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ISCAP APPEAL NO. 2009-068, document no. 118
DECLASSIFICATION DATE: February 25, 2015

NORTH AMERICAN AIR DEFENSE COMMAND

K410.607-264

SCANNED BY ACD

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WEEKLY INTELLIGENCE REVIEW (U)

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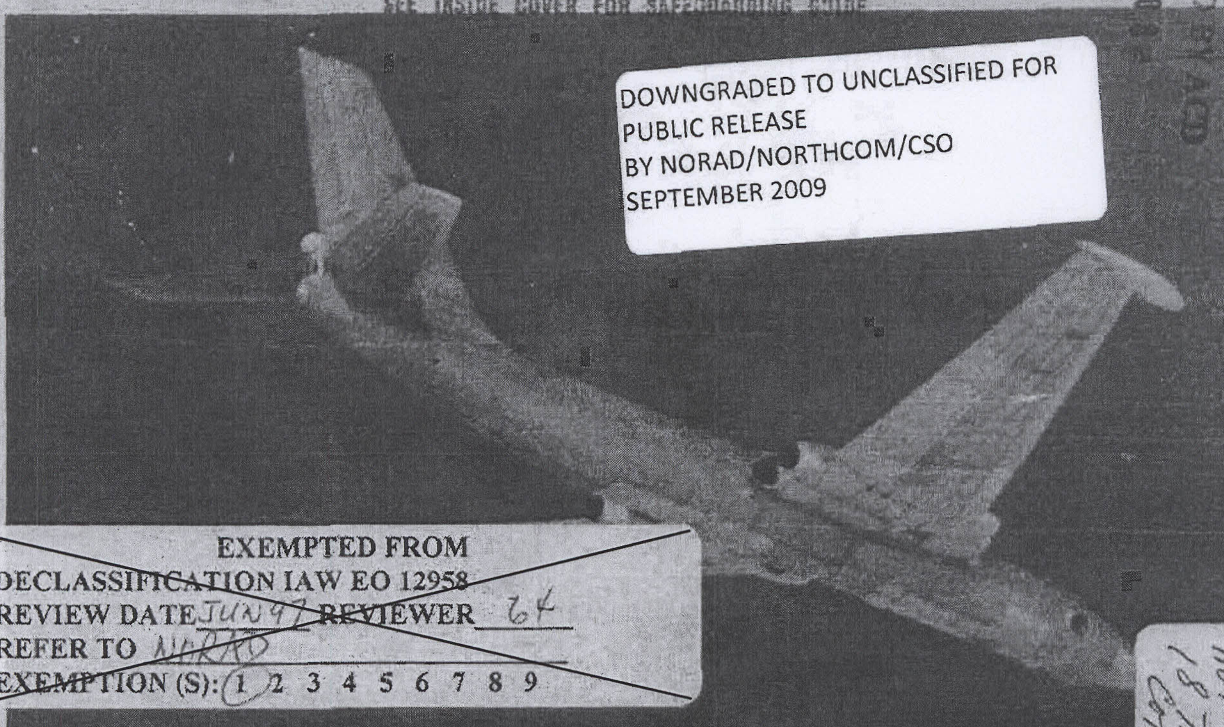

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NORAD Weekly Intelligence Review

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K410.607-264

Issue No. 11/66, 18 March 1966

The WIR in Brief

COVER: BISON bomber (from COMICEDEFOR) (OFFICIAL USE ONLY)

NOTE: Pages 34, 35, 38 and 39 of this issue are blank.

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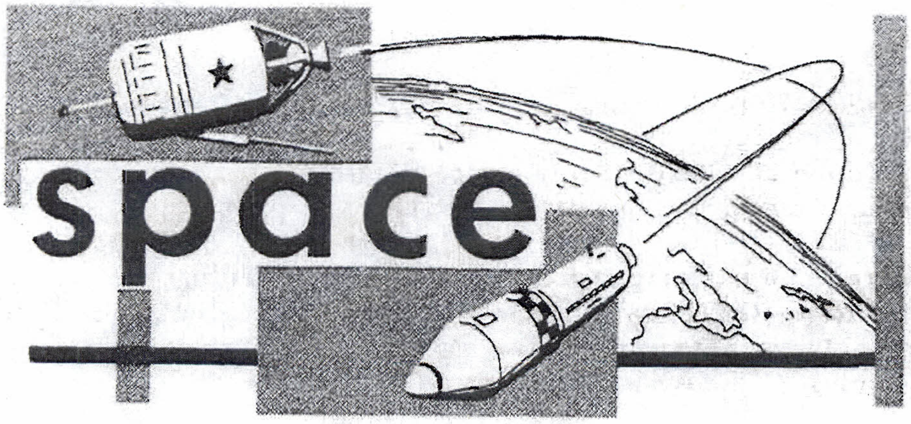

significant intelligence on space developments and trends

Portion identified as non-responsive to the appeal

Self-Sustaining Environment for Manned Space Flight Studied; Success Far Off

50X1, E.O.13526

The Soviets are considering closed ecological (self-sustaining) systems for life support for manned spaceflight of the future, [redacted] but a fully closed operational system is probably a long way off. The Soviets are considering all potential means for regenerating air supplies but are said to be stressing chemical systems.

In the relatively brief flights of the past, all supplies of food, water, and oxygen were put aboard before the flight. None of the processes for controlling carbon dioxide or humidity were regenerative. Oxygen was derived from an "alkaline metal peroxide," probably potassium superoxide. (The US uses stored gaseous oxygen and semiclosed systems involving carbon dioxide reduction.)

For longer flights, such as might be involved in manned operations on the Moon or in the manning of orbiting space stations, partially regenerative systems (those which recover oxygen from carbon dioxide and water from fluid waste) will probably be needed. Both the USSR and the US have the basic technology for developing such systems but it is estimated that the Soviets will not have an operational capability in this area for at least 5 years. Alternatively, if the Soviets make a breakthrough in their studies of metal superoxides and ozonides, which is conceivable, their chemical oxygen-supply systems might support manned flights of 30-60 days. Lithium peroxide, for example, might support much longer flights than the presently used potassium superoxide, since it theoretically should supply more oxygen per unit weight.

For extremely long flights, such as interplanetary voyages (lasting more than a year), or extended manning of orbiting space stations, lunar bases, or military spacecraft, fully regenerative systems will be required. These would involve the use of microorganisms, such as the algae Chlorella (pond scum), in closed bio-ecological systems to recover oxygen, water, and nutrients from solid, liquid, and gaseous waste. However, the state of the art in this area is so poorly developed in both the US and the USSR that no meaningful estimate can be made of an initial operational capability for either nation.
(CIA; FTD; NORAD)
~~(SECRET)~~

Space Listing and Over-All Space Status Report

The over-all space-vehicle status as of 1000Z, 14 March 1966, was as follows:

	USA	UK	Can	Italy	France	USSR	Total
Payloads orbiting Earth	164	2	2		3	42	213
Payloads orbiting Sun	9					9	18
Payloads on Moon	5					5	10
Payloads on Venus						1	1
Debris orbiting Earth	661	1	2		10	146	820
Debris orbiting Sun	8					2	10
Totals	847	3	4		13	205	1072
Payloads decayed or de-orbited	174			1		106	281
Debris decayed	168					583	751
Grand Totals	1189	3	4	1	13	894	2104

A listing of Soviet payloads still orbiting the Earth as of 1200Z, 14 March 1966, is shown on page 40.

The 9 Soviet payloads in heliocentric orbit (around the Sun) include:

	Date of Launch
Luna 1	02 Jan 59
Venera 1	12 Feb 61
Mars 1	01 Nov 62
Luna 4	02 Apr 63
Zond 1	02 Apr 64
Zond 2	30 Nov 64
Luna 6	08 Jun 65
Zond 3	18 Jul 65
Venera 2	12 Nov 65

The Venera 3 payload is not included in this 9, since it presumably impacted on Venus.
(NORAD Space Defense Center)
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'Red Star' Claims Great Accuracy for Venera 2 & 3 Flights

Following is a summarized NORAD translation of parts of an article, "The Flight of the Automatic Interplanetary Stations 'Venera 2' and 'Venera 3'," from the 6 March issue of Red Star, official newspaper of the Soviet Ministry of Defense.

THE DESIGN OF VENERA 2 AND VENERA 3

Venera 2 and Venera 3 each had 2 missions -- an orbital one and a special one. The orbital mission for both was to conduct studies of interplanetary space while en route toward Venus. But in studying the planet itself, each had a different "special" mission. Venera 2 was to pass close to Venus to make a series of physical measurements and to photograph the planet, while Venera 3 was to enter the dense layers of the planet's atmosphere and transmit direct measurements of temperature and pressure from the surface.

In design, the 2 probes had much in common with Mars 1, Zond 1, Zond 2, and Zond 3. Each consisted of 2 sealed compartments, one for the orbital mission, the other for the special mission. (Drawing on page 37.)

The special compartment of Venera 2 carried photo-TV equipment, a radio transmitter which operated in the centimeter waveband, one of the probe's storage batteries, and part of the electronic equipment which supported the special mission and the scientific measurements.

The special compartment of Venera 3 was a landing vehicle in the form of a ball 900 mm (35.433 inches) in diameter covered with heat resistant material to protect it from the high temperatures encountered in braking in the deep layers of Venus's atmosphere. It contained a decimeter-waveband transmitter which was to send to the Earth the measurements made by the scientific instruments. Descent was to be made by means of a parachute system.

Also inside the ball was a hollow globe (page 41, last week's WIR) 70 millimeters (27.559") in diameter, on the surface of which was engraved the outlines of the Earth's continents. And inside the hollow globe was a medal, one side portraying the coat of arms of the Soviet Union, the other a diagram of the solar system and the words, "Union of Soviet Socialist Republic, 1965." The positions for the Earth and for Venus (the only planets for which the names were given) as shown in the diagram corresponded to their relative positions at the time of the impact. This payload was carefully sterilized before the flight, to prevent the possibility of its carrying live microorganisms from the Earth to Venus.

Mounted on the outside of the orbital compartments were radiators to carry away heat, solar-battery panels, engines for inflight course corrections, and gas-fed microjets for orienting the probe in space.

Inside were storage batteries, decimeter-waveband transmitters and receivers, telemetry commutators, instrumentation for the orientation system and for inflight course corrections, electro-optical orientation sensors, gyroscopes, and an electronic programer which controlled all the systems of the probe and automatically switched on various devices for communicating at given intervals. Communications could also be held on command from the Earth.

A heat-regulating system kept the temperature of the compartment at a level suitable for operation of the instrumentation.

Electrical energy for all purposes was supplied by solar batteries deployed on 2 panels and by buffer batteries.

The decimeter- and centimeter-waveband transmitters could be coupled in turn to a highly directional parabolic antenna.

Radio commands from the Earth were received over an antenna of low directivity. This antenna could also be coupled to the decimeter-band transmitter, in which case the spacecraft would not need to be oriented to the Earth, but information would be sent much more slowly.

The radio equipment was also used to measure the probe's distance and rate of withdrawal from the Earth. Distance was measured by the time taken for a signal to be sent to the probe and back from the Earth; velocity was obtained by measuring the Doppler shift. Ground stations also measured the angular coordinates of the probe to determine its position relative to the Earth.

The probe was oriented differently at various times -- to keep the solar panels facing the Sun, to make inflight course corrections, and to hold communications. All this was accomplished with electro-optical sensors, which pointed to such guideposts as the Sun, Earth, and the star Canopus; gas-fed microjets; gyroscopes for measuring the probe's speed of rotation; and control instruments.

In keeping the solar panels oriented toward the Sun, a special electro-optical sensor could search for the Sun from any position of the probe; once it "found" the Sun in its central tube, the control system would maneuver the probe to orient it properly.

Before starting a communications session, the highly directional antenna had to be pointed toward the Earth with an accuracy of a fraction of an angular degree. This was achieved by use of a sensor consisting of two optical tubes -- "solar" and "terrestrial." The axis of the terrestrial tube was pointed along the axis of the parabolic antenna, while the solar tube could be turned to correspond with a measured Sun-probe-Earth angle. After the solar tube "acquired" the Sun, the station would swing around the axis of that tube until the Earth fell within the field of view of the terrestrial tube. The probe would then stop rotating, the transmitter would be coupled to the parabolic antenna, and the transmission of information would start. The control system kept the probe oriented properly throughout the communications session. After the session, the probe would be returned to an orientation which would keep the solar panels facing the Sun.

For making inflight course corrections, a special astrosensor was used to orient the long axis of the guidance-correction engine, which was aligned with the long axis of the probe, in any desired direction. This electro-optical sensor consisted of movable optical tubes, solar and terrestrial. The computed size of the angle between these tubes, determined from trajectory measurements, were sent to the probe by radio. These tubes were then turned to the programed positions relative to the long axis of the probe. At the beginning of the astrocorrection the station executed a turn in space until the optical tube of the sensor pointed at the Sun and then at the star Canopus. Since the tubes were already turned to the programed angles, the axis of the engine was aligned with an accuracy of several angular minutes.

A liquid-fueled engine and 2 gyroscopic devices were used in the correction, one for "remembering" the position of the probe in space before switching on the engine, the other for turning off the engine at the programed speed.

THE FLIGHT OF THE PROBES TO VENUS

Venera 2, launched 12 November, was aimed to fly past the side of the planet then being illuminated by the Sun at a distance of 40,000 kilometers (21,500 n.m.) from the planet's surface. Venus 3, launched 16 November, was to reach the surface of Venus and land in the center of the planet as seen from the Earth.

Each probe was first launched into parking orbit and then injected into trajectories toward Venus. The speed of both stations had to be about 11,500 meters per second when the last stage of the rocket engine was turned off. A deviation by 1 meter per second would have caused a miss distance of about 30,000 kilometers. Because of the difficulty of reaching this speed precisely, each probe had an inflight course correction engine. More than one correction could be made, using either "solar-stellar" or "solar" orientation techniques.

The solar-stellar orientation system used the Sun and Canopus as base points. It permitted the engine to be pointed any direction in space, enabling the probe not only to hit any point on the planet but also to time the impact so that the probe would be visible to the long-range space communications center when it encountered the planet.

In the case of solar-oriented corrections, the axis of the engine was pointed toward or away from the Sun, depending on the type of correction needed. Transmitted data gave the magnitude and direction of the desired correction. This method, which did not use a star, was technically simpler. However, for certain types of deviations, it had definite limitations, requiring several corrections at specified times. Both types of corrections were used earlier in Zond 1 and Zond 3.

A special complex of radiomeasuring facilities and computing centers on the Earth measured the trajectories of Veneras 2 and 3 and determined the corrections required. For Venera 3, measurements were taken during 31 communications sessions, including 16 before the course correction. Total data received consisted of more than 1,300 measurements of distance, 5,000 of radial velocity, and 7,000 of angular coordinates.

Computations indicated that Venera 2's trajectory was close to that required and would pass about 24,000 kilometers (12,900 n.m.) from the surface of Venus, and that no course correction would be required. Its trajectory is shown in Figure 1, page 37.

Unless its course was corrected, Venera 3 would pass 60,550 kilometers (32,500 n.m.) from the center of Venus at 0037 hours, 1 March, at which time it would not be visible to the long-range space communications center. The necessary correction was carried out at 1804 hours, 26 December 1965, when the station was 12,900,000 kilometers (6,900,000 n.m.) from the Earth, using a "solar-stellar" orientation.

The radial velocity of the probe had to be changed by 19.75 meters per second. Data received after the correction showed that the station would reach the surface of Venus at 1000 hours, Moscow time, 1 March, at the center of the planet as seen from the Earth. The radial velocity was actually changed by 19.68 meters per second, differing from the desired changed by only 0.07 meter (2.76 inches) per second. Measurements made between 26 December 1965 and 15 February 1966 indicated that the actual landing point would differ from the one programed by no more than 450 kilometers, and that the probe would impact at 0956:26 hours, Moscow time, less than 4 minutes from the computed time. Moreover, the angle between the local vertical and a line drawn to the Earth would be only 1 degree, 30 minutes.

Two types of errors, however, limit the precision of predicting an impact point: small random and systems errors in electronically measuring distances, velocities, and angles; and errors in our knowledge of astronomical constants, such as the Astronomical Unit (mean distance from the Earth to the Sun). The maximum random and systems errors in predicting Venera 3's impact point was no more than 600 kilometers, while the maximum error due to our imperfect knowledge of astronomical constants was no more than 500 kilometers. The resulting total error, calculated by mean squares, was no more than 800 kilometers, that is, the point of impact on Venus was within plus or minus 800 kilometers of the point predicted. The error in predicting the time of impact was actually about plus or minus 5 minutes.

The last measurements showed that Venera 3 was accelerating as it approached Venus as a result of the planet's gravitational attraction, which is about equal to the Earth's. This attraction would have caused Venera 3 to impact if it passed anywhere within a circle with a radius of 15,000 kilometers while en route to Venus, an area much greater than the 6,100-kilometer radius of the planet. Thus, the probe would have still hit the planet had the errors been 10-15 times the actual ones. (Figure 2, page 37.)

The experience gained in tracking the 2 probes will be useful in future interplanetary flights, because this is our only way of gaining secure knowledge of the factors involved in calculating trajectories for such flights.

The flight also showed that little is known about how probes work in the vicinity of Venus. The US probe Mariner 2 also experienced an unforeseen rise in temperature as it passed Venus. Several breaks in radiocommunications occurred en route. The last communications session with Venera 3 as it approached the planet did not take place, for reasons unknown. Likewise, Venera 2 did not respond to radio commands near Venus. The results of this experiment may become known if communications with Venera 2 can be re-established. This probe continues its flight; on 4 March it was about 65 million kilometers (35 million n.m.) from the Earth.

A total of 63 communications sessions was held with Venera 3, 26 with Venera 2. A greater number of sessions with Venera 3 was necessary because of the trajectory measurements which had to be made in connection with the course correction.

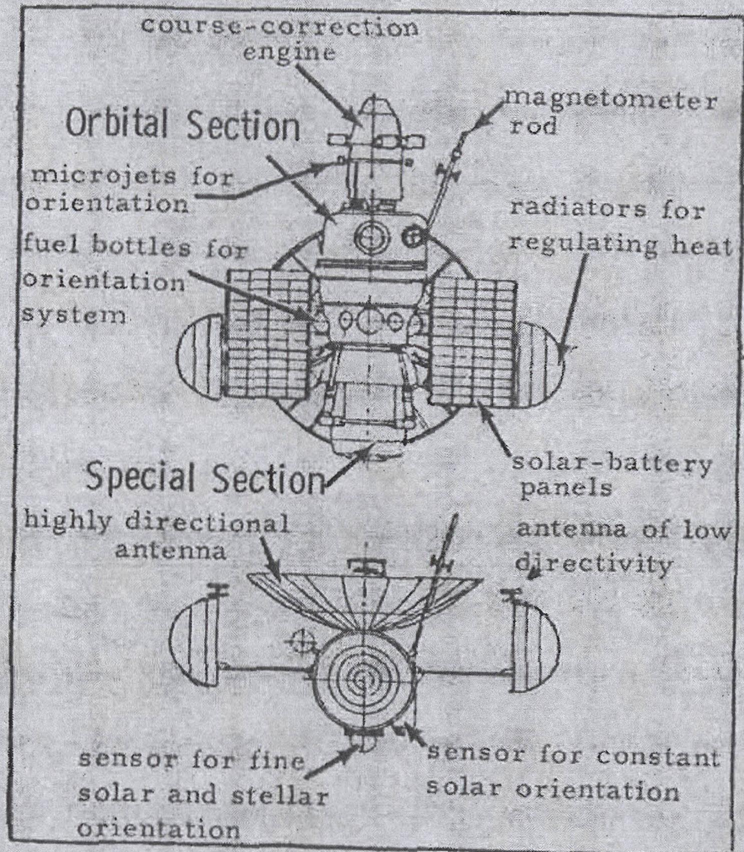
PHYSICAL INVESTIGATIONS DURING THE FLIGHT

Veneras 2 and 3 carried the following instruments to study conditions in interplanetary space:

- A 3-component ferro-sonde magnetometer for measuring interplanetary magnetic fields.
- A gas-discharge counter and semiconductor detector for study of cosmic rays.
- A special sensor (trap) for measuring streams of changed particles of low energy and for determining the magnitude of the streams of solar plasma and determining their energy spectra.
- Piezoelectric sensors for studying micrometeorites.
- Radio receivers for measurement of space radiowave emissions in the 150-meter, 1500-meter, and 15-kilometer bands.

The physical data obtained from Venera 2 and Venera 3 is being studied and the results of which will be published in scientific journals. (TASS) (Red Star)
(UNCLASSIFIED)

Venera 2 and Venera 3 Configuration



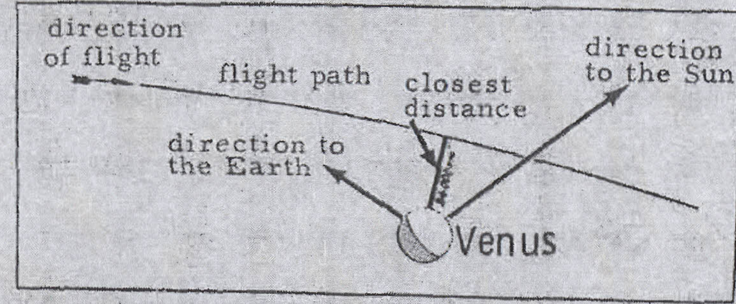


Figure 1. Flight Path of Venera 2 near Venus

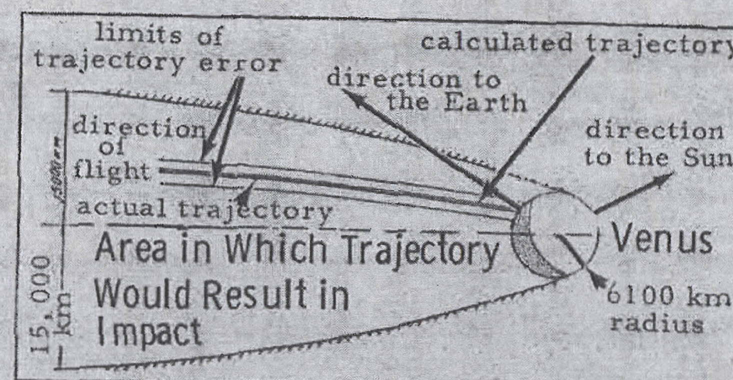


Figure 2. Flight Path of Venera 3 as it Approached Venus

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Soviet Space Vehicles in Orbit

Data as of 1200Z. 11 March 1966

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18 Mar 66

Soviet Designation	Object No.	Date of Launch	Inclination to Equator (degrees)	Period (minutes)	Apogee (kilometers)	Perigee (kilometers)	Number of Revolutions
Polyot 1	683	01 Nov 63	58. 94	102. 2	1379. 2	346. 4	12121
▌Electron 1	746	30 Jan 64	60. 89	169. 2	7109. 6	404. 1	6560
▌Electron 2	748	30 Jan 64	58. 41	1356. 4	66571. 2	1853. 8	818
Polyot 2	784	12 Apr 64	58. 05	90. 7	343. 6	265. 0	10961
▌Electron 3	829	10 Jul 64	60. 93	168. 1	7015. 6	406. 6	5213
▌Electron 4	830	10 Jul 64	58. 96	1313. 8	65497. 9	1217. 7	667
Cosmos 41	869	22 Aug 64	67. 02	714. 9	39359. 4	865. 4	1139
Cosmos 44	876	28 Aug 64	65. 10	99. 5	866. 2	605. 5	8100
Cosmos 53	983	30 Jan 65	48. 69	94. 4	762. 4	210. 2	6035
▌Cosmos 54	1089	21 Feb 65	56. 05	103. 5	1586. 8	260. 8	5293
▌Cosmos 55	1090	21 Feb 65	56. 02	103. 5	1584. 1	260. 5	5286
▌Cosmos 56	1091	21 Feb 65	56. 03	102. 4	1483. 4	258. 3	5331
Cosmos 58	1097	26 Feb 65	65. 02	96. 8	625. 6	583. 6	5628
▌Cosmos 61	1267	15 Mar 65	56. 05	103. 3	1564. 1	263. 0	4990
▌Cosmos 62	1268	15 Mar 65	56. 06	103. 6	1587. 1	262. 8	4992
▌Cosmos 63	1269	15 Mar 65	56. 04	102. 4	1486. 4	259. 9	5027
1st Molniya 1	1324	23 Apr 65	65. 18	720. 3	39673. 2	798. 6	645
Cosmos 70	1431	02 Jul 65	48. 73	96. 2	925. 1	219. 1	3732
▌Cosmos 71	1441	16 Jul 65	56. 05	95. 2	544. 4	516. 3	3604
▌Cosmos 72	1442	16 Jul 65	56. 07	95. 9	587. 1	537. 6	3580
▌Cosmos 73	1443	16 Jul 65	56. 08	95. 6	556. 7	535. 9	3592
▌Cosmos 74	1444	16 Jul 65	56. 05	96. 2	612. 9	541. 4	3568
▌Cosmos 75	1445	16 Jul 65	56. 05	96. 5	640. 2	542. 7	3557
Cosmos 76	1464	23 Jul 65	48. 76	89. 2	232. 6	208. 9	3652
▌Cosmos 80	1570	03 Sep 65	56. 09	115. 0	1547. 7	1360. 6	2367
▌Cosmos 81	1571	03 Sep 65	56. 10	115. 3	1548. 7	1392. 6	2359
▌Cosmos 82	1572	03 Sep 65	56. 10	115. 7	1560. 3	1412. 3	2352
▌Cosmos 83	1573	03 Sep 65	56. 10	116. 1	1567. 1	1439. 8	2344
▌Cosmos 84	1574	03 Sep 65	56. 08	116. 4	1576. 9	1464. 1	2337
▌Cosmos 86	1584	18 Sep 65	56. 04	115. 1	1634. 9	1281. 7	2180
▌Cosmos 87	1585	18 Sep 65	56. 05	115. 5	1645. 7	1307. 3	2172
▌Cosmos 88	1586	18 Sep 65	56. 09	115. 8	1662. 9	1324. 4	2165
▌Cosmos 89	1587	18 Sep 65	56. 09	116. 2	1670. 7	1353. 6	2158
▌Cosmos 90	1588	18 Sep 65	56. 08	116. 7	1684. 0	1377. 8	2150
2d Molniya I	1621	15 Oct 65	64. 91	716. 4	39957. 6	334. 2	300
Cosmos 97	1777	26 Nov 65	48. 41	107. 0	1953. 4	212. 2	1402
Cosmos 100	1843	17 Dec 65	64. 99	97. 6	655. 4	631. 7	1245
Cosmos 101	1846	21 Dec 65	48. 79	91. 9	485. 3	251. 0	1254
Cosmos 103	1868	28 Dec 65	56. 04	97. 0	633. 0	596. 4	1084
Cosmos 106	1949	25 Jan 66	48. 39	92. 7	529. 7	282. 7	698
Cosmos 108	2002	11 Feb 66	48. 86	95. 1	822. 7	221. 3	420
Cosmos 110	2071	22 Feb 66	51. 84	94. 6	799. 2	180. 3	253

▌Multiple Launches

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