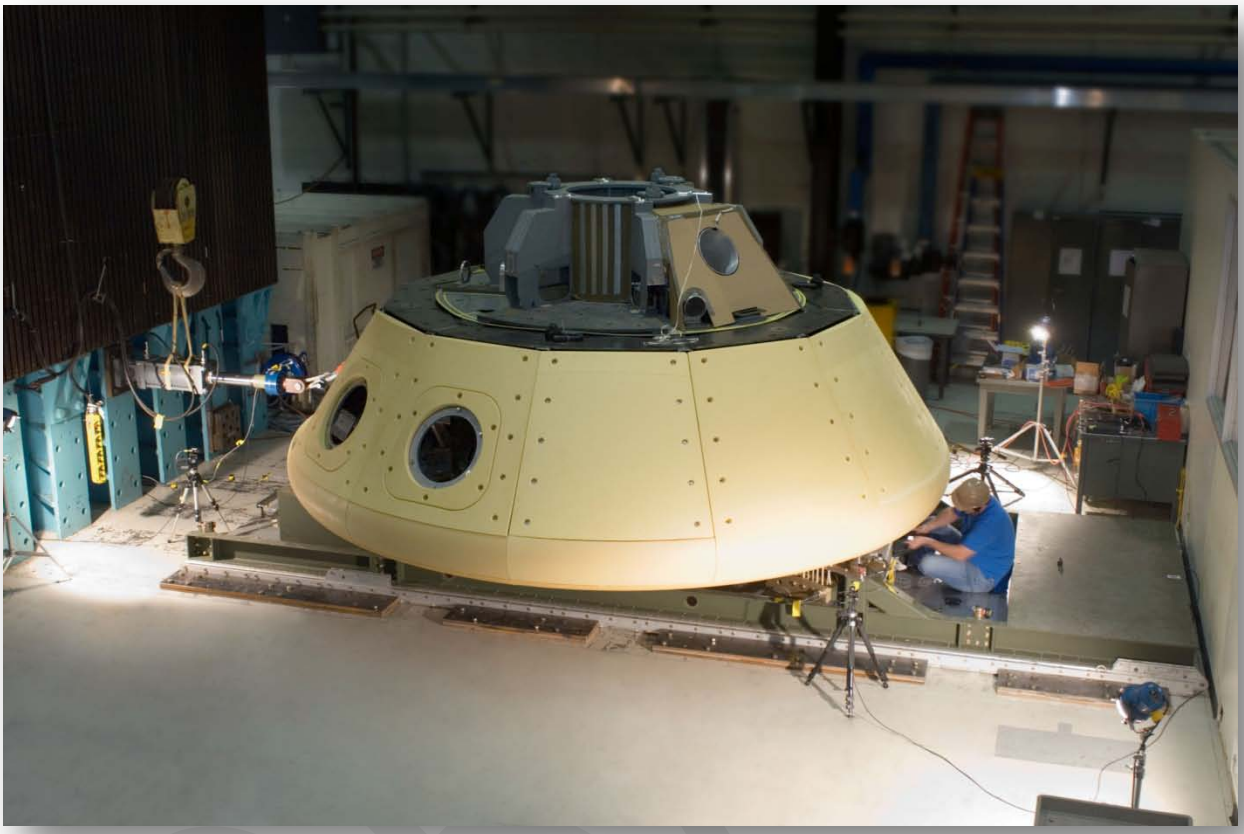
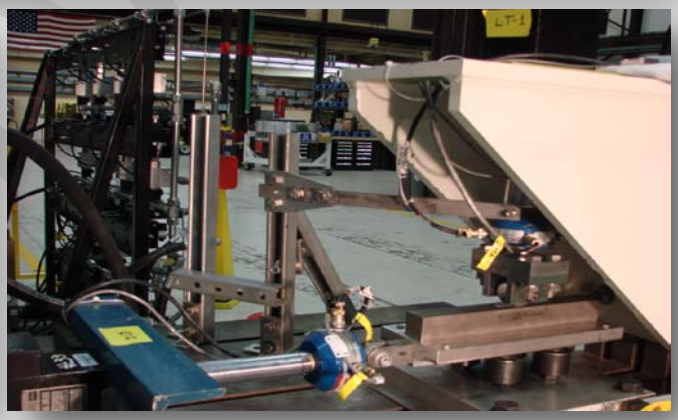
Abstract – Structures Test Laboratory (STL) User Test Planning Guide

Test process, milestones and inputs are unknowns to first-time users of the STL. The User Test Planning Guide aids in establishing expectations for both NASA and non-NASA facility customers. The potential audience for this guide includes both internal and commercial spaceflight hardware/software developers. It is intended to assist their test engineering personnel in test planning and execution. Material covered includes a roadmap of the test process, roles and responsibilities of facility and user, major milestones, facility capabilities, and inputs required by the facility. Samples of deliverables, test article interfaces, and inputs necessary to define test scope, cost, and schedule are included as an appendix to the guide.

Structures Test Laboratory (STL)

User Test Planning Guide





National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas 77058

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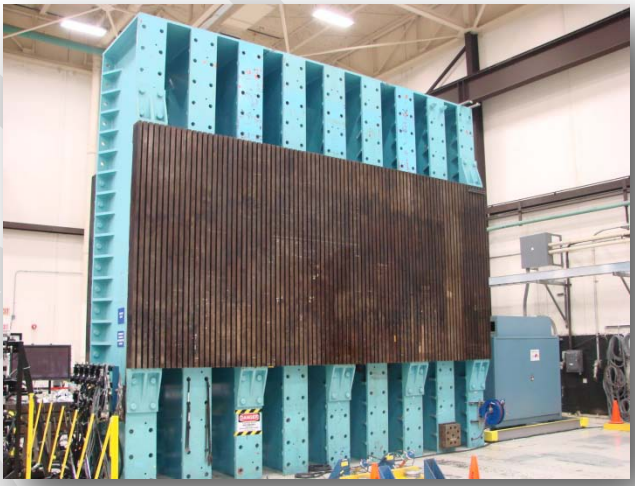
1.0 Structures Test Lab

The Structures Test Laboratory (STL) located in Building 13 at the Johnson Space Center (JSC) conducts static load testing of assemblies and components. Tests range from mechanical properties testing of materials to full-scale verification testing of payloads and spacecraft structures. The STL is equipped with a variety of hydraulic and electromechanical load frames with maximum load capacities ranging from 5 to 220 kip. Test operations can also easily accommodate rapid response research and development testing to support development of future technologies. The test capabilities of the STL have been developed & maintained to meet JSC's specific needs for anomaly resolution, flight qualification, re-certification, engineering evaluation & development. The lab's load control system is capable of managing up to 32 load control channels, and a PC-based data system provides the capability to record 256 data channels.

Services Provided
• Static and fatigue load testing using single or multiple actuators up to 220 kip • 12 Load Frames – Tension and compression testing – Load or displacement control – Metallic's and Composites • Cyclic Testing up to 100 Hz • Fracture mechanics property testing – Automated da/dN testing • Tensile, lap shear and compression testing of materials at low and elevated temperatures • Fatigue/fracture coupon tests



Strongback Wall

Point of Contact

Lab Manager, Chris Briggs
Johnson Space Center
2101 NASA Parkway Houston, TX 77058
(281) 483-9159
christopher.p.briggs@nasa.gov

Specifications

Facility

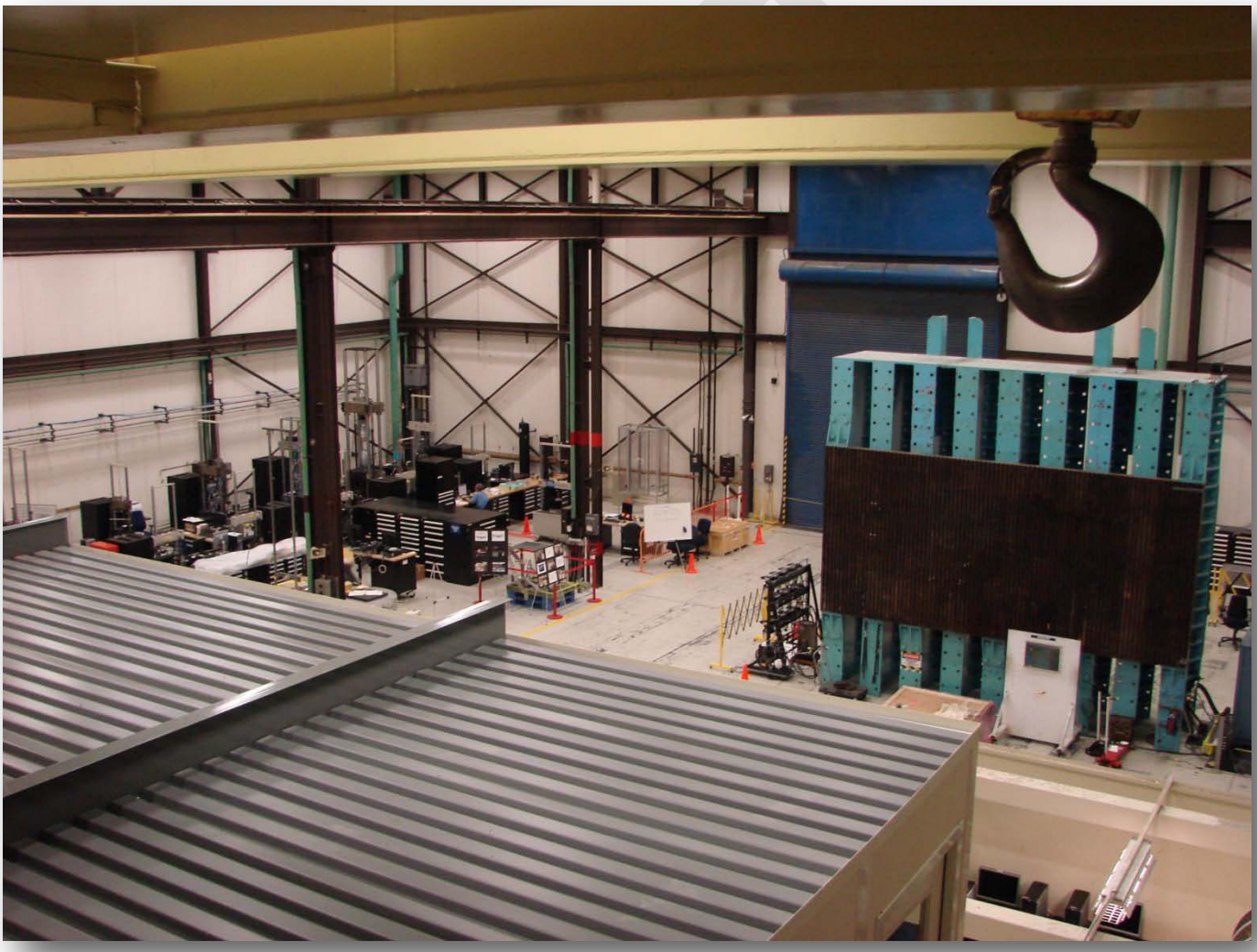
Type	Values
Facility	13,000 ft.^{2} with 39ft. ceiling; (limited to 27ft. by overhead cranes)
Access	22 ft. x 18ft. roll-up door
Bridge Cranes	Two 20 ton & 5 ton cranes
Strongback Wall	20ft. x 21ft. 10ft. x 20ft. steel plates with T-slots on 3 in. centers are attached to each side of the strongback wall to permit attachment of heavy test fixtures
T-Slot Table	7,500lb. capacity to accommodate smaller scale structural testing

Structural Testing

Type	Values
Load Frames	11 Tension/compression load frames
Load Frame Capacities	5 – 220 kip
Load Control System	Aero ST Load Control System - Capability to manage up to 32 load and stroke control channels 1 portable load control system - 2 load and stroke control channels
Data System	256 data channels (1-1000 SPS) 1 portable data system – 40 data channels (1-100 SPS)
Instrumentation	Load cells Linear resistive deflection potentiometers Displacement/velocity transducers Linear variable differential transformer deflection transducers Rotational variable differential angular displacement transducers Thermocouples Force/Load washers Pressure transducers Strain Gages

2.0 Facility Layout

The Structures Test Laboratory is located within the high bay of building 13 at the Lyndon B. Johnson Space Center. The high bay area encompasses about 13,000 square feet of floor space with a 39 foot ceiling. Access is normally via a 22 foot high by 18 foot wide roll-up door at one end of the high bay. Two bridge cranes are available for materials and test article handling. The STL is divided into a number of areas, each supporting a different aspect of static loads testing. These areas include two test bays for testing structural assemblies, a static load frame area, a central data acquisition room, a test article preparation area, a small machine shop, a tool crib, an office area, and storage areas.



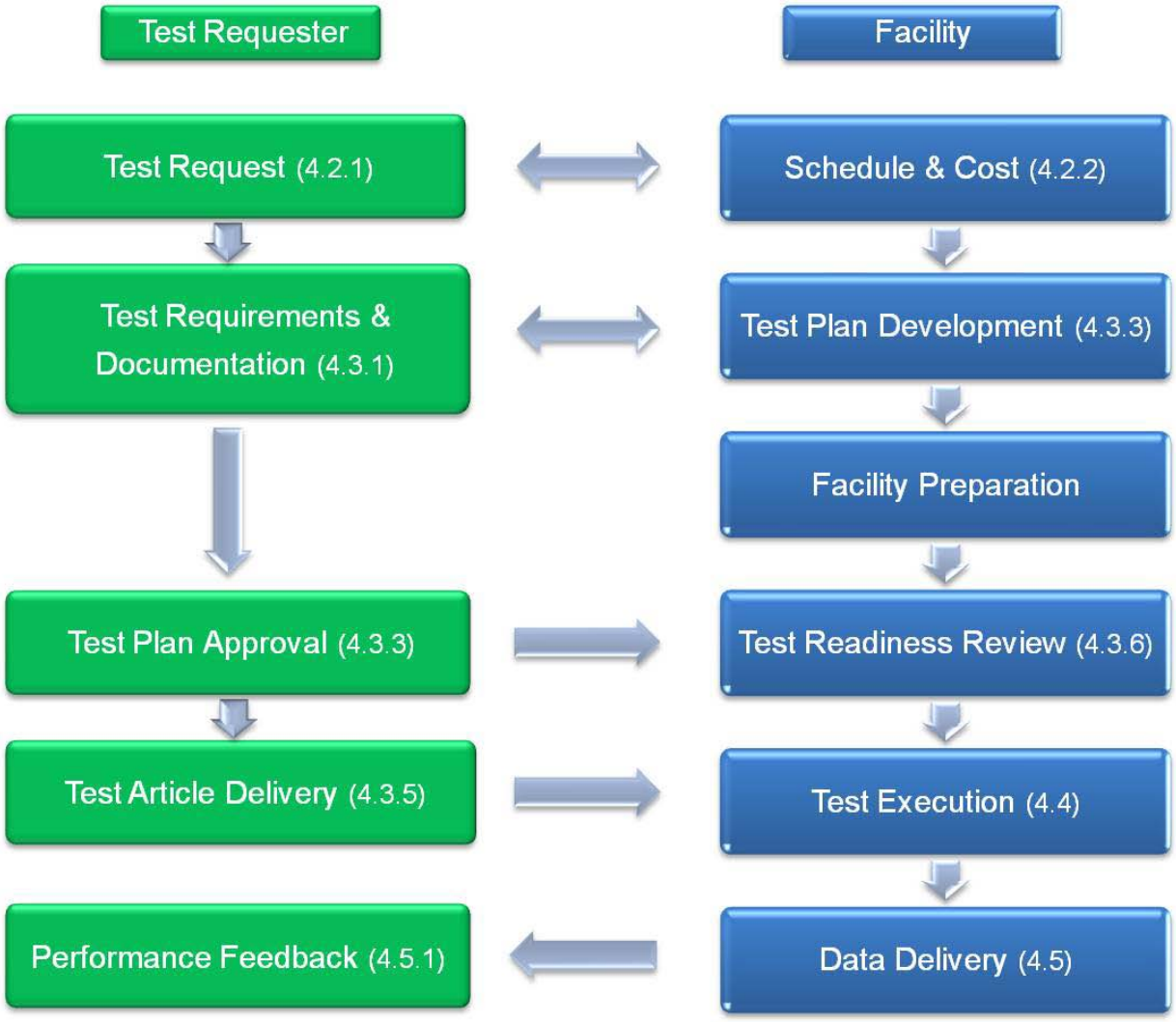
*See Appendix A for facility layouts and sample test configurations

3.0 Safety and Health

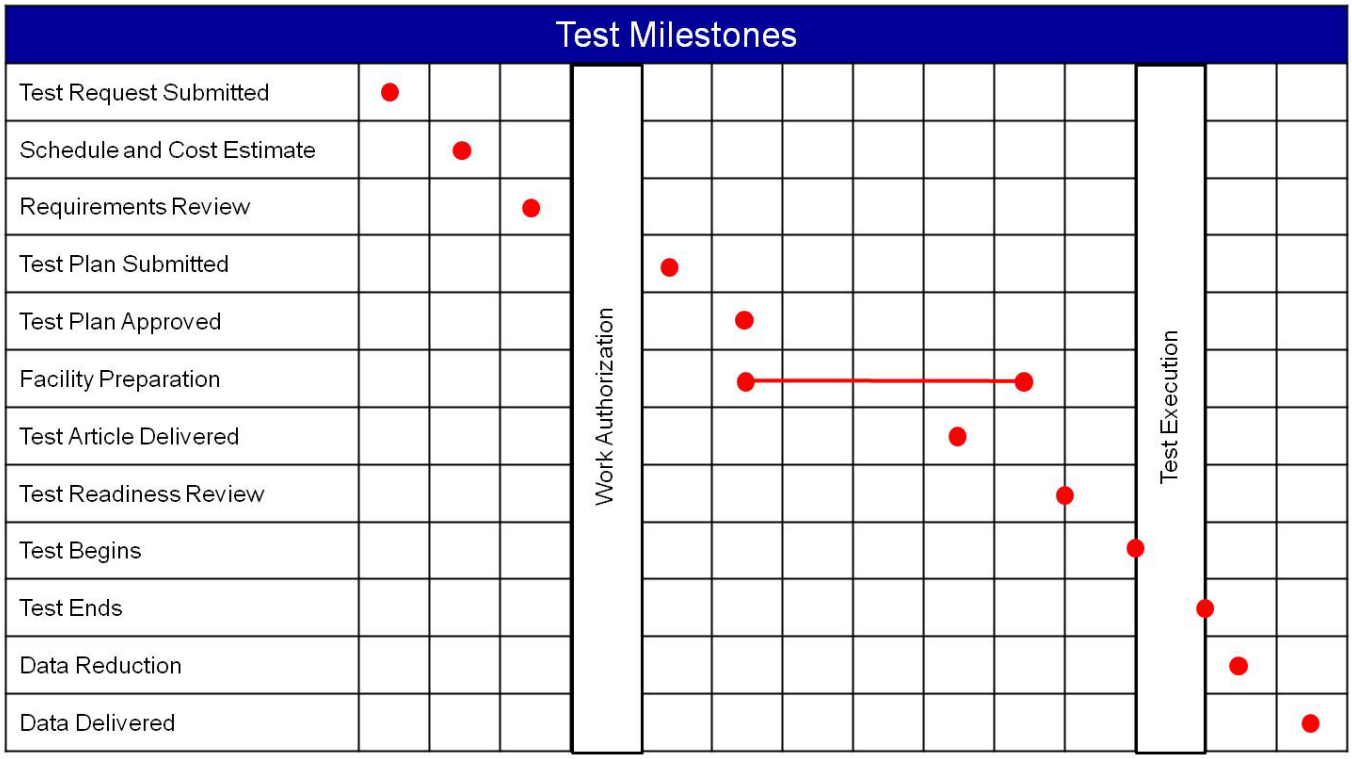
Safety is an integral part of NASA's culture. Management, leadership, and employee involvement from all organizations is critical to the success of NASA's safety program. In order to ensure personal safety as well as a safe test environment, throughout the process, the requester shall furnish the facility with the information necessary to perform a hazard assessment of the test article. Additionally, while visiting JSC, the requester shall follow all facility specific safety and health requirements. A facility safety briefing shall be provided to all personnel prior to the start of the test. The safety briefing will include a review of the STL safety rules, potential hazards, and emergency procedures.

4.0 Test Process Flow

The flow chart below outlines the basic roadmap and significant milestones between the initial test request and delivery of test data. The flow is separated between Test Requester actions and Facility actions, highlightin the interactions and inputs between the Test Requester and the Test Director.



The test schedule is highly dependent on the complexity of the test, facility availability and sequence of runs. A detailed schedule shall be developed following review of test objectives and requirements. Major milestones are presented below:



4.1 Export Controlled and Proprietary Information

The STL provides for protection of export controlled and proprietary information and hardware throughout the test process. The Test Requester shall clearly mark all export controlled or proprietary hardware items and data provided with a notice of restriction on disclosure or usage. The Test Director shall safeguard export controlled or proprietary items from unauthorized use and disclosure and ensure test articles remain secure within the facility and are properly sequestered. Hardware items shall be returned to the Test Requester or disposed of in accordance with the Test Requester's instructions at the completion of the test activity.

4.2 Test Initiation Phase

The test initiation phase establishes the relationship between the Test Requester and the Test Director. The Test Requester shall provide a test request to the Test Director which will be used to determine test feasibility and to develop an estimated cost and a preliminary test schedule. An initial requirements review shall define the characteristics of the test article, test objectives, and special considerations for the test. An on-site tour of the facility is highly recommended for familiarization and to provide an opportunity for an exchange of technical information.

Inputs:	Test Requester provides test request, identifies Test Article Expert
Activities:	Facility Test Director reviews test request to determine test feasibility
Outputs:	Facility delivers preliminary test plan, estimated cost and schedule to Test Requester

4.2.1 Test Request

The test request outlines the test objectives, test article description, and schedule. A test request worksheet is provided as an appendix to this guide (Appendix B). This worksheet addresses the basic requirements for testing in the STL. It is suggested that the Test Requester complete this worksheet to facilitate the development of a preliminary test plan. Please contact the Test Director if you have questions about completing the test request worksheet. At a minimum, the test request should include the following information:

Test Objective

A brief description of the test requirements including, but not limited to:

- Desired test conditions (load/displacement, temperature)
- Proposed test approach
- Test data requirements

Test Article Description

A brief description of test article including, but not limited to:

- Size (provide drawings, sketches, photos)
- Weight
- Test article interface (load points, method of suspension or test article support)
- Test article fluid interface requirements (type, pressure, flow)
- Orientation (fixed or moveable)
- Special considerations (hazards, cleanliness, compatibility, MSDS, etc.)
- Handling and storage requirements

Schedule

Identify the required start date and proposed date for test completion.

4.2.2 Schedule and Cost Estimate

A cost and schedule estimate including major milestones will be delivered following receipt of the test request worksheet.

4.3 Test Preparation Phase

The detailed test plan and test schedule are finalized during the test preparation phase. The Test Requester shall provide detailed test requirements and test article documentation to the Test Director. A Test Readiness Review will be held following approval of the test plan.

Inputs:	Test Requester provides test requirements and test article documentation
Activities:	Facility develops test plan, begins assembly of facility interface/support structure(s)
	Test Requester ships/transports test article to JSC
Outputs:	Test Requester approves test plan and test schedule
	Facility holds Test Readiness Review (TRR)

4.3.1 Test Requirements

A complete understanding of test requirements is mandatory for a successful test. Test requirements must be defined and reviewed so the test team understands the effect of the requirements on test facility preparation. The Test Requester shall provide a detailed list of test requirements to include, but not limited to:

- Specific test conditions
- Interface requirements (fluid, structural, electrical, mechanical, etc.)
- Data/Instrumentation requirements (Test Requester and facility provided)

4.3.2 Test Article Documentation

Test Article Drawings

The Test Requester shall provide detailed test article drawings as requested by the facility. Test article drawings are used to prepare the facility interfaces, test article support structures and instrumentation connection points.

Material Safety Data Sheets

NASA must ensure that all materials exposed to test environments do not present a hazard to personnel or the test facility. The Test Requester shall deliver material safety data sheets (MSDS) for materials used in the construction of the test article to the facility with an assessment of expected byproducts produced during the test. The MSDS shall be delivered prior to delivery of the test article. The Test Director will review the materials list for compatibility with the test environment and to determine protective measures for personnel if required.

Test Article Hazard Identification

The safety of facility personnel, facility equipment and the test article is imperative to NASA. Potential hazards, material compatibility and facility interfaces will be reviewed with the facility prior to test. In certain instances, special precautions must be taken due to the severity level of these potential hazards. The Test Requester may be asked to provide further information to clarify or mitigate a potential hazard. It is highly recommended that the Test Requester provide a test article hazard analysis or complete the Test Article Hazard Assessment checklist included in Appendix B. The analysis should consider test article handling, support equipment, potential failure modes during the test, hazardous materials, batteries, high voltage/current devices, pressurized components, dangerous mechanical devices, sharp edges, and any other potential hazards.

4.3.3 Test Plan

A test plan will be prepared by the Test Director unless submitted by the Test Requester. The final test plan shall be approved by Test Requester with concurrence from the Test Director. The test plan will be the controlling document with respect to scope and approach for the test program. The test plan will include at a minimum, the test objectives, scope, test article description, safety considerations and data requirements. Changes to the test plan that occur after the Test Readiness Review (TRR) that result in a major change to the scope of the test or present new hazards may require a delta TRR. A test plan template is included as an appendix to this guide (Appendix D).

4.3.4 Test Schedule

A detailed schedule shall be developed by the Test Director and approved by the Test Requester. The schedule shall allow adequate time for review and approval of test requirements, assembly of facility interfaces/structures and test article delivery. For time critical testing this schedule may be accelerated. The schedule of other tests and maintenance activities will be reviewed and potential conflicts shall be addressed by the Test Director.

4.3.5 Test Article Delivery

The test article delivery date will be determined on a case by case basis. An agreed upon delivery date shall be captured as a milestone in the test schedule. The Test Requester shall provide detailed handling instructions prior to delivery of the test article including handling hazards, cleanliness and storage requirements. An inspection of the test article shall be performed by the Test Director and Test Article Expert prior to the start of testing. NASA encourages Test Article Expert participation in the test article integration phase to provide immediate feedback on test article handling and any integration issues that arise.

4.3.6 Test Readiness Review (TRR)

A TRR will be held to ensure completion of all necessary facility and test article activities prior to test execution. The TRR will include the following:

- Review of the test plan, test procedures and other required test documentation
- Facility and test article readiness
- Review of configuration records including facility interface control documents, pressure system certification, instrumentation calibration, and materials compatibility
- Controls are in place to mitigate risks or hazards identified in the Test Hazard Analysis
- Data acquisition and processing functions are in place to adequately capture all critical data
- Multimedia coverage is adequate to provide recognition and assessment of potential test anomalies

Approval to proceed with test operations is granted by the Test Readiness Review Board (TRRB). The Test Director shall ensure that all TRR actions have been accomplished prior to the start of the test. The TRRB shall convene between one-to-five business days prior to the start of the test. TRRB participants shall include:

NASA TRRB Chairman	Test Article Expert (Appointed by Test Requester)
Test Director	Safety Engineer
NASA Test Safety Officer	Quality Engineer – if required by facility

4.4 Test Execution Phase

NASA encourages Test Requester participation in the testing activity. The Test Requester shall provide a Test Article Expert to verify that test setup and execution meets stated objectives. The Test Article Expert shall also verify test article performance and approve requested test deviations during test operations.

Inputs: TRRB approval to begin testing

Activities: Facility completes facility buildup, Detailed Test Procedure

Facility conducts testing activity

Outputs: Raw test data

4.4.1 Test Authority

The Test Director has the authority and responsibility to direct the test in accordance with the approved test plan and to terminate test activities per test rules when danger is imminent or test control cannot be maintained. The Test Director will ensure that positive actions are taken to halt any steps in the test procedure whenever unsafe or hazardous test conditions arise. The Test Director, with the concurrence of the Test Article Expert, has the authority to terminate the test when sufficient data has been obtained to meet objectives or when objectives cannot be met. Test team personnel will only accept directions from the Test Director.

4.4.2 Test Deviations

Changes to the test procedure shall be approved by the Test Article Expert with concurrence from the Test Director. Deviations that result in a major change to the scope of the test or present new hazards may require a delta TRR.

4.5 Test Closeout Phase

Data shall be delivered to the Test Requester within 10 business days following completion of test. The Test Requester shall notify Test Director upon receipt of data. Acceptance of test data concludes the test activity.

Inputs: Completed Test

Activities: Facility ships/transports test article to Test Requester

Test Director delivers data to the Test Requester

Outputs: Test Requester accepts data

Test Requester completes Customer Feedback form

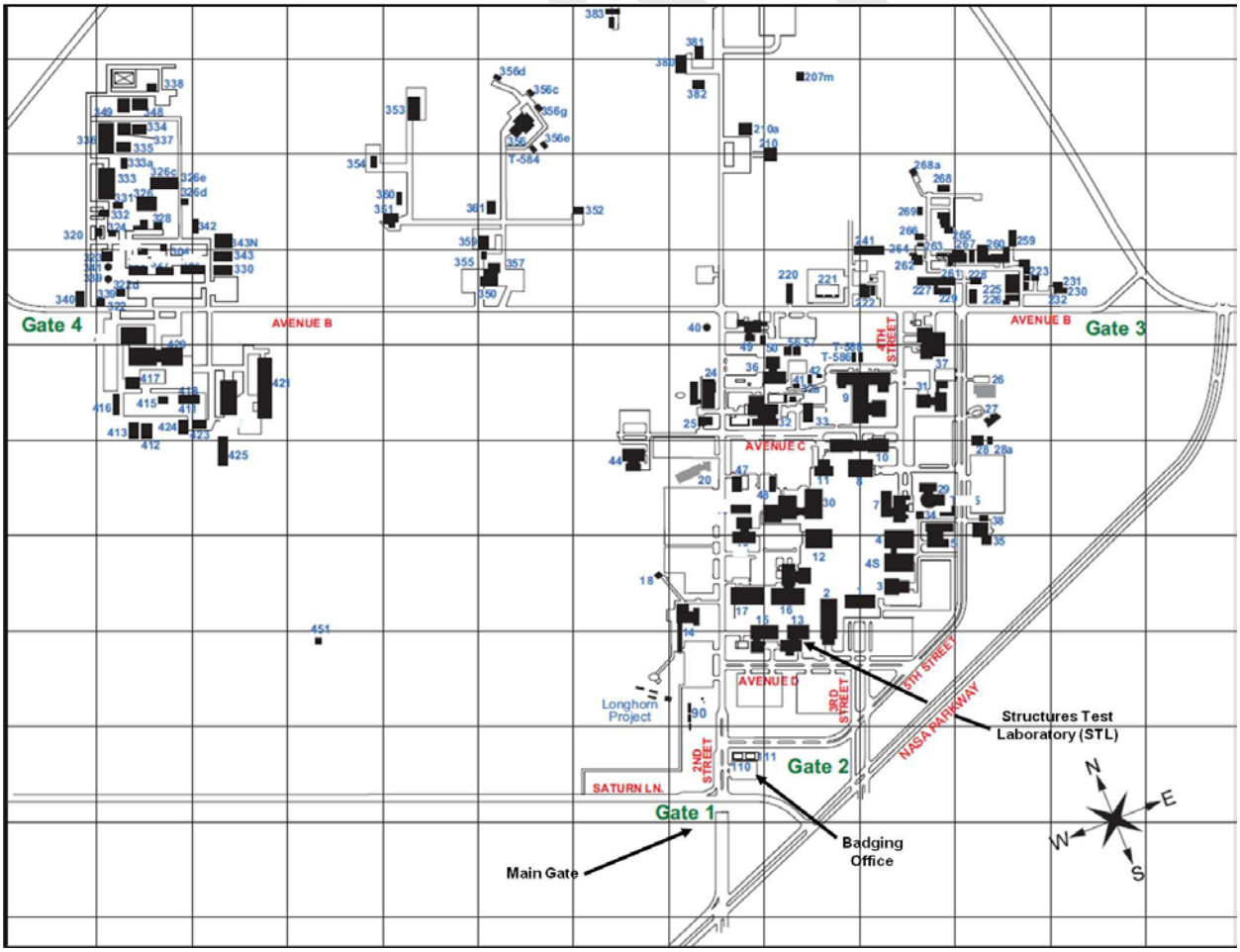
4.5.1 Customer Feedback

The STL encourages feedback from our customers. Evaluation of the services we provide enables continued improvement to our process. A customer feedback form is included as an appendix to this document (Appendix E). We encourage you to complete the customer feedback form and return to the Test Director following receipt of test data. Your participation is greatly appreciated.

5.0 Facility Access

Identification badges are required for all persons requiring access to the NASA Johnson Space Center. The Test Director or designee will initiate a badge request for all Test Requester personnel that will be participating in the test activity. Badge requests must be submitted at least 4 days prior to visit to prevent badge processing delays. Badge requests for Non-U.S. Citizens may require a minimum of 30 business days to process. Test Requester personnel shall arrive at JSC building 110 to pick up temporary identification badges. Visitors to JSC must show current picture identification (valid driver's license, U.S. passport, government ID card).

The STL is located at the Johnson Space Center in building 13. A facility access briefing shall be provided to all personnel requiring access to the facility prior to the start of the test.



6.0 Roles and Responsibilities

Test Director – The Test Director has overall responsibility for all phases of the test process.

Test Requester - The client requesting performance of a test activity. The Test Requester is responsible for the test article and for providing a Test Article Expert.

Test Article Expert – A representative of the Test Requester with thorough knowledge of the test article and how it is to be operated in the test environment. The Test Article Expert is also responsible for approving the test plan and verifying test objectives are met.

Test Conductor – Individual assigned under authority of the Test Director to execute the test in accordance with the approved test plan.

Safety Engineer – The Safety Engineer reviews the test article hazard assessment and integrated hazard analysis for the test facility to identify any additional hazards that could result in injury to personnel.

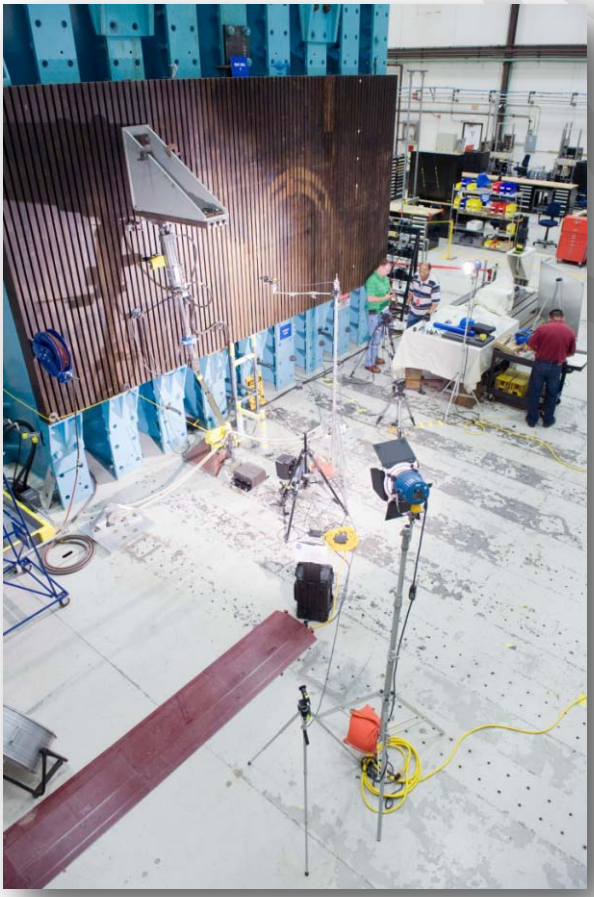
Quality Engineer – The Quality Engineer is responsible for verifying the test facility is ready for the test by assuring that all constraints to test have been closed.

Responsibilities Matrix

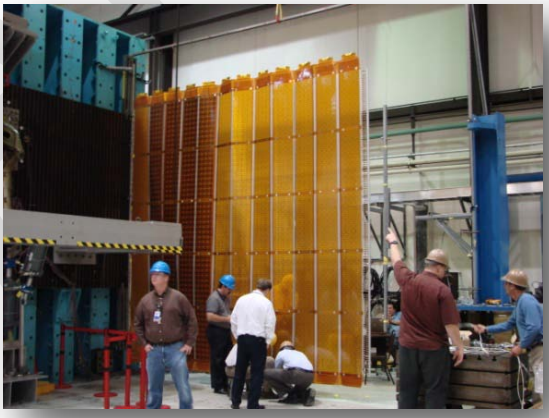
Item	Test Requester	Facility
Test Request Worksheet	Create	Review and provide assistance as needed
Cost and schedule	Approve	Create and Sign-off
Hazards	Identify test article hazards	Create test article facility integrated hazard analysis
Test plan	Review and Approve	Create and Sign-off
Test Readiness Review	Approve	Conduct and Approve
Test execution	Verify test article performance Verify test setup and execution meets objectives Approve requested deviations	Execute Test
Provide test data/results	Notify Test Director of data receipt	Deliver to Test Requester
Review test data/results	Approve	
Shipping	Provide instruction	Execute per request

Acronyms

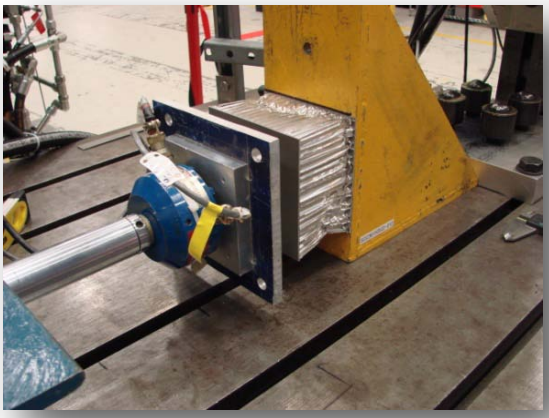
CPAS	CEV Parachute Assembly System
EAR	Export Administration Regulations
ISS	International Space Station
JSC	Johnson Space Center
LVDT	Linear Variable Differential Transformer
NASA	National Aeronautics and Space Administration
SPS	Sample per Second
STL	Structures Test Laboratory
TRR	Test Readiness Review
TRRB	Test Readiness Review Board
TVIS	Treadmill with Vibration Isolation and Stabilization
UCCAS	Unpressurized Cargo Carrier Attachment System



CPAS Extraction Force Transfer Coupling Binding Test



ISS Solar Array Test



Compression of Aluminum Pads

Appendix

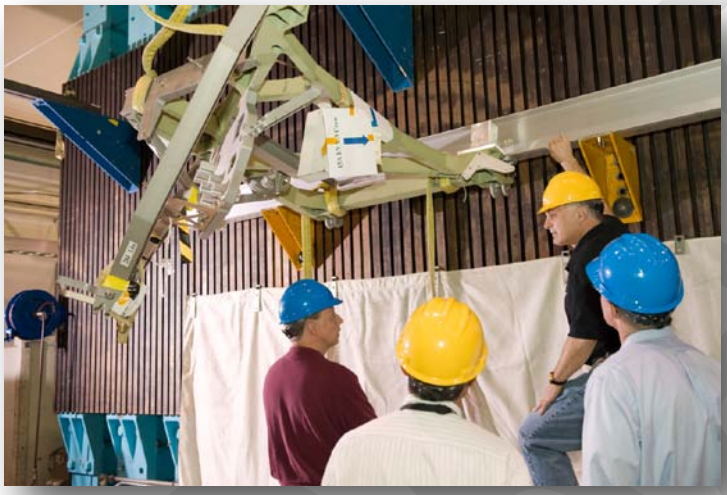
A. Facility Interface and Test Configurations

B. Instrumentation Provided by Facility

C. Test Request Worksheet

D. Sample Test Plan

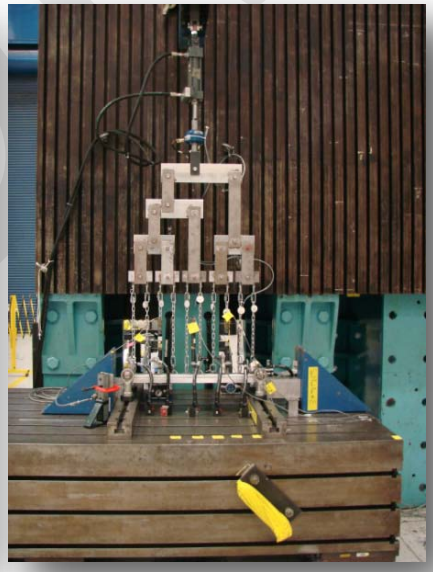
E. Customer Feedback



ISS UCCAS Deployment Checkout

WB-57 Landing Gear Strength Test

TVIS Bungee System Test

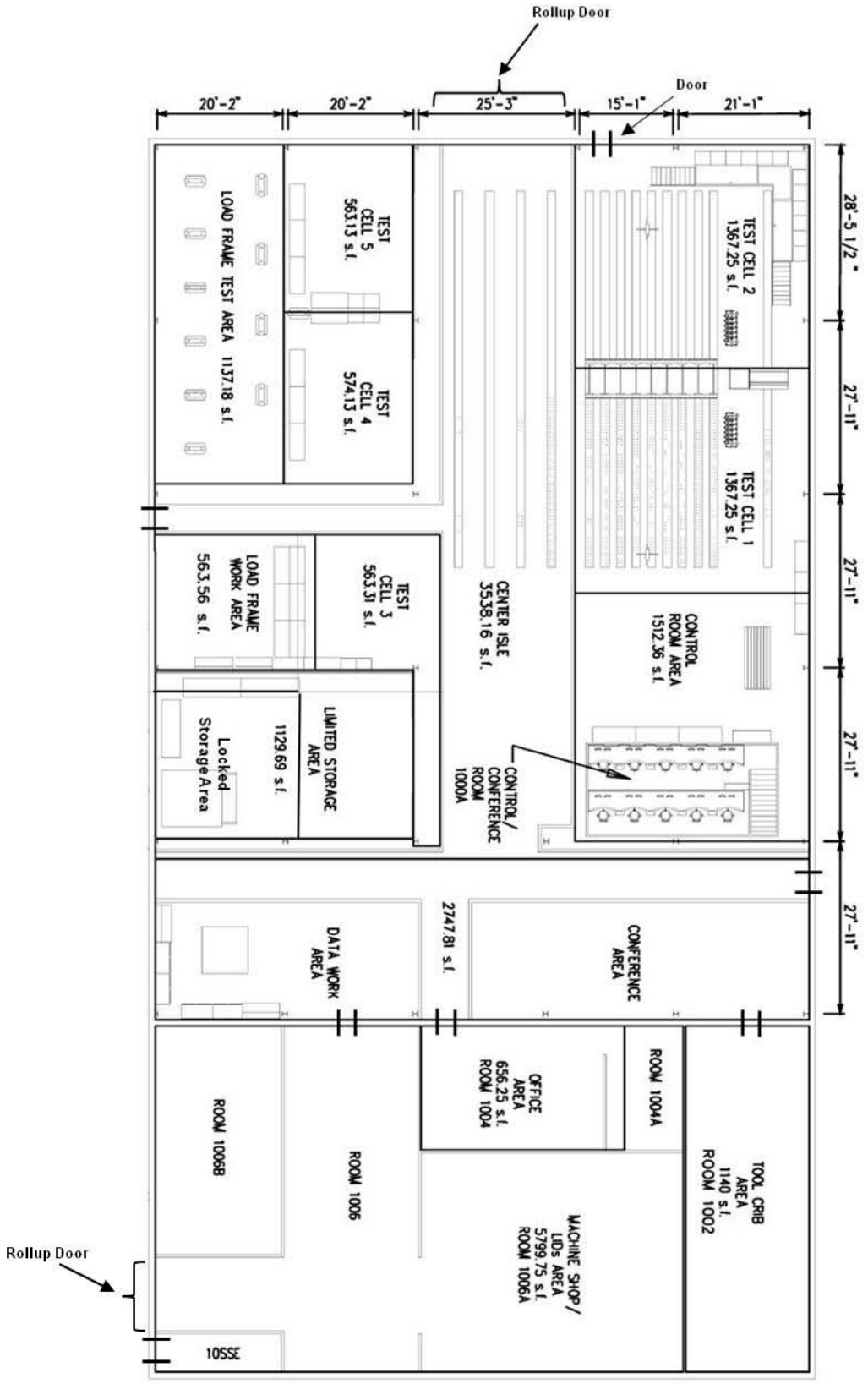


Shuttle Window Beam Stiffness Test

Orion Volume F Cover Load Testing

Appendix A Facility Interfaces

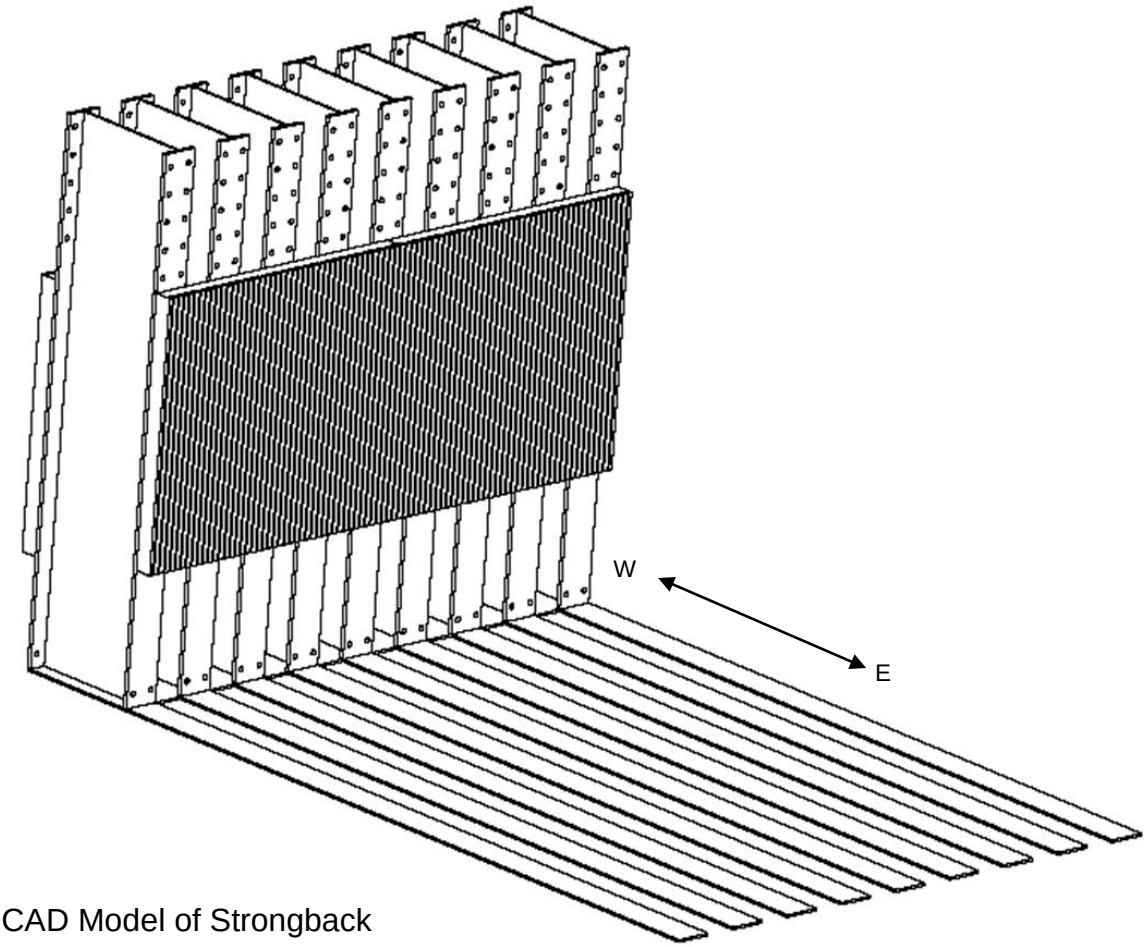
Facility Layout



The test fixture models/images included in this guide are a sampling of the capabilities within the STL. The facility maintains a variety of fixtures to support general and requester specific testing. Additional test fixtures are available upon request. The facility can also manufacture test fixtures to requester specifications. Please contact the Test Director to discuss test article interface requirements.

Strongback

A structural steel strongback, 21 ft. - 4 in. wide by 20 ft. high and 5 ft. thick serves as a rigid attach point for cantilevered structural tests or as an anchor for built-up test fixtures. The strongback is composed of nine steel I-beams embedded into 6.5 feet of concrete. Three inch thick steel plates with vertical 7/8 inch T-slots on 3 inch centers are attached to the east and west face of the vertical strongback. Nine steel built-up I-beams imbedded in the floor are rigidly attached to the strongback and extend 27 ft. 11 inches in both the east and west directions from the faces of the strongback on 2 ft. 6 in. centers. The vertical strongback separates the two test bays. CAD models and hole patterns of this model with dimensions can be provided upon request.



CAD Model of Strongback

Load Frames

The STL has the following closed loop, servo-hydraulic, tension/compression, and electromechanical test equipment for performing mechanical property evaluations of materials and structural loading of components and systems. All of these systems can be operated in either load or displacement control.

220 kip Test System

The test system has a 220,000 lb. nominal capacity, a maximum vertical opening 81 inches minus grips, and 28 inches between columns. Grips are hydraulic, self aligning, and can accept specimens up to 4 inches wide by 2.5 inches thick. The system has a cyclic capability up to 5 hertz (dependent upon stroke).

110 kip Test System

The test system has an 110,000 lb. nominal capacity, maximum vertical opening of 63 inches, and 24 inches between columns. The grips are hydraulic, self aligning, and can grip a specimen up to 3 inches wide by 0.75 inches thick. The system has a cyclic capability up to 6 hertz (dependent upon stroke).

110 kip Test System

55 kip Test System (Servo-Hydraulic) (x2)

The test system has a 55,000 lb. nominal capacity, maximum vertical opening 65 inches between grips, and 25 inches between columns. The grips are hydraulic, self aligning, and can grip a specimen up to 4 inches wide by 0.75 inches thick. The system has a cyclic capability up to 60 hertz, (dependent upon stroke).

22 kip Test System (Servo-Hydraulic) (x2)

The test system has a 22,000 lb. nominal capacity, maximum vertical opening of 48.5 inches minus grips, and 20 inches between columns. The grips are hydraulic, self aligning, and can grip a specimen up to 1.5 inches wide by 0.75 inches thick. The system has a cyclic capability up to 60 hertz (dependent upon stroke).

22 kip Test System (Servo-Hydraulic)

The test system has a 22,000 lb. nominal capacity, maximum vertical opening of 87.5 inches minus grips, and 21 inches between the columns. Grips are hydraulic, self aligning, and can accept specimens 1.5 inches wide x 0.5 inches thick. The system has a cyclic capability up to 90 hertz (dependent upon stroke).

22 kip Test System

11 kip Test System (Servo-Hydraulic) (x3)

The test system has an 11,000 lb. nominal capacity. The system has a 21 inch wide by 37 inch high internal clearance.

5.5 kip Test System (Servo Hydraulic)

The test system has a 5,500 lb. nominal capacity. The system has a 21 inch wide by 37 inch high internal clearance.

45 kip Test System (Electro-Mechanical)

The test system has a 45,000 lb. nominal capacity, cross head travel of 46 inches and 22 inches between columns, and crosshead speeds up to 20 inches per minute dependent upon load.

Electro-Mechanical Loadframe

Test Article in Electro-Mechanical Loadframe

Fabrication

The STL also houses a small machine shop to support in-house fabrication of load frame fracture mechanics test samples. The equipments within this machine shop includes a Computer Numerical Control mill, vertical/horizontal mill, Wire Electrical Discharge Machine, programmable control surface grinder, drill presses, band-saw, power hacksaw, wheel grinder, and sander.

Manual Vertical Mill

Computer Numerical Control Vertical Mill

Utilities

The STL can provide power to test articles and support equipment. Standard electrical power for the facility includes:

- 110 Volt AC, 60 Hz
- 208 Volt AC, 60 Hz 1 Phase
- 208 Volt AC, 60 Hz 3 Phase
- 240 Volt AC, 60 Hz 3 Phase
- 440 Volt AC, 60 Hz 3 Phase

Shop air at 150 psig is available throughout the high bay. The lab has one 90 gpm and one 70 gpm hydraulic power supply.

Liquid Nitrogen (LN2) is available in portable and fixed facility dewars for thermal cooling operations.

Potable water is available throughout the laboratory for cooling equipment and test purposes.

Appendix B Test Request Worksheet

Test Requester Information

Test Article Expert:	Contact Information (Phone, Email, Address):

Test Objectives

Purpose of Test:

Test Article

Test Article Description:	
Physical Dimensions (L/W/H):	Weight:

Test Article Handling Requirements

Cleanliness Level:	Controlled Access:
Special Moving/Handling:	

Test Environment

Complete the Test Environment table below for steady state conditions or provide a plot of the test environment to be simulated for a continuous environment.

	Load Case 1 ☐	Load Case 2 ☐	Load Case 3 ☐	Load Case 4 ☐	Load Case 5 ☐
No. of Loadtrains					
Load/Displacement Control					
Maximum Load/Displacement					
Load/Displacement Increments					
Ramp Rate					
Hold Time					
Wave Form					

Operation Limits

Inner Upper Limit					
Inner Lower Limit					
Outer Upper Limit					
Outer Lower Limit					

Percent Error Limit

Inner Upper Limit					
Inner Lower Limit					
Outer Upper Limit					
Outer Lower Limit					

* Data is only required in each column where the parameter is significant to your desired test environment

Test Article Interface

	Load Case 1 ☐	Load Case 2 ☐	Load Case 3 ☐	Load Case 4 ☐	Load Case 5 ☐
Design					
Component Models					
Assembly Models					
Drawings					
Comments:					
Fabrication					
Component Hardware					
Comments:					
Test Build-up					
Comments:					
Requester Supplied Items					
List materials, instruments supplied by Requester:					

Operational Requirements

Proposed Test Start Date:	Critical Test Start Date:
Quality Support (Yes/No):	

Data Acquisition and Recording

Number of Channels:	Video Recording (Yes/No):
Sampling Rates:	Photographic Film (Yes/No):
Real Time Data Processing (Yes/No):	High Speed/Low Speed:
Data File (ASCII/Excel):	Plots (Yes/No):

Data

Temperature ☐	Load ☐	Deflection ☐	Pressure ☐	Time ☐	Strain ☐

Instrumentation Provided by Test Requester:

Designs/Drawings

We can accept files through an FTP site, by email, or standard mail.

1. Email drawings to christopher.p.briggs@nasa.gov
2. Test Director will send invitation to NASA File Transfer Protocol Site to upload and send files.
3. Mail drawings to National Aeronautics and Space Administration, Attention Chris Briggs Mail Code: ES4 Lyndon B. Johnson Space Center Houston, Texas 77058

Other Information

List any other information pertinent to the test:

Test Article Hazard Checklist

(A hazard analysis statement is required for any of the following applicable attributes of any of your provided hardware (test article, support equipment, etc.)

Hazard	Y	N	Comments
Mechanical	☐	☐	
Handling (> 40 lbs. Or > 4 ft., any dimension)	☐	☐	
Instability	☐	☐	
Sharp Edges	☐	☐	
Pinch Points	☐	☐	
Exposed mechanisms (rotating, reciprocating, etc.)	☐	☐	
Pressure Systems	☐	☐	
Stored energy (springs, weights, flywheels, etc.)	☐	☐	
Ejected parts, projectiles	☐	☐	
Electrical	☐	☐	
Voltage (> 50 volts)	☐	☐	
Batteries	☐	☐	
Generation/storage (coils, magnets, capacitors, etc.)	☐	☐	
Electro-static sensitive devices	☐	☐	
Thermal	☐	☐	
Hot surfaces (> 113^{o} F, 45^{o} C)	☐	☐	
Heaters	☐	☐	
Cold surfaces (< 39^{o} F, 4^{o} C)	☐	☐	
Cooling devices	☐	☐	

Hazard	Y	N	Comments
Radiation	☐	☐	
Ionizing	☐	☐	
Non-Ionizing	☐	☐	
Laser	☐	☐	
Microwave	☐	☐	
Infrared (IR)	☐	☐	
Ultraviolet (UV)	☐	☐	
Radio Frequency (RF)	☐	☐	
Visible light, high intensity	☐	☐	
Material	☐	☐	
Uncontained brittle materials	☐	☐	
Test environment incompatibility	☐	☐	
Contained fluids	☐	☐	
Toxic, corrosive, flammable fluids	☐	☐	
Biohazards	☐	☐	
Miscellaneous	☐	☐	
Noise level (> 85 dBA)	☐	☐	
Ultrasonic	☐	☐	
Pyrotechnics/Explosives	☐	☐	

Appendix C Instrumentation Provided by Facility

Instrumentation	Range
Load Cells	50 – 200,000 lbs
Load Washers	2,000 – 50,000 lbs
Position Transducers	LVDT - +/- 0.05 - +/- 1 in String Pots (Linear Resistive Deflection Potentiometers) – 2 – 500 in Displacement/Velocity – 10 in, 50 in, and 500 in Dial Indicators – 0.1 – 2 in
Torque Transducers	20 – 350 lbs/ft
Pressure Transducers	1 – 20,000 psi
Strain Gages	Various; installation by certified personnel
Thermocouples	Type T, K, J; 300 – 2300F

Appendix D Sample Test Plan

Test Requester Information

Test Article Expert:	Contact Information (Phone, Email, Address):
[Identify Test Article Expert]	[Test Article Expert Contact Information]

Test Objectives

Purpose of Test:
Define Purpose of Test: Sample Objective: Test two assemblies to a load of 500 lbs that will be held for 3 minutes. The assembly is purely mechanical and is not powered or pressurized. Load will be recorded continuously for the duration of the test.

Test Article

Test Article Description:	
Describe Test Article, contents, type of material, etc. The assemblies consist of an aluminum hub of approx. X" in length and X" in diameter. Attached to the assembly is an X" diameter nylon coated steel cable that is approx. X" long.	
Physical Dimensions (L/W/H): X" in length and X" in diameter	Weight: 20 lbs.

Test Article Handling Requirements

Cleanliness Level:	Controlled Access:
N/A	N/A
Special Moving/Handling: Describe any special handling requirements Sharp edges, to be transferred to facility by Requester, etc.	

Test Environment

Complete the Test Environment table below for steady state conditions or provide a plot of the test environment to be simulated for a continuous environment.

	Load Case 1	Load Case 2	Load Case 3	Load Case 4	Load Case 5
	X	X	☐	☐	☐
No. of Loadtrains	N/A	N/A			
Load/Displacement Control	Load Control	Load Control			
Maximum Load/Displacement	+500 lbs	+ 500 lbs			
Load/Displacement Increments	None	None			
Ramp Rate	15 lbs/sec	15 lbs/sec			
Hold Time	2 min	2 min			
Wave Form	Ramp	Ramp			

Operation Limits

Inner Upper Limit	N/A	N/A			
Inner Lower Limit	N/A	N/A			
Outer Upper Limit	+ 550 lbs (10%)	+ 550 lbs (10%)			
Outer Lower Limit	- 180 lbs	- 180 lbs			

Percent Error Limit

Inner Upper Limit	N/A	N/A			
Inner Lower Limit	N/A	N/A			
Outer Upper Limit	N/A	N/A			
Outer Lower Limit	N/A	N/A			

* Data is only required in each column where the parameter is significant to your desired test environment

Test Article Interface

	Load Case 1	Load Case 2	Load Case 3	Load Case 4	Load Case 5
	X	X	☐	☐	☐
Design					
Component Models	Yes	Yes			
Assembly Models	Yes	Yes			
Drawings	Yes	Yes			
Comments: Design two test support fixtures for attaching the test samples to the load frame interface hardware. The test support fixtures will consist of…. Drawing attached					
Fabrication					
Component Hardware	Yes	Yes			
Comments: Design and fabricate per attached drawing					
Test Build-up					
Comments: All test support fixtures will be designed to easily adapt to the load frame fixtures. Facility personnel will be responsible for building up the setup for both load cases.					
Requester Supplied Items					
List materials, instruments supplied by Requester: Two Assemblies and X" diameter shaft					

Operational Requirements

Proposed Test Start Date: Proposed Start Date	Critical Test Start Date: Need Date
Quality Support (Yes/No): No	

Data Acquisition and Recording

Number of Channels: 32	Video Recording (Yes/No): No
Sampling Rates: 10 SPS	Photographic Film (Yes/No): Yes
Real Time Data Processing (Yes/No): No	High Speed/Low Speed: N/A
Data File (ASCII/Excel): Excel	Plots (Yes/No): Yes

Data

Temperature ☐	Load X	Deflection X	Pressure ☐	Time X	Strain ☐

Instrumentation Provided by Test Requester:

None

Other Information

List any other information pertinent to the test:

Appendix E Customer Feedback

TEST CUSTOMER FEEDBACK		
Product (Test Title):		**Facility:**
File Number:	**TD:**	**Test Date:**

	SCORE (Check or Click on Box)					
	Poor					Excellent
SCHEDULE:	**1**	**2**	**3**	**4**	**5**	**N/A**
1. Was the test initiated and completed to meet your requirements?	☐	☐	☐	☐	☐	☐
2. Were we able to accommodate your requested schedule changes?	☐	☐	☐	☐	☐	☐
COST:						
3. Was the test performed within estimated budget?	☐	☐	☐	☐	☐	☐
4. Was the test cost reasonable for the test performed?	☐	☐	☐	☐	☐	☐
PRODUCT:						
5. Was the provided test data accurate?	☐	☐	☐	☐	☐	☐
6. Was the test data provided to you in an acceptable format and a timely manner?	☐	☐	☐	☐	☐	☐
FACILITY (Test Position and Support Hardware):						
7. Did the facility's capability meet the needs of the test requirements?	☐	☐	☐	☐	☐	☐
8. Was the facility reliable during the test?	☐	☐	☐	☐	☐	☐
TEST TEAM:						
9. Did you find the test team helpful and knowledgeable in meeting your objective?	☐	☐	☐	☐	☐	☐
10. Would you consider using this test facility for future tests?	☐	☐	☐	☐	☐	☐

Note: We are concerned and interested in your comments and would like an opportunity to improve our service

Comments/Suggestions for Improvement:

Customer Name & Organization:

Return to: Test Director or Survey Manager, Chris Briggs (Christopher.p.briggs@nasa.gov)