Steer Wrestling in Space: Untethered Satellite Recovery on STS-51A

Astronaut Dale Gardner capturing the stranded Weststar IV satellite (Credit: Nasa)

In November 1984, the Space Shuttle *Discovery* carried out one of the most technically daring and operationally complex missions in the early history of human spaceflight. During mission STS-51A, astronauts *Dale A. Gardner* and *Joseph P. Allen* executed a pair of untethered extravehicular activities (EVAs) to retrieve two malfunctioning commercial communications satellites from Earth orbit—an unprecedented feat that combined orbital mechanics, human maneuvering technology, and on-the-spot engineering improvisation.

Their work marked the first—and remains one of the most striking—demonstrations of astronauts acting as orbital recovery technicians rather than explorers, transforming what could have been permanent space debris into recoverable hardware. In doing so, Gardner and Allen helped define the operational potential of the Space Shuttle era.

Mission Context: Failures in Orbit

Earlier in 1984, two satellites—**Palapa B-2** (Indonesia) and **Westar VI** (United States)—had been launched aboard Shuttle mission STS-41B. Each relied on a Payload Assist Module (PAM-D) upper stage to boost from low Earth orbit into geostationary transfer orbit.
Both PAM-D motors failed to achieve proper stabilization before ignition, leaving the satellites stranded in low Earth orbit and slowly tumbling. Financial losses were severe, and the satellites' continued presence posed navigational and debris risk.
NASA and the satellite operators devised a bold plan: launch a new Shuttle mission and capture both satellites manually in orbit return them to Earth for refurbishment and relaunch.
No prior mission had attempted recovery of free-flying, rotating spacecraft of this size.

Discovery and the Shuttle as an Orbital Work Platform

Discovery lifted off on 8 November 1984, carrying a crew trained not only in Shuttle operations but also in orbital rendezvous and satellite capture. The Shuttle's **Remote Manipulator System (RMS)**—the Canadarm—would provide positioning capability, but the final capture would depend on

astronauts using the **Manned Maneuvering Unit (MMU)**, a nitrogen-gas thruster backpack that allowed completely untethered flight in space. Key operational challenges included:
(1) Relative motion control: Matching velocity and rotation with tumbling satellites, (2) Propellant limits: MMU nitrogen supply constrained maneuver time. (3) Human factors**:** Maintaining spatial orientation and fine motor control in microgravity, (4) Contingency planning: No physical tether meant no immediate rescue line if control was lost. The mission required a synthesis of piloting skill, EVA procedure, and real-time judgment rarely demanded in previous spacewalks.

The First Recovery Attempt

The first EVA targeted **Palapa B-2**.
Allen initially attempted capture using a specialized **stinger device** designed to dock with the satellite's apogee motor nozzle. However, the satellite's slow tumble made rigid capture unsafe; unexpected rotational dynamics risked destabilizing both astronaut and spacecraft.
Mission control and crew rapidly revised the procedure: Allen stabilized himself relative to the satellite using MMU thrust control, Gardner approached carrying a **capture bar**.
The astronauts manually damped the satellite's rotation and the RMS grapple fixture was attached, then the Canadarm drew the satellite into the Shuttle payload bay.
This transition from planned mechanical docking to human-mediated rotational control illustrated the flexibility—and risk tolerance—of Shuttle-era EVA operations.

The Westar VI Retrieval

Days later, Gardner and Allen repeated the process for **Westar VI**, now with improved understanding of the dynamics involved. Operational refinements included: Better synchronization between MMU pilot and RMS operator, modified hand-placement strategy to control angular momentum and more efficient capture-bar positioning.
The second retrieval proceeded more smoothly, demonstrating rapid procedural learning in orbit—an essential trait for complex space operations where ground simulation cannot perfectly reproduce real conditions.

Legacy of the Pioneers

Dale Gardner's celebratory in-orbit sign: **"For Sale: Westar VI"** captured public imagination, but the deeper legacy lies in operational courage and technical adaptability.
STS-51A demonstrated that humans can perform precision capture of large free-flying spacecraft. Untethered EVA, though risky, can enable unique mission profiles, and real-time engineering judgment is indispensable in space operations.
Today's concepts of satellite servicing, debris removal, and on-orbit assembly—now pursued with robotics and autonomous systems—trace intellectual lineage to this mission.
Gardner and Allen were not merely astronauts on a recovery flight.
They were the first orbital mechanics technicians, proving that space is not only a frontier to reach, but a workplace where skill, physics, and courage converge.
They were, unmistakably, **the Pioneers**.

References

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March 2026, Joachim J. Kehr, Editor Journal of SpaceOperations & Communicator
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