

Unique Support Structure – 02, Vacuum Case, and Cryomagnet System Testing Flow

AMS-02 Critical Design Review

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Cryosystem Verification Testing

- Static Testing
 - Cryomagnet Support System Static Testing (England)
 - All strap components will have multiple tests to failure
 - Multiple fatigue tests will be performed on all strap components
 - 2 complete strap assemblies will be tested to for fatigue & failure
 - Static test to 1.0 x limit load to characterize the strap
 - Fatigue tested – includes transportation, launch, on-orbit, landing
 - Another static test to 1.0 x limit load to compare to pre-fatigue static test
 - Straps will then be dynamically tested (see dynamic test section)
 - Following all previous testing, straps will be static tested to failure
 - Each flight strap tested to 1.2 x limit load
 - Flight Cryomagnet Static Testing (England)
 - The flight Cryomagnet will be tested to 1.1 x limit load due to magnetic forces

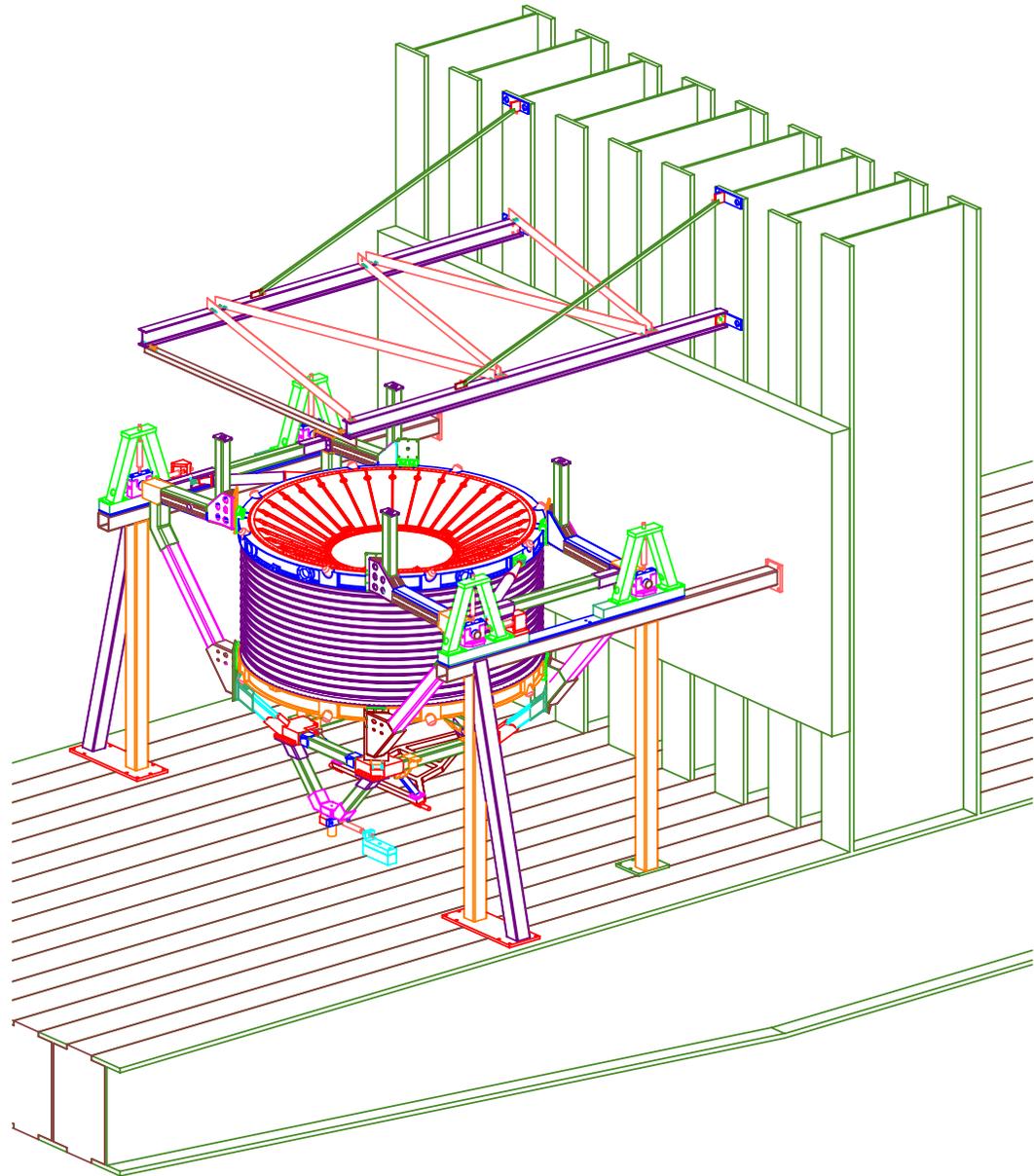


Overall Static Verification Testing

- Static Testing
 - Component Static Testing (JSC Bldg 13)
 - Lower USS to VC interface plate (low margin and analysis uncertainty)
 - Test to 1.1 x limit and check for yielding
 - Repeat test to failure
 - Lower USS to VC joint (low margin)
 - Full Assembly Static Testing (JSC Bldg 13)
 - Orbiter Configuration
 - Testing to 1.1 x limit load
 - Will include enough instrumentation to correlate FEM to 1.4 x limit load
 - PAS Static Testing (LM 3 – Completed Feb. 2003)
 - ISS Configuration
 - The PAS was statically tested to 1.5 x limit load to ensure that it will meet the required stiffness and deflection requirement



JSC Bldg 13 Test Static and Modal Test Configuration





Frequency & Strength Verification Testing

- Acoustic Testing

- Cryomagnet System Acoustic Testing (ESTEC)

- Cryomagnet STA (STA VC, STA He Tank, Cold Mass Replica) will be tested in to flight acoustic levels to determine if there is any o-ring seal leakage
 - Test must be performed with cryosystem at room temperature in order to measure leaks in the o-ring seals, but the straps overloaded to simulate cryogenic load



Frequency & Strength Verification Testing

• Dynamic Testing

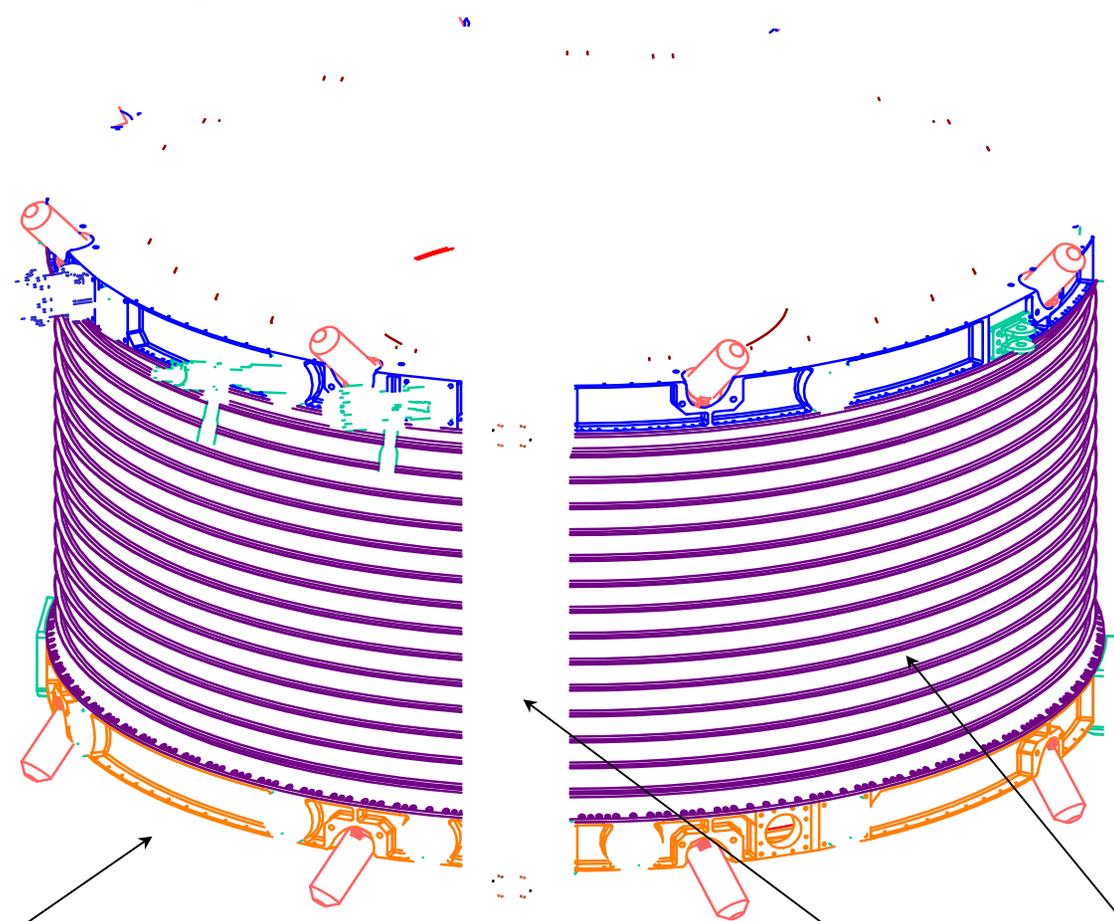
- Cryomagnet Support System (Straps) Testing (LM Denver)
 - 2 complete strap assemblies will be dynamically tested to determine dynamic and damping characteristics
 - This will be performed in a series of tests that gradually increase the complexity of the system (1 DOF and 2 DOF test)
 - Will include enough instrumentation to dynamically correlate FEM
- Cryomagnet System Sine Sweep Testing (JSC Bldg 13)
 - Cryomagnet STA (STA VC, STA He Tank, Cold Mass Replica) will be tested in a high level sine sweep test in order to excite the non-linear support straps to load levels so that the strap reaches and extends into the stiffness region associated with the launch strap engagement
 - Input environment will be developed using non-linear DCLA results. The Cryomagnet system response will be analytically determined and reproduced during testing.
 - Test will be performed with the system at cryogenic temperatures
 - Will include enough instrumentation to dynamically correlate FEM (if possible)



Frequency & Strength Verification Testing

- Modal Testing
 - Full Assembly Modal Testing (JSC Bldg 13)
 - Orbiter Configuration
 - Test will be performed with the system at cryogenic temperatures
 - Will include enough instrumentation to dynamically correlate FEM
 - PAS Modal/Frequency Verification Testing (JSC Bldg 13)
 - ISS Configuration
 - Will include enough instrumentation to ensure payload meets frequency requirement

Upper Frame Assy

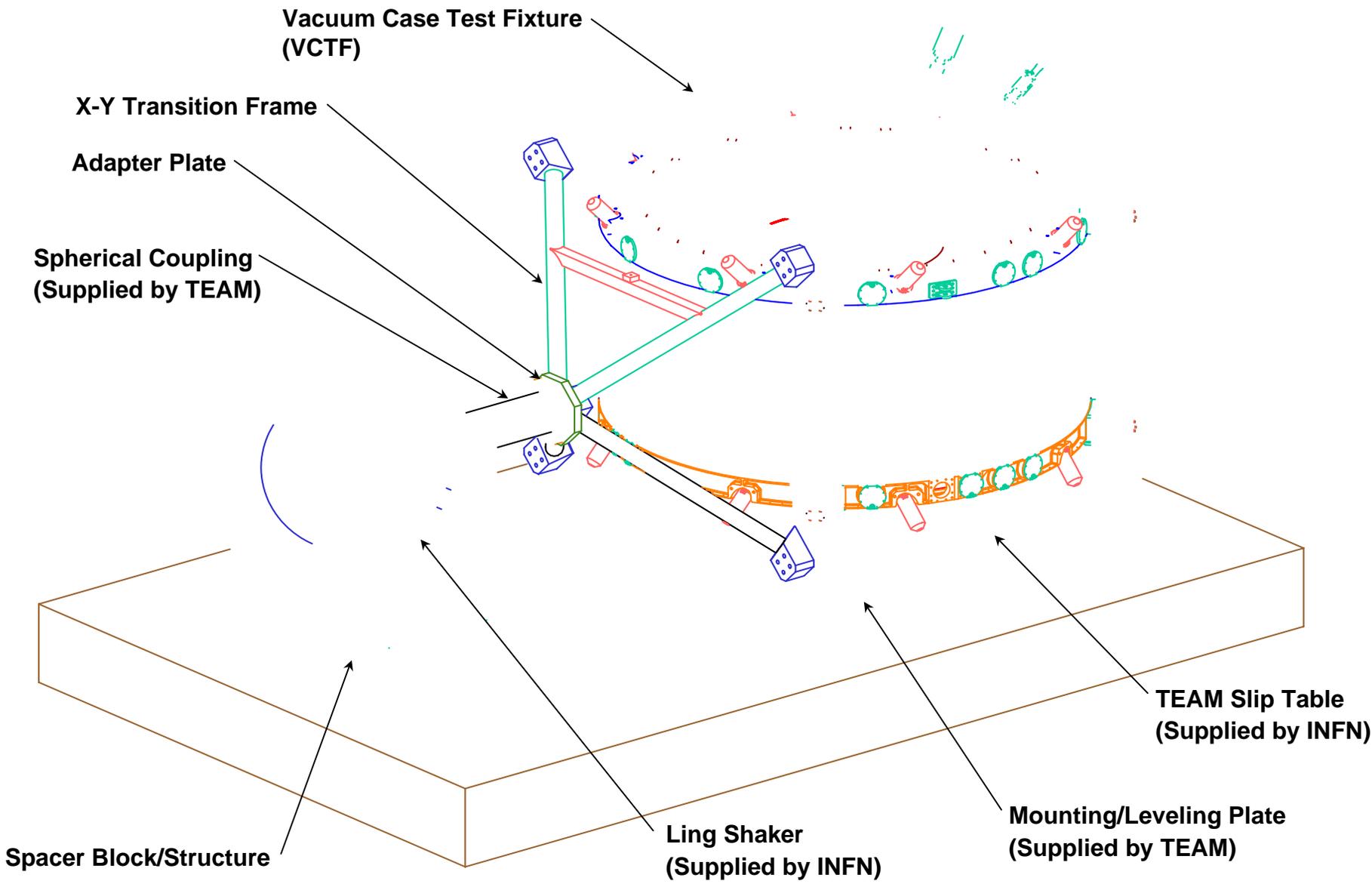


Lower Frame Assy

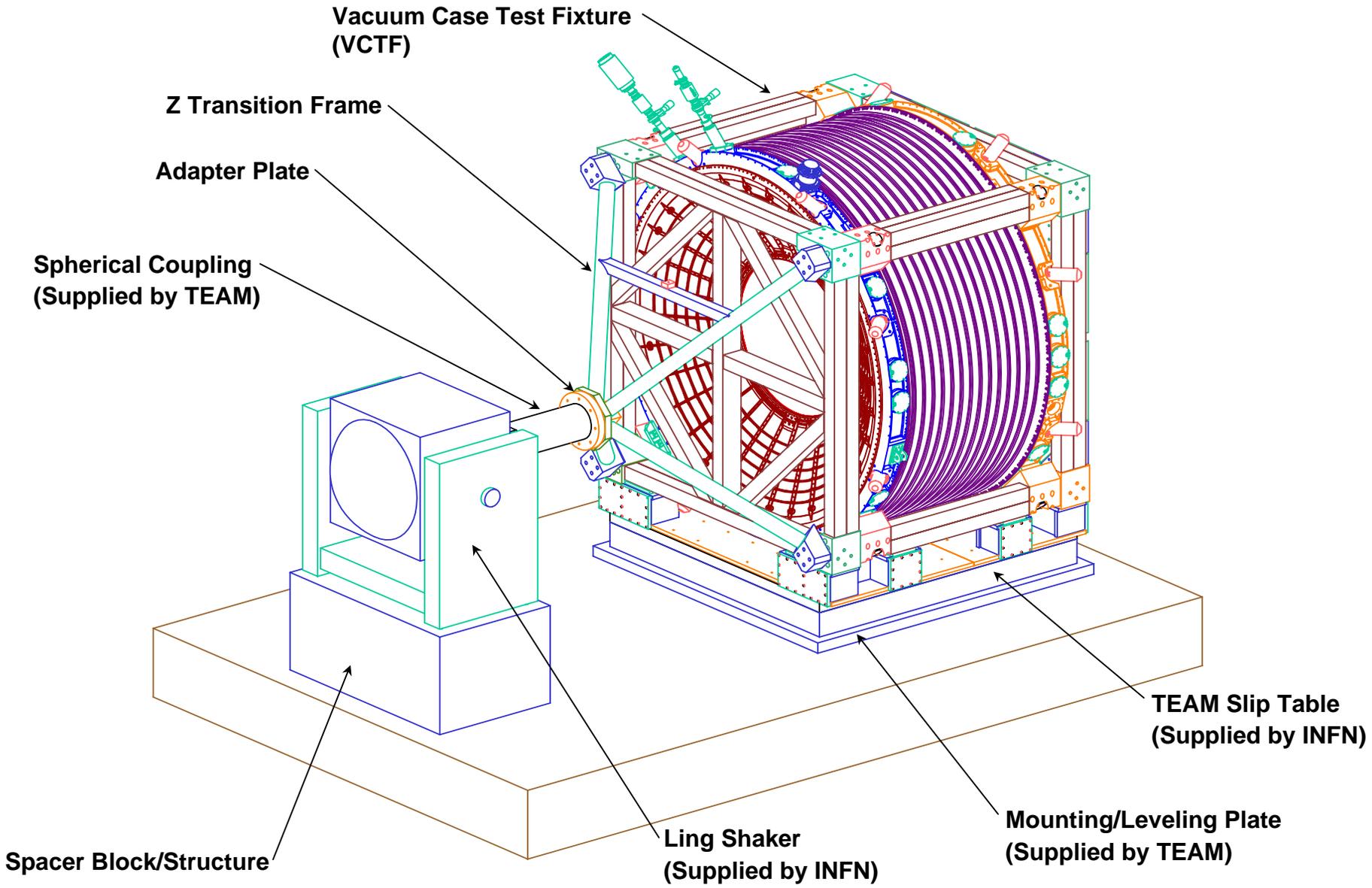
Column Assy
4X

STA Vacuum Case

Vacuum Case Test Fixture (VCTF)



X Direction Layout



Z Direction Layout



Pressure System Verification Testing

- Pressure Systems
 - O-ring Test Fixture (JSC Bldg 13 – Tests On-going)
 - Sub-scale vacuum vessel will be used to show that the leak rate through the o-ring seals is at an acceptable level
 - Same fixture will be pressurized to 0.8 atm differential to aid in FEM correlation
 - Vacuum Case
 - Both Flight and STA VC will undergo proof pressure testing to 1.0 x MDP (This is an emergency case only because system is designed for normal use as a vacuum vessel not as a pressure vessel.)
 - Both Flight and STA VC will undergo vacuum leak checks at various stages of development including during the static and dynamic testing
 - Vacuum Leak Checks at various assembly stages and assembly complete



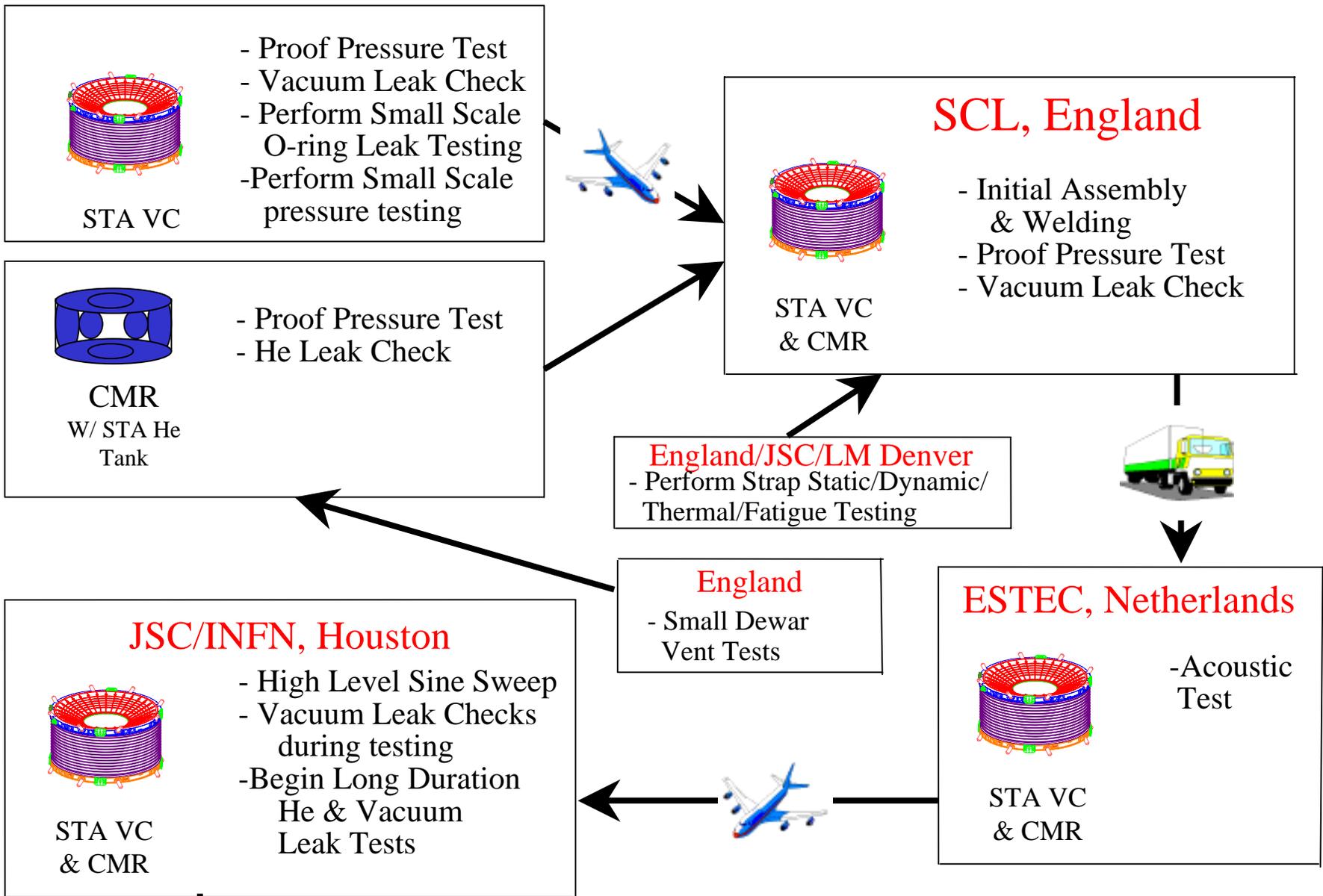
Pressure System Verification Testing

- Pressure Systems
 - Cryomagnet Pressure Systems
 - SFHe Tank - Proof Pressure Tests to 1.1 x MDP
 - Plumbing Systems – Proof Pressure Tests to at least 1.5 x MDP
 - Warm He tank – Proof Pressure Test to at least 1.5 x MDP
 - He Leak Tests
 - Small Scale Dewar Vent Testing (Successfully Completed)
 - Safety Panel agrees that testing proved no Shuttle overboard vent will be required.



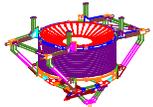
Pressure System Verification Testing

- Pressure Systems
 - TRD & TCS Pressure Systems
 - Xe Tank
 - Proof Pressure Test to 1.5 x MDP
 - Random Vibration to 8.9 Grms
 - TRD CO₂ Tank
 - Proof Pressure Test to 1.5 x MDP
 - Random Vibration to 8.9 Grms (axial) & 4.5 Grms (lateral)
 - TCS CO₂ Tank – Proof Pressure Test to 1.5 x MDP
 - Plumbing Systems – Proof Pressure Tests to at least 1.5 x MDP





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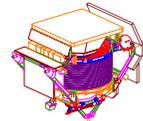


USS-02

- Install STA VC & CMR into USS-02



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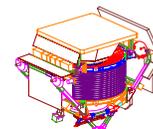


AMS-02

- Install Experiment Mass Sims and STAs onto USS-02



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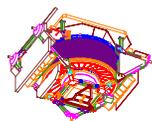


AMS-02

- Full Payload Modal Test
- Full Payload Static Test
- Vacuum Leak Checks during Tests



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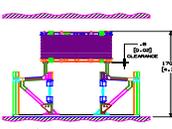


PAS

- PAS Modal/Static Testing



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Remove VC from USS-02

- Remove STA VC
- Start Long Duration Vac Leak Check of STA VC
- Ship USS-02 to Zurich



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Components & MM&OD



NBL

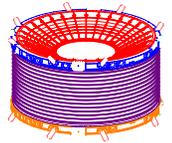
- Perform Tests of USS-02 Components
- Perform NBL Testing
- Perform MM&OD Testing





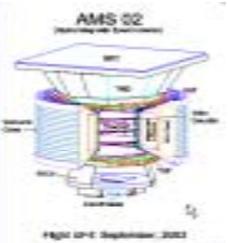
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- Perform long duration endurance and leak checks

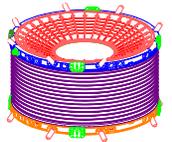


STA VC & CMR

AMS Collaboration

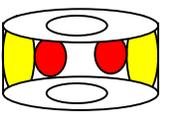


- Experiment Components
- Sub-component Testing

Flight VC

- Proof Pressure Test
- Vacuum Leak Check

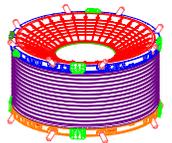


Magnet

- He Tank Proof Pressure Test
- He Tank He Leak Check

Integrate Payload in Switzerland

England



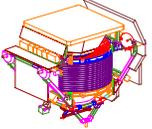
Flight VC & Magnet

- Proof Pressure Test
- Vacuum Leak Check
- Magnetic Load Static Testing
- Quench Testing





CERN/JSC Location



AMS-02

- Experiment Calibration
- Thermal Vacuum Test

KSC

- KSC Processing

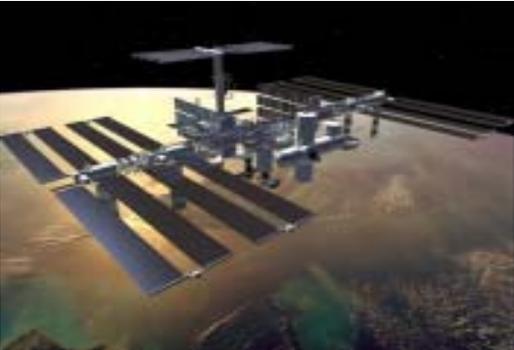


AMS-02

Launch



3 Operational Years



ISS

Landing

