



X-59 Life Support System Design & Testing



Loren J. Newton

Pathways Co-op, NASA Armstrong Flight Research Center
M.S. Candidate, Stanford University Aeronautics & Astronautics



Low Boom Flight Demonstrator (LBFD)



Image: Lockheed Martin

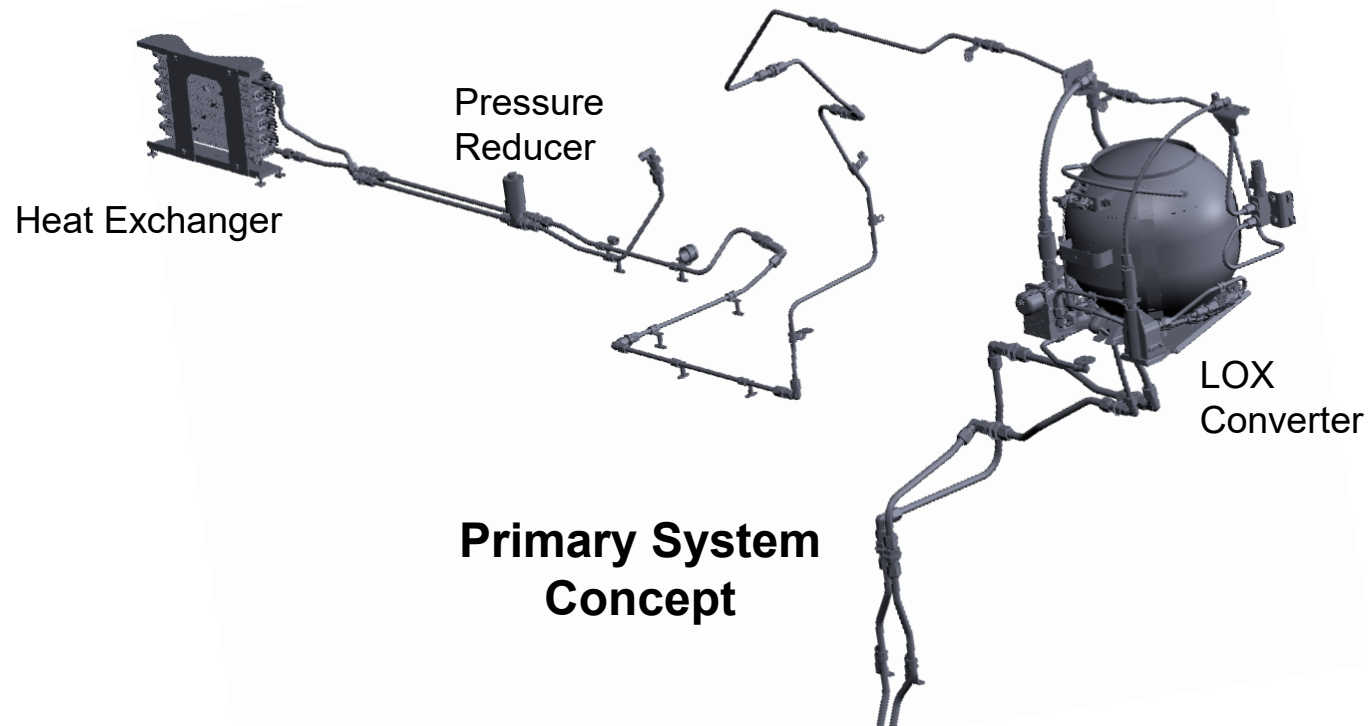
- Seeks to demonstrate a quieter sonic boom, evaluate commercial overland noise standards
- Lockheed Martin X-59 QueSST (Quiet Supersonic Technology)
- Community survey data and pressure measurements
- First flight in 2021



X-59 Life Support System (LSS) Design

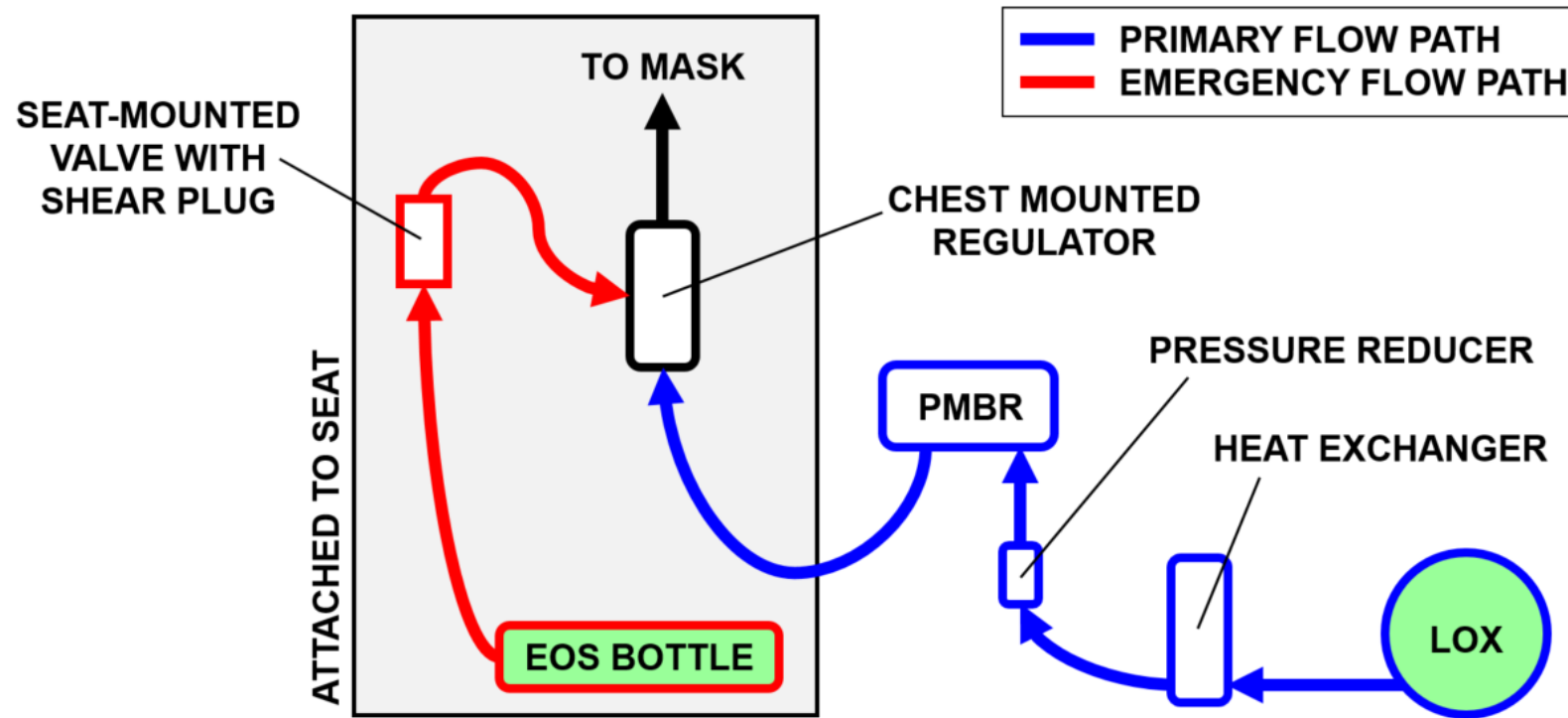


- High-altitude oxygen system: brief periods of flight over 50,000 feet
 - 100% Aviator's Breathing Oxygen (ABO)
 - Positive Pressure Breathing (PPB), partial pressure suit
- Liquid Oxygen (LOX)-driven primary system
- Ejection seat-mounted emergency oxygen system (EOS)
- Integrates components from LSS designs of existing aircraft





X-59 Life Support System (LSS) Design

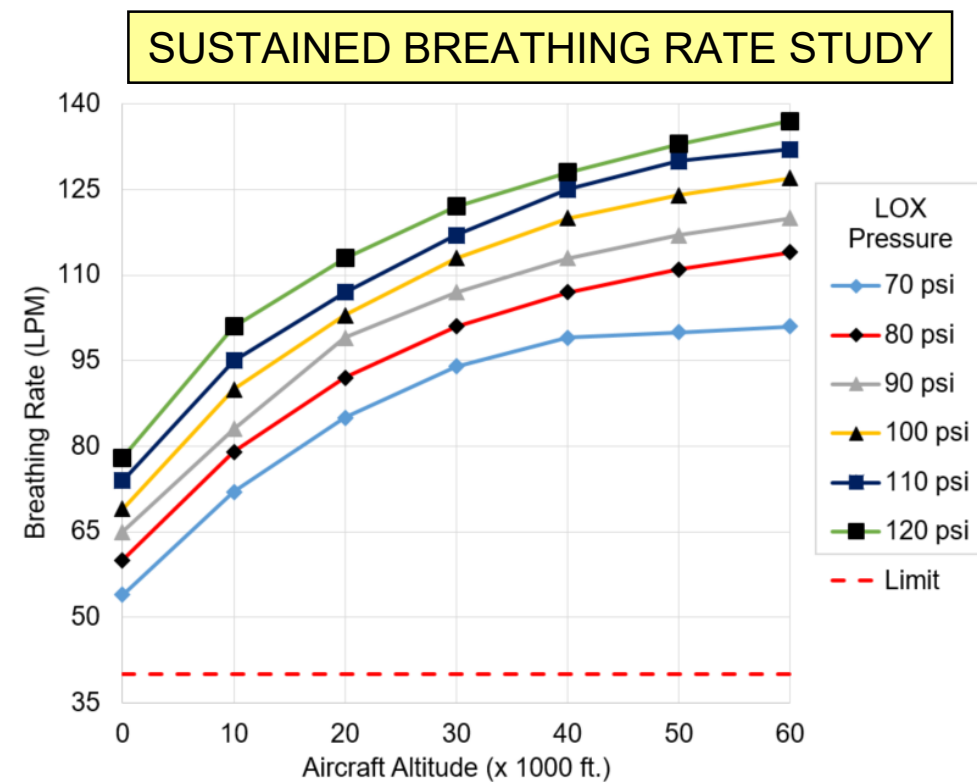
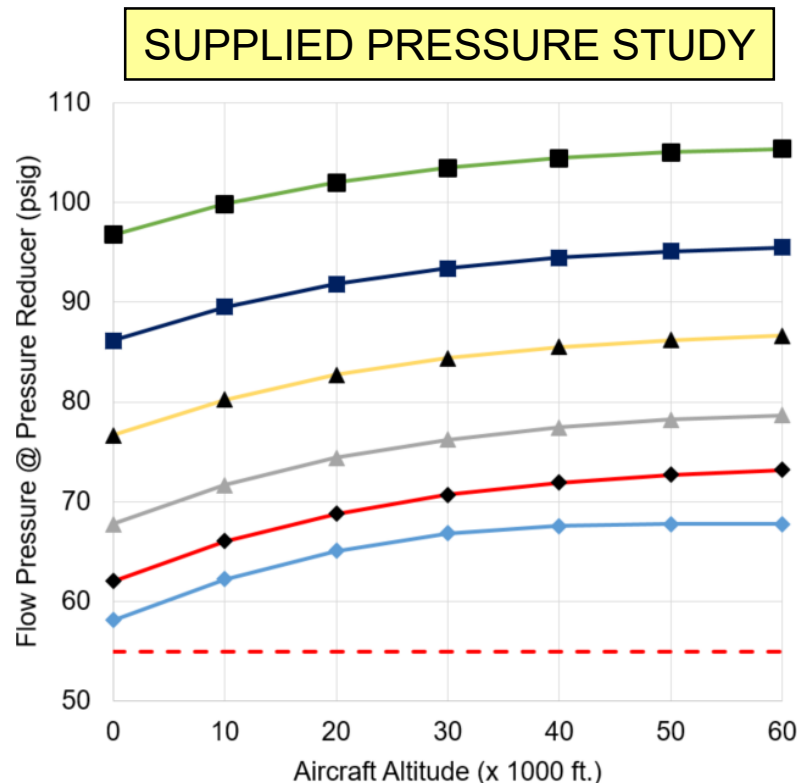


PMBR: Panel-Mounted Breathing Regulator



LSS Testing: Preliminary Modeling

- High-level, “worst case scenario” fluid modelling of X-59 oxygen lines
 - Pressure losses due to fluid friction and flow redirection
 - Relationship between breathing rate, LOX pressure, and PMBR pressure
- Demonstrated expected performance of the system as designed
- Prescribed equivalent straight line lengths for qualification testing



LSS Testing: Test Setup, KBR, San Antonio

Chest Mounted
Regulator

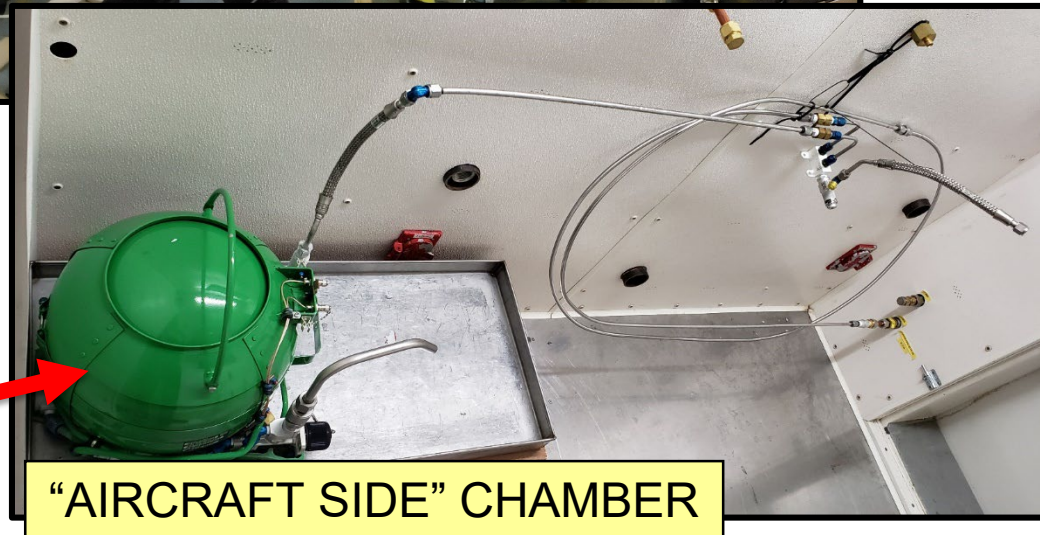
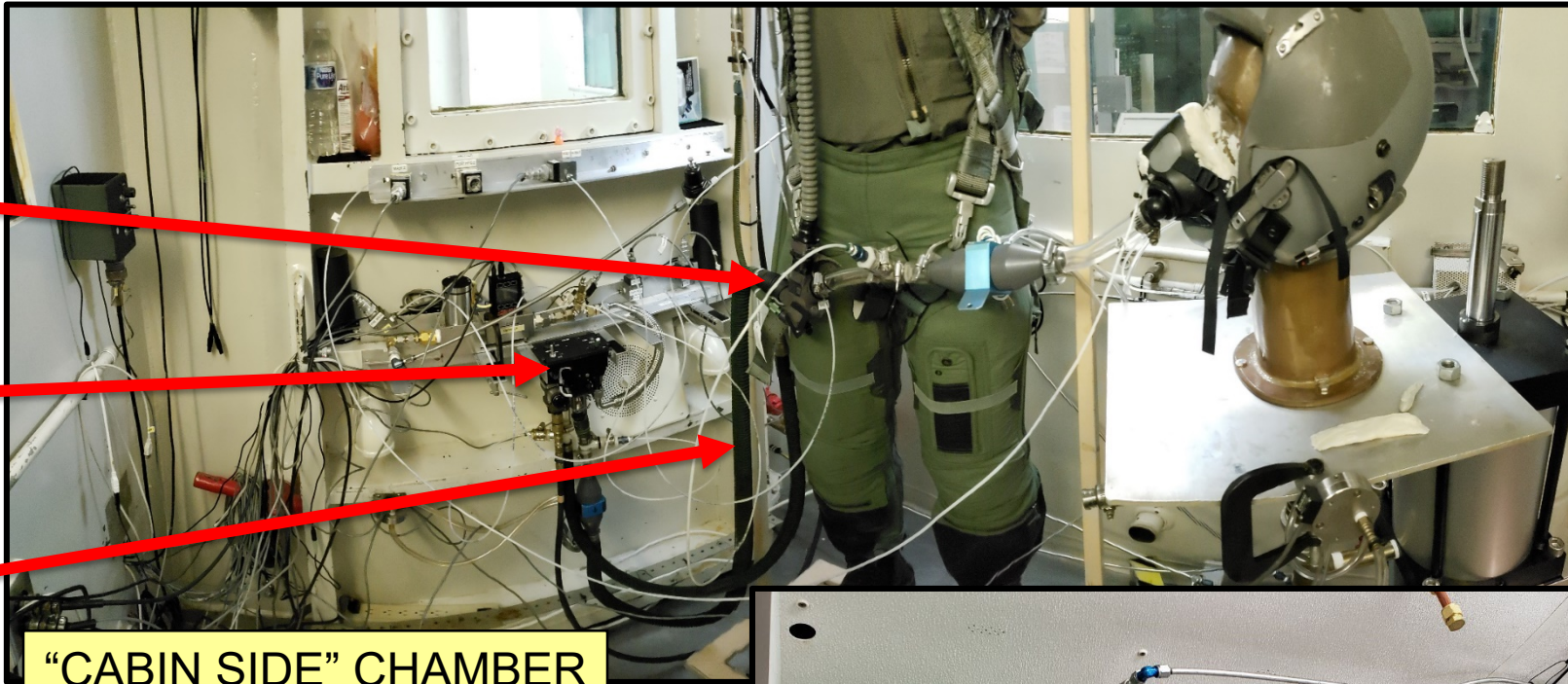
PMBR

Oxygen
Supply Hose

“CABIN SIDE” CHAMBER

LOX Converter

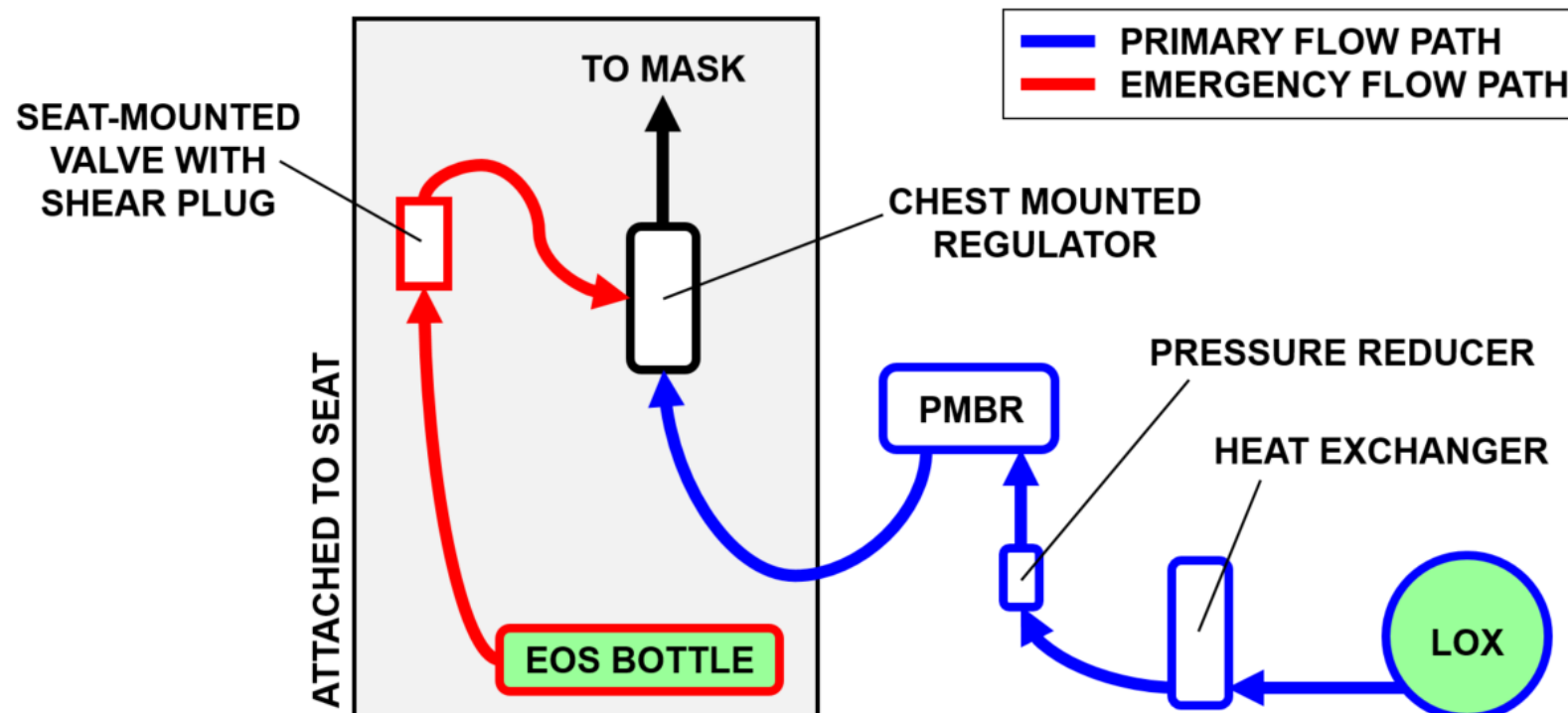
“AIRCRAFT SIDE” CHAMBER





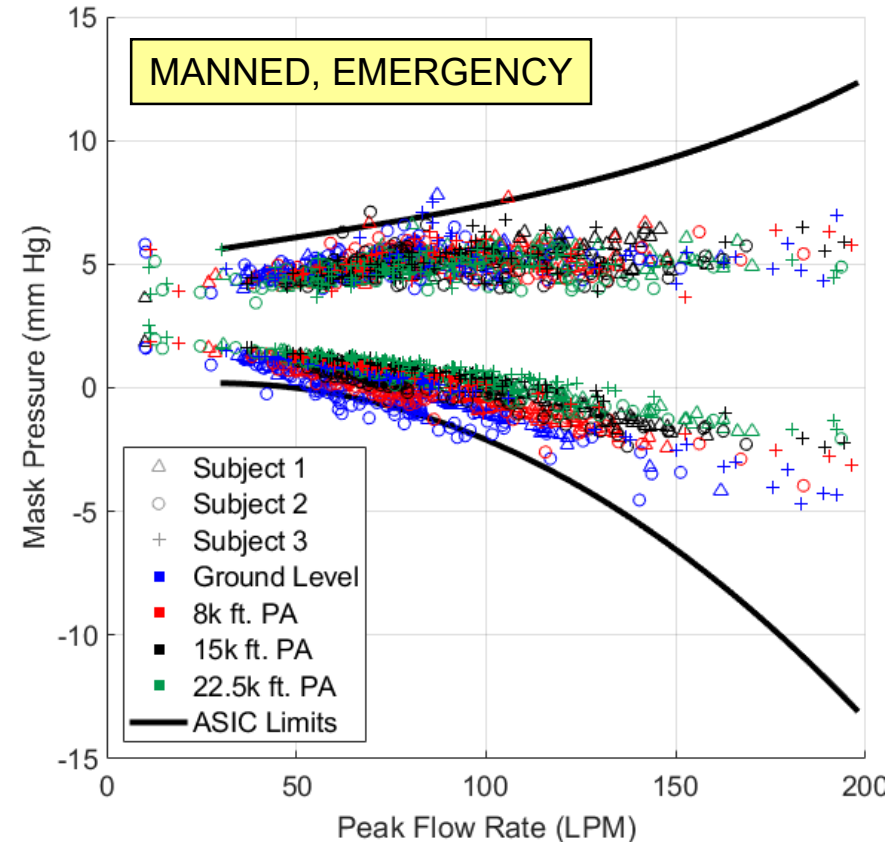
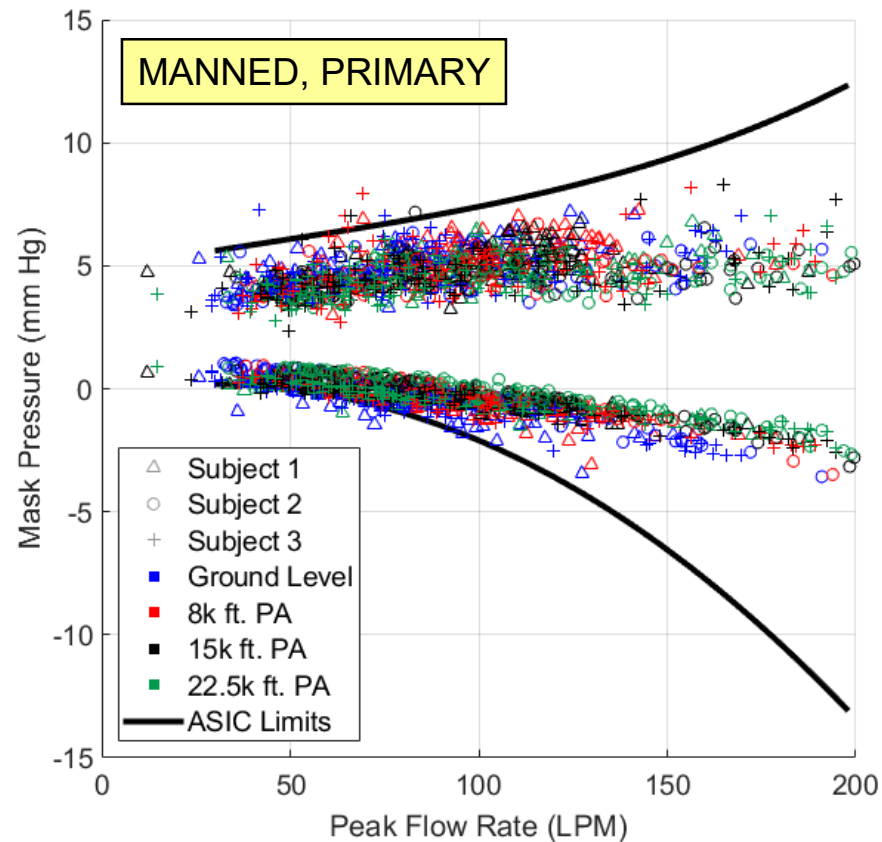
LSS Testing: EOS Actuation

- Determines how to disconnect primary system when EOS is engaged
 1. No special action
 2. Turn off primary regulator
 3. **Disconnect primary hose from chest mounted regulator**
- Nitrogen in primary path, oxygen in emergency path



LSS Testing: Breathing Impedance

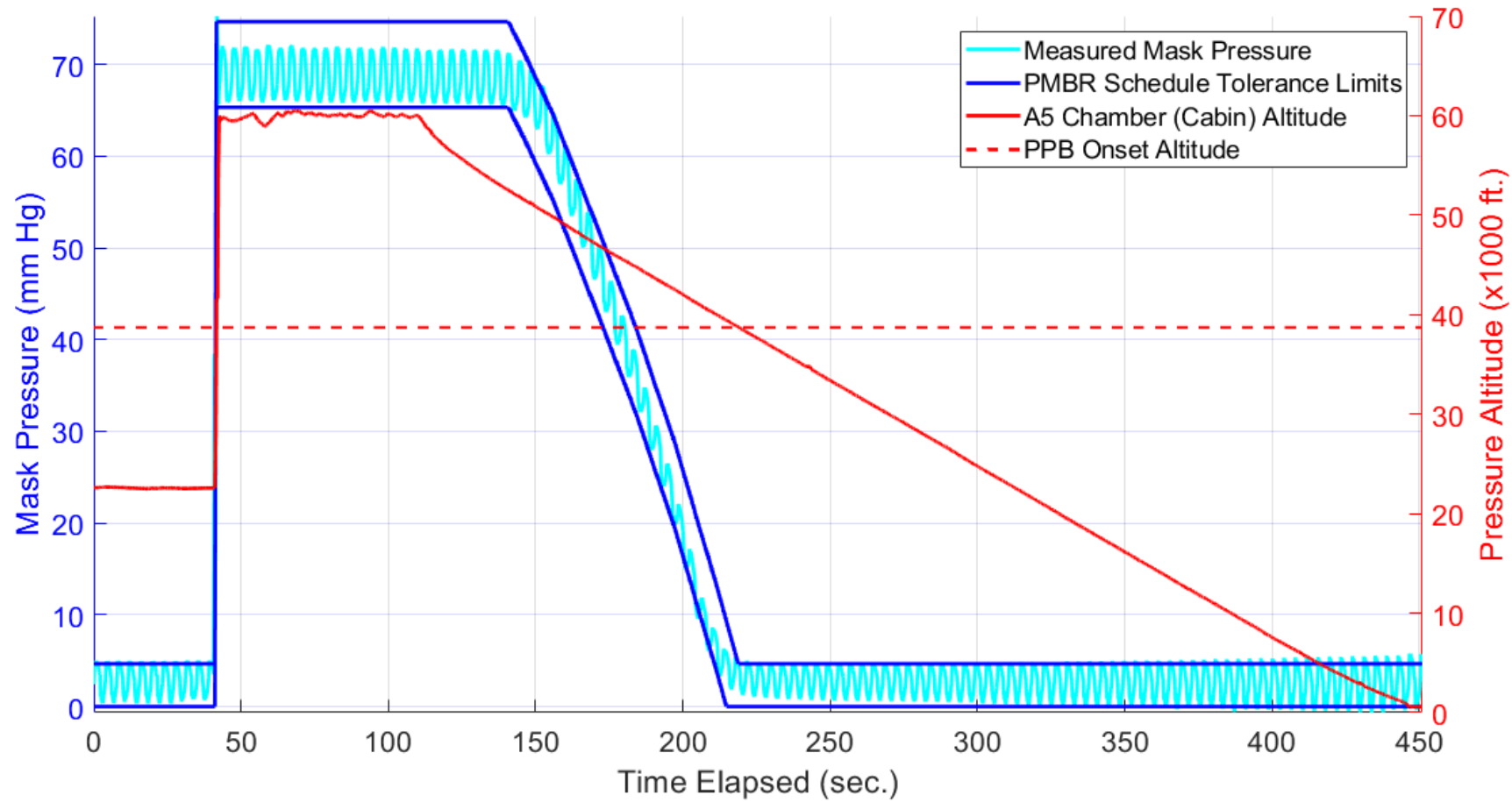
- Demonstrates that breathing workload meets physiological guidelines
 - Primary and emergency systems
 - Unmanned and manned testing
- Drove removal of seat quick-disconnect fitting





LSS Testing: Rapid Decompression

- Ensures performance during sudden drop in cabin pressure
 - Simulated in-cabin decompressions or simulated ejections
 - Primary and emergency systems
 - Unmanned and manned testing

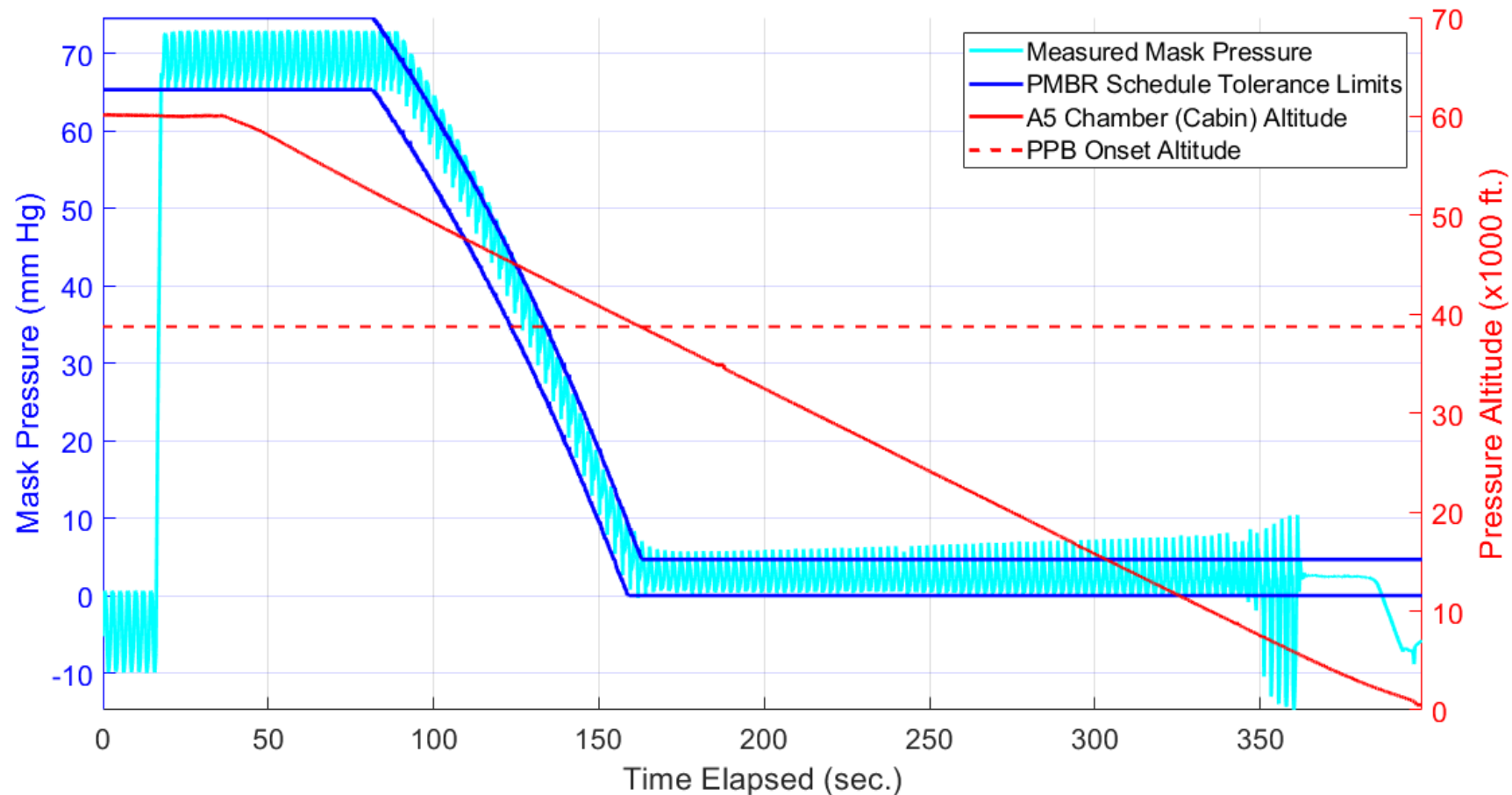




LSS Testing: EOS Duration



- Shows that the EOS can sustain the pilot through a descent from altitude
 - Unmanned testing
 - Off-seat tests completed; on-seat tests pending final mounting design





Conclusions



- Flight-proven hardware in a novel configuration
- PPB capable for high altitude flight
- LSS is qualified throughout flight envelope
- Final testing pending: on-seat EOS qualification
 - Off-seat testing is nearly fluid mechanically equivalent



Image: NASA



Acknowledgments



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Questions?

