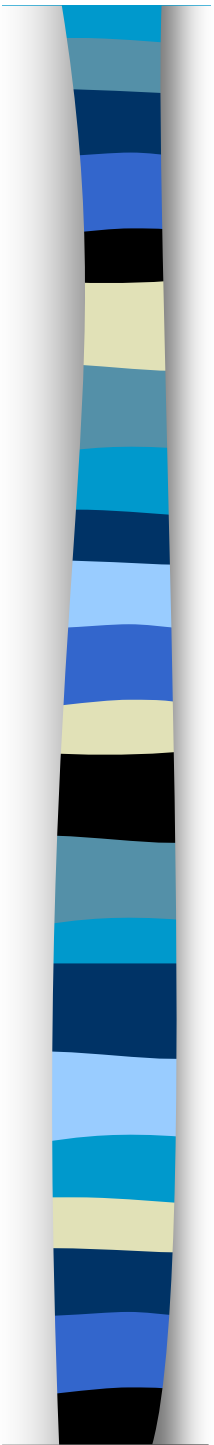




All Optical
Discs are NOT
Created equal



All Optical discs are *not* created equal

- Why use write once optical discs for evidence storage?
- Archive Grade Media
- What qualities are needed for best performance?
- Archiving Guidelines



Digital Evidence: Why use optical discs?

DVD-R, CD-R, and Blue-ray discs are perfectly suited for long term storage of evidence or archival data.

1. Computer evidence is frequently challenged in court
2. When “*authenticity*” is challenged, having data on unalterable media is important.
3. A clause in the Federal Rules of Evidence (FRE 1001.3) states: "If data are stored by computer or similar device, any printout or other output readable by sight, shown to reflect the data accurately, is an original."



Digital Evidence: Why use optical discs?

The Sarbanes-Oxley Act (2002 - post Enron) was enacted in response to a number of major corporate and accounting scandals, and requires “Employment of a media technology that inherently protects against alteration and deletion”

A Partial summary of requirements
for digital document storage:

- A durable medium
- Non-rewriteable and non-erasable storage
- Removeability/portability
- Media longevity
- Backward read compatibility

Digital Evidence: Why use optical discs?

Recordable media offers:

A durable medium

- ✓ *Error correction allows reading through scratches, damage*

Non-rewriteable and non-erasable storage

- ✓ *Write once (recordable) discs cannot be altered or erased*

Removeability/portability

- ✓ *Discs are easily transported and read in any computer*

Media longevity

- ✓ *MAM Gold CD-R life = 300 yrs, DVD-R 100 yrs*

Backward read compatibility

- ✓ *CDs can be read in DVD units, DVDs in HD-DVD or Blu-ray*

Also, All MAM-A discs are serialized for unique identification

Data Archiving on Recordable CD and DVD Media

- Archive Grade Media - How long should it last?
- What makes it “Archive Grade”?
- What is needed for best performance?
- Archiving Guidelines



Archive Media: How long is long enough?

- Eventual migration to another media is inevitable for long term data storage
- Migration is expensive
- It makes sense to keep your data on one media as long as possible.
- Start with media with the longest expected lifetime.



What makes it “Archive Grade” ?

- High Performance Dye
- Long-life Dye
- 24 Karat Gold Reflective Layer
- UV Resistant
- Heat Resistant
- Scratch Resistant

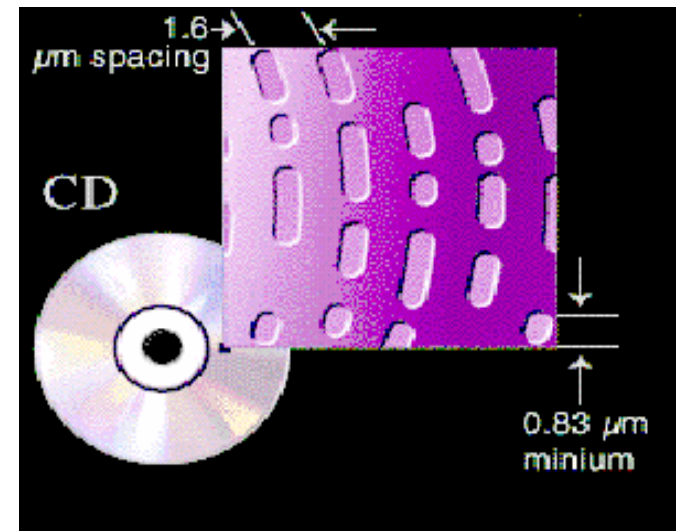


All discs are not created equal: High Performance Dyes



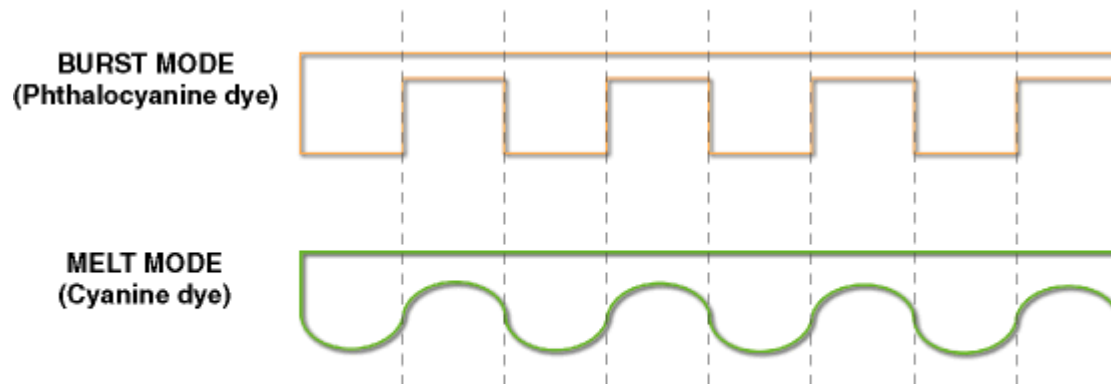
All CD-R and DVD-R discs incorporate a thin dye layer that gets “burned” when you save your data. The stability of that dye layer determines how long your data will be readable. Mitsui’s patented Phthalocyanine (thay-lo-sy-a-noon) dye is extremely stable in a wide range of environmental conditions, providing a platform for long term data storage. The dye is the single most important component for overall disc performance.

When you “burn” a disc, your writer creates “pits” in the dye layer that make up the “0”s and “1”s for digital recording. Phthalocyanine dye reacts more quickly to the writing laser than other dyes.



All discs are not created equal: More sensitive to the writing laser

- Phthalocyanine dye reacts in a "burst" mode instead of a "melt" mode as with cyanine (blue) dyes, so sharper pit edges are created. These sharper edges are easier for CD drives to read, so more faithful sound reproduction is possible; more reliable data storage.



- Because the "PIT" edges are more clearly defined in BURST MODE, CD players read back the signal more accurately, resulting in a faithful, warmer-sounding audio reproduction.

All discs are not created equal: Pure Gold Reflective Layer



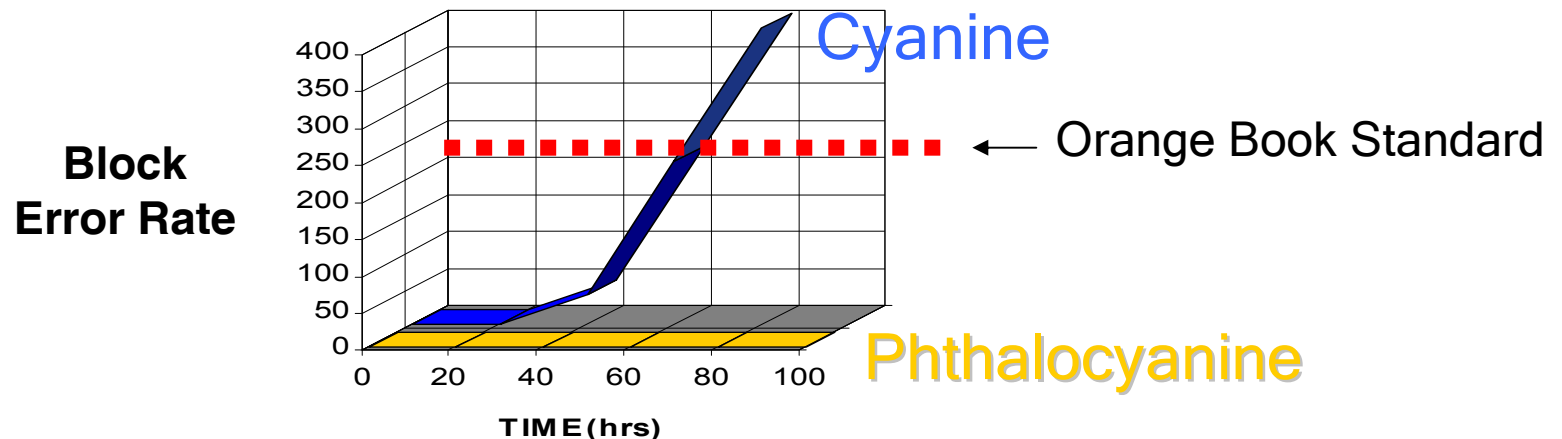
- Disc failure often caused by degradation of the reflective layer.
- When the metal layer oxidizes, disc can become unreadable
- Gold never oxidizes
- MAM uses 99.99% pure gold (24 karat) for archive grade media.

All discs are not created equal: UV Resistance



Mitsui's patented Phthalocyanine dye makes discs more resistant to UV light. While other dyes are very reactive to UV light unless "stabilizers" are added, Phthalocyanine dye is naturally stable, so no additives are needed.

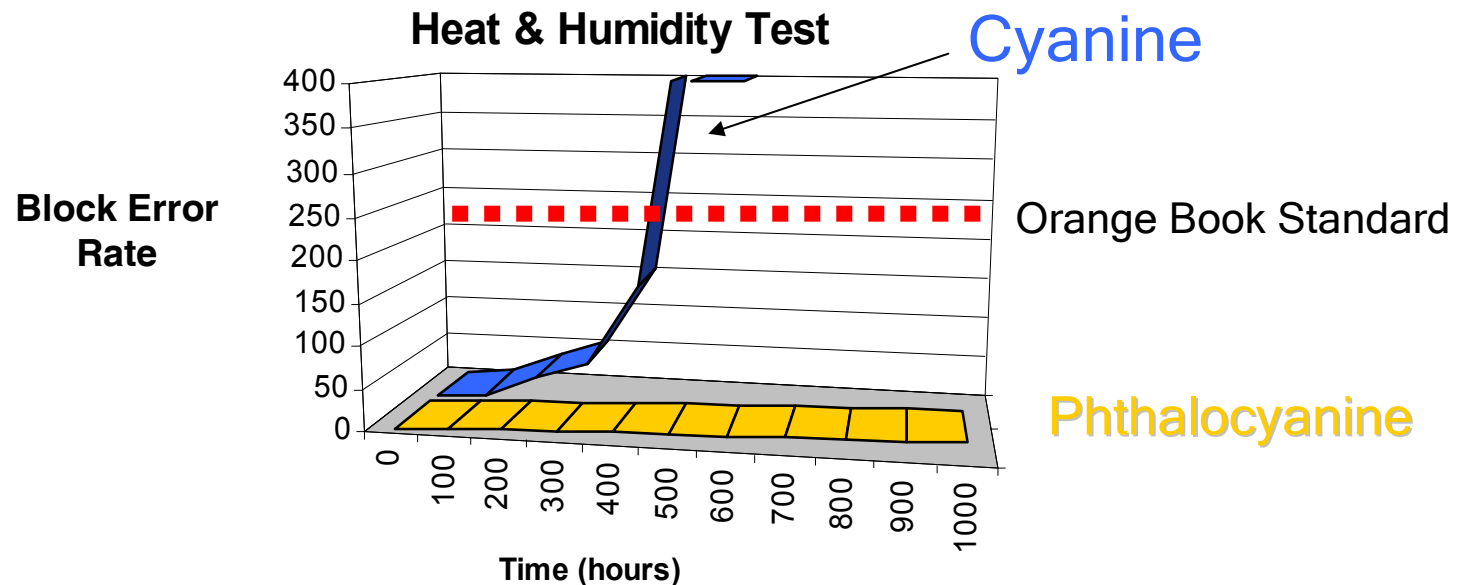
The Light Fastness Test below shows that MAM CD-R will withstand the full spectrum of light, same as the sun, for 100 continuous hours without damage. Cyanine dye, begins to deteriorate after only 20 hours and fail at 65 hours.



All discs are not created equal: Heat & Humidity Resistance



- The chart below shows that a combination of a stable gold reflector and stable dye make for a disc with a very long life. Even the darker color of some dyes can contribute to the amount of heat absorbed by the disc.

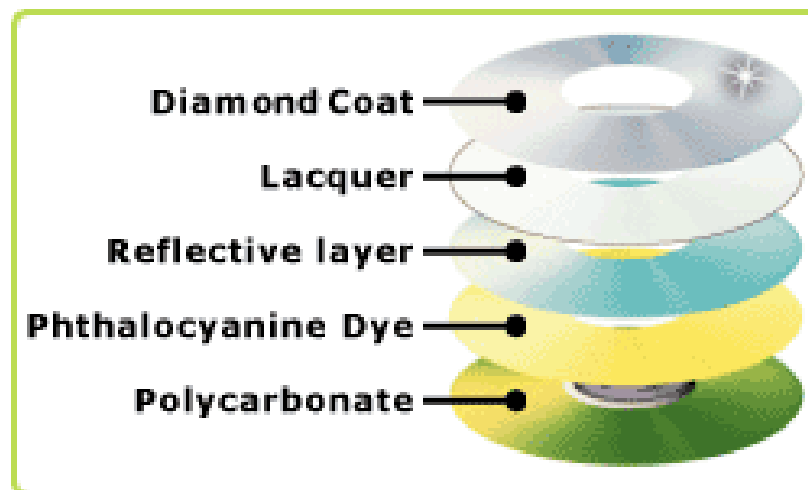


All discs are not created equal: Scratch Resistance



The Difference is Innovation

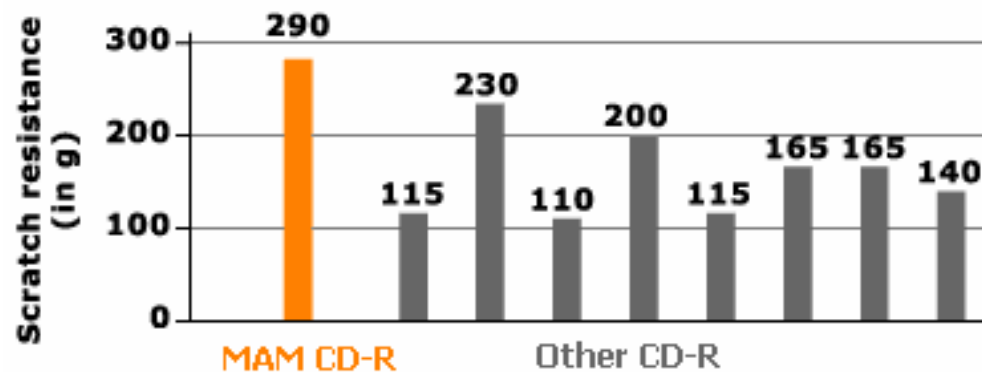
- The dye layer is where your data is stored. It lies just beneath several layers on the top of the polycarbonate disc. If the surface is damaged by scratches or a ball point pen, data will be irretrievably lost.
- With the use of digital photography, no negatives exist, so loss of data can mean loss of your valuable photos.



All discs are not created equal: Scratch Resistance

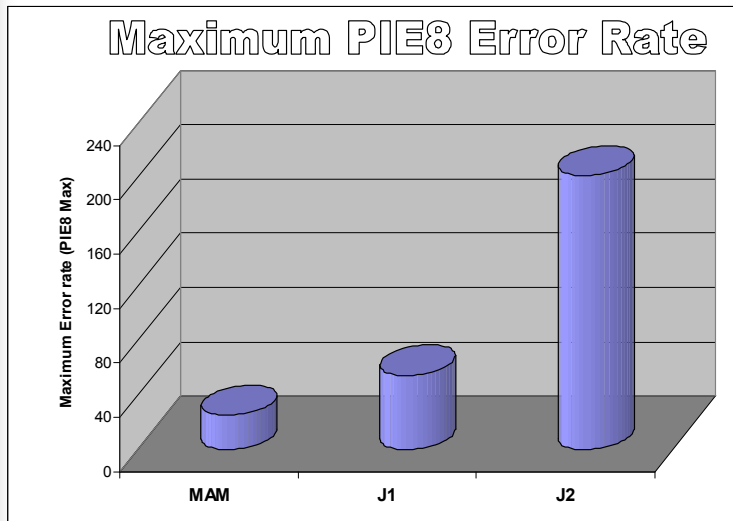


- For maximum safety, there should be a protective layer that guards the data against physical damage. The chart below shows a comparison of CD-R media subjected to a scratch test. A diamond stylus is pulled across the top side of the disc with increasing amounts of force until the disc shows unrecoverable data loss. Many CD-Rs currently available have only a thin (shiny) lacquer layer.



All discs are not created equal: MAM-A DVD-R Lowest Error Rates in the Industry

When comparing our DVD-R media to competitors, MAM media shows much lower error rates. This chart compares MAM PIE8 error rates to two leading Japanese brands.



- A disc is never better than the day it leaves the factory. If it starts out with a high level of errors, it will only increase as the disc is handled. Even in “normal use” discs will accumulate scratches or dirt that will cause the PIE8 errors to increase. Doesn’t it make sense to start out with media that has the fewest ?

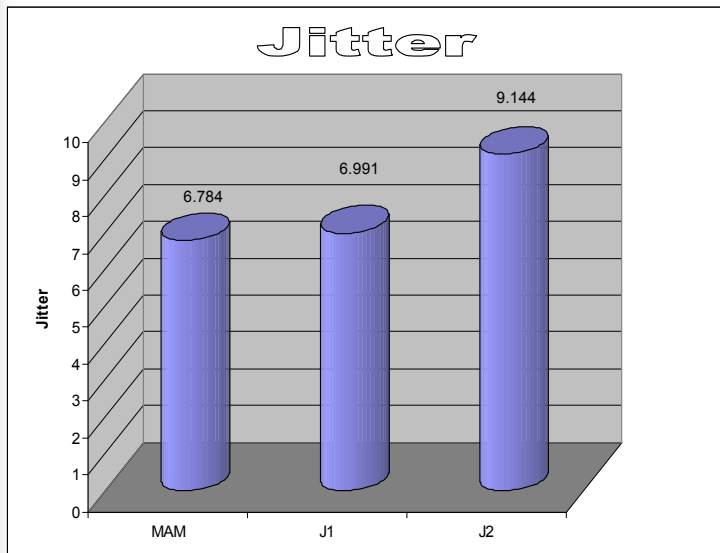
- **What is PIE8?**
PIE8 is the number of “data packets” that have errors which can be corrected by the decoder. The maximum allowable is 280. When evaluating the lifetime of DVD, end-of-life is considered to be at this 280 limit.
(This is often compared to BLER for CD or CD-R)

All discs are not created equal: MAM-A DVD-R -Best Jitter



Jitter?

Funny name. Not much fun if you can't get your data from a disc with high jitter.



- There are over 130 different parameters to look for when evaluating the quality of DVD-R media. Low jitter is one of the key components that manufacturers strive for in the factory. If jitter is high, video discs can show “pixelation” which causes the picture to break up.

■ What is Jitter?

Data is stored on a DVD in the form of “pits”, which are areas of lower reflectivity that become the “1”s and “0”s that ultimately make up your video. Jitter is the measure of differences in the pit lengths. If these differences are too large, the player will have a hard time reading the information, and could result in loss of data. The lower the jitter, the better the playback.

Calculating Lifetime

- MAM longevity tests are conducted according to industry standard ISO 18927-2002 guidelines.
- In general, the test consists of placing samples in an environmental chamber at specified temperature and humidity levels for 5 different "stress conditions".
- Life expectancy is estimated based on the use of the Eyring model which is a mathematical equation derived from thermodynamic laws.
- Based on these tests, lifetime estimates are 300 years for MAM gold CD-R and 100 years for MAM gold DVD-/R

Test Cell	Test Stress	Number of Samples	Incubation Period (hours)	Minumujm Total Time (hours)	Min. Equilibration Duration (hours)
1	80C, 85% RH	10	500	2000	6
2	80C, 70% RH	10	500	2000	5
3	80C, 55% RH	10	500	2000	4
4	70C, 85% RH	15	750	3000	8
5	60C, 85% RH	30	1000	4000	11

Archiving Guidelines



- Factors Affecting the Lifetime of Discs
- General Storage guidelines from NIST
- “Do’s” of disc handling and storage
- “Don’ts “
- Marking



Factors That Affect Lifetime

The life expectancy of optical discs depends on many factors, some controllable by the user, others not.

Factors that affect disc life expectancy include the following:

- type of reflective layer, type of dye
- manufacturing quality
- condition of the disc before recording
- quality of the disc recording
- handling and maintenance
- storage conditions



General Archiving Recommendations from NIST*

General recommendations for long-term storage conditions:
For archiving data on recordable (R) discs, it is recommended to use discs that have a **gold metal reflective layer**.

Media	Temperature	Relative Humidity (RH)
CD, DVD	4°C to 20°C (39° to 68° F)	20% to 50% RH
A temperature of 18°C and 40% RH would be considered suitable for long-term storage.		
A lower temperature and RH is recommended for extended-term storage.		

*“Care and Handling of CDs and DVDs—A Guide for Librarians and Archivists”
National Institute of Standards and Technology
Technology Administration, US Dept of Commerce

Do's

1. Handle discs by the outer edge or the center hole.
2. Use a non-solvent-based felt-tip permanent marker to mark the label side of the CD-R disc.
3. Store discs upright (book style) in plastic cases specified for CDs and DVDs.
4. Return discs to storage cases immediately after use.
5. Leave discs in their packaging (or cases) to minimize the effects of environmental changes.
6. Open a recordable disc package only when you are ready to record data on that disc.
7. Store discs in a cool, dry, dark environment in which the air is clean.
8. Check the disc surface before recording.



Don'ts



1. Touch the surface of the disc.
2. Bend the disc.
3. Use adhesive labels.
4. Store discs horizontally for a long time (years).
5. Expose discs to extreme heat or high humidity.
6. Open a recordable optical disc package if you are not ready to record.
7. Expose discs to extreme rapid temperature or humidity changes.
8. Expose CD-R or DVD-R/+R discs to prolonged sunlight or other sources of UV light.
9. Write or mark in the data area of the disc (area where the laser reads).
10. Clean in a circular direction around the disc.

Labeling Areas

- Clear inner hub
 - Mirror band
 - Main printable area
- * Cannot print or mark in this area on the data side of the disc or on either side of double-sided DVDs.



Acceptable Labeling methods:

1. Water based felt-tipped pen
2. Thermal printer
3. Inkjet Printer
4. Silk screen printing



Thank you!

Click on the link below to view the NIST Archiving guide

[“Care and Handling of CDs and DVDs—A Guide for Librarians and Archivists”](#)

Or go to the NIST site [here](#)

There is additional archiving information at [MAM-A.com](#)