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

STRUCTURE

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

UTILITIES

- Process Feedthroughs for Services
  - Electrical
  - Instrument
  - Gas or Liquid
- Lighting

TRANSFER SYSTEMS

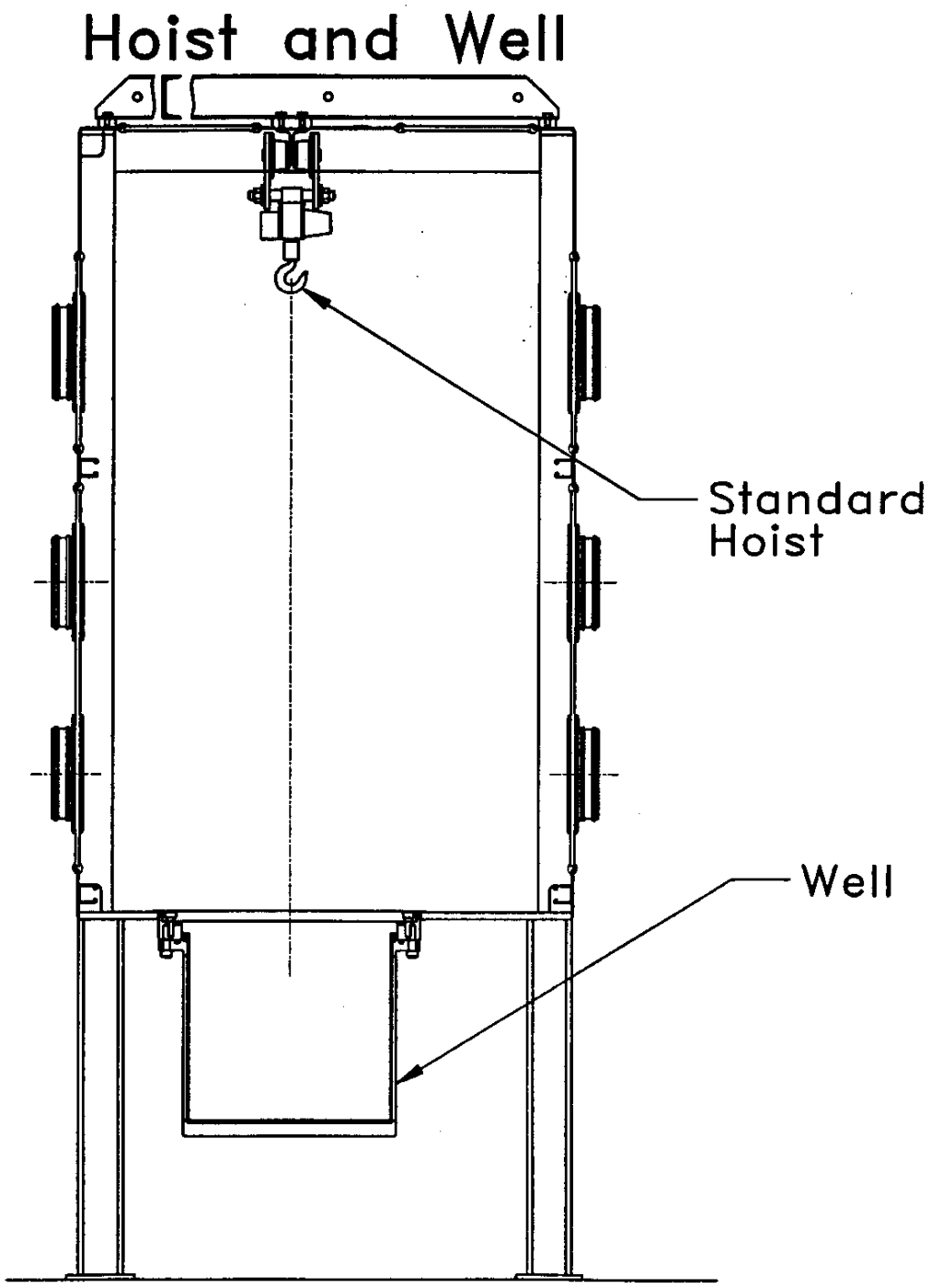
- Bagout
- Large Horizontal Transfer Lock
- Small Horizontal Transfer Lock
- Vertical Transfer Lock
- Sphincter

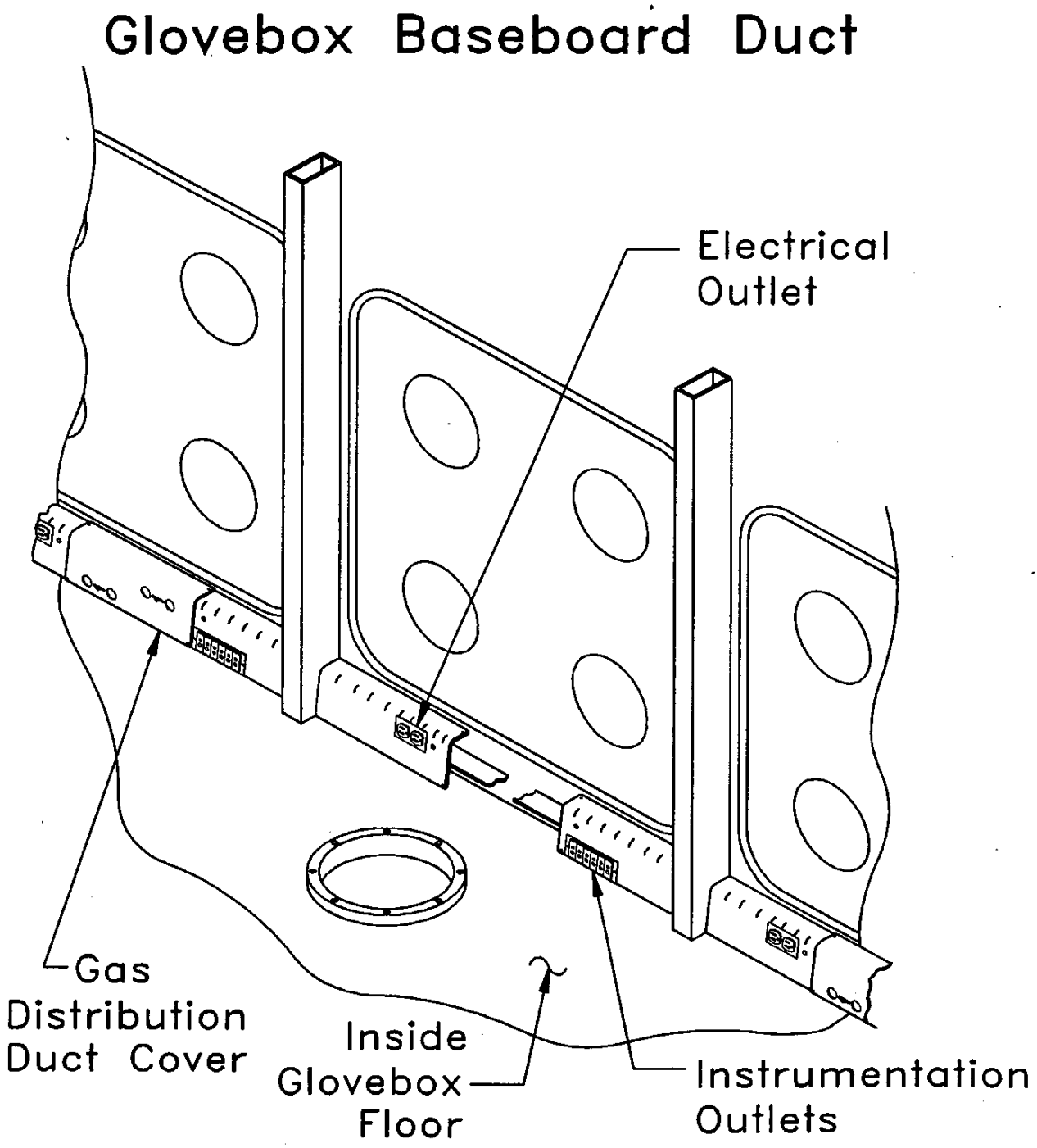
QA APPLICATION

- 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

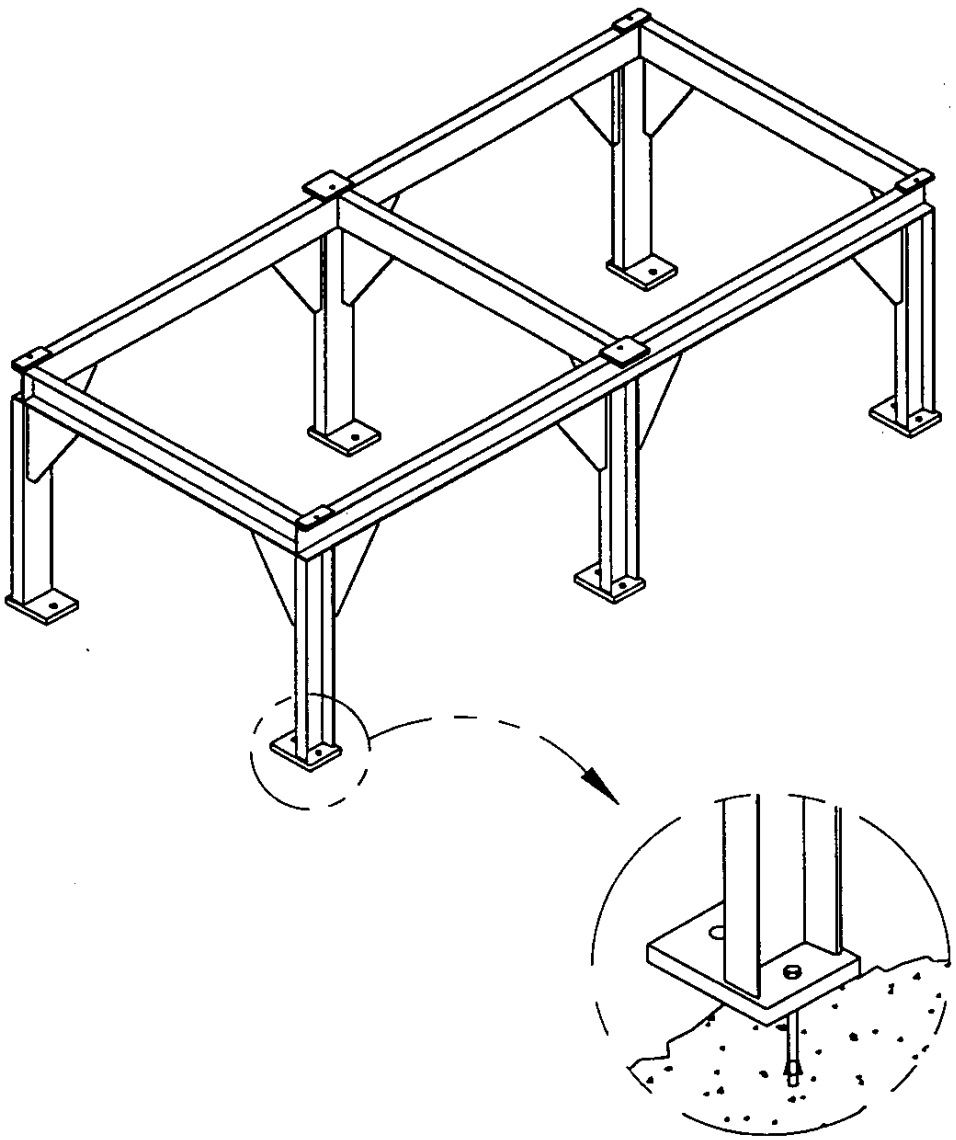
WINDOWS

- 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

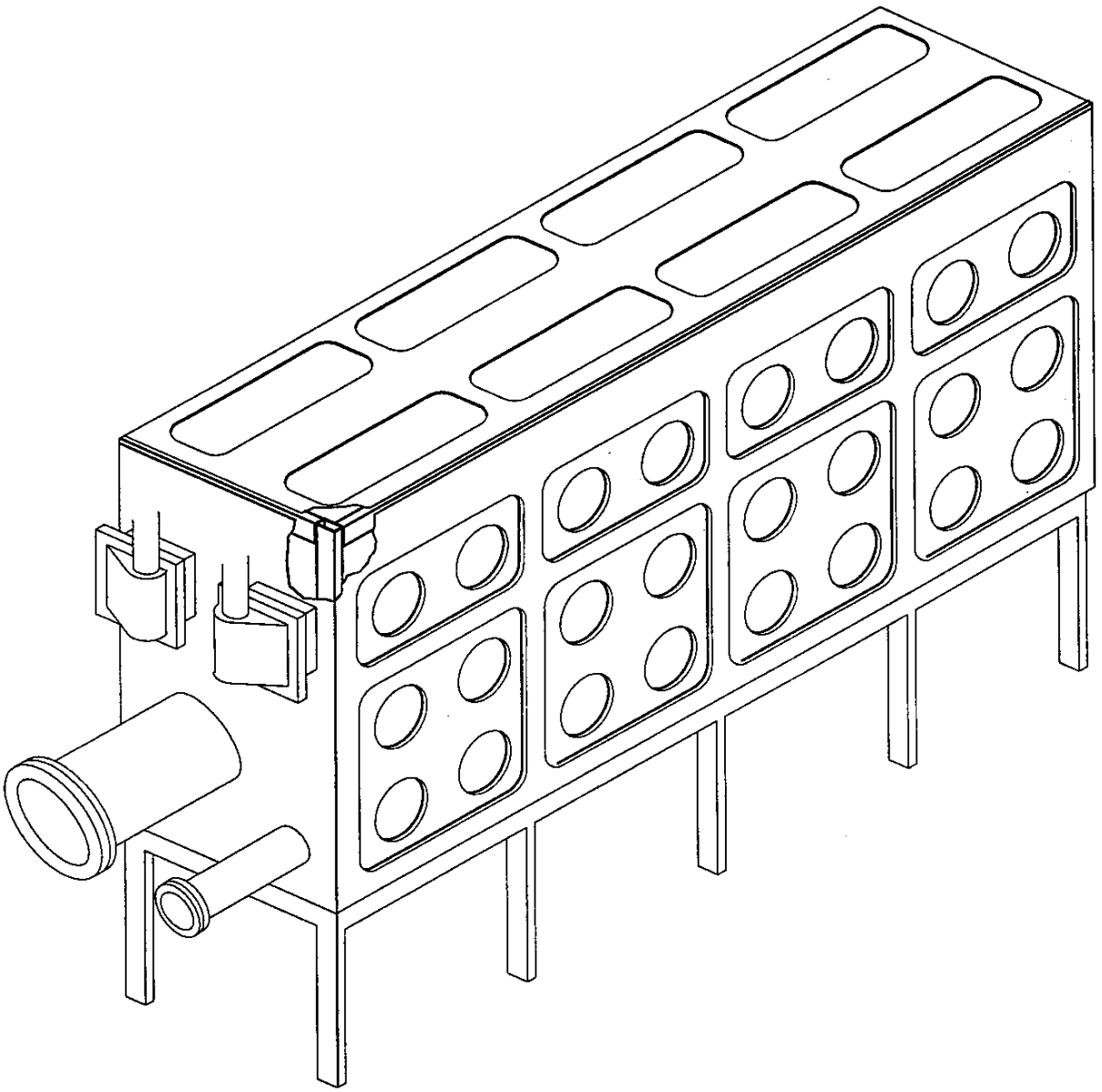

Hoist and Well
Standard Hoist
Well


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

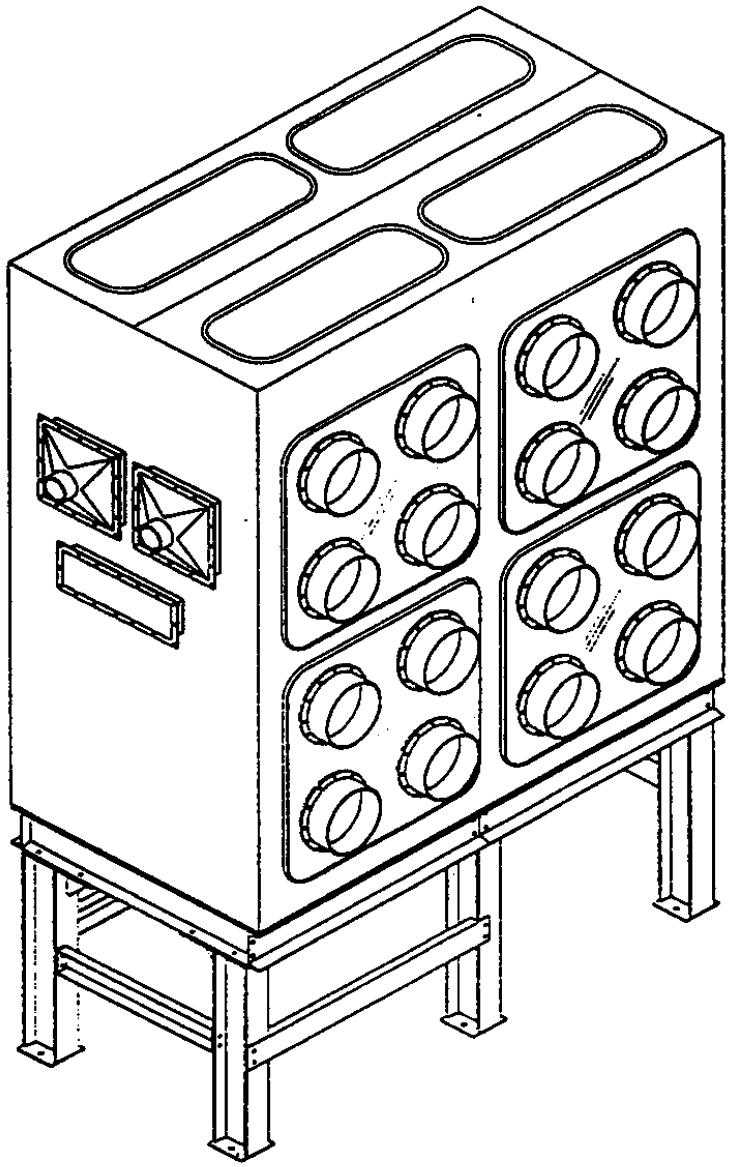
GLOVEBOX SUPPORT STAND



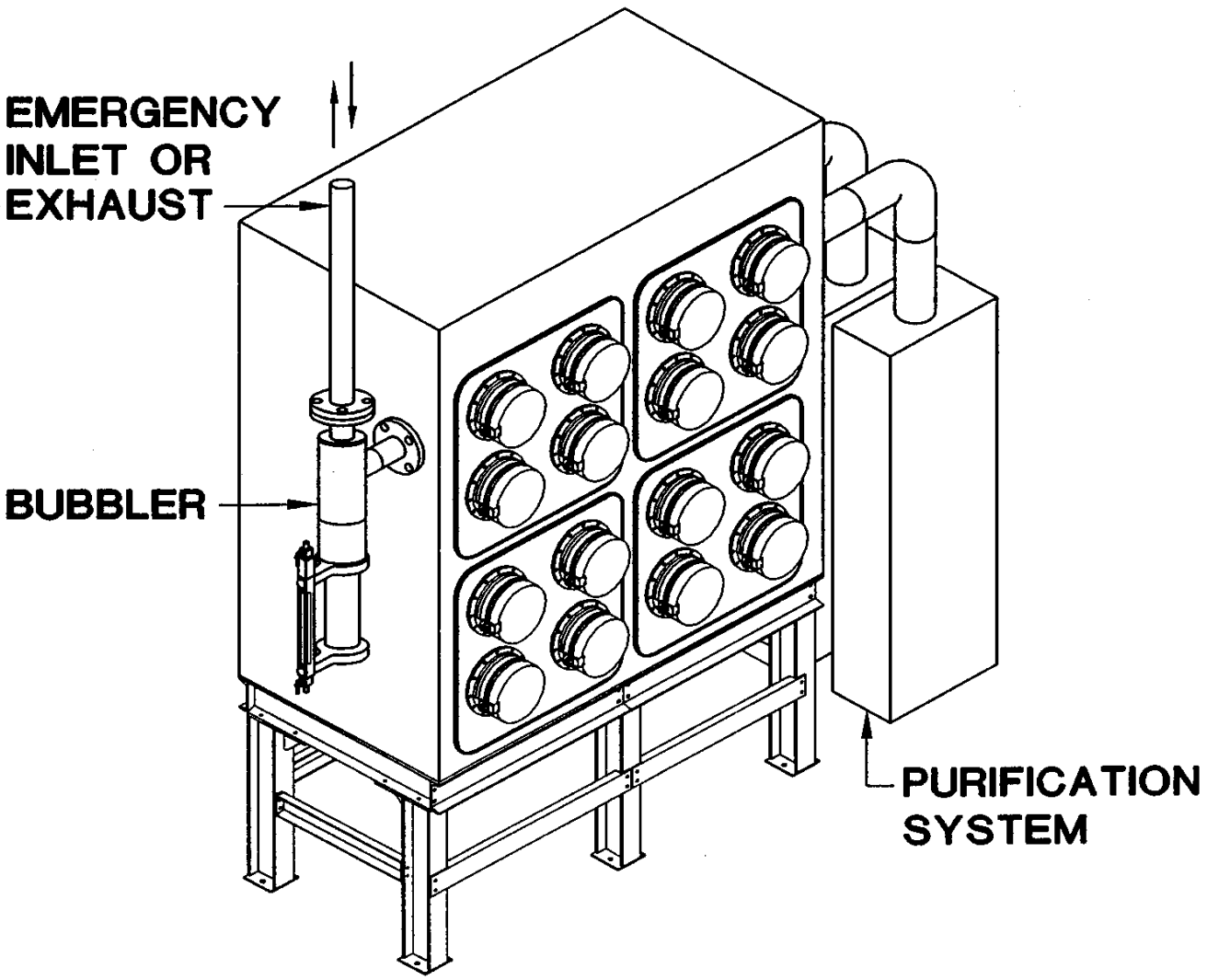
4 MODULE - 1 1/2 TIER GLOVEBOX



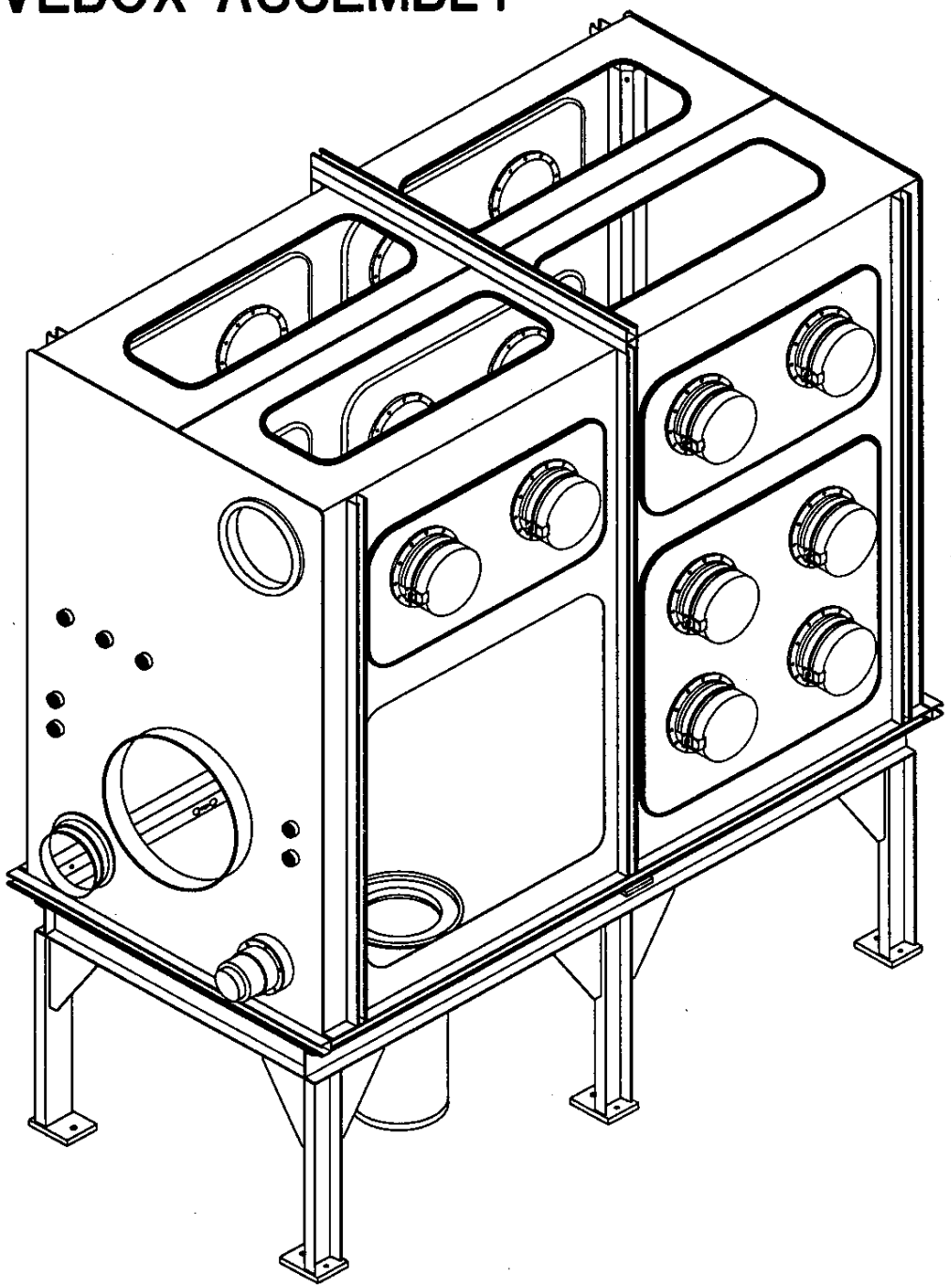
GLOVEBOX
2 MODULE - 2 TIER



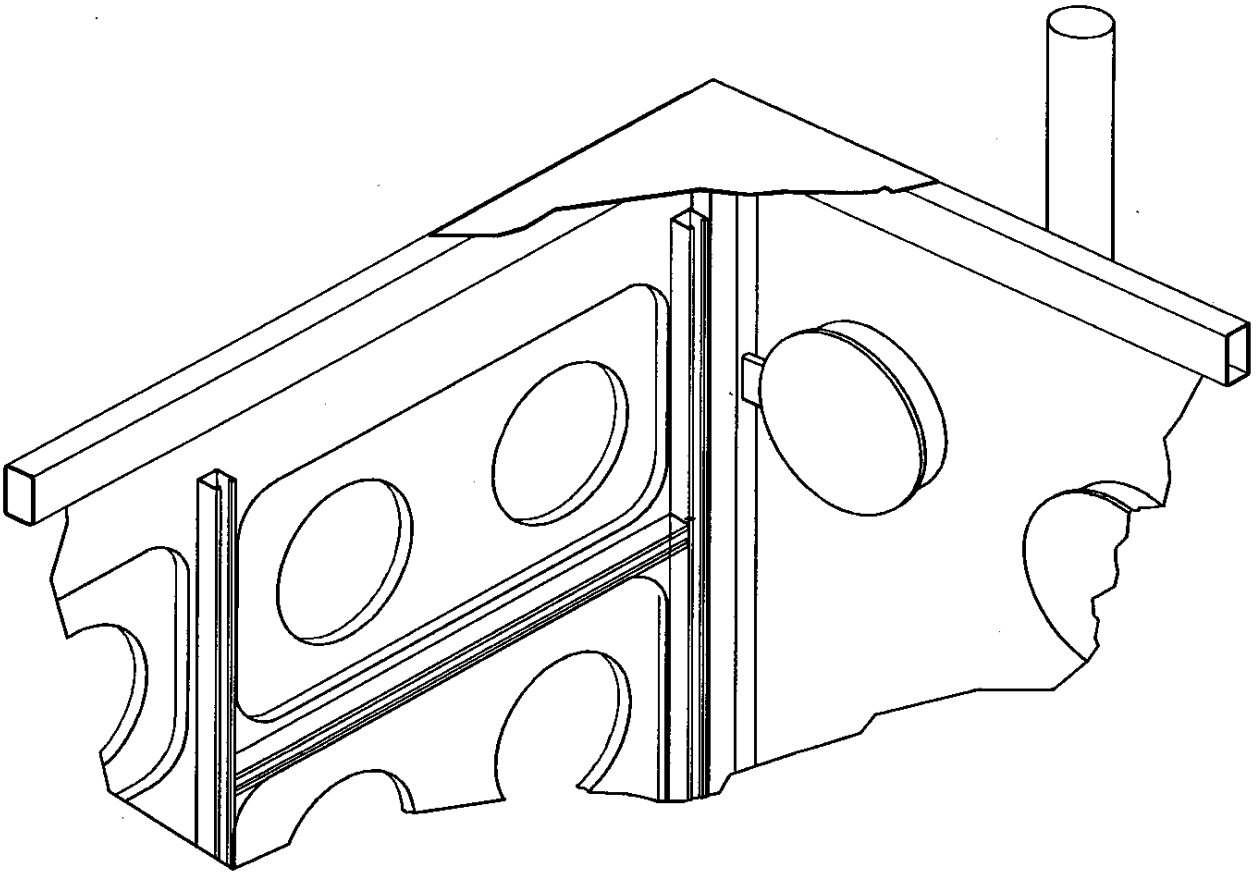
GAS RECIRCULATION SYSTEM



GLOVEBOX ASSEMBLY



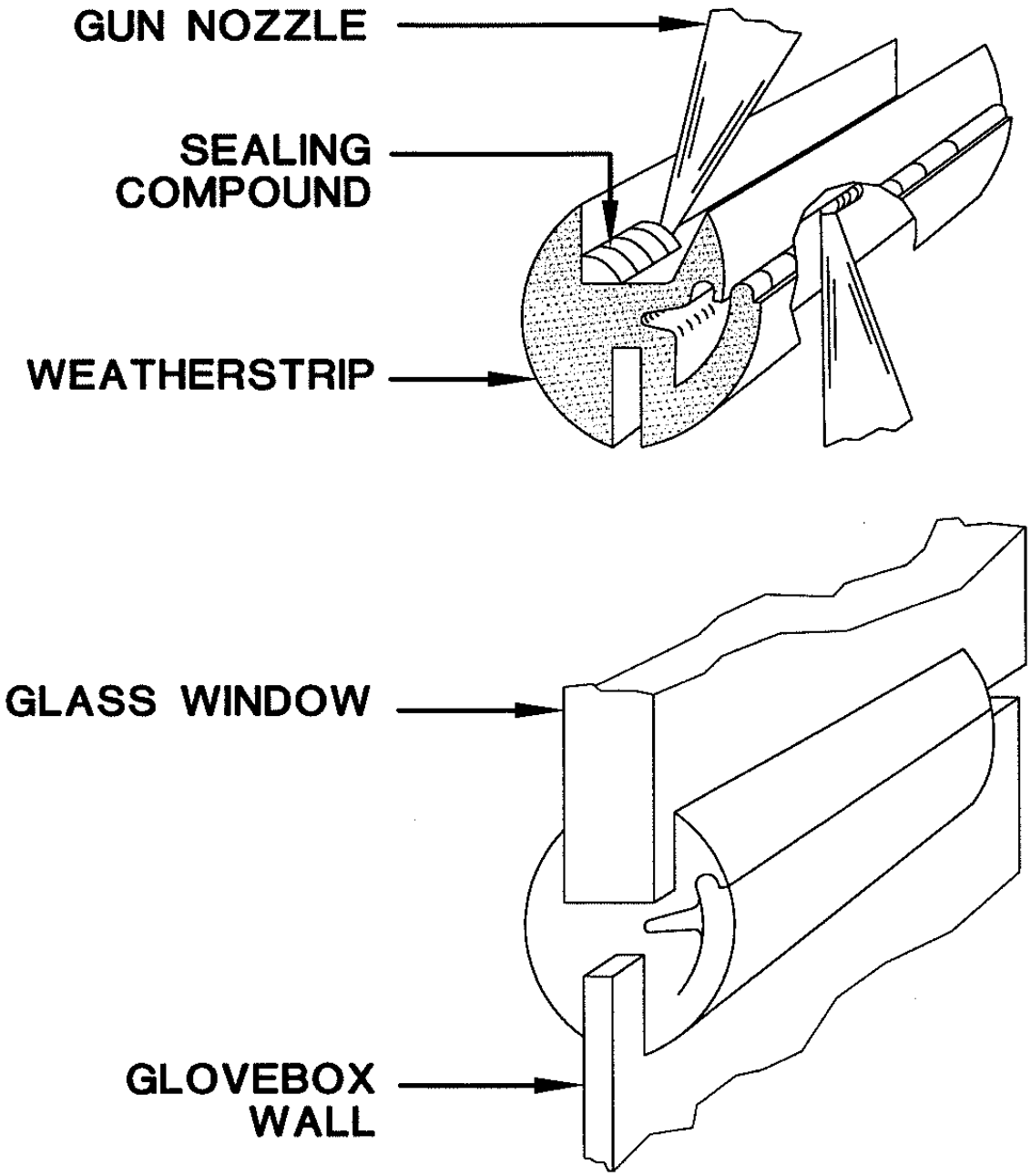
GLOVEBOX FILTER ACCESSIBILITY



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

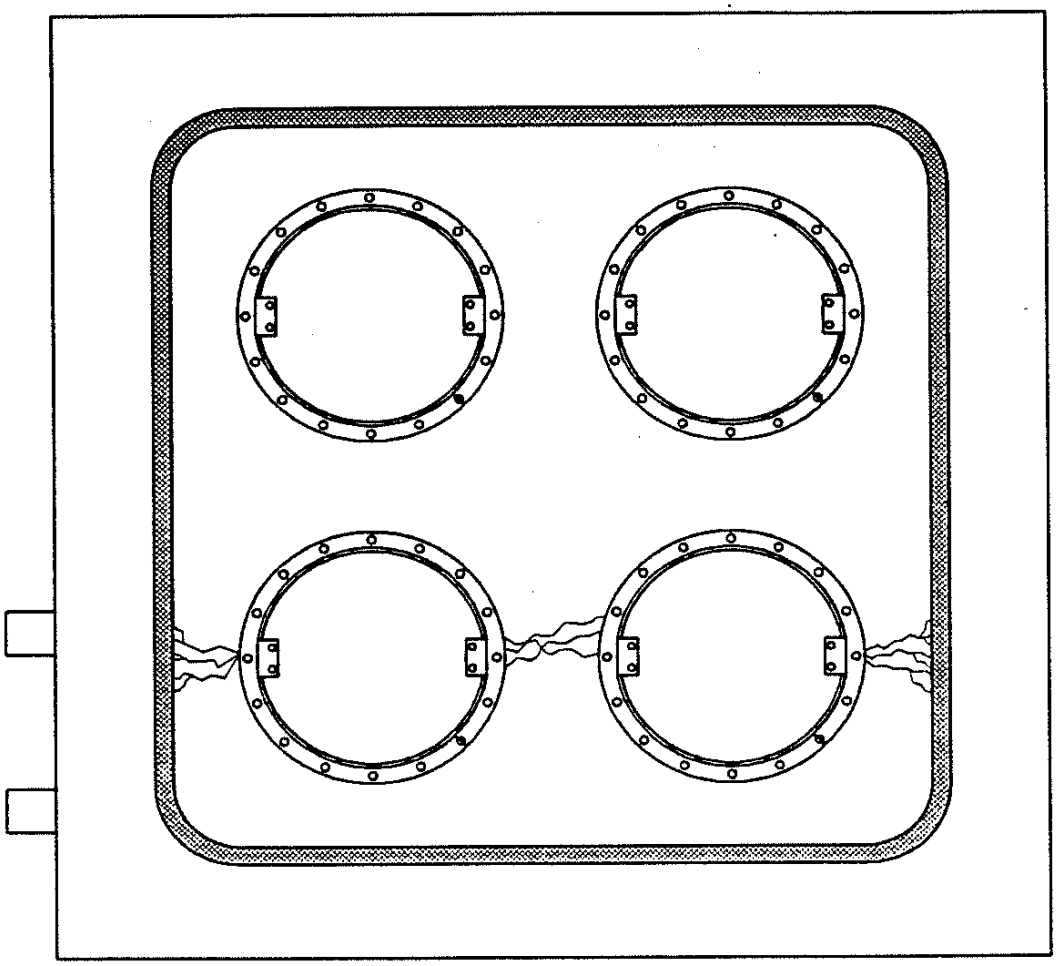
WEATHERSTRIP INSTALLATION



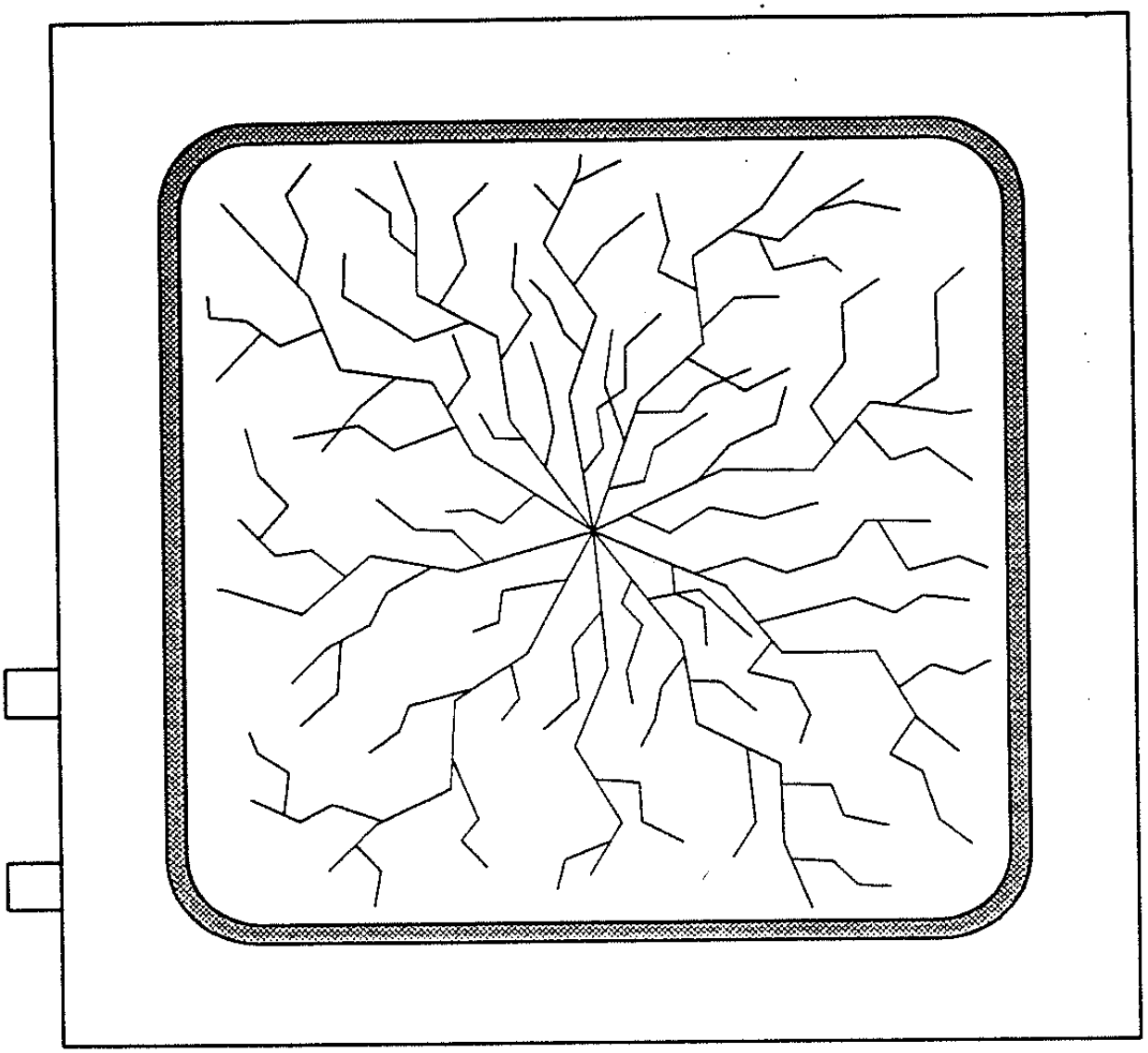
GLASS TYPE

- 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



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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

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.