SPACEX

Space Exploration Technologies

Falcon 1 • Flight 3

PRESS KIT

FALCON

SpaceX | Contents

Falcon 1 Flight 3 Mission

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Trailblazer satellite

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Webcast Information

The SpaceX Falcon 1 Flight 3 mission will be webcast from both the Kwajalein launch facilities as well as corporate headquarters in Hawthorne, California near the Los Angeles International Airport.

SpaceX will provide a live webcast starting before the launch. Starting time for the webcast will be announced on the SpaceX website: **SpaceX.com**

Webcast Archive

After the flight, the webcast content will be available for repeat viewing. The link to the webcast archive will be announced after the flight on the SpaceX website: **SpaceX.com**

High Resolution Photo and Video Content

High resolution images and broadcast quality video from the launch day will be provided on request. Send requests to: **Media@SpaceX.com**

Additional Information

For general information on SpaceX, and our product portfolio, please visit **SpaceX.com**

Payloads | Separating and non-separating

The Falcon 1 Flight 3 mission carries a total of approximately 170 kilograms (375 pounds) of payload, consisting of three separating satellite payloads; Trailblazer, PRESat, and NanoSail-D, which are all carried on the Secondary Payload Adaptor and Separation System (SPASS) which is owned and developed by ATSB of Malaysia. The SPASS, as well as a number of other systems and payloads, remain attached to the second stage.

For more information on the payloads, see the Payload Overview section.

Launch Site | Omelek Island in the Kwajalein Atoll

The Falcon 1 launch facilities are situated on Omelek Island, part of the United States Army Kwajalein Atoll (USAKA), located in the central Pacific about 2,500 miles southwest of Hawaii.

During flight preparations and launch, SpaceX employs the extensive range safety, tracking, telemetry and other services provided by the Reagan Test Site (RTS) at USAKA.

Launch Date | Dates and Windows

Falcon 1 is on the pad at the SpaceX Kwajalein Atoll launch site, and is undergoing final checkouts for Flight 3. We have two Range availabilities for launch: July 29 to August 5 and another in late August to early September, with a daily launch window of 4:00-9:00 p.m. (PDT) / 7:00 p.m.-midnight (EDT).

The SpaceX website (**www.SpaceX.com**) will provide the most up-to-date information on launch date and time.

Flight 3 | Timeline

Major Events	T+secs	T+hh:mm:ss	Comments
Liftoff	0	0:00:00	Lift off of the Space Exploration Technologies Falcon 1 Launch Vehicle carrying multiple payloads to orbit including three satellites.
Tower clear	4	0:00:04	Falcon 1 has cleared the tower
Transonic	56	0:00:54	Approaching Mach 1 - the vehicle is now supersonic
Max-Q	69	0:01:09	Approaching Max-Q - the time of maximum dynamic pressure on the vehicle
Inertial Guidance	140	0:02:20	Vehicle switching to inerital guidance mode
Pressurize Stage 2	145	0:02:25	Stage 2 pressurizing.
MECO	158	0:02:38	Approaching Main Engine Cut-off - “MECO”
Stage Separation	159	0:02:39	Stage Separation confirmed
2nd Stage Ignition	163	0:02:43	2nd stage ignition confirmed
Past 100 km altitude	168	0:02:48	Falcon 1 has crossed the boundary into space - 100 km (62 miles)
Stiffener jettison	173	0:02:53	Kestrel nozzle stiffeners have been jettisoned
Fairing Separation	193	0:03:13	The two halves of the “nose cone” or fairing separate and fall away, revealing the satellites to the vacuum of space.
Terminal Guidance	527	0:08:47	Vehicle is now in terminal guidance mode
Passing 7.5 km/s	574	0:09:34	Falcon 1 has reached orbital velocity - the first rocket privately developed, liquid fuel rocket to achieve this milestone
SECO	577	0:09:37	Approaching 2nd stage engine cut-offf - “SECO”
Deploy Trailblazer	587	0:09:47	Coming up to deployment of the primary payload into orbit - The Trailblazer spacecraft for the U.S. Department of Defense’s Operationally Responsive Space Office.
Settling thrusters	597	0:09:57	Second stage settling thrusters operating
Expect loss of signal	617	0:10:17	“LOS” occurs as the vehicle sinks below the horizon as viewed by the launch range’s receivers
Deploy PRESat	837	0:13:57	Eject PRESat into orbit, it is to operate for 60 days or more
Deploy NanoSail-D	1087	0:18:07	Eject NanoSail-D into orbit, where it will wait for approximately 3 days before unfurling its sail to begin operation.

Falcon 1 is a two stage, liquid oxygen and rocket grade kerosene (RP-1) powered launch vehicle. It is designed from the ground up by SpaceX for cost efficient and reliable transport of satellites to low Earth orbit.

Length:	**21.3 m** (70 feet)
Width:	**1.7 m** (5.5 feet)
Mass:	**27,670 kg** (61,000 lbs)
Thrust on liftoff:	**347 kN** (78,000 lbf)

Performance data above reflects the updated Falcon 1 vehicle only, not the Falcon 1e

First Stage

The primary structure is made of an aluminum alloy (patent pending), graduated monocoque, common bulkhead, flight pressure stabilized architecture developed by SpaceX. The design is a blend between a fully pressure stabilized design, such as Atlas II, and a heavier isogrid design, such as Delta II. As a result, Falcon 1 first stage is able to capture the mass efficiency of pressure stabilization, but avoid the ground handling difficulties of a structure unable to support its own weight.

A single SpaceX Merlin 1C regenerative engine powers the Falcon 1 first stage, and is flying in this configuration for the first time on Flight 3. After first stage engine start, the Falcon is held down and not released for flight until all propulsion and vehicle systems are confirmed to be operating nominally.

Stage separation occurs via redundantly initiated separation bolts and a pneumatic pusher system. All components are space qualified and have flown previously on other launch vehicles.

Second Stage

The tanks are precision machined from plate with integral flanges and ports, minimizing the number of welds necessary. A single SpaceX Kestrel engine powers the Falcon 1 upper stage.

SpaceX Merlin 1C Regeneratively Cooled Engine

The main engine, called Merlin 1C, was developed internally at SpaceX, drawing upon a long heritage of space-proven engines. The pintle style injector at the heart of Merlin was first used in the Apollo Moon program for the Lunar Excursion Module (LEM) landing engine, one of the most critical phases of the mission. For this flight of the Falcon 1, the Merlin 1C performance is as follows:

Sea Level Thrust:	**78,000 lb**
Vacuum Thrust:	**138,400 lb**
Sea Level Isp:	**255 s**
Vacuum Isp:	**304 s**

Performance data above is for the Falcon 1, not the Falcon 1e.

Propellant is fed via a single shaft, dual impeller turbo-pump operating on a gas generator cycle. High pressure kerosene fuel flows through the walls of the combustion chamber and exhaust nozzle before being injected into the combustions chamber. This provides significant cooling, permitting the engine to operate at with much higher performance. The turbo-pump also provides the high pressure kerosene for the hydraulic actuators, eliminating the need for a separate hydraulic power system. Additionally, actuating the turbine exhaust nozzle provides roll control during flight. By combining these three functions into one device, and verifying its operation before the vehicle is allowed to lift off gives a significant improvement in system-level reliability.

With a vacuum specific impulse of 304s, Merlin is the highest performance gas generator cycle kerosene engine ever built, exceeding the Boeing Delta II main engine, the Lockheed Atlas II main engine and on par with the Saturn V F-1.

SpaceX Kestrel Pressure Fed Engine

Kestrel, also built around the pintle architecture, is a high efficiency, pressure-fed vacuum engine.

Vacuum Thrust:	**6,900 lb**
Vacuum Isp:	**320 s**

Kestrel is ablatively cooled in the chamber and throat and radiatively cooled in the nozzle, which is fabricated from a high strength niobium alloy. As a metal, niobium is highly resistant to cracking compared to carbon-carbon, which is a vacuum expansion nozzle alternative. An impact from orbital debris or during stage separation would simply dent the metal, but have no meaningful effect on engine performance. Helium pressurant efficiency is substantially increased via a titanium heat exchanger on the ablative/niobium boundary.

Thrust vector control is provided by electro-mechanical actuators on the engine dome for pitch and yaw. Roll control (and attitude control during coast phases) is provided by helium cold gas thrusters. A highly reliable and proven TEA-TEB pyrophoric system is used to provide multiple restart capability on the upper stage. In a multi-manifested mission, this allows for drop off at different altitudes and inclinations.

DESIGNED FOR MAXIMUM RELIABILITY

The vast majority of launch vehicle failures in the past two decades can be attributed to three causes: engine, stage separation and, to a much lesser degree, avionics failures. An analysis of launch failure history between 1980 and 1999 by Aerospace Corporation showed that 91% of known failures can be attributed to those subsystems.

Engine Reliability

It was with this in mind that SpaceX designed Falcon 1 to have the minimum number of engines. As a result, there is only one engine per stage and only one stage separation event - the minimum pragmatically possible number.

Another notable point is the SpaceX hold-before-release system - a capability required by commercial airplanes, but not implemented on many launch vehicles. After first stage engine start, the Falcon is held down and not released for flight until all propulsion and vehicle systems are confirmed to be operating nominally. An automatic safe shut-down and unloading of propellant occurs if any off nominal conditions are detected.

Stage Separation Reliability

Here Falcon takes advantage of simplicity by having two stages and therefore only one stage separation event - the minimum practical number. Moreover, the stage separation bolts are all redundant initiated, fully space qualified and have a zero failure track record in prior launch vehicles.

The Falcon 1 Flight 3 mission carries a total of nearly 170 kilograms (375 pounds) of payload, consisting of three separating satellite payloads; Trailblazer, PRESat, and NanoSail-D, which are all carried and deployed from the Secondary Payload Adaptor and Separation System (SPASS) which is owned and developed by ATSB of Malaysia.

The payloads include:

Trailblazer | U.S. Department of Defense, Operationally Responsive Space Office (ORS)

In March of 2008 the US Department of Defense's Operationally Responsive Space (ORS) Office selected this Falcon 1 launch to carry their first Jumpstart mission payload to orbit. The Jumpstart program aims to establish a preliminary framework for responsive contracting, and demonstrate the ability to rapidly integrate and execute a mission, from initial call-up to launch.

SpaceX performed initial responsive mission integration for three separate satellites. At the end of May 2008, the ORS selected one of the three satellites, Trailblazer, to fly. Developed by SpaceDev of Poway, California, the 83.5 kilogram Trailblazer satellite was assembled on schedule and budget by SpaceDev in less than five months. It serves as a test platform to validate the hardware, software, and processes of an accelerated microsatellite launch. Trailblazer is deployed from the Falcon 1 second stage shortly after the shut down of the second stage engine.

PRESat (PharmaSat Risk Evaluation Satellite) | NASA Ames Research Center

Developed by NASA's Ames Research Center of Moffett Field, California, PRESat is a micro-laboratory that monitors the growth, density and health of yeast cells living in a controlled environment. PRESat deploys about 4 minutes after Trailblazer. During its sixty day long operation period, PRESat monitors temperature, pressure and other factors experienced by the microorganisms, then relays data back to Earth for further analysis.

NanoSail-D | NASA Marshall Space Flight Center

Developed by NASA's Marshall Spaceflight Center in Huntsville, Alabama in collaboration with the NASA Ames Research Center, NanoSail-D seeks to demonstrate for the first time in history, a novel approach to propellant-less space propulsion. NanoSail-D deploys about 4 minutes after PRESat, then several days later, it will unfurl an ultra-thin solar sail measuring over three meters (10 feet) on each side. The aluminum coated gossamer sail is affected by solar pressure and aerodynamic drag. By tracking the NanoSail-D from the ground, the mission team will be able to pick up slight changes in its orbit after just a few days into the mission.

Using the pressure of sunlight to propel a space vehicle represents a concept first envisioned in the seventeenth century by German astronomer, Johannes Kepler, based on his observations of how the sun affected the tails of comets.

SPASS (Secondary Payload Adaptor and Separation System) | ATSB of Malaysia

The three separating satellites attach to the Falcon 1 second stage via the Secondary Payload Adaptor and Separation System (SPASS) which is owned and developed by ATSB, a company owned by the Government of Malaysia that develops and commercializes space technology.

The SPASS were conceptualized by ATSB as a payload adaptor for Falcon 1 to accommodate small satellites as an affordable access to space. The SPASS was engineered by Space Access Technologies of Ashburn, Virginia. It remains attached to the second stage, along with a number of other systems and payloads

P-POD (Poly Pico-satellite Orbital Deployer) | California Polytechnic State University

The two NASA nano-satellites (PRESat and NanoSail-D) are housed during launch and deployed using P-POD dispensers from the California Polytechnic Institute in San Luis Obispo. The dispensers are attached to the exterior of the SPASS adaptor described above.

In an era when most technology based products follow a path of ever-increasing capability and reliability while simultaneously reducing costs, launch vehicles today are little changed from those of 40 years ago. SpaceX aims to change this paradigm by developing a family of launch vehicles and spacecraft which will ultimately reduce the cost and increase the reliability of space access by a factor of ten. Coupled with the emerging market for private and commercial space transport, this new model will re-ignite humanity's efforts to explore and develop space.

Our company is based on the philosophy that simplicity, low-cost, and reliability go-hand-in hand. By eliminating the traditional layers of internal management, as well as external sub-contractors, we reduce our costs while speeding decision-making and delivery. Likewise, by keeping the vast majority of manufacturing in-house, we reduce costs, keep tighter control of quality, and ensure a tight feedback loop between the design and manufacturing teams. And by focusing on simple, proven designs with a primary focus on reliability, we reduce the costs associated with complex systems operating at the margin.

Established in 2002 by Elon Musk, the founder of PayPal and the Zip2 Corporation, SpaceX has already developed two launch vehicles, established an impressive launch manifest, and was awarded Commercial Orbital Transportation Services (COTS) funding by NASA to demonstrate delivery and return of cargo to the International Space Station. Supported by a strong investment base and initial manifest, SpaceX is on sound financial footing as we move towards volume commercial launches.

Although drawing upon a rich history of prior launch vehicle, spacecraft and engine programs, SpaceX is privately developing the Dragon crew and cargo capsule and the Falcon family of rockets from the ground up, including main and upper stage engines, the cryogenic tank structure, avionics, guidance & control software and ground support equipment.

With the Falcon 1, Falcon 9 and Falcon 9 Heavy launch vehicles, SpaceX offers a full spectrum of light, medium and heavy lift launch capabilities to our customers, delivering spacecraft into any inclination and altitude, from low Earth orbit to geosynchronous orbit to planetary missions. The Falcon 9 and Falcon 9 Heavy are the only US launch vehicles with true engine out reliability. Falcon 9 has nine Merlin engines clustered together. This vehicle will be capable of sustaining an engine failure at any point in flight and still successfully completing its mission. This actually results in an even higher level of reliability than a single engine stage. The SpaceX nine engine architecture is an improved version of the architecture employed by the Saturn V and Saturn I rockets of the Apollo Program, which had flawless flight records despite losing engines on a number of missions.

As a winner of the NASA COTS competition, SpaceX is in a position to help fill the gap when the Space Shuttle retires in 2010. Under the existing contract, SpaceX will conduct three flights of its Falcon 9 launch vehicle and Dragon spacecraft for NASA, culminating in Dragon berthing with the International Space Station (ISS) and as the only reusable offering, returning to Earth. NASA also has a contract option on Falcon 9 / Dragon to provide crew services to the ISS after Shuttle retirement. The first Falcon 9 will arrive at the SpaceX launch site (complex 40) at Cape Canaveral by the end of 2008.

SpaceX design and manufacturing facilities are located near the Los Angeles International airport, leveraging the deep and rich aerospace heritage and talent pool available in Southern California. Our extensive propulsion and structural test facilities are located in Central Texas. We currently have launch complexes available at Vandenberg Air Force Base and the Kwajalein Atoll and in April 2007 we were granted use of and have begun developing Space Launch (Complex 40) at Cape Canaveral.

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