HISTORY OF ON-ORBIT SATELLITE FRAGMENTATIONS

Sixth Edition
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Preface to the Sixth Edition

The first edition of the History of On-Orbit Satellite Fragmentations was published by Teledyne Brown Engineering (TBE) in August, 1984, under the sponsorship of the NASA Johnson Space Center and with the cooperation of USAF Space Command and the U.S. Army Ballistic Missile Command. The objective was to bring together for the first time all known information about the 75 satellites which had at that time experienced noticeable breakups. Revised and up-dated editions were released in February, 1986, and October, 1987.

A major upgrade resulting in the present format was published in January, 1990, covering the period through 4 October 1989. For the next twelve months no satellite fragmentations were observed. With the onset of solar maximum and its primary peak in the summer of 1989 and a secondary rise during the winter of 1990-1991, the total Earth satellite population steadily declined with the preferential decay of satellite fragmentation debris due to the characteristicly higher area-to-mass ratios. By 4 October 1990 more than 250 additional cataloged fragmentation debris had reentered the Earth's atmosphere, reducing the overall proportion of fragmentation debris in the total satellite population from 45% to 42%.

Unfortunately, during the next year and a half twelve satellites were involved in detected fragmentations, including major breakups of two discarded rocket bodies. Without these new events the fragmentation debris portion of the Earth satellite population would have continued to fall. Presently, satellite fragmentation debris account for 41.5% of the on-orbit population.

The fifth edition of this report continued the new format created in the fourth edition, documenting the status of the fragmentation population through April, 1991. The sixth edition updates information presented in the fifth.

New information on fragmentation events is now coming to light since the disassociation of the Soviet Union. At least one previously undetected breakup in geostationary orbit has been identified and several unknown event causes have been clarified from the new information which has been released. Failure mechanisms have been identified or confirmed by Russian scientists, and additional information on the Cosmos 1275 event further supports the supposition that an on-orbit collision with an unknown object was the likely failure mechanism. This volume will continue to reference satellites belonging to the old Soviet empire as "USSR" to remain compatible with the present nomenclature utilized in the USSPACECOM Satellite Catalog.

TBE wishes to acknowledge the long-term and vital contributions of the Naval Space Surveillance System (NAVSPASUR) and its dedicated personnel in Dahlgren, Virginia, not only to the U.S. Space Surveillance Network (SSN) where it is recognized as the pre-eminent authority on satellite fragmentations but also to TBE directly during the past thirteen years. This volume is also indebted to the personnel and activities of the North American Aerospace Defense Command (NORAD), the former USAF Aerospace Defense Command (ADCOM), the USAF Space Command, and the United States Space Command. The Royal Aerospace Establishment in the United Kingdom has also been quite helpful over the years by providing data on specific events as well as via the internationally respected RAE Table of Earth Satellites. Special recognition is due to Mr. John Gabbard, formerly with NORAD/ADCOM and TBE, without whose pioneering work in the field of satellite fragmentations this volume would not be possible.

This is the sixth edition of this compilation. Over the years seven authors have contributed significantly to the data and analysis presented herein. The dates and authors of the previous editions are listed below. The fourth edition represents a
complete rewrite of the entire document and where the present format was first used. TBE acknowledges the considerable contributions of Nicholas Johnson to each of the previous editions of this document and in particular to the entire field of study of orbital man-made debris.

First Edition, August 1984
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Third Edition, October 1987
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Sixth Edition, July 1992
D. J. Nauer
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1.0 INTRODUCTION

Since the first serious satellite fragmentation occurred in June, 1961, and instantaneously increased the total Earth satellite population by more than 400%, the issue of space operations within the finite region of space around the Earth has been the subject of increasing interest and concern. The prolific satellite fragmentations of the 1970's and the marked increase in the number of fragmentations in the 1980's served to widen international research into the characteristics and consequences of such events. Plans for large, manned space stations in the next decade and beyond demand a better understanding of the hazards of the dynamic Earth satellite population.

The contribution of satellite fragmentations to the growth of the Earth satellite population is complex and varied. The majority of detectable fragmentation debris have already fallen out of orbit, and the effects of 40% of all fragmentations have completely disappeared. On the other hand, just 10 of more than 3300 space missions flown since 1957 are responsible for 26% of all cataloged artificial Earth satellites presently in orbit (Figure 1.1). Moreover, the sources of 9 of these 10 fragmentations were discarded rocket bodies which had operated as designed but later broke-up. The primary factors affecting the growth of the true Earth satellite population are the international space launch rate, satellite fragmentations, and solar activity. As of 1 April 1992, the largest element of the cataloged Earth satellite population continued to be fragmentation debris (Figure 1.2).
In this volume, satellite fragmentations are categorized by their assessed nature and to a lesser degree by their effect on the near-Earth space environment. A satellite breakup is the usually destructive disassociation of an orbital payload, rocket body, or structure, often with a wide range of ejecta velocities. A satellite breakup may be accidental or the result of intentional actions, e.g., due to a propulsion system malfunction or a space weapons test, respectively. An anomalous event is the unplanned separation, usually at low velocity, of one or more detectable objects from a satellite which remains essentially intact. Anomalous events can be caused by material deterioration of items such as thermal blankets, protective shields, or solar panels. As a general rule, a satellite breakup will produce considerably more debris, both trackable and non-trackable, than an anomalous event. From one perspective, satellite breakups may be viewed as a measure of the effects of man's activity on the environment, while anomalous events may be a measure of the effects of the environment on man-made objects.

Operational debris results from the release of objects, usually in small numbers, during normal on-orbit operations. Objects ejected during the deployment, activation, and de-orbit of payloads and during manned operations are examples of operational debris. Usually operational debris from a single launch are few in number, but extreme examples occasionally arise, such as the 200 objects from the Salyut 7 space station or the more than 130 objects from the Westford Needles experiment. Although operational debris represent a significant portion (over 12%) of all satellites today and therefore are a legitimate subject in the study of methods to retard the growth of the Earth satellite population, identification of the thousands of operational debris events is beyond the scope of this report.

Figure 1.2 Relative segments of the cataloged in-orbit Earth satellite population.
Although all fragmentations are described by the number of debris cataloged and the number of cataloged debris remaining in orbit, these parameters are poor measures of merit and should be used with extreme caution when undertaking comparative analyses. The sensitivity of the SSN, and hence the degree to which debris will be detected and cataloged, is highly dependent upon satellite altitude and to a lesser degree on satellite inclination. As a rule of thumb, low altitude cataloged debris are assessed to be larger than 10 cm in diameter. At higher altitudes objects less than 1 m in diameter may be undetectable. Individual object sensitivities may vary dramatically from this simple generalization. Debris counts for fragmentations occurring in highly elliptical orbits near 63 degrees inclination (Molniya-type) are traditionally low, in part due to stable perigees situated deep in the Southern Hemisphere beyond SSN coverages. During a special surveillance session in 1987, as many as 250 uncataloged objects were observed in low inclination, highly elliptical orbits, but reliable tracking and parent identification were not achieved. The recent disclosure by the Russian Government of the Ekran 2 battery explosion on 25 June 1978 is the first known fragmentation in geostationary orbit. This event was not detected by the SSN and no associated debris objects have since been cataloged with this event. The explosion was recorded optically by the Soviets and released by the Russians. Cataloging errors, e.g. identification of an object with the wrong parent satellite, are normally not explicitly noted in this volume since many errors have been or may be corrected.

For fragmentations at very low altitudes, i.e. below 400 km, much of the debris may reenter before detection, identification, and cataloging can be completed. For example, when the debris cloud from Cosmos 1813 passed over a single SSN radar, a total of 846 individual fragments could be discerned. However, the total number of debris officially cataloged only reached 194. Likewise, more than 380 fragments are known to have been injected into Earth orbits (an equal number probably were sent on reentry trajectories) following the USA 19 test, but only 18 debris were entered into the official satellite catalog. Where appropriate, these differences are noted in the two-page modules of Section 2.

A number of data sources were employed in the compilation of this volume. However, nearly all are derived from observations collected by the U.S. SSN. The most frequently used sources were the official U.S. Satellite Catalog (issues for 1964 to present), full satellite catalog element set databases taken directly from Cheyenne Mountain computer systems, specific element set retrievals from the Historical Data System (HDS), element sets of specific debris clouds as maintained by NAVSPASUR, and raw radar observations from the PARCS and FPS-85 (Eglin) sites. Some of these databases include element set data on debris prior to official cataloging actions, i.e. from the analyst satellite catalog or 8X,XXX series. In addition, throughout this volume the Cheyenne Mountain organization responsible for managing satellite orbital data is referred to only as the U.S. Space Surveillance Center (SSC), but has been designated during different periods as the NORAD Space Surveillance Center (NSSC), the Space Computational Center (SCC), and the Space Defense Center (SDC).

Due to the variety of sources and geodetic models used to create satellite orbital element sets, all altitudes cited within this volume are presented to the nearest 5 km, referenced to a mean Earth of radius 6378.145 km. Higher precision values are not warranted for the scope of analyses suitable from other data in this volume. Complete base element sets are provided, but manipulations of these data, in particular satellite propagations, should be performed only with validated, SCC-derived software, such as the IBM-compatible SATRAK astrodynamics toolkit. Long term propagations of these elements are not appropriate regardless of the propagation technique applied and are discouraged.
2.0 SATELLITE BREAKUPS

This section summarizes the present fragmentation environment and describes each individual breakup in the standard fourth edition format. The number of breakups continue to grow, although the breakup rate has slackened during the late 80s and early 90s. Although some recent breakups are a legacy to older on-orbit practices (e.g. Nimbus 6 R/B), it is expected that fragmentations will continue, albeit at a reduced rate, into the foreseeable future.

2.1 Background and Status

By far the most important category of satellite fragmentations is satellite breakups, which now account for 42% of the total cataloged Earth satellite population of 6820 objects. Since 1961 a total of 108 satellites are believed to have broken up (Tables 2.1 and 2.2).

The primary causes of satellite breakups (Figure 2.1) are deliberate actions and propulsion-related events, although the cause for about one in four breakups remains uncertain. Recent disclosures by the Russian Government reinforced suspicions that Cosmos 1275 was an accidental collision, the first assessment of its type. Alternately, the fragmentation of Cosmos 1823, another candidate accidental on-orbit collision, has been categorized in prior editions of this document under the "Unknown" cause classification. Recent data from the Russian Government has now identified the failure mechanism of this satellite to be a battery failure under the "Electrical" cause classification. This document will continue to carry fragmentations causes as unknown until a strong case can be made for one of the other cause classifications. Deliberate actions are the most frequent cause, often associated with weapons testing or other activities related to national security; but on the average, the resulting debris from deliberate actions is short-lived (Figures 2.2 and 2.3). Propulsion-related breakups include catastrophic malfunctions during orbital injection or maneuvers, subsequent explosions based on residual propellants, and failures of active attitude control systems. Breakups of rocket bodies due to propulsion failures are usually more prolific and produce longer-lived debris than the intentional destructions of payloads, often due to the higher altitudes of the malfunctioning rocket bodies rather than the mechanics of the explosive event. Although it may appear obvious that a rocket body fragmentation should be classified under the "Propulsion-related" cause category, rocket body events are carried as "Unknown" until a failure mechanism is identified for that rocket body design and is associated with a given rocket body event.

The rate of satellite breakups increased noticeably in the 1970's and again in the 1980's (Figure 2.4). However, the long-term effects of these 1980's events were mitigated by the reduced average number of debris generated per event and the relatively short debris lifetimes. More importantly, increased awareness of the potential hazards of orbital debris may be responsible for the elimination or marked curtailment of many breakup causes by the end of the 1980's, e.g. Delta second stages, weapons testing, and Cosmos 699- and 862-type events. Together, these four programs were responsible for one-half of all satellite breakups in the decade of the 1980's. The quick response of Arianespace and the European Space Agency to the breakup of an Ariane third stage in 1986 is indicative of a desire by most space-faring organizations to operate in near-Earth space responsibly. The number of satellite breakups and the remaining debris by country or organization are indicated in Figures 2.5 and 2.6. Finally, Figure 2.7 vividly illustrates that satellite breakup debris remaining in orbit today have primarily originated from rocket bodies.
Figure 2.1 Causes of known satellite breakups.

Figure 2.2 Proportion of all cataloged satellite breakup debris.
Figure 2.3 Proportion of cataloged satellite breakup debris remaining in orbit.

Figure 2.4 Chronological history of satellite breakups.
The remainder of this section devotes two pages to each identified satellite breakup. Each satellite is listed by common name, international designator, and satellite number. The satellite is then described in terms of type, ownership, launch date, and physical characteristics. The third grouping defines the breakup event by time, location, altitude, and assessed cause. In almost all cases, the calculated time of the event has been determined by NAVSPASUR. The last available element set for the satellite prior to the breakup is provided next. If the breakup occurred soon after launch or after a maneuver and before an element set could be generated, the most appropriate post-event element set is given. Basic characteristics of the cataloged debris cloud, including total number of fragments cataloged by 1 April 1992, the number of debris remaining in orbit on that date, and the maximum observed changes in the orbital period (ΔP) and inclination (ΔI), referenced to the parent’s pre-event element set, are summarized. The reader is reminded that for a given event, the magnitudes of the resultant ΔP and ΔI are a function of the satellite’s latitude and altitude. Comparisons of these values from one event to another cannot be made directly. Additionally, inclination changes measure only one portion of the fragmentation orbital plane change. Changes in Right Ascension also occur in most events and can account for some plane change fragmentation energy. Objects from the launch not associated with the breakup are not included in these counts (see Section 5.0). As previously noted, the number of cataloged debris is often an unreliable description of the breakup. Whenever uncataloged data provide a better assessment of ΔP and ΔI, these values are listed with a footnote.

A general summary of the event, actions leading to the event, debris cataloging progress, and evaluations of the event are collected under the Comments heading. Documents which relate directly to the subject breakup or to breakups of satellites of this type are then listed. All references in this volume are archived at the TBE Colorado Springs Office. Finally, a Gabbard diagram of the early debris cloud prior to perturbative effects, if the data were available, is reconstructed. These diagrams often include uncataloged as well as cataloged debris data. When used correctly, Gabbard diagrams can provide important insights into the features of the fragmentation.

![Figure 2.5 Sources of satellite breakups by owner.](image-url)
Figure 2.6 Proportion of satellite breakup debris remaining in orbit.

Figure 2.7 Sources of satellite breakup debris by satellite type.
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# TABLE 2.1 HISTORY OF SATELLITE BREAKUPS BY LAUNCH DATE (continued)

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2.2 IDENTIFIED SATELLITE BREAKUPS
SATellite DATA

TYPE: Ablestar Stage
OWNER: US
LAUNCH DATE: 29.18 Jun 1961
DRY MASS (KG): 625
MAIN BODY: Flaired Cylinder; 1.6 m by 4.8 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: On-board propellants, range safety device

EVENT DATA

DATE: 29 Jun 1961
TIME: 0608 GMT
ALTITUDE: 990 km
LOCATION: 28N, 254E (dsc)
ASSESSED CAUSE: Propulsion-related

POST-EVENT ELEMENTS

EPOCH: 61187.36647288
RIGHT ASCENSION: 79.1120
INCLINATION: 66.8199
ECCENTRICITY: .0078181
ARG. OF PERIGEE: 288.2398
MEAN ANOMALY: 72.1786
MEAN MOTION: 13.86864257
MEAN MOTION DOT/2: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 296
DEBRIS IN ORBIT: 198
MAXIMUM ΔP: 15.5 min
MAXIMUM ΔI: 1.3 deg

COMMENTS

This is the first known satellite fragmentation. The Ablestar stage performed two main burns and a small payload separation retro burn to successfully deploy three payloads (Transit 4A, Injun, and Solrad 3), although the Injun and Solrad 3 satellites did not separate from one another as planned. The event occurred approximately 77 minutes after orbital insertion and was photographically imaged by the Organ Pass, NM, Baker-Nunn camera system. Fragmentation coincided with cessation of the 378 MHz beacon on the Ablestar stage at 0608:10 GMT. At the time of the event, 100 kg of hypergolic propellants remained on board. This was the first time an Ablestar stage did not vent the fuel tank during payload separation. After a thorough investigation, fuel venting was recommended for future missions. No reliable elements are available prior to the event. Elements above are for one of the payloads with parameters believed to be very similar to those for the Ablestar at the time of the event.
REFERENCE DOCUMENTS


Transit 4A R/B debris cloud of 201 cataloged fragments in May 1964 as reconstructed from U.S. Space Surveillance Center database.
SPUTNIK 29

SATellite DATA

TYPE: Payload and R/B(s) (?)
OWNER: USSR
LAUNCH DATE: 24.75 Oct 1962
DRY MASS (KG): 3900-6200
MAIN BODY: Cylinder; 2.7 m by 7-16 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Unknown at time of event
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 29 Oct 1962
TIME: Unknown
ALTITUDE: ~200 km
LOCATION: Unknown
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 62297.80327270
RIGHT ASCENSION: 336.4972
INCLINATION: 65.1128
ECCENTRICITY: .0044520
ARG. OF PERIGEE: 92.2650
MEAN ANOMALY: 229.0409
MEAN MOTION: 16.15589719
MEAN MOTION DOT/2: .01124103
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 24
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: Unknown
MAXIMUM ΔI: 0.6 deg

COMMENTS

Sputnik 29 (also known as Sputnik 22) was not acknowledged at launch by the USSR and was probably a Mars probe which failed to leave Earth orbit. This was apparently the fourth orbital failure of the SL-6 since 25 August 1962. No SL-6 orbital (3rd) stage nor final (4th) stage was cataloged after launch. Possible that orbital and final stages never separated. Sputnik 29 was officially decayed 29 October 1962 but no debris were cataloged before 11 November. Consequently, ΔP cannot be calculated. Source of the fragmentation was probably the fully-fueled SL-6 final stage.
Sputnik 29 debris cloud of 23 fragments cataloged by mid-December 1962 as reconstructed from U.S. Space Surveillance Center database.
### SATELLITE DATA

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### EVENT DATA

| DATE          | 27 Nov 1963                      |
| TIME          | Unknown                         |
| ALTITUDE      | Unknown                         |
| LOCATION      | Unknown                         |
| ASSESSED CAUSE| Propulsion-related              |

### POST-EVENT ELEMENTS

| EPOCH                  | 63336.85832214                  |
| Right Ascension       | 135.1828                        |
| Inclination           | 30.3440                         |
| Eccentricity          | .98609282                      |
| Arg. of Perigee        | 151.8246                        |
| Mean Anomaly          | 213.1623                        |
| Mean Motion           | 13.34437775                     |
| Mean Motion DOT/2     | .00003262                       |
| Mean Motion DOT DOT/6 | .0                            |
| BSTAR                 | .0                              |

### CATALOGED DEBRIS CLOUD DATA

| Debris Cataloged | 19                          |
| Debris in Orbit  | 10                          |
| Maximum ΔP       | 0.9 min                     |
| Maximum ΔI       | 0.4 deg                     |

### COMMENTS

First Centaur stage to reach Earth orbit. No payload was carried. After orbital insertion, residual liquid hydrogen vaporized, resulting in an increase in tank pressurization. Venting via an aft tube then induced a pin-wheel tumble which reached 48 rpm a little more than one hour after launch. At the beginning of the third orbit insulation blankets around the Centaur stage were thrown off. Subsequent Centaur missions were not subject to this phenomenon which was caused by the unique configuration of Atlas Centaur 2. First six fragments were cataloged within one week of launch. Centaur stage retains large radar cross-section, while all debris are substantially smaller.

### REFERENCE DOCUMENTS

*Supplementary Information on AC-2 Post-Injection Flight Events*, W.S. Hicks, Memorandum BXN63-521, 27 December 1963.
Atlas Centaur 2 debris cloud of 8 fragments five months after the event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 50

SATELLITE DATA

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EVENT DATA

| DATE       | 5 Nov 1964 |
| TIME       | Unknown    |
| ALTITUDE   | ~200 km    |
| LOCATION   | Unknown    |
| ASSESSED CAUSE | Deliberate Detonation |

PRE-EVENT ELEMENTS

| EPOCH             | 64303.72916435 |
| RIGHT ASCENSION   | 198.5952       |
| INCLINATION       | 51.2318        |
| ECCENTRICITY      | 0.0034483      |
| ARG. OF PERIGEE   | 312.9624       |
| MEAN ANOMALY      | 46.7488        |
| MEAN MOTION       | 16.23335350    |
| MEAN MOTION DOT2  | 0.00269057     |
| MEAN MOTION DOT DOT6 | .0          |
| BSTAR             | .0             |

CATALOGED DEBRIS CLOUD DATA

| DEBRIS CATALOGED | 96 |
| DEBRIS IN ORBIT  | 0  |

SUMMARY

Spacecraft was apparently destroyed after a malfunction prevented reentry and landing in the Soviet Union. First of 11 incidents of this type. Event occurred on the anticipated day of recovery. All debris were cataloged without elements. A probable fragment from this event reentered on 12 November 1964, landing in Malawi. See cited reference below.

REFERENCE DOCUMENTS

Insufficient data to construct a Gabbard diagram.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 22.32 Feb 1965
DRY MASS (KG): 5500 (approx.)
MAIN BODY: Cone-Sphere-Cone; 2.4 m by 6 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, 10 kg TNT explosive charge

EVENT DATA

DATE: 22 Feb 1965
TIME: 0957 GMT
ALTITUDE: 380 km
LOCATION: 64S, 284E (asc)
ASSESSED CAUSE: Command

POST-EVENT ELEMENTS

EPOCH: 65056.64509999
RIGHT ASCENSION: 288.1532
INCLINATION: 64.7411
ECCENTRICITY: .0182240
ARG. OF PERIGEE: 68.7266
MEAN ANOMALY: 293.2095
MEAN MOTION: 15.92461677
MEAN MOTION DOT/2: .01501524
MEAN MOTION DOT DOT/6: .0048063
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 167
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 4.4 min
MAXIMUM ΔI: 0.9 deg

COMMENTS

Cosmos 57 was an unmanned precursor for the manned Voskhod 2 mission which took place in March 1965. Spacecraft fragmented a little more than two hours after launch when operational ground instructions were misinterpreted by the on-board command system and the self-destruct system was activated. No elements available for Cosmos 57, but the rocket body elements are provided above. The Royal Aircraft Establishment published the following parameters for Cosmos 57 for 22.4 February: 165 km by 427 km, 64.74 deg inclination, 64 deg argument of perigee. A total of 35 debris were cataloged without elements. Event may have occurred a little later than the time calculated above.
REFERENCE DOCUMENTS


Cosmos 57 debris cloud of 132 fragments cataloged within one month of the event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 61-63 R/B 1965-20D 1270

SATELLITE DATA

TYPE: SL-8 Final Stage
OWNER: USSR
LAUNCH DATE: 15.46 Mar 1965
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 2.4 m by 5 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None at time of event
ENERGY SOURCES: Unknown

EVENT DATA

DATE: 15 Mar 1965
TIME: 1714 GMT
ALTITUDE: 1640 km
LOCATION: 51S, 162E (dsc)
ASSESSED CAUSE: Unknown

POST-EVENT ELEMENTS

EPOCH: 65074.89183830
RIGHT ASCENSION: 357.3218
INCLINATION: 56.0538
ECCENTRICITY: .1056119
ARG. OF PERIGEE: 106.1560
MEAN ANOMALY: 265.7165
MEAN MOTION: 13.57884745
MEAN MOTION DOT: .00231832
MEAN MOTION DOT DOT: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 147
DEBRIS IN ORBIT: 22
MAXIMUM ΔP: 10.3 min
MAXIMUM ΔI: 0.4 deg

COMMENTS

This is the only confirmed case of the fragmentation of the SL-8 final stage. This was the third mission to deploy three payloads and was a repeat of the Cosmos 54-56 mission three weeks earlier. The event occurred a little more than 6 hours after the successful deployment of the three payloads. Elements above are the first developed for the rocket body and are about 4 hours after the event. Official debris cataloging did not begin for six weeks.

REFERENCE DOCUMENTS

Cosmos 61-63 R/B debris cloud of 113 fragments eight months after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

<table>
<thead>
<tr>
<th>TYPE</th>
<th>Titan 3C-4 Transtage</th>
</tr>
</thead>
<tbody>
<tr>
<td>OWNER</td>
<td>US</td>
</tr>
<tr>
<td>LAUNCH DATE</td>
<td>15.72 Oct 1965</td>
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<tr>
<td>DRY MASS (KG)</td>
<td>1500 (?)</td>
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<tr>
<td>MAIN BODY</td>
<td>Cylinder; 3 m by 6 m</td>
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<tr>
<td>MAJOR APPENDAGES</td>
<td>None</td>
</tr>
<tr>
<td>ATTITUDE CONTROL</td>
<td>Active, 3-axis</td>
</tr>
<tr>
<td>ENERGY SOURCES</td>
<td>On-board propellants</td>
</tr>
</tbody>
</table>

EVENT DATA

| DATE            | 15 Oct 1965 |
| TIME            | 1820 GMT    |
| ALTITUDE        | 740 km      |
| LOCATION        | 22S, 108E (asc) |
| ASSESSED CAUSE  | Propulsion-related |

POST-EVENT ELEMENTS

| EPOCH           | 65361.23126396 |
| RIGHT ASCENSION | 21.5316       |
| INCLINATION     | 32.1697       |
| ECCENTRICITY    | .0072678      |
| ARG. OF PERIGEE | 123.6068      |
| MEAN ANOMALY    | 237.1066      |
| MEAN MOTION     | 14.54928550   |
| MEAN MOTION DOT2| .00000268     |
| MEAN MOTION DOT DOT/6 | .071801 |
| BSTAR           | .0           |

CATALOGED DEBRIS CLOUD DATA

| DEBRIS CATALOGED | 469 |
| DEBRIS IN ORBIT | 57  | MAXIMUM ∆P: 4.1 min |
|                  |     | MAXIMUM ∆i: 1.4 deg |
OV2-1/LCS 2 R/B debris cloud of 103 cataloged fragments six weeks after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: US
LAUNCH DATE: 15.85 Feb 1966
DRY MASS (KG): 4
MAIN BODY: Sphere; 0.3 m diameter
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None
ENERGY SOURCES: Unknown

EVENT DATA

DATE: 15 Feb 1966
TIME: Unknown
ALTITUDE: ~200 km

LOCATION: Unknown
ASSESSED CAUSE: Unknown

POST-EVENT ELEMENTS

EPOCH: 66047.01671304
RIGHT ASCENSION: 148.6481
INCLINATION: 96.5380
ECCENTRICITY: .0108362
ARG. OF PERIGEE: 126.3670
MEAN ANOMALY: 234.6777
MEAN MOTION: 16.20030654
MEAN MOTION DOT: .01298049
MEAN MOTION DOT DOT: .0053719
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 38
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: Unknown
MAXIMUM Δi: 0.6 deg

COMMENTS

OPS 3031 was an inflated sphere also known as Bluebell 2. It was deployed from satellite 2012 which was an Agena D stage carrying a separate payload. Elements above are for satellite 2012. Debris cataloging began 19 February after many debris had already decayed. Consequently, ΔP cannot be calculated. OPS 3031 and all debris decayed within one week of launch.
OPS 3031 debris cloud of 38 fragments as initially cataloged by U.S. Space Surveillance Center during February, 1966.
GEMINI 9 ATDA R/B 1966-46B 2188

SATELLITE DATA

TYPE: Atlas Core Stage
OWNER: US
LAUNCH DATE: 1.63 Jun 1966
DRY MASS (KG): 3400
MAIN BODY: Cylinder; 3 m by 20 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: Unknown

EVENT DATA

DATE: Mid-Jun 1966
TIME: Unknown
ALTITUDE: ~250 km
LOCATION: Unknown
ASSESSED CAUSE: Unknown

PRE-EVENT ELEMENTS

EPOCH: 66164.9683397
RIGHT ASCENSION: 223.9064
INCLINATION: 28.7968
ECCENTRICITY: .0025152
ARG. OF PERIGEE: 135.2510
MEAN ANOMALY: 224.9775
MEAN MOTION: 16.0554599
MEAN MOTION DOT/2: .00654808
MEAN MOTION DOT DOT/6: .0010778
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 51
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 5.5 min
MAXIMUM ΔI: 1.5 deg

COMMENTS

This stage successfully deployed the Augmented Target Docking Adapter (ATDA) for the Gemini 9 mission. The elements above are the last available for the rocket body. Debris cataloging began on 21 June. Debris decay dates ranged from 21 June to 4 July with the rocket body officially decaying on 22 June. A review of NASA archives for this mission revealed no documented anomaly with the Atlas booster. Discussions in 1989 with General Dynamics personnel involved in the mission also failed to uncover any knowledge of the event.
Gemini 9 ATDA R/B debris cloud of 24 fragments cataloged between 21 and 24 June as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: US
LAUNCH DATE: 24.01 Jun 1966
DRY MASS (KG): 55
MAIN BODY: Sphere; 30 m diameter
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None
ENERGY SOURCES: None

EVENT DATA (1)

DATE: 12 Jul 1975
TIME: 2248 GMT
ALTITUDE: 5145 km
LOCATION: 67N, 135E (dsc)
ASSESSED CAUSE: Unknown

PRE-EVENT ELEMENTS (1)

EPOCH: 75192.78059719
RIGHT ASCENSION: 238.7429
INCLINATION: 85.2811
ECCENTRICITY: .0921904
ARG. OF PERIGEE: 281.8264
MEAN ANOMALY: 67.9594
MEAN MOTION: 7.99684492
MEAN MOTION DOT/2: .0001217
MEAN MOTION DOT DOT/6: .0
BSTAR: .77087

EVENT DATA (2)

DATE: 20 Jan 1976
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Unknown

PRE-EVENT ELEMENTS (2)

EPOCH: 76019.86486339
RIGHT ASCENSION: 209.8639
INCLINATION: 85.0720
ECCENTRICITY: .1179567
ARG. OF PERIGEE: 66.4633
MEAN ANOMALY: 305.5539
MEAN MOTION: 8.00368182
MEAN MOTION DOT/2: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 79
DEBRIS IN ORBIT: 3
MAXIMUM ΔP: 0.1 min*
MAXIMUM ΔI: 0.7 deg*

*Based on 1st event data

COMMENTS

PAGEOS (Passive Geodetic Earth-Orbiting Satellite) was an inflated balloon made of thin mylar with an aluminum coating. The first fragmentation event occurred nine years after launch and resulted in 11 new cataloged objects. The second event was detected by D.G. King-Hele of the RAE, and...
NAVSPASUR confirmed 44 additional fragments. By August 1976 no additional debris had been cataloged but 19 objects were being tracked in orbits with mean motions near 8 and eccentricities between 0.16 and 0.34. Due to the character of PAGEOS and its subsequent debris, natural perturbations had little effect on orbital period but strongly increased eccentricity by simultaneously lowering perigee and raising apogee. About 10 September 1976 one of the 19 unofficial objects is believed to have broken up into perhaps more than 250 new pieces, none of which were cataloged prior to reentry. Eighteen objects were later cataloged during 7-8 October 1976. On the first anniversary of the second fragmentation (20 Jan 1977), 45 fragments were cataloged without elements and immediately decayed administratively. Additional fragmentations are suspected to have taken place in June 1978, September 1984, and December 1985. Historically, radar tracking of PAGEOS debris has been extremely difficult and cross-tagging frequent. Cause for the second and subsequent events may be material deterioration under environmental stress.

REFERENCE DOCUMENTS


PAGEOS debris cloud of 12 fragments five weeks after the first event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Saturn SIVB Stage
OWNER: US
LAUNCH DATE: 5.62 Jul 1966
DRY MASS (KG): 26,600
MAIN BODY: Cylinder; 6.6 m by 28.3 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: Attitude control and pressurization systems

EVENT DATA

DATE: 5 Jul 1966
TIME: 2111 GMT
ALTITUDE: 205 km
LOCATION: 20N, 277E (dsc)
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS

EPOCH: 66186.73481847
RIGHT ASCENSION: 5.5870
INCLINATION: 31.9810
ECCENTRICITY: .0022272
ARG. OF PERIGEE: 6.1632
MEAN ANOMALY: 353.9219
MEAN MOTION: 16.27379993
MEAN MOTION DOT/2: .03796193
MEAN MOTION DOT DOT/6: .17429
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 34
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 3.5 min
MAXIMUM ΔI: 1.4 deg

COMMENTS

This was the second flight of the SIVB stage. After orbital insertion, the vehicle was intentionally subjected to dynamic integrity tests, including high gravity loadings during attitude control maneuvers and high pressure tests. The vehicle finally broke up after exceeding structural design limits with a propellant tank bulkhead differential pressure in excess of 23.7 N/cm². The fragmentation occurred early on the fifth revolution. Elements for the first fragments were not cataloged until 8 July.

REFERENCE DOCUMENTS

AS-203 debris cloud of 25 fragments using orbits developed within one week of the event as reconstructed from U.S. Space Surveillance Center database.
**USSR UNKNOWN 1**

### SATELLITE DATA

- **TYPE:** Unknown
- **OWNER:** USSR
- **LAUNCH DATE:** 17 Sep 1966
- **DRY MASS (KG):** Unknown
- **MAIN BODY:** Unknown
- **MAJOR APPENDAGES:** Unknown
- **ATTITUDE CONTROL:** Unknown
- **ENERGY SOURCES:** Unknown

### EVENT DATA

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### POST-EVENT ELEMENTS

- **EPOCH:** 66261.0
- **RIGHT ASCENSION:** 338
- **INCLINATION:** 49.63
- **ECCENTRICITY:** .063
- **ARG. OF PERIGEE:** 83
- **MEAN ANOMALY:** 283
- **MEAN MOTION:** 14.879
- **MEAN MOTION DOT/2:** .0
- **MEAN MOTION DOT DOT/6:** .0
- **BSTAR:** .0

### CATALOGED DEBRIS CLOUD DATA

- **DEBRIS CATALOGED:** 53
- **DEBRIS IN ORBIT:** 0
- **MAXIMUM ΔP:** Unknown
- **MAXIMUM ΔI:** Unknown

### COMMENTS

This was the first of two missions of this type flown in 1966 and not acknowledged by the USSR. It is sometimes referred to as Cosmos U1. The identity of the parent orbit is uncertain. Satellite 2437 was the first cataloged fragment. The above elements are taken or derived from the RAE Table of Earth Satellites. The debris distribution is consistent with a fragmentation near 300 km. USSR Unknown 1 and 2 may be related to a series of Cosmos flights with similar orbital parameters conducted during 1967-1971 beginning with Cosmos 139.
USSR Unknown 1 debris cloud of 44 fragments cataloged by 5 October 1966 as reconstructed from U.S. Space Surveillance Center database.
USSR UNKNOWN 2 1966-101A 2536

SATELLITE DATA

TYPE: Unknown
OWNER: USSR
LAUNCH DATE: 2.03 Nov 1966
DRY MASS (KG): Unknown
MAIN BODY: Unknown
MAJOR APPENDAGES: Unknown
ATTITUDE CONTROL: Unknown
ENERGY SOURCES: Unknown

EVENT DATA

DATE: 2 Nov 1966
TIME: Unknown
ALTITUDE: ~225 km

LOCATION: Unknown
ASSESSED CAUSE: Unknown

POST-EVENT ELEMENTS

EPOCH: 66309.99121234
RIGHT ASCENSION: 35.2944
INCLINATION: 49.5617
ECCENTRICITY: .05339049
ARG. OF PERIGEE: 100.3324

MEAN ANOMALY: 265.7893
MEAN MOTION: 15.17033022
MEAN MOTION DOT/2: .01866914
MEAN MOTION DOT DOT/6: .0043309
BSTAR: 0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 41
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: Unknown
MAXIMUM ΔI: Unknown

COMMENTS

This was the second mission of this type flown in 1966 and not acknowledged by the USSR. It is sometimes referred to as Cosmos U2. No elements were cataloged until three days after the launch. The identity of the parent orbit is uncertain. Satellite 2536 was the first object cataloged and was near the center of the debris cloud. The debris distribution is consistent with a fragmentation near 225 km. USSR Unknown 1 and 2 may be related to a series of Cosmos flights with similar orbital parameters conducted during 1967-1971 beginning with Cosmos 139.
USSR Unknown 2 debris cloud composed of 14 different orbits as developed by the U.S. Space Surveillance Center within one week of the event.
SATellite DATA

TYPE: Saturn SIVB Stage
OWNER: US
LAUNCH DATE: 4.5 Apr 1968
DRY MASS (KG): 30,000 (?)
MAIN BODY: Cylinder; 6.6 m by 30 m (?)
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: On-board propellants

EVEnt DATA

DATE: 13 Apr 1968
TIME: 1054 GMT
ALTITUDE: 330 km
LOCATION: 32N, 245E (asc)
ASSESSED CAUSE: Propulsion-related

PRE-EVEnt ELEMENTS

EPOCH: 68103.56521409
RIGHT ASCENSION: 177.3270
INCLINATION: 32.5869
ECCENTRICITY: 0.0129030
ARG. OF PERIGEE: 208.3921
MEAN ANOMALY: 151.0074
MEAN MOTION: 15.97292993
MEAN MOTION DOT/2: .003912835
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATalOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 16
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 0.7 min
MAXIMUM ΔI: 0.1 deg

COmMENTS

This Saturn SIVB Stage was fitted with a 11,800 kg mock Lunar Module (LM). The SIVB stage was programmed for a second firing to place the Apollo 6 vehicle into a more eccentric orbit, but the restart did not occur. The Apollo 6 payload was separated, leaving the SIVB stage and the LM in a low Earth orbit. Vaporization and venting of residual liquid oxygen induced a tumble to the SIVB stage which reached 30 rpm by 13 April. On this date the axial loads on the LM attach strap fittings and support struts were exceeded, resulting in separation of the LM from the SIVB along with numerous debris. Five fragments were cataloged without elements.

USTER DOCUMENTS

Apollo 6 R/B debris cloud of 9 fragments four days after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Titan 3C Transtage
OWNER: US
LAUNCH DATE: 26.32 Sep 1968
DRY MASS (KG): 1500 (?)
MAIN BODY: Cylinder; 3.0 m by 6.0 m (approx.)
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 21 Feb 1992
TIME: Unknown
ALTITUDE: ~ 35600
LOCATION: Unknown (~ 197E)
ASSESSED CAUSE: Unknown

PRE-EVENT ELEMENTS

EPOCH: 92043.23217642
RIGHT ASCENSION: 21.8025
INCLINATION: 11.9635
ECCENTRICITY: .0084771
ARG. OF PERIGEE: 76.2786
MEAN ANOMALY: 284.5600
MEAN MOTION: 1.01459126
MEAN MOTION DOT/2: .00000174
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 1
MAXIMUM ΔP: Unknown
MAXIMUM ΔI: Unknown

COMMENTS

This was the second major fragmentation of a Titan 3C Transtage (the first was 1965-082B). This transtage released ERS-28 (also known as OV5-2) in high-e ascent orbit, then released LES-6 and ERS-21 (also known as OV5-4) in synchronous orbit, before slightly decelerating and releasing OV2-5 into a slightly lower orbit. This rocket body successfully completed its mission and remained on-orbit for 281 months before fragmenting. Mr. Bob Brock, operating the Maui GEODSS sensor, observed this transtage as it fragmented, liberating a reported 20 objects. No orbital data on any fragments have been generated by the Space Surveillance Center.

REFERENCE DOCUMENTS

Insufficient Data to construct a Gabbard Diagram
COSMOS 248

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 19.18 Oct 1968
DRY MASS (KG): 1000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 2 m (?)
MAJOR APPENDAGES: Unknown
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 1 Nov 1968
TIME: 0412 GMT
ALTITUDE: 540 km
LOCATION: 55N, 104E (dsc)
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS

EPOCH: 68304.8383772
RIGHT ASCENSION: 82.2502
INCLINATION: 62.2495
ECCENTRICITY: .0050333
ARG. OF PERIGEE: 298.4670
MEAN ANOMALY: 61.1261
MEAN MOTION: 15.19330723
MEAN MOTION DOT: .00016932
MEAN MOTION DOT DOT: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 5
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: Unknown
MAXIMUM ΔI: 0.1 deg

COMMENTS

Cosmos 248 was the target of rendezvous for the Cosmos 249 and Cosmos 252 tests. Calculations suggest the few fragments detected from Cosmos 248 were released within ten minutes of the Cosmos 252 event which took place in the vicinity of Cosmos 248. The four observed fragments were not cataloged until 4-6 weeks after the event, preventing an accurate assessment of the event due to drag effects. It is possible that the Cosmos 248 event occurred immediately after the rendezvous and was a direct result of interaction with Cosmos 252 debris.

REFERENCE DOCUMENTS

Insufficient data to construct a Gabbard diagram.
SATELLITE DATA

TYPE: Payload  
OWNER: USSR  
LAUNCH DATE: 20.17 Oct 1968  
DRY MASS (KG): 1000 (approx.)  
MAIN BODY: Cylinder; 1.3 m by 2 m (?)  
MAJOR APPENDAGES: None  
ATTITUDE CONTROL: Active, 3-axis  
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 20 Oct 1968  
TIME: 1427 GMT  
ALTITUDE: 1995 km  
LOCATION: 57S, 181E (asc)  
ASSESSED CAUSE: Deliberate Detonation

POST-EVENT ELEMENTS

EPOCH: 68294.55197372  
RIGHT ASCENSION: 118.4255  
INCLINATION: 62.3313  
ECCENTRICITY: .1088260  
ARG. OF PERIGEE: 76.6147  
MEAN ANOMALY: 295.3555  
MEAN MOTION: 12.83515528  
MEAN MOTION DOT/2: .0  
MEAN MOTION DOT DOT/6: .0  
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 109  
DEBRIS IN ORBIT: 57  
MAXIMUM ΔP: 3.9 min  
MAXIMUM Δl: 0.4 deg

COMMENTS

Cosmos 249 was the first of a class of maneuverable spacecraft flown to rendezvous within four hours with another Cosmos satellite. In 9 of 20 such missions, orbital debris clouds were created by the active spacecraft, and in one case a passive (target) spacecraft also spawned a few fragments. Fragmentations occurred either in the vicinity of the passive satellite or a few hours after the rendezvous. In the case of Cosmos 249, the spacecraft was launched on a two-revolution rendezvous with Cosmos 248. After a close approach, Cosmos 249 continued on before its warhead was intentionally fired. The elements above are the first available for the final orbit.

REFERENCE DOCUMENTS

Cosmos 249 cataloged debris cloud of 43 fragments four months after the event as reconstructed from U.S. Space Surveillance Center database. Cross-tagging with Cosmos 252 debris is evident.
**COSMOS 252**

**SATELLITE DATA**

- **TYPE:** Payload
- **OWNER:** USSR
- **LAUNCH DATE:** 1.02 Nov 1968
- **DRY MASS (KG):** 1000 (approx.)
- **MAIN BODY:** Cylinder; 1.3 m by 2 m (?)
- **MAJOR APPENDAGES:** None
- **ATTITUDE CONTROL:** Active, 3-axis
- **ENERGY SOURCES:** On-board propellants, explosive charge

**EVENT DATA**

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<td>LOCATION</td>
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<td>ASSESSED CAUSE</td>
<td>Deliberate Detonation</td>
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**POST-EVENT ELEMENTS**

- **EPOCH:** 68306.70122094
- **MEAN ANOMALY:** 297.5777
- **RIGHT ASCENSION:** 76.5565
- **MEAN MOTION:** 12.81278799
- **INCLINATION:** 62.3531
- **MEAN MOTION DOT/2:** .00811969
- **ECCENTRICITY:** .1040368
- **MEAN MOTION DOT DOT/6:** .0
- **ARG. OF PERIGEE:** 73.6953
- **MEAN MOTION DOT DOT DOT/6:** .0
- **BSTAR:** .0

**CATALOGED DEBRIS CLOUD DATA**

- **DEBRIS CATALOGED:** 140
- **DEBRIS IN ORBIT:** 53
- **MAXIMUM ΔP:** 8.7 min
- **MAXIMUM ΔI:** 0.5 deg

**COMMENTS**

Cosmos 252 was launched on a two-revolution rendezvous with Cosmos 248. The fragmentation occurred in the vicinity of Cosmos 248. Cosmos 252 was part of the test series begun with Cosmos 249. Elements above are for the orbit of the spacecraft after final maneuver, which took place immediately before fragmentation.

**REFERENCE DOCUMENTS**

Cosmos 252 cataloged debris cloud of 43 fragments four months after the event as reconstructed from U.S. Space Surveillance Center database. Cross-tagging with the Cosmos 249 cloud is evident.
SATELLITE DATA

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<td>MAJOR APPENDAGES</td>
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EVENT DATA

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PRE-EVENT ELEMENTS

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<td>ECCENTRICITY</td>
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</tr>
<tr>
<td>MEAN MOTION DOT/6</td>
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<tr>
<td>ARG. OF PERIGEE</td>
<td>184.7318</td>
</tr>
<tr>
<td>BSTAR</td>
<td>.0</td>
</tr>
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</table>

CATALOGED DEBRIS CLOUD DATA

<table>
<thead>
<tr>
<th>DEBRIS CATALOGED</th>
<th>37</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEBRIS IN ORBIT</td>
<td>0</td>
</tr>
<tr>
<td>MAXIMUM ΔP</td>
<td>2.4 min</td>
</tr>
<tr>
<td>MAXIMUM ΔI</td>
<td>0.5 deg</td>
</tr>
</tbody>
</table>

COMMENTS

The vehicle successfully deployed the Meteor 1-1 payload into the desired orbit. An object believed to be the rocket body was found on 27 March in an orbit (1) of 565 km by 755 km, similar to earlier missions of the SL-3. Early on 28 March an object was found in an orbit (2) of 460 km by 850 km with elements as indicated above. Analysis indicates that a transition from orbit (1) to orbit (2) was possible during the latter part of 27 March. Debris analysis clearly indicates that the orbit of the parent satellite had to be similar to orbit (2). Radar cross-section data supports the belief that the post-event object in the center of the debris cloud is the rocket body. No object was found in orbit (1) after the event.
Meteor 1-1 R/B debris cloud of 31 fragments two months after the event as reconstructed from U.S. Space Surveillance Center database.
INTELSAT 3 F-5 R/B 1969-64B 4052

SATELLITE DATA

TYPE: TE 364-4
OWNER: US
LAUNCH DATE: 26.09 Jul 1969
DRY MASS (KG): 1100 (70 without solid propellants)
MAIN BODY: Sphere-Nozzle; 1.0 m by 1.8 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 26 Jul 1969
TIME: 0228 GMT
ALTITUDE: 270 km
LOCATION: 0N, 333E (dsc)
ASSESSED CAUSE: Propulsion-related

POST-EVENT ELEMENTS

EPOCH: 69208.17261261
RIGHT ASCENSION: 130.0186
INCLINATION: 30.3692
ECCENTRICITY: .280049
ARG. OF PERIGEE: 187.9970
MEAN ANOMALY: 166.4542
MEAN MOTION: 9.78100102
MEAN MOTION DOT/2: .00000270
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 26
DEBRIS IN ORBIT: 1
MAXIMUM ΔP: Unknown
MAXIMUM Δl: 1.2 deg

COMMENTS

This solid-propellant upper stage failed soon after ignition, following a normal launch. The cause of the failure is assessed to be a possible rupture of the motor casing or nozzle. See similar failures of two PAM-D upper stages in 1984. Elements above are first developed for the rocket body about one day after the event. Rocket body may later have been cross-tagged with satellite 4053. Validity of debris identification and cataloging after 1969 is suspect.

REFERENCE DOCUMENTS

Intelsat 3 F-5 R/B debris cloud of six fragments ten days after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Agena D Stage
OWNER: US
LAUNCH DATE: 30.57 Sep 1969
DRY MASS (KG): 600
MAIN BODY: Cylinder; 1.5 m by 7.1 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: Unknown

EVENT DATA

DATE: 4 Oct 1969
TIME: 1553 GMT
ALTITUDE: 920 km
LOCATION: 54N, 178E (dsc)
ASSESSED CAUSE: Unknown

POST-EVENT ELEMENTS

EPOCH: 69295.54249482
RIGHT ASCENSION: 243.5157
INCLINATION: 69.9611
ECCENTRICITY: .0117819
ARG. OF PERIGEE: 87.4011
MEAN ANOMALY: 274.0514
MEAN MOTION: 13.68701087
MEAN MOTION DOT/2: .00000064
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 260
DEBRIS IN ORBIT: 107
MAXIMUM ΔP: 3.1 min
MAXIMUM ΔI: 1.0 deg

COMMENTS

This was the first of two Agena D stages to fragment in a span of only 12 months. The vehicle delivered ten payloads to an orbit of about 905 km by 940 km. Four days later, before the rocket body had been cataloged, a large fragmentation occurred. What appeared to be the largest piece of the rocket body was found in the orbit described by the elements above almost three weeks after the event. See 1967-53 as a reference to an earlier mission of this type. Both missions were sponsored by DOD and public information is limited.

REFERENCE DOCUMENTS

OPS 7613 R/B debris cloud (excluding 10 payloads) of 152 fragments eight months after the event. The largest fragment was found in an eccentric orbit with an orbital period of more than 105 min and is presumed to be the rocket body remnant.
NIMBUS 4 R/B 1970-25C 4367

SATELLITE DATA

<table>
<thead>
<tr>
<th>TYPE</th>
<th>Agena D Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>OWNER</td>
<td>US</td>
</tr>
<tr>
<td>LAUNCH DATE</td>
<td>8.35 Apr 1970</td>
</tr>
<tr>
<td>DRY MASS (KG)</td>
<td>600</td>
</tr>
<tr>
<td>MAIN BODY</td>
<td>Cylinder; 1.5 m by 7.1 m</td>
</tr>
<tr>
<td>MAJOR APPENDAGES</td>
<td>None</td>
</tr>
<tr>
<td>ATTITUDE CONTROL</td>
<td>None at time of the event</td>
</tr>
<tr>
<td>ENERGY SOURCES</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

EVENT DATA

| DATE       | 17 Oct 1970           |
| TIME       | 0317 GMT              |
| ALTITUDE   | 1075 km               |
| LOCATION   | 50S, 142E (asc)       |
| ASSESSED CAUSE | Unknown               |

PRE-EVENT ELEMENTS

| EPOCH                  | 70289.33183878        |
| RIGHT ASCENSION       | 203.5235             |
| INCLINATION           | 98.8780              |
| ECCENTRICITY          | .0016616             |
| ARG. OF PERIGEE        | 218.6463             |
| MEAN ANOMALY          | 141.3434             |
| MEAN MOTION           | 13.49254887          |
| MEAN MOTION DOT/2    | .0                   |
| MEAN MOTION DOT DOT/6 | .0                   |
| BSTAR                 | .0                   |

CATALOGED DEBRIS CLOUD DATA

| DEBRIS CATALOGED | 370           |
| DEBRIS IN ORBIT  | 276           |
| MAXIMUM ΔP       | 14.2 min      |
| MAXIMUM ΔI       | 0.8 deg       |

COMMENTS

This was the second Agena D stage to fragment in a span of only 12 months. The event occurred six months after the successful deployment of the Nimbus 4 payload. Twice in 1985, again in 1986, and once in 1991, Nimbus 4 R/B debris spawned a few additional fragments, accounting for an additional 12 new debris objects between the 4 sub-events.

REFERENCE DOCUMENTS

Nimbus 4 R/B debris cloud of 246 fragments eight months after the event as reconstructed from U.S. Space Surveillance Center database. Some lower period fragments already exhibit the effects of natural decay.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 23.18 Oct 1970
DRY MASS (KG): 1000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 2 m (?)
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 23 Oct 1970
TIME: 1513 GMT
ALTITUDE: 1195 km
LOCATION: 22S, 217E (asc)
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 70296.40542099
RIGHT ASCENSION: 129.1049
INCLINATION: 62.9380
ECCENTRICITY: .1039489
ARG. OF PERIGEE: 60.4933
MEAN ANOMALY: 309.5623
MEAN MOTION: 12.82808179
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 103
DEBRIS IN ORBIT: 39
MAXIMUM ΔP: Unknown
MAXIMUM ΔI: Unknown

COMMENTS

Cosmos 374 was launched on a two-revolution rendezvous with Cosmos 373. After a close approach, Cosmos 374 continued on before its warhead was intentionally fired. Cosmos 374 was part of test series begun with Cosmos 249. Considerable cross-cataloging of Cosmos 374 and Cosmos 375 debris; therefore, ΔP and ΔI are not calculated.

REFERENCE DOCUMENTS

Cosmos 374 official debris cloud of 43 fragments five months after the event as reconstructed from U.S. Space Surveillance Center database. All fragments were cataloged after the Cosmos 375 fragmentation, and some contamination exists.
SATCHELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 30.09 Oct 1970
DRY MASS (KG): 1000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 2 m (?)
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 30 Oct 1970
TIME: 0600 GMT
ALTITUDE: 535 km
LOCATION: 54N, 23E (asc)
ASSESSED CAUSE: Deliberate Detonation

POST-EVENT ELEMENTS

EPOCH: 70306.81102869
RIGHT ASCENSION: 96.4080
INCLINATION: 62.8057
ECCENTRICITY: .102289
ARG. OF PERIGEE: 56.0864
MEAN ANOMALY: 313.3102
MEAN MOTION: 12.87482205
MEAN MOTION DOT/2: .00009999
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 47
DEBRIS IN ORBIT: 27
MAXIMUM ΔP: Unknown
MAXIMUM ΔI: Unknown

COMMENTS

Cosmos 375 was launched on a two-revolution rendezvous with Cosmos 373. The fragmentation occurred in the vicinity of Cosmos 373. Cosmos 375 was part of test series begun with Cosmos 249. Elements above are first reliable ones for orbit after final maneuver which took place immediately before fragmentation. Considerable cross-cataloging of Cosmos 374 and Cosmos 375 debris; therefore, ΔP and ΔI are not calculated.

REFERENCE DOCUMENTS

Cosmos 374 official debris cloud of 43 fragments five months after the event as reconstructed from U.S. Space Surveillance Center database. All fragments were cataloged after the Cosmos 375 fragmentation, and some contamination exists.
COSMOS 397 1971-15A 4964

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 25.47 Feb 1971
DRY MASS (KG): 1000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 2 m (?)
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 25 Feb 1971
TIME: 1431 GMT
ALTITUDE: 585 km

LOCATION: 54N, 21E (asc)
ASSESSED CAUSE: Deliberate Detonation

POST-EVENT ELEMENTS

EPOCH: 71057.77590281
RIGHT ASCENSION: 352.8670
INCLINATION: 65.7618
ECCENTRICITY: .1046189
ARG. OF PERIGEE: 50.3064
MEAN ANOMALY: 318.5528
MEAN MOTION: 12.68709606
MEAN MOTION DOT/2: .00013192
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 116
DEBRIS IN ORBIT: 63
MAXIMUM ΔP: 2.8 min
MAXIMUM ΔI: 1.2 deg

COMMENTS

Cosmos 397 was launched on a two-revolution rendezvous with Cosmos 394. The fragmentation occurred in the vicinity of Cosmos 394. Cosmos 397 was part of the test series begun with Cosmos 249. Elements above are first available for orbit after final maneuver which took place immediately before fragmentation.

REFERENCE DOCUMENTS

Cosmos 397 cataloged debris cloud of 26 fragments about seven weeks after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 3.55 Dec 1971
DRY MASS (KG): 1000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 2 m (?)
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 3 Dec 1971
TIME: 1651 GMT
ALTITUDE: 230 km
LOCATION: 51N, 7E (asc)
ASSESSED CAUSE: Deliberate Detonation

POST-EVENT ELEMENTS

EPOCH: 71339.01001769
RIGHT ASCENSION: 294.0999
INCLINATION: 65.7483
ECCENTRICITY: .1062360
ARG. OF PERIGEE: 53.3215
MEAN ANOMALY: 316.0762
MEAN MOTION: 13.65823046
MEAN MOTION DOT/2: .00001349
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 25
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 3.6 min
MAXIMUM ΔI: 0.7 deg

COMMENTS

Cosmos 462 was launched on a two-revolution rendezvous with Cosmos 459. The fragmentation occurred in the vicinity of Cosmos 459. Cosmos 462 was part of test series begun with Cosmos 249. Elements above are first available for orbit after final maneuver which took place immediately before fragmentation.

REFERENCE DOCUMENTS

Cosmos 462 debris cloud of 13 cataloged fragments within one week of the event as reconstructed from U.S. Space Surveillance Center database.
LANDSAT 1 R/B 1972-58B 6127

SATELLITE DATA

TYPE: Delta Second Stage (900)
OWNER: US
LAUNCH DATE: 23.75 Jul 1972
DRY MASS (KG): 800 (?)
MAIN BODY: Cylinder-Nozzle; 1.4 m by 6.3 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: On-board propellants, range safety device

EVENT DATA

DATE: 22 May 1975
TIME: 1827 GMT
ALTITUDE: 730 km
LOCATION: 34S, 46E (asc)
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 75142.56642671
RIGHT ASCENSION: 196.3353
INCLINATION: 98.3439
ECCENTRICITY: .0193108
ARG. OF PERIGEE: 38.1650
MEAN ANOMALY: 323.2981
MEAN MOTION: 14.36209995
MEAN MOTION DOT/2: .00000060
MEAN MOTION DOT DOT/6: .000000027579
BSTAR: .000000

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 226
DEBRIS IN ORBIT: 55
MAXIMUM ΔP: 9.3 min
MAXIMUM ΔI: 1.0 deg

COMMENTS

This was the second Delta Second Stage to experience a severe fragmentation. The event occurred 34 months after the successful deployment of the Landsat 1 payload. Cause of the explosion is assessed to be related to the nearly 150 kg of residual propellants and characteristics of the sun-synchronous orbit.

REFERENCE DOCUMENTS


Landsat 1 R/B debris cloud of 133 fragments fours months after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: SL-13 Final Stage
OWNER: USSR
LAUNCH DATE: 3.38 Apr 1973
DRY MASS (KG): 5600 (approx.)
MAIN BODY: Cylinder-nozzle; 4.2 m by 6.8 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: Unknown

EVENT DATA

DATE: 3 Apr 1973
TIME: 2236 GMT
ALTITUDE: 225 km
LOCATION: 45N, 290E (dsc)
ASSESSED CAUSE: Unknown

PRE-EVENT ELEMENTS

EPOCH: 73093.61404736
RIGHT ASCENSION: 334.5652
INCLINATION: 51.4798
ECCENTRICITY: .0037670
ARG. OF PERIGEE: 2.1878
MEAN ANOMALY: 357.9254
MEAN MOTION: 16.20127597
MEAN MOTION DOT/2: .00508885
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 25
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 3.8 min
MAXIMUM ΔI: 0.5 deg

COMMENTS

This is the only known fragmentation of the SL-13 final stage. Event occurred less than 14 hours after reaching orbit. The event was apparently unrelated to the later payload malfunction. NAVSPASUR counted at least 95 objects shortly after the event. Most reentered before being officially cataloged.
Salyut 2 R/B debris cloud of 25 fragments as reconstructed from U.S. Space Surveillance Center database. Most elements were developed within two days of the event.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 19.38 Apr 1973
DRY MASS (KG): 6000 (approx.)
MAIN BODY: Sphere-Cylinder-Cone; 2.4 m by 6.5 m (?)
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 6 May 1973
TIME: 0724 GMT
ALTITUDE: 310 km
LOCATION: 71S, 215E (asc)
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 73125.63953480
RIGHT ASCENSION: 305.5573
INCLINATION: 72.8514
ECCENTRICITY: .0137599
ARG. OF PERIGEE: 22.9846
MEAN ANOMALY: 337.7411
MEAN MOTION: 16.05578988
MEAN MOTION DOT/2: .00433078
MEAN MOTION DOT DOT/6: .00010923
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 195
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 6.0 min
MAXIMUM Δl: 1.3 deg

COMMENTS

Spacecraft was apparently destroyed after a malfunction prevented controlled reentry and landing in the Soviet Union. Second incident of this type. A total of 88 fragments were cataloged without elements.
Cosmos 554 debris cloud of 107 fragments using initial elements as developed over several weeks. Some decay effects are present. Source is U.S. Space Surveillance Center database.
NOAA 3 R/B

SATellite DATA

TYPE: Delta Second Stage (300)
OWNER: US
LAUNCH DATE: 6.71 Nov 1973
DRY MASS (KG): 800 (?)
MAIN BODY: Cylinder-Nozzle; 1.4 m by 6.3 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: On-board propellants, range safety device

EVENT DATA

DATE: 28 Dec 1973
TIME: 0904 GMT
ALTITUDE: 1515 km
LOCATION: 37S, 181E (asc)
ASSESS CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 73359.56303028
RIGHT ASCENSION: 41.7242
INCLINATION: 102.0500
ECCENTRICITY: .0005689
ARG. OF PERIGEE: 157.9450
MEAN ANOMALY: 202.2816
MEAN MOTION: 12.40088347
MEAN MOTION DOT/2: .00000577
MEAN MOTION DOT DOT/6: .00000056523
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 197
DEBRIS IN ORBIT: 180
MAXIMUM ΔP: 10.4 min
MAXIMUM ΔI: 1.4 deg

COMMENTS

This was the first of seven Delta Second Stages to experience severe fragmentations between 1973 and 1981. Six of the seven stages were left in mid-morning, sun-synchronous orbits with residual propellants. Fragmentations occurred from 2-35 months after launch. The seventh stage exploded within hours of launch on a geosynchronous mission. The assessed cause in all cases is a propellant-induced explosion. Depletion burns to remove residual propellants were initiated in 1981, and no Delta Second Stages have fragmented since. In the case of the NOAA 3 R/B, fragmentation took place nearly two months after successful deployment of the NOAA 3 payload. Approximately 130 kg of propellants were left on board.

REFERENCE DOCUMENTS


NOAA 3 R/B debris cloud of 160 fragments four months after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Delta Second Stage (2310)
OWNER: US
LAUNCH DATE: 15.72 Nov 1974
DRY MASS (KG): 900 (approx.)
MAIN BODY: Cylinder-Nozzle; 1.4 m by 5.8 m
MAJOR APPENDAGES: Mini-skirt; 2.4 m by 0.3 m
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: On-board propellants, range safety device

EVENT DATA

DATE: 20 Aug 1975
TIME: 1307 GMT
ALTITUDE: 1465 km
LOCATION: 52S, 278E (dsc)
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 75231.53619619
RIGHT ASCENSION: 277.2201
INCLINATION: 101.6940
ECCENTRICITY: .0009694
ARG. OF PERIGEE: 51.1891
MEAN ANOMALY: 309.0001
MEAN MOTION: 12.52826370
MEAN MOTION DOT/2: .00000083
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 147
DEBRIS IN ORBIT: 129
MAXIMUM ΔP: 15.7 min
MAXIMUM ΔI: 1.8 deg

COMMENTS

This was the third Delta Second Stage to experience a severe fragmentation. The event occurred 9 months after the successful deployment of the NOAA 4 payload. Cause of the explosion is assessed to be related to the estimated more than 200 kg of residual propellants and characteristics of the sun-synchronous orbit. A fragment from this event (satellite number 8138) may have generated six or more additional pieces in September 1981.

REFERENCE DOCUMENTS


NOAA 4 R/B debris cloud of 101 fragments six months after the event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 699  1974-03A  7587

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 24.46 Dec 1974
DRY MASS (KG): 3000 (approx.)
MAJOR APPENDAGES: Cylinder; 1.3m by 10m (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA (1)

DATE: 17 Apr 1975  LOCATION: 01N, 278E (dsc)
TIME: 2148 GMT  ASSESSED CAUSE: Deliberate Action
ALTITUDE: 437 km

PRE-EVENT ELEMENTS (1)

EPOCH: 75107.81173798  MEAN ANOMALY: 71.8460
RIGHT ASCENSION: 271.0743  MEAN MOTION: 15.44155646
INCLINATION: 65.0355  MEAN MOTION DOT/2: .00007106
ECCENTRICITY: .0014224  MEAN MOTION DOT DOT/6: .0
ARG. OF PERIGEE: 288.1064  BSTAR: .0

EVENT DATA (2)

DATE: 2 Aug 1975  LOCATION: 02S, 258E (dsc)
TIME: 1623 GMT  ASSESSED CAUSE: Deliberate Action
ALTITUDE: 433 km

PRE-EVENT ELEMENTS (2)

EPOCH: 75214.45597981  MEAN ANOMALY: 68.4232
RIGHT ASCENSION: 274.3453  MEAN MOTION: 15.46205523
INCLINATION: 65.0458  MEAN MOTION DOT/2: .00001715
ECCENTRICITY: .0020980  MEAN MOTION DOT DOT/6: .0
ARG. OF PERIGEE: 291.4623  BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 50  MAXIMUM ΔP: 3.5 min*
DEBRIS IN ORBIT: 0  MAXIMUM ΔI: 0.9 deg*

*Based on NRL analysis

COMMENTS

Cosmos 699 was the first of a new type spacecraft. To date 16 members of this class have experienced breakups. The last fragmentation occurred in 1987. Beginning in 1988 old spacecraft have been commanded to lower perigee at end of life, resulting in an accelerated natural decay with no fragmentations. For several spacecraft, two distinct events have been detected and observational data suggest that the spacecraft remain essentially intact after each event. In all but one case, breakups occur after spacecraft has ceased orbit maintenance and entered natural decay. Debris are sometimes highly unidirectional. In the case of Cosmos 699, the spacecraft had been in a regime of natural decay for one month at the time of the event.
Cosmos 699 debris cloud as reconstructed from radar observations following the first breakup event. This diagram is derived from data found in NRL Report 7991 as cited above.
SATELLITE DATA

TYPE: Delta Second Stage (2910)
OWNER: US
LAUNCH DATE: 22.75 Jan 1975
DRY MASS (KG): 900 (approx.)
MAIN BODY: Cylinder-Nozzle; 1.4 m by 5.8 m
MAJOR APPENDAGES: Mini-skirt; 2.4 m by 0.2 m
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: On-board propellants, range safety device

EVENT DATA (1)

DATE: 9 Feb 1976
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Unknown

PRE-EVENT ELEMENTS (1)

EPOCH: 76040.08509016
RIGHT ASCENSION: 60.2329
INCLINATION: 97.7751
ECCENTRICITY: .0120730
ARG. OF PERIGEE: 170.9843
MEAN ANOMALY: 189.3492
MEAN MOTION: 14.19373945
MEAN MOTION DOT/2: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

EVENT DATA (2)

DATE: 19 Jun 1976
TIME: 0659 GMT
ALTITUDE: 750 km
LOCATION: 7N, 344E (dsc)
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS (2)

EPOCH: 76170.97576375
RIGHT ASCENSION: 175.3897
INCLINATION: 97.7497
ECCENTRICITY: .0115288
ARG. OF PERIGEE: 143.6594
MEAN ANOMALY: 217.2433
MEAN MOTION: 14.19574919
MEAN MOTION DOT/2: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 207
DEBRIS IN ORBIT: 43
MAXIMUM ΔP: 5.6 min
MAXIMUM ΔI: 2.3 deg
COMMENTS

This was the fourth Delta Second Stage to experience a severe fragmentation. The first event occurred almost 13 months after the successful deployment of the Landsat 2 payload. Only 14 fragments were cataloged after the first event and all possessed orbital period changes of less than 0.6 min. Four months later a much larger fragmentation occurred. The cause of the second event is assessed to be related to the estimated 150 kg of residual propellants on board and characteristics of the sun-synchronous orbit.

REFERENCE DOCUMENTS


Landsat 2 R/B debris cloud of 147 fragments about six weeks after the second event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Delta Second Stage (2910)
OWNER: US
LAUNCH DATE: 12.34 Jun 1975
DRY MASS (KG): 900 (approx.)
MAIN BODY: Cylinder-Nozzle; 1.4 m by 5.8 m
MAJOR APPENDAGES: Mini-skirt; 2.4 m by 0.3 m
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: On-board propellants, range safety device

EVENT DATA

DATE: 1 May 1991
TIME: 0856 GMT
ALTITUDE: 1090 km
LOCATION: 66N, 322E (dsc)
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 91112.56709963
RIGHT ASCENSION: 329.2109
INCLINATION: 99.5801
ECCENTRICITY: .0006217
ARG. OF PERIGEE: 148.3989
MEAN ANOMALY: 211.7525
MEAN MOTION: 13.43007146
MEAN MOTION DOT/2: .00000050
MEAN MOTION DOT DOT/6: 0.0
BSTAR: .0055458

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 233
DEBRIS IN ORBIT: 191
MAXIMUM ΔP: 27.4 min*
MAXIMUM ΔI: 2.4 min*

*Based on uncataloged debris data

COMMENTS

This was the eighth Delta Second Stage to experience a severe fragmentation. The event occurred nearly 191 months after the successful deployment of the Nimbus 6 payload. Cause of the explosion is assessed to be related to the estimated 245 kg of residual propellants on board and characteristics of the sun-synchronous orbit.

REFERENCE DOCUMENTS


Nimbus 6 R/B debris cloud of 386 identified fragments within one week of the event as reconstructed from a Naval Space Surveillance System database. This diagram is taken from the first cited reference.
COSMOS 758

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 5.62 Sep 1975
DRY MASS (KG): 6000 (approx.)
MAIN BODY: Cone-cylinder; 2.4 m by 7 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 6 Sep 1975
TIME: 1906 GMT
ALTITUDE: 185 km
LOCATION: 32N, 293E (asc)
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 75249.72782895
RIGHT ASCENSION: 189.2795
INCLINATION: 67.1445
ECCENTRICITY: .0113394
ARG. OF PERIGEE: 67.1020
MEAN ANOMALY: 294.2107
MEAN MOTION: 16.0942927
MEAN MOTION DOT/2: .00430774
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 76
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: Unknown
MAXIMUM ΔI: Unknown

COMMENTS

Spacecraft was apparently destroyed after a malfunction prevented controlled reentry and landing in the Soviet Union. Third incident of this type. Most debris reentered before being officially cataloged. All but three official fragments were cataloged without elements.
Insufficient data to construct a Gabbard diagram.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 29.46 Oct 1975
DRY MASS (KG): 3000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 10 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA

DATE: 25 Jan 1976
TIME: 1400 GMT
ALTITUDE: 440 km
LOCATION: 53N, 7E (asc)
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS

EPOCH: 76025.37753295
RIGHT ASCENSION: 303.6319
INCLINATION: 65.0177
ECCENTRICITY: .0009065
ARG. OF PERIGEE: 271.0782
MEAN ANOMALY: 88.9272
MEAN MOTION: 15.43461781
MEAN MOTION DOT/2: .00000373
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 62
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 1.6 min
MAXIMUM ΔI: 0.4 deg

COMMENTS

Cosmos 777 was the second spacecraft of the Cosmos 699-type to experience a fragmentation. It is the only one to breakup before terminating its precise orbit maintenance pattern and entering a regime of natural decay. A second event may have occurred about 90 minutes after the event cited above.

REFERENCE DOCUMENTS

Cosmos 777 debris cloud of 35 fragments about 10 days after the event as reconstructed from U.S. Space Surveillance Center database. Some drag effects are already evident.
COSMOS 838

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 2.44 Jul 1976
DRY MASS (KG): 3000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 10 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA

DATE: 17 May 1977
TIME: 1018 GMT
ALTITUDE: 430 km
LOCATION: 9S, 284E (dsc)
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS

EPOCH: 77136.94211102
RIGHT ASCENSION: 131.3837
INCLINATION: 65.0556
ECCENTRICITY: .0021270
ARG. OF PERIGEE: 286.3253
MEAN ANOMALY: 73.5502
MEAN MOTION: 15.45822335
MEAN MOTION DOT/2: .00007521
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 40
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 8.0 min*
MAXIMUM ΔI: 1.1 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 838 was the third spacecraft of the Cosmos 699-type to experience a fragmentation. Spacecraft had been in a regime of natural decay for six months prior to the event. Many debris reentered before being officially cataloged.

REFERENCE DOCUMENTS

Cosmos 838 debris cloud of 59 fragments about one week after the event as reconstructed from U.S. Space Surveillance Center database.
SATellite DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 8.88 Jul 1976
DRY MASS (KG): 800 (approx.)
MAIN BODY: Cylinder; 2 m by 2 m (?)
MAJOR APPENDAGES: Solar panels, gravity-gradient boom (?)
ATTITUDE CONTROL: Gravity gradient (?)
ENERGY SOURCES: Unknown

Event DATA

DATE: 29 Sep 1977
TIME: 0717 GMT
ALTITUDE: 1910 km
LOCATION: 33S, 162E (dsc)
ASSESSED CAUSE: Unknown

Pre-Event Elements

EPOCH: 77270.46732078
RIGHT ASCENSION: 85.9347
INCLINATION: 65.8538
ECCENTRICITY: .0706585
ARG. OF PERIGEE: 351.1444
MEAN ANOMALY: 7.6996
MEAN MOTION: 12.32137908
MEAN MOTION DOT/2: .00000367
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CataloGED Debris Cloud Data

DEBRIS CATALOGED: 69
DEBRIS IN ORBIT: 66
MAXIMUM ΔP: 2.7 min
MAXIMUM ΔI: 0.3 deg

COMMENTS

Cosmos 839 was the first of three satellites of the same class to experience unexplained fragmentations. These satellites are used in conjunction with the Cosmos 249-type spacecraft which are deliberately fragmented; but the cause of the Cosmos 839-type events appears to be unrelated since they occur more than one year after tests with Cosmos 249-type spacecraft. In the case of Cosmos 839, 14 months elapsed between its test with a Cosmos 249-type spacecraft and its fragmentation.

REFERENCE DOCUMENTS

Cosmos 839 debris cloud of 33 fragments about five weeks after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 22.66 Jul 1976
DRY MASS (KG): 6000 (approx.)
MAIN BODY: Cone-Cylinder; 2.4 m by 7 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA

DATE: 25 Jul 1976
TIME: 1718 GMT
ALTITUDE: 210 km
LOCATION: 49N, 100E (dsc)
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 76207.45032150
RIGHT ASCENSION: 152.6930
INCLINATION: 67.1467
ECCENTRICITY: .0136374
ARG. OF PERIGEE: 70.3553
MEAN ANOMALY: 291.2246
MEAN MOTION: 16.04433196
MEAN MOTION DOT/2: .00313532
MEAN MOTION DOT DOT/6: 0
BSTAR: 0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 248
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: Unknown
MAXIMUM ΔI: Unknown

COMMENTS

Spacecraft was apparently destroyed after a malfunction prevented controlled reentry and landing in the Soviet Union. Fourth incident of this type. No elements were cataloged on any of the official debris. Most fragments reentered rapidly.
Insufficient data to construct a Gabbard diagram.
SATellite DATA

TYPE: Delta Second Stage (2310)
OWNER: US
LAUNCH DATE: 29.71 Jul 1976
DRY MASS (KG): 900 (approx.)
MAIN BODY: Cylinder-Nozzle; 1.4 m by 5.8 m
MAJOR APPENDAGES: Mini-skirt; 2.4 m by 0.3 m
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: On-board propellants, range safety device

EVENT DATA

DATE: 24 Dec 1977
TIME: 1133 GMT
ALTITUDE: 1510 km
LOCATION: 40S, 146E (asc)
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 77354.53228225
RIGHT ASCENSION: 38.5560
INCLINATION: 102.0192
ECCENTRICITY: .0010085
ARG. OF PERIGEE: 29.2920
MEAN ANOMALY: 330.8663
MEAN MOTION: 12.38394892
MEAN MOTION DOT: .0
MEAN MOTION DOT DOT: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 159
DEBRIS IN ORBIT: 155
MAXIMUM ΔP: 12.5 min
MAXIMUM ΔI: 3.0 deg

COMMENTS

This was the sixth Delta Second Stage to experience a severe fragmentation. The event occurred 17 months after the successful deployment of the NOAA 5 payload. Cause of the explosion is assessed to be related to the estimated 250 kg of residual propellants on board and characteristics of the sun-synchronous orbit.

REFERENCE DOCUMENTS


NOAA 5 R/B debris cloud of 98 fragments about four months after the event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 862

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 22.38 Oct 1976
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 1.6 m by 3.4 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 15 Mar 1977
TIME: 1256 GMT
ALTITUDE: 5375 km
LOCATION: 39N, 114E (asc)
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 77066.03986408
RIGHT ASCENSION: 98.8076
INCLINATION: 63.1553
ECCENTRICITY: .7312859
ARG. OF PERIGEE: 318.6653
MEAN ANOMALY: 4.4196
MEAN MOTION: 2.00311741
MEAN MOTION DOT/2: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 11
DEBRIS IN ORBIT: 11
MAXIMUM ΔP: 5.7 min
MAXIMUM ΔI: 0.4 deg

COMMENTS

Cosmos 862 was the first of a new class of operational satellites in highly elliptical, semi-synchronous orbits which experienced a total of 15 fragmentations during the period 1977-1986. A constellation of 8-9 spacecraft is still maintained, but the fragmentations appear to have ceased. By careful examination of all members of this class which have fragmented, an assessed cause of propulsion-related breakup is determined. Due to the nature of these orbits, which result in high altitudes over the Northern Hemisphere where most surveillance sensors are located, debris detection and tracking is extremely difficult. Only the largest fragments can be seen. Cosmos 862 maneuvered into a pre-operational orbit about 1 November 1976. A station-keeping maneuver was anticipated at about the time of the event to synchronize the spacecraft's groundtrack as demonstrated by earlier test satellites.
Cosmos 862 debris cloud of 10 cataloged fragments two weeks after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 9.84 Dec 1976
DRY MASS (KG): 800 (est.)
MAIN BODY: Cylinder; 2 m by 2 m (?)
MAJOR APPENDAGES: Solar panels, gravity-gradient boom (?)
ATTITUDE CONTROL: Gravity gradient (?)
ENERGY SOURCES: Unknown

EVENT DATA

DATE: 27 Nov 1978
TIME: 1703 GMT
ALTITUDE: 560 km
LOCATION: 65S, 306E (dsc)
ASSESSED CAUSE: Unknown

PRE-EVENT ELEMENTS

EPOCH: 78331.59395829
RIGHT ASCENSION: 11.0317
INCLINATION: 65.8440
ECCENTRICITY: .0050108
ARG. OF PERIGEE: 304.0553
MEAN ANOMALY: 55.5772
MEAN MOTION: 14.93841919
MEAN MOTION DOT/2: .00000004
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 49
DEBRIS IN ORBIT: 2
MAXIMUM ΔP: 1.3 min*
MAXIMUM ΔI: 0.0 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 880 was the second spacecraft of the Cosmos 839-type to experience a fragmentation. Although these satellites are used in conjunction with the Cosmos 249-type spacecraft which are deliberately fragmented, the cause of the Cosmos 839-type events appears to be unrelated. In the case of Cosmos 880, 23 months elapsed since its test with a Cosmos 249-type spacecraft.

REFERENCE DOCUMENTS

Cosmos 880 debris cloud of 40 fragments two days after the event as reconstructed from U.S. Space Surveillance Center database.
SATellite DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 27.53 Dec 1976
DRY MASS (KG): 1000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 2 m (?)
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 27 Dec 1976
TIME: 1840 GMT
ALTITUDE: 2090 km
LOCATION: 65S, 210E (asc)
ASSESSED CAUSE: Deliberate Detonation

POST-EVENT ELEMENTS

EPOCH: 77362.79720829
MEAN ANOMALY: 313.0540
RIGHT ASCENSION: 306.5669
MEAN MOTION: 12.54457816
INCLINATION: 65.8434
MEAN MOTION DOT/2: .00004000
ECCENTRICITY: .1087102
MEAN MOTION DOT DOT/6: .0
ARG. OF PERIGEE: 57.0236
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 76
DEBRIS IN ORBIT: 63
MAXIMUM ΔP: 4.3 min
MAXIMUM ΔI: 0.2 deg

COMMENTS

Cosmos 886 was launched on a two-revolution rendezvous with Cosmos 880. After a close approach, Cosmos 886 continued on before its warhead was intentionally fired. Cosmos 886 was part of test series begun with Cosmos 249. The elements above are the first available after the final maneuver of Cosmos 886 but represent the revolution immediately after the event.

REFERENCE DOCUMENTS

Cosmos 886 debris cloud of 53 fragments five months after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 11.07 Apr 1977
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 1.6 m by 3.4 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 8 Jun 1978
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 78156.86414074
RIGHT ASCENSION: 115.5660
INCLINATION: 63.1514
ECCENTRICITY: .7100107
ARG. OF PERIGEE: 319.7397
MEAN ANOMALY: 5.0496
MEAN MOTION: 2.00599850
MEAN MOTION DOT/2: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 2
DEBRIS IN ORBIT: 2
MAXIMUM $\Delta P$: 2.6 min*
MAXIMUM $\Delta I$: 0.5 deg*

*See Comments

COMMENTS

Cosmos 903 was the third spacecraft of the Cosmos 862-type to experience a fragmentation. The last station-keeping maneuver prior to the event occurred about 26 April 1978. Another station-keeping maneuver was required sometime in June to maintain the established groundtrack pattern. After the event Cosmos 903 was found in a lower period orbit consistent with a successful maneuver, but the spacecraft never maneuvered again and drifted off station. One new fragment was cataloged within a week of the event. The $\Delta P$ and $\Delta I$ values above are based on the lower period (717.5 min) orbit of Cosmos 903 after the event.
Cosmos 903 and a single piece of debris three weeks after the event as reconstructed from U. S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 16.06 Jun 1977
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 1.6 m by 3.4 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 30 March 1979
TIME: 1545 GMT
ALTITUDE: 3280 km
LOCATION: 63S, 0E (dsc)
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 79089.17562851
RIGHT ASCENSION: 156.1576
INCLINATION: 62.9498
ECCENTRICITY: .6980052
ARG. OF PERIGEE: 322.3289
MEAN ANOMALY: 5.2297
MEAN MOTION: 2.00553521
MEAN MOTION DOT: .0
MEAN MOTION DOT DOT: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 1
MAXIMUM ΔP: 22.6 min*
MAXIMUM ΔI: 0.6 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 917 was the fifth spacecraft of the Cosmos 862-type to experience a fragmentation. The last station-keeping maneuver prior to the event occurred about 27 December 1978. By the end of March 1979, another maneuver was required to maintain the established groundtrack pattern. After the event the spacecraft was found in a higher period orbit rather than the necessary lower period orbit. The spacecraft then drifted off station.
Cosmos 917 debris cloud of 12 fragments about three weeks after the event as reconstructed from U.S. Space Surveillance Center database.
HIMAWARI 1 R/B

SATELLITE DATA

TYPE: Delta Second Stage (2914)
OWNER: US
LAUNCH DATE: 14.44 Jul 1977
DRY MASS (KG): 900 (approx.)
MAIN BODY: Cylinder-Nozzle; 1.4 m by 5.8 m
MAJOR APPENDAGES: Mini-skirt; 2.4 m by 0.3 m
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: On-board propellants, range safety device

EVENT DATA

DATE: 14 Jul 1977
TIME: 1612 GMT
ALTITUDE: 1450 km
LOCATION: 14N, 249E (dsc)
ASSESSED CAUSE: Propulsion-related

POST-EVENT ELEMENTS

EPOCH: 77197.57445278
MEAN ANOMALY: 303.2693
RIGHT ASCENSION: 262.0317
MEAN MOTION: 12.95114397
INCLINATION: 29.0493
MEAN MOTION DOT/2: .00007335
ECCENTRICITY: .0973469
MEAN MOTION DOT DOT/6: .0
ARG. OF PERIGEE: 66.7255
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 169
MEAN ANOMALY: 9.7 min*
DEBRIS IN ORBIT: 82
MEAN MOTION DOT DOT/6: .0
MAXIMUM ΔP: 3.0 deg*

COMMENTS

This was the fifth Delta Second Stage to experience a severe fragmentation. It is also the only one which was not in a sun-synchronous orbit, which had performed a depletion burn, and which fragmented on the day of launch. This rocket body did perform its mission successfully, carrying the third stage and the payload into a low Earth orbit. The energy for the breakup is assessed to have been the 40 kg of propellants (mainly oxidizer) remaining after the depletion burn. The elements above are the first available after the depletion burn although also after the event.
REFERENCE DOCUMENTS


Himawari 1 R/B debris cloud of 134 fragments about five months after the event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 931 1977-68A 10150

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 20.20 Jul 1977
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 1.6 m by 3.4 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 24 Oct 1977
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 77289.02131186
RIGHT ASCENSION: 305.6648
INCLINATION: 62.9440
ECCENTRICITY: .7341055
ARG. OF PERIGEE: 318.8771
MEAN ANOMALY: 4.2624
MEAN MOTION: 2.00651833
MEAN MOTION DOT/2: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 6
DEBRIS IN ORBIT: 5
MAXIMUM ΔP: 5.3 min*
MAXIMUM ΔI: 0.7 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 931 was the second spacecraft of the Cosmos 862-type to experience a fragmentation. The last station-keeping maneuver prior to the event was about 18 September. At the time of the event Cosmos 931 was at the extreme eastern edge of its groundtrack corridor. However, a maneuver at this time was not necessary since natural perturbations were beginning to shift Cosmos 931's groundtrack westward again. Debris were not officially cataloged until four years after the event.
Cosmos 931 debris cloud of 13 fragments two weeks after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 20.73 Sept 1977
DRY MASS (KG): 2,000 (approx.)
MAIN BODY: Cylinder and plate
MAJOR APPENDAGES: Plate + 2 Solar Panels
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, Battery

EVENT DATA

DATE: 23 Jun 1978
TIME: Unknown
ALTITUDE: 35790 km
LOCATION: 0.0N, 98.7E
ASSESSED CAUSE: Electrical (NiH₂ Battery Failure

PRE-EVENT ELEMENTS

EPOCH: 88166.03647595
RIGHT ASCENSION: 78.3897
INCLINATION: 0.1137
ECCENTRICITY: .0001436
ARG. OF PERIGEE: 325.2771
MEAN ANOMALY: 78.3897
MEAN MOTION: 1.00252588
MEAN MOTION DOT/2: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 1
MAXIMUM ΔP: Unknown
MAXIMUM ΔI: Unknown

COMMENTS

This event was revealed by the Commonwealth of Independent States (CIS) in a meeting in early 1992. The event was not detected by the Space Surveillance Network and was not suspected until the CIS revelation. This is the first known geostationary orbit fragmentation and was not detected by the Space Surveillance Network (SSN). No tracked orbital debris in the geostationary belt could be discerned from the analyst satellite historical archives.
Insufficient data to construct a Gabbard diagram.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 21.44 Dec 1977
DRY MASS (KG): 1000 (est.)
MAIN BODY: Cylinder; 1.3 m by 2 m (?)
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 21 Dec 1977
TIME: 1710 GMT
ALTITUDE: 1135 km
LOCATION: 38S, 274E (asc)
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 77355.65049149
RIGHT ASCENSION: 282.1792
INCLINATION: 65.8467
ECCENTRICITY: .0129854
ARG. OF PERIGEE: 116.3098
MEAN ANOMALY: 245.5638
MEAN MOTION: 13.58084598
MEAN MOTION DOT/2: .00023007
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 70
DEBRIS IN ORBIT: 68
MAXIMUM ΔP: 4.7 min
MAXIMUM ΔI: 1.1 deg

COMMENTS

Cosmos 970 was launched on a two-revolution rendezvous with Cosmos 967. After a close approach, Cosmos 970 continued on before its warhead was intentionally fired. Cosmos 970 was part of test series begun with Cosmos 249.

REFERENCE DOCUMENTS

Cosmos 970 debris cloud of 32 fragments about five months after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Delta Second Stage (2910)
OWNER: US
LAUNCH DATE: 5.75 Mar 1978
DRY MASS (KG): 900 (approx.)
MAIN BODY: Cylinder-Nozzle; 1.4 m by 5.8 m
MAJOR APPENDAGES: Mini-skirt; 2.4 m by 0.3 m
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: On-board propellants, range safety device

EVENT DATA

DATE: 27 Jan 1981
TIME: 0432 GMT
LOCATION: 80S, 301E (dsc)
ALTITUDE: 910 km
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 81026.99107090
RIGHT ASCENSION: 68.7927
INCLINATION: 98.8485
ECCENTRICITY: .0006255
ARG. OF PERIGEE: 212.9842
MEAN ANOMALY: 147.0549
MEAN MOTION: 13.96108433
MEAN MOTION DOT/2: .00000434
MEAN MOTION DOT DOT/6: .0
BSTAR: .00032708

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 208
DEBRIS IN ORBIT: 149
MAXIMUM ΔP: 9.1 min
MAXIMUM ΔI: 0.5 deg

COMMENTS

This was the seventh Delta Second Stage to experience a severe fragmentation. The event occurred nearly 35 months after the successful deployment of the Landsat 3 payload. Cause of the explosion is assessed to be related to the estimated 100 kg of residual propellants on board and characteristics of the sun-synchronous orbit.

REFERENCE DOCUMENTS


Landsat 3 R/B debris cloud of 90 identified fragments four days after the event as reconstructed from U.S. Space Surveillance Center database.
**SATELLITE DATA**

- **TYPE:** Payload
- **OWNER:** USSR
- **LAUNCH DATE:** 6.13 Sep 1978
- **DRY MASS (KG):** 1500 (approx.)
- **MAIN BODY:** Cylinder; 1.6 m by 3.4 m (?)
- **MAJOR APPENDAGES:** Solar panels (?)
- **ATTITUDE CONTROL:** Active, 3-axis
- **ENERGY SOURCES:** On-board propellants

**EVENT DATA**

- **DATE:** 10 Oct 1978
- **TIME:** Unknown
- **ALTITUDE:** Unknown
- **LOCATION:** Unknown
- **ASSESSED CAUSE:** Propulsion-related

**PRE-EVENT ELEMENTS**

- **EPOCH:** 78277.19859350
- **MEAN ANOMALY:** 4.9827
- **RIGHT ASCENSION:** 336.7676
- **MEAN MOTION:** 2.00213289
- **INCLINATION:** 62.8388
- **MEAN MOTION DOT:** .0
- **ECCENTRICITY:** .7350882
- **MEAN MOTION DOT DOT:** .0
- **ARG. OF PERIGEE:** 318.4262
- **BSTAR:** .0

**CATALOGED DEBRIS CLOUD DATA**

- **DEBRIS CATALOGED:** 4
- **DEBRIS IN ORBIT:** 4
- **MAXIMUM ΔP:** Unknown
- **MAXIMUM ΔI:** Unknown

**COMMENTS**

Cosmos 1030 was the fourth spacecraft of the Cosmos 862-type to experience a fragmentation. After entering a Molniya-type transfer orbit on 6 September, Cosmos 1030 maneuvered about 14 September to enter an operational orbit. However, the maneuver was less than that needed to maintain the anticipated groundtrack. Another maneuver on about 18 September increased the orbital period instead of lowering its as required to correct its groundtrack. No other maneuvers were observed prior to the event on 10 October. Elements on the first identifiable fragment did not appear until a year after the event. Official cataloging of debris did not begin until three years after the event.
Cosmos 1030 and a single debris fragment one year after the event as reconstructed from U.S. Space Surveillance Center database.
NIMBUS 7 R/B

1978-68B

11061

SATELLITE DATA

TYPE: Delta Second Stage (2910)
OWNER: US
LAUNCH DATE: 24.34 Oct 1978
DRY MASS (KG): 900 (approx.)
MAIN BODY: Cylinder-Nozzle; 2.4 m by 8 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: On-board propellants, range safety device

EVENT DATA

DATE: 26 Dec 1981
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Unknown

PRE-EVENT ELEMENTS

EPOCH: 81360.19972720
RIGHT ASCENSION: 277.7553
INCLINATION: 99.3003
ECCENTRICITY: .0010821
ARG. OF PERIGEE: 48.3801
MEAN ANOMALY: 311.8261
MEAN MOTION: 13.85390161
MEAN MOTION DOT/2: .000000425
MEAN MOTION DOT DOT/6: .0
BSTAR: .00004426123

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 1
MAXIMUM ΔP: Unknown
MAXIMUM ΔI: 0.6 deg*

*Based on uncataloged debris data

COMMENTS

Nimbus 7 R/B is designated Cameo in U.S. Space Command Satellite Catalog in reference to scientific piggy-back payload attached to the Delta second stage. This satellite experienced an anomalous event prior to and after the event cited above (See Section 3). Most fragments decayed very rapidly, preventing an accurate assessment of the event and its resulting debris cloud. No new objects were cataloged as a result of this event. The event apparently occurred prior to 0700 GMT.
The Nimbus 7 R/B debris cloud remnant of 27 fragments a few days after the event as reconstructed from U.S. Space Surveillance Center database. Most fragments have already experienced considerable drag effects.
COSMOS 1045 R/B

1978-100D

11087

SATELLITE DATA

TYPE: SL-14 Final Stage
OWNER: USSR
LAUNCH DATE: 26.29 Oct 1978
DRY MASS (KG): 1400
MAIN BODY: Cone-Cylinder; 2.1 m by 3.3 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: Unknown

EVENT DATA

DATE: 9 May 1988
LOCATION: 29S, 126E (dsc)
TIME: 1218 GMT
ALITUDE: 1705 km
ASSESSED CAUSE: Unknown

PRE-EVENT ELEMENTS

EPOCH: 88121.02005933
RIGHT ASCENSION: 359.3059
INCLINATION: 82.5543
ECCENTRICITY: .0011463
ARG. OF PERIGEE: 81.1553
MEAN ANOMALY: 279.0818
MEAN MOTION: 11.97080974
MEAN MOTION DOT/2: .000000208
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 42
DEBRIS IN ORBIT: 42
MAXIMUM ΔP: 7.8 min
MAXIMUM ΔI: 0.9 deg

COMMENTS

This flight, which successfully carried three separate payloads, was the fifth orbital mission of the SL-14 final stage. Propellants used were N₂O₄ and UDMH. Nearly 10 years elapsed from launch to breakup. No other SL-14 final stage has broken-up.
Cosmos 1045 R/B debris cloud as determined one week after the event with 25 fragments. Element source is U.S. Space Surveillance Center database.
P-78 (SOLWIND)  1979-17A  11278

SATISLLITE DATA

TYPE: Payload
OWNER: US
LAUNCH DATE: 24.35 Feb 1979
DRY MASS (KG): 850
MAIN BODY: Cylinder; 2.1 m by 1.3 m
MAJOR APPENDAGES: 1 solar panel
ATTITUDE CONTROL: Spin-stabilized
ENERGY SOURCES: None

EVENT DATA

DATE: 13 Sep 1985
TIME: 2043 GMT
ALTITUDE: 525 km
LOCATION: 35N, 234E (asc)
ASSESSED CAUSE: Deliberate Test

PRE-EVENT ELEMENTS

EPOCH: 85256.72413718
RIGHT ASCENSION: 182.5017
INCLINATION: 97.5346
ECCENTRICITY: .002038
ARG. OF PERIGEE: 99.4081
MEAN ANOMALY: 260.9644
MEAN MOTION: 15.11755304
MEAN MOTION DOT: .0000616
MEAN MOTION DOT DOT: .000037918
BSTAR: .000037918

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 285
DEBRIS IN ORBIT: 12
MAXIMUM ΔP: 12.7 min
MAXIMUM ΔI: 1.4 deg

COMMENTS

P-78 was impacted by a sub-orbital object at high velocity as part of a planned test.

REFERENCE DOCUMENTS

P-78 debris cloud remnant of 287 fragments seen 11 hours after the event by the U.S. Space Surveillance Network PARCS radar.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 18.50 Apr 1979
DRY MASS (KG): 3000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 10 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA

DATE: 17 Sep 1979
TIME: 1039 GMT
ALTITUDE: 385 km
LOCATION: 53S, 336E (dsc)
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS

EPOCH: 79260.33615661
RIGHT ASCENSION: 271.8638
INCLINATION: 65.0398
ECCENTRICITY: 0.0016936
ARG. OF PERIGEE: 297.9871
MEAN ANOMALY: 61.9566
MEAN MOTION: 15.58096051
MEAN MOTION DOT/2: 15.58096051
MEAN MOTION DOT DOT/6: 0
BSTAR: 61.9566

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 7.1 min*
MAXIMUM ΔI: 0.3 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1094 was the fourth spacecraft of the Cosmos 699-type to experience a fragmentation. Spacecraft had been in a regime of natural decay for four months prior to the event. All new debris decayed before being officially cataloged.

REFERENCE DOCUMENTS

Cosmos 1094 debris cloud of 20 fragments within one week of the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 27.76 Jun 1979
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 1.6 m by 3.4 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: Mid-Feb 1980
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 80048.26161234
RIGHT ASCENSION: 104.4713
INCLINATION: 63.3495
ECCENTRICITY: .7238911
ARG. OF PERIGEE: 318.4445
MEAN ANOMALY: 5.0375
MEAN MOTION: 2.00453352
MEAN MOTION DOT/2: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 6
DEBRIS IN ORBIT: 6
MAXIMUM ΔP: 3.5 min*
MAXIMUM ΔI: 0.2 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1109 was the seventh spacecraft of the Cosmos 862-type to experience a fragmentation. Cosmos 1109 maneuvered into an operational orbit about 19 July. A station-keeping maneuver was required in the second half of September to maintain groundtrack synchronization, but none was conducted. After five more months in the non-synchronized orbit, Cosmos 1109 fragmented. The payload was "lost" after 17 February 1980 and three pieces of debris were soon found which could be traced back to that period.
Cosmos 1109 and three fragments in February 1980 as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 28.01 Aug 1979
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 1.6 m by 3.4 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 9 Sep 1979
TIME: 0230 GMT
ALTITUDE: 8375 km
LOCATION: 52N, 304E (asc)
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 79249.09448656
RIGHT ASCENSION: 288.1742
INCLINATION: 63.0212
ECCENTRICITY: 0.7383335
ARG. OF PERIGEE: 318.3799
MEAN ANOMALY: 3.7678
MEAN MOTION: 2.00548359
MEAN MOTION DOT/2: 0.0
MEAN MOTION DOT DOT/6: 0.0
BSTAR: 0.0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 5
DEBRIS IN ORBIT: 5
MAXIMUM ΔP: 4.0 min*
MAXIMUM ΔI: 0.1 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1124 was the sixth spacecraft of the Cosmos 862-type to experience a fragmentation. After insertion into a Molniya-type transfer orbit on 28 August, Cosmos 1124’s ascending node was allowed to drift until 3 September when a maneuver placed the spacecraft into an operational, semi-synchronous orbit. The fragmentation occurred six days later. The spacecraft never maneuvered again and soon drifted off station.
Cosmos 1124 debris cloud of six fragments about one week after the event as reconstructed from U.S. Space Surveillance Center database.
### SATELLITE DATA

<table>
<thead>
<tr>
<th>TYPE</th>
<th>Ariane 1 Final Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>OWNER</td>
<td>ESA</td>
</tr>
<tr>
<td>LAUNCH DATE</td>
<td>24.72 Dec 1979</td>
</tr>
<tr>
<td>DRY MASS (KG)</td>
<td>1400</td>
</tr>
<tr>
<td>MAIN BODY</td>
<td>Cylinder; 2.6 m by 10.3 m</td>
</tr>
<tr>
<td>MAJOR APPENDAGES</td>
<td>None</td>
</tr>
<tr>
<td>ATTITUDE CONTROL</td>
<td>None at time of the event</td>
</tr>
<tr>
<td>ENERGY SOURCES</td>
<td>On-board propellants, range safety device</td>
</tr>
</tbody>
</table>

### EVENT DATA

| DATE:         | Apr 1980 |
| TIME:         | Unknown  |
| ALTITUDE:     | Unknown  |
| LOCATION:     | Unknown  |
| ASSESSED CAUSE: | Unknown |

### PRE-EVENT ELEMENTS

| EPOCH:         | 80088.55565320 |
| RIGHT ASCENSION: | 101.5521  |
| INCLINATION:   | 17.9092     |
| ECCENTRICITY:  | 0.7152375   |
| ARG. OF PERIGEE: | 264.7858 |
| MEAN ANOMALY:  | 17.6019     |
| MEAN MOTION:   | 2.48253031  |
| MEAN MOTION DOT/2: | .001764977 |
| MEAN MOTION DOT DOT/6: | .0 |
| BSTAR:         | .001078542  |

### CATALOGED DEBRIS CLOUD DATA

| DEBRIS CATALOGED: | 1 |
| DEBRIS IN ORBIT:  | 0 |
| MAXIMUM ΔP:       | Unknown |
| MAXIMUM ΔI:       | Unknown |

### COMMENTS

This mission was the inaugural flight of the Ariane 1 launch vehicle. Payload and R/B were apparently cross-tagged until mid-January 1980. Detection and tracking of debris has always been extremely difficult in part due to low inclination and highly elliptical orbit. Debris data were first developed in the second half of April, and calculations suggest the fragmentation occurred during the first week of April. The magnitude of the event and the total number of pieces created are unknown. Many debris had high decay rates.

### REFERENCE DOCUMENTS

CAT R/B debris cloud of seven fragments about eight weeks after the event as reconstructed from U.S. Space Surveillance Center database.
SATellite DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 14.44 Mar 1980
DRY MASS (KG): 3000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 10 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA

DATE: 15 Jul 1981
TIME: 0921 GMT
ALTITUDE: 430 km
LOCATION: 10N, 106E (asc)
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS

EPOCH: 81196.1944955
RIGHT ASCENSION: 174.9184
INCLINATION: 65.0101
ECCENTRICITY: .0068471
ARG. OF PERIGEE: 248.6139
MEAN ANOMALY: 110.8351
MEAN MOTION: 15.54665775
MEAN MOTION DOT/2: .00025375
MEAN MOTION DOT DOT/6: 0
BSTAR: .00034595

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 12
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 1.0 min*
MAXIMUM ΔI: 0.5 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1167 was the fifth spacecraft of the Cosmos 699-type to experience a fragmentation. The spacecraft had been in a regime of natural decay for three months prior to the event. Most debris reentered before being officially cataloged.

REFERENCE DOCUMENTS


Cosmos 1167 debris cloud remnant of 53 fragments about two weeks after the event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 1174
1980-30A
11765

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 18.04 Apr 1980
DRY MASS (KG): 1000 (est.)
MAIN BODY: Cylinder; 1.3 m by 2 m (?)
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 18 Apr 1980
TIME: 0726 GMT
ALTITUDE: 1625 km
LOCATION: 47N, 322E (asc)
ASSESSED CAUSE: Deliberate Detonation

POST-EVENT ELEMENTS

EPOCH: 80109.51771250
RIGHT ASCENSION: 250.9679
INCLINATION: 66.1153
ECCENTRICITY: 0.0865337
ARG. OF PERIGEE: 248.5294
MEAN ANOMALY: 102.2095
MEAN MOTION: 13.64414319
MEAN MOTION DOT/2: 0
MEAN MOTION DOT DOT/6: 0
BSTAR: 0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 46
DEBRIS IN ORBIT: 11
MAXIMUM ΔP: 5.4 min
MAXIMUM ΔI: 0.6 deg

COMMENTS

Cosmos 1174 was launched on a two-revolution rendezvous with Cosmos 1171. After a close approach, Cosmos 1174 performed a final maneuver shortly before its warhead was intentionally fired. Elements above are first data available after the final maneuver but also following the fragmentation. Cosmos 1174 was part of test series begun with Cosmos 249.

REFERENCE DOCUMENTS

Cosmos 1174 debris cloud of 18 identified fragments about 10 days after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 2.04 Jul 1980
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 1.6 m by 3.4 m(?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 14 May 1981
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 81133.07322634
RIGHT ASCENSION: 198.5704
INCLINATION: 62.6448
ECCENTRICITY: .7180863
ARG. OF PERIGEE: 319.4330
MEAN ANOMALY: 5.1166
MEAN MOTION: 2.00555560
MEAN MOTION DOT: .00001257
MEAN MOTION DOT DOT: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 2
DEBRIS IN ORBIT: 2
MAXIMUM ΔP: 6.0 min*
MAXIMUM ΔI: 0.1 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1191 was the ninth spacecraft of the Cosmos 862-type to experience a fragmentation. The last station-keeping maneuver prior to the event occurred about 7 March 1981. The next station-keeping maneuver was anticipated in mid-May. A maneuver may have been performed 14 May, during or immediately after which debris was generated. The first debris elements were developed for 25 May. The spacecraft began drifting off station immediately after the event and never recovered.
Cosmos 1191 debris cloud of 5 identified fragments one month after the event as reconstructed from U.S. Space Surveillance Center database.
SATURATE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 4.63 Nov 1980
DRY MASS (KG): 3000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 10 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA (1)

DATE: 20 Jun 1982
TIME: 1818 GMT
ALTITUDE: 875 km
ASSESSSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS (1)

EPOCH: 82171.72558670
RIGHT ASCENSION: 330.3811
INCLINATION: 65.0033
ECCENTRICITY: .0219432
ARG. OF PERIGEE: 357.8883
MEAN ANOMALY: 0.2166
MEAN MOTION: 14.49658466
MEAN MOTION DOT/2: 0.00000066
MEAN MOTION DOT DOT/6: 0
BSTAR: .0
LOCATION: 10S, 332E (dsc)
ASSESSED CAUSE: Deliberate Action

EVENT DATA (2)

DATE: 25 Aug 1982
TIME: 1231 GMT
ALTITUDE: 665 km
ASSESSSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS (2)

EPOCH: 82230.91714195
RIGHT ASCENSION: 159.4489
INCLINATION: 65.0025
ECCENTRICITY: .0225583
ARG. OF PERIGEE: 336.3217
MEAN ANOMALY: 22.7965
MEAN MOTION: 14.49745561
MEAN MOTION DOT/2: 0
MEAN MOTION DOT DOT/6: 0
BSTAR: .0
LOCATION: 65S, 238E (dsc)
ASSESSED CAUSE: Deliberate Action

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 78
DEBRIS IN ORBIT: 1
MAXIMUM ΔP: 3.4 min*
MAXIMUM ΔI: 1.8 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1220 was the seventh spacecraft of the Cosmos 699-type to experience a fragmentation. The spacecraft had been in a natural decay regime for more than 14 months at the time of the first event. A total of 47 fragments had been officially cataloged by the time of the second event which occurred
two months later. See similar dual events happening in the summer of 1982 with Cosmos 1306 and Cosmos 1260.

REFERENCE DOCUMENTS


Cosmos 1220 debris cloud of 72 fragments about one week after the first event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 19.41 Feb 1981
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 1.6 m by 3.4 m (?)
MAJOR APPENDAGES: Solar panels
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 20 Oct 1981
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 81293.1703627
RIGHT ASCENSION: 214.2278
INCLINATION: 62.9685
ECCENTRICITY: .7233048
ARG. OF PERIGEE: 318.2473
MEAN ANOMALY: 5.0298
MEAN MOTION: 2.00570861
MEAN MOTION DOT/2: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 4
DEBRIS IN ORBIT: 4
MAXIMUM ΔP: 2.7 min*
MAXIMUM ΔI: 0.4 deg*

*See comments below

COMMENTS

Cosmos 1247 was the tenth spacecraft of the Cosmos 862-type to experience a fragmentation. The last station-keeping maneuver before the event occurred about 23 July 1981. Another station-keeping maneuver was anticipated for the mid-October to mid-November period. Cosmos 1247 appears to have completed the first burn of a 2-phase maneuver sequence on the event date, followed by debris generation. The ΔP and ΔI values above are based on the post-maneuver, 711-minute orbit of 12303 rather than the pre-maneuver, 718-minute orbit cited above. The spacecraft began drifting off station immediately after the event and never recovered.
Cosmos 1247 debris cloud of six fragments about six weeks after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 20.99+ Mar 1981
DRY MASS (KG): 3000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 10 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA (1)
DATE: 8 May 1982
TIME: 0444 GMT
ALTITUDE: 555 km
LOCATION: 40N, 62E (asc)
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS (1)
EPOCH: 82127.98788154
RIGHT ASCENSION: 337.2406
INCLINATION: 65.0246
ECCENTRICITY: 0.0214690
ARG. OF PERIGEE: 330.7493
MEAN ANOMALY: 28.1726
MEAN MOTION: 14.88799005
MEAN MOTION DOT/2: 0.0003880
MEAN MOTION DOT DOT/6: 0

EVENT DATA (2)
DATE: 10 Aug 1982
TIME: 2335 GMT
ALTITUDE: 750 km
LOCATION: 51N, 238E (dsc)
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS (2)
EPOCH: 82222.89259484
RIGHT ASCENSION: 345.7388
INCLINATION: 65.0248
ECCENTRICITY: 0.0219155
ARG. OF PERIGEE: 295.5864
MEAN ANOMALY: 62.7628
MEAN MOTION: 14.89366232
MEAN MOTION DOT/2: 0.0004369
MEAN MOTION DOT DOT/6: 0

CATALOGED DEBRIS CLOUD DATA
DEBRIS CATALOGED: 68
DEBRIS IN ORBIT: 1
MAXIMUM ΔP: 5.2 min
MAXIMUM Δl: 1.0 deg
COMMENTS

Cosmos 1260 was the sixth spacecraft of the Cosmos 699-type to experience a fragmentation. The spacecraft had been in a regime of natural decay for eight months before the first event. After the event the main remnant became satellite 13183, which then fragmented three months later. A total of 40 new fragments were officially cataloged prior to the second event. See also Cosmos 1220 and Cosmos 1306 for similar dual fragmentations of Cosmos 699-type spacecraft during this period.

REFERENCE DOCUMENTS


Cosmos 1260 debris cloud of 43 fragments three weeks after the first event from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 31.40 Mar 1981
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 1.6 m by 3.4 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: Apr-May 1981
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 81095.90157023
MEAN ANOMALY: 4.6715
RIGHT ASCENSION: 282.6240
MEAN MOTION: 2.00494188
INCLINATION: 63.0386
MEAN MOTION DOT/2: .0
ECCENTRICITY: .7399210
MEAN MOTION DOT DOT/6: .0
ARG. OF PERIGEE: 816.4347
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 4
DEBRIS IN ORBIT: 4
MAXIMUM ΔP: 2.3 min*
MAXIMUM ΔI: 0.3 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1261 was the eighth spacecraft of the Cosmos 862-type to experience a fragmentation. The spacecraft attempted to maneuver from its transfer orbit to an operational orbit three days after launch. The maneuver appears to have been unsuccessful, and the spacecraft never became groundtrack-stabilized. Some debris appeared immediately after the maneuver, while additional debris were discovered in mid-May. More than one event may have occurred. The element set above is the first available after the unsuccessful maneuver.
Cosmos 1261 debris cloud of six fragments about eight weeks after (initial) event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 1275

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 4.66 Jun 1981
DRY MASS (KG): 800
MAIN BODY: Cylinder; 2.0 m by 2.1 m (?)
MAJOR APPENDAGES: Gravity-gradient boom
ATTITUDE CONTROL: Gravity gradient
ENERGY SOURCES: Unknown

EVENT DATA

DATE: 24 Jul 1981
TIME: 2351 GMT
ALTITUDE: 980 km
LOCATION: 68N, 197E (asc)
ASSESSED CAUSE: Probable Unplanned Hypervelocity Impact

PRE-EVENT ELEMENTS

EPOCH: 81205.39693092
RIGHT ASCENSION: 119.8245
INCLINATION: 82.9633
ECCENTRICITY: .0036415
ARG. OF PERIGEE: 139.0334
MEAN ANOMALY: 221.3567
MEAN MOTION: 13.7345672
MEAN MOTION DOT: .00000580
MEAN MOTION DOT DOT: .00004538900
BSTAR: .00004538900

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 306
DEBRIS IN ORBIT: 279
MAXIMUM ΔP: 4.9 min
MAXIMUM ΔI: 0.4 deg

COMMENTS

Cosmos 1275 is the only member of its class to fragment. Satellite was only 50 days old at the time of the event. Probable victim of an accidental collision, no cataloged satellite were in the vicinity at the time of the event. During the February, 1992 Space Debris Converence the Russians indicated that independent analysis favors collision with an unknown object as the most probable fragmentation mechanism. This is the first event to be assessed a probable unplanned collision.

REFERENCE DOCUMENTS


Cosmos 1275 debris cloud of 115 identified fragments one week after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 19.81 Jun 1981
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Unknown
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: Early Dec 1986
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 86334.22199701
RIGHT ASCENSION: 288.0814
INCLINATION: 67.1073
ECCENTRICITY: .6594262
ARG. OF PERIGEE: 291.9890
MEAN ANOMALY: 12.7886
MEAN MOTION: 2.00618298
MEAN MOTION DOT/2: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 2
DEBRIS IN ORBIT: 2
MAXIMUM ΔP: 0.1 min
MAXIMUM ΔI: 0.0 deg

COMMENTS

Cosmos 1278 was the fifteenth spacecraft of the Cosmos 862-type to experience a fragmentation. Spacecraft had apparently been inactive since early 1984. Additional fragments may exist, but surveillance for small objects in this orbit is difficult.
COSMOS 1285  1981-71A  12627

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 4.01 Aug 1981
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 1.6 m by 3.4 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 21 Nov 1981
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 81324.16708257
RIGHT ASCENSION: 249.5852
INCLINATION: 63.1086
ECCENTRICITY: .7350717
ARG. OF PERIGEE: 317.0022
MEAN ANOMALY: 4.8196
MEAN MOTION: 1.98014597
MEAN MOTION DOT/2: .00000781
MEAN MOTION DOT DOT/6: .0
B STAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 3
DEBRIS IN ORBIT: 3
MAXIMUM ΔP: 8.6 min*
MAXIMUM ΔI: 0.2 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1285 was the eleventh spacecraft of the Cosmos 862-type to experience a fragmentation. Spacecraft was placed in a temporary transfer orbit on the day of launch by its launch vehicle but never maneuvered to an operational orbit, suggesting an early fatal spacecraft malfunction. Event occurred three and a half months after the launch.
Cosmos 1285 debris cloud of five fragments less than a week after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 4.35 Aug 1981
DRY MASS (KG): 3000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 10 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA

DATE: 29 Sep 1982
TIME: 0520 GMT
LOCATION: 51N, 80E (asc)
ALTITUDE: 325 km
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS

EPOCH: 82272.21193719
RIGHT ASCENSION: 132.9736
INCLINATION: 65.0071
ECCENTRICITY: .0017215
ARG. OF PERIGEE: 267.4145
MEAN ANOMALY: 92.4681
MEAN MOTION: 15.86141247
MEAN MOTION DOT: .00400345
MEAN MOTION DOT DOT: .0
BSTAR: .0015199

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 2
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 0.9 min*
MAXIMUM ΔI: 0.2 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1286 was the ninth spacecraft of the Cosmos 699-type to experience a fragmentation. The spacecraft had been in a regime of natural decay for more than six months at the time of the event. The low altitude and high drag conditions made determination of the precise breakup time uncertain. The breakup or a precursor event may have occurred earlier on 29 September 1982. Most fragments decayed before being officially cataloged.

REFERENCE DOCUMENTS

Cosmos 1286 debris cloud of 10 fragments one day after the event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 1305 R/B

SATELLITE DATA

TYPE: SL-6 Final Stage
OWNER: USSR
LAUNCH DATE: 11.36 Sep 1981
DRY MASS (KG): 1000 (approx.)
MAIN BODY: Cylinder; 2.4 m by 2.2 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 11 Sep 1981
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Propulsion-related

POST-EVENT ELEMENTS

EPOCH: 81258.60717998
RIGHT ASCENSION: 68.6245
INCLINATION: 62.8156
 ECCENTRICITY: .4855644
ARG. OF PERIGEE: 286.6972
MEAN MOTION: 5.48678032
MEAN MOTION DOT: .0
MEAN MOTION DOT DOT: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 3
DEBRIS IN ORBIT: 3
MAXIMUM ΔP: Unknown
MAXIMUM ΔI: Unknown

COMMENTS

Cosmos 1305 R/B malfunctioned about 1 hour after launch during a maneuver from a LEO parking orbit to a Molniya-type orbit. The maneuver was initiated at approximately 0937 GMT near 58S, 245E (asc) at an altitude of 600 km. Apogee was raised to less than 14,000 km. Debris tracking after the event was limited, preventing an accurate assessment of magnitude of the event. First debris officially cataloged in June 1983. Debris generation is assumed to have occurred during or immediately after the unsuccessful maneuver. The element set above is for the rocket body after burn termination.
Cosmos 1305 R/B debris cloud of seven fragments about two years after the event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 1306  1981-89A  12828

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 14.85 Sep 1981
DRY MASS (KG): 3000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 10 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA (1)

DATE: 12 Jul 1982
TIME: 2325 GMT
ALTITUDE: 380 km
LOCATION: 65S, 40E (asc)
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS (1)

EPOCH: 82193.22052182
RIGHT ASCENSION: 43.8843
INCLINATION: 64.9399
ECCENTRICITY: .0019853
ARG. OF PERIGEE: 287.2390
MEAN ANOMALY: 72.7640
MEAN MOTION: 15.58171668
MEAN MOTION DOT2: .00042116
BSTAR: .00055055

EVENT DATA (2)

DATE: 18 Sep 1982
TIME: 1702 GMT
ALTITUDE: 370 km
LOCATION: 32N, 293E (asc)
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS (2)

EPOCH: 82260.17037940
RIGHT ASCENSION: 173.7764
INCLINATION: 64.9408
ECCENTRICITY: .002181
ARG. OF PERIGEE: 315.2578
MEAN ANOMALY: 44.8033
MEAN MOTION: 15.65882738
MEAN MOTION DOT2: .00076164
BSTAR: .00073994

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 8
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 2.1 min*
MAXIMUM ΔI: 0.2 deg

*Based on uncataloged debris data

COMMENTS

Cosmos 1306 was the eighth spacecraft of the Cosmos 699-type to experience a fragmentation. The first event occurred five months after the spacecraft had entered a regime of natural decay. After the event the main remnant was tagged as satellite 13369, while a piece of debris tagged as 12828 decayed...
on 16 July 1982. Only 5 new fragments were officially cataloged prior to the second event when satellite 13369 experienced a fragmentation. Three long-lived fragments cataloged with 1981-89 (13393, 13404, and 14837) were actually part of the breakup of 1980-89, another Cosmos 699-type satellite. Most Cosmos 1306 debris reentered quickly and elements were developed for only a few fragments.

REFERENCE DOCUMENTS

Analysis of Cosmos 1220 and Cosmos 1306 Fragments (U), D. Fennessy, Report AH-23, FTD/OLAI, Cheyenne Mountain, Colorado, 12 January 1983 (Secret)


Cosmos 1306 debris cloud of five identified fragments one day after the event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 1317  1981-108A  12633

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 31.95 Oct 1981
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 1.6 m by 3.4 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 25-28 Jan 1984
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 84024.46309667
RIGHT ASCENSION: 219.5352
INCLINATION: 62.8286
ECCENTRICITY: .7103977
ARG. OF PERIGEE: 324.1891
MEAN ANOMALY: 4.4900
MEAN MOTION: 2.00535027
MEAN MOTION DOT: .0
MEAN MOTION DOT DOT: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 4
DEBRIS IN ORBIT: 4
MAXIMUM ΔP: 1.8 min
MAXIMUM ΔI: 0.3 deg

COMMENTS

Cosmos 1317 was the fourteenth and the last spacecraft of the Cosmos 862-type to experience a fragmentation. The spacecraft may have been active at the time of the event, having last made a station-keeping maneuver on 5 November 1983. Cosmos 1317's orbital parameters immediately prior to the event were consistent with the need for another station-keeping maneuver. The spacecraft began drifting off station immediately after the event and never recovered.
Cosmos 1317 debris cloud of seven fragments about two weeks after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

- TYPE: Payload
- OWNER: USSR
- LAUNCH DATE: 29.41 Apr 1982
- DRY MASS (KG): 3000 (approx.)
- MAIN BODY: Cylinder; 1.3 m by 10 m (?)
- MAJOR APPENDAGES: Solar panels (?)
- ATTITUDE CONTROL: Active, 3-axis
- ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA (1)

- DATE: 8 Aug 1983
- TIME: 2331 GMT
- ALTITUDE: 365 km
- LOCATION: 32S, 310E (asc)
- ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS (1)

- EPOCH: 83220.21851552
- RIGHT ASCENSION: 279.4096
- INCLINATION: 65.0504
- ECCENTRICITY: .0024043
- ARG. OF PERIGEE: 292.8515
- MEAN ANOMALY: 66.8795
- MEAN MOTION: 15.63233551
- MEAN MOTION DOT/2: .00048258
- MEAN MOTION DOT DOT/6: .0
- BSTAR: .00051620

EVENT DATA (2)

- DATE: 1 Feb 1984
- TIME: 0322 GMT
- ALTITUDE: 320 km
- LOCATION: 4S, 200E (asc)
- ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS (2)

- EPOCH: 84031.38369465
- RIGHT ASCENSION: 25.3553
- INCLINATION: 65.0404
- ECCENTRICITY: .0017572
- ARG. OF PERIGEE: 278.1110
- MEAN ANOMALY: 81.7159
- MEAN MOTION: 15.8452631
- MEAN MOTION DOT/2: .00119378
- MEAN MOTION DOT DOT/6: .0
- BSTAR: .00050318

EVENT DATA (3)

- DATE: 20 Feb 1984
- TIME: Before 0340 GMT
- ALTITUDE: Unknown
- LOCATION: Unknown
- ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS (3)

- EPOCH: 84050.69015256
- RIGHT ASCENSION: 316.3115
- INCLINATION: 65.0338
- ECCENTRICITY: .0014134
- ARG. OF PERIGEE: 254.0517
- MEAN ANOMALY: 105.8772
- MEAN MOTION: 15.97914042
- MEAN MOTION DOT/2: .00430956
- MEAN MOTION DOT DOT/6: .00083799
- BSTAR: .00093344

CATALOGED DEBRIS CLOUD DATA

- DEBRIS CATALOGED: 29
- DEBRIS IN ORBIT: 0
- MAXIMUM ΔP: 36.8 min*
- MAXIMUM Δt: 2.3 deg*

*Based on uncataloged debris data (Event 1)
Cosmos 1355 was the tenth spacecraft of the Cosmos 699-type to experience a fragmentation. The spacecraft had been in a regime of natural decay for six months prior to the first event. Twenty-one fragments were cataloged following the first event, and the main body became satellite 14275. This object spawned at least seven more fragments on 1 February. The parent was then retagged to the original 13150 satellite number. The third event resulted in the development of 13 new fragment element sets, but none were cataloged and the low altitude prevented an estimate of a precise breakup location.

REFERENCE DOCUMENTS


Cosmos 1355 debris cloud of 149 fragments about seven hours after the first event in August 1983 as seen by the U.S. Space Surveillance Network PARCS radar. Figure from the cited reference.
COSMOS 1375

SATELLITE DATA

TYPE: Payload  
OWNER: USSR  
LAUNCH DATE: 6.72 Jun 1982  
DRY MASS (KG): 800 (est.)  
MAIN BODY: Cylinder; 2 m by 2 m (?)  
MAJOR APPENDAGES: Solar panels, gravity-gradient boom (?)  
ATTITUDE CONTROL: Gravity gradient (?)  
ENERGY SOURCES: Unknown  

EVENT DATA

DATE: 21 Oct 1985  
TIME: 0353 GMT  
ALTITUDE: 995 km  
LOCATION: 66N, 351E (asc)  
ASSESSED CAUSE: Unknown  

PRE-EVENT ELEMENTS

EPOCH: 85299.85195210  
RIGHT ASCENSION: 350.2805  
INCLINATION: 65.8390  
ECCENTRICITY: .0005355  
ARG. OF PERIGEE: 26.5667  
MEAN ANOMALY: 333.5602  
MEAN MOTION: 13.71079597  
MEAN MOTION DOT/2: .00000158  
MEAN MOTION DOT DOT/6: .0  
BSTAR: .00023894  

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 58  
DEBRIS IN ORBIT: 57  
MAXIMUM ΔP: 2.3 min*  
MAXIMUM ΔI: 0.1 deg*  
*Based on uncataloged debris data  

COMMENTS

Cosmos 1375 was the third spacecraft of the Cosmos 839-type to experience a fragmentation. Although these satellites are used in conjunction with the Cosmos 249-type spacecraft which are deliberately fragmented, the cause of Cosmos 839-type events appears to be unrelated. In the case of Cosmos 1375, 40 months elapsed since its test with a Cosmos 249-type spacecraft.  

REFERENCE DOCUMENTS

Cosmos 1375 debris cloud of 68 fragments seen a few hours after the event by the U.S. Space Surveillance Network PARCS radar.
SATellite DATA

**Type:** Payload

**Owner:** USSR

**Launch Date:** 4.74 Sep 1982

**Dry Mass (kg):** 3000 (approx.)

**Main Body:** Cylinder; 1.3 m by 10 m (?)

**Major Appendages:** Solar panels (?)

**Attitude Control:** Active, 3-axis

**Energy Sources:** On-board propellants, explosive charge (?)

EVENT DATA

**Date:** 20 Dec 1983

**Time:** 1215 GMT

**Assessed Cause:** Deliberate Action

**Location:** 25S, 45E (dsc)

**Altitude:** 330 km

PRE-EVENT ELEMENTS

**Epoch:** 83354.22079767

**Right Ascension:** 126.1259

**Inclination:** 65.0055

**Eccentricity:** .0020774

**Arg. of Perigee:** 318.0927

**Mean Anomaly:** 42.0375

**Mean Motion:** 15.81899265

**Mean Motion Dot/2:** .00186341

**Mean Motion Dot Dot/6:** 0

**Bstar:** .00088277

CATALOGED DEBRIS CLOUD DATA

**Debris Cataloged:** 32

**Debris in Orbit:** 0

**Maximum ΔP:** 7.3 min*

**Maximum ΔI:** 2.0 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1405 was the eleventh spacecraft of the Cosmos 699-type to experience a fragmentation. Spacecraft had been in natural decay for 12 months prior to the event. Most debris reentered before being officially cataloged.

REFERENCE DOCUMENTS


Cosmos 1405 debris cloud of 142 fragments one hour after the event as seen by the U.S. Space Surveillance Network PARCS radar. Figure from Analysis of the Fragmentation of Kosmos 1405.
SATELLITE DATA

TYPE: SL-6 Final Stage
OWNER: USSR
LAUNCH DATE: 8.58 Dec 1982
DRY MASS (KG): 1000 (approx.)
MAIN BODY: Cylinder; 2.4 m by 2.2 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 8 Dec 1982
TIME: 1448 GMT
ALTITUDE: 400 km
LOCATION: 62S, 302E (asc)
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 82342.56790507
RIGHT ASCENSION: 316.3789
INCLINATION: 62.9496
ECCENTRICITY: .0143321
ARG. OF PERIGEE: 56.2493
MEAN ANOMALY: 305.2204
MEAN MOTION: 15.79849844
MEAN MOTION DOT/2: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 29
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 4.9 min
MAXIMUM ΔI: 0.2 deg

COMMENTS

Fragmentation occurred at the time the SL-6 final stage was fired to move the payload from a parking orbit to a Molniya-type transfer orbit. Pre-event elements are taken from satellite 13686 for first revolution parking orbit. A second fragmentation may have occurred on 9 December 1982.
Cosmos 1423 R/B debris cloud of 24 fragments soon after the event(s) as reconstructed from U.S. Space Surveillance Center database.
ASTRON DEBRIS

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EVENT DATA

| DATE        | 3 Sep 1984 |
| TIME        | 2023 GMT   |
| ALTITUDE    | 400 km     |
| LOCATION    | 12S, 352E (dsc) |
| ASSESSED CAUSE | Unknown    |

PRE-EVENT ELEMENTS

| EPOCH:       | 84247.05150886 |
| RIGHT ASCENSION: | 94.4099       |
| INCLINATION:  | 51.5306       |
| ECCENTRICITY: | 0.0710960     |
| ARG. OF PERIGEE: | 246.1573     |
| MEAN ANOMALY: | 106.3279      |
| MEAN MOTION:  | 14.50264973   |
| MEAN MOTION DOT/2: | 0.0079313 |
| MEAN MOTION DOT DOT/6: | 0.0000075234 |
| BSTAR:       | 106.3279      |

CATALOGED DEBRIS CLOUD DATA

| DEBRIS CATALOGED: 1 |
| DEBRIS IN ORBIT: 0 |
| MAXIMUM ΔP: 2.4 min* |
| MAXIMUM ΔI: 0.3 deg* |

*Based on uncataloged debris data

COMMENTS

Parent satellite was apparently one of two operational pieces of debris which are routinely released after the first burn of the SL-12 final stage and is misidentified as a platform in the U.S. Space Command Satellite Catalog. The nature of these objects is unknown. Element sets on 16 fragments were developed. None were officially cataloged. A second event with as many as five debris may have occurred on 9 September 1984. Possibly related to fragmentation of Cosmos 1656 debris which occurred after 31 months in orbit, Cosmos 1519-1521 debris which occurred after 86 months in orbit, and Cosmos 1710-1712 which occurred after 72 months in orbit.
Fragments from Astron debris as determined within a few days of the first event. Elements from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: US
LAUNCH DATE: 28.66 Mar 1983
DRY MASS (KG): 1000 (approx.)
MAIN BODY: Cylinder-box; 1.9 m by 7.5 m
MAJOR APPENDAGES: 1 solar panel
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 30 Dec 1985
TIME: 1005 GMT
ALTITUDE: 825 km
LOCATION: 68S, 300E (dsc)
ASSESSED CAUSE: Electrical System Malfunction

PRE-EVENT ELEMENTS

EPOCH: 85348.40460348
RIGHT ASCENSION: 16.9717
INCLINATION: 98.6488
ECCENTRICITY: .0015724
ARG. OF PERIGEE: 276.6589
MEAN ANOMALY: 83.2801
MEAN MOTION: 14.22481975
MEAN MOTION DOT/2: .00000037
MEAN MOTION DOT DOT/6: .0
BSTAR: .00025130

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 7
DEBRIS IN ORBIT: 1
MAXIMUM ΔP: 4.7 min
MAXIMUM ΔI: 0.1 deg

COMMENTS

A malfunction on NOAA 8 caused a battery to overcharge, resulting in a minor explosion of the battery. The spacecraft was operational at the time of the event. Six new fragments were detected and cataloged. All decayed by February 1989, leaving the parent still in orbit.

REFERENCE DOCUMENTS

NOAA 8 debris cloud of six fragments plus the parent satellite (large symbols) one day after the event as reconstructed from Naval Space Surveillance System database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 25.81 Apr 1983
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 1.6 m by 3.4 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 13 Aug 1983
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 83225.00107283
RIGHT ASCENSION: 79.8630
INCLINATION: 63.3076
ECCENTRICITY: .7324437
ARG. OF PERIGEE: 320.0041
MEAN ANOMALY: 4.5332
MEAN MOTION: 2.00589678
MEAN MOTION DOT/D: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0068163

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 4
DEBRIS IN ORBIT: 4
MAXIMUM ΔP: 4.8 min*
MAXIMUM ΔI: 0.4 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1456 was the thirteenth spacecraft of the Cosmos 862-type to experience a fragmentation. The spacecraft may have been active at the time of the event, having last made a station-keeping maneuver on 22 June 1983. The next station-keeping maneuver should have occurred in the second half of August or early September 1983. The spacecraft began drifting off station immediately after the event and never recovered.
Cosmos 1456 debris cloud of six fragments less than three weeks after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

**TYPE:** Payload  
**OWNER:** USSR  
**LAUNCH DATE:** 7.44 May 1983  
**DRY MASS (KG):** 3000 (approx.)  
**MAIN BODY:** Cylinder; 1.3 m by 10 m (?)  
**MAJOR APPENDAGES:** Solar panels (?)  
**ATTITUDE CONTROL:** Active, 3-axis  
**ENERGY SOURCES:** On-board propellants, explosive charge (?)

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<tbody>
<tr>
<td>65.0248</td>
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<tr>
<th>ECCENTRICITY:</th>
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<tbody>
<tr>
<td>0.222492</td>
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<table>
<thead>
<tr>
<th>ARG. OF PERIGEE:</th>
<th>BSTAR:</th>
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<tr>
<td>236.8082</td>
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CATALOGED DEBRIS CLOUD DATA

<table>
<thead>
<tr>
<th>DEBRIS CATALOGED:</th>
<th>MAXIMUM ΔP:</th>
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</thead>
<tbody>
<tr>
<td>158</td>
<td>5.9 min*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEBRIS IN ORBIT:</th>
<th>MAXIMUM ΔΔ:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1.0 deg*</td>
</tr>
</tbody>
</table>

*Based on uncataloged debris data

COMMENTS

Cosmos 1461 was the twelfth spacecraft of the Cosmos 699-type to experience a fragmentation. Cosmos 1461 entered a natural decay regime more than 13 months prior to first event. After the first event as many as 20 fragments were detected but only six new objects were cataloged. The second event occurred two months later and produced considerably more debris. These events followed the pattern set by Cosmos 1220 and Cosmos 1260.
REFERENCES DOCUMENTS


Cosmos 1461 debris cloud remnant of 65 fragments four days after the second event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 1481

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 8.80 Jul 1983
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 1.6 m by 3.4 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 9 Jul 1983
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 83189.85702098
RIGHT ASCENSION: 166.3194
INCLINATION: 62.9394
ECCENTRICITY: .7337681
ARG. OF PERIGEE: 317.9301
MEAN ANOMALY: 4.6462
MEAN MOTION: 2.03523282
MEAN MOTION DOT/2: .00000702
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 3
DEBRIS IN ORBIT: 3
MAXIMUM ΔP: 8.7 min*
MAXIMUM ΔI: 0.8 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1481 was the twelfth spacecraft of the Cosmos 862-type to experience a fragmentation. The event apparently occurred within a day of launch. An expected orbital maneuver by Cosmos 1481 to move from its transfer orbit to an operational orbit about 3 days after launch was never performed.
Cosmos 1481 debris cloud of four objects one month after the event as reconstructed from U.S. Space Surveillance Center database.
## SATELLITE DATA

<table>
<thead>
<tr>
<th>Type</th>
<th>Operational Debris</th>
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</thead>
<tbody>
<tr>
<td>Owner</td>
<td>USSR</td>
</tr>
<tr>
<td>Launch Date</td>
<td>20.04 Dec 1983</td>
</tr>
<tr>
<td>Dry Mass (kg)</td>
<td>Unknown</td>
</tr>
<tr>
<td>Main Body</td>
<td>Unknown</td>
</tr>
<tr>
<td>Major Appendages</td>
<td>Unknown</td>
</tr>
<tr>
<td>Attitude Control</td>
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<tr>
<td>Energy Sources</td>
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## EVENT DATA

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<tr>
<td>Time</td>
<td>0312 GMT</td>
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<tr>
<td>Altitude</td>
<td>18550 km</td>
</tr>
<tr>
<td>Location</td>
<td>28N, 106E (dsc)</td>
</tr>
<tr>
<td>Assessed Cause</td>
<td>Unknown</td>
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## PRE-EVENT ELEMENTS

<table>
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<tr>
<th>Epoch</th>
<th>91032.22560633</th>
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<tbody>
<tr>
<td>Right Ascension</td>
<td>133.4557</td>
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<tr>
<td>Inclination</td>
<td>51.9464</td>
</tr>
<tr>
<td>Eccentricity</td>
<td>0.5787304</td>
</tr>
<tr>
<td>Arg. Of Perigee</td>
<td>315.5487</td>
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<td>Mean Anomaly</td>
<td>10.4843</td>
</tr>
<tr>
<td>Mean Motion</td>
<td>4.30882556</td>
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<td>Mean Motion Dot/2</td>
<td>0.0004140</td>
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<td>Mean Motion Dot/6</td>
<td>0.0018354</td>
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<tr>
<td>Bstar</td>
<td>10.4843</td>
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## CATALOGED DEBRIS CLOUD DATA

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<tr>
<td>Debris In Orbit</td>
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<tr>
<td>Maximum ΔP</td>
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</tr>
<tr>
<td>Maximum ΔI</td>
<td>Unknown</td>
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</tbody>
</table>

## COMMENTS

This piece of operational debris was one of two objects which are routinely released by the SL-12 final stage after the first burn. The nature of these objects is unclear. NAVSPASUR observed at least 12 fragments on the day of the event and approximately three dozen on 7 February. An element set was developed on only one new fragment. This object type has been the subject of three other known fragmentation events [Astron Debris -- 1983-020; Cosmos 1656 Debris -- 1985-042; and Cosmos 1710-1712 Debris -- 1985-118].
Insufficient data to construct a Gabbard diagram.
SATELLITE DATA

TYPE: PAM-D Upper Stage
OWNER: US
LAUNCH DATE: 3.54 Feb 1984
DRY MASS (KG): 2230 (205 without solid propellants)
MAIN BODY: Sphere-Nozzle; 1.2 m by 2.1 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Spin-stabilized
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 6 Feb 1984
TIME: 1600 GMT
ALTITUDE: 280 km
LOCATION: 0N, 120E (asc)
ASSESSED CAUSE: Propulsion-related

PRE-EVENT ELEMENTS

EPOCH: 84037.35377144
RIGHT ASCENSION: 139.8370
INCLINATION: 28.4669
ECCENTRICITY: .0006481
ARG. OF PERIGEE: 277.3659
MEAN ANOMALY: 82.4657
MEAN MOTION: 15.97451864
MEAN MOTION DOT2: .00197501
MEAN MOTION DOT DOT/6: 0
BSTAR: .00040999

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 3
DEBRIS IN ORBIT: 1
MAXIMUM ΔP: 9.4 min*
MAXIMUM ΔI: 0.3 deg*

*Based on uncataloged debris data

COMMENTS

Palapa B2 and its PAM-D upper stage were deployed from the Space Shuttle Challenger at 1513 GMT, 6 February 1984. Ignition of the upper stage occurred on schedule at 1600 GMT, but the nozzle fragmented within 10 seconds. Without the nozzle the burn could not be sustained and a natural shutdown quickly followed. The PAM-D then separated from Palapa B2. The above elements are for the Shuttle prior to deployment. The Shuttle made a small posigrade evasive maneuver after deployment and before ignition of the the PAM-D. See also Westar 6 R/B fragmentation.
Palapa B2 R/B debris cloud of five fragments about three days after the event as reconstructed from U.S. Space Surveillance Center database. The Palapa B2 R/B is the object with the second highest orbital period.
WESTAR 6 R/B

SATELLITE DATA

<table>
<thead>
<tr>
<th>TYPE:</th>
<th>PAM-D upper stage</th>
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</thead>
<tbody>
<tr>
<td>OWNER:</td>
<td>US</td>
</tr>
<tr>
<td>LAUNCH DATE:</td>
<td>3.54 Feb 1984</td>
</tr>
<tr>
<td>DRY MASS (KG):</td>
<td>2230 (205 without solid propellants)</td>
</tr>
<tr>
<td>MAIN BODY:</td>
<td>Sphere-Nozzle; 1.2 m by 2.1 m</td>
</tr>
<tr>
<td>MAJOR APPENDAGES:</td>
<td>None</td>
</tr>
<tr>
<td>ATTITUDE CONTROL:</td>
<td>Spin-stabilized</td>
</tr>
<tr>
<td>ENERGY SOURCES:</td>
<td>On-board propellants</td>
</tr>
</tbody>
</table>

EVENT DATA

| DATE:            | 3 Feb 1984 |
| TIME:            | 2145 GMT   |
| ALTITUDE:        | 305 km     |
| LOCATION:        | 0N, 56E (asc) |
| ASSESSED CAUSE:  | Propulsion-related |

PRE-EVENT ELEMENTS

| EPOCH:          | 84034.84362284 |
| RIGHT ASCENSION: | 157.5848      |
| INCLINATION:    | 28.4660       |
| ECCENTRICITY:   | .0006644      |
| ARG. OF PERIGEE: | 311.2683      |
| MEAN ANOMALY:   | 48.7355       |
| MEAN MOTION:    | 15.88299499   |
| MEAN MOTION DOT/2: | .00000250   |
| BSTAR:          | .0             |

CATALOGED DEBRIS CLOUD DATA

| DEBRIS CATALOGED: | 14 |
| DEBRIS IN ORBIT:  | 1  |
| MAXIMUM ΔP:       | 9.7 min |
| MAXIMUM ΔI:       | 0.8 deg  |

COMMENTS

Westar 6 and its PAM-D upper stage were deployed from the Space Shuttle Challenger at 2100 GMT, 3 February 1984. Ignition of the upper stage occurred on schedule at 2145 GMT but the nozzle fragmented within 10 seconds. Without the nozzle the burn could not be sustained and a natural shutdown quickly followed. The PAM-D then separated from Westar 6. See also Palapa B2 R/B fragmentation.

REFERENCE DOCUMENTS

Westar 6 R/B debris cloud of seven fragments less than two days after the event as reconstructed from U.S. Space Surveillance Center database. The Westar 6 R/B is the object in the high, 100-min orbit.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 7.95 Aug 1984
DRY MASS (KG): 3000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 10 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA

DATE: 23 Feb 1986
TIME: 1850 GMT
LOCATION: 29N, 187E (asc)
ALTITUDE: 430 km
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS

EPOCH: 86048.57631415
RIGHT ASCENSION: 268.3025
INCLINATION: 65.0271
ECCENTRICITY: .0022403
ARG. OF PERIGEE: 287.3230
MEAN ANOMALY: 72.5463
MEAN MOTION: 15.47795866
MEAN MOTION DOT/2: .00005888
MEAN MOTION DOT DOT/6: .00011680
BSTAR: .00011680

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 45
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 2.0 min
MAXIMUM ΔI: 0.4 deg

COMMENTS

Cosmos 1588 was the thirteenth spacecraft of the Cosmos 699-type to experience a fragmentation. Spacecraft had been in natural decay for seven months prior to the event.

REFERENCE DOCUMENTS

Cosmos 1588 cataloged debris cloud of 16 fragments three weeks after the event as reconstructed from U.S. Space Surveillance Center database.
SATellite DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 18.90 Apr 1985
DRY MASS (KG): 3000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 10 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA

DATE: 20 Nov 1987
TIME: 0131 GMT
ALTITUDE: 410 km
LOCATION: 65N, 300E (dsc)
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS

EPOCH: 87323.98216942
RIGHT ASCENSION: 286.0367
INCLINATION: 65.0306
ECCENTRICITY: .0018658
ARG. OF PERIGEE: 254.4728
MEAN ANOMALY: 105.3951
MEAN MOTION: 15.56048984
MEAN MOTION DOT/2: .00039428
MEAN MOTION DOT DOT/6: .0
BSTAR: .00055895

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 24
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 5.5 min*
MAXIMUM ΔI: 0.2 deg*

*Based on cataloged and uncataloged debris data

COMMENTS

Cosmos 1646 was the sixteenth and last spacecraft of the Cosmos 699-type to experience a fragmentation. Spacecraft had been in natural decay for nearly 20 months prior to the event. Many debris reentered before being officially cataloged.

REFERENCE DOCUMENTS

Cosmos 1646 debris cloud remnant of 38 fragments about 10 days after the event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 1654  1985-39A  15734

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 23.53 May 1985
DRY MASS (KG): 6000 (approx.)
MAIN BODY: Cone-cylinder; 2.4 m by 7 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 21 Jun 1985
TIME: 1047 GMT
ALTITUDE: 200 km

LOCATION: 8N, 292E (asc)
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 85172.01363851
RIGHT ASCENSION: 1.2391
INCLINATION: 64.8566
ECCENTRICITY: .0086971
ARG. OF PERIGEE: 47.8764
MEAN ANOMALY: 313.0734
MEAN MOTION: 16.11890623
MEAN MOTION DOT/2: .00311214
MEAN MOTION DOT DOT/6: .000034493
BSTAR: .00015520

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 18
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 22.1 min*
MAXIMUM ΔI: 1.5 deg*

*Based on uncataloged debris data

COMMENTS

Spacecraft was apparently destroyed after a malfunction prevented controlled reentry and landing in the Soviet Union. Fifth incident of this type. Most debris reentered before being officially cataloged.

REFERENCE DOCUMENTS

Cosmos 1654 debris cloud remnant of 351 fragments seen nine hours after the event by the U.S. Space Surveillance Network PARCS radar.
COSMOS 1656 DEBRIS

SATellite DATA

TYPE: Operational Debris
OWNER: USSR
LAUNCH DATE: 30.62 May 1985
DRY MASS (KG): Unknown
MAIN BODY: Unknown
MAJOR APPENDAGES: Unknown
ATTITUDE CONTROL: None
ENERGY SOURCES: Unknown

EVENT DATA

DATE: 5 Jan 1988
TIME: 0147 GMT
ALTITUDE: 860 km
LOCATION: 66N, 151E (asc)
ASSESSED CAUSE: Unknown

PRE-EVENT ELEMENTS

EPOCH: 88002.58690356
RIGHT ASCENSION: 205.7335
INCLINATION: 66.5867
ECCENTRICITY: .0034143
ARG. OF PERIGEE: 267.7562
MEAN ANOMALY: 91.9605
MEAN MOTION: 14.17143400
MEAN MOTION DOT/2: .00000144
MEAN MOTION DOT DOT/6: .000088961
BSTAR: .000088961

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 6
DEBRIS IN ORBIT: 6
MAXIMUM ΔP: 3.3 min
MAXIMUM ΔI: 0.0 deg

COMMENTS

This piece of operational debris was one of two objects which are routinely released by the SL-12 final stage after the first burn. The nature of these objects is unclear. NAVSPASUR observed two additional, uncataloged fragments associated with this event. Similar objects from the Astron mission fragmented in 1984 after 17 months in orbit, the Cosmos 1519-1521 mission after 86 months in orbit, and the Cosmos 1710-1712 mission after 72 months in orbit.
Fragments from Cosmos 1656 debris as determined two weeks after the event. Elements from U.S. Space Surveillance Center as published by NASA Goddard Space Flight Center.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 19.07 Sep 1985
DRY MASS (KG): 3000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 10 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA

DATE: 18 Dec 1986
TIME: 2017 GMT
ALTITUDE: 415 km
LOCATION: 22S, 292 E (asc)
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS

EPOCH: 86351. 87879723
RIGHT ASCENSION: 337.4852
INCLINATION: 65.0089
ECCENTRICITY: .0068048
ARG. OF PERIGEE: 45.1423
MEAN ANOMALY: 315.5258
MEAN MOTION: 15.45249396
MEAN MOTION DOT/2: .00011076
MEAN MOTION DOT DOT/6: .0
BSTAR: .00021714

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 23
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 2.3 min*
MAXIMUM ΔI: 0.7 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1682 was the fourteenth spacecraft of the Cosmos 699-type to experience a fragmentation. Spacecraft had been in natural decay for two months prior to the event. Many debris reentered before being officially cataloged.

REFERENCE DOCUMENTS

Cosmos 1682 debris cloud remnant of 66 fragments about one week after the event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 1691

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 9.90 Oct 1985
DRY MASS (KG): 200 (est.)
MAIN BODY: Unknown
MAJOR APPENDAGES: Unknown
ATTITUDE CONTROL: Unknown
ENERGY SOURCES: Unknown

EVENT DATA

DATE: 22 Nov 1985
TIME: 0840 GMT
ALTITUDE: 1415 km
LOCATION: 31N, 326E (dsc)
ASSESSED CAUSE: Electrical

PRE-EVENT ELEMENTS

EPOCH: 85320.62059878
RIGHT ASCENSION: 345.1807
INCLINATION: 82.6124
ECCENTRICITY: .0002812
ARG. OF PERIGEE: 268.9870
MEAN ANOMALY: 91.0897
MEAN MOTION: 12.62038878
MEAN MOTION DOT/2: .00000022
MEAN MOTION DOT DOT/6: .000099999
BSTAR: .000099999

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 14
DEBRIS IN ORBIT: 11
MAXIMUM ΔP: 1.0 min
MAXIMUM ΔI: 0.1 deg

COMMENTS

Cosmos 1691 was one of six independent payloads on this launch, which was only the second in this program. Cosmos 1691 was the last payload deployed and may be referred to as Cosmos 1695 in the Soviet Union. One fragment was administratively decayed in February, 1989. No other payloads in this program have fragmented. This event is assessed to be the second known NiH2 battery failure as indicated by Dr. K. M. Suitnshev during the Early 1992 Space Debris Conference.
Cosmos 1691 debris cloud of 10 fragments two days after the event as reconstructed from Naval Space Surveillance System database.
SATELLITE DATA

<table>
<thead>
<tr>
<th>TYPE</th>
<th>Operational Debris</th>
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<td>LAUNCH DATE</td>
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<tr>
<td>DRY MASS (KG)</td>
<td>Unknown</td>
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<tr>
<td>MAIN BODY</td>
<td>Unknown</td>
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<tr>
<td>MAJOR APPENDAGES</td>
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<tr>
<td>ATTITUDE CONTROL</td>
<td>None</td>
</tr>
<tr>
<td>ENERGY SOURCES</td>
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</tbody>
</table>

EVENT DATA

| DATE            | 29 Dec 1991 |
| TIME            | 0903 GMT   |
| ALTITUDE        | 4728 km    |
| LOCATION        | 25.3N, 331.9E |
| ASSESSED CAUSE  | Unknown    |

PRE-EVENT ELEMENTS

| EPOCH            | 91333.40579226 |
| RIGHT ASCENSION  | 48.0333        |
| INCLINATION      | 65.2547        |
| ECCENTRICITY     | .5645362       |
| ARG. OF PERIGEE  | 245.7447       |
| MEAN ANOMALY     | 46.8976        |
| MEAN MOTION      | 4.23089679     |
| MEAN MOTION DOT2 | .00000167      |
| MEAN MOTION DOT DOT/6 | .0          |
| BSTAR            | .0012603       |

CATALOGED DEBRIS CLOUD DATA

| DEBRIS CATALOGED | 1 |
| DEBRIS IN ORBIT  | 1 |
| MAXIMUM ΔP       | 5.7 min * |
| MAXIMUM ΔI       | 0.8 deg * |

* based upon uncataloed debris data

COMMENTS

There were 26 objects associated with this event on 30 December per a phonecon with NAVSPASUR (Edna Jenkins). Only 2 analyst satellites were generated and insufficient data was available for a Gabbard diagram. This event is likely related to three other events involving SL-12 launch related debris [Astron Debris (83-20), Cosmos 1656 Debris (85-42), and Cosmos 1519-1521 Debris (83-127)].
Insufficient data to construct a Gabbard diagram.
SPOT 1 R/B 1986-19C 16615

SATellite DATA

TYPE: Ariane 1 Final Stage
OWNER: ESA
LAUNCH DATE: 22.07 Feb 1986
DRY MASS (KG): 1400
MAIN BODY: Cylinder; 2.6 m by 10.3 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None at time of the event
ENERGY SOURCES: On-board propellants, range safety package

EVENT DATA

DATE: 13 Nov 1986
TIME: 1940 GMT
ALTITUDE: 805 km
LOCATION: 7N, 42E (asc)
ASSESSED CAUSE: Unknown

PRE-EVENT ELEMENTS

EPOCH: 86305.08337689
RIGHT ASCENSION: 18.0087
INCLINATION: 98.6973
ECCENTRICITY: .0021203
ARG. OF PERIGEE: 60.1312
MEAN ANOMALY: 300.1947
MEAN MOTION: 14.22163662
MEAN MOTION DOT/2: .00000203
MEAN MOTION DOT DOT/6: .0
BSTAR: .000099999

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 489
DEBRIS IN ORBIT: 59
MAXIMUM ΔP: 6.2 min
MAXIMUM ΔI: 1.2 deg

COMMENTS

Event occurred approximately nine months after the rocket body had successfully deployed the Spot 1 and Viking payloads. First use of Ariane launch vehicle for low Earth orbit. May be related to other Ariane fragmentations.

REFERENCE DOCUMENTS


Spot 1 R/B debris cloud of 465 fragments three months after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 4.21 Aug 1986
DRY MASS (KG): 3000 (approx.)
MAIN BODY: Cylinder; 1.3 m by 10 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA

DATE: 21 Sep 1987
TIME: 1205 GMT
ALTITUDE: 320 km
LOCATION: 60S, 174E (dsc)
ASSESSED CAUSE: Deliberate Action

PRE-EVENT ELEMENTS

EPOCH: 87263.81808697
RIGHT ASCENSION: 122.5376
INCLINATION: 65.0147
ECCENTRICITY: .0099296
ARG. OF PERIGEE: 288.4915
MEAN ANOMALY: 70.4851
MEAN MOTION: 15.63167584
MEAN MOTION DOT/2: .00078200
MEAN MOTION DOT DOT/6: .0
BSTAR: .00065556

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 4
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 1.9 min*
MAXIMUM Δi: 0.0 deg*

*Based on uncataloged debris data

COMMENTS

Cosmos 1769 was the fifteenth spacecraft of the Cosmos 699-type to experience a fragmentation. Spacecraft was regularly maneuvered until 17 Sep 1987 when the vehicle began to decay naturally. Most debris reentered before being officially cataloged.

REFERENCE DOCUMENTS

Cosmos 1769 debris cloud remnant of 34 fragments 3 days after the event as reconstructed from Naval Space Surveillance System database.
USA 19

1986-69A

16937

SATELLITE DATA

TYPE: Payload
OWNER: US
LAUNCH DATE: 5.63 Sep 1986
DRY MASS (KG): 930
MAIN BODY: Cylinder-Cone; 1.2 m by 4.6 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge (?)

EVENT DATA

DATE: 5 Sep 1986
TIME: 1752 GMT
ALTITUDE: 220 km
LOCATION: 15N, 166E (asc)
ASSESSED CAUSE: Deliberate Test

POST-EVENT ELEMENTS

EPOCH: 86250.63774662
RIGHT ASCENSION: 28.1524
INCLINATION: 39.0665
ECCENTRICITY: .0390567
ARG. OF PERIGEE: 26.7075
MEAN ANOMALY: 335.3264
MEAN MOTION: 15.28976390
MEAN MOTION DOT/2: .01159823
MEAN MOTION DOT DOT/6: .0000050922
BSTAR: .0028192

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 13
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 424.1 min*
MAXIMUM ΔI: 4.4 deg*

*Based on uncataloged debris data

COMMENTS

USA 19 deliberately collided with USA 19 R/B at high relative velocity. Both satellites were thrusting at the time of impact. Element set above is post-event and is best estimate of orbit at time of the event. Most debris reentered before being officially cataloged.

REFERENCE DOCUMENTS


USA 19 debris cloud remnant of 191 fragments one day after the event as seen by the U.S. Space Surveillance radar FPS-85 at Eglin AFB, Florida.
USA 19 R/B 1986-096 16938

SATCHELATE DATA

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<th>TYPE:</th>
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<td>DRY MASS (KG):</td>
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<tr>
<td>MAJOR APPENDAGES:</td>
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<td>ATTITUDE CONTROL:</td>
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<td>ENERGY SOURCES:</td>
<td>On-board propellants</td>
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EVENT DATA

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POST-EVENT ELEMENTS

| EPOCH:          | 86249.96053354 | MEAN ANOMALY: | 307.9381 |
| RIGHT ASCENSION: | 10.4654       | MEAN MOTION:  | 15.50608380 |
| INCLINATION:    | 22.7830       | MEAN MOTION DOT/2: | .00138611 |
| ECCENTRICITY:   | .0288474      | MEAN MOTION DOT DOT/6: | .0 |
| ARG. OF PERIGEE: | 54.7772       | BSTAR:        | .00033298 |

CATALOGED DEBRIS CLOUD DATA

| DEBRIS CATALOGED: | 5         | MAXIMUM ΔP: | 53.6 min* |
| DEBRIS IN ORBIT:  | 0         | MAXIMUM ΔI: | 2.5 deg*  |

*Based on uncataloged debris data

COMMENTS

USA 19 R/B was deliberately struck by USA 19 at high relative velocity. Both satellites were thrusting at the time of impact. Element set above is post-event and is best estimate of orbit at time of the event. Most debris reentered before being officially cataloged.

REFERENCE DOCUMENTS


USA 19 R/B debris cloud remnant of 190 fragments one day after the event as seen by the U.S. Space Surveillance radar FPS-85 at Eglin AFB, Florida.
COSMOS 1813

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 15.47 Jan 1987
DRY MASS (KG): 6000 (approx.)
MAIN BODY: Sphere-Cylinder-Cone, 2.4 m by 6.5 m (?)
MAJOR APPENDAGES: None
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 29 Jan 1987
TIME: 0555 GMT
ALTITUDE: 390 km
LOCATION: 73N, 122E (asc)
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 87028.91020168
RIGHT ASCENSION: 256.7724
INCLINATION: 72.8163
ECCENTRICITY: .0049147
ARG. OF PERIGEE: 182.0100
MEAN ANOMALY: 178.1696
MEAN MOTION: 15.60427146
MEAN MOTION DOT: .00008569
MEAN MOTION DOT DOT: .0
BSTAR: .000099999

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 194
DEBRIS IN ORBIT: 0
MAXIMUM Δp: 9.1 min*
MAXIMUM ΔI: 0.1 deg*
*Based on PARCS observations

COMMENTS

Spacecraft apparently destroyed after a malfunction prevented controlled reentry and landing in
the Soviet Union. Sixth incident of this type. A total of 846 separate fragments were observed
during one pass over a U. S. Space Surveillance Network radar (PARCS) two days after the
event.

REFERENCE DOCUMENTS

The Fragmentation of Kosmos 1813, R. L. Kling and J. S. Dowdy, Technical Report CS87-LKD-
Cosmos 1813 debris cloud as reconstructed from PARCS radar observations taken about 10 hours after the breakup. A total of 801 fragments were identified with Cosmos 1813. This diagram is taken from the cited reference document.
COSMOS 1823

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 20.20 Feb 1987
DRY MASS (KG): 1500 (est.)
MAIN BODY: Cylinder; 2.0 m by 2.1 m
MAJOR APPENDAGES: Gravity-gradient boom; 10 small solar panels
ATTITUDE CONTROL: Gravity gradient
ENERGY SOURCES: Unknown

EVENT DATA

DATE: 17 Dec 1987
TIME: 1739 GMT
ALTITUDE: 1485 km
LOCATION: 15S, 18E (dsc)
ASSESSED CAUSE: Electrical

PRE-EVENT ELEMENTS

EPOCH: 87351.61079422
RIGHT ASCENSION: 184.5746
INCLINATION: 73.6064
ECCENTRICITY: .0028819
ARG. OF PERIGEE: 212.2988
MEAN ANOMALY: 147.6712
MEAN MOTION: 12.40947361
MEAN MOTION DOT/2: .0
MEAN MOTION DOT DOT/6: .0
BSTAR: .0

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 110
DEBRIS IN ORBIT: 49
MAXIMUM ΔP: 4.9 min
MAXIMUM ΔI: 1.4 deg

COMMENTS

Cosmos 1823 has been acknowledged by the Soviet Union as a geodetic spacecraft, the eighth in a series which debuted in 1981. The spacecraft is known to have been operating three months before the event. USSR acknowledged mission termination as of 19 December 1987. Unusually strong radial velocity components are evident in cloud analyses over a period of many months. This event has been confirmed to be the third known failure of the NiH₂ battery as reported by Dr. K. M. Suitashev at the February, 1992 Space Debris Conference held in Moscow.
Cosmos 1823 debris cloud of 165 fragments two weeks after the event as reconstructed from Naval Space Surveillance System database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 9.67 Jul 1987
DRY MASS (KG): 6000 (approx.)
MAIN BODY: Cone-Cylinder; 2.4 m by 7 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 26 Jul 1987
TIME: 1539 GMT
LOCATION: 57S, 239E (asc)
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 87207.60199851
RIGHT ASCENSION: 98.7735
INCLINATION: 67.1494
ECCENTRICITY: .0073576
ARG. OF PERIGEE: 61.7654
MEAN ANOMALY: 300.9577
MEAN MOTION: 16.25421506
MEAN MOTION DOT/2: .01099941
MEAN MOTION DOT DOT/6: .000028662
BSTAR: .00016423

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 9
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 17.3 min
MAXIMUM ΔI: 0.5 deg

COMMENTS

Spacecraft was apparently destroyed after a malfunction prevented controlled reentry and landing in the Soviet Union. Seventh incident of this type. Hundreds of fragments were detected but most reentered before being officially cataloged.
Cosmos 1866 debris cloud remnant of 27 fragments 1-2 days after the event as reconstructed from U.S. Space Surveillance Center database. Two fragments with orbital periods greater than 103 minutes were cataloged in mid-August 1987.
SATELLITE DATA

TYPE: Ariane 3 Final Stage
OWNER: ESA
LAUNCH DATE: 16.03 Sep 1987
DRY MASS (KG): 1200
MAIN BODY: Cylinder; 2.6 m by 9.9 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 16-19 Sep 1987
TIME: Unknown
ALTITUDE: Unknown
LOCATION: Unknown
ASSESSED CAUSE: Unknown

POST-EVENT ELEMENTS

EPOCH: 87264.18031994
RIGHT ASCENSION: 176.7680
INCLINATION: 6.8720
ECCENTRICITY: .7324768
ARG. OF PERIGEE: 182.0665
MEAN ANOMALY: 170.9704
MEAN MOTION: 2.22860839
MEAN MOTION DOT/2: .00014489
MEAN MOTION DOT DOT/6: .0038829
BSTAR: .0038829

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 2
DEBRIS IN ORBIT: 2
MAXIMUM ΔP: 29.1 min*
MAXIMUM ΔI: 0.9 deg*

*Based on uncataloged debris data

COMMENTS

Above elements are initial published values for the rocket body but are after the event. Third suspected fragmentation of Ariane final stage. Debris may be operational in nature.
AUSSAT/ECS R/B debris cloud of 12 fragments about four days after launch as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 26.48 Dec 1987
DRY MASS (KG): 6000 (approx.)
MAIN BODY: Sphere-Cylinder-Cone; 2.4 m by 6.5 m (?)
MAJOR APPENDAGES: 2 small solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 31 Jan 1988
TIME: 1109 GMT
ALTITUDE: 250 km
LOCATION: 11S, 138E (dsc)
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 88030.87152193
RIGHT ASCENSION: 254.6565
INCLINATION: 82.5872
ECCENTRICITY: .0015551
ARG. OF PERIGEE: 152.1926
MEAN ANOMALY: 208.0352
MEAN MOTION: 16.07088938
MEAN MOTION DOT: .00174892
MEAN MOTION DOT DOT: .000012805
BSTAR: .00022253

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 37
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 5.7 min*
MAXIMUM ΔI: 1.7 deg*

*Based on cataloged and uncataloged debris data

COMMENTS

Spacecraft apparently destroyed after a malfunction prevented controlled reentry and landing in the Soviet Union. Eighth incident of this type. Elements for 83 objects remaining in orbit about 10 days after the event were developed. Other debris reentered before being officially cataloged. This may have been the first or second flight of a new spacecraft modification.
Cosmos 1906 debris cloud remnant of 83 objects 10 days after the event as reconstructed from Naval Space Surveillance System database.
SATELLITE DATA

TYPE: Payload  
OWNER: USSR  
LAUNCH DATE: 3.15 Feb 1988  
DRY MASS (KG): 6000 (approx.)  
MAIN BODY: Cone-Cylinder; 2.4 m by 7 m (?)  
MAJOR APPENDAGES: Solar panels (?)  
ATTITUDE CONTROL: Active, 3-axis  
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 27 Feb 1988  
TIME: 0444 GMT  
LOCATION: 62N, 98E (asc)  
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 88058.12322153  
RIGHT ASCENSION: 264.6529  
INCLINATION: 64.8359  
ECCENTRICITY: 0.0060041  
ARG. OF PERIGEE: 51.6410  
MEAN ANOMALY: 309.0154  
MEAN MOTION: 16.30989909  
MEAN MOTION DOT/2: 0.03233928  
MEAN MOTION DOT DOT/6: 0.00003669  
BSTAR: 0.0025587

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1  
DEBRIS IN ORBIT: 0  
MAXIMUM ΔP: 4.2 min*  
MAXIMUM ΔI: 1.1 deg*  

*Based on uncataloged debris data

COMMENTS

Spacecraft apparently destroyed after a malfunction prevented controlled reentry and landing in the Soviet Union. Ninth incident of this type. Early elements on only 6 objects available. All debris reentered before being officially cataloged.
Cosmos 1916 debris cloud remnant of six objects within one day of the event as reconstructed from U.S. Space Surveillance Center database.
COSMOS 2030 1989-54A 20124

SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 12.63 Jul 1989
DRY MASS (KG): 6000 (approx.)
MAIN BODY: Cone-Cylinder; 2.4 m by 7 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 28 Jul 1989
TIME: 0410-0420 GMT
ALTITUDE: 150 km
LOCATION: 35-65N, 95-140E (asc)
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 89208.98384568
RIGHT ASCENSION: 89.7470
INCLINATION: 67.1441
ECCENTRICITY: 0.048139
ARG. OF PERIGEE: 57.9032
MEAN ANOMALY: 302.7810
MEAN MOTION: 16.33519268
MEAN MOTION DOT/2: 0.03079561
MEAN MOTION DOT DOT/6: 0.00029506
BSTAR: 0.00023479

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 7.1 min*
MAXIMUM ΔI: 1.3 deg*

*Based on uncataloged debris data

COMMENTS

Spacecraft was apparently destroyed after a malfunction prevented controlled reentry and landing in the Soviet Union. Tenth incident of this type. Early element sets on only 20 objects available. Rapid decay of objects made calculation of breakup time and location difficult.

REFERENCE DOCUMENTS

Cosmos 2030 debris cloud remnant of 20 objects 2-3 days after the event as reconstructed from U.S. Space Surveillance Center database. This diagram is taken from the cited reference.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 18.51 Jul 1989
DRY MASS (KG): 6000 (approx.)
MAIN BODY: Cone-Cylinder; 2.4 m by 7 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 31 Aug 1989
TIME: 1851 GMT
ALTITUDE: 270 km
LOCATION: 43N, 111E (dsc)
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 89243.76468690
RIGHT ASCENSION: 242.9132
INCLINATION: 50.5464
ECCENTRICITY: .0093577
ARG. OF PERIGEE: 55.5300
MEAN ANOMALY: 305.4386
MEAN MOTION: 15.89272241
MEAN MOTION DOT/2: .00186451
MEAN MOTION DOT DOT/6: .0002154
BSTAR: .00045172

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 9
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: 7.4 min*
MAXIMUM ΔI: 0.9 deg*

*Based on uncataloged debris data

COMMENTS

Spacecraft was apparently destroyed after a malfunction prevented controlled reentry and landing in the Soviet Union. Eleventh incident of this type. Early elements on 43 objects available. Most debris reentered before being officially cataloged.

REFERENCE DOCUMENTS

Cosmos 2031 debris cloud remnant of 43 objects 2-3 days after the event as reconstructed from Naval Space Surveillance System database. This diagram is taken from the cited reference.
SATellite DATA

TYPE: CZ-4A Final Stage (L-14)
OWNER: PRC
LAUNCH DATE: 3.04 Sep 1990
DRY MASS (KG): 1000 (approx.)
MAIN BODY: Cylinder-Nozzle; 2.9 m by ~5m
MAJOR APPENDAGES: none
ATTITUDE CONTROL: none
ENERGY SOURCES: On-board propellants (?)

EVENT DATA

DATE: 4 Oct 1990
TIME: 2014 GMT
ALTITUDE: 895 km
LOCATION: 81S, 68E (asc)
ASSESSED CAUSE: Unknown

PRE-EVENT ELEMENTS

EPOCH: 90276.6451544
RIGHT ASCENSION: 310.6975
INCLINATION: 98.9340
ECCENTRICITY: .0010179
ARG. OF PERIGEE: 197.4122
MEAN ANOMALY: 162.6773
MEAN MOTION: 14.01192890
MEAN MOTION DOT/2: .000003118
MEAN MOTION DOT DOT/6: .0002183343
BSTAR: .0002183343

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 73
DEBRIS IN ORBIT: 70
MAXIMUM \( \Delta P \): 5.8 min
MAXIMUM \( \Delta I \): 0.1 deg

COMMENTS

This second flight of the CZ-4 final stage successfully deployed three payloads (one weather satellite and two inflated balloons) into a sun-synchronous orbit. Propellants used were N\textsubscript{2}O\textsubscript{4} and UDMH. An estimated 70-75 fragments were detected soon after the event.

REFERENCE DOCUMENTS

Fengyun 1-2 R/B debris cloud remnant of 62 objects 5 days after the event as reconstructed from Naval Space Surveillance System database. This diagram is taken from the cited reference.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 1.46 Oct 1990
DRY MASS (KG): 6000 (approx.)
MAIN BODY: Cone-Cylinder; 2.4 m by 7 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 30 Nov 1990
TIME: 1720 GMT
ALTITUDE: 210 km
LOCATION: 54N, 157E (dsc)
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 90334.45391019
RIGHT ASCENSION: 347.9431
INCLINATION: 64.7547
ECCENTRICITY: .0055418
ARG. OF PERIGEE: 155.2258
MEAN ANOMALY: 205.3252
MEAN MOTION: 16.12811753
MEAN MOTION DOT/2: .00671617
MEAN MOTION DOT DOT/6: .000035339
BSTAR: .00040815

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 4
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: >7.3 min*
MAXIMUM ΔI: 0.3 deg*

*Based on uncataloged debris data

COMMENTS

Spacecraft was apparently destroyed after a malfunction prevented controlled reentry and landing in the Soviet Union. Twelfth incident of this type. Early elements on only 7 objects available. Most debris reentered before being officially cataloged.

REFERENCE DOCUMENTS

Cosmos 2101 debris cloud remnant of 7 objects 3 days after the event as reconstructed from Naval Space Surveillance System database. This diagram is taken from the cited reference.
SATELLITE DATA

TYPE: Payload
OWNER: US
LAUNCH DATE: 1.66 Dec 1990
DRY MASS (KG): 856 kg
MAIN BODY: Cylinder; 1.1 m by 3.7 m
MAJOR APPENDAGES: 1 solar panel
ATTITUDE CONTROL: Active, 3 axis
ENERGY SOURCES: On-board propellants

EVENT DATA

DATE: 1 Dec 1990
TIME: 1610 GMT
ALTITUDE: 850 km
LOCATION: 6N, 232E (dsc)
ASSESSED CAUSE: Propulsion-related

POST-EVENT ELEMENTS

EPOCH: 90335.71008487
RIGHT ASCENSION: 4.0850
INCLINATION: 98.8600
ECCENTRICITY: .0080986
ARG. OF PERIGEE: 359.1948
MEAN ANOMALY: 0.9090
MEAN MOTION: 14.29892145
MEAN MOTION DOT/2: -.00000049
MEAN MOTION DOT/6: .0
BSTAR: -0.000010171

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 29
DEBRIS IN ORBIT: 6
MAXIMUM ΔP: >2.0 min*
MAXIMUM ΔI: 1.0 deg*

*Based on uncataloged debris data

COMMENTS

During the burn of USA 68's solid-fuel apogee kick motor (STAR-37S, TE-M-364-15), the 20 kg nozzle came apart, terminating thrust. At shutdown USA 68 was in an orbit of 610 km by 850 km. Immediately, a hydrazine orbit make-up system was activated, providing an additional 32.3 m/s ΔV. More than 40 pieces of non-operational debris were observed within a day of the event. The observed debris may include components of the USA 68 sun shield and AKM nozzle shield (total mass 2 kg). Most debris decayed very rapidly. The payload remained operational.

REFERENCE DOCUMENTS

USA 68 debris cloud remnant of 46 fragments 12 days after the event as reconstructed from U.S. Space Surveillance Center database.
SATELLITE DATA

TYPE: SL-8 Final Stage
OWNER: USSR
LAUNCH DATE: 12.12 Feb 1991
DRY MASS (KG): 1500 (approx.)
MAIN BODY: Cylinder; 2.4 m by 5 m
MAJOR APPENDAGES: Payload deployment mechanism
ATTITUDE CONTROL: None at the time of event
ENERGY SOURCES: Unknown

EVENT DATA

DATE: 5 Mar 1991
TIME: 1345 GMT
ALTITUDE: 1560 km
LOCATION: 43S, 140E (asc)
ASSESSED CAUSE: Unknown

PRE-EVENT ELEMENTS

EPOCH: 91062.94236834
RIGHT ASCENSION: 166.0317
INCLINATION: 74.0386
ECCENTRICITY: .0166507
ARG. OF PERIGEE: 245.0348
MEAN ANOMALY: 112.8991
MEAN MOTION: 12.19552620
MEAN MOTION DOT/2: .00000005
MEAN MOTION DOT DOT/6: .0
BSTAR: .000099999

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 70
DEBRIS IN ORBIT: 70
MAXIMUM ΔP: 4.3 min*
MAXIMUM ΔI: 0.3 deg*

*Based on uncataloged debris data

COMMENTS

This is the second known fragmentation of the SL-8 final stage and the first in more than 25 years and 370 missions. Like the earlier event (Cosmos 61-63 R/B), this rocket body successfully completed its multiple payload delivery before breakup. NAVSPASUR has determined that several minor separations occurred both prior to and after the main breakup cited above (see NAVSPASUR report referenced below).
REFERENCE DOCUMENTS


Cosmos 2125-2132 R/B debris cloud of 54 objects 5 days after the major breakup event as reconstructed from a Naval Space Surveillance System database. This diagram is taken from the reference cited at the top of this page.
SATELLITE DATA

TYPE: Payload
OWNER: USSR
LAUNCH DATE: 9.55 October 1991
DRY MASS (KG): 6000 (approx.)
MAIN BODY: Cone-Cylinder; 2.4 m by 7 m (?)
MAJOR APPENDAGES: Solar panels (?)
ATTITUDE CONTROL: Active, 3-axis
ENERGY SOURCES: On-board propellants, explosive charge

EVENT DATA

DATE: 6 December 1991
TIME: 2021 GMT
ALTITUDE: 210 km
LOCATION: 55N, 154E (dsc)
ASSESSED CAUSE: Deliberate Detonation

PRE-EVENT ELEMENTS

EPOCH: 91340.51933896
RIGHT ASCENSION: 37.7884
INCLINATION: 64.7678
ECCENTRICITY: .0054670
ARG. OF PERIGEE: 147.5032
MEAN ANOMALY: 213.3470
MEAN MOTION: 16.18797546
MEAN MOTION DOT/2: .00862876
MEAN MOTION DOT DOT/6: .000036685
BSTAR: .00035926

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 0
MAXIMUM ΔP: >9.8 min*
MAXIMUM ΔI: 0.2 deg*

*Based on uncataloged debris data

COMMENTS

Spacecraft was apparently destroyed after a malfunction prevented controlled reentry and landing in the Soviet Union. Thirteenth incident of this type. Early elements on only 8 objects available. All debris reentered before being officially cataloged.

REFERENCE DOCUMENTS

Cosmos 2163 debris cloud remnant of 8 objects one day after the event as reconstructed from U.S. Space Surveillance Center database. This diagram is taken from the cited reference.
3.0 SATELLITE ANOMALOUS EVENTS

This section describes the identified anomalous events compiled by TBE throughout the years of Satellite Catalog and orbital debris analysis associated with this volume. No exhaustive search for anomalous events has yet been conducted, although the following compilation should represent the most significant events noted thus far.

3.1 Background and Status

As defined in the introduction of this volume, an anomalous event is the unplanned separation, usually at low velocity, of one or more detectable objects from a satellite which remains essentially intact. The assessment that the configuration of the parent satellite has not changed significantly is to a degree subjective and is often based on indirect parameters and not on detailed imagery.

Anomalous events can be caused by material deterioration of items such as thermal blankets, protective shields, or solar panels and by impacts of small debris, either natural or man-made. The fact that about half of the satellites noted in this section experienced multiple anomalous events suggests that the former factor may be more prevalent. Other satellite deteriorations, e.g., paint debonding, are known to take place, but are undetectable with the sensors of the U.S. SSN. Interestingly, 10 of the 16 satellites in this section are U.S. payloads, whereas the remaining six are rocket bodies (2 U.S., 4 U.S.S.R.). Four of the last five objects to be the subject of anomalous events have been Soviet SL-3 upper stages in orbit for 16-26 years. These events are summarized in Tables 3.1 and 3.2.

Due to the usually low velocity of debris ejection and the potential delay in detecting debris liberated in small numbers, the accuracy of the calculated time of separation is often degraded. Hence, only the month and year of each event are provided, although in some cases the time of the event has been narrowed to a shorter interval. As in the previous section, orbital altitudes are cited to the nearest 5 km based on a mean Earth radius and on the last element set prior to the assessed event date.

Anomalous event debris often exhibit unusually high decay rates which are indicative of high area-to-mass ratios. This feature, coupled with the normal small size of the debris, hinders official tracking and cataloging. Consequently, some debris are observed but are lost or decay before being assigned a permanent catalog number. The numbers of cataloged debris listed in this section are only from the anomalous events and do not include normal operational debris identified with the particular launch nor the parent itself.

Historically, anomalous events have often been confused with satellite breakups and have not been the subject of separate, extensive analyses. The list of events in this section is known to be incomplete. Several other satellites have been tentatively tagged as sources of anomalous events. Moreover, preliminary satellite catalog surveys suggest that additional anomalous events have occurred but remain unrecognized as such. Table 3.2 suggests a potential correlation of anomalous events with high solar activity. This section will be updated as future studies warrant.
### TABLE 3.1 HISTORY OF SATELLITE ANOMALOUS EVENTS BY LAUNCH DATE (As of 1 April 1992)

<table>
<thead>
<tr>
<th>NAME</th>
<th>INTERNATIONAL DESIGNATOR</th>
<th>CATALOG NUMBER</th>
<th>LAUNCH DATE</th>
<th>FIRST EVENT DATE</th>
<th>KNOWN EVENTS</th>
<th>CATALOGED DEBRIS</th>
<th>IN-ORBIT DEBRIS</th>
<th>APOGEE (KM)</th>
<th>PERIGEE (KM)</th>
<th>INCLINATION (DEG)</th>
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<tr>
<td>OPS 4412 (TRANSIT 9)</td>
<td>1964-26A</td>
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**TOTAL** 82 53


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<th>CATALOG NUMBER</th>
<th>LAUNCH DATE</th>
<th>FIRST EVENT DATE</th>
<th>KNOWN EVENTS</th>
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<th>IN-ORBIT DEBRIS</th>
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<th>PERIGEE (KM)</th>
<th>INCLINATION (DEG)</th>
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<td>89.9</td>
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</table>

TOTAL 82 53
3.2 IDENTIFIED SATELLITE ANOMALOUS EVENTS
SATELLITE DATA

TYPE: Payload
OWNER: US
LAUNCH DATE: 4 June 1964
DRY MASS (KG): 60
MAIN BODY: Octagonal cylinder; 0.5 m by 0.4 m
MAJOR APPENDAGES: 4 solar panels; gravity-gradient boom
ATTITUDE CONTROL: Gravity-gradient boom

EVENT DATA

KNOWN EVENTS: 2
FIRST DATE: December 1980

<table>
<thead>
<tr>
<th>APOGEE</th>
<th>PERIGEE</th>
<th>PERIOD</th>
<th>INCLINATION</th>
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<tbody>
<tr>
<td>930 km</td>
<td>845 km</td>
<td>102.7 min</td>
<td>90.5 deg</td>
</tr>
</tbody>
</table>

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 2
DEBRIS IN ORBIT: 0

COMMENTS

Second event observed Jul 1982. First fragment decayed rapidly; the second decayed more slowly. One of five known Transits involved in anomalous events.
SATELLITE DATA

TYPE: SL-3 Upper Stage
OWNER: USSR
LAUNCH DATE: 28 August 1964
DRY MASS (KG): 2100
MAIN BODY: Cylinder; 2.6 m by 3.1 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None

EVENT DATA

KNOWN EVENTS: 1
FIRST DATE: Late-1990

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<tr>
<th>APOGEE</th>
<th>PERIGEE</th>
<th>PERIOD</th>
<th>INCLINATION</th>
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<tr>
<td>775 km</td>
<td>655 km</td>
<td>99.1 min</td>
<td>65.1 deg</td>
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CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 1

COMMENTS

Cosmos 44 was the first prototype spacecraft of the Meteor 1 program. This is one of four SL-3 rocket bodies associated with this old program to shed a piece of debris since 1987. The age of the rocket bodies at the time of the anomalous event has been 16-26 years.
OPS 4988 (GREB 6)  1965-16A  1271

SATellite DATA

TYPE: Payload
OWNER: US
LAUNCH DATE: 9 March 1965
DRY MASS (KG): 40
MAIN BODY: Sphere
MAJOR APPENDAGES: Unknown
ATTITUDE CONTROL: Unknown

EVENT DATA

KNOWN EVENTS: 1
FIRST DATE: November 1980

APOGEE   PERIGEE   PERIOD     INCLINATION
935 km    900 km    103.4 min  70.1 deg

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 1

COMMENTS

No other events observed.
SATellite DATA

TYPE: Payload (attached to Agena D upper stage)

OWNER: US

LAUNCH DATE: 3 April 1965

DRY MASS (KG): 2500 (approx.)

MAIN BODY: Cylinder-Cone; 1.5 m by 11.6 m

MAJOR APPENDAGES: None

ATTITUDE CONTROL: None at time of event

EVEnt DATA

KNOWN EVENTS: 7

FIRST DATE: November 1979

APOGEE PERIGEE PERIOD INCLINATION
1320 km 1270 km 111.5 min 90.3 deg

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 47

DEBRIS IN ORBIT: 45

COMMENTS


REFErence DOCUMENT

SATELLITE DATA

TYPE: Payload
OWNER: US
LAUNCH DATE: 24 June 1965
DRY MASS (KG): 60
MAIN BODY: Octagonal cylinder; 0.5 m by 0.4 m
MAJOR APPENDAGES: 4 solar panels; gravity-gradient boom
ATTITUDE CONTROL: Gravity-gradient

EVENT DATA

KNOWN EVENTS: 3
FIRST DATE: August 1980

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<th>PERIOD</th>
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<td>1135 km</td>
<td>1025 km</td>
<td>106.8 min</td>
<td>89.9 deg</td>
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CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 6
DEBRIS IN ORBIT: 0

COMMENTS

Two additional events observed: one two days after the initial event and the last in Jun 1981. All debris appear very small. One of five known Transits involved in anomalous events.
SATELLITE DATA

TYPE: Payload
OWNER: US
LAUNCH DATE: 28 January 1966
DRY MASS (KG): 60
MAIN BODY: Octagonal cylinder; 0.5 m by 0.4 m
MAJOR APPENDAGES: 4 solar panels; gravity-gradient boom
ATTITUDE CONTROL: Gravity-gradient

EVENT DATA

KNOWN EVENTS: 3
FIRST DATE: April 1980

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<tr>
<td>1205 km</td>
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<td>105.8 min</td>
<td>89.8 deg</td>
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CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 5
DEBRIS IN ORBIT: 1

COMMENTS

Two additional events observed: Sep 1980 and Jul 1983. Last event may have originated with a piece of debris from earlier event. One of five known Transits involved in anomalous events.
SATELLITE DATA

TYPE: Payload
OWNER: US
LAUNCH DATE: 26 March 1966
DRY MASS (KG): 60
MAIN BODY: Octagonal cylinder; 0.5 m by 0.4 m
MAJOR APPENDAGES: 4 solar panels; gravity-gradient boom
ATTITUDE CONTROL: Gravity-gradient

EVENT DATA

KNOWN EVENTS: 1
FIRST DATE: July 1981

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<td>1115 km</td>
<td>890 km</td>
<td>105.1 min</td>
<td>89.9 deg</td>
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CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 0

COMMENTS

No other events observed. One of five known Transits involved in anomalous events.
SATELLITE DATA

TYPE: Payload
OWNER: US
LAUNCH DATE: 25 September 1967
DRY MASS (KG): 60
MAIN BODY: Octagonal cylinder; 0.5 m by 0.4 m
MAJOR APPENDAGES: 4 solar panels; gravity-gradient boom
ATTITUDE CONTROL: Gravity-gradient

EVENT DATA

KNOWN EVENTS: 2
FIRST DATE: April 1981

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<tr>
<td>1110 km</td>
<td>1035 km</td>
<td>106.7 min</td>
<td>89.3 deg</td>
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CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 5
DEBRIS IN ORBIT: 0

COMMENTS

Second event observed in Aug 1986. One of five known Transits involved in anomalous events.
SATELLITE DATA

TYPE: SL-3 Upper Stage
OWNER: USSR
LAUNCH DATE: 14 March 1968
DRY MASS (KG): 2100
MAIN BODY: Cylinder; 2.6 m by 3.1 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None

EVENT DATA

KNOWN EVENTS: 1
FIRST DATE: Late-1990

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<tr>
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<th>PERIOD</th>
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<tbody>
<tr>
<td>515 km</td>
<td>450 km</td>
<td>94.3 min</td>
<td>81.2 deg</td>
</tr>
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</table>

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 0
DEBRIS IN ORBIT: 0

COMMENTS

Cosmos 206 was a prototype spacecraft of the Meteor 1 program. This is one of four SL-3 rocket bodies associated with this old program to shed a piece of debris since 1987. The age of the rocket bodies at the time of the anomalous event has been 16-26 years. One piece of debris was released and was still in orbit, although not officially cataloged, by 1 April 1991.
SATELLITE DATA

TYPE: SL-3 Upper Stage
OWNER: USSR
LAUNCH DATE: 20 January 1971
DRY MASS (KG): 2100
MAIN BODY: Cylinder; 2.6 m by 3.1 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None

EVENT DATA

KNOWN EVENTS: 1
FIRST DATE: June 1987

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<td>665 km</td>
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CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 1

COMMENTS

No other events observed.
SATELLITE DATA

TYPE: SL-3 Upper Stage
OWNER: USSR
LAUNCH DATE: 30 June 1972
DRY MASS (KG): 2100
MAIN BODY: Cylinder; 2.6 m by 3.1 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None

EVENT DATA

KNOWN EVENTS: 1
FIRST DATE: September 1989

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<tr>
<td>935 km</td>
<td>860 km</td>
<td>102.9 min</td>
<td>81.2 deg</td>
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</tbody>
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CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 1

COMMENTS

No other events observed.
SATELLITE DATA

TYPE: Delta Second Stage (2410)
OWNER: US
LAUNCH DATE: 9 April 1975
DRY MASS (KG): 900 (approx.)
MAIN BODY: Cylinder-Nozzle; 2.4 m by 8 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None

EVENT DATA

KNOWN EVENTS: 1
FIRST DATE: March 1978

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<td>845 km</td>
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<td>115.0 deg</td>
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CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 3
DEBRIS IN ORBIT: 2

COMMENTS

Only one event noted with three fragments cataloged 12 March 1978. Repeated mistaging during 1978 among rocket body and debris. One fragment lost in 1978 and administratively decayed in 1983. This event may be related to series of major Delta Second Stage breakups.
SATELLITE DATA

TYPE: Payload (attached to Agena R/B)
OWNER: US
LAUNCH DATE: 27 June 1978
DRY MASS (KG): 2300
MAIN BODY: Cylinder; 1.5 m by 21 m
MAJOR APPENDAGES: 2 solar panels; 1 antenna panel; miscellaneous booms
ATTITUDE CONTROL: Unknown at time of event

EVENT DATA

DATE: July 1983

APOGEE PERIGEE PERIOD INCLINATION
780 km 780 km 100.5 min 108.0 deg

CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 5
DEBRIS IN ORBIT: 0

COMMENTS

Second event observed Feb 1985. Later events possible. Most debris experience very rapid decay for this altitude.
SATCHEL DATA

TYPE: Payload

OWNER: US

LAUNCH DATE: 13 October 1978

DRY MASS (KG): 725

MAIN BODY: Cylinder; 1.9 m by 3.7 m

MAJOR APPENDAGES: 1 solar panel

ATTITUDE CONTROL: Unknown at time of event

EVENT DATA

KNOWN EVENTS: 1

FIRST DATE: September 1987

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<th>PERIGEE</th>
<th>PERIOD</th>
<th>INCLINATION</th>
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<td>835 km</td>
<td>101.9 min</td>
<td>99.0 deg</td>
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CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 2

DEBRIS IN ORBIT: 0

COMMENTS

Both fragments decayed rapidly during winter of 1988-89.
NIMBUS 7 R/B 1978-98B 11081

SATELLITE DATA

TYPE: Delta Second Stage (2910)
OWNER: US
LAUNCH DATE: 24 October 1978
DRY MASS (KG): 900 (approx.)
MAIN BODY: Cylinder-Nozzle; 2.4 m by 8 m
MAJOR APPENDAGES: None
ATTITUDE CONTROL: None

EVENT DATA

KNOWN EVENTS: 2
FIRST DATE: May 1981

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CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 0

COMMENTS

Second anomalous event apparently occurred about Jan 1987. A more prolific event in Dec 1981 is tentatively categorized as a satellite breakup (see Section 2). The cataloged debris section above refers only to the new fragment observed after the second anomalous event and does not include the Delta second stage which is accounted for in the tables of Section 2. These events may be related to the series of major Delta Second Stage breakups.
OSCAR 24 / 30 1985-066 15935/6

SATELLITE DATA

TYPE: Payload
OWNER: US
LAUNCH DATE: 3 August 1985
DRY MASS (KG): 60
MAIN BODY: Octagonal Cylinder; 0.5 m by 0.4 m
MAJOR APPENDAGES: 4 solar panels; gravity-gradient boom
ATTITUDE CONTROL: Gravity-gradient boom

EVENT DATA

KNOWN EVENTS: 1
FIRST DATE: February 1992

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<td>1000 km</td>
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CATALOGED DEBRIS CLOUD DATA

DEBRIS CATALOGED: 1
DEBRIS IN ORBIT: 1

COMMENTS

Other debris pieces are associated with this dual payload launch. The most recent event identified (SCC 21878) apparently originated from one of the two payloads. Reports indicated that the object originated from Oscar 24, but element set analysis indicates the event most likely occurred between 92030-92034 off 15935 (Oscar 30). One object which may be an additional anomalous event (not accounted for in the totals above) is SSC number 17164 which was cataloged in November/December 1986, 15 months after launch.
4.0 OTHER SATELLITES ASSOCIATED WITH FRAGMENTATIONS

Satellite fragmentation lists compiled by other organizations, in particular by the National Security Council and NAVSPASUR, were carefully reviewed during the preparation of the fourth edition of the *History of On-Orbit Satellite Fragmentations*. However, due to the frequent exchange of information within the small orbital debris and space operations community and the long period during which satellite fragmentation lists have been maintained, no current list is completely independent from all others. For this reason, every known and suspected satellite fragmentation was re-examined and re-validated. Since its publication, new analyses of one historical "breakup", that of the Cosmos 95 rocket body, indicated that in fact no breakup occurred; therefore, this entry no longer appears in the present edition.

These reviews also revealed the need to define better the terms "satellite breakup" and "anomalous event" as discussed in Section 1. Many "breakup" lists have historically included entries related to normal launch and mission activities which resulted in numbers of debris in excess of the handful usually observed on these occasions. Some researchers have been misled by tracking difficulties and cataloging procedures which may cause late cataloging or misidentification of debris, superficially giving the appearance of fragmentations. A higher than average number of debris alone is not sufficient to assume a satellite fragmentation. Such pitfalls can generally be avoided by conducting analyses with complete satellite element set data rather than the limited orbital data available in the *U.S. Satellite Catalog*.

The following space missions, listed by international designator, have been examined in detail and have failed to qualify as either satellite breakup or anomalous event as set forth in Section 1. The source of debris associated with nearly all of these flights is of an operational nature.

| 1965-73 | 1973-27 | 1984-08 |
| 1965-88 | 1973-75 | 1984-106 |
| 1965-112 | 1974-74 | 1985-21 |
| 1967-01 | 1976-12 | 1985-75 |
| 1968-117 | 1979-06 | 1986-30 |
| 1969-21 | 1979-63 | 1986-52 |
| 1971-41 | 1982-07 | 1989-100 |
| 1972-78 |   |   |
5.0 SATELLITES NOT ASSOCIATED WITH FRAGMENTATIONS

Previous editions of the History of On-Orbit Satellite Fragmentations have listed the SSC numbers of satellites which are not associated with a given fragmentation and were not included in the object counts. The table below identifies specific SSC numbers of objects which are not associated with the indicated event. For example, 61-OMI was a fragmentation of the Ablestar Stage Rocket Body. The mission deployed two objects (Transit 4A and Solrad 3/Injun 1) which were not associated with the rocket body explosion. Those two objects are not counted in the 61-OMI totals (296 cataloged at the cut-off date for this edition), although they definitely are associated with the 61-Omicron international designator.

Occasionally it is not obvious whether an object should be included in a fragmentation event. In those cases historical research and historical Satellite Catalogs usually reveal whether an object should be included in the count. The list below represents the best summary of excluded objects.

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