LAUNCH: PAYLOAD USER'S GUIDE

AUGUST 2020
VERSION 6.5

ROCKET LAB

OPENING ACCESS TO SPACE

Small satellites are shaping the way we use space to innovate, explore and improve life on Earth. Historically it has been slow, expensive, and challenging to get these small but incredibly capable spacecraft to orbit. Our Electron launch vehicle changed that, and revolutionized access to space.

Rocket Lab is enabling companies, students, scientists, researchers, governments and entrepreneurs alike to get their ideas to orbit right now. A solar system of possibilities has opened up for people who thought space was out of reach, until now. The satellites we launch are keeping countries connected and borders protected, they're monitoring weather and managing waste, they're providing insights on climate change, and helping us manage resources for future generations.

We believe getting to space should be easy, which is why we developed a launch experience like no other. Every detail of Electron has been designed for rapid production to support frequent and reliable launch for small satellites. Since our first launch in 2017, Electron has become one of the world's most frequently launched orbital vehicles. To give small satellite operators unmatched control over their launch schedule, we also operate three launch pads across the United States and New Zealand that can support more than 130 launches every year.

Every aspect of the launch process has been streamlined to make your mission simple and seamless, from idea to orbit.

Tell us about your mission. We look forward to making it a reality.

Peter Beck
Founder and Chief Executive of Rocket Lab

LAUNCH: PAYLOAD USER'S GUIDE OVERVIEW

This document is presented as an introduction to the launch services available on the Electron Launch Vehicle. It is provided for planning purposes only and is superseded by any mission specific documentation provided by Rocket Lab.

REVISION HISTORY

DATE	VERSION	HISTORY
June, 2015	1.0	First Release
May, 2016	2.0	Updated Release
September, 2016	3.0	Updated Release
December, 2016	4.0	Updated Release
April, 2017	5.0	Updated Release
June, 2018	6.0	Updated Release
July, 2018	6.1	Updated Release
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April, 2019	6.3	Updated Release
June, 2019	6.4	Updated Release
August, 2020	6.5	Updated Release

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ROCKET LAB

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1. MEET ELECTRON

YOUR RIDE TO ORBIT.

YOUR RIDE TO ORBIT

Electron (Figure 1) is an orbital launch vehicle designed specifically to place small satellites of up to 300 kg / 660 lbm into a wide range of low Earth orbits (LEO). Every aspect of Electron has been designed for frequency and reliability to meet the evolving needs of government and commercial small satellite operators.

FLIGHT HERITAGE

Since its first launch in 2017, Electron has become the leading launch vehicle dedicated to small satellites and one of the most frequently launched orbital rockets in the world. More than 50 satellites have been deployed to orbit by Electron for commercial and government partners, including NASA, the U.S. Air Force, DARPA, and the National Reconnaissance Office.

Figure 1 Electron lifts off from Rocket Lab LC-1 Pad A

ELECTRON OVERVIEW

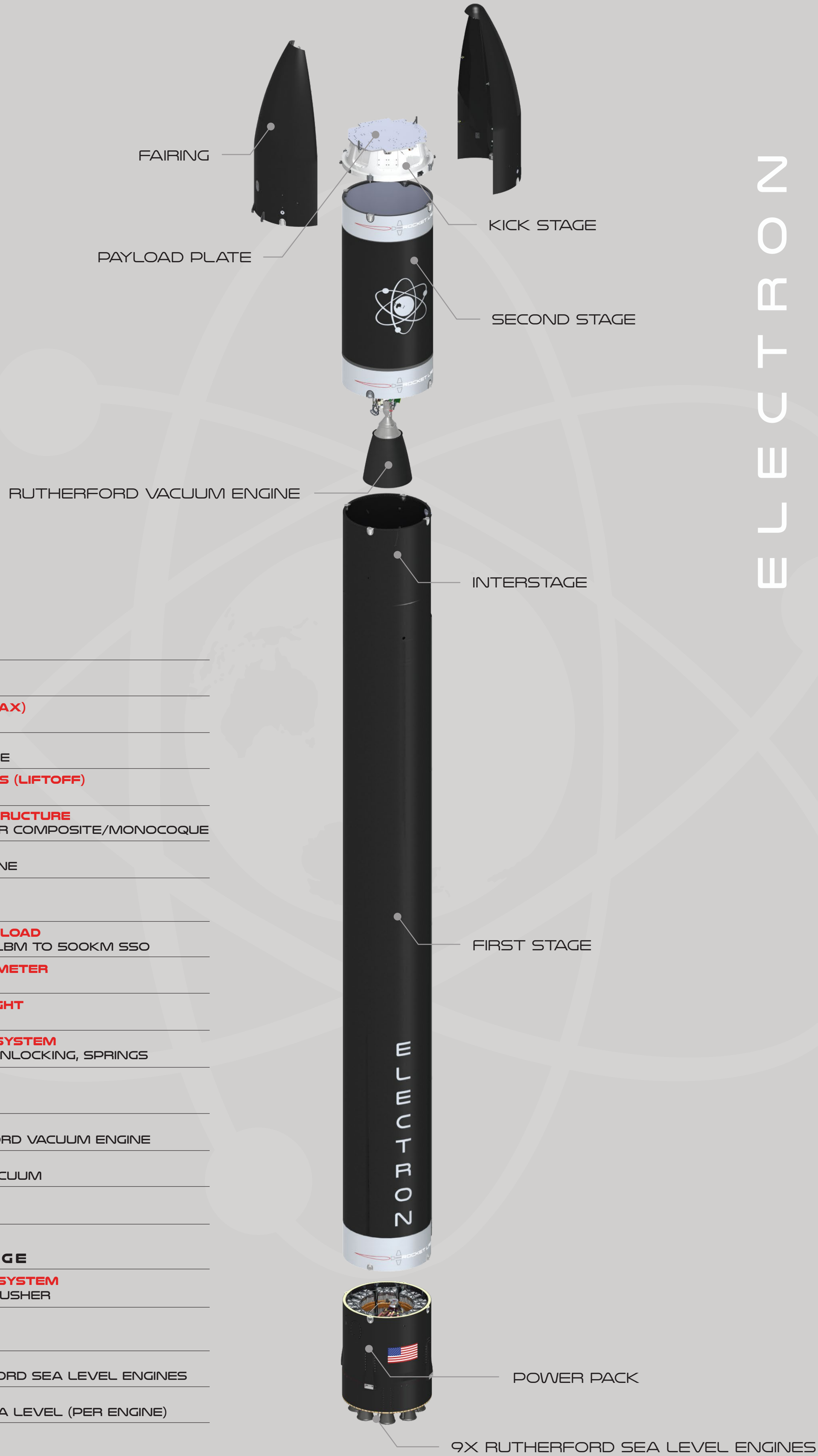
Designed, manufactured, and launched by Rocket Lab, Electron is a two-stage launch vehicle powered by liquid oxygen (LOx) and rocket-grade kerosene (RP-1). By incorporating an orbital transfer vehicle stage (Kick Stage) that can deploy multiple payloads to unique orbits on the same mission, Electron can support dedicated missions and rideshare options without the complexity and schedule risk typically associated with launching on medium or heavy lift launch vehicles.

Electron utilizes advanced carbon composite technologies throughout the launch vehicle structures, including all of Electron's propellant tanks. The all carbon-composite construction of Electron decreases mass by as much as 40 percent compared with traditional aluminum launch vehicle structures, resulting in enhanced vehicle performance. Rocket Lab fabricates tanks and other carbon composite structures in-house to improve cost efficiency and drive rapid production.

Electron is powered by the in-house designed and produced additively manufactured Rutherford engines. Since its first launch in 2017, Rocket Lab has released additional performance from Rocket Lab's Rutherford engines boosting the Electron's total payload lift capacity up to 300 kg / 660 lbm.

TAKE A LOOK INSIDE

ELECTRON



OVERALL

LENGTH
18M

DIAMETER (MAX)
1.2M

STAGES
2 + KICK STAGE

VEHICLE MASS (LIFTOFF)
13,000KG

MATERIAL/STRUCTURE
CARBON FIBER COMPOSITE/MONOCOQUE

PROPELLANT
LOX/KEROSENE

PAYLOAD

NOMINAL PAYLOAD
200KG / 220LBM TO 500KM SSO

PAYLOAD DIAMETER
1.08M

PAYLOAD HEIGHT
1.91M

FAIRING SEP SYSTEM
PNEUMATIC UNLOCKING, SPRINGS

STAGE 2

PROPULSION
1X RUTHERFORD VACUUM ENGINE

THRUST
5800 LBF VACUUM

ISP
343 SEC

INTERSTAGE

SEPARATION SYSTEM
PNEUMATIC PUSHER

STAGE 1

PROPULSION
9X RUTHERFORD SEA LEVEL ENGINES

THRUST
5600 LBF SEA LEVEL (PER ENGINE)

ISP
311 SEC

FIRST STAGE

Electron's first stage consists of nine sea-level Rutherford engines, linerless common bulkhead tanks for LOx and RP-1, and an interstage.

Rocket Lab's flagship engine, the 5,600 lbf (24 kN) Rutherford, is an electric pumped LOx/kerosene engine specifically designed for the Electron launch vehicle. Rutherford adopts an entirely new electric propulsion cycle, making use of brushless DC electric motors and high-performance lithium polymer batteries to drive its propellant pumps. This cuts down on much of the complex turbomachinery typically required for gas generator cycle engines, meaning that the Rutherford is simpler to build than a traditional engine but can achieve 90% efficiency. 130 Rutherford engines have been flown to space on Electron as of July 2020.

Rutherford is also the first oxygen/hydrocarbon engine to use additive manufacturing for all primary components, including the regeneratively cooled thrust chamber, injector pumps, and main propellant valves. The Stage 1 and Stage 2 Rutherford engines are identical, with the exception of a larger expansion ratio nozzle for Stage 2 for improved performance in near-vacuum-conditions. All aspects of the Rutherford engines are completely designed in-house and are manufactured directly at our Long Beach headquarters in California, USA.

Figure 2 First Stage Rutherford Engine

Figure 3 Rutherford Stage 1 Configuration

SECOND STAGE

Electron's second stage consists of a single vacuum optimized Rutherford engine, and linerless common bulkhead tanks for LOx and kerosene. With an expanded nozzle, Electron's second stage engine produces a thrust of 5,800 lbf and has a specific impulse of 343 sec.

The 1.2 m diameter second stage has approximately 2,000 kg of propellant on board. The Electron Stage 2 has a burn time of approximately five minutes with a Rutherford vacuum engine as it places the Kick Stage into orbit.

High Voltage Batteries (HVBs) batteries provide power to the LOx and kerosene pumps for the high-pressure combustion while a pressurant system is used to provide enough pump inlet pressure to safely operate. During the second stage burn, two HVBs power the electric pumps until depletion, when a third HVB takes over for the remainder of the second stage burn. Upon depletion, the first two HVBs are jettisoned from Electron to reduce mass and increase performance in flight.

The engine thrust is directed with electromechanical thrust vector actuators in two axes. Roll control is provided via a cold gas reaction control system (RCS).

KICK STAGE

Rocket Lab's Kick Stage offers our customers unmatched flexibility for orbital deployment. The Kick Stage is a third stage of the Electron launch vehicle used to circularize and raise orbits to deploy payloads to unique and precise orbital destinations. The Kick Stage is powered by Rocket Lab's in-house designed and built Curie engine.

In its simplest form, the Kick Stage serves as in-space propulsion to deploy payloads to orbit. It its most advanced configuration the Kick Stage becomes Photon, Rocket Lab's satellite bus that supports several-year duration missions to LEO, MEO, Lunar, and interplanetary destinations. Comprehensive information about the Kick Stage can be found on page 9.

Figure 4 The Kick Stage in orbit prior to payload deployment, 2019

FAIRING

Electron's payload fairing protects the payload from encapsulation through flight. Electron's payload fairing is a composite split clam shell design and includes environmental control for the payload. During separation, each half of the fairing is designed to rotate on a hinge away from the payload, resulting in a safe separation motion.

Figure 5 Rocket Lab's fairing in clean room 1 after encapsulation at Launch Complex 1

SAMPLE ELECTRON FLIGHT PROFILE

In this example flight profile (figure 6), payload deployment occurs approximately 3,000 seconds after liftoff for a standard dedicated mission to low Earth orbit. In this scenario, Electron's second stage inserts the Kick Stage into a low elliptical orbit, before the Kick Stage initiates a burn of the Curie engine to circularize into the final orbit. For rideshare missions requiring multiple deployments, as well as those requiring higher orbits, the Kick Stage performs multiple engine burns to raise orbits and deploy to different, precise orbits for each payload.

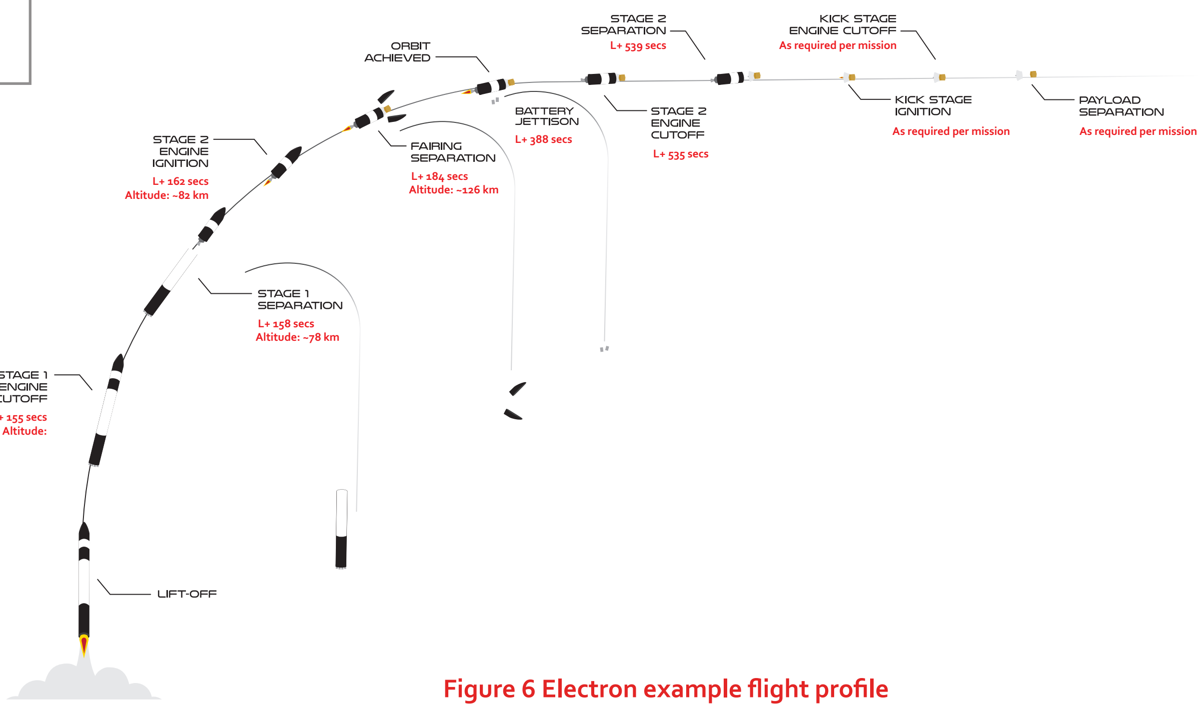


Figure 6 Electron example flight profile

2. THE KICK STAGE

UNRIVALED FLEXIBILITY FOR PRECISE ORBITAL DEPLOYMENT.

UNMATCHED FLEXIBILITY FOR ORBITAL DEPLOYMENT

The Rocket Lab Kick Stage is designed to deliver small satellites to precise and unique orbits, whether flying as dedicated or rideshare on Electron.

The Kick Stage enables missions that require:

- Deployment of payloads at multiple planes/inclinations, including constellations
- Higher altitude deployment
- Inclinations out of range of the launch vehicle
- Hosted payload support
- Multiple trajectory changes
- Sustained low altitude orbits
- Deorbiting

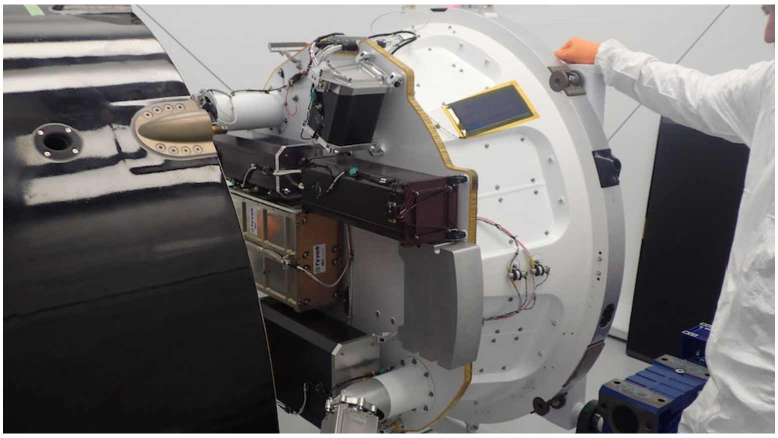


Figure 7 Rocket Lab's Kick Stage being intergrated with the fairing

The Kick Stage is powered by the in-house designed and manufactured Curie engine, a high-energy additively manufactured engine powered with a green bi-propellant. The Kick Stage also employs a cold gas reaction control system to precisely point itself and deploy satellites to independent yet highly precise orbits, and eliminate the risk of recontact with other spacecraft during deployment.

KICK STAGE SPECIFICATIONS

Height	**405 mm**
Diameter	**1.2 m**
Dry mass	**40 kg / 88 lbs (dry)**
Material	**Carbon composite**
Engine	**Curie**
Propellant	**Liquid bi-propellant**
Propellant storage	**Carbon composite tanks**
Number of thrusters	**6 reaction control thrusters (RCS) (2 pods)**
Thrust	**120 N**

Table 1 Kick Stage Specifications

In its simplest form, the Kick Stage serves as in-space propulsion to deploy payloads to orbit. In its most advanced configuration the Kick Stage becomes Photon, Rocket Lab's satellite bus that supports several-year duration missions to LEO, MEO, Lunar, and interplanetary destinations.

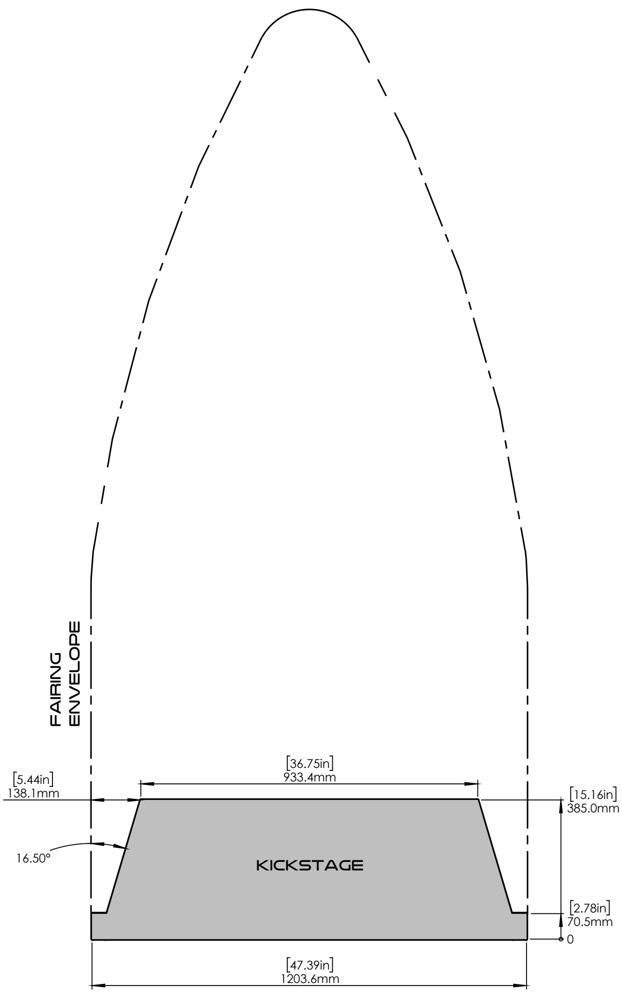


Figure 8 Rocket Lab's Kick Stage inside the fairing envelope

DEORBITING

As the small satellite industry experiences rapid growth, Rocket Lab is determined to be part of the solution for sustainability and the reduction of orbital debris in space. Traditional methods of deploying satellites can leave large rocket stages in orbit, contributing to the global issue of space debris. The Kick Stage has been designed with the capability to deorbit itself on an accelerated time scale, well before the 25 year deorbit guidelines stipulated by NASA. By performing a deorbit burn with the Curie engine, Rocket Lab can lower the Kick Stage's perigee to increase aerodynamic drag on the spacecraft and cause it to deorbit within months or single digit years, as required.

EXTENDED MISSIONS

For missions that require extended payload support on orbit, or for missions exceeding 2,000 km to MEO, lunar, or interplanetary destinations, Rocket Lab offers the Photon spacecraft bus, a high-performance evolution of the Kick Stage. Photon is a configurable, modular spacecraft designed to accommodate a variety of payloads and instruments without significant redesign. Photon is equipped with radiation-tolerant avionics, deep space-capable communications and navigation technology, and high-performance space-storable propulsion capable of multiple restarts on orbit. With the capacity to both host an external payload and perform secondary mission objectives as a separate operational spacecraft, Photon has been designed for dedicated mission or as a rideshare option without the programmatic complexity, expanded cost, and schedule risk typically experienced when launching with a medium or heavy lift launch vehicle. For more comprehensive information about Photon, please contact the Rocket Lab team via launch@rocketlabusa.com

Figure 9 Photon LEO configuration (propulsion angle)

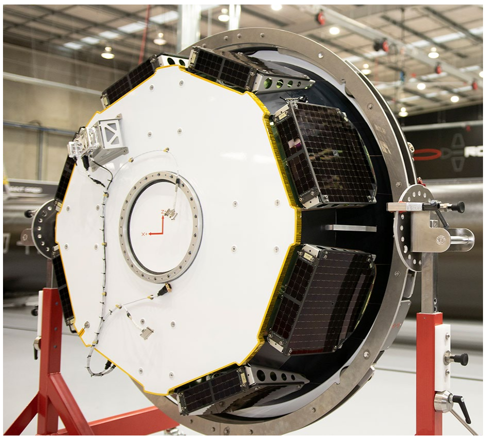


Figure 10 Photon LEO configuration (payload plate view)

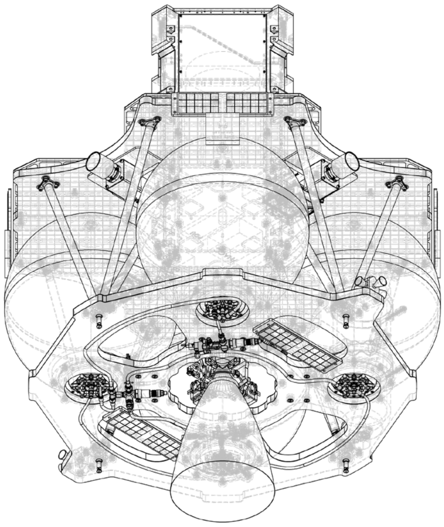


Figure 11 Photon interplanetary configuration

3. PERFORMANCE OVERVIEW

ELEGANT DESIGN.
EXCEPTIONAL PERFORMANCE.

ELECTRON VEHICLE PERFORMANCE

Electron is designed to place payloads of up to 200 kg into a circular SSO at 500 km altitude, however we can accommodate a wide range of different payload and orbit requirements. One of the most common orbits requested by customers is a Sun-synchronous orbit (SSO), which is shown in Figure 12.

Rocket Lab operates two launch sites; Launch Complex 1 on New Zealand's Māhia Peninsula, and Launch Complex 2 within the Mid-Atlantic Regional Spaceport at the NASA Wallops Flight Facility in Virginia.

From Launch Complex 1, Electron can be flown on trajectories of inclinations ranging from 39 degrees to 120 degrees. Additional inclinations outside of this range may also be possible upon request.

From Launch Complex 2, Electron can be flown on trajectories of inclinations ranging from 38 degrees to 60 degrees. Additional inclinations outside of this range may also be possible upon request.

ELECTRON PERFORMANCE CURVES

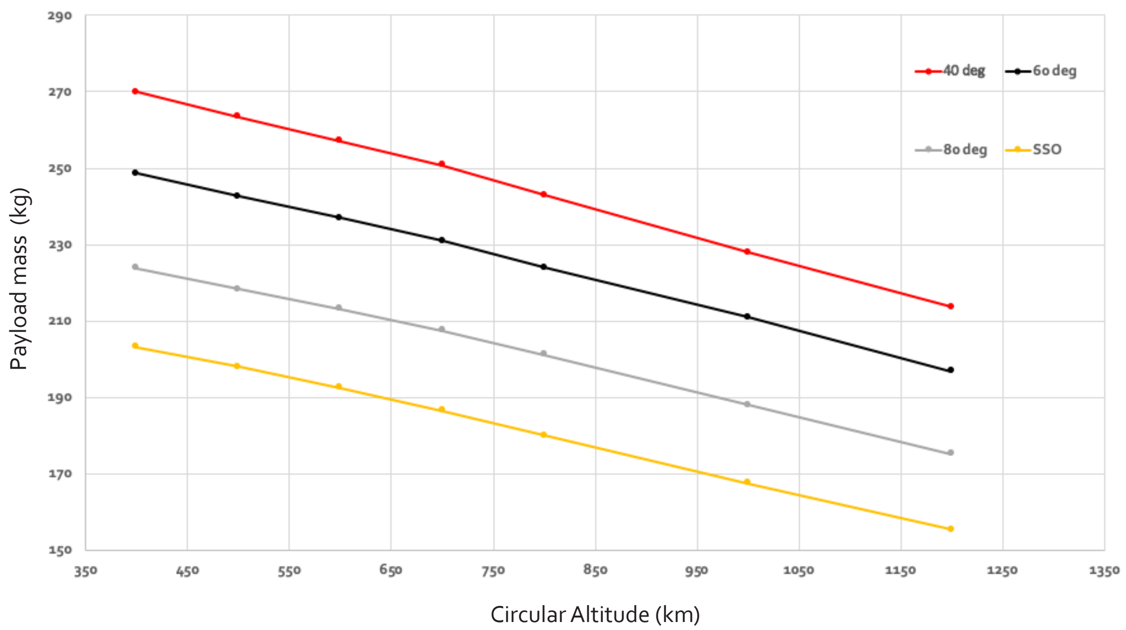


Figure 12 Performance to Circular Orbits

For customers seeking non-traditional orbits, Figure 13 below represents the maximum performance for an elliptical orbit launched due east from the Mahia launch site.

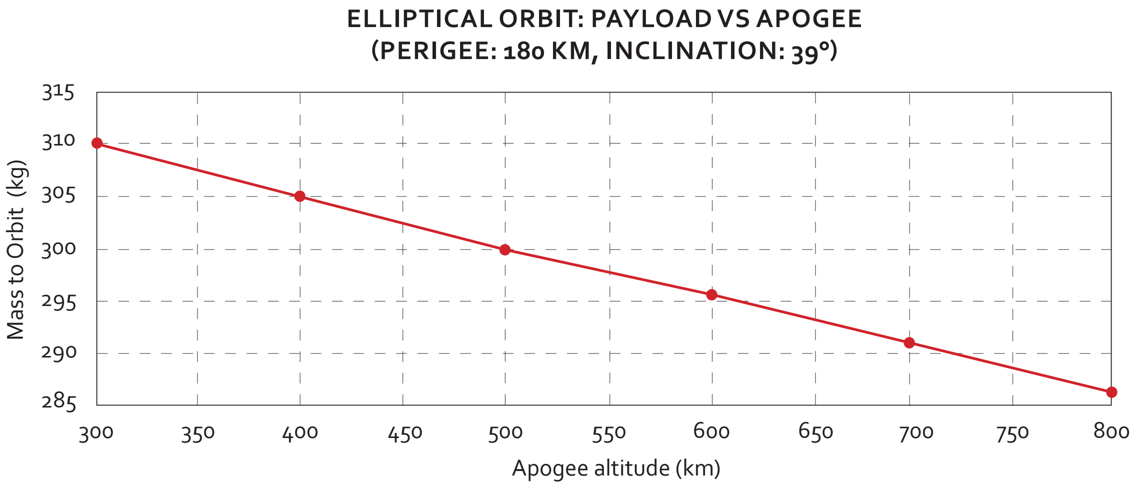


Figure 13 Performance to a 180 km Perigee at 39° Inclination Elliptical Orbit

ORBIT INJECTION ACCURACY

Electron can achieve the following target mission injection accuracies for a typical mission to 500 km SSO, as shown in Table 2. Note that mission-specific payload injection accuracies will be calculated as part of mission analysis at Rocket Lab.

Inclinations	**+/- 0.15 deg**
Perigee	**+/- 15 km**
Apogee	**+/- 15 km**

Table 2 Orbit Injection Accuracy

ATTITUDE AND DEPLOYMENT RATES

Electron can achieve the following target mission injection accuracies for a typical mission to 500 km SSO, as shown in Table 3. Note that mission-specific payload injection accuracies will be calculated as part of mission analysis at Rocket Lab.

Attitude	+/- 5 deg
Rates	+/- 1.5 deg/s

Table 3 Deployment Rates

The onboard cold gas thruster attitude reaction control system (RCS) of the Kick Stage will provide the capability to hold a nominal attitude prior to separation of the payload, resulting in low deployment attitude and rate margins. Mission-specific values will be provided by Rocket Lab.

4. AVIONICS

HIGH-PERFORMANCE FLIGHT
COMPUTER SYSTEMS.

HIGH-PERFORMANCE FLIGHT COMPUTER SYSTEMS

Rocket Lab has designed high-performing avionics and flight computer systems, including in-house assembly and testing. The computing nodes make use of state-of-the-art Field Programmable Gate Array (FPGA) architecture, allowing massive customization of function while retaining hardware commonality.

Rocket Lab performs avionics validation not only at the component level, but also in our sophisticated hardware-in-the-loop (HITL) test facility which allows for integrated launch vehicle and software simulation and testing.

The Electron launch vehicle is equipped with a proven, Federal Aviation Authority (FAA) certified autonomous flight termination system which has been in use on Electron since 2019. The system safely terminates the flight of the vehicle automatically if mission rules are violated.

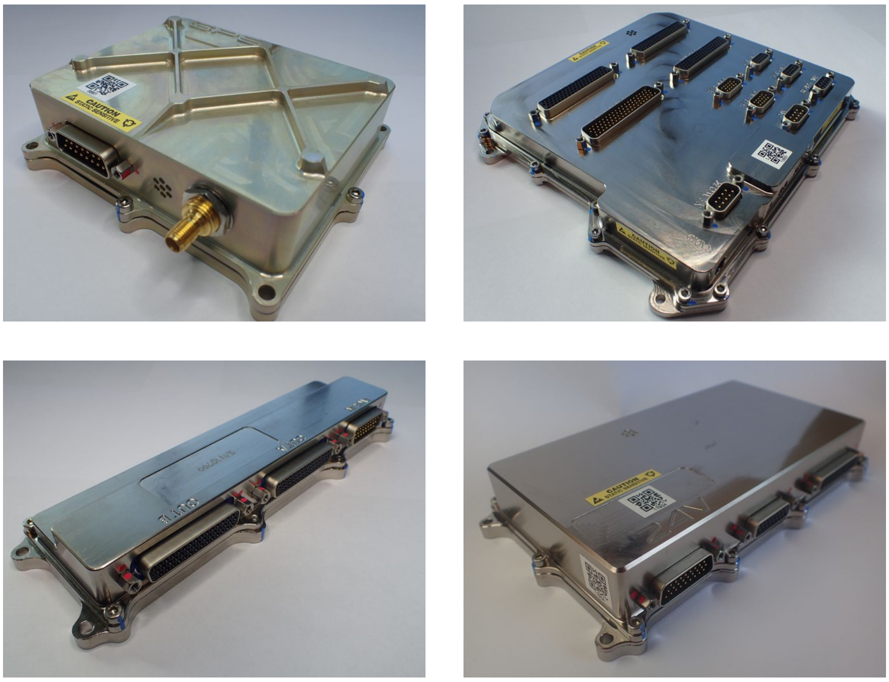


Figure 14 Rocket Lab Avionics

5. PAYLOAD ACCOMMODATION

MAKE YOURSELF AT HOME.

THE FAIRING

Electron's payload fairing is a composite split clam shell design and includes environmental control for the payload. During separation, each half of the fairing is designed to rotate on a hinge away from the payload, resulting in a safe separation motion.

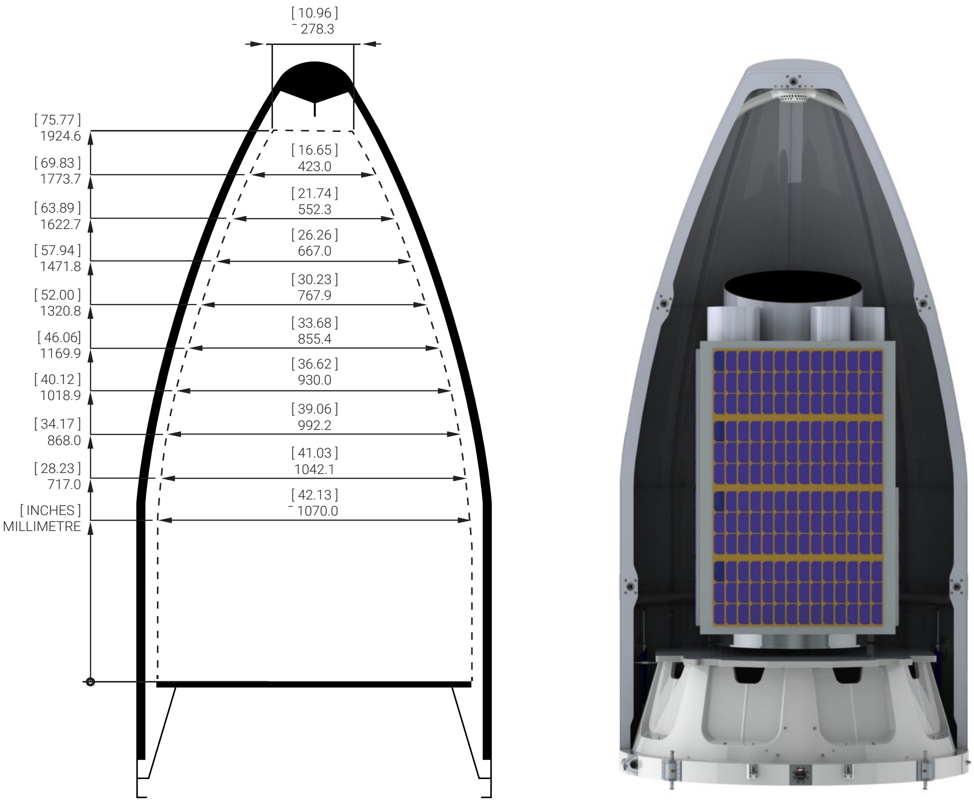


Figure 15 Fairing capacity & sample configuration inside of the fairing

SPECIFICATION	VALUE
Length	**2.5 m**
Diameter (maximum)	**1.2 m**
Mass	**44 kg**
Acoustic Protection	**Foam Sheets**
Separation System	**Pneumatic Unlocking, Springs**

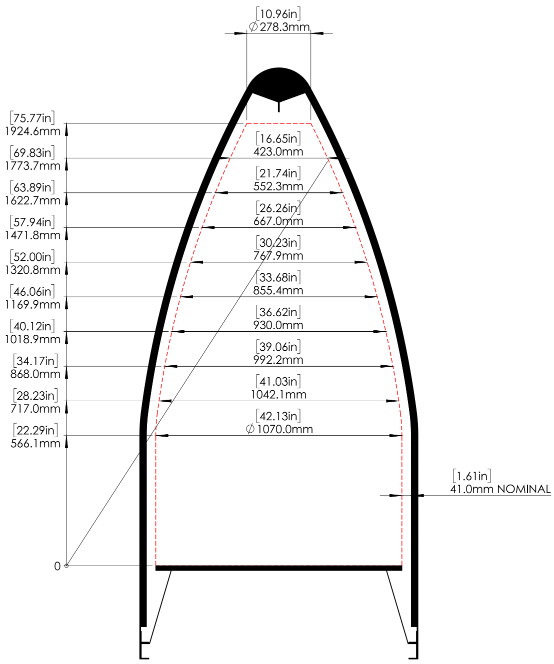
Table 4 Electron fairing specifications

EXPANDED FAIRING OPTIONS

Rocket Lab can develop custom solutions for customers with payloads that exceed the standard envelope.

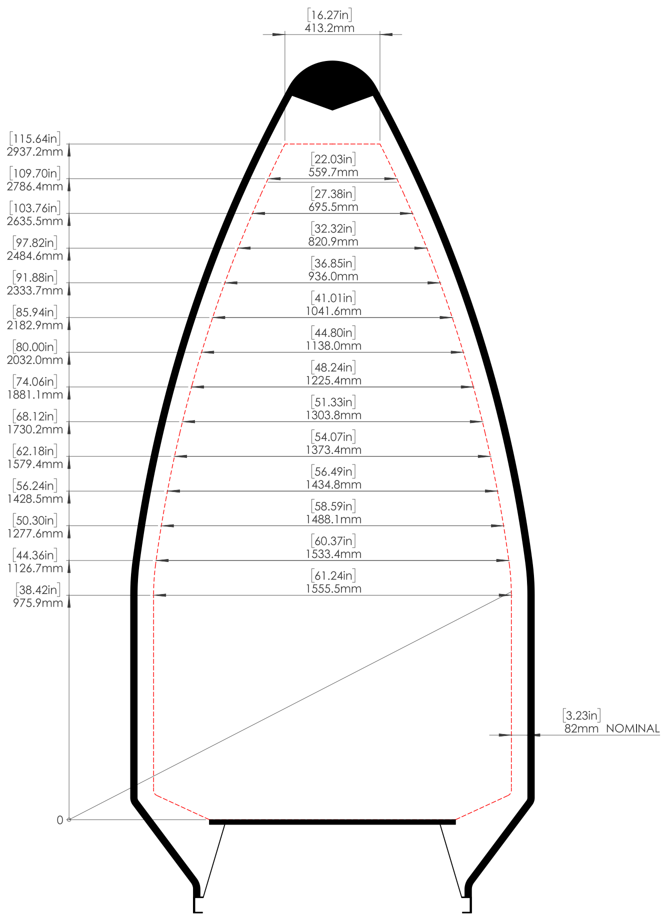
To explore an expanded fairing option for your mission, contact the Rocket Lab team via launch@rocketlabusa.com.

Expanded fairings are a non-standard service and are only available for missions with a mission integration schedule exceeding 12 months.



STANDARD ELECTRON FAIRING

Figure 16 Standard Electron Fairing



EXPANDED ELECTRON FAIRING

Figure 17 Expanded Electron Fairing

PAYLOAD PLATE

The primary means of attachment between the Electron launch vehicle and the customer payload is via the Payload Plate, which typically forms the direct interface between the spacecraft separation system and the launch vehicle. For rideshare missions, multiple spacecraft separation systems may be mounted directly to the payload plate or Rocket Lab may recommend the use of a multiple payload adapter, to make best use of the available space within the fairing. Customers can provide their own adapters or Rocket Lab can provide one as a non-standard service.

Approximately 1 m in diameter, Rocket Lab's Payload Plate is a honeycomb composite structure which is customized with an interface bolt pattern specifically to match the customer's requirements. Payload Plate configurations can be customized to accept single or multiple satellites, independent of whether they are CubeSat or microsatellite form factors.

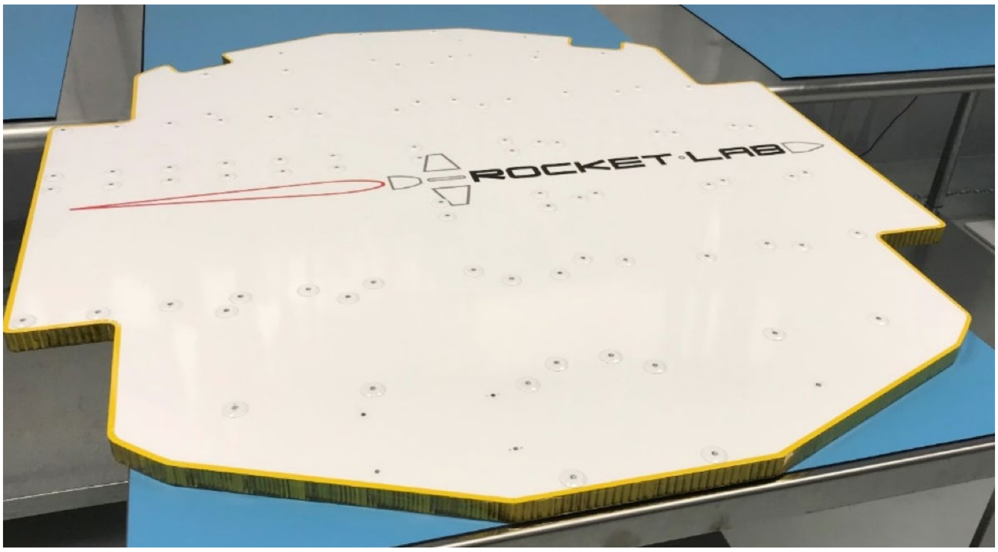


Figure 18 Rocket Lab payload plate

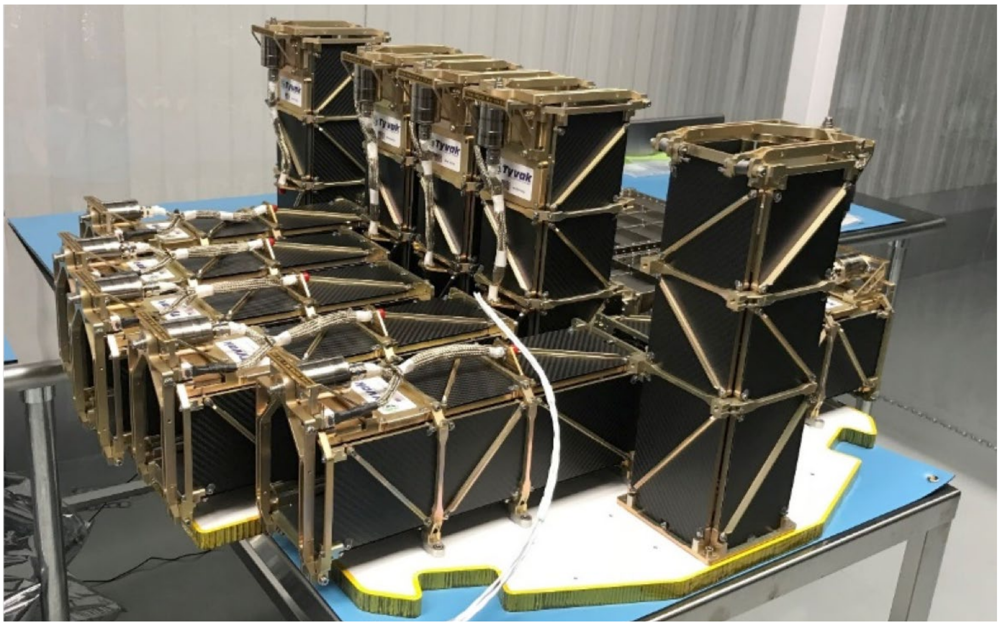


Figure 19 Rocket Lab payload plate, payload configuration for NASA ELaNa-19 mission

PAYLOAD ELECTRICAL INTERFACES

The Electron offers a Standard Electrical Interface Panel (SEIP) for connecting one or more spacecraft separation systems. Details of this interface are provided in the mission specific ICD. As a non-standard service, a payload electrical umbilical, available from spacecraft mate to the launch vehicle, through day of launch, is available for customer use. The umbilical provides up to ten twisted shielded pairs and ethernet connectivity, allowing Customers to charge and monitor spacecraft during integration and post-encapsulation. If this service is utilized, an electrical ground support equipment interface panel will be accessible in the client room, hangar and in a customer equipment room near the launch pad. Umbilical harness specifications will be defined in the mission specific ICD and provided in accordance with contractual requirements.

SEPARATION SYSTEMS

For CubeSat customers, Electron has been designed to support all commercially available payload separation systems, both mechanically and electrically. Electron has the added capability to deploy multiple separation systems during a single mission, enabling rideshare missions without additional sequencer hardware. Rocket Lab can procure the separation system on a customer's behalf, integrate a customer supplied system, or supply a Rocket Lab-developed separation system – such as our Maxwell series of CubeSat dispensers.

For microsatellites customers Electron is designed to support the RUAG Clamp-band, Planetary Systems Corp Motorized Light-band and 4-point Hold Down separation systems. Please contact Rocket Lab for compatibility of other separation systems.

Rocket Lab has worked with RUAG to offer the PAS 381S separation system. The PAS 381S is perfectly sized for Electron-class dedicated payloads and is cross compatible with the standard 15" ESPA interface that many small satellites have been designed to. The PAS 381S can be configured for flight in advance of the spacecraft arrival at the launch site, so all that remains is the installation of bolts at the mechanical interface and any required electrical connections or hookups. The RUAG PAS 381S for Electron has also been designed to accommodate a fly-away electrical umbilical interface, for those customers who require power or connectivity during post-encapsulation and on-pad operations.

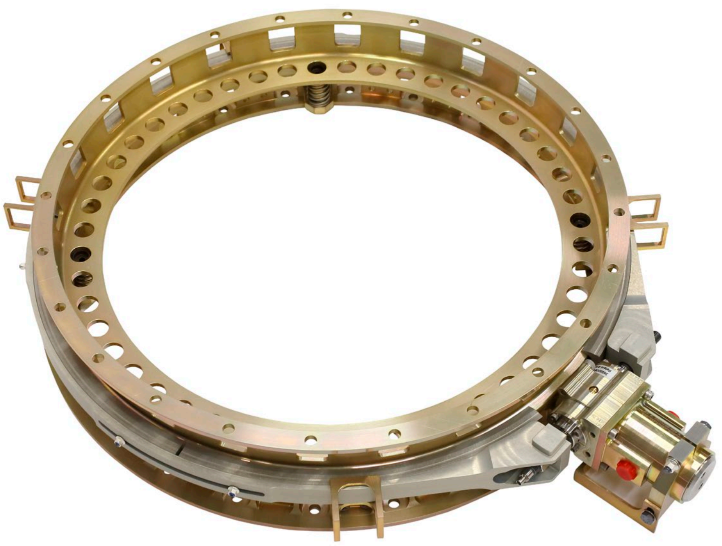


Figure 20 PAS 381S separation system

Rocket Lab has worked with Planetary Systems Corp (PSC) to offer multiple Motorized Light-Band (MLB) diameters specifically suited to the footprint of the spacecraft. The MLBs that are compatible with the Electron mechanical interface are 8" through 24" diameters. The MLB integration at the launch site utilizes Rocket Lab or customer provided standard electrical test hardware compatible with all MLB's and the PSC CSD CubeSat dispenser available from PSC. The MLBs for Electron have also been designed to accommodate a fly-away electrical umbilical interface, for those customers who require power or connectivity during post-encapsulation and on-pad operations.

Figure 21 PSC Motorized Light Band (MLB) separation system

6. FLIGHT ENVIRONMENTS

THE SMOOTHEST RIDE TO ORBIT.

THE SMOOTHEST RIDE TO ORBIT

Electron's payload environments provide the most secure and smooth ascent to orbit on the market.

Rocket Lab can perform a mission specific Integrated Thermal Analysis (ITA) as part of the launch service statement of work on request, including incorporating data from previous flights to further refine launch environments. The loads and environments provided in this section are for reference only – final mission environments are provided to customers via the mission specific interface control document (ICD). The environments represent the flight level maximum predicted environment (MPE) at the top of the payload plate and do not include any additional margin for testing of spacecraft. Rocket Lab recommends customers follow the guidelines in GSFC-STD-7000 for spacecraft testing margins.

FAIRING THERMAL AND HUMIDITY ENVIRONMENT

The fairing environment is controlled from encapsulation through deployment, with a maximum relative humidity of 65%. A standard mission will experience free molecular heating around 1135 W/m^2 at fairing deployment.

Rocket Lab can perform a mission specific thermal analysis encompassing events from roll-out to orbital deployment on request.

ACCELERATION LOADS

The payload will be subjected to a range of axial and lateral accelerations during flight. The maximum predicted load factors will typically be within the envelope shown in the Figure below. This envelopes both static and dynamic loads. Mission specific accelerations will be determined via coupled loads analysis and provided in the mission ICD.

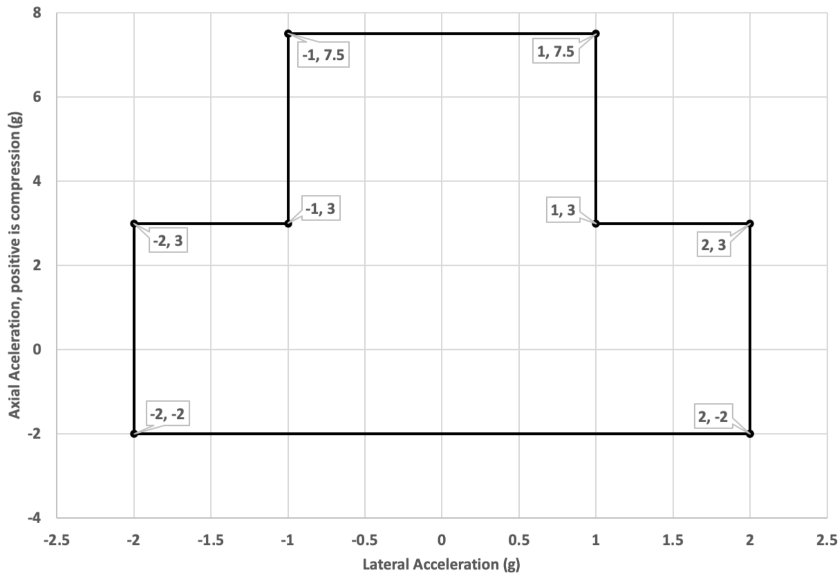


Figure 22 Electron Acceleration MPE

SHOCK

The maximum predicted shock response at the Payload Plate from all sources of launch vehicle shock is shown below in Figure 23 and Table 6.

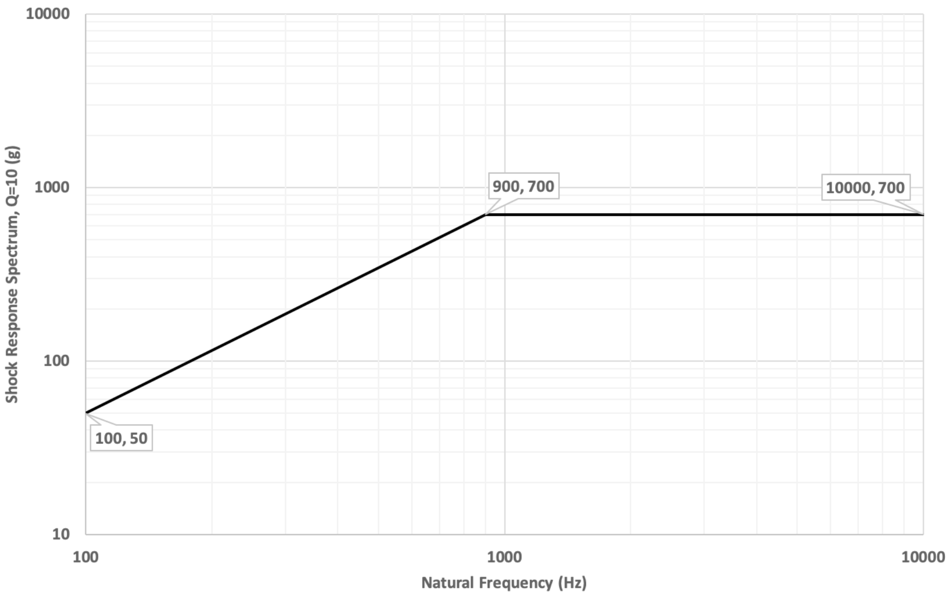


Figure 23 Electron Shock MPE

FREQUENCY(HZ)	SRS ACCELERATION
100	**50**
900	**700**
10000	**700**

Table 5 Electron Shock MPE

ACOUSTICS

The maximum predicted acoustic environment within the Payload Fairing will be at or below the levels shown in Figure 24, below.

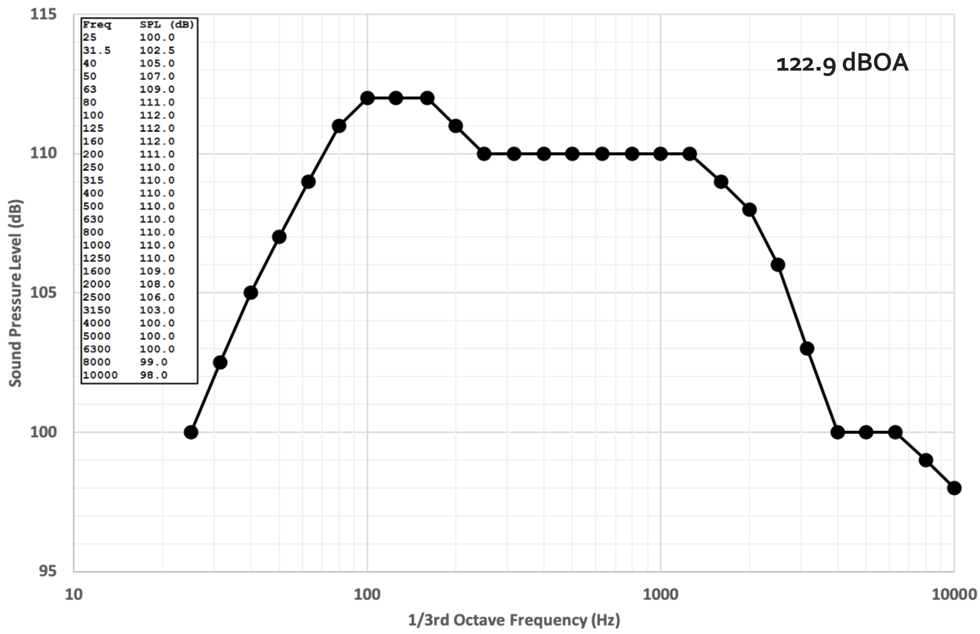


Figure 24 Electron Acoustic MPE

RADIO FREQUENCY

Electron radiates radio frequency emissions in three frequency bands. These emissions come from omnidirectional antennas mounted around and under the ring of the Kick Stage and from the body of the lower stages. Payloads can expect to experience an electric field from these emissions no worse than the levels in the table below. Some frequency adjustments may be able to occur within these bands to accomplish inter-compatibility if required.

FREQUENCY BAND (MHZ)	OPERATING PERIOD	ELECTRON ANTENNA TO MOUNTED PAYLOAD (MM)	E-FIELD DURING LAUNCH (V/M)
401-402	Orbital Phase	150	41.7
2200-2290	Entire Mission	350	15.6
2360-2395	Boost Phase	500	24.5

Table 6 The worst case radiated emissions during launch and at the time of payload activation

RANDOM VIBRATION

The curves below specify the Maximum Predicted Random Vibration Environment for CubeSat and MicroSat class payloads integrated to the Electron launch vehicle. The levels combine predicted environments and flight data, and are supplied at the spacecraft interface. Customer specific test levels and notching strategies will be reviewed by Rocket Lab on a mission specific basis.

CubeSat Class MPE: Applicable for satellites with a total mass no greater than 30 kg.
MicroSat Class MPE: Applicable for satellites with a total mass greater than 30 kg.

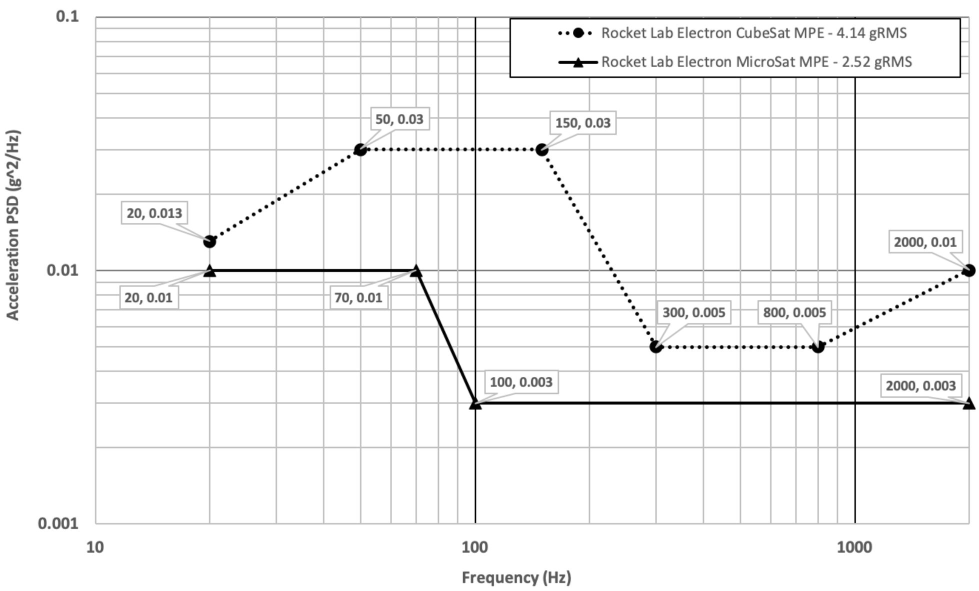


Figure 25 Electron Random Vibration MPE

VENTING

The fairing compartment depressurization rate is less than 2.0 kPa/sec, apart from a short period during transonic flight with a duration of no longer than 5 seconds. The maximum depressurization rate during transonic flight is no greater than 3.7 kPa/sec. A typical profile of depressurization rate and absolute pressure in the fairing are provided, but is subject to specific trajectory.

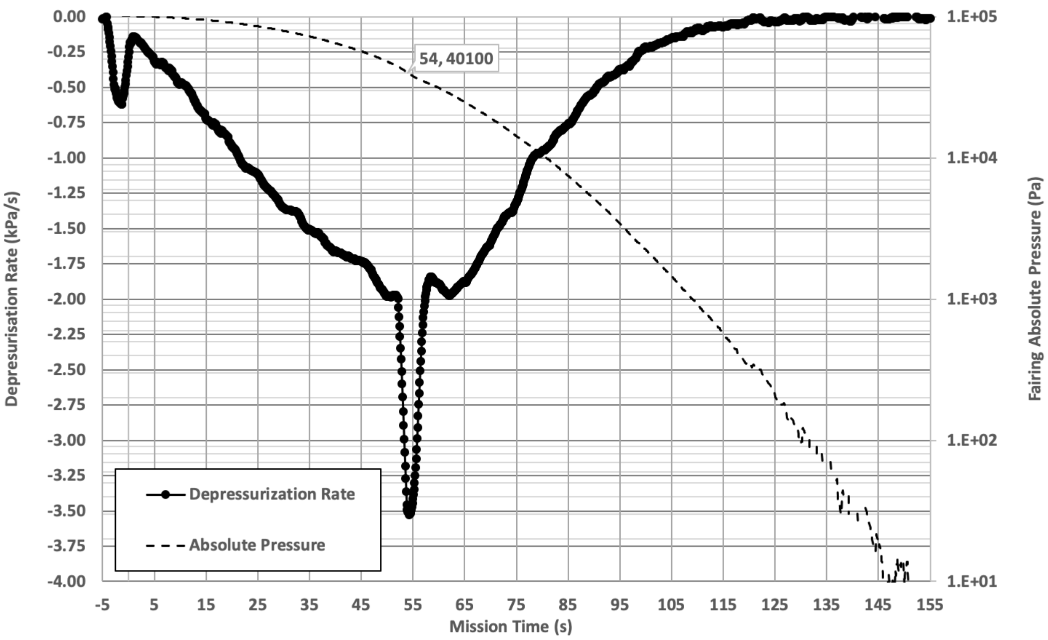


Figure 26 Electron Typical Fairing Venting Environment

7. LAUNCH SITES AND FACILITIES

LAUNCH SITES

Rocket Lab operates two launch sites comprising a total of three pads for the Electron launch vehicle. Between the two sites, located in Māhia, New Zealand, and Virginia, Rocket Lab offers more than 130 launch opportunities every year. This means our customers enjoy unmatched flexibility for their launch location and schedule.

LAUNCH COMPLEX 1, MAHIA, NEW ZEALAND

Rocket Lab operates the world's only private orbital launch range, Launch Complex 1. The Māhia Peninsula-based complex is licensed by the FAA and can support up to 120 launches per year. The site is located at (39.262°S, 177.865°E) in the Hawke's Bay, New Zealand.

Rocket Lab operates two pads at Launch Complex 1; Pad A and Pad B. The operation of two launch pads within the launch complex eliminates the time currently required between launches for a full pad recycle. This enables truly responsive launch opportunities, providing Rocket Lab with the ability to launch back-to-back within hours – not days, weeks or months.

Figure 27 Rocket Lab's Launch Complex 1, Pad A

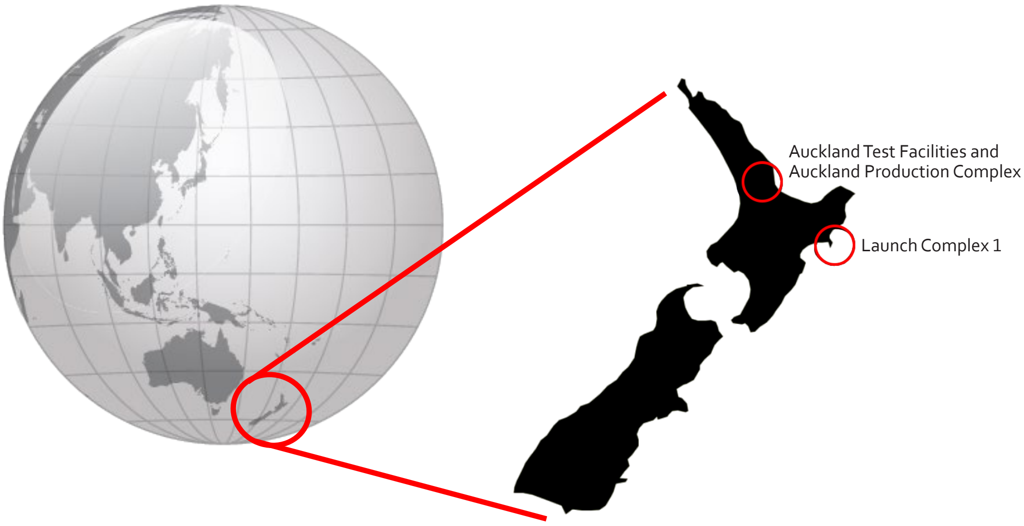


Figure 28 New Zealand Locations

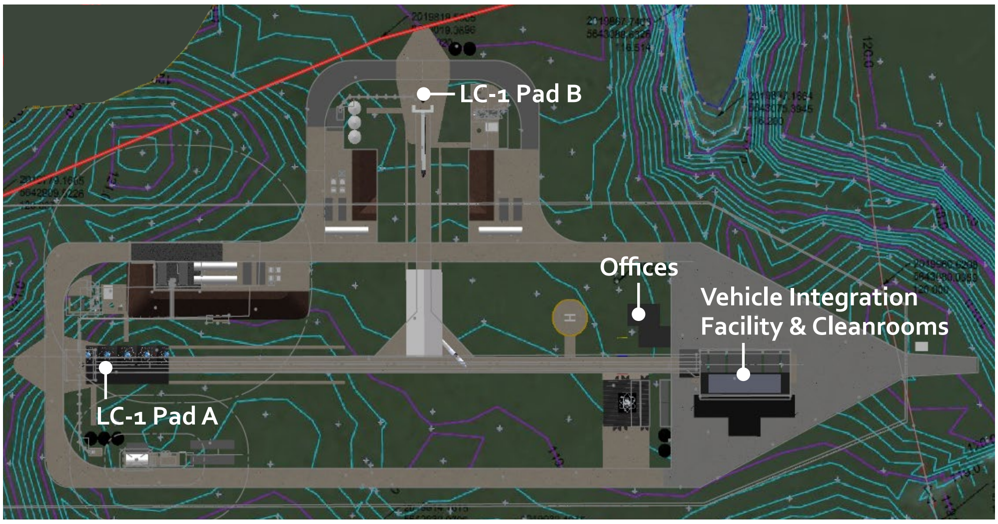


Figure 29 Launch Complex 1 Layout

The launch site also includes a Command and Control Facility located 2.5 km from the launch pad. This location houses workstations for flight safety, payloads, launch vehicle teams, and the launch director. This is also the location of the tracking antennas on the day of launch, supported by a downrange facility on the Chatham Islands.

Figure 30 Electron at Launch Complex 1 - Pad A

Figure 31 Electron inside Launch Complex 1's Vehicle Integration Facility

LAUNCH COMPLEX 2, WALLOPS ISLAND, VA, USA

Rocket Lab operates a launch site for the Electron launch vehicle from a dedicated pad located at the Mid-Atlantic Regional Spaceport within the NASA Wallops Flight Facility in Virginia. Launch Complex 2 represents a new responsive launch capability for the United States on home soil.

The complex is tailored for U.S. government small satellite missions, but it can support commercial missions as required. Launch Complex 2 can support up to 12 missions per year.

The site is located at 37. 834°N, 75.488°W and can support launches to inclinations between 38 and 60 degrees.

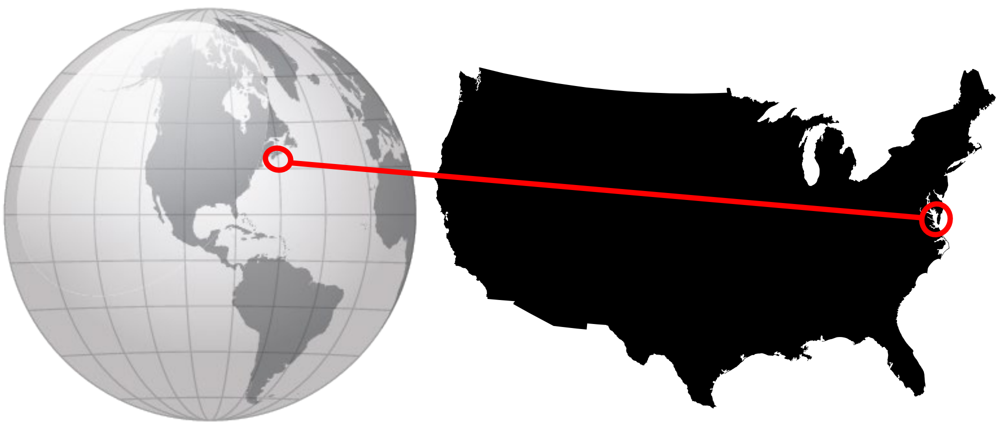


Figure 32 Launch Complex 2's Location

Rocket Lab also operates an Integration and Control Facility (ICF) within the Wallops Research Park. This facility is dedicated to secure vehicle and payload processing facilities. The facility can process several Electron vehicles concurrently, enabling rapid and responsive launch opportunities.

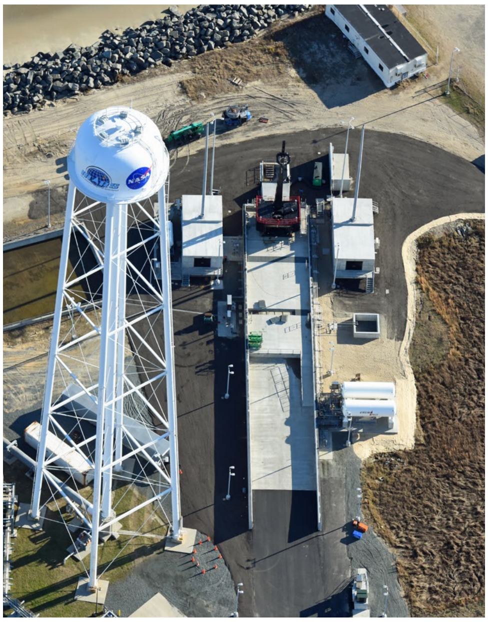


Figure 33 Electron at Launch Complex 2

Figure 34 Electron at Launch Complex 2

Figure 35 Rocket Lab ICF and LC-2 Locations

OTHER ROCKET LAB FACILITIES

In addition to the two launch complexes, Rocket Lab operates a manufacturing headquarters in Long Beach, California, a production complex in Auckland, New Zealand, and test facilities in New Zealand.

ROCKET LAB HEADQUARTERS – LONG BEACH, CA

Rocket Lab USA headquarters are based in Long Beach, California, five minutes from Long Beach Airport and less than an hour from Los Angeles International Airport. Rocket Lab has dedicated a portion of HQ specifically to our customers, with meeting areas, office space, and a Customer Control Center with connectivity to Auckland, Mahia, and any future launch sites. Rocket Lab HQ includes production, payload processing, and office facilities. Rocket Lab's Mission Management team is based within headquarters as well.

Figure 36 Rocket Lab's Long Beach HQ

Figure 37 Rocket Lab's Long Beach Production Facilities

ROCKET LAB AUCKLAND PRODUCTION COMPLEX, NEW ZEALAND

Rocket Lab's Auckland Production Complex is located 20 minutes from the Auckland International Airport in New Zealand. This facility is the location of Rocket Lab's Research and Development team, and includes engineering, manufacturing, and test personnel under one roof. In addition, Rocket Lab Mission Control is also based in the Auckland Facility. The Mission Control facility also includes a dedicated Customer Mission Operations Room, for use during the launch campaign.

Rocket Lab's engine test cell and stage test cell are also conveniently located within driving distance of the Auckland office.

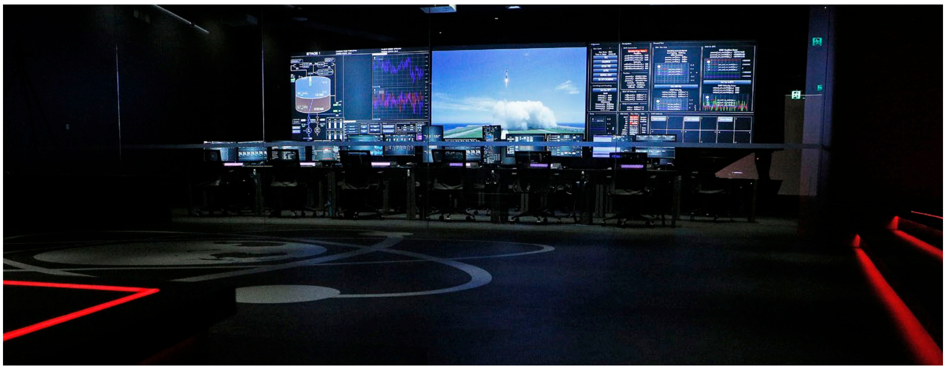


Figure 38 Rocket Lab's Mission Control

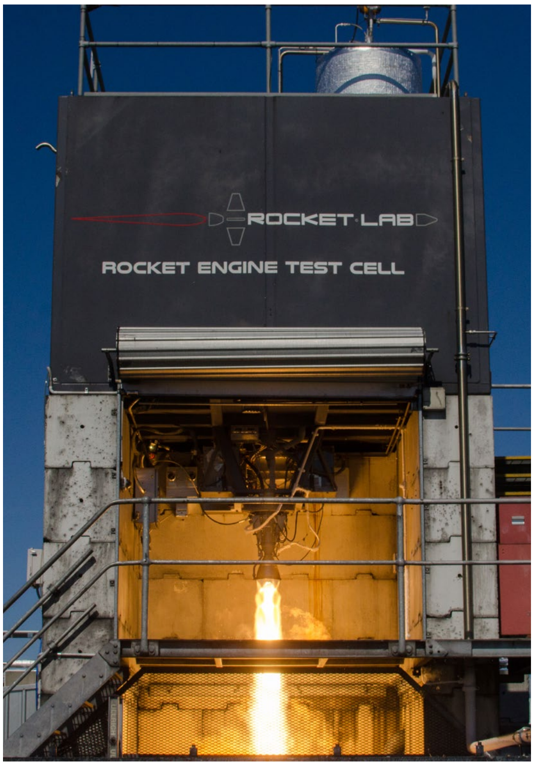


Figure 39 Rocket Lab's Engine Test Cell in Auckland

SAFETY

Rocket Lab ensures safety of people and property at all launch and processing facilities through compliance with GSFC-STD-8009 WFF Range Safety Manual for all spacecraft and ground support equipment. Compliance with AFSPCMAN 91-710 will be considered as an alternative at the discretion of range safety.

Hazardous systems and operations typically include chemical, electrical, lifting, mechanical, ordnance, pressurized, propulsion, and radiation systems. Details of these and other systems may be required in the range safety process to assess the hazards and implement controls. Safety controls could include clear zones or verification in procedure.

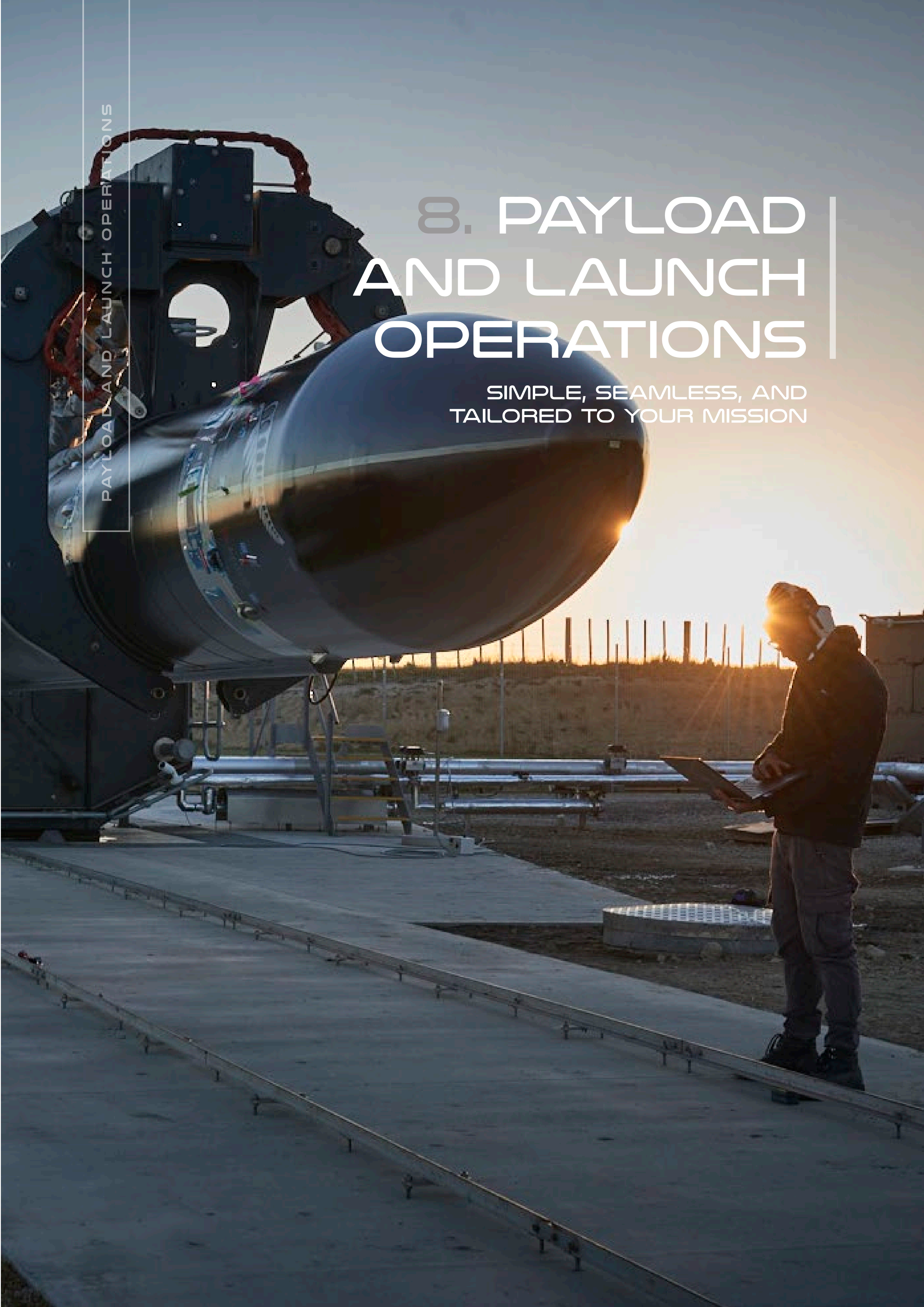
Where requirements are not applicable, or an acceptable level of safety is otherwise achieved, range safety should be engaged for tailoring. Waivers are not considered standard practice.

SECURITY

Rocket Lab's security offering provides our clients with total confidence that their security expectations will be met. Proactive environmental scanning, integrated security barriers and systems, 24/7 manned guarding, local authority liaison and coordinated response plans all provide a highly secure launch environment. On top of that, segregated client suites and clean rooms with additional access control, CCTV and alarm systems allow our clients to take real security ownership of their space. As a non-standard service we can offer payload security transport planning and escort services from point of arrival to launch site. Our professional security staff will consult with you to meet your specific security requirements.

8. PAYLOAD AND LAUNCH OPERATIONS

SIMPLE, SEAMLESS, AND TAILORED TO YOUR MISSION



PAYLOAD PROCESSING AND LAUNCH OPERATIONS

Payload integration and launch operations have been designed to be simple, seamless, and tailored to your mission. This section covers the typical processing flow of standard Electron missions from Rocket Lab's two launch sites: Launch Complex 1 in Māhia, New Zealand and Launch Complex 2 in Virginia. Rocket Lab can tailor standard payload processing and launch procedures to specific mission requirements as needed.

Customers have the choice of processing their payload at Rocket Lab's state-of-the art payload processing facility (PPF) in Māhia, New Zealand at Launch Complex 1, or at either of the two Rocket Lab PPFs in development in the U.S at Long Beach, California (Rocket Lab Headquarters, and Wallops Island, Virginia (Launch Complex 2).

The facilities include ISO 8 cleanrooms, dedicated electrical control rooms, and comfortable customer lounge style offices.

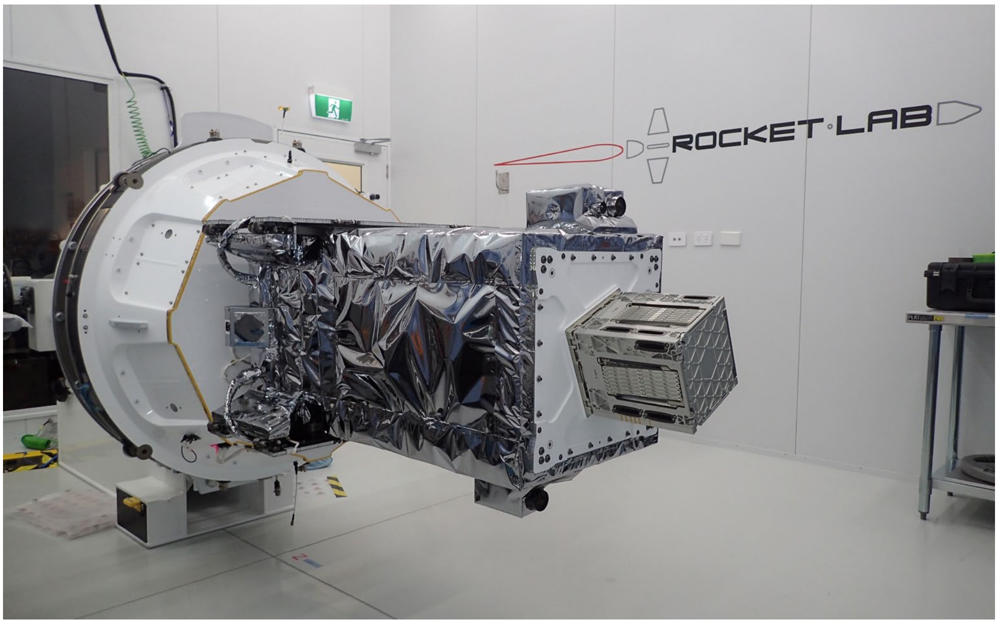


Figure 40 DARPA Spacecraft Intergrated with Rocket Lab's Kick Stage

STANDARD SERVICES AND EQUIPMENT AVAILABLE AT THE PAYLOAD PROCESSING FACILITIES INCLUDE:

- Certified ISO 8 cleanliness level (Class 100K)
  - Relative Humidity: 40-60%
  - Temperature: 63-77°F
- Pass-through between the customer control room and the cleanroom for electrical cables
- Power provided for customer electrical ground support equipment at Standard 110VAC @60Hz (RLHQ) and 230VAC @ 50 Hz (LC-1) Power
- Overhead crane for payload integration operations
- Compressed air, helium, and nitrogen
- Consumables including isopropyl alcohol, lint free wipes, gloves, gowns, hair nets
- Security is tailored to customer and mission requirements. Available measures include electronic access control, 24-hour facility security guards, closed-circuit video monitoring
- Rocket Lab integration support personnel
- Comfortable lounge style offices and conference rooms with wi-fi, printer, copier, and coffee facilities

ADDITIONAL NON-STANDARD SERVICES AVAILABLE

- Live video feed into the cleanrooms for remote monitoring of payload integration activities
- Fueling carts and procurement of "green" propellants
- Payload EGSE Room Adjacent to Launch Pad
- Customer Range Control Center

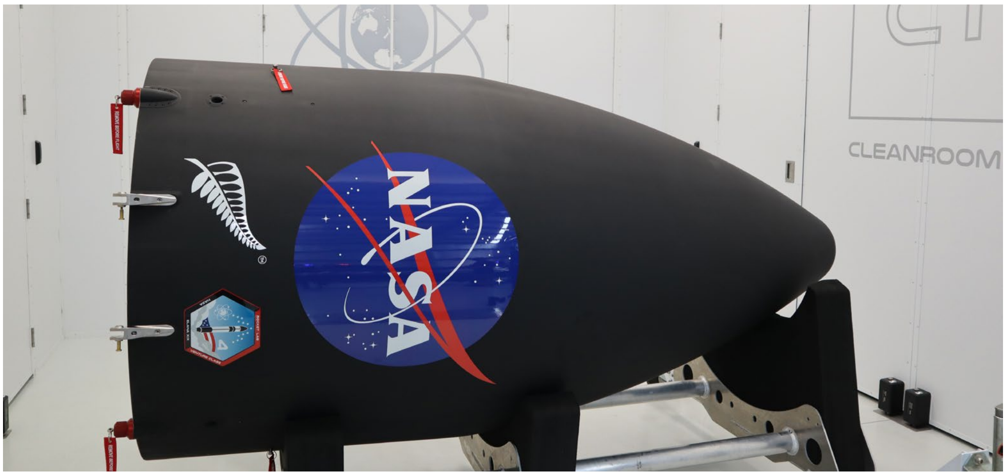


Figure 41 Electron's Fairing For Nasa ELaNa-19 Mission

Figure 42 Flight 7 'Make It Rain' Payloads Intergrated With Rocket Lab's Kick Stage

Figure 43 Launch Complex 1, Clean Room 1 Customer Lounge

PAYLOAD PROCESSING FACILITY LAYOUTS

LAUNCH COMPLEX 1, MAHIA

The Payload Processing Facility at LC-1 includes dual customer spacecraft processing areas consisting of a single airlock, dual cleanrooms and gowning rooms, and two separate client areas adjacent to the cleanrooms. The client rooms provide the customer connectivity to their payload and a comfortable work area with desk space, sofas, internet connectivity, and power outlets. See layout in Figure 44.

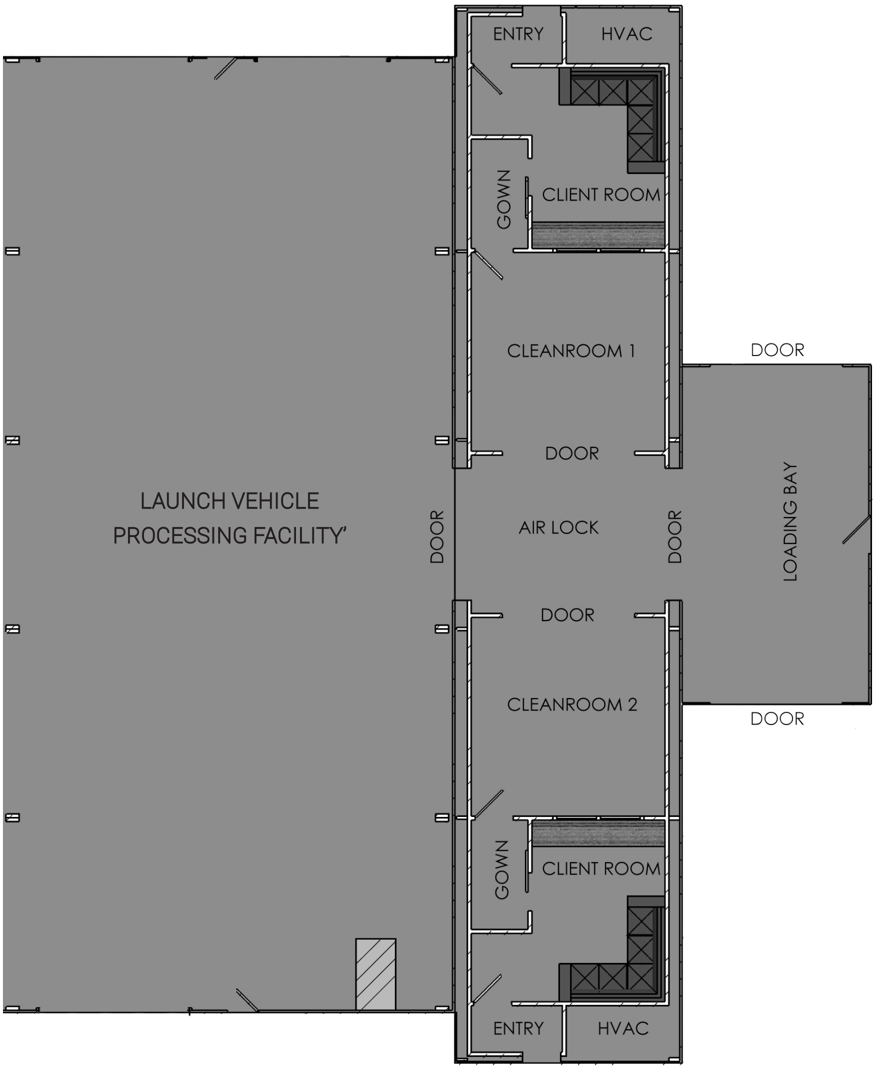


Figure 44 The layout of the Payload Processing Facility at LC-1

For missions lifting-off from Launch Complex 1, Rocket Lab also offers a Customer Launch Experience Room (CLER) located at the Range Control Center approx. 2.5 km from the launch pad. The CLER is a comfortable private facility that provides our customers with panoramic views of the launch pad, enabling them to experience an unrivaled lift-off

Figure 45 Customer Launch Experience Room at Launch Complex 1, Māhia, New Zealand.

LAUNCH COMPLEX 2, WALLOPS ISLAND, VIRGINIA

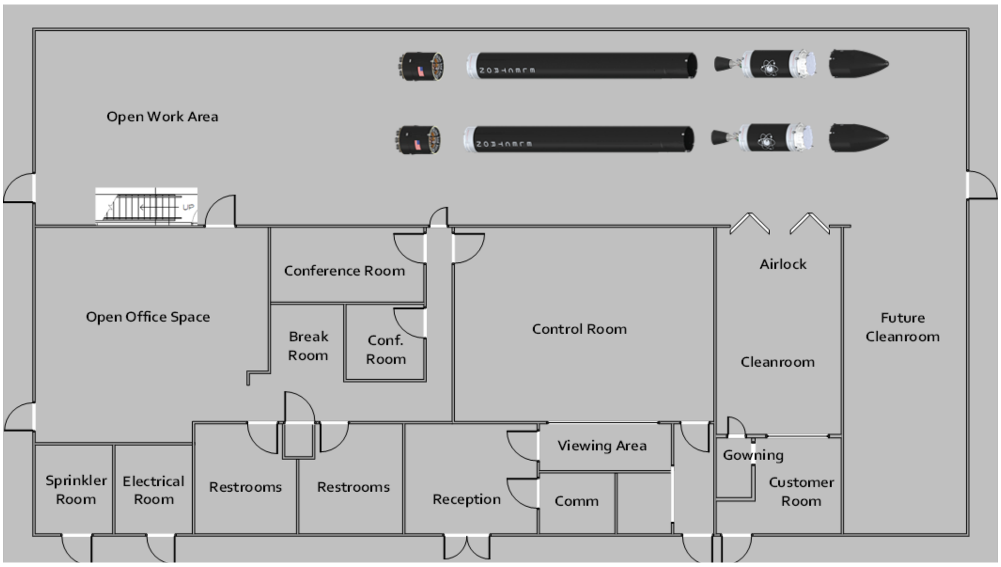


Figure 46 The layout of the Payload Processing Facility at LC-2

ROCKET LAB HQ, LONG BEACH, CALIFORNIA

The Long Beach Payload Processing Facility at Rocket Lab Headquarters in California currently includes a gowning room and an ISO 8 (Class 100,000) cleanroom. Construction is underway on new cleanroom facilities at this location to mirror those available at Launch Complex 1. The new cleanroom facilities will be available for customer use in mid-2021

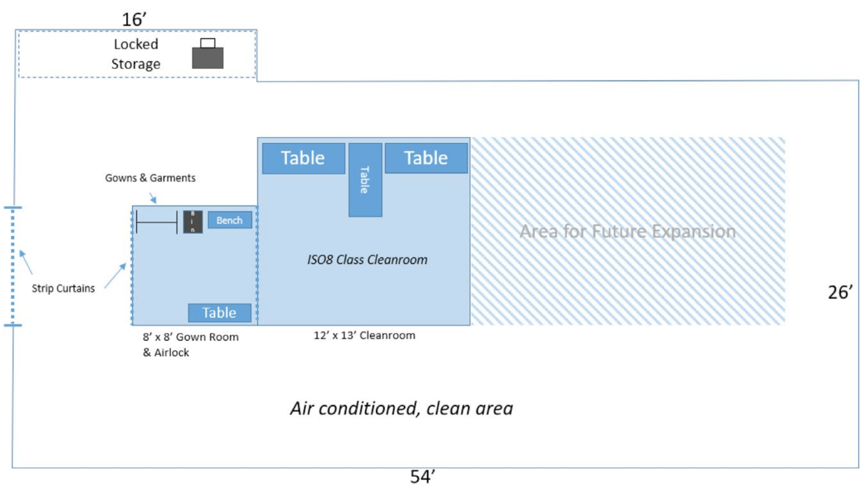


Figure 47 Rocket Lab's Long Beach Payload Processing Facility Layout

PAYLOAD PROCESSING WORKFLOW

We believe the payload processing flow should be simple, seamless and tailored to your mission, which is why we give our customers a choice of integration locations. The Rocket Lab integration team works closely with our customers on all missions, providing support every step of the way.

1. Spacecraft Delivery to the preferred PPF (Long Beach, LC-2, or LC-1):
Spacecraft delivery typically occurs 30 days prior to launch, however this timeline can be adapted to specific mission requirements. Once received, Rocket Lab supports customers with unpacking the spacecraft and associated ground checkout equipment.

2. Spacecraft Processing (Long Beach, LC-1, or LC-2)
Customers complete independent verification of the spacecraft, perform final tests, and carry out final preparations such as battery charging, software loading, power ups.

3. Spacecraft Integration:
At this point the spacecraft is mated to separation system or payload plate. For customers integrating in Long Beach, the spacecraft can be transported to the launch site mated to the payload plate, or this final mate can occur once the spacecraft has arrived at the launch site. The payload plate with integrated spacecraft is mated to the Electron's Kick Stage.

4. Fairing Encapsulation (LC-1 or LC-2)
The integrated spacecraft and separation system on the payload plate (mated with the Kick Stage) is then encapsulated within Electron's payload fairing. Encapsulation occurs horizontally, however the fairing is raised vertical in the cleanrooms for vertical checks.

5. Final mate with the Electron Launch Vehicle: (LC-1 or LC-1)
Rocket Lab horizontally mates the encapsulated payload assembly to the launch vehicle ahead of wet dress rehearsal and launch.

Late Payload Access:
It is possible to allow late access to the payload for mission-critical needs on request. Additionally, it is possible for spacecraft to be stored securely at Rocket Lab facilities in a flight-ready state for responsive launch on demand.

TRANSPORTATION

Payload shipment to the launch site is to arrive no later than 30 days prior to launch. Depending on customer preference, payloads can either be integrated and prepared for shipment in Rocket Lab's Long Beach, CA cleanroom facility, or can be shipped directly to the launch site and integrated in the Payload Processing Facility (PPF) at LC-1.

All payloads will arrive in Auckland, New Zealand to clear customs, then will be transported by ground (or by air, if the Customer prefers) to the Mahia LC-1 PPF. Rocket Lab can arrange transportation between Auckland and Mahia as an additional service if requested.

For Rideshare Missions, CubeSats will typically be integrated to their dispensers at Long Beach approximately 40 days prior to launch.

Upon arrival at the LC-1 PPF, the payload is immediately unloaded and transferred to the cleanroom.

LAUNCH OPERATIONS SCHEDULE

The standard payload processing schedule is consistent with the example schedule shown in Figure 48. Note that timelines can be altered upon Customer request. Please contact Rocket Lab for more information.

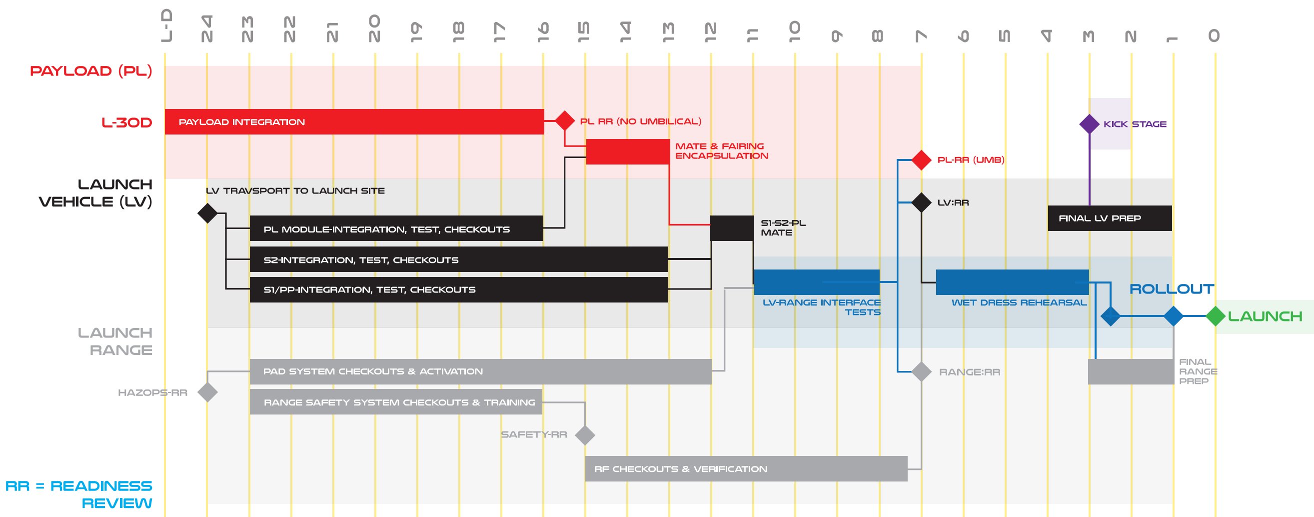


Figure 48 Example of a Standard Payload Processing Schedule

POST-LAUNCH REPORTING

Post-payload separation, within T + 90 minutes, Rocket Lab will deliver a state vector to the Customer based on initial data.

STANDARD SERVICES

As a part of the standard launch service, Rocket Lab offers the following services. Note that these services will be included in the mission-specific Statement of Work.

- Commercial mission assurance and risk management
- Dedicated Mission Manager
- Mission integration analyses including coupled load analysis and nominal trajectory
- Creation and management of the interface control documentation and associated verification planning and deliverables
- Securing of launch licensing from the Federal Aviation Administration (FAA) with customer inputs, including detailed flight safety analyses
- Electrical interface design and definition from spacecraft separation system to launch vehicle interface
- Facilitation of the Range safety review process
- Temperature, humidity, and cleanliness control in the fairing leading up to launch
- ISO 8 equivalent processing facilities with temperature and humidity control
- Installment of customer logo on payload fairing (dedicated missions only)
- Option to include video (up to 2 minutes) in the Rocket Lab live launch webcast (dedicated missions only)
- Mission operations support during launch and deployment
- Provision of required signals for payload deployment
- Confirmation of separation and provision of state vector
- Post-flight summary or report
- Top level technical design reviews (e.g., mission design review)
- Launch/Range readiness and hardware pre-ship reviews
- Ground operations and day-of-launch working groups
- Detailed mission/launch campaign integrated master schedule (IMS)
- Weekly integration meetings
- Umbilical capability enhancement
- Fit check (options)
  - Separation systems to spacecraft (Rocket Lab provided separation system)
  - Separation system to launch vehicle adapter
  - CubeSat into dispenser
  - CubeSat dispenser to launch vehicle adapter
  - Launch vehicle adapter electrical wire harness checks
- Tracking of meeting minutes and actions items

NON-STANDARD SERVICES

- Provision of spacecraft deployment systems and associated testing hardware (including Maxwell CubeSat dispensers)
- Fit checks at customer facilities
- Payload fueling services and hardware
- Additional analyses (e.g., integrated thermal analysis)
- Mission concept and preliminary integration studies
- Provision of spacecraft servicing electrical harnesses and connectors
- External spacecraft umbilical connection to external ground support equipment in cleanroom, hangar, or at the pad
- Enhanced cleanliness controls (ISO 7, GN2 purge)
- Arrangement of payload transportation to launch site
- International traffic in Arms Regulations (ITAR) – Export compliance support
- Late payload integration (post-wet dress rehearsal)
- Formal technical design reviews (e.g. Critical Design Review & Qualification Design Review)
- Delivery of additional documents such as qualification/acceptance test plans and/or test reports, analysis inputs/outputs
- Mission assurance reviews: critical design review, test readiness review, qualification design review, pedigree review (utilizing Rocket Lab's proprietary Pedigree Portal), recurring program management reviews, launch vehicle readiness review, mission readiness review, flight readiness review)
- Provide insight into quality and range safety programs
- Insight into production activities, including observation of major launch vehicle integration and test milestones
- Requirements analysis, including decomposition, traceability, and validation
- Independent verification and validation (IV&V) and other additional mission assurance
- Qualification matrix
- Change history and first-flight items
- Customer insight on all hardware and mission-specific risks
- Mission-specific day of launch requirements
    - On console
- Participation in go/no-go polling
- Classified reviews/communications and payload processing in Sensitive
- Compartmented Information Facilities (SCIF)

MISSION INTEGRATION SCHEDULE

The following timeline is an example of a standard Integration dedicated mission. Rideshare missions may work to shorter, more streamlined schedules. Rocket Lab can work to accelerated schedules as needed; please contact Rocket Lab to discuss mission-specific timeline needs.

Approximate Timeframe	Rocket Lab to Customer	Customer to Rocket Lab
Pre-Signature		Completed Payload Questionnaire
Launch - 12m	Draft Mission ICD	Payload CAD Model Preliminary Mass Properties
Launch - 10m	Payload Plate Layout	Mission Specific ICD Edits
Launch - 9m	Initial Mission ICD Release	Payload CLA Model Payload Thermal Model
Launch - 8m	Signed Mission ICD	
Launch - 6m	Mission ICD Verifications Nominal Trajectory, Separation & Recontact Analysis CLA Results Thermal Results EMI/EMC Assessment Launch Window Notification	Payload Processing Inputs Payload Safety Inputs Mission ICD Verifications
Launch - 4m	Payload Processing Plan	Final Mass Properties ICD Verifications
Launch - 3m	Dispersed Trajectory, Separation & Recontact Analysis	Payload Licensing Confirmations Launch License Inputs Daily Payload Processing Schedule Licensing Confirmations
(Preship Review) Launch - 45d	Electron Readiness Confirmation Launch Date Confirmation	As Measured Mass Properties Spacecraft Readiness Verification
Launch - 1m	Mission Analysis Updates (A/R)	Shipment of Payload
Launch - 15d	Fairing Encapsulation	
Launch - 5d	Launch Readiness Review	
LAUNCH		

Table 7 Example of a Standard Integration Schedule

11. THE TEAM

SUPPORTING YOUR MISSION FROM IDEA TO ORBIT

THE ROCKET LAB TEAM

Our people are the most important part of the Rocket Lab launch experience. Our team is driven to broaden the horizons of what's already possible in space and we're inspired by the possibilities not yet imagined. With almost 600 people spread across Long Beach, Auckland, and Māhia, the Rocket Lab team is dedicated to supporting you through every step of your mission.

QUICK REFERENCE GUIDE

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LIST OF ACRONYMS

CAA	Civil Aviation Authority of New Zealand
CLA	Coupled Loads Analysis
DARPA	Defence Advanced Research Projects Agency
EMC	Electromagnetic Capability
FTS	Flight Termination System
GN2	Gaseous Nitrogen
GNC	Guidance, Navigation and Control
GPS	Global Positioning System
GSE	Ground Support Equipment
HIL	Hardware In the Loop
IMU	Inertial Measurement Unit
LOx	Liquid Oxygen
LV	Launch Vehicle
MDR	Mission Dress Rehearsal
ONRG	US Office of Naval Research Global
ORS	Operationally Responsive Space
TVC	Thrust Vector Control
UHF	Ultra-High Frequency

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