



Manned Chamber Mods for Next Generation Space Suits

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Context of What We Do



- Johnson Space Center (JSC) Building 7 is home to the Crew and Thermal Systems Division (CTSD).
- CTSD requires oxygen, breathing air, and nitrogen gases as utilities for two primary activities:
 - ISS crew training operations
 - Space suit testing at the component level and full suit level
- CTSD recently did a major upgrade of the gas supply infrastructure as part of the larger upgrade to make the facility ready for next generation space suit testing.

Before the Mods



LN2 tank, pump, and ambient vaporizer



- Our only permanent vessel infrastructure was an LN2 tank that we used to refill the 1507 PSIG GN2 tube trailer.
- Cannot generate enough pressure for next gen suit requirements.

Before the Mods



O₂, GN₂, and 2X BA Tube Trailers



- NASA permits DOT tube trailers to be permanently installed and to skip DOT recertification **IF** they are derated to 2/3 of original pressure.
- The tube trailers could not provide the pressure or capacity needed for next gen space suits.



Context for Mods



- Crew and Thermal Systems Division required facility and chamber modifications to support testing for the next generation space suits.
- CTSD requires 3600 PSIG oxygen, nitrogen, and breathing air supplied by ASME vessels; and gas management stations to support test chamber operations.
- The Space Suit Systems Lab required their own, independent sources of 5000 PSIG oxygen, nitrogen and heliox (downregulated to 4500 PSIG at the lab).
- This provided the opportunity to upgrade the LN2 vaporizer and transition from stationary tube trailers to permanent ASME vessels.

Before the Mods



The tube trailers were walled in after they were placed and had to be craned out.



Capacity Improvements

Derated Tube Trailer Operational Volume	8,620 ft ³	8,620 ft ³	18,198 ft ³	-	-	-
Derated Tube Trailer Max Pressure	1507 PSIG	1507 PSIG	1507 PSIG	-	-	-
New ASME Vessels Operational Volume	48,922 ft ³	48,922 ft ³	48,922 ft ³	701 ft ³	701 ft ³	701 ft ³
New ASME Vessels Max Pressure	3600 PSIG	3600 PSIG	3600 PSIG	5000 PSIG	5000 PSIG	5000 PSIG
Percent Increase in Op Volume ASME Vessel vs Derated Trailer	468%	468%	169%	-	-	-
Refill Time	~18 hr	~18 hr	~36 hr	~9 hr	~9 hr	~27 hr
Vessel Source	2750 PSIG Tube trailer	50 PSIG LN2	Ambient Air	3600 PSIG O2 Vessel	3600 PSIG N2 Vessel	1800 PSIG K-bottle

After the Mods



Same LN2 tank, new pump,
and new ambient vaporizer

New pump and vaporizer can
provide enough pressure to
fill the 3600 PSIG vessels.

After the Mods



3600 PSIG and 5000 PSIG Vessels



ASME Appendix 2 Vessels – N₂, O₂, BA, Heliox



Summary



- Transitioning from DOT tube trailers to ASME Appendix 22 permanent vessels was painful but well worth the effort.
- We were able to incorporate a state-of-the-art gas management system with remote control features and integration to our data acquisition system.
- Very safe – the system has its own emergency management built in
- We still have tube trailers coming/going but they're here for the day/week instead of several weeks.