

# SpaceX

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## SpaceX Exploration Technologies Corp.

SpaceX Headquarters during the Iridium-4 Mission, December 2020

<b>Trade name</b>	SpaceX
<b>Company type</b>	<a href="#">Private</a>
<b>Industry</b>	<a href="#">Aerospace</a>
<b>Founded</b>	6 May 2002; 22 years ago <sup>[1]</sup>
<b>Headquarters</b>	<a href="#">Hawthorne, California</a> , U.S. <a href="#">33.9207°N 118.3278°W</a> <a href="#">Elon Musk</a> ( <a href="#">CEO</a> and <a href="#">CTO</a> )
<b>Key people</b>	Gwynne Shotwell ( <a href="#">President</a> and <a href="#">COO</a> )
<b>Products</b>	<a href="#">Launch vehicles</a> <a href="#">Rocket engines</a> <a href="#">Space capsules</a> <a href="#">Starship</a> (in <a href="#">development</a> ) <a href="#">Starlink</a> <a href="#">Landing platforms</a> on <a href="#">drone ships</a>
<b>Owner</b>	Elon Musk Trust (54% equity; 78% voting control) <sup>[2]</sup>
<b>Number of employees</b>	Est. 7,000 <sup>[3]</sup> (November 2017)
<b>Website</b>	<a href="http://www.spacex.com">www.spacex.com</a>
<b>Footnotes / references</b>	<sup>[4]</sup> <sup>[5]</sup> <sup>[6]</sup> <sup>[7]</sup>

The astronauts on the Crew-7 mission

**Space Exploration Technologies Corp. (SpaceX)** is an American aerospace [company](#) in [Hawthorne, California](#). The company makes and launches [space rockets](#) and [communications satellites](#) (some of which one can use to have a [connection](#) to the [internet](#)). SpaceX was founded in 2002 by [Elon Musk](#). SpaceX makes the [Falcon 9](#) and [Falcon Heavy](#) rockets, some rocket engines, [Dragon](#) spacecraft and [Starlink](#) satellites.

SpaceX was the first private company to make a rocket that uses liquid [propellant](#) that reach [orbit](#) ([Falcon 1](#) in 2008). SpaceX was also the first private company to successfully launch, orbit, and recover a spacecraft ([Dragon](#) in 2010). SpaceX also first landed a [multistage rocket astronauts](#) to the [International Space Station](#) ([Crew Dragon Demo-2](#) in 2020). SpaceX has launched Falcon 9 rockets over a hundred times.

SpaceX has put a [network](#) of [Starlink](#) satellites into space. It gives internet service. In 2020, the network (or satellite constellation) became the largest in the world.

The [Starship flight test 5](#), is planned (for) no earlier than late November 2024.

Starship rockets are supposed to (become able or to) be able to lift 100 metric tons to low Earth orbit and be used many times. The company also has an idea to launch a Starship rocket to [Mars](#).

The company's goal is to make going to space cheap, so humans can [colonize Mars](#).

As of 2024's fourth quarter, there are [astronauts](#) in space, that were taken there by SpaceX,

- [United States Nick Hague](#)
- [Russia Aleksander Gorbunov](#)<sup>[8]</sup>

## History

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In 2001, Elon Musk [proposed](#) a project to land a small [greenhouse](#) to grow [plants](#) on Mars. He said, "This would be the furthest that life [... has] ever traveled"<sup>[9]</sup> in an attempt to get more public interest in space exploration and increase the budget of [NASA](#).<sup>[10][11][12]</sup> Musk tried to buy cheap rockets from Russia but returned empty-handed after not finding rockets for the price he wanted to pay.<sup>[13][14]</sup>

Later, Musk [realized](#) that he could start a company that could build the rockets he needed.<sup>[14]</sup> Musk [calculated](#) that the [raw materials](#) for building a rocket were actually 3% of the price of a rocket at the time, according to [Steve Jurvetson](#) (who has [invested](#) money in SpaceX).<sup>[15]</sup> Making around 85% of launch hardware in-house, was one main reason why launch prices could become ten times cheaper; Using ways of easily changing software (or [software engineering](#)), was another main reason.<sup>[16][17][13][18]</sup>

In early 2002, Musk was seeking workers for his new space company, soon to be named SpaceX. Rocket engineer [Tom Mueller](#) started to work for Musk.<sup>[19]</sup> The first headquarters of SpaceX was in a warehouse in [El Segundo, California](#).

## Work force

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The company has grown from 160 workers in November 2005 to 1,100 in 2010,<sup>[20][21]</sup> 3,800 workers and contractors by October 2013,<sup>[22]</sup> nearly 5,000 by late 2015,<sup>[23][24]</sup> and about 6,000 in April 2017.<sup>[25]</sup> As of November 2017, the company had grown to nearly 7,000.<sup>[3]</sup> In 2016, Musk gave a speech at the [International Astronautical Congress](#), where he explained that the US government uses rocket technology as an "advanced weapon technology", making it difficult to hire non-Americans.<sup>[26]</sup>

## Launch vehicles, spacecraft, and rocket engines

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### Current rockets

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*Main articles: [Falcon 9](#) and [Falcon Heavy](#)*

Falcon 9 on the GRACE-FO Mission

The Falcon 9 is a working, [reusable](#) two-part rocket that is launched using its nine Merlin engines in its first part and a special Merlin engine that was made for places where there is no air. It is powered by [liquid oxygen](#) and fuel made for rockets called RP-1. It can hold up to 22,800 kilograms (50,300 pounds), and can also support SpaceX's Dragon vehicle. It is the first rocket able to get into orbit that can get its first part back to earth.

Falcon Heavy is another working, reusable rocket similar to Falcon 9. However, the Falcon Heavy has a three-core system for its first part instead of the single-core design of the Falcon 9. With the three cores, the rocket's 1st part has 27 Merlin engines. The second part still only has 1 Merlin(Vacuum Version) engine. Currently, Falcon Heavy is the world's most powerful operating rocket and the 4th most powerful rocket in the world. This added power allows the rocket to be able to put 63,800 kg (140,660 lb) into low earth orbit, and 26,700 kg (58,860 lb) into [geosynchronous orbit](#).

On February 6, 2018, the Falcon Heavy took off for the first time at Kennedy Space Center, Florida, from Pad 39A.

### Dragon 2

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A Crew Dragon making a connection with the [International Space Station](#), during the Demo-1 Mission

See the main article: [SpaceX Dragon 2](#)

The Dragon spacecraft is a [cargo](#) capsule that has taken equipment and supplies for the astronauts on the ISS; On other flights it has taken astronauts to ISS. The capsule is put on the Falcon 9 rocket (because the Dragon does not have big enough rockets to fly to space on its own) and flown into orbit. From orbit it separates from the [boosters](#), then the capsule uses its own smaller rockets to get to the ISS. Then the capsule is filled up with old equipment, the results of scientific experiments, and [garbage](#). It then reenters the Earth's atmosphere and [parachutes](#) into the ocean. The first flight of Dragon was in June 2010.

In May 2014, a [prototype](#) version of Dragon V2 was shown to the public. It could hold both cargo and astronauts. Another feature of this upgraded version of Dragon - to protect the life of the [crew](#) in the event of a failure of Falcon 9 it was fitted with SuperDraco thrusters, which would push the capsule away from the rocket.

## No longer in use

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The Falcon 1 was SpaceX's first launch vehicle. It launched a total of 5 times, however only the 4th and final flights were successful. Falcon 1, as the name implies, ran on 1 Kestrel engine and could take a maximum of 670 kilograms to orbit. <sup>[27]</sup>

Another early vehicle was the cancelled Falcon 5, which has 5 Merlin engines on its first stage, and 2 Kestrel on its second stage. It was cancelled in 2007 when it was removed from the company's user guide. <sup>[28]</sup>

The last flight of a [Dragon 1](#) spacecraft, was on 6 March 2020. <sup>[29][30]</sup>

## Rocket engines

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A [Merlin 1D](#) engine during testing at SpaceX's Rocket Development and Test Facility in McGregor, Texas. The company has many of that kind of engine.

Since SpaceX started in 2002, the company has created three types of [rocket engines](#) — [Merlin](#) and the retired [Kestrel](#) for [launch vehicle propulsion](#), and the [Draco](#) control thrusters. SpaceX is currently working on two further rocket engines: [SuperDraco](#) and [Raptor](#). The Merlin engine was originally designed for sea recovery and reuse. Kestrel is a Liquid Oxygen/Rocket fuel [pressure-fed](#) rocket engine and was used as the Falcon 1 rocket's second stage main engine. Both names for the [Merlin](#) and [Kestrel](#) engines come from species of North American falcons: the [kestrel](#) and the merlin. <sup>[31]</sup>

Draco are [hypergolic](#) liquid-propellant rocket engines that use [monomethyl hydrazine fuel](#) and [nitrogen tetroxide oxidizer](#). Each Draco thruster creates 400 newtons (90 lbf) of thrust.<sup>[32]</sup> They are used as [reaction control system](#) thrusters on the Dragon spacecraft.<sup>[33]</sup> [SuperDraco](#) engines are a much more powerful version of the Draco thrusters, which were meant to be used for [landing](#) and a way to get the capsule away in an emergency on the version 2 Dragon spacecraft, [Dragon 2](#). The idea of using these SuperDraco engines for landing was cancelled in 2017 when it was decided to have a parachute descent and landing in the sea.<sup>[34]</sup>

[Raptor](#) is a new family of [methane-fueled](#) engines to be used in its future Starship rockets.<sup>[35]</sup> [Testing](#) versions were test fired in late 2016.<sup>[36]</sup> On April 3, 2019, SpaceX did a successful test in which the engine was started but the rocket was held down in Texas on its [Starhopper](#) vehicle, which ignited the engine while the vehicle remained attached to the ground.<sup>[37]</sup> On July 24, 2019 SpaceX did a successful test flight of 20 meters up, with its Starhopper test vehicle.<sup>[38]</sup> On the 28th August 2019 SpaceX's Starhopper prototype did a successful test flight of 150-meters.<sup>[39]</sup>

## Satellite internet

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In November 2022, the company had 3,236 [Starlink](#) satellites that were working while in orbit; The number of Starlink satellites in orbit is 3,271.<sup>[40]</sup> These satellites work together as a kind of [satellite constellation](#): a [Satellite internet constellation](#).

One goal is to build a [network](#) of 4,425 satellites capable of beaming the [Internet](#) to the entire world, including remote places which currently do not have Internet access.<sup>[41][42]</sup> The Internet service would use 4,425 cross-linked [communications satellites](#) in 1,100 km orbits. It started to be made in 2015, and testing satellites were launched on the SpaceX PAZ mission in 2017. SpaceX filed with the [US regulatory authorities](#) plans for 7,518 more satellites in non-[geosynchronous orbits](#) to provide communications services called the "V-band low-Earth-orbit constellation". it would have 7,518 satellites to follow the [earlier] proposed 4,425 satellites that would function in Ka-band and Ku-band".<sup>[43]</sup> One goal is to create up to 1,000,000 [fixed satellite earth stations](#) that will communicate with its Starlink system.<sup>[44]</sup> In May 2019, SpaceX launched the first batch of 60 satellites aboard a Falcon 9 from Cape Canaveral, FL.<sup>[45]</sup>

## Research and development

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## Reusability

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Es'hail-2 Mission first stage on the *Of Course I Still Love You* droneship

SpaceX's secondary mission is to reuse rockets, like planes. It first began to test reusability with a prototype called Grasshopper in 2012, as well as controlled soft landings into the water during Falcon 9 launches. In 2014, Grasshopper was replaced by F9R, which was an upgraded version of Grasshopper, included [retractable landing gear](#) and 3 engines, compared to Grasshopper's single engine. Falcon 9 was landed in December on a ground pad, followed by a landing on a [drone](#) ship the next year. Currently,<sup>[[when?](#)]</sup> SpaceX has landed successfully 48 boosters. Dragon capsules, as well as [farings](#), are also being reused. Reusing parts of rockets greatly reduce costs.

## Starship and Super Heavy

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See the main article: [SpaceX Starship](#)

SpaceX has created a family of super-heavy lift rockets, [Starship](#). The rockets have two parts that can be used over and over again.<sup>[[46](#)]</sup>

SpaceX first had a 12-meter-diameter [Interplanetary Transport System](#) plan in 2016. It was only planned for Mars travel and other interplanetary uses. In 2017, SpaceX designed a smaller 9-meter-diameter "Big Falcon Rocket" to replace all of SpaceX launch capabilities— [Earth-orbit](#), lunar-orbit, interplanetary missions, and potentially, even earth transit—but do so on a fully reusable set of vehicles with a lower cost structure.<sup>[[47](#)]</sup> Many of the components on Starship are made of 301 [stainless steel](#).<sup>[[48](#)][[49](#)][[50](#)]</sup>

Musk's long term vision for the company is the creation of technology and means suitable for human colonization on Mars.<sup>[[51](#)]</sup>

## Contracts

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### Cargo to ISS

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The COTS 2 Dragon is berthed to the ISS by [Canadarm2](#).

In 2006, SpaceX won a [NASA](#) Commercial Orbital Transportation Services (COTS) [Phase](#) 1 contract to show that the company can take cargo to the ISS; The contract had a possible [option](#) for crew flight.<sup>[[52](#)]</sup> This contract was designed by NASA to provide "seed money" through Space Act Agreements



for developing new space opportunities. NASA paid SpaceX \$396 million to work on the cargo configuration of the Dragon spacecraft. SpaceX spent more than \$500 million to develop the Falcon 9 launch vehicle.<sup>[53]</sup> These [Space Act Agreements](#) have saved NASA millions of dollars in development costs, making rocket development ~4-10 times cheaper than if produced by NASA alone.

In December 2010, with the launch of the [COTS Demo Flight 1](#) mission, SpaceX became the first private company to successfully launch, orbit and recover a spacecraft.<sup>[54]</sup> Dragon was successfully put into orbit, circled the Earth twice, and then made a controlled burn for a water landing in the [Pacific Ocean](#). With Dragon's safe recovery. Before this mission, only government agencies had been able to recover orbital spacecraft.

[COTS Demo Flight 2](#) was launched in May 2012. Dragon successfully connected with the ISS, - the first time that a private spacecraft had accomplished this feat.<sup>[55][56]</sup>

## Commercial cargo

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Commercial Resupply Services (CRS) are a group of contracts given by NASA from 2008 to 2016 for delivery of cargo and supplies to the ISS on commercially operated spacecraft. The first CRS contracts were signed in 2008 and gave \$1.6 billion to SpaceX for 12 cargo sending missions, covering deliveries to 2016.<sup>[57]</sup> [SpaceX CRS-1](#), the first of the 12 planned resupply missions, launched in October 2012, achieved orbit, connected to and remained on station for 20 days, before [re-entering the atmosphere](#) and splashing down in the Pacific Ocean.<sup>[58]</sup> CRS missions have flown about twice a year to the ISS since then. In 2015, NASA extended the Phase 1 contracts by ordering three more resupply flights from SpaceX.<sup>[59][60]</sup> After further extensions late in 2015, SpaceX is to fly a total of 20 missions.<sup>[61]</sup> A second group of contracts (known as CRS2) were proposed in 2014. They were given in January 2016, for cargo transport flights beginning in 2019 and expected to last through 2024.

## Commercial crew

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Crew Dragon undergoing testing prior to flight

The Commercial Crew Development (CCDev) program has made commercially operated spacecraft that has taken astronauts to the ISS. SpaceX did not win a [Space Act Agreement](#) in the first round (CCDev 1), but during the second round (CCDev 2), NASA awarded SpaceX a contract worth \$75 million to further develop their [launch escape system](#), test a crew accommodations [mock-up](#), and to further progress their Falcon/Dragon crew transportation design.<sup>[62][63][64]</sup> The CCDev program later became

Commercial Crew Integrated Capability ([CCiCap](#)), and in August 2012, NASA announced that SpaceX had been awarded \$440 million to continue development and testing of its [Dragon 2](#) spacecraft.<sup>[65][66]</sup>

In September 2014, NASA chose SpaceX and Boeing as the two companies that will be funded to develop systems to transport U.S. crews to and from the ISS. SpaceX won \$2.6 billion to complete and certify Dragon 2 by 2017.<sup>[67]</sup>

In early 2017, SpaceX was awarded four additional crewed missions to the ISS from NASA to shuttle astronauts back and forth.<sup>[68]</sup> In early 2019, SpaceX successfully conducted a test flight of Crew Dragon, which it docked (instead of Dragon 1's method of berthing using Canadarm 2) and then splashed down in the Atlantic Ocean.

In January 2020, SpaceX conducted an In-Flight Abort Test, which demonstrated the ability to get away from a rocket in case of a problem.

The first flight with crew took place on May 30, 2020.<sup>[69]</sup> The flight launched astronauts Doug Hurley and Bob Behnken to the ISS.<sup>[70][71]</sup>

## Astronauts

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- [United States Matthew Dominick](#)
- [United States Michael Barratt](#)
- [United States Jeanette Epps](#)
- [Russia Alexander Grebenkin](#), members on the mission, [Crew-8](#). They [were] supposed to leave the [ISS](#) (to return to Earth) no earlier than October 8, 2024.
- [Scott Poteet](#)
- [Sarah Gillis](#) and
- [Anna Menon](#) are the astronauts [that were] on the [Polaris Dawn](#) flight that started on September 10, 2024.<sup>[72][73]</sup>
- [United States Jasmin Moghbeli](#)<sup>[74]</sup>
- [Denmark Andreas Mogensen](#)<sup>[75]</sup>
- [Japan Satoshi Furukawa](#)
- [Russia Konstantin Borisov](#),<sup>[76][77]</sup> members on the mission, [Crew-7](#). They are supposed to leave the [ISS](#) (to return to Earth) in 2024's first quarter.

The astronauts on the Crew-6 mission

- [United States Stephen Bowen](#)
- [United States Warren Hoburg](#)
- [United Arab Emirates Sultan Al Neyadi](#)
- [Russia Andrey Fedyaev](#), members on the mission, [Crew-6](#).



The four astronauts that were on the Crew-5 mission. From left to right: Kikina, Cassada, Mann and Wakata

- [United States Nicole Aunapu Mann](#)
- [United States Josh Cassada](#)
- [Japan Koichi Wakata](#)
- [Russia Anna Kikina](#),<sup>[78][79][80]</sup> the members on the mission, [Crew-5](#), came back to Earth in March 2023.

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## Other websites

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- [Official website](#)
- [Starlink official website](#)

v · t · e <span> </span> <span> </span> <span> </span> SpaceX		
<b><a href="#">Launch vehicles</a></b>	<b>Current</b>	<a href="#">Falcon 9</a> ( <a href="#">Block 5</a> ) · <a href="#">Falcon Heavy</a>
	<b>In development</b>	<a href="#">Starship</a> ( <a href="#">Super Heavy booster</a> · <a href="#">upper stage</a> · <a href="#">lunar lander</a> · <a href="#">flight tests</a> ( <a href="#">IFT-1</a> · <a href="#">IFT-2</a> · <a href="#">IFT-3</a> · <a href="#">IFT-4</a> ))
	<b>Retired</b>	<a href="#">Falcon 1</a> · <a href="#">Falcon 9</a> ( <a href="#">v1.0</a> · <a href="#">v1.1</a> · <a href="#">"Full Thrust" v1.2</a> · <a href="#">Block 4</a> )
<b>Spacecraft</b>	<b>Cargo</b>	<a href="#">Dragon 1 Cargo</a> · <a href="#">Dragon 2 Cargo</a> · <a href="#">Dragon XI</a> *
	<b>Crewed</b>	<a href="#">Dragon 2 Crew</a> ( <a href="#">C206 Endeavour</a> · <a href="#">C207 Resilience</a> · <a href="#">C210 Endurance</a> · <a href="#">C212 Freedom</a> )
<b>Test vehicles</b>	<b>Current</b>	Starship prototypes ( <a href="#">first stage booster</a> · <a href="#">upper stage</a> )
	<b>Retired</b>	<a href="#">Grasshopper</a> · <a href="#">F9R Dev1</a> <sup>†</sup> · <a href="#">DragonFly</a> · <a href="#">Starhopper</a>
<b><a href="#">Rocket engines</a></b>	<a href="#">Merlin</a> (1A · 1B* · 1C · 1D · Vacuum) · <a href="#">Kestrel</a> · <a href="#">Draco</a> · <a href="#">SuperDraco</a> · <a href="#">Raptor</a> (1 · <a href="#">2</a> <sup>[<i>broken anchor</i>]</sup> · <a href="#">3</a> <sup>[<i>broken anchor</i>]</sup> · Vacuum)	
<b><a href="#">Lists of missions</a></b>	<a href="#">Falcon 1</a> · <a href="#">Falcon 9 and Falcon Heavy</a> (2010–2019 · <a href="#">2020–2021</a> ) · <a href="#">SpaceBEE</a> · <a href="#">Starlink</a> ( <a href="#">launches</a> · <a href="#">in the Russo-Ukrainian War</a> ) · <a href="#">Starship</a>	
<b><a href="#">Launch facilities</a></b>	<b>Orbital</b>	<a href="#">CCSFS SLC-40</a> · <a href="#">KSC LC-39A</a> · <a href="#">VSFB SLC-4E</a> · <a href="#">VSFB SLC-6</a> * · <a href="#">Omelek Island</a> <sup>†</sup>
	<b>Atmospheric</b>	<a href="#">McGregor</a> · <a href="#">New Mexico</a> <sup>†</sup> · <a href="#">Starbase</a> ( <a href="#">Boca Chica</a> )
<b>Landing sites</b>		



	<a href="#">Autonomous spaceport drone ships</a> • Landing Zones ( <a href="#">LZ-1</a> and <a href="#">LZ-2</a> • <a href="#">LZ-4</a> )
<b>Other facilities</b>	<a href="#">Headquarters and factory</a> ( <a href="#">Hawthorne, California</a> ) • <a href="#">Rocket development and test facility</a> ( <a href="#">McGregor, Texas</a> ) • <a href="#">Satellite development facility</a> ( <a href="#">Redmond, Washington</a> ) • <a href="#">Regional offices</a> (Chantilly, Houston, Seattle, Washington DC) • <a href="#">STARGATE</a>
<b>Support</b>	<a href="#">Megan</a> (recovery ship) • <a href="#">Shannon</a> (recovery ship) • <a href="#">SpaceX fairing recovery program</a>
<b>Contracts</b>	<a href="#">Commercial Orbital Transportation Services</a> • <a href="#">Commercial Resupply Services</a> • <a href="#">Commercial Crew Program</a> • <a href="#">Commercial Lunar Payload Services</a> • <a href="#">Gateway Logistics Services</a> • <a href="#">Human Landing System</a> • <a href="#">Polaris</a> • <a href="#">Rocket Cargo</a> • <a href="#">Starshield</a>
<b>R&amp;D programs</b>	<a href="#">Reusability</a> • <a href="#">Falcon 9 landing tests</a> • <a href="#">Red Dragon</a> (canceled) • <a href="#">Mars transport</a>
<b>Key people</b>	<a href="#">Elon Musk</a> (CEO, CTO) • <a href="#">Gwynne Shotwell</a> (President and COO) • <a href="#">Tom Mueller</a> (former VP of Propulsion Development)
<p>* denotes unflown vehicles or engines, and future missions or sites. † denotes failed missions, destroyed vehicles, and abandoned sites.</p> <p><a href="#"><b>Commons</b></a></p>	

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