LOK-1

The LOK, which stands for Lunar Orbital Craft in Russian, could be called the Soyuz on steroids. While from the outside it looked like a stretched version of the original (7K-OK) version of the Soyuz, inside the LOK featured a number of upgrades and unique systems, which enabled it to support manned lunar expedition.

The LOK was developed as a part of the L3 lunar expeditionary complex carried aloft by the N1 rocket. The spacecraft was intended to carry a two-man crew to the lunar orbit, where one of the cosmonauts would transfer to the lunar lander, LK. The LK would then separate from the LOK and conduct descent and landing on the lunar surface.

After a spacewalk, the cosmonaut would blast off from the lunar surface onboard the LK and rendezvous with the LOK. After successful docking and transfer from LK to LOK, both cosmonauts would depart to Earth onboard the LOK.

Upon approaching the Earth, the habitation module and instrument modules would separate from the reentry capsule of the LOK, which would provide for safe landing of the crew.

LOK technical overview:

Crew	2 (two) people
Maximum flight duration	13 days
Mass in lunar orbit	9,850 kilograms
Mass at the departure from lunar orbit	7,530 kilograms
Mass of the reentry capsule (SA)	2,804 kilograms
Main engine (two-chamber Block I) thrust	3,388 kilograms
Rendezvous and correction engine (SKD) thrust	417 kilograms
Oxidizer (Nitrogen Tetroxide, NTO) supply	2,032 kilograms
Fuel (Unsymmetrical Dimethyl Hydrazine, UDMH) supply	1,120 kilograms
Total length	10.06 meters
Body diameter	2,930 meters

Development history

In the heat of the Moon Race of mid-1960s, the Soviet designers at OKB-1, specialized in manned spacecraft, faced overwhelming challenges. While their rivals in the US concentrated on a single Apollo system for the lunar expedition, Korolev and his associates, had to split long days and sleepless nights between Earth-orbiting Soyuz, circumlunar L1, and lunar-landing L3 complex.

Basic configuration of the L3 complex, which included LOK spacecraft was formulated by 1963, or roughly two years behind a similar effort in the United States.

Technical description

Power supply: The most notable difference between the original Soyuz and LOK was the power supply system. Unlike solar panels which provided electrical energy for the 7K-OK spacecraft, the LOK would feature liquid hydrogen/oxygen-powered fuel cells, EKhG, similar to those used on the US Gemini, and Apollo spacecraft. In addition to generating electrical energy, fuel cells would output critically needed breathing oxygen and potable water as byproducts, thus greatly increasing spacecraft's life-support capacity.

The development of this system was delegated to the Ministry of Medium Machine-building, known as MSM or Minsredmash, which was responsible for nuclear technology in the USSR.

The EKhG system was actually installed on the mockup of the N1/L3 complex No. 1M1A, and tests loading of the fuel cells with hydrogen and oxygen was conducted from Nov. 1 to Dec 29, 1971. Another such fueling took place during the stay of the flight vehicle on the launch pad from Aug. 24 to Nov. 23, 1972.

Life-support system: The LOK spacecraft would also carry more capable life-support system than the original Soyuz 7K-OK. From around 1964, NIIKhIMMash research institute of the Ministry Chemical Machine-building was working on closed-loop systems of recycling water, which could enable much longer presence of people in space.

Specifically for the LOK program, NIIKhIMMash was developing system called Rosa (Russian for "Dew"). It would receive humidity collected from the LOK's atmosphere, separate liquids and gases filter out water and mineralize it for drinking. The Rosa unit would be installed in the habitation module along with the standard life-support hardware inherited from the Soyuz.

During its unmanned test flights, which could include circumlunar missions, the LOK would also carry a special system imitating the release of humidity with the sweat by the human body. The system aimed to test the performance of the Rosa system. Such system was apparently installed on the LOK spacecraft carried in the last two of four ill-fated launches of the N1 rocket.

Docking system: To conduct mechanical docking between the LOK and LK, the L3 complex carried Kontakt system, rather than the Igla installed on the regular Soyuz. The LOK spacecraft carried active part of the Kontakt system, including a main engagement probe and four peripheral amortization devices. It was enough for the main probe to enter into any of multiple holes of the docking plate of the LK to provide a reliable docking.

The docking mechanism of the Kontakt system did not provide internal tunnel for the crew transfer between LOK and LK, however it helped to reduce mass deficit during the development of the N1-L3 complex and simplified overall design of the mechanism.