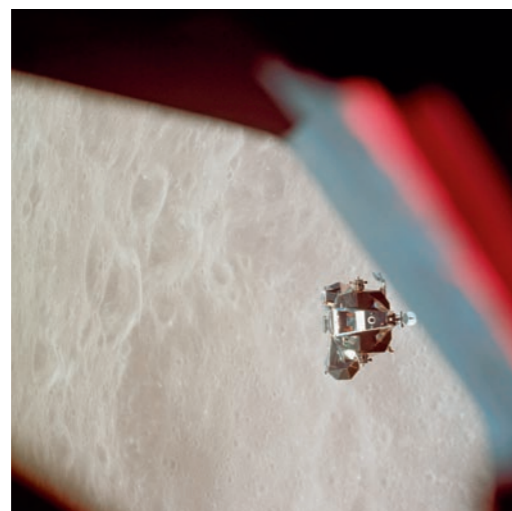




**ABOVE** The Lunar Module 'Spider' ascent stage is photographed from the Command/Service Module on the fifth day of the Apollo 9 Earth-orbital mission. The Lunar Module's descent stage had already been jettisoned. (NASA)

explosive charges blew off fragments of foil from the lower stage. Using the ascent engine McDivitt spent the next two hours playing catch up as he manoeuvred the LM's ascent stage back towards Dave Scott in the CM.

The first LM to fly in space had proved it could keep two astronauts alive for up to six hours, manoeuvring them safely between orbits and ultimately to a safe and successful rendezvous with the Command Module. Back on Earth McDivitt wrote to the designers with a photograph of his *Spider* in space. The caption below read: "Many thanks for the funny-looking spacecraft. It sure flies better than it looks." The next Lunar Module to fly (LM-4) would carry its crew to within 8 miles of the Moon's rugged surface on Apollo 10.



**RIGHT** The ascent stage of the Apollo 10 Lunar Module (LM) is photographed from the Command Module prior to docking in lunar orbit. The LM is approaching the Command/Service Modules from below. The LM descent stage had already been jettisoned. (NASA)

## Apollo 10 – the LM's first flight to the Moon

**D**esigned as a dress rehearsal for a landing mission, Apollo 10 would practise every step of a landing short of the final descent to the lunar surface. It would be the first time the Lunar Module was taken to the Moon. The crew, Tom Stafford, Gene Cernan and John Young, had christened LM-4 *Snoopy* to go with their Command Module *Charlie Brown*.

The mission lifted off on 18th May 1969, and despite severe pogo oscillations of the second stage of the Saturn V, they reached Earth orbit and continued on to arrive at the Moon by 21st May. The next day Stafford and Cernan boarded the LM and, after some concern over an undocking problem, the two spacecraft separated successfully on the far side of the Moon. At nearly 100 hours into the mission Stafford fired up the descent engine for a 30-second burn which would take them lower towards the surface.

At a point 300 miles east of the Sea of Tranquillity the crew fired the descent engine once more to place them in an elliptical orbit and on a trajectory which would swoop them down to an altitude of 47,400 feet above the rehearsal landing site on their next pass. Grumman's LM-4 was too heavy to make a full landing and lift off back from the surface and so there was never a thought of attempting a full landing.

As they came round for this final orbit the astronauts prepared to jettison the descent stage and return to *Charlie Brown*. Suddenly, without warning, the LM began to roll unexpectedly. The incident startled the crew and through a hot microphone Cernan exclaimed "Son of a bitch ... what the hell happened?" Stafford quickly jettisoned the heavy descent stage and used his hand controllers to stabilise the tumble. It turned out that the problem was caused by human error. A switch for the Abort Guidance System had been left in the wrong 'automatic' position and the LM was searching for the Command Module above, as it had been instructed to do.

After a successful rendezvous and docking, using the LM's rendezvous radar for the first time in lunar orbit, the crew transferred back to

the CM and jettisoned LM-4 – propelling it into a solar orbit. The Service Module engine was fired up on 23rd May and the crew headed home.

With the Apollo 10 dress rehearsal mission declared a triumph, Apollo 11, carrying LM-5, was already being rolled out towards Pad 39A in preparation for mankind's first attempt to land on the Moon.

## How to land on the Moon

**A**ny Apollo flight required hundreds of complicated procedures which had been planned and tested, modified, re-tested, and rehearsed until all those concerned could

execute them in their sleep. But undisputedly at the top of this list was the 12-minute time line it took to go from travelling at the equivalent of Mach 5 in lunar orbit to standing still at a precise point on the Moon's surface. This task was divided up into three distinct phases each controlled by a separate computer programme: braking (P63), approach (P64) and terminal descent (P66).

### Braking (P63)

The final descent to the lunar surface was always begun from the low point of an orbit which occurred 250 miles east of the designated landing site. Ten minutes prior to Powered Descent Initiation (PDI), the

**BELOW** A view looking forward towards the windows inside the LM, showing the locations of the various control and instrument panels ('Panel 1', 'Panel 2', etc). Refer to the illustration on pages 132–133 for further details of the panels. (NASA/Frank O'Brien)

