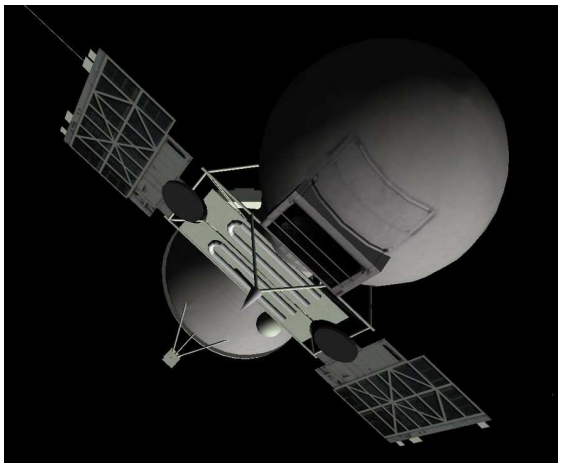
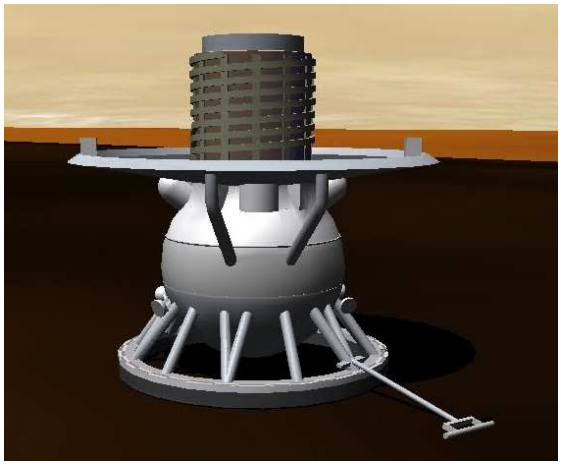
Venera 9 (Венера-9, 4V-1 No. 660)

USSR unmanned orbiter and a lander mission to Venus.

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Spacecraft descrition and implementation in Orbiter space sim.

The Venera 9 is implemented as two spacecraft (Orbiter+Lander). The meshes are as accurate as I was able to model them. I tried to follow authentic flight hardware photos as much as possible. Please take into acount the fact that Russian hardware on display doen't have thr thermal covers that were actually used for spaceflight and is sometimes painted with diferent colors for estetic purposes. Therefore, my models will look diferent from some of the Venera 9 replica photos you might see. Texturing could be improved to give a more uniform thermal cloth cover to the orbiter bus, and other small mesh bugs are present. Nevertheless I think that those small issues don't detract from the addon usability and can always be corrected at a latter stage.

The general addon organization and vessel parameters come straight from the *Venera-D* addon by *kodiak*. Masses and fuel were changed to reflect the Venera 9 values but the lander's aerodynamic parameters are unchanged. The generic Venera orbiter mesh came from the model available for *Celestia* by *Jack Higgins*, in turn based on a *VRML* by *Alexander Chernov*. All credit goes to them for the base model used. I did a lot of adaptations so that it would represent the Venera 9 configuration. I added new solar panels with the right dimensions and shape and removed some non-existing instruments. Also, the engine bell and RCS jet hardware was added and the dimensions were scaled to match the entry sphere.

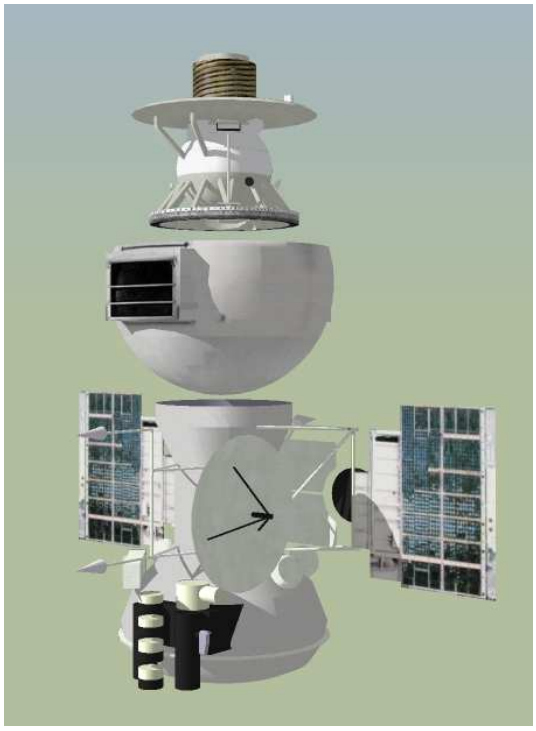
Scenarios for Venus transfer and orbiter insertion were **provided by** rseferino: *"Launches from the earth with great accuracy because the fuel probe is very limited, only allows mid-course corrections of 30 m/s in total, and after separation of the lander is 250 m/s and 940 m/s for orbital insertion Venus. Arriving at 3% fuel."*

Launch scenarios **require the** **Proton Launch Vehicle v.1.0** by thorton.

Hardware configuration

Orbiter

The orbiter consisted of a cylinder with two solar panel wings and a high gain parabolic antenna attached to the curved surface. A bell-shaped unit holding propulsion systems was attached to the bottom of the cylinder, and mounted on top was a 2.4 meter sphere which held the lander.



It's implemented in Orbiter as a spacecraft3 vessel with the lander's entry sphere as a payload and RCS thruster exhaust visible.

The "J" key will jettison the lander's sphere if still attached.

Lander

The lander spacecraft separates from the orbiter. A system of circulating fluid was used to distribute the heat load. This system, plus pre-cooling prior to entry, permitted operation of the spacecraft for 53 minutes after landing. During descent, heat dissipation and deceleration were accomplished sequentially by protective hemispheric shells, three parachutes, a disc-shaped drag brake, and a compressible, metal, doughnut-shaped landing cushion.

It's implemented in Orbiter as a series of spacecraft3 vessels and payloads, starting with the entry sphere that is released from the orbiter and ending with the lander itself. As in reality, no fuel or any kind of control is possible. The entry sphere simply follows the path it was released on.

Use the "j" key to control the deployment of parachures and release of the protective sphere.

Mission sequence:

I'm providing 5 scenarios that cover all of the mission stages. Descriptions folow the actual mission events and not necessarilly the values you will see in Orbiter. Nevertheless, you can try to follow them as guidelines.

Situation 1 –Venera 9 Launch (requires Proton K and Baikonour pad 24)

1975 June 8 - The Proton booster (8K82K) with Block D upper stage blasted off from the "right-hand" launch pad at Site 81 in Baikonur Cosmodrome at 0237 UTC. *(press "o" to launch)*

After the vehicle reached a low circular orbit around the Earth and Block D engine fired for the second time sending the probe toward Venus. *(use whatever instrument you prefer to perform the escape burn)*

Situation 1b – Venera 9 on transfer orbit to Venus (requires Proton K and Baikonour pad 24)

During **July to September** there were two course corrections. The first (11.93 m/s dv) placed the trajectory of the probe within 1,600 kilometres from the surface of Venus, and the second (13.44 m/s dv) refined the landing region and time of the entry for the lander. *(use whatever instrument you prefer to refine your Venus entry)*

Situation 2 – Entry capsule separation

October 20: The Venera-9 lander separated from the orbiter. Immediately, after the separation, the orbital module conducted a manoeuvre (247.3 m/s dv) which sent the

spacecraft on a swing around the opposite side of the planet. *(press "j" to release the entry sphere containing the lander. Manouver the orbiter using whatever instrument you prefer and prepare for the orbital insertion burn)*

Situation 3 – Orbital insertion

October 22: Immediately after the Orbiter's closest approach to Venus, the main propulsion unit fired (922.7 m/s dv) injecting the spacecraft into a 1,510 by 112,200-kilometer orbit around Venus, with the inclination 34.10 degrees and the rotation period of 48 hours 18 minutes. The selected orbit around Venus was designed to provide at least 115 minutes of communications between the lander and the orbiter, during the latter's descent and landing. *(perform the orbital insertion burn trying to achieve the indicated orbit)*

The Venera-9 lander plunged into the atmosphere of Venus an entry angle of 20.5 degrees and a speed of 10.7 km/s. *(switch to the lander using "F3")*

After initial aerodynamic braking, covers of the parachute compartments were jettisoned at the altitude of 65 kilometers, the speed of 250 meters per second and acceleration of 2G. It was followed by the deployment of a small "pullout" parachute and jettisoning of the top hemisphere of the protective reentry shell of the lander. The descent velocity then decreased to around 150 meters per second. *(press "j" to deploy the droge chute at 65Km)*

At the altitude of 62 kilometers above the surface, three main parachutes with the total area of 180 square meters open. After working for 15 seconds, they reduced the descent speed of the lander to 50 meters per second. *(press "j" to deploy the main parachute at 62Km)*

Four seconds later, the lower half of the protective sphere separated from the lander and fell off under its own weight, while the lander continued slow descent through the layers of clouds under main parachutes for some 20 minutes, providing wealth of atmospheric data. *(press "j" to release the protective sphere)*

Main parachutes were jettisoned at the altitude of 50 kilometers above the surface and the lander was then in a free fall, slowing down only with the help of a disk-shaped aerodynamic break. *(press "j" to release the lander at 50km)*

Situation 4 – Landed on Venus

The Venera-9 lander hit the surface of the planet with the speed of around seven meters per second at 0513 UT on October 22, 1975. It was the daylight local time on the side of the planet not visible from Earth. The landing site was determined to be 32 degrees north latitude and 291 degrees longitude in Beta Regio.

During next 53 minutes, the lander streamed data to the orbiter, which in turn relayed it back to Earth. The transmission of priceless imagery started some two minutes after the landing and continued until the end of communications.

The lander ended up under a 30-degree angle and its cameras could only see as far as few dozen meters. Soviet scientists suggested that the material at the site represented remnants of rocks fractured as a result of the internal shifts and faults in the planet's crust. The tectonic process possibly caused a mass of debris to slide along the slope.

Another surprise was a relatively good visibility - landscape features could be discerned as far as 100 meters from the lander -- despite enormous density of the surrounding haze. One Soviet scientist apparently went far enough to compare lighting conditions on Venus with a "cloudy day in Moscow."

October 26 / December 25 - The orbiter gathered further data.