

Wayfinders as spacecraft trackers

NASA's Nelson on 2022 budget priorities

Building UAM ground infrastructure

AEROSPACE

★ ★ ★ A M E R I C A ★ ★ ★

The text you're reading now is sized to represent the tonnage of satellites that fall back to Earth annually. The text would need to look like this...

MEGA

...to represent the tonnage from the coming megaconstellations. Learn about the risks. [PAGE 34](#)



A giant leap for
**SPACE
TOURISM?**
PAGE 18

KEY MOMENTS IN

The July 20 flight by Jeff Bezos and his fellow passengers will take about 11 minutes, but like astronaut Alan Shepard's 15-minute flight 60 years ago, the impact could be felt for decades. Success by Blue Origin would end a race with Virgin Galactic to send the first paying customer to the fringes of space and could spark regular tourist flights. The flight will be the 16th for the company's New Shepard rocket and capsule design. After capsule separation, the passengers will float free for three minutes as they continue to climb to 100 kilometers, and they will view Earth silhouetted against the black of space through six large windows before descending back to Texas for a landing under parachutes. Here are the top milestones in the battle of the billionaires, Bezos and Richard Branson of Virgin Galactic.

— *Cat Hofacker*



SECRET START

September 2000 — Jeff Bezos quietly founds Blue Origin. The company's existence isn't known publicly until 2003, when reports emerge of Bezos purchasing thousands of acres in West Texas to be converted into a launch site.

FIRST FLIGHT

1 March 5, 2005 — Blue conducts a test flight of its jet engine-powered vertical takeoff and landing experimental vehicle, named Charon. The tank-like article reaches 96.3 meters in altitude and then fires its thrusters for a controlled landing.

OUT OF THE SHADOWS

2 Jan. 2, 2007 — Blue makes the first public reference to "New Shepard," in a blog post on the company website signed by Bezos. He describes a November 2006 low-altitude test with a different experimental vehicle, a rocket-powered test article named Goddard that is "a first development vehicle in the New Shepard program."

MINOR SETBACK

Sept. 2, 2011 — A blog post on the company website signed by Bezos describes two "short hop" flights Blue conducted with the Propulsion Module 2 test vehicle. The rocket was destroyed during the second flight when "a flight instability drove an angle of attack that triggered our range safety system to terminate thrust on the vehicle."

NEW SHEPARD DEBUT

3 April 29, 2015 — Blue completes the first flight of the New Shepard design, consisting of a rocket and unoccupied dummy capsule that reach about 93.5 kilometers in altitude. The capsule separates from the rocket for a parachute-assisted landing, but the booster crashes upon descent.

LANDING DOWN PAT

4 Nov. 23, 2015 — Blue launches the second uncrewed flight of the New Shepard design. Both the capsule and the rocket, dubbed New Shepard 2, are recovered.

REUSABILITY MILESTONE

Jan 22, 2016 — Blue conducts the second uncrewed flight of the New Shepard 2 topped with an unoccupied capsule, the first time the company has reflown a rocket.

PLAN FOR PASSENGERS

Oct. 13, 2016 — Blue will fly employees as "test astronauts" in 2017, President Rob Meyerson says at the International Symposium for Personal and Commercial Spaceflight in New Mexico. This does not happen. He says commercial flights would then begin in 2018, and this does not happen either.

SCHEDULE SLIP

Oct. 10, 2018 — With the 2018 deadline slipping away, Blue plans to begin passenger flights in the first half of 2019, CEO Bob Smith tells attendees at the Aerospace Futures Alliance Summit in Washington.

BREAKING RECORDS

Dec. 11, 2019 — Blue launches the New Shepard 3 rocket for the sixth time, surpassing the record of five flights set by New Shepard 2 before that vehicle was retired.

A NEW ROCKET

6 Jan. 13, 2021 — The New Shepard 4 rocket, with an unoccupied crew capsule, makes its first flight. This is the version that will perform passenger flights.

READY FOR PASSENGERS

7 May 5, 2021 — Blue holds a webcast announcing plans to auction off a seat aboard New Shepard's first crewed flight on July 20. The seat sells for \$28 million in June to an undisclosed buyer.

THE RACE

BLUE ORIGIN V. VIRGIN GALACTIC



ONGOING TESTS

Oct. 22, 2012 — Blue posts a video on its website showing the first test of the crew capsule escape system, a collection of thrusters that would propel the capsule and passengers inside away from a sizzling or exploding launch vehicle. In the video, a test capsule blasts off from the ground in a plume of smoke, landing under three parachutes.



MULTIPLE FIRSTS

Dec. 12, 2017 — Blue flies its first customer payloads. The 12 experiments from companies, universities and a K-8 school launch aboard Blue's Crew Capsule 2.0 and New Shepard 3 rocket, the first flight for both vehicles.



BEZOS ON BOARD

June 7, 2021 — Bezos posts on Instagram that he and his brother Mark will be among the four passengers on New Shepard's July 20 flight.



KEY MOMENTS IN THE RACE



VIRGIN GALACTIC

BOLD BEGINNING

September 2004 — Richard Branson founds Virgin Galactic. He gives a press conference at the Royal Aeronautical Society in London, laying out plans to begin suborbital flights with customers in 2007 aboard piloted SpaceShipTwo planes, to be built by Scaled Composites and based on the SpaceShipOne design that won the 2004 X-prize. AvWeek reports that Branson and Scaled founder Burt Rutan will be Virgin's first passengers.

DEADLY EXPLOSION

July 26, 2007 — A tank of nitrous oxide at the Mojave Air and Space Port in California explodes, killing three employees of Scaled Composites, which was building the SpaceShipTwo planes for Virgin. Scaled becomes a Northrop Grumman subsidiary in late August, concluding a deal that was announced in July before the explosion.

SHIFTING TIMELINES

1 July 28, 2008 — Virgin rolls out its WhiteKnightTwo carrier aircraft at the Mojave Air and Space Port in California with a ceremony that includes Branson popping a bottle of champagne and naming the aircraft VSS Eve (short for Virgin Space Ship), after his mother. He says passenger flights could begin between 2009 and 2011.

SPACEPLANE ROLL OUT

2 Dec. 7, 2009 — Virgin unveils the first SpaceShipTwo, VSS Enterprise, at the Mojave Air and Space Port in California.

NEW MEXICO HUB OPENS

3 Oct. 17, 2011 — Branson dedicates Virgin's hangar and runway at Spaceport America in New Mexico by rappelling down a balcony alongside aerial performers and swigging from a bottle of champagne. He tells event attendees and press that he hopes test flights will wrap up by the end of 2012 and that passenger flights from the facility, Virgin's planned hub, will begin shortly after.

FIRING THE ENGINES

4 April 29, 2013 — Virgin completes the first powered flight of VSS Enterprise after a series of captive-carry and unpowered glide flights spanning three years. The spaceplane is released from the WhiteKnightTwo carrier aircraft and fires its hybrid rocket motor for 30 seconds. The two pilots then steer Enterprise for a glided landing at Mojave Air and Space Port.

TARGETING 2014

Jan. 10, 2014 — Virgin pilots complete the third powered flight of VSS Enterprise, and CEO George Whitesides says in a press release that "we are progressively closer to our target of starting commercial service in 2014."

A SECOND TRAGEDY

5 Oct. 31, 2014 — Traveling at Mach 0.8 over Koehn Dry Lake, California, VSS Enterprise breaks apart seconds after it is released from the WhiteKnightTwo carrier aircraft. Co-pilot Michael Alsbury is killed, and pilot Peter Siebold parachutes to the ground but is severely injured. It will be two years before Virgin conducts its next piloted flight.

DEADLY ERROR

July 28, 2015 — Last year's crash was caused by pilot error and a design flaw, the National Transportation Safety board reports. Scaled should have considered that a pilot might prematurely pull the lever that held the vehicle's tail wings in place, leaving it vulnerable to drag that pulled it upward while Enterprise was traveling too fast and the atmosphere was too thick.

NEW SPACEPLANE

6 Feb. 19, 2016 — Branson unveils the second SpaceShipTwo plane, Virgin Space Ship or VSS Unity, in a ceremony at the Mojave Air and Space Port in California. The spaceplane's first free flight occurs in December, when VSS Unity is released from the WhiteKnightTwo carrier aircraft and pilots steer it back to Mojave for a glided landing.

SCHEDULE UPDATE

April 26, 2017 — Virgin will begin customer flights in 2018, CEO George Whitesides tells the Senate Commerce Committee.

EDGE OF SPACE

Dec. 13, 2018 — VSS Unity burns its hybrid rocket motor for 60 seconds during its second powered flight, propelling the plane and its pilots over the 80-kilometer mark that the U.S. Air Force defines as the boundary of space.

FIRST PASSENGER

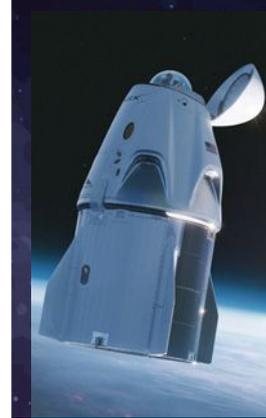
7 Feb. 22, 2019 — Virgin's chief astronaut trainer Beth Moses joins the two pilots for a powered test flight aboard VSS Unity, becoming the company's first passenger. The flight also marks the second time VSS Unity reaches space.

GOING PUBLIC

July 9, 2019 — Virgin announces plans to become a publicly traded company via a merger with investment firm Social Capital Hedosophia, a deal closed in October. Executives say the plan is to begin passenger flights in mid-2020.

NEW TARGETS

Aug. 3, 2020 — Branson's flight aboard VSS Unity will occur between January and March 2021, according to a Virgin press release, delaying customer flights to mid-2021 at the earliest.



Orbital tourism

While Blue Origin and Virgin Galactic are focused on going up and down on missions lasting minutes to at most hours, SpaceX's planned tourist flights would span days at much higher altitudes. In the company's Inspiration-4 mission planned for September, four private citizens will orbit Earth for three days in a Crew Dragon capsule. This would be the first SpaceX launch of tourists, and the company is marking the occasion with a Crew Dragon upgrade: the addition of a 2-meter-diameter glass dome in the capsule's nose, through which passengers would get a panoramic view of Earth and space from their orbit of 540 kilometers.

TESTING SETBACK

Dec. 12, 2020 — The first powered test flight of VSS Unity from Spaceport America in New Mexico is cut short when electromagnetic interference from Unity's flight computer cut off the data connection with the hybrid rocket motor, prompting the computer to end the ignition sequence.

GROWING THE FLEET

March 30, 2021 — Virgin rolls out the first Spaceship III plane, named VSS Imagine.

NEW MEXICO SPACEFLIGHT

May 22, 2021 — Virgin completes the first powered flight of VSS Unity from Spaceport America, reaching a speed of Mach 3 and altitude of about 89 kilometers, high enough for the two pilots to glimpse "the bright, blue-rimmed curvature of the earth against the blackness of space," according to a press release.

THE ROAD AHEAD

June 10, 2021 — In an email update, Virgin says it is "on track to complete VSS Unity's flight test program by late summer or early fall." The three remaining flights consist of tests with a handful of Virgin employees and then Branson, concluding with three spaceflight participants from the Italian Air Force. ★