Anoxic Encasements for Select Treasures

"In and Out Air Strategies"
From Climate Change to Microclimate
Library, Archives and Museum Preservation Issues
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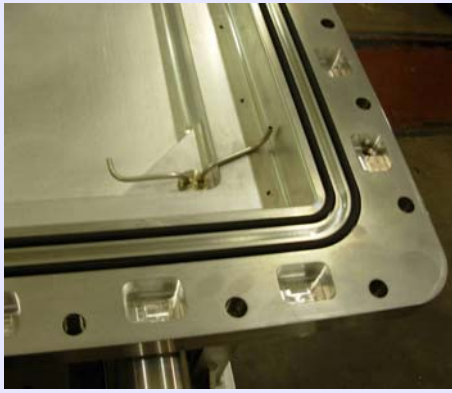
LIBRARY OF
CONGRESS

Anoxic Encasements

LC Top Treasures

Waldseemüller 1507 World Map

- Development of anoxic storage for long-term display of artifacts
- Importance of appropriate materials
- Critical nature of seal to achieve anoxic conditions (long-term)
- Challenges for sensors & monitoring
- Advanced anoxic applications



Historical

- Russell & Abney (1888) – watercolour fading reduced in vacuo
- Papyrus wrapped in protective blank papyrus
- Heavy bindings on manuscripts and books
- Gases: helium, nitrogen
- Case materials: plexiglas, stainless steel
- Pressure: bellows, metal gaskets
- Hermetic seals?
  method of seal, points of weakness, capacity to open and reseal

Nitrogen-filled, hermetically sealed display and storage case to preserve the Royal Mummy Collection at the Egyptian Museum in Cairo.
(Collaboration with Getty Conservation Institute) Photo by T. Moon

The Baptistry of St. John in Florence & the Doors of Paradise

Photo credit: http://en.wikipedia.org/wiki/Florence_Baptistry

Charters of Freedom cases - NARA www.nara.gov

LHS 1951 helium case

RHS 2001 argon case

Anoxia for Visual Storage

An encasement used for storage and display where items are visually accessible

- Requirement for Library of Congress (LC) collection items of significant cultural heritage
  - specific materials, fragile condition, treatments
- Controlled environment for artifact specific needs
- Items requiring long-term exhibition
- Decreased handling from storage to display
- Allows ease of assessment of the artifact

Advantages of Anoxic Cases

- Allows the reduction of oxidative and hydrolytic degradation effects
- Enabled by advances in technology, material performance, design and construction methods
- Basic preservation techniques – protective storage, environmental control, controlled exhibition – remain critical for longevity of artifacts
- Anoxic storage combined with new technology, can be used to control as well as monitor effects of improved storage

Issues for Anoxic Cases

- Case construction and design
- Case materials, backing materials
  - Permeability, gas
  - Material properties / performance specifications
- Access for artifact assessment and monitoring
- Monitoring sensor technology
- Case environment parameters to be monitored
- Environmental parameters for storage and exhibition
- Permanent display versus temporary exhibit
- Feasibility for other collection materials

Top Treasure Cases

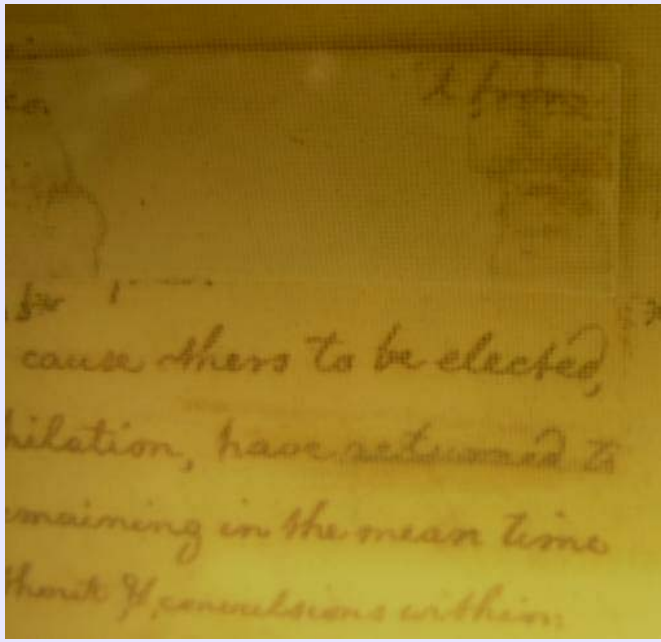
Anoxic Top Treasure Cases

Rough Draft of the Declaration of Independence

Virginia Declaration of Rights

Gettysburg Address(es) – Draft 1 & Draft 2

L'Enfant Plan of Washington D.C.



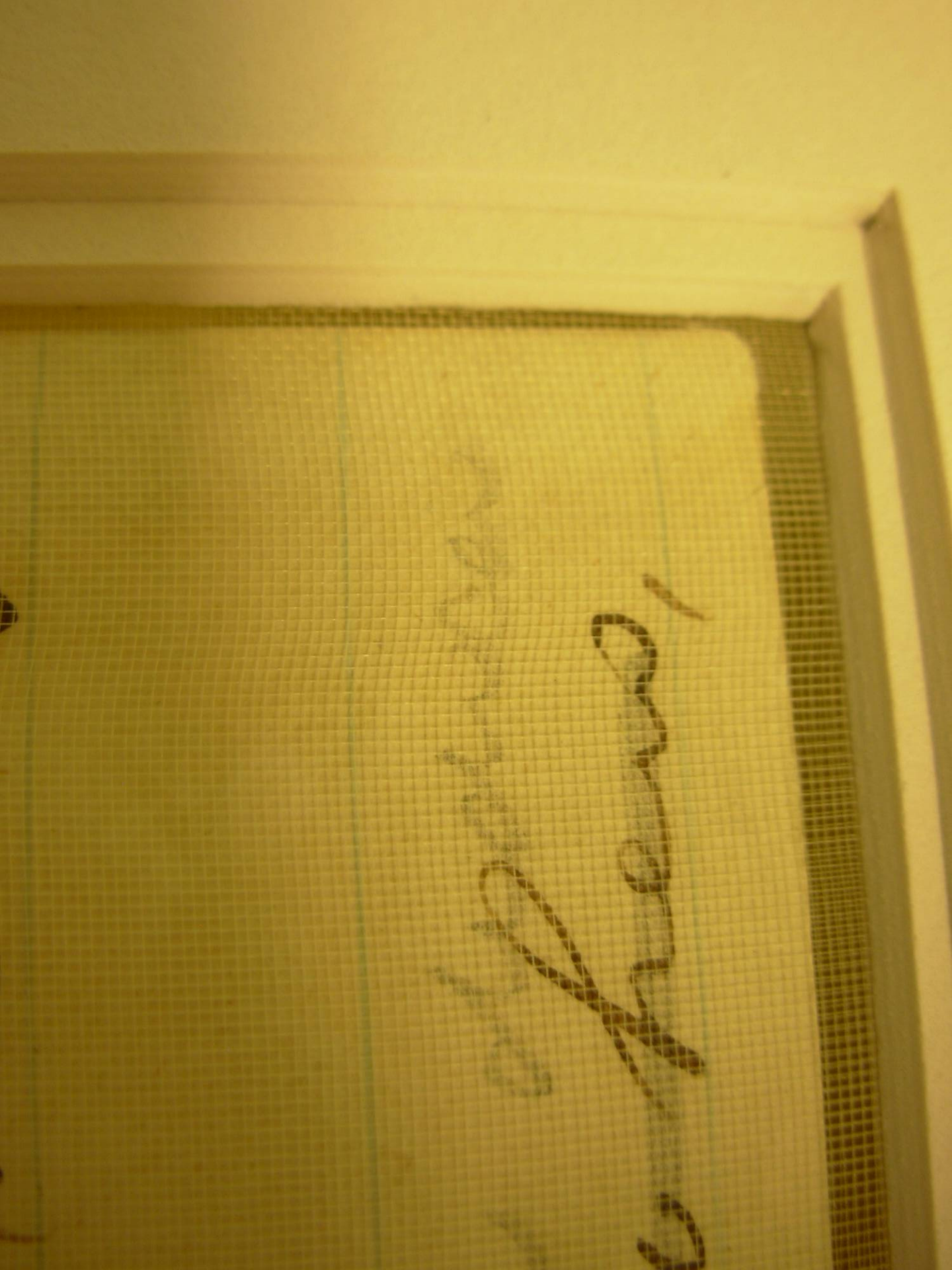
- Cases constructed in early 1990s
- Two-sided cases for display
- Heavy case construction materials

- Advances in:
  - case construction
  - available materials
  - performance specifications of sealant materials

Case Specifications (early 1990s)

- Heavy gauge stainless steel (304)
- Dimensions approx. 62 x 70cm (24.5” x 27.5”)
- Low off-gassing neoprene flat and o-ring gaskets
- 3/8” UF3 plexiglas* (< 98% UV)
- Document suspended between window mats of alkaline paper board with stabiltex fabric

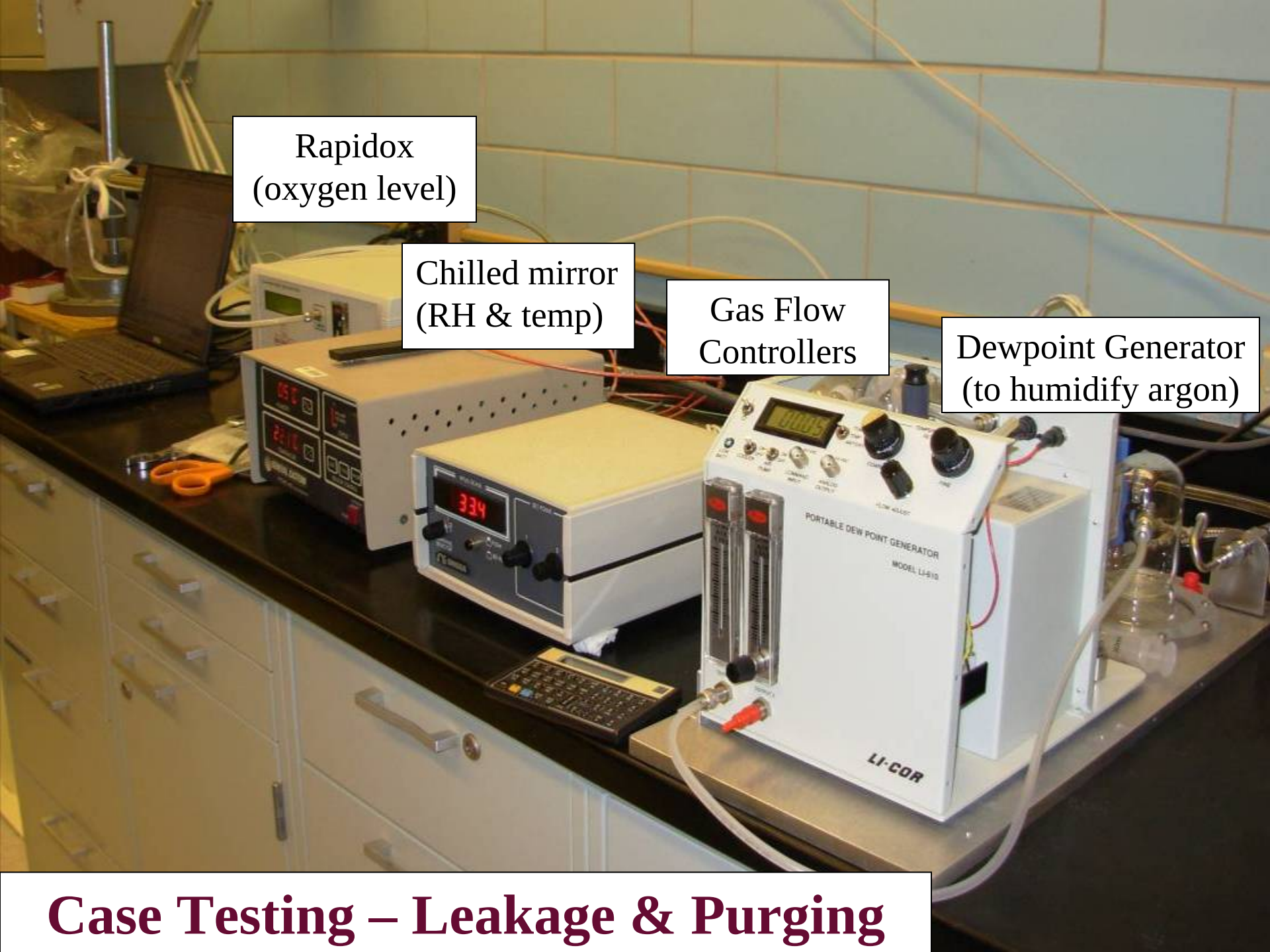
*Polymethylmethacrylate



Leakage Testing

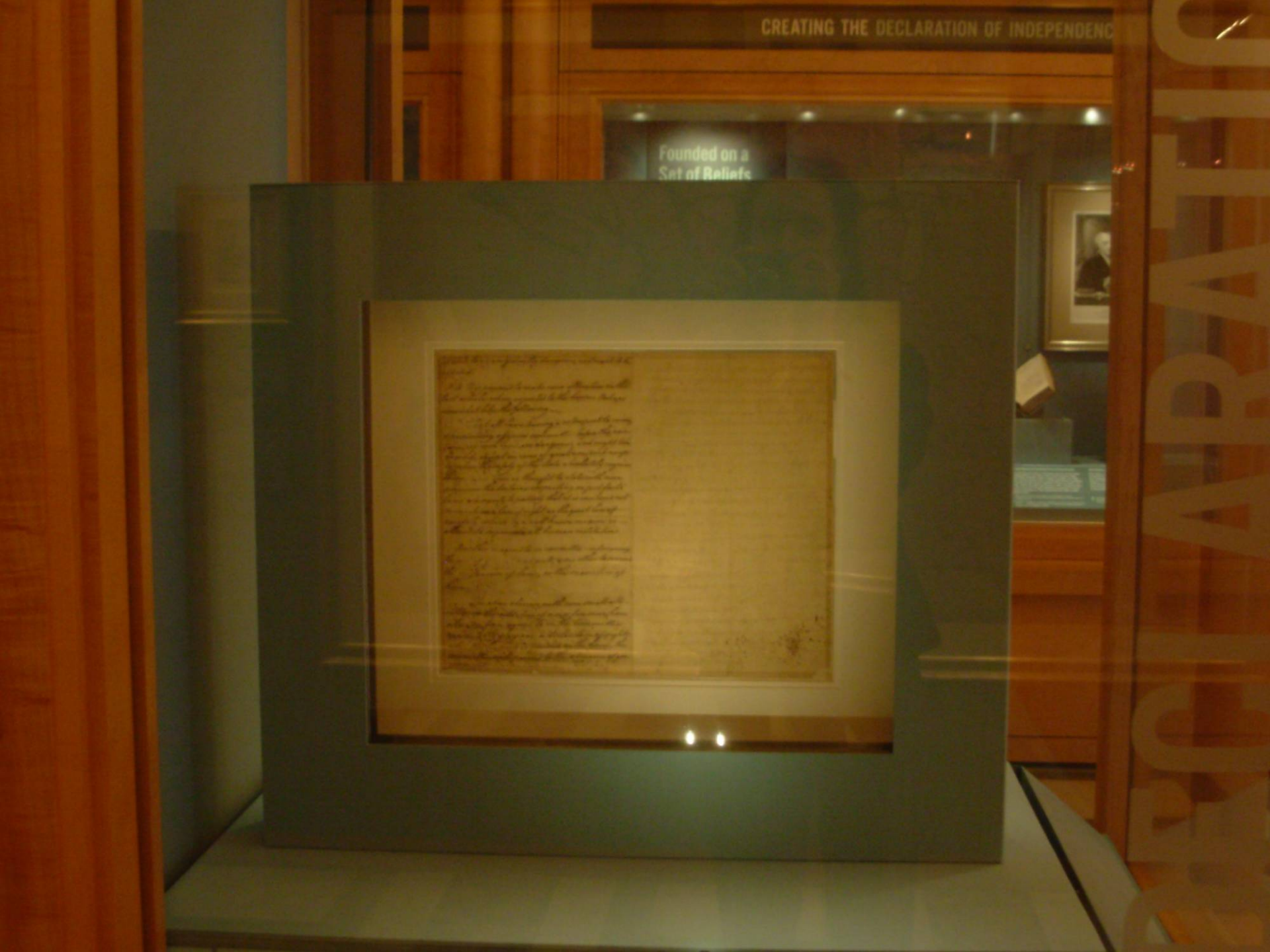
Replacing Argon in the Cases

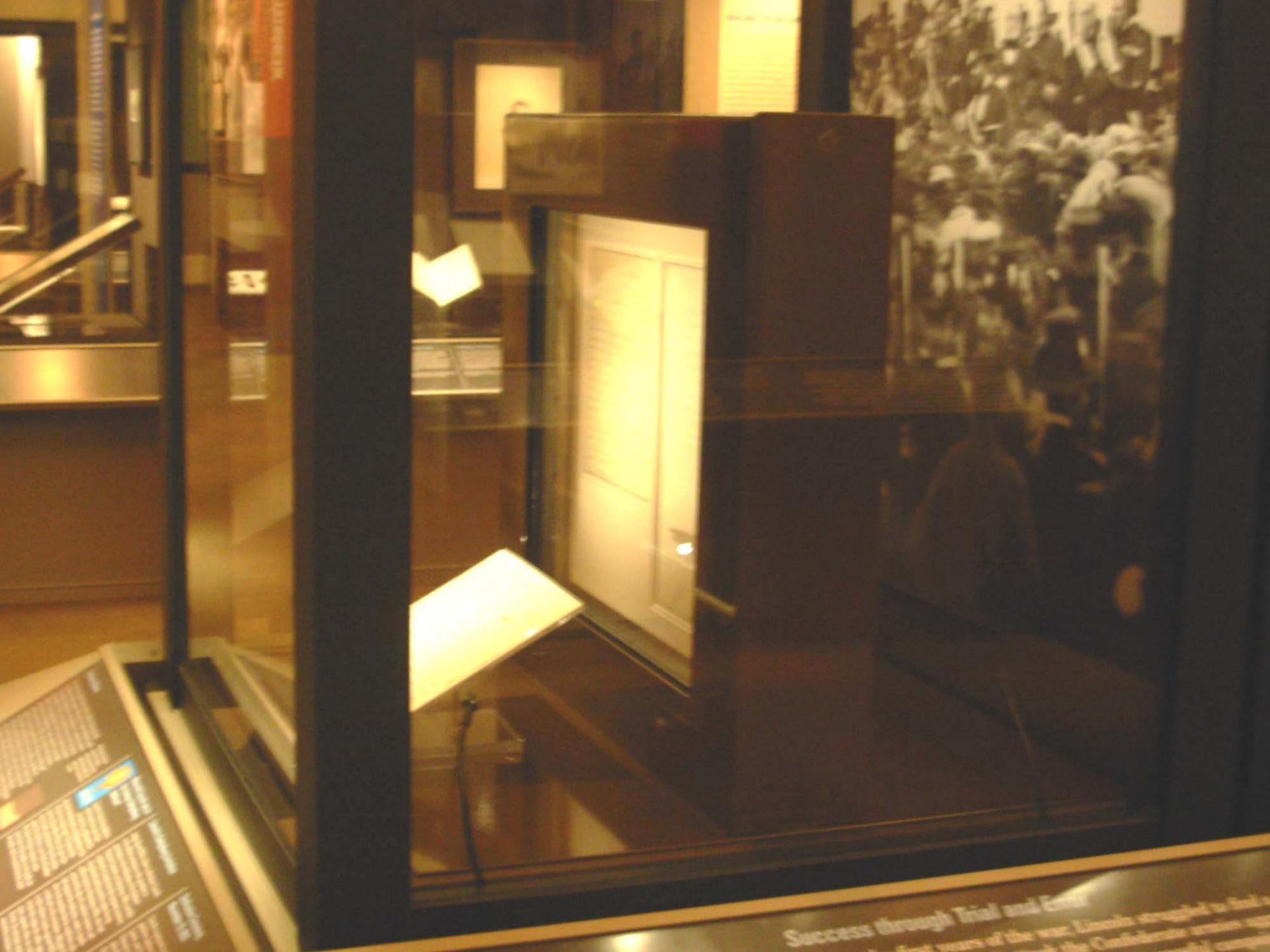
Case sampling for VOCs



Case Testing – Leakage & Purging


CREATING THE
UNITED STATES
CONSTITUTION
CREATING THE
DECLARATION
OF INDEPENDENCE
The American Revolution ushered in an age of democratic revolutions. Unlike many later revolutions, America's war did not lead to unbridled violence and dictatorship but to the Constitutional Convention of 1787 and the peaceful transfer of political power between parties in 1801.
Cooperation and compromise distinguish the creation of the United States from the more violent revolutions. Despite great uncertainties, America's founders pressed forward to independence and the creation of a federal republic. The Declaration of Independence became a lasting beacon for those seeking justice, human dignity, and self-government throughout the world.


CREATING THE DECLARATION OF INDEPENDENC
Founded on a



The Waldseemüller 1507 World Map

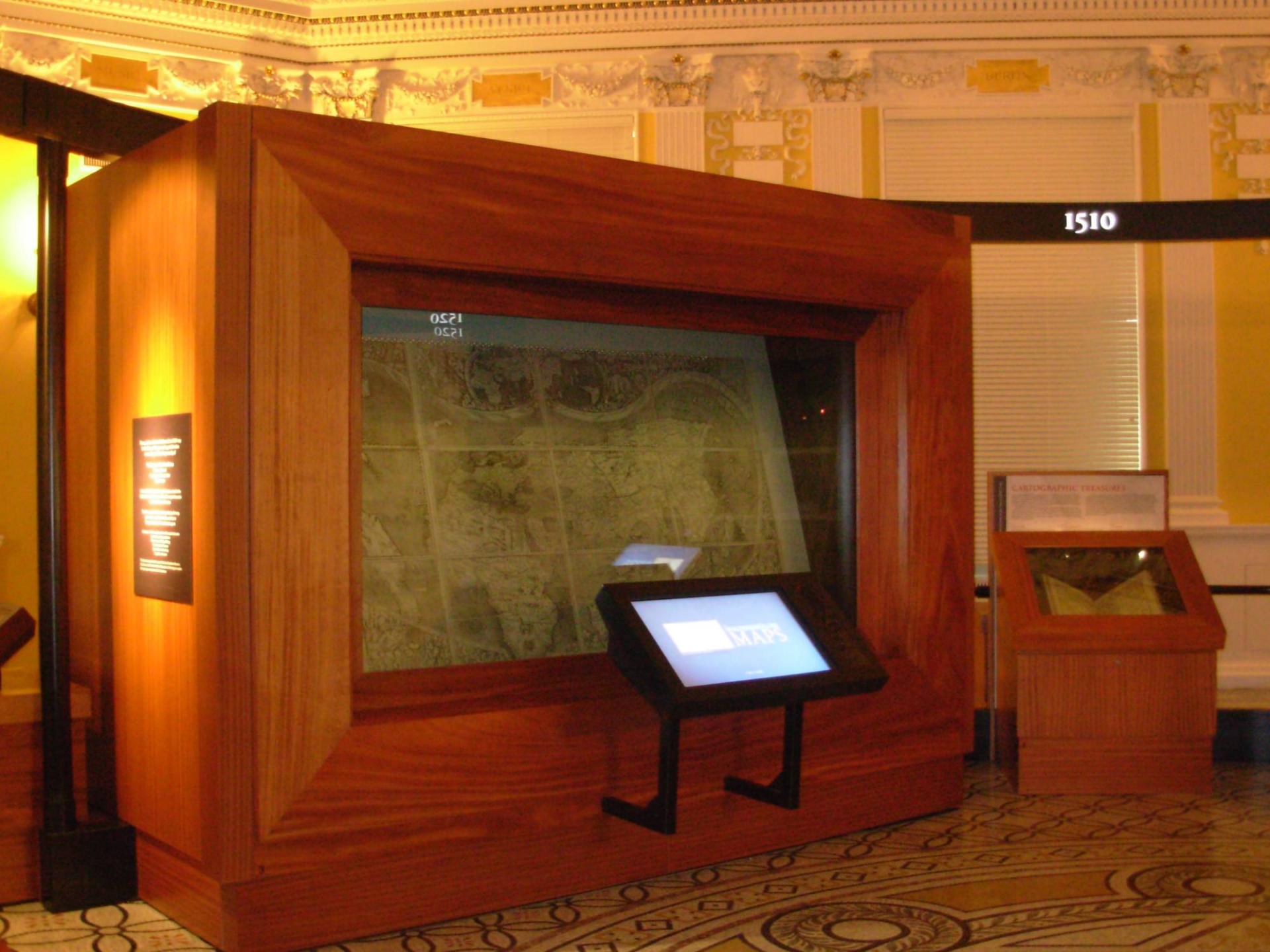
Universalis Cosmographia Secundum Ptholomaei Traditionem et Americi Vespucii Alioru[m]que Lustrationes, St. Dié, 1507

- Martin Waldseemüller, St. Dié, near Strasbourg, France
- Waldseemüller christened the new lands "America" in recognition of Vespucci's understanding that a new continent had been uncovered as a result of the voyages of Columbus and other explorers
- The only known surviving copy of the first printed edition of the map (believed to be 1,000 copies)
- The first map, printed or manuscript, to depict clearly a separate Western Hemisphere
  With the Pacific as a separate ocean

Waldseemüller Map Encasement

- Total encasement approx. 2.75 x 1.5m (9 x 5 feet)
  - 12 sheets - each approx. 45 x 60cm (18 x 24 inches)
- Housed in a 1000kg encasement (2200 lb)
  - Flexible aluminum shell with hurricane proof glass
  - Two “in series” viton o-ring seals
  - 400L volume
- Encasement conditions
  - Argon humidified to 40% relative humidity
  - Temperature in the exhibit area maintained at 21 ± 2°C
  - Monitored for changes in oxygen, relative humidity, temperature, and pressure
  - Low light levels
- On permanent exhibit in the Jefferson Building


EXIT


1510
1520
1520
MAPS

Case Specification Requirements

- Hermetically sealed case to maintain anoxic environment to prevent constant maintenance and potential for mechanical failure
- Requirement for a 20-30 year seal
  - Two concentric elastomer O-rings
- Rigorous testing of case leakage
  - Ability to test inner and outer seal
- Monitoring of environmental parameters
- High performance materials (longevity & minimising potential for leakage)

Case Design

- Collaboration between designers, engineers, conservators, scientists, curators
- Design and construction specifications must concur
- Design must address critical environmental and construction requirements, not aesthetics

Case Construction

- Construction must meet design specification
  - Engineering
  - Materials performance and specification
- Leakage Testing
  - Case components and sensors
- Specification Testing
- Testing !
- Modification of design in construction phase to address changes in requirements

Case Materials

- Tooled aluminium
  - single 10cm (4”) block
  - ~6mm (1/4”) flexible base for pressure changes
- Laminated hurricane proof glass
- High purity Argon inert gas
- Minimized points of weakness – entry/exit points – reduce potential leakage
- High performance gasket material
- 92 bolts – security – and even torque force application for hermetic seal & safety

Hermetic Seal

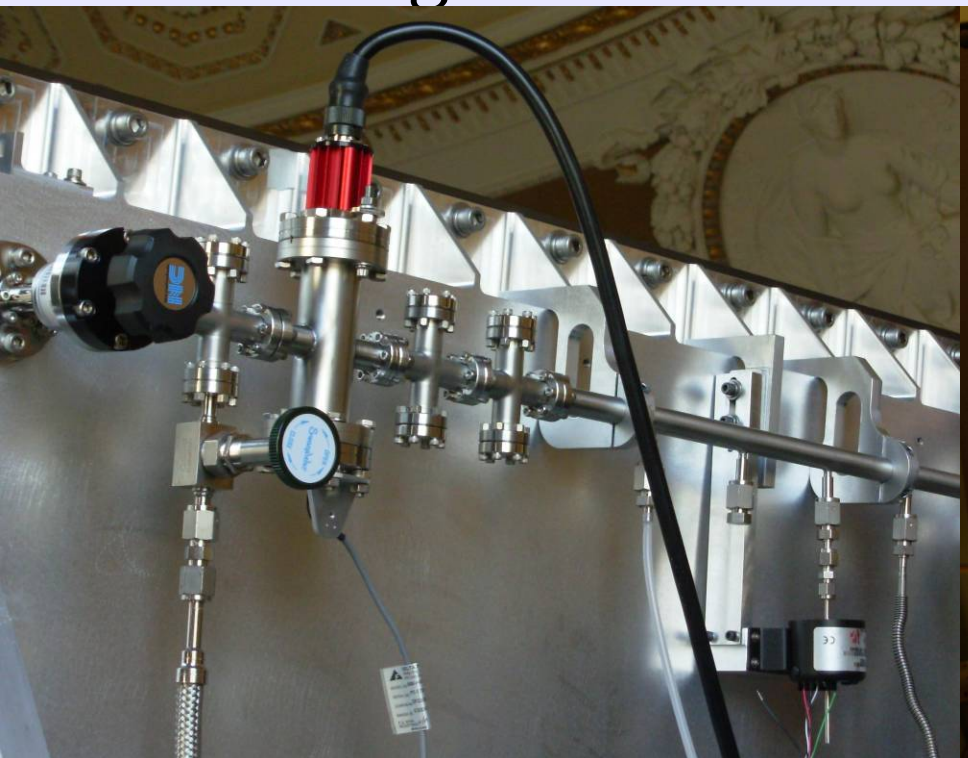
- Material properties
  - Glass vs plexiglas
    - Permeability approx. 1000x less for glass
  - Viton
    - Chemical stability, longevity, permeability
- Double series gasket
- Leakage testing (double groove)
- External manifold (minimized leakage points)
- Leak testing of sensors

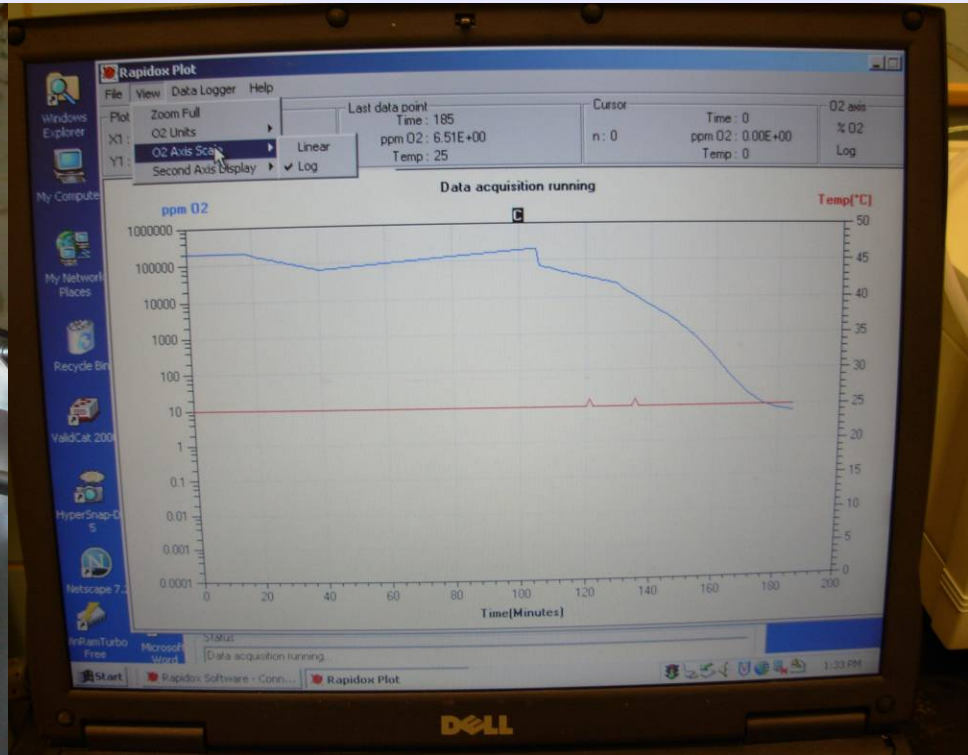
Encasement Seal

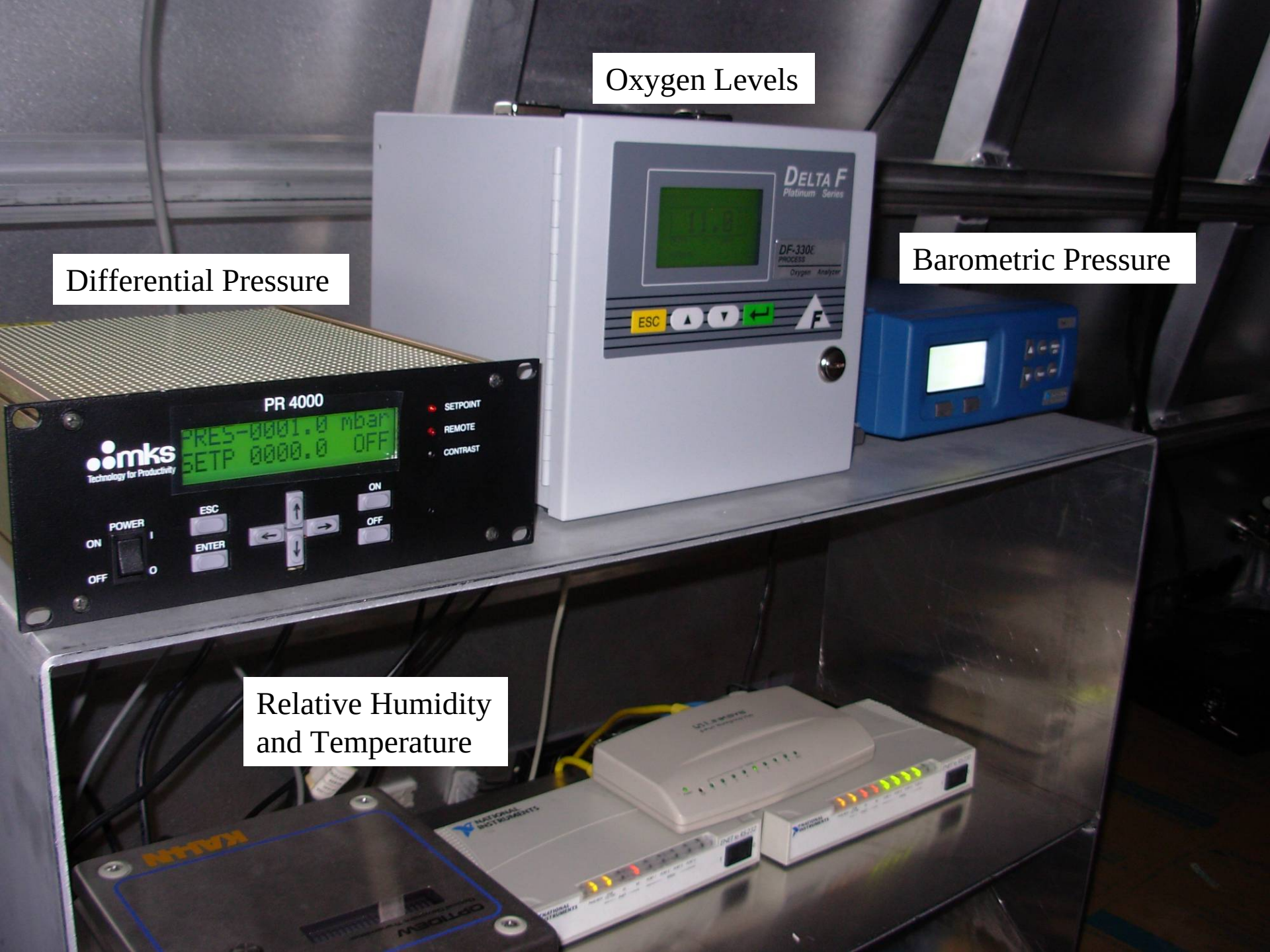
- Double groove for leakage testing
- Argon feed tube above and below platform

Monitoring Anoxic Cases

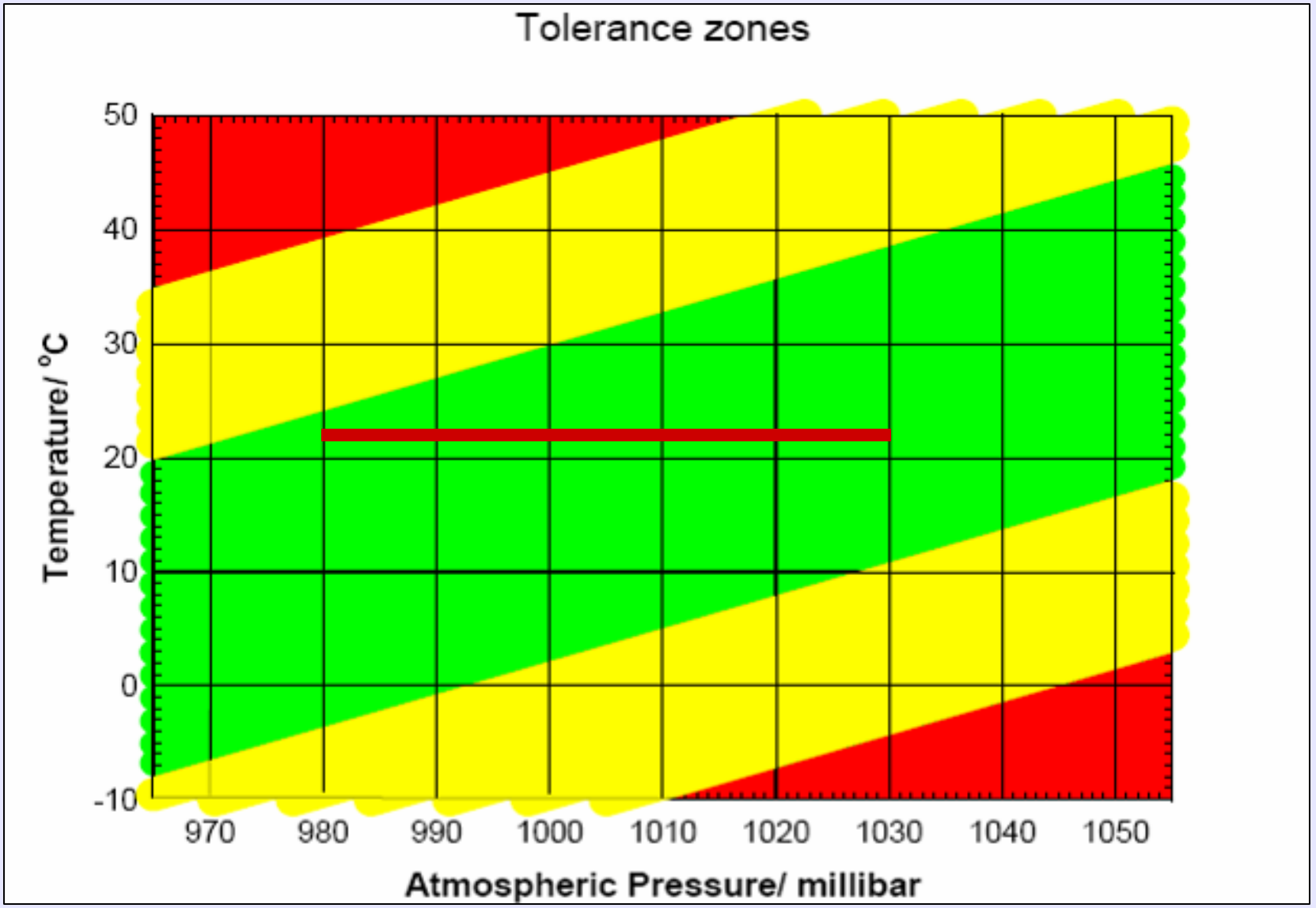
- Oxygen
- Relative humidity and temperature
- Pressure – differential and barometric
- Volatiles and other degradation products
- Light






Oxygen Levels
Differential Pressure
Barometric Pressure
Relative Humidity
and Temperature
DELTA F
Platinum Series
DF-330
PROCESS
Oxygen Analyzer
ESC
PR 4000
mks
Technology for Productivity
PRES-0001.0 mbar
SETP 0000.0 OFF
SETPOINT
REMOTE
CONTRAST
POWER
ON
OFF
ESC
ENTER
ON
OFF

Flexible Encasement Model (NIST)



Monitoring Issues

- Limits of sensors
- Maintenance, upgrades and support of monitors over time
- Data format, storage and access
- Interpretation of data
- Notification for response to case changes
- Monitoring or sampling for degradation products

Calibration Issues

- Sampling rate and calculation of rate constant
- Range, flow rate and sensitivity of sensor
- Compatibility with institution (real-time download) for data ports and software
- Accuracy
- Sensor drift
- Testing hardware
  (e.g. tygon vs. braided metal hoses)

Anoxic Case Conclusions

- High performance materials
  - Laminated glass
  - Flexible back designed to attenuate pressure by factor of 4 without penetrations into case
- True hermetic seal
  - In series resistant low permeability viton gasket
  - Continuous testing confirms 150 year period to reach 0.5% oxygen level
  - *NB: gasket performance to achieve 150 yr seal unknown*
- Standardised monitoring protocol
- Sensor calibration maintenance

Anoxic Case Considerations

- Utilization of anoxic cases for specific artifacts or materials *versus* visual storage micro-climates for control of specific environmental parameters
  - relative humidity, light, pollutants, temperature
- Applicability to a range of materials, objects
- Cost-benefit of anoxic encasements
- Implications of hypoxic vs. anoxic with less rigorous case specifications
- Technology developments

Future Directions

- Convergence of library, archive and museum needs
- Continued research for real-time, small, low maintenance case environmental monitors/ sensors
  (exhibition case as mini-laboratory)
- Development of prototype for smaller, modified case design to meet required seal, e.g. 10, 20 yrs
- Monitoring of case environment
- In-situ monitoring to assess impact of anoxia on range of preservation aspects
  (life-time impact study of controlled environment)

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