Payload Users Guide
Falcon Launch Vehicle

Rev. 2 October 2004

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1. Introduction

The Company

Space Exploration Technologies (SpaceX) is developing a family of launch vehicles intended to reduce the cost and increase the reliability of access to space ultimately by a factor of ten. The company officially began operations in June 2002 and is located in the heart of the aerospace industry in Southern California. The SpaceX technical staff was drawn from the top ranks of leading aerospace firms, all with the common belief that a much better launch vehicle solution could be built.

The Launch Vehicle

Our initial product, the Falcon I, is a mostly reusable, two stage, liquid oxygen and rocket grade kerosene powered launch vehicle. The first stage is turbo-pump fed with high mass efficiency monocoque aluminum tanks that use pressure assisted stabilization in flight. It is almost entirely reusable and returns via parachute to a water landing.

The upper stage is pressure fed and constructed of the highest strength to weight aluminum-lithium alloy available – the same material as used in the 'super lightweight' version of the Shuttle external tank. It is capable of multiple restarts on orbit, limited only by onboard propellant.

Lift-off weight for the standard Falcon is approximately 27,000kg (60,000 lbs), length is just under 32m (70 ft) and diameter is 2.5m (5.5 ft). *Note: A larger vehicle, Falcon V, will be available starting in the fourth quarter of 2005 with 10,000 lb capability to the standard reference orbit. A Falcon V User's Guide will be available in late 2004.*

Falcon is designed to achieve substantial improvements in reliability, cost and flight environment, in that order of importance.

Why do we believe Falcon is a high reliability design?

The vast majority of launch vehicle failures in the past two decades can be attributed to three causes: engine, avionics and stage separation failures. An analysis by Aerospace Corporation[1] showed that 91% of known failures can be attributed to those subsystems.

It was with this in mind that we designed Falcon to have the minimum number of engines and separation events. As a result, there is only one engine per stage and only one stage separation event – the minimum pragmatically possible number. Moreover, the vehicle is not released until the first stage engine is confirmed to be operating normally, allowing a safe shut-down if any off nominal conditions occur.

Unlike most small launch vehicles, Falcon also has fully redundant flight computers and inertial navigation, with a GPS overlay for additional orbit insertion accuracy. We have gone the extra

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[1] http://www.aero.org/publications/crosslink/winter2001/03.html

mile in building a first class avionics system in order to have minimal changes when we use this system in our large vehicle development following Falcon I.

Cost and Operations

Our price per launch for the standard Falcon, which is the same for all customers, is set at $5.9 million (2004 dollars) plus range launch fees that vary by location. The only discounts offered are for multi-launch contracts. Moreover, our goal is to make pre-launch operations as simple and painless for you as possible. Your satellite needs to be brought to the launch site only 2 weeks prior to launch and SpaceX provides clean room facilities for non-hazardous processing at no charge.

Once the satellite arrives at the launch site, attachment and fairing encapsulation can be completed in less than 24 hours.

Flight Environment

Most of a satellite's design and a great deal of the weight are driven by the launch loads experienced in the first ten minutes of its life. After separation, the satellite spends the rest of its time in microgravity and does not experience such loads again during its useful life.

We have worked hard to minimize those launch loads, so that vibration and acoustic environments are better than any other available launch vehicle. The fact that Falcon uses no solid fuel boosters, has low thrust levels and a low thrust to weight all contribute to this.

2. Launch Vehicle Performance

Falcon is capable of delivering approximately 670 kg (1480 lb) payload into a reference low Earth orbit with 200 km circular altitude, when launched due east from Cape Canaveral. With increasing altitude, a two-impulse insertion provides more payload capability by inserting into a lower, slightly eccentric orbit and performing a circularization burn at apogee. The following graphs show performance for both types of orbit insertion (Figure 2.1, Figures 2.2) for a range of circular orbit altitudes.

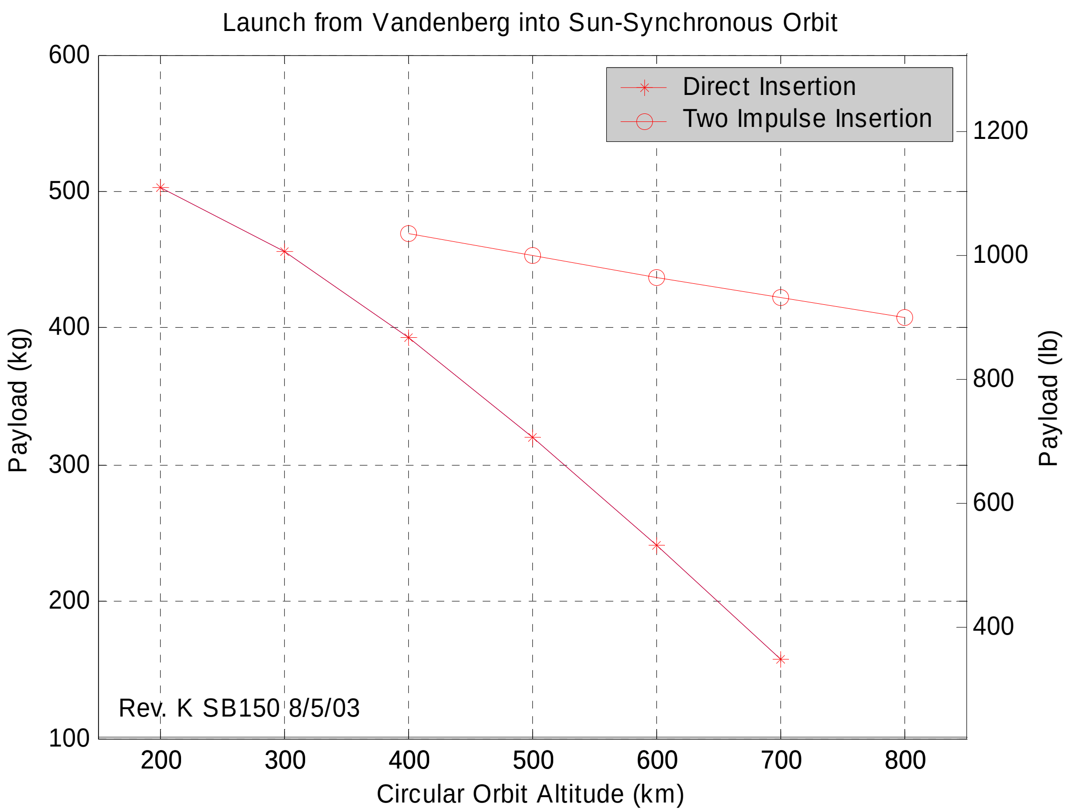
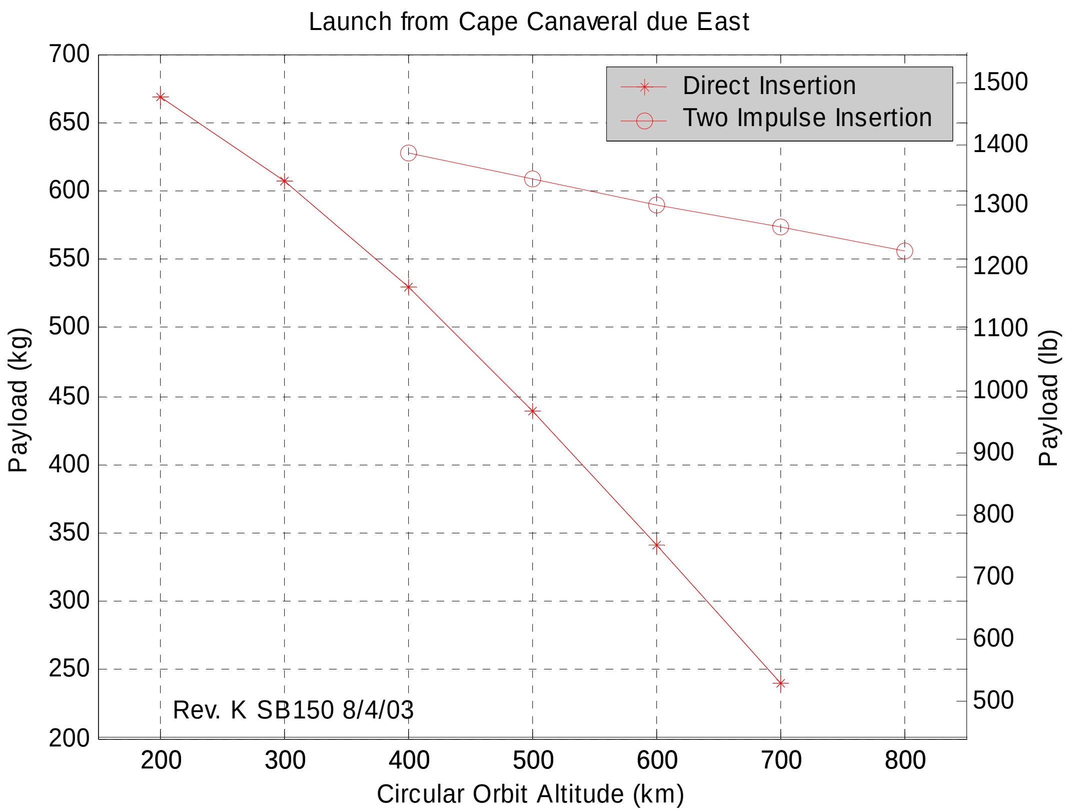


Figure 2.1 Falcon performance from the Western Range



Figures 2.2 Performance from the Eastern Range to 28.5 °

For orbit inclinations other than provided above, certain azimuth limitations have to be taken into account. The azimuth limits depend on the type of payload and orbit; Figure 2.3 shows the payload performance as a function of inclination and circular orbit altitude for typical azimuth limitations.

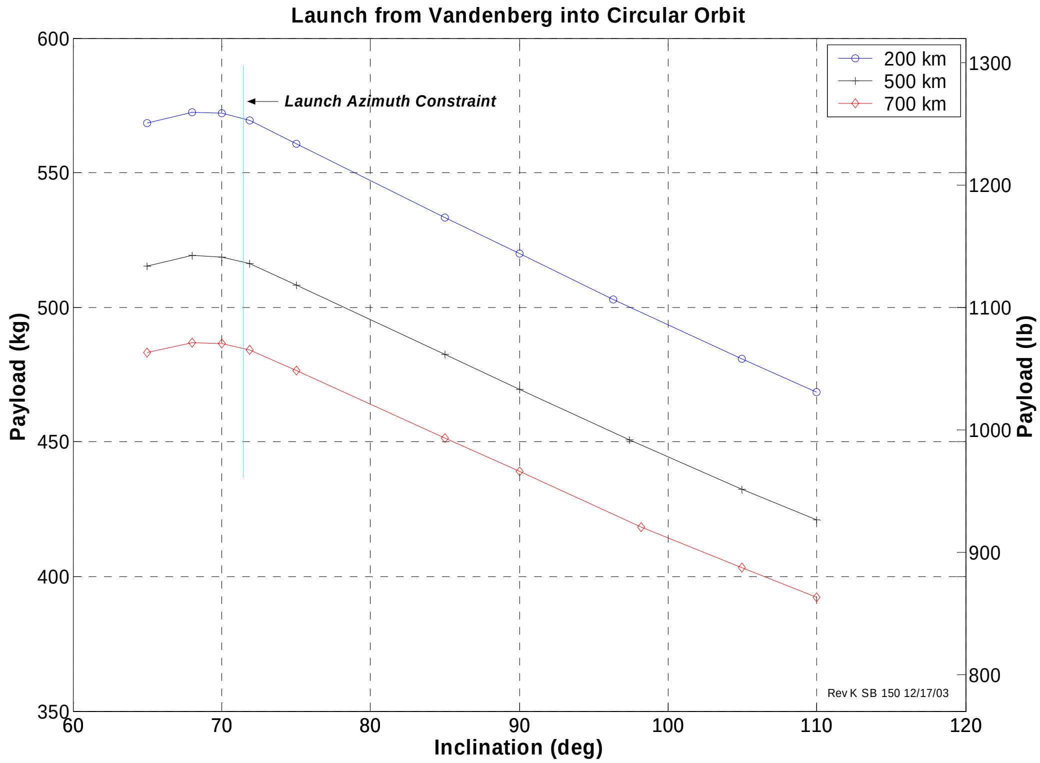


Figure 2.3: Circular orbit performance from Western Range as a function of orbit inclination

As a liquid vehicle, Falcon provides flexibility required for payload insertion into orbit with higher eccentricity deploying multiple payloads into slightly different orbits. Target orbital insertion accuracy is currently determined as follows:

- inclination +/- 0.1 deg
- perigee +/- 10 km
- apogee +/- 20 km

As for every new vehicle, insertion accuracy has to be verified during the first flights. The current estimates are expected to improve since Falcon uses a GPS system for guidance correction.

Falcon can accommodate payloads with the following mass properties:

Characteristic	**Value**	
Mass	Up to 1500 lbs	
CG offset	*From centerline*	*From separation plane*
	See Figure 2.4	See Figure 2.5
Stiffness	*Axial*	*Lateral*
	$\geq$ 25 Hz	$\geq$ 25 Hz

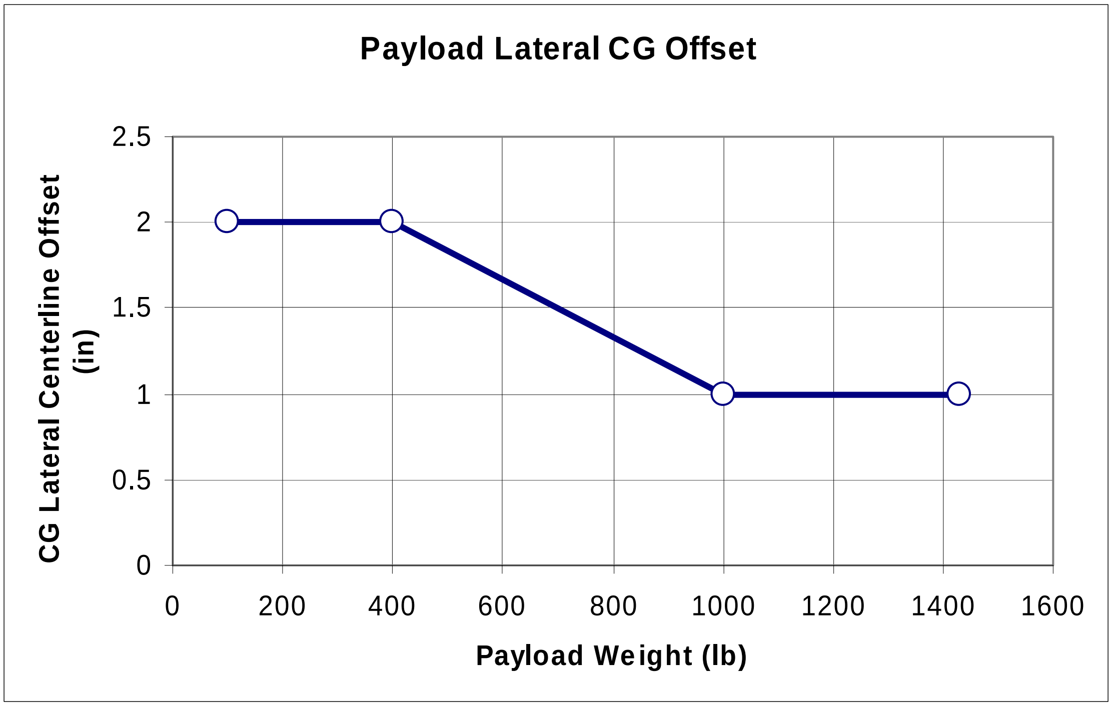


Figure 2.4 Allowable Cg offset from Centerline

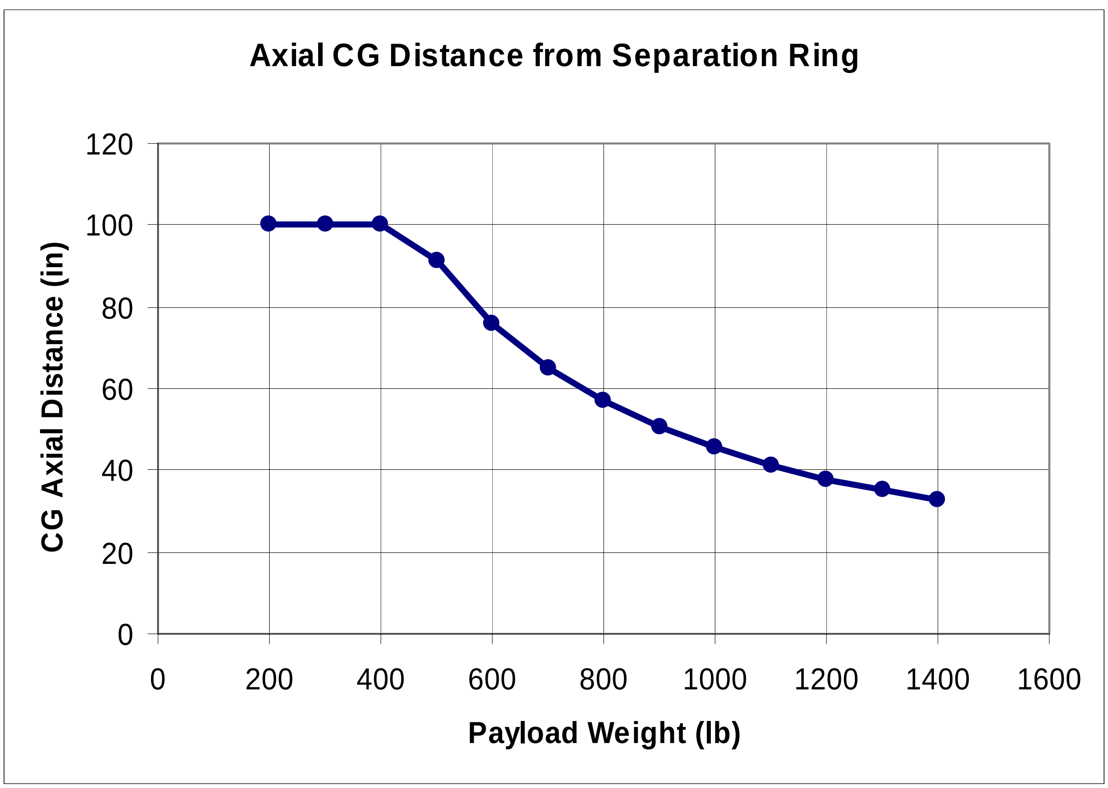


Figure 2.5 Allowable Cg offset from Separation Plane

3. Launch Vehicle to Payload Interfaces

The Falcon coordinate system is shown in Figure 3.1

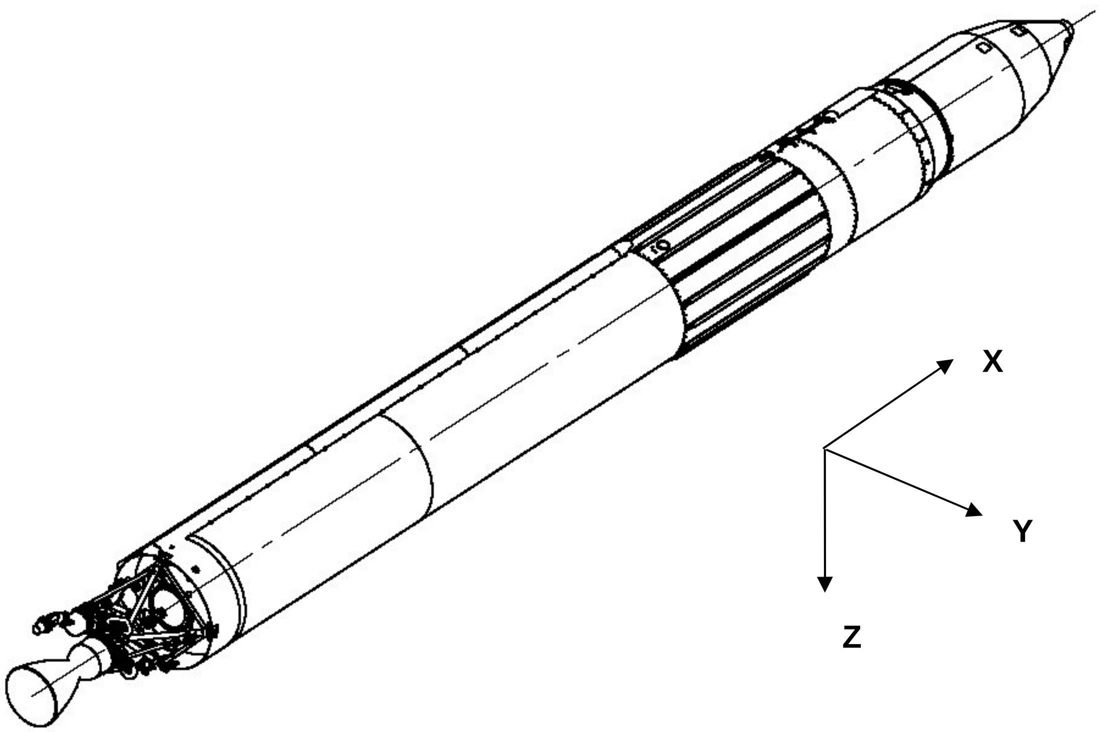


Figure 3.1 Launch vehicle coordinate system

Mechanical

Falcon baselines the Lightband separation system. SpaceX will provide the payload half of the interface (this in not counted against the payload mass in performance curves) to the payload provider. A drawing of the mechanical interface is shown in Figure 3.2. Figure 3.3 shows the dynamic envelope for the Falcon fairing.

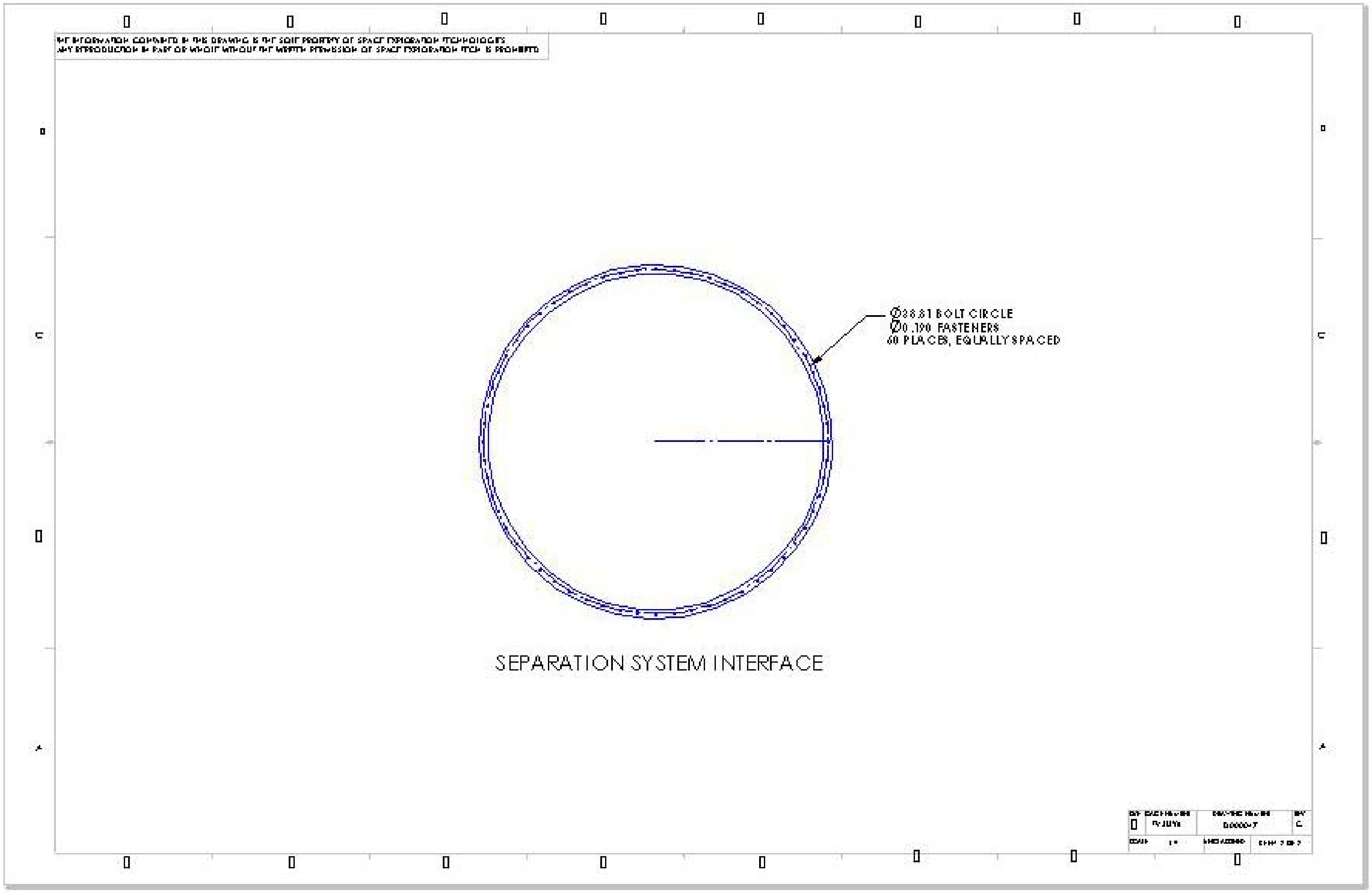


Figure 3.2 Falcon Mechanical Interface

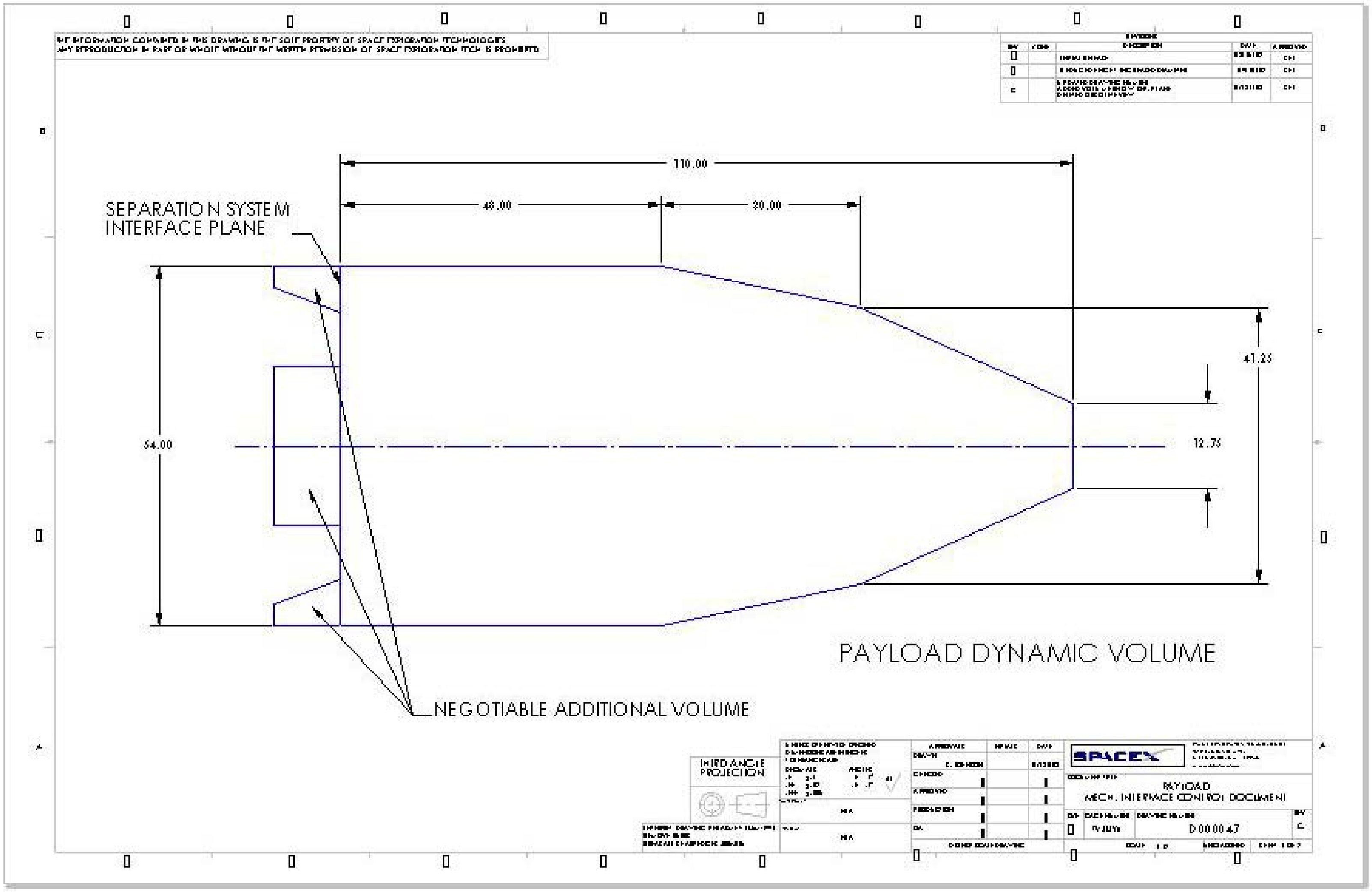


Figure 3.3 Falcon Dynamic Envelope

The launch vehicle will provide a signal to the payload at separation to initiate payload power-up. Alternate configurations for separation signals (break-wires, separation switches monitored directly by the payload, or other configurations) can be negotiated as an option.

An access door is included in the fairing for contingency purposes only. Under nominal operating conditions, all processing that requires access to the payload must be completed prior to fairing installation. Payloads with consumables must include an on-pad de-tanking capability, which must be accomplished through the fairing access door. The location of the fairing access door can be modified, as an option, to allow access for payload de-tanking.

A GN2 purge is an optional service. The method for providing the purge (through a door in the fairing or across the payload separation system interface) will be worked as part of the service.

Electrical

The electrical interface for Ground and Flight operations is shown in Figure 3.4. It is preferred that the satellite is switched OFF during launch; if the satellite is on, it may not transmit and special precautions with respect to interference have to be taken. Note that the distance between Mission Control and the vehicle is significant and that the Ethernet data line is the only connection between Mission Control and the launch pad.

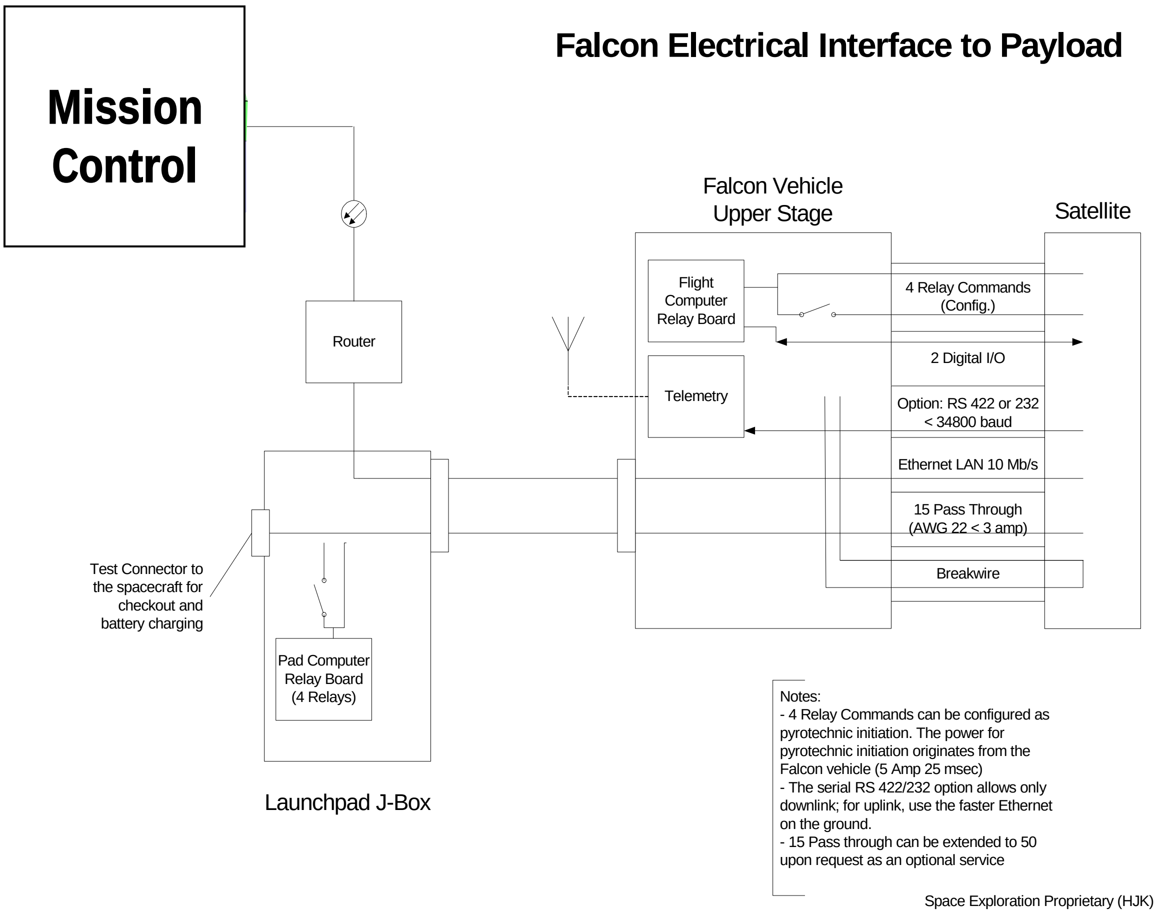


Figure 3.4 Falcon electrical interface to the payload

The electrical interface provides all flexibility on the ground through Ethernet, not hardwire. The Ethernet is a shared resource, and the payload should therefore not saturate the network. For remote control of battery chargers located at the launch pad and other ground equipment, up to 4 relays are available with a maximum load of 3 Amps at 28 V, through the pad computer.

As a standard service, 15 pass-through connections with a capacity of up to 3 amps are available between the launch pad and the integrated payload.

As a standard service during the flight, 4 relay commands and 2 uni-directional (configurable) digital TTL signals are available. The user provides Space Exploration Technologies with a sequence description if and how these commands are being used, including the direction of the digital signal (payload to Launch Vehicle or vice versa). If pyrotechnics are initiated through the relay commands, vehicle power is being used to provide adequate inhibits.

A break wire is mounted on the payload side of the connector; if desired, a separation switch can be provided for the payload. As an option, a telemetry serial data stream is available for the payload with up to 34800 baud. Data reception depends on ground station visibility during ascent and might not be reliable for certain orbits as the vehicle approaches the horizon.

With the standard interface, two connectors are used between Falcon and the payload, configured as follows (Table 3.1):

Table 3.1 Connector pin identification

Connector/Pin	Designation	AWG
A1	Relay 1	22
A2	Relay 2	22
A3	Relay 3	22
A4	Relay 4	22
A5	Relay GND	22
A6	Digital 1	22
A7	Digital 2	22
A8	Digital GND	22
A9	TX+	22
A10	TX-	22
A11	RX+	22
A12	RX-	22
A13	Breakwire +	22
A14	Breakwire Return	22
A15	Spare	22
B1	User Configurable (to Pad)	22
B2	User Configurable (to Pad)	22
B3	User Configurable (to Pad)	22
B4	User Configurable (to Pad)	22
B5	User Configurable (to Pad)	22
B6	User Configurable (to Pad)	22
B7	User Configurable (to Pad)	22
B8	User Configurable (to Pad)	22
B9	User Configurable (to Pad)	22
B10	User Configurable (to Pad)	22
B11	User Configurable (to Pad)	22
B12	User Configurable (to Pad)	22
B13	User Configurable (to Pad)	22
B14	User Configurable (to Pad)	22
B15	User Configurable (to Pad)	22

Grounding

The satellite mounting interface must be conductive. The electrical resistance will be verified prior to the assembly of the Payload on the separation system.

4.0 Facilities

SpaceX has launch facilities at Space Launch Complex 3W at Vandenberg Air Force base for high inclination missions, Launch Complex 46 at Cape Canaveral Air Force Station for mid inclination missions, and the Reagan Test Site on the Kwajalein Atoll for very low inclination missions.

Facilities for Payload Preparation

The Space Exploration Technologies Payload processing facility will be made available for non-hazardous Payload operations for up to 3 weeks prior to launch from each of our sites. If additional time is needed, then the Payload must procure a processing facility independently.

The payload processing room at SLC 3W (Figure 4.1) consists of 1200 square feet of floor space. The processing room consists of a high bay 60 ft long, 20 ft wide, 20 ft high. Personnel access doors provide access to the processing room from the launch vehicle/payload checkout control room. The outside cargo entrance door is 16 ft wide by 16 ft high which leads into a 20 ft wide, 20 ft long, 20 ft high anti-room. A bridge crane with an 18 ft hook height and 5 ton capacity is available for handling spacecraft and associated equipment. The processing room provides a class 100,000 laminar flow cleanroom 40 ft long, 20 ft wide, 20 ft high. Temperature of 60° - 80° F ± 2° (controlled) and humidity 30% - 60% (monitored only) with a differential pressure of .05 inches of water minimum with all doors and pass-throughs closed.

The Payload processing facilities will be consists of a common work area (anti-room) and the clean room bay. The common work area of the processing facility is dedicated for spacecraft ground support equipment unloading, unpacking/packing and intermediate storage of empty cargo container. The working area shall be equipped with a crane to lift the Payload onto the adapter.

SpaceX will monitor relative humidity, temperature and cleanliness in the payload processing facility. This is true with the exception of periods when the satellite is mated to the launcher second stage. Monitoring data will be made available to the payload customer. In order to ensure this, satellite preparation will be performed using clean processes.

The processing facility has the following characteristics:

- Smooth, continuous floor surface (anti-static)
- Illumination equals 300 Lux (with localized capability up to 1000 Lux)
- Uninterrupted power supply for satellite control and test equipment
- Fire protection
- Emergency exit and illumination
- Controlled access and security

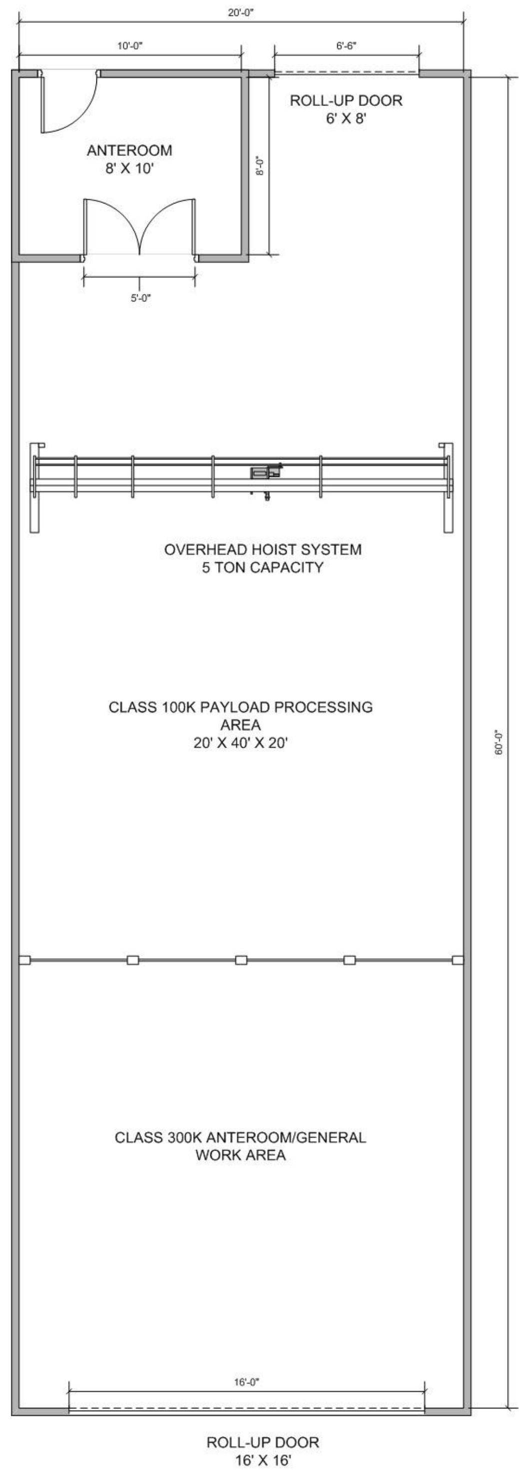


Figure 4.1 Space Exploration Technologies SLC 3W payload processing facility layout

Service and Equipment

The services and equipment provided for satellite processing in the clean area are shown in Table 4.1.

Table 4.1 Services and equipment for satellite processing

Constraints	**User provided support**
• No installed GN_2 or GHe systems • Non-hazardous processing only	• GN_2 and He pressure carts • Electrical interfaces to processing area

Capability type	**Capability**
Space/access	Design Floor Loading: - 100 psf on checkout floor cell - 75 psf plus a 4000 load on four casters Work space 20 ft by 20 ft Cell door opening 16 ft wide, 16 ft high Adjacent to launch vehicle and control rooms
Handling	5-ton overhead bridge crane Hook height: - 16 ft Speeds - Hoist 10 fpm - Bridge N/S 10 fpm - Trolley E/W 5 fpm Micro Drive - Hoist 0.5 fpm - Bridge 0.5 fpm - Trolley 0.5 fpm
Electrical	Utility and Technical Power 120/208, 408 VAC Multipoint grounding per MIL-STD-1542
Liquids	Cleaning water supply - 50 gpm at 80 psig - 1 inch hose bib with 1 inch male thread
Pneumatics	Compressed air at 125 psi 3/8 inch QD's at 2 locations in processing room
Environment	100,000 clean room capability - Temp 60° - 80° F ± 2° (controlled) - RH 30% - 60% (monitored only)
Safety	All electrical equipment is hazard-proof as defined in the National Electrical Code Fire detection and suppression system
Security	Access control - KeyCard/cipher system - Intrusion detection system - Lockable personnel doors
Communications	Administrative phone Area Warning System Paging System

Electrical Power Supply

The electrical power supplied in the payload processing area is shown in Table 4.1. Customer shall provide the necessary cables to interface GSE to payload processing room power. Customer shall state power requirements in the payload to launcher interface control document.

Fueling—no fueling or other hazardous operation can be performed in the SpaceX payload processing area. Please contact Astrotech, Spaceport Systems International, or another facility provider if such services are required.

Administrative & Payload Monitoring and Control Space

Near the payload processing facility, one office area will be provided that contains two desks (approximately 2 ft by 3.5 ft), four office chairs, one class A telephone line, and high speed internet connectivity (via a commercial source). Fax service is available in the nearby SpaceX office. Portable units will supply sanitation needs for both SpaceX and payload support personnel at the launch pad. Payload support personnel are welcome to share small amounts of refrigerator space, coffee machines, microwaves, and other conveniences that may be available.

For monitoring of spacecraft telemetry during test and launch operations, one console is provided for the payload customer in the SpaceX command van, and stations for up to five other payload support personnel will be available either in the payload processing area or in other facilities (during launch ops). These additional stations will consist of a connection to the SpaceX telemetry server – payload customers should bring computers for these stations (PC systems). All stations will be able to monitor any telemetry received through the Falcon vehicle telemetry stream or via the payload Ethernet connection. Currently, two stations in off pad locations will include communications consoles, as will the console in the Command Van. Any commanding of the spacecraft that is required during launch operations (if available) will have to be physically implemented by the SpaceX launch controller, but is authorized only by the payload customer.

5. Payload Integration and Flight Profile

Falcon missions and associated operations have been designed for minimal complexity and minimal time at the pad. The payload will be integrated horizontally to the launcher approximately 4 days prior to launch. Once integrated, the vehicle is moved to the pad and is erected using the Falcon transporter. Final system close-out, fueling and testing is then completed. Twenty four hours prior to launch, the launch readiness review is held. Once the launch approval is given, the 24 hour countdown begins. The flight profile is shown in Figure 5.1.

Figure 5.1 Falcon sample flight profile—direct injection

Payload Integration

Payload arrival is expected not more than 3 weeks prior to flight. During this time, SpaceX provides a payload processing facility for non hazardous operations only. Top level summary of the launch site operations is described below. Note that during hazardous operations, the pad (including the payload processing facility) must be cleared of personnel.

Note that if hazardous operations or longer payload processing time is required, a separate facility must be procured by the customer.

At approximately launch minus 4 days, the integration process begins and includes the following:

- Payload is vertically integrated with payload fairing and encapsulated in the payload processing facility.

- The encapsulated payload is then driven to the launch deck
- Payload is rotated horizontally and prepared for integration to booster.
- Encapsulated payload and booster are integrated by lifting the payload and placing it on the mobile erector forward platform.
- Payload is then positioned and mated to the booster.
- Umbilical connections are made
- Booster umbilical connections are made in the horizontal position
- Payload and booster are erected as a single unit
- Final connections and installations are completed

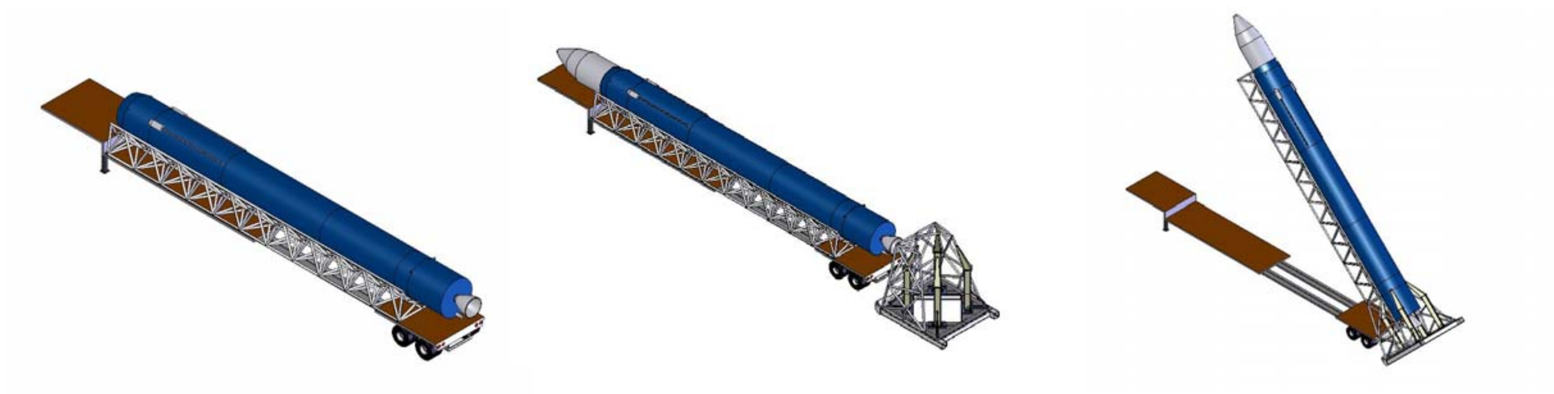


Figure 5.2 Operations with launch vehicle and payload in mobile erector

Once Falcon is launched it follows the profile described in Figure 5.1. Note this profile will vary for various trajectories. For direct injected missions, payload separation occurs at approximately 570 seconds. For two burn missions, the payload is released approximately 3270 seconds into the mission.

Payload Separation

Payload separation is a timed event referenced to the second stage burnout. A command is sent initiating the Lightband system. Separation is initiated non-explosively. Separation springs then impart separation velocity. The system maintains tip off rates below 1 degree per second. Once the two halves of the system separate, a signal is sent to the payload using either a Breakwire or Microswitch. If the payload desires, it can be spun at separation up to approximately 6 RPM.

Almost any attitude can be accommodated at separation. However, it may take up to 10 minutes to obtain some attitudes prior to separation. The second stage attitude and rate accuracies at separation are:

- Roll +/- 2 degrees
- Pitch/Yaw +/- 0.5 degrees
- Body rates +/- 0.1 deg/sec/axis

Collision Avoidance

Ten seconds post separation, Falcon performs a collision avoidance maneuver using the heated helium pressurant and the RCS thrusters. The thrusters are positioned to minimize gas impingement on the spacecraft yet still provide adequate separation.

6.0 Payload Environments

This section provides details on the maximum predicted environments (MPE) the payload will experience during *Falcon* ground ops, integration, flight, and initial orbital operations. The environmental design and test criteria presented here have been calculated using the most sophisticated and accurate methods available and, where possible, have been correlated and scaled with data from vehicles with similar engine types, materials, construction, and size. Because all data is mostly calculation based and in the process of being verified through ground testing, appropriate margins are added and indicted (additional margins over those presented here are not recommended but up to user discretion).

Falcon was designed to have the most benign payload environments possible to reduce interface complexity and risk. The vehicle is all liquid with a single staging event, low thrust to weight, and low dynamic pressure flight. In addition, a low shock (non pyrotechnic) separation system and a vibration + shock damping and isolation system is baselined at the payload interface. The environments presented here are intended to reflect typical mission levels; mission specific analyses are to be performed and documented in the ICD per payload needs. Specific individual environments are defined in the following sections.

Throughout pre-flight and flight operations various environmental contributions become more or less important. Certain events, such as pyrotechnic firings and stage burnout, add specific quasi-static or dynamic loads for specified durations which may or may not need to be added to other environments experienced at the same time. Table 6.1 below specifies the relative periods of loading events and detailed information about specific loads can be found in subsequent sections. Because *Falcon* is a new vehicle, these environments will be updated as new data becomes available.

Table 6.1: Summary of environmental conditions at various flight events.

Flight Event	Typical Flight Time (s)	Steady / Quasi-Static Loading	Transient or Shock Loads	Acoustic Loads	Random Vibration
Liftoff	0-5	Low	Yes	Yes	Yes
Subsonic	5-50	Yes	Low	Very Low	Low
Transonic	50-65	Yes	Yes	Low	Low
Max *q*	65-80	Yes	Yes	Yes	Yes
Stage I Burnout	170	Yes	Yes	Low	Low
Stage Separation	172	Low	Yes	Very Low	Low
Stage II Burn	174-540	Yes	Low	No	Low
Stage II Burnout	542	Yes	Low	No	Very Low
Payload Separation	560	Yes	Yes	No	No

Quasi-Static Loads

During flight, payload will experience a range of axial and lateral acceleration. Axial acceleration is determined by the vehicle thrust history and drag, while max. lateral accelerations are primarily determined by wind gusts, engine gimbal maneuvers, and other short-duration events. Conservative loads used for payload design are summarized in table 6.2 and axial acceleration vs. time is plotted in Figure 6.1 for a nominal trajectory. Mission specific loads will be determined approximately four months prior to launch with the coupled loads analysis (including specific trajectory details and payload mass properties). These results should only be used to validate that the design loads envelope the mission specific loads.

Table 6.2: Summary of payload design C.G. limit load factors for nominal *Falcon*

Flight Event	Quasi-static Load Factors	
	Axial (g): Steady ± Dynamic (Total)	Lateral (g)
Ground Handling	0.5	2.0
Lift Off	1.2 ± 0.4 (0.8 / 1.6)	0.50
Max q_α	2.0 ± 1.0 (3.0 / 1.0)	0.75
Stage I burnout	6.4 ± 1.25 (7.7 / 5.2)	0.75
Stage II Ignition	3.2±.25 (3.0/3.4)* to 6.0±.25 (5.75/6.25)*	0.25
Stage II burnout	4.5 ± 0.5 (5.0 / 4.0)* to 6.5 ± 0.5 (7.0 / 6.0)*	0.25

*Payload weight and trajectory dependent. Please contact SpaceX for further details.

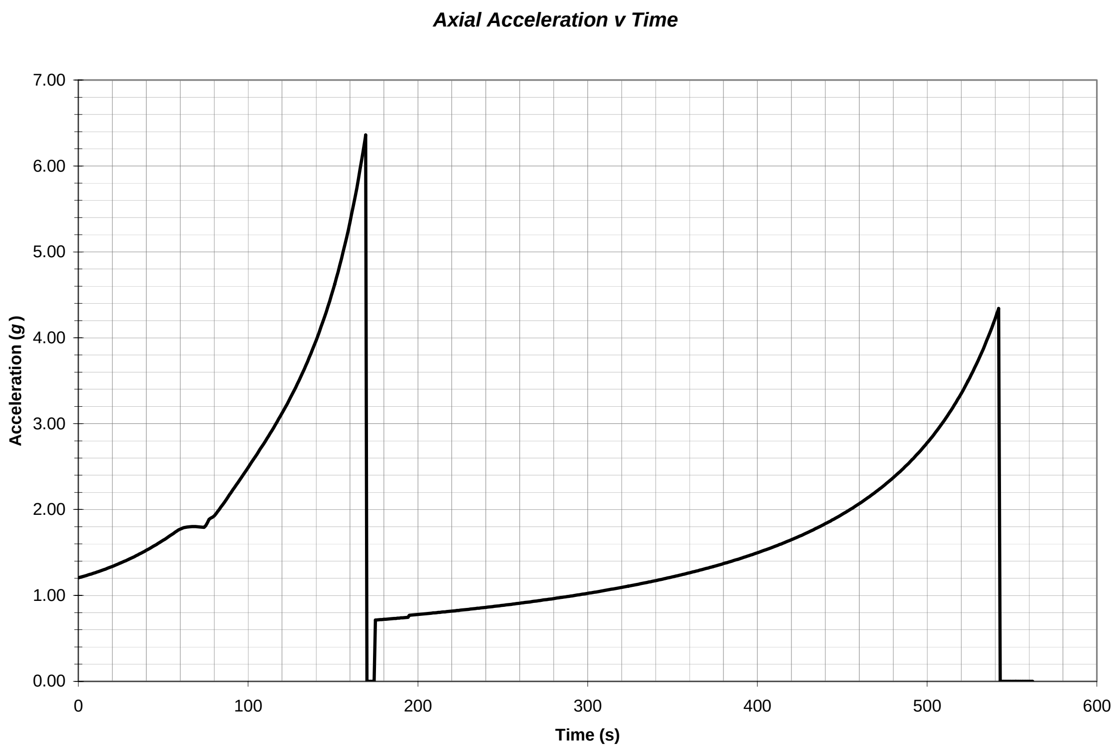


Figure 6.1 Nominal steady state axial acceleration time history for *Falcon*.

Random Vibration Environment

The payload vibration environment is generated by acoustic noise in the fairing and also by engine and aero-induced vibration that is transmitted through the vehicle structure. Because random vibration is very difficult to predict analytically, preliminary Falcon environment was calculated using empirical correlations coupled with scaling data from vehicles of similar size (physical and thrust), materials, and construction. The generation and transmission of random vibrations scales closely with the acoustic power generation of the engine, the materials comprising the skin, tanks, and fairing, and the type of joints used respectively. Based on this analysis, Falcon's random vibration Maximum Predicted Environment is shown below in Figure 6.2. Note that these values include appropriate margins due to uncertainty and that this data will be continuously refined as additional engine tests are performed. The corner frequencies and slope values are summarized in table 6.3.

Table 6.3. Summary of random vibration PSD values.

Frequency (Hz)	PSD (g^2/Hz)	Frequency Range (Hz)	PSD Slope
20	0.0043	0 – 20	0
100	0.020	20-100	+3 dB/oct
800	0.020	100-800	0
2000	0.0019	800-2000	-9 dB/oct

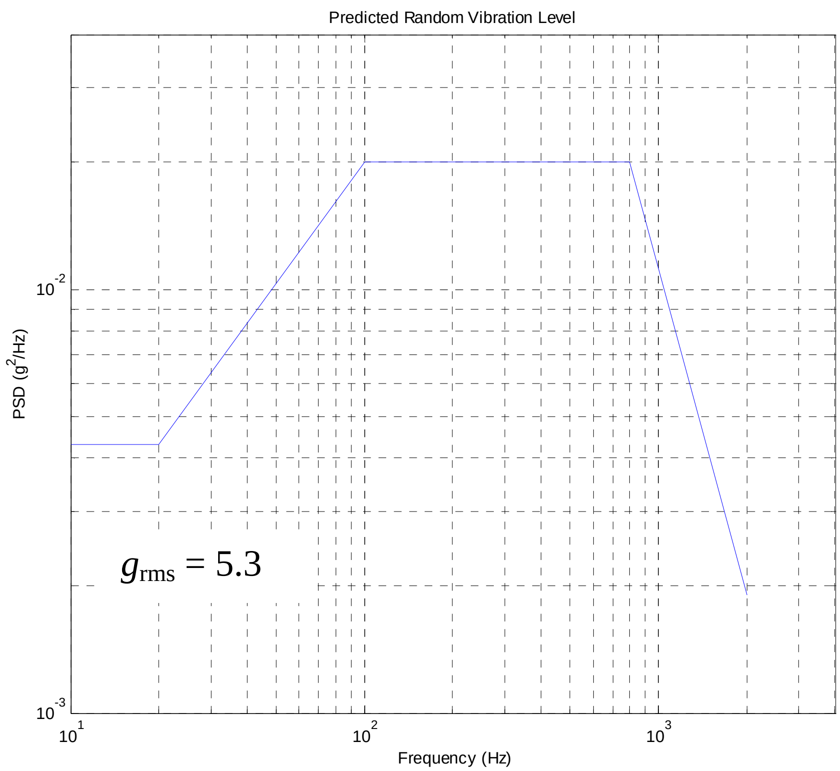
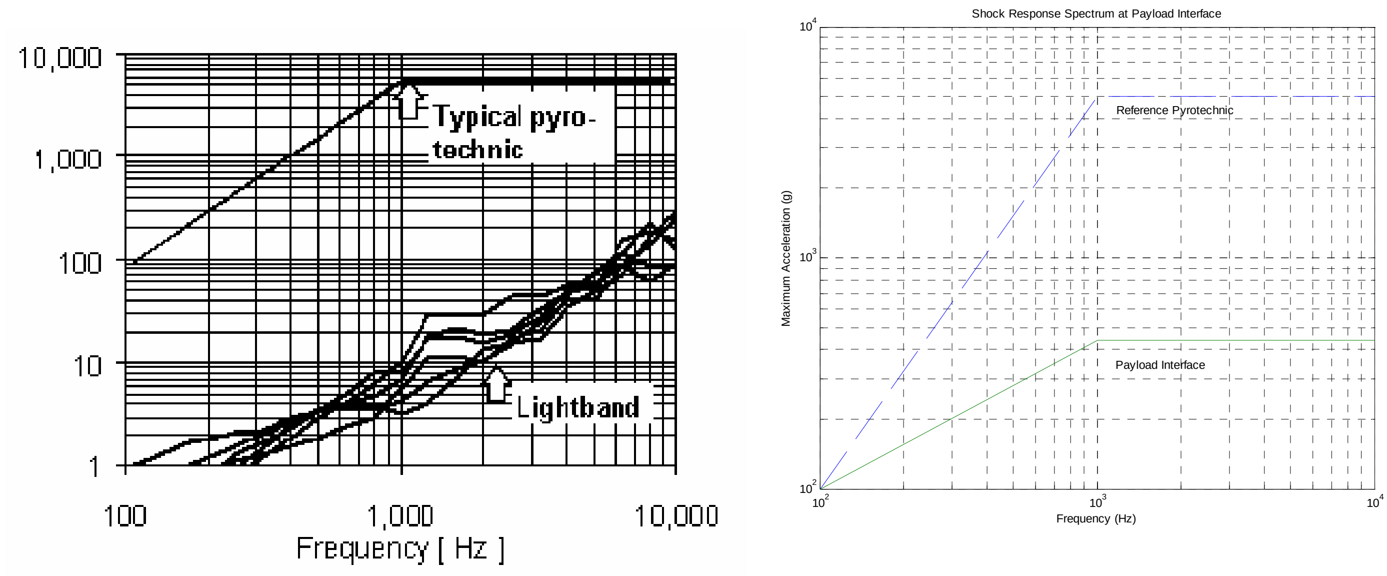


Figure 6.2 Falcon random vibration spectra

Shock Environment

There a four events during flight that are characterized as shock loads: 1) vehicle hold-down release at lift-off, 2) stage separation, 3) fairing separation, and 4) payload separation. The baseline separation system for Falcon is the *Lightband*® motorized ring system, which provides a very low shock load (negligible compared pyrotechnic events). Data from *Lightband* is shown in Figure 6.3.a (shock response spectrum (SRS)) below with a typical pyrotechnic shock spectrum shown for reference. Of the other shock events, (1) and (2) are negligible for the payload relative to (3) due to the large distance and number of joints over which shocks (1) and (2) will travel and dissipate. Max shock loading (3) is modeled using by assuming an initial SRS given by the typical pyrotechnic curve in Figure 6.3.a and scaling down via standard correlations based on distance from source and joints. The resulting max. shock environment predicted at payload interface is shown in Figure 6.3.b.

It should be noted that vibration test data of the *Lightband* system suggests very low response at the high frequencies associated with shock events which will likely add considerable attenuation to any shock acceleration loads. In addition, a damping and isolation system is being design at the payload interface which will further reduce any shock loads. These systems are not modeled here and hence the SRS presented should be treated as very conservative.



Figures 6.3 a & b Falcon shock response at separation plane due to payload separation system and other ordnance events

Acoustic Environment

During flight, the payload will be subjected to a varying acoustic environment. Levels are highest at lift off and during transonic flight due to aerodynamic excitation. *Falcon* will make use of acoustic blanketing to reduce the acoustic environment and a nominal (minimal) 2" thick blanket configuration is assumed for predicted environment. Spectral energy methods were used to predict worst-case acoustic environment below. A 1.5 dB margin is typically added for qualification and a 3 dB margin is typically added for testing, but this is left to the discretion of the user. A summary of acoustic MPE is shown in Table 6.4 and plotted in Figure 6.4.

Table 6.4. Summary of *Falcon* payload acoustic environment assuming nominal 2" acoustic blankets.

1/3 Octave Frequency (Hz)	SPL (dB)	1/3 Octave Frequency (Hz)	SPL (dB)
20.0	104	1000	112
25.0	107	1250	107
31.5	110	1600	104
40.0	113	2000	102
50.0	115	2500	101
63.0	117	3150	100
80.0	119	4000	101
100	120	5000	101
125	121	6300	100
160	122	8000	100
200	122	10000	100
250	122		
315	121		
400	119	**OASPL**	**131**
500	117		
630	115		
800	115		

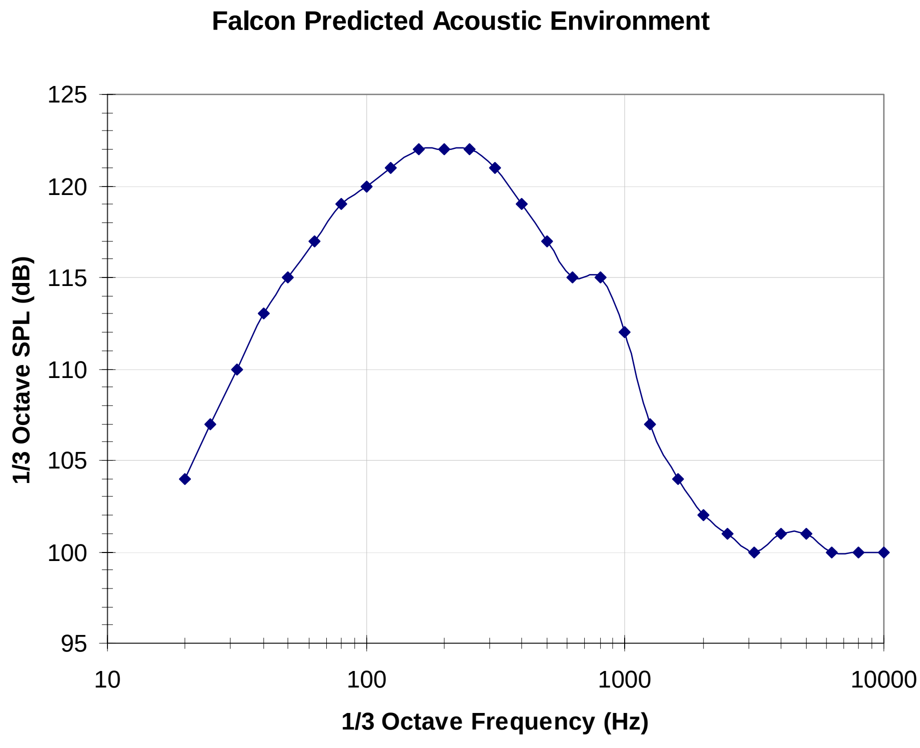


Figure 6.4. SPL spectrum for Falcon assuming 2" acoustic blankets.

RF Environment

Payload customers must ensure that spacecraft materials or components sensitive to an RF environment are compatible with both the launch pad environment and the RF environment during flight.

Vandenberg AFB guarantees an RF environment not greater than 24.2 dbm (pulsed) at SLC-3W. This environment could be experienced by the payload during transport to the launch site and during spacecraft preparations and integration with the adaptor and fairing. When the spacecraft and launch vehicle are vertical on the pad, the fairing will attenuate most of the RF environment. The RF environment at our other sites are expected to be similar.

The *Falcon* fairing attenuates the launch vehicle transmissions during launch pad operations and flight, up to fairing separation. After fairing separation, the C-band transmissions will not exceed 3.38 dbm (pulsed) at the CG of the fairing. The S-band transmissions at this time will not exceed -4.87 dbm (continuous) at the CG of the fairing.

Table 6.5. Summary of transmitter RF characteristics.

	Transmitter 1 Characteristics	Transmitter 2 Characteristics	Transmitter 3 Characteristics
Transmitter	**Telemetry**	**Video**	**Xponder**
Nominal frequency	S Band	S Band	C Band
Power output	10 W (40 dbm)	10 W (40 dbm)	400 W (56 dbm)

Humidity, Cleanliness and Thermal Control

Relative humidity will be controlled to 40-60%. The payload will be exposed to thermal environments and cleanliness levels for the various mission phases summarized in table 6.7.

Table 6.6. Summary of thermal and humidity environments.

Location	Temperature Heating Level	Cleanliness Level	Humidity Level
Clean room	Customer desired with a range of 60° - 80° F ± 2°	100K	30-60 % Condensation of water inside the Payload compartment will not occur.
Encapsulated during transport	Air purge at payload desired temperature between 60° - 80° F ± 2°	Visibly clean	30-60 % Condensation of water inside the Payload compartment will not occur.
Encapsulated and stacked	Air purge at payload desired temperature between 60° - 80° F ± 2°	Visibly clean Filtered (3-5 micron) purified air purge Positive pressure will keep fairing environment clean.	30-60 % Condensation of water inside the Payload compartment will not occur.
Launch	Radiated environment: 15-150° C TBD Conducted environment: 15-150° C TBD Time history will be provided.	Positive pressure will keep fairing environment clean	***N/A***
	Fairing separated when aero-thermal heating is less than 1135 W/m2	N/A	***N/A***

Flight Pressure Profile

The fairing flight pressure profile is defined in the Figure 6.5

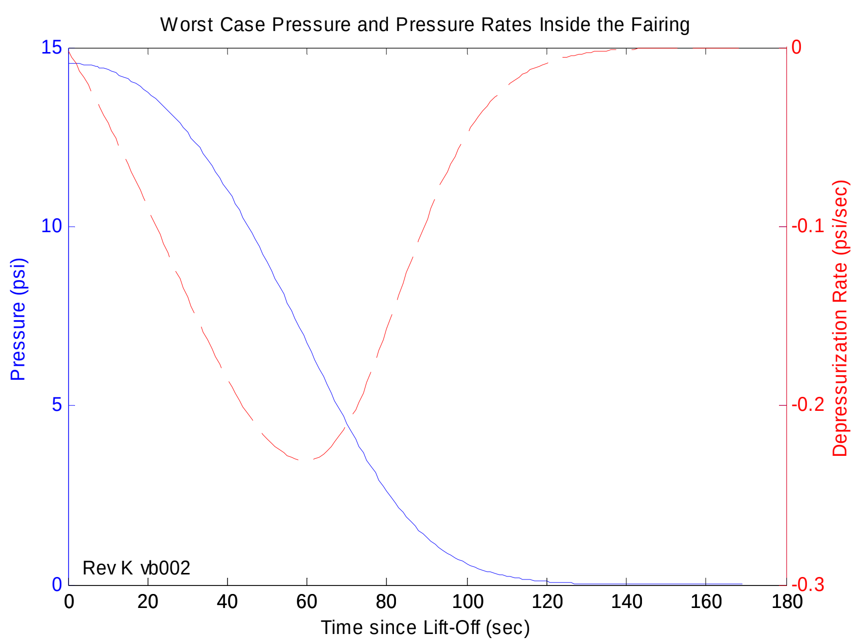


Figure 6.5 Depressurization environment and depressurization rates

7. The Integration Process & Schedule

The standard launch integration process consists of the following:

- Contract signing and authority to proceed (Launch – 8 months or more)
  - Estimated Payload mass, volume, mission, operations and interface requirements
  - Safety information (Safety Program Plan; Design information: battery, ordnance, propellants; and operations)
  - Mission analysis summary provided to the Customer within 30 days of contract

- Final payload design, including: mass, volume, structural characteristics, mission, operations, and interface requirements (Launch – 6 months)
  - Payload to provide test verified structural dynamic model

- Payload readiness review for Range Safety (Launch – 4 months)
  - Launch site operations plan
  - Hazard analyses

- Verification (Launch – 3 months)
  - Review of Payload test data verifying compatibility with Falcon environments
  - Coupled Payload and Falcon loads analysis completed
  - Confirm Payload interfaces as built are compatible with Falcon
  - Mission safety approval

- Pre-shipment review (Launch -1 month)

- Payload arrival at launch location (Launch – 2 weeks)

- Payload encapsulation (Launch – 3 days)

- Payload stacking (Launch – 2 days)

- Launch readiness Review (Launch – 1 day); Launch

User Documentation Requirements

The payload customer is responsible for generating their own range safety, range, and FAA documentation. SpaceX will facilitate the required discussions, however and will coordinate submittals with the appropriate organizations. At a minimum, the following documents must be provided:

- Program introduction to the Range
- Spacecraft design overview with graphics.
- Safety documentation including: hazard analyses and reports, vehicle break up models (debris data) and detailed design and test information for all hazardous systems (batteries, pressurized systems or other hazardous or safety critical materials, propellant data,
- Launch site operations plan and detailed procedures (note hazardous procedures must be approved by range safety)
- Interface verification plan and report
- Application for a payload determination (for non US gov't payloads only)
- Environmental statement

In addition to these documents, input is required to support development of the Interface Control Document, launch countdown procedures, and the launch readiness review package.