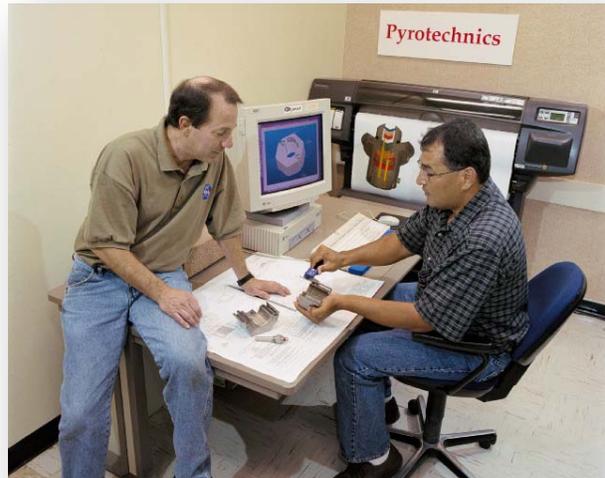
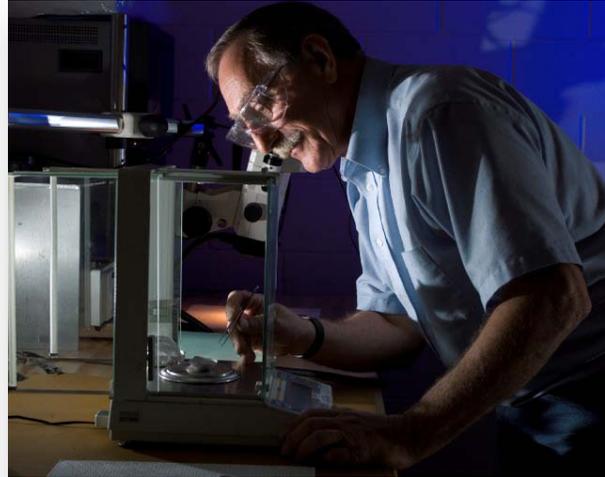


Energy Systems Test Area (ESTA) Pyrotechnic Operations

User Test Planning Guide



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

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1.0 Introduction

The Johnson Space Center (JSC) has created and refined innovative analysis, design, development, and testing techniques that have been demonstrated in all phases of spaceflight. JSC is uniquely positioned to apply this expertise to components, systems, and vehicles that operate in remote or harsh environments. We offer a highly skilled workforce, unique facilities, flexible project management, and a proven management system.

1.1 Purpose

The purpose of this guide is to acquaint Test Requesters with the requirements for test, analysis, or simulation services at JSC. The guide includes facility services and capabilities, inputs required by the facility, major milestones, a roadmap of the facility's process, and roles and responsibilities of the facility and the requester. Samples of deliverables, facility interfaces, and inputs necessary to define the cost and schedule are included as appendices to the guide.

1.2 Facility Availability

JSC test facilities are available for the National Aeronautics and Space Administration (NASA), other government agencies, and commercial requesters. We have developed user-friendly agreements to streamline business relationships and are eager to share our unique facilities and expertise. We invite your inquiries regarding application or adaptation of our capabilities to satisfy your special requirements. Briefings on general or specific subjects of mutual interest can be arranged at JSC or at your business site.

1.3 Inquiries

General inquiries regarding the use of JSC facilities should be directed to:

JSC Engineering Directorate
Johnson Space Center
2101 NASA Parkway, Houston, TX 77058
Phone: 281-483-8991
Email: beth.a.fischer@nasa.gov

Inquiries regarding pyrotechnic operations at the Energy Systems Test Area (ESTA) should be directed to:

Martin McClean
Energy Systems Test Area Branch Chief
Johnson Space Center
2101 NASA Parkway, Houston, TX 77058
Phone: (281) 483-6478
Email: jsc-cal-ep6-esta@nasa.gov

Please refer to the Engineering Services website: <http://jsceng.nasa.gov>, for additional information and general inquiries about test, analysis, and simulation capabilities at JSC.

1.4 Pyrotechnic Operations

ESTA has a long heritage of providing safe, reliable pyrotechnic solutions for aerospace applications. ESTA provides for testing of pyrotechnically-actuated devices, including performance, environmental, and safety testing. ESTA's facility includes an explosives loading and handling room and pyrotechnics storage in earth-covered bunkers. We have experience in design, development, and testing of a number of pyrotechnic devices, including, but not limited to, NASA Standard Initiators (NSI), pressure cartridges, pin pullers, strap cutters, parachute components, pyrotechnic valves, detonating cord, shape charges, and a reefing line cutter. The facility provides the unique capability to perform NSI testing at $-420\text{ }^{\circ}\text{F}$ and is responsible for lot testing and providing the NSIs for all spacecraft applications for NASA.



Services Provided

- Performance Testing
 - Loading of propellants, pressure cartridges, and explosives
 - X-ray, dimensional inspection, proof pressure, and functional testing of pyrotechnic devices and full systems
 - Destructive performance testing
 - Bridgewire resistance and firing line voltage/resistance
- Environmental Testing
 - Vibration at cryogenic temperatures
 - Pyrotechnic shock
 - Thermal cycling
 - Thermal/vacuum environment
- Safety Testing
 - Age-life extension
 - Auto-ignition
 - Minimum/maximum energy
 - Drop testing
- Special Services
 - Detonation velocity measurement
 - High-speed video
 - Explosive cord cutting
 - Pyrotechnic storage
 - Live pyrotechnic machining
 - Laser marking

1.5 Specifications

1.5.1 Performance Testing

Hydraulic Load/Firing

Work Envelope	Orientation	Temperature Range	Unique Features
12" Dia x 3' L	Horizontal	-300 – 350 °F	<ul style="list-style-type: none"> Tensile loads up to 680,000 lb_f Moment loads up to 240,000 in-lb_f

High-Speed Firing and Data Acquisition

Work Envelope	Orientation	Temperature Range	Unique Features
Any	Any	-450 – 1,000 °F	<ul style="list-style-type: none"> Piezoelectric pressure transducers Pyroshock accelerometers 1 GHz data sampling Capacitive discharge, programmable constant current, or custom firing sources

Leak Detection

Work Envelope	Unique Features
3" dia x 6" L	<ul style="list-style-type: none"> Flow through or bombing method for sealed items Leak rates down to 1×10^{-10} sccs

1.5.2 Environmental Testing

Hazardous Vibration Testing

The hazardous vibration test stand provides for vibration of pressurized systems and explosive materials within a thermal environment. The test stand supports test articles (including fixture) up to 480 lb_f.

Vibration capability includes sine, random, and classical shock.

Frequency Range	Shaker Range	Work Envelope	Temperature Range	Displacement
20 – 2,000 Hz	11,000 lb _f RMS Up to 16,000 lb _f sine Up to 15,500 lb _f random	36" table 42" head	-300 – 350 °F	1" stroke

Thermal Vacuum Testing

Work Envelope	Orientation	Temperature Range	Pressure	Unique Features
16" Dia x 24" H	Bell Jar	-280 – 300 °F	760 – 1×10^{-5} torr	<ul style="list-style-type: none"> LN₂ cold plate, heater

Thermal Testing

Work Envelope	Orientation	Temperature Range	Unique Features
2' x 3' x 3'	Front Load	-100 – 350 °F	<ul style="list-style-type: none"> Controllable ramp rates and soak durations
20" x 20" x 18"	Front Load	-100 – 350 °F	<ul style="list-style-type: none"> Controllable ramp rates and soak durations
34" x 34" x 32"	Front Load	-100 – 390 °F	<ul style="list-style-type: none"> Viewing window
22" x 22" x 22"	Front Load	-100 – 600 °F	<ul style="list-style-type: none"> Fast ramp rate, glove box door
1' x 1' x 1'	Front Load	-100 – 350 °F	<ul style="list-style-type: none"> Humidity controllable 10 – 90% relative humidity

1.5.3 Safety Testing

Pyrotechnic Auto-Ignition Chamber

Work Envelope	Orientation	Temperature Range	Unique Feature
4" dia x 12" long	Vertical	+1500 °F	<ul style="list-style-type: none"> Remote operation, programmable ramp rates and hold periods

1.5.4 Special Services

Capability	Work Envelope	Unique Features
Detonation Velocity Measurement	Any	<ul style="list-style-type: none"> Measures detonation velocity of linear explosive components to 10,000 meters
Live Pyrotechnic Machining	3" dia x 8" L for cartridges	<ul style="list-style-type: none"> Linear explosive components of unlimited length Used for device disassembly for failure analysis and facing of linear explosive components for booster cup attachment
Explosives Cord Cutting	1" dia x unlimited length	<ul style="list-style-type: none"> Remote operation
Laser Marking	6" dia x 36" L	<ul style="list-style-type: none"> Programmable rotary chuck for round parts
Laser Interferometer	Any	<ul style="list-style-type: none"> Measures speeds up to 10,000 meters/s 1% accuracy at 10,000 meters
High-Speed Video	Any	<ul style="list-style-type: none"> Up to 4M frames/second Integrated into high speed firing and data system for triggering and data synchronization

2.0 Facility Layout

JSC Building 352 Pyrotechnics Test Facility*



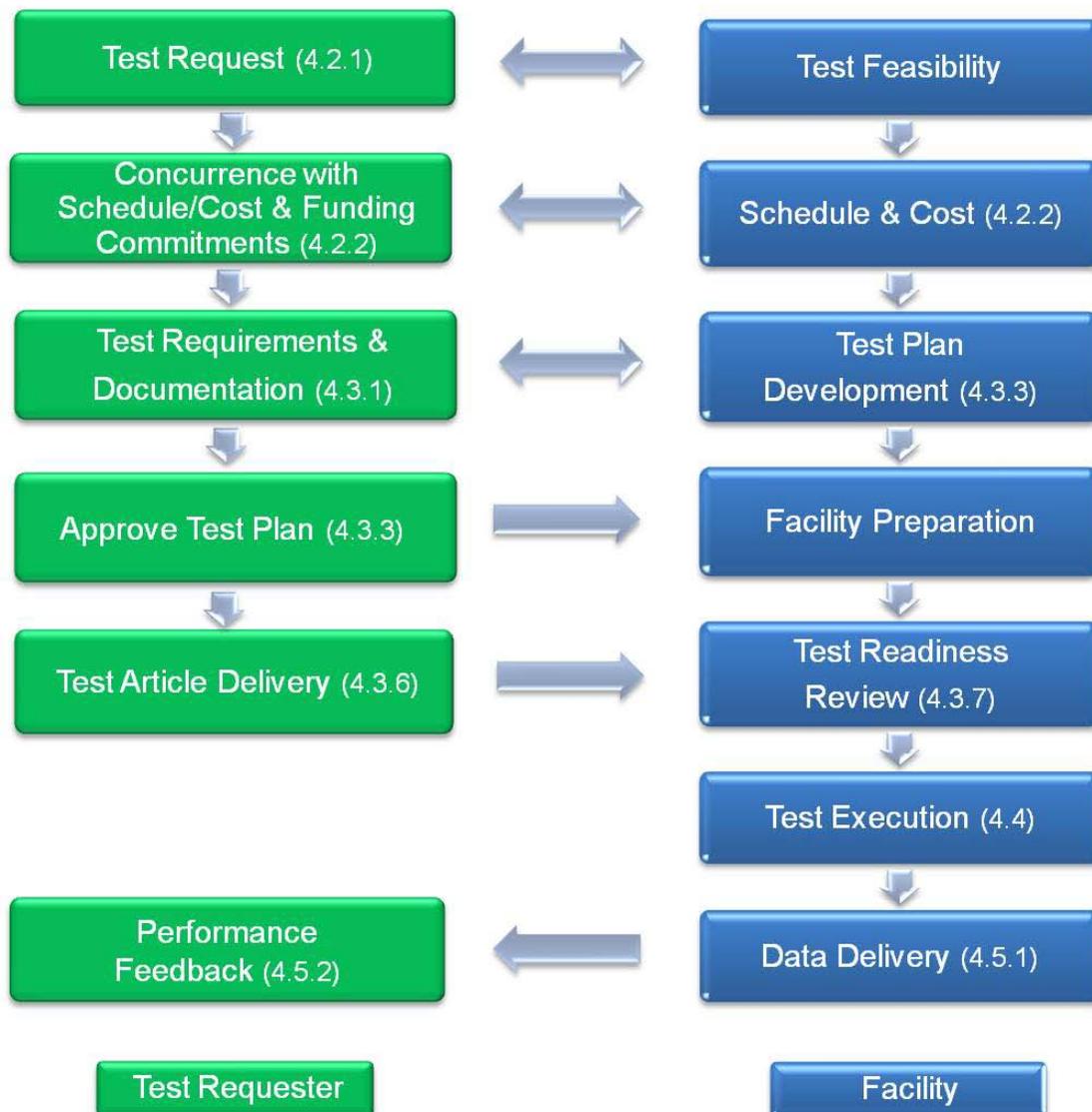
* See Appendix A for facility interfaces and the facility layout.

3.0 Safety and Health

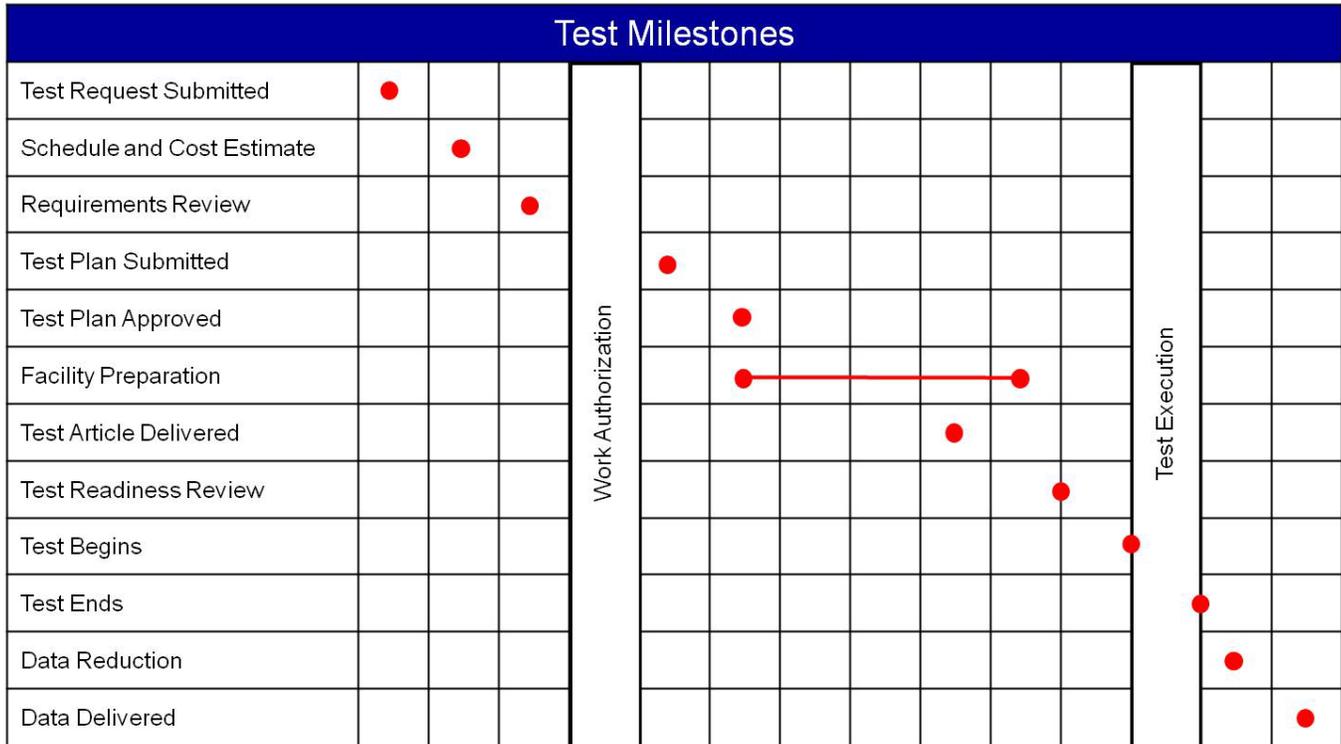
Safety is an integral part of the culture at NASA. Management, leadership, and employee involvement from all organizations are critical to the success of NASA’s safety program. In order to ensure personal safety and a safe test environment throughout the process, the requester shall furnish the facility 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 ESTA safety rules, potential hazards, and emergency procedures.

4.0 Test Process Flow

The flowchart presented 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, highlighting interactions and inputs between the Test Requester and the facility 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 a review of the test objectives and requirements. For time-critical testing, this schedule may be accelerated. Major milestones are presented below:



4.1 Export Controlled and Proprietary Information

ESTA 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 that 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 onsite 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 and estimated cost and schedule to Test Requester
- Test Requester concurs with estimated cost and schedule and provides necessary funding commitment to pay for test

4.2.1 Test Request

The test request outlines the test objectives, test article description, and schedule. A Test Request Worksheet is provided in Appendix B. This worksheet addresses the basic requirements for pyrotechnics testing at ESTA. It is suggested that the Test Requester complete this worksheet to facilitate the development of a preliminary test plan. 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, the following:

- Desired test conditions (vibration, thermal, vacuum, thermal/vacuum, thermal shock)
- Proposed test approach
- Test data requirements

Test Article Description

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

- Size (provide drawings, sketches, photos)
- Weight
- Test article interface (load points, method of suspension or test article support)
- Test article interface requirements
- Orientation (x, y, z)

- Special considerations [e.g., hazards, cleanliness, compatibility, Material Safety Data Sheets (MSDS)]
- 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. Test preparation will not begin until the Test Requester concurs with the estimated cost and schedule. The Test Requester must also provide the necessary funding commitment to pay for the test.

4.3 Test Preparation Phase

The detailed test plan, test schedule, and Interface Control Document (ICD) 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 (TRR) 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 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 that the test team understands the effect of the requirements on test facility preparation. The Test Requester shall provide a detailed list of test requirements, including, but not limited to, the following:

- Specific test conditions
- Interface requirements (e.g., fluid, structural, electrical, mechanical)
- Data/instrumentation requirements (provided by Test Requester and facility)

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 to the facility MSDS for materials used in the construction of the test article 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 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 testing. 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 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 one is submitted by the Test Requester. The final test plan shall be approved by the 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 TRR that result in a major change to the scope of the test or that present new hazards may require a delta TRR. A sample test plan is included in 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 delivery of the test article. The schedule of other tests and maintenance activities will be reviewed, and potential conflicts shall be addressed by the Test Director.

4.3.5 Interface Control Document

The ICD defines the interface between the test article and facility test equipment. An ICD will be prepared by the Test Director and approved by the Test Readiness Review Board (TRRB) with concurrence from the Test Requester. The ICD will include test fixture assembly requirements, a list and plot of specifications for the test, and test article interface drawings.

4.3.6 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 the 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.

Department of Transportation (DOT) Class 1.1, 1.2, and 1.3 explosives must be delivered directly to JSC Building 352 with a fire department escort and a vehicle equipped with warning placards, a fire extinguisher, and a blast shield. DOT Class 1.4 explosives can be delivered directly to JSC Central Receiving; however, the explosives will need to be picked up by JSC Building 352 personnel. Notify the Test Director upon shipment of explosives.

4.3.7 Test Readiness Review

A TRR will be held to ensure the 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
- Confirmation of facility and test article readiness
- Review of configuration records, including facility interface control documents, pressure system certification, instrumentation calibration, and materials compatibility
- Assurance that controls are in place to mitigate risks or hazards identified in the Test Article Hazard Analysis
- Verification that data acquisition and processing functions are in place to adequately capture all critical data
- Confirmation that multimedia coverage is adequate to provide recognition and assessment of potential test anomalies

Approval to proceed with test operations is granted by the TRRB. The Test Director shall ensure that all TRR actions have been accomplished prior to the start of the test. The TRRB shall convene 1 to 5 business days prior to the start of the test. TRRB participants shall include the following:

NASA TRRB Chairman

Test Article Expert (Appointed by Test Requester)

Test Director
NASA Test Safety Officer

Safety Engineer
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 meet the stated objectives. The Test Article Expert also shall verify test article performance and approve requested test deviations during test operations.

Inputs: Approval to begin testing received from TRRB
Activities: Facility completes facility buildup, Detailed Test Procedure
Facility conducts testing activity
Outputs: Test completed

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 accept directions only 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 that 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 testing. The Test Requester shall notify the Test Director upon receipt of the data. Acceptance of the test data concludes the test activity.

Inputs: Test completed

Activities: Facility ships/transport test article to Test Requester

Test Director delivers data to Test Requester

Outputs: Test Requester accepts data

Test Requester completes Customer Feedback form

4.5.1 Data Package

A data package is an assembly of test results. The format of the data package is normally specified by the Test Requester. The standard data package format includes a description of the test and objectives, test observations, test results, and data plots.

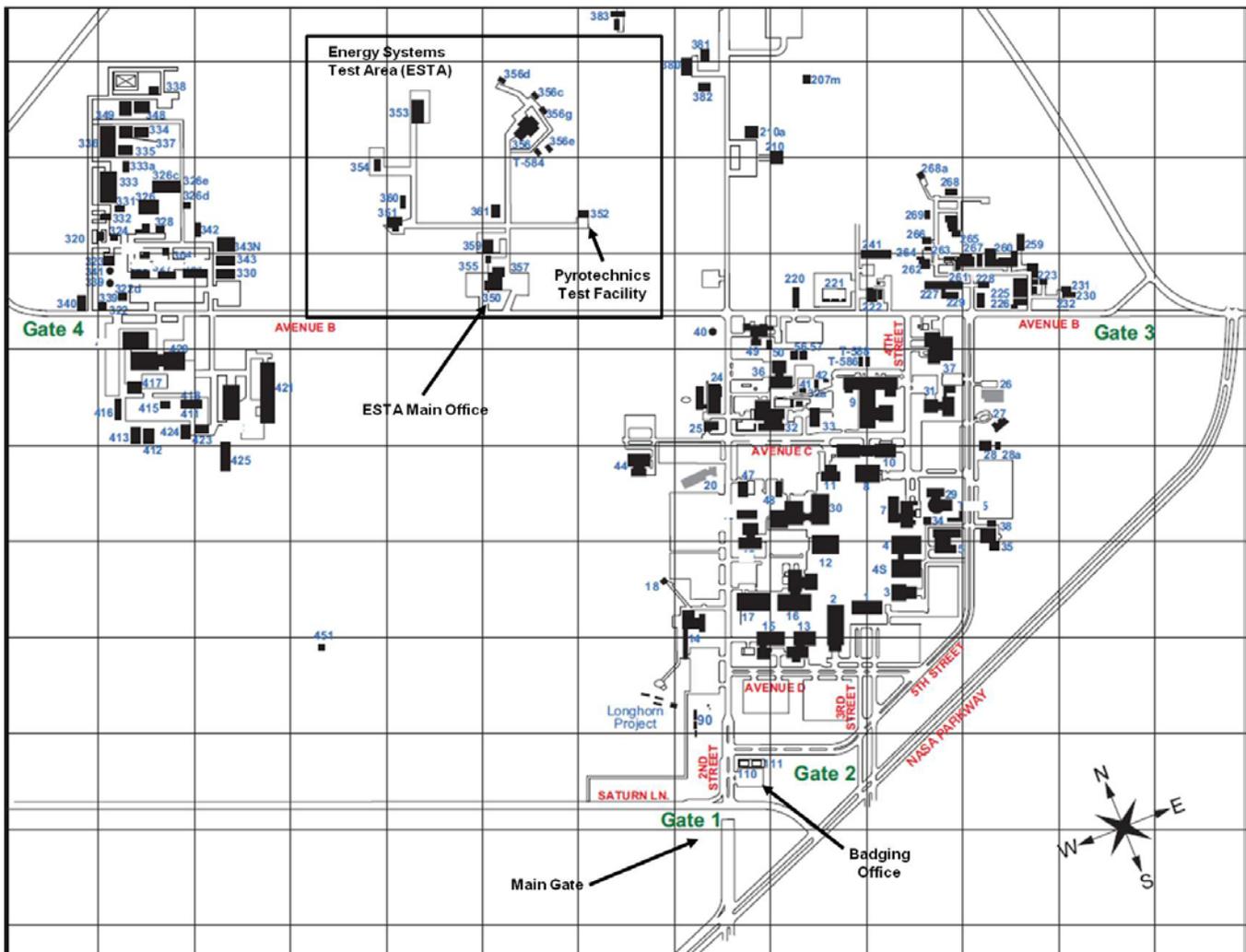
4.5.2 Customer Feedback

ESTA requests feedback from our customers. Evaluation of the services we provide enables continued improvement to our process. A Customer Feedback form is included in Appendix E. You are encouraged to complete the Customer Feedback form and return it to the Test Director, following receipt of the test data. Your participation is greatly appreciated.

5.0 Facility Access

Identification badges are required for all persons requiring access to JSC. The Test Director or designee will initiate a badge request for all Test Requester personnel who will be participating in the test activity. Badge requests must be submitted at least 4 days prior to the 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 a current picture identification (valid driver's license, U.S. passport, government ID card).

The Pyrotechnics Test Facility is located in JSC Building 352. The facility is part of the Energy Systems Test Area identified on the map below. Test Requester personnel shall go to JSC Building 350, ESTA Main Office, to complete a facility access briefing prior to arriving at JSC Building 352. Cellular and radio transmitting devices are not allowed within a 200 foot radius around JSC Building 352 and the explosives storage bunker.



6.0 Roles and Responsibilities

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 also is responsible for approving the test plan and verifying that test objectives are met.

Facility Engineering – Responsible for designing and fabricating any required test article interfaces, including structures, fluids, and power. Facility engineering also provides support for external test article instrumentation and data acquisition.

Safety Engineer – Reviews the test article hazard assessment and prepares an integrated hazard analysis for the test facility to identify any additional hazards that could result from mating the test article to the test facility.

Quality Engineer – Responsible for verifying that the test facility is ready for the test by ensuring that all constraints to the 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 that test setup and execution meet 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

°C	degrees Celsius
°F	degrees Fahrenheit
ASCII	American Standard Code for Information Interchange
dB	decibel(s)
dBA	decibel A-weighting
DOT	Department of Transportation
e.g.	for example
ESTA	Energy Systems Test Area
ft	feet
FTP	File Transfer Protocol
g ²	square grams
H	Height
hr	hour(s)
Hz	Hertz
ICD	Interface Control Document
IR	Infrared
JSC	Johnson Space Center
L	Length
lb	pound(s)
lb _f	pound-force
LN ₂	Liquid Nitrogen
mg	milligram(s)
MSDS	Material Safety Data Sheets
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
No.	Number
NSI	NASA Standard Initiator
RF	Radio Frequency
RMS	Root Mean Square
sccs	standard cubic centimeters per second

sec	second(s)
SPS	Samples per Second
TRR	Test Readiness Review
TRRB	Test Readiness Review Board
UV	Ultraviolet
V	volt(s)
VISAR	Velocity Interferometer System for Any Reflector
W	Width

Appendices

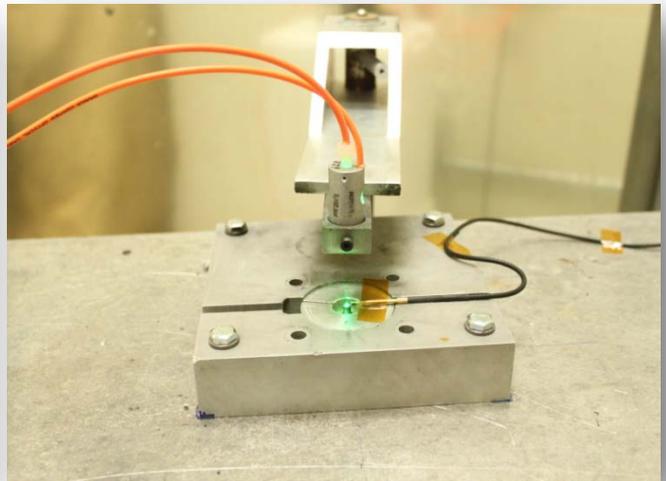
- A. Facility Interfaces/Sample Test Configurations
- B. Test Request Worksheet
- C. Instrumentation Provided by Facility
- D. Sample Test Plan
- E. Customer Feedback

Appendix A Facility Interfaces/Sample Test Configurations

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

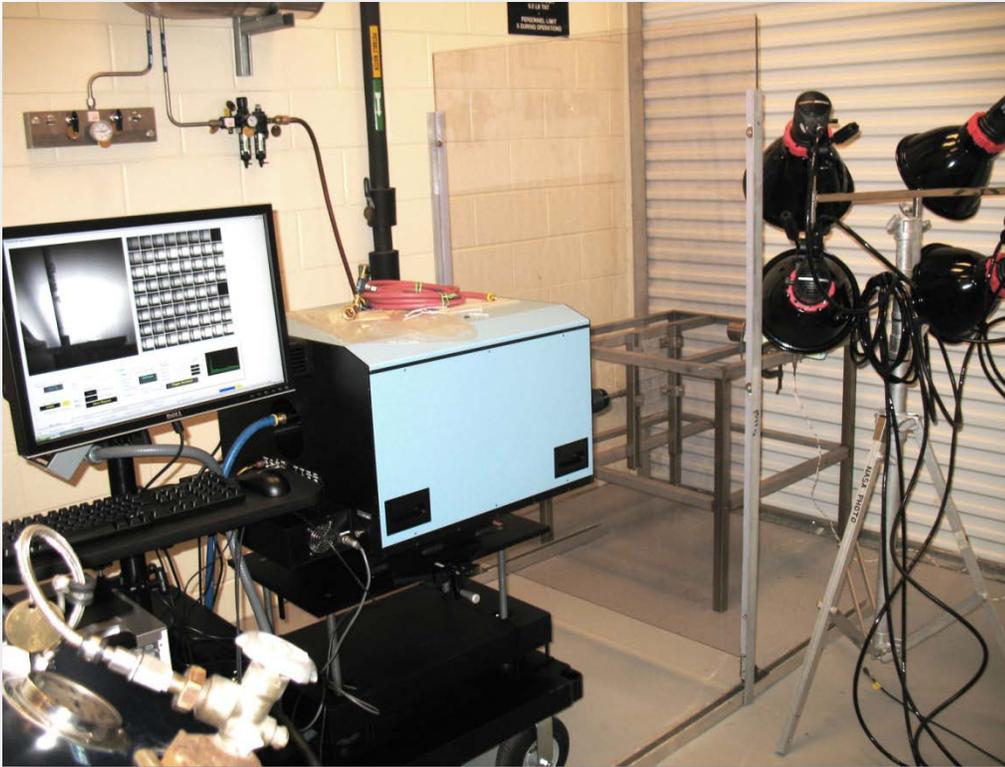
Velocity Interferometer System for Any Reflector (VISAR)

VISAR is a laser interferometer capable of measuring detonation velocity at speeds up to 10,000 meters per second with 1 percent accuracy at 10,000 meters.

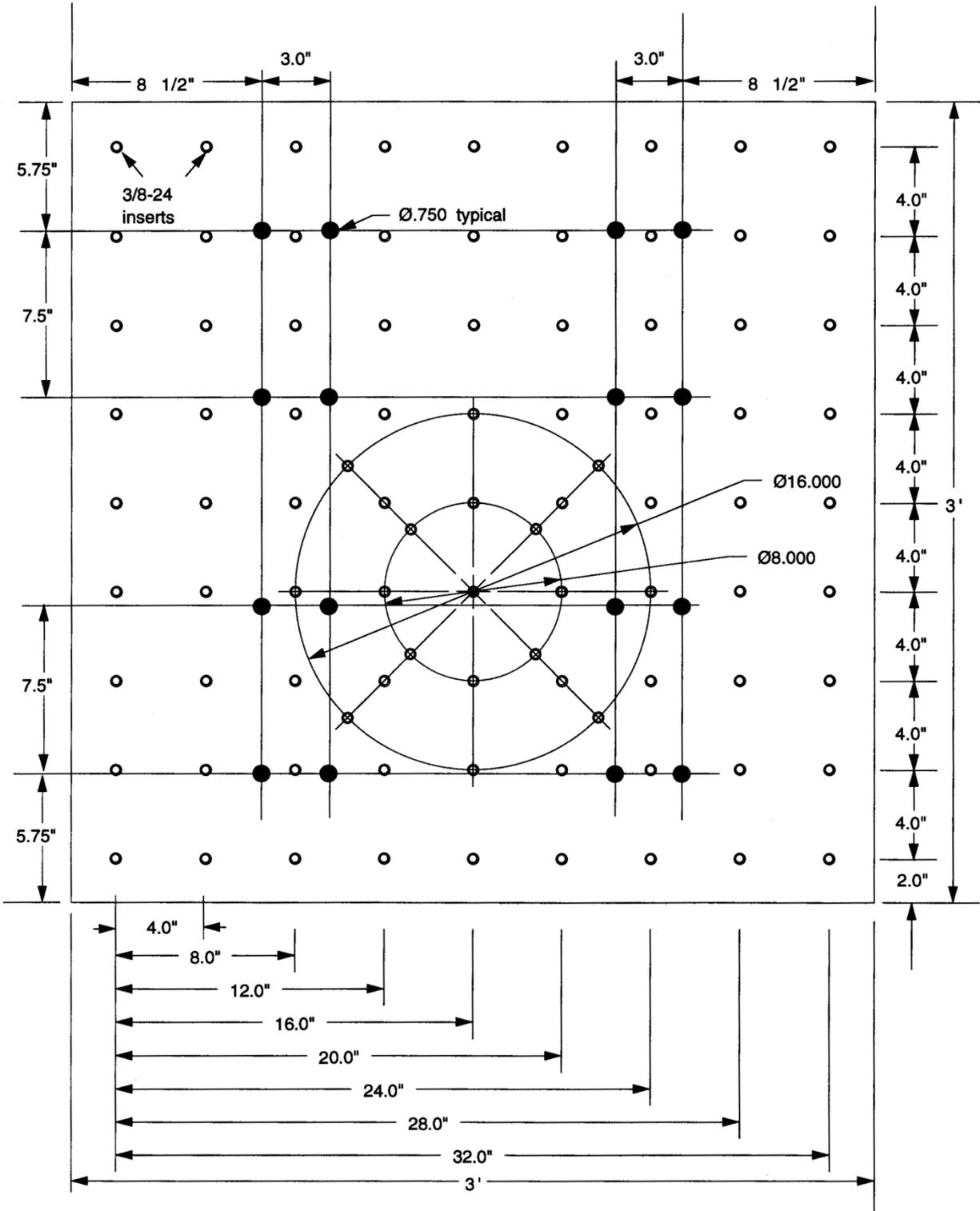


High-Speed Video System

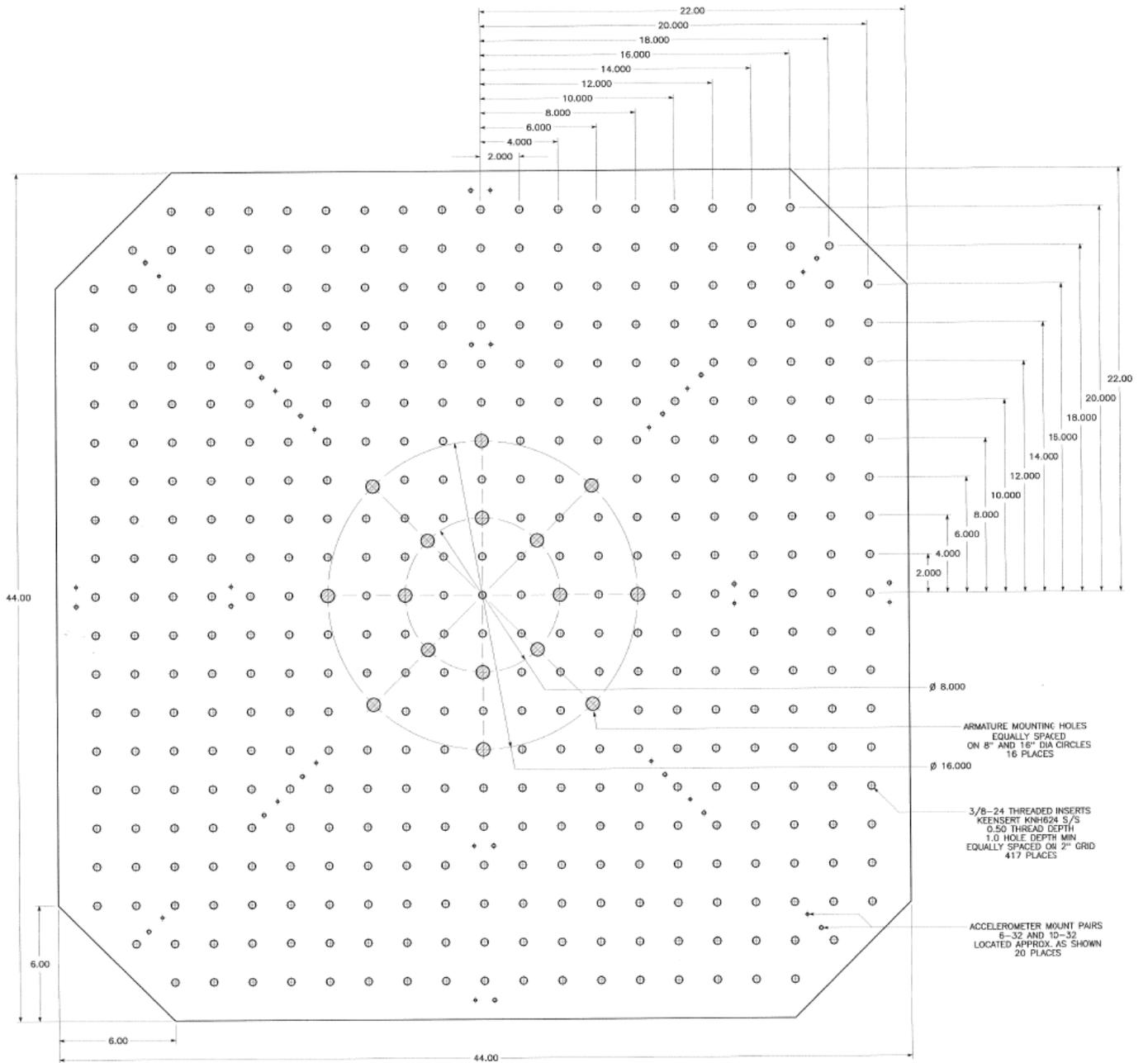
The high-speed video camera can capture up to 4 million frames per second and can be integrated into the high-speed firing and data system for triggering and data synchronization.



Slip Table Bolt Pattern



Expander Head – 44-inch Bolt Pattern



Sample Test Configurations

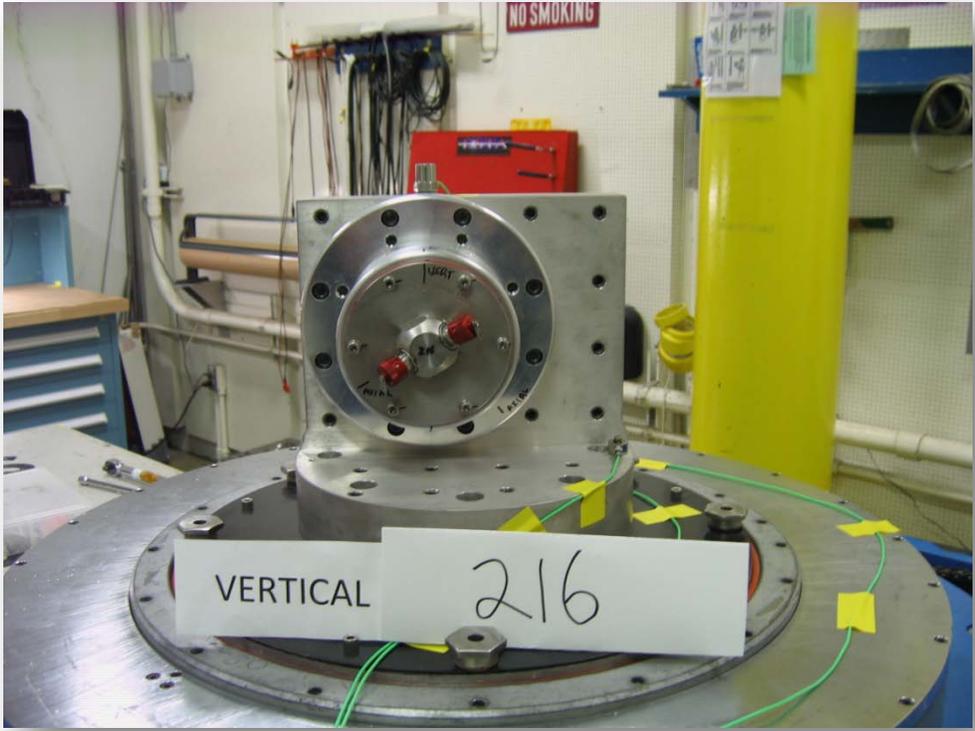
Hazardous Vibrations Test Stand Y-Axis



Hazardous Vibrations Test Stand Z-Axis



Vertical Mount Adapter



Appendix B Test Request Worksheet

Test Requester Information

Test Article Expert:	Contact Information (Phone, E-mail, Address):
----------------------	---

Test Objectives

Test Type:	Vibration <input type="checkbox"/>	Sinusoidal <input type="checkbox"/>	Random <input type="checkbox"/>	Shock <input type="checkbox"/>	
	Pyrotechnics <input type="checkbox"/>	Firing <input type="checkbox"/>	Inspection <input type="checkbox"/>	Drop Test <input type="checkbox"/>	Pressure Test <input type="checkbox"/>
		Thermal/Vacuum <input type="checkbox"/>	Thermal <input type="checkbox"/>	Vacuum <input type="checkbox"/>	

Purpose of Test:

Proposed Test Start Date:	Critical Test Start Date:
---------------------------	---------------------------

Test Article

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

Operational Requirements

Functional Checks (Describe any functional checks to be performed prior to, during, or after testing):	
Continuous Operations (24 hr):	Authorized Shutdown Points:

Test Article Handling Requirements

Cleanliness Level:	Controlled Access:
Special Moving/Handling:	
Storage Requirements:	

Test Article Interface

Test Article Interface Design (Facility or Requester designed, drawings attached, instructions):
Test Fixture (facility stock, facility fabricated, or requester provided):

Test Environment (Thermal/Vacuum)

Complete the Test Environment table below or provide a plot of the test environment to be simulated.

Type	Minimum	Maximum	Ramp Rate	Tolerance	No. of Cycles
Pressure					
Temperature					
Describe any holds at temperature outside of thermal soaks:					
Termination Criteria:					

Test Environment (Pyrotechnics)

Test Firing:
Drop Testing:
Thermal Shock Testing:
Pressure Testing (Hydrostatic, Pneumatic, Pressure, Burst Expected, Pressure Rise Rate):

Instrumentation

Instrumentation (type of instrumentation, number, attach diagram of planned sensor locations):

Instrumentation Provided by Test Requester:

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 (Video):
Data File (ASCII/Excel):	Plots (Yes/No):

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 (e.g., test article, support equipment).

Hazard	Y	N	Comments
Mechanical	<input type="checkbox"/>	<input type="checkbox"/>	
Handling (> 40 lb or > 4 ft in any dimension)	<input type="checkbox"/>	<input type="checkbox"/>	
Instability	<input type="checkbox"/>	<input type="checkbox"/>	
Sharp Edges	<input type="checkbox"/>	<input type="checkbox"/>	
Pinch Points	<input type="checkbox"/>	<input type="checkbox"/>	
Exposed Mechanisms (e.g., rotating, reciprocating)	<input type="checkbox"/>	<input type="checkbox"/>	
Pressure Systems	<input type="checkbox"/>	<input type="checkbox"/>	
Stored Energy (e.g., springs, weights, flywheels)	<input type="checkbox"/>	<input type="checkbox"/>	
Ejected Parts, Projectiles	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical	<input type="checkbox"/>	<input type="checkbox"/>	
Voltage (> 50 volts)	<input type="checkbox"/>	<input type="checkbox"/>	
Batteries	<input type="checkbox"/>	<input type="checkbox"/>	
Generation/Storage (e.g., coils, magnets, capacitors)	<input type="checkbox"/>	<input type="checkbox"/>	
Electrostatic Sensitive Devices	<input type="checkbox"/>	<input type="checkbox"/>	
Thermal	<input type="checkbox"/>	<input type="checkbox"/>	
Hot Surfaces (> 113 °F, 45 °C)	<input type="checkbox"/>	<input type="checkbox"/>	
Heaters	<input type="checkbox"/>	<input type="checkbox"/>	
Cold Surfaces (< 39 °F, 4 °C)	<input type="checkbox"/>	<input type="checkbox"/>	
Cooling Devices	<input type="checkbox"/>	<input type="checkbox"/>	

Hazard	Y	N	Comments
Radiation	<input type="checkbox"/>	<input type="checkbox"/>	
Ionizing	<input type="checkbox"/>	<input type="checkbox"/>	
Non-Ionizing	<input type="checkbox"/>	<input type="checkbox"/>	
Laser	<input type="checkbox"/>	<input type="checkbox"/>	
Microwave	<input type="checkbox"/>	<input type="checkbox"/>	
Infrared (IR)	<input type="checkbox"/>	<input type="checkbox"/>	
Ultraviolet (UV)	<input type="checkbox"/>	<input type="checkbox"/>	
Radio Frequency (RF)	<input type="checkbox"/>	<input type="checkbox"/>	
Visible Light, High Intensity	<input type="checkbox"/>	<input type="checkbox"/>	
Material	<input type="checkbox"/>	<input type="checkbox"/>	
Uncontained Brittle Materials	<input type="checkbox"/>	<input type="checkbox"/>	
Test Environment Incompatibility	<input type="checkbox"/>	<input type="checkbox"/>	
Contained Fluids	<input type="checkbox"/>	<input type="checkbox"/>	
Toxic, Corrosive, Flammable Fluids	<input type="checkbox"/>	<input type="checkbox"/>	
Biohazards	<input type="checkbox"/>	<input type="checkbox"/>	
Miscellaneous	<input type="checkbox"/>	<input type="checkbox"/>	
Noise Level (> 85 dBA)	<input type="checkbox"/>	<input type="checkbox"/>	
Ultrasonic	<input type="checkbox"/>	<input type="checkbox"/>	
Pyrotechnics/Explosives	<input type="checkbox"/>	<input type="checkbox"/>	

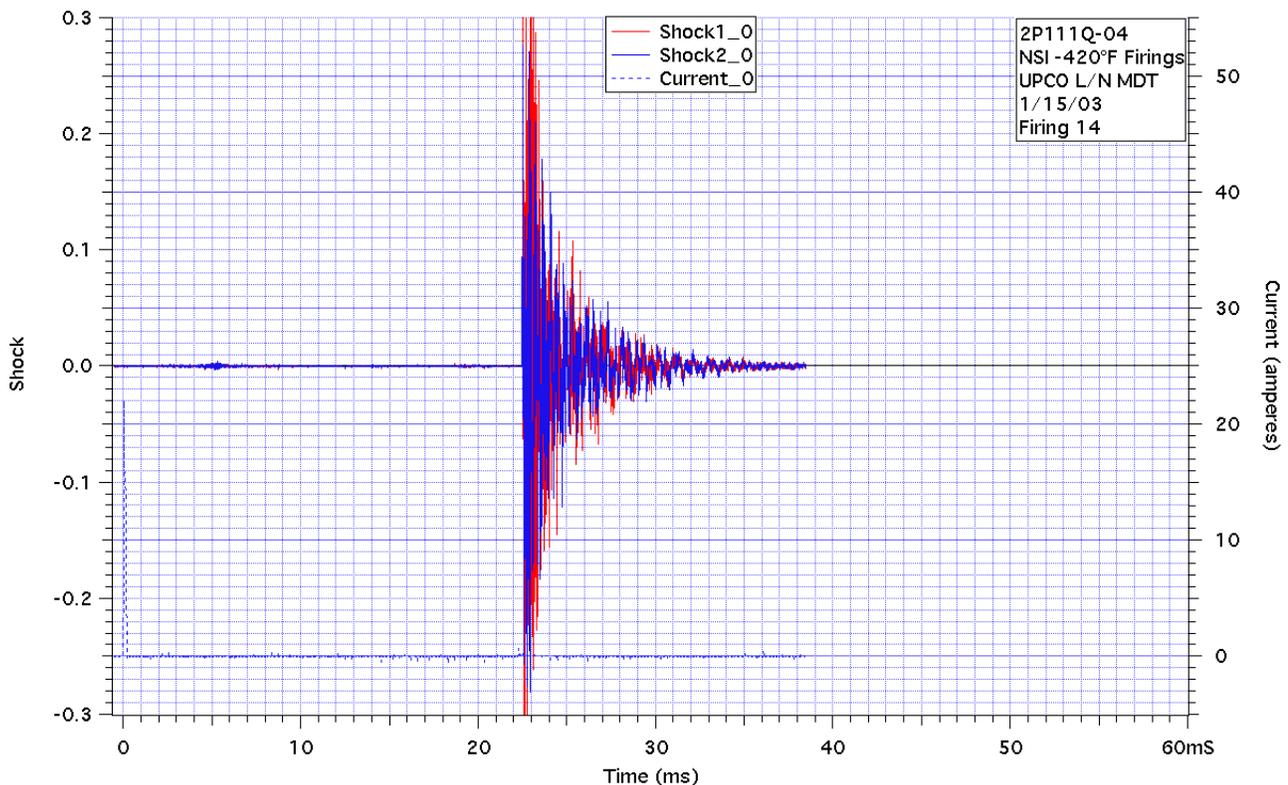
Appendix C Instrumentation Provided by Facility

The following is a list of instrumentation that is commonly available for testing. We can accommodate different ranges or types of instrumentation as required by the Test Requester. Contact the Test Director to discuss data/instrumentation requirements.

- Piezoelectric Pressure Transducers
- Pyroshock Accelerometers
- Detonation Velocity Measurement
- Laser Interferometer
- Thermocouples
- Accelerometers
- Strain Gages

We can accommodate a wide range of pressure parameters. We can also accommodate current and voltage measurements.

Sample Data Plot – NSI



Appendix D Sample Test Plan

Test Requester Information

Test Article Expert: [Identify Test Article Expert]	Contact Information (Phone, E-mail, Address): [Test Article Expert Contact Information]
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Test Objectives

Test Type:	Vibration <input checked="" type="checkbox"/>	Sinusoidal <input checked="" type="checkbox"/>	Random <input checked="" type="checkbox"/>	Shock <input checked="" type="checkbox"/>
	Pyrotechnics <input type="checkbox"/>	Firing <input checked="" type="checkbox"/>	Inspection <input type="checkbox"/>	Drop Test <input checked="" type="checkbox"/>
		Thermal/Vacuum <input type="checkbox"/>	Thermal <input checked="" type="checkbox"/>	Vacuum <input type="checkbox"/>
Purpose of Test: Provide stated primary and secondary objectives. Wherever possible, specific goals and/or limitations should be included. The primary objectives are to be interpreted as minimum achievements for test success, and the secondary objectives are considered highly desirable options. <i>Sample Objective: The primary objective of this program is to perform an engineering evaluation on TA1 Initiator by performing the following tests: test firing, drop test, thermal cycling, thermal shock, sine vibration, and random vibration</i>				
Proposed Test Start Date: <i>Proposed Start Date</i>			Critical Test Start Date: <i>Need Date</i>	

Test Article

Test Article Description: Technical description of the test article, defining method of operation and theoretical considerations, referring to drawings and/or schematics if necessary. Operational characteristics, including normal and off-limit performance parameters, such as temperature, thrust, voltage, current, and flow rate. Operational constraints of the test article that cannot be violated without harming the test article (for example, pressure limits, environmental temperature limits, vibration levels, system cleanliness, and fluid purity). <i>Sample Description: TA1 contains a housing, an initiator, an input charge, a first barrier, a second barrier, and an output charge. The input charge contains X mg of propellant and contains an output charge of X mg of propellant.</i>	
Physical Dimensions (L/W/H): <i>X" in length and X" in diameter</i>	Weight: <i>X mg</i>

Operational Requirements

Functional Checks (Describe any functional checks to be performed prior to, during, or after testing):

Requester personnel will be responsible for the hookup and operation of the test article and operation of the electrical equipment supplied for testing.

Continuous Operations (24 hr):

No

Authorized Shutdown Points:

At completed test point or defined termination criteria

Test Article Handling Requirements

Cleanliness Level:

N/A

Controlled Access:

Special Moving/Handling:

Storage Requirements:

Test Article Interface

Test Article Interface Design (Facility or Requester designed, drawings attached, instructions):

Facility designed; test article drawing attached

Test Fixture (facility stock, facility fabricated, or requester provided):

Three-axis fixturing on slip table, 4" mounting holes, with one triaxial accelerometer (three channels) mounted on center of crossbar at top of unit. Special fixture with test article mounted with standard mounting bolts and interfacing to shaker tables with 3/8" countersunk bolts. Fixture will be defined per approved engineering drawings, including axes indication and mounting definition for triaxial accelerometer.

Power Supply (Describe power supply to test article, include voltage, current, and connections):

Portable 12 V power supply with cable and connection to test article

List materials supplied by Requester:

Portable 12 V power supply with cable and connection to test article, for posttest functional only; triaxial accelerometer (three channels) mounted to test article.

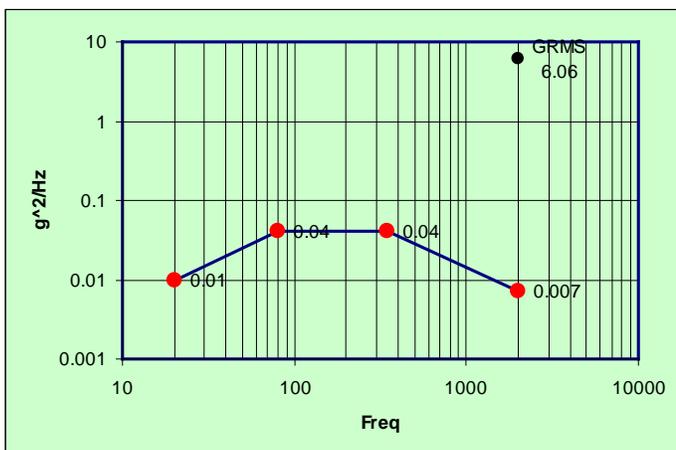
Provide a detailed explanation of the proposed test conditions and schedule of operations. Include a test matrix as appropriate.

Test Environment (Vibration)

Complete the Test Environment table below or provide a plot of the test environment to be simulated.

Axis (x, y, z or all)	Frequency Range (Hz):	Amplitude (g ² /Hz)	Tolerance (dB)	Temperature (°F)	Tolerance (°F)	Duration
X	20	0.01	+1, -3	-240 °F	± 5.4 °F	60 sec/axis
X	80	0.04	+1, -3	-240 °F	± 5.4 °F	60 sec/axis
X	350	0.04	+1, -3	-240 °F	± 5.4 °F	60 sec/axis
X	2000	0.007	+1, -3	-240 °F	± 5.4 °F	60 sec/axis

Sample Vibration Environment Plot



Test Environment (Thermal/Vacuum)

Complete the Test Environment table below or provide a plot of the test environment to be simulated.

Type	Minimum	Maximum	Ramp Rate	Tolerance	No. of Cycles
Pressure					
Temperature	-65.2 °F	159.8 °F	7 °F per minute	± 5.4 °F	12
Describe any holds at temperature outside of thermal soaks: <i>Minimum 1 hour hold at minimum and maximum temperatures.</i>					
Termination Criteria:					

Test Environment (Pyrotechnics)

Test Firing: <i>Demonstrate capability of TA1 to be initiated at a temperature of -420 °F.</i>
Drop Testing: <i>Submit TA1 to a 6-foot drop test. For the first drop unit, the test article will be oriented to impact the output end. For the second drop unit, the test article will be oriented to impact the side. For the third drop unit, the test article will be oriented to impact the connector.</i>
Thermal Shock Testing: <i>Verify capability of TA1 to survive high thermal transition rates from ambient to -320 °F without degradation in performance. Expose TA1 to -320 °F for 15 minutes; remove and allow to warm to ambient. Expose TA1 to -320 °F for 12 hours; remove and allow to warm to ambient.</i>
Pressure Testing (Hydrostatic, Pneumatic, Pressure, Burst Expected, Pressure Rise Rate):

Instrumentation

Instrumentation (type of instrumentation, number, attach diagram of planned sensor locations):

Identify requirements for instrumentation, data recording, displays, and data processing.

Instrumentation diagram attached.

Instrumentation Provided by Test Requester:

Identify instrumentation; data recording to be provided to the facility.

Data Acquisition and Recording

Number of Channels: <i>32</i>	Video Recording (Yes/No): <i>Yes</i>
Sampling Rates: <i>10 SPS</i>	Photographic Film (Yes/No): <i>Yes, pretest and posttest and test setup</i>
Real-Time Data Processing (Yes/No): <i>No</i>	High Speed/Low Speed (Video): <i>High Speed</i>
Data File (ASCII/Excel): <i>Excel</i>	Plots (Yes/No): <i>Yes, Vibration</i>

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 (e.g., test article, support equipment).

Hazard	Y	N	Comments
Mechanical	<input type="checkbox"/>	<input type="checkbox"/>	Identify the hazards and present the approach for mitigating each
Handling (> 40 lb or > 4 ft in any dimension)	<input type="checkbox"/>	<input type="checkbox"/>	
Instability	<input type="checkbox"/>	<input type="checkbox"/>	
Sharp Edges	<input type="checkbox"/>	<input type="checkbox"/>	
Pinch Points	<input type="checkbox"/>	<input type="checkbox"/>	
Exposed Mechanisms (e.g., rotating, reciprocating)	<input type="checkbox"/>	<input type="checkbox"/>	
Pressure Systems	<input type="checkbox"/>	<input type="checkbox"/>	
Stored Energy (e.g., springs, weights, flywheels)	<input type="checkbox"/>	<input type="checkbox"/>	
Ejected Parts, Projectiles	<input type="checkbox"/>	<input type="checkbox"/>	
Electrical	<input type="checkbox"/>	<input type="checkbox"/>	
Voltage (> 50 volts)	<input type="checkbox"/>	<input type="checkbox"/>	
Batteries	<input type="checkbox"/>	<input type="checkbox"/>	
Generation/Storage (e.g., coils, magnets, capacitors)	<input type="checkbox"/>	<input type="checkbox"/>	
Electrostatic Sensitive Devices	<input type="checkbox"/>	<input type="checkbox"/>	
Thermal	<input type="checkbox"/>	<input type="checkbox"/>	
Hot Surfaces (> 113 °F, 45 °C)	<input type="checkbox"/>	<input type="checkbox"/>	
Heaters	<input type="checkbox"/>	<input type="checkbox"/>	
Cold Surfaces (< 39 °F, 4 °C)	<input type="checkbox"/>	<input type="checkbox"/>	
Cooling Devices	<input type="checkbox"/>	<input type="checkbox"/>	

Appendix E Customer Feedback

EP TEST REQUESTER FEEDBACK (ESTA & EPSL)	
Test Number/Title:	Date:
Test Requester/Org (Optional):	Facility:
<div style="text-align: right; margin-bottom: 10px;"> SCORE * 1= Poor, 5 = Excellent </div> <p>SCHEDULE:</p> <p>1. Was the test initiated and completed to meet your requirements/test objectives? <input type="text"/></p> <p>2. Was the test performed within the agreed to schedule? <input type="text"/></p> <p>3. Was the test data/report provided to you in a timely manner? <input type="text"/></p> <p>COST:</p> <p>1. Was the test performed within the estimated cost? <input type="text"/></p> <p>2. Was the test cost reasonable for the test performed? <input type="text"/></p> <p>PRODUCT:</p> <p>1. Was the provided test data/report sufficient? <input type="text"/></p> <p>2. Was the test data/report provided to you in an acceptable format? <input type="text"/></p> <p>3. Were the objectives of the test satisfied? <input type="text"/></p> <p>SAFETY:</p> <p>1. Was safety during test operations adequately addressed and controlled? <input type="text"/></p> <p>2. Was test article handling and use safe while in the care of the test facility/personnel? <input type="text"/></p> <p>FACILITY/TEST TEAM:</p> <p>1. Did the facility's capability meet the needs of the test requirements? <input type="text"/></p> <p>2. Was the facility reliable during the test? <input type="text"/></p> <p>3. Did you find the test team helpful and knowledgeable in meeting your objective <input type="text"/></p> <p>4. Would you consider using this test facility for future tests? <input type="text"/></p> <p><small>* If score is below 3, please provide comment below.</small></p>	
<p>COMMENTS/Suggestions for Improvements or Future Capability Needs:</p> <hr/> <hr/> <hr/>	
<p>Note: We are concerned and interested in your comments and would like an opportunity to improve our service.</p>	
<p>RETURN TO: Mail code EP/Test Feedback (or e-mail to jsc-cal-ep6-esta@nasa.gov)</p>	