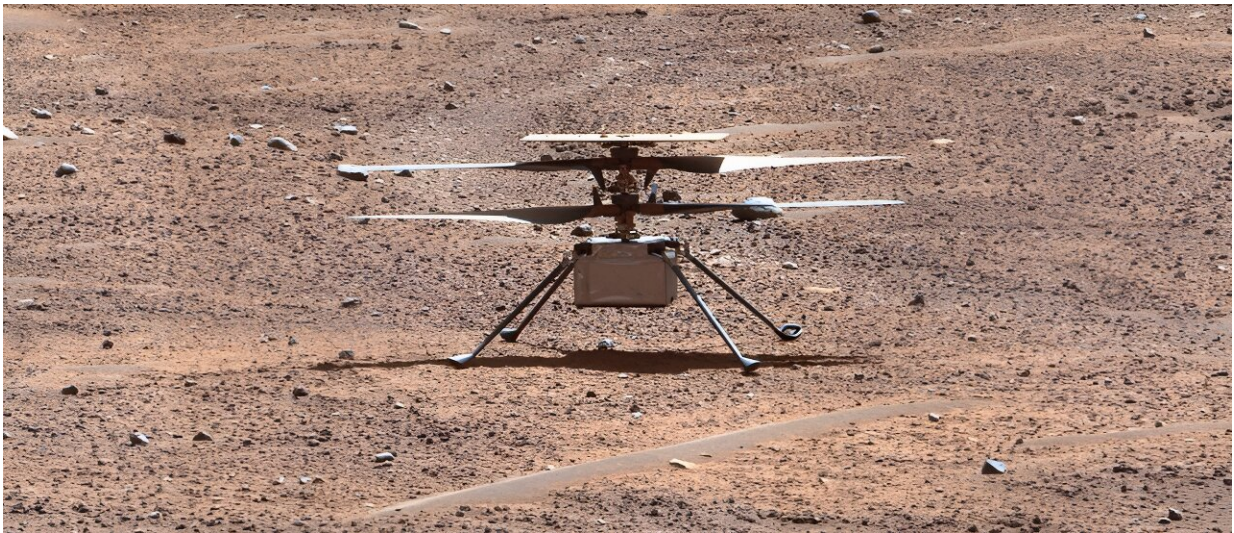


After three years on Mars, NASA's Ingenuity helicopter mission ends

January 25 2024, by Alise Fisher and Alana Johnson



NASA's Ingenuity Mars Helicopter is seen Aug. 2, 2023, in an enhanced-color image captured by the Mastcam-Z instrument aboard the agency's Perseverance Mars rover. Credit: NASA/JPL-Caltech/ASU/MSSS

NASA's history-making Ingenuity Mars Helicopter has ended its mission at the Red Planet after surpassing expectations and making dozens more flights than planned. While the helicopter remains upright and in communication with ground controllers, imagery of its Jan. 18 flight sent to Earth this week indicates one or more of its rotor blades sustained damage during landing and it is no longer capable of flight.

Originally designed as a technology demonstration to perform up to five experimental test flights over 30 days, the first aircraft on another world operated from the Martian surface for almost three years, performed 72 flights, and flew more than 14 times farther than planned while logging more than two hours of total flight time.

"The historic journey of Ingenuity, the first aircraft on another planet, has come to end," said NASA Administrator Bill Nelson. "That remarkable helicopter flew higher and farther than we ever imagined and helped NASA do what we do best—make the impossible, possible. Through missions like Ingenuity, NASA is paving the way for future flight in our solar system and smarter, safer human exploration to Mars and beyond."

Ingenuity landed on Mars Feb. 18, 2021, attached to the belly of NASA's Perseverance rover and first lifted off the Martian surface on April 19, proving that powered, controlled flight on Mars was possible. After notching another four [flights](#), it embarked on a new mission as an operations demonstration, serving as an aerial scout for Perseverance scientists and rover drivers. In 2023, the helicopter executed two successful flight tests that further expanded the team's knowledge of its aerodynamic limits.

"At NASA JPL, innovation is at the heart of what we do," said Leshin. "Ingenuity is an exemplar of the way we push the boundaries of what's possible every day. I'm incredibly proud of our team behind this historic technological achievement and eager to see what they'll invent next."

Ingenuity's team planned for the helicopter to make a short vertical flight on Jan. 18 to determine its location after executing an [emergency landing](#) on its previous flight. Data shows that, as planned, the helicopter achieved a maximum altitude of 40 feet (12 meters) and hovered for 4.5 seconds before starting its descent at a velocity of 3.3 feet per second (1

meter per second).

However, about 3 feet (1 meter) above the surface, Ingenuity lost contact with the rover, which serves as a communications relay for the rotorcraft. The following day, communications were reestablished and more information about the flight was relayed to ground controllers at NASA JPL. Imagery revealing damage to the rotor blade arrived several days later. The cause of the communications dropout and the helicopter's orientation at time of touchdown are still being investigated.

Triumphs, challenges

Over an extended mission that lasted for almost 1,000 Martian days, more than 33 times longer than originally planned, Ingenuity was upgraded with the ability to autonomously choose landing sites in treacherous terrain, dealt with a dead sensor, cleaned itself after [dust storms](#), operated from 48 different airfields, performed three emergency landings, and survived a frigid Martian winter.

Designed to operate in spring, Ingenuity was unable to power its heaters throughout the night during the coldest parts of winter, resulting in the flight computer periodically freezing and resetting. These power "brownouts" required the team to redesign Ingenuity's winter operations in order to keep flying.

With [flight operations](#) now concluded, the Ingenuity team will perform final tests on helicopter systems and download the remaining imagery and data in Ingenuity's onboard memory. The Perseverance rover is currently too far away to attempt to image the helicopter at its final airfield.

"It's humbling Ingenuity not only carries onboard a swatch from the original Wright Flyer, but also this helicopter followed in its footsteps

and proved flight is possible on another world," said Ingenuity's project manager, Teddy Tzanetos of NASA JPL.

"The Mars helicopter would have never flown once, much less 72 times, if it were not for the passion and dedication of the Ingenuity and Perseverance teams. History's first Mars helicopter will leave behind an indelible mark on the future of space exploration and will inspire fleets of aircraft on Mars—and other worlds—for decades to come."

Provided by JPL/NASA

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