The flight of Maj. Kermit Haderlie saved other lives, but it cost him his own.

ZOOM CLIMB

By John Lowery

On Nov. 22, 1968, Maj. Kermit L. Haderlie, a student in the Air Force's Aerospace Research Pilot School, flew a Lockheed F-104C Starfighter on a zoom climb mission to the edge of the Earth's atmosphere. For ARPS students at Edwards AFB, Calif., the zoom maneuver was a rehearsal for possible future spaceflight.

The Mach 2 mission took the airplane so high that the standard F-104's jet engines routinely exceeded their temperature limits and had to shut down. Sometimes the engine simply flamed out for lack of air. Then the pilot steered the aircraft like a returning spaceship to a lower altitude, where he would restart the engine.

Failing that, a returning zoom climb pilot would instead make a horizontal glide landing on the base's 15,000-foot runway. If short of the main runway, the lake bed runway complex offered another landing option.

Without engine power, the cockpit would depressurize on these missions. Consequently, for protection against the rarified atmosphere, the pilot wore a full-body pressure suit. Properly outfitted, a pressure-suited pilot received oxygen under very high

The F-104 Starfighter, above, often was described as the "missile with a man in it." It was the first operational fighter capable of speeds higher than Mach 2 and set both speed and altitude records. USAF had Lockheed add a rocket engine to three F-104s (designated NF-104 or Aero Space Trainer) for zoom climbs above 100,000 feet. Haderlie used the non-rocket-assisted F-104, which was limited to climbs to 80,000 feet.

pressure, at extreme altitudes, without ill effects.

Standard Air Force pressure suits of the time were found to be effective even in the vacuum of outer space. But in Haderlie's case, a bad design made his suit ineffective, and the defect killed him.

Zoom Missions

The Air Force's investigation into Haderlie's flight revealed a design flaw in the ring that locked his gloves to his pressure suit. This allowed an "inadvertent disconnection" when Haderlie was at 66,000 feet. The primary cause of the mishap was a "design deficiency," investigators found, in a suit that was otherwise "as sound as if it were new."

Officials ordered a "permanent locking design fix" for the problematic pressure suits, to "preclude inadvertent unlocking ... in flight."

As risky as the test program sounds, it was found to be well-planned and supervised and was the Air Force's "only fully controlled environment ... for flight-test training in a full pressure suit," critical for spaceflight and extreme-altitude flight.

The zoom mission was an important part of the school's curriculum. It was designed to familiarize students with the problems of operating in the upper atmosphere. The actual climb angle and apogee altitude were calculated, by the student, based on current atmospheric conditions.

At the top of the zoom, the pilot had to have at least 35 pounds per square foot of dynamic pressure on the aerodynamic surfaces in order to maintain control. Otherwise he would tumble out of the top into a potentially unrecoverable spin. Haderlie's calculations called for a 30-degree zoom angle.

Nearing the end of the course—and among the top students in class standing—he was already enthused about the possibility of becoming an astronaut. Several of his classmates became part of the space program.

The zoom mission capped the final phase of the ARPS program, which took a seasoned operational pilot and gradually helped him develop the skill and confidence needed to perform at the edge of the Earth's atmosphere.

The day prior to his zoom flight, Haderlie had flown with an instructor pilot and practiced the procedures applicable to a solo zoom mission. This was his first zoom flight alone. His projected apogee altitude was probably around 80,000 feet.

Haderlie was flying a single seat F-104C, call sign Zoom 3. His chase airplane (call sign Zoom Chase) was used to monitor all such flights and was a dual seat F-104D crewed by two of the school's students.

Unlike the usual Air Force procedure, for these missions the chase pilot was tasked with preflighting the zoom aircraft. This relieved the pressure-suited and constrained pilot from the chore. He had enough to manage with the cumbersome life-support system.

Haderlie's chase pilot dutifully completed the walk-around inspection and signed the ship's logbook.

The procedure used at the time called for the pilot to don the pressure suit in a special room that housed all the protective equipment used by the Aerospace Research Pilot School. After fitting and pressure-checking the suit, the pilot went through a denitrogenation procedure—eliminating nitrogen from his blood and body tissue.

This required the pilot to breathe

Haderlie, shown as a lieutenant when he was a member of the Skyblazers, pursued a graduate degree in astrophysics to improve his chances to enter test pilot school and become an astronaut.

A life sciences technician waits to connect the pilot (not Haderlie) in a pressure suit, to the F-104's life-support system. After the technician did his work, a life sciences officer or senior NCO would make a final check.

100 percent oxygen for at least 30 minutes before the flight. Then, carrying and breathing from a portable oxygen bottle, he was escorted to the airplane by life sciences personnel.

A suit technician then helped the pilot enter the cockpit, and the technician made the suit-to-ship connections. Finally, the life sciences officer in charge rechecked the connections and again pressure-checked the suit. Both pressure checks simulated a pressure differential much greater than what was expected in flight.

Technicians qualified to manage pressure suits were carefully trained and supervised by a life sciences officer and NCO for several weeks before being certified for their job. Certification required proficiency in tasks for specific missions, such as the zoom climb.

It was at this point that the critical factor came into play. USAF's suit-donning procedures originally required the glove-locking slide to be taped over after the slide had been attached to the pressure suit. The objective of this technique was to increase the force required to move the sliding lock and thus reduce the possibility of an inadvertent unlocking.

The Pressure-Filled Environment

While flying an F-104 in the upper atmosphere on a zoom climb mission, the oxygen pressure needed to keep the blood-oxygen level in the normal range would cause severe eye and sinus pain. Higher pressure would collapse the lung alveoli, which collect and distribute the oxygen. The collapsed alveoli would then prevent the lungs from drawing oxygen from the air and transferring it to the red blood cells.

Therefore, Air Force regulations at the time required a full pressure suit for all flights above 50,000 feet.

In the event of an emergency depressurization, the maximum altitude at which a pilot was thought able to function with the standard pressure demand oxygen system was 43,000 feet. (This has since been revised to 25,000 feet.) At that altitude, 100 percent oxygen is supplied under 30 mm HG (millimeters of mercury) of pressure to provide an 82 percent blood saturation. This is roughly equivalent to breathing air at 15,000 feet.

But at pressures above 25 mm HG, it is difficult to get a good seal on an oxygen mask. Further, flight surgeons found that human lungs could tolerate a maximum oxygen regulator pressure of 30 mm HG—but just barely and only for short periods.

Greater pressure could rapidly lead to unconsciousness and shock.

To overcome these deleterious effects, it was necessary to counterbalance the high oxygen pressure in the lungs. The full-body pressure suit did that. And to prevent the pain produced by high oxygen pressure in the eyes and ears, it was necessary to enclose the entire head in a pressure-containing helmet.

Inexplicably, in the spring of 1968—shortly before Haderlie's zoom flight—the taping procedure was removed from the regulations.

The full pressure suit worn by Haderlie was designed to provide counterpressure on the human body, beginning at 35,000 feet. It accomplished this by surrounding the user with an envelope of pressurized air.

A life sciences technician checks the locking mechanism on an unidentified pilot's pressure suit glove. Failure of that mechanism led to Haderlie's death and a change in USAF equipment and procedures.

Fatal Flight

Haderlie and his chase were airborne at 9:15 a.m. After departure, Zoom 3 contacted the Edwards space positioning facility that controlled the flight. The facility began radar and optical tracking of Haderlie's flight.

Meanwhile, the entire ARPS class watched his mission on closed-circuit television.

Haderlie and his chase airplane climbed toward the northeast. At 35,000 feet, Haderlie ran through checklist items peculiar to the zoom mission. These included depressurization of the cockpit to activate and check the pressure suit, along with a check of the angle of attack indicator and electronics bay pressurization.

About 80 miles from Edwards Air Force Base, Zoom 3 began a right-climbing turn to 45,000 feet. During the climb, additional checks of electronics bay pressurization were accomplished, along with a check for proper functioning of the pilot's pressure suit. Everything appeared normal.

At this point, Edwards cleared Zoom 3 to enter the supersonic flight corridor, to begin the acceleration run to Mach 2. This acceleration would culminate in the zoom maneuver.

Once in position on the corridor's

inbound track, Zoom 3 accelerated to the target airspeed.

Haderlie again notified his chase aircraft that all checks were complete. Then he requested that the Edwards space positioning facility notify him as he approached the geographical abort point. That would be the farthest point on the acceleration track from which a zoom maneuver could be initiated. From there, if the engine failed to restart, the aircraft could still be recovered on the Edwards runway.

As requested, Edwards called Haderlie with 20 seconds and again with 10 seconds remaining. At the 10-second warning—at 47,500 feet and Mach 2—Haderlie initiated the zoom maneuver. As required by mission protocol, upon reaching 50,000 feet, he confirmed that his pressure suit was inflating properly.

At 61,000 feet, the F-104 was in its preplanned 30-degree climb. When it reached 63,000 feet, the positioning facility called Haderlie to order the standard afterburner shut down.

The call was not acknowledged. On the closed-circuit television monitor in the space positioning facility, the Starfighter was seen rolling inverted. Four seconds later, Haderlie transmitted, "I lost my glove."

Before any zoom flight, pressure suits were checked several times by different technicians. The pilot checked the suit again at about 35,000 feet, just before going beyond the limit for the standard oxygen system.

The aircraft had now passed through 66,000 feet.

Loss of the glove caused total loss of air pressure within the suit and helmet. With an explosive decompression, his body was instantly in a depressurized cockpit. He would stay conscious for only a few seconds.

Zoom Chase transmitted, "How do you read?" There was an immediate but garbled reply, then silence.

The accident report shows that Haderlie attained an apogee altitude of 69,400 feet, then three seconds later began an inverted descent—still in afterburner.

As the Starfighter rapidly descended past the chase aircraft's altitude of 44,000 feet, the chase crew began transmitting, "Pull out! Pull out! ... Eject! Eject!"

Hurtling down at an extreme airspeed, the aircraft exceeded the so-called thermal barrier. As space positioning personnel and his classmates watched, the F-104's skin and canopy overheated. Then, as the aircraft reached the denser air in the lower altitudes, Haderlie's Starfighter disintegrated.

Sixty-one seconds elapsed from the time of Haderlie's final garbled transmission at 69,000 feet until ground impact.

Westerly winds caused significant dispersion of the wreckage. The ejection system had not been activated, but he could not have survived an ejection at more than 1,750 mph.

At the time, three major commands had roughly 400 of these pressure suits, and "large quantities" of a new suit—with the same connection mechanism—were on order. USAF therefore reinstituted the emergency safety procedure of taping over the connections and ordered a glove-to-pressure suit connector redesign to prevent additional accidents. ■

A Long Climb

Maj. Kermit Lloyd Haderlie's path to the edge of space had been challenging. He was born and raised in rural Wyoming, where his staunch Mormon parents were ranchers. Haderlie paid his college tuition by working summers driving bulldozers and other heavy equipment. In 1952, he graduated from Utah State University and was commissioned a USAF second lieutenant through the school's ROTC program.

Haderlie found his niche in the Air Force. He was first in his flight school class and designated a "distinguished graduate." At fighter gunnery school, in the F-86 Sabrejet, he was again first in his class and upon graduation received the "Top Gun" award. He was assigned to the 36th Tactical Fighter Wing in Germany as a fighter pilot.

Subsequently he was picked as a member of the wing's aerobatic team, the Skyblazers, the European version of the Thunderbirds. He was then sent to Luke AFB, Ariz., as an instructor pilot. It was there, while teaching new Air Force pilots to operate the F-100 Super Sabre, that he nurtured his plans for spaceflight.

A year later, he applied for the test pilot school but was rejected. An advisor told him he had the wrong education: He had a bachelor of science degree, but for test pilot school, he was told, a degree in engineering or astrophysics was preferable.

So Haderlie went back to school, earned a degree in astrophysics from the University of Arizona, and was immediately accepted for the Aerospace Research Pilot School at Edwards Air Force Base in California.

Haderlie was approaching his dream of spaceflight. The zoom climb mission was to have helped prepare him for the job.

John Lowery is a veteran Air Force fighter pilot and freelance writer. He is the author of four books on aircraft performance and aviation safety. This is his first article for Air Force *Magazine.*