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Produced by the NASA Center for Aerospace Information (CASI)
HISTORY OF ON-ORBIT SATELLITE FRAGMENTATIONS

August 1984

Prepared for
Ballistic Missile Defense Systems Command
Huntsville, Alabama 35807
Technical Report

History of On-Orbit Satellite Fragmentations

by

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August 1984

Prepared for

Ballistic Missile Defense Systems Command
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Contract No. DASG60-84-C-0005
CDRL Item A029

Prepared By

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Colorado Springs, Colorado  80910
INTRODUCTION

The phenomenon of on-orbit satellite fragmentation was first observed in June 1961 when the Transit 4A rocket body disintegrated into 261 detectable pieces of debris. Since that time there have been more than eighty similar events from 75 parent satellites accounting for over 5,200 cataloged pieces of debris. Today approximately 50% of all the objects currently being tracked by the NORAD Spacetrack Network originated from on-orbit fragmentations.

The causes of on-orbit fragmentations are varied and may be intentional or accidental. For example, a satellite may be deliberately destroyed by an explosive charge as part of a spacecraft test or a rocket stage may suffer a catastrophic propulsion failure. Unfortunately, the cause of many fragmentations remains unknown. While a few cases are currently under investigation as on-orbit collision candidates, man is directly responsible for the vast majority of artificial debris polluting the near-Earth space environment.

The magnitude of each fragmentation (i.e. the number of liberated pieces observed) may also vary substantially. Low altitude rocket stage explosions may result in hundreds of short-lived pieces of debris whereas only a few pieces may be observed in conjunction with much higher fragmented objects. It should be emphasized that the number of fragments listed with each event in this document represent only those debris officially cataloged by NORAD. At low altitude fragmentations many pieces are not cataloged as a result of their high drag rates and quick reentries. For example, although only 31 fragments were cataloged from the break-up of 1982-88A, at least 138 objects were detected by one NORAD radar shortly after the event. Likewise many small objects are believed to be orbiting at higher altitudes as the result of fragmentations above 600 km but are undetectable with the current SPACETRACK network. Finally, some spacecraft
eject several or tens of objects during their normal operational duties; however, these events do not qualify as fragmentations as defined in this document.

The data compiled in this document originated from several sources: NORAD archives, the Naval Space Surveillance System (NAVSPASUR), the Royal Aircraft Establishment, miscellaneous reports, and in-house technical analyses. Special thanks for their cooperation and guidance are extended to Mr. Preston Landry (Space Command, XPYS) and Mr. D. G. King-Hele (Royal Aircraft Establishment). Whenever possible, the data have been cross-checked. For instance, when a break-up time and location were provided by NAVSPASUR, satellite element sets and fragment distribution curves (Gabbard diagrams) were examined to verify the feasibility of this information. In this way many data base errors were discovered and corrected. Complete information is not available on all events due to the absence of archival data. Indeed documentation of some events is sparse or virtually non-existent.

Each known on-orbit satellite fragmentation is described within this document in module format. The first page is headed by the satellite's international designator, common name, and NORAD Space Surveillance Center (NSSC) control number. Also listed on this page will be pertinent characteristics of each fragmentation event. Page two of each module will contain comments regarding the nature of the satellite and additional details of the event(s) as well as the probable cause of the event. The remaining pages of each module contain plots of debris distributions on Gabbard diagrams and maps indicating the event orbit groundtrack and location of the satellite at the time of the events. The two large symbols on each Gabbard diagram indicate the apogee and perigee of the parent satellite. The reader is cautioned that all orbital parameters on the Gabbard diagrams are not referenced to a single epoch. In some cases when fragment element sets were developed several days or weeks after the event, the effects of atmospheric drag can be observed. Where the precise location of the event is known a satellite symbol on the orbit trace marks this position. In other cases,
only the orbit(s) on which the event probably occurred are provided.

This work was sponsored by the NASA Johnson Space Center with cooperation of USAF Space Command and the U.S. Army Ballistic Missile Command under Contract Number DASC60-84-C-0005.

Nicholas L. Johnson
Principal Technologist

Frank Deis
Technical Director
Colorado Springs Office
TOTAL NUMBER OF FRAGMENTATION EVENTS

HISTORY OF ON-ORBIT FRAGMENTATIONS

DEBRIS EVENTS

TOTAL NUMBER OF CATALOGED PIECES OF DEBRIS
CAUSES OF ON-ORBIT FRAGMENTATIONS AND DEBRIS

- CAUSES
  - 50%
  - 15%
  - 35%

- DEBRIS CREATED
  - 38%
  - 32%
  - 30%

- DEBRIS IN ORBIT
  - 41%
  - 19%
  - 40%

(AS OF 1 JANUARY 1984)
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II. Satellite Fragmentation Summary Table 2-1

III. Other Anomalous Event Summary Table 3-1
Section I

Satellite Fragmentations
1961-Omicron

TRANSIT 4A ROCKET

LAUNCH DATE: 29.18 Jun 1961

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 29 Jun 1961 (DAY 180)

TIME: 06'58'10.0 GMT

LOCATION: 28N, 254E

ALTITUDE: 950 KM

PIECES CATALOGED (1 JAN 84): 261

PIECES STILL IN ORBIT (1 JAN 84): 199

ORBIT CHARACTERISTICS:

INCLINATION: 66.81°

APOGEE: 998 km

PERIGEE: 880 km

PERIOD: 103.8 min

TRUE ANOMALY: 183°
COMMENTS:  
* The Ablestar rocket fragmented before it could be cataloged, therefore, no catalog number was assigned to the rocket.

* The orbital information given is for one of the payloads, Transit 4A, satellite number 116.

* No element set is available for the rocket but a "Moonwatch" team headed by Arthur Leonard of Davis, California observed the rocket ahead of the two payloads at 0605:12 GMT, 29 June 1961.

* Separation between payloads and rocket at 0608:10 GMT was approximately 68 km.

* The Organ Pass, New Mexico Baker-Nunn camera operated by the Smithsonian took a photograph at 0608:09 which showed three distinct objects which were judged to be the rocket and two payloads (2 of the 3 payloads did not separate). A subsequent frame at 0608:11 continued to show two payloads but in the area where the rocket should have been, a patchy and distributed image was apparent. The next frame at 0608:13 showed the two payloads and the patchy image slightly enlarged.

* General shape of rocket; cylinder; length 4.8 m; dia. 1.4 m; weight 450 kg.

CAUSE:  
* Potential causes listed by Aerospace Corp., "Transit 4-A Abelstar Vehicle Fragmentation Study" para. 4 are:

1. Propulsion system valve leakage.

2. Abnormal electrical system operation.

3. Meteoric impact.

4. Command destruct activation.

5. Other

* Cited study on file at Teledyne Brown Engineering, Colorado Springs, Colorado.
1962-B Iota  SPUTNIK-29  443

LAUNCH DATE:  24.(75?) Oct 1962

COUNTRY OF ORIGIN:  USSR

EVENT DATA:

DATE:  29 Oct 1962 (DAY 302)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84):  23

PIECES STILL IN ORBIT (1 JAN 84):  0

ORBIT CHARACTERISTICS:

INCLINATION:  65.11°

APOGEE:  261 km

PERIGEE:  202 km

PERIOD:  89.1 min

TRUE ANOMALY:
COMMENTS:

- Probable Mars probe failure.
- This launch is also known as Sputnik 22. To-date the USSR has not acknowledged this launch.
- Orbital characteristics derived from element set #1 of satellite 443.
- General shape; cylinder; length 7m?; dia. 2m; weight full 6500 kg?
- Insufficient data available to determine time and location of the event.

CAUSE: Probable propulsion failure during transfer orbit maneuver.
COMMENTS: Insufficient data to show an appropriate ground track for Sputnik 29.

1962-B Iota
LAUNCH DATE: 27.79 Nov 1963

COUNTRY OF ORIGIN: US

EVENT DATA:

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PIECES CATALOGED (1 JAN 84): 14

PIECES STILL IN ORBIT (1 JAN 84): 12

ORBIT CHARACTERISTICS:

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<td>502 km</td>
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<tr>
<td>PERIOD</td>
<td>107.7 min</td>
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TRUE ANOMALY:
COMMENTS:

- Centaur 2nd stage. Length 8.6m; Diameter 3 m. Propellants LH₂/LOX pump fed. Thrust 13,500 kg total from 2 engines. Weight 4,590 kg empty.

- This satellite is listed as a payload in the NORAD catalog, however, this was the 2nd flight test of the Atlas Centaur and carried no payload. The 1st flight test failed 5-8-62.

- Element set #1 was developed 12 hrs. after launch resulting in an orbit with a period of 99.55 minutes and does not fit with the distribution of the orbits of fragments. Element set #2 results in an orbit with a period of 107.66 minutes and this orbit fits well with the distribution of the orbits of the fragments. Actual orbit manipulations have not been confirmed but is assumed the Centaur thrusted from the first to the second orbit and exploded. One of the fragments was then designated to continue as satellite 694. Element set #2 on 594 (a fragment) was used to develop the orbit characteristics shown.

COMMENTS  * Insufficient data available to determine an appropriate ground track for satellite 694.
LAUNCH DATE: 4.16 Jun 1964

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: Jan-Feb 1966

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 11

PIECES STILL IN ORBIT (1 JAN 84): 3

ORBIT CHARACTERISTICS:

INCLINATION: 90.5°

APOGEE: 935 km

PERIGEE: 848 km

PERIOD: 102.8 km

TRUE ANOMALY:
COMMENTS:

- Satellite 809 is an assumed parent. It was an Altair rocket; weight 24 kg; length 1.5 m; dia. 0.46 m.

- Eleven small debris type objects were cataloged at various times among several launches that had taken place long before the small objects were found in space. The orbits of these objects were not in reasonable locations relative to the launches they were cataloged with. The only reasonable association was inclination. Plots of this debris shows systematic trending of the apogees/perigees and the trends fall very close to the payload and rocket of the 64-26 launch. Details leading to this assumed event are recorded in Technical Memorandum 81-6, Directorate of Analysis DCS/Plans, Programs, Policy and Requirements, Headquarters NORAD/ADCOM, Peterson AFB, Colorado Springs, Colorado.

- The eleven objects are: 1399, 2086, 2335, 3809, 4587, 5363, 6290, 6372, 7259, 7558, 8000

- Insufficient data is available to determine the time and location of the assumed event.

CAUSE: Unknown
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HEIGHT OF ApOGEE/PERIGEE
95.  575.  650.  875.  950.  1025.  1100.

OPS 4412 ROCKET
COMMENTS: * Insufficient data available to determine an appropriate ground track for satellite 809, Ops. 4412.
LAUNCH DATE: 28.45 OCT 1964

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 5 NOV 1964 (DAY 310)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 95

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 51.23°

APOGEE: 233 km

PERIGEE: 188 km

PERIOD: 88.7 min

TRUE ANOMALY:
COMMENTS:  
  * This payload had a general shape of a sphere-cylinder; length 4.3 m; dia. 2.4 m; weight 4750 kg?  
  * The fragmentation was very low in altitude and orbital elements were not developed on any of the fragments. The piece count is an estimate made by the USAF.  
  * The orbital data was developed from element set #3 of 919 which had an epoch of 30 Oct 1964. These are the elements nearest the event date that are available.  

CAUSE:  
Apparently intentionally detonated due to the failure of satellite 919 to respond to a signal to deorbit.
COSMOS 50 SIMULATION

1-20
COMMENTS:  • Insufficient data available to show an applicable ground trace for satellite 919.
COSMOS 57

1965-12

LAUNCH DATE: 22.32 FEB 1965

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 22 Feb 1965 (DAY 53)
TIME: 0957 GMT
LOCATION: 64 S/284 E

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 166

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 64.8°

APOGEE:

PERIGEE:

PERIOD:

TRUE ANOMALY:

1-22
COMMENTS: • Payload had a general shape of spheric-cylinder; length 6 m; dia. 2.4 m; weight 5,500 kg.
• This was an unmanned Voskhod test flight.
• 34 of the cataloged objects were cataloged with "no initial elements." This count is an USAF estimate of very low orbiting pieces that could not be tracked enough to develop elements.
• Satellite 1093 fragmented approximately 1½ revolutions after launch.
• Orbit at the time of break-up is unknown as a result of maneuvers prior to the event.

CAUSE: Unknown
HEIGHT OF APOGEE/PERIGEE

COSMOS 57
LAUNCH DATE: 15.46 Mar 1965

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 15 Mar 1965 (DAY 74)

TIME: 171350.0 GMT

LOCATION: 51 S/162 E

ALTITUDE: 1639 km

PIECES CATALOGED (1 JAN 84): 147

PIECES STILL IN ORBIT (1 JAN 84): 26

ORBIT CHARACTERISTICS:

INCLINATION: 56.05°

APOGEE: 1827 km

PERIGEE: 260 km

PERIOD: 106.0 min

TRUE ANOMALY: 143 °
COMMENTS:

- General shape was cylindrical; length 7.4 m; dia. 2.4 m; weight 2200 kg?
- This was the third triple payload launch by the USSR. It was a communications satellite test launch.
- Orbit characteristics were derived from element set #1 satellite 1270.

CAUSE: Unknown
LAUNCH DATE: 15.72 Oct 1965
COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 15 Oct 1965 (DAY 288)
TIME: 1820 GMT
LOCATION: 2° S/108 E
ALTITUDE: 739 km

PIECES CATALOGED (1 JAN 84): 464
PIECES STILL IN ORBIT (1 JAN 84): 163

ORBIT CHARACTERISTICS:

INCLINATION: 32.6°
APOGEE: 791 km
PERIGEE: 708 km
PERIOD: 99.8 min

TRUE ANOMALY:

1-30
COMMENTS:

- Transtage fragmented.
- General shape was cylindrical; length 6 m; dia. 3 m; weight 1500 kg? Lester Sobel’s Space: From Sputnik to Gemini indicates mass was 3764.5 kg but does not qualify the rocket as full or empty of fuel.
- Payloads OV2-1 and LCS-2 did not separate from the transtage.
- The restartable transtage employed one AJ10-138 engine with storable hypergolic propellants and produced 7,257.0 kg of thrust.
- The orbit characteristics shown are from the initial elements on file for satellite 1624, the OV2-1, LCS-2 payloads.
- The main body of OV2-1 was 23 in. square and 24 in. long. There were 4 solar panels. Total weight was 375 lbs. The LCS-2 was a highly polished rigid hollow sphere of 1/8 in. aluminum sheet and weighed 75 lbs.

CAUSE: Assume leak of hypergolic fuels.
TITAN 3C-4
LAUNCH DATE: 4.23 Nov 1965

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 4-15? Nov 1965 (DAY 308-319)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 21

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 48.44°

APOGEE: 521 km

PERIGEE: 211 km

PERIOD: 91.9 min

TRUE ANOMALY: 1-34
COMMENTS:

- The general shape of this payload was cylindrical; length 1.8 m; dia. 1.2 m; weight 400 kg.

- The orbit characteristics were extracted from the initial element set generated for 1966 that remains on file in the USAF NSSC computer.

- One fragment was cataloged near time of launch; two more between 19 and 20 Nov 1965; 19 cataloged between 27 and 29 Nov 1965.

- Insufficient data is available to determine time and position for this event.

CAUSE: Unknown
ORIGINAL PAGE IS OF POOR QUALITY
COMMENTS: Insufficient data available to show the applicable ground trace for satellite 1706.
LAUNCH DATE: 15.85 Feb 1966

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 15 Feb 1966 (DAY 46)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 37

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 96.5°

APOGEE: 268 km

PERIGEE: 147 km

PERIOD: 88.6 min

TRUE ANOMALY: 1-38
COMMENTS:

- Satellite 2015 was an inflated sphere; dia. 3m; weight 4.1 kg.
- There is no rocket cataloged with this launch. The launch hardware was an Atlas-Agena D. Three payloads launched.
- NORAD cataloged the fragments with payload 2015, Ops 3031.
- Payload 2014 was also an inflated sphere. 3 m in dia.; and payload 2012 was a capsule.
- Orbit characteristics derived from initial element set on satellite 2015.
- Parent identification tentative.
- Insufficient data is available to determine time and position for this event.

CAUSE: Unknown
HEIGHT OF APOGEE/PERIGEE

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OPS 3031

1-40
COMMENTS:  • Insufficient data available to show the applicable ground track for satellite 2015, Ops. 3031.
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<th>Description</th>
</tr>
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<tbody>
<tr>
<td>LAUNCH DATE:</td>
<td>1.63 Jun 1966</td>
</tr>
<tr>
<td>COUNTRY OF ORIGIN:</td>
<td>US</td>
</tr>
<tr>
<td>EVENT DATA:</td>
<td></td>
</tr>
<tr>
<td>DATE:</td>
<td>21 Jun 1966</td>
</tr>
<tr>
<td>TIME:</td>
<td></td>
</tr>
<tr>
<td>LOCATION:</td>
<td></td>
</tr>
<tr>
<td>ALTITUDE:</td>
<td></td>
</tr>
<tr>
<td>PIECES CATALOGED (1 JAN 84):</td>
<td>50</td>
</tr>
<tr>
<td>PIECES STILL IN ORBIT (1 JAN 84):</td>
<td>0</td>
</tr>
<tr>
<td>ORBIT CHARACTERISTICS:</td>
<td></td>
</tr>
<tr>
<td>INCLINATION:</td>
<td>28.82°</td>
</tr>
<tr>
<td>APOGEE:</td>
<td>300 km</td>
</tr>
<tr>
<td>PERIGEE:</td>
<td>281 km</td>
</tr>
<tr>
<td>PERIOD:</td>
<td>90.3 min</td>
</tr>
<tr>
<td>TRUE ANOMALY:</td>
<td>1-42</td>
</tr>
</tbody>
</table>
COMMENTS:

• This was the Atlas rocket that launched the Gemini rendezvous and docking Agena Target Vehicle 09; Augmented Target Docking Adaptor (ATDA).

• The orbit characteristics were derived from element set #1 for satellite 2188.

• General shape; cylinder; length 20 m; dia. 3 m; weight 3400 kg.

CAUSE: Unknown
COMMENTS: Insufficient data available to show applicable ground trace for satellite 2188.
LAUNCH DATE: 24.01 Jun 1966
COUNTRY OF ORIGIN: US

EVENT DATA:

1. DATE: 12 Jul 1975 (DAY 193) TIME: 224757.9 GMT LOCATION: 67 N/135 ° ALTITUDE: 5144 km PIECES CATALOGED (1 JAN 84): 75 PIECES STILL IN ORBIT (1 JAN 84): 13

ORBIT CHARACTERISTICS:

INCLINATION: 85.28° APOGEE: 5169 km PERIGEE: 3201 km PERIOD: 180.1 min TRUE ANOMALY: 192°

2. DATE: 20 Jan 1976 (DAY 20) TIME: 013000.0 GMT ± 3 hrs. LOCATION: 85.070 ° ALTITUDE: 5424 km PERIGEE: 2934 km PERIOD: 180.1 min TRUE ANOMALY: 2629 km

3. DATE: Jun 78
COMMENTS:

- Payload 2253 was a 30.48 m alumized mylar balloon.
- See NORAD Technical Memorandum 81-6 for details of this fragmentation.
- 45 pieces were cataloged with no initial elements and 30 with elements.
- The RAE Table of Earth Satellites indicated a fragment of Pageos fragmented into 44 pieces on 20 Jan 1976. NORAD had a provisional satellite number of 82130 for that fragment. This 2nd group of fragments was observed by King-Hele and P. Neirinick.
- The time of the 2nd breakup was calculated by P. Neirinick based on optical observations.
- A 3rd breakup was detected by optical observations from Dubai & Invercargill, England and North Canton, Ohio. Its epoch appears to be mid June 1978.

CAUSE:

Unknown for the 1st event, collision appears to be a more elevated possibility than for many other fragmentation cases.

The Science Research Council, Appleton Laboratory, England has shown a general correlation between event time and object spin-up as the object moves to the position where its orbit grazes the earth shadow. Their data follows:

<table>
<thead>
<tr>
<th>Spin Up</th>
<th>Max. Spin</th>
<th>Shadow Grazing</th>
<th>Break-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>?</td>
<td>?</td>
<td>2 Jul 75</td>
<td>12 Jul 75</td>
</tr>
<tr>
<td>?</td>
<td>?</td>
<td>11 Dec 75</td>
<td>20 Jan 76</td>
</tr>
<tr>
<td>2 Jun 78</td>
<td>22 Jun 78</td>
<td>5 Jul 78</td>
<td>19? Jun 78</td>
</tr>
</tbody>
</table>

1966-56

1-47
COMMENTS: * Insufficient data to identify debris associated with the Second Event, therefore, an orbit distribution plot is not provided.
COMMENTS: * Insufficient data to identify debris associated with the Third Event, therefore, an orbit distribution plot is not provided.
COMMENTS: * Insufficient data to show applicable ground track for satellite 2256, Third Event.
1966-59		SA-203 R/B		2289

LAUNCH DATE:  5.62 Jul 1966

COUNTRY OF ORIGIN:  US

EVENT DATA:

DATE:  5 Jul 1966 (DAY 186)

TIME:  211100.0 GMT

LOCATION:  20 N/277 E

ALTITUDE:  204 KM

PIECES CATALOGED (1 JAN 84):  33

PIECES STILL IN ORBIT (1 JAN 84):  0

ORBIT CHARACTERISTICS:

INCLINATION:  31.98°

APOGEE:  214 km

PERIGEE:  185 km

PERIOD:  88.5 min

TRUE ANOMALY:  140°
COMMENTS:

- This was a Saturn IB launch associated with the Apollo program.
- The NORAD catalog carries the common name AS-203 and other documents refer to it as SA-203.
- The orbit characteristics were derived from element set #1 for satellite 2289.
- NORAD was unable to catalog the S-IVB stage prior to its fragmentation. Its length was 28.3 m; dia. 6.6 m; weight 26552 kg.
- This launch tested venting and restart of the S-IVB stage after a coast period. Later in the flight this stage was allowed to build pressure for a structures test which then exploded the S-IVB stage in orbit.

CAUSE: Planned structures test.

1966-59
LAUNCH DATE: 17.94 Sep 1966

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 17 Sep 1966 (DAY 260)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 54

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 49.6°

APOGEE: 792 km

PERIGEE: 138 km

PERIOD: 93.9 min

TRUE ANOMALY:
COMMENTS:  * Alleged Fractional Orbit Bombardment System (FOBS) test.

* This launch was between Cosmos 128 and 129 and was not acknowledged by the USSR.

* Only debris was cataloged and satellite 2437 was the first piece cataloged.

* No elements are in the archives for 2437. The orbit characteristics were taken from the initial element set for 2437 which is saved on file in the NORAD computational system.

* General shape was cone-cylinder; length 6 m? dia. 1.5 m?

* Probably fragmented on first revolution.

CAUSE:  Unknown
1966-88 FOBS
1-60
LAUNCH DATE: 2.03 Nov 1966
COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 2 Nov 1966 (DAY 306)
TIME:
LOCATION:
ALTITUDE:

PIECES CATALOGED (1 JAN 84): 40
PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 49.7°
APOGEE: 651 km
PERIGEE: 188 km
PERIOD: 92.9 min

TRUE ANOMALY:
COMMENTS:  

- Alleged Functional Orbit Bombardment System (FOBS) test.

- Only debris cataloged.

- Satellite 2536 is the first piece of debris cataloged.

- No elements are in the archives for 2536. The orbit characteristics were taken from the initial element set for 2536 which is saved on file in the NORAD computational system.

- This launch was not acknowledged by the USSR.

- General shape was cone-cylinder; length 6 m; dia. 1.5 m.

- Probably fragmented on first revolution.

CAUSE:  Unknown

1966-101
LAUNCH DATE: 11.45 Jan 1967

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 

TIME: 

LOCATION: 

ALTITUDE: 

PIECES CATALOGED (1 JAN 84): 23

PIECES STILL IN ORBIT (1 JAN 84): 4

ORBIT CHARACTERISTICS:

INCLINATION: 28.73°

APOGEE: 589 km

PERIGEE: 253 km

PERIOD: 93.6 min

TRUE ANOMALY:
 COMMENTS:  

- Due to the low inclination of this launch and severe sensor limitations on low inclination orbits information on this event is sparse. Inconsistent observation of debris in the region between 2,800 and 6,000 km was experienced. Attempts to maintain elements on this debris were largely unsuccessful.

- The identification of this debris with this launch is provisional.

- Orbit characteristics developed from element set #1 on satellite 2640. However, the characteristics of the orbits of the debris indicates the event most likely occurred during a transfer maneuver.

- Insufficient data is available to determine time and location of the event for satellite 2640.

- Launch vehicle was a thrust augmented Delta (TAD). Payload was placed in planned orbit.

CAUSE:  

Unknown.

1967-01
COMMENTS: Insufficient data is available to show the applicable ground track for satellite 2640, Intelsat 2-F2 rocket.
LAUNCH DATE: 19.18 Oct 1968

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 1 Nov 1968 (DAY 306)

TIME: 041205.7 GMT

LOCATION: 55 N/104 E

ALTITUDE: 542 km

PIECES CATALOGED (1 JAN 84): 4

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 62.25°

APOGEE: 543 km

PERIGEE: 473 km

PERIOD: 94.8 min

TRUE ANOMALY: 172°
COMMENT:

* Alleged anti-satellite test target.
* Orbit characteristics derived from element set #5 on satellite 3503, epoch 30 Oct 68.
* General shape was cylinder?: length 4 m? dia. 2 m?

CAUSE:

Pieces detected after second alleged ASAT test which involved the interceptor, Kosmos 252. This is the only alleged Soviet ASAT target which has experienced fragmentation immediately after an alleged ASAT test.
1968-91

COSMOS 249

LAUNCH DATE: 20.17 Oct 1968

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 20 Oct 1968 (DAY 294)
TIME: 142708.9 GMT
LOCATION: 57 S/181 E
ALTITUDE: 1994 km

PIECES CATALOGED (1 JAN 84): 91
PIECES STILL IN ORBIT (1 JAN 84): 55

ORBIT CHARACTERISTICS:

INCLINATION: 62.33°
APOGEE: 2159 km
PERIGEE: 496 km
PERIOD: 112.2 min
TRUE ANOMALY: 214°
COMMENTS:  
* General shape was cylinder?; length 4 m?; dia. 1.5 m?
* This was the 1st alleged USSR ASAT test.
* The distribution of debris suggests 2 separate fragmentation events.
* The break-up events did not occur near the target satellite (Kosmos 248).

CAUSE: Plannned fragmentation as part of an alleged USSR ASAT test.
LAUNCH DATE: 1.02 Nov 1968

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 1 Nov 1968 (DAY 306)

TIME: 040159.3 GMT

LOCATION: 58 N/34 E

ALTITUDE: 534 km

PIECES CATALOGED (1 JAN 84): 122

PIECES STILL IN ORBIT (1 JAN 84): 55

ORBIT CHARACTERISTICS:

INCLINATION: 62.34°

APOGEE: 2139 km

PERIGEE: 534 km

PERIOD: 112.4 min

TRUE ANOMALY: 360°
COMMENTS:  • Alleged 2nd USSR ASAT test.
  • Orbit data derived from element set #2 satellite 3530.
  • General shape was cylinder?; length 4 m.?; dia. 2 m?
  • Break-up occurred at perigee in the vicinity of the target satellite (Kosmos 248).

CAUSE:  Planned fragmentation as part of an alleged USSR ASAT test.
1969-29

METEOR 1/ROCKET

LAUNCH DATE: 26.52 Mar 1969

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 28 Mar 1969 (DAY 87)

TIME: 184431.52

LOCATION: 59 N/91 E

ALTITUDE: 554 km

PIECES CATALOGED (1 JAN 84): 36

PIECES STILL IN ORBIT (1 JAN 84): 2

ORBIT CHARACTERISTICS:

INCLINATION: 81.17°

APOGEE: 851 km

PERIGEE: 462 km

PERIOD: 97.9 min

TRUE ANOMALY: 300°
COMMENTS:  
* General shape was cylinder; length 3.8 m; dia. 2.6 m; weight 1440 kg.
* Orbit data derived from element set #2 (Epoch = 69087.213) of payload satellite 38J5. (Identity of payload and rocket had been switched in element data).

CAUSE:  Unknown
1969 - 29
EXPLOSION
26 MARCH 1969
DATA FROM 60

ALTITUDE (km)

PERIOD (minutes)

METEOR 1/ROCKET

1-84
LAUNCH DATE: 26.09 Jul 1969

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 26 Jul 1969 (DAY 207)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 24

PIECES STILL IN ORBIT (1 JAN 84): 4

ORBIT CHARACTERISTICS:

INCLINATION: 30.37°

APOGEE: 5445 km

PERIGEE: 271 km

PERIOD: 147.2 min

TRUE ANOMALY:
COMMENTS:

- Orbit data derived from element set #1 on satellite 4052.
- The launch vehicle was a LTTA-Delta rocket.
- General shape was sphere-cone; length 1.32 m; dia. 94 m; weight 66 kg.
- This launch attained orbit, however, the payload was unusable because a 3rd stage malfunction placed it into an incorrect orbit.
- Four cataloged debris not from this event; satellites 5309, 13913, 13914 and 13915. They are not plotted on the following orbit distribution plot.

CAUSE: Unknown
COMMENTS:    * Insufficient data to show applicable ground trace for satellite 4052.
1969-82	 OPS 7613 R/B	 4132

LAUNCH DATE: 30.57 Sep 1969
COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 4 Oct 1969 (DAY 277)
TIME: 155309.2 GMT
LOCATION: 54 N/178 E
ALTITUDE: 919 km

PIECES CATALOGED (1 JAN 84): 241
PIECES STILL IN ORBIT (1 JAN 84): 123

ORBIT CHARACTERISTICS:

INCLINATION: 70.0°
APOGEE: 940 km
PERIGEE: 907 km
PERIOD: 103.4 min
TRUE ANOMALY: 11°
Launched with Thorad-Agena D rocket. The rocket was not cataloged by NORAD for this launch because the rocket fragmented before its orbit could be developed.

- NORAD cataloged the debris with a substitute parent: payload #9, Ops 7613, satellite 4132.

- The orbital characteristics shown are from satellite 4132 and serve as an approximation of the unknown rocket orbit.

- The ground trace was derived from the orbit of a large piece of debris and fits the rocket orbit at the point of fragmentation and approximates the actual rocket orbit for the remainder of the ground trace.

CAUSE: Unknown
LAUNCH DATE: 8.35 Apr 1970

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 17 Oct 1970 (DAY 290)

TIME: 031717.0 GMT

LOCATION: 50 S/142 E

ALTITUDE: 1076 km

PIECES CATALOGED (1 JAN 84): 330

PIECES STILL IN ORBIT (1 JAN 84): 282

ORBIT CHARACTERISTICS:

INCLINATION: 99.79°

APOGEE: 1094 km

PERIGEE: 1051 km

PERIOD: 106.7 min

TRUE ANOMALY: 93°
COMMENTS:  
- Launched with Thor-Agena D.
- General shape was cylinder; length 6 m; dia. 1.5 m; weight 700 kg?
- Orbit data derived from element set #966 for satellite 4367.

CAUSE:  Unknown
LAUNCH DATE: 23.18 Oct 1970

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 23 Oct 1970 (DAY 296)
TIME: 151323.6 GMT
LOCATION: 22 S/217 E
ALTITUDE: 1197 km
PIECES CATALOGED (1 JAN 84): 92
PIECES STILL IN ORBIT (1 JAN 84): 44

ORBIT CHARACTERISTICS:

INCLINATION: 62.94
APOGEE: 2132 km
PERIGEE: 529 km
PERIOD: 112.3 min
TRUE ANOMALY: 273°
COMMENTS:  
- Alleged Soviet ASAT test.
- Orbit data derived from element set #2 for satellite 4594.
- General shape was cylinder; length 4 m; dia. 2 m.
- Break-up did not occur in the vicinity of the alleged target satellite (Kosmos 373).

CAUSE: Planned fragmentation as part of an alleged USSR ASAT test.
ORIGINAL PAGE IS OF POOR QUALITY
LAUNCH DATE: 30.09 Oct 1970

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 30 Oct 1970 (DAY 303)

TIME: 060003.77 GMT

LOCATION: 54 N/23 E

ALTITUDE: 565 km

PIECES CATALOGED (1 JAN 84): 41

PIECES STILL IN ORBIT (1 JAN 84): 31

ORBIT CHARACTERISTICS:

INCLINATION: 62.83°

APOGEE: 2186 km

PERIGEE: 464 km

PERIOD: 112.1 min

TRUE ANOMALY: 359°
COMMENTS:  
- Alleged Soviet ASAT test.
- Orbit data derived from element set #2 for satellite 4598.
- General shape was cylinder?; length 4 m?; dai. 2 m?
- Break-up occurred in the vicinity of the alleged target satellite (Kosmos 373).

CAUSE:  Planned fragmentation as part of an alleged USSR ASAT test.
LAUNCH DATE: 25.47 Feb 1971

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 25 Feb 1971 (DAY 56)

TIME: 143039.2 GMT

LOCATION: 54 N/21 E

ALTITUDE: 587 km

PIECES CATALOGED (1 JAN 84): 88

PIECES STILL IN ORBIT (1 JAN 84): 73

ORBIT CHARACTERISTICS:

INCLINATION: 65.76°

APOGEE: 2,200 km

PERIGEE: 575 km

PERIOD: 113.5 min

TRUE ANOMALY: 11°
COMMENTS:

- Alleged Soviet ASAT test.
- General shape was cylinder; length 4 m; dia. 2 m;
- Orbit data derived from element set #2 for satellite 4964.
- Break-up occurred in the vicinity of the alleged target satellite (Kosmos 394).

CAUSE: Planned fragmentation as part of an alleged USSR ASAT test.
1971-106

COSMOS 462

5646

LAUNCH DATE: 3.55 Dec 1971

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 3 Dec 1971 (DAY 337)

TIME: 165102.2 GMT

LOCATION: 52 N/9 E

ALTITUDE: 231 km

PIECES CATALOGED (1 JAN 84): 27

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.88°

APOGEE: 1,654 km

PERIGEE: 231 km

PERIOD: 103.8 min

TRUE ANOMALY: 359°
COMMENTS:

- Alleged Soviet ASAT test.
- General shape was cylinder; length 4 m; dia. 2 m.
- Orbit data derived from element set #1 for satellite 5646.
- Break-up occurred at perigee in vicinity of the alleged target satellite (Kosmos 459).

CAUSE: Planned fragmentation as part of an alleged USSR ASAT test.
HEIGHT OF APOGEE/PERIGEE \times 10^1

PERIOD

COSMOS 462

1-112
LAUNCH DATE: 23.75 Jul 1972

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 22 May 1975 (DAY 142)

TIME: 182720.5 GMT

LOCATION: 34 S/46 E

ALTITUDE: 725 km

PIECES CATALOGED (1 JAN 84): 218

PIECES STILL IN ORBIT (1 JAN 84): 88

ORBIT CHARACTERISTICS:

INCLINATION: 98.34°

APOGEE: 909 km

PERIGEE: 633 km

PERIOD: 100.3 min

TRUE ANOMALY: 289°
COMMENTS:

- Delta 2nd stage rocket.
- General shape was cylinder; length 4.9 m; dia. 1.43 m; weight 350 kg?
- Orbit data derived from element set #260 on satellite 6127.

CAUSE:

Hypercold fuel ignition due to tank bulkhead rupture is the most probable cause.
LAUNCH DATE: 3.38 Apr 1973

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 3 Apr 1973 (DAY 93)

TIME: 223626.9 GMT

LOCATION: 45 N/290 E

ALTITUDE: 224 km

PIECES CATALOGED (1 JAN 84): 25

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 51.48°

APOGEE: 244 km

PERIGEE: 195 km

PERIOD: 88.9 min

TRUE ANOMALY: 117°
COMMENTS:  
- General shape was cylinder; length 12 M?; dia. 4 m.?; weight 400 kg?
- Orbit data derived from element set #1 for satellite 6399.

CAUSE:  Unknown
LAUNCH DATE: 19.38 Apr 1973

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 6 May 1973 (DAY 126)

TIME: 072333.0 GMT

LOCATION: 71 S/215 E

ALTITUDE: 309 km

PIECES CATALOGED (1 JAN 84): 196

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 72.85

APOGEE: 350 km

PERIGEE: 168 km

PERIOD: 89.7 min

TRUE ANOMALY: 251°
COMMENTS:

* General shape was sphere-cylinder; length 5 m?; dia. 2 m?; weight 4000 kg?

* 88 debris cataloged with "no initial elements." This count is contained in "pieces cataloged" count.

CAUSE: Intentionally destroyed by USSR

1973-21
LAUNCH DATE: 6.71 Nov 1973

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 28 Dec 1973 (DAY 362)

TIME: 090800.0 GMT

LOCATION: 26 S/176 E

ALTITUDE: 1513 km

PIECES CATALOGED (1 JAN 84): 180

PIECES STILL IN ORBIT (1 JAN 84): 168

ORBIT CHARACTERISTICS:

INCLINATION: 102.05°

APOGEE: 1513 km

PERIGEE: 1504 km

PERIOD: 116.2 min

TRUE ANOMALY: 181°
COMMENTS:

- Delta 2nd stage rocket
- General shape was cylinder; length 4.9 m; dia. 1.43 m; weight 350?
- Orbit data derived from element set 015 for satellite 6921.
- Time and location of this event taken from analysis of NOAA-3 (ITOS-F) rocket body breakup by R. R. Dasenbrock, B. Kaufman and W. B. Heard and reported in AAS/AIAA paper No. AAS-75-040.

CAUSE: Hypergolic fuel ignition due to ruptured fuel tank bulkhead most probable cause.
LAUNCH DATE: 26.69 Sept 1974

COUNTY OF ORIGIN: USSR

EVENT DATA:

DATE: 26 Sept 1974 (DAY 269)
TIME: 213538.2 GMT
LOCATION: 26 N/94 E
ALTITUDE: 355 km

PIECES CATALOGED (1 JAN 84): 19
PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 70.9°
APOGEE: 456 km
PERIGEE: 259 km
PERIOD: 91.7 min

TRUE ANOMALY: 1-130
COMMENTS:  * Orbit data derived from element set #1 for satellite 7448
* General shape was cylinder; length 8 m; dia. 1.65 m; weight 1500 kg?
* All fragments were launched forward except one. This fragment was catalyzed after it had decayed.

CAUSE: Unknown

1974-74

1-131
HEIGHT OF APOGEE/PERIGEE
350, 400, 450, 500, 550, 600.

COSMOS 686

1-132
LAUNCH DATE: 15.72 Nov 1974

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 20 Aug 1975 (DAY 232)

TIME: 130638.8 GMT

LOCATION: 52 S/278 E

ALTITUDE: 1460 km

PIECES CATALOGED (1 JAN 84): 132

PIECES STILL IN ORBIT (1 JAN 84): 124

ORBIT CHARACTERISTICS:

INCLINATION: 101.69°

APOGEE: 1460 km

PERIGEE: 1445 km

PERIOD: 114.9 min

TRUE ANOMALY: 185°
COMMENTS:

- Delta 2nd stage rocket.
- General shape was cylinder; length 4.9 m; dia. 1.43 m; weight 350 kg?
- Orbit data derived from element set #64 on satellite 7532.

CAUSE:  Hypergolic fuel ignition due to ruptured fuel tank bulkhead most probable cause.
LAUNCH DATE: 24.46 Dec 1974

COUNTRY OF ORIGIN: USSR

EVENT DATA:

1. 
   DATE: 17 Apr 1975 (DAY 107)
   TIME: 214825.5
   LOCATION: 01 N/278 E
   ALTITUDE: 437 km

   PIECES CATALOGED (1 JAN 84): 50

   PIECES STILL IN ORBIT (1 JAN 84): 0

2. 
   DATE: 2 Aug 1975 (DAY 214)
   TIME: 162310.0
   LOCATION: 2 S/258 E
   ALTITUDE: 433 km

ORBIT CHARACTERISTICS:

   INCLINATION: 65.04° 65.05°
   APOGEE: 444 km 442 km
   PERIGEE: 424 km 414 km
   PERIOD: 93.3 min 93.1 min
   TRUE ANOMALY: 250° 250°
Comments:

- Orbit data derived from element set #132 and #333 for satellite 7587; 1st and 2nd events respectively.

- This event analyzed by William Heard of the Naval Research Laboratory. Report on file at Teledyne Brown Engineering, Colorado Springs, Colorado.

- Debris highly unidirectional.

- This was the first of a class of USSR satellites at 65° inclination and approximately 440 km altitude. The majority of the satellites in this class fragment.

CAUSE: Apparently deliberate fragmentation.
COMMENTS: Unable to unambiguously identify debris associated with 2nd event, therefore, an orbit distribution plot is not provided.
LAUNCH DATE: 22.75 Jan 1975

COUNTRY OF ORIGIN: US

EVENT DATA:

1. DATE: 9 Feb 1976 (DAY 40)  
   TIME: 065916.6 GMT  
   LOCATION: 7 N/344 E  
   ALTITUDE: 751 km  
   PIECES CATALOGED (1 JAN 84): 14  
   PIECES STILL IN ORBIT (1 JAN 84): 54 (Both Events)

2. DATE: 19 Jun 1976 (DAY 171)  
   LOCATION:  
   ALTITUDE:  
   PIECES CATALOGED (1 JAN 84): 183

ORBIT CHARACTERISTICS:

INCLINATION: 97.78°
APOGEE: 915 km
PERIGEE: 741 km
PERIOD: 101.5 min
TRUE ANOMALY: 28°
COMMENTS:  
  * Delta 2nd stage rocket.  
  * Orbit data derived from element set #127 for satellite 7616, for 1st event; #145 for 2nd event.  
  * Two events. First event on 9 Feb 1976 was a small fragmentation resulting in only 14 pieces cataloged. The 2nd event followed the first by 131 days and was a far more forceful event.  
  * General shape was cylinder-annulus; length 6.4 m and 1.52 m; dia. 2.44 m; weight 350 kg?  

CAUSE:  Hypergolic fuel ignition due to ruptured fuel tank bulkhead most probable cause for 2nd event. 1st event unknown cause.
LANDSAT 2 ROCKET
1ST EVENT
COMMENTS  * Insufficient data to show applicable ground trace for satellite 7616, first event.
1975-027

GEOS 3 ROCKET

LAUNCH DATE: 10.00 Apr 1975

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 12 Mar 1978 (DAY 71)

TIME: ~1200 GMT

LOCATION:

ALTITUDE: ~840 km

PIECES CATALOGED (1 JAN 84): 5

PIECES STILL IN ORBIT (1 JAN 84): 3

ORBIT CHARACTERISTICS:

INCLINATION: 114.99°

APOGEE: 844 km

PERIGEE: 837 km

PERIOD: 101.7 min

TRUE ANOMALY:

1-150
COMMENTS:

- Delta 2nd stage rocket.
- No other event at this inclination.
- This event was discovered when researching the NORAD satellite catalog for new objects cataloged with old launches.
- Orbit data derived from 1 March 1978 element set on satellite 7735.
- General shape was cylinder plus annulus; length 6.4 and 1.52 m; dia. 2.44 m; weight 350 kg?

CAUSE:

Unknown; may not be related to the more violent mechanism which has plagued other Delta second stages.
LAUNCH DATE: 5.62 Sep 1975

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 6 Sep 1975 (DAY 249)
TIME: 190611.0 GMT
LOCATION: 32 N/293 E
ALTITUDE: 184 km

PIECES CATALOGED (1 JAN 84): 77
PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 67.14
APOGEE: 324 km
PERIGEE: 173 km
PERIOD: 89.5 min
TRUE ANOMALY: 328°
COMMENTS:

- General shape was sphere-cylinder; length 7 m; dia. 2.4 m; weight 670 kg.
- Orbit data derived from element set #5 for satellite 8191.
- 72 pieces of those counted under "pieces cataloged" were cataloged without elements.

CAUSE: Possibly deliberately detonated.
COSMOS 758

1-156

PERIOD

HEIGHT OF APOGEE/PERIGEE $\times 10^1$
**LAUNCH DATE:** 29.46 Oct 1975

**COUNTRY OF ORIGIN:** USSR

<table>
<thead>
<tr>
<th>EVENT DATA:</th>
<th>1.</th>
<th>2.</th>
</tr>
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<tbody>
<tr>
<td><strong>DATE:</strong></td>
<td>25 Jan 1976 (DAY 25)</td>
<td>25 Jan 1976 (DAY 25)</td>
</tr>
<tr>
<td><strong>TIME:</strong></td>
<td>135941.1 GMT</td>
<td>152928.0 GMT</td>
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<tr>
<td><strong>LOCATION:</strong></td>
<td>53 N/7 E</td>
<td>42 N/331 E</td>
</tr>
<tr>
<td><strong>ALTITUDE:</strong></td>
<td>441 km</td>
<td>440 km</td>
</tr>
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</table>

**PIECES CATALOGED (1 JAN 84):** 62

**PIECES STILL IN ORBIT (1 JAN 84):** 0

**ORBIT CHARACTERISTICS:**

<table>
<thead>
<tr>
<th>INCLINATION:</th>
<th>65.02°</th>
<th>66.02°</th>
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<tbody>
<tr>
<td><strong>APOGEE:</strong></td>
<td>442 km</td>
<td>442 km</td>
</tr>
<tr>
<td><strong>PERIGEE:</strong></td>
<td>430 km</td>
<td>430 km</td>
</tr>
<tr>
<td><strong>PERIOD:</strong></td>
<td>93.3 min</td>
<td>93.3 min</td>
</tr>
<tr>
<td><strong>TRUE ANOMALY:</strong></td>
<td>151°</td>
<td>138°</td>
</tr>
</tbody>
</table>
COMMENTS:

- Payload still active when it fragmented.
- Orbit data derived from element set #96 for satellite 8416.
- 2 events about 1 orbital revolution apart in time.
- Member of Cosmos 699 class.

CAUSE: Apparently deliberate fragmentation.
COMMENTS: "Unable to unambiguously identify debris associated with event 2, therefore, an orbit distribution plot is not provided for event 2."
1976-63  COSMOS 838  8932

LAUNCH DATE:  2.44 Jul 1976

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE:  17 May 1977 (DAY 137)

TIME:  101758.7 GMT

LOCATION:  9 S/284 E

ALTITUDE:  431 km

PIECES CATALOGED (1 JAN 84):  40

PIECES STILL IN ORBIT (1 JAN 84):  0

ORBIT CHARACTERISTICS:

INCLINATION:  65.06°

APOGEE:  444 km

PERIGEE:  415 km

PERIOD:  93.2 min

TRUE ANOMALY:  263°
COMMENTS:

- Orbit data derived from element set #250 on satellite 8932.
- General shape; cylinder?
- Member of Cosmos 699 class.

CAUSE: Apparently deliberate fragmentation.
LAUNCH DATE: 8.88 Jul 1976

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 29 Sep 1977 (DAY 272)

TIME: 071647.3 GMT

LOCATION: 33 S/162 E

ALTITUDE: 1911 km

PIECES CATALOGED (1 JAN 84): 53

PIECES STILL IN ORBIT (1 JAN 84): 52

ORBIT CHARACTERISTICS:

INCLINATION: 65.85°

APOGEE: 2100 km

PERIGEE: 981 km

PERIOD: 116.9 min

TRUE ANOMALY: 226°
COMMENTS:

- Alleged Soviet ASAT target.
- General shape was cylinder?; length 4 m?; dia. 2 m?
- Did not break-up due to alleged ASAT test activity.
- Orbit data derived from element set #379 for satellite 9011.

CAUSE: Unknown.
LAUNCH DATE: 22.66 Jul 1976

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 25 Jul 1976 (DAY 207)

TIME: 171754.7 GMT

LOCATION: 49 N/100 E

ALTITUDE: 209 km

PIECES CATALOGED (1 JAN 84): 248

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 67.15

APOGEE: 353 km

PERIGEE: 172 km

PERIOD: 89.8

TRUE ANOMALY: 55°
COMMENTS:

- Orbit data derived from element set #8 for satellite 9046.
- All debris decayed before elements could be developed. Piece count approximation determined from sensors; satellite numbers assigned and each piece was designated "decayed" when cataloged. This procedure has not been consistent over the years, other satellites have fragmented in low orbit and all debris decayed before it could be cataloged but the pieces were not cataloged.
- General shape was sphere-cylinder; length 7 m?; dia. 2.4 m; weight 6700 kg?

CAUSE: Probably deliberately detonated.
LAUNCH DATE: 29.71 Jul 1976

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 24 Dec 1977 (DAY 358)

TIME: 11324.7 GMT

LOCATION: 40 S/146 E

ALTITUDE: 1510 km

PIECES CATALOGED (1 JAN 84): 130

PIECES STILL IN ORBIT (1 JAN 84): 126

ORBIT CHARACTERISTICS:

INCLINATION: 102.02°

APOGEE: 1521 km

PERIGEE: 1506 km

PERIOD: 116.3 min

TRUE ANOMALY: 298°
COMMENTS:  
- Delta 2nd stage rocket.
- Orbit data derived from element set #97 for satellite 9063.
- General shape was cylinder plus annulus; length 6.4 m; dia. 1.52 and 2.44 m; weight 350 kg?

CAUSE:  Hypergolic fuel ignition due to ruptured tank bulkhead most probable cause.
HEIGHT OF APOGEE/PERIGEE

NOAA-5 ROCKET

1-178
LAUNCH DATE: 22.39 Oct 1976

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 15 Mar 1977 (DAY 74)

TIME: 125626.1 GMT

LOCATION: 29 N/114 E

ALTITUDE: 5678 km

PIECES CATALOGED (1 JAN 84): 11

PIECES STILL IN ORBIT (1 JAN 84): 11

ORBIT CHARACTERISTICS:

INCLINATION: 63.16°

APOGEE: 39644 km

PERIGEE: 1352 km

PERIOD: 718.9 min

TRUE ANOMALY: 88°
COMMENTS:  * Orbit data derived from element set #46 for satellite 9495.

* General shape was windmill plus 6 vanes; length 4.2 m; dia. 1.6 m; weight 1250 kg.

CAUSE:  Unknown; first of many break-ups associated with this class of satellites.
LAUNCH DATE: 9.84 Dec 1976

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 27 Nov 1978 (DAY 331)

TIME: 170248.3 GMT

LOCATION: 65 S/306 E

ALTITUDE: 559 km

PIECES CATALOGED (1 JAN 84): 50

PIECES STILL IN ORBIT (1 JAN 84): 13

ORBIT CHARACTERISTICS:

INCLINATION: 65.84°

APOGEE: 621 km

PERIGEE: 551 km

PERIOD: 96.4 min

TRUE ANOMALY: 321°
**COMMENTS:**
- General shape was cylinder?; length 4 m?; dia. 2 m?
- Orbit characteristics derived from element set #403 for satellite 9601.
- This apparent ASAT target did not fragment due to alleged ASAT test activity.

**CAUSE:** Unknown.
LAUNCH DATE: 27.53 Dec 1976

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 27 Dec 1976 (DAY 362)

TIME: 183955.7 GMT

LOCATION: 65 S/211 E

ALTITUDE: 2088 km

PIECES CATALOGED (1 JAN 84): 57

PIECES STILL IN ORBIT (1 JAN 84): 51

ORBIT CHARACTERISTICS:

INCLINATION: 65.84°

APOGEE: 2297 km

PERIGEE: 595 km

PERIOD: 114.8 min

TRUE ANOMALY: 217°
COMMENTS:

- Alleged Soviet ASAT test.
- General shape was cylinder; length 4 m; dia. 2m
- Orbit data derived from element set #2 for satellite 9634.
- Fragmentation did not occur near the alleged target satellite (Kosmos 880).

CAUSE: Fragmentation due to alleged ASAT test activity.
LAUNCH DATE: 11.07 Apr 1977

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 8 Jun 1978 (DAY 159)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 2

PIECES STILL IN ORBIT (1 JAN 84): 2

ORBIT CHARACTERISTICS:

INCLINATION: 63.15°

APOGEE: 39035 km

PERIGEE: 1323 km

PERIOD: 717.8 min

TRUE ANOMALY:

1-192
COMMENT:

General shape was windmill plus 6 vanes; length 4.2 m; dia. 1.6 m; weight 1250 kg.

Orbit data derived from element set #84 for satellite 9911.

Insufficient data is available to determine time and location for the satellite 9911 event.

CAUSE: Unknown.

#77-27 1-193
LAUNCH DATE: 16.09 Jun 1977

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 30 Mar 1979 (DAY 89)

TIME: 154507.4 GMT

LOCATION: 63 S/0 E

ALTITUDE: 3283 km

PIECES CATALOGED (1 JAN 84): 1

PIECES STILL IN ORBIT (1 JAN 84): 1

ORBIT CHARACTERISTICS:

INCLINATION: 62.95°

APOGEE: 38723 km

PERIGEE: 1643 km

PERIOD: 718.0 min

TRUE ANOMALY: 306°
COMMENTS:  
- General shape was windmill plus 6 vanes; length 4.2 m; dia. 1.6 m; weight 1250 kg.
- Orbit data derived from element set #134 for satellite 10059.

CAUSE:  Unknown.
LAUNCH DATE: 14.44 Jul 1977

COUNTRY OF ORIGIN: US

EVENT DATA:

DATE: 14 Jul 1977 (DAY 195)

TIME: 161155.1 GMT

LOCATION: 14 N/249 E

ALTITUDE: 1450 km

PIECES CATALOGED (1 JAN 84): 147

PIECES STILL IN ORBIT (1 JAN 84): 93

ORBIT CHARACTERISTICS:

INCLINATION: 29.05°

APOGEE: 2027 km

PERIGEE: 536 km

PERIOD: 111.2 min

TRUE ANOMALY: 108°
COMMENTS: * Delta 2nd stage rocket.
* Orbit data derived from element set #2 for satellite 10144.
* General shape was cylinder; length 3 m; dia. 2.1 m?; weight 670 kg full, 281 kg empty.

CAUSE: Hypergolic fuel ignition due to ruptured tank bulkhead most probable cause.
ORIGINAL PAGE IS OF POOR QUALITY

HEIGHT OF APOGEE/PERIGEE
0, 400, 800, 1200, 1600, 2000, 2400, 2800, 3200.

PERIOD
102, 105, 108, 111, 114, 117, 120.

HIMAWARI ROCKET

1-202
LAUNCH DATE: 20.20 Jul 1977

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 24 Oct 1977 (DAY 297)

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 4

PIECES STILL IN ORBIT (1 JAN 84): 2

ORBIT CHARACTERISTICS:

INCLINATION: 62.94°

APOGEE: 39667 km

PERIGEE: 682 km

PERIOD: 717.7 min

TRUE ANOMALY:
COMMENTS: • General shape was windmill plus 6 vanes; length 4.2 m; dia. 1.6 m; weight 1250 kg.
• Orbit data derived from element set #16 for satellite 10150.

CAUSE: Unknown.
1977-121  

LAUNCH DATE:  21.44 Dec 1977

COUNTRY OF ORIGIN:  USSR

EVENT DATA:

DATE:  21 Dec 1977 (DAY 355)

TIME:  170946.4 GMT

LOCATION:  38 S/274 E

ALTITUDE:  1133 km

PIECES CATALOGED (1 JAN 84):  54

PIECES STILL IN ORBIT (1 JAN 84):  54

ORBIT CHARACTERISTICS:

INCLINATION:  65.85°

APOGEE:  1139 km

PERIGEE:  946 km

PERIOD:  106.0 min

TRUE ANOMALY:  201°
COMMENTS:

- Alleged Soviet ASAT test.
- General shape was cylinder?; length 4 m; dia. 2m?
- Orbit data derived from element set #6 for satellite 10531.

CAUSE: Fragmentation due to alleged ASAT test activity.
LAUNCH DATE:  5.75 Mar 1978

COUNTRY OF ORIGIN:  US

EVENT DATA:

DATE:  27 Jan 1981 (DAY 27)

TIME:  043202.3 GMT

LOCATION:  80 S/301 E

ALTITUDE:  905 km

PIECES CATALOGED (1 JAN 84):  172

PIECES STILL IN ORBIT (1 JAN 84):  155

ORBIT CHARACTERISTICS:

INCLINATION:  98.85°

APOGEE:  912 km

PERIGEE:  903 km

PERIOD:  103.1 min

TRUE ANOMALY:  62°
COMMENTS:  
* Delta 2nd stage rocket.
* Orbit data derived from element set #569 for satellite 10704.
* General shape was cylinder plus annulus; length 6.4 m; 
dia. 1.52 and 2.44 m; weight 350 kg.

CAUSE:  Hypergolic fuel ignition due to ruptured tank bulkhead most 
probable cause.
LANDSAT 3 ROCKET

HEIGHT OF APOGEE/PERIGEE
800.  600.  400.  200.  1000.  1200.  1400.  1600.  1800.
1978-83 COSMOS 1030 1-216

LAUNCH DATE: 6.13 Sep 1978

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 10 Oct 1978 (DAY 283)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 4

PIECES STILL IN ORBIT (1 JAN 84): 3

ORBIT CHARACTERISTICS:

INCLINATION: 62.84°

APOGEE: 39760 km

PERIGEE: 666 km

PERIOD: 719.2 min

TRUE ANOMALY:
COMMENTS: • General shape was windmill plus 6 vanes?; length 4.2 m; dia. 1.6 m?; weight 1250 kg?
• Orbit data derived from element set #8 for satellite 11015.
• Insufficient data available to determine time and location for the satellite 11015 event.

CAUSE: Unknown.

1978-83
HEIGHT OF APOGEE/PERIGEE

2000, 7000, 12000, 17000, 22000, 27000, 32000, 37000, 42000.

PERIOD

COSMOS 1030

1-218

1-1
1979-33 COSMOS 1094 11333

LAUNCH DATE: 18.50 Apr 1979

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 17 Sep 1979 (DAY 260)

TIME: 103906.0 GMT

LOCATION: 54 S/336 E

ALTITUDE: 403 km

PIECES CATALOGED (1 JAN 84): 2

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.03°

APOGEE: 405 km

PERIGEE: 382 km

PERIOD: 92.4 min

TRUE ANOMALY: 206°
COMMENTS: • 23 known pieces decayed before they could be cataloged but provisional (8X,XXX) elements were developed.

• Member of Cosmos 699 class.

CAUSE: Apparently deliberate fragmentation.
LAUNCH DATE: 27.76 Jun 1979

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: Late Sep 1979

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 4

PIECES STILL IN ORBIT (1 JAN 84): 4

ORBIT CHARACTERISTICS:

INCLINATION: 62.86°

APOGEE: 39679 km

PERIGEE: 712 km

PERIOD: 718.5 min

TRUE ANOMALY: 1-224
COMMENTS:  
- General shape was windmill plus 6 vanes?; length 4.2 m; dia. 1.6?; weight 1250 kg?  
- Orbit data derived from element set #7 for satellite 11417.  
- Insufficient data available to determine time and location for the satellite 11417 event.

CAUSE:  Unknown.
COMMENTS • Insufficient data was available to obtain a ground trace for 1979-58, COSMOS 1109.
LAUNCH DATE: 28.01 Aug 1979

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 9 Sep 1979 (DAY 252)

TIME: 022932.4 GMT

LOCATION: 52 N/304 E

ALTITUDE: 8100 km

PIECES CATALOGED (1 JAN 84): 5

PIECES STILL IN ORBIT (1 JAN 84): 5

ORBIT CHARACTERISTICS:

"CLINATION: 62.93°

APOGEE: 39754 km

PERIGEE: 574 km

PERIOD: 717.2 min

TRUE ANOMALY: 103°
COMMENTS:  * General shape was windmill plus 6 vanes?; length 4.2 m; dia. 1.6 m?; weight 1250 kg?
  * Orbit data derived from element set with epoch 79249.09583699 for satellite 11509.

CAUSE:  Unknown.
**1979-104**  
**ARIANE V1**

**LAUNCH DATE:**  24.72 Dec 1979

**COUNTRY OF ORIGIN:**  France

**EVENT DATA:**

**DATE:**  Early 1980

**TIME:**

**LOCATION:**

**ALTITUDE:**

**PIECES CATALOGED (1 JAN 84):**  1

**PIECES STILL IN ORBIT (1 JAN 84):**  Est. at least 25

**ORBIT CHARACTERISTICS:**

**INCLINATION:**  17.6°

**APOGEE:**  35839 km

**PERIGEE:**  189 km

**PERIOD:**  631.9 min

**TRUE ANOMALY:**

1-232
COMMENTS:

• This event was discovered by analysis of the provisional (8X,XXX) elements in the NORAD catalog.

• Only the payload and rocket of this launch have been cataloged. Due to inconsistent observation of the smaller low inclination, (17°) fragments they become alternately lost then found as the observable portion of the orbits moved within and then out of sensor coverages.

• At any given time from 7 to 12 provisional elements are resident in the catalog.

• General shape was a sphere; dia. unk; weight 217 kg capsule plus 1385 kg ballast.

• Insufficient data available to determine the time and location for the satellite 11659 event.

• Orbit data for satellite 11659 derived from element set #1.

• Millstone radar team believes third stage blew-up approximately 90 days after launch.

CAUSE: Unknown.
DISTRIBUTION OF PIECES 1979-104 ARIANE V1
1-234
COMMENTS

- Insufficient data available to show applicable ground track for satellite 11659.

1979-104

1-235
1980-21

COSMOS 1167

11729

LAUNCH DATE: 14.45 Mar 1980

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 15 Jul 1981 (DAY 196)

TIME: 092049.7 GMT

LOCATION: 10 N/106 E

ALTITUDE: 437 km

PIECES CATALOGED (1 JAN 84): 12

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.31°

APOGEE: 450 km

PERIGEE: 357 km

PERIOD: 92.6 min

TRUE ANOMALY: 222°
COMMENTS:  
- Orbit derived from element set #573 for satellite 11729.
- Member of Cosmos 699 class.

CAUSE:  Apparently deliberate fragmentation.
1980-30                              COSMOS 1174                              11765

LAUNCH DATE: 18.04 Apr 1980

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 18 Apr 1980 (DAY 109)

TIME: 072616.1 GMT

LOCATION: 47 N/322 E

ALTITUDE: 986 km

PIECES CATALOGED (1 JAN 84): 39

PIECES STILL IN ORBIT (1 JAN 84): 22

ORBIT CHARACTERISTICS:

INCLINATION: 65.84°

APOGEE: 1025 km

PERIGEE: 362 km

PERIOD: 98.6 min

TRUE ANOMALY: 154°
COMMENTS:  
- Alleged Soviet ASAT test.
- Orbit data derived from element set #2 for satellite 11765.
- General shape; cylinder?

CAUSE:  Fragmentation due to alleged ASAT test.
1980-57 COSMOS 1191

LAUNCH DATE: 2.04 Jul 1980

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 14 May 1981 (DAY 134)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 2

PIECES STILL IN ORBIT (1 JAN 84): 2

ORBIT CHARACTERISTICS:

INCLINATION: 62.64°

APOGEE: 39283 km

PERIGEE: 1083 km

PERIOD: 718.0 min

TRUE ANOMALY:

1-244
COMMENTS:

- This event uncovered after the fact by analysis of provisional (8X,XXX) elements being actively carried in the NORAD system.
- The event date was determined by examination of the mean motion for satellite 11871 over a period of 2 years and correlating a significant change with the appearance of the provisional element sets.
- Six 8X,XXX elements were in the system but only one was cataloged.
- Orbit data derived from an element set with 14 March 1981 epoch for satellite 11871.
- General shape was windmill plus 6 vanes?; length 4.2m?; dia. 1.6 m; weight 1250 kg?
- Insufficient data available to determine time and location of the event for satellite 11871.

CAUSE:  Unknown.
**LAUNCH DATE:** 4.63 Nov 1980

**COUNTRY OF ORIGIN:** USSR

<table>
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<tr>
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<td><strong>DATE:</strong></td>
<td>20 Jun 1982 (DAY 171)</td>
<td>25 Aug 1982 (DAY 237)</td>
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<tr>
<td><strong>TIME:</strong></td>
<td>181814.2 GMT</td>
<td>123121.6 GMT</td>
</tr>
<tr>
<td><strong>LOCATION:</strong></td>
<td>10 S/332 E</td>
<td>65 S/238 E</td>
</tr>
<tr>
<td><strong>ALTITUDE:</strong></td>
<td>877 km</td>
<td>666 km</td>
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</table>

**PIECES CATALOGED (1 JAN 84):** 63

**PIECES STILL IN ORBIT (1 JAN 84):** 57

**ORBIT CHARACTERISTICS:**

| **INCLINATION:** | 65.00° | 65.00° |
| **APOGEE:**      | 883 km | 873 km |
| **PERIGEE:**     | 571 km | 580 km |
| **PERIOD:**      | 99.3 min | 99.3 min |
| **TRUE ANOMALY:** | 195° | 293° |
COMMENTS:

- Orbit data derived from element set #656 for satellite 12054.
- Eleven of the 63 pieces cataloged were cataloged after the 2nd event.
- Member of Cosmos 699 class.

CAUSE:  Apparently deliberate fragmentations.
HEIGHT OF APOGEE/PERIGEE

COSMOS 1220
(EVENT 1)

1-250
LAUNCH DATE: 19.48 Feb 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 20 Oct 1981 (DAY 293)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 4

PIECES STILL IN ORBIT (1 JAN 84): 4

ORBIT CHARACTERISTICS:

INCLINATION: 62.97°

APOGEE: 39401 km

PERIGEE: 362 km

PERIOD: 717.9 min

TRUE ANOMALY:
COMMENTS:  
* General shape was windmill plus 6 vanes?; length 4.2 m?; dia. 1.6 m; weight 1250 kg?
* Best estimate of event date is mid October 1981 and the orbit data has been derived from a mid October element set #236 for satellite 12303.

CAUSE:  Unknown.
1981-24

COSMOS 1258

LAUNCH DATE: 14.71 Mar 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 14 Mar 1981 (DAY 73)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 1

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.8°

APOGEE: 1024 km

PERIGEE: 301 km

PERIOD: 98.0 min

TRUE ANOMALY:

1-258
COMMENTS:

• Alleged Soviet ASAT test.

• 12 to 18 pieces detected re-entering. No fragments were cataloged.

• Insufficient data available to determine time and location of the event for satellite 12337.

CAUSE: Fragmentation due to alleged ASAT test activity.
A graph of the distribution of orbits of the fragments can not be presented because no fragments were cataloged. A simulation of the expected distribution of orbits could not be generated due to the uncertainty of the orbit at time of fragmentation.
 COMMENTS:  

- Insufficient data available to show applicable ground trace for satellite 12337.
1981-28  

COSMOS 1260  

12364

LAUNCH DATE:  21.00 Mar 1981

COUNTRY OF ORIGIN:  USSR

EVENT DATA:

1.  

DATE:  8 May 1982 (DAY 128)  
TIME:  044424.3 GMT  
LOCATION:  40 N/62 E  
ALTITUDE:  557 km  

2.  

DATE:  10 Aug 1982 (DAY 222)  
TIME:  233513.4 GMT  
LOCATION:  51 N/238 E  
ALTITUDE:  752 km

PIECES CATALOGED (1 JAN 84):  65

PIECES STILL IN ORBIT (1 JAN 84):  37 (Event 1 & 2)

ORBIT CHARACTERISTICS:

INCLINATION:  65.02°  
APOGEE:  720 km  
PERIGEE:  422 km  
PERIOD:  96.1 min  
TRUE ANOMALY:  74°

APOGEE:  753 km  
PERIGEE:  447 km  
PERIOD:  96.7 min  
TRUE ANOMALY:  186°
COMMENTS:  
  - Two separate events. The largest piece remaining after the first event was designated satellite 13183. Its orbit was a little higher than the original parent orbit. This piece fragmented on 10 Aug 1982.
  - Orbit data for satellites 12364 and 13183 was derived from element sets #483 and #47 respectively.
  - General shape; cylinder?
  - Member of Cosmos 699 class.

CAUSE: Apparently deliberate fragmentation.
LAUNCH DATE: 31.41 Mar 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 12 May 1981 (DAY 132)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 JAN 84): 4

PIECES STILL IN ORBIT (1 JAN 84): 4

ORBIT CHARACTERISTICS:

INCLINATION: 63.04°

APOGEE: 39743 km

PERIGEE: 649 km

PERIOD: 718.5 min

TRUE ANOMALY: 1-268
COMMENTS:  
- Orbit data derived from element set #34 for satellite 12376.
- General shape was windmill plus 6 vanes; length 4.2 m; dia. 1.6 m; weight 1250 kg.

CAUSE:  Unknown.
HEIGHT OF APOGEE/PERIGEE

COSMOS 1261
LAUNCH DATE: 4.65 Jun 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 24 Jul 1981 (DAY 205)

TIME: 235103.2 GMT

LOCATION: 68 N/197 E

ALTITUDE: 977 km

PIECES CATALOGED (1 JAN 84): 226

PIECES STILL IN ORBIT (1 JAN 84): 223

ORBIT CHARACTERISTICS:

INCLINATION: 82.96°

APOGEE: 1014 km

PERIGEE: 961 km

PERIOD: 104.8 min

TRUE ANOMALY: 292°
COMMENTS:  General shape was cylinder; length 1.3 m?; dia. 1.9 m?; weight 700 kg?

LAUNCH DATE: 4.01 Aug 1981
COUNTRY OF ORIGIN: USSR

EVENT DATA:
DATE: 21 Nov 1981 (DAY 325)
TIME:
LOCATION:
ALTITUDE:
PIECES CATALOGED (1 JAN 84): 3
PIECES STILL IN ORBIT (1 JAN 84): 3

ORBIT CHARACTERISTICS:
INCLINATION: 63.11°
APOGEE: 40109 km
PERIGEE: 721 km
PERIOD: 727.4 min
TRUE ANOMALY:
COMMENTS:  
- General shape was windmill plus 6 vanes; length 4.2 m; dia. 1.6 m; weight 1250 kg.

- Orbit data derived from element set #95 for satellite 12627.

CAUSE:  Unknown
1981-72 COSMOS 1286 12631

LAUNCH DATE: 4.35 Aug 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 29 Sep 1982 (DAY 272)

TIME: 051955.9 GMT

LOCATION: 51 N/80 E

ALTITUDE: 317 km

PIECES C.TALOGED (1 JAN 84): 2

PIECES STILL IN ORBIT (1 JAN 84): 0

ORBIT CHARACTERISTICS:

INCLINATION: 65.21°

APOGEE: 328 km

PERIGEE: 305 km

PERIOD: 92.6 min

TRUE ANOMALY: 251°
COMMENTS:

- Orbit data derived from element set #581 for satellite 12631.
- NORAD sensor personnel estimated 30 pieces but only one could be cataloged before decay.
- Member of Cosmos 699 class.

CAUSE: Apparently deliberate fragmentation.
COSMOS 1286 SIMULATION
1-282
LAUNCH DATE: 11.37 Sep 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 11 Sep 1981 (DAY 254)

TIME: 093631.1 GMT

LOCATION: 62 S/225 E

ALTITUDE: 649

PIECES CATALOGED (1 JAN 84): 2

PIECES STILL IN ORBIT (1 JAN 84): 2

ORBIT CHARACTERISTICS:

INCLINATION: 62.82°

APOGEE: 13864 km

PERIGEE: 626 km

PERIOD: 263.7 min

TRUE ANOMALY: 352
COMMENTS:  
- Orbit data derived from element set #1 for satellite 12818.
- Four additional pieces noted but not cataloged at this time.

CAUSE:  Rocket malfunction during a transfer orbit attempt.
LAUNCH DATE: 14.86 Sep 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

1. 

DATE: 12 Jul 1982 (DAY 193)

TIME: 232436.0 GMT

LOCATION: 65 S/40 E

ALTITUDE: 380 km

PIECES CATALOGED (1 JAN 84): 6

PIECES STILL IN ORBIT (1 JAN 84): 1

2. 

DATE: 18 Sep 1982 (DAY 261)

TIME: 170141.5 GMT

LOCATION: 32 N/293 E

ALTITUDE: 370 km

ORBIT CHARACTERISTICS:

INCLINATION: 64.94°

APOGEE: 407 km

PERIGEE: 380 km

PERIOD: 92.4 min

TRUE ANOMALY: 347°
COMMENTS:

- Two fragmentation events.
- For the first event NORAD sensor personnel counted 27 pieces but most decayed before they could be cataloged. A large fragment was given the number of the original parent, 12828, and it decayed 16 July 1982. One piece of debris from the first event, satellite 13369, fragmented 18 Sept 1982.
- Four cataloged pieces from the 1st event had not decayed by time of 2nd event.
- Orbit data derived from element sets #302 and #85 for satellites 12828 and 13369 respectively.
- 25 provisional element sets were developed on fragments from these events.
- Member of Cosmos 699 class.

CAUSE: Apparently deliberate fragmentations.
COSMOS 1306 SIMULATION

FIRST EVENT

1-290
COSMOS 1306 SIMULATION
2ND EVENT
1-292
LAUNCH DATE: 31.96 Oct 1981

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 25-28 Jan 1984 (Day 25-28)

TIME:

LOCATION:

ALTITUDE:

PIECES CATALOGED (1 MAR 84): 6 (3 cataloged plus 3 more provisional)

PIECES STILL IN ORBIT (1 MAR 84): 6

ORBIT CHARACTERISTICS:

INCLINATION: 62.8°

APOGEE: 39085.2 km

PERIGEE: 1318.9 km

PERIOD: 718.8 min

TRUE ANOMALY:
COMMENTS:  • General shape: windmill plus 6 vanes; 4.2 m long; 1.6 m dia.; weight 1250? kg.

  • Element data derived from NSCC elements on satellite 12933 epoch 1984 day 26.45925295.

CAUSE:  Unknown.
COMMENTS  * Insufficient data available to show applicable ground trace for satellite 12933.

1981-108
LAUNCH DATE: 29.42 Apr 1982

COUNTRY OF ORIGIN: USSR

EVENT DATA:

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<td>2.</td>
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PIECES CATALOGED (1 JAN 84): 22

PIECES STILL IN ORBIT (1 JAN 84): 3

ORBIT CHARACTERISTICS:

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<td>APOGEE:</td>
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<td>PERIGEE:</td>
<td>362 km</td>
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<td>289 km</td>
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<td>PERIOD:</td>
<td>92.1 min</td>
<td>90.9 min</td>
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<td>TRUE ANOMALY:</td>
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<td>79°</td>
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1982-38 COSNOS 1355 13150

1-298
COMMENTS: • Orbit data derived from element set #632 for satellite 13150, 1st event; element set #242 for 2nd event, satellite 14275 and elements generated on day 51.19, Feb. 19, 1984 on satellite 13150 for the 3rd event.

• The 1st and 3rd fragmentation was satellite 13150 and the 2nd fragmentation was satellite 14275.

• Thirteen fragments were detected after 3rd event.

• Member of Cosmos 699 class.

CAUSE: Apparently deliberate fragmentations.
COSMOS 1355
2ND EVENT
1-302
COMMENTS: * Insufficient data available to show applicable ground trace for COSMOS 1355 - 3rd event.
LAUNCH DATE: 4.74 Sep 1982

COUNTRY OF ORIGIN:

EVENT DATA:

DATE: 20 Dec 1983 (DAY 354)

TIME: 121434.0 GMT

LOCATION: 25 S/45 E

ALTITUDE: 333 km

PIECES CATALOGED (1 JAN 84): 5 (others cataloged after 1 Jan)

PIECES STILL IN ORBIT (1 JAN 84): 5

ORBIT CHARACTERISTICS:

INCLINATION: 65.00°

APOGEE: 342 km

PERIGEE: 315 km

PERIOD: 91.1 min

TRUE ANOMALY: 247°
COMMENTS:  
- Orbit data as of 16 Dec 1983
- Total count of pieces by sensors was approximately 140.
- Member of Cosmos 699 class.

CAUSE: Apparently deliberate fragmentation.
LAUNCH DATE: 8.58 Dec 1982

COUNTRY OF ORIGIN: USSR

EVENT DATA:


2. DATE: 9 Dec 1982 (DAY 343) TIME: 125820.6 GMT LOCATION: 40 S/16 E ALTITUDE: 369 km PIECES STILL IN ORBIT (1 JAN 84): 22

ORBIT CHARACTERISTICS:

INCLINATION: 62.8° 62.8°

APOGEE: 516 km 516 km

PERIGEE: 400 km 400 km

PERIOD: 93.8 min 93.8 min

TRUE ANOMALY: 222° 326°
COMMENTS:

- General shape was windmill plus cylinder; length 6.2 m; dia. 1.6 m²; weight full, 6050 kg.
- Failure during attempt to transfer payload to Molniya highly eccentric orbit.
- 13685 fragmented twice.
- 17 pieces counted by NORAD sensor for the 2nd fragmentation.

CAUSE: Upper stage engine failure.
COMMENTS

* Insufficient data was available to resolve the element set information for the two breakups, therefore no orbit distribution plot is provided for the second event.
LAUNCH DATE: 25.60 Apr 1983

COUNTRY OF ORIGIN: USSR

EVENT DATA:

DATE: 12 Aug 1983 (DAY 224)
TIME:
LOCATION:
ALTITUDE:

PIECES CATALOGED (1 JAN 84): 4
PIECES STILL IN ORBIT (1 JAN 84): 4

ORBIT CHARACTERISTICS:

INCLINATION: 63.29°

APOGEE: 39631 km
PERIGEE: 729 km
PERIOD: 717.9 min

TRUE ANOMALY:
COMMENTS:

- Orbit data derived from element set #49 for satellite 14034.
- General shape was windmill plus 6 vanes?; length 4.2 m?; dia. 1.6m; weight 1250 kg?
- Five cataloged pieces in event orbit. One of the 5 is the 2nd rocket of this launch.
- Ten objects cataloged with this international designator. These include objects in both the low transfer orbit and the high event orbit.

CAUSE: Unknown
launch date: 8.81 jul 1983

country of origin: ussr

event data:

date: 9 jul 1983 (day 190)

time:

location:

altitude:

pieces cataloged (1 jan 84): 2

pieces still in orbit (1 jan 84): 2

orbit characteristics:

inclination: 62.92°

apogee: 39199 km

perigee: 642 km

period: 707.4 min

true anomaly:

1-320
 COMMENTS:  
* Orbit data derived from element set #8 for satellite 14182.
* General shape was windmill plus 6 vanes?; length 4.2 m?;
dia. 1.6 m; weight 1250 kg?
* Never attained planned orbit.
* Pieces appeared the day after launch.
* Two additional 8X,XXX pieces identified.

CAUSE: Unknown; possibly propulsion related.
Section II

Satellite Fragmentation Summary Table

Satellite Breakup Status as of 31 Dec 1983
<table>
<thead>
<tr>
<th>LAUNCH DATE</th>
<th>LAUNCH DATE</th>
<th>DATE OF EVENT</th>
<th>INCL (°)</th>
<th>APOGEE (KM)</th>
<th>PERIGEE (KM)</th>
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ORIGINAL PAGE 19
OF POOR QUALITY
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**SATELLITE DEBRIS**

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<td>65.8</td>
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<td>65.8</td>
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<td>63.1</td>
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<td>29.0</td>
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<td>62.9</td>
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<td>682</td>
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<td>65.8</td>
<td>1139</td>
<td>946</td>
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<td>98.9</td>
<td>912</td>
<td>903</td>
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<tr>
<td>63.0</td>
<td>39760</td>
<td>666</td>
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</table>

**REMARKS**

- Delta second stage; small fragmentation.
- Large fragmentation
- Payload
- Payload; two events one revolution apart
- Payload
- Alleged ASAT target
- Debris cataloged but no elements. Payload
- Delta second stage
- Payload
- Alleged ASAT target
- Alleged ASAT target
- Payload
- Payload
- Delta second stage
- Payload
- Alleged ASAT
- Delta second stage
- Payload
<table>
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<tr>
<th>LAUNCH DATE</th>
<th>COMMON NAME</th>
<th>NSSC NUMBER</th>
<th>LAUNCH DATE</th>
<th>DATE OF EVENT</th>
<th>CATALOGED</th>
<th>IN ORBIT</th>
</tr>
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<tbody>
<tr>
<td>1979-33</td>
<td>COSMOS 1094</td>
<td>11333</td>
<td>18 Apr</td>
<td>17 Sep</td>
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<tr>
<td>1979-58</td>
<td>COSMOS 1109</td>
<td>11417</td>
<td>27 Jun</td>
<td>Sep ?</td>
<td>4*</td>
<td>4</td>
</tr>
<tr>
<td>1979-77</td>
<td>COSMOS 1124</td>
<td>11509</td>
<td>28 Aug</td>
<td>9 Sep</td>
<td>5*</td>
<td>5</td>
</tr>
<tr>
<td>1979-104</td>
<td>ARIANE VI</td>
<td>11659</td>
<td>24 Dec</td>
<td>Early 1980</td>
<td>1*</td>
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</tr>
<tr>
<td>1980-21</td>
<td>COSMOS 1167</td>
<td>11729</td>
<td>14 Mar</td>
<td>15 Jul 81</td>
<td>12</td>
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<tr>
<td>1980-30</td>
<td>COSMOS 1174</td>
<td>11765</td>
<td>18 Apr</td>
<td>18 Apr</td>
<td>39</td>
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<tr>
<td>1980-57</td>
<td>COSMOS 1191</td>
<td>11871</td>
<td>2 Jul</td>
<td>14 May 81</td>
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<td>1980-89</td>
<td>COSMOS 1220</td>
<td>12054</td>
<td>4 Nov</td>
<td>20 Jun 82</td>
<td>63</td>
<td>57</td>
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<td>12303</td>
<td>19 Feb</td>
<td>20 Oct</td>
<td>4*</td>
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<td>12317</td>
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<td>14 Mar</td>
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<td>0</td>
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<td>12364</td>
<td>20 Mar</td>
<td>8 May 82</td>
<td>63</td>
<td>37</td>
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<td></td>
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<td></td>
<td>10 Aug 82</td>
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</tr>
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<td></td>
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<td>12376</td>
<td>31 Mar</td>
<td>12 May</td>
<td>4*</td>
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<td></td>
<td></td>
<td>12504</td>
<td>4 Jun</td>
<td>24 Jul</td>
<td>226</td>
<td>223</td>
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<td></td>
<td></td>
<td>12627</td>
<td>4 Aug</td>
<td>21 Nov</td>
<td>3*</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>12631</td>
<td>4 Aug</td>
<td>29 Sep 82</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>1981-88</td>
<td>COSMOS 1305</td>
<td>12818</td>
<td>11 Sep</td>
<td>11 Sep</td>
<td>2*</td>
<td>2</td>
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</tbody>
</table>

**REMARKS**

- **Payload**: 23 fragments decayed before being cataloged
- **Payload**: Rocket; appears to have fragmented shortly after launch; at least 25 objects have been tracked
- **Alleged ASAT**: 12-18 pieces detected reentering
- **Payload**: Est. 30 pieces decayed before they could be cataloged
- **Rocket malfunction**: other pieces detected, but not cataloged

**TELEDYNE BROWN ENGINEERING**
### SATELLITE BREAKUP STATUS AS OF 31 DEC 1983

<table>
<thead>
<tr>
<th>INTERNATIONAL DESIGNATOR</th>
<th>COMMON NAME</th>
<th>NSCC NUMBER</th>
<th>LAUNCH DATE</th>
<th>LAUNCH EVENT</th>
<th>DATE OF EVENT</th>
<th>CATALOGED</th>
<th>IN ORBIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981-89</td>
<td>COSMOS 1306</td>
<td>12628</td>
<td>14 Sep</td>
<td>17 Jul 82</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>13369</td>
<td>18 Sep 82</td>
<td>1</td>
<td>0</td>
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<td></td>
</tr>
<tr>
<td>1982-38</td>
<td>COSMOS 1353</td>
<td>13150</td>
<td>29 Apr</td>
<td>8 Aug 83</td>
<td>22</td>
<td>3</td>
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</tr>
<tr>
<td>1982-88</td>
<td>COSMOS 1405</td>
<td>13708</td>
<td>7 Sep</td>
<td>20 Dec 83</td>
<td>5</td>
<td>5</td>
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<tr>
<td>1982-115</td>
<td>COSMOS 1423</td>
<td>13685</td>
<td>8 Dec</td>
<td>8 Dec</td>
<td>28</td>
<td>22</td>
<td></td>
</tr>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>1983-38</td>
<td>COSMOS 1436</td>
<td>14034</td>
<td>25 Apr</td>
<td>12 Aug</td>
<td>9*</td>
<td>5</td>
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<tr>
<td>1983-70</td>
<td>COSMOS 1481</td>
<td>14182</td>
<td>8 Jul</td>
<td>9 Jul</td>
<td>1*</td>
<td>1</td>
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</table>

**Total** 5250 2497

*Note: Fragments in highly elliptical, "deep-space" orbits are extremely difficult to track. Consequently, the number of pieces of debris cataloged with these orbits is very small and probably not representative of the true population.*

**Update:** Cosmos 1317 fragmented between 25 & 28 January 1984, six pieces detected. Cosmos 1353 experienced two other fragmentation events; one on 1 February 1984 and one on 21 February 1984.
Section III

Other Anomalous Event Summary Table

The space events in this section can not be classed as forceful fragmentations. However, small amounts of debris listed under "NSSC Debris Number" have been left in space due to unplanned events and the causes for most are unknown. Of particular interest are those old US payloads that spawn pieces at irregular intervals.
<table>
<thead>
<tr>
<th>INTERNATIONAL DESIGNATOR</th>
<th>COMMON NAME</th>
<th>NSSC CATALOG NUMBER</th>
<th>LAUNCH DATE</th>
<th>INCL (°)</th>
<th>APOGEE (Km)</th>
<th>PERIGEE (Km)</th>
<th>EVENT DATE</th>
<th>NSSC DEBRIS NUMBER</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964-014</td>
<td>WESTFORD NEEDLES</td>
<td>184</td>
<td>9 May</td>
<td>87.3</td>
<td>3694</td>
<td>3597</td>
<td>9 May 63</td>
<td>See Remarks</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>1271</td>
<td>9 Mar</td>
<td>90.3</td>
<td>1319</td>
<td>1272</td>
<td>Late Nov 79</td>
<td>11631</td>
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<tr>
<td></td>
<td></td>
<td>1314</td>
<td>3 Apr</td>
<td>90.3</td>
<td>1320</td>
<td>1271</td>
<td>Late Aug 83</td>
<td>14715</td>
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<td></td>
<td>1420</td>
<td>24 Jun</td>
<td>89.9</td>
<td>1132</td>
<td>1021</td>
<td>Jun 81</td>
<td>12516</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>1952</td>
<td>28 Jan</td>
<td>89.8</td>
<td>1202</td>
<td>860</td>
<td>17 Sep 80</td>
<td>11991</td>
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</tbody>
</table>

131 debris pieces cataloged, deployed as part of launch sequence but not expected

Decayed 25 Oct 81

Payload contains SNAP nuclear power supply

Decayed 11 Jan 83

Spawned from debris 11991
<table>
<thead>
<tr>
<th>INTERNATIONAL DESIGNATOR</th>
<th>COMMON NAME</th>
<th>NSC CATALOG NUMBER</th>
<th>LAUNCH DATE</th>
<th>INCL (°)</th>
<th>APOGEE (KM)</th>
<th>PERIGEE (KM)</th>
<th>EVENT</th>
<th>NSC DEBRIS NUMBER</th>
<th>REMARKS</th>
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<tbody>
<tr>
<td>1966-24</td>
<td>OPS 1117</td>
<td>2119</td>
<td>26 Mar</td>
<td>89.9</td>
<td>1114</td>
<td>888</td>
<td>5 Jul 81</td>
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<tr>
<td>1967-92</td>
<td>OPS 4947</td>
<td>2965</td>
<td>25 Sep</td>
<td>89.3</td>
<td>1110</td>
<td>1036</td>
<td>Late Apr 81</td>
<td>12554</td>
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<tr>
<td>1974-89</td>
<td>Debris (NOAA)</td>
<td>8138</td>
<td>15 Nov</td>
<td>101.6</td>
<td>1323</td>
<td>1135</td>
<td>17 Sep 81</td>
<td>13130</td>
<td>Radar cross section of parent, 0.12 m²; 6 pieces noted; Only one cataloged</td>
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<tr>
<td>1978-64</td>
<td>SEASAT 1</td>
<td>10967</td>
<td>27 Jun</td>
<td>108.0</td>
<td>782</td>
<td>780</td>
<td>18 Jul 83</td>
<td>14244</td>
<td>Noticed on 18 Jul 83. Separation rate 16-17 seconds per day</td>
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<td>1978-98</td>
<td>CANEO</td>
<td>11081</td>
<td>24 Oct</td>
<td>99.3</td>
<td>954</td>
<td>937</td>
<td>6 May 81</td>
<td>88503**</td>
<td>The two pieces came off 11081 5 hours apart</td>
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<tr>
<td>1984-11</td>
<td>WESTAR 6</td>
<td>14688</td>
<td>3 Feb</td>
<td>27.7</td>
<td>457</td>
<td>303</td>
<td>3 Feb 84</td>
<td>14698</td>
<td>Decay rate extremely high on both pieces</td>
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<td>14765</td>
<td>Debris caused by PAM engine failure</td>
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<td>14773</td>
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</table>

**Satellites pending cataloging as of 1 Jan 84.**

**Satellites decayed before formally cataloged.**

#Previously designated "OSCAR 4"