first ever sealed internal environment. The Winchester disk drive also greatly reduced the flying height of the disk to only 17 microinches above the surface of the disk.

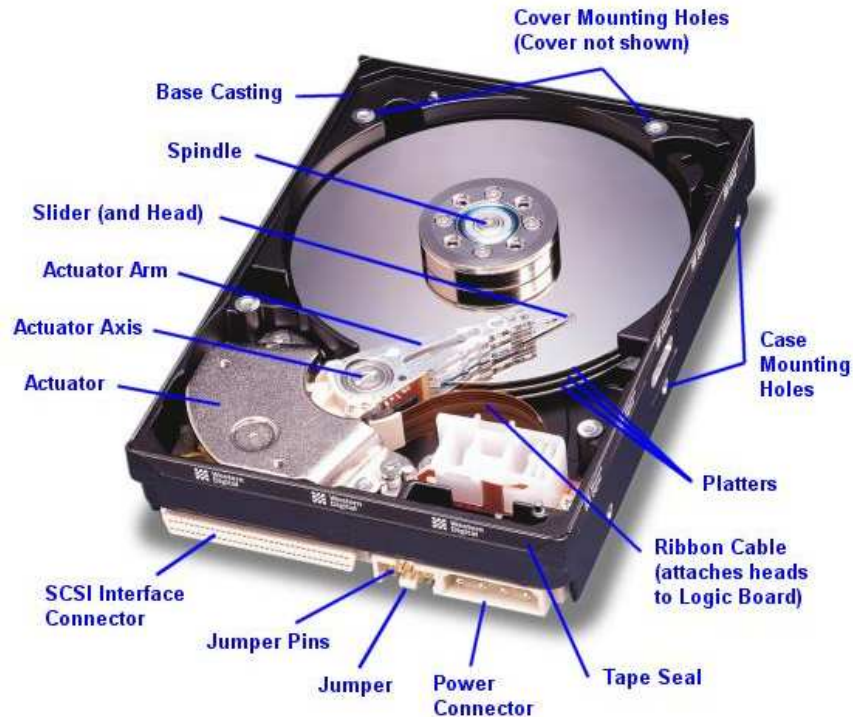
The first hard disk drive designed in the 5.25" form factor used in the first PCs was the Seagate ST-506. It featured four heads and a 5 MB capacity. Below is a diagram which illustrates the evolution of the IBM harddisk from 1984 to date.



Modern Hard Disk Drives

Since we started using hard disk drives, there have been many advances in the technology within the computing and manufacturing industry. This has led to major improvements within the manufacture of hard disk drives although the basic principles and operating procedures of hard disks have remained unchanged since the early 80's.

Most PC's now come with a minimum of 10GB of hard disk drive storage space, and it can be as much as around 73 GB. An image of a modern hard disk can be clearly seen below, including labelling illustrating the most important features.



How Do Hard Disks Work?

A hard disk uses round, flat disks called *platters*, coated on both sides with a special material designed to store information as magnetic patterns. The platters are mounted on a spindle. The platters rotate on the spindle at high speed, powered by a special spindle motor. Special heads are mounted onto sliders and used to either record information onto the disk or read from it. The sliders are mounted onto actuator arms, which are positioned over the surface of the disk and controlled by a device called an actuator.

The surface of each platter on the disk can hold tens of billions of individual bits of data. Each platter has two heads, one on the top of the platter and one on the bottom. The information held on platters is arranged as tracks in concentric circles along the platters surface. These tracks are also broken down into smaller sections which hold 512 bytes of information known as sectors.

It is important that hard disks are air tight to ensure that contaminants such as dust particles can't get onto the platters and cause damage to the heads on the actuator arm.

Platter Size

The size of the platters in the hard disk is the primary determinant of its overall physical dimensions, also generally called the drive's form factor. Today, by far the most common hard disk platter size in the PC world is 3.5". Actually, the platters of a 5.25" drive are 5.12" in diameter, and those of a 3.5" drive are 3.74"; but the "approximate" names are -commonly used. Laptop drives are usually smaller, for obvious reasons. The platters on these drives are usually 2.5" in diameter or less; 2.5" is the standard form factor, but drives with 1.8" and even 1.0" platters are becoming more common in mobile equipment.

There are several reasons why platters are shrinking, and they are primarily related to performance. The main reasons why companies are going to smaller platters are :

- **Enhanced Rigidity:** The *rigidity* of a platter refers to how stiff it is. Stiff platters are more resistant to shock and vibration, and are better-suited for being mated with higher-speed [spindles](#) and other high-performance hardware. Reducing the hard disk platter's diameter by a factor of two approximately *quadruples* its rigidity.
- **Manufacturing Ease:** The flatness and uniformity of a platter is critical to its quality; an ideal platter is perfectly flat and consistent. Imperfect platters lead to low manufacturing yield and the potential for data loss due to the heads contacting uneven spots on the surface of a platter. Smaller platters are easier to make than larger ones.
- **Mass Reduction:** For performance reasons, hard disk spindles are increasing in speed. Smaller platters are easier to spin and require less-powerful motors. They are also faster to spin up to speed from a stopped position.
- **Power Conservation:** The amount of power used by PCs is becoming more and more of a concern, especially for portable computing but even on the desktop. Smaller drives generally use less power than larger ones.
- **Noise and Heat Reduction:** These benefits follow directly from the improvements enumerated above.
- **Improved Seek Performance:** Reducing the size of the platters reduces the distance that the [head actuator](#) must move the heads side-to-side to perform random seeks; this improves [seek time](#) and makes random reads and writes faster. Of course, this is done at the cost of capacity; you could theoretically achieve the same performance improvement on a larger disk by only filling the inner cylinders of each platter. In fact, some demanding customers used to [partition](#) hard disks and use only a small portion of the disk, for exactly this reason: so that seeks would be faster. Using a smaller platter size is more efficient, simpler and less wasteful than this sort of "hack".

The smallest hard disk platter size currently available on the market is only 1" in diameter. IBM's Microdrive has a single platter and is designed to fit into digital cameras and other small equipment. The Microdrive can run off battery power due to the tiny platters. It can spin down and back up again in less than a second, and withstand shock that would destroy a normal hard disk, and it's got a capacity of 340 MB.

The following table summarises the most common platter sizes used in PC's

Platter Diameter	Typical Form Factor	Application
5.12	5.25"	Oldest PCs, used in servers through the mid-1990s and some retail drives in the mid-to-late 1990s; now obsolete
3.74	3.5"	Standard platter size for the most common hard disk drives used in PCs
3.0	3.5"	High-end 10,000 RPM drives
2.5	2.5", 3.5"	Laptop drives (2.5" form factor); 15,000 RPM drives (3.5" form factor)
1.8	PC Card (PCMCIA)	PC Card (PCMCIA) drives for laptops
1.3	PC Card (PCMCIA)	Originally used on hand-held PCs (no longer made)
1.0	CompactFlash	Digital cameras, hand-held PCs and other consumer electronic devices

Researchers at IBM are currently developing a new substance that could be used in the manufacture of hard disk drive platters in the future. Instead of using metallic film on the surface, a solution containing organic molecules and iron and platinum particles if used on the platters. This solution is spread out and heated. This causes the iron and platinum particles to arrange themselves into a natural grid of crystals, with each crystal able to hold a magnetic charge. This has the potential to increase the areal density capability of the recording media of hard disks by as much as 100 times. It is still in the development stages, and advances still need to be made in the read/write head capabilities of a hard disk before it can be put into commercial use.