FIREFLY AEROSPACE

LAUNCH WITH

ALPHA

Payload User Guide

Contents

Revision History

Date	Version	History
March 2018	1.0	First Release
August 2019	2.0	Updated Release
March 2022	3.0	Updated Release
April 2022	3.1	Improved Release

The Alpha Payload User's Guide - Version 3.1 has been cleared for open publication by the Defense Office of Prepublication and Security Review, Department of Defense, as stated in letter 22-S-1137, dated March 18, 2022.

1—FIREFLY OVERVIEW

Figure 1. Firefly Family

Firefly was founded to provide economical and reliable access to space through the design, manufacture, and operation of launch vehicles and spacecraft. To reduce risk and increase reliability, Firefly employs a vertically integrated manufacturing process while leveraging high maturity COTS components. The technologies employed in the flagship Alpha vehicle provide a clear pathway for future incremental improvements in capability, and expansion of the Firefly Beta launch vehicle.

Though this guide is specific to the Alpha Launch Vehicle (LV), Firefly offers a family of other space transportation services. The Alpha and Beta launch vehicles are the foremost choice for small and medium launchers. The Space Utility Vehicle (SUV) offers in-space transportation, maintenance, and refueling options. The Blue Ghost lunar lander completes the end-to-end transportation service with its entry, descent, and landing capabilities.

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Alpha provides low-cost launch capability for small satellite customers at a price of $15M for dedicated commercial launch services. Alpha is designed to be the world's most reliable, responsive, and operationally capable launch option within the small launch vehicle class. Supported by Firefly's streamlined approach to mission planning, integration, and launch, Alpha is a well-rounded choice for commercial, civil, and national security missions.

Table 1. Alpha Launch Vehicle Specifications

Performance	Alpha	
Payload [SSO, 500km]	745 860 (avail. 06/2023)	kg
Payload [LEO, 200km]	1,170 1,375 (avail. 06/2023)	kg
Architecture		
Gross Lift-Off Weight (GLOW)	54,120	kg
Number of Stages	2	
Total Length	29.48	m
Max Diameter	2.2	m
Structure	All Composite	
Propulsion		
Oxidizer	LOX	
Fuel	RP-1	
Max Thrust [Stage 1]	801 / 180	kN / klbf
Max Thrust [Stage 2]	70 / 15.7	kN / klbf

Examples of Firefly efficiencies:

- Streamlined Coupled Loads Analysis (CLA) and Interface Control Document/Drawings (ICD) to decrease mission analysis completion times from months to weeks or days, depending on payload complexity
- 100% carbon composite airframe including state-of-the-art linerless, cryogenic propellant tanks
- Stage 1 Reaver engines and stage 2 Lightning engines with a patented tap-off cycle

2—ALPHA LAUNCH VEHICLE

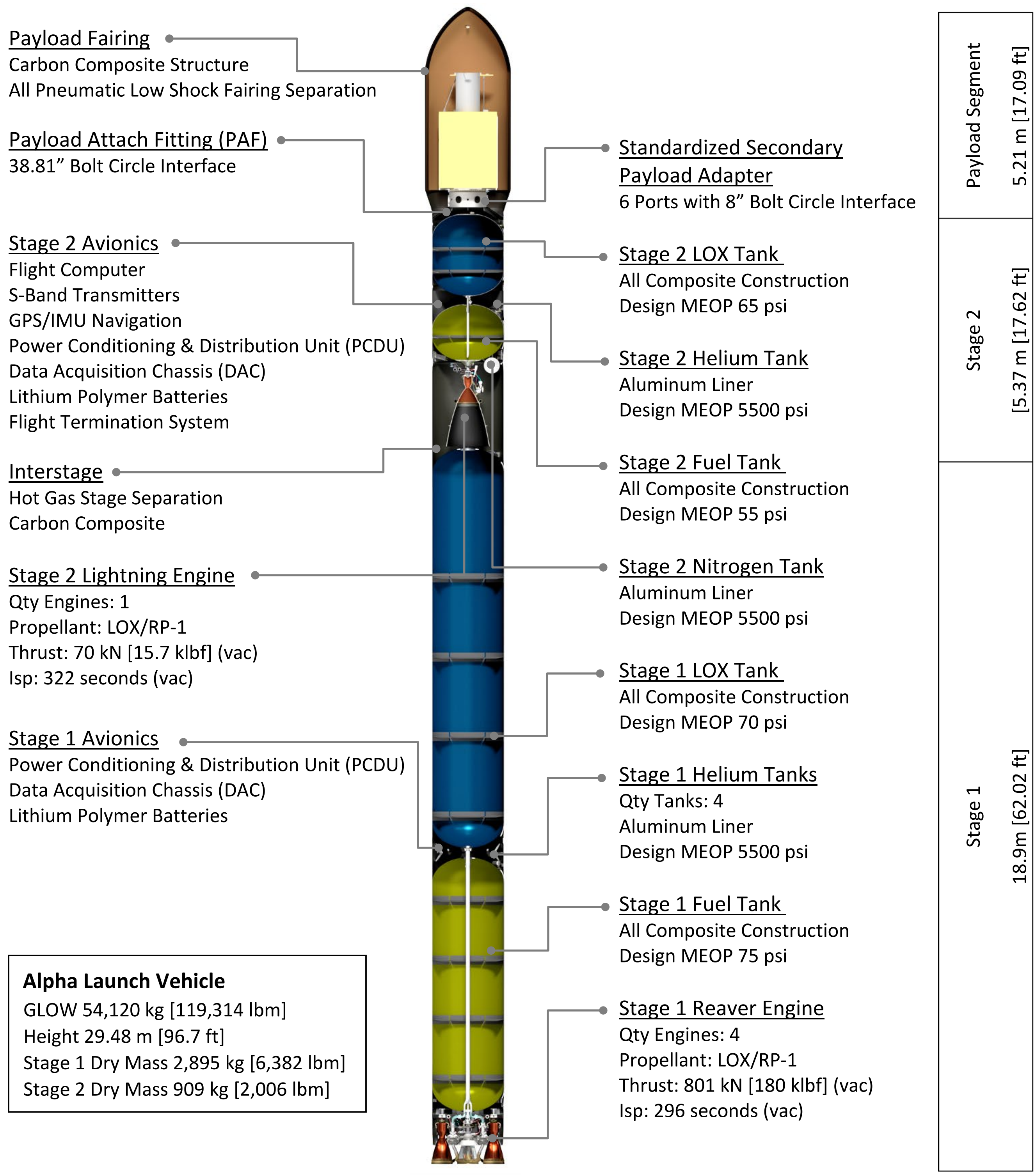


Figure 2. Alpha Launch Vehicle

Performance

The figures below show Alpha's performance capabilities from eastern and western ranges. These payload masses to orbit represent the total payload mass including the spacecraft, separation system, and adapter.

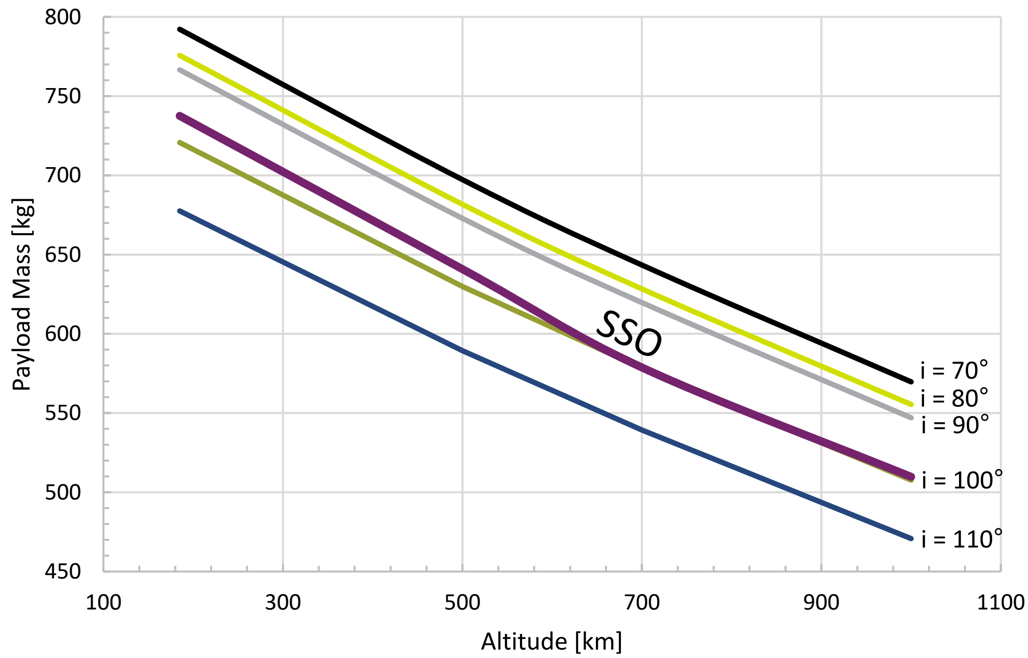


Figure 3. Alpha West Coast Performance Capability for Common Inclinations

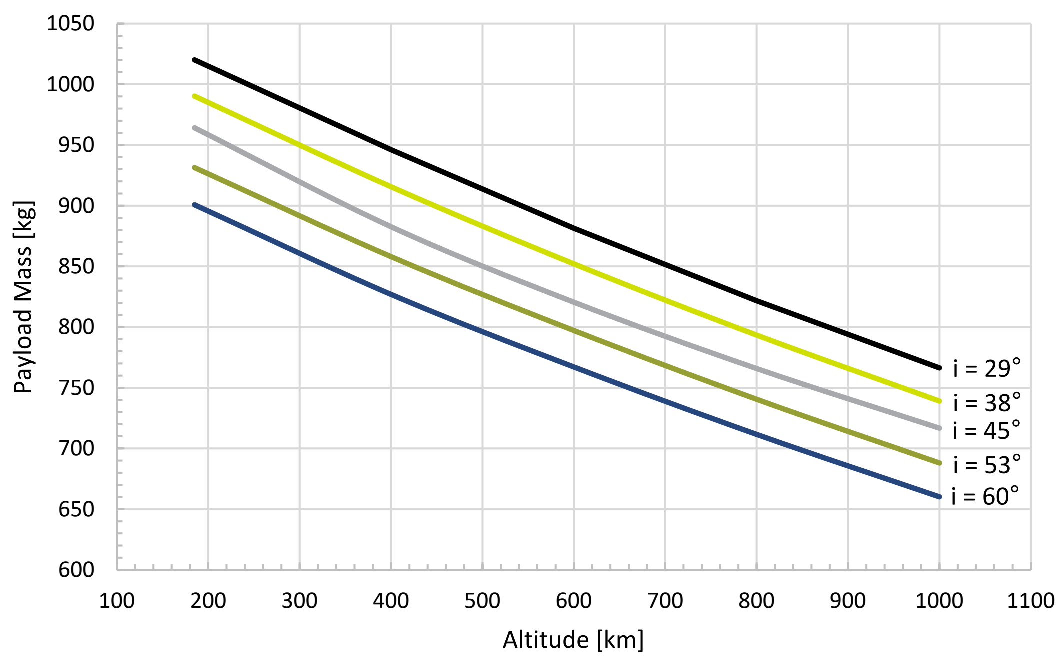


Figure 4. Alpha East Coast Performance Capability for Common Inclinations

Flight Profile

The axis definitions in Figure 5 are used throughout the remainder of this document to specify and reference payload environments, loads, flight, and test requirements.

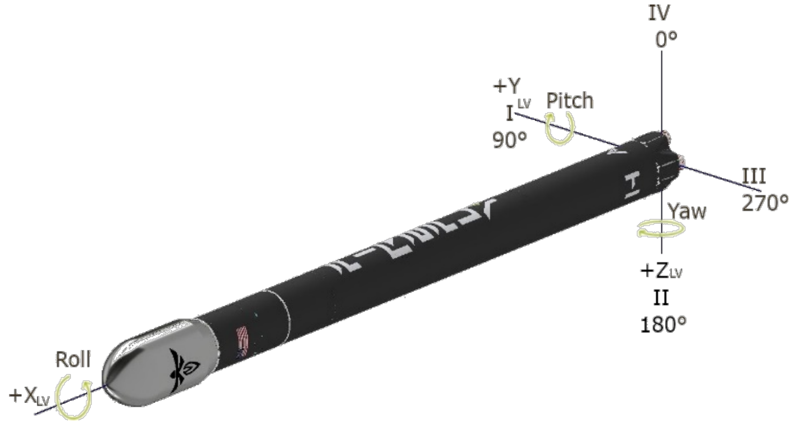


Figure 5. Alpha Vehicle Coordinate Frame

Figure 6 illustrates a representative flight profile of an Alpha launch vehicle 2-burn mission. Although all missions follow a similar profile, timing and altitude for key events may vary per mission.

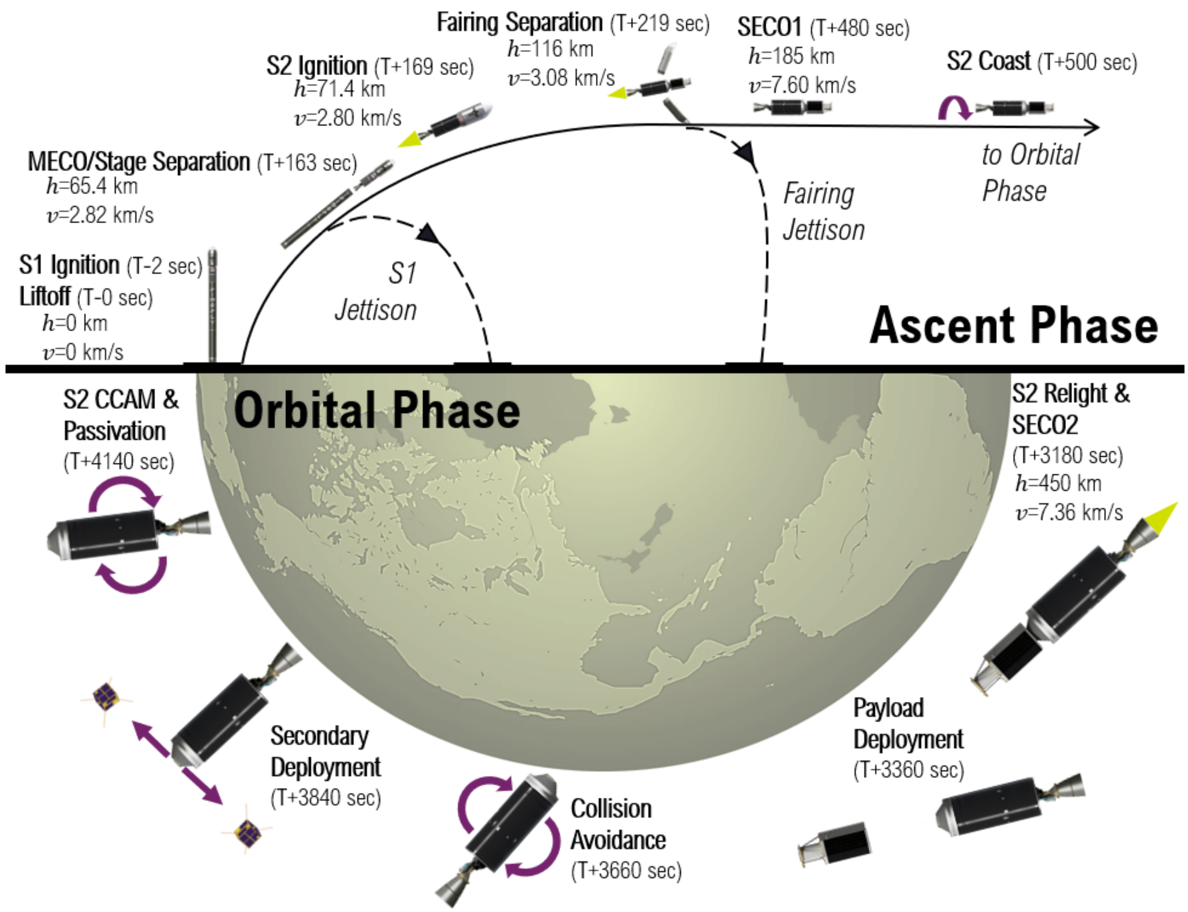


Figure 6. Alpha Direct Insert Flight Profile

Payload Injection & Separation

Precise pointing and orbital insertion are provided by a navigation control module consisting of an Inertial Measurement Unit (IMU) and Global Positioning System (GPS) receiver on the upper stage of the launch vehicle. The values in Table 2 represent three-sigma dispersions for a LEO mission with a second stage Probability of Command Shutdown of 99.7%.

For missions requiring orbits above 400 km, Alpha's second stage inserts into a low elliptical transfer orbit, coasts to apogee, and then initiates a second burn maneuver to circularize into the final desired orbit.

Table 2. Payload Injection and Separation

Payload Injection Accuracy
± 5 km perigee altitude
± 15 km apogee altitude
± 0.1 deg inclination
Payload Separation Parameters
> 1 ft/sec [0.348 m/sec] separation velocity
< 1.4 deg pointing accuracy on each axis
< 1 deg/sec stability in pitch, yaw, and roll

Figure 7. Alpha Payload Section

Payload Fairing

The Alpha payload fairing (PLF) is a carbon composite structure developed, manufactured, and qualified by Firefly. It measures 2.2 m (7.2 ft) in diameter, and 5 m (16.4 ft) in height. The fairing separation system employs a debris free, low-shock pneumatic separation system fully tested prior to each flight.

The payload fairing remains latched until launch ascent free molecular heating is below 1,136 W/m^2. Immediately thereafter, Alpha initiates a low shock separation event to deploy the two fairing halves from the payload attach fitting (PAF) and LV upper stage.

The dynamic payload envelope accounts for dynamic movement of the fairing and payload relative to one another, acoustic isolation panels, thermal expansion, and manufacturing tolerances. To avoid coupling with low frequency LV modes and violating this envelope, the SC should be designed to fundamental frequencies of greater than 8 Hz lateral and 25 Hz axial.

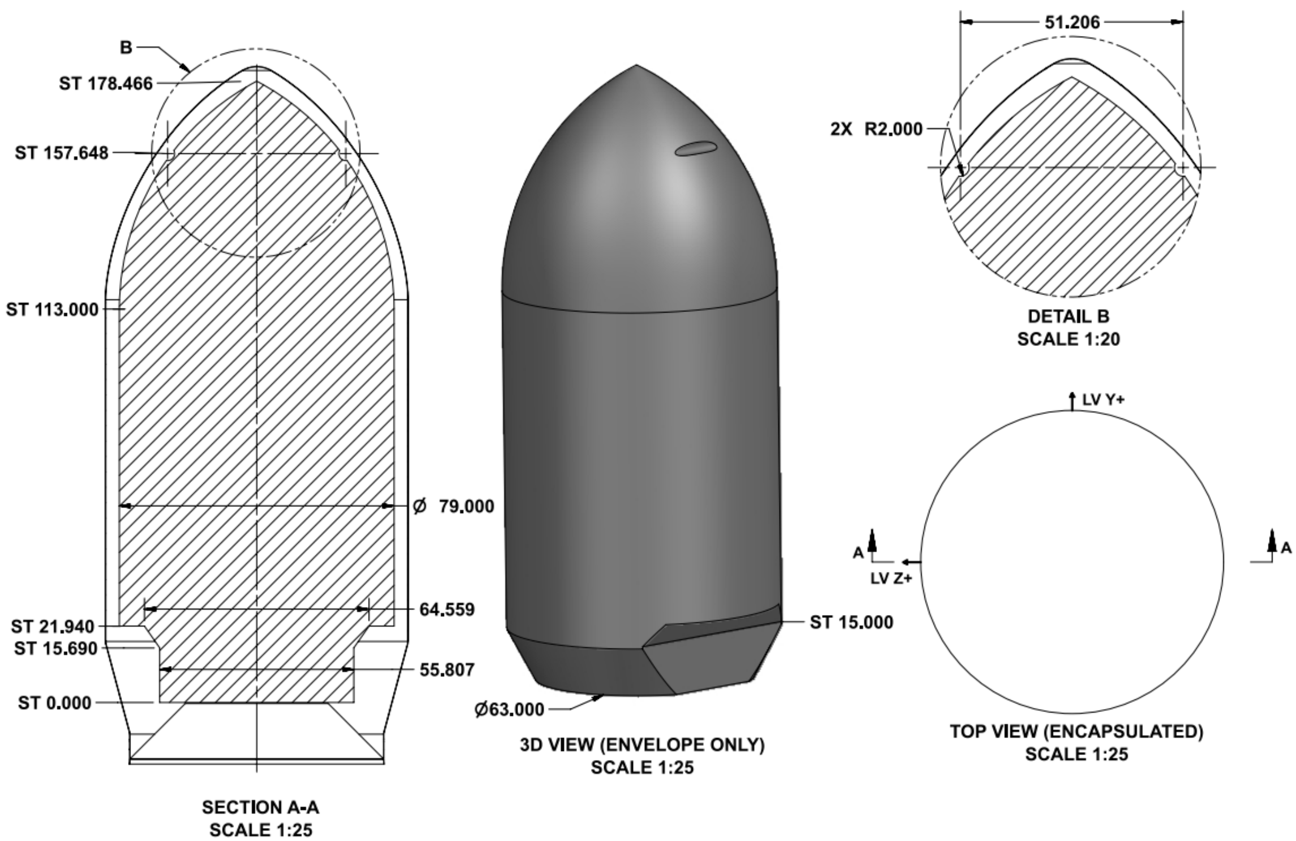


Figure 8. Alpha Payload Fairing Dynamic Envelope

Payload Accommodation and Interfaces

The Alpha vehicle features a standard 38.81” ESPA bolt pattern interface which is compatible with the industry standard 937mm adapter and other Firefly-specific dispenser structures. Firefly can accommodate all industry standard interfaces and separation systems currently flight proven, depending on customer needs. Accommodations outside the standard bolt pattern may be negotiated and should be discussed early in the mission planning process.

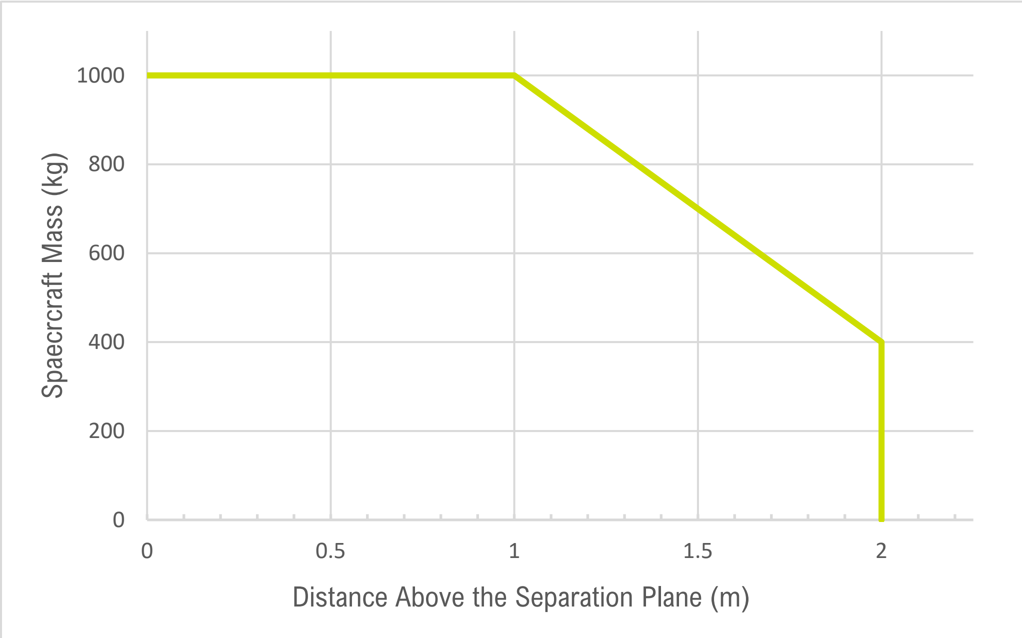


Figure 9. Allowable Payload CG Height

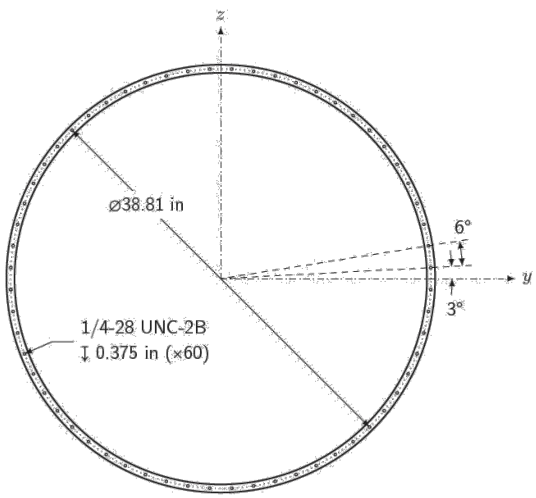


Figure 10. Payload Interface Dimensions in Launch Vehicle Coordinate Frame

Payload Configurations

Firefly offers several standardized payload configurations. Each configuration is compatible with industry standard separation systems. Firefly also has the ability to design customized adapters. The available primary payload volume for each configuration is shown in green in Figure 11 below.

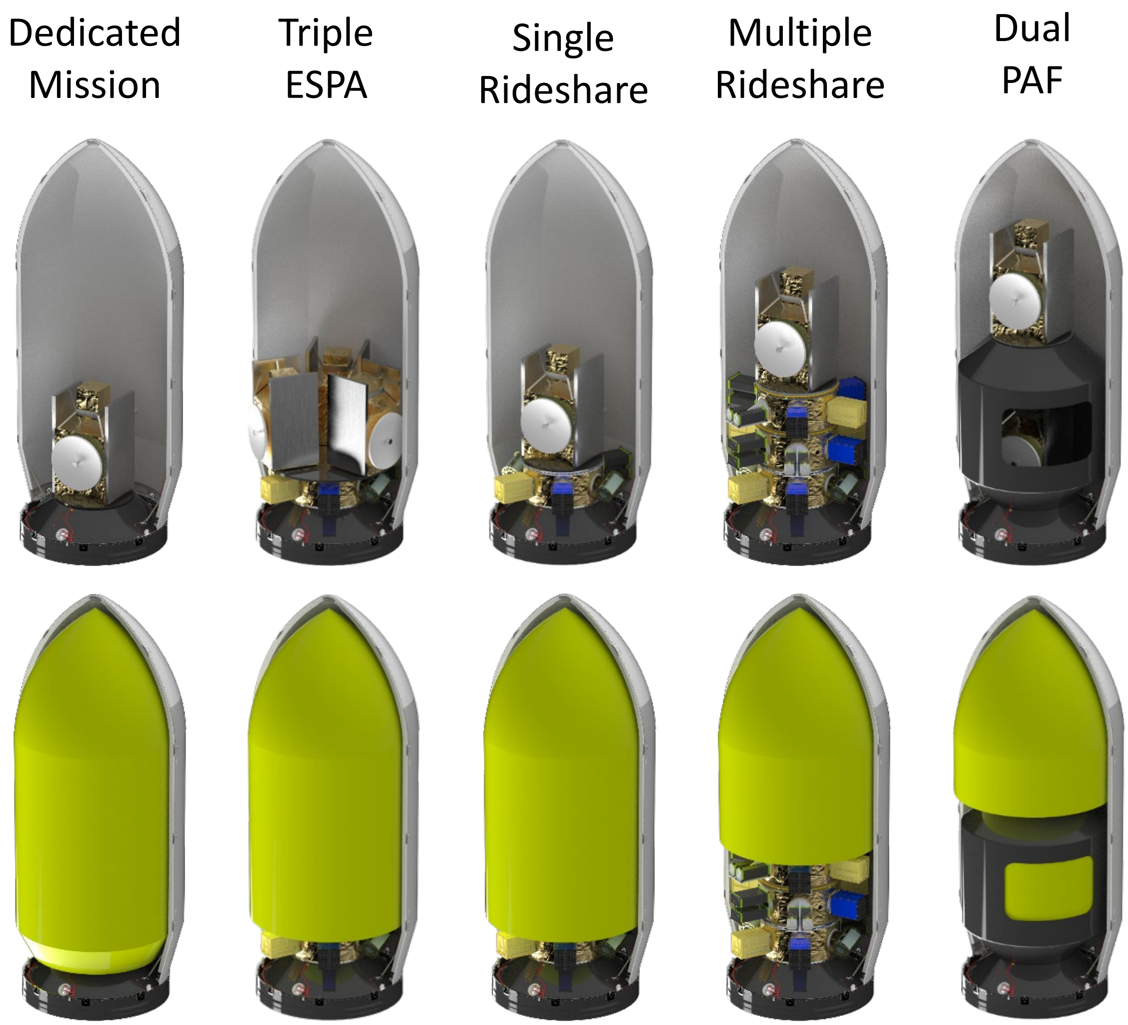
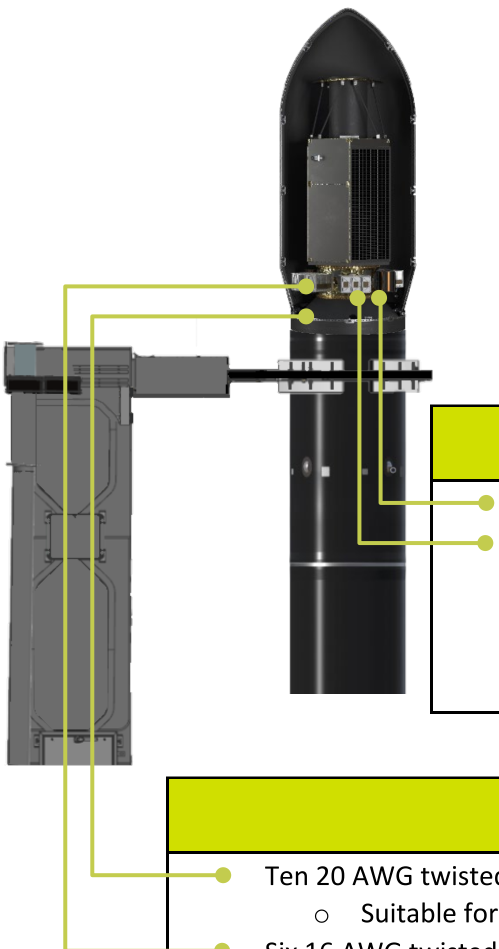


Figure 11. Common Payload Attach Fitting Configurations

Alpha Electrical Interfaces

The Alpha launch vehicle provides an electrical interface between the spacecraft and the customer ground support equipment. The Alpha LV is equipped with one or two connector(s) totaling 30 pins between the spacecraft and the vehicle; this includes both a flight interface and a ground interface. The flight interface with the spacecraft is for separation commands and monitoring. The ground interface is available up to T-0 via a quick-disconnect umbilical on the Alpha payload fairing.

Alpha's standard electrical interface for the primary payload is compatible with all industry standard separation systems and spacecraft customer needs. Additional electrical interface options are available based on customer mission unique needs.



Flight Interface

- Two separation loops for spacecraft (SC) to detect separation
- Eight redundant 28 VDC separation commands:
  - 5 amps each
  - Minimum pulse of 35ms up to 500ms
  - Up to 4 signals simultaneously within 10ms
  - Inhibits in accordance with AFSPCMAN 91-710

Ground Interface

- Ten 20 AWG twisted shielded pairs
  - Suitable for RS- 422 serial or ethernet communication
- Six 16 AWG twisted shielded pairs
  - Suitable for battery charging

Figure 12. Alpha Electrical Interface

3—FLIGHT ENVIRONMENTS

Alpha LV loads and environments are less than those historically produced by small to medium class launch vehicles, limiting the need for payloads to expend resources for additional isolation systems or other mitigation techniques. Key design elements to reduce environmental levels include eliminating the use of pyrotechnic devices near the payload, near full coverage (5 cm, 2” thick) acoustic panels in the fairing, pad-based water suppression, and advanced composite structures that mitigate transmission of LV produced loads and environments. Coupled Loads Analysis (CLA) and integrated thermal analysis models are used to ensure full compatibility with each SC design. All payloads shall be qualified to these minimum levels prior to launch.

Quasi-Static Acceleration Loads

Figure 13 illustrates the maximum predicted axial and lateral quasi-static loads induced to the payload during launch. Payloads desiring launch on Alpha should account for these worst-case loads. These loads originate from a complex mix of vehicle accelerations, pitch maneuvers, aerodynamic buffeting, and coupling of loads. The completion of the mission specific CLA analyses will confirm if potential loads can be reduced for a specific mission.

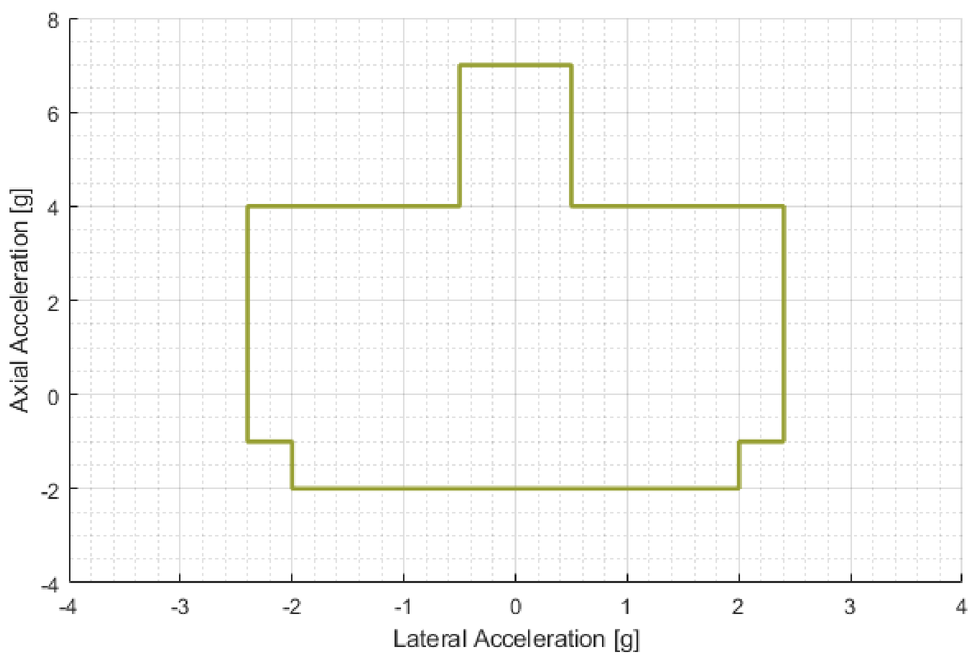


Figure 13. Alpha Maximum Quasi-Static Load Factors

Acoustics

Alpha LV acoustic protection is intended to provide an Overall Sound Pressure Level (OASPL) below 139 dB. Currently predicted sound pressure levels within the PLF are well below this value due to the use of water deluge. The fairing will be equipped with acoustic foam to further reduce predicted values.

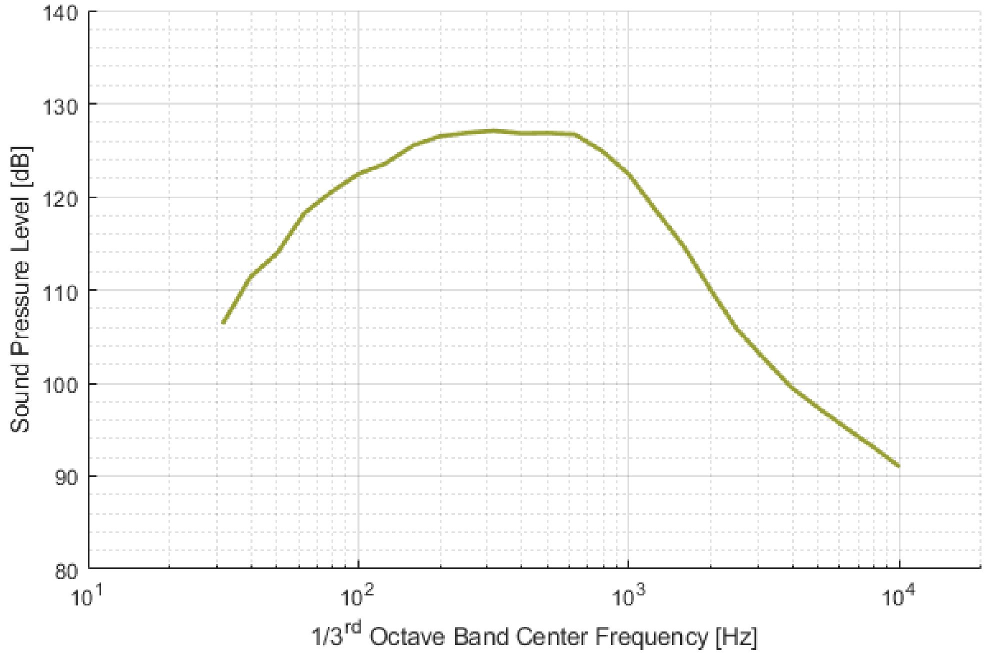


Figure 14. Alpha Maximum Predicted Acoustic Environment

Table 3. Alpha Sound Pressure Levels

Center Frequency [Hz]	Sound Pressure Level [dB]	Center Frequency [Hz]	Sound Pressure Level [dB]
31.5	106.3	630	126.7
40	111.4	800	124.8
50	113.9	1000	122.4
63	118.2	1250	118.6
80	120.6	1600	114.6
100	122.4	2000	110.0
125	123.5	2500	105.8
160	125.5	3150	102.6
200	126.5	4000	99.4
250	126.8	5000	97.3
315	127.1	6300	95.2
400	126.8	8000	93.1
500	126.8	10000	91.0
OASLP [dB]		136.5	

Shock

The maximum shock environment at the payload interface occurs during payload deployment. Shock levels at the payload separation interface due to hold-down release, stage separation, engine ignition and cutoff, and payload fairing separation are all maintained below a maximum acceleration of 750 g's at 1400 Hz. Shock environments heavily depend on the mission-specific payload separation system. The shock environment below is for the usual shock at the payload separation plane.

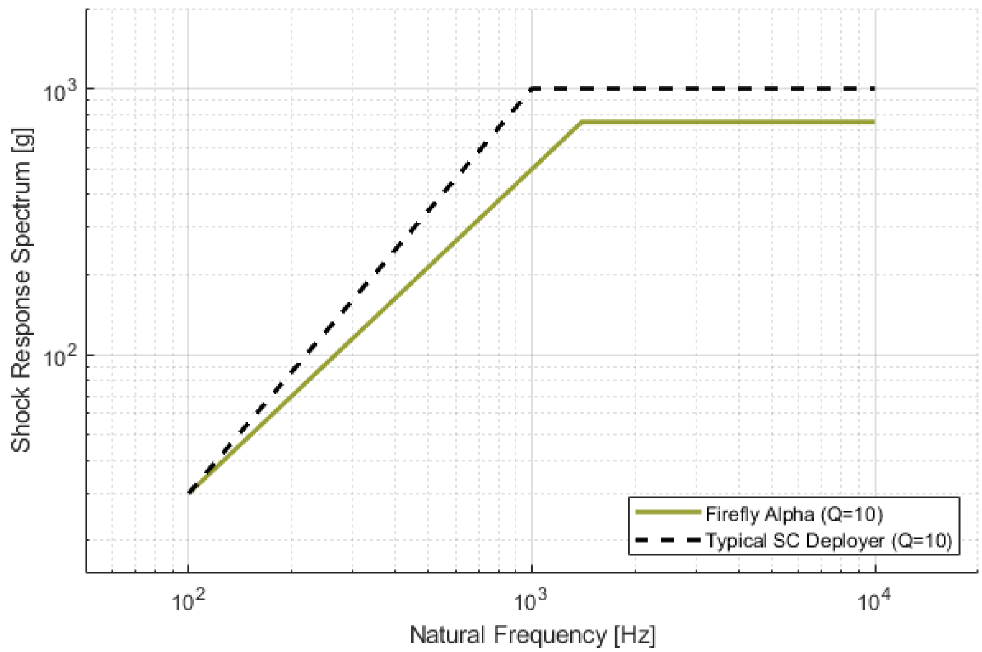


Figure 15. Alpha Maximum Predicted Shock Response Spectrum

Table 4. Alpha Frequency and Acceleration Levels

Natural Frequency [Hz]	Maximum Acceleration [g]
100	30
100 - 1,000	See Figure
1,400 - 10,000	750

Random Vibration

Payloads are subjected to a combination of engine vibrations, vehicle structural modes, acoustics, and aerodynamic forces. The intensity of these vibrations is highly dependent on the payload mass, stiffness, and the interface between the payload and the launch vehicle. The predicted maximum random vibration Power Spectral Density (PSD) is for a payload mass of 90 kg or greater.

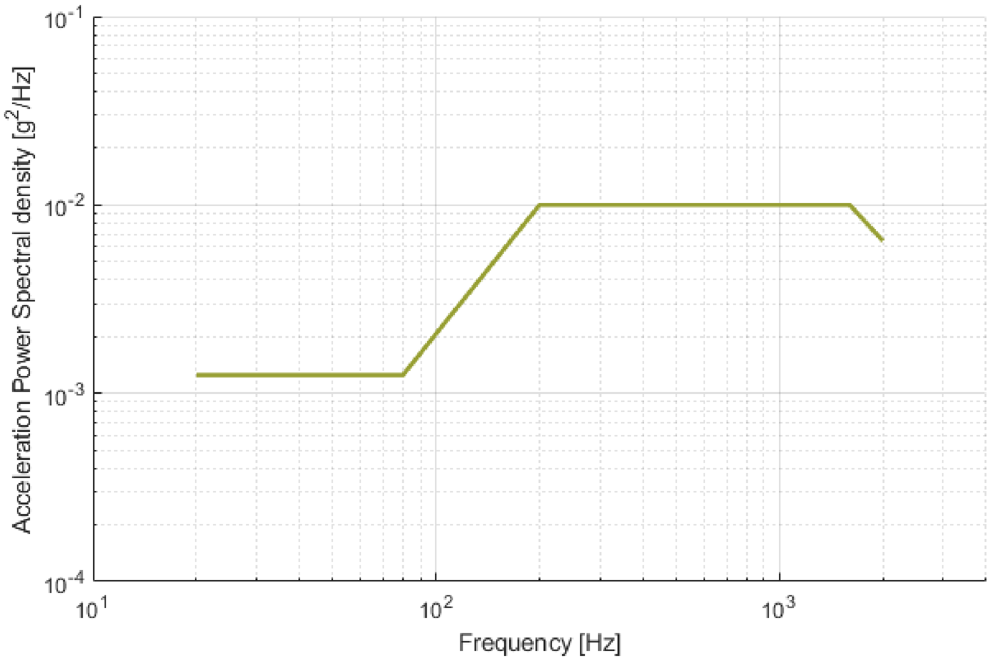


Figure 16. Alpha Random Vibration Environment Plot

Table 5. Alpha Random Vibration Frequency and PSD Levels

Frequency [Hz]	Alpha PSD Level [g^2/Hz]
20 - 80	0.00125
80 – 200 Hz	See Figure
200 – 1600 Hz	0.01
1600 – 2,000 Hz	See Figure
2,000 Hz	0.00644
g_{RMS} [g]	4.32

Equivalent Sine Vibration

Maximum Alpha sinusoidal vibration environments envelope all stages of flight. These represent the maximum predicted sine vibe environments for the payload, but a CLA analysis will be needed to prove further compliance.

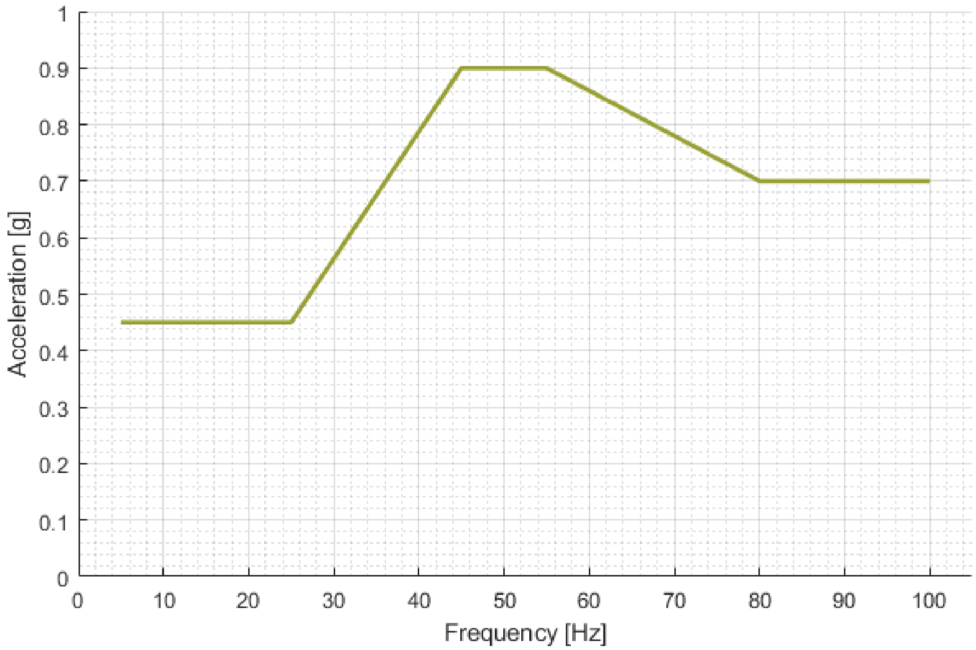


Figure 17. Alpha Axial Sine Vibration Environment

Table 6. Axial Sine Frequency and Acceleration Levels

Frequency [Hz]	Acceleration [g]
5	0.45
25	0.45
45	0.9
55	0.9
80	0.7
100	0.7

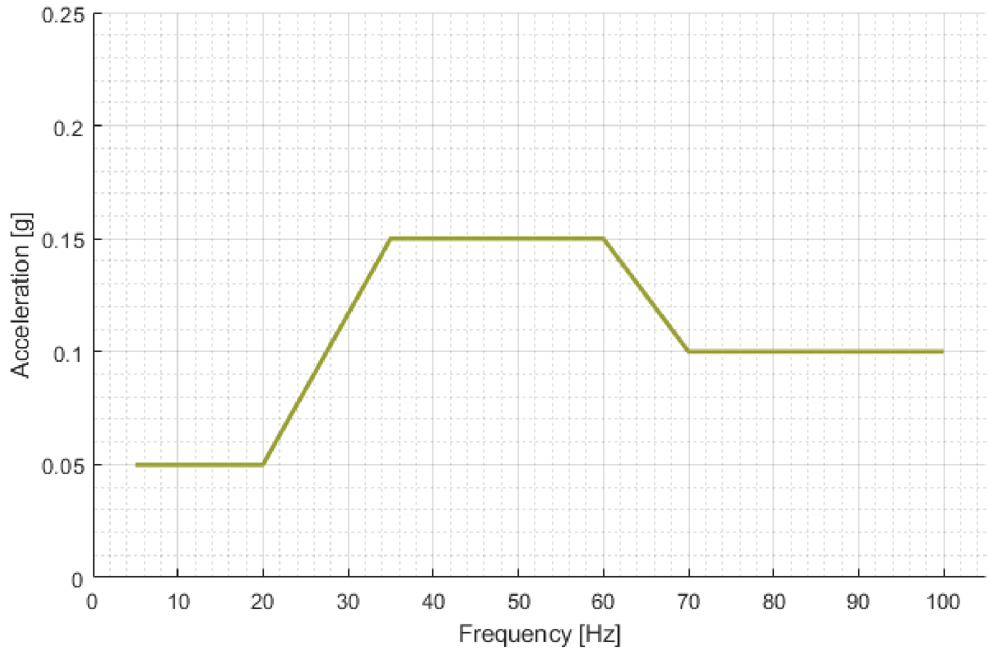


Figure 18. Alpha Lateral Sine Vibration Environment

Table 7. Lateral Sine Frequency and Acceleration Levels

Frequency [Hz]	Acceleration [g]
5	0.05
20	0.05
35	0.15
60	0.15
70	0.1
100	0.1

Pressure and Venting

During ascent, the fairing will relieve internal pressure through one-way vents located at the aft end of the payload fairing. The pressure decay rate will not exceed -0.3 psi/second, except for a brief period during transonic flight, when the decay rate is not expected to exceed -0.9 psi/second (not depicted in the plot).

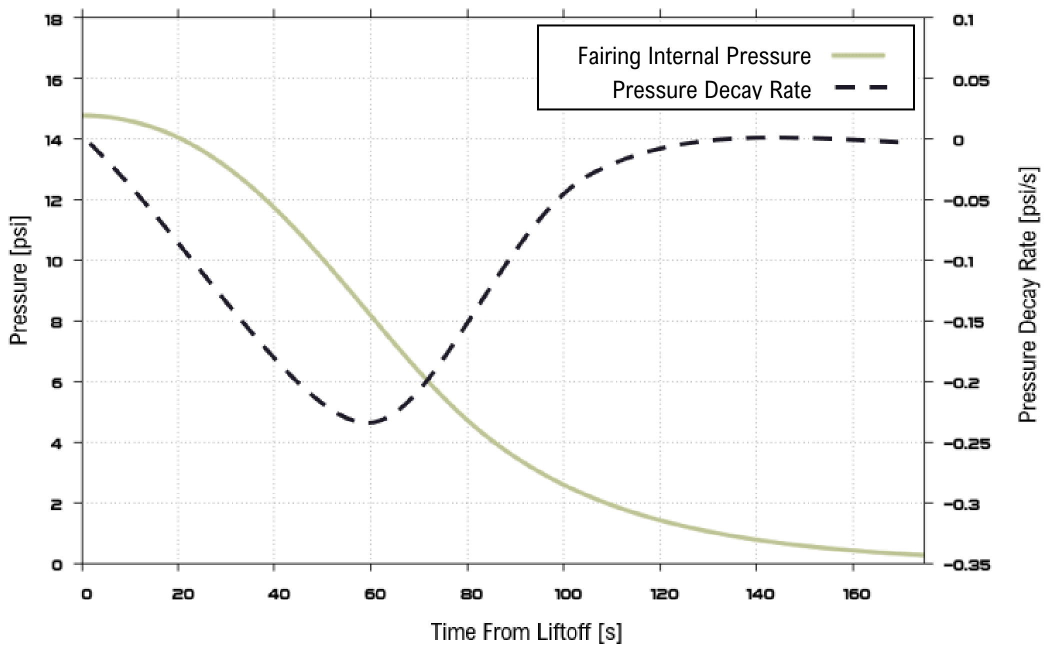


Figure 19. Alpha Payload Fairing Venting Environment

Thermal and Cleanliness

The Alpha launch vehicle provides the payload with standard thermal, humidity, and High Efficiency Particulate Air (HEPA) clean controlled environments from encapsulation through liftoff. Firefly can accommodate contamination-sensitive payloads from integration in the Payload Processing Facility (PPF), roll-out to the launch pad, and through launch. For payloads with more extensive requirements, Firefly can provide additional cleaning, filtration, contamination mitigation protocol, and verification services.

Table 8. Thermal and Cleanliness Environments

Cleaning and Materials	**Payload Processing**	**Rollout and Pad Ops**	**Flight**
All major surfaces including the PLF, Acoustic Blankets, and PAF are Visibly Cleaned to IEST-STD-CC1246D	✓		
Major materials within line of sight of the payload comply to 1% TML 0.1% CVCM	✓	✓	✓
Mission specific cleaning down to 500A available	✓		
Air Cleanliness			
ISO 8 (Class 100K) HEPA air in PPF and PLF	✓	✓	
GN2 purge available as an upgrade	✓	✓	
Prevention of high velocity air impingement directly onto the payload	✓	✓	
Air ventilates out through ports on the PLF	✓	✓	✓
Mission specific ISO 7 (Class 10k) available	✓	✓	
Temperature			
Temperature controlled air 10-21 deg C [50-70 deg F]	✓	✓	
Maximum FMH < 1,136 W/m^2 [0.1 BTU/ ft^2 /s]			✓
Relative air humidity controlled from 20-60%	✓	✓	
PLF internal surface temperature < 93 deg C [200 deg F]	✓	✓	✓

Radio Frequency and EMI/EMC

Alpha can accommodate payloads which are powered on during launch, but for standard operations it is recommended payloads be powered off during launch to reduce the potential for interference or damage caused by Radio Frequency (RF) or Electro Magnetic Interference (EMI). The Alpha vehicle is capable of interleaved telemetry for payload monitoring during flight. Customers must ensure payload components or material constituents sensitive to RF transmissions are compatible with the radio frequency and EMI/EMC environment provided in the table below.

Table 9. Alpha Radio Frequency and EMI/EMC Environments

Function	Frequency
S-Band Transmitter	2.2 – 2.29 GHz
Avionics Power Switching	100 kHz - 400 kHz, 440 kHz, 660 kHz, 960 kHz
GPS L-Band Receiver	L1: 1575.42 MHz
	L2: 1227.60 MHz
	L5: 1176.45 MHz
UHF Receiver	421 MHz

4—OPERATIONS

Standard and Non-Standard Services

As part of the launch package, Firefly offers the standard services listed below. Firefly also offers mission unique services upon request. These non-standard services may have impacts to schedule and cost. Requests for mission unique services should be discussed early in the mission planning process.

Standard Services

- Dedicated Firefly Mission Manager
- Development of a mission-specific Interface Control Document (ICD)
- Launch vehicle licensing, including FAA and Range Safety Documentation
- Preliminary and final modeling and analysis of the integrated mission, including performance analysis, CLA, and thermal modeling
- Fit Check verification of the Payload to the PAF
- Certified ISO 8 (Class 100K) cleanroom for payload to PAF integration areas, encapsulation, and through launch
- Mission dress rehearsal for key launch personnel
- Payload access prior to payload fairing closure
- Post-flight launch services, including payload separation confirmation, delivery of the Post-Flight Data Package, Payload Environment Report, and final deployment Orbital Parameter Message (OPM)

Mission Unique Services

- Separation system provided by Firefly
- Customized or multi-payload dispenser
- Payload qualification support for regulatory compliance
- Certified ISO 7 (Class 10K) cleanroom for payload to PAF integration areas and encapsulation
- Contamination control analysis
- Payload hazardous fueling and pressurization accommodations
- Payload access after payload fairing closure
- Dedicated payload GN2 purge and fairing thermal environment control, up to T-0
- RF Transmission after payload encapsulation, and before payload separation
- Re-Radiation System
- Payload-facing mounted cameras

Additional services may be available upon request.

Payload Processing Flow

Payload Arrival

The payload arrives at the Payload Processing Facility (PPF) and is lifted from the transportation carrier by lift truck or overhead crane located within the airlock. The payload is removed from its shipping container and readied for checkouts. Once checkouts and fueling are complete, combined SC and LV operations begin with mating of the SC to the PAF. Once the payload is fully assembled onto the PAF and any additional services performed, it is then ready for encapsulation.

Payload Encapsulation

Payloads are encapsulated within the payload fairing in a vertical orientation. Once encapsulated, a continuous supply of HEPA filtered and temperature-controlled air is supplied to the PLF. Direct airflow impingement upon sensitive components is minimized. Then the encapsulated payload is broken over to a horizontal position and mated to the LV. The encapsulated payload remains in the horizontal position until the integrated launch vehicle is rolled to the launch pad and erected to vertical position prior to launch.

Payload Fueling

As a non-standard option; hazardous, green, other propellants, and pressurization accommodations may be provided by Firefly. Depending on the propellant, these accommodations may take place at third-party facilities prior to transportation to the launch complex. Propellant loading details will be coordinated as part of tailored mission support to the payload.

Launch Campaign Timeline

Each Firefly mission follows a standard mission timeline. Flexibility is offered for customers needing an expedited schedule and should be discussed early in the mission planning process. All dates provided in the table below are intended as guidelines, and not firm constraints.

Table 10. Notional Launch Campaign Timeline

Schedule	Event
L-18 m	Initial Customer Contact and Completion of the Payload Questionnaire
L-14 m	Signing of Launch Agreement and Down Payment
L-12 m	Kickoff Working Group and Delivery of Payload Data Package
L-9 m	Firefly Delivery of Preliminary Mission Analysis
L-8 m	Mission Integration & Ground Operations Working Group
L-6 m	Fit Check (Flight or Mass Simulator)
L-3 m	Firefly Delivers Final Mission Analysis
L-6 w	Commencement of Launch Campaign
L-4 w	Customer Delivery of Payload
L-2d	Launch Readiness Review
L-0	Launch
L+1 h	Final Confirmation of Payload Separation and State Vector
L+1 w	Mission Data Review

Customer Deliverables

Table 11. Customer Deliverables

Deliverable	Description
Completed Payload Questionnaire	An important first step for mission planning is the completion of Firefly's Payload Questionnaire. This is provided by the Mission Manager and gives necessary insight into the mission requirements.
Payload Safety Data Package	Safety documentation and data to support Range Safety operations and launch planning are requested early in the mission planning process. It is the customer's responsibility to supply all design, qualification, and acceptance test information for all hazardous elements of the payload. Customers are expected to complete inputs to the Missile System Prelaunch Safety Package (MSPSP) using the template provided by Firefly. The Firefly Mission Manager integrates this information into both the Federal Aviation Administration (FAA) licensing application and the Range Safety Review Package.
Engineering Data Package	The Engineering Data Package includes, but is not limited to: • CAD (inclusive of separation systems and appendages) • Thermal and Structural Models • Archimedes Volume • Emitter Characteristics • Mass Properties Report • Payload Analysis and Test Report Any requests to operate outside of standard environmental parameters specified herein must be included.
Payload Processing Plan	A detailed Payload Processing Plan including any requests for non-standard services pertaining to payload processing and launch operations.
Mass Model	A mass model of the payload is to be provided by the customer for fit checks. Mass models should show interfaces representative to flying on Alpha.

Mission Management

Each customer is assigned a Firefly Mission Manager (FMM), who will remain the direct point-of-contact throughout the mission planning and launch process. Customers can expect transparency and open communication from their FMM. The FMM works closely with their customer counterpart mission manager, ensuring all facets of the mission planning and integration process are completed in a timely manner. The FMM holds weekly mission integration meetings to keep an open discussion with the customer. In addition to ensuring a seamless integration process to the launch vehicle, the FMM is also the key interface to both the Firefly Launch Campaign Manager and the Range Safety Officer. The Launch Campaign Manager interface exists to accommodate the SC and customer needs at launch site facilities. The Range Safety Officer ensures compliance to all ground and flight safety requirements.

Safety Requirements

Safety is paramount in the mission planning and launch process. The customer's Mission Manager, along with the Mission Assurance team, will ensure payloads meet all safety requirements throughout the design and launch planning process. Firefly will serve as a direct liaison between all customers and range safety officials.

It is mandatory for customers to be in compliance with applicable AFSPCMAN 91-710 requirements, as well as FAA 14 CFR, Part 400 for payload development, including the design of both flight and ground systems. Customers are responsible for providing inputs to the Firefly MSPSP during early stages of mission planning as part of Firefly's Safety Data Package.

Customers are responsible for obtaining their own remote sensing, radio frequency approvals, and ensuring their payload meets all launching states involved in their mission's insurance requirements.

Hazardous Systems and Operations

Payloads qualifying as a hazardous system or requiring hazardous operations outside of Firefly's Standard Service Package will require both Firefly and range safety approval prior to performing the operation or conducting launch. The customer's payload classification will be determined early in the mission planning stages, to ensure proper permissions are granted.

Waivers

In the event systems or operations do not meet safety requirements but are believed to be acceptable for ground and launch operations, Range Safety officials may grant a waiver. It is the policy of both Firefly and Range Safety that waivers are used as a recourse and are not considered standard practice.

6—FACILITIES

Corporate Headquarters

Firefly's Corporate Office is headquartered in Cedar Park, Texas. It is an open engineering environment to encourage collaboration. Headquarters also houses the main Mission Control Center (MCC) where major stage tests, operations, and launch can be monitored and supported.

Figure 20. Firefly's Texas Headquarters, Production, and Test Facilities

Production and Test Facilities

LV production, integration, and testing are conducted in Briggs, Texas, at a 200-acre facility 30 minutes north of Firefly Headquarters. The test site is fully staffed and incorporates multiple facilities including a 10,000 ft^2 test control and fabrication building, a 2,500 ft^2 surface finish shop, and a 30,000 ft^2 production shop. The site includes several operational test stands for engine testing, component testing, and integrated stage testing.

Launch Complexes

Firefly launch sites provide customers with a wide range of orbit options to fit mission objectives. Each facility supports both dedicated and multiple manifest missions. Other orbit inclinations than those shown may be possible; inquire with Firefly for additional details.

SLC-2, Vandenberg Space Force Base

Firefly conducts Polar and SSO launches to high inclinations from SLC-2 at Vandenberg Space Force Base (VSFB), California. VSFB can support launch azimuths from 140 degrees to 260 degrees.

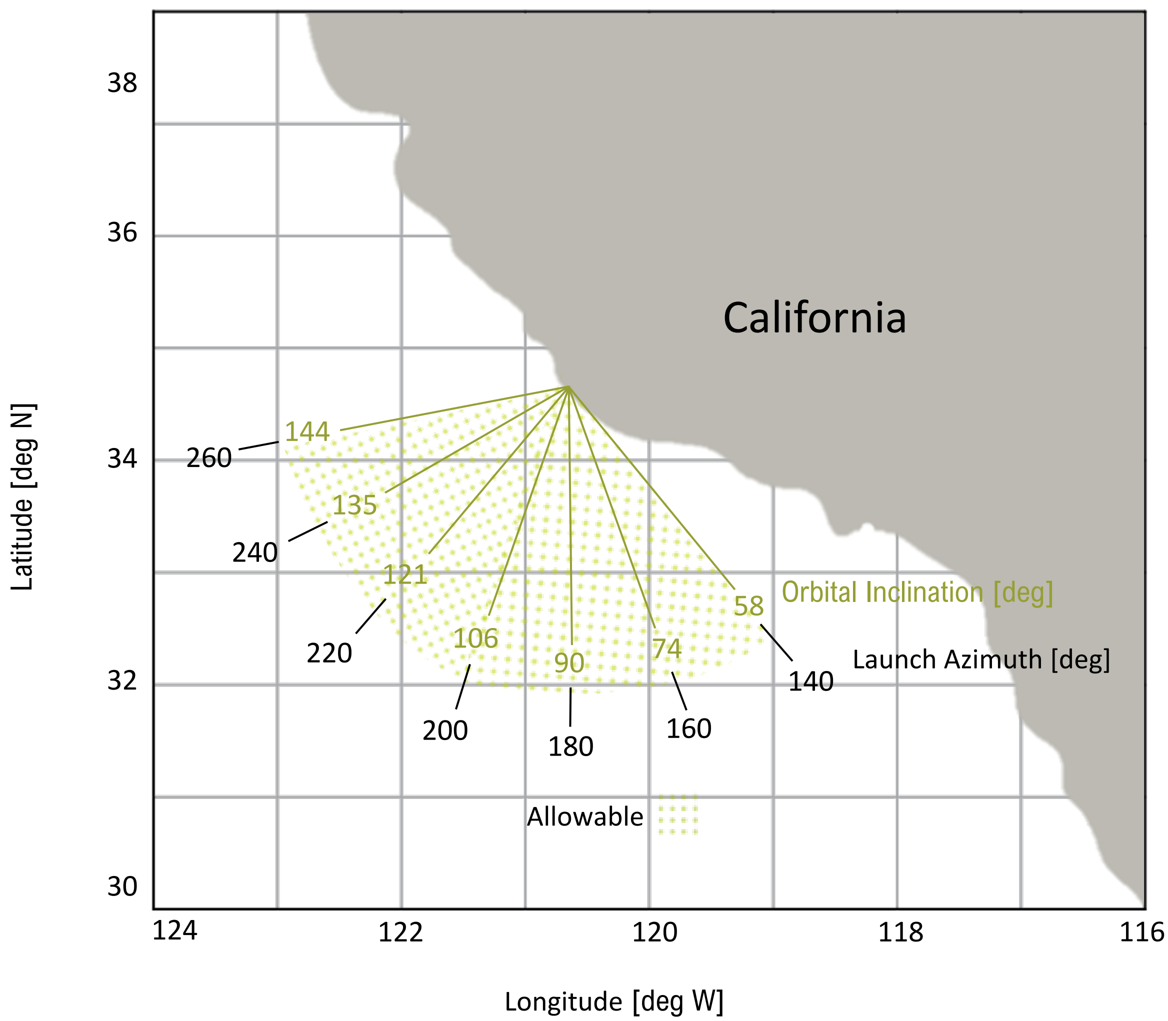


Figure 21. VSFB Launch Inclinations and Azimuths

SLC-20, Cape Canaveral Space Force Station

SLC-20 is an established launch complex located at Cape Canaveral Space Force Station (CCSFS) Florida. CCSFS can support launch azimuths from 35 degrees to 120 degrees.

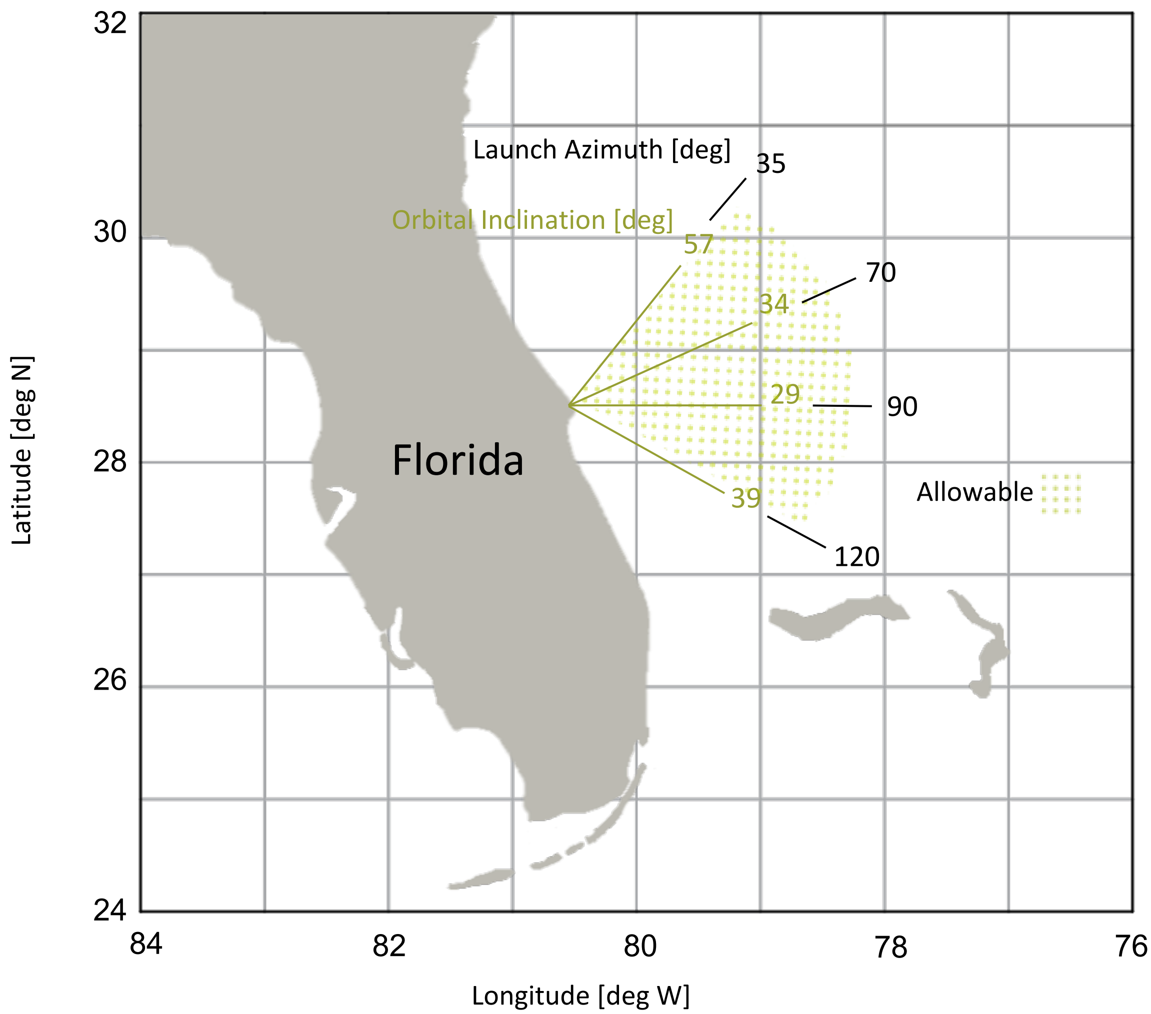


Figure 22. CCSFS Launch Inclinations and Azimuths

LP-0A, Wallops Flight Facility

Launch Pad 0A (LP-0A) is an established launch pad located at Wallops Flight Facility in Virginia. Wallops can support launch azimuths from 90 degrees to 160 degrees.

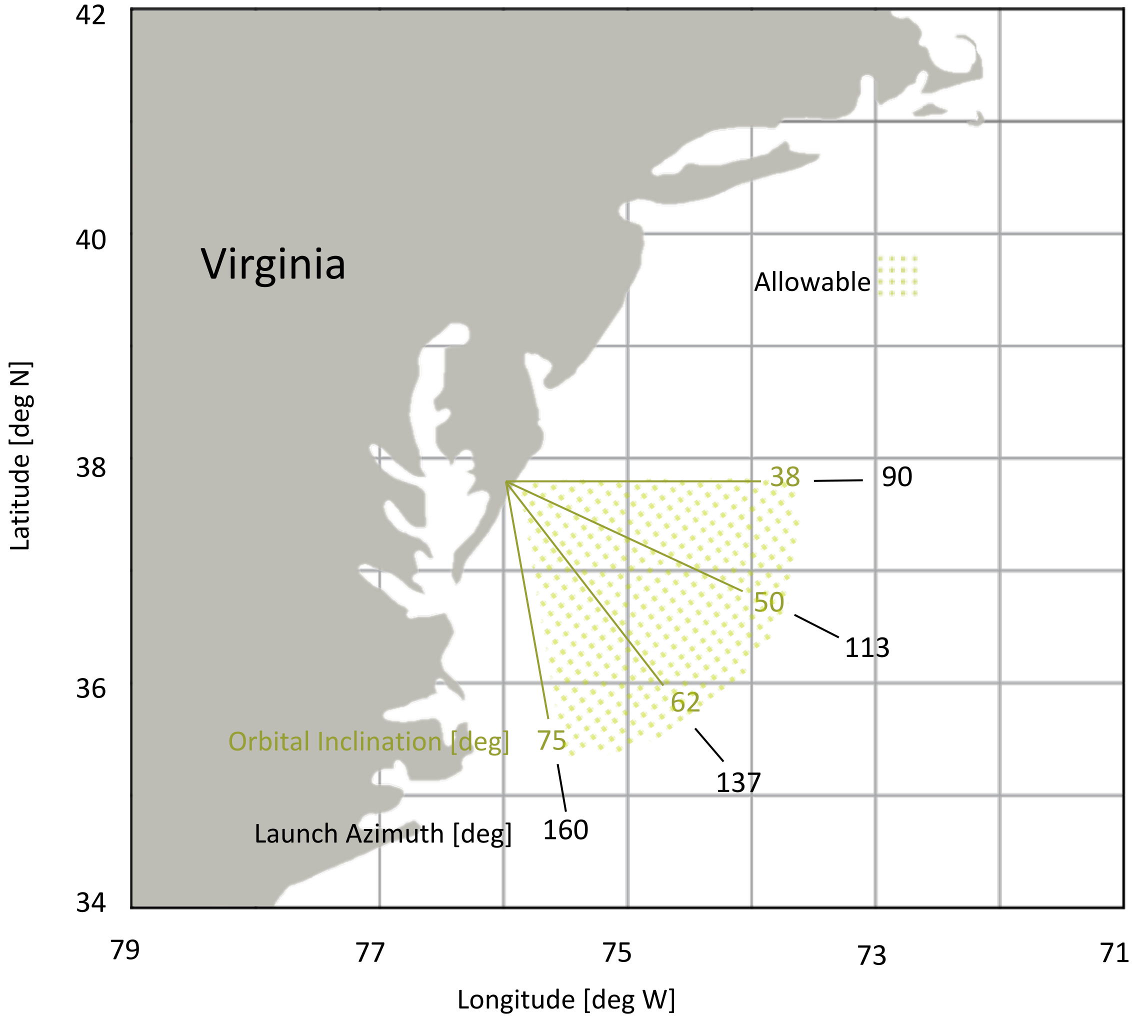


Figure 23. Wallops Flight Facility Launch Inclinations and Azimuths

Horizontal Integration Facility

An on-site Horizontal Integration Facility (HIF) is utilized for processing and integration of Firefly launch vehicle stages. The HIF is also where the integrated PLF will be mated to the LV. The facility is climate controlled and provides power and the high-pressure gases used for processing Alpha LVs. The HIF is a 5,000 ft^2 open high bay with an eave height of 25 feet. This allows for removal and unloading of components from flatbed transportation trailers with deck heights up to 58”. Two bridge cranes in the high bay support processing and operations. Multiple engineering workstations, administrative space, and communications equipment rooms are available for customers.

Figure 24. VSFB Horizontal Integration Facility

Payload Processing Facility

The PPF provides environment controlled space and equipment for payload processing and encapsulation with a high bay, an airlock, a garment room, and office space. The PPF high bay is a climate-controlled ISO 8 (Class 100K) cleanroom. Ancillary rooms will be visibly clean, air conditioned, humidity-controlled workspaces. Available power consists of 120/240 V single phase 60 Hz, 208 V three phase 60 Hz, and 240/480 V three phase 60 Hz for processing. Shop air is also available. Additional power and gasses can be made available on a mission unique basis.

Infrastructure

Firefly offers standard infrastructure for customers. In addition to office workspace, Firefly offers high-speed broadband internet access in the payload processing facilities. Electrical ground support equipment (EGSE) power sources are available at the PPF and the launch equipment building.

Customer access to the launch vehicle is restricted to payload/launch vehicle processing operations and activities. Customers may view the launch vehicle during precoordinated times. Escorted viewing of and access to the launch pad is granted to customers on a non-interference basis with launch vehicle operations. Due to U.S. Government International Traffic in Arms Regulations (ITAR), and Export Administration Regulations (EAR), non-US customers and personnel may view the vehicle while in its processing and assembly facility only if proper U.S. Government approvals are in place.

Customers will be invited to view the launch from an official observation point, a safe distance from the launch site.

7—REFERENCES

Acronyms

AFSPCM	Air Force Space Command Manual
AFTS	Autonomous Flight Termination System
AFTU	Autonomous Flight Termination Unit
AVI	Avionics
AWG	American Wire Gauge
C&DH	Command and Data Handling
CAD	Computer Aided Design
CCSFS	Cape Canaveral Space Force Station
CFM	Cubic Feet per Minute
CLA	Coupled Loads Analysis
COTS	Commercial-Off-The-Shelf
CG	Center of Gravity
CVCM	Collected Volatile Condensable Materials
EAR	Export Administration Regulations
EEE	Electrical, Electronic and Electromechanical
EGSE	Electrical Ground Support Equipment
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EPS	Electrical Power System
EELV	Evolved Expendable Launch Vehicle
ESPA	(EELV) Secondary Payload Adapter
FAA	Federal Aviation Administration
FEA	Finite Element Analysis
FED-STD	Federal Standard
FMM	Firefly Mission Manager
FRR	Flight Readiness Review
FPS	Frames Per Second
GLOW	Gross Lift-Off Weight
GN2	Gaseous Nitrogen
GN&C	Guidance, Navigation and Control
GPS	Global Positioning System
GRMS	Gravity Root Mean Square Acceleration
GSE	Ground Support Equipment
GUI	Graphical User Interface
HEPA	High Efficiency Particulate Air
HIF	Horizontal Integration Facility
ICD	Interface Control Document
ISO	International Organization for Standardization
I_{sp}	Specific Impulse
ITAR	International Traffic in Arms Regulations
LEO	Low-Earth Orbit
LRR	Launch Readiness Review
LOCC	Launch Operations Command Control
LOX	Liquid Oxygen
LV	Launch Vehicle
MCC	Mission Control Center
MECO	Main Engine Cut-Off
MEOP	Maximum Expected Operating Pressure
MIL-STD	Military Standard
MLB	Motorized Lightband
MRR	Mission Readiness Review
MSPSP	Missile System Prelaunch Safety Package
OASPL	Overall Sound Pressure Level
PAF	Payload Attach Fitting
PCS	Probability of Command Shutdown
PLF	Payload Fairing
PPF	Payload Processing Facility
PS	Payload Segment
PSD	Power Spectral Density
QPSK	Quadrature Phase Shift Keying
RCC	Range Commander Council
RF	Radio Frequency
RP-1	Kerosene Propellant
SC	Spacecraft
SECO	Second Engine Cut-Off
SLC-2	Space Launch Complex 2
SLC-20	Space Launch Complex 20
SMC	Space and Missile Systems Center
SRS	Shock Response System
SSO	Sun-Synchronous Orbit
TBC	To Be Confirmed
TBD	To Be Determined
TML	Total Mass Loss
TRL	Technology Readiness Level
VSFB	Vandenberg Space Force Base

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