

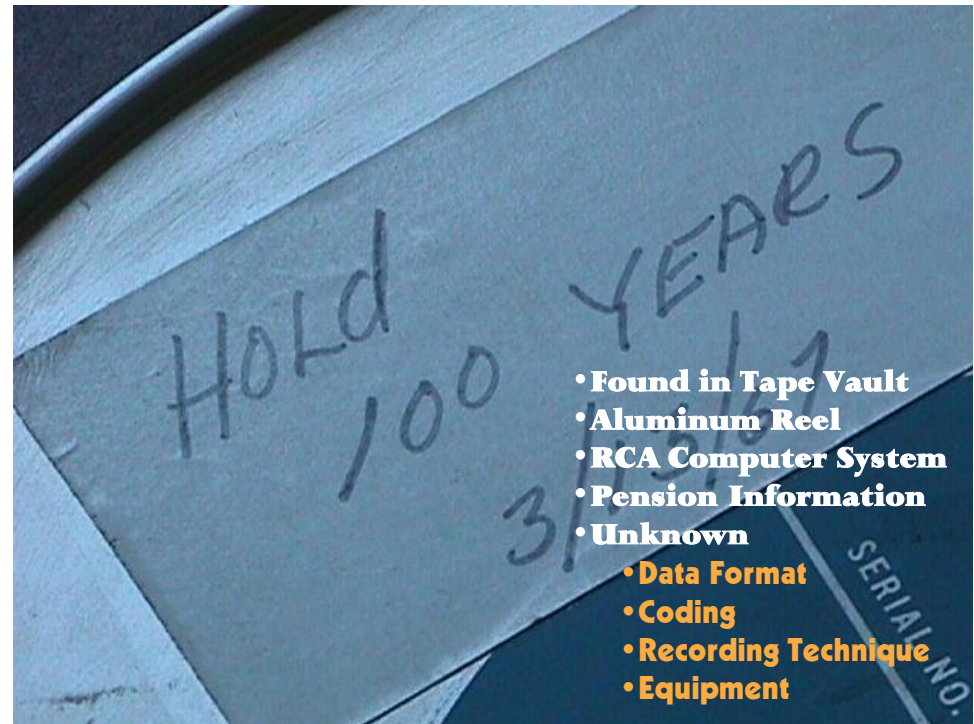
# Will Your Records Be There When You Need Them?

## Digital Records & Media Stability

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## Topics

- Focus & Assumptions
- Magnetic Media
- Optical Media
- Emerging Technologies
- Practical Procedures
- Bibliography

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## Focus & Assumptions

- Records Retention, not Backup
- Assumptions
  - Unsuitable Media
    - Magnetic Hard Disks
    - Magnetic Flexible Disks
  - Candidate Media
    - Magnetic Tape
    - Optical Disk [CD, DVD]

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# Magnetic Tape

## Types

- **Ferric Oxide**
  - Used since
    - 1920s [audio]
    - 1940s [data]
    - 1950s [video]
  - Fortified with cobalt for higher density
  - Inferior remanence

## Technology

- **Magnetism**
  - Inert substrate: polyester/Mylar
  - Base: Coating of metal [Digital '0']
  - Positive charge imparted [Digital '1']
  - Not a permanent state ['remanence']

Metal Particle or Evaporated Metal Coating

Polyester or Mylar Substrate

## Types

- **Chromium Dioxide**
  - High quality audio tape
  - 34xx tape family since 1986
  - Higher density than ferric oxide
  - Higher remanence
  - Prone to corrosion

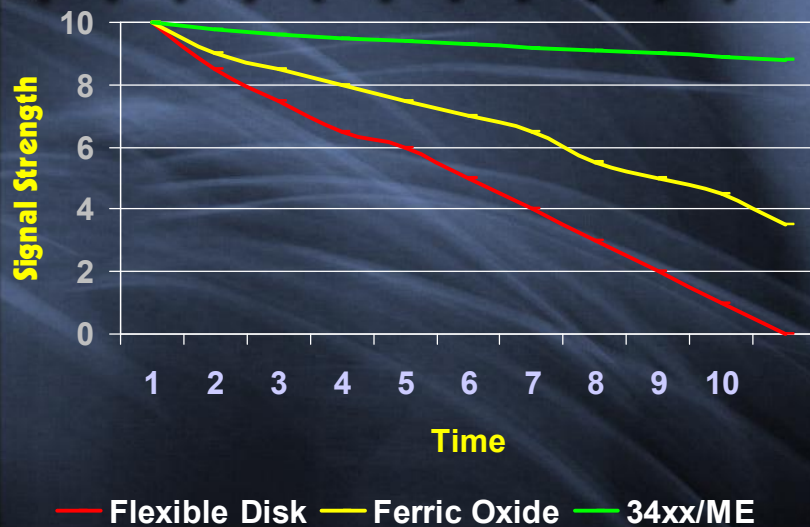
## Types

- **Evaporated Metal**
  - LTO – Linear Tape Open
  - DLT – Digital Linear Tape
  - Ultra High Density
  - 359x tape family
  - Higher remanence
  - Resistant to corrosion

## Environmental

- **Goals**
  - Humidity & Temperature
    - Operating
      - 16°C - 32°C [60°F – 90°F]
      - 20%-80% RH
    - Storage
      - 5°C - 20°C [40°F – 68°F]
      - 20%-45% RH
- **Concerns**
  - Hydrolysis
  - Magnetic Fields

## Signal Retention



## Life Expectancy

- **Life = Unacceptable Error Rate**
  - Flexible Disks
    - 1-3 years
  - Ferric Oxide
    - 5-7 years
  - Chromium Dioxide
    - 10+ years [if no activity]
  - Evaporated Metal
    - 10+ years

# Optical Media

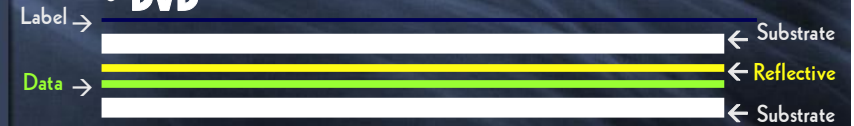
## Technology

- **Structure**

- **CD**



- **DVD**



## Technology

- **Reflectivity**

- **Focus on Writable Media** [Not CD-ROM/DVD-ROM]
- **Inert Substrate**
  - **Glass** [older]
  - **Polycarbonate**
- **Base: Dye/Metal Alloy** [Digital '0']
- **Laser Burn Changes Reflectivity** [Digital '1']
- **Relative Permanence**

## Types

- **Ablative** [dye - write once]
  - **CD-R** [sequential]
  - **DVD-R, DVD+R** [sequential]
- **Phase Change** [metal alloy - rewritable]
  - **CD-RW** [sequential]
  - **DVD-RW, DVD+RW** [sequential]
  - **DVD-RAM** [random]

## Environmental

- **Goals**
  - **Humidity & Temperature**
    - 15°C - 20°C [59°F - 68°F]
    - 25%-40% RH
  - **Protection from Light**
- **Concerns**
  - **Abrupt Temperature Changes**
  - **UV/Sunlight on Dye**
    - **Degradation of Dye [R]**
    - **Photochemical [Molecular] Reaction [RW]**

## Emerging Technologies

## Life Expectancy

- **Life = Unacceptable Error Rate**
  - **CD-R, DVD-R, DVD+R**
    - 5-10 years before recording
    - 100-200 years after recording
  - **CD-RW, DVD-RW, DVD+RW**
    - 25+ years
  - **DVD-RAM**
    - 25+ years

## Options

- **Ultradense Optical**
  - Blue Laser [narrower path] - 30GB
  - Successor to magneto-optical/consumer DVD
  - Blue-ray [Sony]; UDO [Plasmon]
- **Holography**
  - Lensless photography
  - HD = 200 DVDs / 1,000 CDs
  - Tapestry [In Phase]

**Unknown life expectancy!**

# Practical Procedures

## Handling & Transport

- **Tape**
  - **Do not** jar, bump or drop reel/cartridge.
  - **Do not** expose to high humidity.
  - **Avoid** extreme temperature changes.
- **Optical**
  - Handle by edges only; **do not** touch surface.
  - **Do not** expose to high humidity.
  - **Avoid** extreme temperature changes.
  - **Do not** expose to direct sunlight.

## Recording

- **Tape**
  - Moderately used tape; not brand new
  - Test to validate manufacturing batch
  - Exercise before recording
- **Optical**
  - Reflective layer = gold, not silver
  - Only ablative type for retention [WORM]
  - Test to validate manufacturing batch

**Verify after recording!**

## Storage

- **Tape**
  - Wind tightly
  - Store vertically
- **Optical**
  - **Do not**
    - Use adhesive labels
    - Use pen, pencil, or marker to write on label
    - Scratch label side of CDs
  - Store vertically
  - Avoid exposure to UV and sunlight

## Maintenance & Testing

- **Tape**
  - Sample 3% Annually
  - Recopy batch, if **errors** appear
  - **Recopy every 7-10 years.**
- **Optical**
  - Sample 3% annually
  - Use check-sum application [e.g., CD-Check]
  - Recopy batch, if **errors** appear

## Bibliography

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If media is taken care of well,  
the recording technology will be obsolete  
long before the media is not readable.

**Therefore ...  
plan for migration of any retention media  
to new technology  
as an integral component of  
good digital records management.**

## Will Your Records Be There When You Need Them?

**Digital Records & Media Stability**

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