

THE COMPUTER HISTORY MUSEUM



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MEMOREX

Flexible Disks

MEMOREX

the quality flexible disk

Our name is our guarantee

Today's business world demands rapid, efficient information storage.

The success of the system chosen depends on the easy, accurate retrieval of the information. For if it is damaged, or lost completely, the consequences can be incalculable.

It is essential, therefore, to choose a flexible disk from a manufacturer with a reputation for reliability and performance in computer technology.

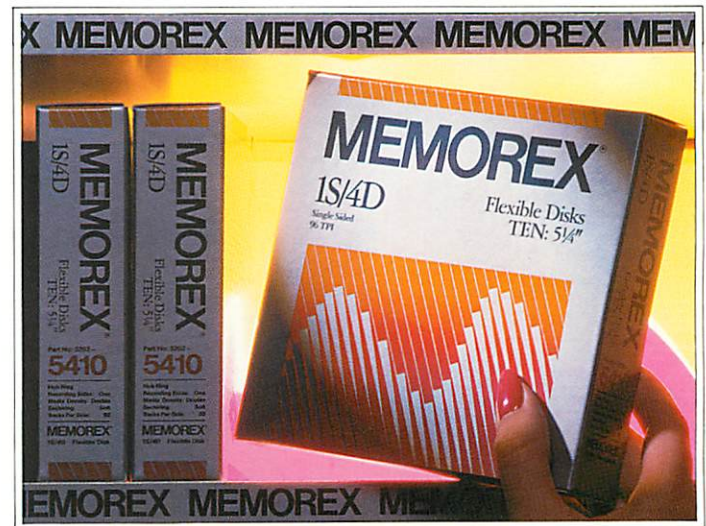
What is a flexible disk?

Looking rather like a gramophone record, this extraordinary circle of plastic, 3½", 5¼" or 8" across, is capable of holding an enormous amount of data and allowing access to it at amazing speed. Developed in the early 1970s, the flexible disk quickly became established as a low-priced, high precision product, ideal for almost any information storage application, whether for large or small business computers, personal computers or word processors.

Manufacturers, seeing this active growth market, launched a series of competitive disks. Although they all look very similar – what distinguishes the good disk from the bad is quality and durability.

And in the world of flexible disks, there's a name that is prominent for trouble-free performance and years of dependable service.

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Reach up for quality

About this brochure

This brochure contains detailed information on Memorex flexible disks – how they are made, which disk suits what application and how to protect disks and so ensure error-free use. For readers new to the computer field, a brief history of Memorex, one of the world's leading suppliers of equipment and media in data storage, retrieval and communications, is also included.

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About MEMOREX

Memorex employs over 11,000 highly skilled people in more than 100 locations throughout the world. With modern headquarters and major manufacturing facilities in Santa Clara, California, Memorex has other production facilities in Europe, the Americas and the Far East.

But it wasn't always like that – from humble beginnings the company has grown to its present size by anticipating changes in its chosen markets.

The early years

In February 1962 change was very much on the minds of Lawrence Spitters and the fourteen people who were the first employees of the company they called the Memorex Corporation. They saw a handful of companies dominating the markets for computer tape. It was a situation they were determined to change – by producing better products.

The first Memorex instrumentation and computer tapes gained rapid acceptance and respect.

By 1966 Memorex was ready to take advantage of the edge it had achieved in manufacturing computer tape and began to apply its expertise to a related field of computer media – rigid disks. The computer industry now clearly saw Memorex as a competitive force.

Moving into new fields

Today Memorex is the only independent producer of magnetic media also manufacturing equipment. This gives Memorex a distinct advantage over its competitors, as the company understands the demands of both markets.



As a matter of historical fact, Memorex developed its first disk drive, not because it wished to enter the equipment market, but because it wanted to test its own rigid disks.

In order to meet the tough, error-free standards the company had set for its disk packs, it needed to design test equipment that would detect the slightest faults in them. Memorex was forced to build a test drive that proved its media to be not just as good as the competition's, but even better.

The test equipment that resulted – in effect an innovative disk drive – was quickly recognised as a superior product, delivering faster access times, better reliability and fewer maintenance problems than the available drives. Strong customer demand encouraged Memorex to start commercial production of its disk drives, a move which was instrumental in expanding the company.

By the early 1970s Memorex produced a full range of products dedicated to information recording, storage and retrieval – products which satisfied the needs of customers in many settings, from home entertainment to scientific and business-related data processing.

A company with worldwide respect

Between 1962 and 1984 Memorex has produced some 50,000 disk drives, over 60,000 flexible disk drives and made enough computer tape to stretch to the moon and back more than 50 times.

For almost a quarter of a century of manufacturing magnetic media Memorex has seen rapid changes. It now has four media plants across the continents – in Santa Clara, California; Liege, Belgium; Mihara and Gifu, Japan; and Clondalkin, Ireland – plus an extensive network of almost 300 sales offices, regional warehouses and distribution centres.

In a flexible disk market, which produced almost 600 million units in 1984 and is increasing annually by some 40 per cent, Memorex has proved it chose its name well. An accepted word for its kind of business – the memory business – is linked with one describing the on-going challenge of that business – Excellence.

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How disks are made

A flexible disk starts life as a 26" wide, 6 mile long roll of polyester film. The film is coated with a precisely formulated computer grade magnetic oxide to a uniform thickness of one hundred microinches on both sides.

This Memorex cross-linked coating is unique and results in stronger signal holding and greater recording and playback accuracy.

The punched disks are then placed into a semi-automatic machine which polishes both sides using a silica-treated film. This process, known as burnishing, creates a fine, smooth finish which enhances electrical performance and so improves the reading and writing of data. The smoother the finish the more protection there is against surface friction and ultimate head wear.

1. Roll of magnetic media



2. Disks are punched out from roll of magnetic media



3. Punched disks are burnished to give a smooth finish



Circles of 3½", 5¼" and 8" diameter are then punched out. At the same time as the disks are formed the centre drive spindle, index and sector holes are also punched.

4. Jackets
Vinyl and liner material are combined



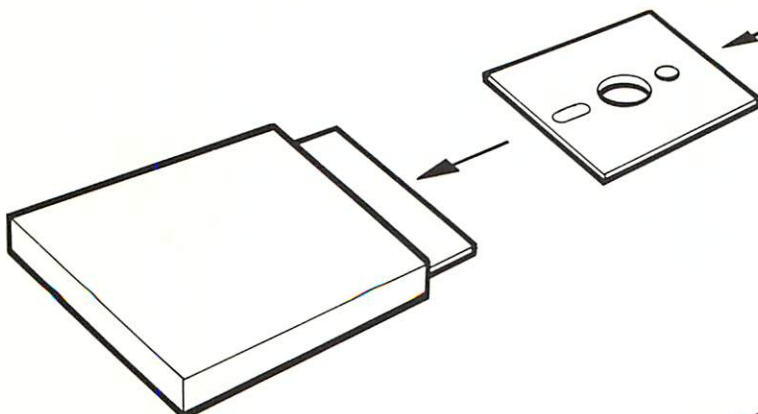
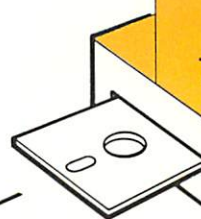
5. The jacket is carefully folded



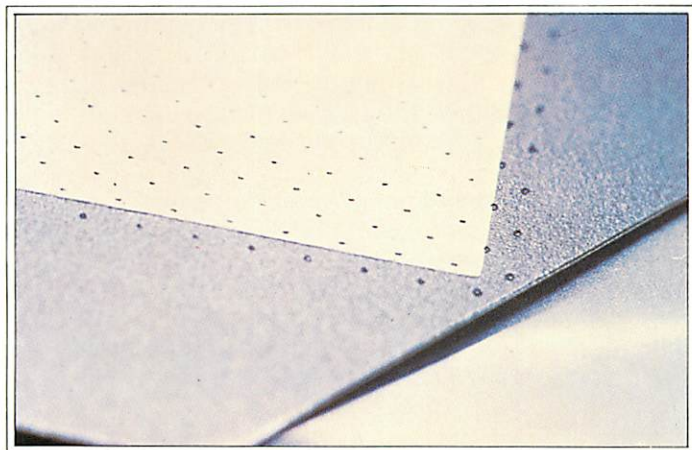
6. Disk is inserted in jacket



7. Every single disk is tested



The Memorex disk jacket



The Memorex disk is opened up.

Also important to the performance of a flexible disk is its protective jacket. This is made up of two units – a vinyl outer and a non-woven, lint-free synthetic fibre lining – punched, to very close tolerances, into the required shapes. Once in their final form all jackets are subject to stringent quality inspections.

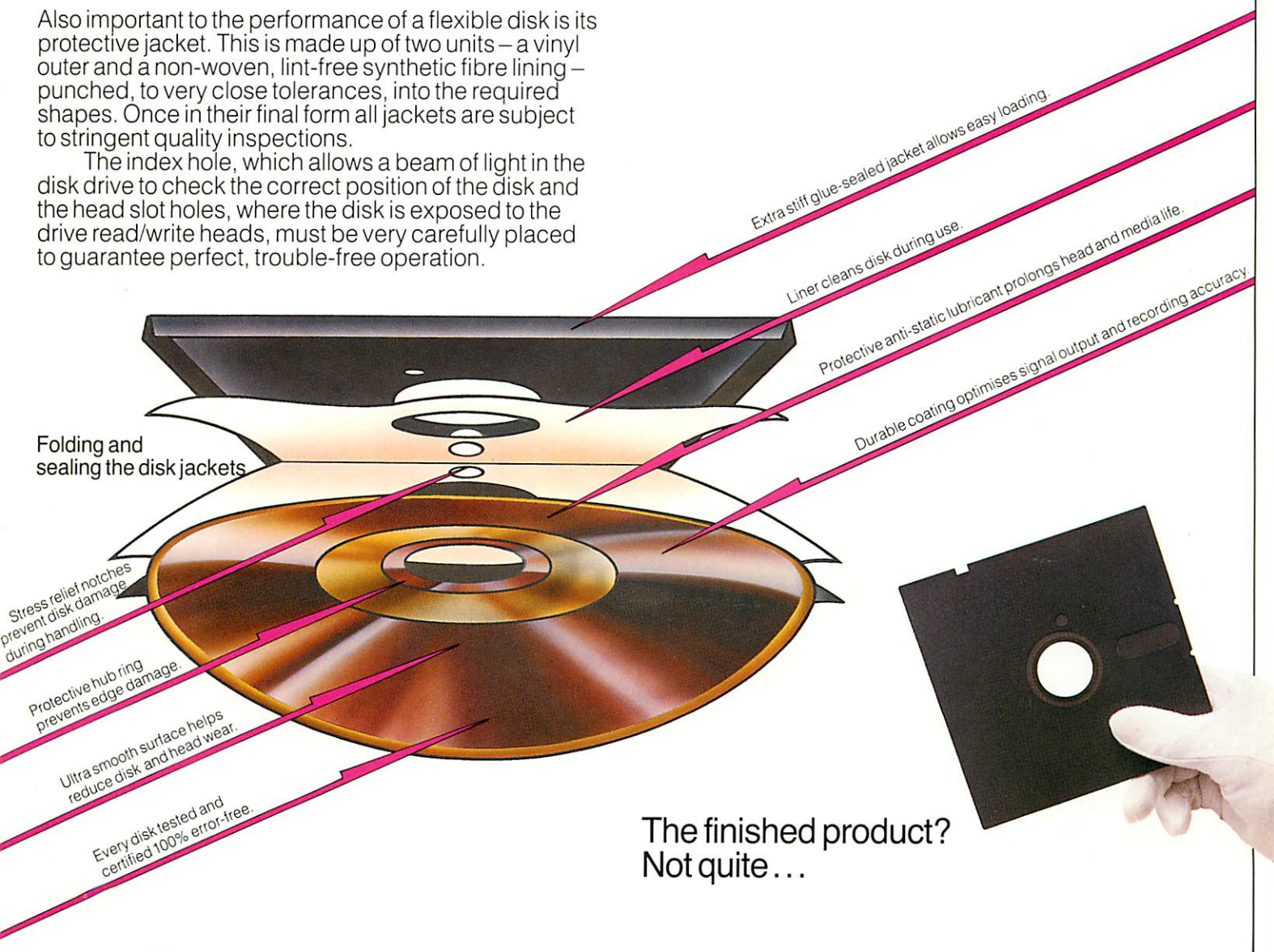
The index hole, which allows a beam of light in the disk drive to check the correct position of the disk and the head slot holes, where the disk is exposed to the drive read/write heads, must be very carefully placed to guarantee perfect, trouble-free operation.

The position and shape of the individual holes varies according to the type of disk. Stress relief notches are added, helping to prevent distortion of the head slot, as too are write protect notches which prevent data being inadvertently erased.

The burnished disk is inserted into the jacket. The end flap is then sealed enclosing the disk completely.

100% clean, 100% error-free

Throughout the whole assembly process the plant maintains a contamination-free atmosphere in 100 per cent clean rooms. Great care is taken in handling and storing the disks and protective clothing is worn at all times.



Testing, ...testing ...testing

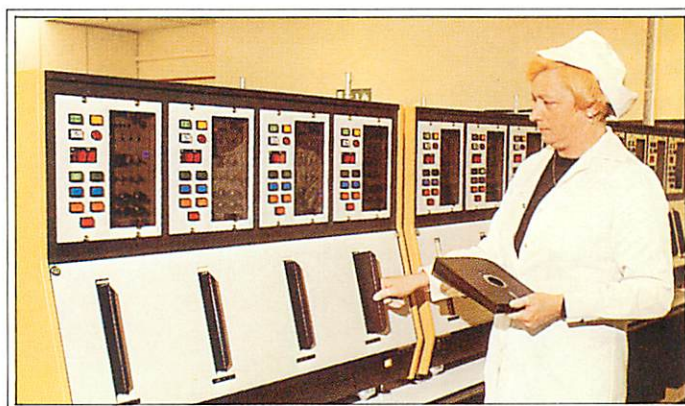
At every stage of the manufacturing process Memorex undertakes the most rigorous testing of its product. This is why Memorex flexible disks have become known as the highest quality media. Every track of every side of every disk is tested to ensure the guarantee of a 100 per cent error-free product. Even before the disk stage the raw materials used at the plant are stringently analysed down to their molecular content. The unique Memorex oxide coating passes through many tests to maintain superior sensitivity.

Certification and de-gaussing

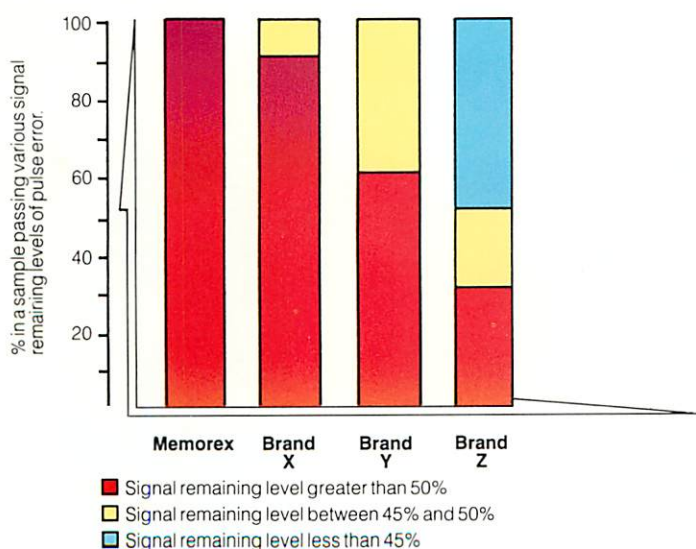
Following the enclosure of the disk in the jacket the whole cartridge is inserted into a special disk drive mechanism. This is a certifier, jointly designed by Memorex and a leading test equipment manufacturer, which magnetically writes a test pattern on the disk and then reads it back, comparing the output to a standard test pattern. Parameters include signal resolution, missing pulse error and extra pulse error. Notch and hole sizes are checked on a random sample basis, as are the starting and running torques of the disk. To remove all unwanted test signals every disk is passed through a strong magnetic field. This is known as de-gaussing.

The greatest attention is paid to the surface of the disk and its abrasivity. The lower the abrasivity level the less the wear that will occur on the drive head; the fewer errors in data reading or writing the more money subsequently saved on head replacement and disk life.

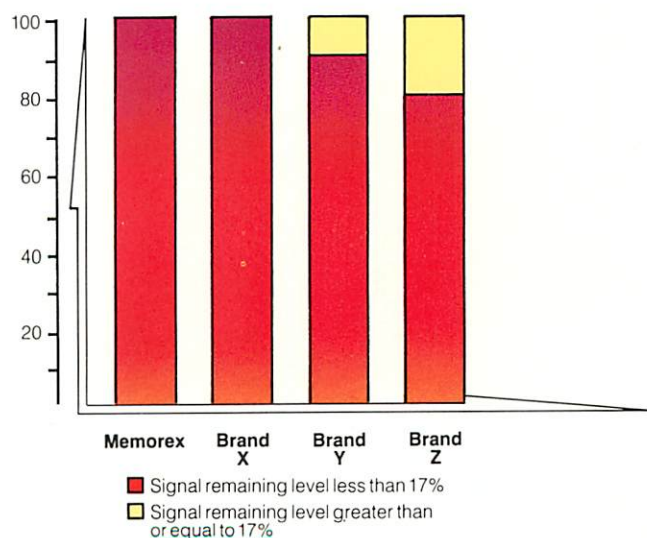
To check whether or not a track on a disk is defective, measurements of MPE (missing pulse error) and EPE (extra pulse error) are compared. The higher the MPE levels the less chance a customer has of getting data errors at high density recording. The graph below shows how leading competitive brands perform alongside the Memorex disk.



Missing pulse error



Extra pulse error

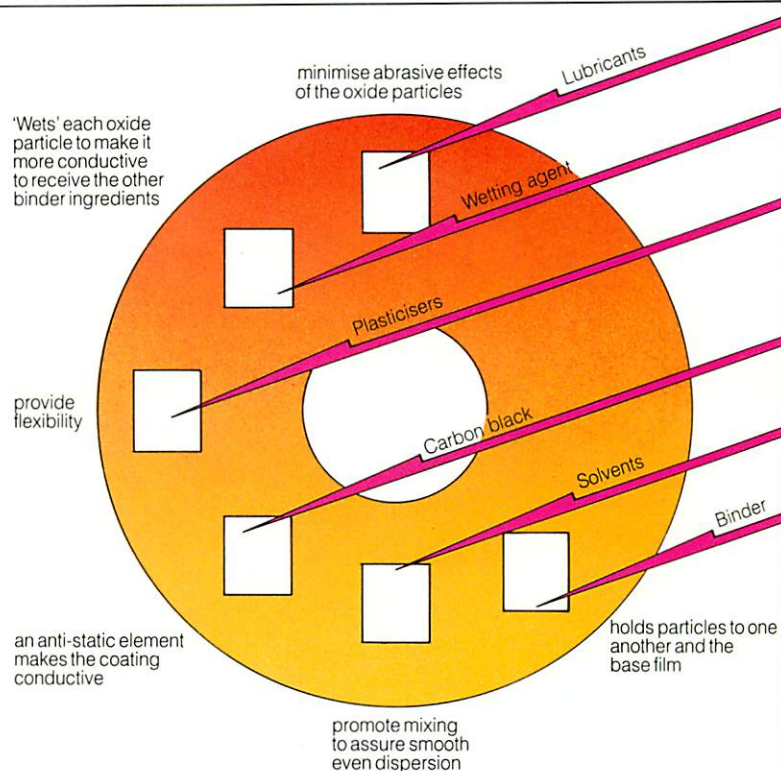


The Memorex coating

Because it plays such a vital part in the accuracy and life of a flexible disk, it is useful to understand the nature of the unique oxide coating.

The heart of a flexible disk is the ferric oxide particle which is capable of retaining magnetic force. But, because oxide particles are so abrasive by nature, each individual particle must be completely coated with a binder. A typical binder formulation consists of the general constituents illustrated here.

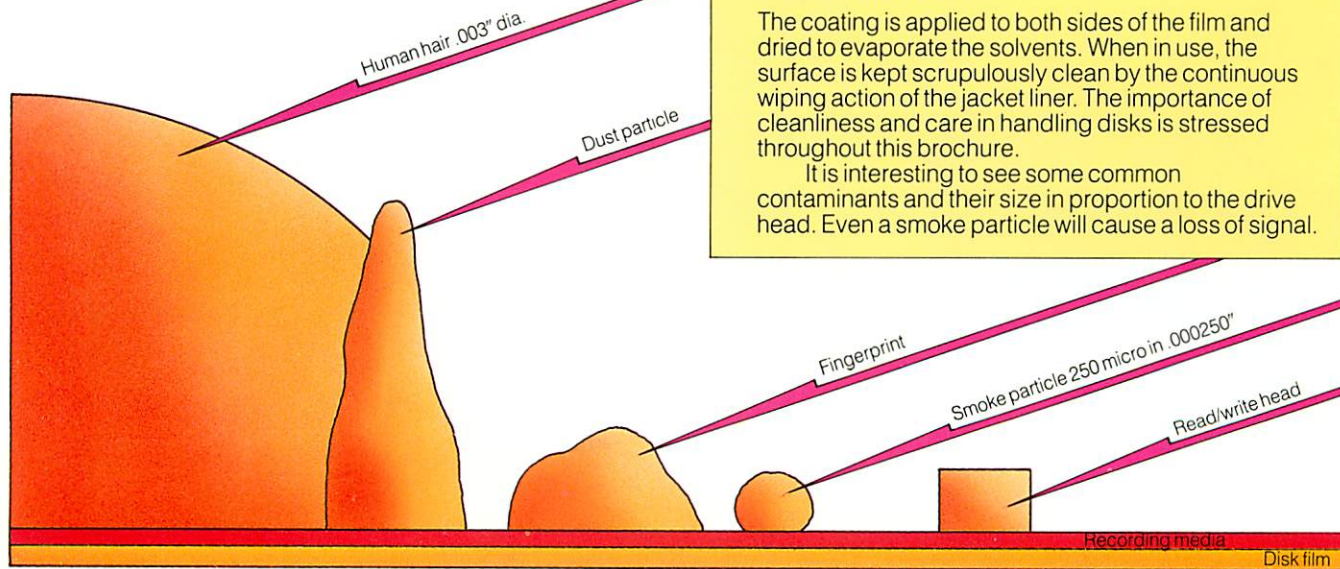
Oxide particles have a strong tendency to bunch up into clumps. Dispersion distributes the oxide particles uniformly throughout the coating and lubricates the oxide particles within the resin. The presence of clumps degrades performance in several ways. Clumping can produce noisy output. If clumps protrude from the surface, they may also cause errors. A clump can become a potential weak spot in the coating. Dispersing is, therefore, one of the most important steps in the manufacture of the flexible disk.



Cleanliness

The coating is applied to both sides of the film and dried to evaporate the solvents. When in use, the surface is kept scrupulously clean by the continuous wiping action of the jacket liner. The importance of cleanliness and care in handling disks is stressed throughout this brochure.

It is interesting to see some common contaminants and their size in proportion to the drive head. Even a smoke particle will cause a loss of signal.



Formatting

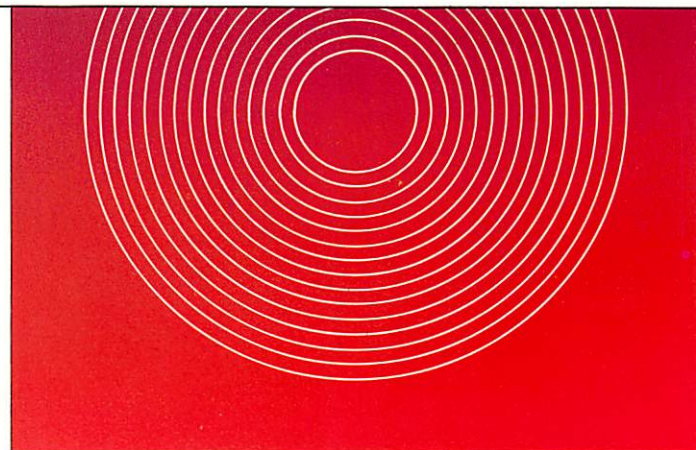
Information is magnetically recorded on a flexible disk much as it would be on a tape, except that on a disk the data is organised in circles and wedge-shaped fields or sectors. Bits are recorded in a circular line around the disk by the drive head. Each circle of bits is called a track and each track is numbered. The first track on the outer edge of the disk is called track 00. This is the index track and is reserved for information describing the contents of the disk, such as volume and owner identification.

The disk drive finds a desired track by measuring its distance from the rim straight across the disk. It locates a field or sector in one of two ways via hard or soft sectors – these terms are explained below.

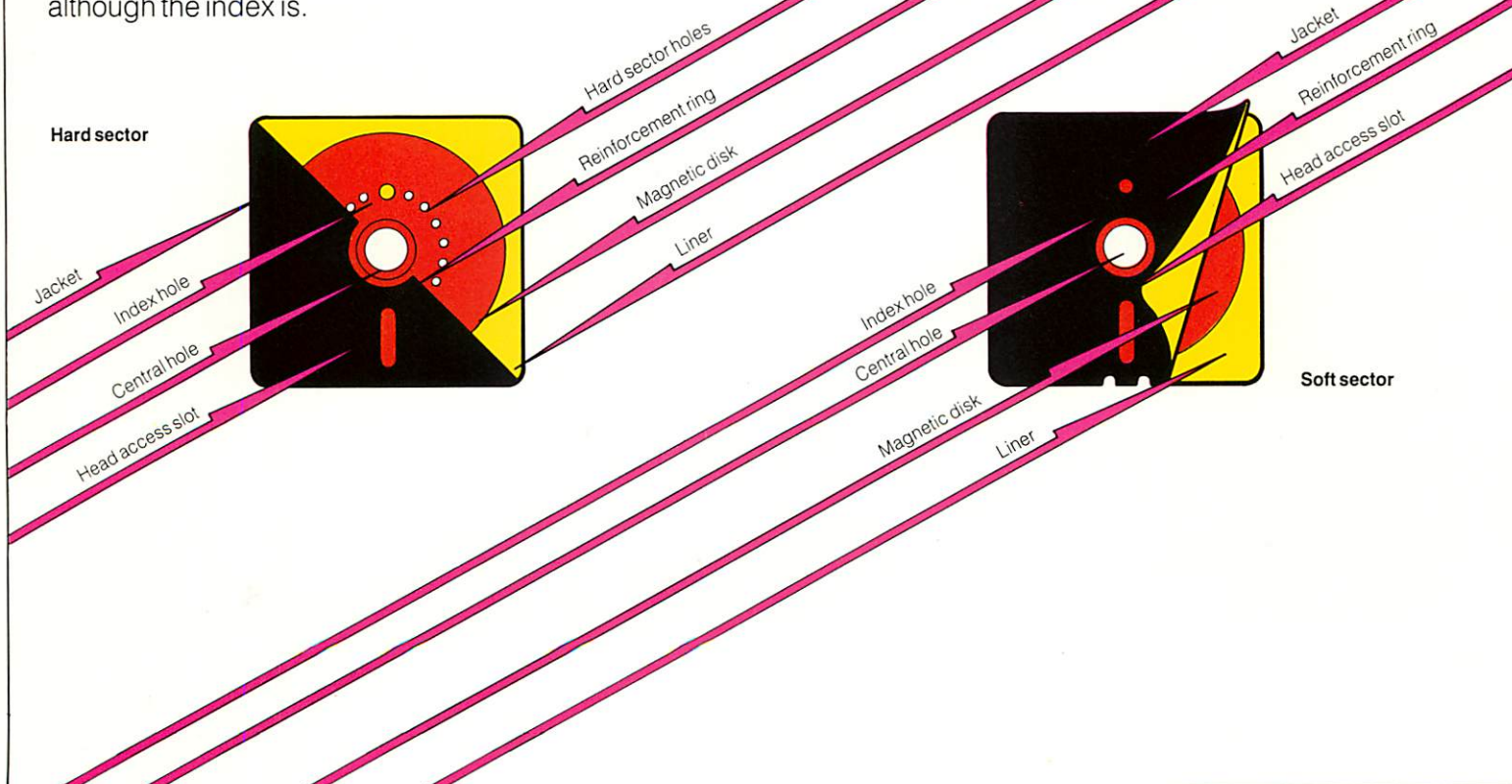
Hard and soft sectoring

All flexible disks can be sectored in two different ways: hard or soft, depending on the type of drive. A flexible disk which is hard sectored has index and sector holes which are physically punched out of the disk prior to jacket enclosure. There are usually 32 sector holes on 8" disks and 10 or 16 sector holes on 5¼" disks. They can be punched out near the inner or outer diameter depending on the drive.

A flexible disk which is soft sectored also has an index and sectors. In this case, however, the sectors are not physically punched, although the index is.

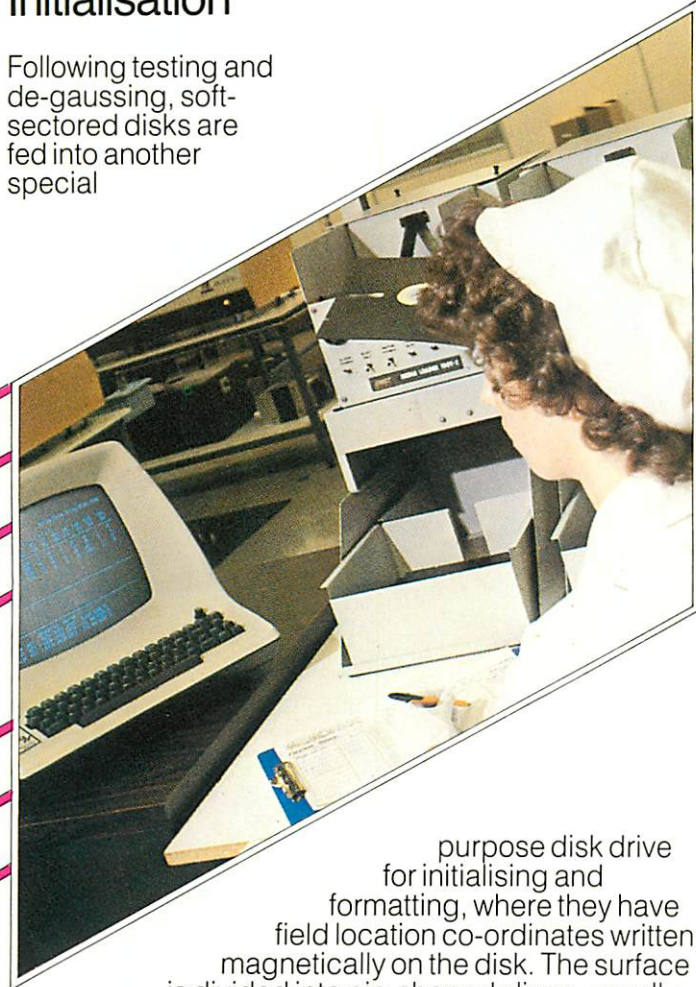


tpi You will come across the term tpi – tracks per inch – in the lists of disks available. Usually there are 48 tpi on a standard disk. A 96 tpi disk, sometimes known as 80 track, or quad density, is simply a disk that contains twice as many tracks per inch as the 48 tpi disks. The storage capacity has, therefore, been doubled.

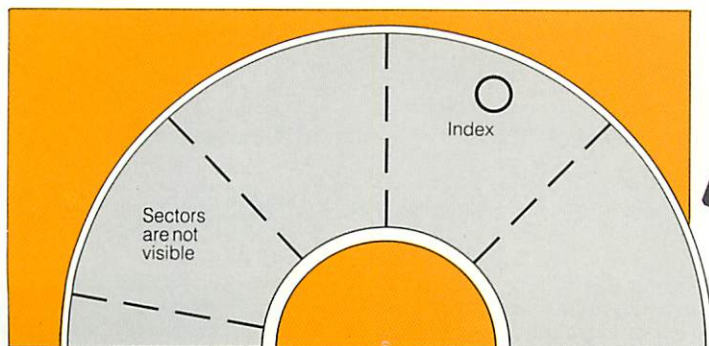


Initialisation

Following testing and de-gaussing, soft-sectored disks are fed into another special



purpose disk drive for initialising and formatting, where they have field location co-ordinates written magnetically on the disk. The surface is divided into pie-shaped slices, usually 26, and the tracks devoted to receiving data. In addition, two tracks, known as alternate tracks, are located at the inner diameter of the disk and are reserved for use as replacements for defective tracks.



Serial numbers

Before initialisation the jacket of every disk is automatically stamped with a serial number to ensure complete traceability of all the components.



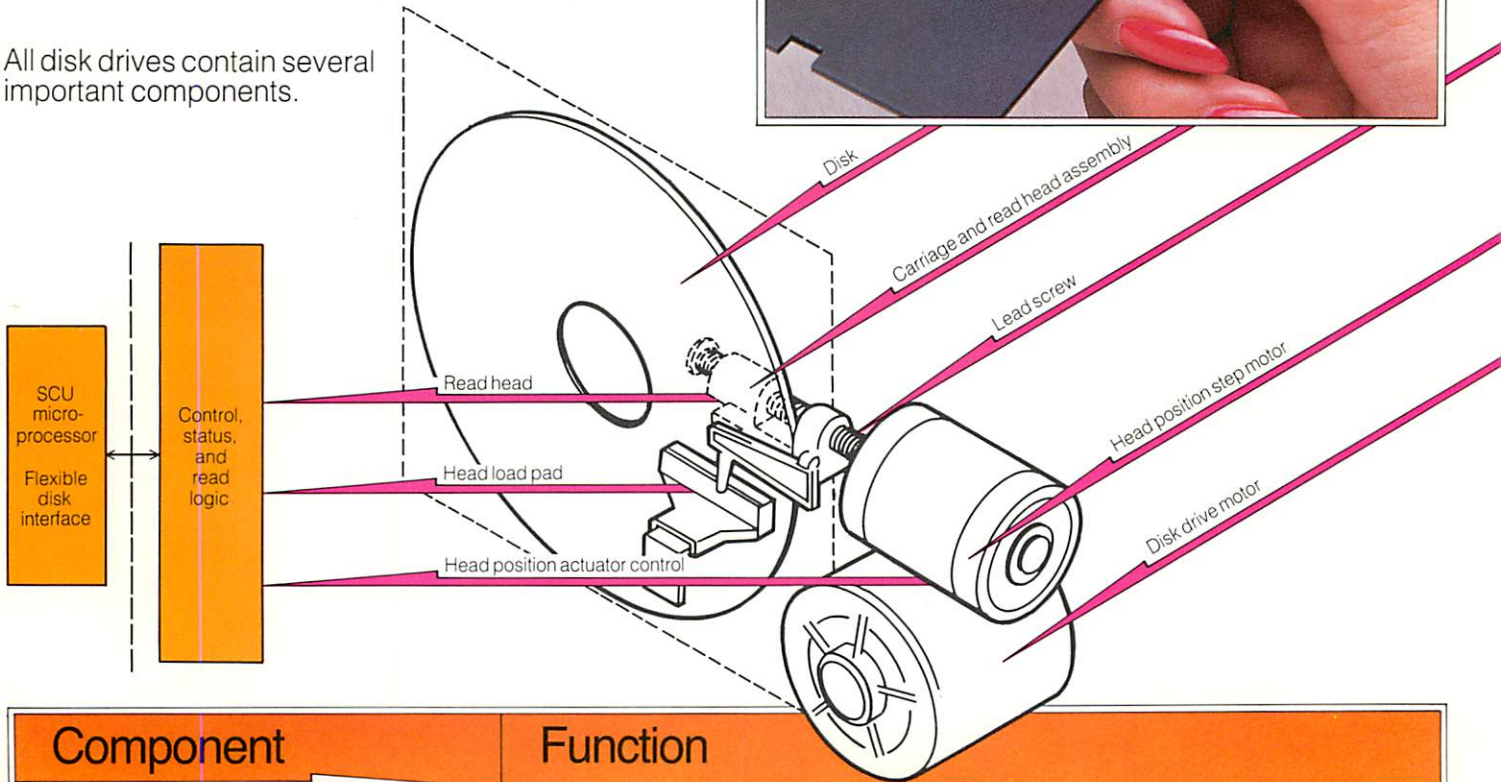
The disk drive – how it works



To load the cartridge, the door is opened, the disk inserted into the cartridge door in the direction of the arrow on the disk label, and the door is finally closed. The disk drive then spins the 8" flexible disk within its jacket at 360 revolutions per minute. 5¼" drives operate at 300 revolutions per minute.

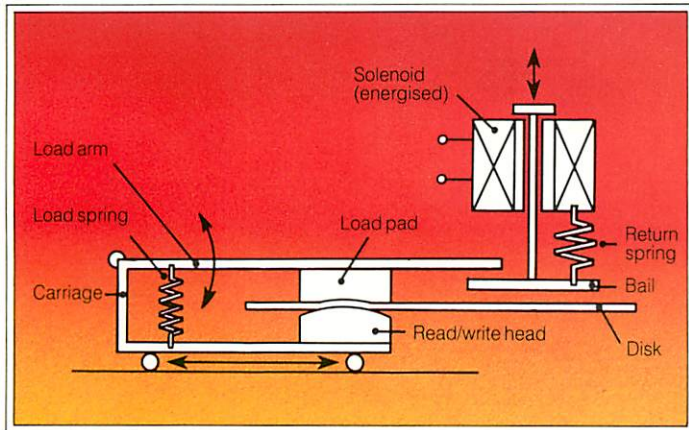


All disk drives contain several important components.



Component	Function
Control, status, read logic	Receives and generates control signals
Disk drive motor	Rotates the spindle, which spins the disk
Head load pad	Loads the disk against the head so that data may be read or written on the disk
Read/write head	Senses (reads) magnetic signals from the coating and records (writes) signals on to the coating
Head position step motor	Moves the read/write head from one track to another on receipt of signals from the control logic
Write protect feature (common, but not universal)	A light which shines through the write protect notch. On 5¼" disks covering this notch protects the data from being erased. On 8" disks removal of covering label protects the data.

Reading and writing on a flexible disk



On single-sided flexible disks, a pressure pad pushes the recording surface of the disk against the read/write head through the head slot. After use the pad lifts the disk off the read/write head to prevent excessive wear. The head position actuator can place the read/write head at many locations across the disk surface providing random (direct) access to the stored information.

Double-sided drives have two read/write heads – one on each side of the disk.

Meeting the demands of the disk drive

Choose Memorex flexible disks for:

- ☐ Business computers, large or small
- ☐ Word processors
- ☐ Distributed data processing
- ☐ Personal computers

There are over 500 disk drives marketed by over 3,000 companies. There is a Memorex disk to suit every one of them.

The Memorex range


Memorex disks are available in three sizes, 3½", 5¼" and 8". All three can be produced as double density, single sided or double sided. 5¼" and 8" disks can be produced hard or soft sectored, dependent entirely on a customer's requirements and the amount of data to be stored. A Memorex 8" double-sided, double-density flexible disk is capable of holding over 1.6 megabytes of information.

Every disk is placed in a paper envelope and packed in tens, together with a kit containing a write enable and colour coded labels. Each pack is shrink wrapped to protect it from moisture and other contaminants and despatched to a finished goods warehouse to await shipment to customers worldwide.




Memorex Flexible disks


Some simple hints for their care and handling




Never touch the flexible disk surface. It is susceptible to damage and even fingerprints can cause data to be lost.




Store flexible disks away from direct sunlight or heaters. Temperature extremes, especially heat, can damage disks. Also avoid sudden temperature changes (more than 20°C in an hour).




Insert carefully by grasping the upper edge and placing it into the disk drive. Never force the disk into the drive. Call your authorised service engineer to check the machine if something is wrong.




Keep disks in their envelope and store disks not for immediate use in their specially designed containers, standing them upright.




Do not bend or fold flexible disks. This will render disks inoperable.



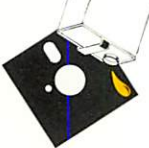
Put identification labels in a suitable position. Never use them in layers.




Do not place heavy objects on a disk.




Do not clip, staple or rubber-band flexible disks together.




Do not use solutions like alcohol, thinners and Freon to clean the disk. The special liner cleans the disk surface continuously. No other cleaning is necessary. Dirty or damaged disks should be discarded as placing them in a disk drive can contaminate the read/write head.



Do not write on a flexible disk with anything but a soft, felt-tip pen. Ideally, write labels separately, then place them on the disk jacket. Erasers can cause damage just as easily as ballpoint pens or pencils. Make a new label if you need to change reference information.



Magnets and magnetised materials should never come close to a flexible disk. Be particularly careful with magnetised paperweights, motors and power cables. Data can be lost from a disk exposed to a magnetic field.

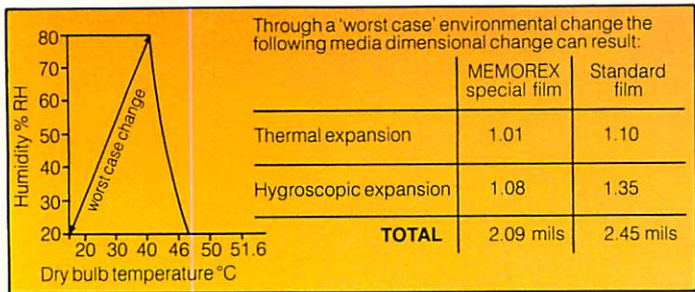


Keep the area of operation as clean as possible. Occasional static electricity on disks can attract contaminants. Plastic carpet protectors increase the risk of such static and should not be used.

Examples of optimum conditions are as follows:

	Temperature	Relative humidity	Conditioning before use	Ambient stray magnetic field
Test	68°F to 72°F 20°C to 22.2°C	40 to 60%	24 hours (min)	Less than 4000 A/M
Transport	-40°F to 125°F -40°C to 51.6°C	8 to 90%	24 hours (min)	Less than 400 A/M
Store	50°F to 125°F 10°C to 51.6°C	8 to 80%	24 hours (min)	Less than 4000 A/M
Operate	50°F to 125°F 10°C to 51.6°C	20 to 80%	24 hours (min)	Less than 4000 A/M

Disk operating range – track expansion



The graph shows the operating temperature and humidity range to which a disk is exposed – from a low temperature, low humidity condition to the worst expansion conditions. The values show the result of the media expansion based on the thermal and hygroscopic expansion coefficients.

Memorex flexible disks minimise track expansion through the use of their special polyester material. A further advantage of Memorex quality and high technology.

Research and development for the future

Memorex has a continuous policy of expanding its investments in research and development. Over the past five years Memorex engineering manpower has more than doubled, engineering spending has nearly tripled and technology related spending has increased more than sevenfold. The company has introduced four times as many storage equipment products in the past three years as in the previous ten years combined. More media products have been developed in the past three years than in the previous fifteen.

In its research and development programme Memorex concentrates on key disciplines for maintaining product leadership in information storage and communications. It also benefits from the research and development work of affiliates and suppliers. Product innovations and technological advance through the years have provided Memorex customers with increasingly better value than the competitors. At Memorex technology is not only directed towards new products but also towards enhancement of the company's existing range.

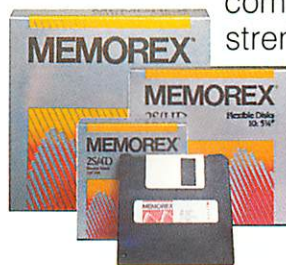
Anticipating trends

In its constant search for larger capacity, smaller physical size, extended product life and lower prices Memorex see the future for flexible disks developing along two major lines:

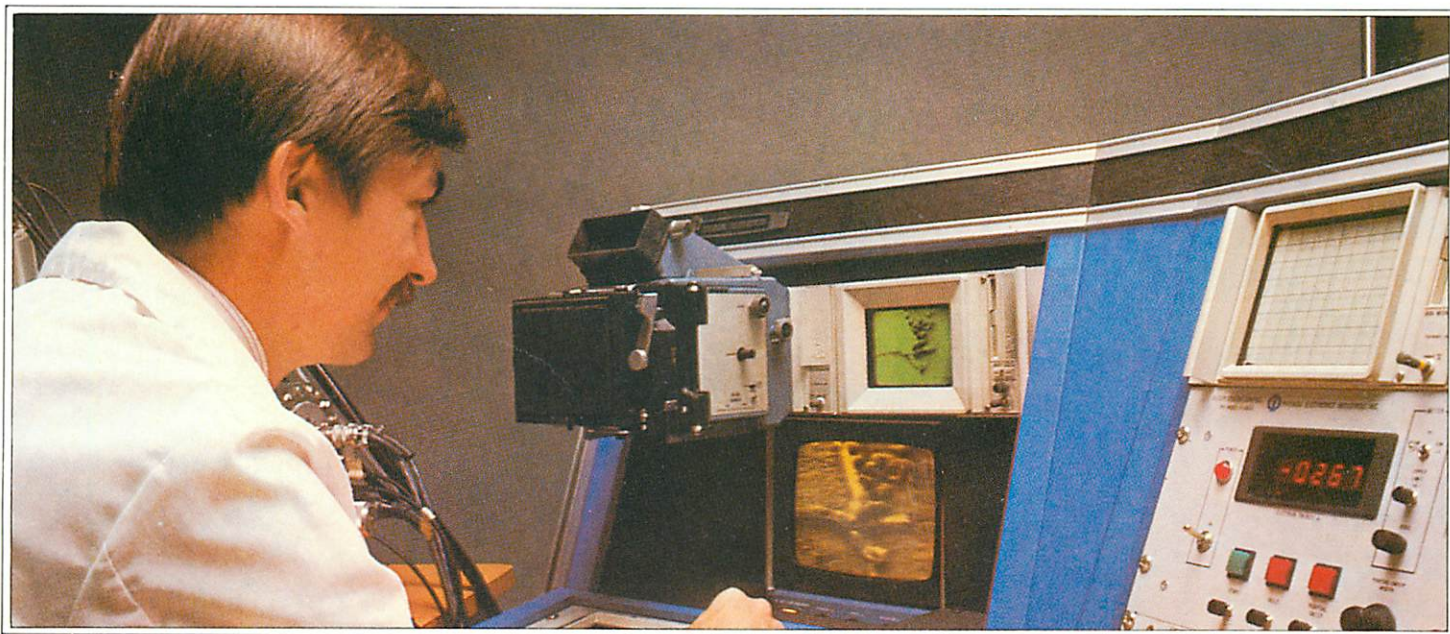
1. Higher density disks, 3.3 MB disks is the first generation of this family of increased capacity disks.
2. Smaller disks, initially 3½", to improve storage capability and reduce materials costs.

With regular additions to its high quality flexible disk range Memorex now offers the most extensive range of disks available.

With over two decades of experience, Memorex intends to stay at the forefront of computer technology and to strengthen its commitment to the words that gave birth to its name...



**MEMORY
EXCELLENCE**



For the latest in spectroscopy, Memorex operates a scanning auger microprobe, which uses a micro-beam technique to analyse the atoms that make up a surface structure. Only a few of these microprocessor-based systems are in existence today.

Quality.
When it matters, make it Memorex
MEMOREX