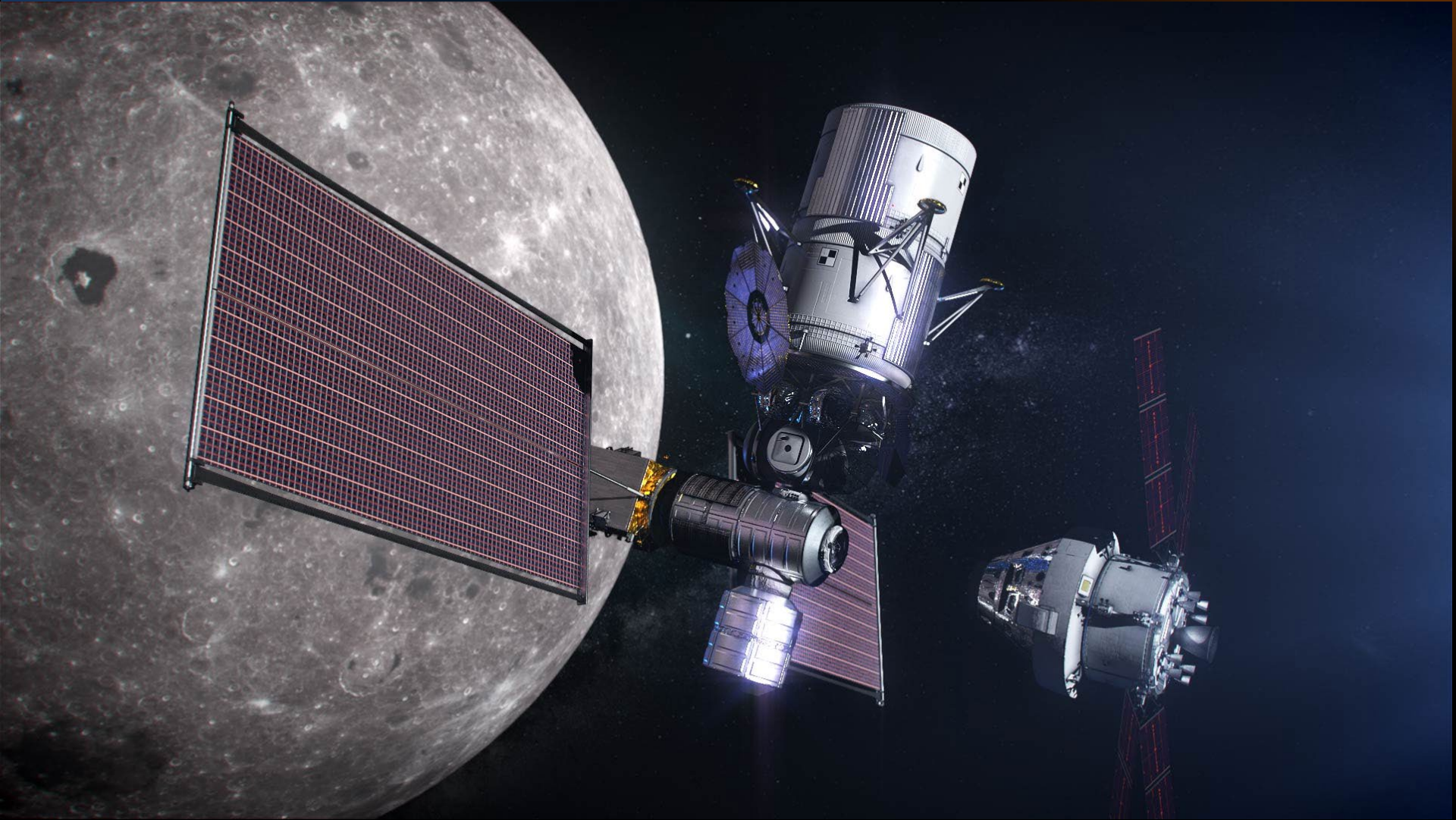




JSC Docking Systems Partnering Opportunities





JSC Engineering Capabilities



- Johnson Space Center is the out-of-this-world leader in development and testing of systems for human-rated rendezvous, proximity operations, and docking (RPOD) for meeting space functional and performance requirements

JSC Capabilities | NASA

nasa.gov/centers/johnson/partnerships/jsc-capabilities

NASA TV Search

JSC Partnership Gateway

JSC Capabilities

- Launch Environment
- Light Weight Hatch and Docking Systems
- Materials Analysis
- Models, Simulation and Software
- Planetary Sample Analysis and Mission Science Fact Sheet
- Power and Battery Systems
- Propulsion Systems
- Pyrotechnics
- Radiant Heat Test Facility
- Rendezvous, Proximity Operations and Docking
- Robotics
- Space Analog Environments
- Spacecraft Communications
- Structural Testing
- Thermal Testing
- Thermal-Vacuum Testing
- Vacuum Test Facilities (Altitude Chambers)
- Window Material Database

TAP

National Aeronautics and Space Administration

Light Weight Hatch and Docking Systems

JSC has extensive experience in the design and development of space vehicle mating attachment systems and hatches.

Services Provided

- Design, Development, Test and Evaluation of Spacecraft Docking, Berthing, and Hatch Systems
- Component, System and Vehicle-level Systems Engineering and Integration
- Analytical Simulation/Prediction, Independent Modeling and Model Validation
- Dynamic, Static, and Natural/Induced Environmental Testing
- System Management, Flight Hardware Acceptance, Joint Integrative Testing
- Standards and Specifications Development
- Avionics, Software and Controls
- Rapid Prototyping and Evaluation
- Contact Modeling and Simulation
- Collaborative Working Environment

Johnson Space Center

Rendezvous, Proximity Operations and Docking

Digital displays enable rendezvous and proximity operations a complex task. Johnson Space Center (JSC) performs systems equipment definition, analysis, design and testing necessary to support the development of rendezvous, proximity operations and docking system design and to verify the compatibility of design with functional and performance requirements. JSC provides ground facilities, including real-time simulators for development, testing and training for manual and automated spacecraft rendezvous, proximity operations and docking operations. Facilities offer high-fidelity, real-time, human-in-the-loop engineering simulations utilizing math models, scene generator and realistic control system interfaces.

Services Provided

- Simulation of multiple free-flying vehicles with accurate six-degree-of-freedom equations of motion
- Docking contact dynamics
- Shroud plume impingement
- Vehicle control systems
- Robotic manipulator dynamics
- Autonomous Rendezvous & Docking (ARMD) - navigation and guidance algorithm development and on-orbit validation, testing and integration
- Real-time, real-time-of-flight, short range motion base simulation
- Open and closed-loop testing of automated rendezvous and docking systems
- Develop test scenarios of hardware in system level test environment
- Fault recovery scenarios in hour-of-normal conditions
- Dynamic systems testing
- Closed-loop testing of mating interfaces, including contact forces
- Physical simulation of spacecraft motion with motion platforms
- Human-in-the-loop control

Johnson Space Center

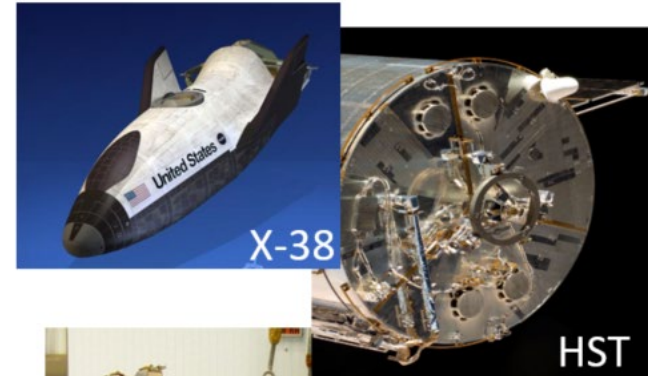
<https://www.nasa.gov/centers/johnson/partnerships/jsc-capabilities>



JSC Capability



- NASA recognizes that
 - RPOD systems and components are very long lead items and that limited vendors/sourcing on current pressurized docking system production lines will be a challenge for Vendors competing for contracts in the US efforts to commercialize Lunar orbit and Lunar surface access.
 - Unpressurized mechanism/interfaces required to “integrate” the HLS vehicle accommodating engine bells, abort scenarios, and reusability doesn’t exist today.
- JSC Engineering and its Support Contractor Jacobs, have been preparing this year to provide extensive access and “reach back” to the significant expertise and capabilities resulting from over 60 years* of US space flight in the form of in-line partnering, tailored support, and/or turn-key products.



*Agena, Apollo, ASTP, Shuttle-MIR/ISS, X-38, HST, LIDS, Constellation, Orion, ISS



JSC Relevant Experience



	Engineering Dev/Design	Fabrication and Production	Testing and Verification Including Modeling	Integration into Host Vehicle
Agena/Apollo/ASTP	X	X	X	X
MIR	X		X	
Shuttle	X		X	X
ISS			X	X
LIDS/X-38	X	X	X	X
LIDS/HST	X	X	X	X
NDSB0/Orion-Cx	X	X	X	X
ATLAS (adapter)-Cx	X	X	X	X
Space-X/CCP			X	X
CST-100/CCP			X	X
NDSB1			X	X
NDSB2				X
Orion (incl. hatches)	X	X	X	X
Gateway			X	X
IDSS/GDSS, RPO Stds	X		X	

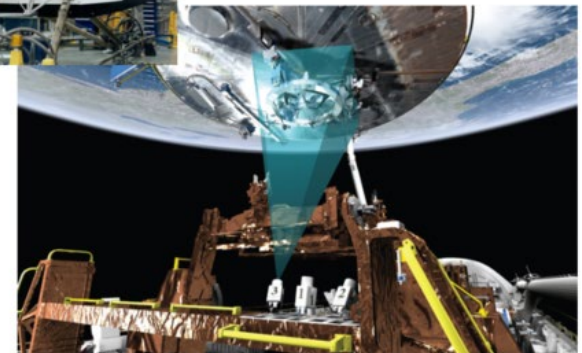
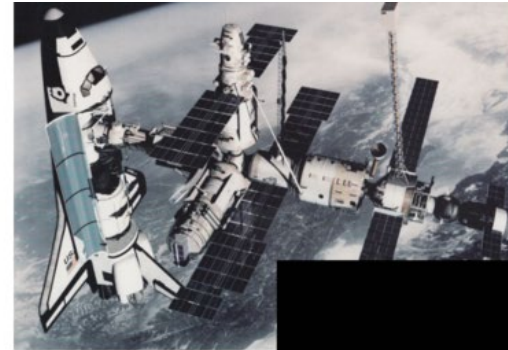




JSC Relevant Experience



- Shuttle / MIR
 - Working with RSA/Energia , APAS mechanical and Avionics redesign performed to meet NASA performance requirements
 - APAS integration into Space Shuttle
 - Certification for Shuttle MIR and including in depth capture performance assessments / docking techniques
- Shuttle / ISS
 - Working with RSA/Energia continued evolution of APAS for Shuttle/ISS implementation
 - Integration for APAS systems onto ISS and Space Shuttle
 - Certification for ISS LEO requirements
- Design/Dev of low Impact docking system (LIDS)
 - design started during x38 development effort
 - selected design for Constellation program
 - design transferred to ISS / Boeing, NDSB0
 - hard mate system is NASA design, soft capture replaced by Boeing soft capture system NDSB1
- Hubble space Telescope
 - Passive LIDS docking system built and installed on HST for purpose of deorbit

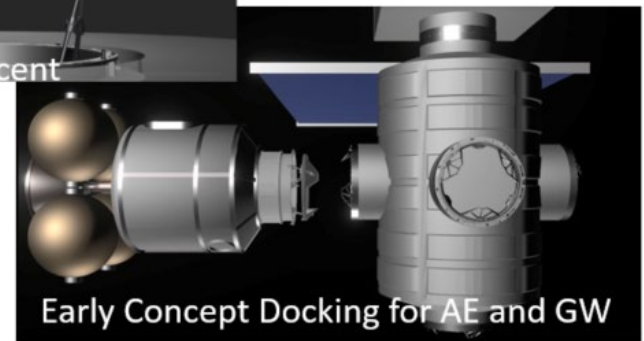




JSC BOM24 Assessment



- NASA design and analysis efforts have validated that lightest possible Lunar Ascent vehicle is achieved by the incorporation of a passive docking interface on AE.
 - Gateway AE Docking port is a Passive Docking Interface
 - Active to Active adapter allows Passive on AE
- NASA design and analysis efforts have produced an attachment concept which leverages common proven docking components to support docking of descent element vehicle to the ascent element vehicle to transfer element vehicle.
- NASA JSC Engineering along with our partner Jacobs Engineering through our HLS DAC2 work and ongoing project planning activities are confident these critical BOM24 docking systems and adapter are feasible.



JSC Engineering has extensive experience and has been preparing for our BOM24 Docking needs



JSC BOM24 Products/Deliverables*



- ✓ DDT&E of a new IDSS/GDSS compatible docking system
 - Based on NDSB1 hard mate system with a new soft capture system, including avionics control system
 - Integrated design support to enable direct integration of a passive docking interface on the Ascent Veh.
 - Integration activities with NG for HALO supporting control & power of active Docking system on the adapter
- ✓ GW-HLS Docking Adapter optimized for volume and mass (including docking aids)
- ✓ Loads analysis and integration
 - Docking dynamics models and simulations for the system correlated to 6 DOF contact testing
- ✓ DDT&E for new docking system supporting AE to DE to TE docking
- ✓ Rendezvous and proximity requirement definition, analyses, simulation, design and testing including
 - Navigation and guidance algorithm development and sensor selection, testing, and integration
 - Open and closed-loop testing of automated rendezvous and docking systems

*Not a comprehensive list of potential products/deliverables; also tailoring is negotiable

JSC Engineering stands ready to partner and/or collaborate with HLS commercial companies for docking development and integration activities.



JSC Docking Systems Partnering Opportunities



For more information call or email:

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 - 281-483-0466