

HARD DISK ***DRIVES***

- Performance
- Storage capacity
- Software support
- Reliability

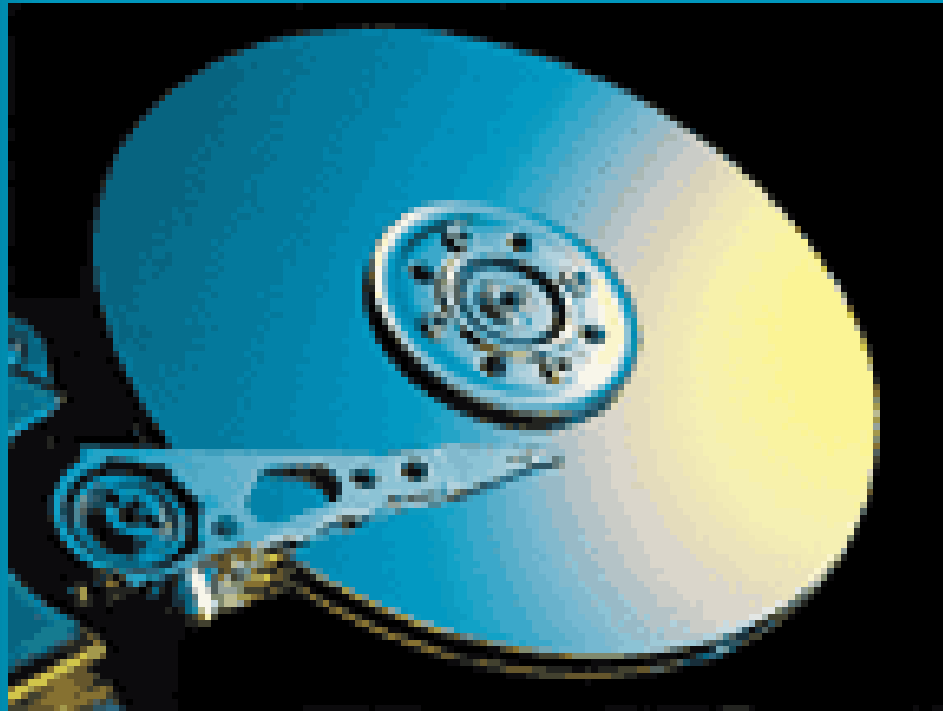
Why we call it as.....

- *Hard disk*
- *Fixed disk*
- *Winchester disk*

Hard Disk Drive Components

- Disk platter
- Read/Write head
- Head arm/Head slider
- Head actuator mechanism
- Spindle motor
- Logic board
- Air filter
- Cables & Connectors

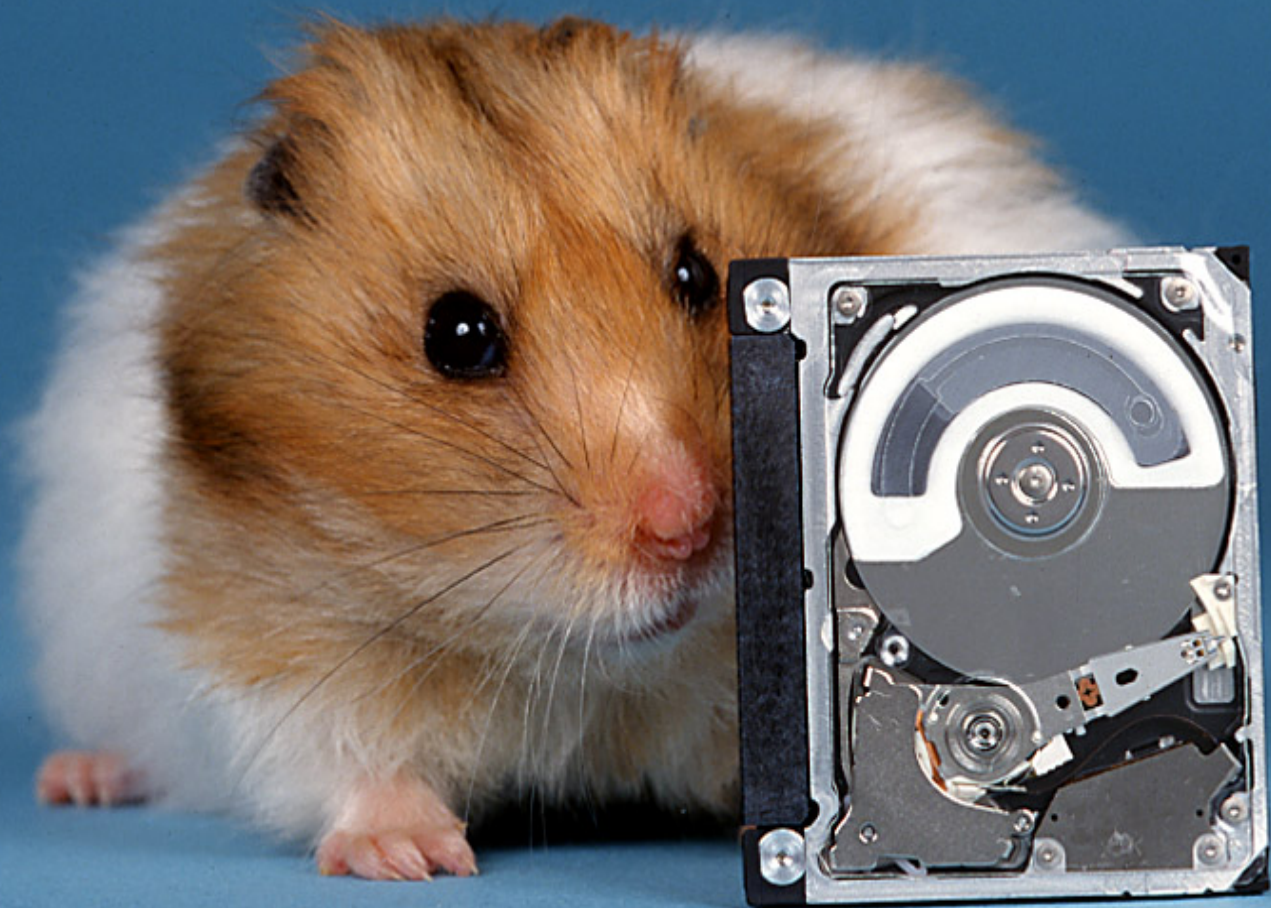
- Disk platter



- The data's are stored in this media
- Form factor
 - ✓ 5.5" - actual size is 5.12"
 - ✓ 3.5" - actual size is 3.74"
 - ✓ 2.5"
 - ✓ 1 1/8"
 - ✓ 1 1/3"
 - ✓ 1"

- The 5.25" platters were used in earlier days
- Now a days it is replaced by the 3.5" platter
- The 2.5", 1 1/8", 1 1/3" & 1" platters are using in the laptop computers
- Among this the 1" platter are known as "Microdrive"









- Substrate

- The material by which a disk platter is manufactured

- Aluminum

- Glass or Glass Ceramic compounds

- To hold the data on the substrate, it must be coated with magnetic media

- Iron Oxide media

- Thin Film media

➤ Iron Oxide media

- ✓ It gives around 30 meu inch thickness
- ✓ Looks brown or amber in colour
- ✓ Semi liquid coating of the iron oxide compound

➤ Thin Film media

- ✓ Very thin coating
- ✓ Only 1-4 meu inch thickness
- ✓ It is coated over the substrate by using two types of process

■ Plating process

- ⊕ The media is produced by electroplating process
- ⊕ Substrate is immersed in different chemicals

■ Sputtering process

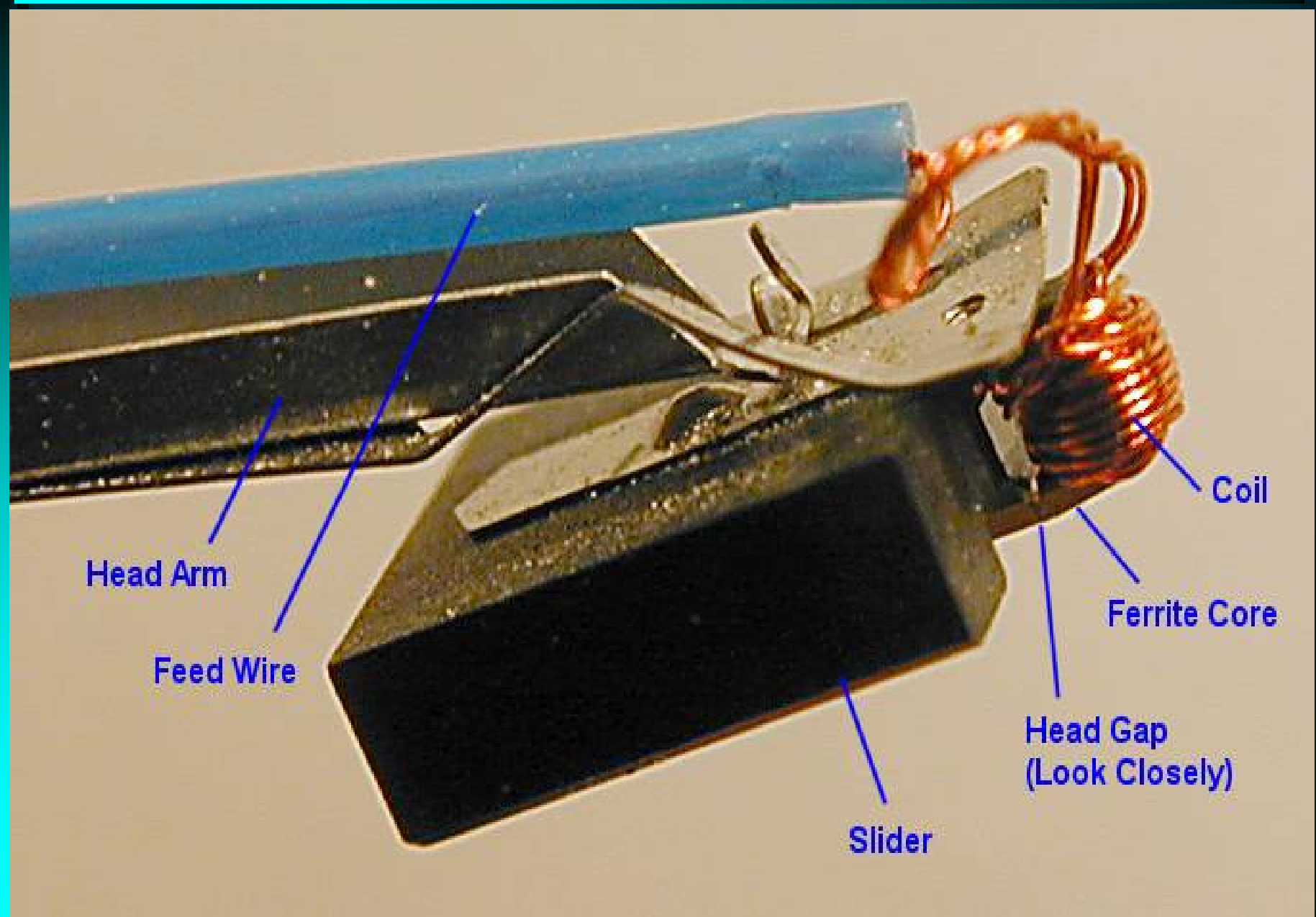
- ⊕ It provides better thin film coating
- ⊕ This provides thinnest, hardest and finest media surface
- ⊕ 3 substances are coated
- ⊕ Nickel phosphorous, Cobalt alloy, carbon coating
- ⊕ +ve points & cost are high

Read / Write heads

- Ferrite heads
- MIG heads
- TF heads
- MR/AMR heads
- GMR heads
- CMR heads
- TMR heads

Ferrite heads

- ✓ For Winchester disks
- ✓ Made of iron oxide core wrapped with electro magnetic coils
- ✓ It is a u shaped iron core wrapped with electrical windings
- ✓ They are not so small in size
- ✓ Used in hard disk up to 50 MB



Head Arm

Feed Wire

Slider

Coil

Ferrite Core

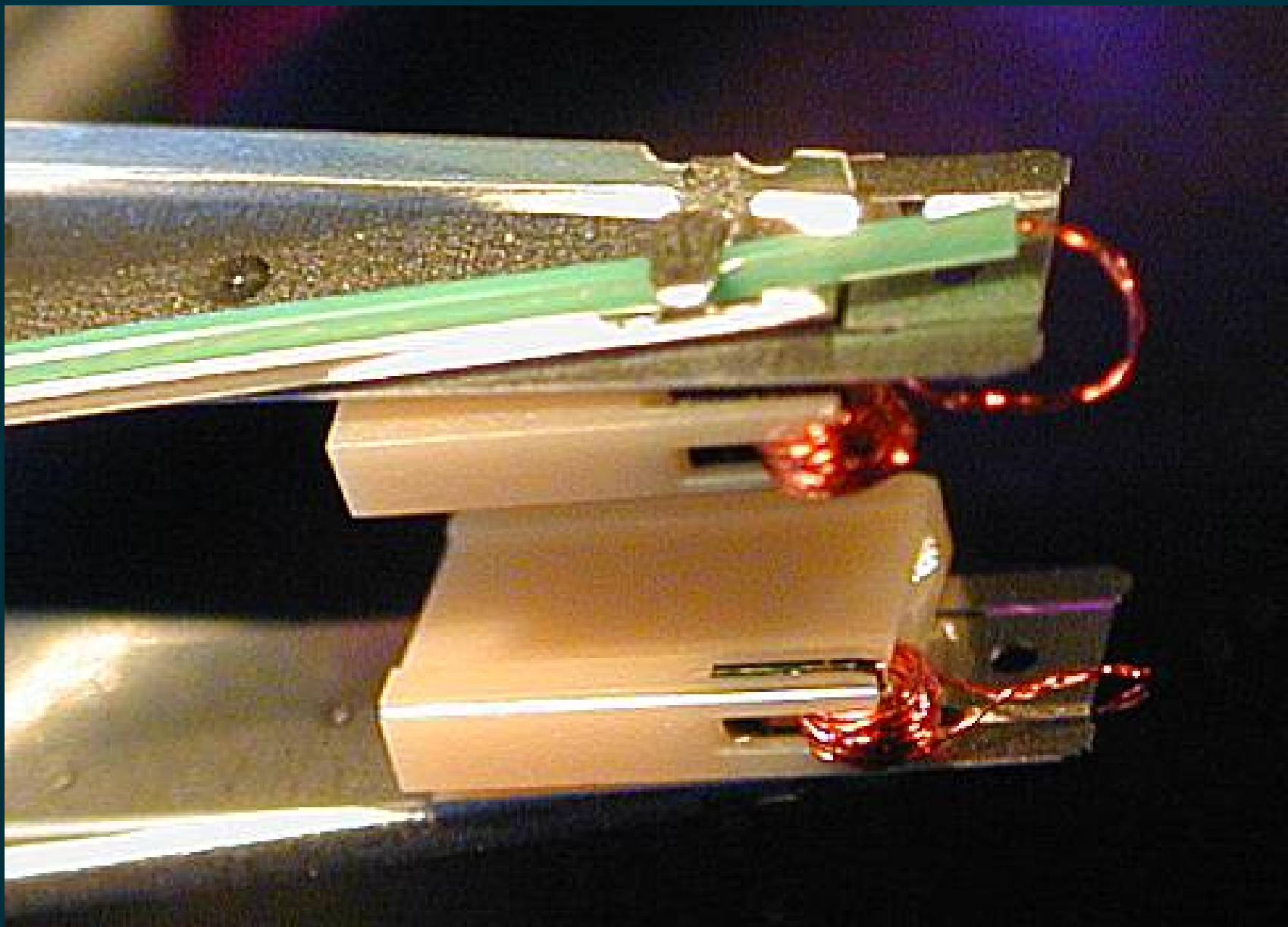
Head Gap
(Look Closely)

Metal -In- Gap head

- ✓ Same design as ferrite heads
- ✓ Added a special metallic alloy on the head
- ✓ Usually found in hard disks of about 50 MB – 100 MB

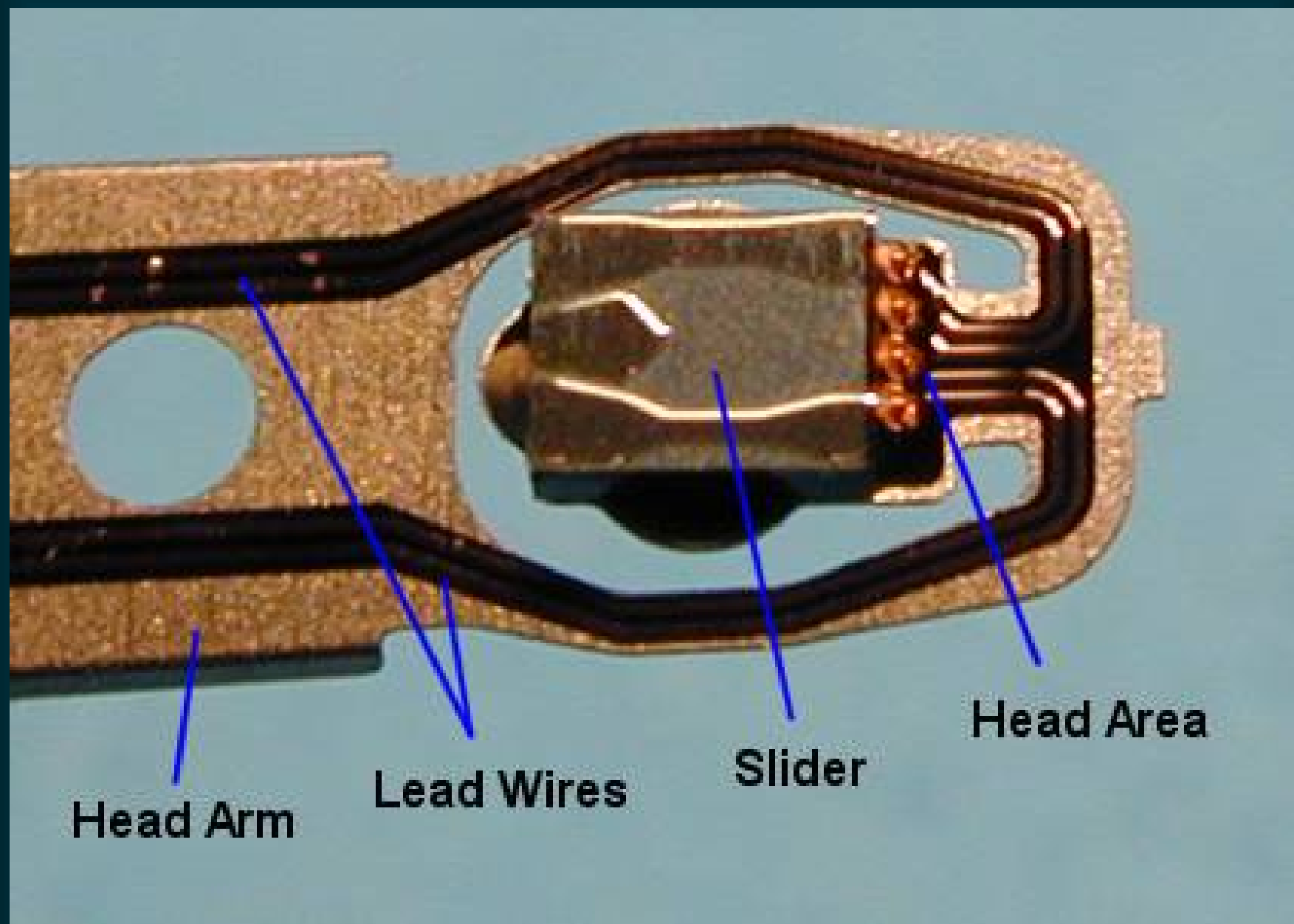
Thin Film Head

- ✓ Very small & light weight heads
- ✓ Instead of iron oxide, iron nickel alloy core is used
- ✓ Magnetically more powerful
- ✓ It is costly compared to the other two heads
- ✓ Usually used in hard disks of 100 – 1000 MB capacities



Magneto Resistive Heads

- ✓ Also known as Anisotropic MR (AMR) heads
- ✓ It is the key invention that led to the creation of hard disks over 1 GB in size
- ✓ Two separate heads, one for reading & one for writing on a single assembly
- ✓ Read head based on MR design & write head based on Thin film head design
- ✓ Commonly used in hard disks about 1 GB – 30 GB capacities



Head Arm

Lead Wires

Slider

Head Area

Giant MR Heads

- ✓ Works on the same general principles of MR heads
- ✓ But uses some what different design that makes them superior in several ways
 - ✓ The name “Giant” is not due to the size, but due to the superior technology
- ✓ By December 1997, IBM introduced their first hard disk with GMR heads
- ✓ They are more sensitive
- ✓ GMR are used in latest technology drives which capacities up to 75 GB

GMR Head Structure

Integrated Lead Suspension/ Pico Slider

Inductive Write Head
P2 Layer

Inductive Write
GMR Read Sensor

Copper Write Coils

Spin Valve/GMR
Sensor

Inductive Head P1
Shield2

Shield1

Antiferromagnetic
Exchange Film

Contact

Contact

Hard Bias
CoPtCr

Hard Bias
CoPtCr

Cu
Spacer

NiFe GMR
Free Film

Co GMR
Pinned Film



ED GROCHOWSKI at ALMADEN

Colossal MR Heads

- ✓ Know the GMR heads are taking over the market
- ✓ It is more sensitive & powerful than the GMR heads

Tunnelling MR Heads

- ✓ It is latest head design which will increase the areal density too much
- ✓ It is still under research

Head Arm/Head Slider

- ✓ The arm on which the Read/Write head is located
- ✓ The size of a slider in a 3.5" size hard disk is $0.08 \times 0.063 \times 0.017$ inch
- ✓ Slider of this size is called "Nano Slider"

Spindle Motor

- ✓ It is the main motor which rotates the hard disk drive platter
- ✓ It is called Spindle motor because it is directly connected to the Spindle on which the platters are connected
- ✓ Spindle motor rotates at a speed of 3600 to 7200 RPM or more

Logic Board

- ✓ An intelligent circuit board is in built to the hard disk in the modern days
- ✓ It contains the electronic components that controls various sections of the hdd
- ✓ It also acts as an interface between the hard disk drive and the computer

Air filter

- ✓ To filter the air
- ✓ Most hdd will have two air filters
- ✓ The two air filters are
 - ✓ One is called the Recirculating Air filter & the second one is called Breather filter

Cables & Connectors

- ✓ Cables & connectors are used to connect the hdd to the main computer system
- ✓ Data/Control interface cable of 40 pins
- ✓ A 4 pin Molex power connector

Head Actuator Mechanism

- ✓ The Read/Write head is moved on the platter using a mechanism
- ✓ Two types of head actuator mechanism
- ✓ They are stepper motor actuator & voice coil actuator

Stepper Motor Actuator

- ✓ It is a motor which rotates in steps
- ✓ Stepper motor turns in a fixed angle
- ✓ The smallest fixed angle is called a “detent”
- ✓ The stepper motor is connected to the R/W head by using two mechanism
- ✓ They are Split metal band mechanism & Rack and pinion gear mechanism

Voice Coil Actuator

- ✓ In the voice coil actuator head moves in & out in a straight line
- ✓ It is more faster and accurate
- ✓ Stepper motor is used in the Open loop disk drive and the Voice coil actuator is used in the closed loop disk drive

Disk Geometry

- ✓ To arrange the data on the disk surface, the disk surface is divided into different sections called Tracks, Sectors, Cylinders, Sides etc
- ✓ Two types of disk geometry
- ✓ Physical geometry & Logical geometry

Sides/Heads

- ✓ Each platter of a hard disk will have two sides
- ✓ Each side will have each heads
- ✓ Total no of sides = Total no of heads
- ✓ When addressing either, heads or sides is denoted
- ✓ Total no of heads may range from 2-256 (in logical geometry)
- ✓ Total no of sides may range from 2-20(in physical geometry)
- ✓ The head numbering starts from 0-.....
- ✓ It starts from the uppermost of the platter

Tracks

- ✓ Each side of the platter's surface is divided in to so many concentric circles
- ✓ The track numbering starts from 0-....
- ✓ The outermost tracks is given the track number 0 and next 1, next2 and so on
 - ✓ The innermost track will have the highest number
 - ✓ No of tracks on a platter may range from 300-3000
 - ✓ Modern hard disk will have thousands of tracks on each platter

Cylinders

- ✓ Same tracks on different platters or sides forms an imaginary cylinder
- ✓ In a hard disk the data is stored in a cylinder by cylinder method
- ✓ The reason is due to the single head assembly
- ✓ A track & cylinder are two different things, but they are used simultaneously
- ✓ Total no of tracks on a side = Total no of cylinders
- ✓ The cylinder numbering starts from 0-....
- ✓ It starts from the outermost of the platter

Sectors

- ✓ It is the smallest unit of data storage (in physical geometry)
- ✓ It can hold up to 512 MB of data only
- ✓ The sector numbering starts from 1-....
- ✓ The storage capacity of the hdd will vary according to the no of sectors/track present in it

Clusters

- ✓ A group of sector is called Clusters
- ✓ It is the smallest unit of data storage which can identified by the operating system

Normal Data Recording

Zone Bit Recording

Interleave Factors

Head Skewing

Cylinder Skewing

Head Parking

Park & Lock

Head Crashes

Floating Height/Head Gap

Formatting

Types Of Formatting

Low Level Formatting

High Level Formatting

Re-Formatting/Re-Initializing

Data Encoding & Decoding

- ✓ FM
- ✓ MFM
- ✓ RLL
- ✓ PRML
- ✓ EPRML

Hard Disk Interfaces

- ✓ ST-506/412
- ✓ ESDI
- ✓ IDE
- ✓ EIDE
- ✓ SCSI