

The Apollo 1 Fire

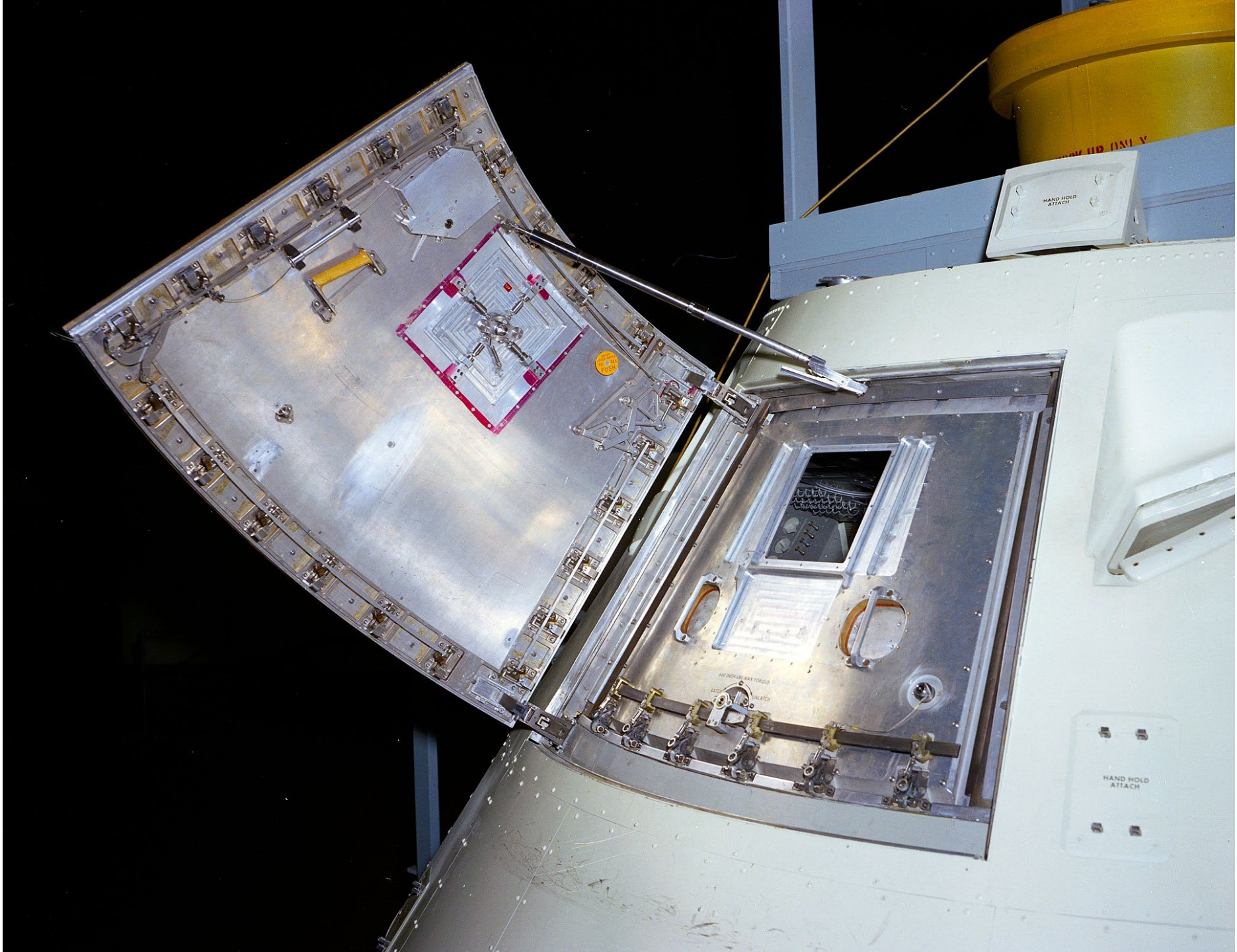
HONR 269i

To the Moon and Back: The Apollo Program

The Path to the Fire

- North American's Apollo proposal included a mixed-gas environment
 - NASA directed a change to 5psi oxygen for weight and operational reasons
- Two approaches to minimizing fire risk:
 - Eliminate ignition sources
 - Minimize paths for fire propagation
- Preflight tests involve pressurizing spacecraft to check for leaks
 - In Apollo, a 2 psi overpressure above the normal sea level 14.7 psi was used
- This type of test was not recognized as hazardous



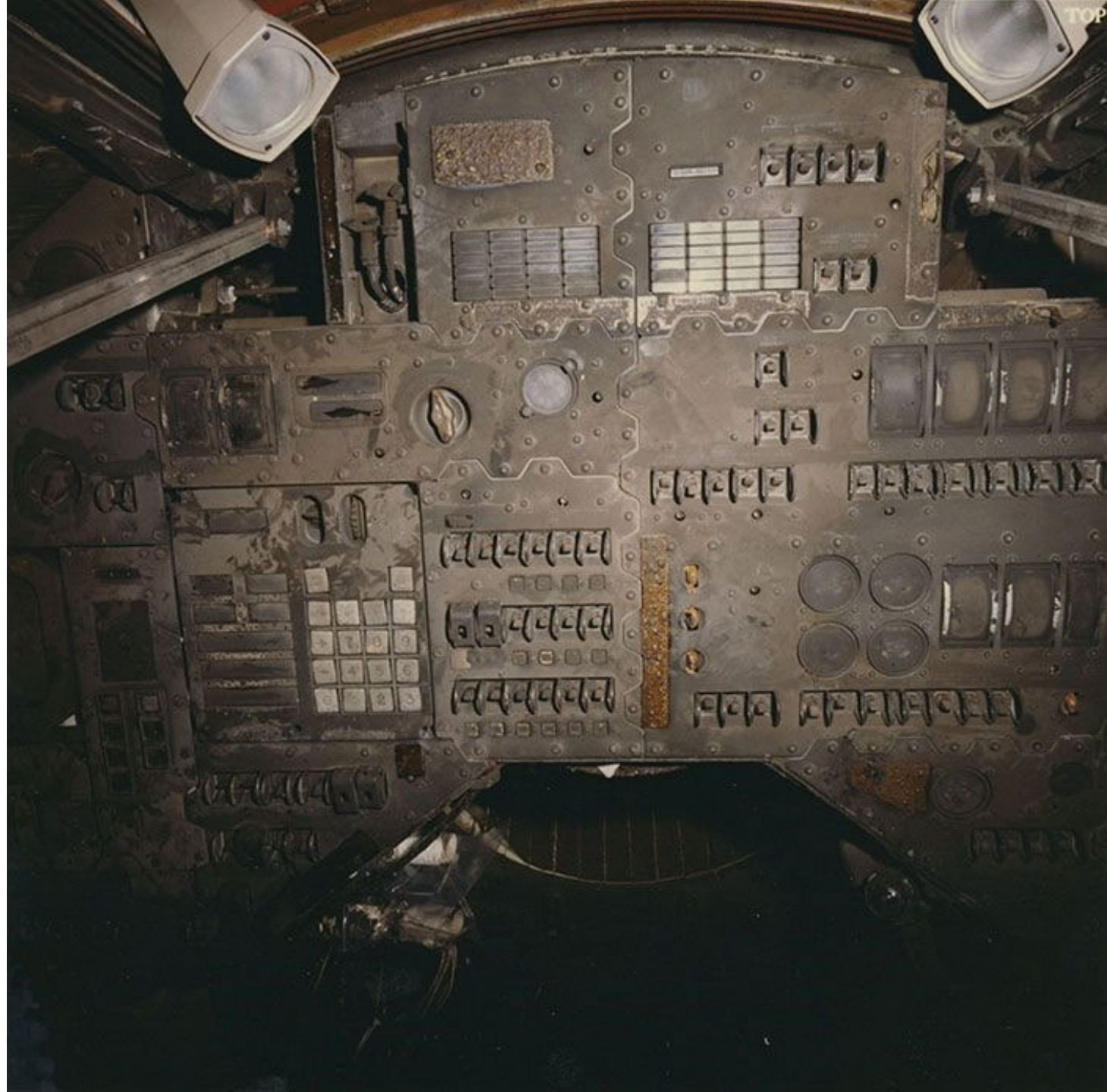


HAND HOLD ATTACH

HAND HOLD ATTACH

NO FORCE TO BE APPLIED
TO THIS SLATCH





Apollo 204 Review Board

- Floyd Thomson, Langley Research Center (Director)
- Max Faget, Manned Spacecraft Center (Apollo designer)
- Frank Borman, Astronaut (Gemini 7, Apollo 8)
- Colonel Charles Strang, US Air Force (Missile and Space Safety Chief)
- Barton Geer, Langley Research Center (Flight Vehicles Division)
- George White, HQ Apollo Program Office (Apollo Reliability Director)
- John Williams, Kennedy Space Center (Spacecraft Operations Director)
- George Malley, Lawyer
- Robert Van Dolah, Bureau of Mines (fire expert)
- Frank Long, Cornell University (Presidential Science Advisory Committee)
- George Jeffs, North American Aviation (Chief Engineer)

Spacecraft Design Recommendations

- The amount and location of combustible materials in the Command Module must be severely restricted and controlled.
- Studies of the use of a diluent gas be continued with particular reference to assessing the problems of gas detection and control and the risk of additional operations that would be required in the use of a two-gas atmosphere.
- An in-depth review of all elements, components and assemblies of the Environmental Control System be conducted to assure its functional and structural integrity and to minimize its contribution to fire risk.
- Investigation be made of the most effective means of controlling and extinguishing a spacecraft fire. Auxiliary breathing oxygen and crew protection from smoke and toxic fumes be provided.
- Present design of soldered joints in plumbing be modified to increase integrity or the joints be replaced with a more structurally reliable configuration.
- Deleterious effects of coolant leakage and spillage be eliminated.

Testing Recommendations

- Full-scale mock-ups in flight configuration be tested to determine the risk of fire.
- The fire safety of the reconfigured Command Module be established by full-scale mock-up test.
- Vibration tests be conducted of a flight-configured spacecraft.
- Management continually monitor the safety of all test operations and assure the adequacy of emergency procedures.
- All emergency equipment (breathing apparatus, protective clothing, deluge systems, access arm, etc.) be reviewed for adequacy.
- Personnel training and practice for emergency procedures be given on a regular basis and reviewed prior to the conduct of a hazardous operation.
- The Ground Communication System be improved to assure reliable communications between all test elements as soon as possible and before the next manned flight.

Other Recommendations

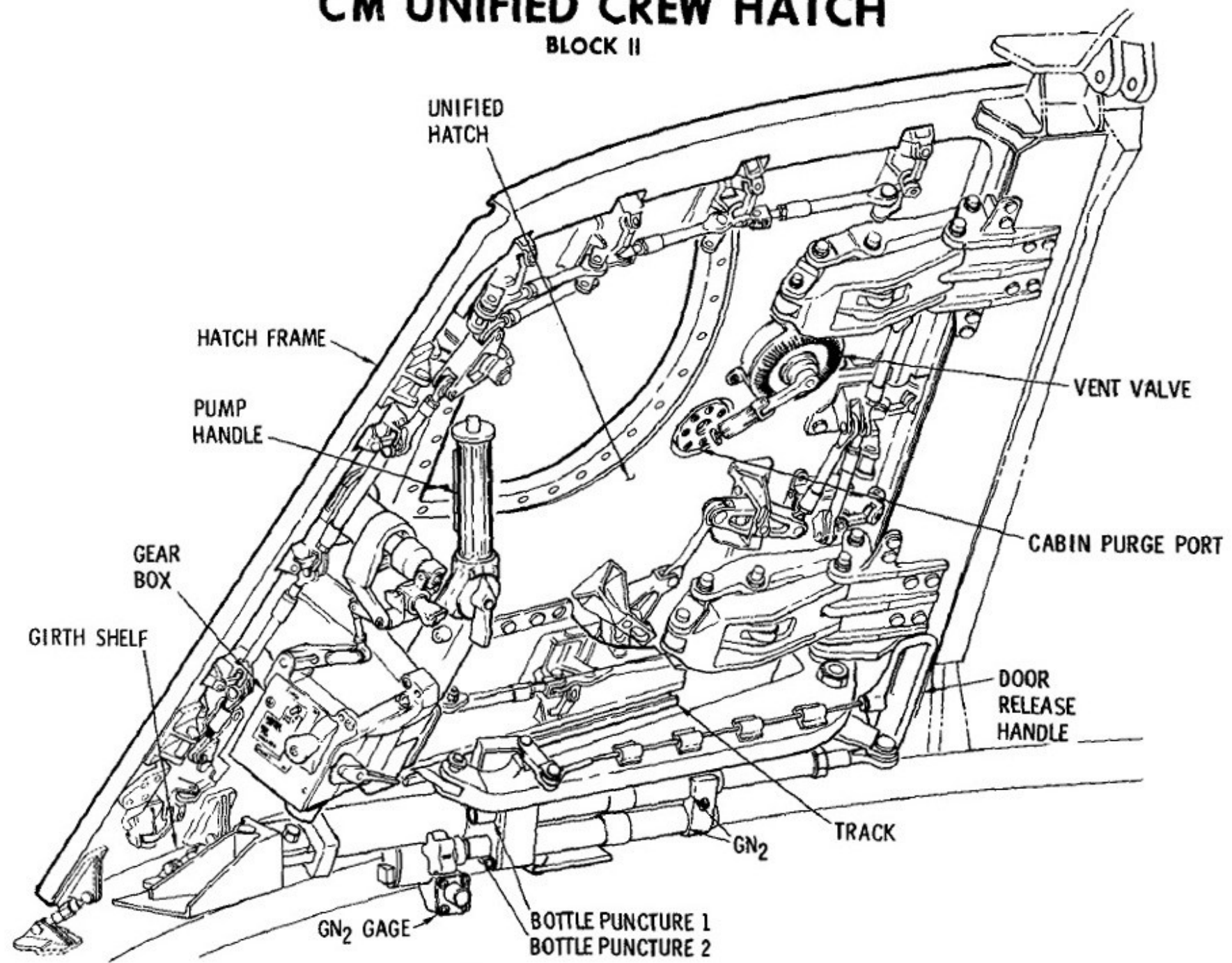
- That the time required for egress of the crew be reduced and the operations necessary for egress be simplified.
- The necessity for electrical connections or disconnections with power on within the crew compartment be eliminated.
- Review of specifications be conducted, 3-dimensional jigs be used in manufacture of wire bundles and rigid inspection at all stages of wiring design, manufacture and installation be enforced.
- Service structures and umbilical towers be modified to facilitate emergency operations.
- A detailed design review be conducted on the entire spacecraft communication system.
- Every effort must be made to insure the maximum clarification and understanding of the responsibilities of all the organizations involved, the objective being a fully coordinated and efficient program.

Major Changes

- Decision not to fly Block I command modules
 - To allow focus on correcting deficiencies in the Block II command modules
- Comprehensive flammability review to prevent flame propagation
 - Command module and lunar module
- Mixed gas atmosphere before and during launch
 - 60% oxygen, 40% nitrogen (normal air is 78% nitrogen)
- New outward-opening hatch
 - Reduced time to open from 60 seconds to 3 seconds
- Congress established the Aerospace Safety Advisory Board
 - To advise the NASA Administrator on safety

CM UNIFIED CREW HATCH

BLOCK II



Discussion Groups

- Report of the Apollo 204 Review Board
 - Complete history, timeline and analysis of the accident
- Cox
 - The engineers' view of the fire
- Chaikin
 - The Astronaut's view of the fire
- FETM episode 2 ("Apollo One")
 - A dramatization of the effects of the fire