

# VV07

PerúSAT-1  
SkySats-4 to 7





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# A MULTI-PAYLOAD VEGA MISSION FOR EARTH OBSERVATION

For its seventh launch of the year, and seventh Vega mission since the light launcher began operations at the Guiana Space Center— French Guiana, in 2012, Arianespace will orbit the PerúSAT-1 satellite as part of a turnkey contract with Airbus Defence and Space for the Peruvian space agency CONIDA, and the SkySats-4 to 7 satellites for the American operator Terra Bella, a Google company.

With this multi-payload Vega mission, Arianespace clearly confirms that its light launcher offers the adaptability needed to meet emerging requirements in the broad-based Earth observation market.

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#### • PerúSAT-1

PerúSAT-1 is Peru's first Earth observation satellite. Ordered within the scope of an agreement between the Peruvian and French governments, this launch is being carried out under a turnkey contract with Airbus Defence and Space for the Peruvian space agency CONIDA.

PerúSAT-1 is a powerful optical observation satellite featuring very high resolution (0.7 meters). It is equipped with a latest-generation silicon carbide optical sensor.

Built by Airbus Defence and Space in Toulouse, France, using an AstroBus-S platform and its NAOMI instrument, the satellite will be injected into Sun-synchronous orbit at an altitude of 675 km. PerúSAT-1 will operate at an altitude of 695 km to take pictures of the entire globe.

PerúSAT-1 will be the 115th satellite built by Airbus Defence and Space to be launched by Arianespace. Arianespace's order book includes 13 more satellites from this manufacturer, along with a special order for the OneWeb constellation, involving over 600 satellites.

#### SkySats-4 to 7

SkySat-4, 5, 6 and-7 are the first four of these micro-satellites to be launched by Arianespace for Terra Bella, a new customer and a commercial operator of Earth observation satellites.

Terra Bella is a Google company using data from space to solve problems on Earth. SkySat-4,5, 6, and 7 will augment Terra Bella's existing 3 on-orbit satellites—growing the constellation and enabling Terra Bella to help enterprise customers solve the challenges affecting their business and generate insights into important global economic, environmental, and humanitarian challenges.

The four satellites, SkySats-4 to 7, will be injected into a Sun-synchronous orbit at an altitude of 500 km. They will be used to provide very-high-resolution (sub meters) maps of the entire Earth. Initially, they will provide complete coverage once a day, eventually increasing that rate to several times a day.

SSL (Space Systems/Loral) in Palo Alto, California, USA, is Terra Bella's contract manufacturer. Designed by Terra Bella and using the Skysats 4-7 dedicated platform, these satellites will be the 55th to 58th SSL spacecraft launched by Arianespace.

The Arianespace order book includes five more SSL geostationary communications satellites.

### CONTACT PRESSE

Isabelle Veillon  
i.veillon@arianespace.com  
+33 (0)1.60.87.60 04





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## PerúSAT-1 SkySats-4 to 7

### MISSION DESCRIPTION

The seventh Vega launch from the Guiana Space Center (CSG) will place its satellite passengers into two elliptic low-Earth orbits.

The launcher will be carrying a total payload of approximately 1,230 kg.

The launch will be from the Vega Launch Complex (SLV) in Kourou, French Guiana.

### DATE AND TIME



Liftoff is scheduled for **Thursday, September 15, 2016**, at exactly:

- > **10:43:00 p.m.**, local time in French Guiana
- > **08:43:35 p.m.**, Lima – Peru time,
- > **09:43:00 p.m.**, Washington D.C. time
- > **01:43:00 a.m.**, Universal Time (UTC) on September 16
- > **03:43:00 a.m.**, Paris time on September 16.

### MISSION DURATION



The nominal mission duration (from liftoff to separation of the satellites) is: **1 hour, 42 minutes and 59 seconds.**

### TARGETED ORBIT for PerúSAT-1

Elliptic low-Earth orbit - Semi major axis of **675 km.**



**Perigee altitude**  
667 km.



**Apogee altitude**  
684 km.



**Inclination**  
98.2 degrees

### TARGETED ORBIT for SkySat-4, 5, 6 and 7

Elliptic low-Earth orbit Semi major axis of **500 km.**



**Perigee altitude**  
491 km.



**Apogee altitude**  
508 km.



**Inclination**  
97.4 degrees

### THE LAUNCH AT A GLANCE

Following liftoff from the Guiana Space Center, the powered phase of Vega's first three stages will last 6 minutes and 41 seconds. After this first phase, the launcher's third stage will separate from the upper composite, which includes the AVUM upper stage, a payload adapter and the satellites. The lower three stages will fall into the sea.

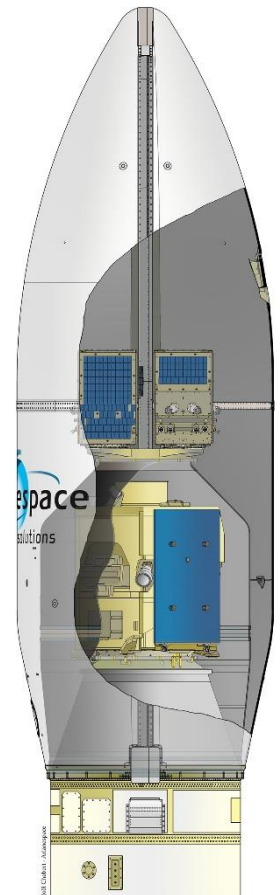
The AVUM upper stage will ignite its engine for the first time, operating for about six minutes, followed by a ballistic phase lasting approximately 24 minutes. The AVUM stage will then reignite its engine for about one and a half minutes, prior to releasing the SkySats-4 to 7 satellites about one minute after the engine is shut down.

The AVUM upper stage will ignite its engine for the third time, operating for about one minute, followed by a new ballistic phase lasting approximately 14 minutes. The AVUM stage will then reignite its engine for about one and a half minutes, prior to releasing the PerúSAT-1 spacecraft about one minute after the engine is shut down.

The PerúSAT-1 satellite will be released at 1 hour, 42 minutes and 59 seconds after liftoff.

### VEGA PAYLOAD CONFIGURATION

- > **Lower payload (CUH): PerúSAT-1**  
Mass at liftoff: 430kg.
- > **Upper payload (CUB): SkySat-4, 5, 6 and 7**  
Mass at liftoff: 4 x 110 kg. – 440 kg.in total.
- > **VESPA - Vega Secondary Payload Adaptor**

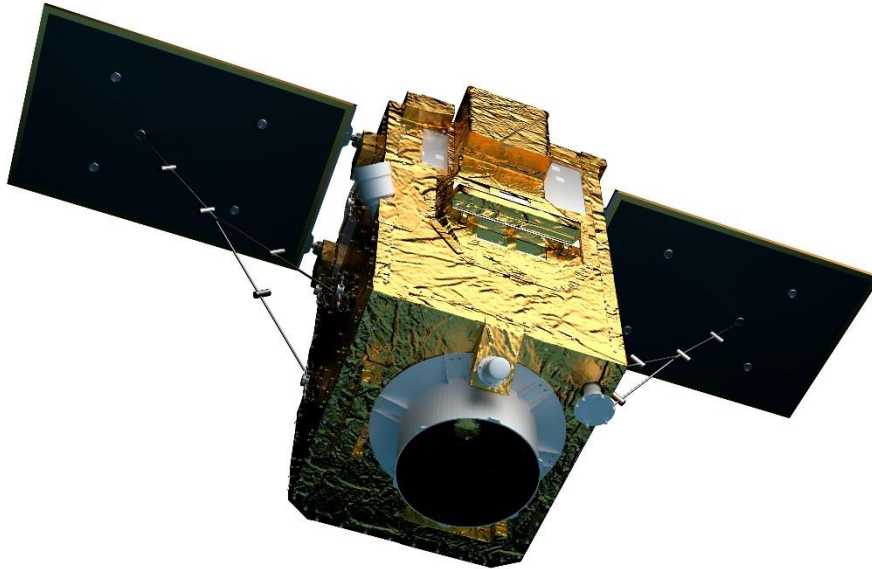




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## PerúSAT-1 SATELLITE



<b>CUSTOMER</b>	Airbus Defence and Space, on behalf of CONIDA (Peruvian Space Agency)
<b>PRIME CONTRACTOR</b>	Airbus Defence and Space
<b>MISSION</b>	Earth observation
<b>PLATFORM</b>	AstroBus-S
<b>MASS</b>	Approximately 430 kg. at liftoff
<b>STABILIZATION</b>	Three axis
<b>DIMENSIONS</b>	1.0 m x 1.0 m x 1.7 m
<b>TARGETED ORBIT</b>	At injection : Sun-synchronous orbit at 675 km. of altitude / Operational orbit at 695 km.
<b>DESIGN LIFE</b>	10 years

**CONTACT PRESSE**

**Airbus Defence and Space**  
**Francisco Lechón**  
 Head of Communication / Space Systems / Spain  
[www.airbusdefenceandspace.com](http://www.airbusdefenceandspace.com)  
 Tel: +34 91 585 56 30  
 Mobile: +34 630 196 993



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## SkySats-4 to 7 MICRO-SATELLITES



<b>CUSTOMER</b>	Terra Bella
<b>PRIME CONTRACTOR</b>	SSL (Space Systems/Loral)
<b>MISSION</b>	Earth observation
<b>PLATFORM</b>	Skysats 4-7
<b>MASS</b>	Approximately 110 kg. at liftoff for each micro-satellite (440 kg. in total)
<b>STABILIZATION</b>	Three axis
<b>DIMENSIONS</b>	60 cm x 60 cm x 95 cm
<b>TARGETED ORBIT</b>	Sun-synchronous orbit at 500 km. altitude

**PRESS CONTACT**

**Terra Bella**  
**Mara Harris**  
[maraharris@google.com](mailto:maraharris@google.com)

**SSL (Space Systems/Loral)**  
**Joyce Wong**  
Marketing Communications Manager  
[Joyce.Wong@sslmda.com](mailto:Joyce.Wong@sslmda.com)  
Office : +1 650-852-6015  
[sslmda.com](http://sslmda.com)

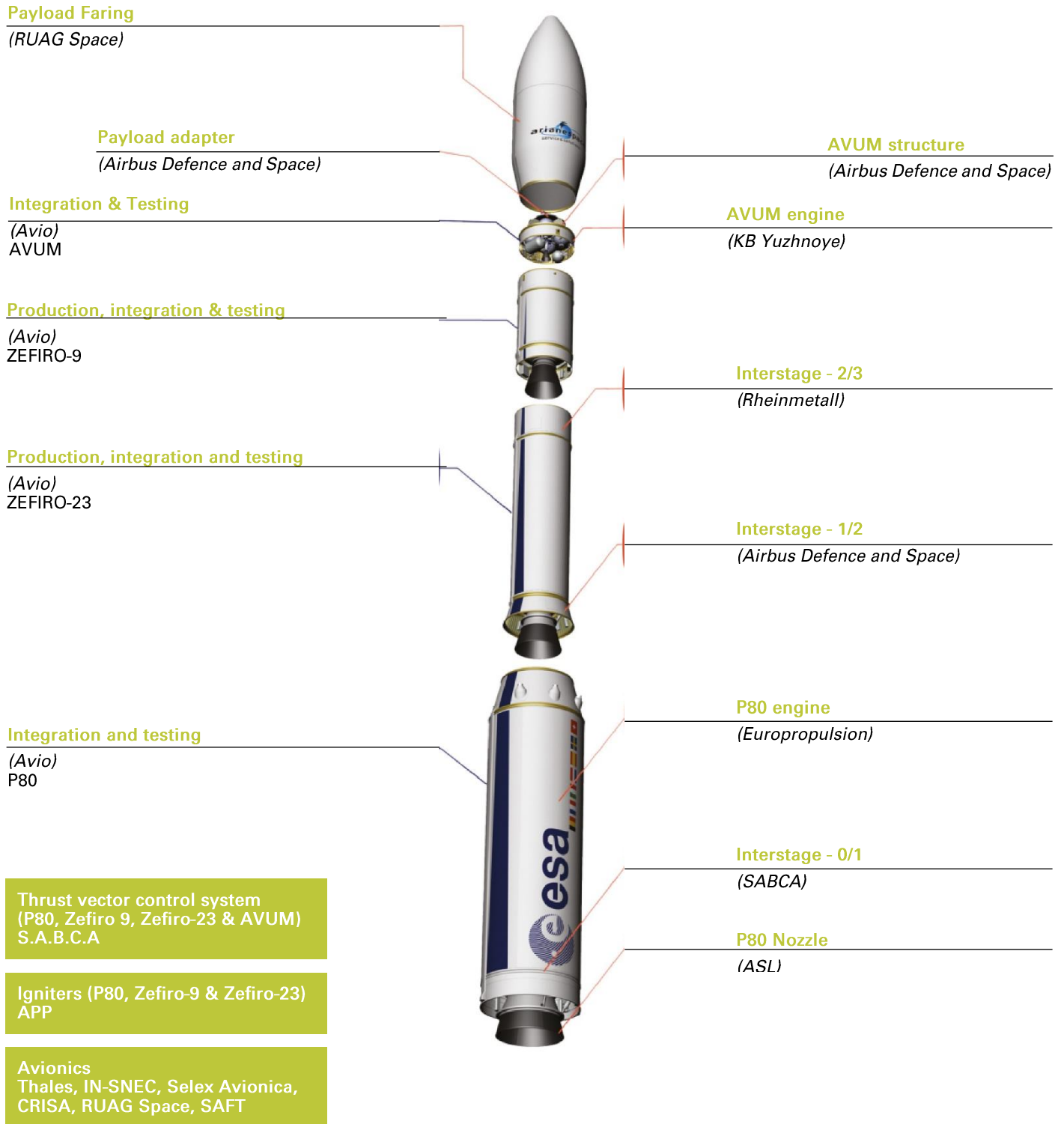


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# THE VEGA LAUNCHER

ELV – the production prime contractor – delivers the Vega launcher to Arianespace.





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# LAUNCH CAMPAIGN: VEGA - PerúSAT-1 / SkySats-4 to 7

## SATELLITES AND LAUNCH VEHICLE CAMPAIGN CALENDAR

DATE	SATELLITE ACTIVITIES	LAUNCH VEHICLE ACTIVITIES
June 1, 2016		Campaign start review - Transfer of P80 stage
June 7, 2016		Interstage 1/2 integration
June 8, 2016		Z23 integration
June 14, 2016		Z9 integration
June 20, 2016		AVUM integration
June 28, 2016		Synthesis control test
August 5, 2016	Arrival in French Guiana of PerúSAT-1; beginning of preparation in the S3B facility	
August 12, 2016	Arrival in French Guiana of SkySats-4 to 7; beginning of preparation in the S5 facility	
August 19, 2016	Beginning of SkySats-4 to 7; fueling operations in S5B hall	
August 22, 2016	PerúSAT-1 fueling operations in S3B hall	
August 25, 2016	Beginning of the integration of the first two SkySats in S5B hall PerúSAT-1 integration on payload adapter in S3B	
August 26, 2016	Integration of the last two SkySats in S5B hall	
August 29, 2016	PerúSAT-1 encapsulation in the VESPA (Vega Secondary Payload Adaptor)	
August 29, 2016	SkySats-4 to 7; transfer from S5B to S3B hall	
August 30, 2016	SkySats-4 to 7; integration on VESPA	
August 30, 2016		Launcher final inspection
August 31, 2016	Encapsulation SkySats-4 to 7; and VESPA in payload fairing (to create the upper composite)	
September 1 <sup>st</sup> , 2016		Completion of fairing, and preparation of upper composite for transfer

## SATELLITE AND LAUNCH VEHICLE CAMPAIGN FINAL CALENDAR

DATE	SATELLITE ACTIVITIES	LAUNCH VEHICLE ACTIVITIES
Friday, September 2, 2016	Transfer of upper composite from S3B to SLV	
Monday, September 5, 2016	Composite Integration on the launcher	
Thursday, September 8 to Saturday, September 10, 2016		Fueling operations for RACS (Roll and Attitude Control Subsystem) and AVUM
Monday, September 12, 2016		AVUM final pressurization and rehearsal
Tuesday, September 13, 2016		Arming of launch vehicle and fairing
Wednesday, September 14, 2016		Launch readiness review (RAL), final preparation of launcher and final inspection of the fairing
Thursday, September 15, 2016		Final launch countdown



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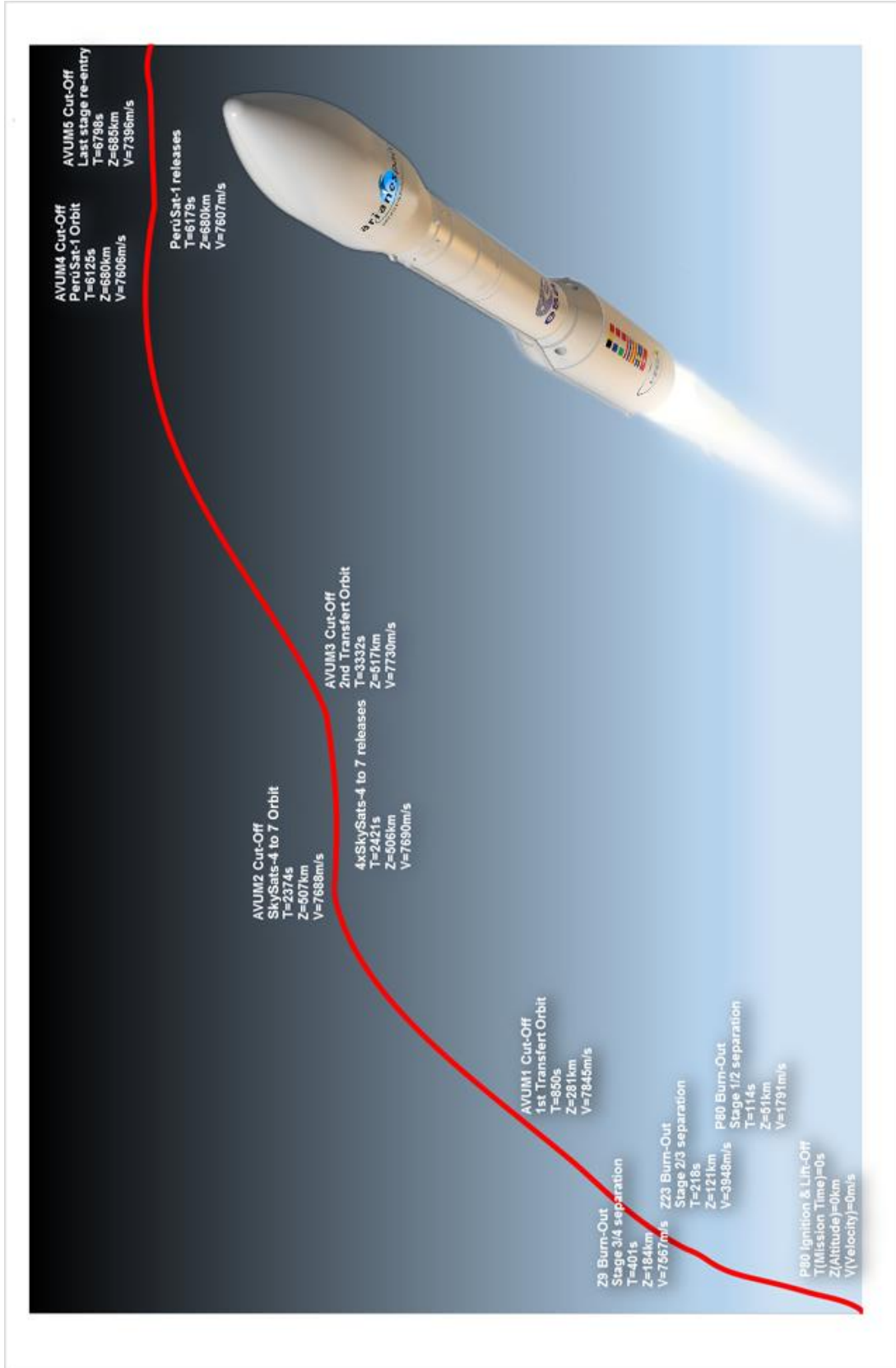
## COUNTDOWN AND FLIGHT SEQUENCE

The countdown comprises all final preparation steps for the launcher, the satellites and the launch site, including the steps leading up to authorization of P80 first-stage ignition.

TIME	EVENT
- 09 h 00 min	Start of final countdown
- 05 h 50 min	Activation of Multi-Functional Unit (MFU)
- 05 h 30 min	Activation of Inertial Reference System (IRS)
- 05 h 30 min	Activation of telemetry
- 05 h 00 min	Activation of Safeguard Master Unit (SMU)
- 04 h 30 min	Activation of onboard computer and loading of flight program
- 04 h 40 min	Removal of safety devices
- 04 h 20 min	IRS alignment and checks
- 03 h 05 min	Mobile gantry withdrawal (45 min.)
- 02 h 15 min	IRS alignment and checks after withdrawal of gantry
- 01 h 15 min	Activation of the telemetry transmitter after withdrawal of gantry
- 01 h 15 min	Activation of transponders and receptors
- 00 h 40 min	Launcher system ready
- 00 h 10 min	Last weather report prior to launch
- 00 h 04 min	Start of synchronized sequence

T-O	00 s	LIFTOFF
+ 00 h 01 min	54 s	1 <sup>st</sup> stage (P80) separation
+ 00 h 01 min	54 s	2 <sup>nd</sup> stage (Zefiro-23) ignition
+ 00 h 03 min	38 s	2 <sup>nd</sup> stage (Zefiro-23) separation
+ 00 h 03 min	59 s	3 <sup>rd</sup> stage (Zefiro-9) ignition
+ 00 h 04 min	04 s	Fairing separation
+ 00 h 06 min	41 s	3 <sup>rd</sup> stage (Zefiro-9) separation
+ 00 h 08 min	07 s	1 <sup>st</sup> ignition of AVUM
+ 00 h 14 min	10 s	1 <sup>st</sup> cut-off of AVUM
+ 00 h 38 min	05 s	2 <sup>nd</sup> ignition of AVUM
+ 00 h 39 min	34 s	2 <sup>nd</sup> cut-off of AVUM
+ 00 h 40 min	21 s	SkySat-4 release command
+ 00 h 40 min	23 s	SkySat-5 release command
+ 00 h 40 min	25 s	SkySat-6 release command
+ 00 h 40 min	28 s	SkySat-7 release command
+ 00 h 54 min	44 s	3 <sup>rd</sup> ignition of AVUM
+ 00 h 55 min	31 s	3 <sup>rd</sup> cut-off of AVUM
+ 01 h 41 min	20 s	4 <sup>rd</sup> ignition of AVUM
+ 01 h 42 min	05 s	4 <sup>d</sup> cut-off of AVUM
+ 01 h 42 min	59 s	PerúSAT-1 release command
+ 01 h 52 min	03 s	5 <sup>rd</sup> ignition of AVUM
+ 01 h 52 min	18 s	5 <sup>rd</sup> cut-off of AVUM
+ 02 h 06 min	38 s	End of the Arianespace mission

# MISSION PROFILE





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# ARIANESPACE AND THE GUIANA SPACE CENTER

## ARIANESPACE, THE WORLD'S FIRST LAUNCH SERVICES COMPANY

Arianespace was founded in 1980 as the world's first launch services & solutions company. Arianespace now has 20 shareholders from 10 European countries (including Airbus Safran Launchers, CNES and all European companies participating in the production of Ariane launchers). Since the outset, Arianespace has signed over 530 launch contracts and launched 520-plus satellites. More than half of the commercial satellites now in service around the globe were launched by Arianespace. The company posted sales of more than 1.4 billion euros in 2015.

The company's activities are worldwide, with the headquarters in Evry, France (near Paris); the Guiana Space Center in French Guiana, where the Ariane, Soyuz and Vega launch pads are located; and offices in Washington, D.C., Tokyo and Singapore. Arianespace offers launch services to satellite operators from around the world, including private companies and government agencies. These services call on three launch vehicles:

- > The Ariane 5 heavy-lift launcher, operated from the Guiana Space Center in French Guiana.
- > The Soyuz medium-lift launcher, currently in operation at the Guiana Space Center and the Baikonur Cosmodrome in Kazakhstan.
- > The Vega light-lift launcher, also operated from the Guiana Space Center.

Building on its complete family of launchers, Arianespace has won over half of the commercial launch contracts up for bid worldwide in the past two years. Arianespace now has a backlog of more than 70 satellites to be launched.

## THE GUIANA SPACE CENTER: EUROPE'S SPACEPORT

For more than 40 years, the Guiana Space Center (CSG), Europe's Spaceport in French Guiana, has offered a complete array of facilities for rocket launches. It primarily comprises the following:

- > The CNES/CSG technical center, including various resources and facilities that are critical to launch base operations, such as radars, telecom network, weather station, receiving sites for launcher telemetry, etc.
- > Payload processing facilities (EPCU), in particular the S5 facility.
- > Ariane, Soyuz and Vega launch complexes, comprising the launch zones and launcher integration buildings.
- > Various industrial facilities, including those operated by Regulus, Europropulsion, Air Liquide Spatial Guyane and Airbus Safran Launchers - all participating in the production of Ariane 5 components. A total of 40 European manufacturers and local companies are involved in the launcher operations.

Europe's commitment to independent access to space is based on actions by three key players: the European Space Agency (ESA), the French CNES space agency and Arianespace. ESA is responsible for the Ariane, Soyuz and Vega development programs. Once these launch systems are qualified, ESA transfers responsibility to Arianespace as the operator. ESA has helped change the role of the Guiana Space Center, in particular by funding the construction of the launch complexes, payload processing buildings and associated facilities. Initially used for the France's space program, the Guiana Space Center has evolved into Europe's own Spaceport, according to the terms of an agreement between ESA and the French government. To ensure that the Spaceport is available for its programs, ESA takes charge of the lion's share of the CNES/CSG fixed expenses, and also helps finance the fixed costs for the ELA launch complexes.

The French CNES space agency has several main responsibilities at the Guiana Space Center. It designs all infrastructure and, on behalf of the French government, is responsible for safety and security. It provides the resources needed to prepare the satellites and launchers for missions. Whether during tests or actual launches, CNES is also responsible for overall coordination of operations and it collects and processes all data transmitted from the launcher via a network of receiving stations to track Ariane, Soyuz and Vega rockets throughout their trajectories.

## ARIANESPACE IN FRENCH GUIANA

In French Guiana, Arianespace is the contracting authority in charge of operating the family of three launchers, Ariane, Soyuz and Vega.

For Vega, Arianespace supervises the integration and inspection of the launcher built by ELV, which is production prime contractor. Before taking official delivery of the launcher, it coordinates the preparation of satellites in the payload preparation facility (EPCU) operated by CNES/CSG, handles the final assembly of the launcher and integrates satellites on the launcher, and oversees the final countdown and launch from Launch Control Center 3 (CDL3).

Arianespace deploys a top-flight team and technical facilities to ensure the launchers and their satellites payloads are ready for their missions. Building on this unrivalled expertise and outstanding local facilities, Arianespace is now the undisputed benchmark in the global launch services market.