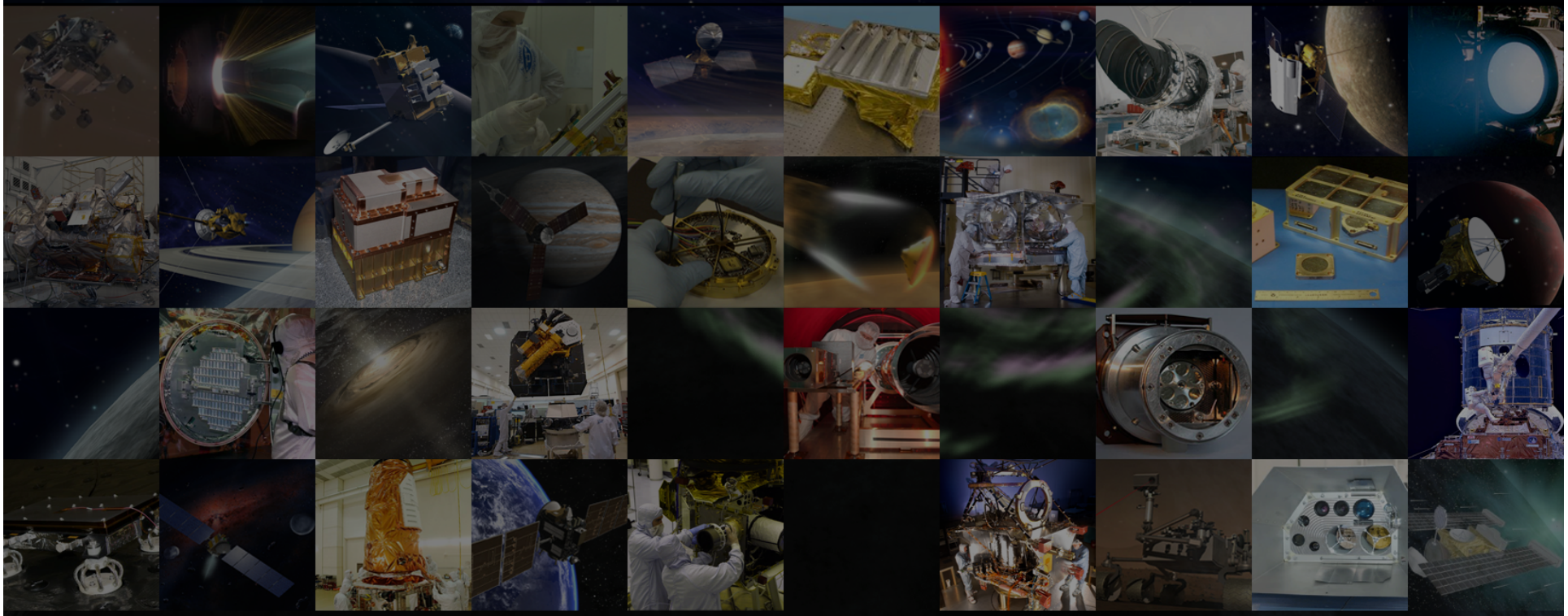
National Aeronautics and Space Administration

GRC Extreme Environments Facility
Tibor Kremik, NASA Glenn Research Center
Overview and Status - August, 2011



Characteristics

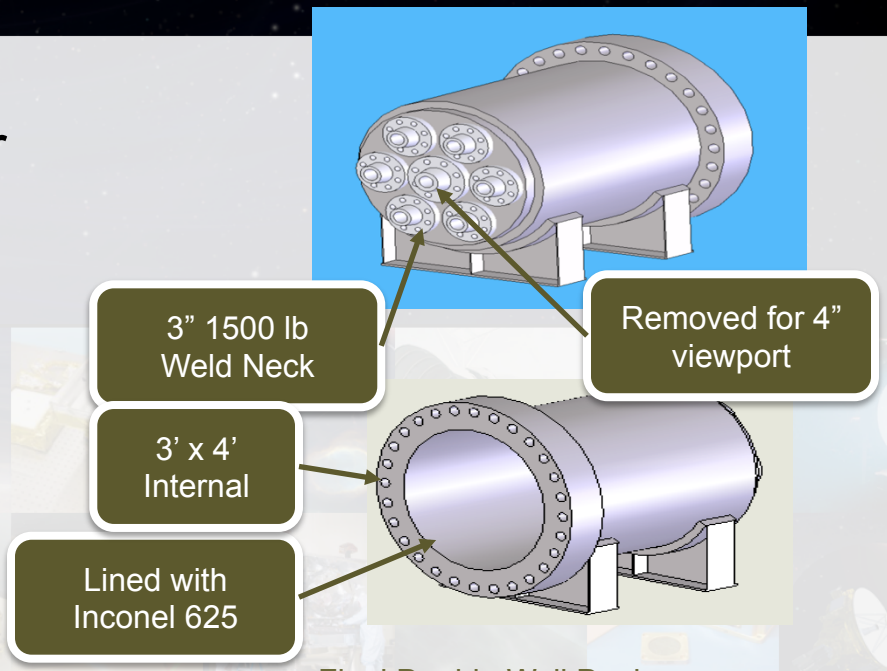
Specs for existing US facilities and the new NASA GRC Facility

Location	Volume (ft^3)	Pressure (bar)	Temperature (°C)	Species	Material of Construction	Dimensions (ft by ft)
MIT	0.005	1 to 200	20 to 700	CO_2	Inconel 625	0.04 by 1
MIT	0.08	1 to 200	20 to 700	CO_2	Inconel 625	0.08 by 4
NASA GSFC	0.52	1 to 95.6	20 to 467	CO_2, N_2	Stainless Steel 316	0.41 by 1
NASA JPL	1.53	1 to 92	20 to 500	CO_2, N_2	Stainless Steel	0.33 by 4.5
Georgia Institute of Technology	4.22	1 to 100	20 to 343	CO_2, N_2	Stainless Steel 304	1.16 by 1
NASA Glenn **	***113***	***10^{-3} to 103****	***20 to 537****	***All***	***Inconel liner, SS304 hull***	***3 by 4***

****Plans for adding cryo capability - the facility operating range can be extended to include cryogenic temperatures (-150C) and hard vacuum (10^{-10} bar).**

Test Chamber Details

- ASME stamped vessel rated for 1500 psig and 500 ˚C (932 ˚F)
- 3’ diameter X 4’ length
- 2” Stainless Steel 316
  - Supports pressure
- 1/8” Inconel 625 liner
  - Chemical protection
- 14 tons
- Flat 10” head



Final Double Wall Design

Pressure		Temperature	
Min	Max	Min	Max
10^{-10} bar	103 bar	Atmospheric	537 ˚C
Chemical			
7 corrosive/acidic		2 extreme corrosive	
Computer controlled altitude adjustment, up to 1 m/s recirculation			

Test Chamber Details

- 9 gas streams
- Corrosion resistant
  - Inconel 625
  - 316 Stainless 4Ra finish
- H_2O bubbler adds water vapor
- Thermal mass flow controllers
- Pressure sensors
- PLC with touch screen
  - Input gas concentrations
  - Monitors temp, pressure, mass flow
  - Capable of 5 ppb ±0.7%
  - ISO 17025 certified calibration

Polycontrols
Gas Mixing System

- Initial capability:
  - Full Venus Environment, Jupiter thermosphere, Mars equator, Io near volcanic vents, etc.
- Capability with cold wall:
  - Mars, Jupiter (to -78 km), Io, Europa, Ganymede, Titan, etc.

Potential Additions and Testing

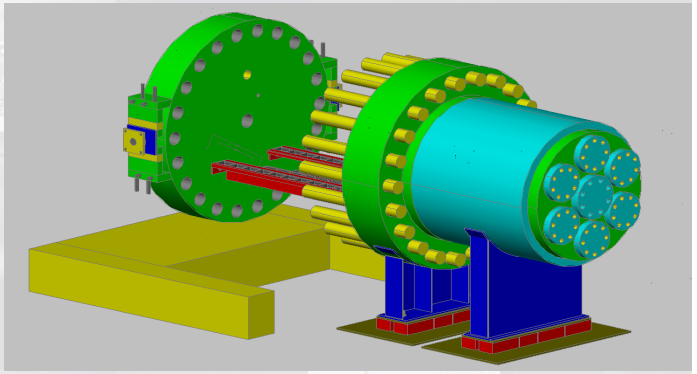
- Chamber additions can utilize existing PI&D – Would offer potential for full scale testing
  - » Fill and purge system
  - » Mixing system
  - » Leak/Low oxygen detection
  - » Exhaust scrubbing system
  - » Expanded data acquisition
- Circulation and Cold wall

Testing Process

•Test article fixed to standard mounting plate
•Transported from 14' bay door through 6' double doors on vented clean room to 3' x 4' test chamber
•Mounting plate affixed to test article tray and vessel sealed
•Filling and mixing process
•All gas cylinders route to the mixer
•The mixer outputs to an accumulator where pressure is charged with CO_2 up to ~514 psi and pumped into vessel
•Mixture is fed to the vessel, heated, and test runs for up to 1 year
•Atmosphere is vented to scrubber to neutralize chemicals
•System is nitrogen purged and drawn down to vacuum
•Chamber refilled with air and opened to remove article

Status

- Leveraging NASA and GRC investments
  - ✓ Have dedicated space – facility prepared
  - ✓ Have a separate control room
  - ✓ Most (90% plus) of the needed equipment (for minimum operations) is purchased – most already being installed at GRC
  - ✓Main chamber procured and in fabrication
  - ✓Completed Gas Mixer initial safety testing
  - ✓Procured safety systems
  - ✓Designed Gas Cabinet ductwork
  - ✓Floor loading checks and design completed
  - ✓Developing gas system controls for PLC
  - ✓Setting equipment
  - ✓IF funding is available could be ready next summer 2012



Images