THE EVOLUTION OF ANL CMT GLOVEBOXES

by

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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
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
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
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
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
QA APPLICATION

• Management Control
  – Team Approach
  – Process Development
  – Design and Fabrication
  – Scheduling

• Design Review

• Design for Functionality and Manufacturability Reviews (DFM)

• System Design Description

• Safety Review

• Operational Readiness Review
WINNDOWS

• 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
GLOVEBOX SUPPORT STAND
4 MODULE - 1 1/2 TIER GLOVEBOX
GAS RECIRCULATION SYSTEM

EMERGENCY INLET OR EXHAUST

BUBBLER

PURIFICATION SYSTEM
GLOVEBOX ASSEMBLY
GLOVEBOX FILTER ACCESSIBILITY
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
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
FAILURE OF GLOVEBOX WINDOW WITH GLOVEPORTS
FAILURE OF GLOVEBOX WINDOW WITHOUT GLOVEPORTS
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
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.