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Chapter 3

A-1: The First French Satellite*

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Introduction

On November 26th, 1965 with the first flight of the French launcher "Diamant" France became—after the USSR and the United States—the third country to put in orbit a satellite built by its own industry and carried on a national launcher.

The success, as it happens in all complex operations of that kind, came after a long progress of ideas and decisions, and represents the fruits of the work of numerous participants. Especially in this case they had a limited time: approximately 43 months for the launcher and about 24 months for the satellite, between the decisions and the launch.

In 1995, the celebration of the 30th Anniversary, it seems interesting to come back briefly to the genesis of the event, which was the first French space venture in space.

Space and Political Context

First, the space environment should be recalled as well as the French political context at the time of the first French satellite launch.

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World-Wide Space Activities

The first satellite, Sputnik 1, had been launched eight years before. In December 1965, the United States was planning to launch Gemini VI; two Russians probes to Venus had already been launched, and they were preparing the launch to the Moon of Luna 9 for the first automatically soft landing on the Moon, which took place in January 1966.

At the same time, the Americans had also announced that they would launch the French satellite FR-1 developed by Centre national d'études des télécommunications (CNET), on a Scout launcher from Vandenberg, according to an agreement signed between the US and France in 1963.

French Political Context

During that period, General de Gaulle and François Mitterrand were running for the Presidency, the former to get a new mandate as President in order to show the credibility of the French strategic missile program.

General de Gaulle wanted to prove that France could be involved in a national space program which included the development of a launcher and a satellite. Therefore, it was "imperative" for the French government to launch as soon as possible its first satellite.

The Origins

The development of the French satellite cannot be separated from the development of the launcher itself.

General Organizations

In addition to the involvement of many industries and subcontractors, the operation was concerned with four principal bodies, each of them having a special task:

• **Direction Technique des Enqins** (DTEN) from Délégation Ministérielle pour l'Armement (DMA),[1] in charge of the Strategic Missile Program, had general management for the satellite launcher program.

• **Société d'Etudes et de Réalisations des Engins Balistiques** (SEREB),[2] was the Main Contractor for the Diamant program. Created on September 17, 1959,[3] the firm combined several industries and laboratories, such as Nord-Aviation, Sud-Aviation, Engins Matra, GAMD Dassault, Onera, etc. With Charles Cristofini as general Manager, SEREB was the technical arm for the development of the precious stones tests vehicles series Pierres Précieuses) within the strategic missiles program.

• **Centre national d'études spatiales** (CNES). In Diamant's program, the new space agency CNES would assure the additional financial cost needs for the Saphir transformation. It was about 15% of the cost of the Diamant program total cost. Founded on December 19, 1964,[4] with Pierre Auger as its first Chairman, and General Aubinière as its first General Manager, one of the first activities of the Satellite Division, with Jean-Pierre Causse, as the director, prepared a French scientific satellite program: the "D" series (D as in Diamant), and had already begun the construction of several telemetry stations for its future space network.

• **Engins Matra**, was one of the SEREB shareholders, but did not get a specific mission in the strategic missile program. But its know-how in the field of missile guidance and electronics and the tenacity of Marcel Chassagny, Matra General Manager, gave the company the opportunity to become part of the Diamant program.

Between 1953 and 1958, a Matra team had been working on several missiles projects, especially on an aircraft interceptor project. This two-stage vehicle had an autopilot and guidance system, with two radars. Matra had no relation to propulsion in this project, but was largely involved with the electronics systems. However, in 1958, this project was canceled, after the French government just decided to choose the American Hawk System for its Army.

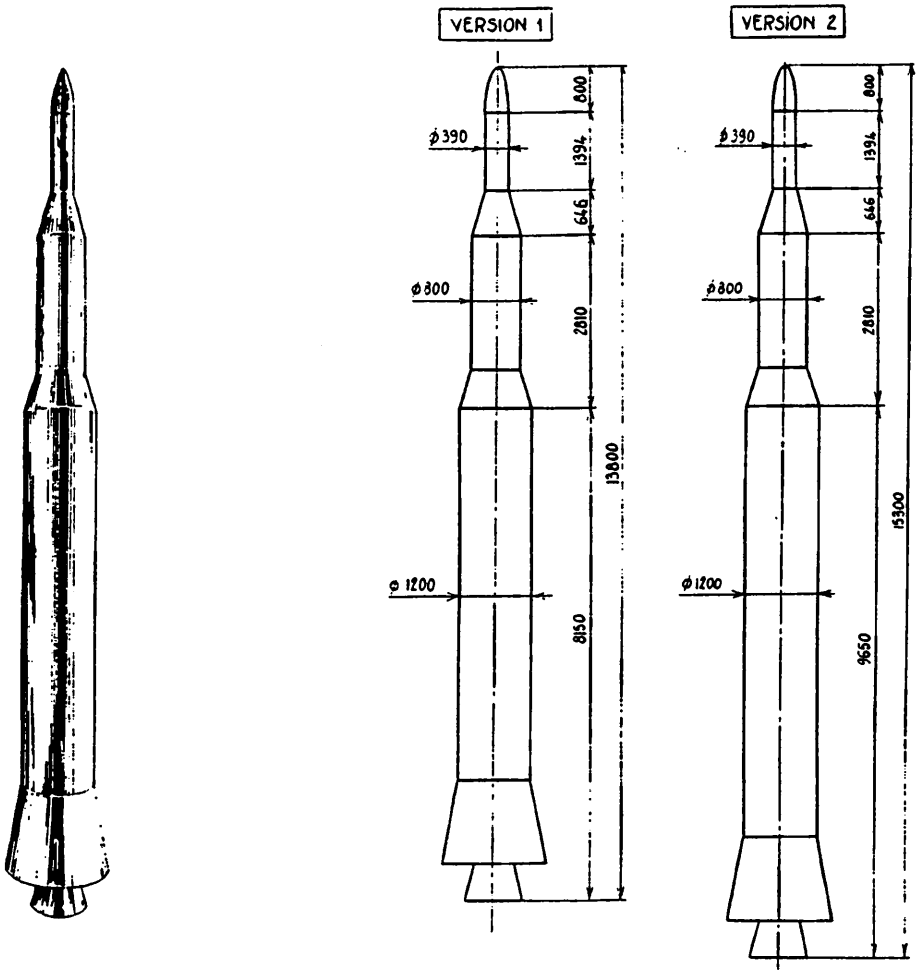
Nevertheless, the team was still working on space systems as a meteorological rocket and even a postal rocket. And, in 1962 the Matra team became part of the satellite program, getting responsibility for the equipment bay and pitch-over subsystem in the Diamant launcher project. With Pierre Quetard as the Director, the team was principally composed of Jean Masse as satellite project manager, Joseph Delaunay as the equipment bay manager, and Jean Dilly as the pitch-over subsystem manager.

First Blue Prints

Even before 1958, there were some studies and considerations about the launch of an artificial satellite, especially in the world of science. Some ideas were advanced a few years earlier. In this way we could go back to the First IAF Congress, in September 1950.

The first real project of a "porte-satellite" (launcher) and its satellite was really initiated by December 1959. During the SEREB employees Christmas party, M. Bernard Dorléac informed a few members of his staff that a meeting was scheduled for the following Monday morning, with the subject: "We will build a satellite."

On the following Monday, the meeting was held in the office of M. Dorléac, with M. Melin, Charley Attali and Hubert Gossot. The Diamant program was led at SEREB by MM. Bernard Dorléac and Charley Attali.



In January 1960, an official request gave SEREB an order starting the first investigations to determine the possibilities and feasibilities for realizing a French launcher. The results of this first study would be the first SEREB technical notes in May and June 1960.

In the first note dated May 18, 1960, MM. C. Attali and B. Dorléac present a draft of a three-stage launcher project. The first stage would be a modified Super-Veronique. The second stage would be a missile test vehicle, with solid propellant. The third stage, also solid, would have to be entirely new. The draft proposed two versions. In fact, this note described, for the first time, the process that would be used five years later. The conclusion of the note said that it would be possible to launch, in the middle of 1963, a small payload (20-35 kg) for a small over-cost, the satellite mass depending of the version and the perigee chosen.

In June 1960, MM. H. Gossot and L. De Peretti in the second technical note, dated June 13, brought more precision to the propulsion and launcher per-

formance specifications. And on June 17th, in a second note the authors discussed the life expectancy of the satellite. On December 23, 1960, another SEREB note concluded:

> It appears from this study that it is possible to realize, for a small over-cost on a test vehicle in the strategic missile series a "porte-satellite" vehicle able to place with sufficient precision, a mass of 50 kg in an orbit with 300 km of perigee (or 60 kg for a perigee of 200 km). It is also possible to study two other versions upgraded. The first version is a satellite of 80 kg, the second 100 kg (with a perigee of 360 km). The choice of the minimum perigee would be a function of the life duration.
>
> The development program as it is actually planned allows us to expect achievement of the first version in the middle of 1964. The second version could be ready in the middle of 1965 and the third one at the beginning of 1966.[5]

Tests and studies in progress made it possible to predict the launcher characteristics and the satellite mass. For example, in 1961, because of the utilization of new techniques, like roving instead of steel for the third stage casing, the launcher performances changed to 46 kg at 300 km.[6] When the political decision was made, at the end of 1961, the project took the name of "Diamant" (See Appendix 1: Diamant A Data).

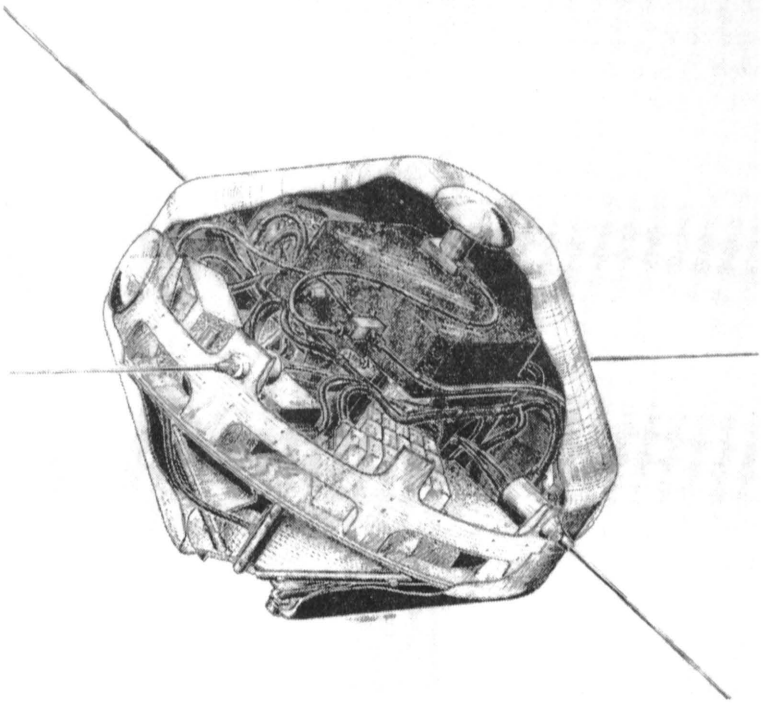
The Decision

On December 18, 1961, the French Government made the final decision to prepare the launch of the first French satellite. The second of the two versions proposed in late 1960 by SEREB was adopted (100 kg, perigee 360 km), with an objective launch date for 1965.

A document dated April 13th, 1962 described for the first time the Diamant vehicle. This three-stage French launcher would be composed of a modified two-stage "Saphir" vehicle to which it was necessary to add an equipment bay and a third stage upon which would be placed the satellite.

On May 9, 1962, an agreement was signed between DMA and CNES, for improvement of the two-stage vehicle "Saphir." The contract was signed on July 1962. This agreement scheduled four Diamant test flights. The test vehicles would be equipped with a technological capsule. Only after the successful test flight could CNES use the other remaining launchers for its scientific satellites.

At the end of 1962, the CNES Satellite Division proposed to modify the terms of the May agreement, concerning the payload of the four flights. CNES proposed to divide by two the mass of the capsule. Matra would keep the technological and experimental part. The remaining mass, about 20 kg, would be used by CNES to make scientific experiments, in preparation for the geodesic satellite "D" program.



Artist's View of the Satellite in October 1962 (Matra Photo).

The Director of the Army DTEn did not agree to the above proposition as CNES's contribution was only a fixed price. He also recalled that it was the Army who took all the risks for the first flight, as the complete launcher did not ever fly before. In July, an ultimate meeting was held, between DMA and CNES, with M. Pierre Messmer, the French Army Ministre and M. Yvon Bourges, State Secretary from the Prime Minister in charge of Scientific and Atomic Research. M. Bourges pleaded without success in favor of the CNES solution. Finally, it was decided that the first test of the Diamant rocket would launch the technological capsule of SEREB built by Matra. It was also decided that the satellite would be named "A" (A=Army).

Preliminary Flight Tests

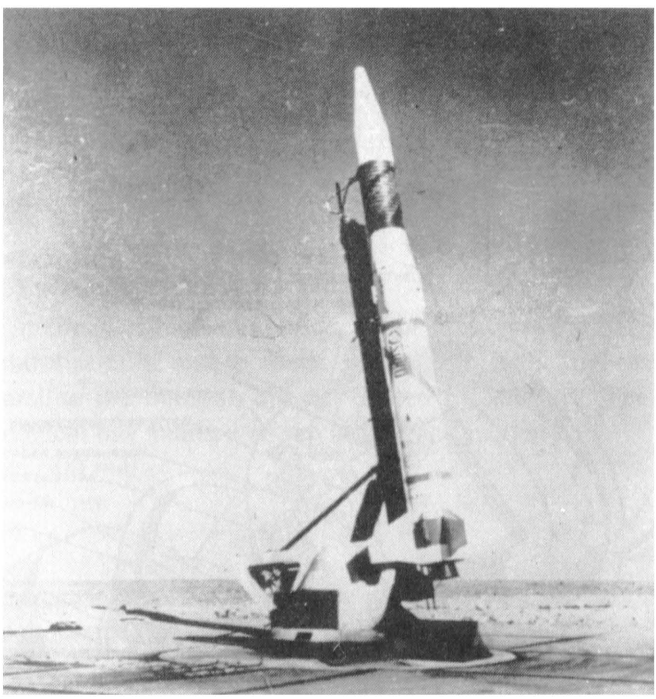
The three stages of the Diamant launcher were tested in flight, two by two, with the test vehicles Saphir and Rubis.

SAPHIR Vehicle Test (VE 231)

Developed within the strategic missile program, the "Saphir" test vehicle represented the first and second stages of the Diamant vehicle. The first stage of Saphir was a liquid bi-propellant test vehicle "Emeraude" (VE 121). The second stage was a solid booster "Agate" (VE 11 1).[7] In its piloted version the Saphir (VE 231P) was tested in flight three times between July 5 and October 9, 1965 (See Appendix 2: Saphir Flights).

RUBIS Vehicle Test (VE 210)

The "Rubis" vehicle represented the second and third stages of the Diamant. The development of the third stage, which was completely new, needed test flights. That was the origin of a new vehicle: "Rubis." The Rubis first stage was also the Agate test vehicle upon which was placed the new P-6 third stage built by Nord-Aviation.



Rubis Test Vehicle With Mock-up of A-1.

For the Diamant development program, the Rubis vehicle was tested in flight eight times, between June 10, 1964 and September 30, 1965 (See Appendix 3: Rubis Flights).

The first six flights were equipped with mock-ups of the technological capsule, in prefiguration of the experimental A-1 capsule. After the flight of

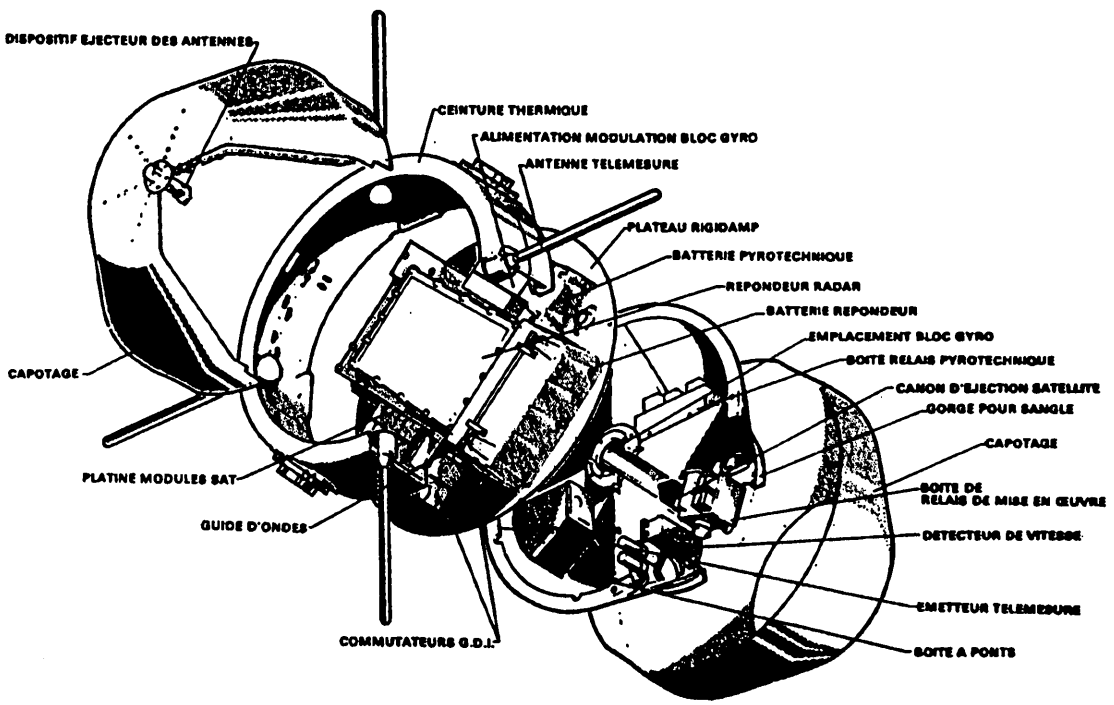
June 3, 1965, Rubis was qualified. The two last flights on June 5 and September 30, 1965 were ordered by CNES. They lifted various devices, such as the equipment bay and the satellite D-1A mock-up, built by Electronique Marcel Dassault.

With the qualification of Rubis and the performances obtained during the last Saphir flight on October 9 (Altitude 1150 km), all stages of the Diamant launcher were therefore qualified. The way was open to the launch of the first Diamant.

A-1 Satellite

Name Genesis

As seen above, the experimental capsule was named A-1 (A=Army) in opposition to the D series (D=Diamant) from CNES. Because of the presence of a large spring for its separation, the A-1 satellite, when it was presented to the press, was nick-named by them "Zébulon."[8] Program officials were not satisfied by term Zébulon, and they selected "Astérix" as an alternative nick-name. It was the name of a well known heroic Gallic character from a comic strip called "Astérix le Gaulois."[9]



Satellite A-1 General View.

Satellite A-1 General View (Matra Photo).

Satellite Description

As the satellite was built only to verify the ability of the Diamant launcher to put into orbit a satellite and to control the main in-orbit flight sequences, the provisional satellite life duration did not exceed fifteen days. The capsule was only a technological one and had no any scientific function.

Diameter: 500 mm
Height: 536 mm
Mass: 39 kg

Satellite Functions

Being only technological and experimental the main functions of the satellite A-1 were:

- Measurement of the launcher's parameters during the orbit injection phase, principally during the thrusting phase of the third stage.
- Position determination of the third stage with a radar transponder during the orbit injection sequence.
- Position determination of the satellite in its orbit with a beacon system.

Third Stage/Satellite Interface

The interface between the satellite and the third stage was accomplished by a truncated skirt of magnesium. Satellite separation was obtained by a pyrotechnic belt and a spring. Both were protected by a faring built of stratified resin by Sud Aviation.

Geometric Shape and Structure

The general shape of the satellite was two steel truncated segments adjusted on a steel cylinder which supported the satellite equipment.

Thermal Control

The external skin of the satellite was painted with nine black stripes, in order to obtain a passive thermal balance.

Electronic Equipment

Systems placed in the satellite were mainly composed of:

- A telemetry system AJAX which transmitted 29 data streams in the FM/FM mode developed by Matra on an SAT hardware model.
- Radar (Motorola).
- Batteries (SAFT).

Antennas

Four telemetry antennas were used. During the launch phase they were folded, and after the farings were jettisoned they were released by a pyrotechnic device.

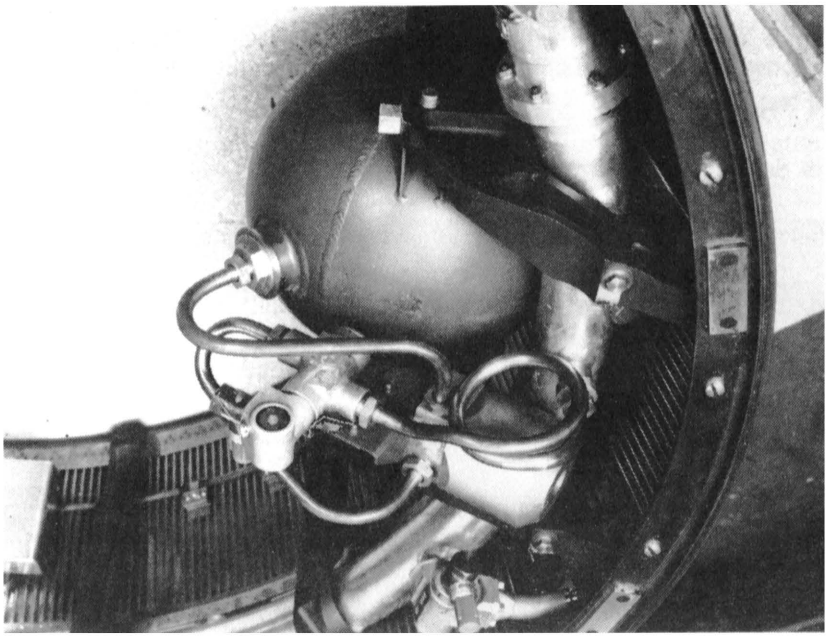
The six mock-ups flight tested on as part of the Rubis vehicle tests, were not prototypes with any measurement systems. They were used only for examining structure and dimension compatibility.

Five prototypes were scheduled in the SEREB contract to Matra:

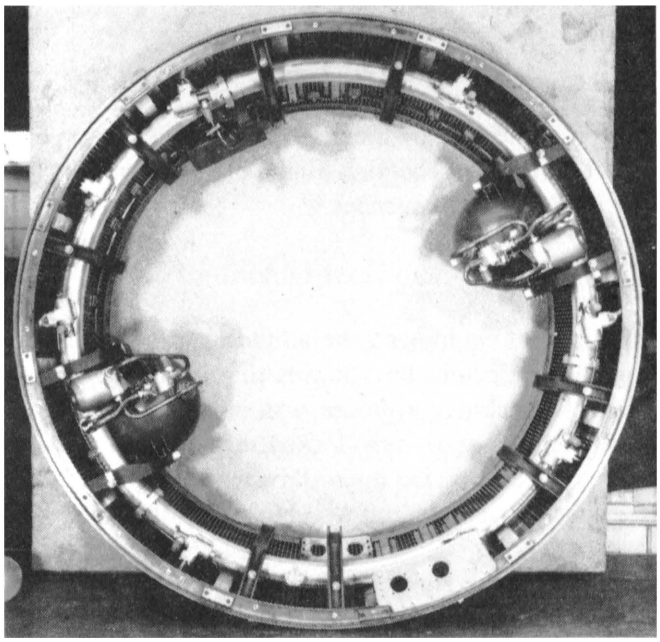
- 2 for several ground tests.
- 1 vibration prototype.
- 2 flight prototype (only one flown).

Pitch-Over System

Even though the pitch-over system concerned the launcher and not the satellite, it was a fundamental element in the process of placing the satellite A-1 in orbit.



Pitch-Over System (Matra Photo).



Pitch-Over System (Matra Photo).

As the pitch-over system had never been tested in flight before the first Diamant flight, the Matra technicians were very careful, during the design and realization of it. Many tests, especially regarding vibration, were conducted on a special test bench.

System Sequences

The pneumatic pitch-over system was used to bring the vehicle to a horizontal plane and point it out precisely toward the right direction before the firing of the third stage. The pitch-over system was placed forward of the second stage. The separation of the second/third stages would occur after positioning the vehicle.

System Description

The system was equipped with fixed micro-thrusters, placed at the periphery of the second stage back skirt. These micro-thrusters were fed with nitrogen under pressure, stored at 240 bars inside two spherical tanks: the feeding was realized at 20 bars pressure through two valves which supplied a toric distribution section. This section was operated with different nozzles through electrovalves which could be opened or closed by logic orders.

Tests of the Pitch-Over System

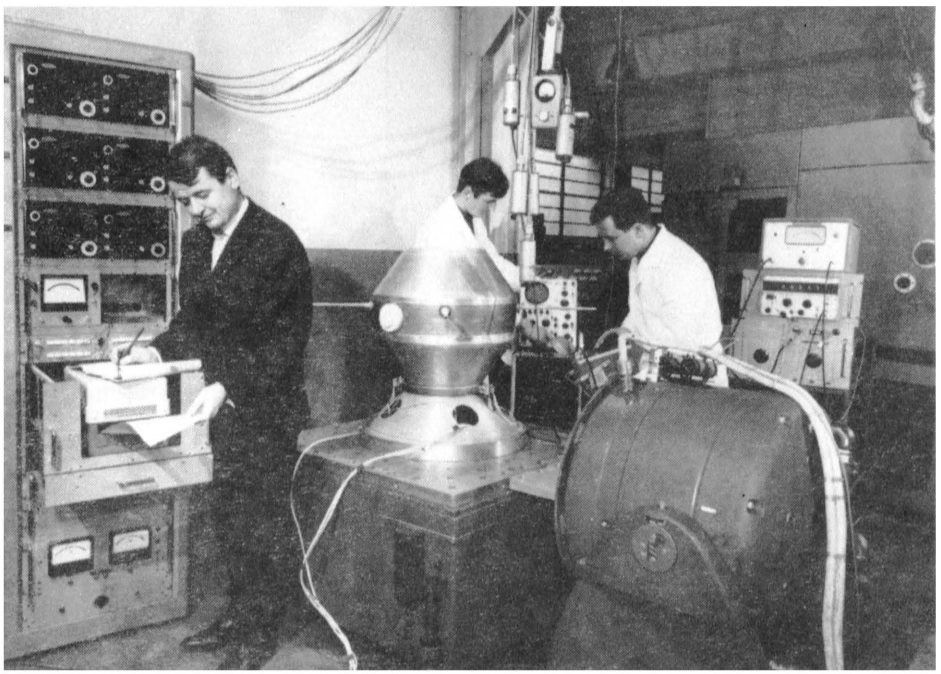
One of the more acute difficulties to be solved was the problem of the amplification of vibrations generated during the thrust phase of the launcher, especially vibrations generated by the Pogo effect, that had appeared during previous Emeraude test flights. The first flight of Diamant was subjected to the same effect, but with real consequences.[10]

Electronic

All electronic pilot equipment, the attitude platform, and gyrometers were grouped also in the equipment bay. It was during the extinction phase of the second stage that the inclination device was initiated. Simultaneously the four orientable second stage nozzles were locked in a neutral position, and the control of attitude was realized by the micro-thrusters of the pitch-over system.

At the burnout of the engine, the vehicle was stabilized on the calculated attitude: micro-thrusters jettisoned brief impulses to maintain angular deviation within the scheduled limits (0.9° in pitch, 1° roll and 1.8° in yaw). Around twenty seconds after the second stage burnout the attitude calculator sent an order to "pitch inclination": The vehicle was inclined on the horizontal at an 0.6°/sec angular speed rate; simultaneously roll-yaw micro-thrusters continued to control the angular deviation on those two axes.

The vehicle reached the right inclination about one minute and a half following the beginning of the pitch maneuver: At the final step of pointing out, the sequential calculator sent an order to reduce at a maximum of 0.15° in pitch and 0.3° in yaw around these two axes. Immediately following, another order was given to put in rotation the vehicle: pitch micro-thrusters were then stopped.

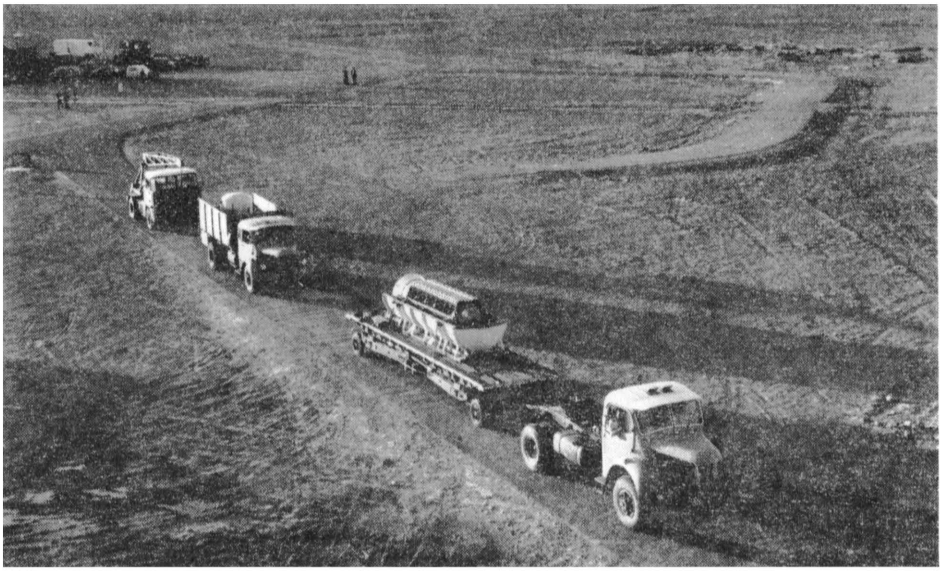


Vibrations Tests at Matra Facilities (Matra Photo).

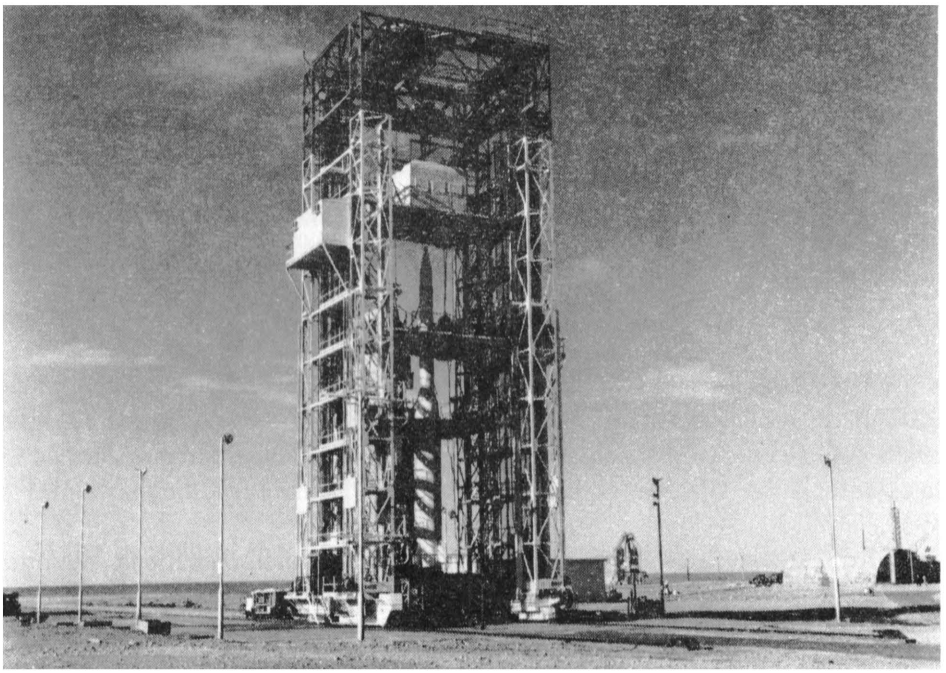
Launch Operations

The final integration of launcher and satellite were conducted, under SEREB responsibility, at the end of October 1965, at the Integration Facilities of the CAEPE de Saint-Médard-en-Jalles. When the integration was finished the satellite and the Diamant's parts were sent to Hammaguir, on November 4, 1965.

Among anecdotes arising during the preflight launch operations, one question was difficult to solve. What must be painted on the Diamant vehicle? Every contractor wished to see their logos on the rocket. This important point was resolved by the painting of a French Tricolor emblem. But on the following flights of Diamant the contractors' logos would be painted on the launchers.



Arrival of Diamant and Satellite on the Launch Pad
(Photo: © SIRPA/ECPA France).

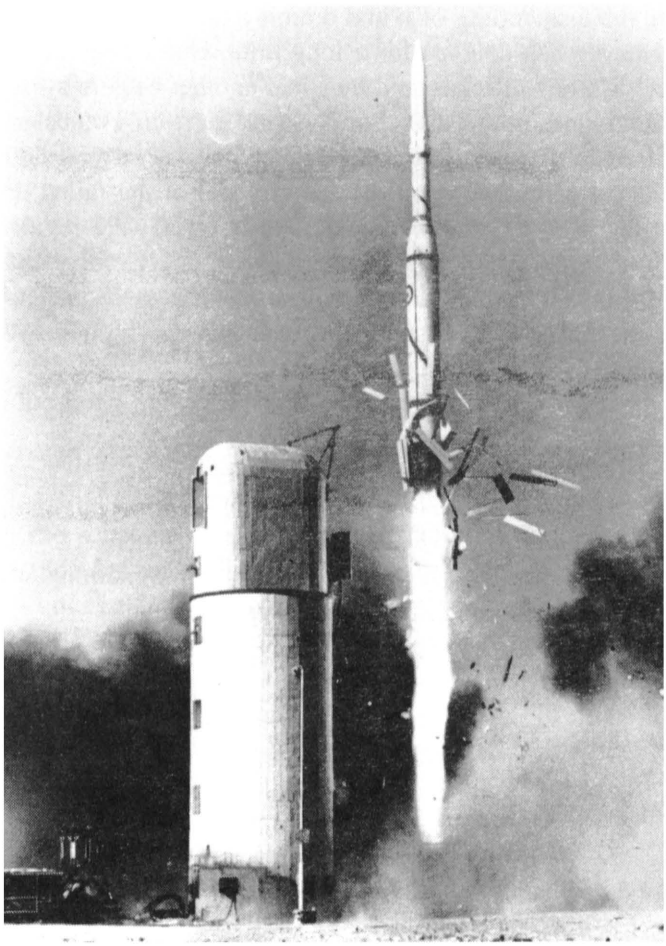


Diamant Ready to Launch at the Brigitte Site
(Photo: © SIRPA/ECPA France).

The Launch

Under the responsibility of the DMA, the launch occurred, after several false starts, on November 26, 1965 at 14h 47mn 21s 15/100 (T.U) (15h 47mn Paris hour) from the launching pad B-2 (called Brigitte) at the Hammaguir Test Range in Centre Interarmées d'Essais d'Engins Spéciaux (CIEES).[11]

The launch was announced in Paris by a press release from the French Presidency, just a few minutes after 6.00 pm. A press release from the French Minister of Army (6.24 pm) almost immediately gave the first details of the launch. In the evening, General Nordin gave a press conference at the French Ministry of the Army, in which he detailed the launch operation.



Launch of A-1 Satellite, November 26, 1965
(Photo: © SIRPA/ECPA France).

Reports

On November 26, 1965 the final count-down had already started at 00 h 56 mn (T.U); the launch was scheduled for 6 h 30 mn (T.U), but several incidents came which perturbed and stopped the chronology. The most significant one was a failure of a Zener diode on an electronic circuit board of the pitch-over equipment. If this failure did not doom the launch, it was nevertheless decided to research the possible origin and to evaluate the risk of a malfunctioning of the component during flight.

This failure occurred when the launcher was in its flight configuration: the first stage tanks were filled with corrosive hypergolic propellants.

Even though a back-up system existed on the Hammaguir base, it was important to avoid changing the electronic system. A change of the system would involve the dismantling of it and draining the launcher. By doing this, the launch would have been delayed for a long time. Don't forget the general concern in France! Matra's officials said they had another backup system at Matra's facilities in Boulogne, near Paris. For the first time in France a process was rapidly organized to detect failure at a distance. During several hours numerous endurance tests were conducted on the same model of the failed diode, at Boulogne. The officials on the Hammaguir Launch Center were regularly informed about the progress of tests. When those tests were satisfactory, and after taking the advice of MM. C. Attali and P. Quetard, Général Soufflet, Director of Flight, made the decision to resume the count-down chronology. The launch sequence would commence again after lunch.

The flight sequences of the Diamant launcher were good but not nominal. However, the capsule A-1 was put in orbit.

First Orbit Parameters

In orbit the satellite A-1 took the International Denomination: 1965-96A. A-1 was placed on an orbit slightly different than nominal.

First Orbit Parameters

- Perigee, 528 km.
- Apogee, 1752 km.
- Inclination, 34.39°.
- Period, 108.8 mn.

During this launch, the performance of the Diamant A no. 1 launcher placed 107 kg in orbit:

Satellite: 38 kg.
Separation system: 4 kg.
Third stage: 65 kg.

Unfortunately, a short time after the launch the telemetry signals were scrambled and disrupted. Only the radar transponder had allowed the tracking of the satellite. The reason of the failure in telemetry was damage or the breakage of one telemetry antenna, when the faring was jettisoned.

Tracking Network

Tracking of the satellite was followed both by CIEES and the new CNES Tracking Network. Telemetry stations were installed in Hammaguir, Bretigny (France), Pretoria (South Africa), Ouagadougou (Haute-Volta) and Brazzaville (Congo). The reception of satellite signals was obtained by Hammaguir and Bretigny Station for two days. Diane localization equipment was placed at Hammaguir and Pretoria, during the first semester of 1965. Tests and calibration were conducted during the May-June period. The calibration of interferometers was made with American satellites.

The satellite was also tracked by a "Telemaque" antenna mounted on the *Guepratte*, an escort vessel of Marine Nationale, cruising near the Gabes Gulf (Tunisia).

A large antenna, the "Cyclope," at Hammaguir also received some strong signals after the launch of Diamant. The "Aquitaine" Radar for trajectography, placed at Colomb-Bechar followed the satellite 11 mn 17 s during the launch sequence, and 10 mn at every orbit.

Conclusion

The first flight of Diamant A rocket was a success. In consequence, as it had been in the schedule of the agreement between DMA and CNES (May 9, 1865), it was decided after this flight that no other experimental and technological capsule would be launched. The three remaining Diamant As were reserved for CNES use. It started preparation for its first geodesic satellite D1-A, which would be launched two months later, on February 17, 1966.

In the meantime, a second French satellite, FR-1, was successfully launched, from Vandenberg, by an American Scout launcher, on December 6, 1965.

At the beginning of 1966 the French space program became a reality. The three other Diamant As were launched from Hammaguir in 1967. The new versions of Diamant B and Diamant BP4 were launched from Centre Spatial Guyanais (C.S.G) at Kourou. (See Appendix 4: Diamant Flight Log)

Acknowledgments

For preparation of this paper we interviewed several people who were part of this early program. We especially want to thank:

M. Pierre Quétard, director of the A-1 Matra team.

M. Kordi, from Matra Public Relations.

M. Serge Berg, from press wire agency Agence France-Presse, who was the only reporter to be accredited for this flight at Hammaguir.

M. Hubert Gossot, Aérospatiale, for anecdotes and precisions he gave us about early years of the Diamant program.

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- AFP News.
- Newspapers: Several newspapers were also consulted: Ex: *Paris-Jour;*, *Le Figaro;*, *France-Soir*, etc.

Reference Notes

[1]Organization defending the French Air Headquarters.

[2]In 1970, SEREB had merged with Nord-Aviation, Sud-Aviation to create the Sociéité nationals industrielle Aerospatiale (SNIAS), in which SEREB teams were composed mainly as part of the new, Division des Systèmes Balistiques et Spatiaux.

[3]SEREB creation followed works from an expert group, created on September 30, 1958.

[4]Loi no.61-1382 du 19 décembre 1961. – The law creating a French national space center (CNES).

[5]Note SEREB citée par Jacques Morisset in *Air & Cosmos*, no. 129, 4 décembre 1965, p. 15.

[6]Cette note fait état pour la première fois de la technique du Roving, développée chez Sud-Aviation à Courbevole.

[7]About the "Agate" test vehicle, see Jung, Philippe, IAA History paper, 1992. Published in, *History of Rocketry and Astronautics*, Vol. 21, *AAS History Series*, P. Jung, ed., 1997, pp. 229-268.

[8]Excerpt from Jack Muller, citation, CNES. In Les trente premières années du CNES. p. 147.

[9]"Astérix le Gaulois," Goscinni et Uderzo, 1961, ed. Dupuis, (Paris).

[10]The trouble of the Pogo effect, met principally on VE 121 "Emeraude," was resolved by M. Melin.

[11]CIEES was created April 24, 1947 and the first missile prototype was fired in December 1949. CIEES was composed of Colomb-Béchar and the Hammaguir base. CIEES was left in 1967, after France left Algeria. A new space center was built in Kourou, French Guyana.

Appendix 1: Diamant A – Technical Data

GENERAL DESCRIPTION

Total Length with Faring	18,942 m
Total Mass (Take-off)	18 400 kg
Diameter Max.	1,40 m
Envegure Totale	2,70 m
Number of Stages	3

STAGES CHARACTERISTICS

désignation	1st stage (VE 121)	2nd stage (VE 111)	3rd stage
Lenght	10m	4,7m	2,06m (without fairing)
Diameter	1,40m (2,70 with wings)	0,80m	0,66m
Mass (empty)	1 950kg	670kg	67,9kg
Thrust	30 t env.	15t	2,7 à 5,3t
Combustion duration	93s	44 s	45s
propergols	liquid	solid	solid
Combustible/comburant	terebenthine /nitric acid	powder isolane	powder isolane
Mass ergols combustible comburant	12 645 kg 3 070 kg 9 700 kg	2 260kg	641 kg
Totale Mass	14 710 kg	2 960kg	710kg

Appendix 2: "SAPHIR" (VE 231P) – Launches

#	launch dates	results	
1	July 5, 1965	success	
2	July 10, 1965	partial success	2nd stage failed
3	October 9, 1965	success	

Appendix 3: "RUBIS" (ve 210) – Launches

#	launch dates	results	
1	june 10, 1964	success	
2	june 12, 1964	success	
3	October 12, 1964	partial success	
4	December 18, 1964	partial success	
5	May 31, 1965	success	
6	June 3, 1965	success	
7	June 5, 1965	success	CNES - equipment bay + D1 Mockup
8	Septembre 29, 1965	succes	CNES - equipment bay + D1 mockup

Appendix 4: "Diamant" Launches

DIAMANT A

Launches from Hammaguir

Launcher	Launch Dates	Result	Satellite Names	Mass	Mission
Diamant A-1	November 26, 1965	success	A1 - Astérix	42 kg	Technology
Diamant A-2	Février 17, 1966	success	D1-A - Diapason	18, 5 kg	Geodesy
Diamant A-3	February 8, 1967	success	D1-C - Diadème 1	23 kg	Geodesy
Diamant A-4	February 15, 1967	success	D1-D - Diadème 2	23 kg	Geodesy

DIAMANT B

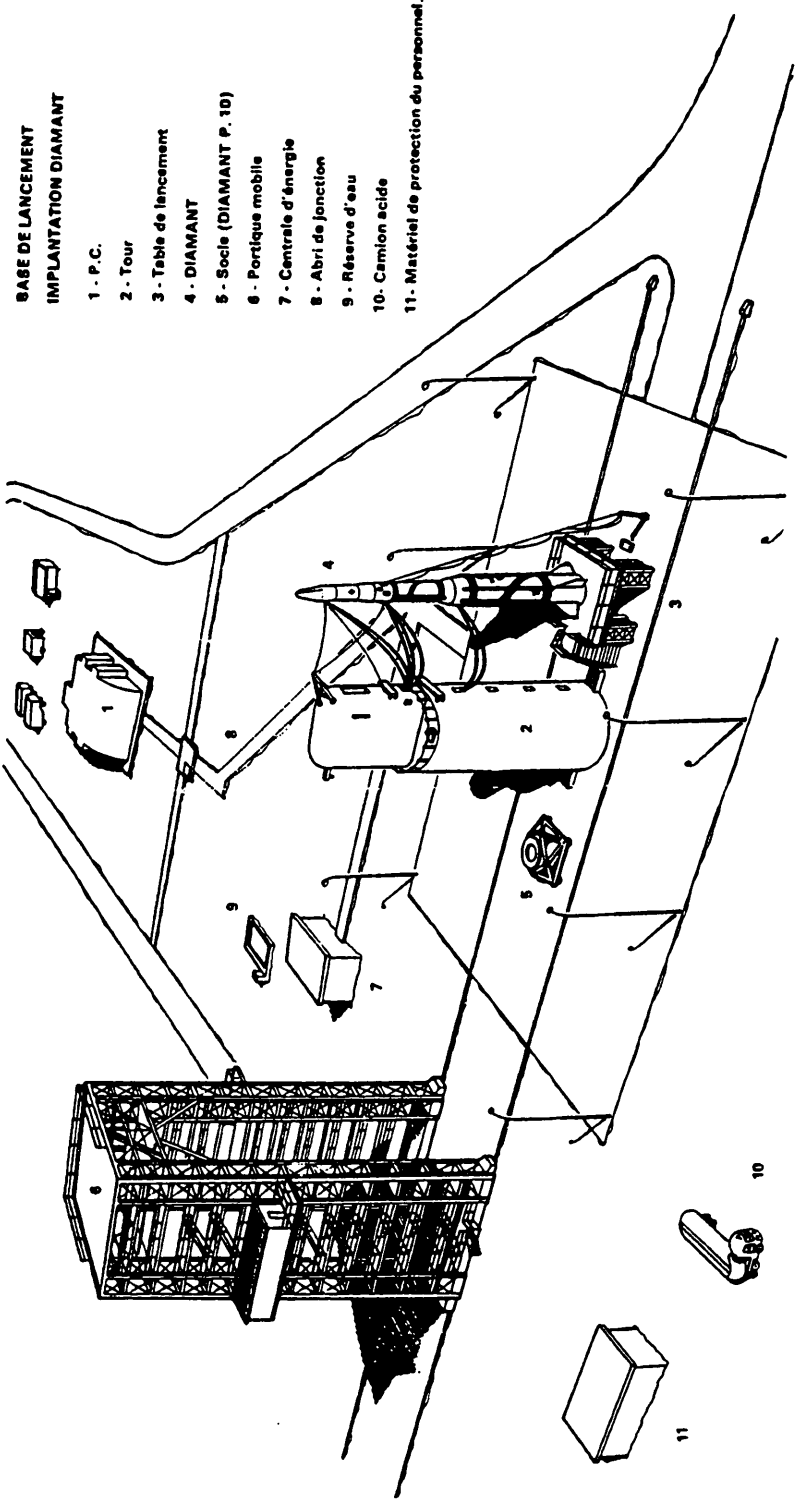
Launches from Kourou (French Guyana)

Launcher	Launch Dates	result	Satellites Names	Mass	Mission
Diamant B-1	March 10, 1970	success	Wika Mika	6 3 kg 52 kg	Aeronomy
Diamant B-2	December 12, 1970	success	Peole	60 kg	Technology/ Geodesy
Diamant B-3	April 15, 1971	success	D2-A Tournesol	96 kg	aéronomique
Diamant B-4	December 5, 1971	failed	D2-A Polaire	96 kg	aéronomique
Diamant B-5	May 22, 1972	failed	D5A Castor D5-B Pollux	36 kg 76 kg	technologiques

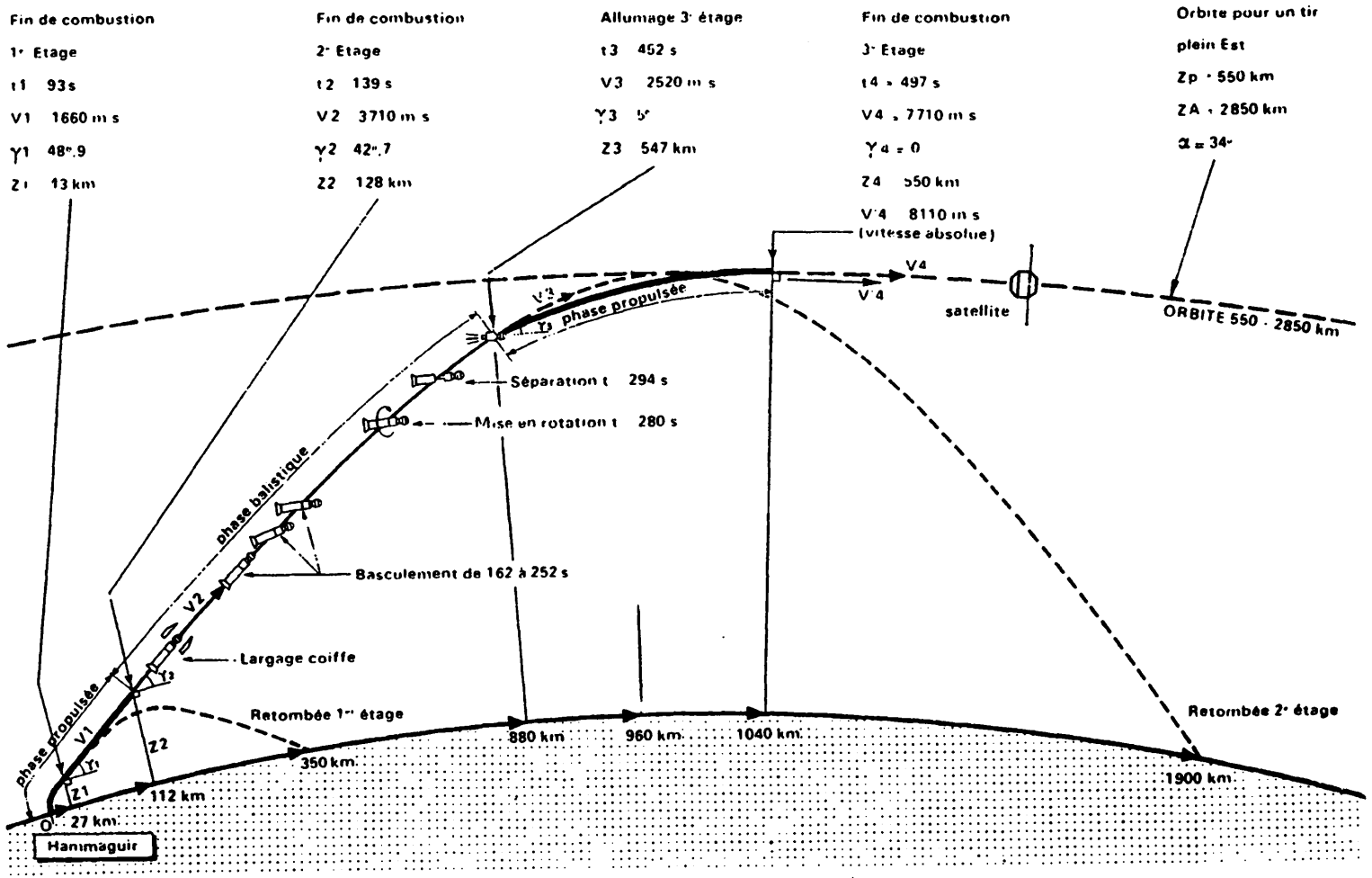
DIAMANT BP-4

Launches from Kourou (French Guyana)

Launcher	Launch Dates	Result	Satellite Names	Mass	Mission
Diamant BP4-1	February 6, 1975	success	Starlette 1	47 kg	Geodesy
Diamant BP4-2	May 17, 1975	success	D5-A Castor & D5-B Pollux	36 kg 76 kg	Technlogy
Diamant BP4-3	September 27, 1975	success	D2B- Aurora		Astronomy



Hammaguir - Diamant Launching Pad B-2 "Brigitte."



Flight Sequences of the First Diamant A with Satellite A-1.