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Kick In The Apogee: 40 Years of Upper Stage Applications For Solid Rocket Motors, 1957-1997

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Abstract

In this paper, I summarize the use of solid motors in orbital launch vehicle upper stages and satellite propulsion systems, concentrating on United States rocket motors. Early attempts to use the apogee motor technique were unsuccessful, but after a several-year gap apogee motors became a common feature of payloads. Over several generations of solid rocket technology, as launch vehicle final stage motors have been replaced by more powerful successors, the older motors began new roles as spacecraft apogee motors. Some motors have been used in a large number of different roles, and I describe several of the most widely used examples. Finally, I give a brief overview of the motors used in worldwide space programs.

Pioneer Days

This year marks four decades since the launch of the first artificial satellite PS-1 by the Soviet Union. The Soviets used liquid rocket engines for space applications almost exclusively until the 1990s, with the exception of deorbit engines, although the Korolev and Nadiradze bureaus did develop solid propellant ICBMs. In other countries, however, solid rocket motors have played a key role in delivering satellites to their final orbits for most of the years since Sputnik. America's first orbital launch attempt, Vanguard TV3 in Dec 1957, used a Grand Central Rocket 133-KS-2800 solid motor as its orbit insertion stage. Of course, the solid motor never fired on TV3 as the shot ended in an ignominious pad explosion, but the GCR stage did successfully enter orbit on two later missions with the Vanguard 1 and 2 satellites. Two months later, a successful Jupiter C shot placed Explorer 1 in orbit. The upper stages for Jupiter C were developed by the Jet Propulsion Laboratory; they scaled down their Sergeant missile motor to make the RTV (Reentry Test Vehicle) motor. The original RTV motor used a polysulfide fuel in a steel case; the Explorer 1 satellite was built around the final stage RTV motor. Explorer 4 introduced a higher performance polyurethane fuel and the Pioneer 3 lunar probe saw the use of a titanium motor case for the first time.

The first satellites used a stack of stages firing in sequence with relatively little coast time, with the final stage providing orbital insertion a few hundred kilometers downrange. Most of these early satellites were in elliptical orbits with relatively low perigees. In 1957, William Pickering and his team at the Jet Propulsion Laboratory realized that they could easily lengthen the orbital lifetime of their low-perigee Explorer satellites by including a small 'Two Pound Rocket Motor' which would wait on a timer to fire until the satellite had made exactly half a circuit of the Earth. Now this was before we got clever about active satellite attitude control, and their plan was to mount the motor nozzle upside down, so that retaining its inertial attitude half an orbit around would leave the nozzle pointing back along the velocity vector, allowing the burn to raise perigee and prolong the orbital lifetime. Pickering gave this idea the colorful name of the 'Kick in the Apogee' technique. At around the same time the rival Navy team at China Lake (Naval Ordnance Test Station or NOTS) came up with the same idea and discussed it with Pickering; there is some question that the concept may go back as far as Peenemunde, but Pickering was definitely responsible for the name, which led to today's term of 'apogee kick motor'.

The first launch attempt was made by the NOTS team in July 1958. Their small cylindrical satellites were launched by a four-stage vehicle from an F-4D Skyray. This was the first attempt to launch a satellite from an aircraft, similar to today's Pegasus system. The satellite, nicknamed 'NOTSnik', was originally intended as a military weather satellite. It was modified as a diagnostic payload for the Project Argus high altitude nuclear tests. The 'NOTS 3 in. Spherical Motor' would have provided the kick in the apogee. The aircraft took off from China Lake and headed out to the ocean for the drop; 53 minutes after launch the apogee motor would have fired to place the satellite in a 2400 km circular orbit. Despite some claims from NOTS team members, most analysts believe that all six launches in July and August of 1958 were failures well before the kick stage would have come into play.

JPL's try was in connection with the Army's inflatable Beacon satellite in October of the same year, but once again the technique could not be tested, when the upper stages separated prematurely during first stage burn and inital orbit was not reached. [Sources: Jupiter Bimonthly Summary No. 12, JPL, 1958; Project Pilot Informal Research Package, NOTS.] After these two failures, the solid apogee motor remained in limbo for several years. Explorer 6 used a small perigee rocket to increase its apogee in Aug 1959; in April 1960 a technique similar to that of apogee motors was used for the first time, but using a restartable liquid rocket - the Transit 1B navigation satellite was placed in circular orbit when the Ablestar rocket reignited after a 20-minute coast phase. In early 1963, a series of small classified Lockheed satellites used a solid motor to enter a higher circular orbit after deployment from CORONA recon satellites: I don't have any details on this motor.

It was in Feb 1963 that the apogee technique got its first real test, when the Syncom 1 satellite carried a Thiokol solid apogee motor to geosynchronous altitude. Unfortunately, the motor seems to have exploded on ignition, and Syncom 1 was lost. It was not until July 1963 that the 'kick in the apogee' concept was brought to fruition, when a JPL kick motor successfully placed Syncom 2 in a circular synchronous altitude orbit.

Widely used motors

The NOTS team were also involved in the Air Force's Pioneer lunar probe, which had a similar design to their own satellite and included a Thiokol lunar orbit insertion motor in place of the NOTS kick motor. In that same hectic summer of 1958 this first American moon probe attempt met a fiery end over Cape Canaveral. Its Thor Able launch vehicle carried the the first Allegany Ballistics Lab (ABL) X-248 fiberglass-cased solid motor, soon known as Altair. Altair was the first of several solid motors to be used as 'universal' final stages serving a variety of launch vehicles. A prototype version of Altair, the X-241, was also used as the third stage of the NOTS vehicle. In 1959 the X-248 was used on Atlas Able and on the final Vanguard launch, while in 1960 it became the final stage for both the new Thor Delta and the all-solid-propellant Scout. Altair was also used as a final stage for the suborbital Javelin and for the Sergeant-based Journeyman and Shotput sounding rockets, and the Martin Bold Orion antisatellite weapon. A scaled up Altair, called Antares, provided another Scout stage. An improved Altair 2 version was introduced in 1963. Altair 2 was used on Scout and Delta, as well as on the unusual OV1 vehicle. Multiple OV1s were strapped to Atlas rockets and fired separately into orbit carrying their payloads.

Altair was so successful that clones of it appeared. First on the scene was Grand Central Rocket, which had now become Lockheed Propulsion Co. Its high mass ratio MG-18 stage was used instead of the X-248 on six Scout and Thor launches used to orbit classified weather satellites.

In 1965 Altair began to be phased out by another clone called the FW4, made by UTC of San Jose. The fiberglass cased FW4 was externally a slot-in replacement for ABL's Altair, and a lot of reference books fail to make the distinction between them. However, FW4 was more powerful and had the highest mass fraction of any contemporary stage. FW4 became the standard Scout and Delta third stage and was also used on the later OV1 and Burner 1 missions. It last flew on a 1983 Scout mission, being phased out in its turn by Thiokol's Star 20, also known as Altair III.

Another widely used motor is Thiokol's Star 37, which well illustrates the diverse uses that a single motor design may be put to. The first Star 37 was developed as the soft-landing retromotor for the Surveyor lunar probes in the 1960s. Shortly afterwards, it was drafted for use as the upper stage on the Thor Burner 2 rocket used to launch military weather satellites, before reaching its most well known role as the Delta rocket's final stage for most of the 1970s, replacing the Altair series in that role. The Star 37 was also used as a kick stage to boost the Pioneer and Voyager probes on their way to the outer planets, and the Helios probes down toward the Sun, the only times the Atlas Centaur and Titan Centaur probes have used an extra stage beyond the Centaur. Star 37 was also used as a payload orbit insertion motor with Atlas and Thor: the launch vehicle inserted the payload on a suborbital trajectory, and the Star 37, which is counted as part of the payload, fires at apogee to place Tiros-N class weather satellites or other payloads in their final orbits. Most recently, as launch vehicle power has increased, the Star 37 has been used as an apogee motor for the GPS navigation satellites, continuing 30 years of growth for the same basic design.

Another interesting motor from the early years is the BE-3, also known as Alcyone (one of the Pleiades). Hercules built the BE-3 as the retro-rocket for the early Ranger moon probes. The 1962 Block II Rangers were meant to dump a balsa-wood capsule on the lunar surface, and the BE-3 would fire just before touchdown to lessen the impact. In the event BE-3 never got the chance to prove its mettle, as none of the three Block II Rangers launched reached the Moon in working order. Nevertheless, BE-3 went on to be a small success story. It was used in 1963 as the kick motor for the US Air Force's Vela satellites. The Velas were placed in orbits with apogees of 100000 km, and BE-3 fired to make them circular. In contrast to Ranger, Vela was highly successful and in the

late 1970s later Vela satellites were still being used to search for illegal nuclear explosions. Next, in 1964, BE-3 was used as a reentry stage for the Athena test vehicle. Athena was a small rocket launched from Green River in Utah; during descent towards White Sands the BE-3 would ignite to punch the reentry vehicle back down to the desert at high speed, simulating reentry of a larger missile. A couple years later, it was pressed into service in the same role for the SPARTA rocket, flown in Australia by a joint US/British/Aussie team and using the venerable Redstone as its first stage. For the last SPARTA flight, the profile was changed as BE-3 was fired during ascent to place itself and Australia's first satellite into orbit. In 1974, BE-3 was again used as an upper stage, this time as the fifth stage of Scout E, which flew a single mission to place the University of Iowa's Hawkeye satellite in elliptical orbit. The last use of BE-3 that I know about was in 1984, when it was again used as an apogee motor on a multiple Delta Explorer payload, and placed Germany's Ion Release Module satellite in its final orbit.

I emphasize these varied histories because there's a lot of discussion about launch vehicle reliability these days - and I think you have to factor in individual stage reliabilities. Of course the same motor flying as a launch vehicle stage and as a reentry test vehicle may have very different avionics attached to it, and we've seen in recent years commercial launch vehicles based on existing motors which have run into unexpected problems, but having burned the same motor design a large number of times has to count for something.

US Motors in the 1960s

In the mid 1960s the first geostationary satellites were launched. Syncom 1, the first satellite to try and reach synchronous altitude, used a small Thiokol motor, but Syncom 2 and 3 used a motor developed by JPL and Thiokol's comsat apogee motor business languished for some time as it concentrated on other rockets. JPL also provided apogee motors for Early Bird (the first Intelsat) and the ATS technology development satellites. ATS 5, which flew in 1969, was the last satellite to carry a JPL motor, the swansong of JPL's involvement in space propulsion. From now on, JPL would concentrate on its planetary exploration expertise.

Aerojet moved in to fill the vacuum. The Sacramento company, which of course was originally a von Karman offshoot, provided the SVM (Space Vehicle Motor) series of comsat apogee motors, SVM-1 of 1966 to SVM-7 in the late 1970s. SVM-1 powered the Intelsat II satellites in the 1960s, SVM-2 was aboard Intelsat III, SVM-4 was the Intelsat IV motor, and SVM-5 was used in the SMS and GOES weather satellites. SVM-6 was on the first two NATO 3 satellites, and SVM-7 was apogee motor for the initial Satcom birds from RCA/East Windsor, the ancestors of today's Lockheed Martin A2100s.

Another successful apogee motor of the 1970s was UTC's FW5, a scaled down version of their Altair-class FW4 upper stage. The FW5 was the apogee motor for Hughes's HS-333, the first real production series comsat which pioneered the Anik, Westar and Marisat series.

By this time, in the late 1970s, Thiokol was ready with a new line of products which would lead to a dominant presence in the US market. Thiokol had provided small kick motors in the Star series for scientific satellites throughout the 1960s and 1970s. In 1968 the Star 17 was used as apogee motor for the Radio Astronomy Explorer, and in 1969-70 the same motor went to geostationary orbit in the Royal Air Force's Skynet I and NATO's first satellite, NATO IIA. But the Star 17 was too small for most comsats. 1976 saw the first flight of the Star 27, as apogee motor for Canada's Communications Technology Satellite. Star 27 took over from Aerojet's SVM as kick motor for the later GOES weather satellites and NATO 3 comsats, and made 11 flights as kick motor for the Block I GPS navigation satellites.

Star 27 was Thiokol's first comsat apogee motor to see wide use, but its success was eclipsed by the Star 30 which came on line in 1980 to power the Hughes HS-376 and the RCA advanced Satcom satellites. Unlike the other motors I've talked about, Star 30 has been used exclusively as an apogee motor for geostationary comsats, and it's now made over 80 flights.

As payloads get larger and rockets more powerful, the motors move upward in the vehicle. The Star 37 has been replaced as a third stage by the Star 48 PAM-D, but in turn replaced the Star 27 as an apogee motor, first for the FLTSATCOM Navy comsat and more recently for the GPS Block II satellites and Loral's Intelsat-5 class comsats. The Star 48, in turn, has seen some use as a kick motor, for Magellan's Venus orbit insertion and Ulysses' solar orbit kick stage.

The Present Day

The role of solid motors changed in the 1990s. Apogee motors are becoming less common as comsats take advantage of the operational flexibility of liquid propellant systems, but it seems clear that the relative simplicity of the solid motors will ensure a niche for them for the forseeable future. The Shuttle and expendable launch vehicles with profiles matched to it created a new market for perigee kick motors. Notable among these in the US are UTC's Orbus series: the big Orbus 21 makes up the first stage of Boeing's IUS and the single stage of OSC's Transfer Orbit Stage, and the Orbus 7 used as the perigee

stage for some commercial satellites. Thiokol's Star 48 and big sibling Star 63 have also been used in this role. The Boeing IUS is the largest solid upper stage system in use, with an Orbus 21 motor topped by an Orbus 6. It has seen service on both Shuttle and Titan.

Other Countries

As I said earlier, the USSR made relatively little use of solid motors in space applications. The US-A military radar satellites probably used solid motors to boost their nuclear reactors to high orbit, and the orbital FOBS weapon used a solid retro. In the late 1960s or early 1970s the liquid engines used to deorbit the early Zenit-2 spy satellites were phased out in favor of the PTDU solid deorbit engine, but liquid engines continue to be used for apogee motors and upper stages. The Russian Federation, however, now features the all-solid Start rocket which has five solid stages. Various other solid-propellant military vehicles have been proposed for conversion to space launchers.

The widest range of upper stage solid motors outside the US is probably from Japan, mostly made by Nissan. The original L480S upper stage for Japan's Lambda formed the core of the first successful Japanese satellite Osumi in 1970 (four earlier attempts since 1966 ended up in the ocean). The Mu series of rockets which followed were again all solid rockets. The Mu-3S-II was the last of the original Mu variants and had an M-3B upper stage - but it often also carried small kick motors in the KM series to increase the payload's orbital height or perform solar orbit or translunar insertion burns. The new Mu-V rocket is an entirely new design and has a much larger third stage, the M34, which is even bigger than the Orbus 21 and Star 63.

Meanwhile the larger Japanese N-1 rocket, first launched in 1975, was based on Delta and used a Thiokol Star 37 first stage. The later H-1, however, used a Nissan UM129A motor, and some of its payloads used the first Japanese comsat solid apogee motor after some initial mixed experiences with US-built ones.

France's first launch vehicle, the Diamant, used a P0.64 solid motor third stage made by SEP - this motor is sometimes nicknamed Rubis (Ruby). SEP also provided the Mage apogee motor used for European satellites in the 1980s. Mage 1 was a small motor comparable to the Star 27, but Mage 2 was similar to the larger Star 30 apogee motor.

Italy's most ambitious entry in this field is the Iris solid upper stage, a PAM-class rocket which flew only once in a 1992 Shuttle flight. But the Italian SNIA-BPD firm provided several state-of-the-art apogee motors for European satellites in the 1970s and 1980s and collaborated on Mage.

Britain developed a number of significant solid motors for its sounding rocket program, but only one satellite was ever launched using its Black Arrow rocket, which had a solid motor with the somewhat poetic name of Waxwing.

Finally, India continues to develop its own solid motors based on its 1979 SLV-3 rocket and successors; a Chinese perigee kick motor is now in use based on their 1970-era Long March 1 third stage; and Israel's Shaviyt adds an AUS-51 solid motor to turn their Jericho missile into a satellite launcher.

Tables and Bibliography

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Table 1: Motors in approximate order of fuelled mass. Fuelled mass correlates well with total impulse, which is harder to get reliable values for.

Table 2: Flight histories for all motors with the exception of the Zenit PTDU retro and the Star 12 SRV retro (several hundred of each have been flown, and many of these flights are still classified). International designations are given for the motors where relevant; designators containing 'F', e.g. 1982-F06, indicate a failed orbital launch attempt. The suffix /NNA after an international designation indicates a vehicle in orbit but not cataloged by Space Command. The suffix /SO represents a suborbital component of an orbital launch, while SO on its own indicates a suborbital launch. The 'status' column is S for a successful burn (even if orbit was not achieved because of malfunctions on earlier stages), P for a partial success, F for a failure of that stage (including guidance and other non-propulsive failures) and NT for no test (e.g. motor not fired because launch vehicle destroyed due to failure of an earlier stage). U denotes unknown; the status of many suborbital launches fall in this category. D indicates a dummy motor. The date given is that of the motor being fired; in some cases, denoted by a trailing colon, this is uncertain to a day or so. The author welcomes corrections and additions to the tables.

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Table 1: List of motors

Motor	Impulse kNs	Fuelled mass kg	Use	Notes
NOTS 3"SM	0.8	0.5	AKM	X-14, steel case
JPL 2 lb Motor	0.1?	1.5	AKM	
ARC 420	2	Unk.	AKM	
TX-8		Unk.	AKM	
TE Star 6	16	10	Kick motor	FG case
TE Star 13	80	16	AKM	AP/Al/Urethane, Ti case
TE Star 12	46	27	Retro	Steel case
JPL RTV motor	53	36	Juno upper stage	Polysulfide, Steel case
JPL RTV motor (2)	53	36	Juno upper stage	Polyurethane, Ti case
LP-104		Unk.	AKM	
LPC-509		Unk.	AKM	
TE Star 17	198	78	AKM	
TE-375		Unk.	AKM	
JPL SR-18		Unk.	AKM	
AJ SVM-1		87	AKM	PB/A, FG case
Hercules BE-3		90	AKM	
Nissan L480S	250?	110	L4S upper stage	Steel case
TE Star 17A	319	126	AKM	Ti case
AJ SVM-2		159	AKM	PB/AP, FG case
ABL X-241	435	196	Upper stage	AP/BUU/Al, FG case
GRC 133-KS-2800	347	200?	Vanguard upper stage	
SNIA-BPD Sirio ABM	500	200	AKM	AP/PB/Al, Ti case
TE Star 24	561	218	AKM	AP/HTPB/Al, Ti case
ABL X-248 Altair	517	226	Upper stage	AP/BUU/Al, FG case
ABL X-249 Altair 2	530?	226	Upper stage	AP/BUU/Al, FG case
LPC MG-18	591	248	Upper stage	
Nissan KM-D	629	244	AKM	
TE Star 26B	635	261	Burner 2A stage	Ti case
Shanxi Retro	582	265	Retro motor	
UTC FW5		290?	AKM	FG case
UTC FW4	750?	300?	Upper stage	FG case
TE Star 20	772	301	Scout upper stage	CTPB, FG case
ISRO SLV3-4		310?	SLV-3 uppe stage	FG case
AJ SVM-5		319	AKM	PB/AP, FG case
ISRO AS4	850?	320	ASLV upper stage	HEF-20, Kevlar case
Bristol Waxwing	1000?	352	Black Arrow upper stage	
AJ SVM-6		354	AKM	
TE Star 27	951	361	AKM	AP/HTPB/Al, Ti case
SEP MAGE 1	950?	369	AKM	CTPB, Kevlar case
JPL SR-28-3		380	AKM	
AJ SVM-7		440	AKM	
Nissan KM-P	1174	470	AKM	
Nissan M-40	1000?	508	Mu-4S upper stage	
Nissan KM-M	1375	527	AKM	
SEP Mage 2	1900?	530	AKM	CTPB, Kevlar case
TE Star 30B/BP	1460	542	AKM	AP/HTPB/AL, Ti case
Nissan H-1 AKM	1452	545	AKM	AP/HTPB/Al
Shanxi AKM	1432	580	AKM	HTPB
TE Star 37	1584	620	Retro	
TE Star 37N	1590	622	N-1 upper stage	

Table 1: List of motors

Motor	Impulse kNs	Fuelled mass kg	Use	Notes
TE Star 30C	1677	630	AKM	AP/HTPB/AL, Ti case
TE Star 30E	1788	668	AKM	AP/HTPB/AL, Ti case
AJ SVM-4A		707	AKM	PB/AP, FG case
TE Star 37S	1869	711	Tiros N AKM	
SEP P0.64	2300	712	Diamant upper stage	FG case
TE Star 37B/37D	1855	717	Burner 2, Delta stage	
SEP P0.68	2100?	775	Diamant upper stage	FG case
Hercules Orion 38	2180	893	Pegasus upper stage	HTPB, GE case
TE Star 37F	2443	933	AKM	
TE Star 37XF	2540	952	AKM	
TE Star 37XFP	2537	955	AKM	AP/HTPB/Al, Ti case
ABL X-249 Antares	2200?	1000	Scout stage 3	FG case
TE Star 37C	2708	1046	Delta stage	
TE Star 37E	2910	1123	Upper stage	
TE Star 37FM	3053	1148	AKM	AP/HTPB/Al, Ti case
ABL X-259 Antares 2	3400?	1260	Scout stage 3	FG case
Nissan M-3A	3295	1307	Mu-3C upper stage	
TE Star 31	3738	1393	Scout stage 3	
Nissan KM-V1		1400	AKM	
BPD IRIS	4488	1726	PKM	HTPB, Kevlar case
Start stage		Unk.	Start-1 upper stage	
Nissan UM-129A	5429	2000	H-1 upper stage	HTPB/Al
Rafael AUS-51	5400?	2007	Shaviyt upper stage	HTPB, Ti case
Shanxi GF-02	4500	2050	CZ-1 upper stage	
TE Star 48	5700	2140	PAM-D PKM	AP/HTPB/Al, Ti case
Nissan M-30	5500?	2700	Mu-4S Stage 3	
Orbus 6		2750		
Orbus 6E	8140	3018	IUS stage	HTPB, Kevlar case
TU Star 63D	9046	3502	PKM	
Orbus 7	12500	3547	PKM	CTPB, FG case
Nissan M-3B	9456	3570	Mu upper stage	HTPB, Ti case
TE Star 63F	12530	4591	PKM	
Shanxi PKM	11360	4635	PKM	HTPB, FG case
Shanxi FG-46	15600	6001	PKM	HTPB, FG case
Orbus 21	28380	10398	PKM	HTPB, Kevlar case
Orbus 21D	28140	10619	IUS stage	HTPB, Kevlar case
Nissan M-34	30000?	11100	M-V upper stage	CF case

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
		CALT/Shanxi GF-02		
1970-034	GF-02	1970 Apr 24	CZ-1 Stage 3	CZ-1 1
1971-018	GF-02	1971 Mar 3	CZ-1 Stage 3	CZ-1 2
		CALT/Shanxi FG-46		
1990-059	PKM Prototype	1990 Jul 16	PKM	CZ-2E 1
1995-064	FG-46	1995 Nov 28	FG-46 EPKM	CZ-2E
1995-073	FG-46	1995 Dec 28	FG-46 EPKM	CZ-2E

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
		CALT/Shanxi Retro		
	(All FSW satellites)			
		CALT/Shanxi Apogee Motor		
1984-008	PRC AKM	1984 Jan 29	STW-1	CZ-3
1984-035	PRC AKM	1984 Apr 8	STW-2	CZ-3
1986-010	PRC AKM	1986 Feb 1	STW-3	CZ-3
1988-014	PRC AKM	1988 Mar 7	DFH-2	CZ-3
1988-111	PRC AKM	1988 Dec 22	DFH-2	CZ-3
1990-011	PRC AKM	1990 Feb 4	DFH-2	CZ-3
1991-088	PRC AKM	1991 Dec 28	DFH-2	CZ-3
		SNIA-BPD IRIS		
1992-070	IRIS	1992 Oct 22	IRIS	STS-52
		SNIA-BPD Glass fibre AKM (possibly called Ciron)		
1977-029	Geos 1 AKM	1977 Apr 20	Geos 1 ABM	Delta 130
1977-080	Sirio 1 AKM	1977 Aug 25	Sirio 1 ABM	Delta 133
1978-071	Geos 2 ABM	1978 Jul 14	Geos 2 ABM	Delta 143
1982-F06	Sirio 2 AKM	1982 Sep 9	Sirio 2 ABM	Ariane 1 L5
		SNIA-BPD Carbon Fibre SNIA/SEP/MAN apogee motor (Mage precursor)		
1977-F04	?	1977 Sep 13	OTS 1	Delta 134 (possibly SVM-7)
1977-108	?	1977 Nov 23	Meteosat 1	Delta 136 (possibly SVM-5)
1978-044	?	1978 May 11	OTS 2	Delta 141
		SEP/Bordeaux Mage		
1981-57	Mage 1	1981 Jun 19	Meteosat 2 AKM	Ariane 1
1983-58	Mage 2	1983 Jun 16	ECS AKM/ECS 1	Ariane 1
1984-81	Mage 2	1984 Aug 4	ECS AKM/ECS 2	Ariane 3 V10
1984-81	Mage 2	1984 Aug 4	ECS AKM/Telecom 1A	Ariane 3 V10
1984-114	Mage 2	1984 Nov 10	ECS AKM/Marecs B2	Ariane 3 V11
1985-35	Mage 2	1985 May 8	ECS AKM/Telecom 1B	Ariane 3 V13
1985-56	Mage 1S	1985 Jul 2	Giotto AKM	Ariane 1
1985-F03	Mage 2	1985 Sep 12	ECS AKM/ECS 3	Ariane 3 V15
1987-78	Mage 2	1987 Sep 16	ECS AKM/ECS 4	Ariane 3 V19
1988-18	Mage 2	1988 Mar 11	ECS AKM/Telecom 1C	Ariane 3 V21
1988-51	Mage 1	1988 Jun 15	Meteosat 3 AKM	Ariane 4 V22
1988-63	Mage 2	1988 Jul 21	ECS AKM/ECS 5	Ariane 3 V24
1989-20	Mage 1	1989 Mar 6	Meteosat 4 AKM	Ariane 4 V29
1989-062	Mage 2	1989 Aug 8	Hipparcos AKM	Ariane 4 V33
1991-015	Mage 1	1991 Mar 2	Meteosat 5 AKM	Ariane 4 V42
1992-070	Mage 1S	1992 Oct 22	Lageos 2 AKM	STS-52
		SEP/Bordeaux Mars		
1993-031	Mars	1993 May 12	Arsene AKM	Ariane
		SEP/Bordeaux P0.6 (Rubis)		
-	P064	1964 Jun 10	Rubis Stage 2	Rubis R1
-	P064	1964 Jun 12	Rubis Stage 2	Rubis R2
-	P064	1964 Oct 12	Rubis Stage 2	Rubis R3
-	P064	1964 Dec 18	Rubis Stage 2	Rubis R4
-	P064	1965 May 31	Rubis Stage 2	Rubis R5

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	P064	1965 Jun 3	Rubis Stage 2	Rubis R6
-	P064	1965 Jun 5	Rubis Stage 2	Rubis R7
-	P064	1965 Sep 30	Rubis Stage 2	Rubis R8
1965-096	P064	1965 Nov 26	Diamant A Stage 3	Diamant A
1966-013	P064	1966 Feb 17	Diamant A Stage 3	Diamant A
-	P064	1966 Apr 22	Rubis Stage 2	Rubis R9
1967-011	P064	1967 Feb 8	Diamant A Stage 3	Diamant A
1967-014	P064	1967 Feb 15	Diamant A Stage 3	Diamant A
-	P064	1967 Jul 5	Rubis Stage 2	Rubis R10
1970-017	P068/Mika	1970 Mar 10	Diamant B Stage 3	Diamant B
1970-109	P068	1970 Dec 12	Diamant B Stage 3	Diamant B
-	P064	1971 Feb 23	Tibere St 3	Tibere 1
1971-030	P068	1971 Apr 15	Diamant B Stage 3	Diamant B
1971-F10	P068	1971 Nov 5	ELDO-PAS Perigee Stage	Europa II F11
1971-F14	P068	1971 Dec 5	Diamant B Stage 3	Diamant B
-	P064	1972 Mar 18	Tibere St 3	Tibere 2
1973-F02	P068	1973 May 21	Diamant B Stage 3	Diamant B
1975-010	P068	1975 Feb 6	Diamant BP.4 Stage 3	Diamant BP.4
1975-039	P068	1975 May 17	Diamant BP.4 Stage 3	Diamant BP.4
1975-092	P068	1975 Sep 27	Diamant BP.4 Stage 3	Diamant BP.4
		Bristol Aerojet/Bristol Waxwing		
-	Dummy Waxwing	1969 Jun 28	R-0 Stage 3	Black Arrow R-0
-	Dummy Waxwing	1970 Mar 4	R-1 Stage 3	Black Arrow R-1
1970-F07	Waxwing	1970 Sep 2	R-2 Stage 3	Black Arrow R-2
1971-093	Waxwing	1971 Oct 28	R-3 Stage 3	Black Arrow R-3
		ISRO-VSSC/Trivandrum SLV-3 4th stage		
1979-F03	SLV-3 St4	1979 Aug 10	SLV-3 Stage 4	SLV-3-E1
1980-062	SLV-3 St4	1980 Jul 18	SLV-3 Stage 4	SLV-3-E2
1981-051	SLV-3 St4	1981 May 31	SLV-3 Stage 4	SLV-3-D3
1981-057	Apple AKM	1981 Jun 19	Apple AKM	Ariane 1
1983-033	SLV-3 St4	1983 Apr 17	SLV-3 Stage 4	SLV-3-D4
1987-F01	ASLV St4	1987 Mar 24	ASLV Stage 4	ASLV-D1
1988-F03	ASLV St4	1988 Jul 12	ASLV Stage 4	ASLV-D2
1992-028	ASLV St4	1992 May 20	ASLV Stage 4	ASLV-D3
1994-027	ASLV St4	1994 May 4	ASLV Stage 4	ASLV-D4
		Rafael/Haifa AUS-51 Marble		
1988-087	AUS-51	1988 Sep 19	Shaviyt Stage 3	'Ofeq 1
1990-027	AUS-51	1989 Sep 14	Shaviyt Stage 3	'Ofeq 2
1995-018	AUS-51	1995 Apr 5	Shaviyt Stage 3	'Ofeq 3
		Nissan/Tokyo H-1 AKM		
1977-014	NASDA AKM	1977 Feb 23	Kiku 2	N-1-3
1987-070	H-1 AKM	1987 Aug 27	ETS AKM/ETS-5	H-1

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1990-077	H-1 AKM	1990 Aug 28	BS-3 AKM/BS-3A	H-1-22
1991-060	H-1 AKM	1991 Aug 25	BS-3 AKM/BS-3B	H-1-23
		Nissan/Tokyo KM		
1977-012	KM?	1977 Feb 19	MS-T3 Kick Motor	M-3H-1
1978-014	KM?	1978 Feb 4	EXOS-A Kick Motor	M-3H-2
1978-087	KM?	1978 Sep 16	EXOS-B Kick Motor	M-3H-3
1985-001	KM-P	1985 Jan 7	MS-T5 Kick Motor	M-3S2-1
1985-073	KM-P	1985 Aug 18	PLANET-A Kick Motor	M-3S2-2
1989-016	KM-D	1989 Feb 21	EXOS-D Kick Motor	M-3S2-4
1990-007	KM-M	1990 Jan 24	MUSES-A Kick Motor	M-3S2-5
1990-007	KM-L	1990 Jan 24	Subsat Kick Motor	M-3S2-5
1995-U01	KM-M	1995 Jan 15	EXPRESS Kick Motor	M-3S2-8
1997-005	KM-V1	1997 Feb 12	VSOP Kick Motor	M-5-1
		Nissan/Tokyo L480S		
1966-F10	L480S	1966 Sep 26	L-4S Stage 4	L-4S-1
1966-F13	L480S	1966 Dec 20	L-4S Stage 4	L-4S-2
1967-F03	L480S	1967 Apr 13	L-4S Stage 4	L-4S-3
-	L480S	1969 Sep 3	L-4T Stage 4	L-4T-1
1969-F13	L480S	1969 Sep 22	L-4S Stage 4	L-4S-4
1970-011	L480S	1970 Feb 11	L-4S Stage 4	L-4S-5
-	L480S?	1971 Aug 20	L-4SC Stage 4?	L-4SC-1
-	L480S?	1973 Jan 28	L-4SC Stage 4?	L-4SC-2
-	L480S?	1974 Sep	L-4SC Stage 4?	L-4SC-3
		Nissan/Tokyo M-30		
-	Dummy M-30	1966 Oct 31	Mu-1 Stage 3	M-1-1
-	M-30	1969 Aug 17	Mu-3D Stage 3	M-3D-1
1970-F08	M-30	1970 Sep 25	Mu-4S Stage 3	M-4S-1
1971-011	M-30	1971 Feb 16	Mu-4S Stage 3	M-4S-2
1972-064	M-30	1972 Aug 19	Mu-4S Stage 3	M-4S-3
1974-008	M-3A	1974 Feb 16	Mu-3C Stage 3	M-3C-1
1975-014	M-3A	1975 Feb 24	Mu-3C Stage 3	M-3C-2
1976-F01	M-3A	1976 Feb 4	Mu-3C Stage 3	M-3C-3
1977-012	M-3A	1977 Feb 19	Mu-3H Stage 3	M-3H-1
1978-014	M-3A	1978 Feb 4	Mu-3H Stage 3	M-3H-2
1978-087	M-3A	1978 Sep 16	Mu-3H Stage 3	M-3H-3
1979-014	M-3A	1979 Feb 21	Mu-3C Stage 3	M-3C-4
1980-015	M-3A	1980 Feb 17	Mu-3S Stage 3	M-3S-1
1981-017	M-3A	1981 Feb 21	Mu-3S Stage 3	M-3S-2
1983-011	M-3A	1983 Feb 20	Mu-3S Stage 3	M-3S-3
1984-015	M-3A	1984 Feb 14	Mu-3S Stage 3	M-3S-4
1985-001	M-3B	1985 Jan 7	Mu-3S2 Stage 3	M-3S2-1
1985-073	M-3B	1985 Aug 18	Mu-3S2 Stage 3	M-3S2-2
1987-012	M-3B	1987 Feb 5	Mu-3S2 Stage 3	M-3S2-3
1989-016	M-3B	1989 Feb 21	Mu-3S2 Stage 3	M-3S2-4
1990-007	M-3B	1990 Jan 24	Mu-3S2 Stage 3	M-3S2-5
1991-062	M-3B	1991 Aug 30	Mu-3S2 Stage 3	M-3S2-6
1993-011	M-3B	1993 Feb 20	Mu-3S2 Stage 3	M-3S2-7
1995-U01	M-3B	1995 Jan 15	Mu-3S2 Stage 3	M-3S2-8
		Nissan/Tokyo M-34		

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1997-005	M-34	1997 Feb 12	M-V Stage 3	M-5-1
		Nissan/Tokyo M-40		
-	Dummy M-40	1966 Oct 31	Mu-1 Stage 4	M-1-1
-	Dummy M-40	1969 Aug 17	Mu-3D Stage 4	M-3D-1
1970-F08	M-40	1970 Sep 25	Mu-4S Stage 4	M-4S-1
1971-011	M-40	1971 Feb 16	Mu-4S Stage 4	M-4S-2
1972-064	M-40	1972 Aug 19	Mu-4S Stage 4	M-4S-3
		Nissan/Tokyo UM-129A		
1987-070	UM-129A	1987 Aug 27	H-1 Stage 3	H-1-17
1988-012	UM-129A	1988 Feb 19	H-1 Stage 3	H-1-18
1988-086	UM-129A	1988 Sep 16	H-1 Stage 3	H-1-19
1989-070	UM-129A	1989 Sep 5	H-1 Stage 3	H-1-20
1990-077	UM-129A	1990 Aug 28	H-1 Stage 3	H-1-22
1991-060	UM-129A	1991 Aug 25	H-1 Stage 3	H-1-23
		NII-TT/Votkinsk Start orbital stage		
1993-014	Blok Start	1993 Mar 25	Start-1 Stage 4	Start-1 1
1995-F02	Blok Start	1995 Mar 28	Start Stage 5	Start 1
1997-010	Blok Start	1997 Apr 4	Start-1 Stage 4	Start-1 1
		Unknown: EXPRESS Retro Motor (also OGCh FOBS?)		
1995-U01	?	1995 Jan 15	Express RV	M-3S2-8
		Atlantic Research Corp. ARC 420		
1959-004	ARC 420	1959 Aug 7	Explorer 6 AKM	Thor 134
		Aerojet/Sacramento SVM-1		
1966-096	SVM-1	1966 Oct 26	HS-303 AKM/Intelsat 2F1	Delta 42
1967-001	SVM-1	1967 Jan 11	HS-303 AKM/Intelsat 2F2	Delta 44
1967-026	SVM-1	1967 Mar 23	HS-303 AKM/Intelsat 2F3	Delta 47
1967-094	SVM-1	1967 Sep 28	HS-303 AKM/Intelsat 2F4	Delta 52
		Aerojet/Sacramento SVM-2		
1968-F08	SVM-2	1968 Sep 18	Intelsat III F-1 AKM	Delta 59
1968-116	SVM-2	1968 Dec 19	Intelsat III F-2 AKM	Delta 63
1969-011	SVM-2	1969 Feb 6	Intelsat III F-3 AKM	Delta 66
1969-045	SVM-2	1969 May 22	Intelsat III F-4 AKM	Delta 68
1969-064	SVM-2	1969 Jul 26	Intelsat III F-5 AKM	Delta 71
1970-003	SVM-2	1970 Jan 23	Intelsat III F-6 AKM	Delta 75
1970-032	SVM-2	1970 Apr 23	Intelsat III F-7 AKM	Delta 78
1970-055	SVM-2	1970 Jul 23	Intelsat III F-8 AKM	Delta 79
1979-009	SVM-2B	1979 Feb 6	ECS AKM/ECS 1	N-1-5
1980-018	SVM-2B	1980 Feb 22	ECS AKM/ECS 2	N-1-6
		Aerojet/Sacramento SVM-4A		
1971-006	SVM-4A	1971 Jan 26	HS-312 AKM/Intelsat 4F2	AC-25
1971-116	SVM-4A	1971 Dec 20	HS-312 AKM/Intelsat 4F3	AC-26
1972-003	SVM-4A	1972 Jan 23	HS-312 AKM/Intelsat 4F4	AC-28
1972-041	SVM-4A	1972 Jun 13	HS-312 AKM/Intelsat 4F5	AC-29
1973-058	SVM-4A	1973 Aug 23	HS-312 AKM/Intelsat 4F7	AC-31
1974-093	SVM-4A	1974 Nov 21	HS-312 AKM/Intelsat 4F8	AC-32
1975-F01	SVM-4A	1975 Feb 20	HS-312 AKM/Intelsat 4F6	AC-33
1975-042	SVM-4A	1975 May 22	HS-312 AKM/Intelsat 4F1	AC-35
1975-091	SVM-4A	1975 Sep 26	HS-353 AKM/Intelsat 4AF1	AC-36
1976-010	SVM-4A	1976 Jan 29	HS-353 AKM/Intelsat 4AF2	AC-37

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1976-042	SVM-4A	1976 May 13	HS-351 AKM/Comstar D-1	AC-38
1976-073	SVM-4A	1976 Jul 22	HS-351 AKM/Comstar D-2	AC-40
1977-041	SVM-4A	1977 May 26	HS-353 AKM/Intelsat 4AF4	AC-39
1977-F05	SVM-4A	1977 Sep 30	HS-353 AKM/Intelsat 4AF5	AC-43
1978-002	SVM-4A	1978 Jan 7	HS-353 AKM/Intelsat 4AF3	AC-46
1978-035	SVM-4A	1978 Mar 31	HS-353 AKM/Intelsat 4AF6	AC-48
1978-068	SVM-4A	1978 Jun 29	HS-351 AKM/Comstar D-3	AC-41
1981-018	SVM-4A	1981 Feb 21	HS-351 AKM/Comstar D-4	AC-42
		Aerojet/Sacramento SVM-5		
1974-033	SVM-5	1974 May 17	Ford SMS AKM/SMS 1	Delta 102
1975-011	SVM-5	1975 Feb 6	Ford SMS AKM/SMS 2	Delta 108
1975-100	SVM-5	1975 Oct 16	Ford SMS AKM/GOES A	Delta 116
1977-048	SVM-5	1977 Jun 16	Ford SMS AKM/GOES B	Delta 131
1977-118	SVM-5?	1977 Dec 15	CS AKM/CS 1	Delta 137
1978-062	SVM-5	1978 Jun 16	Ford SMS AKM/GOES C	Delta 142
		Aerojet/Sacramento SVM-6		
1976-035	SVM-6	1976 Apr 22	Ford NATO 3/NATO 3A	Delta 122
1977-005	SVM-6	1977 Jan 28	Ford NATO 3/NATO 3A	Delta 128
1978-106	SVM-6?	1978 Nov 19	Ford NATO 3 AKM/NATO 3C	Delta 146
		Aerojet/Sacramento SVM-7		
1975-117	SVM-7	1975 Dec 13	Satcom AKM/Satcom 1	Delta 118
1976-029	SVM-7	1976 Mar 26	Satcom AKM/Satcom 2	Delta 121
1978-116	SVM-7	1978 Dec 16	Satcom AKM/Anik B	Delta 147
1979-101	SVM-7	1979 Dec 7	Satcom AKM/Satcom 3	Delta 150
		Hercules/? BE-3 Alcyone		
1962-001	BE-3	1962 Jan 26	Ranger 3 Retro	Atlas Agena B 121D/6003
1962-012	BE-3	1962 Apr 23	Ranger 4 Retro	Atlas Agena B 133D/6004
1962-055	BE-3	1962 Oct 18	Ranger 5 Retro	Atlas Agena B 215D/6005
1963-039	BE-3A	1963 Oct 17	Vela 1A AKM	Atlas Agena D 197D
1963-039	BE-3A	1963 Oct 17	Vela 1B AKM	Atlas Agena D 197D
-	Alcyone	1964 Feb 10	Athena	A001
-	Alcyone	1964 May 28	Athena	Athena A002
-	Alcyone	1964 Jul 8	Athena	Athena A003
1964-040	BE-3A	1964 Jul 17	Vela 2A AKM	Atlas Agena D 216D
1964-040	BE-3A	1964 Jul 17	Vela 2B AKM	Atlas Agena D 216D
1965-058	BE-3A	1965 Jul 20	Vela 3A AKM	Atlas Agena D 225D
1965-058	BE-3A	1965 Jul 20	Vela 3B AKM	Atlas Agena D 225D

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	Alcyone	1964 Sep 28	Athena	Athena C001
-	Alcyone	1964 Oct 3	Athena	Athena D001
-	Alcyone	1964 Nov 6	Athena	Athena C004
-	Alcyone	1964 Nov 28	Athena	Athena C003
-	Alcyone	1964 Dec 4	Athena	Athena C002
-	Alcyone	1965 Jan 15	Athena	Athena C006
-	Alcyone	1965 Feb 2	Athena	Athena D003
-	Alcyone	1965 Feb 12	Athena	Athena D002
-	Alcyone	1965 Feb 15	Athena	Athena D008
-	Alcyone	1965 Jun 21	Athena	Athena B002
-	Alcyone	1965 Jun 22	Athena	Athena B001
-	Alcyone	1965 Jul 16	Athena	Athena B003
-	Alcyone	1965 Jul 20	Athena	Athena C007
-	Alcyone	1965 Jul 26	Athena	Athena C011
-	Alcyone	1965 Jul 27	Athena	Athena D005
-	Alcyone	1965 Jul 31	Athena	Athena D004
-	Alcyone	1965 Aug 2	Athena	Athena C014
-	Alcyone	1965 Aug 6	Athena	Athena C005
-	Alcyone	1965 Aug 7	Athena	Athena C009
-	Alcyone	1965 Aug 20	Athena	Athena D009
-	Alcyone	1965 Aug 20	Athena	Athena C008
-	Alcyone	1965 Aug 27	Athena	Athena D012
-	Alcyone	1965 Sep 13	Athena	Athena B004
-	Alcyone	1965 Sep 14	Athena	Athena D033
-	Alcyone	1965 Sep 20	Athena	Athena D006
-	Alcyone	1965 Sep 27	Athena	Athena C012
-	Alcyone	1965 Oct 1	Athena	Athena B006
-	Alcyone	1965 Oct 11	Athena	Athena C016
-	Alcyone	1965 Nov 5	Athena	Athena D007
-	Alcyone	1965 Nov 22	Athena	Athena B007
-	Alcyone	1965 Dec 6	Athena	Athena C017
-	Alcyone	1965 Dec 10	Athena	Athena C023
-	Alcyone	1966 Jan 21	Athena	Athena C025
-	Alcyone	1966 Feb 3	Athena	Athena C030
-	Alcyone	1966 Feb 17	Athena	Athena D014
-	Alcyone	1966 Mar 31	Athena	Athena D019
-	Alcyone	1966 Mar 31	Athena	Athena B009

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	Alcyone	1966 May 12	Athena	Athena D018
-	Alcyone	1966 May 27	Athena	Athena C019
-	Alcyone	1966 May 27	Athena	Athena D031
-	Alcyone	1966 Jun 9	Athena	Athena D021
-	Alcyone	1966 Jun 10	Athena	Athena D023
-	Alcyone	1966 Jun 23	Athena	Athena D034
-	Alcyone	1966 Jul 14	Athena	Athena C015
-	Alcyone	1966 Aug 18	Athena	Athena B011
-	Alcyone	1966 Aug 19	Athena	Athena E001
-	Alcyone	1966 Sep 1	Athena	Athena D029
-	Alcyone	1966 Sep 2	Athena	Athena D025
-	Alcyone	1966 Sep 22	Athena	Athena B015
-	Alcyone	1966 Oct 6	Athena	Athena D024
-	Alcyone	1966 Oct 7	Athena	Athena D049
-	Alcyone	1966 Oct 13	Athena	Athena D035
-	Alcyone	1966 Oct 13	Athena	Athena D036
-	Alcyone	1966 Nov 7	Athena	Athena D041
-	Alcyone	1966 Nov 7	Athena	Athena D039
-	Alcyone	1966 Nov 10	Athena	Athena B017
-	Alcyone	1966 Nov 10	Athena	Athena D020
-	Alcyone	1966 Nov 11	Athena	Athena D047
-	BE-3	1966 Nov 28	SPARTA Stage 3	?/SV-1
-	BE-3	1966 Dec 13	SPARTA Stage 3	2034/SV-2
-	Alcyone	1966 Dec 15	Athena	Athena D038
-	Alcyone	1966 Dec 16	Athena	Athena D042
-	Alcyone	1967 Feb 9	Athena	Athena B045
-	Alcyone	1967 Feb 23	Athena	Athena D037
-	Alcyone	1967 Mar 2	Athena	Athena C048
-	Alcyone	1967 Mar 16	Athena	Athena B012
-	Alcyone	1967 Mar 17	Athena	Athena D040

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	Alcyone	1967 Mar 17	Athena	Athena D051
-	Alcyone	1967 Mar 30	Athena	Athena D049
-	Alcyone	1967 Mar 30	Athena	Athena D046
-	Alcyone	1967 Mar 31	Athena	Athena E002
-	Alcyone	1967 Apr 6	Athena	Athena B031
-	Alcyone	1967 Apr 6	Athena	Athena D043
-	Alcyone	1967 Apr 12	Athena	Athena B020
-	BE-3	1967 Apr 20	SPARTA Stage 3	?/SV-3
1967-040	BE-3B1	1967 Apr 28	Vela 4A AKM	Titan 3C
1967-040	BE-3B1	1967 Apr 28	Vela 4B AKM	Titan 3C
-	Alcyone	1967 May 4	Athena	Athena B030
-	Alcyone	1967 May 5	Athena	Athena B032
-	Alcyone	1967 May 5	Athena	Athena B033
-	Alcyone	1967 Jun 1	Athena	Athena B034
-	Alcyone	1967 Jun 8	Athena	Athena D053
-	BE-3	1967 Jul 5	SPARTA Stage 3	2032/SV-4
-	Alcyone	1967 Jul 14	Athena	Athena D050
-	BE-3	1967 Jul 25	SPARTA Stage 3	2009/SV-5
-	Alcyone	1967 Aug 18	Athena	Athena E002
-	Alcyone	1967 Aug 18	Athena	Athena D055
-	BE-3	1967 Aug 18	SPARTA Stage 3	2039/SV-6
-	Alcyone	1967 Aug 24	Athena	Athena D059
-	Alcyone	1967 Aug 25	Athena	Athena D048
-	Alcyone	1967 Sep 8	Athena	Athena D057
-	Alcyone	1967 Sep 14	Athena	Athena D056
-	BE-3	1967 Sep 16	SPARTA Stage 3	2012/SV-7
-	Alcyone	1967 Sep 28	Athena	Athena C051
-	Alcyone	1967 Sep 28	Athena	Athena D066
-	Alcyone	1967 Sep 29	Athena	Athena C050
-	Alcyone	1967 Oct 11	Athena	Athena B030
-	BE-3	1967 Oct 12	SPARTA Stage 3	2030/SV-8
-	BE-3	1967 Oct 31	SPARTA Stage 3	2041/SV-9
-	Alcyone	1967 Nov 16	Athena	Athena D063
1967-118	BE-3	1967 Nov 29	SPARTA Stage 3	2029
-	Alcyone	1967 Nov 30	Athena	Athena B023
-	Alcyone	1968 Jan 11	Athena	Athena B022
-	Alcyone	1968 Jan 18	Athena	Athena B039

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	Alcyone	1968 Feb 1	Athena	Athena B037
-	Alcyone	1968 Mar 21	Athena	Athena B046
-	Alcyone	1968 Mar 28	Athena	Athena B044
-	Alcyone	1968 Mar 28	Athena	Athena D068
-	Alcyone	1968 Mar 29	Athena	Athena V114C
-	Alcyone	1968 May 2	Athena	Athena V116B
-	Alcyone	1968 May 16	Athena	Athena D061
-	Alcyone	1968 Jul 18	Athena	Athena B040
-	Alcyone	1968 Nov 14	Athena	Athena V120B
-	Alcyone	1968 Nov 15	Athena	Athena D062
-	Alcyone	1968 Dec 5	Athena	Athena V137D
-	Alcyone	1968 Dec 5	Athena	Athena D045
-	Alcyone	1968 Dec 6	Athena	Athena V136D
-	Alcyone	1968 Dec 12	Athena	Athena V118B
-	Alcyone	1969 Jan 16	Athena	Athena V140D
-	Alcyone	1969 Jan 16	Athena	Athena V145D
-	Alcyone	1969 Jan 23	Athena	Athena B038
-	Alcyone	1969 Feb 13	Athena	Athena B043
-	Alcyone	1969 Mar 27	Athena	Athena V138D
1969-046	BE-3A7	1969 May 23	Vela 5A AKM	Titan 3C
1969-046	BE-3A7	1969 May 23	Vela 5B AKM	Titan 3C
-	Alcyone	1969 Jun 5	Athena	Athena B036
-	Alcyone	1969 Jun 6	Athena	Athena V132D
-	Alcyone	1969 Jun 20	Athena	Athena V119D
-	Alcyone	1969 Jun 26	Athena	Athena V142D
-	Alcyone	1969 Sep 10	Athena	Athena V147D
-	Alcyone	1969 Sep 25	Athena	Athena V130D
1970-027	BE-3A7	1970 Apr 8	Vela 6A AKM	Titan 3C
1970-027	BE-3A7	1970 Apr 8	Vela 6B AKM	Titan 3C
-	Alcyone	1970 Apr 23	Athena	Athena V141D

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	Alcyone	1970 Jul 11	Athena	Athena V123D
-	Alcyone	1971 Jan 8	Athena	Athena V144D
-	Alcyone	1971 Mar 11	Athena	Athena B035
-	Alcyone	1971 Apr 3	Athena	Athena H-1JD
-	Alcyone	1971 Apr 16	Athena	Athena V127D
-	Alcyone	1971 May 14	Athena	Athena V146D
-	Alcyone	1971 Jun 3	Athena	Athena B041
-	Alcyone	1971 Jun 10	Athena	Athena V139D
-	Alcyone	1971 Aug 20	Athena	Athena V131D
-	Alcyone	1971 Sep 16	Athena	Athena V126D
-	Alcyone	1972 Oct 15	Strypi 7AR Stage 3	NASA 12.18NE
1974-040	BE-3	1974 Jun 3	Scout E-1 Stage 5	Scout S191C
1984-088	BE-3-A9	1984 Aug 16	IRM AKM	Delta 175
		Hercules/ABL X-248 Altair		
1958-F07	X-241	1958 Jul 25	NOTS Stage 3	NOTS D-1
1958-F08	X-241	1958 Aug 12	NOTS Stage 3	NOTS D-2
1958-F09	Altair	1958 Aug 17	Thor Able Stage 3	Thor 127
1958-F10	X-241	1958 Aug 22	NOTS Stage 3	NOTS D-3
1958-F12	X-241	1958 Aug 25	NOTS Stage 3	NOTS R-1
1958-F13	X-241	1958 Aug 26	NOTS Stage 3	NOTS R-2
1958-F14	X-241	1958 Aug 28	NOTS Stage 3	NOTS R-3
1958-007	Altair	1958 Oct 11	Thor Able Stage 3	Thor 130
1958-F19	Altair	1958 Nov 8	Thor Able Stage 3	Thor 129
-	Altair	1958 Dec 8	Bold Orion Stage 2	Bold Orion 7
-	Altair	1958 Dec 16	Bold Orion Stage 2	Bold Orion 8
-	Altair	1959 Apr 4	Bold Orion Stage 2	Bold Orion 9
-	Altair	1959 Jul 7	Javelin Stage 4	-
-	Altair	1959 Jul 21	Javelin Stage 4	-
1959-004	Altair	1959 Aug 7	Thor Able Stage 3	Thor 134
1959-F08	Altair	1959 Sep 17	Thor Able Stage 3	Thor 136
1959-007	Altair	1959 Sep 18	Vanguard Stage 3	Vanguard SLV7
-	Altair	1959 Sep 24	Atlas Able Stage 3	Atlas 9C
-	Altair	1959 Oct 13	Bold Orion Stage 2	Bold Orion
-	Altair	1959 Oct 28	Shotput Stage 2	Shotput
1959-F09	Altair	1959 Nov 26	Atlas Able Stage 3	Atlas 20D
-	Altair	1959 Dec 22	Javelin Stage 4	NASA 8.01GT
-	Altair	1960 Jan 15	Javelin Stage 4	-
-	Altair	1960 Jan 16	Shotput Stage 2	Shotput

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	Altair	1960 Jan 26	Javelin Stage 4	NASA 8.02GT
-	Altair	1960 Feb 27	Shotput Stage 2	Shotput
1960-001	Altair	1960 Mar 11	Thor Able Stage 3	Thor 219
1960-002	Altair	1960 Apr 1	Thor Able Stage 3	Thor 148
-	Altair	1960 Apr 1	Shotput Stage 2	Shotput
-	Dummy Altair	1960 Apr 18	Scout X Stage 4	Scout X
1960-F07	Altair	1960 May 13	Thor Delta Stage 3	Thor 144
-	Altair	1960 May 31	Shotput Stage 2	Shotput
-	Altair	1960 Jun 30	Javelin Stage 4	NASA 8.07GE
-	Altair	1960 Jul 1	Scout X-1 Stage 4	Scout X-1 ST-1
1960-009	Altair	1960 Aug 12	Delta Stage 3	Delta 2
-	Altair	1960 Sep 19	Journeyman Stage 4	NASA 11.01GE
1960-F11	Altair	1960 Sep 25	Atlas Able Stage 3	Atlas 80D
-	Altair	1960 Oct 4	Scout X-1 Stage 4	Scout X-1 ST-2
-	Altair	1960 Nov 10	Javelin Stage 4	NASA 8.04CA
1960-016	Altair	1960 Nov 23	Delta Stage 3	Delta 3
1960-F17	Altair	1960 Dec 4	Scout X-1 Stage 4	Scout X-1 ST-3
-	Altair	1960 Dec 10	Javelin Stage 4	NASA 8.05CA
-	Altair	1960 Dec 12	Javelin Stage 4	NASA 8.08GE
1960-F18	Altair	1960 Dec 14	Atlas Able Stage 3	Atlas 91D
1961 Del	Altair	1961 Feb 16	Scout X-1 Stage 4	Scout ST-4
-	Altair	1961 Mar 3	Blue Scout II Stage 4	Scout D-4
1961-010	Altair	1961 Mar 25	Delta Stage 3	Delta 4
-	Altair	1961 Apr 12	Blue Scout II Stage 4	Scout D-5
-	Altair	1961 Apr 27	Javelin Stage 4	NASA 8.10GI
-	Altair	1961 Jun 13	Javelin Stage 4	NASA 8.09GI
-	Altair	1961 Jun 15	Javelin Stage 4	NASA 8.13II
-	Altair	1961 Jun 24	Javelin Stage 4	NASA 8.15AI
1961-F06	Altair	1961 Jun 30	Scout X-1 Stage 4	Scout ST-5
1961-017	Altair	1961 Jul 12	Delta Stage 3	Delta 5
1961-020	Altair	1961 Aug 16	Delta Stage 3	Delta 6
1961 Chi	Altair	1961 Aug 25	Scout X-1 Stage 4	Scout ST-6
-	Altair	1961 Sep 13	Javelin Stage 4	NASA 8.06CA
-	Altair	1961 Sep 13	Javelin Stage 4	NASA 8.22CA
-	Altair	1961 Oct 10	Javelin Stage 4	NASA 8.23GA

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	Altair	1961 Oct 14	Javelin Stage 4	NASA 8.17AI
-	Altair	1961 Oct 19	Scout X-1 Stage 4	Scout ST-7
1961-F12	Altair	1961 Nov 1	Blue Scout II Stage 4	Scout D-8
-	Altair	1961 Nov 15	Journeyman Stage 4	NASA 11.04GB
-	Altair	1961 Nov 17	Javelin Stage 4	-
-	Altair	1961 Nov 18	Journeyman Stage 4	NASA 11.05GB
-	Altair	1962 Feb 7	Javelin Stage 4	NASA 8.16AI
1962-002	Altair	1962 Feb 8	Delta Stage 3	Delta 7
-	Altair	1962 Mar 1	Scout X-1A Stage 4	Scout ST-8
1962-006	Altair	1962 Mar 7	Delta Stage 3	Delta 8
-	Altair	1962 Mar 29	Scout X-2 Stage 4	Scout ST-9
1962-F03	Altair	1962 Apr 26	Scout X-2 Stage 4	Scout S111
1962-015	Altair	1962 Apr 26	Delta Stage 3	Delta 9
-	Altair	1962 May 3	Javelin Stage 4	NASA 8.21GI
-	Altair	1962 May 6	Trailblazer Stage 3	Meteor 1
1962-025	Altair	1962 Jun 19	Delta Stage 3	Delta 10
-	Altair	1962 Jul 9	Javelin Stage 4	-
-	Altair	1962 Jul 9	Javelin Stage 4	-
-	Altair	1962 Jul 9	Journeyman Stage 4	-
1962-029	Altair	1962 Jul 10	Delta Stage 3	Delta 11
-	Altair	1962 Jul 23	Javelin Stage 4	-
-	Altair	1962 Aug 31	Scout X-3A Stage 4	Scout S114
1962-047	Altair	1962 Sep 18	Delta Stage 3	Delta 12
1962-051	Altair	1962 Oct 2	Delta Stage 3	Delta 13
-	Altair	1962 Oct 25	Javelin Stage 4	-
1962-059	Altair	1962 Oct 27	Delta Stage 3	Delta 14
-	Altair	1962 Sep 22	Journeyman Stage 4	NASA 11.02UR
-	Altair	1962 Nov 27	Javelin Stage 4	-
1962-068	Altair	1962 Dec 13	Delta B Stage 3	Delta 15
1962 B CHI	Altair	1962 Dec 16	Scout X-3 Stage 4	Scout S115
1962 B PSI	Altair	1962 Dec 19	Scout X-3 Stage 4	Scout S118
-	Altair	1963 Feb 12	Journeyman Stage 4	NASA 11.06UE
1963-004	Altair	1963 Feb 14	Delta B Stage 3	Delta 16
1963-009	Altair	1963 Apr 3	Delta B Stage 3	Delta 17
1963-F04	Altair	1963 Apr 5	Scout X-3 Stage 4	Scout S119
-	Altair	1963 Apr 20	Shotput Stage 2	Shotput
1963-013	Altair	1963 May 7	Delta B Stage 3	Delta 18
-	Altair	1963 May 22	Scout X-3 Stage 4	Scout S116
1963-022	Altair	1963 Jun 16	Scout X-3 Stage 4	Scout S120
1963-024	Altair	1963 Jun 19	Delta B Stage 3	Delta 19

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	Altair	1963 Jul 2	Javelin Stage 4	NASA 8.14GI
-	Altair	1963 Jul 20	Scout X-3A Stage 4	Scout S110
1963-031	Altair	1963 Jul 26	Delta B Stage 3	Delta 20
-	Altair	1963 Aug 2	Shotput Stage 2	Shotput
-	Altair	1963 Sep 29	Javelin Stage 4	NASA 8.18GI
1963-054	Altair	1963 Dec 21	Delta B Stage 3	Delta 22
-	Altair	1964 Jan 17	Javelin Stage 4	NASA 8.31DA
1964-003	Altair	1964 Jan 21	Delta B Stage 3	Delta 23
1964-F02	Altair	1964 Mar 19	Delta B Stage 3	Delta 24
-	Altair	1964 Mar 25	Shotput Stage 2	Shotput
1964-015	Altair	1964 Mar 27	Scout X-3 Stage 4	Scout S127R
-	Altair	1964 Apr 15	Javelin Stage 4	NASA 12.03GT/GI
-	Altair	1964 Oct 8	Javelin Stage 4	NASA 8.03CA/CI
-	Altair	1964 Oct 19	Javelin Stage 4	NASA 8.24GI-II
-	Altair	1964 Oct 23	Javelin Stage 4	NASA 8.33GR
-	Altair	1964 Nov 5	Javelin Stage 4	NASA 8.34CA
-	Altair	1964 Nov 5	Javelin Stage 4	NASA 8.19DI
-	Altair	1964 Nov 7	Javelin Stage 4	NASA 8.20DI
-	Altair	1965 Jan 13	Javelin Stage 4	NASA 8.28UI
-	Altair	1965 Apr 14	Journeyman Stage 4	NASA 11.07UE
-	Altair	1965 May 19	Javelin Stage 4	NASA 8.29UI
-	Altair	1965 May 26	Javelin Stage 4	NASA 8.37GI
-	Altair	1965 Jun 30	Journeyman Stage 4	NASA 11.03UR
-	Altair	1965 Aug 25	Javelin Stage 4	NASA 8.11UA
-	Altair	1965 Sep 23	Javelin Stage 4	NASA 8.36GI
-	Altair	1965 Oct 5	Javelin Stage 4	NASA 8.30UI
-	Altair	1965 Oct 10	Javelin Stage 4	NASA 8.42UI
-	Altair	1966 Mar 2	Javelin Stage 4	NASA 8.25GA-GI
-	Altair	1966 May 1	Javelin Stage 4	AB19.286

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	Altair	1966 May 20	Javelin Stage 4	NASA 8.44GR
-	Altair	1966 Jun 28	Javelin Stage 4	AC19.191
-	Altair	1966 Jul 12	Javelin Stage 4	NASA 8.12UA
-	Altair	1966 Aug 15	Javelin Stage 4	NASA 8.32DA
-	Altair	1966 Sep 24	Javelin Stage 4	NASA 8.27IA
-	Altair	1966 Oct 6	Javelin Stage 4	NASA 8.38GI
-	Altair	1967 Feb 9	Javelin Stage 4	NASA 8.41UE
-	Altair	1967 Mar 18	Javelin Stage 4	NASA 8.47UE
-	Altair	1967 Apr 12	Javelin Stage 4	NASA 8.39GI
-	Altair	1967 May 17	Javelin Stage 4	NASA 8.43UA
-	Altair	1967 Jun 16	Javelin Stage 4	NASA 8.49IE
-	Altair	1967 Jun 17	Javelin Stage 4	NASA 8.50IE
-	Altair	1967 Jun 21	Javelin Stage 4	NASA 8.26UI
-	Altair	1967 Jun 28	Trailblazer 2 Stage 3	AD21.860
-	Altair	1967 Sep 21	Javelin Stage 4	NASA 8.45UI
-	Altair	1967 Dec 8	Javelin Stage 4	NASA 8.35UI
-	Altair	1968 Mar 2	Javelin Stage 4	NASA 8.48UE
-	Altair	1968 Apr 9	Javelin Stage 4	NASA 8.40UA
-	Altair	1968 May 25	Javelin Stage 4	NASA 8.46UI
-	Altair	1968 Nov 9	Javelin Stage 4	AB19.287
-	Altair	1968 Dec 10	Javelin Stage 4	NASA 8.51UA
-	Altair	1969 May 16	Javelin Stage 4	AC19.289
-	Altair	1969 May 30	Javelin Stage 4	AF19.291
-	Altair	1969 Jun 18	Trailblazer 2 Stage 3	AD21.861
-	Altair	1969 Jun 26	Javelin Stage 4	NASA 8.53UI
-	Altair	1970 Feb 18	Javelin Stage 4	NASA 8.55UE
-	Altair	1970 Mar 7	Javelin Stage 4	NASA 8.57CE
-	Altair	1970 Apr 3	Javelin Stage 4	NASA 8.56UE

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	Altair	1970 Sep 1	Javelin Stage 4	NASA 8.52UA
-	Altair	1970 Oct 5	Javelin Stage 4	NASA 8.58IE
-	Altair	1970 Nov 21	Trailblazer 2 Stage 3	AD21.862
-	Altair	1971 Jun 25	Javelin Stage 4	NASA 8.59AI
-	Altair	1972 Feb 10	Javelin Stage 4	NASA 8.60AE
-	Altair	1972 Jul 28	Trailblazer 2 Stage 3	A21.011-1
-	Altair	1972 Sep 12	Javelin Stage 4	NASA 8.62GE
-	Altair	1973 Jul 17	Javelin Stage 4	NASA 8.61UA
-	Altair	1973 Nov 18	Javelin Stage 4	NASA 8.63UI-II
-	Altair	1973 Nov 22	Javelin Stage 4	NASA 8.64UI-II
-	Altair	1973 Dec 6	Trailblazer 2 Stage 3	A21.220-1
-	Altair	1975 Feb 11	Javelin Stage 4	NASA 8.65UE
-	Altair	1976 Jul 18	Javelin Stage 4	NASA 12.1776GT
		Hercules/ABL X-258 Altair 2		
1963-026	Altair 2	1963 Jun 28	Scout X-4 Stage 4	Scout S113
1963-F12	Altair 2	1963 Sep 27	Scout X-2B Stage 4	Scout S132
1963-046	Altair 2	1963 Nov 27	Delta C Stage 3	Delta 21
1963-053	Altair 2	1963 Dec 19	Scout X-4 Stage 4	Scout S122R
1964-026	Altair 2	1964 Jun 4	Scout X-4 Stage 4	Scout S125R
1964-F08	Altair 2	1964 Jun 25	Scout X-4 Stage 4	Scout S128R
-	Altair 2	1964 Jul 20	Scout X-4 Stage 4	Scout S124R
-	Altair 2	1964 Aug 18	Scout X-4A Stage 4	Scout S129R
1964-047	Altair 2	1964 Aug 19	Delta D Stage 3	Delta 25
1964-051	Altair 2	1964 Aug 25	Scout X-4 Stage 4	Scout S134R
1964-060	Altair 2	1964 Oct 4	Delta C Stage 3	Delta 26
1964-064	Altair 2	1964 Oct 10	Scout X-4 Stage 4	Scout S123R
1964-074	Altair 2	1964 Nov 6	Scout X-4 Stage 4	Scout S133R
1964-076	Altair 2	1964 Nov 21	Scout X-4 Stage 4	Scout S135R
1964-084	Altair 2	1964 Dec 15	Scout X-4 Stage 4	Scout S137R
1964-086	Altair 2	1964 Dec 21	Delta C Stage 3	Delta 27
1965-F01	X-258	1965 Jan 21	OV1-1P	Atlas 172D
1965-004	Altair 2	1965 Jan 22	Delta C Stage 3	Delta 28
1965-007	Altair 2	1965 Feb 3	Delta C Stage 3	Delta 29
1965-028	Altair 2	1965 Apr 6	Delta D Stage 3	Delta 30
1965-032	Altair 2	1965 Apr 29	Scout X-4 Stage 4	Scout S136R
1965-F06	X-258	1965 May 27	OV1-3P	Atlas 68D
1965-042	Altair 2	1965 May 29	Delta C Stage 3	Delta 31
1965-051	Altair 2	1965 Jul 2	Delta C Stage 3	Delta 32
1965-078	Dummy X-258	1965 Oct 5	OV1 Dummy	Atlas 34D
1965-078	X-258	1965 Oct 5	OV1-2P	Atlas 34D

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1965-089	Altair 2	1965 Nov 6	Delta E Stage 3	Delta 34
1965-093	Altair 2	1965 Nov 19	Scout X-4 Stage 4	Scout S138R
1965-101	Altair 2	1965 Dec 6	Scout X-4 Stage 4	Scout S139R
1965-105	Altair 2	1965 Dec 16	Delta E Stage 3	Delta 35
1965-109	Altair 2	1965 Dec 22	Scout A Stage 4	Scout S140C
1966-005	Altair 2	1966 Jan 28	Scout A Stage 4	Scout S142C
1966-008	Altair 2	1966 Feb 3	Delta C Stage 3	Delta 36
-	Altair 2	1966 Feb 9	Scout X-4A Stage 4	Scout S141C
1966-016	Altair 2	1966 Feb 28	Delta E Stage 3	Delta 37
1966-024	Altair 2	1966 Mar 26	Scout A Stage 4	Scout S143C
1966-025	X-258	1966 Mar 30	OV1-4P	Atlas 72D
1966-025	X-258	1966 Mar 30	OV1-5P	Atlas 72D
1966-041	Altair 2	1966 May 19	Scout A Stage 4	Scout S146C
1966-063	X-258	1966 Jul 14	OV1-7P	Atlas 58D
1966-063	X-258	1966 Jul 14	OV1-8P	Atlas 58D
1966-076	Altair 2	1966 Aug 18	Scout A Stage 4	Scout S149C
1966-087	Altair 2	1966 Oct 2	Delta E Stage 3	Delta 41
1966-111	X-258	1966 Dec 11	OV1-9P	Atlas 89D
1966-111	X-258	1966 Dec 11	OV1-10P	Atlas 89D
1967-006	Altair 2	1967 Jan 26	Delta E Stage 3	Delta 45
1967-020	Altair 2	1967 Mar 8	Delta C Stage 3	Delta 46
1967-034	Altair 2	1967 Apr 14	Scout A Stage 4	Scout S154C
1967-036	Altair 2	1967 Apr 20	Delta E Stage 3	Delta 48
1967-042	Altair 2	1967 May 5	Scout A Stage 4	Scout S155C
1967-048	Altair 2	1967 May 18	Scout A Stage 4	Scout S156C
1967-072	X-258	1967 Jul 27	OV1-6P	Atlas 92D
1967-092	Altair 2	1967 Sep 25	Scout A Stage 4	Scout S157C
1968-012	Altair 2	1968 Mar 2	Scout A Stage 4	Scout S162C
1970-067	Altair 2	1970 Aug 27	Scout A Stage 4	Scout S176C
1973-081	Altair 2	1973 Oct 30	Scout A-1 Stage 4	Scout S178C
		Hercules/ABL X-249 Antares		
-	Antares	1960 Apr 18	Scout X Stage 3	Scout X
-	Antares	1960 Jul 1	Scout X-1 Stage 3	Scout ST-1
-	Antares	1960 Sep 21	Blue Scout Jr Stage 2	Blue Scout D-1
-	Antares	1960 Oct 4	Scout X-1 Stage 3	Scout ST-2
-	Antares	1960 Nov 8	Blue Scout Jr Stage 2	Blue Scout D-2
-	Antares	1960 Dec 4	Scout X-1 Stage 3	Scout ST-3
-	Antares	1961 Jan 7	Blue Scout I Stage 3	Scout D-3
1961 Del	Antares	1961 Feb 16	Scout X-1 Stage 3	Scout ST-4
-	Antares	1961 Mar 3	Blue Scout II Stage 3	Scout D-4
-	Antares	1961 Apr 12	Blue Scout II Stage 3	Scout D-5
-	Antares	1961 May 9	Blue Scout I Stage 3	Scout D-6
1961-F06	Antares	1961 Jun 30	Scout X-1 Stage 3	Scout ST-5
-	Antares	1961 Aug 17	Blue Scout Jr Stage 2	Blue Scout O-1
1961 Chi	Antares	1961 Aug 25	Scout X-1 Stage 3	Scout ST-6
-	Antares	1961 Oct 19	Scout X-1 Stage 3	Scout ST-7
1961-F12	Antares	1961 Nov 1	Blue Scout II Stage 3	Scout D-8

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	Antares	1961 Dec 4	Blue Scout Jr Stage 2	Blue Scout O-3
-	Antares	1962 Mar 1	Scout X-1A Stage 3	Scout ST-8
-	Antares	1962 Apr 12	Blue Scout I Stage 3	Scout D-7
-	Antares	1962 May 31	Blue Scout Jr Stage 2	Blue Scout 102
-	Antares	1962 Jul 24	Blue Scout Jr Stage 2	Blue Scout 103
-	Antares	1962 Sep 21	RAM-B Stage 2	RAM-B
-	Antares	1962 Nov 21	Blue Scout Jr Stage 2	Blue Scout 201
-	Antares	1962 Dec 19	Blue Scout Jr Stage 2	Blue Scout 21-1
-	Antares	1963 Feb 2	Blue Scout Jr Stage 2	Blue Scout 202
-	Antares	1963 Mar 14	Blue Scout Jr Stage 2	Blue Scout 203
-	Antares	1963 May 17	Blue Scout Jr Stage 2	Blue Scout 301
-	Antares	1963 Jul 30	Blue Scout Jr Stage 2	Blue Scout AD622
-	Antares	1963 Dec 17	Blue Scout Jr Stage 2	Blue Scout 302
-	Antares	1964 Mar 13	Blue Scout Jr Stage 2	Blue Scout AD623
-	Antares	1964 Apr 9	RAM-B	RAM-B
-	Antares	1964 Aug 29	Blue Scout Jr Stage 2	Blue Scout 21-2
-	Antares	1964 Dec 21	Blue Scout Jr Stage 2	Blue Scout 21-3
-	Antares	1965 Jan 28	Blue Scout Jr Stage 2	Blue Scout 22-3
-	Antares	1965 Mar 30	Blue Scout Jr Stage 2	Blue Scout 22-4
-	Antares	1965 Apr 9	Blue Scout Jr Stage 2	Blue Scout 22-9
-	Antares	1965 May 12	Blue Scout Jr Stage 2	Blue Scout 22-8
-	Antares	1965 Jun 9	Blue Scout Jr Stage 2	Blue Scout 22-5
-	Antares	1970 Nov 25	Blue Scout Jr Stage 2	NB22.208
Hercules/ABL X-259 Antares 2				
-	Antares 2	1962 Mar 29	Scout X-2 Stage 3	Scout ST-9
1962-F03	Antares 2	1962 Apr 26	Scout X-2 Stage 3	Scout S111
1962-F05	Antares 2	1962 May 24	Scout X-2M Stage 3	Scout S112
1962 A OMI	Antares 2	1962 Aug 23	Scout X-2M Stage 3	Scout S117
-	Antares 2	1962 Aug 31	Scout X-3A Stage 3	Scout S114
1962 B CHI	Antares 2	1962 Dec 16	Scout X-3 Stage 3	Scout S115

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1962 B PSI	Antares 2	1962 Dec 19	Scout X-3 Stage 3	Scout S118
1963-005	Antares 2	1963 Feb 19	Scout X-3M Stage 3	Scout S126
1963-F04	Antares 2	1963 Apr 5	Scout X-3 Stage 3	Scout S119
1963-F06	Antares 2	1963 Apr 26	Scout X-2M Stage 3	Scout S121
-	Antares 2	1963 May 22	Scout X-3 Stage 3	Scout S116
1963-022	Antares 2	1963 Jun 16	Scout X-3 Stage 3	Scout S120
1963-026	Antares 2	1963 Jun 28	Scout X-4 Stage 3	Scout S113
-	Antares 2	1963 Jul 20	Scout X-3A Stage 3	Scout S110
1963-F12	Antares 2	1963 Sep 27	Scout X-2B Stage 3	Scout S132
1963-053	Antares 2	1963 Dec 19	Scout X-4 Stage 3	Scout S122R
1964-015	Antares 2	1964 Mar 27	Scout X-3 Stage 3	Scout S127R
-	Antares 2	1964 Apr 14	FIRE 1	Atlas 263D
1964-026	Antares 2	1964 Jun 4	Scout X-4 Stage 3	Scout S125R
1964-F08	Antares 2	1964 Jun 25	Scout X-4 Stage 3	Scout S128R
-	Antares 2	1964 Jul 20	Scout X-4 Stage 3	Scout S124R
-	Antares 2	1964 Aug 18	Scout X-4A Stage 3	Scout S129R
1964-051	Antares 2	1964 Aug 25	Scout X-4 Stage 3	Scout S134R
-	Antares 2	1964 Oct 9	Scout X-3C Stage 3	Scout S130R
1964-064	Antares 2	1964 Oct 10	Scout X-4 Stage 3	Scout S123R
1964-074	Antares 2	1964 Nov 6	Scout X-4 Stage 3	Scout S133R
1964-076	Antares 2	1964 Nov 21	Scout X-4 Stage 3	Scout S135R
1964-084	Antares 2	1964 Dec 15	Scout X-4 Stage 3	Scout S137R
1965-032	Antares 2	1965 Apr 29	Scout X-4 Stage 3	Scout S136R
-	Antares 2	1965 May 22	FIRE 2	Atlas 264D
1965-063	Antares 2	1965 Aug 10	Scout B Stage 3	Scout S131R
1965-093	Antares 2	1965 Nov 19	Scout X-4 Stage 3	Scout S138R
1965-101	Antares 2	1965 Dec 6	Scout X-4 Stage 3	Scout S139R
1965-109	Antares 2	1965 Dec 22	Scout A Stage 3	Scout S140C
1966-005	Antares 2	1966 Jan 28	Scout A Stage 3	Scout S142C
-	Antares 2	1966 Feb 9	Scout X-4A Stage 3	Scout S141C
1966-024	Antares 2	1966 Mar 26	Scout A Stage 3	Scout S143C
1966-034	Antares 2	1966 Apr 22	Scout B Stage 3	Scout S145C
1966-041	Antares 2	1966 May 19	Scout A Stage 3	Scout S146C
1966-052	Antares 2	1966 Jun 10	Scout B Stage 3	Scout S147C
1966-070	Antares 2	1966 Aug 4	Scout B Stage 3	Scout S148C
1966-076	Antares 2	1966 Aug 18	Scout A Stage 3	Scout S149C
1966-097	Antares 2	1966 Oct 28	Scout B Stage 3	Scout S150C
-	Antares 2	1966 Nov 28	SPARTA	?/SV-1
-	Antares 2	1966 Dec 13	SPARTA	2034/SV-2
1967-F01	Antares 2	1967 Jan 31	Scout B Stage 3	Scout S151C
1967-034	Antares 2	1967 Apr 14	Scout A Stage 3	Scout S154C
-	Antares 2	1967 Apr 20	SPARTA	?/SV-3
1967-038	Antares 2	1967 Apr 26	Scout B Stage 3	Scout S153C
1967-042	Antares 2	1967 May 5	Scout A Stage 3	Scout S155C
1967-048	Antares 2	1967 May 18	Scout A Stage 3	Scout S156C
1967-F05	Antares 2	1967 May 30	Scout B Stage 3	Scout S152C
-	Antares 2	1967 Jul 5	SPARTA	2032/SV-4
-	Antares 2	1967 Jul 25	SPARTA	2009/SV-5
-	Antares 2	1967 Aug 18	SPARTA	2039/SV-6

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	Antares 2	1967 Sep 16	SPARTA	2012/SV-7
1967-092	Antares 2	1967 Sep 25	Scout A Stage 3	Scout S157C
-	Antares 2	1967 Oct 12	SPARTA	2030/SV-8
-	Antares 2	1967 Oct 19	Scout B Stage 3	Scout S159C
-	Antares 2	1967 Oct 31	SPARTA	2041/SV-9
1967-118	Antares 2	1967 Nov 29	SPARTA	2029
1967-120	Antares 2	1967 Dec 5	Scout B Stage 3	Scout S158C
1968-012	Antares 2	1968 Mar 2	Scout A Stage 3	Scout S162C
1968-017	Antares 2	1968 Mar 5	Scout B Stage 3	Scout S160C
-	Antares 2	1968 Apr 27	Scout X-5C Stage 3	Scout S164C
1968-041	Antares 2	1968 May 17	Scout B Stage 3	Scout S161C
1968-066	Antares 2	1968 Aug 8	Scout B Stage 3	Scout S165C
-	Antares 2	1968 Aug 22	Scout B Stage 3	Scout S168C
1968-084	Antares 2	1968 Oct 3	Scout B Stage 3	Scout S167C
1969-083	Antares 2	1969 Oct 1	Scout B Stage 3	Scout S172C
1969-097	Antares 2	1969 Nov 8	Scout B Stage 3	Scout S169C
1970-067	Antares 2	1970 Aug 27	Scout A Stage 3	Scout S176C
-	Antares 2	1970 Sep 30	Scout B Stage 3	Scout S171C
1970-094	Antares 2	1970 Nov 9	Scout B Stage 3	Scout S178C
1970-107	Antares 2	1970 Dec 12	Scout B Stage 3	Scout S175C
-	Antares 2	1971 Apr 3	Athena H	Athena H H001
1971-036	Antares 2	1971 Apr 24	Scout B Stage 3	Scout S173C
-	Antares 2	1971 Jun 20	Scout B Stage 3	Scout S144CR
1971-058	Antares 2	1971 Jul 8	Scout B Stage 3	Scout S177C
-	Antares 2	1971 Aug 13	Athena H	Athena H H002
1971-071	Antares 2	1971 Aug 16	Scout B-1 Stage 3	Scout S180C
-	Antares 2	1971 Sep 20	Scout B Stage 3	Scout S166C
1971-096	Antares 2	1971 Nov 15	Scout B Stage 3	Scout S163CR
1971-109	Antares 2	1971 Dec 11	Scout B-1 Stage 3	Scout S183C
-	Antares 2	1972 Mar 17	Athena H	Athena H H003
-	Antares 2	1972 Aug 12	Athena H	Athena H H004
1972-061	Antares 2	1972 Aug 13	Scout D-1 Stage 3	Scout S184C
1972-069	Antares 2	1972 Sep 2	Scout B-1 Stage 3	Scout S182C
-	Antares 2	1972 Oct 26	Athena H	Athena H H007
1972-091	Antares 2	1972 Nov 15	Scout D-1 Stage 3	Scout S170CR
1972-092	Antares 2	1972 Nov 22	Scout D-1 Stage 3	Scout S185C
1972-100	Antares 2	1972 Dec 16	Scout D-1 Stage 3	Scout S181C
-	Antares 2	1973 Jan 12	Athena H	Athena H H005
-	Antares 2	1973 Jan 12	Athena H	Athena H H009

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
-	Antares 2	1973 Mar 29	Athena H	Athena H H006
-	Antares 2	1973 Mar 29	Athena H	Athena H H008
-	Antares 2	1973 Apr 26	Athena H	Athena H H010
-	Antares 2	1973 Aug 24	Athena H	Athena H H011
1973-081	Antares 2	1973 Oct 30	Scout A-1 Stage 3	Scout S178C
-	Antares 2	1974 Feb 13	Athena H	Athena H -
1974-009	Antares 2	1974 Feb 18	Scout D-1 Stage 3	Scout S190C
1974-013	Antares 2	1974 Mar 9	Scout D-1 Stage 3	Scout S188C
-	Antares 2	1974 Mar 9	Athena H	Athena H -
-	Antares 2	1974 Mar 24	Athena H	Athena H -
-	Antares 2	1974 May 19	Athena H	Athena H -
-	Antares 2	1974 May 29	Athena H	Athena H -
1974-040	Antares 2	1974 Jun 3	Scout E-1 Stage 3	Scout S191C
-	Antares 2	1974 Jun 13	Athena H	Athena H -
-	Antares 2	1974 Jun 23	Athena H	Athena H -
1974-055	Antares 2	1974 Jul 16	Scout D-1 Stage 3	Scout S186C
1974-070	Antares 2	1974 Aug 30	Scout D-1 Stage 3	Scout S189C
1974-077	Antares 2	1974 Oct 15	Scout B-1 Stage 3	Scout S187C
1975-037	Antares 2	1975 May 7	Scout F-1 Stage 3	Scout S194C
1975-099	Antares 2	1975 Oct 12	Scout D-1 Stage 3	Scout S195C
1975-F06	Antares 2	1975 Dec 5	Scout F-1 Stage 3	Scout S196C
-	Antares 2?	1976 Apr 2	Athena D	Athena D -
1976-047	Antares 2	1976 May 22	Scout B-1 Stage 3	Scout S179CR
-	Antares 2	1976 Jun 18	Scout D-1 Stage 3	Scout S193C
1976-089	Antares 2	1976 Sep 1	Scout D-1 Stage 3	Scout S197C
-	Antares 2?	1976 Dec 15	Athena D	Athena D -
-	Antares 2?	1977 Mar 20	Athena D	Athena D -
1977-106	Antares 2	1977 Oct 28	Scout D-1 Stage 3	Scout S200C
1978-041	Antares 2	1978 Apr 26	Scout D-1 Stage 3	Scout S201C
1979-013	Antares 2	1979 Feb 18	Scout D-1 Stage 3	Scout S202C
1979-047	Antares 2	1979 Jun 2	Scout D-1 Stage 3	Scout S198C
1983-063	Antares 2	1983 Jun 27	Scout D-1 Stage 3	Scout S205C
		Hercules/Magna Orion 38		
1990-028	Orion 38	1990 Apr 5	Pegasus Stage 3	Pegasus 1
1991-051	Orion 38	1991 Jul 17	Pegasus Stage 3	Pegasus 2
1993-009	Orion 38	1993 Feb 9	Pegasus Stage 3	Pegasus 3
1993-026	Orion 38	1993 Apr 25	Pegasus Stage 3	Pegasus 4
1994-017	Orion 38	1994 Mar 13	Taurus 1 Stage 4	Taurus 1
1994-029	Orion 38	1994 May 19	Pegasus Stage 3	Pegasus 5
1994-F03	Orion 38	1994 Jun 27	Pegasus XL Stage 3	Pegasus XL1
1994-046	Orion 38	1994 Aug 3	Pegasus Stage 3	Pegasus 6
1995-017	Orion 38	1995 Apr 3	Pegasus Stage 3	Pegasus 7
1995-F03	Orion 38	1995 Jun 22	Pegasus XL Stage 3	Pegasus XL2
1996-014	Orion 38	1996 Mar 9	Pegasus XL Stage 3	Pegasus XL3
1996-031	Orion 38	1996 May 17	Pegasus Stage 3	Pegasus 8

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1996-037	Orion 38	1996 Jul 2	Pegasus XL Stage 3	Pegasus XL4
1996-049	Orion 38	1996 Aug 21	Pegasus XL Stage 3	Pegasus XL5
1996-061	Orion 38	1996 Nov 4	Pegasus XL Stage 3	Pegasus XL6
1997-018	Orion 38	1997 Apr 21	Pegasus XL Stage 3	Pegasus XL7
		JPL Cluster		
-	Cluster Stage 2	1956 Sep 20	Jupiter C	RS-27
-	Cluster Stage 3	1956 Sep 20	Jupiter C	RS-27
-	Cluster Stage 2	1957 May 15	Jupiter C	RS-34
-	Cluster Stage 3	1957 May 15	Jupiter C	RS-34
-	Cluster Stage 2	1957 Aug 8	Jupiter C	RS/CC-40
-	Cluster Stage 3	1957 Aug 8	Jupiter C	RS/CC-40
1958-001	Cluster Stage 2	1958 Feb 1	Jupiter C	RS-29
1958-001	Cluster Stage 3	1958 Feb 1	Jupiter C	RS-29
1958-001	Cluster Stage 4	1958 Feb 1	Jupiter C	RS-29
1958-F02	Cluster Stage 2	1958 Mar 5	Jupiter C	RS-26
1958-F02	Cluster Stage 3	1958 Mar 5	Jupiter C	RS-26
1958-F02	Cluster Stage 4	1958 Mar 5	Jupiter C	RS-26
1958-003	Cluster Stage 2	1958 Mar 26	Jupiter C	RS-24
1958-003	Cluster Stage 3	1958 Mar 26	Jupiter C	RS-24
1958-003	Cluster Stage 4	1958 Mar 26	Jupiter C	RS-24
1958-005	Cluster Stage 2	1958 Jul 26	Jupiter C	RS/CC-44
1958-005	Cluster Stage 3	1958 Jul 26	Jupiter C	RS/CC-44
1958-005	Cluster Stage 4	1958 Jul 26	Jupiter C	RS/CC-44
1958-F11	Cluster Stage 2	1958 Aug 24	Jupiter C	RS/CC-47
1958-F11	Cluster Stage 3	1958 Aug 24	Jupiter C	RS/CC-47
1958-F11	Cluster Stage 4	1958 Aug 24	Jupiter C	RS/CC-47
1958-F13	Cluster Stage 2	1958 Oct 23	Jupiter C	RS/CC-49
1958-F13	Cluster Stage 3	1958 Oct 23	Jupiter C	RS/CC-49
1958-F13	Cluster Stage 4	1958 Oct 23	Jupiter C	RS/CC-49
1958-008	Cluster Stage 2	1958 Dec 6	Juno II	AM-11
1958-008	Cluster Stage 3	1958 Dec 6	Juno II	AM-11
1958-008	Cluster Stage 4	1958 Dec 6	Juno II	AM-11
1959-013	Cluster Stage 2	1959 Mar 3	Juno II	AM-14
1959-013	Cluster Stage 3	1959 Mar 3	Juno II	AM-14
1959-013	Cluster Stage 4	1959 Mar 3	Juno II	AM-14
1959-F05	Cluster Stage 2	1959 Jul 16	Juno II	AM-16
1959-F05	Cluster Stage 3	1959 Jul 16	Juno II	AM-16
1959-F07	Cluster Stage 2	1959 Aug 15	Juno II	AM-19B
1959-F07	Cluster Stage 3	1959 Aug 15	Juno II	AM-19B
1959-009	Cluster Stage 2	1959 Oct 13	Juno II	AM-19A
1959-009	Cluster Stage 3	1959 Oct 13	Juno II	AM-19A
1959-009	Cluster Stage 4	1959 Oct 13	Juno II	AM-19A
-	Baby Sergeant	1959 Nov 10	Strongarm Stage 5	OB11.01
-	Baby Sergeant	1959 Nov 18	Strongarm Stage 5	OB11.02
1960-F04	Cluster Stage 2	1960 Mar 23	Juno II	AM-19C
1960-F04	Cluster Stage 3	1960 Mar 23	Juno II	AM-19C
1960-F04	Cluster Stage 4	1960 Mar 23	Juno II	AM-19C
-	Baby Sergeant	1960 Jul 13	Strongarm Stage 5	-
-	Baby Sergeant	1960 Jul 14	Strongarm Stage 5	-
-	Baby Sergeant	1960 Aug 2	Strongarm Stage 5	-

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1960-014	Cluster Stage 2	1960 Nov 3	Juno II	AM-19D
1960-014	Cluster Stage 3	1960 Nov 3	Juno II	AM-19D
1960-014	Cluster Stage 4	1960 Nov 3	Juno II	AM-19D
-	Baby Sergeant	1961 Feb 14	Strongarm Stage 5	E22-H1-1
-	Baby Sergeant	1961 Feb 18	Strongarm Stage 5	E22-H1-2
1961-F01	Cluster Stage 2	1961 Feb 24	Juno II	AM-19F
1961-F01	Cluster Stage 3	1961 Feb 24	Juno II	AM-19F
1961-F01	Cluster Stage 4	1961 Feb 24	Juno II	AM-19F
1961-013	Cluster Stage 2	1961 Apr 27	Juno II	AM-19E
1961-013	Cluster Stage 3	1961 Apr 27	Juno II	AM-19E
1961-013	Cluster Stage 4	1961 Apr 27	Juno II	AM-19E
1961-F04	Cluster Stage 2	1961 May 24	Juno II	AM-19G
1961-F04	Cluster Stage 3	1961 May 24	Juno II	AM-19G
1961-F04	Cluster Stage 4	1961 May 24	Juno II	AM-19G
-	Baby Sergeant	1961 Jul 27	Strongarm Stage 5	AA11.501
		JPL Two Pound Motor		
1958-F13	2 lb Motor	1958 Oct 23	Beacon AKM	RS/CC-49
		JPL Apogee Motor		
1963-031	JPL SR-12-1	1963 Jul 26	HS-301 AKM/Syncom 2	Delta 20
1964-047	JPL SR-12-1	1964 Aug 19	HS-301 AKM/Syncom 3	Delta 25
1965-028	Starfinder	1965 Apr 6	HS-303 AKM	Delta 30
1966-110	JPL SR-28-3	1966 Dec 7	ATS 1 AKM	Atlas Agena D 5101/6151
1967-111	JPL SR-28-3	1967 Nov 5	ATS 3 AKM	Atlas Agena D 5103/6153
1969-069	JPL SR-28-3	1969 Aug 12	ATS 5 AKM	AC-18
		UTC/San Jose FW-4		
1965-038	FW-4S	1965 May 20	Thor Burner 1 Stage 2	Thor 282
1965-063	FW-4S	1965 Aug 10	Scout B Stage 4	Scout S131R
1965-072	FW-4S	1965 Sep 10	Thor Burner 1 Stage 2	Thor 213
1966-F01	FW-4S	1966 Jan 7	Thor Burner 1 Stage 2	Thor 251
1966-026	FW-4S	1966 Mar 31	Thor Burner 1 Stage 2	Thor 147
1966-044	FW-4D	1966 May 25	Delta C Stage 3	Delta 38
1966-034	FW-4S	1966 Apr 22	Scout B Stage 4	Scout S145C
1966-052	FW-4S	1966 Jun 10	Scout B Stage 4	Scout S147C
1966-058	FW-4D	1966 Jul 1	Delta E Stage 3	Delta 39
1966-070	FW-4S	1966 Aug 4	Scout B Stage 4	Scout S148C
1966-075	FW-4D	1966 Aug 17	Delta E Stage 3	Delta 40
1966-096	FW-4D	1966 Oct 26	Delta E Stage 3	Delta 42
1966-097	FW-4S	1966 Oct 28	Scout B Stage 4	Scout S150C
1967-001	FW-4D	1967 Jan 11	Delta E Stage 3	Delta 44
1967-F01	FW-4S	1967 Jan 31	Scout B Stage 4	Scout S151C
1967-026	FW-4D	1967 Mar 23	Delta E Stage 3	Delta 47
1967-038	FW-4S	1967 Apr 26	Scout B Stage 4	Scout S153C
1967-051	FW-4D	1967 May 24	Delta E Stage 3	Delta 49
1967-F05	FW-4S	1967 May 30	Scout B Stage 4	Scout S152C
1967-070	FW-4D	1967 Jul 19	Delta E Stage 3	Delta 50
1967-072	FW-4S	1967 Jul 27	OV1-11P	Atlas 92D
1967-072	FW-4S	1967 Jul 27	OV1-12P	Atlas 92D
1967-094	FW-4D	1967 Sep 28	Delta E Stage 3	Delta 52

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1967-100	FW-4D	1967 Oct 18	Delta C Stage 3	Delta 53
-	FW-4S	1967 Oct 19	Scout B Stage 4	Scout S159C
1967-114	FW-4D	1967 Nov 10	Delta E Stage 3	Delta 54
1967-120	FW-4S	1967 Dec 5	Scout B Stage 4	Scout S158C
1967-123	FW-4D	1967 Dec 13	Delta E Stage 3	Delta 55
1968-002	FW-4D	1968 Jan 11	Delta E Stage 3	Delta 56
1968-017	FW-4S	1968 Mar 5	Scout B Stage 4	Scout S160C
1968-026	FW-4S	1968 Apr 6	OV1-13P	Atlas 107F
1968-026	FW-4S	1968 Apr 6	OV1-14P	Atlas 107F
1968-041	FW-4S	1968 May 17	Scout B Stage 4	Scout S161C
1968-059	FW-4S	1968 Jul 11	OV1-15P	Atlas 75F
1968-059	FW-4S	1968 Jul 11	OV1-16P	Atlas 75F
1968-066	FW-4S	1968 Aug 8	Scout B Stage 4	Scout S165C
-	FW-4S	1968 Aug 22	Scout B Stage 4	Scout S168C
1968-084	FW-4S	1968 Oct 3	Scout B Stage 4	Scout S167C
1968-100	FW-4D	1968 Nov 8	Delta E Stage 3	Delta 60
1968-109	FW-4D	1968 Dec 5	Delta E Stage 3	Delta 61
1969-006	FW-4D	1969 Jan 22	Delta E Stage 3	Delta 64
1969-009	FW-4D	1969 Jan 30	Delta E Stage 3	Delta 65
1969-016	FW-4D	1969 Feb 26	Delta E Stage 3	Delta 67
1969-025	FW-4S	1969 Mar 18	OV1-17P/OV1-17A	Atlas 104F
1969-025	FW-4S	1969 Mar 18	OV1-18P	Atlas 104F
1969-025	FW-4S	1969 Mar 18	OV1-19P	Atlas 104F
1969-053	FW-4D	1969 Jun 21	Delta E Stage 3	Delta 69
1969-F12	FW-4D	1969 Aug 27	Delta E Stage 3	Delta 73
1969-083	FW-4S	1969 Oct 1	Scout B Stage 4	Scout S172C
1969-097	FW-4S	1969 Nov 8	Scout B Stage 4	Scout S169C
-	FW-4S	1970 Sep 30	Scout B Stage 4	Scout S171C
1970-094	FW-4S	1970 Nov 9	Scout B Stage 4	Scout S178C
1970-107	FW-4S	1970 Dec 12	Scout B Stage 4	Scout S175C
1971-024	FW-4D	1971 Apr 1	Delta L Stage 3	Delta 84
1971-036	FW-4S	1971 Apr 24	Scout B Stage 4	Scout S173C
-	FW-4S	1971 Jun 20	Scout B Stage 4	Scout S144CR
1971-058	FW-4S	1971 Jul 8	Scout B Stage 4	Scout S177C
1971-067	FW-4S	1971 Aug 7	OV1-20P	Atlas 76F
1971-067	FW-4S	1971 Aug 7	OV1-21P	Atlas 76F
1971-071	FW-4S	1971 Aug 16	Scout B-1 Stage 4	Scout S180C
-	FW-4S	1971 Sep 20	Scout B Stage 4	Scout S166C
1971-096	FW-4S	1971 Nov 15	Scout B Stage 4	Scout S163CR
1971-109	FW-4S	1971 Dec 11	Scout B-1 Stage 4	Scout S183C
1972-005	FW-4D	1972 Jan 31	Delta L Stage 3	Delta 87
1972-061	FW-4S	1972 Aug 13	Scout D-1 Stage 4	Scout S184C
1972-069	FW-4S	1972 Sep 2	Scout B-1 Stage 4	Scout S182C
1972-091	FW-4S	1972 Nov 15	Scout D-1 Stage 4	Scout S170CR
1972-092	FW-4S	1972 Nov 22	Scout D-1 Stage 4	Scout S185C
1972-100	FW-4S	1972 Dec 16	Scout D-1 Stage 4	Scout S181C
1974-009	FW-4S	1974 Feb 18	Scout D-1 Stage 4	Scout S190C

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1974-013	FW-4S	1974 Mar 9	Scout D-1 Stage 4	Scout S188C
1974-040	FW-4S	1974 Jun 3	Scout E-1 Stage 4	Scout S191C
1974-055	FW-4S	1974 Jul 16	Scout D-1 Stage 4	Scout S186C
		UTC/San Jose FW-5		
1972-090	FW5	1972 Nov 10	HS-333 AKM/Anik A1	Delta 92
1973-023	FW5	1973 Apr 20	HS-333 AKM/Anik A2	Delta 94
1974-022	FW5	1974 Apr 13	HS-333 AKM/Westar 1	Delta 101
1974-075	FW5	1974 Oct 10	HS-333 AKM/Westar 2	Delta 103
1975-038	FW5	1975 May 7	HS-333 AKM/Anik A3	Delta 110
1976-017	FW5	1976 Feb 19	HS-356 AKM/Marisat 1	Delta 120
1976-053	FW5	1976 Jun 10	HS-356 AKM/Marisat 2	Delta 124
1976-066	FW5	1976 Jul 8	HS-333 AKM/Palapa A1	Delta 125
1976-101	FW5	1976 Oct 14	HS-356 AKM/Marisat 3	Delta 127
1977-018	FW5	1977 Mar 10	HS-333 AKM/Palapa A2	Delta 129
1979-007	FW5	1979 Jan 30	SCATHA AKM	Delta 148
1979-072	FW5	1979 Aug 10	HS-333 AKM/Westar 3	Delta 149
		GRC/Redlands GRC 133-KS-2800		
-	Dummy GRC	1957 Oct 23	Vanguard TV2	
1957-F01	GRC 133-KS-2800	1957 Dec 6	Vanguard TV3	
1958-F01	GRC 133-KS-2800	1958 Feb 5	Vanguard TV3BU	
1958-002	GRC 133-KS-2800	1958 Mar 17	Vanguard TV4	
1958-F04	GRC 133-KS-2800	1958 Apr 28	Vanguard TV5	
1958-F05	GRC 133-KS-2800	1958 May 28	Vanguard SLV1	
1958-F06	GRC 133-KS-2800	1958 Jun 26	Vanguard SLV2	
1958-F16	GRC 133-KS-2800	1958 Sep 26	Vanguard SLV3	
1959-001	GRC 133-KS-2800	1959 Feb 17	Vanguard SLV4	
1959-F01	GRC 133-KS-2800	1959 Apr 14	Vanguard SLV5	
1959-F03	GRC 133-KS-2800	1959 Jun 22	Vanguard SLV6	
		LPC/Redlands MG-18		
1962-F05	MG-18	1962 May 24	Scout X-2M Stage 4	Scout S112
1962 A OMI	MG-18	1962 Aug 23	Scout X-2M Stage 4	Scout S117
1963-005	MG-18	1963 Feb 19	Scout X-3M Stage 4	Scout S126
1963-F06	MG-18	1963 Apr 26	Scout X-2M Stage 4	Scout S121
1965-003	MG-18	1965 Jan 19	Thor Burner 1 Stage 2	Thor 224
1965-021	MG-18	1965 Mar 18	Thor Burner 1 Stage 2	Thor 306
		LPC/Redlands LP-104		
1969-025	LP-104	1969 Mar 18	OV1-17 kick motor	Atlas 104F
		LPC/Redlands LPC-509		
1974-020	LPC-509	1974 Apr 10	S73-7 kick motor	Titan 3D
		NOTS/China Lake 3-inch Spherical Motor		
1958-F07	NOTS 3"SM	1958 Jul 25	NOTS D-1	NOTS
1958-F08	NOTS 3"SM	1958 Aug 12	NOTS D-2	NOTS
1958-F10	NOTS 3"SM	1958 Aug 22	NOTS D-3	NOTS
1958-F12	NOTS 3"SM	1958 Aug 25	NOTS R-1	NOTS
1958-F13	NOTS 3"SM	1958 Aug 26	NOTS R-2	NOTS
1958-F14	NOTS 3"SM	1958 Aug 28	NOTS R-3	NOTS
-	NOTS motor	1959 Sep 24	P-1 kick motor	Atlas 9C
1959-F09	NOTS motor	1959 Nov 26	P-3 kick motor	Atlas 20D
1960-F11	NOTS motor?	1960 Sep 25	P-30 kick motor	Atlas 80D

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1960-F18	NOTS motor?	1960 Dec 14	P-31 kick motor	Atlas 91D
		UTC/San Jose Orbus 21		
1982-106	Orbus 21	1982 Oct 30	IUS Stage 1	Titan 34D-1
1983-026	Orbus 21	1983 Apr 4	IUS Stage 1	STS-6
1985-010	Orbus 21	1985 Jan 24	IUS Stage 1	STS 51-C
1985-092	Orbus 21	1985 Oct 3	IUS Stage 1	STS 51-J
1986-F01	Orbus 21	1986 Jan 28	IUS Stage 1	STS 51-L
1988-091	Orbus 21	1988 Sep 29	IUS Stage 1	STS-26R
1989-021	Orbus 21	1989 Mar 13	IUS Stage 1	STS-29R
1989-033	Orbus 21	1989 May 4	IUS Stage 1	STS-30R
1989-046	Orbus 21	1989 Jun 14	IUS Stage 1	Titan 45K-1
1989-084	Orbus 21	1989 Oct 18	IUS Stage 1	STS-34R
1989-090	Orbus 21	1989 Nov 23	IUS Stage 1	STS-33R
1990-021	Orbus 21S	1990 Mar 14	HS-389 PKM	Titan CT2
1990-056	Orbus 21S	1990 Jun 23	HS-389 PKM	Titan CT3
1990-090	Orbus 21	1990 Oct 6	IUS Stage 1	STS-41
1990-095	Orbus 21	1990 Nov 13	IUS Stage 1	Titan 45K-6
1991-054	Orbus 21	1991 Aug 2	IUS Stage 1	STS-43
1991-080	Orbus 21	1991 Nov 24	IUS Stage 1	STS-44
1992-026	Orbus 21S	1992 May 7	HS-389 PKM	STS-49
1992-063	Orbus 21	1992 Sep 25	TOS	Titan CT4
1993-003	Orbus 21	1993 Jan 13	IUS Stage 1	STS-54
1993-058	Orbus 21	1993 Sep 12	TOS	STS-51
1994-084	Orbus 21	1994 Dec 22	IUS Stage 1	Titan 45K-14
1995-035	Orbus 21	1995 Jul 13	IUS Stage 1	STS-70
1995-F04	Orbus 21D	1995 Aug 15	LLV-1 Stage 2	LLV-1
1997-008	Orbus 21	1997 Feb 23	IUS Stage 1	Titan 45K-24
		UTC/San Jose Orbus 6		
1982-106	Orbus 6E	1982 Oct 30	IUS Stage 2	34D-1
1983-026	Orbus 6E	1983 Apr 4	IUS Stage 2	STS-6
1985-010	Orbus 6E	1985 Jan 24	IUS Stage 2	STS 51-C
1985-092	Orbus 6E	1985 Oct 3	IUS Stage 2	STS 51-J
1986-F01	Orbus 6E	1986 Jan 28	IUS Stage 2	STS 51-L
1988-091	Orbus 6E	1988 Sep 29	IUS Stage 2	STS-26R
1989-021	Orbus 6E	1989 Mar 13	IUS Stage 2	STS-29R
1989-033	Orbus 6E	1989 May 4	IUS Stage 2	STS-30R
1989-046	Orbus 6E	1989 Jun 14	IUS Stage 2	45K-1
1989-084	Orbus 6E	1989 Oct 18	IUS Stage 2	STS-34R
1989-090	Orbus 6E	1989 Nov 23	IUS Stage 2	STS-33R
1990-090	Orbus 6E	1990 Oct 6	IUS Stage 2	STS-41
1990-095	Orbus 6E	1990 Nov 13	IUS Stage 2	45K-6
1991-054	Orbus 6E	1991 Aug 2	IUS Stage 2	STS-43
1991-080	Orbus 6E	1991 Nov 24	IUS Stage 2	STS-44
1993-003	Orbus 6E	1993 Jan 13	IUS Stage 2	STS-54
1994-084	Orbus 6E	1994 Dec 22	IUS Stage 2	Titan 45K-14
1995-035	Orbus 6E	1995 Jul 13	IUS Stage 2	STS-70

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1997-008	Orbus 6E	1997 Feb 23	IUS Stage 2	Titan 45K-24
		UTC/San Jose Orbus 7		
1984-093	Orbus 7S	1984 Aug 30	HS-381 PKM	STS 41-D
1984-113	Orbus 7S	1984 Nov 8	HS-381 PKM	STS 51-A
1985-028	Orbus 7S	1985 Apr 12	HS-381 PKM	STS 51-D
1985-076	Orbus 7S	1985 Aug 27	HS-381 PKM	STS 51-I
1990-001	Orbus 7S	1990 Jan 1	HS-393 PKM	Titan CT1
1990-002	Orbus 7S	1990 Jan 9	HS-381 PKM	STS-32R
		Thiokol/Huntsville TX-8 Falcon?		
1958-F09	TX-8	1958 Aug 17	Able/Pioneer AKM	Thor 127
1958-007	TX-8	1958 Oct 11	Able/Pioneer AKM	Thor 130
1958-F19	TX-8	1958 Nov 8	Able/Pioneer AKM	Thor 129
		Thiokol/Elkton TE-M-236 SARV Retro (excluding USAF use)		
1966-114	Retro	1966 Dec 14	Biosatellite 1	Delta 43
1967-083	Retro	1967 Sep 7	Biosatellite 2	Delta 51
		Thiokol/Elkton Star 6 (not including classified uses)		
1988-009	TE-M-790 Star 6B	1988 Feb 8	Solid Motor Subsatellite	Delta 181
1988-009	TE-M-790 Star 6B	1988 Feb 8	Group 2 Subsatellite	Delta 181
1988-009	TE-M-790 Star 6B	1988 Feb 8	Group 2 Subsatellite	Delta 181
1988-009	TE-M-790 Star 6B	1988 Feb 8	Group 2 Subsatellite	Delta 181
-	TE-M-790 Star 6B	1990 Aug 25	SDIO BP-1 motor	Black Brant 10CM1
-	TE-M-790 Star 6B	1991 Apr 17	SDIO BP-2 motor	Black Brant 10CM1
1992-064	TE-M-790 Star 6B	1992 Oct 6	Freja AKM	CZ-2C
-	TE-M-790 Star 6B	1992 Oct 21	SDIO BP-3 motor	Aries
		Thiokol/Elkton Star 13 (excluding Gemini Retro)		
1963-004	TE-M-375 Star 13D	1963 Feb 14	Syncom 1 AKM	Delta 16
1965-008	TE-M-444 Star 13A	1965 Feb 11	LES 1 AKM	Titan 3A
1965-034	TE-M-444 Star 13A	1965 May 6	LES 2 AKM	Titan 3A
1966-058	TE-M-458 Star 13	1966 Jul 1	Explorer 33	Delta 39
1967-065	TE-M-516 Star 13A	1967 Jun 29	Aurora 1 AKM	Thor 171
1967-070	TE-M-458 Star 13	1967 Jul 19	Explorer 35	Delta 50
1968-F07	TE-M-516 Star 13A	1968 Aug 16	P68-1 AKM	Atlas Burner 2
1971-067	TE-M-516 Star 13A	1971 Aug 7	LCS 4 AKM	Atlas 76F
1975-114	TE-M-516 Star 13A	1975 Dec 4	S3-2 AKM	Titan 3D-13
1976-023	TE-M-516 Star 13A	1976 Mar 15	SR11A AKM	Titan 3C
1976-023	TE-M-516 Star 13A	1976 Mar 15	SR11B AKM	Titan 3C
1980-F02	TE-M-345-12 Star 13C	1980 May 23	AMSAT Phase 3A AKM	Ariane 1 L02
1984-088	TE-M-763 Star 13B	1984 Aug 16	CCE AKM	Delta 175
1988-008	TE-M-516 Star 13A	1988 Feb 8	SPX AKM	Delta 181
1992-064	TE-M-516 Star 13A	1992 Oct 6	Freja PKM	CZ-2C
1995-F05	TE-M-516 Star 13A	1995 Oct 23	Meteor 1 RV	Conestoga 1
		Thiokol/Elkton Star 17 and Star 17A		
1968-055	TE-M-479 Star 17	1968 Jul 4	RAE 1 AKM	Delta 57
1969-101	TE-M-521 Star 17A	1969 Nov 22	Skynet 1A AKM	Delta 74
1970-021	TE-M-521 Star 17A	1970 Mar 20	NATO IIA AKM	Delta 77

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1970-062	TE-M-521 Star 17A	1970 Aug 19	Skynet 1B AKM	Delta 80
1971-009	TE-M-521 Star 17A	1971 Feb 3	NATO IIB AKM	Delta 82
1972-073	TE-M-521 Star 17A	1972 Sep 23	IMP 7 AKM	Delta 90
1973-039	TE-M-479 Star 17	1973 Jun 10	RAE 2 AKM	Delta 95
1973-078	TE-M-521 Star 17A	1973 Oct 26	IMP 8 AKM	Delta 97
1974-085	TE-M-479 Star 17	1974 Oct 29	S3-1 AKM	Titan 3D
1975-F03	TE-M-521 Star 17A	1975 Apr 12	P72-2 AKM	Atlas 71F
1976-023	TE-M-521 Star 17A	1976 Mar 15	SR11A PKM	Titan 23C-12
1976-023	TE-M-521 Star 17A	1976 Mar 15	SR11B PKM	Titan 23C-12
1976-065	TE-M-521 Star 17A	1976 Jul 8	S3-3 AKM	Titan 3D-14
		Thiokol/Elkton Star 20		
1974-070	TE-M-640 Star 20	1974 Aug 30	Scout D-1 Stage 4	Scout S189C
1974-077	TE-M-640 Star 20	1974 Oct 15	Scout B-1 Stage 4	Scout S187C
1975-037	TE-M-640 Star 20	1975 May 7	Scout F-1 Stage 4	Scout S194C
1975-099	TE-M-640 Star 20	1975 Oct 12	Scout D-1 Stage 4	Scout S195C
1975-F06	TE-M-640 Star 20	1975 Dec 5	Scout F-1 Stage 4	Scout S196C
1976-038	TE-M-640 Star 20	1976 Apr 30	OIS	Atlas 59F
1976-047	TE-M-640 Star 20	1976 May 22	Scout B-1 Stage 4	Scout S179CR
-	TE-M-640 Star 20	1976 Jun 18	Scout D-1 Stage 4	Scout S193C
1976-089	TE-M-640 Star 20	1976 Sep 1	Scout D-1 Stage 4	Scout S197C
1977-106	TE-M-640 Star 20	1977 Oct 28	Scout D-1 Stage 4	Scout S200C
1977-112	TE-M-640 Star 20	1977 Dec 8	OIS	Atlas 50F
1978-041	TE-M-640 Star 20	1978 Apr 26	Scout D-1 Stage 4	Scout S201C
1979-013	TE-M-640 Star 20	1979 Feb 18	Scout D-1 Stage 4	Scout S202C
1979-047	TE-M-640 Star 20	1979 Jun 2	Scout D-1 Stage 4	Scout S198C
1980-019	TE-M-640 Star 20	1980 Mar 3	OIS	Atlas 67F
1980-F04	TE-M-640 Star 20	1980 Dec 9	OIS	Atlas 68E
1983-063	TE-M-640 Star 20	1983 Jun 27	Scout D-1 Stage 4	Scout S205C
1979-094	TE-M-640 Star 20	1979 Oct 30	Scout G-1 Stage 4	Scout S203C
1981-044	TE-M-640 Star 20	1981 May 15	Scout G-1 Stage 4	Scout S192C
1983-008	TE-M-640 Star 20?	1983 Feb 9	OIS	Atlas 6001H
1983-056	TE-M-640 Star 20?	1983 Jun 9	OIS	Atlas 6002H
-	TE-M-640-4 Star 20B	1984 Jan 21	ASAT Stage 2	ASAT 1
1984-012	TE-M-640 Star 20?	1984 Feb 5	OIS	Atlas 6003H
1984-110	TE-M-640 Star 20	1984 Oct 12	Scout G-1 Stage 4	Scout S208C
-	TE-M-640-4 Star 20B	1984 Nov 13	ASAT Stage 2	ASAT 2
1985-066	TE-M-640 Star 20	1985 Aug 3	Scout G-1 Stage 4	Scout S209C
-	TE-M-640-4 Star 20B	1985 Sep 13	ASAT Stage 2	ASAT 3
1985-114	TE-M-640 Star 20	1985 Dec 13	Scout G-1 Stage 4	Scout S207C
1986-014	TE-M-640 Star 20?	1986 Feb 9	OIS	Atlas 6004H
-	TE-M-640-4 Star 20B	1986 Aug 22	ASAT Stage 2	ASAT 4
-	TE-M-640-4 Star 20B	1986 Sep 30	ASAT Stage 2	ASAT 5
1986-088	TE-M-640 Star 20	1986 Nov 14	Scout G-1 Stage 4	Scout S199C
1987-043	TE-M-640 Star 20?	1987 May 15	OIS	Atlas 6005H
1987-080	TE-M-640 Star 20	1987 Sep 16	Scout G-1 Stage 4	Scout S204C
1988-026	TE-M-640 Star 20	1988 Mar 25	Scout G-1 Stage 4	Scout S206C
1988-033	TE-M-640 Star 20	1988 Apr 26	Scout G-1 Stage 4	Scout S211C

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1988-052	TE-M-640 Star 20	1988 Jun 16	Scout G-1 Stage 4	Scout S213C
1988-074	TE-M-640 Star 20	1988 Aug 25	Scout G-1 Stage 4	Scout S214C
1990-031	TE-M-640 Star 20	1990 Apr 11	Stacksat OIS	Atlas 28E
1990-043	TE-M-640 Star 20	1990 May 9	Scout G-1 Stage 4	Scout S212C
1991-045	TE-M-640 Star 20	1991 Jun 29	Scout G-1 Stage 4	Scout S216C
1992-038	TE-M-640 Star 20	1992 Jul 3	Scout G-1 Stage 4	Scout S215C
1992-078	TE-M-640 Star 20	1992 Nov 21	Scout G-1 Stage 4	Scout S210C
1993-041	TE-M-640 Star 20	1993 Jun 25	Scout G-1 Stage 4	Scout S217C
1994-028	TE-M-640 Star 20	1994 May 9	Scout G-1 Stage 4	Scout S218C
		Thiokol/Elkton Star 24		
1974-002	TE-M-604 Star 24	1974 Jan 19	Skynet IIA AKM	Delta 100
1974-054	TE-M-604 Star 24	1974 Jul 14	NTS 1 AKM	Atlas 69F
1974-094	TE-M-604 Star 24	1974 Nov 23	Skynet IIB AKM	Delta 105
1976-039	TE-M-604 Star 24	1976 May 4	Lageos AKM	Delta 123
1978-012	TE-M-604 Star 24	1978 Jan 26	IUE AKM	Delta 138
1978-051	TE-M-604 Star 24	1978 May 20	PVO OIM	AC-50
		Thiokol/Elkton Star 26		
1971-087	TE-M-442-1 Star 26B	1971 Oct 14	Burner IIA Stage 2	Thor 159
1972-018	TE-M-442-1 Star 26B	1972 Mar 24	Burner IIA Stage 2	Thor 153
1972-076	TE-M-442-1 Star 26B	1972 Oct 2	Burner IIA Stage 2	Atlas 102F
-	TE-M-442 Star 26	1972 Oct 15	Strypi 4	Strypi 4
1972-089	TE-M-442-1 Star 26B	1972 Nov 9	Burner IIA Stage 2	Thor 294
1973-054	TE-M-442-1 Star 26B	1973 Aug 17	Burner IIA Stage 2	Thor 291
1974-015	TE-M-442-1 Star 26B	1974 Mar 16	Burner IIA Stage 2	Thor 207
1974-063	TE-M-442-1 Star 26B	1974 Aug 9	Burner IIA Stage 2	Thor 275
1975-043	TE-M-442-1 Star 26B	1975 May 24	Burner IIA Stage 2	Thor 197
1976-016	TE-M-442-1 Star 26B	1976 Feb 19	Burner IIA Stage 2	Thor 182
-	TE-M-442 Star 26	1970s	Sandia Strypi 4	Strypi 4
-	TE-M-442 Star 26	1970s	Sandia Halberd	Strypi 4
-	TE-M-442 Star 26	1970s	Sandia Bart	Strypi 4
-	TE-M-442 Star 26	1970s	Sandia Swerve II	Strypi 4
-	TE-M-442 Star 26	1970s	Sandia MTV-1	Strypi 4
-	TE-M-442 Star 26	1970s	Sandia MTV-1	Strypi 4
-	TE-M-442-2 Star 26	1970s	Sandia Bolero	Strypi 4
-	TE-M-442-2 Star 26	1970s	Sandia Swerve-I	Strypi 4
-	TE-M-442-2 Star 26	1970s	Sandia Swerve-II	Strypi 4
-	TE-M-442-2 Star 26	1980 Feb 5	DOT	Castor/DOT 2
-	TE-M-442-2 Star 26	1980 Sep 17	DOT	Castor/DOT 3
-	TE-M-442-2 Star 26	1981 Jun 12	DOT	Castor/DOT 4
1986-19	TE-M-442-3 Star 26C	1986 Feb 22	Viking AKM	Ariane V16
		Thiokol/Elkton Star 27		
1976-004	TE-M-616-1 Star 27	1976 Jan 17	CTS AKM	Delta 119
1977-053	TE-M-616-9 Star 27	1977 Jun 23	NTS 2 AKM	Atlas 65F
1977-065	TE-M-616-5 Star 27	1977 Jul 14	HS-335 AKM/GMS 1	Delta 132
1978-020	TE-M-616-8 Star 27	1978 Feb 22	GPS AKM/Navstar 1	Atlas 64F
1978-039	TE-M-616-4 Star 27	1978 Apr 7	BSE AKM/BSE	Delta 140
1978-047	TE-M-616-8 Star 27	1978 May 13	GPS AKM/Navstar 2	Atlas 49F

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1978-093	TE-M-616-8 Star 27	1978 Oct 7	GPS AKM/Navstar 3	Atlas 29F
1978-112	TE-M-616-8 Star 27	1978 Dec 11	GPS AKM/Navstar 4	Atlas 39F
1979-017	TE-M-616-11 Star 27	1979 Feb 24	P78-1 OIM	Atlas 27F
1980-011	TE-M-616-8 Star 27	1980 Feb 9	GPS AKM/Navstar 5	Atlas 35F
1980-032	TE-M-616-8 Star 27	1980 Apr 26	GPS AKM/Navstar 6	Atlas 34F
1980-074	TE-M-616-5 Star 27	1980 Sep 9	HS-371 AKM/GOES D	Delta 152
1981-049	TE-M-616-5 Star 27	1981 May 22	HS-371 AKM/GOES E	Delta 154
1981-076	TE-M-616-5 Star 27	1981 Aug 10	HS-378 AKM/GMS 2	N-2-8
1981-F03	TE-M-616-8 Star 27	1981 Dec 18	GPS AKM/Navstar 7	Atlas 76E
1983-006	TE-M-616-12 Star 27B	1983 Feb 4	CS-2 AKM/CS-2A	N-2-10
1983-041	TE-M-616-5 Star 27	1983 Apr 28	HS-371 AKM/GOES F	Delta 168
1983-072	TE-M-616-8 Star 27	1983 Jul 14	GPS AKM/Navstar 8	Atlas 75E
1983-081	TE-M-616-12 Star 27B	1983 Aug 5	CS-2 AKM/CS-2B	N-2-11
1984-005	TE-M-616-4 Star 27	1984 Jan 23	BS-2 AKM/BS-2A	N-2-12
1984-059	TE-M-616-8 Star 27	1984 Jun 13	GPS AKM/Navstar 9	Atlas 42E
1984-080	TE-M-616-5 Star 27	1984 Aug 2	HS-378 AKM/GMS 3	N-2-13
1984-097	TE-M-616-8 Star 27	1984 Sep 8	GPS AKM/Navstar 10	Atlas 14E
1984-115	TE-M-616-12 Star 27B	1984 Nov 14	Ford NATO 3 AKM/NATO 3D	Delta 177
1985-021	TE-M-616-13 Star 27B	1985 Mar 13	Geosat OIS	Atlas 41E
1985-093	TE-M-616-8 Star 27	1985 Oct 9	GPS AKM/Navstar 11	Atlas 55E
1986-016	TE-M-616-4 Star 27	1986 Feb 12	BS-2 AKM/BS-2B	N-2-14
1986-F04	TE-M-616-5 Star 27	1986 May 3	HS-371 AKM/GOES G	Delta 178
1987-022	TE-M-616-5 Star 27	1987 Feb 26	HS-371 AKM/GOES H	Delta 179
-	TE-M-616 Star 27	1988 Feb 8	Strypi Stage 3	SDIO Delta
1989-070	TE-M-616-5 Star 27	1989 Sep 5	HS-378 AKM/GMS 4	H-1-20
-	TE-M-616 Star 27	1991 Feb 18	Strypi Stage 3	SDIO UVSP
1995-011	TE-M-616-5 Star 27	1995 Mar 17	HS-378 AKM/GMS 5	H-II-3F
		Thiokol/Elkton Star 30		
1980-091	TE-M-700-5 Star 30B	1980 Nov 15	HS-376 AKM/SBS 1	Delta 153
1981-096	TE-M-700-5 Star 30B	1981 Sep 24	HS-376 AKM/SBS 2	Delta 156
1981-114	TE-M-700-8 Star 30B	1981 Nov 20	Satcom AKM/Satcom 3R	Delta 158
1981-122	TE-M-700-9 Star 30B	1981 Dec 20	ECS AKM/Marecs A	Ariane 1 LO4
1982-004	TE-M-700-8 Star 30B	1982 Jan 16	Satcom AKM/Satcom 4	Delta 159
1982-014	TE-M-700-5 Star 30B	1982 Feb 26	HS-376 AKM/Westar 4	Delta 160
1982-058	TE-M-700-5 Star 30B	1982 Jun 9	HS-376 AKM/Westar 5	Delta 162
1982-082	TE-M-700-5 Star 30B	1982 Aug 26	HS-376 AKM/Anik D-1	Delta 164
1982-F06	TE-M-700-9 Star 30B	1982 Sep 9	ECS AKM/Marecs B	Ariane 1 L5
1982-105	TE-M-700-8 Star 30B	1982 Oct 28	Satcom AKM/Aurora 1	Delta 165
1982-110	TE-M-700-5 Star 30B	1982 Nov 11	HS-376 AKM/SBS 3	STS-5
1982-110	TE-M-700-5 Star 30B	1982 Nov 11	HS-376 AKM/Anik C3	STS-5
1983-030	TE-M-700-8 Star 30B	1983 Apr 11	Satcom AKM/Satcom 1R	Delta 167
1983-059	TE-M-700-5 Star 30B	1983 Jun 18	HS-376 AKM/Anik C2	STS-7
1983-059	TE-M-700-5 Star 30B	1983 Jun 18	HS-376 AKM/Palapa B1	STS-7
1983-065	TE-M-700-5 Star 30B	1983 Jun 28	HS-376 AKM/Galaxy 1	Delta 170
1983-077	TE-M-700-5 Star 30B	1983 Jul 28	HS-376 AKM/Telstar 301	Delta 171
1983-094	TE-M-700-8 Star 30B	1983 Sep 8	Satcom AKM/Satcom 2R	Delta 172
1983-098	TE-M-700-5 Star 30B	1983 Sep 22	HS-376 AKM/Galaxy 2	Delta 173
1984-011	TE-M-700-5 Star 30B	1984 Feb 3	HS-376 AKM/Westar 6	STS 41-B

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1984-011	TE-M-700-5 Star 30B	1984 Feb 3	HS-376 AKM/Palapa B2	STS 41-B
1984-049	TE-M-700-8 Star 30B	1984 May 23	AS3000 AKM/Spacenet F1	Ariane 1 V9
1984-093	TE-M-700-5 Star 30B	1984 Aug 30	HS-376 AKM/SBS 4	STS 41-D
1984-093	TE-M-700-5 Star 30B	1984 Aug 30	HS-376 AKM/Telstar 303	STS 41-D
1984-101	TE-M-700-5 Star 30B	1984 Sep 21	HS-376 AKM/Galaxy 3	Delta 176
1984-113	TE-M-700-5 Star 30B	1984 Nov 8	HS-376 AKM/Anik D2	STS 51-A
1984-114	TE-M-700-17 Star 30BP	1984 Nov 10	AS3000 AKM/Spacenet F2	Ariane 3 V11
1985-015	TE-M-700-5 Star 30B	1985 Feb 8	HS-376 AKM/Brasilsat 1	Ariane 3 V12
1985-028	TE-M-700-5 Star 30B	1985 Apr 12	HS-376 AKM/Anik C1	STS 51-D
1985-035	TE-M-700-17 Star 30BP	1985 May 8	AS 3000 AKM/GSTAR 1A	Ariane 3 V13
1985-048	TE-M-700-17 Star 30BP	1985 Jun 17	HS-376 AKM/Morelos 1	STS 51-G
1985-048	TE-M-700-17 Star 30BP	1985 Jun 17	HS-376 AKM/Telstar 304	STS 51-G
1985-076	TE-M-700-17 Star 30BP	1985 Aug 27	HS-376 AKM/Aussat K1	STS 51-I
1985-076	TE-M-700-18 Star 30C	1985 Aug 27	AS 3000 AKM/ASC 1	STS 51-I
1985-F03	TE-M-700-17 Star 30BP	1985 Sep 12	AS 3000 AKM/Spacenet F3	Ariane 3 V15
1985-109	TE-M-700-17 Star 30BP	1985 Nov 27	HS-376 AKM/Morelos 2	STS 61-B
1985-109	TE-M-700-17 Star 30BP	1985 Nov 27	HS-376 AKM/Aussat K2	STS 61-B
1986-026	TE-M-700-17 Star 30BP	1986 Mar 28	AS 3000 AKM/GSTAR 2	Ariane 3 V17
1986-026	TE-M-700-17 Star 30BP	1986 Mar 28	HS-376 AKM/Brasilsat 2	Ariane 3 V17
1987-029	TE-M-700-17 Star 30BP	1987 Mar 20	HS-376 AKM/Palapa B2P	Delta 182
1987-078	TE-M-700-17 Star 30BP	1987 Sep 16	HS-376 AKM/Aussat K3	Ariane 3 V19
1988-012	TE-M-700-5 Star 30B	1988 Feb 19	CS-3 AKM/CS-3A	H-2-18
1988-018	TE-M-700-18 Star 30C	1988 Mar 11	AS 3000 AKM/Spacenet F3R	Ariane 3 V21
1988-051	TE-M-700-18 Star 30C	1988 Jun 15	AS 3000 AKM/PAS 1	Ariane 4 V22
1988-081	TE-M-700-17 Star 30BP	1988 Sep 8	AS 3000 AKM/GSTAR 3	Ariane 3 V25
1988-081	TE-M-700-17 Star 30BP	1988 Sep 8	HS-376 AKM/SBS 5	Ariane 3 V25
1988-086	TE-M-700-5 Star 30B	1988 Sep 16	CS-3 AKM/CS-3B	H-2-19
1988-109	TE-M-700-19 Star 30E	1988 Dec 11	ECS AKM/Skynet 4B	Ariane 4 V27
1989-067	TE-M-700-17 Star 30BP	1989 Aug 27	HS-376 AKM/Marcopolo 1	Delta 187
1990-034	TE-M-700-17 Star 30BP	1990 Apr 13	HS-376 AKM/Palapa B2R	Delta 194
1990-001	TE-M-700-19 Star 30E	1990 Jan 1	ECS AKM/Skynet 4A	Titan CT1
1990-F01	TE-M-700-18 Star 30C	1990 Feb 22	AS 3000 AKM/BS-2X	Ariane 4 V36
1990-030	TE-M-700-18 Star 30C	1990 Apr 7	HS-376 AKM/Asiasat 1	CZ-3
1990-074	TE-M-700-17 Star 30BP	1990 Aug 18	HS-376 AKM/Marcopolo 2	Delta 198
1990-079	TE-M-700-19 Star 30E	1990 Aug 30	ECS AKM/Skynet 4C	Ariane 4 V38
1990-091	TE-M-700-17 Star 30BP	1990 Oct 12	HS-376 AKM/Galaxy 6	Ariane 4 V39
1990-100	TE-M-700-17 Star 30BP	1990 Nov 20	AS 3000 AKM/Satcom C1	Ariane 4 V40
1990-100	TE-M-700-18 Star 30C	1990 Nov 20	AS 3000 AKM/GSTAR 4	Ariane 4 V40
1991-001	TE-M-700-19 Star 30E	1991 Jan 8	ECS AKM/NATO 4A	Delta 202
1991-028	TE-M-700-18 Star 30C	1991 Apr 13	AS 3000 AKM/Spacenet 4	Delta 204
1991-F01	TE-M-700-18 Star 30C	1991 Apr 18	AS 3000 AKM/BS-3H	AC-70
1991-037	TE-M-700-18 Star 30C	1991 May 29	AS 3000 AKM/Aurora 2	Delta 205
1992-013	TE-M-700-18 Star 30C	1992 Mar 14	HS-376 AKM/Galaxy 5	AC-72
1992-027	TE-M-700-17 Star 30BP	1992 May 14	HS-376 AKM/Palapa B4	Delta 209
1992-F02	TE-M-700-18 Star 30C	1992 Aug 22	HS-376 AKM/Galaxy 1R	AC-71
1992-057	TE-M-700-18 Star 30C	1992 Aug 31	AS 3000 AKM/Satcom C4	Delta 213
1992-060	TE-M-700-18 Star 30C	1992 Sep 10	AS 3000 AKM/Satcom C3	Ariane 4 V53
1993-076	TE-M-700-19 Star 30E	1993 Dec 8	ECS AKM/NATO 4B	Delta 224
1993-078	TE-M-700-17 Star 30BP	1993 Dec 18	HS-376 AKM/Thaicom 1	Ariane 4 V62

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1994-013	TE-M-700-18 Star 30C	1994 Feb 19	HS-376 AKM/Galaxy 1R	Delta 225
1994-040	TE-M-700-17 Star 30BP	1994 Jul 8	AS 3000 AKM/BS-3N	Ariane 4 V65
1994-043	TE-M-700-18 Star 30C	1994 Jul 21	HS-376 AKM/Apstar 1	CZ3-9
1994-065	TE-M-700-19 Star 30E	1994 Oct 8	HS-376 AKM/Thaicom 2	Ariane 4 V68
1995-041	TE-M-700-19 Star 30E	1995 Aug 5	AS 3000 AKM/Koreasat 1	Delta 228
1996-002	TE-M-700 Star 30	1996 Jan 12	HS-376 AKM/Measat 1	Ariane 4 V82
1996-003	TE-M-700-19 Star 30E	1996 Jan 14	AS 3000 AKM/Koreasat 2	Delta 231
1996-039	TE-M-700 Star 30	1996 Jul 3	HS-376 AKM/Apstar 1A	CZ3
1996-048	TE-M-700 Star 30	1996 Aug 18	HS-376 AKM/Zhongxing 7	CZ3
1996-063	TE-M-700 Star 30	1996 Nov 13	HS-376 AKM/Measat 2	Ariane 4 V92
1997-016	TE-M-700 Star 30	1997 Apr 16	HS-376 AKM/BSAT 1a	Ariane 4
1997-025	TE-M-700 Star 30	1997 May 21	HS-376 AKM/Thor II	Delta
Thiokol/Elkton Thiokol Star 31 Antares 3				
1979-094	Antares 3	1979 Oct 30	Scout G-1 Stage 3	Scout S203C
1981-044	Antares 3	1981 May 15	Scout G-1 Stage 3	Scout S192C
1984-110	Antares 3	1984 Oct 12	Scout G-1 Stage 3	Scout S208C
1985-066	Antares 3	1985 Aug 3	Scout G-1 Stage 3	Scout S209C
1985-114	Antares 3	1985 Dec 13	Scout G-1 Stage 3	Scout S207C
1986-088	Antares 3	1986 Nov 14	Scout G-1 Stage 3	Scout S199C
1987-080	Antares 3	1987 Sep 16	Scout G-1 Stage 3	Scout S204C
1988-026	Antares 3	1988 Mar 25	Scout G-1 Stage 3	Scout S206C
1988-033	Antares 3	1988 Apr 26	Scout G-1 Stage 3	Scout S211C
1988-052	Antares 3	1988 Jun 16	Scout G-1 Stage 3	Scout S213C
1988-074	Antares 3	1988 Aug 25	Scout G-1 Stage 3	Scout S214C
1990-043	Antares 3	1990 May 9	Scout G-1 Stage 3	Scout S212C
1991-045	Antares 3	1991 Jun 29	Scout G-1 Stage 3	Scout S216C
1992-038	Antares 3	1992 Jul 3	Scout G-1 Stage 3	Scout S215C
1992-078	Antares 3	1992 Nov 21	Scout G-1 Stage 3	Scout S210C
1993-041	Antares 3	1993 Jun 25	Scout G-1 Stage 3	Scout S217C
1994-028	Antares 3	1994 May 9	Scout G-1 Stage 3	Scout S218C
Thiokol/Elkton Star 37				
1966-045	TE-M-364-1 A21-26	1966 May 30	Surveyor 1 Retro	AC-10
1966-082	TE-M-364-2 Star 37B	1966 Sep 16	Burner II	Thor 167
1966-084	TE-M-364-1 A21-27	1966 Sep 20	Surveyor 2 Retro	AC-7
1967-010	TE-M-364-2 Star 37B	1967 Feb 8	Burner II	Thor 169
1967-035	TE-M-364-5 A22-8	1967 Apr 17	Surveyor 3 Retro	AC-12
1967-065	TE-M-364-2 Star 37B	1967 Jun 29	Burner II	Thor 171
1967-068	TE-M-364-5 A22-9	1967 Jul 14	Surveyor 4 Retro	AC-11
1967-080	TE-M-364-2 Star 37B	1967 Aug 23	Burner II	Thor 266
1967-084	TE-M-364-1 A21-28	1967 Sep 8	Surveyor 5 Retro	AC-13
1967-096	TE-M-364-2 Star 37B	1967 Oct 11	Burner II	Thor 268
1967-112	TE-M-364-1 A21-29	1967 Nov 7	Surveyor 6 Retro	AC-14
1968-001	TE-M-364-5 A22-14	1968 Jan 7	Surveyor 7 Retro	AC-15
1968-042	TE-M-364-2 Star 37B	1968 May 23	Burner II	Thor 277
1968-055	TE-M-364-3 Star 37D	1968 Jul 4	Delta J Stage 3	Delta 57
1968-F07	TE-M-364-2 Star 37B	1968 Aug 16	Burner II No. 14	Atlas Burner 2
1968-F08	TE-M-364-3 Star 37D	1968 Sep 18	Delta J Stage 3	Delta 59
1968-092	TE-M-364-2 Star 37B	1968 Oct 23	Burner II	Thor 173
1968-116	TE-M-364-3 Star 37D	1968 Dec 19	Delta J Stage 3	Delta 63

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1969-011	TE-M-364-3 Star 37D	1969 Feb 6	Delta J Stage 3	Delta 66
1969-045	TE-M-364-3 Star 37D	1969 May 22	Delta J Stage 3	Delta 68
1969-062	TE-M-364-2 Star 37B	1969 Jul 23	Burner II	Thor 279
1969-064	TE-M-364-3 Star 37D	1969 Jul 26	Delta J Stage 3	Delta 71
1969-101	TE-M-364-3 Star 37D	1969 Nov 22	Delta J Stage 3	Delta 74
1970-003	TE-M-364-3 Star 37D	1970 Jan 15	Delta M Stage 3	Delta 75
1970-012	TE-M-364-2 Star 37B	1970 Feb 11	Burner II	Thor 287
1970-021	TE-M-364-3 Star 37D	1970 Mar 20	Delta M Stage 3	Delta 77
1970-032	TE-M-364-3 Star 37D	1970 Apr 23	Delta M Stage 3	Delta 78
1970-055	TE-M-364-3 Star 37D	1970 Jul 23	Delta M Stage 3	Delta 79
1970-062	TE-M-364-3 Star 37D	1970 Aug 19	Delta M Stage 3	Delta 80
1970-070	TE-M-364-2 Star 37B	1970 Sep 3	Burner II	Thor 288
1971-009	TE-M-364-3 Star 37D	1971 Feb 3	Delta M Stage 3	Delta 82
1971-012	TE-M-364-2 Star 37B	1971 Feb 17	Burner II	Thor 249
1971-019	TE-M-364-3 Star 37D	1971 Mar 13	Delta M Stage 3	Delta 83
1971-054	TE-M-364-2 Star 37B	1971 Jun 8	Burner II	Thor 210
1971-087	TE-M-364-2 Star 37B	1971 Oct 14	Burner IIA	Thor 159
1972-012	TE-M-364-4 Star 37E	1972 Mar 3	Star 37E	AC-27
1972-018	TE-M-364-2 Star 37B	1972 Mar 24	Burner IIA	Thor 153
1972-073	TE-M-364-18 Star 37C	1972 Sep 23	Delta 1604 Stage 3	Delta 90
1972-076	TE-M-364-2 Star 37B	1972 Oct 2	Burner IIA	Atlas 102F
1972-089	TE-M-364-2 Star 37B	1972 Nov 9	Burner IIA	Thor 294
1972-090	TE-M-364-18 Star 37C	1972 Nov 10	Delta 1914 Stage 3	Delta 92
1973-019	TE-M-364-4 Star 37E	1973 Apr 6	Star 37E	AC-30
1973-023	TE-M-364-18 Star 37C	1973 Apr 20	Delta 1914 Stage 3	Delta 94
1973-039	TE-M-364-3 Star 37D	1973 Jun 10	Delta 1913 Stage 3	Delta 95
1973-054	TE-M-364-2 Star 37B	1973 Aug 17	Burner IIA	Thor 291
1973-078	TE-M-364-18 Star 37C	1973 Oct 26	Delta 1604 Stage 3	Delta 97
1974-002	TE-M-364-3 Star 37D	1974 Jan 19	Delta 2313 Stage 3	Delta 100
1974-015	TE-M-364-2 Star 37B	1974 Mar 16	Burner IIA	Thor 207
1974-022	TE-M-364-18 Star 37C	1974 Apr 13	Delta 2914 Stage 3	Delta 101
1974-033	TE-M-364-4 Star 37E	1974 May 17	Delta 2914 Stage 3	Delta 102
1974-054	TE-M-364-4 Star 37E	1974 Jul 14	PTS	Atlas 69F
1974-063	TE-M-364-2 Star 37B	1974 Aug 9	Burner IIA	Thor 275
1974-075	TE-M-364-18 Star 37C	1974 Oct 10	Delta 2914 Stage 3	Delta 103
1974-094	TE-M-364-3 Star 37D	1974 Nov 23	Delta 2313 Stage 3	Delta 105
1974-097	TE-M-364-4 Star 37E	1974 Dec 10	Star 37E	TC-2
1974-101	TE-M-364-4 Star 37E	1974 Dec 19	Delta 2914 Stage 3	D106
1975-011	TE-M-364-4 Star 37E	1975 Feb 6	Delta 2914 Stage 3	D108
1975-038	TE-M-364-18 Star 37C	1975 May 7	Delta 2914 Stage 3	D110
1975-043	TE-M-364-2 Star 37B	1975 May 24	Burner IIA	Thor 197
1975-072	TE-M-364-3 Star 37D	1975 Aug 9	Delta 2913 Stage 3	D113
1975-077	TE-M-364-4 Star 37E	1975 Aug 27	Delta 2914 Stage 3	D114
1975-082	TE-M-364-14 Star 37N	1975 Sep 9	N-1 Stage 3	N-1-1
1975-100	TE-M-364-4 Star 37E	1975 Oct 16	Delta 2914 Stage 3	D116
1975-117	TE-M-364-4 Star 37E	1975 Dec 13	Delta 3914 Stage 3	D118
1976-003	TE-M-364-4 Star 37E	1976 Jan 15	Star 37E	TC-5
1976-004	TE-M-364-4 Star 37E	1976 Jan 17	Delta 2914 Stage 3	D119
1976-016	TE-M-364-2 Star 37B	1976 Feb 19	Burner IIA	Thor 182
1976-017	TE-M-364-4 Star 37E	1976 Feb 19	Delta 2914 Stage 3	D120

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1976-019	TE-M-364-14 Star 37N	1976 Feb 29	N-1 Stage 3	N-1(2F)
1976-029	TE-M-364-4 Star 37E	1976 Mar 26	Delta 3914 Stage 3	D121
1976-035	TE-M-364-4 Star 37E	1976 Apr 22	Delta 2914 Stage 3	D122
1976-039	TE-M-364-3 Star 37D	1976 May 4	Delta 2913 Stage 3	D123
1976-053	TE-M-364-4 Star 37E	1976 Jun 10	Delta 2914 Stage 3	D124
1976-066	TE-M-364-18 Star 37C	1976 Jul 8	Delta 2914 Stage 3	D125
1976-091	TE-M-714-4 Star 37XE	1976 Sep 11	DMSP OIS	Thor 172
1976-091	TE-M-364-15 Star 37S	1976 Sep 11	Tiros-N AKM/DMSP S-1	Thor 172
1976-101	TE-M-364-4 Star 37E	1976 Oct 14	Delta 2914 Stage 3	D127
1977-005	TE-M-364-4 Star 37E	1977 Jan 28	Delta 2914 Stage 3	D128
1977-014	TE-M-364-14 Star 37N	1977 Feb 23	N-1 Stage 3	N-1-3
1977-018	TE-M-364-4 Star 37E	1977 Mar 10	Delta 2914 Stage 3	D129
1977-029	TE-M-364-4 Star 37E	1977 Apr 20	Delta 2914 Stage 3	D130
1977-044	TE-M-714-4 Star 37XE	1977 Jun 5	DMSP OIS	Thor 183
1977-044	TE-M-364-15 Star 37S	1977 Jun 5	Tiros-N AKM/DMSP S-2	Thor 183
1977-048	TE-M-364-4 Star 37E	1977 Jun 16	Delta 2914 Stage 3	D131
1977-053	TE-M-364-4 Star 37E	1977 Jun 23	SVS Stage 1	Atlas 65F
1977-053	TE-M-364-4 Star 37E	1977 Jun 23	SVS Stage 2	Atlas 65F
1977-065	TE-M-364-4 Star 37E	1977 Jul 14	Delta 2914 Stage 3	D132
1977-076	TE-M-364-4 Star 37E	1977 Aug 20	Star 37E	TC-7
1977-080	TE-M-364-3 Star 37D	1977 Aug 25	Delta 2313 Stage 3	D133
1977-084	TE-M-364-4 Star 37E	1977 Sep 5	Star 37E	TC-6
1977-F04	TE-M-364-4 Star 37E	1977 Sep 13	Delta 3914 Stage 3	D134
1977-102	TE-M-364-4 Star 37E	1977 Oct 22	Delta 2914 Stage 3	D135
1977-108	TE-M-364-4 Star 37E	1977 Nov 23	Delta 2914 Stage 3	D136
1977-118	TE-M-364-4 Star 37E	1977 Dec 15	Delta 2914 Stage 3	D137
1978-012	TE-M-364-4 Star 37E	1978 Jan 26	Delta 2914 Stage 3	D138
1978-016	TE-M-364-19 Star 37F	1978 Feb 9	FSC AKM/FLTSAT F1	AC-44
1978-018	TE-M-364-14 Star 37N	1978 Feb 16	N-1 Stage 3	N-1 (4F)
1978-020	TE-M-364-4 Star 37E	1978 Feb 22	SVS Stage 1	Atlas 64F
1978-020	TE-M-364-4 Star 37E	1978 Feb 22	SVS Stage 2	Atlas 64F
1978-039	TE-M-364-4 Star 37E	1978 Apr 7	Delta 2914 Stage 3	D140
1978-042	TE-M-714-4 Star 37XE	1978 May 1	DMSP OIS	Thor 143
1978-042	TE-M-364-15 Star 37S	1978 May 1	Tiros-N AKM/DMSP S-3	Thor 143
1978-044	TE-M-364-4 Star 37E	1978 May 11	Delta 3914 Stage 3	D141
1978-047	TE-M-364-4 Star 37E	1978 May 13	SVS Stage 1	Atlas 49F
1978-047	TE-M-364-4 Star 37E	1978 May 13	SVS Stage 2	Atlas 49F
1978-062	TE-M-364-4 Star 37E	1978 Jun 16	Delta 2914 Stage 3	D142
1978-071	TE-M-364-4 Star 37E	1978 Jul 14	Delta 2914 Stage 3	D143
1978-079	TE-M-364-4 Star 37E	1978 Aug 12	Delta 2914 Stage 3	D144
1978-093	TE-M-364-4 Star 37E	1978 Oct 7	SVS Stage 1	Atlas 47F
1978-093	TE-M-364-4 Star 37E	1978 Oct 7	SVS Stage 2	Atlas 47F
1978-096	TE-M-364-15 Star 37S	1978 Oct 13	Tiros-N AKM/Tiros N	Atlas 29F
1978-106	TE-M-364-4 Star 37E	1978 Nov 19	Delta 2914 Stage 3	D146
1978-112	TE-M-364-4 Star 37E	1978 Dec 11	SVS Stage 1	Atlas 39F
1978-112	TE-M-364-4 Star 37E	1978 Dec 11	SVS Stage 2	Atlas 39F
1978-116	TE-M-364-4 Star 37E	1978 Dec 16	Delta 3914 Stage 3	D147
1979-007	TE-M-364-4 Star 37E	1979 Jan 30	Delta 2914 Stage 3	D148
1979-009	TE-M-364-14 Star 37N	1979 Feb 6	N-1 Stage 3	N-1-5
1979-038	TE-M-364-19 Star 37F	1979 May 4	FSC AKM/FLTSAT F2	AC-47

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1979-050	TE-M-714-4 Star 37XE	1979 Jun 6	DMSP OIS	Thor 264
1979-050	TE-M-364-15 Star 37S	1979 Jun 6	Tiros-N AKM/DMSP S-5	Thor 264
1979-057	TE-M-364-15 Star 37S	1979 Jun 27	Tiros-N AKM/NOAA A	Atlas 25F
1979-072	TE-M-364-4 Star 37E	1979 Aug 10	Delta 2914 Stage 3	D149
1979-101	TE-M-364-4 Star 37E	1979 Dec 7	Delta 3914 Stage 3	D150
1980-004	TE-M-364-19 Star 37F	1980 Jan 18	FSC AKM/FLTSAT F3	AC-49
1980-011	TE-M-364-4 Star 37E	1980 Feb 9	SVS Stage 1	Atlas 35F
1980-011	TE-M-364-4 Star 37E	1980 Feb 9	SVS Stage 2	Atlas 35F
1980-018	TE-M-364-14 Star 37N	1980 Feb 22	N-1 Stage 3	N-1-6
1980-032	TE-M-364-4 Star 37E	1980 Apr 26	SVS Stage 1	Atlas 34F
1980-032	TE-M-364-4 Star 37E	1980 Apr 26	SVS Stage 2	Atlas 34F
1980-043	TE-M-364-15 Star 37S	1980 May 29	Tiros-N AKM/NOAA B	Atlas 19F
1980-F03	TE-M-714-4 Star 37XE	1980 Jul 14	DMSP OIS	Thor 304
1980-F03	TE-M-364-15 Star 37S	1980 Jul 14	Tiros-N AKM/DMSP S-4	Thor 304
1980-074	TE-M-364-4 Star 37E	1980 Sep 9	Delta 3914 Stage 3	D152
1980-087	TE-M-364-19 Star 37F	1980 Oct 31	FSC AKM/FLTSAT F4	AC-57
1980-098	TE-M-364-19 Star 37F	1980 Dec 6	FS-1300 AKM/Intelsat 502	AC-54
1981-012	TE-M-364-4 Star 37E	1981 Feb 11	N-2 Stage 3	N-2-7
1981-049	TE-M-364-4 Star 37E	1981 May 22	Delta 3914 Stage 3	D154
1981-050	TE-M-364-19 Star 37F	1981 May 23	FS-1300 AKM/Intelsat 501	AC-56
1981-059	TE-M-364-15 Star 37S	1981 Jun 23	Tiros-N AKM/NOAA C	Atlas 87F
1981-070	TE-M-364-14 Star 37N	1981 Aug 3	Delta 3913	D155
1981-073	TE-M-364-19 Star 37F	1981 Aug 6	FSC AKM/FLTSAT F5	AC-59
1981-076	TE-M-364-4 Star 37E	1981 Aug 10	N-2 Stage 3	N-2-8
1981-119	TE-M-364-19 Star 37F	1981 Dec 15	FS-1300 AKM/Intelsat 503	AC-55
1981-F03	TE-M-364-4 Star 37E	1981 Dec 18	SVS Stage 1	Atlas 76E
1981-F03	TE-M-364-4 Star 37E	1981 Dec 18	SVS Stage 2	Atlas 76E
1982-017	TE-M-364-19 Star 37F	1982 Mar 5	FS-1300 AKM/Intelsat 504	AC-58
1982-087	TE-M-364-14 Star 37N	1982 Sep 3	N-1 Stage 3	N-1-9
1982-097	TE-M-364-19 Star 37F	1982 Sep 28	FS-1300 AKM/Intelsat 505	AC-60
1982-105	TE-M-364-4 Star 37E	1982 Oct 28	Delta 3924 Stage 3	D165
1982-118	TE-M-364-15 Star 37S	1982 Dec 21	Tiros-N AKM/DMSP S-6	Atlas 60E
1983-006	TE-M-364-4 Star 37E	1983 Feb 4	N-2 Stage 3	N-2-10
1983-022	TE-M-364-15 Star 37S	1983 Mar 28	Tiros-N AKM/NOAA E	Atlas 73E
1983-030	TE-M-364-4 Star 37E	1983 Apr 11	Delta 3924 Stage 3	Delta 167
1983-041	TE-M-364-4 Star 37E	1983 Apr 28	Delta 3914 Stage 3	D168
1983-047	TE-M-714-6 Star 37XF	1983 May 19	FS-1300 AKM/Intelsat 506	AC-61
1983-051	TE-M-364-4 Star 37E	1983 May 26	Delta 3914 Stage 3	D169
1983-081	TE-M-364-4 Star 37E	1983 Aug 5	N-2 Stage 3	N-2-11
1983-094	TE-M-364-4 Star 37E	1983 Sep 8	Delta 3924 Stage 3	Delta 172
1983-105	TE-M-714-6 Star 37XF	1983 Oct 19	FS-1300 AKM/Intelsat 507	Ariane 1 L7
1983-113	TE-M-364-15 Star 37S	1983 Nov 18	Tiros-N AKM/DMSP S-7	Atlas 58E
1984-005	TE-M-364-4 Star 37E	1984 Jan 23	N-2 Stage 3	N-2-12
1984-023	TE-M-714-6 Star 37XF	1984 Mar 5	FS-1300 AKM/Intelsat 508	Ariane 1 L8
1984-057	TE-M-714-6 Star 37XF	1984 Jun 9	FS-1300 AKM/Intelsat 509	AC-62
1984-080	TE-M-364-4 Star 37E	1984 Aug 2	N-2 Stage 3	N-2-13
1984-088	TE-M-364-4 Star 37E	1984 Aug 16	Delta 3924 Stage 3	Delta 175
1984-115	TE-M-364-4 Star 37E	1984 Nov 14	Delta 3914 Stage 3	D177
1984-123	TE-M-364-15 Star 37S	1984 Dec 12	Tiros-N AKM/NOAA F	Atlas 39E
1985-025	TE-M-714-6 Star 37XF	1985 Mar 22	FS-1300 AKM/Intelsat 510	AC-63

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1985-055	TE-M-714-6 Star 37XF	1985 Jun 30	FS-1300 AKM/Intelsat 511	AC-64
1985-087	TE-M-714-6 Star 37XF	1985 Sep 28	FS-1300 AKM/Intelsat 512	AC-65
1985-109	TE-M-714-16 Star 37XFP	1985 Nov 27	AS 4000 AKM/Satcom K2	STS 61-B
1986-003	TE-M-714-16 Star 37XFP	1986 Jan 12	AS 4000 AKM/Satcom K1	STS 61-C
1986-016	TE-M-364-4 Star 37E	1986 Feb 12	N-2 Stage 3	N-2-14
1986-F04	TE-M-364-4 Star 37E	1986 May 3	Delta 3914 Stage 3	D178
1986-F05	TE-M-714-6 Star 37XF	1986 May 31	FS-1300 AKM/Intelsat 514	Ariane 2 V18
1986-073	TE-M-364-15 Star 37S	1986 Sep 17	Tiros-N AKM/NOAA G	Atlas 52E
1986-096	TE-M-783-1 Star 37FM	1986 Dec 5	FSC AKM/FLTSAT F7	AC-66
1987-022	TE-M-364-4 Star 37E	1987 Feb 26	Delta 3914 Stage 3	D179
1987-F02	TE-M-364-19 Star 37F	1987 Mar 26	FSC AKM/FLTSAT F6	AC-67
1987-053	TE-M-364-15 Star 37S	1987 Jun 20	Tiros-N AKM/DMSP S-9	Atlas 59E
1988-006	TE-M-364-15 Star 37S	1988 Feb 3	Tiros-N AKM/DMSP S-8	Atlas 54E
1988-040	TE-M-714-6 Star 37XF	1988 May 17	FS-1300 AKM/Intelsat 513	Ariane 2 V23
1988-089	TE-M-364-15 Star 37S	1988 Sep 24	Tiros-N AKM/NOAA H	Atlas 63E
1988-109	TE-M-714-16 Star 37XFP	1988 Dec 11	AS 4000 AKM/Astra 1A	Ariane 4 V27
1989-006	TE-M-714-6 Star 37XF	1989 Jan 27	FS-1300 AKM/Intelsat 515	Ariane 2 V28
1989-013	TE-M-714-16 Star 37XFP	1989 Feb 14	GPS 2 AKM/Navstar 14	Delta 184
1989-044	TE-M-714-16 Star 37XFP	1989 Jun 10	GPS 2 AKM/Navstar 13	Delta 185
1989-064	TE-M-714-16 Star 37XFP	1989 Aug 18	GPS 2 AKM/Navstar 16	Delta 186
1989-077	TE-M-783-1 Star 37FM	1989 Sep 25	FSC AKM/FLTSAT F8	AC-68
1989-085	TE-M-714-16 Star 37XFP	1989 Oct 21	GPS 2 AKM/Navstar 19	Delta 188
1989-097	TE-M-714-16 Star 37XFP	1989 Dec 11	GPS 2 AKM/Navstar 17	Delta 190
1990-008	TE-M-714-16 Star 37XFP	1990 Jan 24	GPS 2 AKM/Navstar 18	Delta 191
1990-025	TE-M-714-16 Star 37XFP	1990 Mar 26	GPS 2 AKM/Navstar 20	Delta 193
1990-068	TE-M-714-16 Star 37XFP	1990 Aug 2	GPS 2 AKM/Navstar 21	Delta 197
1990-088	TE-M-714-16 Star 37XFP	1990 Oct 1	GPS 2 AKM/Navstar 15	Delta 199
1990-103	TE-M-714-16 Star 37XFP	1990 Nov 26	GPS 2A AKM/Navstar 23	Delta 201
1990-105	TE-M-364-15 Star 37S	1990 Dec 1	Tiros-N AKM/DMSP S-10	Atlas 61E
1991-032	TE-M-364-15 Star 37S	1991 May 14	Tiros-N AKM/NOAA D	Atlas 50E
1991-047	TE-M-714-16 Star 37XFP	1991 Jul 4	GPS 2A AKM/Navstar 24	Delta 206
1991-082	TE-M-364-15 Star 37S	1991 Nov 28	Tiros-N AKM/DMSP S-12	Atlas 53E
1992-009	TE-M-714-16 Star 37XFP	1992 Feb 23	GPS 2A AKM/Navstar 25	Delta 207
1992-019	TE-M-714-16 Star 37XFP	1992 Apr 10	GPS 2A AKM/Navstar 28	Delta 208
1992-039	TE-M-714-16 Star 37XFP	1992 Jul 7	GPS 2A AKM/Navstar 26	Delta 211
1992-058	TE-M-714-16 Star 37XFP	1992 Sep 9	GPS 2A AKM/Navstar 27	Delta 214
1992-079	TE-M-714-16 Star 37XFP	1992 Nov 22	GPS 2A AKM/Navstar 32	Delta 216
1992-089	TE-M-714-16 Star 37XFP	1992 Dec 18	GPS 2A AKM/Navstar 29	Delta 217
1993-007	TE-M-714-16 Star 37XFP	1993 Feb 3	GPS 2A AKM/Navstar 22	Delta 218
1993-017	TE-M-714-16 Star 37XFP	1993 Mar 30	GPS 2A AKM/Navstar 31	Delta 219
1993-032	TE-M-714-16 Star 37XFP	1993 May 13	GPS 2A AKM/Navstar 37	Delta 220
1993-042	TE-M-714-16 Star 37XFP	1993 Jun 26	GPS 2A AKM/Navstar 39	Delta 221
1993-050	TE-M-364-15 Star 37S	1993 Aug 9	Tiros-N AKM/NOAA I	Atlas 34E
1993-054	TE-M-714-16 Star 37XFP	1993 Aug 30	GPS 2A AKM/Navstar 35	Delta 222
1993-058	TE-M-783-1 Star 37FM	1993 Sep 12	AS4000 AKM/ACTS	STS-51
1993-F04	TE-M-714-16 Star 37XFP	1993 Oct 5	Landsat 6 PKM	Titan 23G-5
1993-068	TE-M-714-16 Star 37XFP	1993 Oct 26	GPS 2A AKM/Navstar 34	Delta 223
1994-004	TE-M-783-1 Star 37FM	1994 Jan 24	ISA	Titan 23G-11
1994-016	TE-M-714-16 Star 37XFP	1994 Mar 10	GPS 2A AKM/Navstar 36	Delta 226

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1994-057	TE-M-364-15 Star 37S	1994 Aug 29	Tiros-N AKM/DMSP S-11	Atlas 20E
1994-089	TE-M-364-15 Star 37S	1994 Dec 30	Tiros-N AKM/NOAA J	Atlas 11E
1995-015	TE-M-364-15 Star 37S	1995 Mar 24	Tiros-N AKM/DMSP S-13	Atlas 45E
1996-019	TE-M-714-16 Star 37XFP	1996 Mar 28	GPS 2A AKM/Navstar 33	Delta 234
1996-020	TE-M-783-1 Star 37FM?	1996 Apr 3	AS4000 AKM/Inmarsat 3F1	AC-122
1996-041	TE-M-714-16 Star 37XFP	1996 Jul 16	GPS 2A AKM/Navstar 40	Delta 237
1996-056	TE-M-714-16 Star 37XFP	1996 Sep 12	GPS 2A AKM/Navstar 30	Delta 238
1996-070	TE-M-783-1 Star 37FM?	1996 Dec 17	AS4000 AKM/Inmarsat 3F3	AC-129
1997-F01	TE-M-783-1 Star 37FM	1997 Jan 17	GPS 2R AKM/Navstar 42	Delta 241
1997-012	TE-M-364-15 Star 37S	1997 Apr 4	Tiros-N AKM/DMSP S-14	Titan 23G-6
1997-027	TE-M-783-1 Star 37FM?	1997 Jun 3	AS 4000 AKM/Inmarsat 3F4	Ariane
		Thiokol/Elkton Star 48		
1980-091	TE-M-711 Star 48	1980 Nov 15	PAM-D	Delta 153
1981-096	TE-M-711 Star 48	1981 Sep 24	PAM-D	Delta 156
1981-114	TE-M-711 Star 48	1981 Nov 20	PAM-D	Delta 158
1982-004	TE-M-711 Star 48	1982 Jan 16	PAM-D	Delta 159
1982-014	TE-M-711 Star 48	1982 Feb 26	PAM-D	Delta 160
1982-031	TE-M-711 Star 48	1982 Apr 10	PAM-D	Delta 161
1982-058	TE-M-711 Star 48	1982 Jun 9	PAM-D	Delta 162
1982-082	TE-M-711 Star 48	1982 Aug 26	PAM-D	Delta 164
1982-110	TE-M-711 Star 48	1982 Nov 11	PAM-D	STS-5
1982-110	TE-M-711 Star 48	1982 Nov 11	PAM-D	STS-5
1983-059	TE-M-711 Star 48	1983 Jun 18	PAM-D	STS-7
1983-059	TE-M-711 Star 48	1983 Jun 18	PAM-D	STS-7
1983-065	TE-M-711 Star 48	1983 Jun 28	PAM-D	Delta 170
1983-072	TE-M-711 Star 48	1983 Jul 14	SGS-2 Stage 1	Atlas 75E
1983-072	TE-M-711 Star 48	1983 Jul 14	SGS-2 Stage 2	Atlas 75E
1983-077	TE-M-711 Star 48	1983 Jul 28	PAM-D	Delta 171
1983-089	TE-M-711 Star 48	1983 Aug 30	PAM-D	STS-8
1983-098	TE-M-711 Star 48	1983 Sep 22	PAM-D	Delta 173
1984-011	TE-M-711 Star 48	1984 Feb 3	PAM-D	STS 41-B
1984-011	TE-M-711 Star 48	1984 Feb 3	PAM-D	STS 41-B
1984-059	TE-M-711 Star 48	1984 Jun 13	SGS-2 Stage 1	Atlas 42E
1984-059	TE-M-711 Star 48	1984 Jun 13	SGS-2 Stage 2	Atlas 42E
1984-093	TE-M-711 Star 48	1984 Aug 30	PAM-D	STS 41-D
1984-093	TE-M-711 Star 48	1984 Aug 30	PAM-D	STS 41-D
1984-097	TE-M-711 Star 48	1984 Sep 8	SGS-2 Stage 1	Atlas 14E
1984-097	TE-M-711 Star 48	1984 Sep 8	SGS-2 Stage 2	Atlas 14E
1984-101	TE-M-711 Star 48	1984 Sep 21	PAM-D	Delta 176
1984-113	TE-M-711 Star 48	1984 Nov 8	PAM-D	STS 51-A
1985-028	TE-M-711 Star 48	1985 Apr 12	PAM-D	STS 51-D
1985-048	TE-M-711-9 Star 48B	1985 Jun 17	PAM-D	STS 51-G
1985-048	TE-M-711-9 Star 48B	1985 Jun 17	PAM-D	STS 51-G
1985-048	TE-M-711-9 Star 48B	1985 Jun 17	PAM-D	STS 51-G
1985-076	TE-M-711-9 Star 48B	1985 Aug 27	PAM-D	STS 51-I
1985-076	TE-M-711-9 Star 48B	1985 Aug 27	PAM-D	STS 51-I
1985-093	TE-M-711 Star 48	1985 Oct 9	SGS-2 Stage 1	Atlas 55E
1985-093	TE-M-711 Star 48	1985 Oct 9	SGS-2 Stage 2	Atlas 55E
1985-109	TE-M-711-9 Star 48B	1985 Nov 27	PAM-D	STS 61-B
1985-109	TE-M-711-9 Star 48B	1985 Nov 27	PAM-D	STS 61-B

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1987-029	TE-M-711-9 Star 48B	1987 Mar 20	PAM-D	Delta 182
1989-013	TE-M-711-9 Star 48B	1989 Feb 14	PAM-D	Delta 184
1989-033	TE-M-711-9 Star 48B	1989 May 4	Magellan OIM	STS-30R
1989-044	TE-M-711-9 Star 48B	1989 Jun 10	PAM-D	Delta 185
1989-064	TE-M-711-9 Star 48B	1989 Aug 18	PAM-D	Delta 186
1989-067	TE-M-711-9 Star 48B	1989 Aug 27	PAM-D	Delta 187
1989-085	TE-M-711-9 Star 48B	1989 Oct 21	PAM-D	Delta 188
1989-097	TE-M-711-9 Star 48B	1989 Dec 11	PAM-D	Delta 190
1990-008	TE-M-711-9 Star 48B	1990 Jan 24	PAM-D	Delta 191
1990-025	TE-M-711-9 Star 48B	1990 Mar 26	PAM-D	Delta 192
1990-034	TE-M-711-9 Star 48B	1990 Apr 13	PAM-D	Delta 194
1990-051	TE-M-711-9 Star 48B	1990 Jun 12	PAM-D	Delta 196
1990-068	TE-M-711-9 Star 48B	1990 Aug 2	PAM-D	Delta 197
1990-074	TE-M-711-9 Star 48B	1990 Aug 18	PAM-D	Delta 198
1990-088	TE-M-711-9 Star 48B	1990 Oct 1	PAM-D	Delta 199
1990-090	TE-M-711-9 Star 48B	1990 Oct 6	PAM-S	STS-41
1990-093	TE-M-711-9 Star 48B	1990 Oct 30	PAM-D	Delta 200
1990-103	TE-M-711-9 Star 48B	1990 Nov 26	PAM-D	D201
1991-001	TE-M-711-9 Star 48B	1991 Jan 8	PAM-D	D202
1991-018	TE-M-711-9 Star 48B	1991 Mar 9	PAM-D	D203
1991-028	TE-M-711-9 Star 48B	1991 Apr 13	PAM-D	D204
1991-037	TE-M-711-9 Star 48B	1991 May 29	PAM-D	D205
1991-047	TE-M-711-9 Star 48B	1991 Jul 4	PAM-D	D206
1992-009	TE-M-711-9 Star 48B	1992 Feb 23	PAM-D	D207
1992-019	TE-M-711-9 Star 48B	1992 Apr 10	PAM-D	D208
1992-027	TE-M-711-9 Star 48B	1992 May 14	PAM-D	D209
1992-039	TE-M-711-9 Star 48B	1992 Jul 7	PAM-D	D211
1992-044	TE-M-711-9 Star 48B	1992 Jul 24	PAM-D	D212
1992-057	TE-M-711-9 Star 48B	1992 Aug 31	PAM-D	D213
1992-058	TE-M-711-9 Star 48B	1992 Sep 9	PAM-D	D214
1992-066	TE-M-711-9 Star 48B	1992 Oct 12	PAM-D	D215
1992-079	TE-M-711-9 Star 48B	1992 Nov 22	PAM-D	D216
1992-089	TE-M-711-9 Star 48B	1992 Dec 18	PAM-D	D217
1993-007	TE-M-711-9 Star 48B	1993 Feb 3	PAM-D	D218
1993-017	TE-M-711-9 Star 48B	1993 Mar 30	PAM-D	D219
1993-032	TE-M-711-9 Star 48B	1993 May 13	PAM-D	D220
1993-042	TE-M-711-9 Star 48B	1993 Jun 26	PAM-D	D221
1993-054	TE-M-711-9 Star 48B	1993 Aug 30	PAM-D	D222
1993-068	TE-M-711-9 Star 48B	1993 Oct 26	PAM-D	D223
1993-076	TE-M-711-9 Star 48B	1993 Dec 8	PAM-D	D224
1994-013	TE-M-711-9 Star 48B	1994 Feb 19	PAM-D	D225
1994-016	TE-M-711-9 Star 48B	1994 Mar 10	PAM-D	D226
1994-071	TE-M-711-9 Star 48B	1994 Nov 1	PAM-D	D227
1995-041	TE-M-711-9 Star 48B	1995 Aug 5	PAM-D	D228
1995-F05	TE-M-940-1 Star 48V	1995 Oct 23	Conestoga 1620 Stage 4	Conestoga 1
1996-003	TE-M-711-9 Star 48B	1996 Jan 14	PAM-D	D231
1996-008	TE-M-711-9 Star 48B	1996 Feb 17	PAM-D	D232
1996-013	TE-M-711-9 Star 48B	1996 Feb 24	PAM-D	D233
1996-019	TE-M-711-9 Star 48B	1996 Mar 28	PAM-D	D234
1996-033	TE-M-711-9 Star 48B	1996 May 24	PAM-D	D236

Table 2: Motor flight histories

Int'l Desig.	Motor	Launch Date	Usage	Launch Vehicle
1996-041	TE-M-711-9 Star 48B	1996 Jul 16	PAM-D	D237
1996-056	TE-M-711-9 Star 48B	1996 Sep 12	PAM-D	D238
1996-062	TE-M-711-9 Star 48B	1996 Nov 7	PAM-D	D239
1996-068	TE-M-711-9 Star 48B	1996 Dec 4	PAM-D	D240
1997-F01	TE-M-711-9 Star 48B	1997 Jan 17	PAM-D	D241
1997-025	TE-M-711-9 Star 48B	1997 May 21	PAM-D	D243
Thiokol/Elkton Star 63				
1985-109	TU-936 Star 63D	1985 Nov 27	PAM-D2	STS 61-B
1986-003	TU-936 Star 63D	1986 Jan 12	PAM-D2	STS 61-C
1990-001	TU-936 Star 63D	1990 Jan 1	PAM-D2/ECS PKM	Titan CT1
1992-054	TE-M-963-2 Star 63F	1992 Aug 13	HS-601 PKM	CZ-2E 2
1992-090	TE-M-963-2 Star 63F	1992 Dec 21	HS-601 PKM	CZ-2E 3
1994-055	TE-M-963-2 Star 63F	1994 Aug 27	HS-601 PKM	CZ-2E 4
1995-F01	TE-M-963-2 Star 63F	1995 Jan 25	HS-601 PKM	CZ-2E 5
Unknown: Classified Titan II SLV payload orbit insertion motor (possibly LAE)				
1988-078	?	1988 Sep 5	USA 32 motor	Titan 23G-1
1989-072	?	1989 Sep 6	USA 45 motor	Titan 23G-2
1992-023	?	1992 Apr 25	USA 81 motor	Titan 23G-3
Unknown: Classified payload perigee motor (probably Orbus 6)				
1989-061	?	1989 Aug 8	USA 40 PKM	STS-28R
1990-097	?	1990 Nov 15	USA 67 PKM	STS-38
1992-086	?	1992 Dec 2	USA 89 PKM	STS-53
1996-038	?	1996 Jul 3	USA 125 PKM	Titan 45K-2
Classified payload apogee motor (possibly Aerojet SVM-3)				
1970-046	?	1970 Jun 19	AFP-720 AKM/RH-1	Atlas Agena D 5201A
1972-101	?	1972 Dec 20	AFP-827 AKM/CY-5	Atlas Agena D
1973-013	?	1973 Mar 6	AFP-720 AKM/RH-2	Atlas Agena D
1975-055	?	1975 Jun 18	AFP-827 AKM/CY-6	Atlas Agena D
1977-038	?	1977 May 23	AFP-827 AKM/CY-7	Atlas Agena D
1977-114	?	1977 Dec 11	AFP-472 AKM/RH-3	Atlas Agena D
1978-038	?	1978 Apr 8	AFP-472 AKM/RH-4	Atlas Agena D
Classified payload apogee motor (or possibly LAE)				
1985-010	?	1985 Jan 24	USA 8 AKM	STS 51-C
1989-090	?	1989 Nov 23	USA 48 AKM	STS-33R

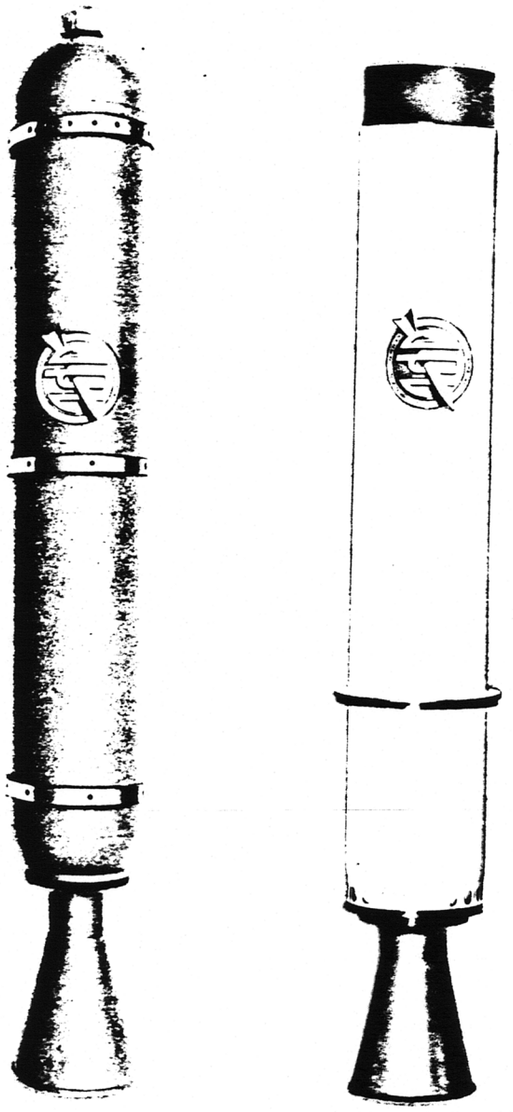
III. GENERAL DESCRIPTION OF THE HIGH-SPEED STAGES

A. Structure

The high-speed stages of the re-entry test vehicle, or *Jupiter C*, are built up as clusters of solid-propellant motors. Each motor has a diameter of 6 in., and an overall length, including the nozzle, of 47⅞ in., except for the stage 4 motor which is slightly shorter (Fig. 1). Their design is based on a scaled-down design of the *Sergeant* rocket motor, which was being developed at this Laboratory. The first high-speed stage is propelled by eleven such motors, the next by three, and the last by one. The stages are designated by the following numbering convention. The *Redstone* missile is called stage 1, or booster, the first high-speed section is stage 2, the next is stage 3, and the last, stage 4.

The eleven motors forming the propulsive unit of stage 2 are arranged in a ring with their axes parallel (Fig. 2). The radius of this ring, measured from the axis of symmetry of the stage to the axis of any one motor, is 13⅜ in. The motors are held together with three transverse bulkheads.

Inside this ring of motors is carried the group of three motors comprising the propulsive unit of stage 3 (Fig. 3).



a. SECOND-AND THIRD-STAGE MOTOR

b. FOURTH-STAGE MOTOR

Figure 1. High-speed motors

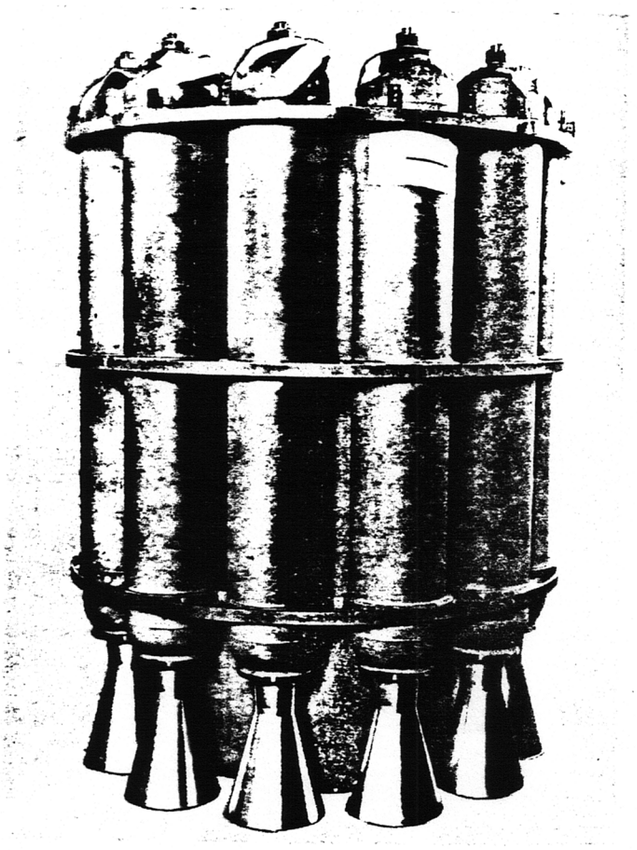


Figure 2. Stage 2 motor assembly

[redacted]

Fig 1. RTV motor

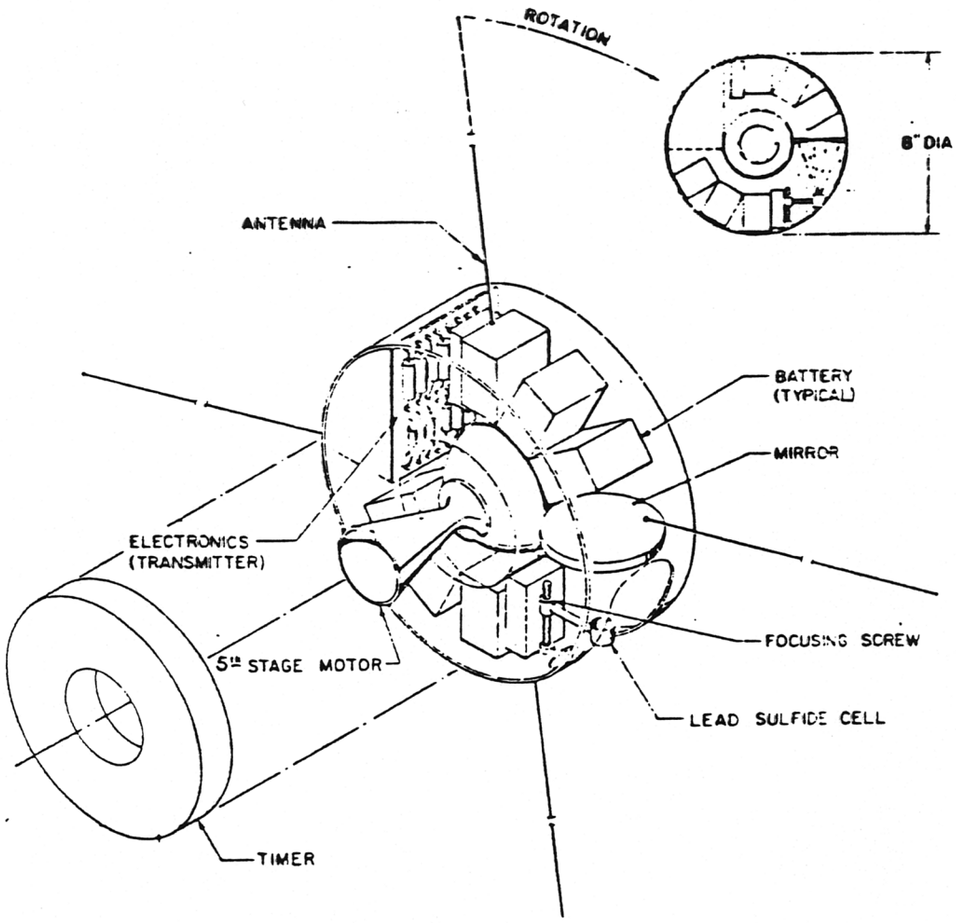


FIG. 4. NOTS Satellite.

Fig 2. NOTSnik

XXIV. ROUND 49

A. General

Round 49 carried as its main payload an inflatable plastic sphere covered with aluminum foil, a payload developed at Langley Research Center, Virginia. After inflation this sphere would have a diameter of 12 ft (Fig. 86 and 87).

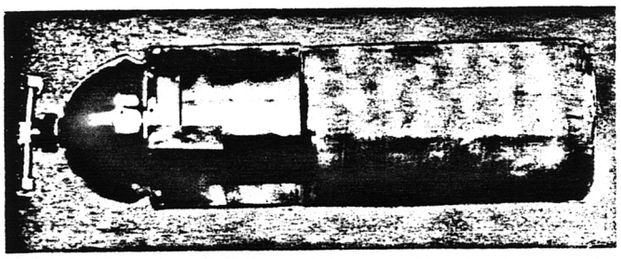


Figure 86. Balloon assembly

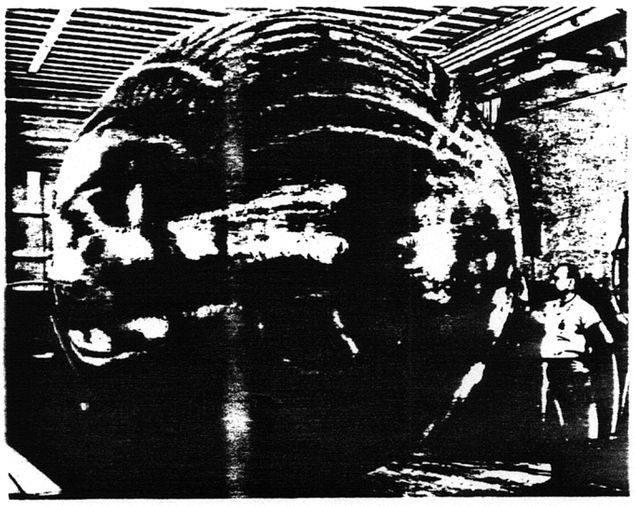


Figure 87. NACA balloon

The orbit intended for this sphere was approximately circular at an altitude of about 750 km. This comparatively high perigee would be achieved by the use of a "kick motor," or fifth stage, to be fired half way around the Earth (at the apogee) from the launching point. The principal effect of the kick motor was the increase in altitude at perigee from 120 to nearly 800 km. It was the purpose of the experiment to enable accurate measurements to be made of atmosphere density at high altitudes. The measurements were to be based on close observation of the satellite's orbit.

B. Payload Desig

1. Payload Components

The principal payload components (Fig. 88) included a 2-lb kick motor (Fig. 89), a Microlock beacon (Fig. 90), and NACA balloon package. To accommodate the larger volumetric requirements, the diameter of the payload cylindrical shell was increased from 6 to 7 in., still keeping the payload critical speed at reasonable value.

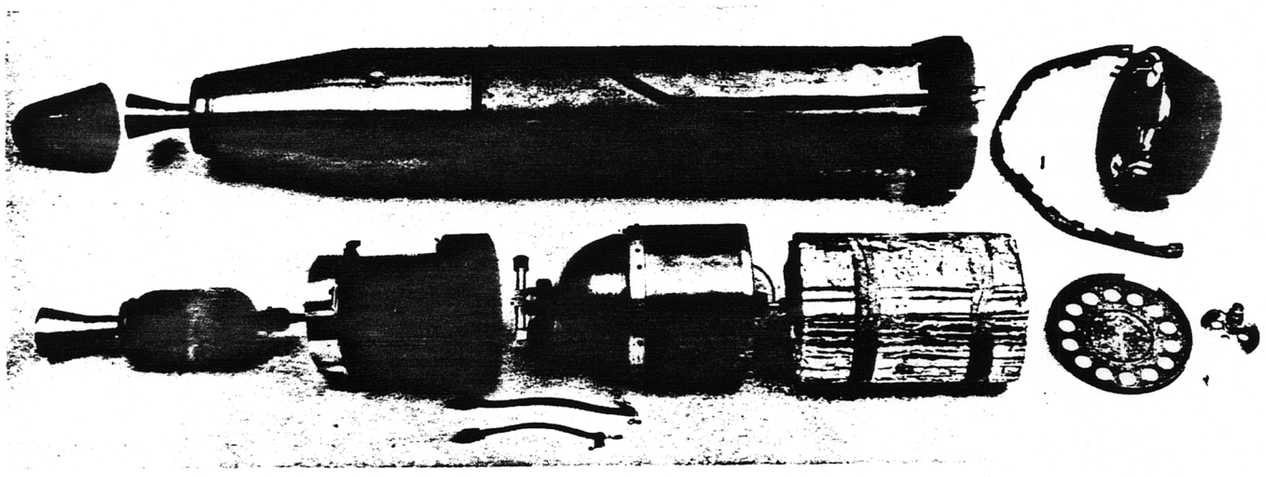
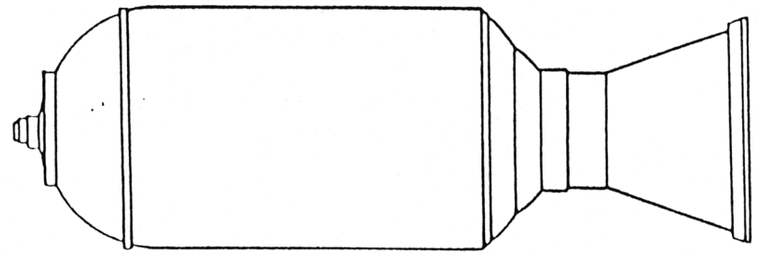


Figure 88. Payload assembly



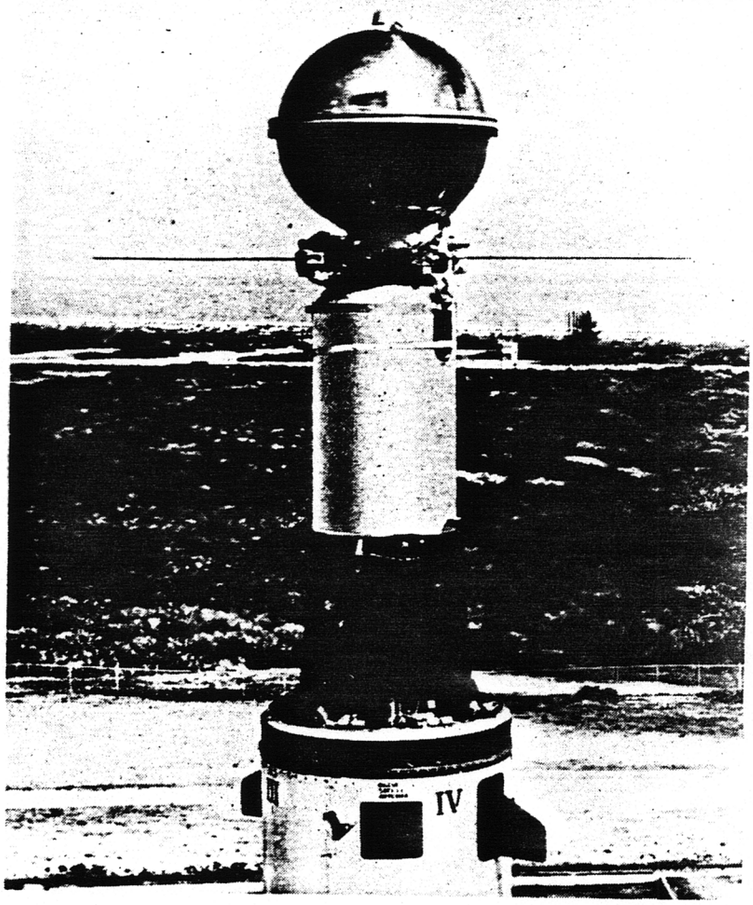
ABL x 248 A6 MOTOR

LOADED WEIGHT	517 LB
PROPELLANT WEIGHT	454 LB
THRUST	2,980 LB
BURNING TIME	39 SEC
TOTAL IMPULSE	116,224 LB-SEC
OPERATING PRESSURE	250 PSI
SPECIFIC IMPULSE	256 LB-SEC/LB

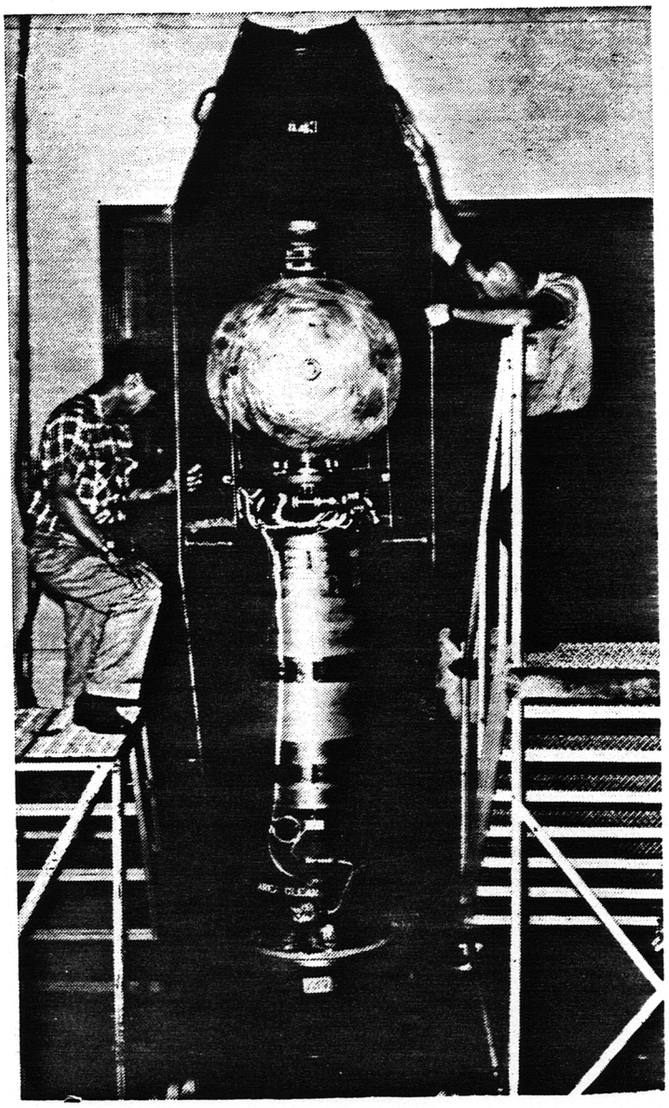
PROPELLANT: CAST MODIFIED DOUBLE BASE (AMMONIUM PERCHLORATE & ALUMINUM) DESIGNATED BUU

FIG. 12. Second-Stage Booster.

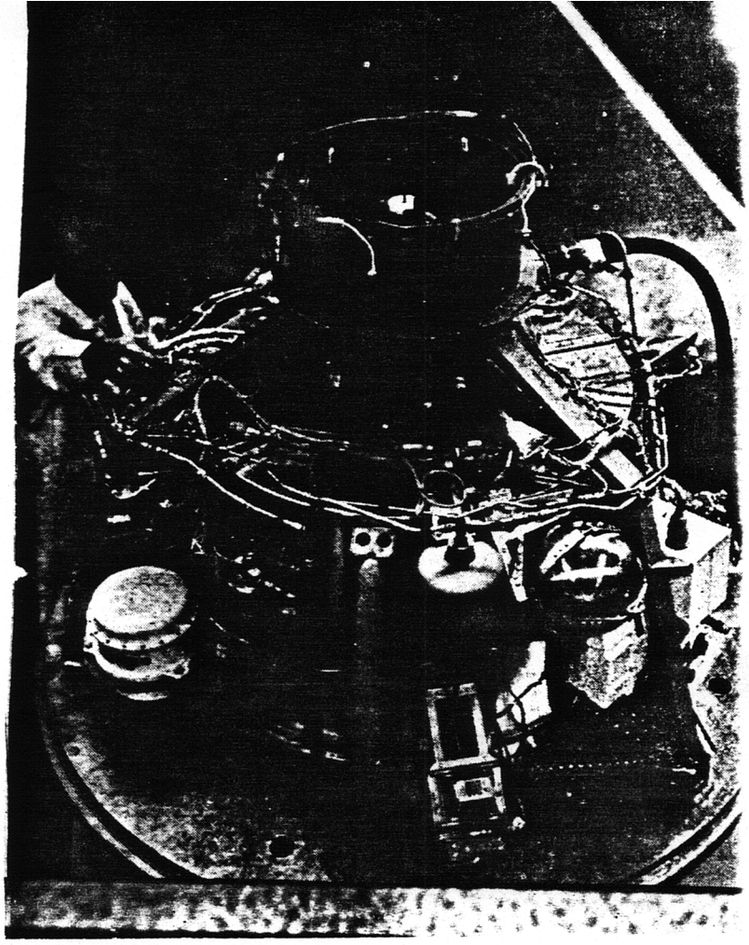
CONFIDENTIAL



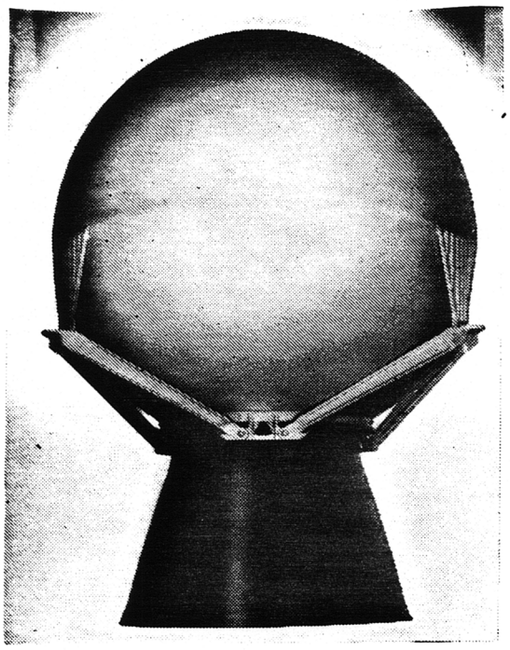
ABL Altair (X-248)



UTC FW-4 solid-propellant upper-stage motor

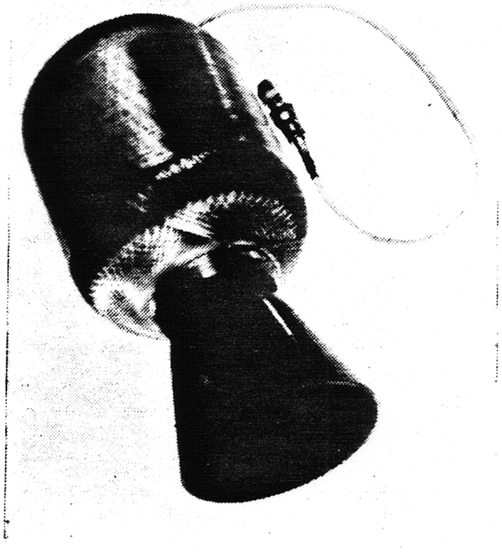


Bumer II

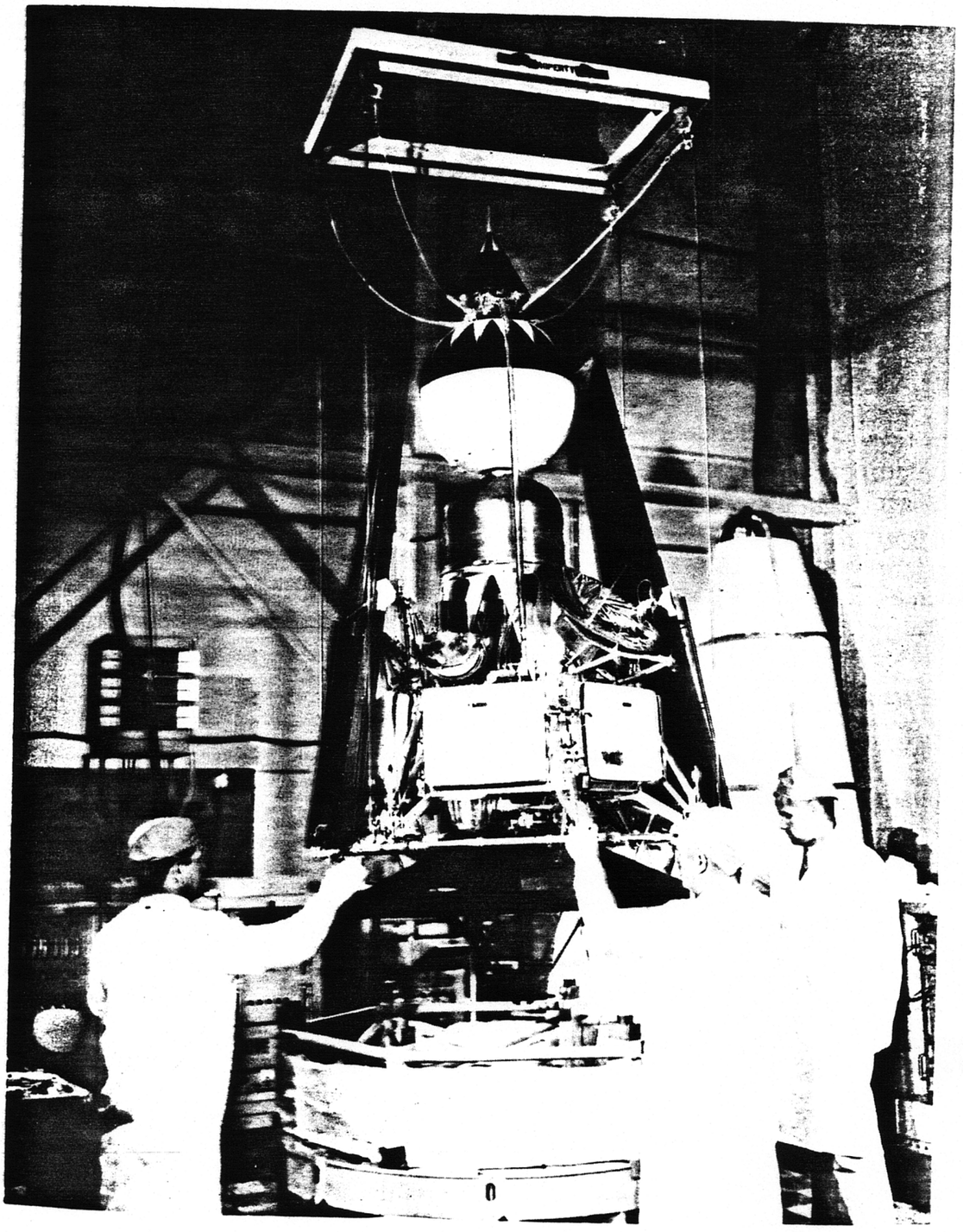


Thiokol TE-M-364-2 (STAR-37B) motor

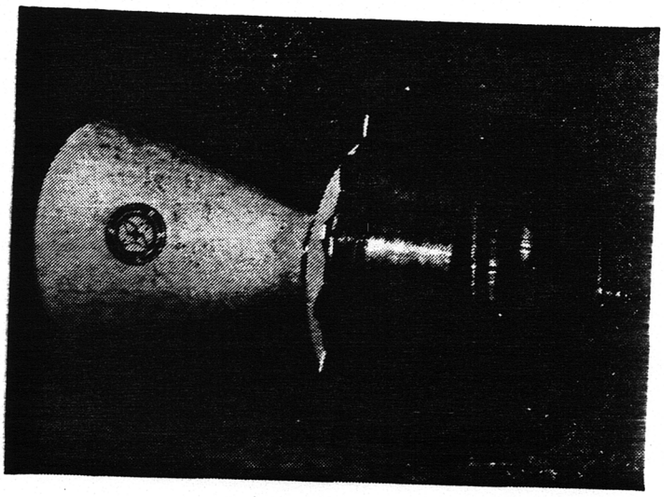
Thiokol TE-M-442-1 (STAR-26B) motor

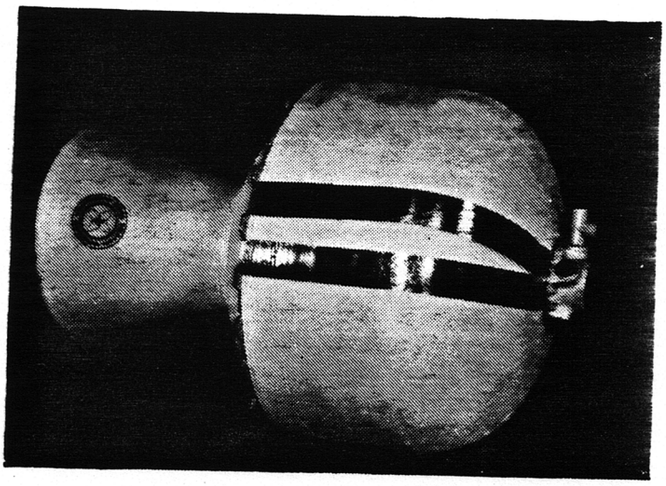


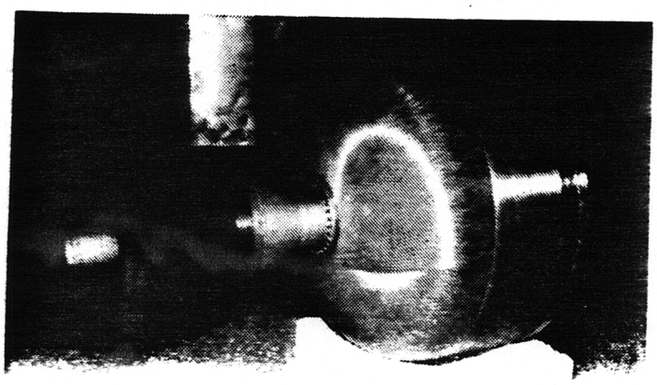
Thiokol TE-M-541 (STAR-6) motor



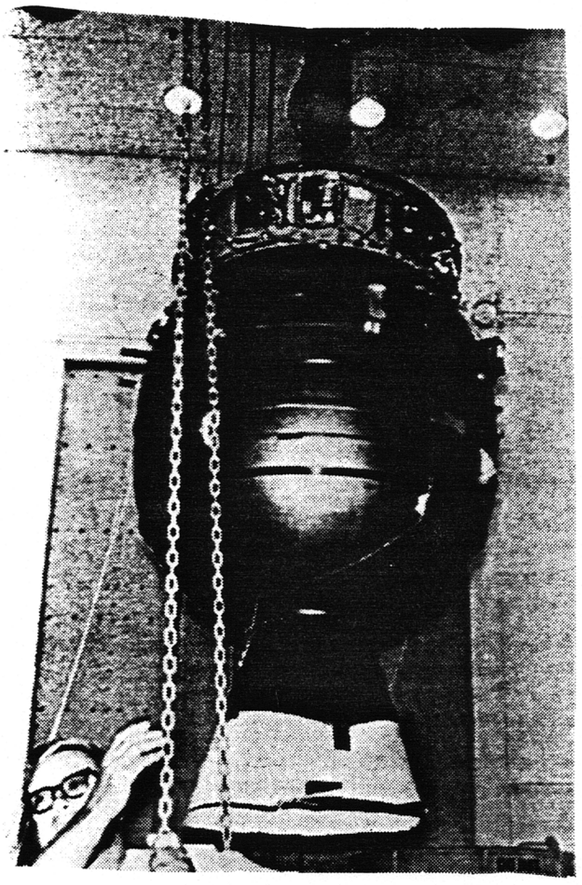
BE-3 on Ranger 4



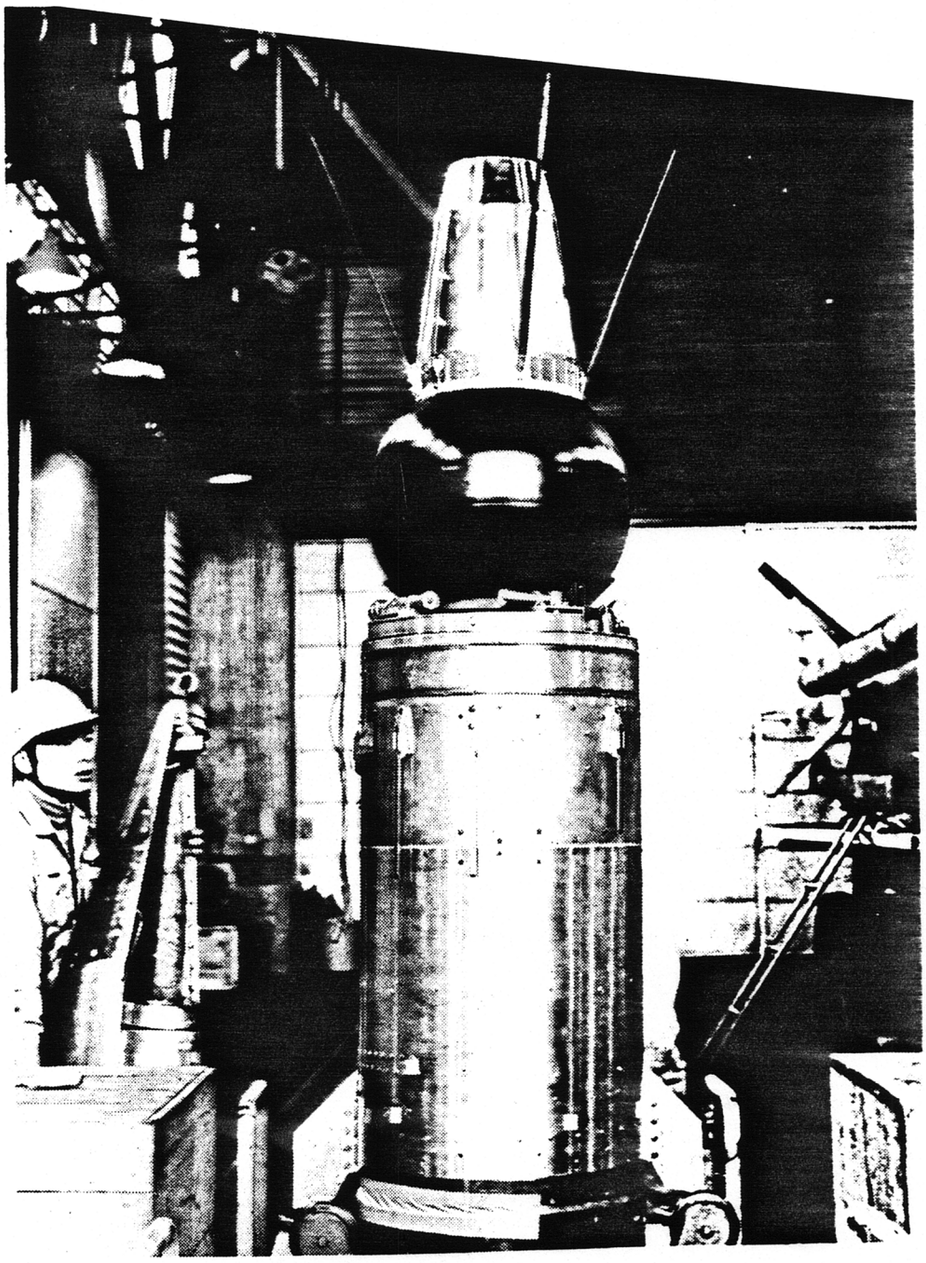




Aerojet SUM-1, 2, 4A



Star 48



Japan's first satellite 'Ohsumi'.