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June 2002, Flight Journal: "Soyuz 5's Flaming Return"

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Soyuz 5's Flaming Return pp. 56-60

Fliers love to tell tales of overcoming hazards, and the more dangerous and unusual, the better. But for Russian cosmonaut Boris Volynov, his brush with fiery death on a spaceflight forty years ago was a state secret so deep that it only came out recently. As his Soyuz landing capsule plunged wrong-way-forward into the flames of atmospheric re-entry and smoke filled the cabin, he and everyone in Mission Control in Moscow assumed he was about to die. But when he didn't, the next order of business was to pretend it had never happened, and Volynov was ordered to NOT tell the story.

The ferocious energy required to climb into space is obvious in the flames and roar of a rocket liftoff. Clawing against gravity's embrace, the rocket frantically expels tons of mass the only way we've figured out, by burning it and aiming the hot exhaust towards the ground. The thunderous tail of flame is an unforgettable image of spaceflight. The result is that 95% of the rocket's original weight winds up as smoke floating in the air, while another part, a very small percentage, is thrown upwards and, when above the atmosphere, sideways, fast enough to 'fall over' Earth's curving horizon. The payload is then 'in orbit', safely in space. Its tremendous velocity is the key to remaining in space.

The reverse process - returning to earth -- is just as fiery and just as fierce, but usually not so well known or widely witnessed. We know that the spacecraft slows down just a bit - maybe 2% of its speed, using small rockets - and then dips into the atmosphere. Air drag slows it the rest of the way, but the price is the tremendous temperatures in the super-compressed shock wave in front of the Mach-25 spacecraft. The temperatures are as high as the surface of the sun, tearing the very air molecules apart into ions.

These temperatures would incinerate improperly aimed vehicles the way that natural meteors flare in the skies. But by placing a specially shielded portion of the vehicle forward into the flames, space fliers have been able to survive the process by which the tremendous energy in their fast-moving craft is bled off in the form of ravenous heat.

Space travelers see this incandescent trail pluming behind them, out their overhead windows. They may occasionally see flames from the front shock wave licking up past their side windows. But Boris Volynov, alone among Earth's space voyagers, had a view straight forward, looking ahead into the flames. The window was pointed that way because his spacecraft was aligned wrong, and the flames were washing over the weaker end of his vehicle. He expected the vision to be the last thing he ever saw, but he could not close his eyes.

The basic Soyuz spacecraft design which Russian cosmonauts used - and still use -- contains three connected modules. In the center is the "Descent Module", in which the crew rides during launch and landing. Attached at the back end of this module is the "Equipment Module", which contains the rocket engines and power supplies for the space vehicle. Attached at the front end is the "Orbital Module",

which contains additional living space, radios, and the docking equipment for linking up with other space vehicles.

In the first years of its use, the Soyuz had suffered two fatal accidents, in 1967 and 1971. In the first case, Vladimir Komarov, the lone pilot, had struggled with malfunctioning controls for a day, until at last he managed to head back into the atmosphere, where an independent hardware flaw caused his parachute to malfunction so the spacecraft hit the ground at about 300 mph. Four years later, a three-man crew was returning from a pioneering space station mission when an air valve prematurely opened while they were still in space, and they suffocated.

Boris Volynov's near-disaster had occurred in January, 1969, at the end of a Soyuz-5 flight. Aboard Soyuz-5, cosmonaut Boris Volynov was returning to Earth alone, after his ship had docked in space with a Soyuz-4 and transferred two of his crew to the other vehicle. The "Moon Race" was in full swing, and the Soyuz double flight had tested the space-walking techniques that were to be used by Soviet cosmonauts during their planned moon landing, which they hoped would be ahead of the Americans.

The 34-year-old rookie space pilot had completed the course change back to Earth, and the Soyuz spaceship then was supposed to jettison its extra modules so that the headlight-shaped "Descent Module" could enter the atmosphere safely. Flying over the South Atlantic, headed northeast, Volynov expected to be on the ground within a half an hour. But something went wrong: the equipment module failed to fully separate from the descent module. The explosive "separation bolts" had fired, but when Volynov looked out the spacecraft window, he was horrified to see the whip antennas from that module still extending past the window. It was still attached, as Volynov confirmed from the feel of the ship as he tried to turn it manually with the hand-controller which fired his orientation thrusters. "No panic," he whispered to himself once, and then again, according to interviews published decades later. He radioed his situation to a tracking ship below him, and it passed on the terrifying news to Mission Control in Russia. It only took a few moments for them to realize that nothing more could be done. The ship's heat shield was at the base of the Descent Module, now blocked by the balky Equipment Module. Unshielded portions of the vehicle would now be exposed to the 5,000 degree (Celsius) heat of atmospheric entry. This would destroy the entire capsule and its pilot.

Russian journalist Aleksander Milkus added a poignant detail to this drama in his account, that was published in the Moscow newspaper "Komsomolskaya Pravda" on April 10, 1998. "In the Mission Control Center one of the officers took off his cap, put three rubles into it and sent it further. Little by little it was filling up with money. This had already happened once, on the day when Vladimir Komarov died" (two years before). Other controllers, knowing themselves to be utterly helpless, buried their faces in their hands.

For Volynov, doing nothing at such a moment was impossible, so he continued to make reports into his voice recorder and to write notes in his flight log. He thought of his 34th birthday party in his apartment near Moscow, only a few weeks before. He thought of his family and friends. "It's hard to describe my feelings," he said later. "There was no fear but a deep-cutting and very clear desire to live on when there was no chance left."

As the spaceship fell back into the atmosphere, he heard grinding as the deceleration stresses built up. The ship was slowly tumbling end over end, exposing all of its surface to the growing fireball. Then it stabilized with its nose forward, which was exactly the wrong orientation possible because that part of the capsule's skin was the thinnest. In the top area, there was only an inch of insulation, compared to the 6 inches along the bottom, and during a normal reentry three inches of that was expected to burn away.

Volynov lost radio contact with the ground. He heard and felt the explosions of the equipment module's overheated fuel tanks, and from his seat, he watched the overhead exit hatch bulge inwards under the head-on blast of air. The rubber seal on the hatch began to smoke. As flames seared his cabin walls, he watched as smoke from the singed insulation filled the descent module. Since he didn't have a space suit to wear, he could feel the heat against his unprotected skin. His body strained upwards against restraining straps as it tried to fall "down" onto the steaming hatch. Concluding that he only had seconds to live, he grabbed his logbook, tore out the most recent pages, and stuffed them deeply inside his jacket. By some chance, he thought, they might escape full incineration. He heard and felt another crash, and the module tumbled violently. Miraculously, it then settled itself into the proper orientation -- its shielded bottom at last pointing in the correct direction and facing the super-heated shock wave. Volynov's body sagged backward into his seat. Whatever mechanical failure had prevented the separation had itself been overcome by the severe stresses of reentry. All of this took place during the longest minutes of Volynov's life.

His next worries concerned landing and recovery. Had the flames damaged the flimsy parachutes in the outer containers? The capsule spun rapidly, as the fuel for the control thrusters that were supposed to stabilize it had been exhausted. Would this tangle the lines of the parachute? Where would he land? Would his recovery beacon work to guide the searchers to him? Two thousand kilometers short of his aim point and the waiting rescuers, Volynov rode the Soyuz down onto the snowy Ural Mountains near Orenburg, Russia (normal landings were in north-central Kazakhstan). Although the capsule's spin did tangle the shroud lines and partially close the canopy, the parachute slowed the descent.

The force of the impact tore him from his seat, threw him across the cabin, and knocked out several of his top front teeth; he tasted blood as it filled his mouth. In the silence after landing, he could hear the hissing of his overheated capsule as it lay deep in the snow that had cushioned his impact just barely enough; Volynov knew that he had survived. It was then that he felt the bitter cold seeping into the ship; it was minus 38 degrees Celsius outside (-40 degrees Fahrenheit).

Ground searchers didn't know that he was alive, but radar had indicated that the capsule was far off course. Many hours later, helicopters spotted the downed spacecraft and landed nearby. The rescuers were unsure whether they were on a rescue mission or would recover a body. At the landing site, they found the capsule's hatch open -- no one inside, and no trace of the cosmonaut.

Volynov had quickly realized out that he would die in the mid-winter cold if he stayed where he was, so he set out on foot towards a distant vertical line of smoke in the sky. He had landed just before noon, and the weather was clear. Only a few kilometers away, he found the hut of peasants who took him in and kept him warm until searchers, following his footprints and the bloody spots where he had spit in the snow, found him.

No news of this was ever printed in the Soviet press at that time; this space-related accident was kept strictly secret. The post-Soviet Russian space program also kept the information under wraps until 1997, when an 'official' new history book briefly mentioned the incident; that cleared the way for a few newspaper accounts.

Volynov is at last recognized as a heroic. He survived not because of any decision he made or implemented; but rather as the result of what is probably the greatest factor in most survivals - a good luck.

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