

# Voskhod, - the Russian Space Ship

*By Barry Davidoff, EAF  
Photos Provided by Andi Wuestner*

"I felt like a bird with wings and able to fly". These were the sensations of Alexi Leonov as he ventured forth from Voskhod 2 on the world's first spacewalk on March 18, 1965. Although Leonov floated free of his capsule for only ten minutes, his space-walk was a very important space first. Leonov had proven that man could function in the vast void of space outside the confines of a spacecraft.



*Left: The world's first space walk by Alexi Leonov*

## Success of Vostok

The Soviets had staged a series of space spectaculairs during the six flights of the Vostok spacecraft. Starting with the launch of the first Vostok carrying Yuri Gagarin on April 12, 1961 the Soviets had established a firm lead in the space race. German Titov had spent an entire day in space orbiting the earth 17 times aboard Vostok 2, while Americans had only flown two sub-orbital Mercury missions.



The Soviets flew two cosmonauts in space simultaneously during the dual flights of Vostok 3 & 4 in August 1962. Although the two Vostoks were incapable of a rendezvous, they did come within 6.5 kilometers of each other. In June 1963, while Valeri Bykovsky orbited for five days in Vostok 5, the first woman to enter space, Valentina Tereshkova, was launched in Vostok 6.



At the conclusion of the Vostok program the Soviet Union had spent 382 man-hours in space (nearly 16 days) compared with only 54 hours for the Americans during the entire Mercury program.

## Voskhod Design

After the successes of Vostok, the Soviet space program was at a cross roads. Unlike the

Americans, which had planned the Gemini program between Mercury and Apollo to gain further experience and develop new techniques, the Soviets initially only had planned on Soyuz, which still was several years away from its first launch. The Kremlin wanted to continue to press forward with their leading position.

The Chief Designer, Sergei Korolev, responded by hastily developing the Voskhod series of spacecraft for the interim between Vostok and Soyuz. Details were not released to the West until many years later, but Voskhod was simply a modified Vostok capsule. Although the Kremlin proudly proclaimed that the launch of Voskhod 1 in October 1964 carried a crew of three, they did not announce that the cosmonauts had been crammed into a capsule that had been designed originally to carry only a single cosmonaut.



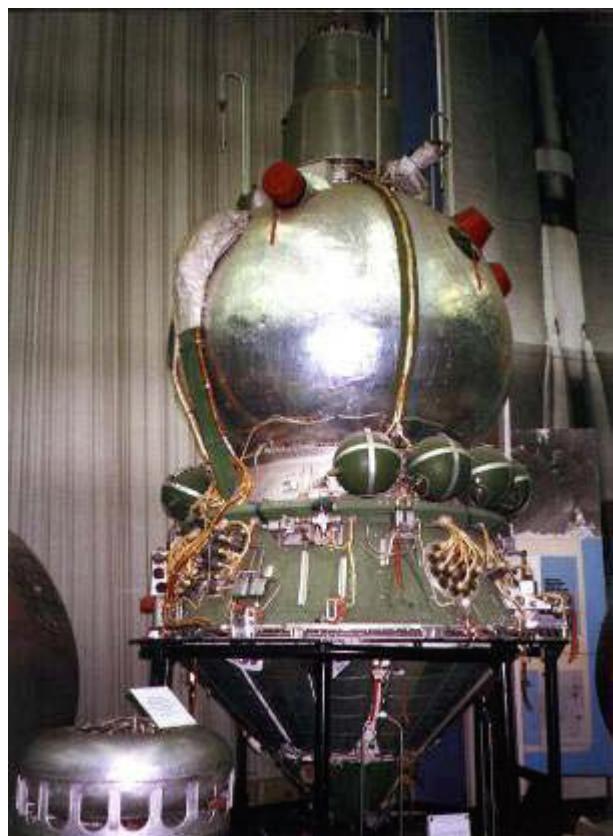
*Voskhod Launcher Based on the R-7*

Voskhod was launched into space by the SL-4 booster, which was a variant of the basic R-7 booster that had carried Sputnik and Vostok and is still being used today. The first stage was a central core surrounded by four booster rockets. The upper stage of the SL-4 had been designed originally as part of the R-9A intercontinental missile and its engine could launch the greater mass of Voskhod into a higher orbit than had the R-7 Vostok launcher variant.

Voskhod, like the Vostok capsule, consisted of three sections; a spherical descent capsule, a conical instrument module, and a retro-rocket module. Voskhod was based upon design studies for an extended Vostok capsule that would have been capable of carrying a single cosmonaut for a two week mission. Every cubic centimeter of interior space was wrung from the earlier

Vostok design. Voskhod 2 weighed 5,682 kilograms, which was almost a ton more than Vostok's weight of 4,725.

There were several major changes in converting the Vostok design into Voskhod. In order to save weight and have sufficient room in the descent capsule, the ejection seat that had been used in Vostok was eliminated. The six Vostok cosmonauts all had ejected at a height of about 7,000 meters and landed separately from their capsules. In Voskhod, the cosmonauts had to stay within their descent capsule throughout the landing. In order to reduce the capsule's final velocity to survivable limits, a small retro-rocket was used. This retro-rocket package was deployed by the two main parachutes and suspended above the descent capsule. The retro-rocket fired just seconds before actual landing and reduced the capsule's velocity from 8-10m/sec. to 0-2m/sec.



*Unflown Voskhod 3 at Energia Museum in Moscow  
(Courtesy of Gary Kitmacher)*

The elimination of ejection seats aboard Voskhod also meant that in the event of a mishap on the launch pad escape was not possible. Voskhod

hod didn't have a separate launch escape rocket system that could separate it from its launcher. On Soyuz, which also used the SL-4 upper stage, a launch escape system was added and this system was used in two launch abort mission mishaps saving the lives of the Soyuz crews.

Another major Voskhod modification was the addition of the prominent secondary retro-rocket system atop the descent capsule. All the Vostok launches had been in orbits low enough so that if the retro-rocket failed, orbital decay would return the capsule to earth in about 10 days time. Voskhod, however, due to the greater thrust of the SL-4 upper stage, was launched into much higher orbits with apogees of 400-500 kilometers. Therefore the designers added the solid propellant rocket system which could be used in the event that the main retro-rocket module failed.

## The Two Voskhod Flights

The world's first multi-passenger crew was launched aboard Voskhod 1 on October 12, 1964. The crew consisted of Vladimir Komarov as the commander and pilot, Konstantin Feoktistov as the flight engineer, and Boris Yegorov as the medical doctor. Feoktistov had been one of the main design engineers in both the Vostok and Voskhod programs. He had been provided his seat through Korolev's insistence, who believed that actual flight experience would be useful in the future design of spacecraft.

The crew of Voskhod 1 flew in a shirt sleeve environment. The truth was that there wasn't room in the small interior for three cosmonauts to wear bulky spacesuits. The three couches for the cosmonauts were turned 90° from their original orientation in Vostok and Komarov's couch was slightly forward of the other two. Voskhod 1 mission lasted one day and orbited the earth 18 times without significant difficulties. Dr. Yegorov performed several medical experiments on the effects of weightlessness, including taking blood samples.

The most significant event in the space program occurred not aboard Voskhod 1, but back in the Kremlin. During the flight, Soviet Premier Nikita Khrushchev had been deposed and replaced by Leonid Brezhnev and Alexi Kosygin. Khrushchev had been one of the main proponents of the Soviet space efforts and believed that success in the space race brought national and ideological glory. Khrushchev, as Premier, spoke to the crew while in orbit, but when the cosmonauts arrived on the day after landing at celebrations in Red Square, they were greeted by Brezhnev.

Voskhod 2 was launched on March 18, 1965 from the Baikonur Cosmodrome. Voskhod 2 differed from Voskhod 1 with the addition of the inflatable airlock and that the two cosmonauts wore full space suits. The commander of Voskhod 2 was 39 year old Pavel Belyayev and he was accompanied by 30 year old Alexi Leonov, who would perform the spacewalk.



*Voskhod Airlock*

Voskhod's airlock had been designed so that it was only projected 0.7 meters above the surface of the descent capsule during launch. Once in orbit, the fabric airlock would be inflated by the four tanks at its base.

After use the entire airlock mechanism would be detached from the descent module and left in space.

As Voskhod 2 was completing its first orbit, Leonov entered the airlock. After depressurization, the outer hatch of the airlock was opened and Leonov entered the blackness of space. He was attached to the capsule by his umbilical tether which supplied oxygen and a radio link. Leonov floated majestically outside the capsule for about 12 minutes greatly enjoying being the first to experience the view and the wonders of spacewalking.

Unfortunately, he was unable to take photos with his still camera, so that there are not any still photos of a Voskhod in space. The spacewalk was recorded by the television camera mounted on the airlock and a movie camera mounted on the top of the secondary retro-rocket system.



Alexi Leonov's Beikurt Space Suit

By the conclusion of the spacewalk his Beikurt

spacesuit had ballooned and become rigid so that Leonov couldn't get back into the airlock correctly. He therefore decided without consulting ground control to rapidly lower the pressure within his spacesuit risking the bends. Once the outer hatch was closed he finally was assisted back into the descent capsule by Belyayev.

Voskhod 2 planned to return to earth during its seventeenth orbit, but the attitude control sensor malfunctioned and the primary retro-rockets failed to fire. Belyayev on the eighteenth orbit had to manually orient the craft, but he fired the retro-rockets 46 seconds late. During much of re-entry the descent capsule remained attached to the instrument section since certain cables had failed to separate. As a result, Voskhod 2 was seriously off-course and landed 386 kilometers away from its target.

Belyayev and Leonov landed in a dense forest with very deep snow in the Ural Mountains. Recovery teams were unable to reach Voskhod 2 and conditions were bitterly cold with snow drifts two meters deep. Despite being sheltered in one of the great achievements of 20th century technology, Leonov stated that they remained inside overnight when they saw a bear approaching the capsule. Recovery teams on skis were able to reach the cosmonauts the next day, but it was too late for the cosmonauts to ski to the helicopter landing area. The cosmonauts and the recovery team spent a second night in the forest before finally skiing to the waiting helicopters.

## Additional Voskhod Flights

Following Voskhod 2 there were plans for additional Voskhod missions. Voskhod 3 was constructed for a 15 day mission carrying a pilot and a scientist in late 1965. Voskhod 4 was planned for medical experiments on a 15-18 day flight carrying a pilot and a doctor. An EVA would be performed on a later Voskhod mission lasting 3-5 days. There were even plans for another space spectacular involving two woman cosmonauts in which one would make a spacewalk. Another mission profile

was flying a journalist as a passenger and two journalists actually began training.

The Voskhod program was limited to only two flights. There were many problems in expanding the environmental system which had been originally designed to support one cosmonaut for a few days. Resources also were needed to support the Soyuz program which was scheduled to start flying in 1966. The death of Chief Designer Sergei Korolev in January 1966 left the Soviet space program in disarray. Korolev had been the cohesive force in the technical and political labyrinth of the Soviet program.

### The Last Soviet First

The flight of Voskhod 2 marks the absolute height of the Soviet space program. The Soviet Union then had a significant lead in the number of man hours and the complexity of their space missions. Alexi Leonov's walk among the stars was the last major "first" for the Soviet manned space program. Gemini would fling the American space program far ahead in the space race.

Just five days after the launch of Voskhod 2, manned flights aboard Gemini began with the launch of Gemini 3. By the end of the 1965, two American astronauts would spend two weeks aboard Gemini 7, while it made the first rendezvous in space with Gemini 6. During 1966 there would be regular dockings with Agena targets and numerous spacewalks last-

ing for hours in five Gemini missions. These skills learned during Gemini would lead to the success of Apollo. All the possible goals of future Voskhod flights would have been exceeded by the actual accomplishments of the Gemini program.

Following Voskhod 2 there would be a wait of 2 1/2 years until the launch of the next Soviet manned space flight. The flight of Vladimir Komarov, who had commanded Voskhod 1, would end in tragedy due to numerous problems in the design and construction of Soyuz 1.

Voskhod 2 would be the only space flight for its commander, Pavel Belyayev. He was selected as one of the cosmonauts to train for the Soviet lunar landing program. Belyayev, however, would die following an operation for ulcers on January 10, 1970.

The world's first spacewalker, Alexi Leonov continued his career as a cosmonaut following Voskhod 2. According to many sources, Leonov would have been the first Soviet citizen to land on the moon in the event that the N-1 and lunar landing programs had been successful. Leonov later commanded the Soviet portion of the Apollo-Soyuz Test Program in July 1975. His handshake with Tom Stafford while orbiting was one of the milestones in the exploration of space. Leonov still resides in Star City on the outskirts of Moscow. Leonov continues his work as an artist and has painted many scenes based upon what he witnessed in space and during his historic spacewalk.



*From left to right, Vladimir Komarov, Boris Yegorov, and Konstantin Feoktistov, the crew of the first Voskhod spacecraft, make their way to the launch pad on October 12, 1964, prior to the launch. Note their causal attire, a contrast to the bulky suits worn on the earlier Vostok flights.*

Image from the files of Peter Gorin in the GRIN database (NASA).

# Summary of Maunder (solar) Minimum and global climate variability: the human dimension

Written By Steven Haywood Yaskell

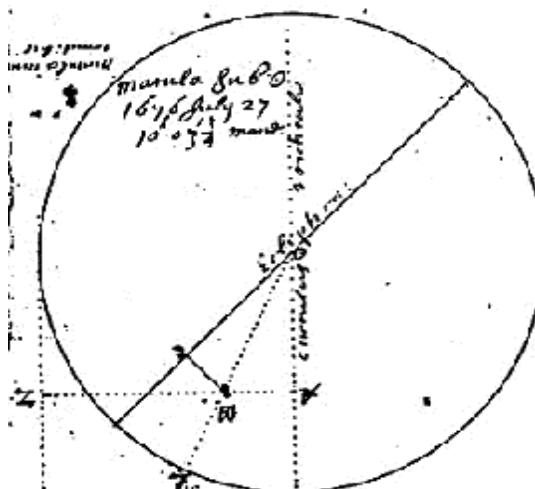
How did humans react against worldwide cooling in the Seventeenth Century? Earth's Northern Hemisphere had already withstood a prolonged solar minimum some forty years before the Maunder (Spörer Minimum): had the effects of cold worsened the climate more, this on top of an ongoing "Little Ice Age" (c. 1480?-1880)? How did this affect human custom, architecture, art and literature – even war? Evidence suggests that the cold had made bellies emptier than usual, and tempers worse. For some wars begun then haven't completely died out even after all these centuries.

This summary for *EAF Nytt* briefly surveys the Maunder Minimum's effects on humans as covered in my June 4<sup>th</sup> talk at Telefonplan.

In my October, 2001 talk on the Maunder Minimum (see summary, pp 17-20, *EAF Nytt*, Vintern 2001) it was shown how the Sun goes through normal 11-year cycles in minimum and maximum phases. Some cycles extend to longer minima and maxima phases. For how long is impossible to predict. The Maunder Minimum (c. A.D. 1645-1710 [we date it from A.D. 1620-1720]) is a classic, well-studied solar grand minimum. When low solar activity occurs more plasma build-up enters the Earth's biomass due to relaxed Earth magnetic shielding. This plasma (isotope) build-up allows us to see when the Earth was going through cooler phases, historically. In more solar active times, less build up occurs (Error note: p. 17 of *EAF Nytt*, Vintern 2001 incorrectly states that *more* isotopes build up in *stronger* solar winds.) Sunspot movement is slower in minima times, with less (but large) spots dominating. Electromagnetic phenomena such as Aurora Borealis are less noticeable, etc. Two human generations passed without seeing northern lights in the Maunder. When this minimum occurred, no scientist regularly associated the Sun with being reduced in activity so far as we know.

We assume that Earth's climate is infinitely changeable. That our Sun heats us by over 50% is no mystery. It must assist greatly in affecting global climate (not to be confused with "weather"). For Earth climate is not weather, but is one of the "controlling buttons" of climate locally and globally in a wider, still poorly understood dynamic. Not all areas of Earth are evenly affected by extended solar minima and maxima. This happens for many reasons, some mere speculation. For not

only internal heating or cooling, or external heating or cooling, is a factor. Purely the physics involved in Earth's shape and construction (internal, crust, core) plus its rotation around the Sun, play a role here: possibly even extra galactic factors could affect Earth climate.



Sunspots were few in the Maunder Minimum – yet sometimes very large. Some took months to cross the Sun's face. Here's one on July 27, 1676, observed and drawn by English Astronomer Royal John Flamsteed. (from *Forbes: Letters of John Flamsteed*)

In the Maunder Minimum cold and strange weather was a rule – and predictably, an unevenly applied one. After a prolonged sunspot-poor 25-year period from c. 1635-1660, it got progressively worse, weather-wise in the Northern Hemisphere, at least. A "secondary" low sunspot period from c. 1665-1690 was punctuated by massive volcanic eruptions adding to Sun-blocking atmospheric effects. (Postulated is that cold build-up had been occurring in the Spörer Minimum forty or so years before, then carried forward, along with a Little Ice Age). In Maunder's secondary phase some of the worst