



Lunar Surface Environment Test Capabilities – JSC B351

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Outline



- ESTA
- General Facility information
- Test capabilities
 - Lunar Simulant handling areas
 - Settling dust chamber
 - Component dirty thermal vacuum chamber - 3ft
 - System level dirty thermal vacuum chamber - 15ft
 - Experience & previous testing

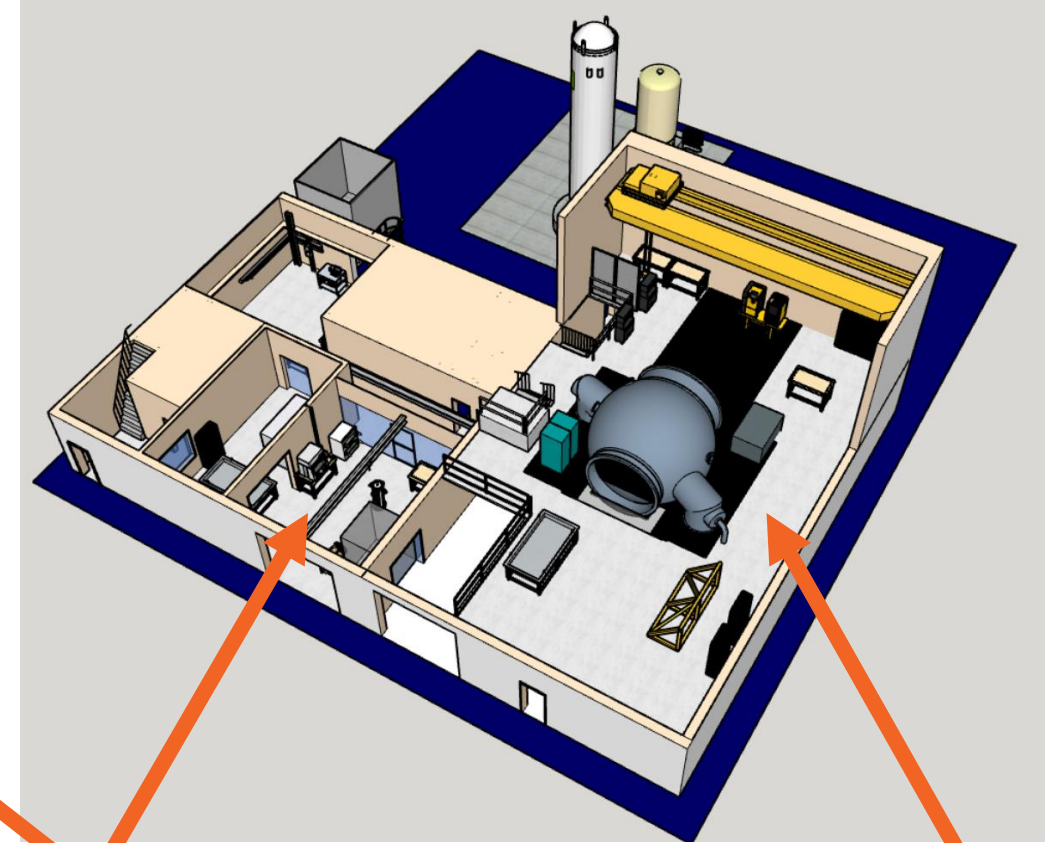


B351: Thermal Vacuum Test Facility





Dust Containment and Preparation Room



Dust containment & preparation room

15' chamber



- Enclosed 750 ft² room sealed and equipped with HEPA fan filtration unit for dust containment and negative pressure maintenance.
- Particulate monitoring and audible alarm to ensure air quality is maintained.
- Provides room for regolith bin loading and preparation.
- Provides room for test article preparation and pre-conditioning prior to transfer to the 15' chamber.
- Houses desktop ambient dust box and small vacuum bell jar.

Settling Dust Chamber

- Meets some industry standards for dust exposure
- 72"x36"x30" interior
- Timed dusting allows for repeated application of dust to moving test articles
- Initial validation testing with Lunar simulants underway
- Located in B351 Dust Preparation Room
- Status: Online and available for use



- Thermal Vacuum capability with dust mitigation for pumping system
- 36"x36"x36" Box shape
- Rough or High vacuum (10-5 torr range quickly, 10-7 demonstrated)
- Shroud temperature range of -300F to +300F
- Shroud walls independently controlled for zone temperature conditioning if needed
- Status: Online and available for use





15ft Chamber Capability

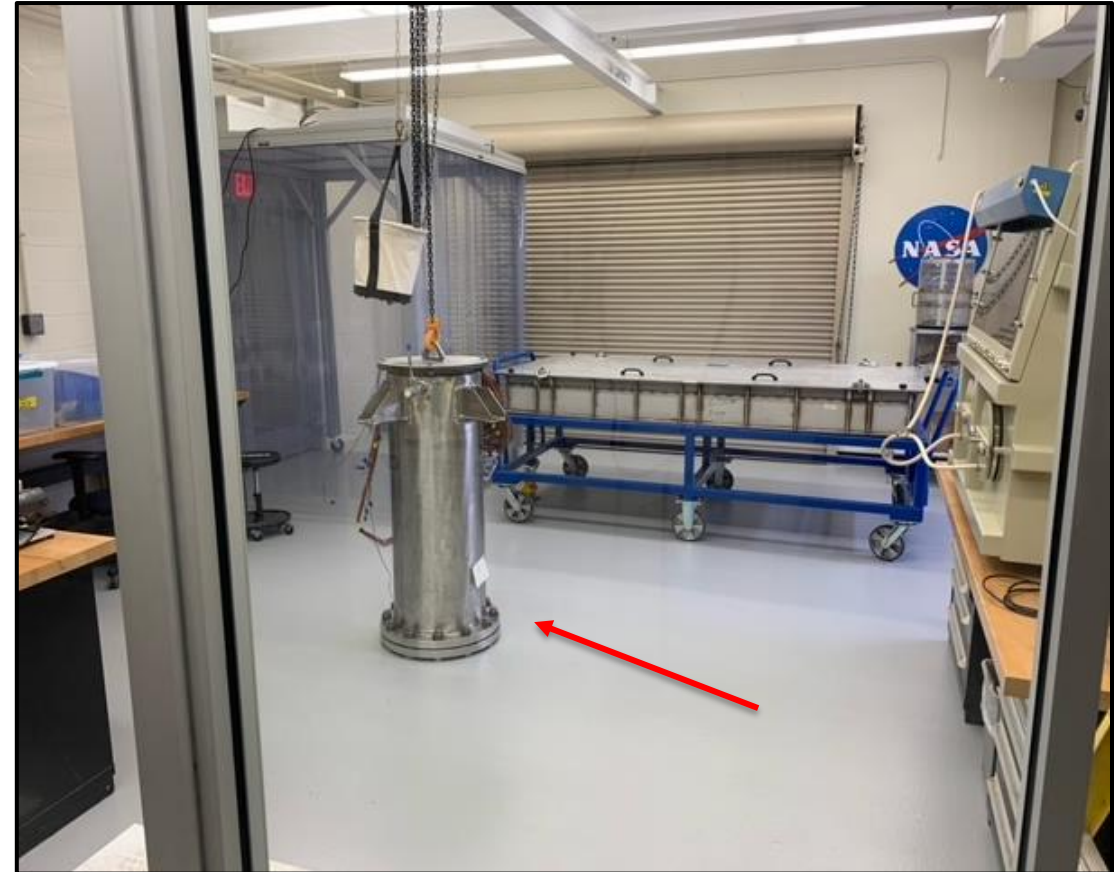


- Description
 - 15ft Φ Spherical Chamber with ~78in Φ clear entry
- Environment Capability
 - **Vacuum:** 1×10^{-6} torr (ultimate),
 - Pumping, rotary piston pumps, roots blowers & two 36in diameter diffusion pumps
 - **Atmosphere:** Air or GN_2 Repressurization
 - **Thermal Range:** -185°C to $+120^\circ\text{C}$ Thermal shroud temperatures
 - High channel count data feedthroughs
 - High power feedthroughs available
 - Max platform load: 4,000 lb
 - Test article operation on 48" x 96" regolith bed in chamber with surface interactions with regolith to depths down to ~3 ft
- Previous tests: used for fuel cell, electric APU during Shuttle, Cryogenic propellant storage, Apollo lunar rover tire, CaRD (ISRU)



Simulant Drill Tube

- Tube jacket to be flooded with LN2 for cooling and heated GN2 for return to ambient temperature
- 13.5" (.342 m) ID and 42" (1.06 m) drill depth with 4" clearance above soil height
- Designed to be filled with compacted lunar regolith simulant with a target water content of 5% water by weight
- Holds ~370 lb. (168 kg) of simulant for a combined weight of ~984 lb. (446 kg)



Drill Tube in Dust Prep Room

Simulant Bin

➤ Description

- For use in 15' Chamber
- Basic bin, designed to be filled with simulant in dust containment room and transported into chamber after preparation.

➤ Soil Bin Specifications

- Dimensions: 48" x 96"
- Empty weight: 650 lb
- Max level fill: 8"
- Max level fill weight: 2,880 lb
- Max test article weight at max fill: 520 lb*

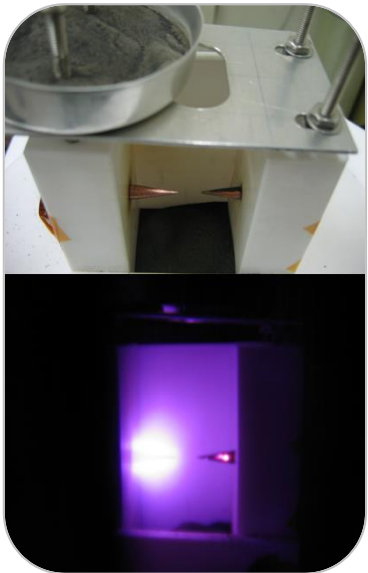
* Based on max platform load of 4,000 lb and assuming two techs (200 – 300 lb each) are needed to install into chamber.

Movable partitions provide customization for a lower fill percentage to minimize unnecessary simulant and maximize test article weight budget



Experience with Regolith Simulants/Dust

Lunar dust effects on electrical components



OVEN in Dust Box (ISRU/Resource Prospector)



O2 Extraction via H2 Reduction (ISRU)



Planetary Surface Simulation- Dust mitigation



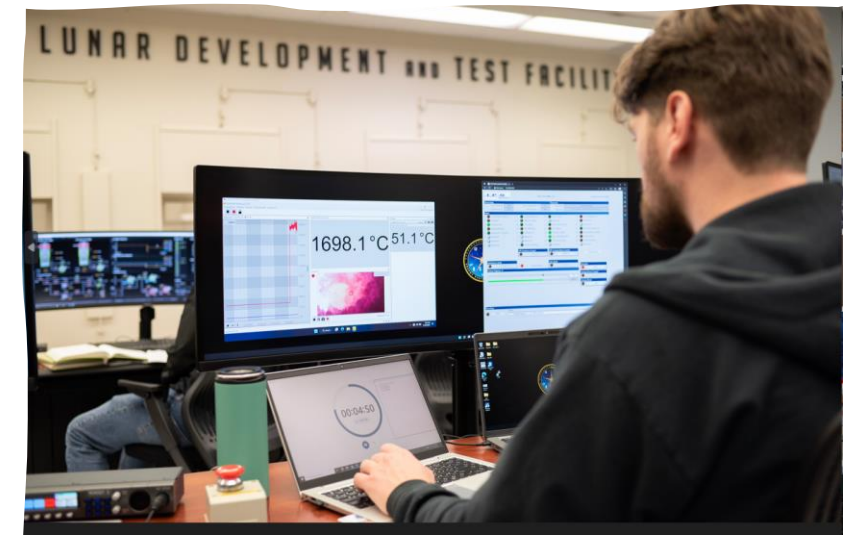
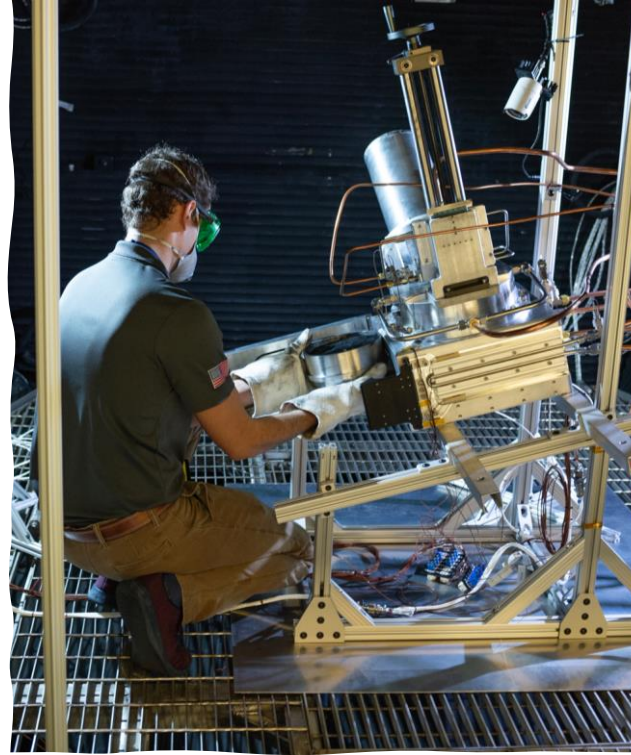
VIPER Wheel Assy Dust Exposure Test



Auger Dryer for Water extraction Mars soil (ISRU)

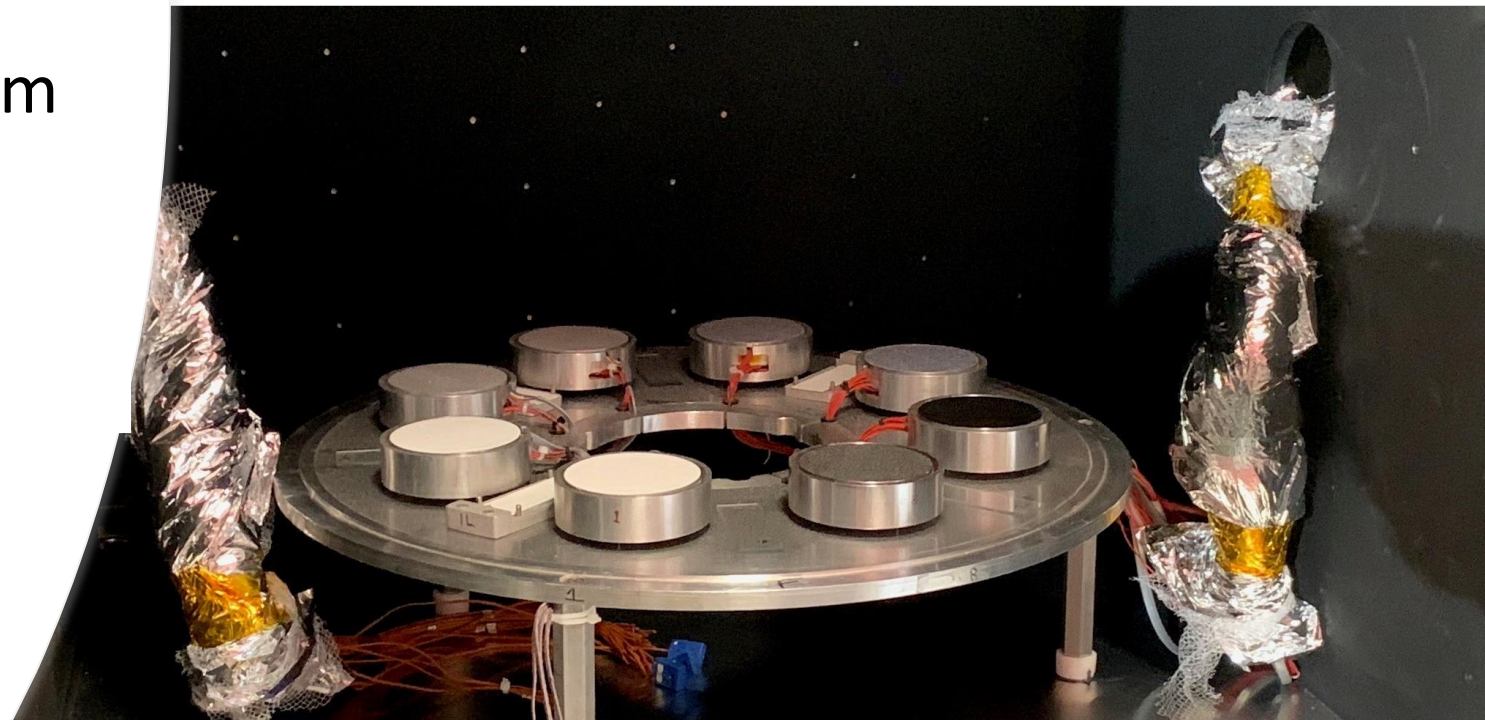
Experience with Lunar Simulant – CaRD (ISRU)

- Lunar Simulant Prep (bottom left)
- Simulant installation in CaRD reactor – top left
- CaRD in 15ft thermal vacuum chamber – top right
- CaRD under test – bottom right



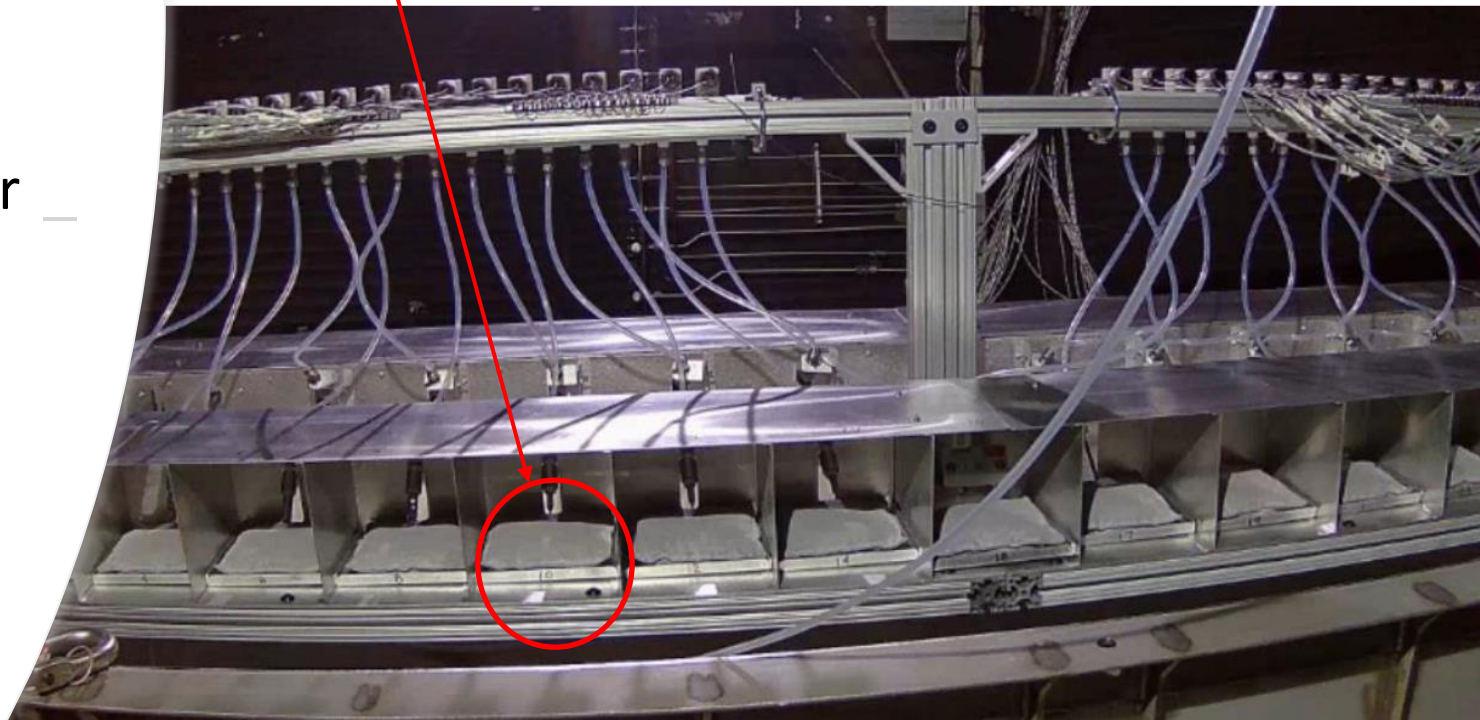
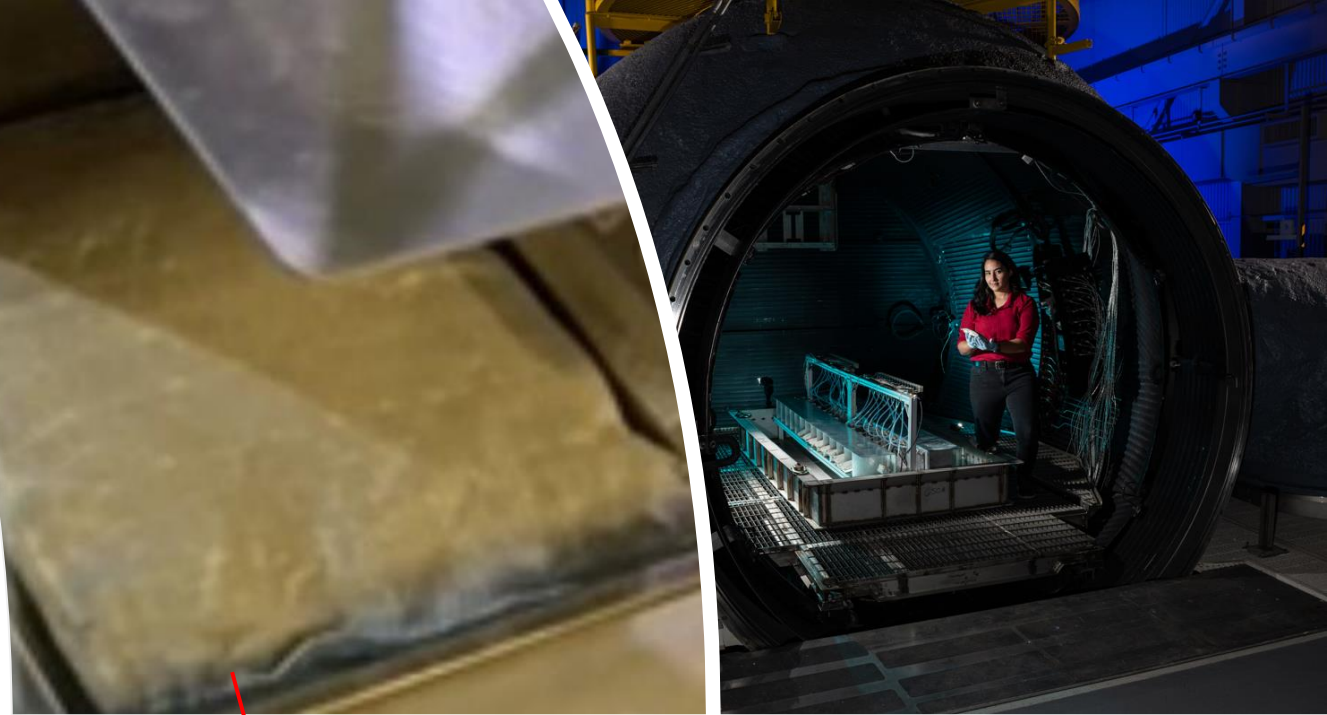
Experience with Lunar Simulant – LDES

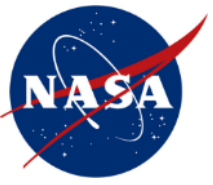
- Test article dusting in simulant prep & handling area – top left
- Loading test article in 3ft vacuum chamber – top right
- LDES test setup in 3ft vacuum chamber - bottom



Experience with Lunar Simulant – Dust Mitigation Study on Suit material

- Close-up of suit material coupon covered in dust– top left
- Test articles in 15ft vacuum chamber – top right
- View of test assembly with dusty coupons -Bottom

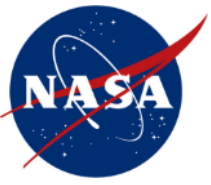




Backup



Detailed Chamber & Facility Interface Information

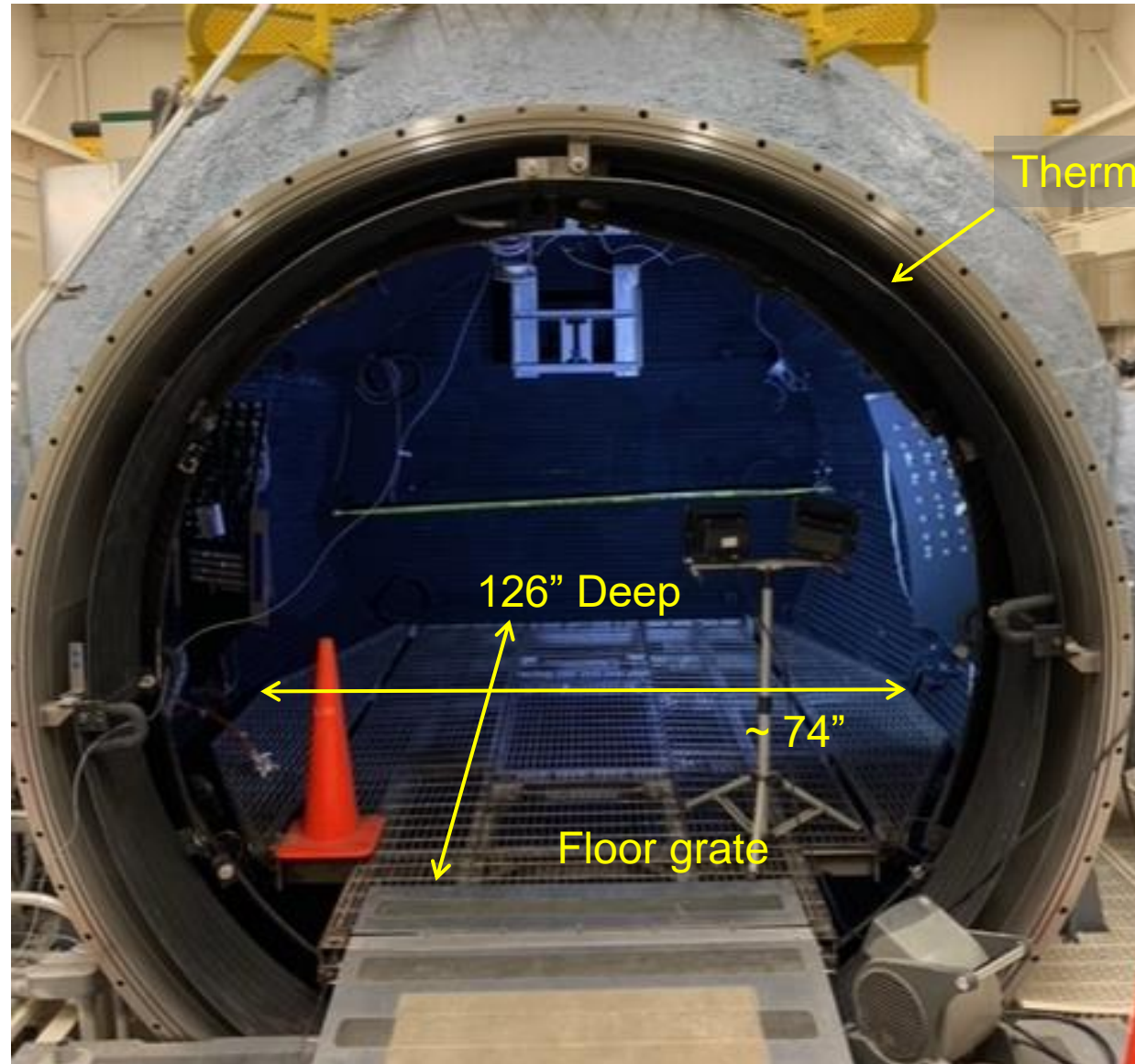


Control Room



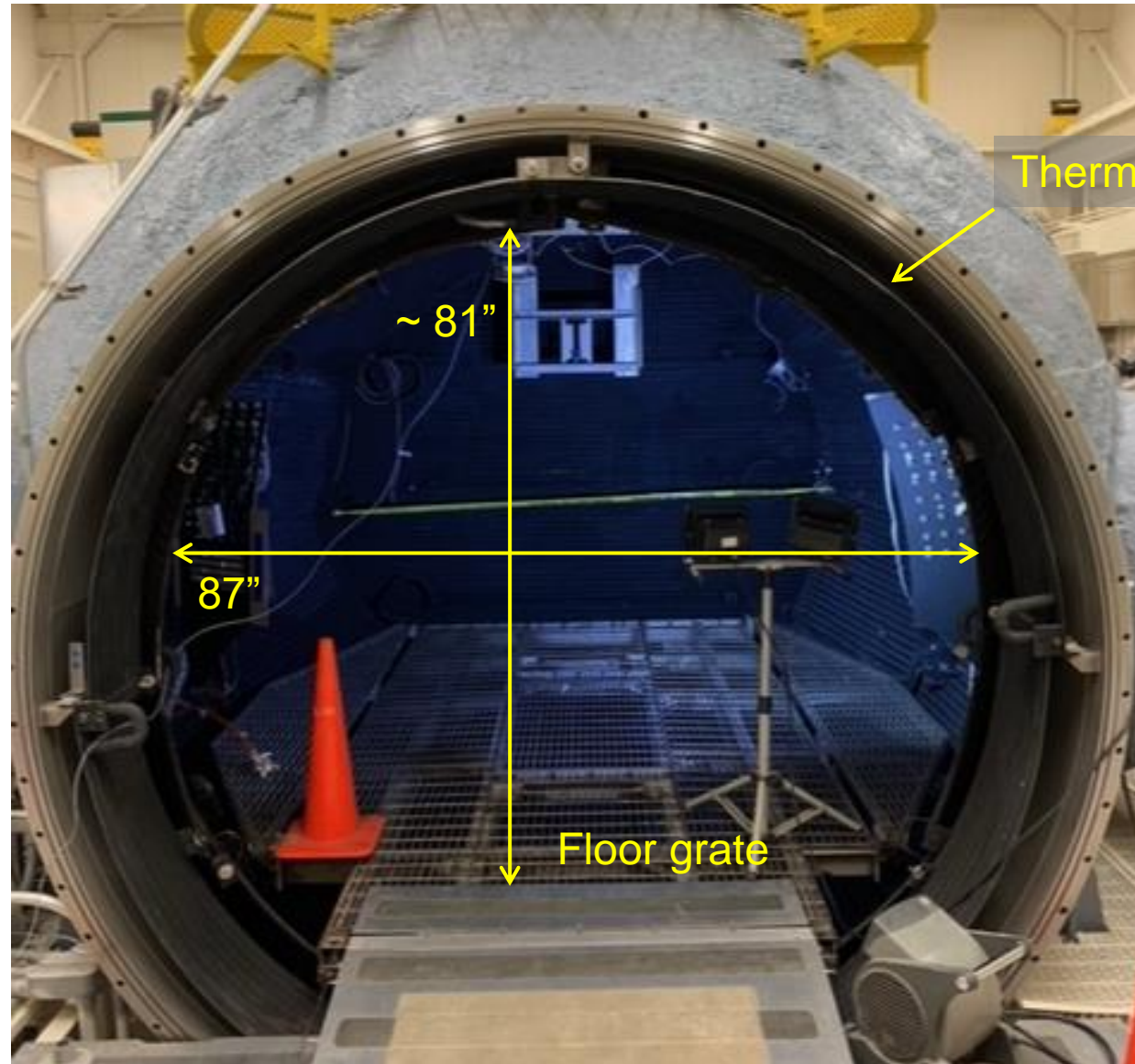


15ft Chamber Platform





15ft Chamber Opening





15ft Chamber Facing West



15ft Chamber Facing North

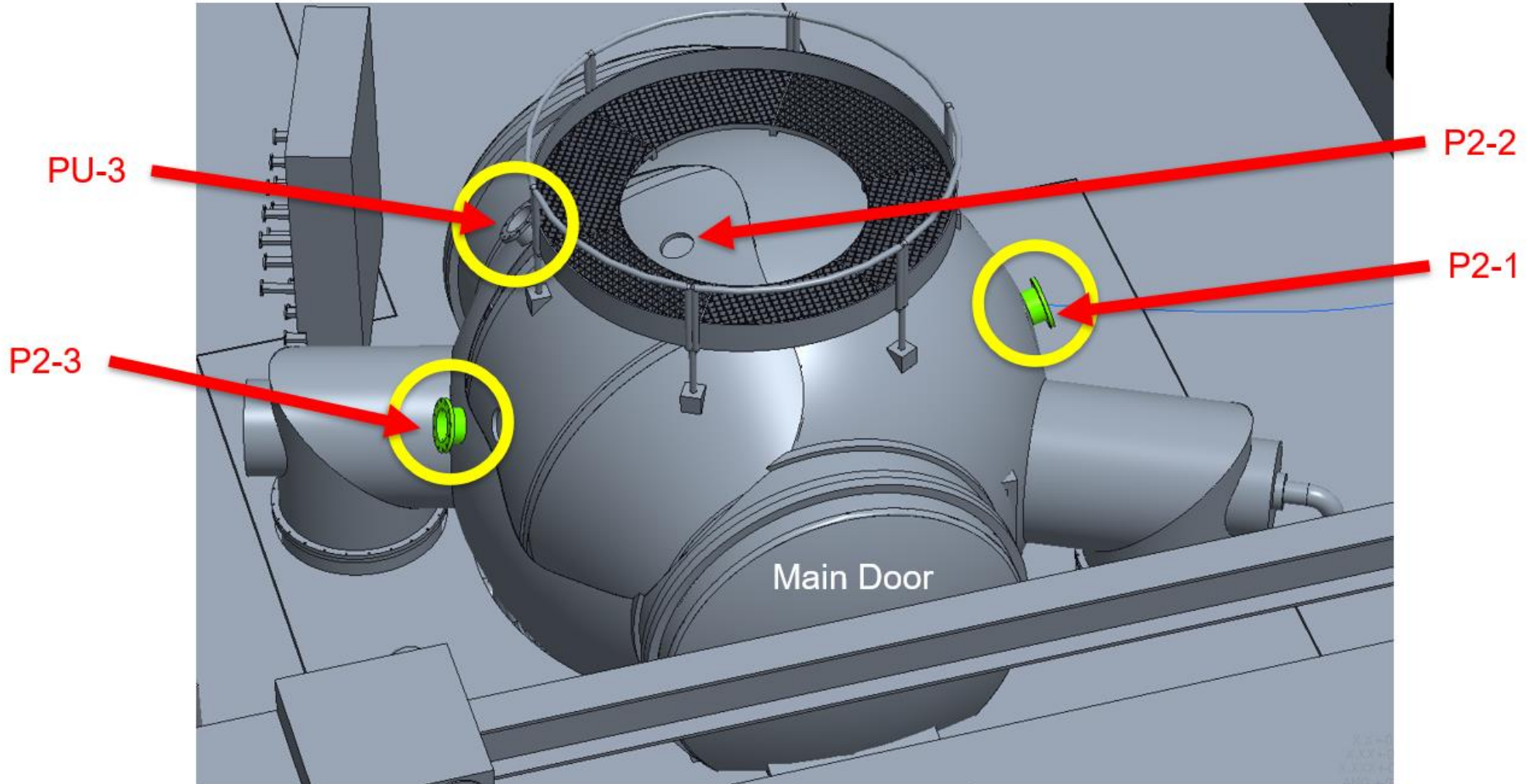


Heights & Clearances for 15ft Chamber

- The height of the crane hook over the 2nd floor is 14 ft.
- Hardware brought into facility via 12 ft roll-up door
- Lifted up over the 3.5 ft railing- railing is removable

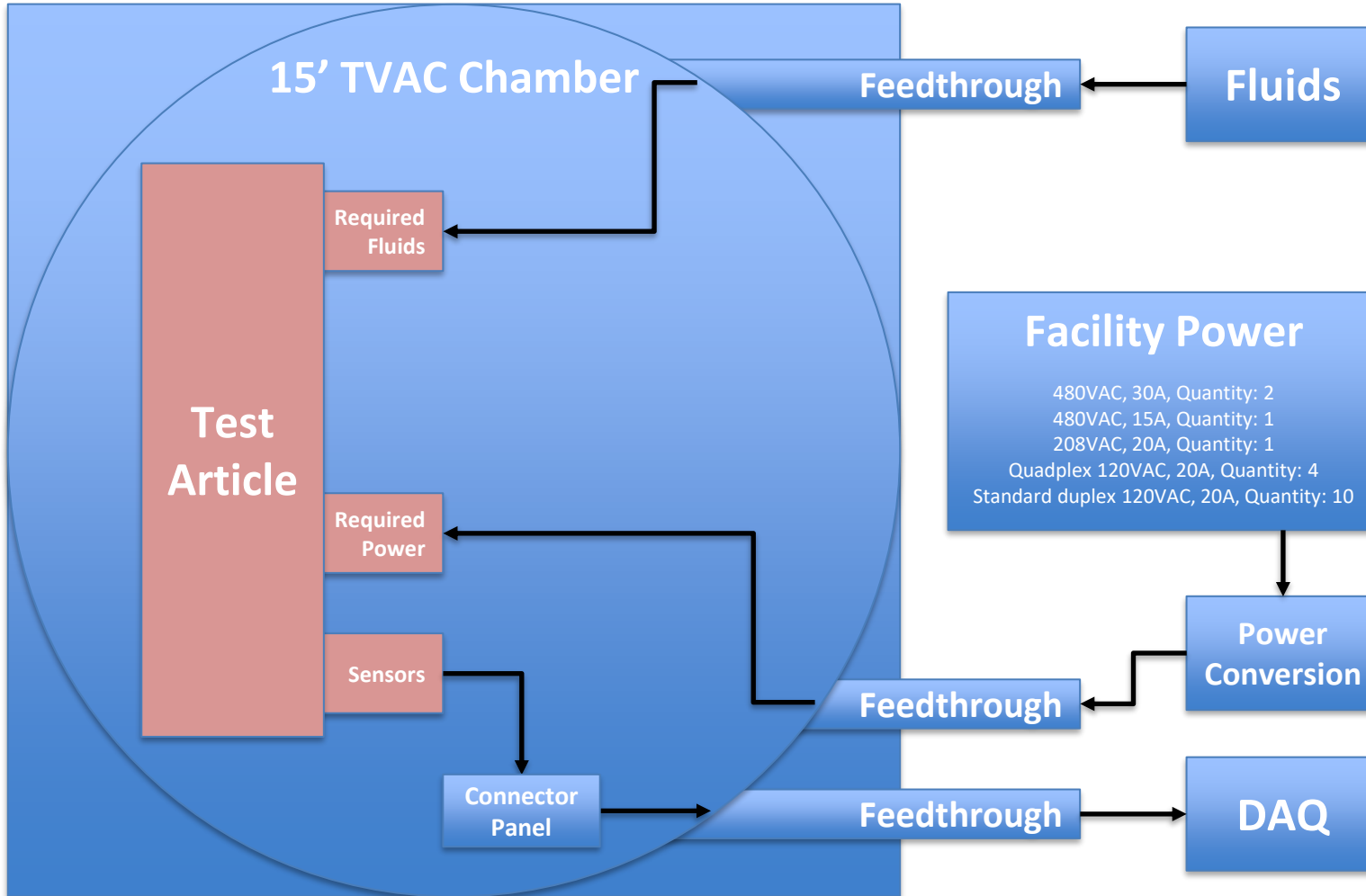


Main Penetration Flange Locations





15' Chamber Interfaces



Fluid Penetrations

- Three 15" OD (10.5" feedthrough real estate) available to test article
- Multiple flanges on hand to accommodate a variety of fluid line feedthroughs
- 2 flanges currently installed, each with the following cryogenic feedthroughs:
 - Four 1" lines with AN818-16J nut
 - One 2" line with AN818-16J nut
- 1 flange currently installed with the following feedthroughs for water transmission:
 - Six ¼" AN lines
 - Three ½" AN lines

Power:

- Power delivery is flexible
- Facility power can be converted from AC to DC as needed using power supplies
- Currently known high end power need is 8 kW

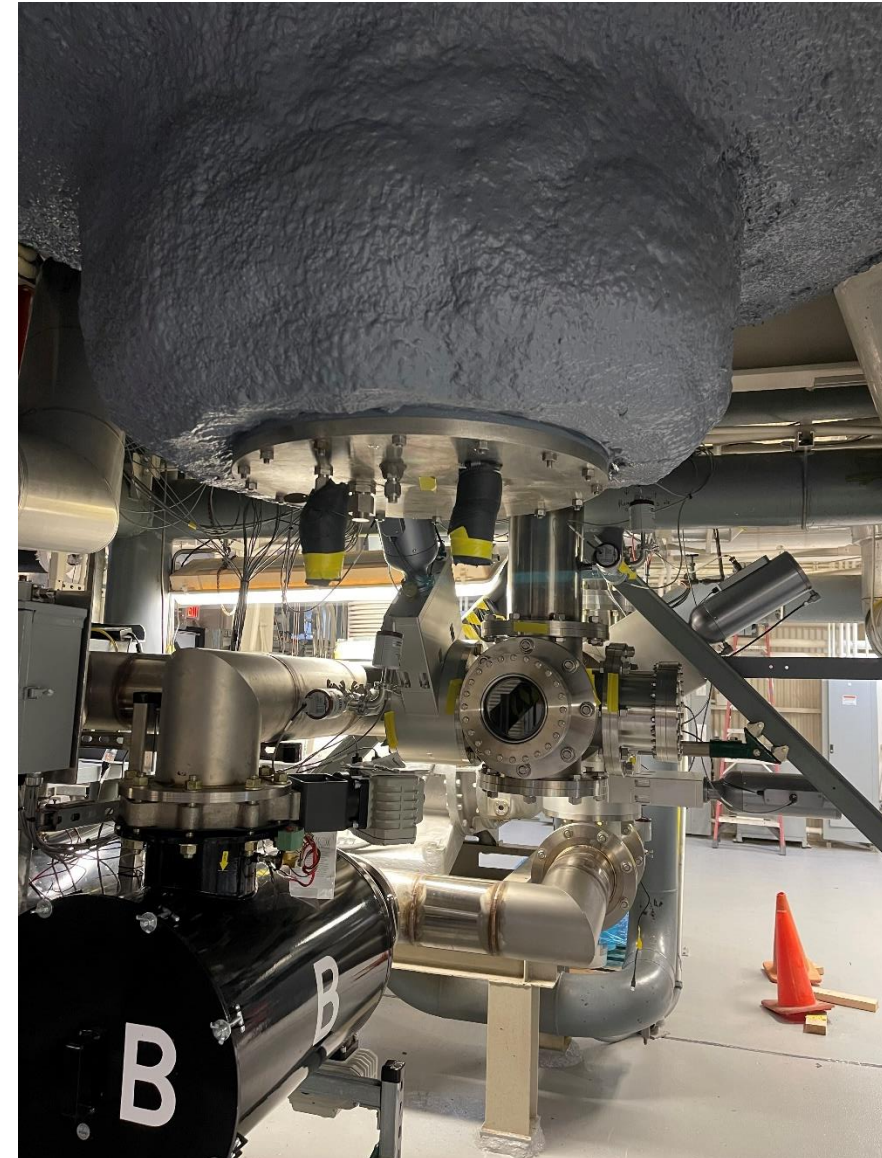
Data Interfaces:

- 72 Type-T TC connectors
- 32 Circular MIL Spec Connectors (3#16 pin Jam nut receptacle)
- 25 Circular MIL Spec Connectors (8#20, 4#16 pin Jam nut receptacle)

[Click here for a full list of flanges and connector interfaces for the chamber](#)

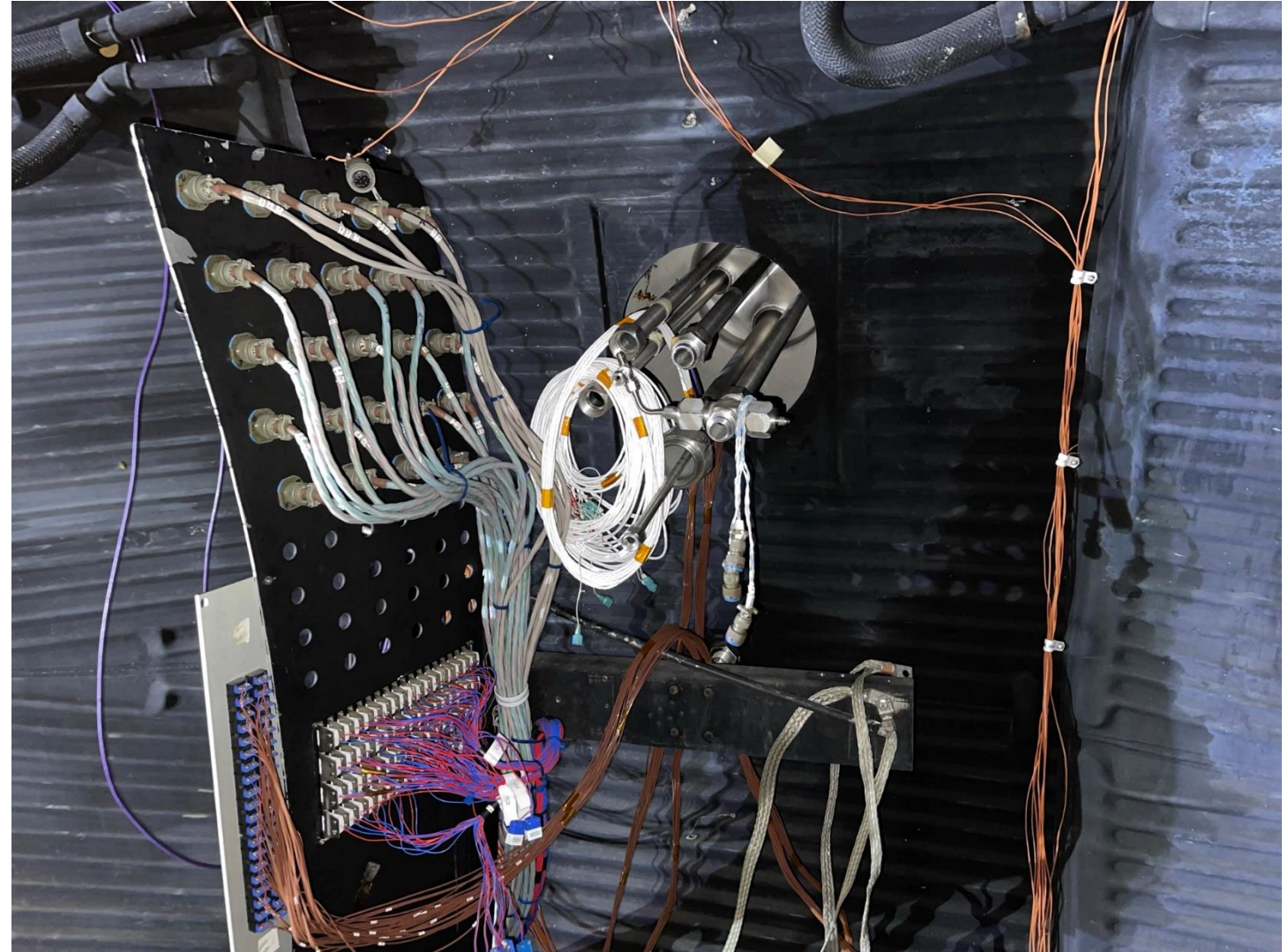
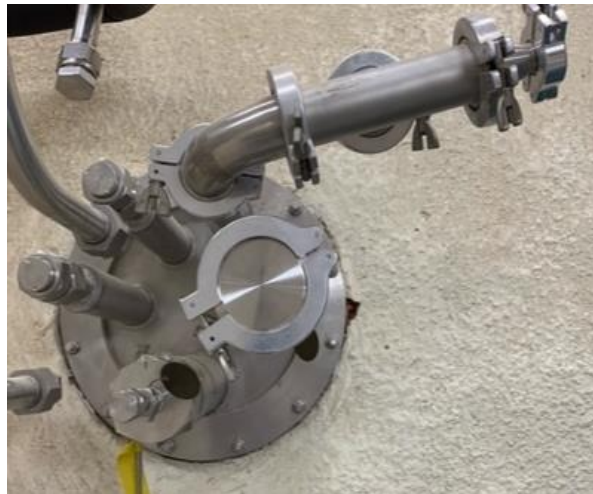
15ft Chamber Bottom

- Located directly below the middle of the chamber
- 20" flange



15ft Chamber Fluid Feedthroughs (South)

- South Side Fluid Pass-through & Electrical Patch panel
- 15" Flange, 10.5" Through



15ft Chamber Fluid Feedthroughs (North)

- North Side Fluid Pass-through
- 15" Flange, 10.5" Through



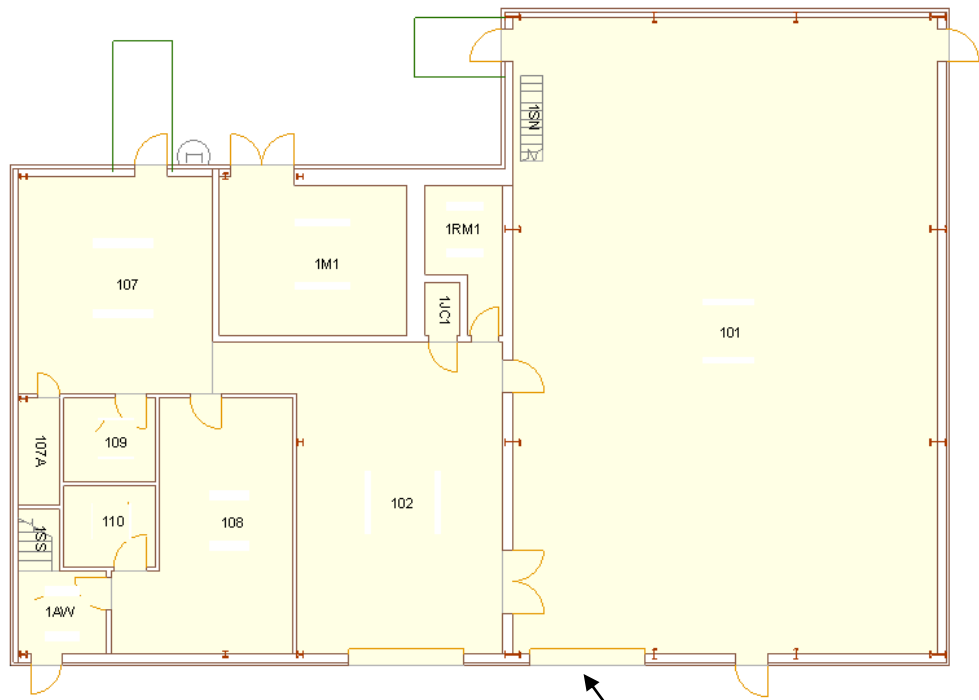


B351: Floor Plan



1st Floor

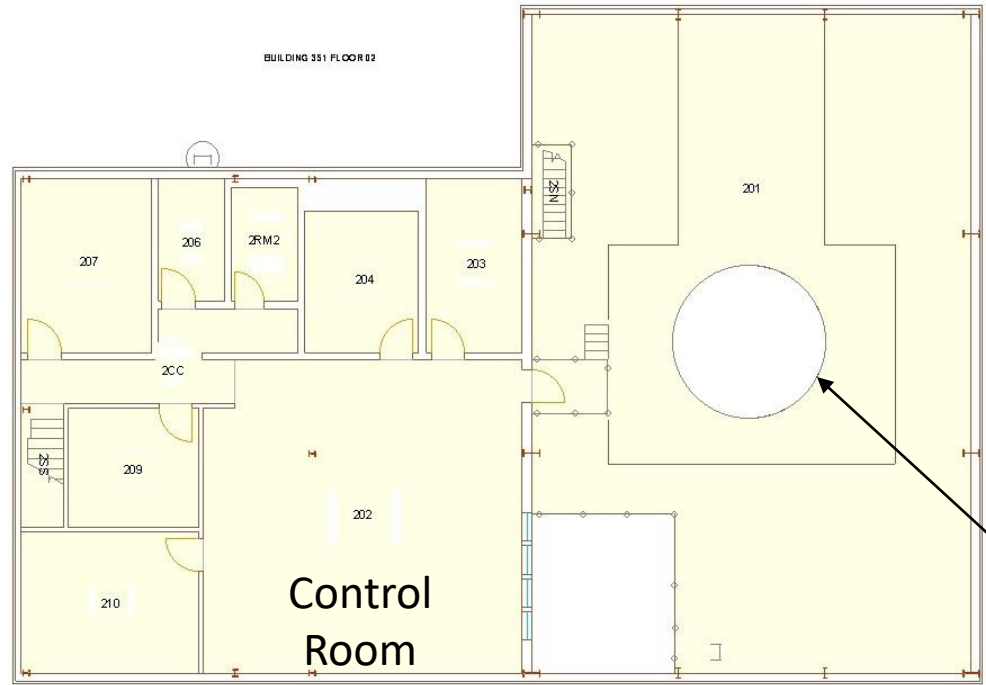
BUILDING 351 FLOOR 01



12ft Rollup Door

2nd Floor

BUILDING 351 FLOOR 02



Control Room

15' Chamber



Flange Feedthrough Example

