TECHNOLOGY Facts
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Paresev

"The Paraglider Research Vehicle"

The overhead lever used for lateral control on the original Paresev-1 is clearly seen in this photo of the vehicle in flight behind a towline.

NASA Photo E-8009

A NASA aeronautical research project conducted in the early 1960s at the Dryden Flight Research Center studied the feasibility of using a steerable kite-like parawing as a replacement for parachutes used then to safely land spacecraft on Earth. The project was called Paresev, an acronym for Paraglider Research Vehicle.

The unpowered Paresev was based on the design of the Rogallo wing, conceived in the late 1940s by Francis Rogallo, an aeronautical engineer who worked at the Langley Research Center for the NACA (National Advisory Committee for Aeronautics, the predecessor agency of NASA).

The unpowered Paresev had the shape of a triangular kite with a pilot sitting in the open on a seat suspended beneath an aluminum triangular frame covered with fabric. When subjected to air pressure, the fabric formed a billowy lifting surface. The pilot controlled pitch and lateral movement of the parawing with an overhead control stick attached to the frame.

The Dryden tests also included evaluation of an inflatable Rogallo-type wing similar to the design of the parawing considered for spacecraft use.

During the NASA study, the Paresev was towed into the air by ground vehicles and aircraft. At pre-determined altitudes, pilots released the towline and landed on Rogers Dry Lake following their brief flights that were measured in minutes, and often in seconds. Between 1962 and 1964, the Paresev was flown nearly 350 times to test four versions of the vehicle.

The Paresev evaluation, underway at the height of the Mercury spaceflight program, was looking at the parawing concept as a possible replacement of the parachute recovery system on future Gemini and Apollo spacecraft. The parawing concept was not selected for the spaceflight program, but interest it generated because of the NASA study helped popularize the Rogallo wing which made the sport of hang gliding one of the most widespread forms of flying throughout the world.

Rogallo created the flexible wing on his own and successfully flew a prototype in 1948. He patented the design in 1951, but the first real public exposure didn't come until 11 years later when NASA began evaluating the concept for the manned spaceflight program.

Rogallo wings and variations on the original design are now being flown by hundreds of thousands of hang glider enthusiasts around the world. Rogallo-type parawings are also used on ultra-lights, simple powered flying machines that resemble the original Paresev research vehicle evaluated by NASA pilots more than four decades ago.

Paresev History

The Paresev project originated in early 1961 during the formative days of America's first venture into space. As the Mercury program was putting the nation's first astronauts into space, the Gemini program was fully underway planning for the next phase.

Parachutes had already been chosen as the primary means of slowing the descent of a spacecraft returning to Earth, and they were proven to be safe and reliable. But the exact location of the landing site on a broad ocean could not always be identified correctly, and the retrieval of astronauts and spacecraft could become costly when a large fleet of recovery ships had to be deployed. Some NASA planners also feared the risk of astronauts drowning and spacecraft being lost because of water leaking into capsules or from total immersion.

Most NASA officials were already aware of the Rogallo wing. The designer had first proposed the parawing concept to Langley in the late 1940s as a simple, inexpensive approach to recreational flying, but the idea was not accepted as a project. In early 1961, however, NASA spaceflight planners began looking for a better way to land astronauts in their space capsules and called for a study of a Rogallo-type parawing. The initial idea was to use an inflatable parawing that would be folded up and stowed on the Gemini capsules. At a pre-selected altitude, the parawing would be deployed, inflated, and the capsule would be steered to an airplane-like landing on the ground. This would eliminate the

need for an ocean landing and a large flotilla of recovery ships.

The need for baseline parawing experience and developmental testing shifted the operational effort to NASA Dryden where Paresev-1 was built in just seven weeks within a timetable that Center management said must be "quick and cheap." The cost was only $4,280, and it was the first NASA research aircraft to be built totally in-house.

The Paresev and the Flight Test Program

The Paresev flight test program began in February 1962 and ended two years later after nearly 350 flights. During this period, the original Paresev vehicle was modified for testing three times. Each version had its own designation: Paresev-1, 1-A, 1-B, and 1-C.

Paresev's main three-piece frame, made of aluminum tubing, came together at a forward point to create a triangular shape with a leading edge sweep angle of 50 degrees. The sweep angle was held firm by a spreader bar. The wing fabric was attached to the two leading edges and the center longitudinal keel. In flight, the cloth billowed into two half-cone lobes that created the parawing's unconventional look and shape.

The pilot seat was attached to a three-wheeled frame that supported a tripod mast on which the parawing was mounted. The basic vehicle was slightly more than 11 feet high from the top of the parawing to the ground, while the length of the center keel was 15 feet. Total weight was about 600 pounds.

As a vehicle or another aircraft was towing the Paresev it usually rose from the ground at about 46 mph and had a maximum air speed of about 65 mph. The pilot controlled the ascent and descent rate by either tilting forward or aft. On the first model, turns were initiated by tilting the wing from side to side with an overhead control stick.

The first Paresev flights were made with triangular frame covered with linen, but it took just five flights to show that linen was too flexible and caused trailing edge flutter. There was also an undesirable time delay between a control command and aircraft movement. Rigging modifications failed to improve flying characteristics and longitudinal and lateral control forces remained severe.

On the fifth ground tow the vehicle and pilot plunged to the ground from a height of 10 feet. The pilot was not hurt seriously, but the Paresev had to be rebuilt.

Dacron was used to recover the wing on the rebuilt vehicle, now called Paresev 1-A, and better aerodynamics and handling qualities were quickly noticed. The original overhead control lever was also replaced with a more conventional stick and pulley system on Paresev 1-A. The new control system was linked to lines attached to the outboard tips of the parawing where movement would cause a change in attitude and pitch. Other alterations included larger wheels, salvaged from a Cessna 175 aircraft, and auto-type shock absorbers.

Paresev 1-A became the first version to be towed by an aircraft. Following a series of ground tows to check handling qualities at low altitudes, a rented Stearman biplane pulled Paresev 1-A to 10,000 feet above Rogers Dry Lake where the pilot reported great improvements in control forces. That altitude became the normal tow release point on most flights when towed by an aircraft.

Paresev 1-B evolved from the same vehicle when project officials made the wing smaller to study lower lift-over-drag values, giving it a gliding ability that was described as "pretty scary" by more than one test pilot.

NASA Dryden pilot Milton Thompson, right, and NASA astronaut Gus Grissom are pictured with the modified Paresev 1-A. The original lateral control lever was replaced on Paresev 1-A with a stick and pulley system of control wires linked to the tips of the parawing.

NASA Photo E-8937

After sufficient data were generated with the smaller wing, the final project modification was made. The vehicle was called Paresev 1-C and used a half-size inflatable parawing based on the concept originally envisioned for the Gemini and Apollo space capsules.

The new wing, 179 square feet in size, had three chambers that became rigid support spars when pressurized with nitrogen. The gas-filled center spar was nearly 16 feet in length, while the other two inflatable spars formed the two leading edges. When pressurized, this half-scale configuration resembled the larger space-capsule version. For reentry use, the larger parawings on Gemini spacecraft would have been folded and stowed during spaceflight. They would have been deployed upon atmospheric reentry where the nitrogen-filled chambers would form the steerable parawing to bring the capsules and crews back to Earth.

Paresev flight tests at NASA Dryden, however, showed that the inflatable parawing concept was very unstable in flight and difficult to fly, even after rudder pedals had been installed as a booster mechanism for roll control.

After evaluating the results of the Paresev flight test program and additional reentry studies by NASA and North American Aviation, the parachute recovery concept was retained for the Gemini and Apollo spaceflight programs, and the Paresev concept was discarded.

The Paresev vehicle was turned over to the Smithsonian Institute's Air and Space Museum following the flight test program, and is now on loan to the Experimental Aircraft Association (EAA) museum in Oshkosh, Wisconsin.

Pilots who took part in the Paresev flight research program were NASA Dryden research pilots Milton Thompson, Bruce Peterson, and Neil Armstrong, Robert Champine of NASA Langley, and NASA astronaut Gus Grissom.

The inflatable wing tested on Paresev 1-C is clearly seen in this photo of the vehicle mounted on a flatbed truck. The half-scale parawing is the same design as the larger version once considered for reentry use on Gemini and Apollo spacecraft.

NASA Photo E-10365