Standard K-1 Passive Flight Experiment Interface Definition and Requirements Document

For the

K-1 Space Launch Vehicle

NASA Contract Number NAS8-01103

DRD 958 CM-009
DRD 958 CM-007 (partial submission)
DRD 958 VR-001 (partial submission)

Change Record

REV	AUTHORIZATION	REASON FOR CHANGE	AFFECTED PAGE(S)
A		Not Released	
B		Not Released	
C	P22-0060	Initial Baseline Release	All

Table of Contents

List of Figures

List of Tables

1. INTRODUCTION

1.1 SCOPE

This Interface Definition and Requirements Document (IDRD) describes the standard interfaces on the K-1 Reusable Launch Vehicle (RLV) available for passive Add-on Technology experiments. Although it is a stand-alone document, the IDRD is also included as an appendix to the *K-1 Vehicle TA-10 Flight Experiment Design and Requirements Document* (21-Report-N-001) developed for NASA as part of Kistler's flight demonstration contract for the Space Launch Initiative (contract NAS8-01103). This document applies to all standard passive technology experiments to be flown on the K-1.

The IDRD describes the physical, functional, and environmental interfaces to experiments on the K-1 vehicle, as well as facility accommodations for experiment processing available at the K-1 launch site in Woomera, South Australia. The IDRD also describes experiment verification requirements to fly on the K-1, describes optional services offered to experimenters by Kistler Aerospace Corporation, and delineates the roles and responsibilities of the experimenter and the integrator, Kistler.

This IDRD serves as the baseline Kistler input to all experiment-specific Interface Control Documents (ICDs). The experiment ICDs capture all K-1 vehicle interfaces described in this IDRD and additional experiment-specific information provided by the experimenter. The ICDs will have the same form and outline as the IDRD. Sections in the IDRD currently marked, "Reserved for Experimenter Input through Detailed Experiment Questionnaire," will appear in the ICDs with input provided by the experimenter through a detailed Experiment Questionnaire.

1.2 DEFINITIONS

<u>Active Experiment</u>: An experiment requiring power, command, and/or data monitoring from the K-1 vehicle to meet flight demonstration objectives. All standard active experiments are mounted inside the K-1 vehicle.

<u>Passive Experiment</u>: An experiment requiring no power, command, and/or data monitoring input from the K-1 vehicle to meet flight demonstration objectives. Passive experiments have no electrical interface to the K-1 vehicle other than possibly data recording through sensors mounted on the experiment. Passive experiments are externally mounted to the K-1 vehicle.

<u>Standard Experiment</u>: An experiment utilizing previously defined standard interfaces on the K-1 vehicle described in this IDRD.

<u>Non-Standard Experiment</u>: An experiment requiring customization of interfaces to fly on the K-1 vehicle. Interfaces to Non-Standard experiments are not covered in their entirety by this IDRD. This document will be used as a starting point to develop the ICD for Non-Standard passive Experiments.

<u>Standard Service</u>: A service provided by Kistler to the experimenter to support standard experiments as part of the base integration price paid by NASA, other government agencies, or industry.

Optional Service: A service that can be provided by Kistler to the experimenter to support experiments as an option over the base integration price. Optional services include, but are not limited to, the services described in Section 6 of this IDRD. The price for all optional services is based on the specific details of each service.

Hazardous Operation: A ground processing activity is classified as hazardous based on the following considerations:

(1) Energy is involved and loss of control could result in injury to personnel or damage to equipment.

(2) A significant change from ambient condition will occur; e.g., increase or decrease of oxygen content, pressure, or temperature.

(3) Presence of hazardous materials or physical agents which presents potential exposure to personnel.

1.3 DOCUMENT CONVENTIONS

A unique number identifies each requirement in this IDRD. The number is identified in parentheses after the word "shall" and consists of "PAS" followed by the paragraph number. For paragraphs containing more than one requirement, an additional digit is appended to make the requirement identification unique. All requirements are listed with the verification methods identified in Section 4.1.

Design goals are explicitly stated as such and do not require verification. Other descriptive information such as that described by "will" may be included to clarify a requirement. The descriptive information does not constitute a verifiable requirement.

1.4 EXPERIMENT DESCRIPTION

Reserved for Experimenter Input through Detailed Experiment Questionnaire.

1.5 IDRD/ICD CONTROL PROCESS

Kistler Aerospace Corporation maintains configuration control of this IDRD. This IDRD, which applies to all standard passive K-1 flight experiments, will be periodically updated as the interface definition matures. Kistler will also maintain configuration control of the experiment-specific ICD. Kistler will generate a unique ICD for every experiment in coordination with the experimenter. Kistler will deliver the draft and baseline version of the ICD as specified in Section 8 of this document.

1.6 IDRD DEVIATIONS AND EXCEEDANCES

Kistler will consider all deviations and exceedances from this IDRD. Any deviations or exceedances will be evaluated by Kistler to assure that no additional risk is added to the mission. Deviations and exceedances may be accommodated for standard experiments as an optional service as described in Section 6.

2. REFERENCED DOCUMENTS

The documents listed below form a part of this document to the extent specified herein. Unless otherwise specified, the latest issue of the referenced document should be used.

2.1 KISTLER DOCUMENTS

21-Report-N-001	K-1 Vehicle TA-10 Flight Experiment Design and Requirements Document
K1-01-001	K-1 Vehicle Payload User's Guide, May 2001
PL-98-042	System Safety and Personnel Health Plan – Woomera Facility

2.2 EXPERIMENTER DOCUMENTS

Reserved for Experimenter Input through Detailed Experiment Questionnaire.

2.3 U.S. GOVERNMENT DOCUMENTS

MIL-STD-1246	Product Cleanliness Levels and Contamination Control Program
ISO 14644-1	Cleanrooms and associated controlled environments - Part 1: Classification of air cleanliness
MIL-STD-882	Standard Practice For System Safety Program Requirements
MIL-STD-1540	Product Verification Requirements for Launch, Upper Stage, and Space Vehicles
ASTM-E-595	Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment
NSTS 22206	Requirements for Preparation and Approval of Failure Modes and Effects Analysis and Critical Items List
OSHA Standard 1910.1200	Hazard Communication Standard

2.4 OTHER PUBLICATIONS

None.

2.5 ORDER OF PRECEDENCE

In the event of a conflict between the text of this document and all references cited herein, the text of this document takes precedence. The experiment ICD will take precedence over this document and all other referenced technical documents. Nothing in this document or any ICD, however, supercedes applicable laws and regulations unless a specific exemption has been obtained.

3. INTERFACE SPECIFICATION

3.1 STRUCTURAL AND MECHANICAL INTERFACES

3.1.1 LV Coordinate System

The K-1 vehicle coordinate system is given in Figure 1. The X-axis is along the longitudinal axis of the vehicle. The zero datum is located well aft of the end of the first stage (Launch Assist Platform, or LAP), with the separation plane of the two stages (referred to as Body Station 1000) located at x = 1000 inches. The clocking of the vehicle is denoted with positive theta (θ) in the counterclockwise direction from the +Y-axis. For example, the +Z axis is at θ = 90 degrees.

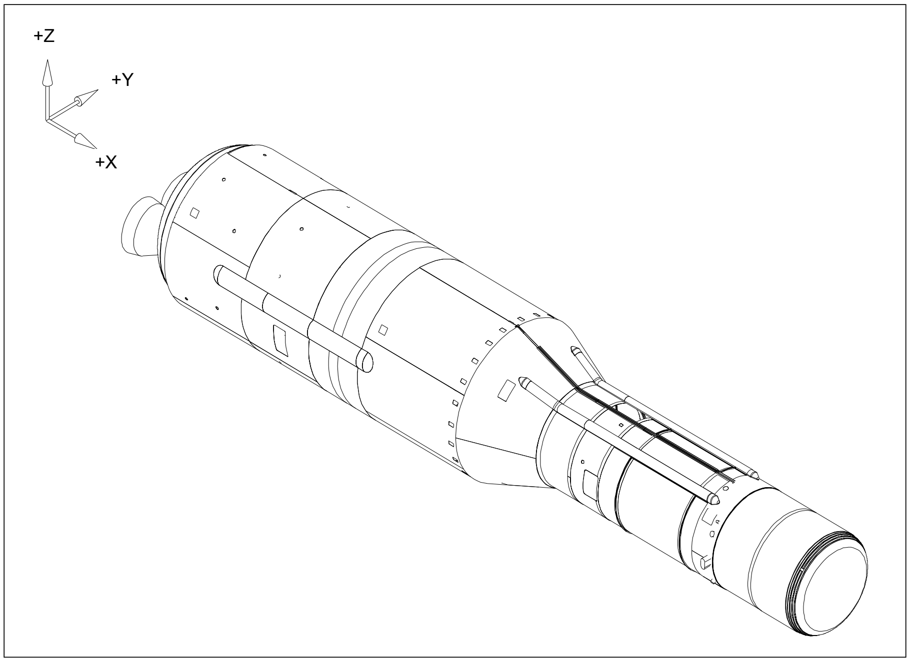

Figure 1: K-1 Vehicle Coordinate System

3.1.2 Passive Experiment Mounting Footprints

Six footprints are available to mount Passive Experiments on the outside of the K-1 Orbital Vehicle (OV). These footprints are shown in Figure 2. Kistler's approach for passive experiments is to replace existing K-1 hardware (access panels, doors, tile, or blanket parts) with experiments mounted on Carrier Plates or bonded directly to the K-1 structure.

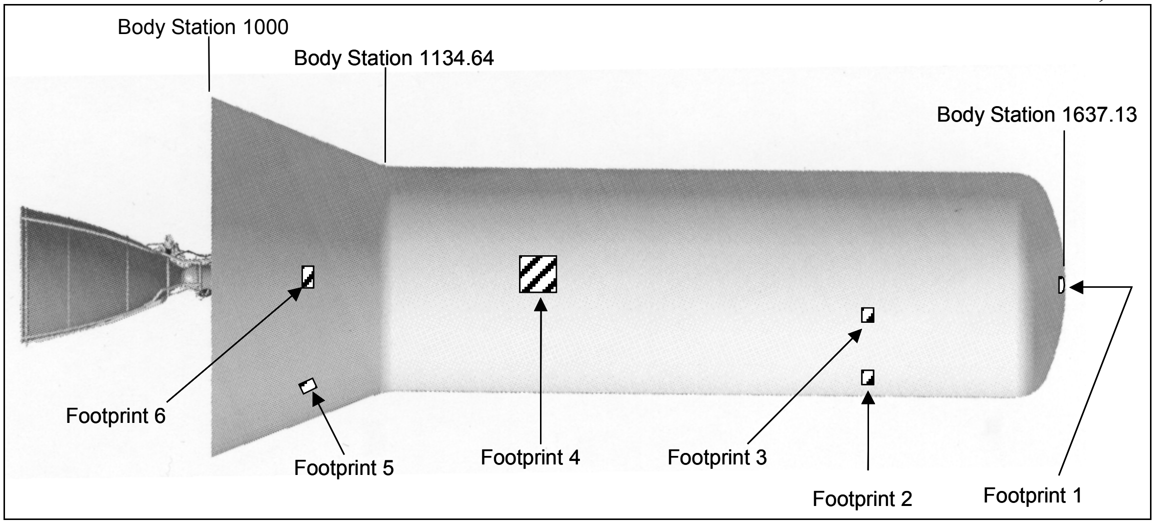

Figure 2: Passive Experiment Mounting Footprints on K-1 OV

Table 1 shows the Body Station and θ-location of the center of each mounting footprint.

Table 1: Passive Experiment Mounting Footprints on K-1 OV

Footprint #	Body Station	θ (in º)
1	1637.13	n/a
2	1495	248
3	1495	203
4	1235	180
5	1064	240
6	1064	180

These mounting footprints experience a range of different heat loads. Two of the mounting footprints (#1 and #5) are in tile, and the remainder are in thermal blanket.

3.1.3 Experiment Interface and Envelope

Figure 3 shows a cross-section of the interface for a passive experiment. For footprints #2-#4 and #6, the experimenter delivers the experiment mounted to a Kistler-supplied Carrier Plate, and Kistler integrates the experiment onto the K-1. For tile experiments mounted in Footprint #1 and #5, Kistler will bond the experiment directly to the K-1 structure (with no Carrier Plate). Kistler will install backup insulation in the form of bordering blankets, gap fillers, and an ablator bonded to the K-1 structure to maintain thermal integrity.

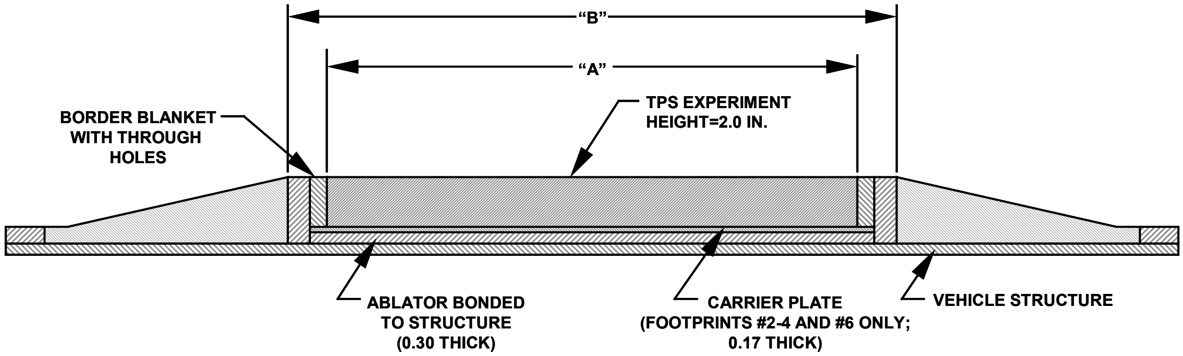

Figure 3: Cross-Section of Passive Experiment Interface

Table 2 shows the planform dimensions of the envelope available for passive experiments at each OV footprint location. The dimension "A" and "B" correspond to the callouts in Figure 3. The actual experiment footprint is given by the "A" dimension. The "B" dimension is the actual total footprint after attachment provisions and closeouts are added. Mounting Footprints #1 and #5, located in tile, are limited to a 9.0 x 9.0 in. planform. All other mounting footprints are limited by the size of existing access panels and doors in that portion of the K-1 structure.

The experimenter shall (PAS.3.1.3.1) verify their experiment has the planform dimensions designated in the "A" column in Table 2. In all footprints, the height of each experiment is limited to the Outer Mold Line (OML) of the vehicle, or 2.0 inches.

Table 2: Passive Experiment Footprint Dimensions

Footprint #	Location	Type	A (in.)	B (in.)
1	Nosecap	Tile Substitution	9.00 x 9.00	9.16 x 9.16
2	Payload Module	Carrier Plate	7.50 x 4.25	10.50 x 7.25
3	Payload Module	Carrier Plate	7.50 x 4.25	10.50 x 7.25
4	Mid Body	Carrier Plate	24.00 x 24.00	27.00 x 27.00
5	Aft Flare	Tile Substitution	9.00 x 9.00	9.16 x 9.16
6	Aft Flare	Carrier Plate	6.00 x 14.00	9.00 x 17.00

3.1.4 Structural Loads

A design limit load factor of 35 g encompasses both predicted static and dynamic loads for passive experiments in all footprints. The load factors apply to all axes (one at a time). For experiments mounted on Carrier Plates, the method of attachment is at the discretion of the experimenter, but Kistler prefers the experimenter bond the experiment to the Carrier Plate (see Section 3.1.10). For Carrier Plate mounted experiments, the experimenter shall (PAS.3.1.4.1) design the method of attachment with an ultimate factor of safety of at least 1.50. There is no requirement for yield factor of safety.

3.1.5 Mass Properties

Experimenters shall (PAS.3.1.5.1) verify their experiments do not exceed the mass limitations in Table 3 for each footprint location. The mass limit shown includes the test article, wiring, and adhesives, but does not include the mass of Kistler supplied hardware, such as the Carrier Plate and electrical connectors.

Table 3: Passive Experiment Maximum Mass

Footprint #	Mass (lbm)
1	12.0
2	5.0
3	5.0
4	20.0
5	12.0
6	12.0

3.1.6 Material Compatibility

The experiment materials shall (PAS.3.1.6.1) be compatible with bonding agents, solvents, ceramic adhesives or any other materials that may come in contact during the installation process.

3.1.7 Material Cleanliness

All external surfaces shall (PAS.3.1.7.1) be visibly clean. The surfaces shall be free of oil and other contaminants that could cause degradation in performance of adhesives or thermal interface materials.

3.1.8 Material Outgassing

Materials within the experiment shall (PAS.3.1.8.1) be selected that have a Total Mass Loss of less than 1.0% and a Collectible Volatile Condensable Material content of less than 0.1% as determined by ASTM-E-595.

3.1.9 External Moldline

The experiment OML shall (PAS.3.1.9.1) be aerodynamically smooth.

3.1.10 Installation Details

Kistler will supply the experimenter with an Interface Kit containing a Carrier Plate (for experiments not in Footprints #1 or #5) and an electrical connector by L-5 months before the scheduled flight. As shown in Section 3.1.11, Carrier Plates are 0.17" thick composite (Graphite/BMI) plates containing a pass-through hole in the center to run instrumentation wires. The plates are larger than the experiment planform described in 3.1.3 to allow for closeouts (gap fillers) and attachment provisions to the K-1 vehicle. Bolt-holes along the perimeter of the Carrier Plate allow for attachment to the K-1 structure.

Kistler prefers the experimenter attach their experiment onto the Carrier Plate by bonding. If the experimenter insists on the use of mechanical fasteners, Kistler will work with the experimenter to define and document the method of attachment in the ICD. Specifically, the experiment must use flush head fasteners on the outward surface such that there are no exceedances of the OML described in Section 3.1.3. Also, if mechanical fasteners are used, Kistler must work with the experimenter to insure that any protrusions from fasteners on the inward surface of the Carrier Plate are compatible with the inner mold line.

When the experiment is ready for flight, experimenters will pack the experiment according to the instructions in Section 5.1 for shipment to the designated Kistler facility in the U.S.

3.1.11 Mechanical Interface Drawings

Figure 4 through Figure 12 show drawings of the different Carrier Plates Kistler will provide the experimenter, depending upon the mounting footprint location. The Carrier Plates for footprints #2 and #3 are identical. For each Carrier Plate, an isometric drawing showing the experiment envelope affixed is shown first, followed by an isometric drawing without the experiment envelope. Then, a planform dimensional drawing of the Carrier Plate is shown.

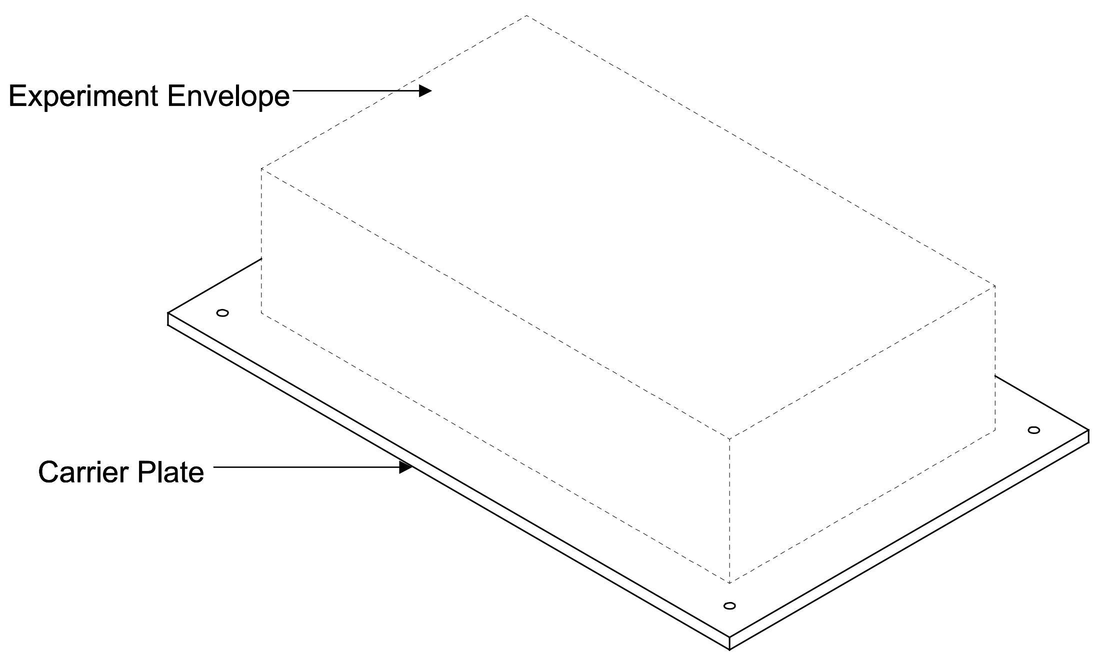

Figure 4: Carrier Plate for Footprint #2 & #3 with Experiment Envelope Shown

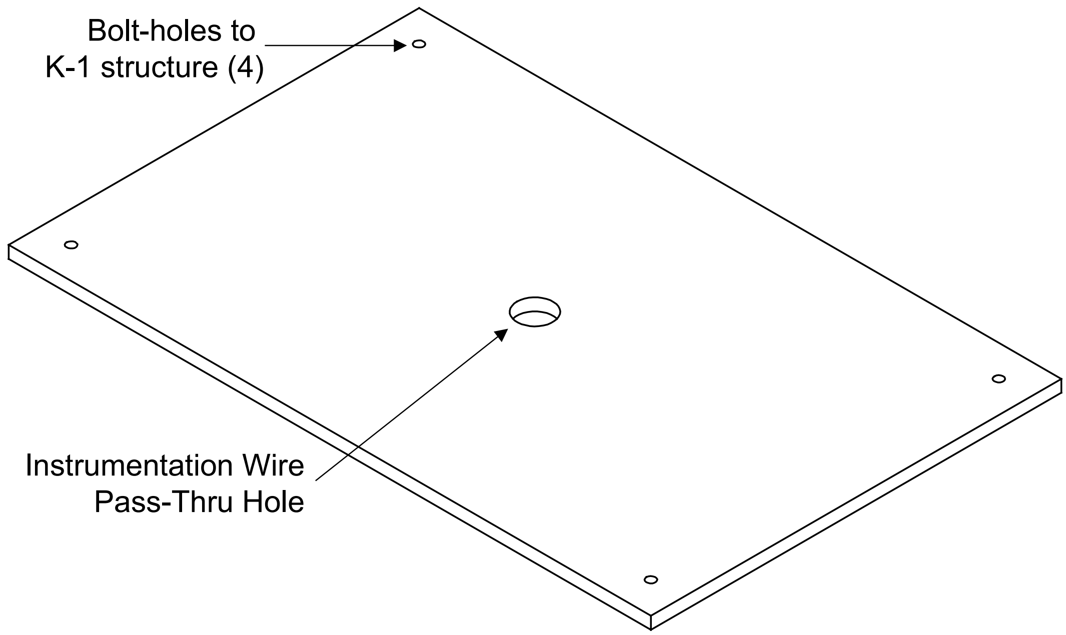

Figure 5: Carrier Plate for Footprint #2 & #3

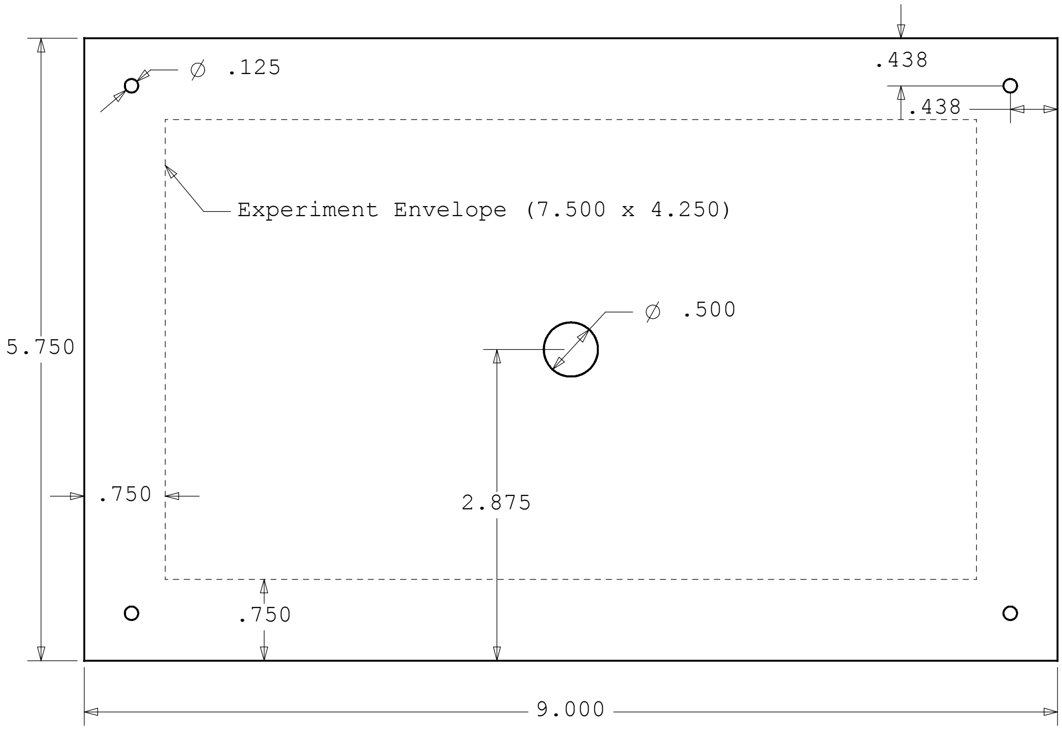

Figure 6: Dimensional Drawing of Carrier Plate for Footprint #2 & #3
(not to scale; dimensions in inches)

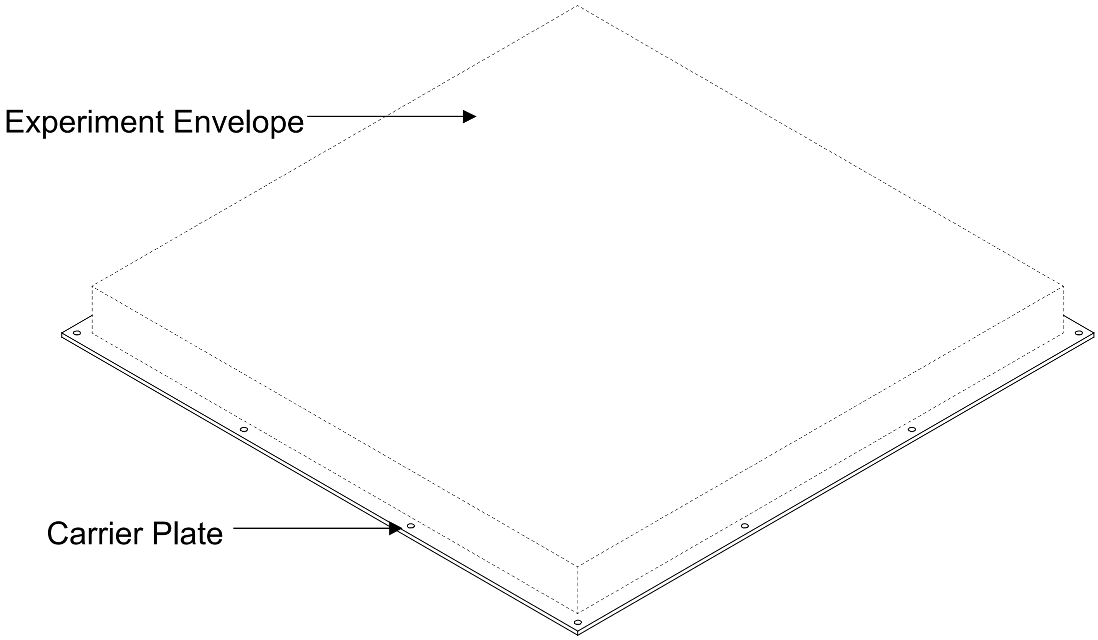

Figure 7: Carrier Plate for Footprint #4 with Experiment Envelope Shown

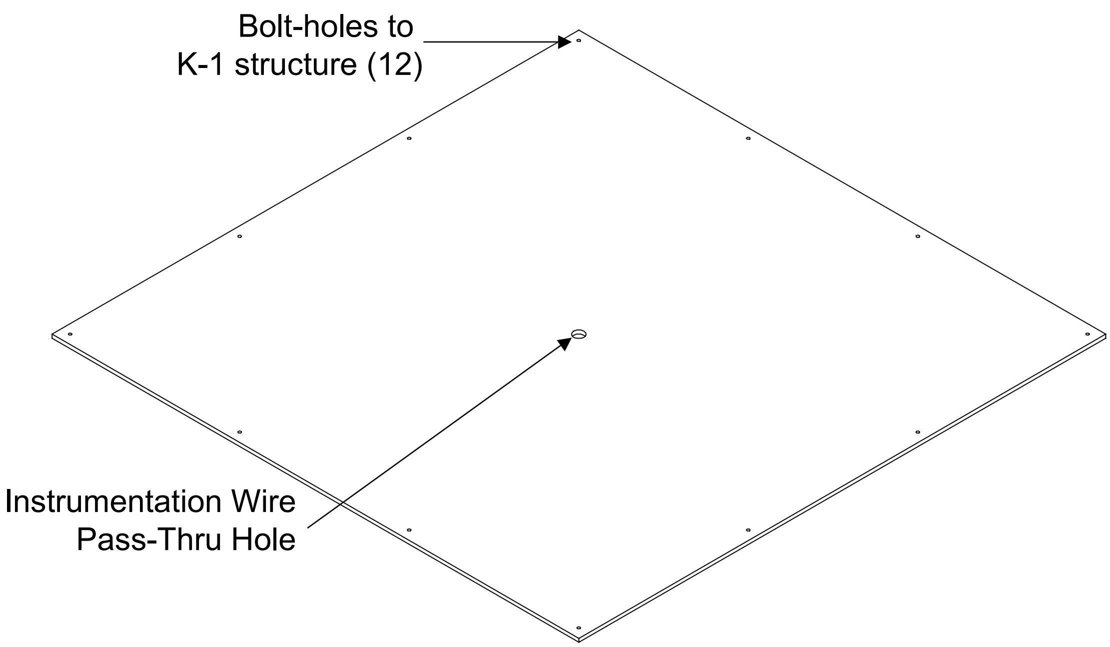

Figure 8: Carrier Plate for Footprint #4

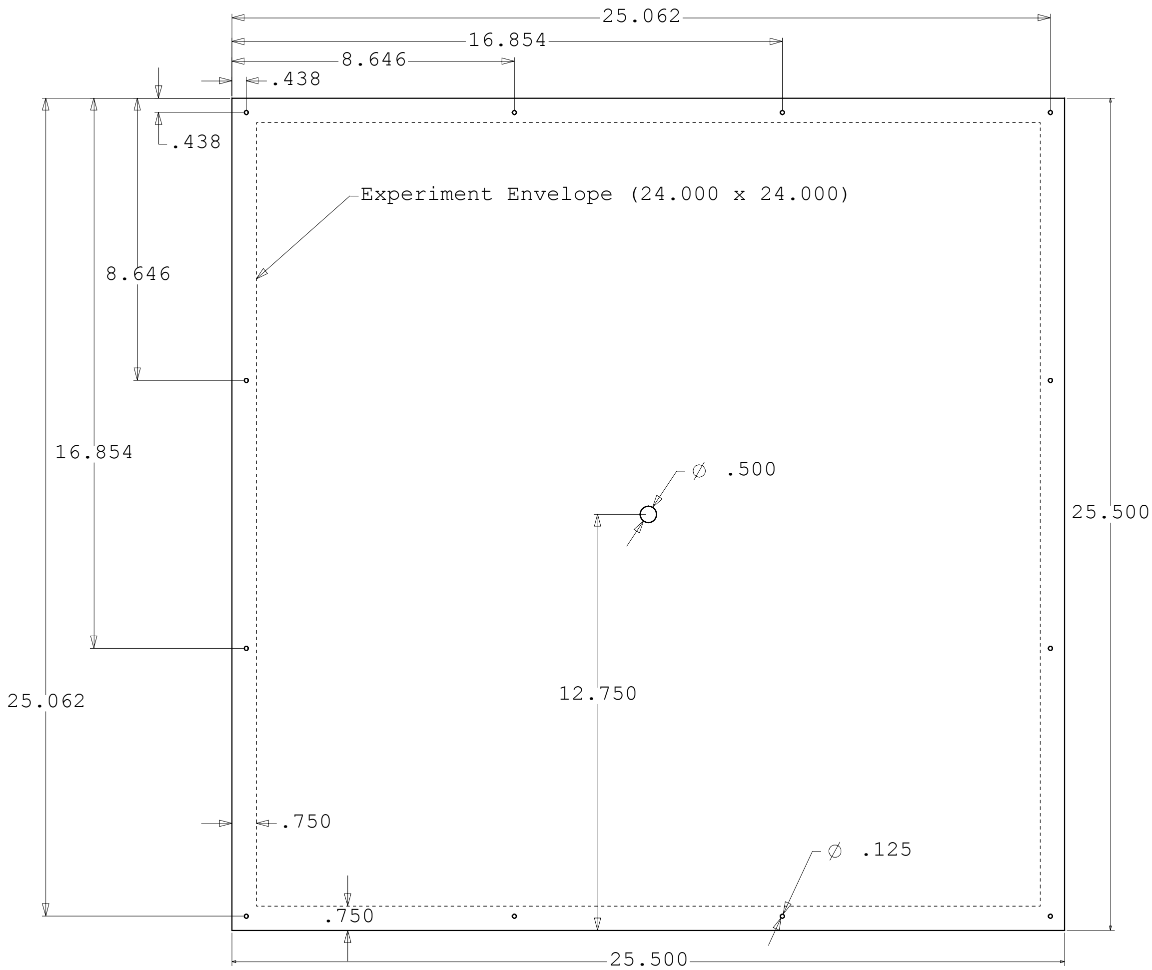

Figure 9: Dimensional Drawing of Carrier Plate for Footprint #4

(not to scale; dimensions in inches)

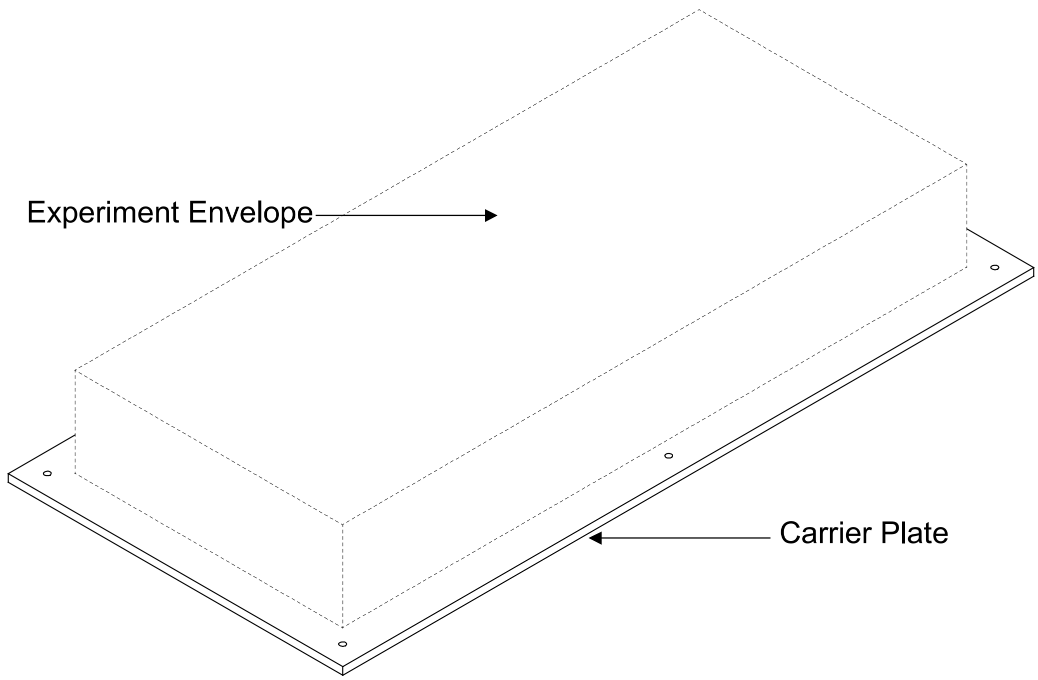

Figure 10: Carrier Plate for Footprint #6 with Experiment Envelope Shown

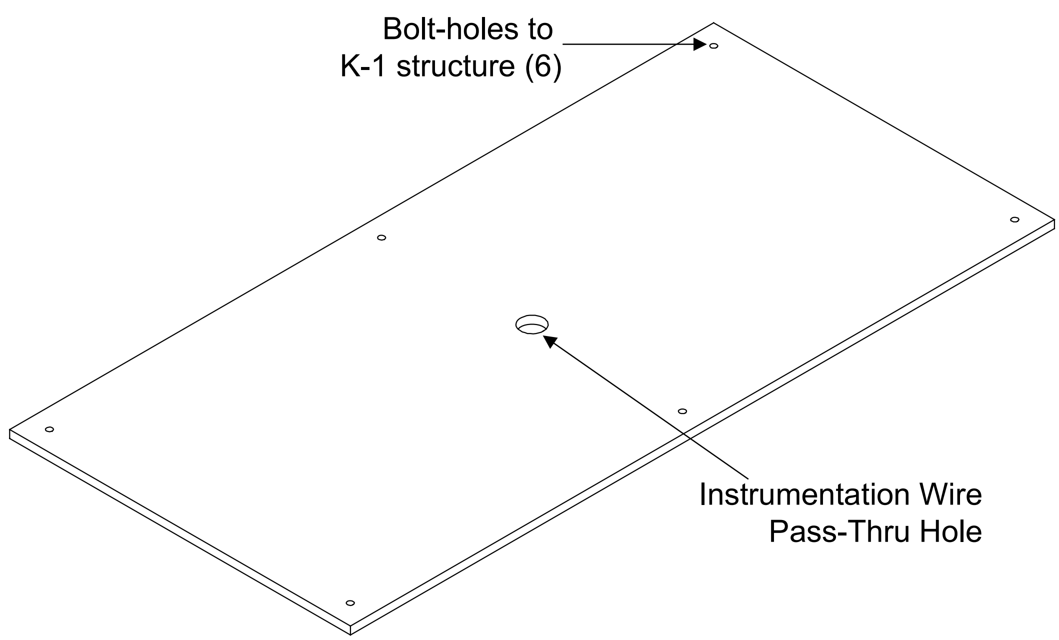

Figure 11: Carrier Plate for Footprint #6

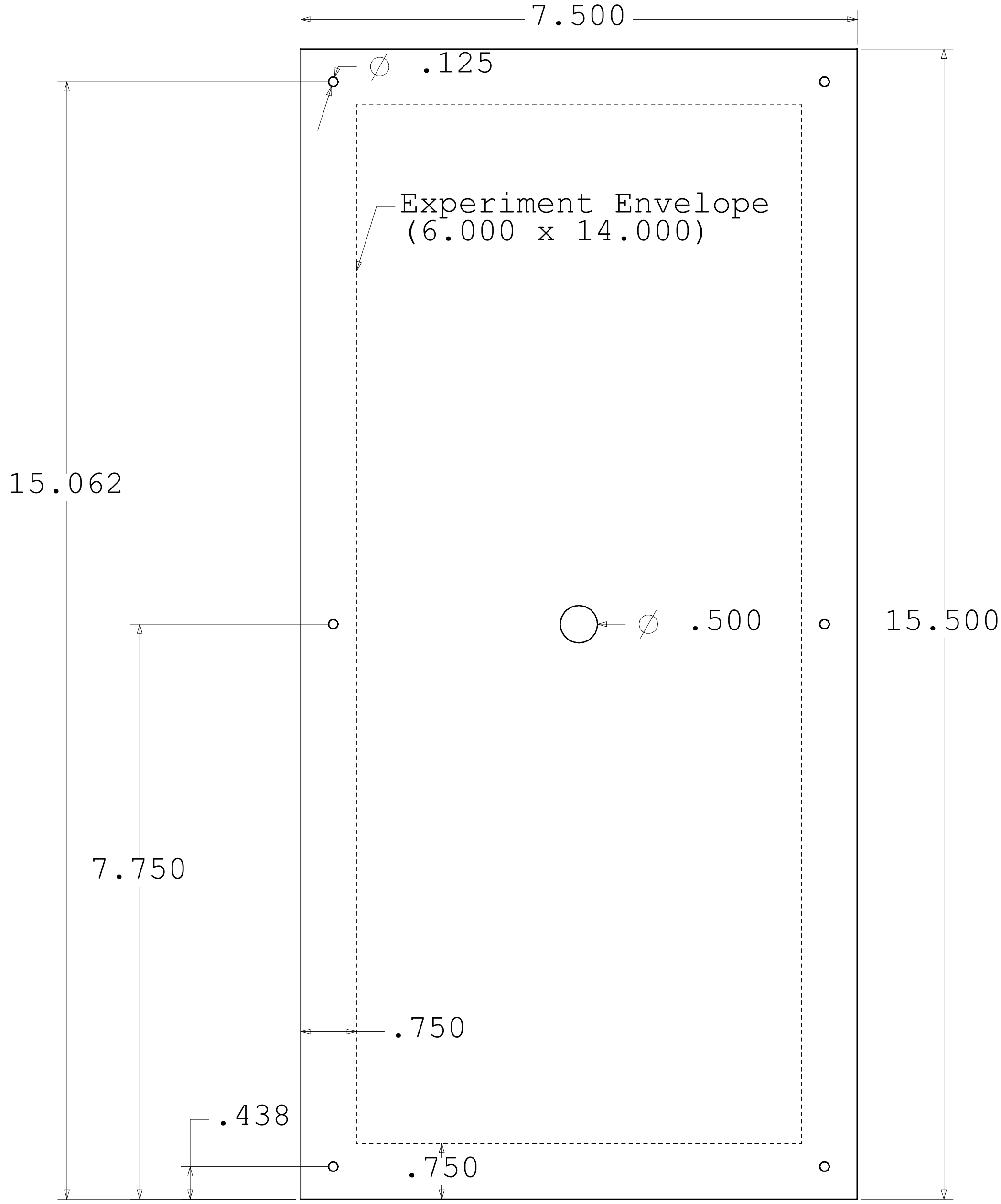

Figure 12: Dimensional Drawing of Carrier Plate for Footprint #6

(not to scale; dimensions in inches)

3.2 ELECTRICAL INTERFACES

This section defines the standard electrical interfaces between the K-1 vehicle and standard passive flight experiments. Standard passive flight experiments interface with the Development Flight Instrumentation (DFI) system installed in the K-1 vehicle. The DFI system provides analog-to-digital data recording with a large memory storage capacity. Data recording is available for up to 3 pressure transducers, 3 strain gauges, and 8 thermocouples at each mounting footprint. The specific sensors used and sampling rates is at the discretion of the experimenter, subject to approval by Kistler, and will be documented in the ICD.

Kistler will deliver the experimenter a DFI simulator at L-5 months. The DFI simulator mimics all physical and functional interfaces of the DFI. It will include a launch vehicle electrical interface receptacle and experiment-specific software to verify data recording interfaces. The experimenter will return the DFI simulator to Kistler in its original packing material by L-1 month. A DFI simulator will be available at the launch site for final test and checkout.

3.2.1 Connectors and Pin Assignments

A 37-pin plug connector will be used to route instrument data to the K-1 DFI system. The experimenter will splice their instrumentation wiring to a Kistler-supplied electrical connector (delivered along with the Interface Kit at L-5 months), part number D38999/26FD35SN.

Table 4 shows the interface connector pin assignments.

Table 4: Experiment Interface Connector Pin Assignments

Pin #	Function	Voltage (VDC)
1	Pressure Transducer 1 Excitation +	0-10
2	Pressure Transducer 1 Excitation -	0-10
3	Pressure Transducer 1 Signal +	0-10
4	Pressure Transducer 1 Signal -	0-10
5	Pressure Transducer 2 Excitation +	0-10
6	Pressure Transducer 2 Excitation -	0-10
7	Pressure Transducer 2 Signal +	0-10
8	Pressure Transducer 2 Signal -	0-10
9	Pressure Transducer 3 Excitation +	0-10
10	Pressure Transducer 3 Excitation -	0-10
11	Pressure Transducer 3 Signal +	0-10
12	Pressure Transducer 3 Signal -	0-10
13	Strain Gauge 1 +	0-10
14	Strain Gauge 1 -	0-10
15	Strain Gauge 2 +	0-10
16	Strain Gauge 2 -	0-10
17	Strain Gauge 3 +	0-10
18	Strain Gauge 3 -	0-10
19	Thermocouple 1 +	0-10

Pin #	Function	Voltage (VDC)
20	Thermocouple 1 -	0-10
21	Thermocouple 2 +	0-10
22	Thermocouple 2 -	0-10
23	Thermocouple 3 +	0-10
24	Thermocouple 3 -	0-10
25	Thermocouple 4 +	0-10
26	Thermocouple 4 -	0-10
27	Thermocouple 5 +	0-10
28	Thermocouple 5 -	0-10
29	Thermocouple 6 +	0-10
30	Thermocouple 6 -	0-10
31	Thermocouple 7 +	0-10
32	Thermocouple 7 -	0-10
33	Thermocouple 8 +	0-10
34	Thermocouple 8 -	0-10
35	Spare	
36	Spare	
37	Spare	

3.2.2 Data Recording Interfaces

The K-1 DFI system is equipped with signal conditioners to sample, convert (analog-to-digital) measurements from sensors, and routes this data to a solid-state data recorder. The data from the recorder is downloaded after the OV is recovered. Table 5 shows the DFI analog-to-digital conversion characteristics.

Table 5: Analog Input Conversion Characteristics

Characteristic	Value
Resolution	12 bits
Conversion Time	50 microseconds maximum
Absolute Accuracy	0.1% full-scale (RMS)
Minimum resolution for no missing codes	11 bits minimum

The DFI system implements first-order low-pass filters on all analog inputs.

Up to 1,000 MB of flash data recording memory are available in the DFI for all flight experiments at a rate of 10 Mbps. Of this amount, each experimenter should expect an allocation of up to 250 MB and a maximum data rate of 2.5 MBps, unless otherwise required and stated in the ICD. As an optional service, this is expandable to 4,500 MB.

The Detailed Questionnaire will ask the experimenters to specify the types and number of sensors the K-1 will record data from, including required sample rates, sampling times, excitation voltage, units, sensor range, and minimum and maximum expected values. Based on these responses, Kistler will document the detailed interface for data recording in the ICD, which will conform with existing K-1 DFI capabilities. Using the DFI simulator provided by Kistler, the experimenter shall (ACT.3.2.2.1) verify the experiment meets its functional requirements when connected to the data recording interface specified in the ICD.

3.2.3 Pyrotechnic Devices

The experiment shall (PAS.3.2.3.1) not use any pyrotechnic devices.

3.2.4 Installation Details

Experimenters will route their wires through the instrumentation pass-through hole in the center of the Carrier Plate (if used). The total wire length measured from the base of the experiment to the connector shall (PAS.3.2.4.1) be a minimum of 12.0 inches and a maximum 18.0 inches. The experimenter will splice their wiring into the Kistler provided connector according to the pin assignments specified in Table 4. All wiring shall (PAS.3.2.4.2) be 24 AWG, twisted pair, shielded, round braid, high strength.

During installation of the Carrier Plate onto the K-1 vehicle, Kistler will connect a 35-pin plug connector running from the Carrier Plate to the DFI receptacle connector attached to an electrical harness on the vehicle.

The Interface Kit delivered to the experimenter by Kistler at L-5 months will contain detailed instructions for wiring the experiment into the connector, including a list of requisite tools and detailed techniques for crimping and contact insertion.

3.2.5 Electrical Interface Drawing

Figure 13 shows the 37-pin plug connector and arrangement of the pins referenced in Section 3.2.1.

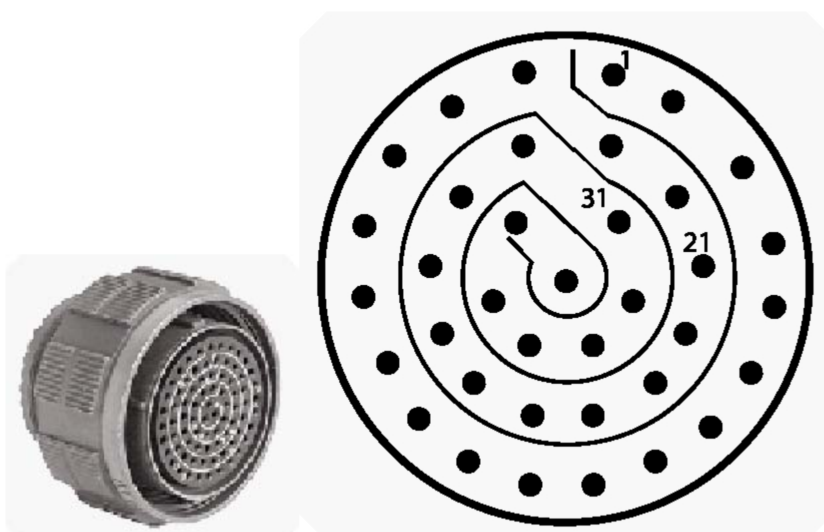

Figure 13: Electrical Interface Connector and Pin Locations

3.3 ENVIRONMENTAL INTERFACES

This section describes the predicted environments experienced by passive flight experiments on the K-1 vehicle during both ground and flight phases.

3.3.1 Thermal

Heat loads during reentry drive the design of materials and TPS experiments externally mounted to the OV. Table 6 shows the overall predicted heating environment at each footprint. Detailed heating histories have been omitted from this document for export control reasons. Kistler will document the predicted heating history in the ICD.

The experimenter shall (PAS.3.3.1.1) verify the experiment can satisfy its performance requirements when exposed to the predicted heat environment shown in Table 6 and the heating time history documented in the ICD with a 25% margin in each case.

Table 6: Heating Environment in K-1 OV External Experiment Footprints

Footprint #	Peak Heating Rate ($BTU/ft^2/sec$)	Integrated Heat Load (BTU/ft^2)	Radiation Eq. Temp.(F)
1	65.0	14,350	3,060
2	9.5	1,830	1,716
3	7.6	1,300	1,598
4	2.2	450	1,050
5	33.0	5,940	2,511
6	12.4	2,435	1,866
NOTE: Radiation equilibrium temperature assumes $\varepsilon = 0.89$ and $\sigma = 4.76E-13$.			

3.3.2 Aerodynamic Loads

Detailed pressure histories have been omitted from this document for export control reasons. Kistler will document the predicted pressure time history in the ICD.

The experimenter shall (PAS.3.3.2.1) verify the experiment can satisfy its performance requirements when exposed to the predicted pressure environment documented in the ICD with a 25% margin in each case.

3.3.3 Humidity

The experiment shall (PAS. 3.3.3.1) satisfy its performance requirements after extended exposure to a relative humidity 20 - 95%, non-condensing, through a temperature range of 15 to 120 °F.

3.3.4 Contamination

Kistler can provide the experimenter with a Class 8 clean environment per ISO 14644-1 to process experiments. Surfaces within Kistler clean areas are cleaned to Level 750B particulate per MIL-STD-1246. The experiment will be exposed to the ambient air environment of the

Woomera launch site once integrated into the vehicle in the K-1 Vehicle Processing Facility (VPF).

3.4 FACILITY INTERFACES

This section describes experimenter interfaces to the K-1 launch facility in Woomera, Australia, if experimenter personnel must be on-site during integration and flight operations. Experimenter personnel have access to processing facilities and support personnel in Woomera to accomplish the technology experiment mission.

3.4.1 Pre-Launch Site Visits

Rationale for a pre-launch visit (defined as a visit occurring before L-4 weeks) to the Woomera launch site will be mutually agreed upon and documented in the ICD. Kistler support of a pre-launch site visit may include access to launch site facilities and Kistler technical personnel for site surveys, as well as training and assistance in obtaining security clearance, training, accommodations, transportation, and other logistics as defined in Sections 3.4.8 through 3.4.11. No more than five experimenter personnel will be accommodated on the K-1 launch site for pre-launch site visits at any one time.

If required, additional site visits of longer duration, or for a larger number of personnel, can be accommodated as an optional service.

3.4.2 Pre-flight and Post-flight Experiment Access

The last opportunity for the experimenter to physically access experiments occurs at approximately L – 24 hours. The flight experiment can be uninstalled from the K-1 and given to experimenter personnel (if present at the launch site) approximately 24 hours after the OV lands.

3.4.3 Facility Space

3.4.3.1 Processing Space

Kistler will provide work areas for experimenters to perform test, checkout, and other processing of their experiments at the launch site before integration to the K-1 vehicle. The work area will be located in a Highbay within the K-1 Payload Processing Facility (PPF) as described in Section 8.2 of K1-01-001, or within the K-1 Vehicle Processing Facility (VPF). If required, the work area will be maintained at a Class 8 cleanliness level, per ISO 14644-1. Kistler will provide clean room garments and change areas. If the work area is located in the VPF, cleanliness will be maintained within a tented area provided by Kistler. Environmental conditions can be controlled to a set point of 65 to 75 ° F with a tolerance of ± 5° F, and 50 ± 5% relative humidity. The Highbay can support limited hazardous processing operations, but does not support safe containment and removal of toxic waste from fueling operations.

Kistler will allocate a minimum of 200 ft^2 of processing space to each experimenter. In the VPF Highbay, a 7.5-ton crane with a 10-meter hook height is available, if required. If multiple experimenters are in the same room in the PPF or VPF, Kistler will provide fabric walls to partition the experimenters' work areas.

The processing space will be available from L – 2 weeks to L + 3 days.

Additional processing space and/or processing space for longer periods can be provided as an optional service.

3.4.3.2 Office Space

Kistler will provide limited office accommodations for experimenter personnel to support experiment integration and mission operations. Accommodations may be inside the K-1 Payload Processing Facility, Vehicle Processing Facility, or in another structure designated by Kistler, including temporary structures and structures in Woomera village (8.4 miles from the launch site). A minimum of 100 ft^2 of space will be available to each experimenter. This space includes standard office furniture, electrical power, a telephone, and nearby access to at least one copy machine and at least one fax machine. The office space will be available from L – 4 weeks to L + 1 week. If the experiment is reflown on the K-1 on one or more consecutive flights, Kistler will provide this office space from L-4 weeks before the first launch to L + 1 week after the last launch.

Additional processing space and/or processing space for longer periods can be provided as an optional service.

3.4.3.3 Storage Space

Limited space will be provided by Kistler for storage of equipment required for the experimenter to process experiments at the launch site. Storage accommodations will be in a secure, covered, non-climate controlled facility on the Woomera launch site designated by Kistler. A minimum of 100 ft^2 of space with a minimum 8-foot ceiling height will be available to each experimenter. The storage space will be available from L – 4 weeks to L + 2 weeks. If the experiment is scheduled for reflight on the K-1 in the future, Kistler will provide this storage space from L-4 weeks before the first launch to L + 2 weeks after the last launch.

Additional storage space, climate-controlled space, and/or processing space for longer periods can be provided as an optional service.

3.4.3.4 Janitorial Service

Kistler will provide regular janitorial service for all processing areas and office areas used by the experimenter.

3.4.4 Utilities

Kistler will provide facility power in processing and office areas. Power in processing areas will be uninterruptible with a frequency of 50 Hz at 220 V or 60 Hz at 120 V, as required. In office areas, power will be 50 Hz at 220 V.

If required, 125-psi compressed shop air can be provided to the experimenter.

Other commodities (including gaseous nitrogen, helium, deionized water, and isopropyl alcohol) are available as an optional service.

3.4.5 Hazardous Processing Area

Experimenters will not have access to the K-1 Hazardous Processing Area.

3.4.6 Communications

At least one local and international telephone connection, and one internet connection with a minimum transfer rate of 128 kbps will be available to experimenters in Kistler provided office areas. Kistler will bill the experimenter separately for all long distance telephone charges incurred. Kistler will provide wireless radio units and/or cellular phones (with local access only) for mobile communications on the launch site and processing areas. The experimenter is responsible for compliance with all U.S. export regulations, including International Traffic in Arms (ITAR) regulations, in communication of information from the U.S.

3.4.7 Experiment Ground Support Equipment

As a standard service, Kistler will not supply ground support equipment to support experiment processing and checkout not specifically mentioned in this IDRD. If the experimenter requires Kistler to provide ground support equipment at the launch site not specifically mentioned in this document (such as work benches, load cells, hand tools, etc.), the experimenter should include a list of this equipment in responses to the Detailed Questionnaire. This equipment may be provided by Kistler as an optional service at an additional price if equivalent surplus equipment is not already available at the launch site. The experiment-specific ICD will capture the list of all additional ground support equipment provided by Kistler to the experimenter.

3.4.8 Security

The Kistler launch site lies within the restricted Woomera Prohibited Area (WPA), operated by the Australian government. The WPA authorities must authorize by name all personnel entering the WPA. This provides the first level of security.

Security is also subject to compliance with all applicable U.S. export regulations, including International Traffic in Arms Regulations (ITAR).

A Kistler Woomera guard station has been established on Koolymilka Road, the only road access to the launch complex. Access to the launch site is controlled by this checkpoint 24 hours a day, 7 days a week.

There are established guard posts outside and inside the VPF/PPF to control personnel and equipment entering these facilities. Inside the PPF, coded cipher locks are used to control access to key areas. All Kistler provided processing, office, and storage spaces will either be in these facilities, or will have a level of security similar to these facilities.

3.4.9 Training

Kistler will provide required safety and procedural training to experimenter personnel for access and use of Kistler facilities, including:

- General site orientation
- Site security

- Safety equipment and procedures
- Hands-on training to experimenter personnel for the use of required facility equipment

3.4.10 Accommodations

Kistler will provide support to the experimenter in securing visas, accommodations, meal service, recreation, and other services for experimenter personnel working at the Woomera launch site. The experimenter is responsible for all accommodation costs incurred for its personnel.

3.4.11 Transportation

Kistler's standard experiment integration price includes transportation of the experiment from the United States to the Woomera launch site. Kistler will take receipt of packaged experiment in the U.S. (location TBD) and deliver the package to the K-1 VPF (see Section 5.1).

If experimenter personnel must be at the launch site during integration and flight operations, Kistler will provide support to the experimenter in securing air/ground transportation for experimenter personnel and test equipment to the Woomera area. Kistler will also provide support in securing rental cars and trucks in the Woomera area. The experimenter is responsible for all costs incurred for the aforementioned transportation services. Kistler will operate a regular scheduled bus service between Woomera village and the launch site as a standard service. Kistler will have an on-call taxi service available during normal work hours for travel between Woomera Village and the launch site.

3.5 OPERATIONS INTERFACE

This section is primarily reserved for experimenter input on the procedures required to integrate their standard passive flight experiments with the K-1 vehicle at the launch site.

3.5.1 Installation Procedure

Kistler will deliver packaged experiments to the Woomera launch site as detailed in Section 5.1. After unpacking the experiments in Woomera, Kistler will deliver the experiment to experimenter personnel (if present at the launch site) for final test and checkout of the experiment. If experimenter personnel are not present for the flight, Kistler can perform final test and checkout per Section 3.5.3. If required, ISO Class 8 clean facilities can be provided for unpacking, test, and checkout. A DFI simulator is available for use by the experimenter (as described in Section 4.2).

No later than L-24 hours, Kistler Woomera personnel will perform final installation of the experiment onto the K-1. Final mechanical installation of the experiment onto the K-1 vehicle is performed in the VPF, and is accomplished by either mechanically fastening the Carrier Plate onto the vehicle (backed by an ablator) and installing gap fillers, or bonding the experiment (if it is a tile) directly onto the structure. Kistler will connect the electrical interface to the DFI, and power-on the DFI briefly to perform experiment continuity testing and other final testing specified in Section 3.5.3.

After installation, Kistler will perform a pull-test on the experiment to verify the strength of the bond.

3.5.2 Hazardous Operations

Experimenters will not have access to the Hazardous Processing Area at the Woomera launch site. All processing operations must be safely performed in the Non Hazardous Processing Area. Kistler will not dispose of hazardous waste for experimenters.

3.5.3 Test and Checkout Procedure

Reserved for Experimenter Input through Detailed Experiment Questionnaire.

3.5.4 Procedure to Uninstall Experiment

Reserved for Experimenter Input through Detailed Experiment Questionnaire.

3.6 SAFETY AND MISSION INSURANCE

3.6.1 Australian Government Requirements

Experiments shall (PAS.3.6.1.1) be designed and operated in accordance with Australian government requirements as defined in PL-98-042 for both ground and flight operations.

3.6.2 Hazards

All hazards will be identified in the System Safety/Hazard Analysis submitted to Kistler by the experimenter, prepared in accordance with MIL-STD-882 (see Section 8.2.6). Kistler will incorporate the experiment's hazard analysis into the System Safety/Hazard Analysis Report specific to the Add-on Technology Experiment flight (see Section 8.2.7).

3.6.3 Debris

Standard Passive Experiments shall (PAS.3.6.3.1) be designed such that no debris is generated during mission operations.

4. INTERFACE VERIFICATION MATRIX

4.1 VERIFICATION MATRIX DEFINITIONS

4.1.1 Inspection (I)

Verification will be performed by comparison of the experiment or its component parts with approved design or specification documents. Inspections as defined herein will include such assessments as physical measurements, surface finish inspections, process and certification verifications, physical or electronic feature identification, x-ray examinations, and visual inspections. Quantitative data is collected.

4.1.2 Demonstration (D)

Verification will be performed by visual confirmation of functional performance and/or interface compatibility using information provided during normal system operation. No quantitative performance data is required.

4.1.3 Analysis (A)

Verification will be performed by mathematical proofs and calculations that demonstrate compliance between numerical design requirements and the manufactured experiment and/or its component assemblies. This method is most frequently used when quantitative performance data is critical, and the performance of a test, or tests, is impractical or cost/schedule prohibitive. Analysis can also be used in conjunction with test data to establish experiment performance characteristics. Quantitative performance data, including the supporting analysis, is required.

4.1.4 Test (T)

Verification will be performed by conducting conclusive tests to establish performance characteristics of the experiment or its component assemblies. Calibration test instrumentation, providing data of sufficient resolution and accuracy are required to collect the test results. Test results may require data reduction and analysis to establish the performance characteristics of the unit under test. Quantitative performance data, including the supporting analysis, is required.

4.2 VERIFICATION RESPONSIBILITIES

The experimenter will be responsible for fulfilling the verification requirements described in Section 4.3. The experimenter may use its facilities or any commercial laboratory acceptable to Kistler. The experimenter will document verification results in a Verification Report, as described in Section 8.2.13. Kistler reserves the right to perform any of the verifications necessary to ensure the item confirms to the prescribed requirements.

4.3 VERIFICATION REQUIREMENTS

Each experiment requirement will be verified by the corresponding methods defined by Table 7. The experimenter will use MIL-STD-1540 as a guide for verification methods, but may suggest tailoring these requirements consistent with the intent of the standard. Kistler is willing to work with experimenters on the specific verification methods in this table. For example, for requirements calling for a verification test, the test may not be necessary if the experiment uses only off-the-shelf components for which manufacturer test data exists. Any modifications to these requirements will be documented in the ICD.

Table 7: K-1 Passive Flight Experiment Verification Requirements

		Verification Method				
Requirement #	Paragraph Title	I	D	A	T	Comment
PAS.3.1.3.1	Experiment Interface and Envelope	X				
PAS.3.1.4.1	Structural Stiffness and Loads			X	X	See Note 1
PAS.3.1.5.1	Mass Properties	X				
PAS.3.1.6.1	Material Compatibility	X				
PAS.3.1.7.1	Material Cleanliness	X				White glove test acceptable
PAS.3.1.8.1	Material Outgassing	X				
PAS.3.1.9.1	External Moldline	X				
PAS.3.2.2.1	Data Recording Interface				X	DFI simulator provided
PAS.3.2.3.1	Pyrotechnic Devices	X				
PAS.3.2.4.1	Installation Details	X				
PAS.3.2.4.2	Installation Details	X				
PAS.3.3.1.1	Thermal			X	X	See Note 2
PAS.3.3.2.1	Aerodynamic Loads			X		
PAS.3.3.3 1	Humidity			X		See Note 2
PAS.3.6.1.1	Australian Government Requirements	X				
PAS.3.6.3.1	Orbital Debris	X				

Note 1: (A) only if ultimate factor of safety of 2.0 or greater is used; otherwise, (A) and (T). If (T) required, acceptance test level is 1.10 x limit load.

Note 2: (T) can be replaced by (A) if suitable test data for all sensitive components at the predicted flight environment already exists.

5. PACKAGING AND SHIPPING

5.1 SHIPPING PROCESS FLOW

As a standard service for experimenters located in the United States, Kistler will take receipt of experiments in the U.S. The experimenter is responsible for packing the experiment in an appropriate container and shipping the experiment to a location TBD by Kistler in the U.S. by no later than L-1 month. Experiment acceptance will be conducted at this designated location.

Kistler will deliver the experiment to the Woomera launch site no later than L-2 weeks before launch. If experimenter personnel are present at the launch site for the experiment flight, Kistler will deliver the experiment package to them for final test and checkout. If experimenter personnel will not be present, Kistler will unpackage the experiment, perform final test and checkout per the ICD, and install the experiment in the K-1 vehicle.

After the experiment flight, Kistler will uninstall the experiment according to the instructions in Section 3.5.4, and repackage the experiment according to the instructions in Section 5.3. Kistler will ship the experiment back to the experimenter's facility in the U.S. in the container it arrived in by no earlier than L+2 weeks after its last launch, and no later than L+4 weeks after its last launch.

5.2 SHIPPING CONTAINER LABELLING INSTRUCTIONS

Experimenter shipping containers containing experiment trays or experiment ground support equipment will be clearly marked with the following information:

- Experiment Name
- Owner Name and Address
- Shipping Container Number (e.g., 1 of 3)
- "K-1 Experiment Flight Hardware" or "K-1 Experiment Ground Support Equipment," as appropriate

5.3 PACKING INSTRUCTIONS FOR EXPERIMENT RETURN

Reserved for Experimenter Input through Detailed Experiment Questionnaire.

5.4 PACKING LIST FOR EXPERIMENT RETURN

Reserved for Experimenter Input through Detailed Experiment Questionnaire.

5.5 MATERIAL SAFETY DATA SHEETS

The experimenter will include in the experiment shipping container any applicable Material Safety Data Sheets if their experiment contains materials that are a potential hazard, as defined in OSHA Standard 1910.1200.

5.6 HAZARDOUS WASTE DISPOSAL

Kistler will not dispose of any hazardous waste for experimenters.

6. OPTIONAL SERVICES

Kistler can provide a number of optional services for standard experiments if the standard services described in this IDRD do not satisfy experiment requirements. The prices for these optional services are based on the details on the service, subject to negotiation, and may be contracted for directly with Kistler. Optional services include, but are not limited to, the services described in this section.

6.1 IN-FLIGHT TELEMETRY

The baseline DFI does not send experiment data to the ground. Real time data is collected and recording in a solid-state recorder as specified in Section 3.2.2. Data is downloaded from the recorder after recovering the second stage. As an optional service, limited telemetry downlink can be provided. Kistler will work with experimenters who require telemetry to further define this capability.

6.2 EXCESS DATA MEMORY

Kistler can provide memory for flight measurements from experiment beyond the 1,000 MB described in Section 3.2.2, up to 4,500 MB. Kistler will work with experimenters to understand experiment requirements and define K-1 capabilities in this area.

6.3 ENGINEERING ANALYSES AND TESTING

As an optional service, Kistler can support experimenters in fulfilling the verification requirements described in Section 4 of this IDRD. This includes, but is not limited to, engineering analysis and testing to fulfill the requirements of the verification matrix in Section 4.

6.4 SPECIAL FACILITIES AND UTILITIES

Storage space, processing space, office space, logistical support, and utilities exceeding the specifications and/or duration described in Section 3.4 can be provided as an optional service. Kistler will work with experimenters to understand experiment requirements and define K-1 capabilities in this area.

6.5 TECHNICAL SHOP SUPPORT

As an optional service, Kistler can provide the experimenter with unplanned technical shop support as required at the launch site. Services and capabilities that can be provided include a calibration lab for electronic GSE, and machine shop support including a metal working lathe, milling machine, drill press, welding/soldering equipment, hand tools, and machinists.

7. ROLES AND RESPONSIBILITIES

Experimenters are responsible for designing and developing their technology experiment and performing verification activities (described in Section 4) required by Kistler to fly on the K-1. Kistler will have approval authority for verification activities performed by the experimenter. Kistler will also be responsible for K-1 preparation and flight operations. Section 5.1 of 21-

Report-N-001 describes the specific responsibilities of the experimenter and Kistler in greater detail.

8. SCHEDULE

Kistler will work with experimenters to develop an experiment integration program schedule for each Add-on Technology experiment flight. Integration activities begin after NASA releases a Preliminary Manifest for the experiment flight. Figure 14 shows a typical integration program schedule (in terms of major program milestones and data deliverables) from the point the Preliminary Manifest is published.

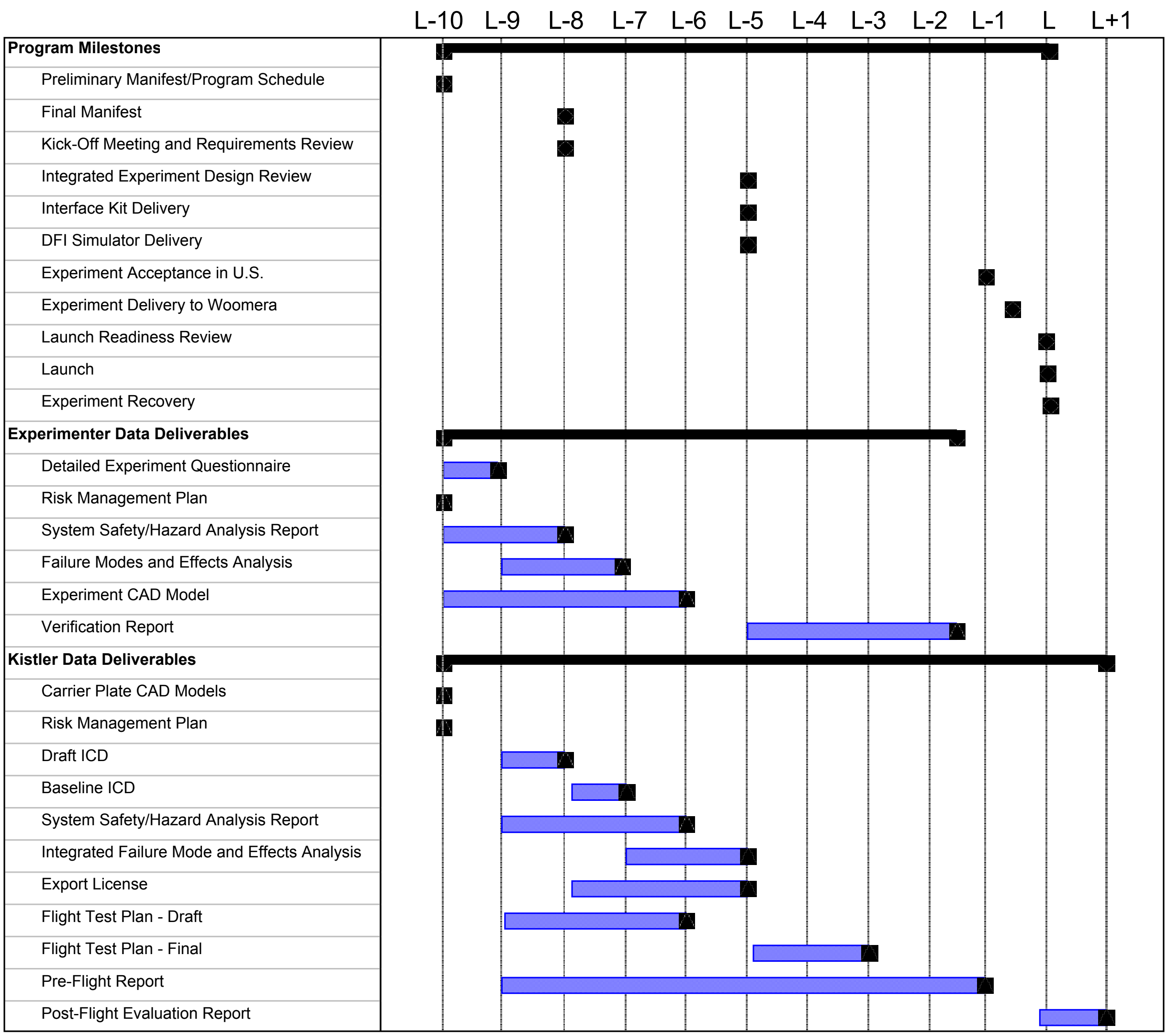

Figure 14: Typical Add-on Technology Experiment Integration Schedule

The following sections describe this typical integration program schedule for major program milestones and data deliverables in greater detail, relative to the scheduled experiment launch date.

8.1 PROGRAM MILESTONES

This section describes the nominal schedule of major milestones (including reviews and hardware deliveries) in a standard Add-on Technology Experiment flight program.

8.1.1 Preliminary Manifest/Program Schedule

NASA will announce a Preliminary Manifest/Program Schedule for the experiment flight at L-10 months based on feedback it has received from Preliminary Experiment Questionnaires and coordination with Kistler. At this time, experimenters on the Manifest are requested to complete a Detailed Experiment Questionnaire and return it to Kistler (with a also copy delivered to NASA) by L-9 months.

8.1.2 Final Manifest

NASA will announce a Final Manifest for the experiment flight at L-8 months based on feedback it has received from Preliminary and Detailed Experiment Questionnaires and coordination with Kistler.

8.1.3 Kick-Off Meeting and Requirements Review

Kistler will hold a one-day Kick-Off Meeting and Requirements Review with all experimenters manifested on a flight to review the Draft ICDs. This meeting will occur at L-8 months at Kistler Aerospace facilities in Kirkland, Washington.

8.1.4 Integrated Experiment Design Review (IEDR)

Kistler will hold an IEDR (typically for three days) with all experimenters manifested on a flight to review integrated requirements. This review will bring all experimenters on a particular flight together to review interfaces, environments, and vehicle accommodations, and any potential interactions between different experiments. This review will occur at L-5 months at Kistler Aerospace Corporation facilities in Kirkland, Washington.

8.1.5 Interface Kit Delivery

Kistler will deliver an Interface Kit (described in Section 3.1.10), including the requisite number of carrier plates and connectors to each experimenter by L-5 months.

8.1.6 DFI Simulator Delivery

At L-5 months, Kistler will deliver a DFI simulator to the experimenter as described in Section 3.2 to perform electrical interface verification testing.

8.1.7 Experiment Acceptance in the U.S.

No later than L-1 month, the experimenter will deliver the experiment and return the DFI simulator to a U.S. location TBD by Kistler. At this location, Kistler and experimenter personnel will unpack the experiment container, and Kistler will accept the experiment. At least one representative of the experimenter must be present. Acceptance includes visual inspection of the hardware for damage, comparison of the experiment with drawings in the ICD, comparison of container contents with the packing list for completeness, and inspection of Materials Safety Data Sheets. Acceptance may also include use of the DFI simulator to run test scripts as specified by the experimenter and documented in the ICD.

Kistler reserves the right to return the experiment to the experimenter if a problem is identified during the inspection process. If the experiment is accepted, Kistler will repack the container for delivery to the Woomera launch site.

8.1.8 Experiment Delivery to Woomera

Kistler will deliver the experiment to the launch site no later than L-2 weeks.

8.1.9 Launch Readiness Review

At L-1 day, the Kistler Director of Flight Operations will conduct a Launch Readiness Review at the Woomera launch site to determine if the mission is ready for launch. Present at this meeting will be members of the Kistler launch team, the Woomera Range Administrator, and the Launch Director of the primary payload customer. Experimenter personnel are welcome to attend this meeting if they are present at the launch site; however, experimenters have no control authority over the go/no-go decision for the launch. The Director of Flight Operations will take into account input from experimenters before making the final go/no-go decision.

8.1.10 Experiment Recovery

Approximately 24 hours after launch, the OV will return to the launch site. Kistler personnel will uninstall the experiment and make it available to the experimenter personnel (if they are present at the launch site) approximately 24 hours after OV landing. Kistler will also download data from the DFI at this time, in preparation for delivering the Post-Flight Evaluation Report to the experimenter. The experiment will be shipped back to the experimenter between L+2 weeks and L+4 weeks of the last launch of the experiment.

8.2 DELIVERABLES

This following sections describe the general content and nominal delivery schedule of major data deliverables developed by Kistler and the experimenter for a specific technology flight experiment. Table 8 lists all the data deliverables, the responsible parties, and a typical delivery schedule. This table does not include any briefing materials required to support the reviews described in Section 8.1. The table also does not include the set of standard documentation Kistler has developed to cover all experiment flights, such as Kistler's Program Management Plan, Configuration Management Plan, and Off-Site Contractor Safety Program Plan.

Table 8: Data Deliverable Responsible Parties and Typical Delivery Schedule

Deliverable	Responsible Party	Typical Delivery Date
Flight Experiment Design and Requirements Document	Kistler	Delivered
Preliminary Experiment Questionnaire	Experimenter	Prior to L – 10 months
Carrier Plate CAD Model	Kistler	L – 10 months
Risk Management Plan	Kistler	L – 10 months
Risk Management Plan	Experimenter	L – 10 months
Detailed Experiment Questionnaire	Experimenter	L – 9 months
Draft ICD	Kistler	L – 8 months
System Safety/Hazard Analysis Report	Experimenter	L – 8 months
Baseline ICD	Kistler	L – 7 months
Failure Modes and Effects Analysis (FMEA)	Experiment	L – 7 months
System Safety/Hazard Analysis Report	Kistler	L – 6 months
Experiment CAD Model	Experimenter	L – 6 months
Flight Test Plan – Draft	Kistler	L – 6 months
Integrated FMEA	Kistler	L – 5 months
Export License	Kistler	L – 5 months
Flight Test Plan – Final	Kistler	L – 3 months
Verification Report(s)	Experimenter	L – 6 weeks
Pre-Flight Report	Kistler	L – 1 month
Post-Flight Report	Kistler	L + 1 month

8.2.1 Flight Experiment Design and Requirements Document (FEDR)

The FEDR (21-Report-001) describes Kistler's mission approach for standard flight experiments, and defines the standard interface to the K-1 vehicle. The FEDR is available immediately to all prospective experimenters and includes the appendices described in Section 8.2.1.1 through 8.2.1.3.

8.2.1.1 Preliminary Experiment Questionnaire

The Preliminary Experiment Questionnaire is a simple, one-page form designed to provide data to support early mission planning and manifesting. Prospective experimenters should fill out the Preliminary Questionnaire at the earliest possible stage (before the release of the Preliminary Manifest) and return a copy to Kistler to assist in advance planning and flight scheduling.

8.2.1.2 Interface Definition and Requirements Document (IDRD)

This IDRD defines the standard K-1 physical, functional, and operational interface to flight experiments, including design requirements for flight experiments. The FEDR contains the IDRD for both Active and Passive flight experiments.

8.2.1.3 Detailed Experiment Questionnaire

Using feedback from Preliminary Questionnaires, Kistler will develop a Preliminary Flight Manifest (see Section 8.1.1) and inform all experimenters on the manifest of the flight opportunity. Typically at L-9 months, experimenters will submit a completed Detailed Experiment Questionnaire to Kistler. The Detailed Experiment Questionnaire form is available to experimenters immediately. Through the Questionnaire, experimenters will provide detailed interface data on their experiments, including an assessment of whether the K-1 standard experiment interface described in the IDRD is compatible with the experiment, what interface modifications Kistler may have to make, and what optional services the experimenter may require.

8.2.2 Carrier Plate CAD Models

At L-10 months, after NASA has published the Preliminary Manifest for the flight, Kistler will deliver, via an e-mail attachment, Unigraphics CAD models (.prt file) of the Carrier Plates and the electrical connector to each experimenter on the manifest. STEP translated files (in ASCII format) can be delivered if the developer does not use Unigraphics.

8.2.3 ICD

Based on this IDRD and responses received from experimenters in the Detailed Experiment Questionnaire, Kistler will deliver a Draft ICD to the experimenter at a Kick-Off Meeting and Requirements Review (see Section 8.1.3) typically occurring at L-8 months. Based on the results of this meeting and ongoing communication with the experimenter, Kistler will deliver a Baseline ICD to the experimenter (see Section 8.1.4) at L-7 months. For subsequent revisions, the ICD will be updated as required through Kistler's change control process.

8.2.4 Risk Management Plan and Reports – Kistler

Kistler has developed a Risk Management Plan to serve as a baseline document for planning, control, and implementation of Kistler's risk management program. Kistler will deliver an electronic copy of this plan to the experimenter once the Preliminary Flight Manifest is published by NASA (typically at L – 10 months). Kistler will also deliver Risk Management Reports to the experimenter; these documents provide a status of risk mitigation plans of activities specific to the Add-on Technology Experiment flight, and are already a data deliverable to NASA. Kistler will deliver these reports to the experimenter in the same format and same frequency as required by NASA.

8.2.5 Risk Management Plan and Reports – Experimenter

NASA will require the experimenter to submit a Risk Management Plan and Risk Management Reports to the SLI Flight Demonstration Program Office. The experimenter will also deliver a copy of the Risk Management Plan and any Risk Management Reports to Kistler to support the Risk Management program. The Risk Management Plan addresses how NASA risk management requirements are to be implemented throughout the program's life cycle. The Risk Management Report provides a status of risk mitigation plans and activities. The format and content of these documents agreed to between NASA and the experimenter will be acceptable to Kistler. The experimenter's Risk Management Plan will be delivered to Kistler once the Preliminary Manifest is published (typically at L - 10 months). Risk Management Reports will be delivered as required by the experimenter's contract with NASA.

8.2.6 Hazard Analysis Report - Experimenter

The experimenter will deliver a System Safety/Hazard Analysis Report to Kistler using MIL-STD-882 as a guide. This report will identify hazards unique to its experiment, evaluate risk, and evaluate verification methods. This report will be delivered typically at L-8 months.

8.2.7 System Safety/ Hazard Analysis Report - Kistler

Kistler will deliver a System Safety/Hazard Analysis Report, specific to one Add-on Technology flight, to all experimenters with experiments on the flight. This report will identify hazards unique to the flight, evaluate risk, and evaluate verification methods. This report will be delivered typically at L-6 months.

8.2.8 Failure Modes and Effects Analysis - Experimenter

The experimenter will deliver a Failure Modes and Effects Analysis (FMEA) to Kistler. The FMEA is an analysis of the experiment to determine possible modes of failure and their effects on mission success, with provisions for identifying each failure by its criticality category number. The FMEA will be prepared using NSTS 22206 as a guide. This analysis will typically be delivered and baselined at L – 7 months.

8.2.9 Integrated Failure Modes and Effects Analysis

Kistler will deliver a FMEA integrating all experiments on the flight to NASA and each experimenter on the flight. This analysis will be delivered at the IEDR, typically at L – 5 months.

8.2.10 Experiment CAD Model

The experimenter will deliver a complete Unigraphics CAD model of the experiment integrated with the CAD model of the Carrier Plate previously supplied by Kistler (see Section 8.2.2). The CAD model will include the complete static envelope of the experiment and physical interfaces (including protrusions of bolt heads and wire routing). A STEP translated file (in ASCII format) will be accepted if the developer does not use Unigraphics. The experimenter will also deliver a Microsoft Powerpoint file showing isometric views of the experiment (hidden lines removed) for visualization purposes. The model will typically be delivered at L – 6 months.

8.2.11 Export License

Kistler will begin the process of applying for an export license for U.S. experiments after the Kick-off Meeting at L-8 months. Typically, Kistler will receive approval of the export license from the U.S. State Department by the time of the Integrated Experiment Review at L-5 months. Kistler will forward a copy of the approved export license to the experimenter.

8.2.12 Flight Test Plan

Kistler will deliver a draft Flight Test Plan to each experimenter by L-6 months and a final Flight Test Plan to each experimenter by L-3 months. One plan is generated for the entire flight. This plan defines all aspects of the launch campaign for all experiments, including transportation and storage, integration activities, launch operations, vehicle checkout, launch commit processes, security, communications, export control issues, and launch site safety. Integration activities for all experiments and payloads on the flight are described in this document.

8.2.13 Verification Report(s)

The experimenter will deliver a Verification Report(s) to Kistler by L-6 weeks. This report describes the methodology and results of all required verification activities described in Section 4.3.

8.2.14 Pre-Flight Report

At L-1 month, Kistler will deliver a Pre-Flight Report to the experimenter, documenting the expected results of the technology mission. The Pre-Flight Report will include information such as the designed flight profile (including trajectory), flight test objectives, measurement requirements, predicted values and performance, and success criteria. Kistler will generate the report based on flight-specific mission analysis performed by Kistler, data contained in the ICD, and additional support, as required, from the experimenter.

8.2.15 Post-Flight Report

At approximately L+1 month, Kistler will submit a Post-Flight report to the experimenter. The Post-Flight report will include a description of the success of the flight operation, and the degree to which expected results (relative to Pre-Flight Report predictions) were achieved. It will include final trajectory performance data, major event timelines, environments, and data from on-board sensors. A description of any problems encountered, and any recommendations for future flights, will also be included.

9. ACRONYMS

AWG	American Wire Gauge
DFI	Development Flight Instrumentation
FEDR	Flight Experiment Design and Requirements Document
Ft	foot
G	gravity
ICD	Interface Control Document
IEDR	Integrated Experiment Design Review
IDRD	Interface Definition and Requirements Document
ITAR	International Traffic in Arms Regulations
lbf	pound-force
lbm	pound-mass
lbs	pounds
LAP	Launch Assist Platform
MB	Megabyte
Mbps	Megabits per second
ºF	Degrees Fahrenheit
OML	Outer Mold Line
OV	Orbital Vehicle
PPF	Payload Processing Facility
psi	pounds per square inch
RLV	Reusable Launch Vehicle
RMS	Root-Mean-Square
TBD	To Be Determined
TPS	Thermal Protection System
VC-I	Visibly Clean Level 1
VPF	Vehicle Processing Facility
WPA	Woomera Prohibited Area