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NASA News

National Aeronautics and
Space Administration

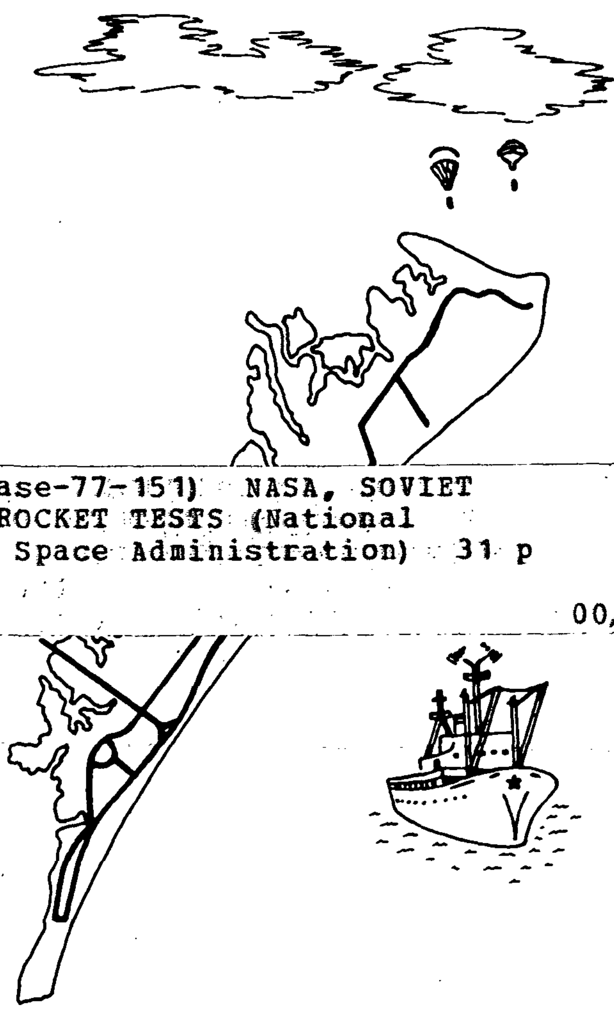
Washington, D.C. 20546
AC 202 755-8370

For Release IMMEDIATE

Press Kit

Project NASA, Soviet Joint
Sounding Rocket Tests

RELEASE NO: 77-151



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For Release:

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RELEASE NO: 77-151

SOVIET SHIP DUE TO ARRIVE AUG. 7 FOR JOINT ROCKET TESTS

The Soviet hydrometeorological research ship "Akademik Korolev" is expected to arrive off the Virginia coast near NASA's Wallops Flight Center, Wallops Island, Va., about Aug. 7 to participate in a series of rocket tests designed to compare U.S. and Soviet measurements of the physical state of the stratosphere and mesosphere.

The Akademik Korolev will anchor from 5 to 8 kilometers (3 to 5 miles) offshore and serve as the Soviet launch platform.

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Mailed:
July 27, 1977

These comparison tests will consist of the paired launching of approximately 22 each of the Super Loki Datasonde and the U.S.S.R. M-100B meteorological rockets. NASA will launch its rockets from Wallops Center.

Each organization will be responsible for (1) conducting countdown and launch operations and (2) all aspects of safety for their respective launchings.

In 1971, NASA and the Soviet Academy of Sciences signed an agreement on space science and applications which called for exchange of meteorological rocket data from several launch sites in the Eastern Hemisphere (about 60 degrees East) and Western Hemisphere (about 70 degrees West). The Eastern Hemisphere network would be coordinated by the U.S.S.R. Hydrometeorological Service and the Western Hemisphere network coordinated by NASA.

Exchange of meteorological rocket data began in January 1972 and both sides began performing hemispheric analyses with that information. These analyses revealed that the measured temperature field in the Eastern Hemisphere was consistently colder than that of the Western Hemisphere. As a result of this discrepancy, both countries began evaluating their sounding rocket systems for possible sources of error.

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In 1973,direct comparisons of the U.S., U.S.S.R., French and British meteorological rocket data were conducted at Kourou, French Guiana. These comparisons revealed some discrepancies in measurements of temperature and wind data.

Since the 1973 comparisons, improvements in meteorological rocket systems and data analysis techniques make it necessary again to compare the U.S. and U.S.S.R. systems.

(END OF GENERAL RELEASE. BACKGROUND INFORMATION FOLOWS.)

BACKGROUND INFORMATION

In August 1971 NASA and the Soviet Academy of Sciences agreed to exchange meteorological rocket data from several launch sites along two meridional zones, one in the Eastern Hemisphere (about 60 degrees E.) and one in the Western Hemisphere (about 70 degrees W.). This agreement calls for the exchange of mid-week operational meteorological rocket data by teletype messages within seven days after launching and more detailed scientific data within four months. The overall scientific aim of the Eastern-Western Hemispheres data exchange is to investigate the processes which characterize the physical state of the stratosphere and mesosphere. General areas of research in the 1971 agreement are:

- Cyclic processes in the tropical stratosphere,
- Large scale strato-mesospheric meteorological processes and
- Seasonal transitions of circulation and inter-seasonal phenomena.

In addition to the exchange of meteorological rocket data for research purposes, the agreement calls for the exchange of technical data on:

- Flight and ground systems,
- Measurement and processing techniques and
- Sensor calibration techniques.

The agreement also recommends that intercomparison tests be conducted in order to obtain information on the comparability of the measurements derived from the respective systems.

The exchange of operational data began in January 1972 and both sides began performing hemispheric analysis with the data. This data analysis soon revealed that the measured temperature field in the Eastern Hemisphere was consistently colder than that of the Western Hemisphere. As a result of this discrepancy, both countries began evaluating their sounding rocket systems for possible sources of error. The U.S. conducted a special series of day-night launchings to determine radiation effects on temperature measurements and began a special study to determine the effect of other parameters such as aerodynamic heating on the measured temperature.

From the day-night launchings and from the special studies, temperature adjustments up to an altitude of 60 kilometers were determined for the U.S. datasonde system.

Because of the obvious scientific need for comparability of meteorological rocket measurements, intercomparisons were suggested. Under the sponsorship and supervision of the Commission for Instruments and Methods of Observation (CIMO) of the World Meteorological Organization (WMO), an intercomparison of rocketsondes was carried out in two phases. The first phase, conducted at NASA's Wallops Flight Center, Wallops Island, Va., in 1972, involved participants from Japan, France and the United States. The second phase which was carried out in 1973, from Kourou, French Guiana, involved participants from the United Kingdom, France, the U.S.S.R. and the United States.

The results of the CIMO intercomparison tests have been extremely useful in evaluating the compatibility of meteorological sounding rocket data being gathered by various countries. Because of these tests, adjustment factors were developed to make reported sounding rocket temperatures more compatible.

The effect of these adjustments is to diminish the temperature discrepancy among the U.S.S.R., French, U.S., U.K. and Japanese systems.

The mean temperature difference at 65-70 km between the U.S.S.R. and U.S. systems was found to be about 18 degrees C, with the U.S.S.R. system being colder. Another important observation was the large difference in wind velocity between the different systems.

At the second meeting of the Joint U.S./U.S.S.R. Working Group on Space Meteorology held at Goddard Space Flight Center, Greenbelt, Md., March 3-7, 1975 discrepancies observed between the U.S.S.R. and U.S. systems were discussed. As a result of these discussions, it was recognized that improvements to the measurements were planned and were being accomplished. It was recommended that information on the details of the work to improve the quality of the measurement and data processing methods be exchanged and that an intercomparison of U.S.-U.S.S.R. meteorological rockets be held in the region of Wallops Center during the summer of 1977.

MISSION DESCRIPTION

The primary objective of these intercomparison tests is to improve the understanding and comparability of thermodynamic measurements and winds taken by the U.S. Super Loki Datasonde and the U.S.S.R. M-100B meteorological rockets.

This intercomparison will consist of the paired launching of approximately 22 each of the Super Loki Datasonde and the U.S.S.R. M-100B rockets. Also, six Super Loki sphere systems will be launched in conjunction with selected pairs of sounding rockets as an independent method of obtaining temperature and wind data.

The aim of these comparison tests is to gain comparability of observations to a degree that will allow a separation between real atmospheric effects and instrument effects.

Tests will involve comparisons of temperature and winds at different geometric height. Comparison of derived pressure and density requires that only one rawinsonde (balloon lofted) system provide initial level data for the M-100B and Super Loki Datasonde data reduction.

To minimize differences due to radiation and atmospheric effects, the launchings will be as close together in space and time as possible. Day and night measurements will be conducted.

A direct comparison of wind data reduction techniques will be made. This wind data comparison will be accomplished by NASA radars tracking at least four U.S.S.R. M-100B meteorological rocket payloads. For these four rockets the Hydromet Service will reduce their data as they normally do and NASA will reduce the Wallops Center radar track data using the standard meteorological data reduction program. Both raw radar data and reduced wind data will be exchanged. The results of this exercise should reveal whether differences are induced by the different radars, by the reduction program or by the decelerator performance.

In order to conduct a valid comparison between the U.S. Datasonde and the U.S.S.R. M-100B, it will be necessary to know the variance of the temperature and wind versus altitude for the Datasonde and of the M-100B.

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The standard deviation of the Datasonde will be obtained by launching a minimum of five pairs of Datasonde systems. The time difference between each sounding rocket in a pair should be no greater than approximately 30 minutes. A similar test will be conducted for the M-100B.

Comparison Criteria

For a proper statistical evaluation, 22 successful paired launchings of the Super Loki Datasonde and the U.S.S.R. M-100B meteorological rocketsonde are required. A total of 14 successful pairs would be marginally acceptable.

A pair will be considered successful if the following criteria are met:

- Launch times are within 30 minutes of each other.
- Horizontal distance between data gathering regions is not in excess of 50 km.
- Both systems obtain temperature data from at least 30 to 65 km altitude and wind data from 30 to 60 km altitude.
- Launching of any pair will be on the same side of twilight.

LAUNCH OPERATIONS

NASA will launch 22 meteorological rockets from Wallops Center and the Hydromet Service will launch 33 meteorological rockets from a ship near Wallops.* Each organization will be responsible for (1) conducting countdown and launch operations, and (2) all aspects of safety for their respective launchings. Close coordination will be required in order to conduct successful intercomparison tests. Radio communications between Wallops Center and the ship will be established. Wallops and the ship will keep each other advised of all launch activities from the time the ship arrives in the Wallops area until it departs. During launch activities associated with the intercomparison test, continuous communications between Wallops and the ship will be maintained. Each participant will keep the other advised of the countdown status, including the reasons for any delays in launch, changes in the launch schedule and flight results.

*In addition, Wallops Center will launch six Super Loki Sphere systems.

LAUNCH SCHEDULE

Following is the preliminary launch schedule based on a ship arrival date of Aug. 8, 1977. Because the launch schedule must consider both twilight and ocean tides, this schedule is valid only for the dates given below.

Date	Group	Time (LST)	System
Aug. 10	1	1000	Super Loki
	1	1005	M-100B
	2	1200	Super Loki
	2	1205	M-100B
Aug. 12	3	000	Super Loki
	3	0005	M-100B
	4	0200	Super Loki
	4	0205	M-100B
	5	0700	Super Loki
	5	0705	M-100B
	5	0710	Super Loki Sphere
Aug. 15	6	1300	Super Loki
	6	1305	M-100B
	6	1310	Super Loki Sphere
	7	1500	Super Loki
	7	1505	M-100B
	8	2100	Super Loki
	8	2105	M-100B
	8	2110	Super Loki Sphere
Aug. 16	9	1400	Super Loki
	9	1405	M-100B
	9	1410	Super Loki Sphere
	10	1600	Super Loki
	10	1605	M-100B

Date	Group	Time (LST)	System
Aug. 17	11	1600	Super Loki
	11	1605	M-100B
	12	2100	Super Loki
	12	2105	M-100B
	13	2300	Super Loki
	13	2305	M-100B
	13	2310	Super Loki Sphere
Aug. 18	14	2100	Super Loki
	14	2105	M-100B
	14	2110	Super Loki Sphere
	15	2300	Super Loki
	15	2305	M-100B
Aug. 19	16	1600	Super Loki
	16	1605	M-100B
	17	1800	Super Loki
	17	1805	M-100B
Aug. 22	18	1900	Super Loki
	18	1905	M-100B
	19	2100	Super Loki
	19	2105	M-100B
	20	2300	Super Loki
	20	2305	M-100B
Aug. 23	21	2100	Super Loki
	21	2105	M-100B
	22	2300	Super Loki
	22	2305	M-100B

-more-

Since the Hydromet Service will launch from a ship at sea and NASA will launch from Wallops Island, it will not be necessary to have a detailed integrated countdown. Each side will prepare and conduct its own countdown in accordance with their respective requirements. In order to insure that each launch group is properly coordinated, it will be necessary for the participants to communicate launch status in a timely fashion. Following are the major countdown items for the various launch systems:

Super Loki Datasonde Countdown

Time	Event
"T" MINUS Hr.-Min.-Sec.	
01-30-00	Firing circuit check
01-00-00	Mate payload to booster and load into launcher
00-20-00	Launch test rocket
00-15-00	Begin final launcher settings
00-10-00	Verify M-100B ready for launch
00-05-00	Station check
00-03-00	Begin pre-launch payload checks
00-00-15	Fire datasonde tail fuse
00-00-00	Launch Super Loki booster
"T" PLUS Hr.-Min.-Sec.	
00-00-02	Super Loki burnout
00-00-38	Super Loki booster apogee
00-01-43	Super Loki booster impact
00-02-00	Payload ejection
00-02-09	Dart apogee
00-04-11	Dart impact
00-35-00	End of data period - Payload altitude approximately 20 km

M-100B Countdown

Time	Event
"T" MINUS Hr.-Min.-Sec.	
02-00-00	Begin countdown
01-30-00	Install M-100B into launcher
01-00-00	Radar and telemetry system preparations complete
00-50-00	Release wind balloon Mate payload to rocket
00-15-00	Payload on internal power Check and verify all ground systems
00-10-00	Verify Super Loki Datasonde ready for launch
00-05-00	Final launcher settings complete
00-00-00	Launch M-100B booster
"T" PLUS Hr.-Min.-Sec.	
00-00-05	M-100B booster burnout
00-00-08	Second stage ignition
00-00-13	Second stage burnout
00-01-00	Payload shroud ejection and sensor deployment
00-01-10	Payload second stage separation Parachute deployment
00-02-10	Booster impact
00-02-16	Payload apogee
00-07-00	Second stage impact
00-20-00	Payload at 20 km altitude

-more-

VEHICLE AND PAYLOAD DESCRIPTION

Super Loki Datasonde System Description (U.S.)

The Super Loki Datasonde System consists of the Super Loki rocket motor with a heavy interstage adapter and the nonpropulsive Datasonde/Walmet dart with a high ballistic coefficient. This system is launched from a 3.66-meter long helical rail launcher which provides support and imparts spin to the system during the launch phase. The rocket motor is the high thrust solid propellant unit with a short burning time of approximately 2 seconds. At rocket motor burnout, dart separation occurs. The dart consists of an ogive nose cone, body assembly (dart body) and tail assembly. The dart body contains the decelerator and instrument payload. The dart tail contains the delay and ejection system. After separation from the booster the dart coasts to apogee altitude where payload ejection from the dart body occurs at 120 seconds after liftoff. Upon ejection, the inflated decelerator controls the rate of payload descent. The Datasonde instrument transmits at a carrier frequency of 1690 MHz.

(The illustration on page 21 is a drawing of the Super Loki Datasonde System. Table 1 (pages 19-20) gives the design and performance summary of the system. The illustration on page 22 is a drawing of the payload expulsion.)

Wind Sensor

The Datasonde Wind Sensor is a ram-air inflated decelerator called a "Starute." (Characteristics of the Starute are contained in Table 1.) Portions of the Starute have been metalized to facilitate radar tracking. (An illustration of the Starute and instrument sections in descent appears on page 23.) Atmospheric wind data are obtained from the positional data taken by the tracking radar.

Temperature

The temperature sensor is a small spherical aluminized bead thermistor (about .25 millimeters in diameter) whose electrical resistance varies inversely with its temperature. The thermistor is attached to a metalized mylar loop mount by means of short lead wires. (The drawing on page 24 shows the details of the loop mount.) As the instrument descends, the thermistor resistance controls the modulation rate of the data circuit which is transmitted to the ground receiver. The temperature data are interrupted periodically through electronic switching to permit the transmission of a reference resistance.

Sphere System

The Super Loki Sphere vehicle (shown on page 27) consists of a 4.128-centimeter dart second stage with the Super Loki rocket motor. The dart body is coated with an ablative material to reduce the effect of rather severe aerodynamic heating upon the inflatable sphere payload. The inflator contains a percussion-initiated time delay charge to initiate sphere inflation through a two stage chamber after deployment from the dart body at an altitude of 115 km. (Characteristics of the Super Loki Sphere system are in Table 1.)

The falling sphere payload is a 1-m diameter inflatable spherical balloon. The balloon is made from .5 mil mylar which has been aluminized for radar tracking. After ejection from the dart at apogee, a capsule of cis-2-Butene is used to inflate the sphere to a superpressure equivalent to a 32 km altitude. The inflator has been designed to delay the initiation of inflation until 6 seconds after payload ejection. This has been done to protect the thin balloon skin from damage during the ejection process. The inflator also has a two stage inflation feature to achieve a relatively slow and controlled inflation rate.

Atmospheric density and wind data are derived from a precise radar track of the descending inflated sphere.

M-100B System Description (U.S.S.R.)

M-100B is a two-stage, solid-propellant, unguided fin stabilized rocket. The rocket consists of a radial burning 250-mm diameter, 4,100-mm long booster, which burns approximately 5 seconds and a radial burning 250-mm diameter, 1,600-mm long sustainer which burns for 4.5 seconds. First-stage separation is achieved by mechanically cutting a special pin by second-stage exhaust gases upon second-stage ignition. The vehicle will be launched from a spiral rail launcher which imparts 15 r.p.s. initial spin. The nose cone with payload is separated from second-stage at T+70 seconds by means of small separation motor system armed on the ground and actuated by a pre-set mechanical timer. (The M-100B launch vehicle is shown on page 28.)

Payload Description

The payload consists of four temperature sensors (40 micron tungsten rhenium wire), two Pirani heat manometers for measuring static pressure and membrane-type pressure transducers and supplementary resistance thermometers for monitoring payload housing temperature. The onboard telemetry package (22.15 MHz + 100 KHz, 1.8 watts) includes a mechanical commutator for 60 channels per cycle scanning at the rate of one cycle per 5 seconds. In addition, a special super regenerative radar transponder with a frequency of 1780 MHz and an output power of 0.4 watts is used for accurate trajectory data. Radar track data of the $50m^2$ semispherical surface area parachute is used for measurement of wind speed and direction. (The M-100B temperature sensor is shown on page 25 and the M-100B parachute is shown on page 26.)

TECHNICAL SUPPORT

Radar

Wallops Center high precision C-Band (FPS-16 or FPQ-6) radars will track all U.S. rockets and will track the U.S.S.R. rockets when U.S. Super Loki Spheres are not launched. These radars will record slant range, azimuth and elevation angles on digital magnetic tape at a 10 per second sample rate.

M-100B Radar Data

The standard U.S.S.R. meteorological radar, the Meteorit-R, will track all M-100B rockets. This radar operates on a frequency of 1780 MHz to transponder track the flights. The angular accuracy of this radar is 0.12 degrees in both elevation and azimuth and the range accuracy is 40 m. Data will be recorded on film and magnetic tape and sent directly into a Minsk 22 computer.

Telemetry

Super Loki Datasonde -- The primary telemetry receiving system for the Datasonde will be a GMD-1 located on Wallops Island. Telemetry data will be recorded on a pen and ink analog recording system and at a data rate of 10 samples per second on magnetic tape.

Super Loki Sphere -- The Super Loki Sphere contains no instrumentation.

M-100B -- The telemetry systems will record the M-100B data on film or magnetic tape. The 22 MHz system will record data on film. The second system will record the telemetry data, which is contained on the 1780 MHz signal, on magnetic tape and will input the telemetry data directly into the Minsk 22 computer for real time processing.

Data Processing

Super Loki Datasonde and Sphere -- Data will be processed using standard meteorological data reduction techniques. The output will be in the WDC-a format.

M-100B -- The data will be processed by standard Hydromet Service procedures and presented in the standard Hydromet Service format.

MISSION COORDINATION TEAMS

Dr. Morris Tepper of NASA and Dr. L. A. Aleksandrov of the Soviet Hydrometeorological Service are the co-chairmen of the Rocket Meteorology Working Group and are the principal points of contact for the intercomparison. Each side has designated a project manager to coordinate the intercomparison test and a project scientist to be responsible for the scientific conduct, data analysis and reporting of the tests. These personnel are:

NASA

Joseph R. Duke	Project Manager, Wallops Flight Center
Francis J. Schmidlin	Project Scientist, Wallops Flight Center

Hydromet Service

A. I. Ivanovsky	Project Manager/Scientist
Yuriy M. Chernyshenko	Deputy Project Manager/ Technical Director

MISSION EVALUATION

Quick Look Post Flight Reports

Both participants will keep a summary of launch activity as follows:

- Date
- Time
- Group
- Model Number
- System
- Maximum altitude
- Flight azimuth
- Horizontal Range at Ejection
- Results
- Comments

This summary will contain all scheduled and unscheduled launches and radio sounding balloon releases associated with the intercomparison.

Approximately 30 minutes after each rocket launch, the post-launch summary information will be exchanged via radio.

One day after the completion of all intercomparison launchings, the participants will exchange the complete post-launch summary.

Preliminary Data Report

Within approximately two weeks after the completion of the intercomparison launchings, a preliminary Data Evaluation Report will be jointly prepared. Following is a general outline for the report:

- Background and general information
- Objectives
- Systems description
- Post-launch summary of launch activity
- Preliminary evaluation of selected groups of launches

Final Data Report

The Final Data Evaluation Report will be completed approximately one year after the intercomparison. Following is a general outline for the final report:

- Background and general information
- Objectives
- Systems description
- Repeatability data
- Summary of launchings
- Analysis and evaluation of data
- Conclusions

Table 1

SUPER LOKI DATASONDE/WALMET AND SPHERE DESIGN AND PERFORMANCE SUMMARY

Rocket Motor Without Interstage Characteristics

Length (cm)	200.33
Diameter (cm)	10.16
Inert Weight (kg)	5.90
Propellant Weight (kg)	17.01

Rocket Motor Performance

Total Impulse (kg/sec.)	2860
Action Time (sec.)	2.11
Average Thrust (kg)	1824

Datasonde/Walmet Dart

Dart Hardware (kg)	4.04
Parachute (kg)	0.154
Instrument (kg)	0.040
Complete Dart (kg)	4.53
Booster Rocket Motor (kg)	22.68
Interstage (kg)	3.06
Complete Launch Weight (kg)	30.27

Datasonde/Walmet Descent System Characteristics

Parachute Type	Ram-air inflated
Canopy Material	1/4 mil mylar
Flying Width (m)	1.3
Flying Area (m^2)	4.55
Parachute Weight (grams)	155
Parachute-Sonde Ballistic Coefficient (kg/m^2)	.02

Datasonde/Walmet Payload Ejection Time (Sec.)   120

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Datasonde/Walmet Instrument Information	Datasonde	Walmet
Power Output (mw)	400	700
Modulation	PFM	PFM
Pulse Width (us)	65-115	65-115
Pulse Repetition Rate (PPS)	10-200	10-200
Polarity of Modulation	Negative	Negative
Time Reference is Transmitted (sec.)	6-10	4-6
Time Temperature is Transmitted (sec.)	30-60	25-40
Frequency (MHz)	1660-1700	400-407
Reference Switching	Relay	Relay
Batteries	Nickel Cadmium	Nickel Cadmium
Operating Time (min.)	40-50	200
Battery Voltage	6.25	6.25
Length (cm)	28.2	28.2
Diameter (cm)	2.8	2.8
Thermistor	10-mil Coated Bead	10-mil Coated Bead

Super Loki Sphere	Weights
Dart Hardware	5.954 kg
Sphere System	.168 kg
Complete Dart	6.122 kg

Super Loki Sphere	Characteristics
Diameter	1 meter
Balloon Material	Aluminized 1/2-mil mylar
Construction	20 gores
Sealing	1.27 cm heat pressure sensitive mylar type
Inflation Gas	Cis-2-Butene
Inflation Gas Weight	19.16 gm
Balloon Weight	66.50 gm
Inflation Weight	82.50 gm
Total Sphere System Weight	167.73 gm
Radar Cross-Section (C-Band)	0.785 m^2
Design Deflation Altitude	32 km

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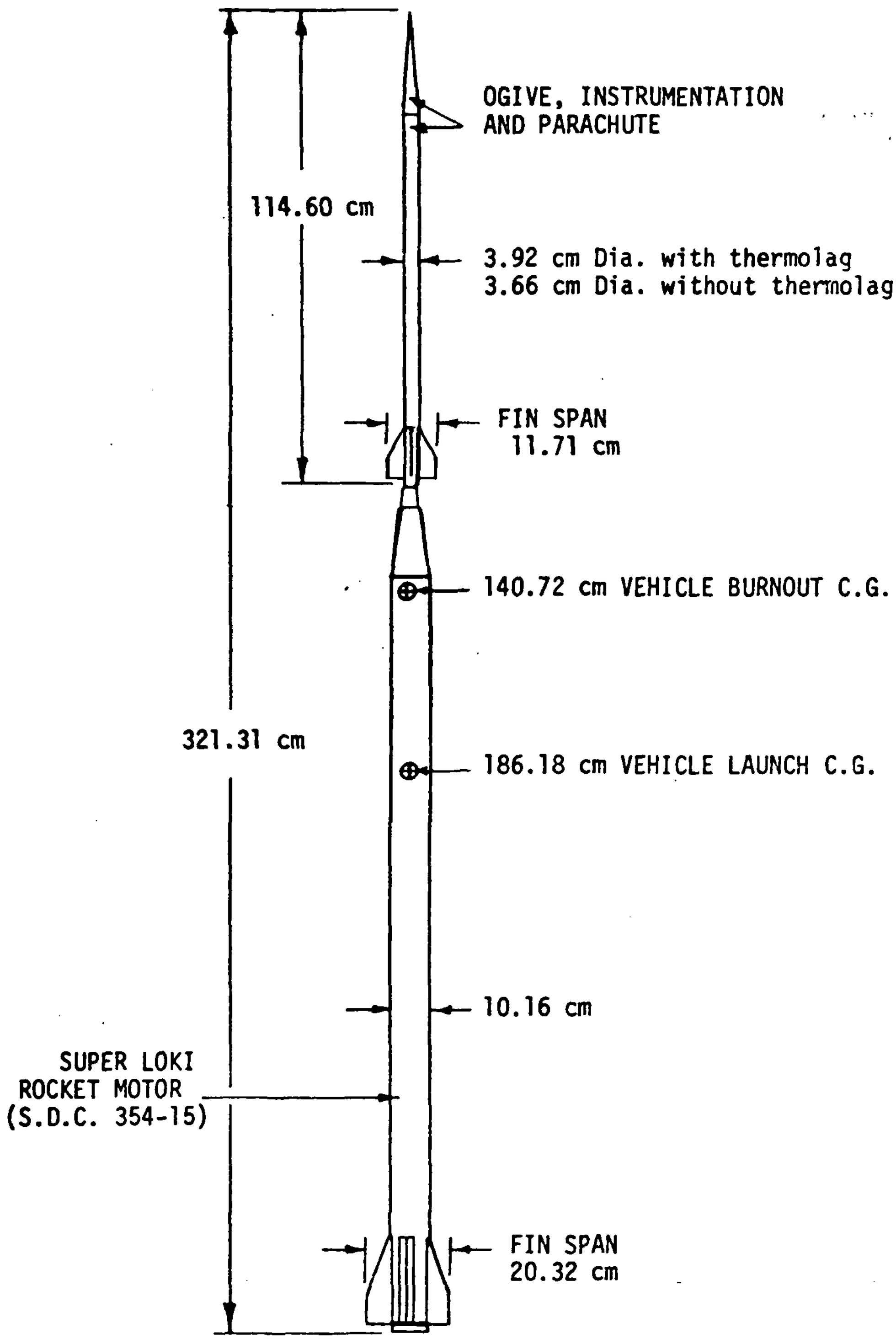

SUPER LOKI DATASONDE SYSTEM (U.S.)

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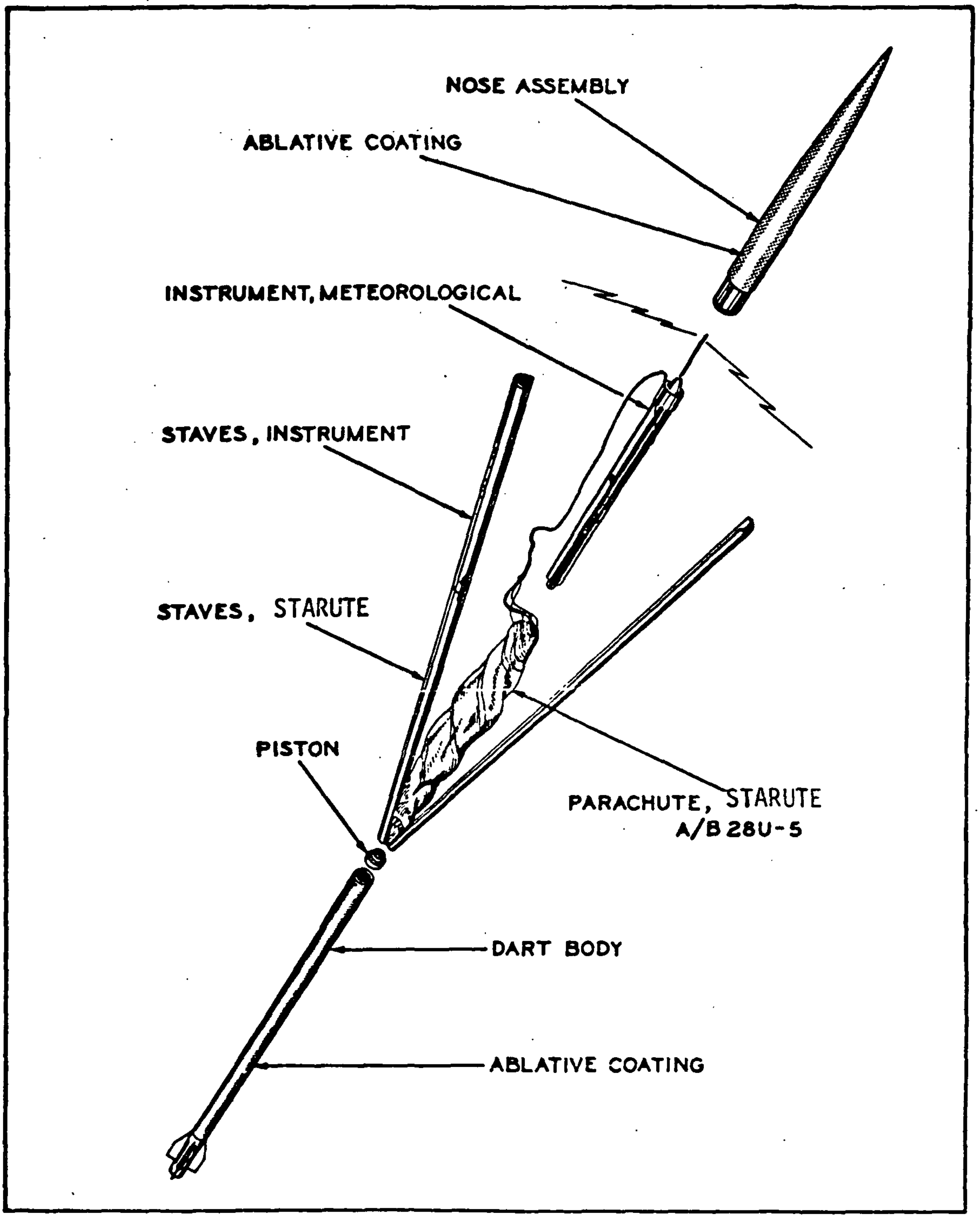

DATASONDE PAYLOAD EXPULSION SKETCH (U.S.)

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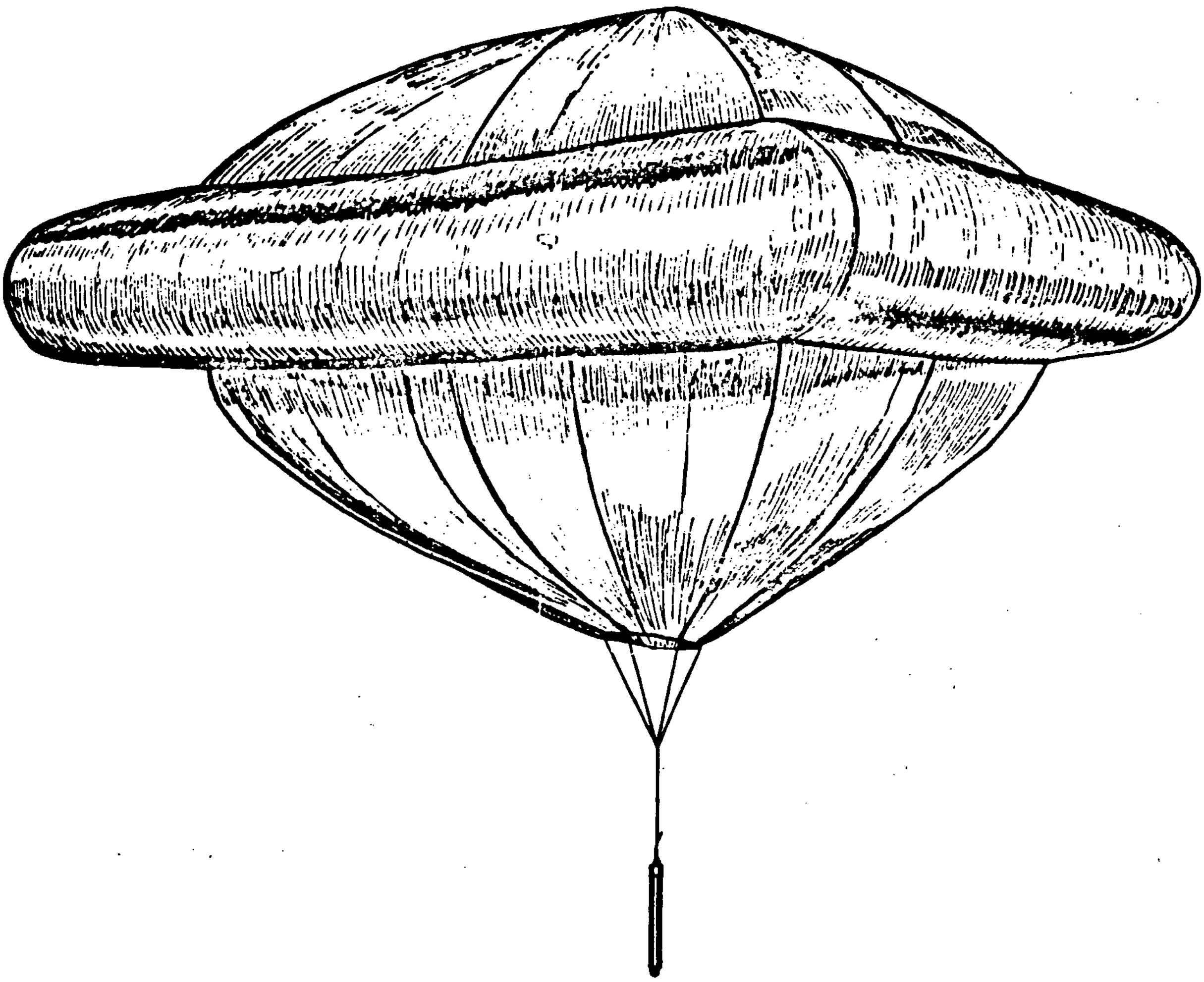
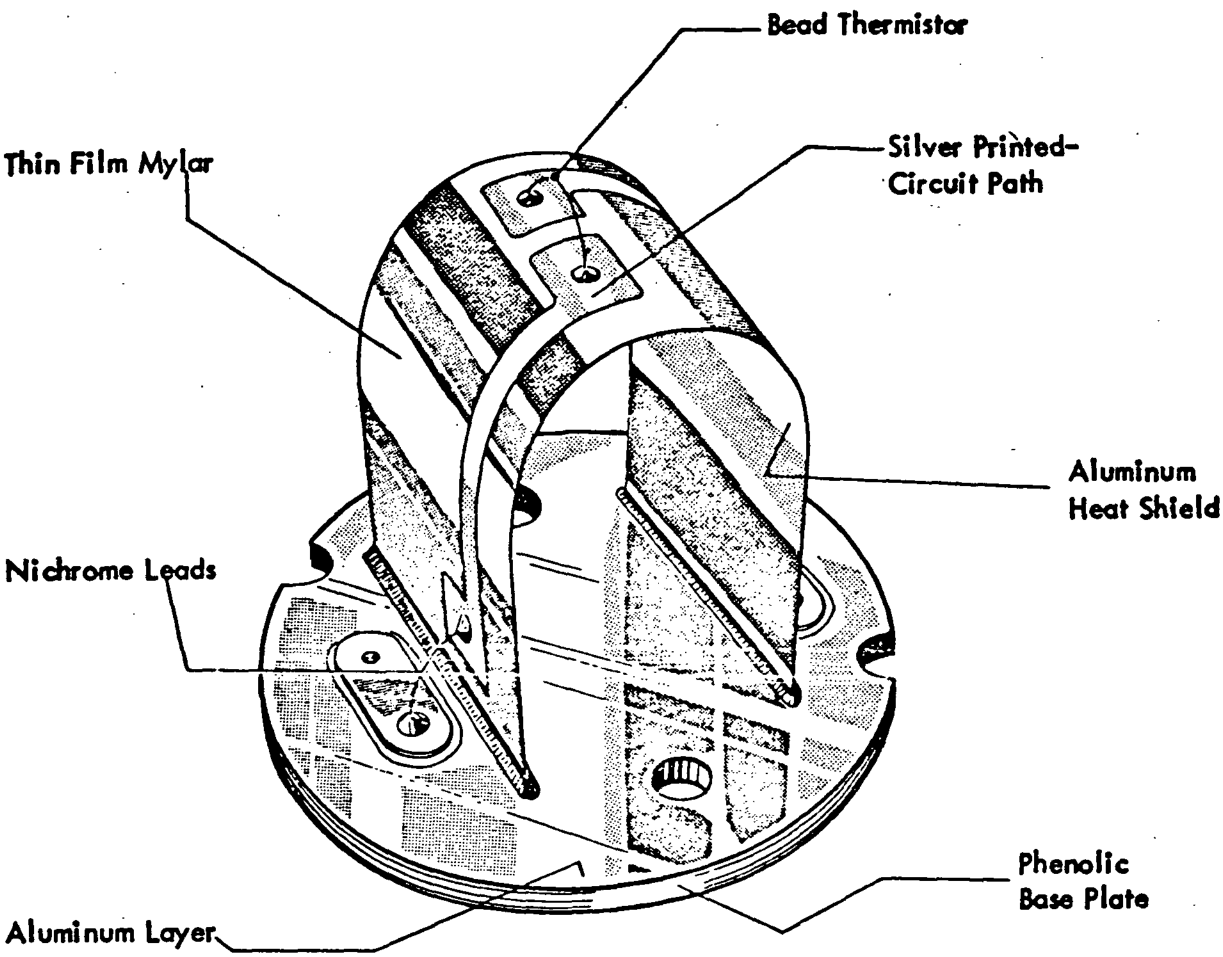
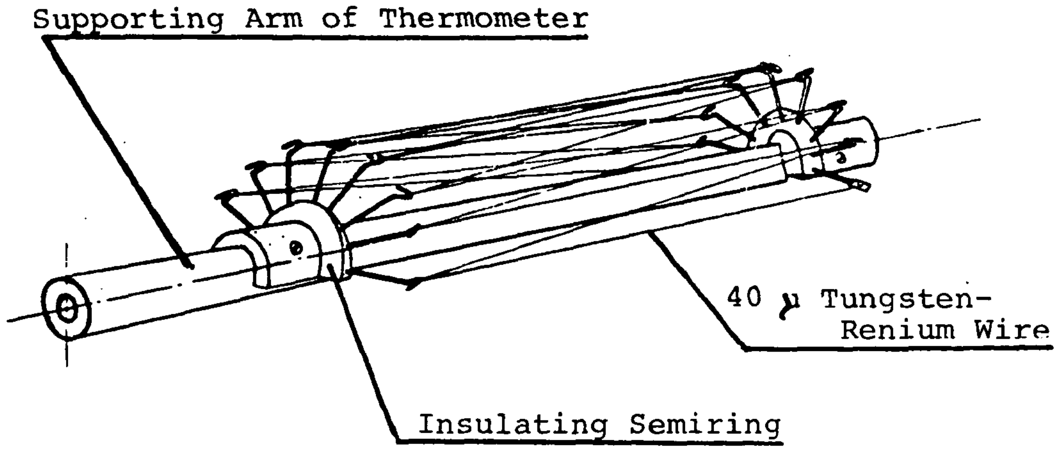


SUPER LOKI DATASONDE STARUTE CONFIGURATION SKETCH (U.S.)



DETAILS OF LOOP THERMISTOR MOUNT (U.S.)



M-100B TEMPERATURE SENSOR (U.S.S.R.)

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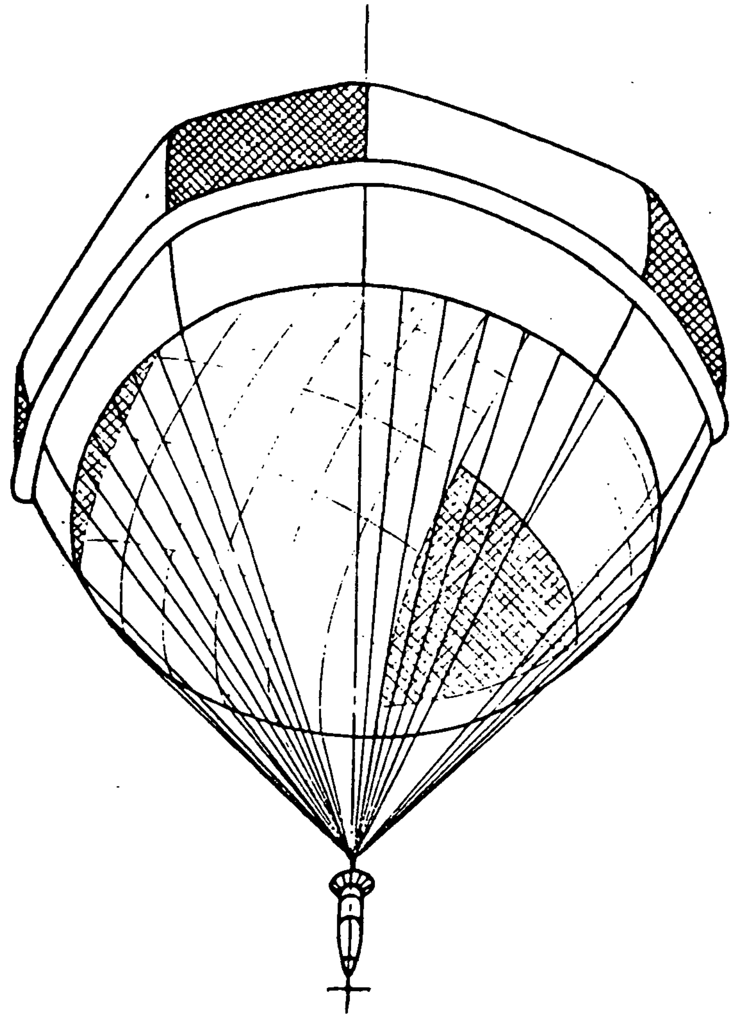
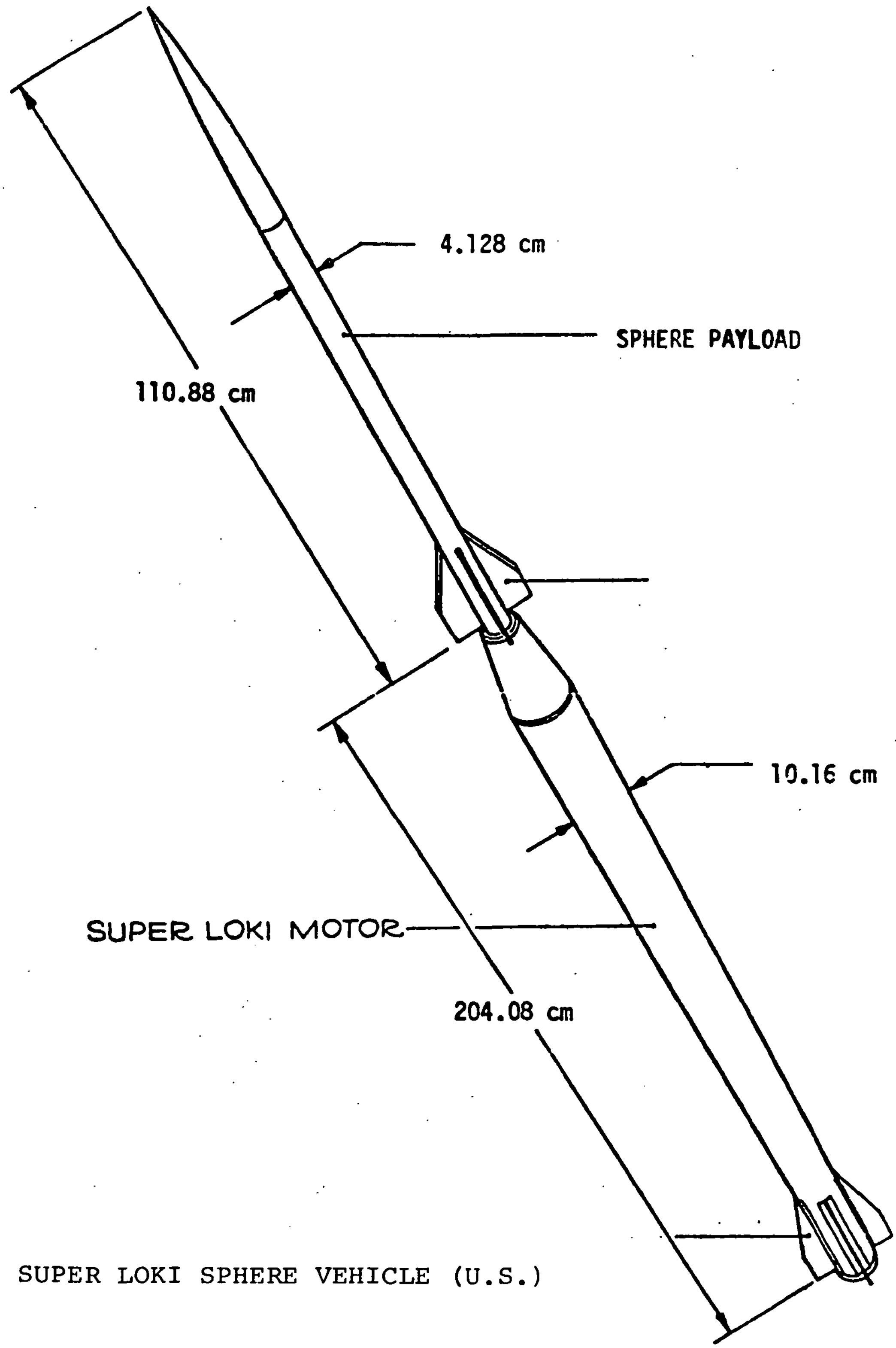


M-100B PARACHUTE SYSTEM (U.S.S.R.)



SUPER LOKI SPHERE VEHICLE (U.S.)

M-100B

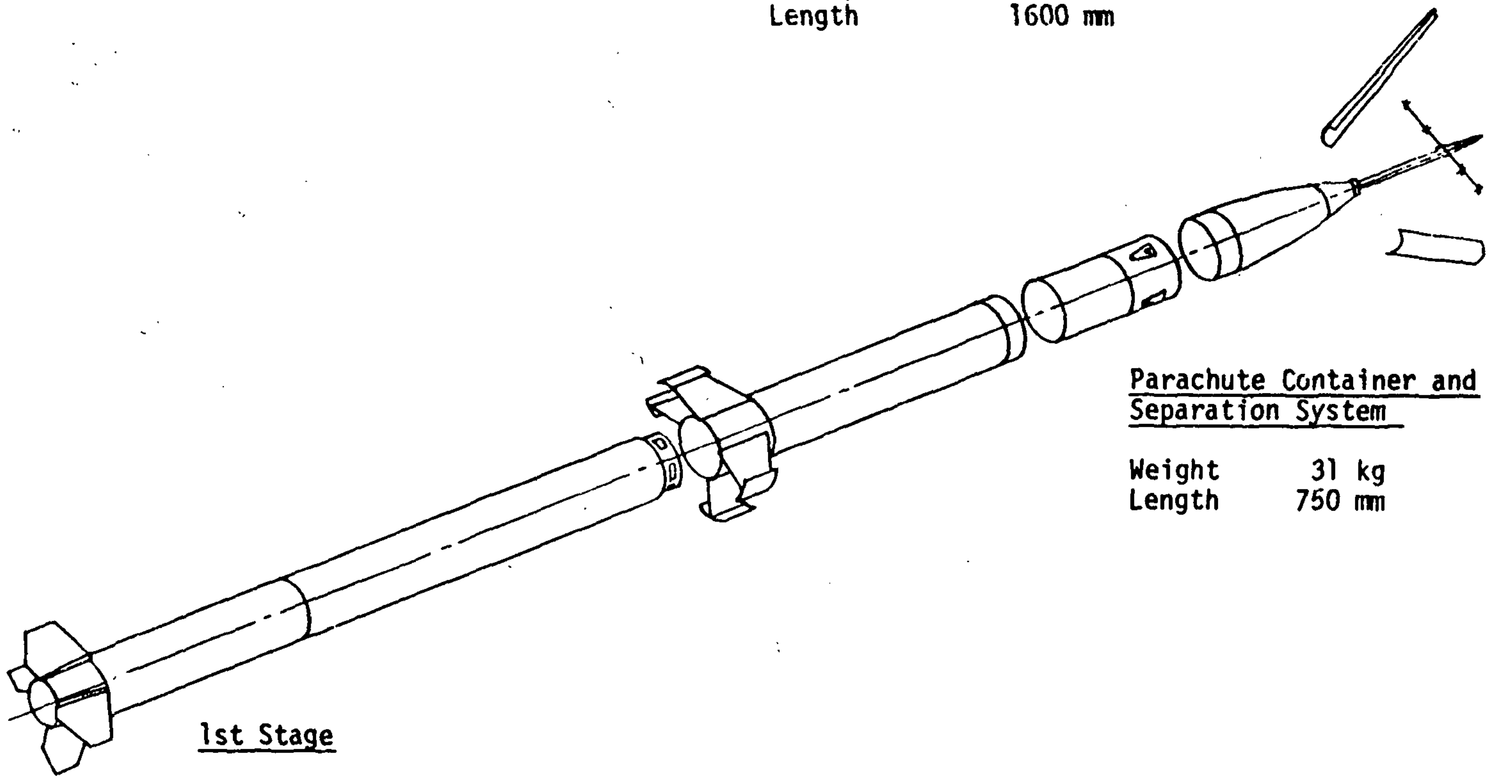
Total Weight	480 kg
Total Length	8.340 meters

2nd Stage

Loaded Weight	118 kg
Empty Weight	55 kg
Diameter	250 mm
Fin Span	680 mm
Length	1600 mm

Payload

Weight	41 kg
Length	1900 mm



Parachute Container and Separation System

Weight	31 kg
Length	750 mm

1st Stage

Loaded Weight	290 kg
Empty Weight	110 kg
Diameter	250 mm
Fin Span	680 mm
Length	4100 mm

M-100B (U.S.S.R.)

NOTE: Scientists and engineers from both nations will record all measurements and make their reports using the metric system. For the convenience of newsmen wishing to convert metric to English figures, the following table is supplied.

CONVERSION TABLE

Multiply	By	To Get
Inches	2.54	Centimeters
Centimeters	0.3937	Inches
Feet	30.48	Centimeters
Centimeters	4.7244	Feet
Feet	0.3048	Meters
Meters	3.2808	Feet
Yards	0.9144	Meters
Meters	1.0936	Yards
Statute Miles	1.6093	Kilometers
Kilometers	0.6214	Miles
Feet Per Second	0.3048	Meters Per Second
Meters/Second	3.281	Feet/Second
Meters/Second	2.237	Statute Miles/Hour
Feet/Second	0.6818	Miles/Hour
Miles/Hour	1.6093	Kilometers/Hour
Kilometers/Hour	0.6214	Miles/Hour
Pounds	0.4563	Kilograms
Kilograms	2.2046	Pounds

To convert Fahrenheit to Celsius(Centigrade), subtract 32 and multiply by 5/9.
To convert Celsius to Fahrenheit, multiply by 9/5 and add 32.
To convert Celsius to Kelvin, add 273.
To convert Kelvin to Celsius, subtract 273.

-end-