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FOREIGN TECHNOLOGY

BULLETIN

FTD-TA-64-15

17 APRIL 1964

FOREIGN TECHNOLOGY DIVISION

AIR FORCE SYSTEMS COMMAND

WRIGHT-PATTERSON AIR FORCE BASE, OHIO

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TABLE OF CONTENTS

Several open source indications suggest that the Soviets are in the process of testing and evaluating a new protective garment for space operations. It is possible that the new space suit will have some capability for extravehicular protection. (C)

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Portion identified as non-responsive to the appeal

4. (U) POSSIBLE NEW SOVIET SPACE SUIT
Miss Elizabeth Comfort (TDES)

Several references to a current Soviet research and test program to develop a new space suit have been noted recently in the Soviet and East European news media. Tests of the new suit in ice water are described together with evaluation in near space-vacuum conditions, during explosive decompression, at low temperatures from -70°C to -100°C and heat to +80°C. The most recent reference claims that the suit satisfies all microclimate requirements for a closed cycle system. The statement is also made that the wearer can be protected outside the spaceship.

Separate references mention using a bactericidal fabric for space suits to protect astronauts landing on another planet. Such a fabric would also prevent contamination of the space or planetary environment with terrestrial organisms - a matter of serious concern to space biologists.

The development of an efficient, self-sustaining extravehicular suit is a logical and essential step in the postulated Soviet man-in-space program. In order for man to operate effectively as a subsystem on an advanced space mission he must eventually be able to leave the protective confines of the space vehicle in an independent artificial environment, preferably a space suit. Present Soviet and US pressure suits would probably not support an astronaut if he were required to remain more than a few minutes outside the space vehicle. The most critical development problem is to devise a feasible method of thermal transport which will successfully dissipate the metabolic heat of the astronaut which may be generated at a rate of 1000 BTU/hour.

Theoretical analyses by US scientists of the heat transfer problem in space suits for use outside an orbiting vehicle or on the lunar surface have shown a

liquid system to be the most economical means of maintaining thermal equilibrium. However, it is possible that the Soviets may have elected to accept the greater thickness and weight of metal construction (where the metal serves as a radiator) to avoid the complication of circulating water in a duct system within the suit. For example, an aluminum shell that radiates heat would have a mass some 5 times that of a water filled shell. At present there is no information on which to base an opinion of such details as specific suit materials or thermal transport techniques. (The overall classification of this item is ~~CONFIDENTIAL~~.) ~~(Gp 3 Normal - Downgraded at 12 year intervals; not automatically declassified.)~~ (NO FOREIGN DISSEM, except UK, Can, Aus, NZ and NATO.)

5. (U) SOVIET 65° COSMOS PROGRAM
Mr. M. K. Ellingsworth (TDFSE)

This item presents a summary of the information related to the Soviet 65° Cosmos Unmanned Earth Satellites 4, 7, 9, 10, 12 and 13.

With the launching of Cosmos 1 in March 1962 the Soviets announced the beginning of the Cosmos series of earth satellites for the scientific investigation of the upper atmosphere and Cosmic space. Two series of spaceflights have been observed within the Cosmos Program — those launched from Tyura Tam with inclinations of 65° (TT Cosmos), and those launched from Kapustin Yar with inclinations of 49° (KY Cosmos). Subsequent to their initial announcement the Soviets have not revealed specific missions or results of the individual flights nor have they distinguished between the TT and KY Cosmos series.

All six of these satellites were launched during the time interval 0830Z to 1003Z. By choosing this time interval the Soviets align the satellite's orbital plane with the sun. One direct result is that each ascending pass of the spacecraft occurs very near local noon (sun time). This alignment may have been directed by the recovery system but it is also a requirement for satellite reconnaissance. The near circular orbits, earth orientated spacecraft and recoverable payloads could also be indicative of satellite reconnaissance. While the extent of this function cannot be established, it is clear that the first six TT Cosmos vehicles may have obtained extensive photographic coverage of the US.

Specific sensors which have been identified to date are a video system, a photometer, a particle detector and possibly a magnetometer.

50X1 and 3, E.O.13526

The 65° satellites are launched from the Tyura Tam Missile Test Range by the SS-6 booster-sustainer system with a Lunik class upper stage. They traverse a narrow altitude band of from 110 to 220 nautical miles and remain earth oriented while in orbit. The spacecraft are of the 10,000 pound weight class and have been recovered after 3 to 8 days in orbit.

The launch system is reliable, having also been used in the Sputnik, Vostok and direct ascent Lunar flights. It is probably capable of placing a 12,000 pound payload into a low altitude earth orbit. Although the evidence is still not conclusive, it is assumed that the configuration of the booster system is parallel rather than partial. As such, the vehicle consists of four separate booster units clustered around a sustainer. The sustainer and each booster unit are powered by liquid bi-propellant, turbopump-fed engines using a LOX-Amine type propellant. Total vehicle weight at lift-off is 562,000 pounds with a sea level thrust of 804,000 pounds. The sustainer is approximately 8.5 feet in diameter with a length of about 85 feet. Each booster unit is about 5.4 feet in diameter and about 70 feet in length.

The upper stage of the launch system is believed to be the Lunik stage. It is estimated that the stage consists of a liquid bi-propellant, turbopump-fed engine developing between 11,000 and 11,500 pounds vacuum thrust with a specific impulse of 320 seconds. The lunik stage is approximately 10 feet in length and 8.5 feet in diameter.

It is believed that the basic SS-6 ICBM guidance system is used during booster and sustainer operation. This system, based upon a modified form of the Principle Axis or Pitch Plane scheme, is a thrust modulated, programmed guidance system with inertial components in pitch and roll and external assistance in yaw by radio. The method of attitude control during upper stage operation is not clearly known. It appears to be accomplished either by a gimballed main engine in conjunction with two roll nozzles or by jet vanes.

There is very little direct information available on the 65° Cosmos spacecraft. Similarities of the launch system, orbital characteristics, [redacted] however, have led to the conclusion of a 10,000 pound class spacecraft with a configuration possibly similar to the Vostok vehicles. The spacecraft is earth oriented with gross orientation resulting from an intentionally induced tumble. To provide corrections to the tumble rate a horizon seeking device controlling a gas jet system is probably used.

[redacted]

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50X1 and 3, E.O.13526

The spacecraft have all been de-orbited and recovered. De-orbit is accomplished by firing a 3600 pound thrust retrorocket after the spacecraft has been oriented in space in reference to the sun. The retro system is similar, if not identical, to that used for the Vostok spacecraft.

Overall control of each space event is probably exercised from the "Coordinating Computer Center" in Moscow.

50X1 and 3, E.O.13526

A graphic summary of the Soviet 65° Cosmos system is shown in the following Tables and Figures. (The overall classification of this item, including the Tables and Figures, is ~~SECRET~~.) ~~(Gp 1 - Excluded from automatic downgrading and declassification.)~~ (NO FOREIGN DISSEM, except UK, Can, Aus, NZ and NATO.)

TABLE I

TT COSMOS SYSTEM GENERAL CHARACTERISTICS

Type - USSR R&D ESV, unmanned, recoverable
Duration - 3-8 days
Inclination - 65°
Period - 90 minutes
Perigee - 110-175 NM
Apogee - 182-214 NM
Payload weight - 10,000 lb
Gross weight 562,000 lb*
SL thrust - (gross) - 804,000 lb*
Launch - Tyura Tam Missile Test Range
Missions - video system development,
scientific measurements
and others.

*Assumes parallel configuration.

TABLE II

TT COSMOS SYSTEM SPECIFIC CHARACTERISTICS

Booster/sustainer - SS-6
Third Stage - Lunik (probably)
Payload - 10,000 lb unmanned,
recoverable - possibly
similar to Vostok spacecraft.
Power - Battery and solar cells

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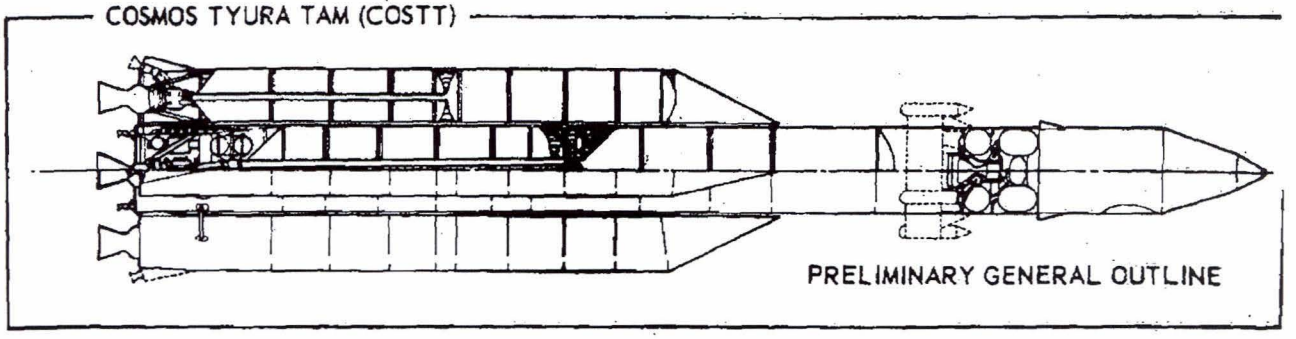
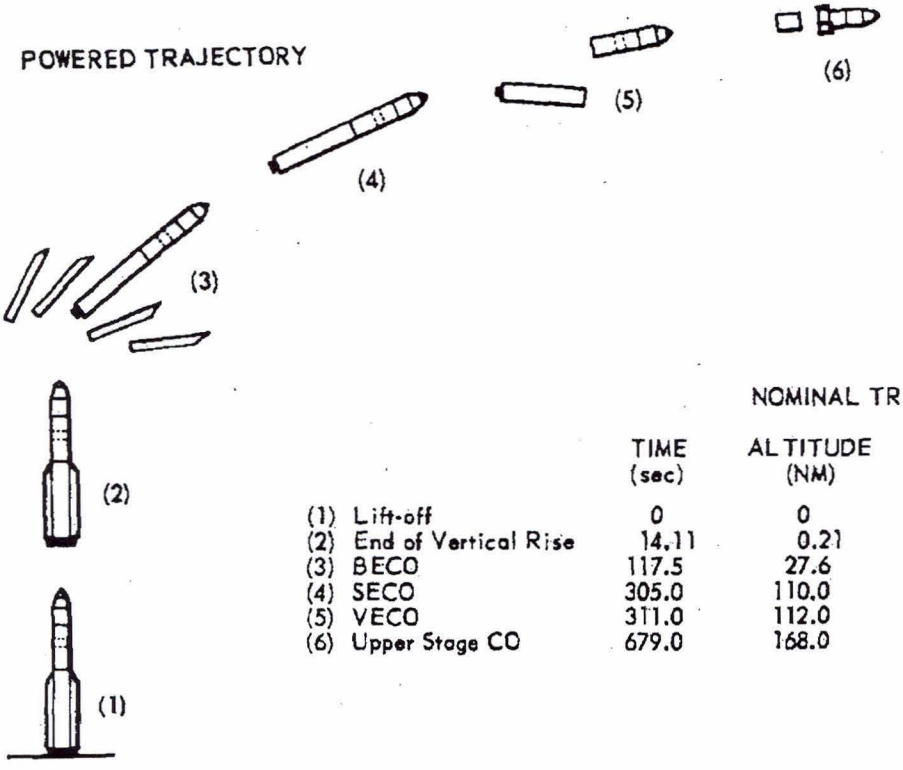
Launch Site - TTMTR

50X1 and 3, E.O.13526



SS-6 - LUNIK (WITH VOSTOK PAYLOAD)

Figure 1



NOMINAL TRAJECTORIES

		TIME (sec)	ALTITUDE (NM)	RANGE (NM)	VELOCITY (fps)
(1)	Lift-off	0	0	0	0
(2)	End of Vertical Rise	14.11	0.21	0	1,090.0
(3)	BECO	117.5	27.6	28.7	7,300.0
(4)	SECO	305.0	110.0	338.0	18,440.0
(5)	VECO	311.0	112.0	355.0	18,520.0
(6)	Upper Stage CO	679.0	168.0	1585.0	25,370.0

NOMINAL CHARACTERISTICS

	THRUST (lb SL)	BURNING TIME (sec)
Booster	643,200	110-120
Sustainer	160,800	301-308
Lunik	11,000-11,500	370

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Figure 2

SIZING

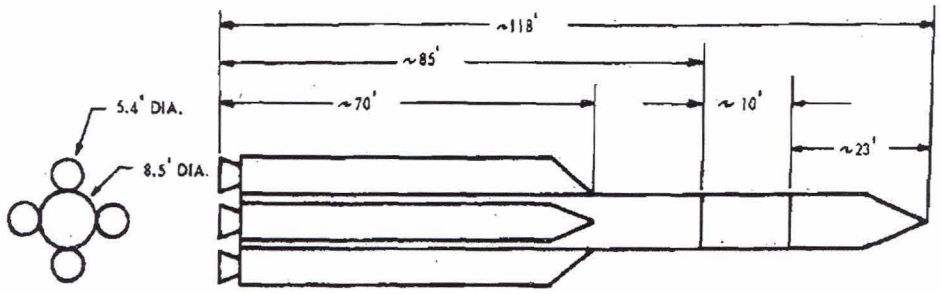

Figure 3

ORBITAL TRAJECTORY

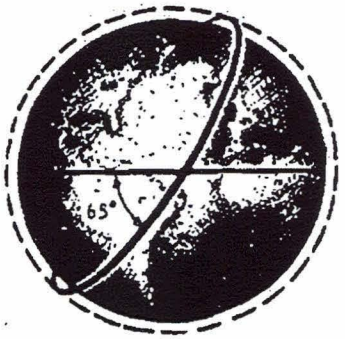

Figure 4

PERIGEE-APOGEE (NM)

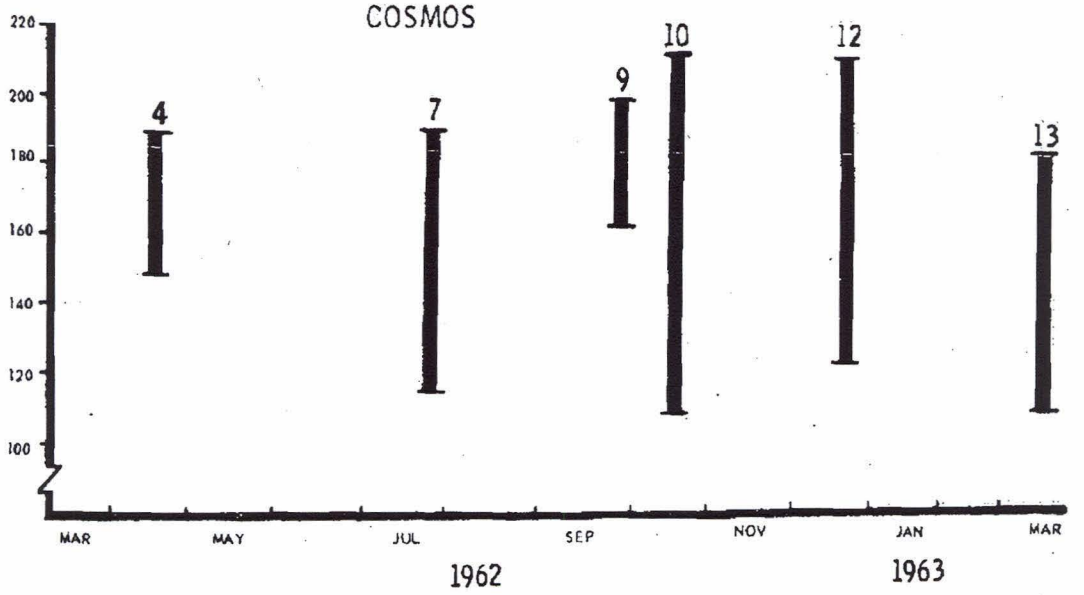

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Figure 5

6. (U) ROCKET PROPULSION SYSTEM
Mr. J. L. Teague (TDEPR)

The 3 December 1963 Soviet ICBM firing involved a second-stage propulsion system different from any previously identified.

50X1 and 3, E.O.13526

The following table lists major propulsion events for the 3 December 1963 ICBM flight.

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(The overall classification of this item is ~~SECRET~~.) ~~(Gp 1 - Excluded from automatic downgrading and declassification.)~~
(NO FOREIGN DISSEM, except UK, Can, Aus and NZ.)

7. (U) SOVIET PLANETARY EXPLORATION PROGRAM
Sq Ldr P. J. Colebourn (TDFSE)

This information represents a summary of the Soviet planetary exploration program to 1 January 1964. It does not include the 27 March 1964 launching which failed to eject a Venus probe.

Since October 1960, the Soviets have utilized every optimum launch window in attempts to send space probes to the planets Mars and Venus. A total of ten attempts have been made — five to Mars and five to Venus (see Table I). Similar launch vehicles, designated SP-1, were used and in all instances, the Soviets intended to use a pre-programmed parking orbit prior to injection into a free flight interplanetary trajectory. The SP-1 consists of the SS-6 missile as first and second stages plus a third stage — the Venik (heavy) stage, which place the fourth stage containing the interplanetary injection propulsion and

TABLE I

Soviet Planetary Exploration Program Events

Year	Launch Date	Target Planet	Soviet Designation	Mission Evaluation
1960	10 Oct	Mars	None	Failure
1960	14 Oct	Mars	None	Failure
1961	4 Feb	Venus	None	Failure
1961	12 Feb	Venus	Venus I	Partial success
1962	25 Aug	Venus	None	Failure
1962	1 Sep	Venus	None	Failure
1962	12 Sep	Venus	None	Failure
1962	24 Oct	Mars	None	Failure
1962	1 Nov	Mars	Mars I	Partial success
1962	4 Nov	Mars	None	Failure

the space probe into a pre-programmed earth orbit. The system characteristics of the Soviet planetary exploration program are listed in Table II, and the instrumentation frequencies are shown in Table III.

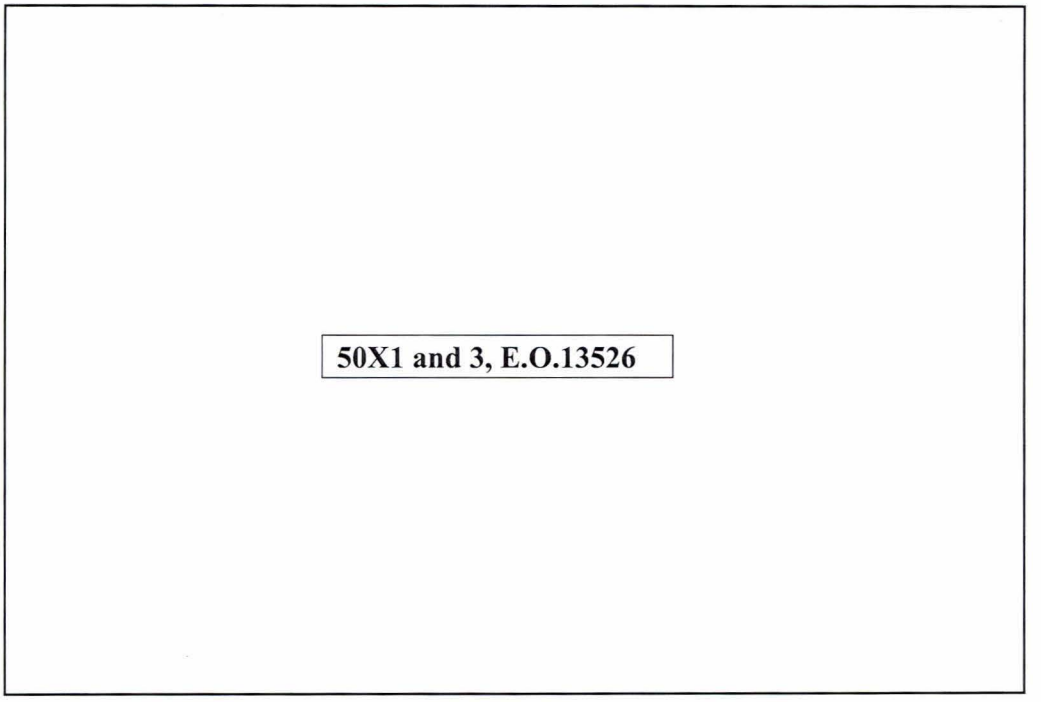
Guidance requirements at the point of injection into the free-flight interplanetary trajectory are stringent. Using accurate tracking data, the Soviets probably calculate the deviation of the actual earth orbit of the fourth stage from the pre-planned orbit. Corrections are then computed and transmitted to the fourth stage prior to its injection into a planetary trajectory. All the attempts took place toward the end of the launch windows, when the propulsion requirements are not optimum, but the injection guidance accuracy requirements, the interplanetary flight time, and the communication distance are near minimum.

The Soviet interplanetary program has been characterized by an excessive failure rate, resulting from their inability to achieve a smooth transfer of the probe from the parking orbit to an accurate planetary trajectory. Of the ten attempts, two failed in the third stage, six failed in the fourth stage. Only two probes, Venus I and Mars I, were conditional successes and in both instances communications were lost before the probes could have reached their target planets. Modifications were incorporated in the SS-6 booster and sustainer in mid-1962 to enable the Soviets to launch the heavier Mars I probe. In its present configuration the vehicle has probably reached its engineering limits and no further performance improvements are anticipated.

TABLE II

Systems Characteristics

Type	USSR planetary probes
Missions	Scientific exploration and development of space subsystems.
Trajectory	Parking orbit prior to transfer into free-flight interplanetary trajectories with mid-course correction after 1962.
Limitations	Flights possible - 19 months for Venus at intervals - 25 months for Mars
Flight Duration	Venus 80-110 days Mars 205-225 days
Payload	1961 Venus 1415 lb 1962 Mars 1965 lb
Launch Point	Tyura Tam Missile Test Range
Powered Flight	SS-6 booster/sustainer, Venik (heavy) third stage and interplanetary injection fourth stage.



The design of Soviet planetary probes indicates progress through 1961-1962. The Mars I probe would, of necessity, be a relatively sophisticated spacecraft since, according to the Soviets, it was equipped with a mid-course correction engine and facilities for photography. No hard intelligence is available on the spacecraft but the many reports published by the Soviets are consistent with US state-of-the-art and accepted design criteria. It is probable that the object of the Soviet program is the acquisition of scientific data related to the characteristics of solar space and the planets. However, these missions would also have provided valuable technical information on space communications, flight power supplies, guidance and space-startable engines, which are important components of military space weapons systems.

The Soviets have yet to achieve a completely successful planetary probe, but it is believed that if all systems function properly the Soviets could do so with their present capability. It is probable that the Soviets will continue to probe interplanetary space, utilizing every launch window and thereby increase their background knowledge of the solar system and scientific data on the planets. Anticipated Soviet Venus and Mars probes in 1964 will probably continue to aim at a fly-by in the planetary atmosphere or an impact on the planet.

The development of the larger payload capacity launch systems expected in the near future will permit the launching of larger probes and it is possible that attempts will be made to soft-land an instrument package on the planets in the 1970's — possibly aiming for Mars in 1971. It is believed that the problems to be solved for manned flight to the planets, including a thorough study of interplanetary space, solar radiation, and planetary scientific data, the development of closed ecological systems, electrical and nuclear propulsion systems, multi-manned spacecraft, and other problems mitigate against manned interplanetary flights before 1980. (The overall classification of this item is ~~SECRET~~.) (Gp 1 - Excluded from automatic downgrading and declassification.) (NO FOREIGN DISSEM, except UK, Can, Aus and NZ.)

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