THE EVOLUTION OF ANL CMT GLOVEBOXES

by

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Submitted for presentation at:

2000 Annual Conference and Equipment Exhibit
of the American Glovebox Society
August 21-23, 2000
New Orleans, Louisiana

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Work supported by the U.S. Department of Energy under Contract W-31-109-ENG-38.
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THE EVOLUTION OF ANL CMT GLOVEBOXES

INTRODUCTION

• Argonne National Laboratory
• Chemical Technology Division (CMT)
• Modular Gloveboxes Designed for Experimental Work
  – Laboratory Scale
  – Engineering Scale
• Experimental Work Includes Equipment and Process Development for:
  – Pyrochemical
  – Nuclear Waste Treatment
  – Electrochemistry
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HISTORY

● The First ANL-CMT Division Modular Glovebox was Designed and Installed in 1959. It was designated as the CENHAM glovebox.

● Design Objective:
  – Provide Modular Configuration
  – Provide Controlled Atmosphere Environment
  – Maximize Viewing Accessibility
  – Provide "Standardized" Work Area for Laboratory Research Work
  – Provide Modular Utility Service Access
  – Include User-Friendly Considerations

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GLOVEBOX DESIGN REQUIRES AWARENESS OF USER NEEDS

- Evolution of Design Over the Past 40 Years
- Request for New Gloveboxes Usually Based Upon Similar Attributes of an Existing Enclosure Plus Particular Project Changes for Use.
- Discussion with Staff and Laboratory Operating Personnel.
- Considerations:
  - Simplicity in Design
  - Cost Saving
  - Schedule
- Defining "What is Necessary" and "What Would be Nice."
USER-FRIENDLY GLOVEBOX DESIGN

• Gloveboxes Use a Modular Design Concept

• Glovebox Size is Designated as Modules in Length and Tiers in Height

• Basic Module is 42 inch Cube

• Modular End Plates Provide for:
  – Utility Services
  – Ventilation/Purification System
  – Filter Housings
  – Transfer Locks
  – Bagports
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MATERIALS OF CONSTRUCTION

- Steel Shell (Painted)
- Stainless Steel Shell
- Steel Support Frame
- Gloveports
- Glass Windows
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STRUCTURE

• Glovebox Shell
• Structural Elements
• Unistrut
• Floor
• End Plates
• Hoists
• Floor Wells

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UTILITIES

• Process Feedthroughs for Services
  – Electrical
  – Instrument
  – Gas or Liquid

• Lighting
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TRANSFER SYSTEMS

- Bagout
- Large Horizontal Transfer Lock
- Small Horizontal Transfer Lock
- Vertical Transfer Lock
- Sphincter
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QA APPLICATION

- Management Control
  - Team Approach
  - Process Development
  - Design and Fabrication
  - Scheduling
- Design Review
- Design for Manufacturability Reviews (DFM)
- System Design Description
- Safety Review
- Operational Readiness Review

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WINDOWS

• Window Viewing Area Comprises Approximately 60% of the Glovebox Side Walls that Suffices for Monitoring Experimental Equipment and Process Operation

• Weatherstrip Type “Zipper” Seal Used for Window Installation

• Window Concept
  - Nominal 36 Inch Square Windows and Window Openings with Rounded Corners
  - 3/8 Inch Thick Laminated Safety Glass Windows
  - Gloveports are Attached Through the Windows

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Glovebox Baseboard Duct

- Electrical Outlet
- Gas Distribution Duct Cover
- Inside Glovebox Floor
- Instrumentation Outlets

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GLOVEBOX SUPPORT STAND

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4 MODULE - 1 1/2 TIER GLOVEBOX

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GLOVEBOX
2 MODULE - 2 TIER
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GLOVEBOX FILTER ACCESSIBILITY

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EPOXY RESIN

- Inside Weld Joints are Caulked with an Epoxy Resin.
- The Epoxy Resin (ABAWELD) has been Used on Gloveboxes in CMT for Many Years
- The Caulked Joints Provide a Smooth Corner Fillet Designed for Easy Clean-Up
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WEATHERSTRIP INSTALLATION

GUN NOZZLE

SEALING COMPOUND

WEATHERSTRIP

GLASS WINDOW

GLOVEBOX WALL

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GLASS TYPE

- Glass laminate per ASTM C1172-91
- Two lite laminate of Kind LA, Class 1, \( q^3 \) quality glass
- Each lite is .19 inch thick with overall composite thickness of .38 inch
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FAILURE OF GLOVEBOX WINDOW WITH GLOVEPORTS

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FAILURE OF GLOVEBOX WINDOW WITHOUT GLOVEPORTS

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WINDOW TEST RESULTS

• Window with four gloveports
  – Test terminated due to structural failure of the window glass
  – Cracks developed in the glass extending across the two lower gloveports
  – Test pressure at failure was 17 inches of water
  – No evidence of seal failure
WINDOW TEST RESULTS

- Window without gloveports
  - Test terminated due to structural failure of the window glass
  - Crack developed in the glass radiating out from the center
  - Test pressure at failure was 30 inches of water (> 2 psig)
  - No evidence of seal failure
INTERIOR ENVIRONMENT ATMOSPHERE

- Flow Controls - Once Through Gas
- Inert Gas Recirculation System - Requires Purification System with Filters
- Pressure Controls
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SUMMARY

• Design Approach Based Upon User-Friendly Concept

• Utilization of Existing Component Designs

• Cost Effective

• Schedule

• Adaptable to Project Process Changes Without Losing Overall Effectiveness of "User-Friendly" Approach.