

Grade Measurement Test

National Institute of Standards and Technology (NIST)

Information Technology Laboratory
Information Access Division

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What is the National Institute of Standards and Technology (NIST)?



Department of Commerce

International Trade Administration

National Oceanic and Atmospheric Administration

Export Administration

Economics and Statistics Administration

Patent and Trademark Office

Minority Business Development Agency

Economic Development Administration

National Telecomm. & Info. Administration

Technology Administration

Office of Technology Policy

National Institute of Standards and Technology (NIST)

National Technical Information Service

NIST

Advanced Technology Program

Co-funding of private sector R&D to develop broadly beneficial new technologies

Manufacturing Extension Partnership

Nationwide network of extension centers assisting the Nation's 385,000 smaller manufacturers in all 50 states and Puerto Rico.

Measurements and Standards Laboratories

Nation's ultimate reference point for measurements and standards to support industry, science, health care, safety, and the environment.

Baldrige National Quality Program

Annual Baldrige awards in manufacturing, service, small business, education, and health care promote business excellence

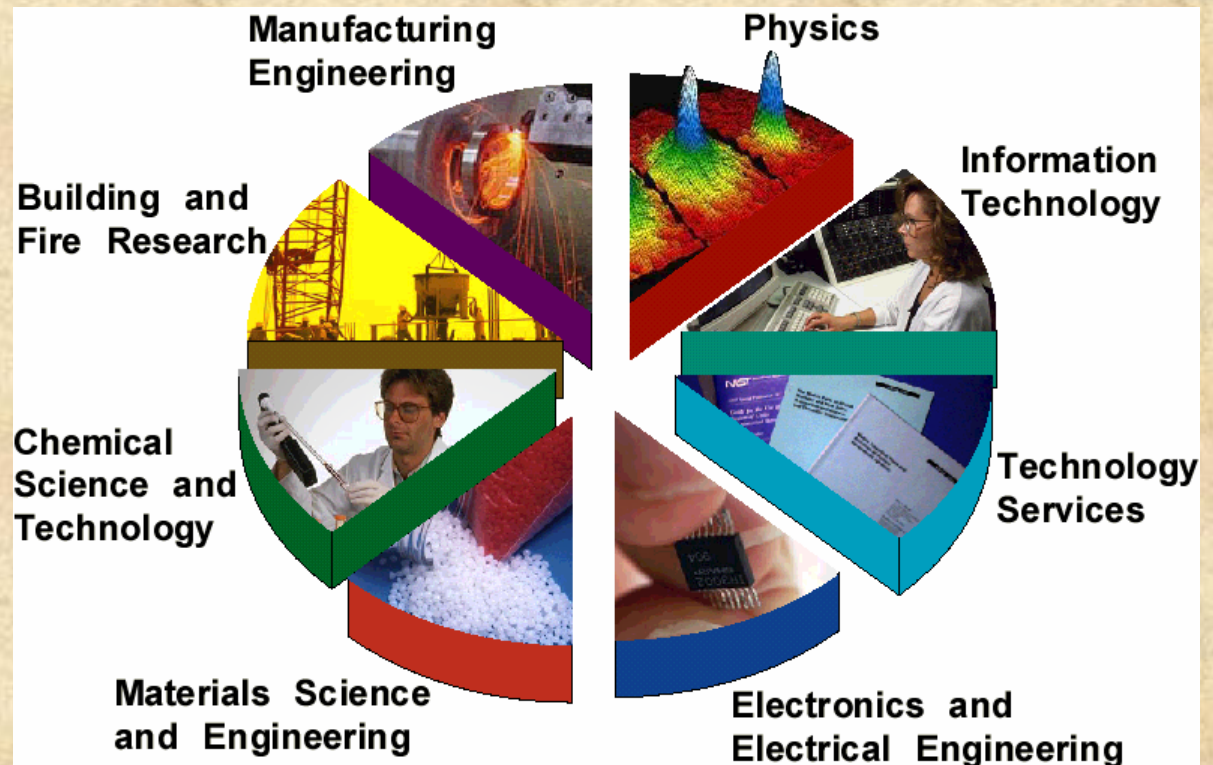




NIST → Measurements and Standards Laboratories

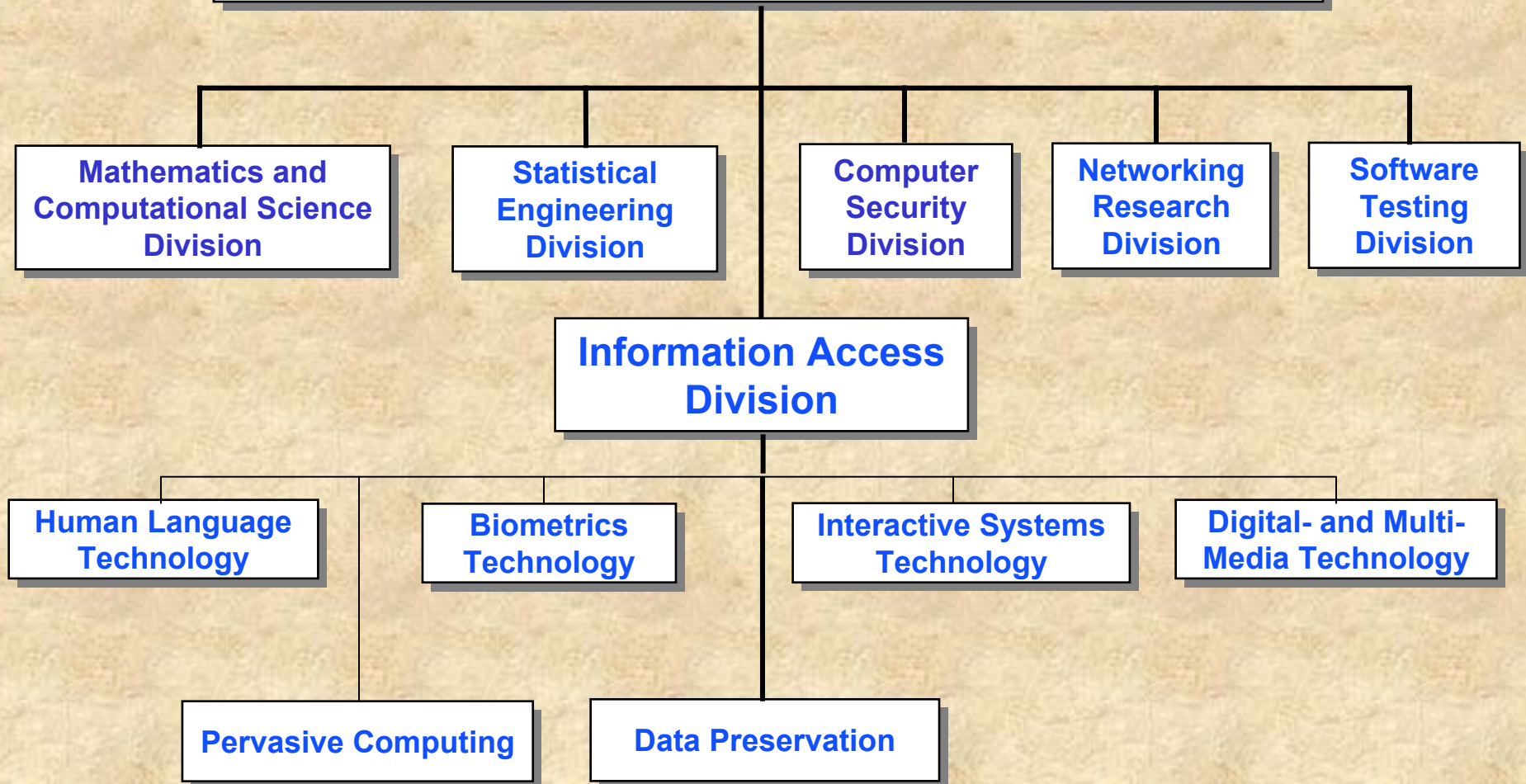
- Strengthen the U.S. economy and improve the quality of life by working with industry to develop and apply technology, measurements, and standards

- Enhance US industrial competitiveness and economic growth through critically needed standards, measurements, and data



Information Technology Laboratory (ITL)

6 Divisions



Grade Measurement Test

- A measurement to indicate disc grade
- A test that can be preformed in a reasonable time
- An indicator to consumers about quality
- Provide number that consumers can use for planning

Topics

- ✓ Consumer Perception
- ✓ LE Test Issues
- ✓ Alternatives
- ✓ Benefits

Manufacturers vs. Headlines

LE Best Case

- Manufacturers
 - ~ 100 – 300 years CD-Rs
 - ~ 100 years DVD-Rs

LE Worst Case

- Headlines
 - CDs fail in short time frame
 - 2 -10 years failure
 - “CD Rot”

Most Commonly Asked Question

How long will my (recordable) disc last?

Answer: It depends 😊

- Disc construction
 - Materials
 - Manufacturing process
- Initial recording quality
 - Quality of burn (depends on disc and burner)
 - Condition of disc before recording
- Care and handling
 - Physical handling
 - Environmental influences

Why

- Variation in life expectancy among discs
 - Quality differences between brands
 - Quality differences within brands
- General claims of up to 100 years LE (DVD±R)
 - Actual could be as low as 30 years in normal ambient room conditions
 - Anecdotal stories conflicting with general claims
- User confidence/uncertainty/awareness
 - Consumer expectations - uncertain or unrealistic
 - Planning under uncertainty – sampling and migration

Archive Quality Labeled Discs

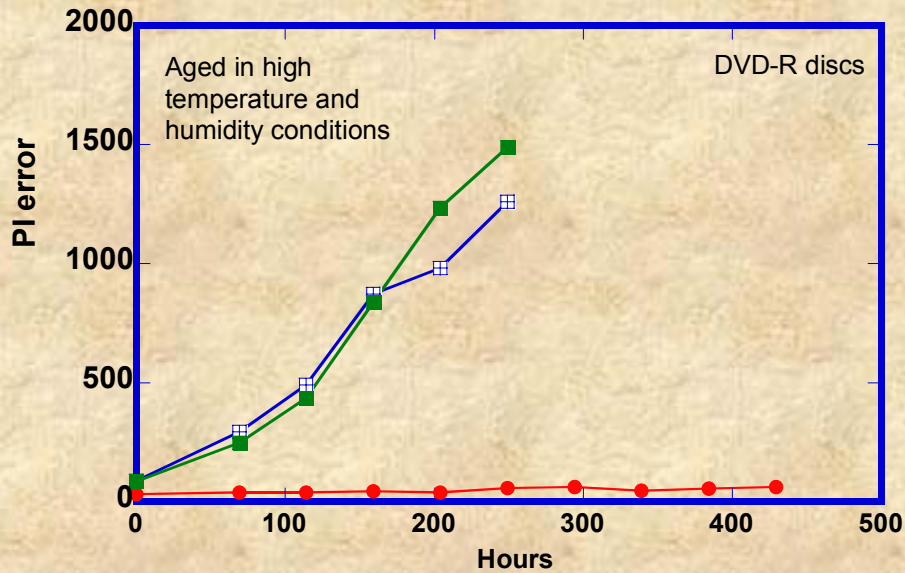
“Archive” quality discs available from some manufacturers

- What does it mean?
 - How are they different from regular discs?
 - How many years will they last? Longer LE?
 - How does archive quality disc from manufacturer A compare to archive quality disc from manufacturer B?
 - How are they determined to be longer lasting?

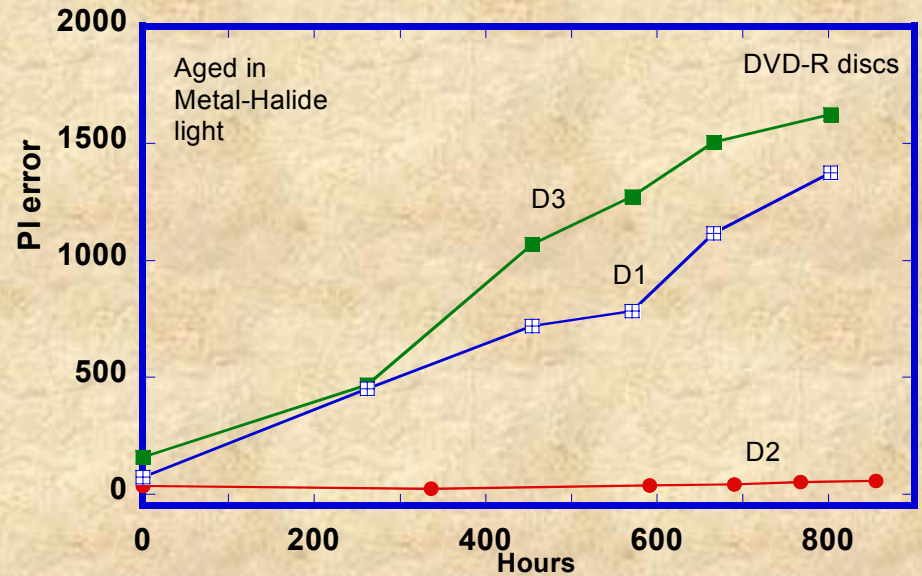
Consumer Indecision - More Questions

- Should I trust my digital content to optical discs?
- Which disc should I buy?
- How long will it last?
- What is the minimum number of years I can expect?
- Does price make a difference?
- What should I look for, in a disc?

DVD-R Accelerated Aging Comparison Examples

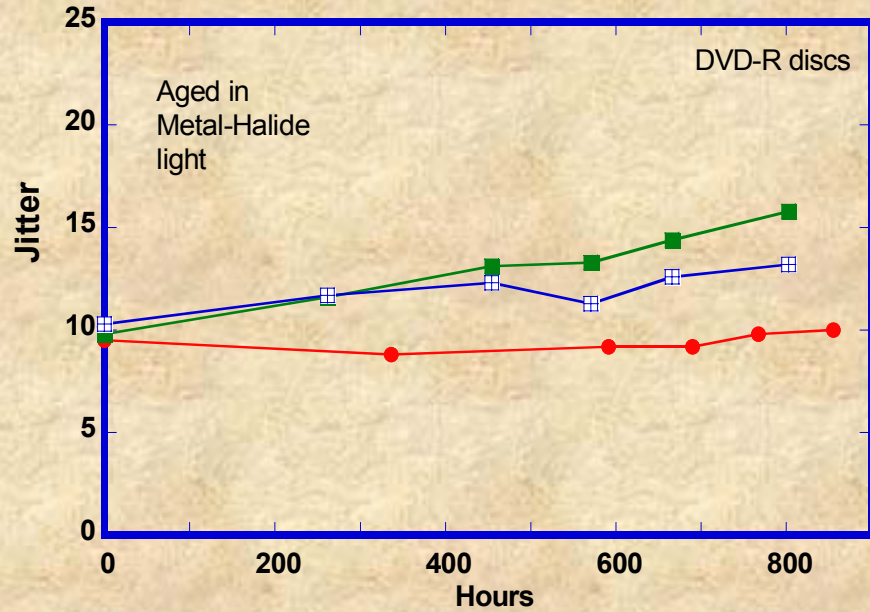


PIE from High T and RH

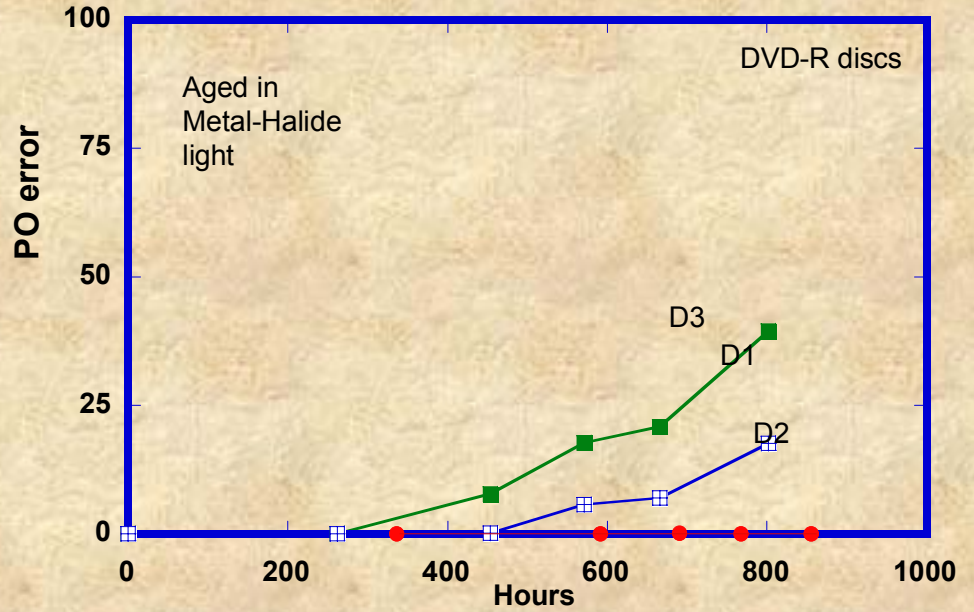


PIE from Metal-Halide Light

Metal-Halide Light Test



Jitter from Metal-Halide Light



POE from Metal-Halide Light

Life Expectancy (LE) Test Standards

Existing LE Test Method Standards

- CD-ROM
 - ISO 18925:2002, AES 28-1997, ANSI/NAPM IT9.21
- CD-R
 - ISO 18927:2002, AES 38-2000

LE Testing Issues

- Time duration
 - Typically one to two years
 - Time to market
- Capability
 - Equipment
 - Space
 - Expertise
- Cost
 - Labor
 - Contract out
- Existing LE Test Followed?
- No Standard DVD Test
 - No Standard LE Test for DVD yet
 - NIST is developing a proposed procedure
- No Standard “archive quality” test methodology
 - NIST proposal

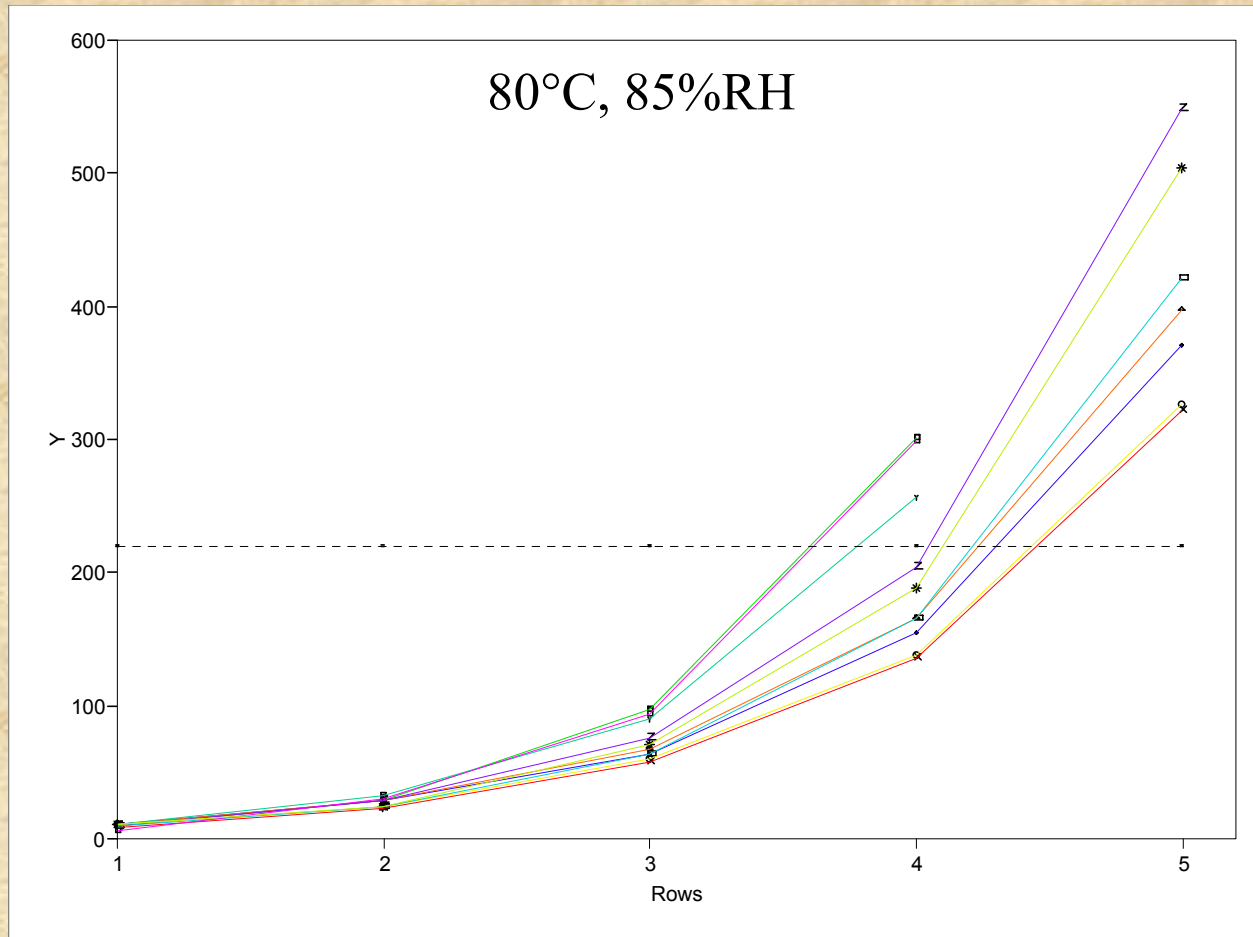
LE - Accelerated Aging Times

Stress Test-Set	Stressed at (T_{inc} , RH_{inc})	Incubation duration	Minimum total time	Specimen quantity
1	80 °C, 85 %	500 h	2000 h	10
2	80 °C, 70 %	500 h	2000 h	10
3	80 °C, 55 %	500 h	2000 h	15
4	70 °C, 85 %	750 h	3000 h	15
5	60 °C, 85 %	1000 h	4000 h	30
			13,000 h total	80 total

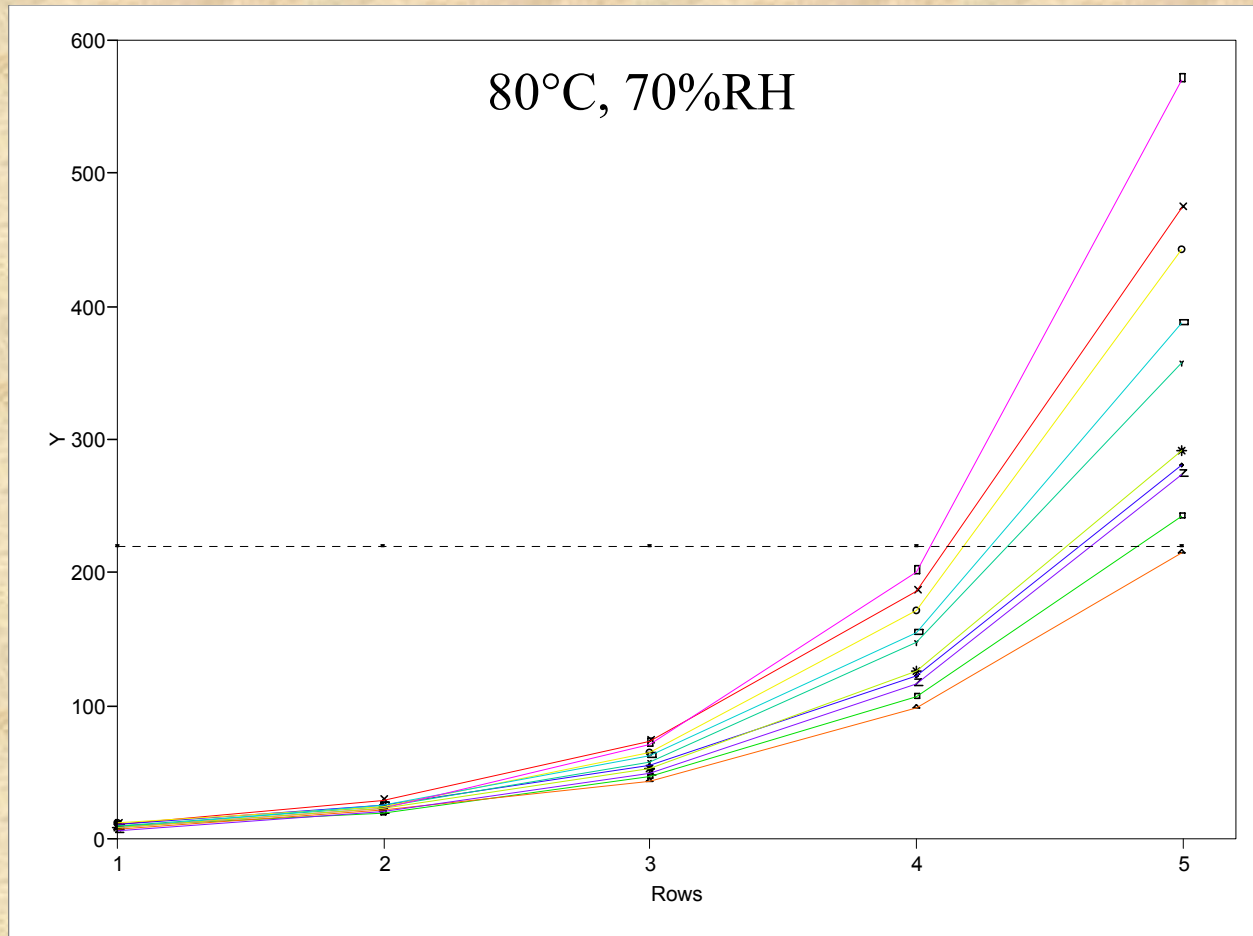
Incubation + Testing Time

No. of Chambers	Incubation time	No. of weeks	Testing time (2 analyzers)	Total Time
1	13,000 hrs	78 wks	6 wks	84 wks
2	7,000 hrs	42 wks	6 wks	48 wks
3	5,000 hrs	30 wks	6 wks	36 wks
4	4,000 hrs	24 wks	6 wks	30 wks

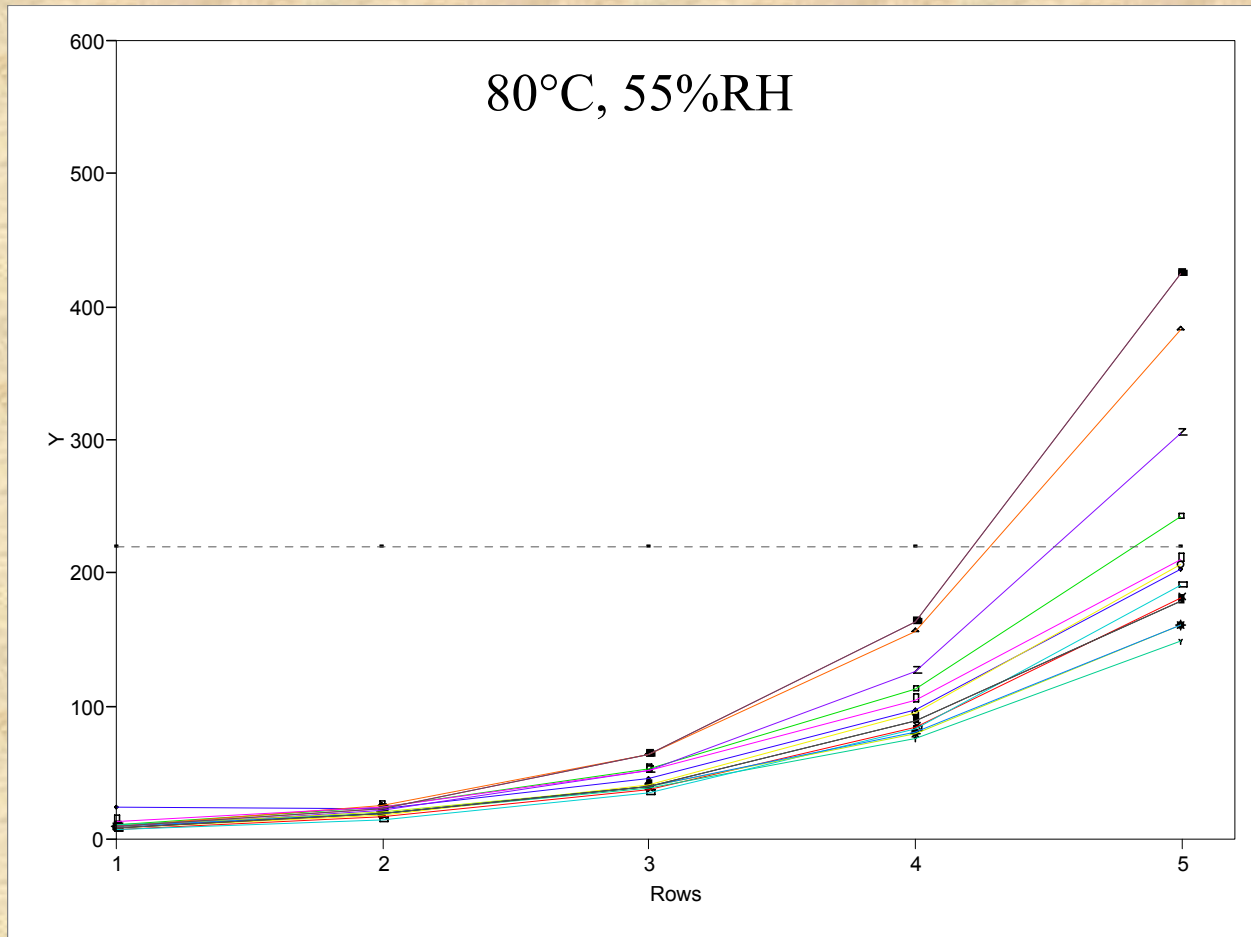
First Stress Test Set 500 hour intervals x 4



Second Stress Test Set 500 hour intervals x 4

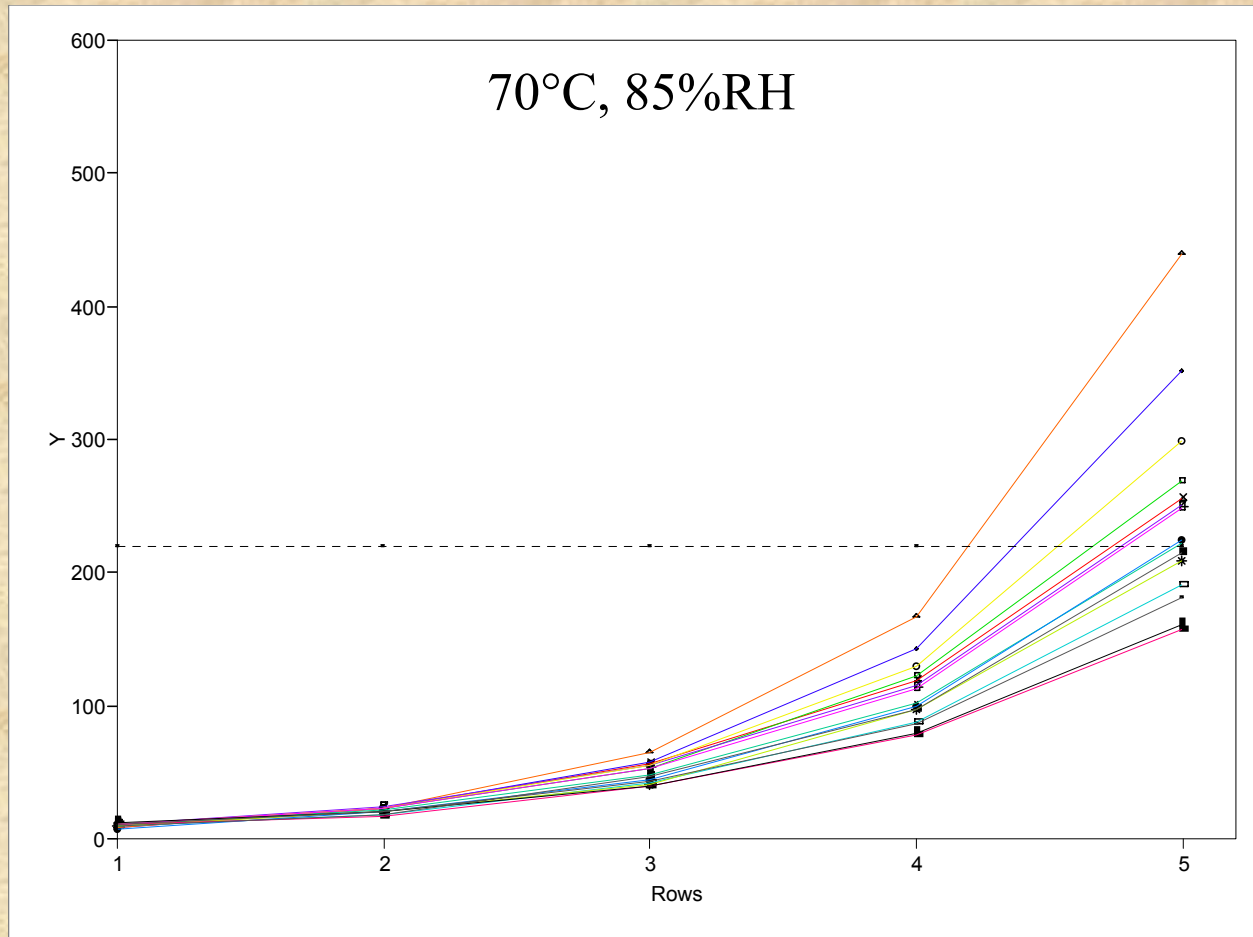


Third Stress Test Set 500 hour intervals x 4

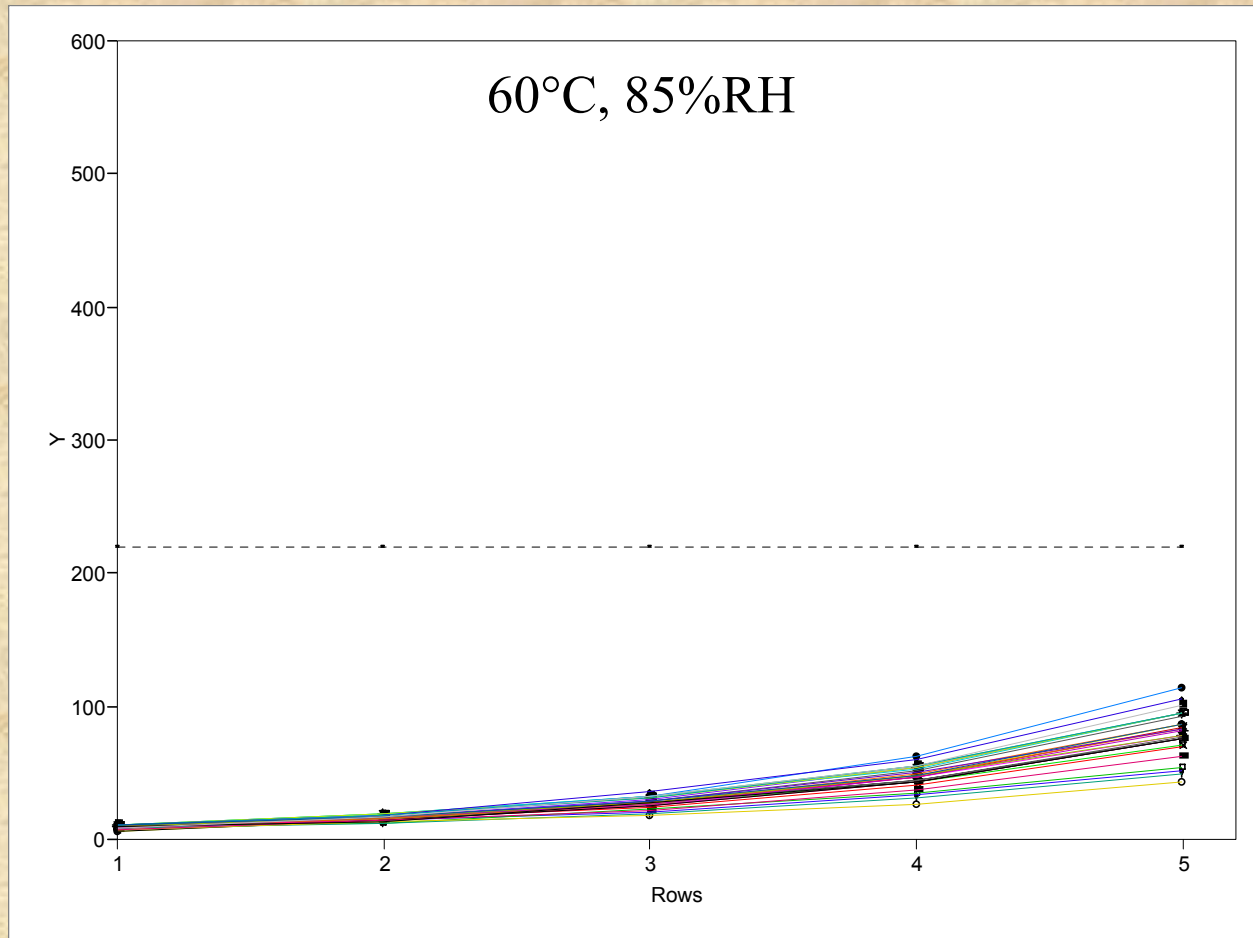


Fourth Stress Test Set

750 hour intervals x 4



Fifth Stress Test Set 1000 hour intervals x 4



Alternatives to Existing LE Test (to save time and cost)

- Shorter LE Test
 - Less expensive
 - Less accurate
- Initial Error Rate Test
 - Measures initial quality of data on disc
 - Does not account for disc degradation rate
 - Does not indicate life expectancy
- Target Test - “Archival”, or “Longevity” or “Grade”
 - Longevity specific, i.e.: minimum number of years expected
 - Not a test to determine total disc LE

One Approach

- Shorten the LE test
 - Creates higher uncertainty for total disc LE measurement
- But
 - Uncertainty level is still good for lower limit or hurdle
- Consider error increase rate
 - $> x = \text{fail}$
- Consider initial error rate?
 - $> x = \text{not acceptable}$

Another Approach

T_s with RH_s for (x)hrs = Y_n (other values remain constant)

Set Y_n = “Grade” (examples: 30, 50, 75)

For given “Grade” (example: 50), determine hrs, for T_s , and RH_s

At determined T_s , RH_s , hrs (correlating to a given “Grade”), if error rate is:

> BLER max (CD), PIE max (DVD) → Fail

< BLER max (CD), PIE max (DVD) → Pass

Also consider error increase rate through interval testing.

Targeted Time Period Test

- A test for targeted time period for longevity
 - 50 year example
 - Discs are expected to have less than BLER-max or PIE-max at 50 yrs
 - Error rate increases less than an established maximum acceptability
 - Total disc LE is unknown (not necessary)
- Can have more than one target or establish only one target.
 - > 30 yrs
 - > 50 yrs
 - > 75 yrs
 - > 100 yrs

Consumer/Industry Benefits

- Consumer
 - Consumer uncertainty reduced
 - More informed choice for consumer
 - Increase consumer confidence
 - More realistic consumer expectation
 - Consumer purchasing can be based on needs or migration plans
- Industry
 - Industry standard test
 - Self-test or third party
 - Time to market
 - Testing cost (compared to LE testing)
 - Pricing

Thank you!

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Digital Data Preservation

Fred Byers, Oliver Slattery, Jian Zheng

<http://www.itl.nist.gov/div895/preservation/>

Care and Handling Guide

<http://www.itl.nist.gov/div895/carefordisc/>

Other ideas

- Early warning indicator
- RFID

Early Warning Indicator

- Could also be called:
 - Error Alert
 - Check Disc
- A warning about error rates that are approaching BLER max or PIE max.
 - May also consider Burst errors
- Just a light as an indicator or a pop-up window