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LAUNCH KIT

AUGUST 2017

VV10

OPTSAT-3000

Venμs

esa TELESPAZIO a LEONARDO and THALES company OHB ITALIA MINISTRY OF DEFENCE IAI ISA Israel Space Agency cnes

FLIGHT VV10: VEGA TO LAUNCH EARTH OBSERVATION SATELLITES FOR ITALY, FRANCE AND ISRAEL

For its eighth launch of the year, and the 10th Vega mission since this launcher began its career at the Guiana Space Center in 2012, Arianespace will orbit OPTSAT-3000 and Venμs - two Earth observation satellites for civil and military applications.

This marks the seventh Earth observation mission for Vega, a light launcher now in full commercial operation, whose versatility has been largely proven during its nine previous missions - all successful.

CONTENTS

OPTSAT-3000

OPTSAT-3000 is an Earth observation program for the Italian Ministry of Defense. It comprises a high-resolution optical satellite and a ground segment for in-orbit control, mission planning and the acquisition and processing of images.

OPTSAT-3000 will allow national defense entities to acquire and use high-resolution images from any part of the globe.

The OPTSAT-3000 system is supplied by the prime contractor Telespazio, a joint venture between Leonardo (67%) and Thales (33%). Telespazio is responsible for the entire system, including the satellite, ground segment, launch and early orbital operations, preparation and execution of operations and logistics, in-orbit tests and commissioning.

The satellite and ground control systems were built by Israel Aerospace Industries (IAI), chosen by the Italian Ministry of Defense on the basis of an inter-governmental agreement between Italy and Israel. OHB Italia is responsible for the launch services and related engineering support.

The OPTSAT-3000 system will be inter-operable with Italy's second-generation COSMO-SkyMed radar satellites. This will give the Italian Defense Ministry access to state-of-the-art technology, and ensure maximum operational capabilities because of the combined optical and radar data offered by the two systems.

OPTSAT-3000 is a three-axis stabilized satellite, highly autonomous and combining reduced weight, low power consumption, and high reliability.

The satellite features:

- High resolution,
- High-precision geolocation,
- High-quality images,
- Reduced weight, which allows a wide range of launch options,
- High agility, thanks to the satellite's reduced weight and small size. This means low inertia, which in turn allows the acquisition of a large number of images,
- Design life exceeding seven years.

The ground segment includes facilities in Fucino, CITS in Pratica di Mare, MBT in Tel Aviv and CIGC in Vigna di Valle.

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Venμs

Venμs is an earth observation and exploratory mission of the Israel Space Agency (ISA) – a government body sponsored by the country's Ministry of Science & Technology – and the French CNES space agency (Centre National d'Etudes Spatiales).

The satellite has a twofold objective:

1. Scientific: Frequent revisits (up to two days) of scientific sites spread worldwide for the study and evolution of vegetation, and for environmental purposes.
2. Technological: In-flight qualification of the Israeli Electrical Propulsion System.

While the satellite's designation may sound like the name of a planet, it actually is the acronym for: Vegetation and Environment monitoring on a New Micro Satellite.

Venμs is equipped with a multi-spectral camera that can capture important details, some of them are not visible to the human eye. The camera operates in 12 wavelengths that work simultaneously. It takes 12 simultaneous images of the same location - each in different spectral bands, including those in the near-infrared range. These separate images are processed into one very precise complete color photograph.

The satellite will image vast areas around the globe and provide dozens of images every day, each of them covering approximately 760 square kilometers. Venμs will fly in a Sun-synchronous, near-polar orbit – which enables its return to view each area around the world, exactly at the same time and under the same imagery conditions.

By analyzing and comparing the images taken from the same location, researchers will be able to assess the state of the soil, understand how vegetation is developing, and detect the spreading of disease or contamination in the field.

The technological payload of Venμs comprises a unique electric propulsion system, which is based on Hall-Effect thrusters. Such an electrical propulsion system allows for minimizing the mass of hydrazine chemical propellant while achieving flexible orbital maneuvers that can be affected online, considerably extending the lifetime. In order to reduce the mission's risk, Venμs is also equipped with a redundant common chemical propulsion system.

The satellite's overall size is only 1.7 X 1.2 meters, with a wingspan of 4.4 meters when the solar array is extended.

CNES is in charge of the multi-spectral instrument (camera), the image processing and the image distribution ground station. Elbit Electro-Optic Systems, Elop Ltd. developed the camera for CNES.

ISA is in charge of development and integration of the satellite, the platform, the monitoring and control center, and the electrical propulsion system. Israel Aerospace Industries (IAI) was the main integrator of the system, as well as the developer of the platform and the ground control system. Rafael is the developer of the electric propulsion system.

The launch service was shared equally by the agencies.

The satellite will be operated from four ground facilities located in Tel Aviv and Haifa in Israel, as well as from Toulouse in France and Kiruna in Sweden.

Both the Venμs and OPTSAT-3000 satellites to be launched on Flight VV10 were built by Israel Aerospace Industries (IAI), based in Tel Aviv, Israel, using the IMPS Bus platform.

IAI Ltd. is Israel's largest aerospace and defense company and a globally recognized technology and innovation leader, specializing in developing and manufacturing advanced, state-of-the-art systems for air, space, sea, land, cyber and homeland security.

The OPTSAT-3000 and Venμs satellites both operate in three frequency bands: S-band (housekeeping), L-band (positioning/GPS) and X-band (data collection).

These are the third and fourth satellites from IAI to be launched by Arianespace, following Amos 1 (May 1996) and Amos 2 (December 2003, orbited via Arianespace's Starsem affiliate).

MISSION DESCRIPTION

The 10th Arianespace Vega launch from the Guiana Space Center (CSG) will place its satellite passengers into two Sun-synchronous orbits (SSO).

The launcher will be carrying a total payload of approximately 990 kg.

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

DATE AND TIME

Liftoff is scheduled for **Tuesday, August 1, 2017**, at exactly:

> **09:58:33 p.m.,** Washington D.C. time
> **10:58:33 p.m.,** local time in French Guiana
> **01:58:33,** Universal Time (UTC), on August 2
> 03:58:33 a.m., Paris time, on August 2
> 04:58:33 a.m., Tel Aviv, time, on August 2

MISSION DURATION

The nominal mission duration (from liftoff to separation of the satellite) is:
1 hour, 37 minutes, 18 seconds.

TARGETED ORBIT for OPTSAT-3000

Orbit
SSO
(Sun-synchronous orbit)

Altitude at separation
Approx. 450 km.
Semi major axis: 6825 km.

Inclination
97 degrees

TARGETED ORBIT for Venμs

Orbit
SSO
(Sun-synchronous orbit)

Altitude at separation
Approx. 720 km.
Semi major axis: 7098 km.

Inclination
98 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 42 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 26 minutes. The AVUM stage will then reignite its engine for about one and a half minutes, prior to releasing the OPTSAT-3000 satellite 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 41 minutes. The AVUM stage will then reignite its engine for about one minute, prior to releasing the Venμs spacecraft about one minute after the engine is shut down.

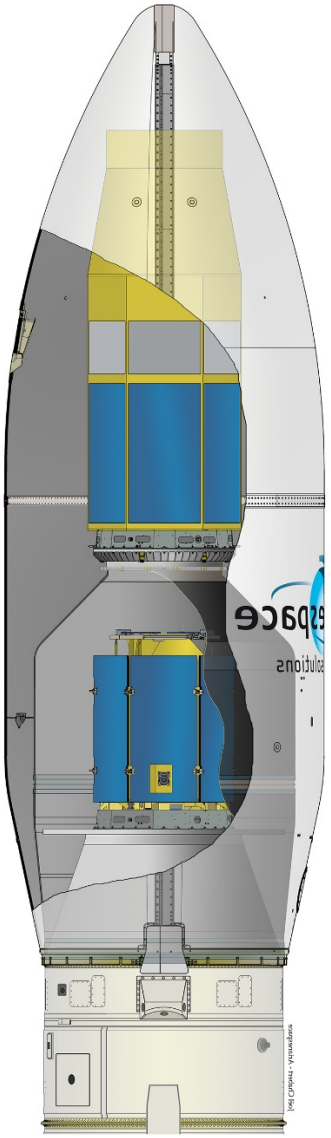
The Venμs satellite will be released at 1 hour, 37 minutes and 17 seconds after liftoff.

VEGA PAYLOAD CONFIGURATION

> **Upper payload (CUH):** OPTSAT-3000
Mass at liftoff: 368 kg.

> **Lower payload (CUB):** Venμs
Mass at liftoff: 264 kg

> **VESPA - Vega Secondary Payload Adaptor (dual launch carrying structure)**



OPTSAT-3000 SATELLITE

CUSTOMER	OHB Italia on behalf of Telespazio for the Italian Ministry of Defence
PRIME CONTRACTOR	Telespazio (manufacturer: Israel Aerospace Industries Ltd)
MISSION	Earth observation
PLATFORM	IMPS bus
MASS	Total mass at launch: 368 kg.
STABILIZATION	3 axis
DIMENSIONS	4.58 m x 3.35 m 1.2 m
TARGETED ORBIT	Sun-synchronous, at an altitude of approximately 450 km.
DESIGN LIFE	7 years

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Venμs SATELLITE

CUSTOMER	Israel Ministry of Science and Technology within the framework of a joint program by CNES and ISA
PRIME CONTRACTOR	Israel Aerospace Industries Ltd (IAI) - Tel Aviv, Israel
MISSION	Earth observation and technology demonstrator
PLATFORM	IMPS bus
MASS	Total mass at launch: 264 kg.
STABILIZATION	3 axis
DIMENSIONS	4.4 m x 1.7 x m 1.2 m
TARGETED ORBIT	Sun-synchronous, at an altitude of approximately 720 km.
DESIGN LIFE	4.5 years

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THE VEGA LAUNCHER

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

Payload faring
(RUAG Space)

Payload adapter
(Airbus Spain)

Integration and testing
(Avio)
AVUM

Production, integration and testing
(Avio)
ZEFIRO-9

Production, integration and testing
(Avio)
ZEFIRO-23

Integration and testing
(Avio)
P80

AVUM structure
(Airbus)

AVUM engine
(KB Yuzhnoye)

Interstage - 2/3
(RheinmetalI)

Interstage - 1/2
(Airbus Netherlands)

P80 engine
(Europropulsion)

Interstage - 0/1
(SABCA)

P80 Nozzle
(ArianeGroup)

Thrust vector control system (P80, Zefiro 9, Zefiro-23 & AVUM)
S.A.B.C.A

Igniters (P80, Zefiro-9 & Zefiro-23)
APP

Avionics
Thales, IN-SNEC, Selex Avionica, CRISA, RUAG Space, SAFT

LAUNCH CAMPAIGN: VEGA – OPTSAT-3000 / Venµs

SATELLITES AND LAUNCH VEHICLE CAMPAIGN CALENDAR

DATE	SATELLITE ACTIVITIES	LAUNCH VEHICLE ACTIVITIES
June 14, 2017		Campaign start review - Transfer of P80 stage
June 20, 2017		Interstage 1/2 integration
June 21, 2017	Arrival in French Guiana of OPTSAT-3000 and Venµs at Felix Eboue Airport (Cayenne)	Z23 integration
June 24, 2017		Z9 integration
June 29, 2017	Transfer of Venµs to S3B	
July 5 and 6, 2017	Venµs fueling operations	
July 6, 2017	Venµs integration on the payload adaptor	
July 6, 2017	Transfer of OPTSAT-3000 to S3B	
July 7, 2017		Synthesis control test
July 10, 2017	Venµs encapsulation in the VESPA (Vega Secondary Payload Adaptor)	
July 11 and 12, 2017	OPTSAT-3000 fueling operations	
July 13, 2017	OPTSAT-3000 integration on VESPA	
July 17 and 18, 2017	The assembled payload is encapsulated in Vega's payload fairing	

SATELLITES AND LAUNCH VEHICLE CAMPAIGN FINAL CALENDAR

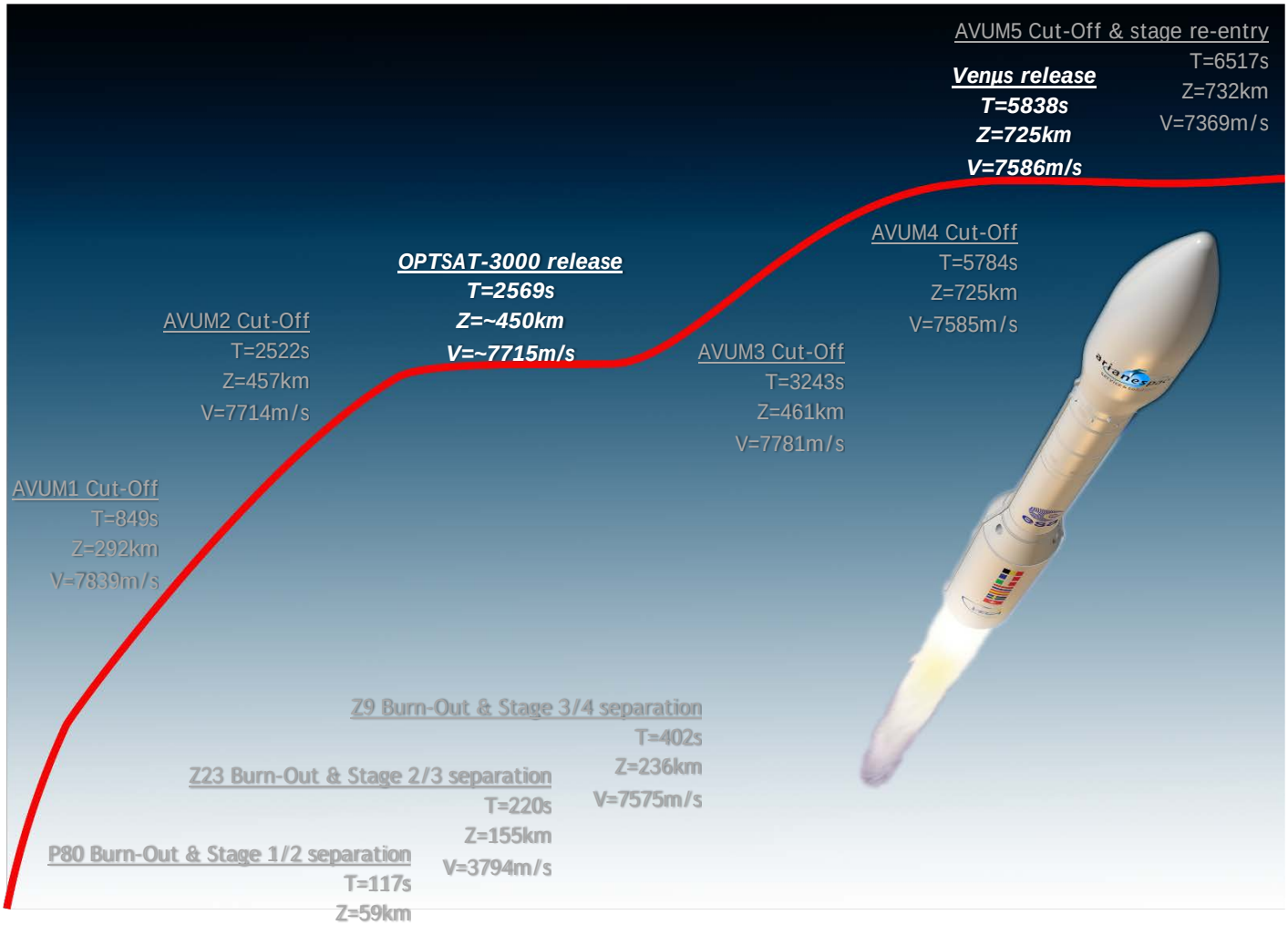
DATE	SATELLITE ACTIVITIES	LAUNCH VEHICLE ACTIVITIES
Wednesday, July 19, 2017	Transfer of upper composite from S3B to SLV (Vega Launch Site)	
Thursday, July 20, 2017	Upper composite integration on the launcher	
From Monday, July 24 to Wednesday July 26, 2017		Fueling operations for AVUM and RACS (Roll and Attitude Control Subsystem)
Thursday, July 27, 2017		AVUM final preparation and rehearsal
Friday, July 28, 2017		Arming of launch vehicle and fairing
Monday, July 31, 2017		Launch readiness review (RAL), final preparation of launcher and final inspection of the fairing
Tuesday, August 1, 2017		Final launch countdown

COUNTDOWN AND FLIGHT SEQUENCE

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

TIME	EVENT
- 09 h 10 min	Start of final countdown
- 06 h 00 min	Activation of Multi-Functional Unit (MFU)
- 05 h 40 min	Activation of Inertial Reference System (IRS)
- 05 h 40 min	Activation of telemetry
- 05 h 10 min	Activation of Safeguard Master Unit (SMU)
- 04 h 50 min	Removal of safety devices
- 04 h 40 min	Activation of onboard computer and loading of flight program
- 04 h 30 min	IRS alignment and checks
- 03 h 15 min	Mobile gantry withdrawal (45 min.)
- 02 h 25 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 50 min	Launcher system ready
- 00 h 10 min	Final weather report prior to launch
- 00 h 04 min	Start of synchronized sequence
T-O	**00 s LIFTOFF**
+ 00 h 01 min 57 s	1st stage (P80) separation
+ 00 h 01 min 58 s	2nd stage (Zefiro-23) ignition
+ 00 h 03 min 40 s	2nd stage (Zefiro-23) separation
+ 00 h 04 min 03 s	3rd stage (Zefiro-9) ignition
+ 00 h 04 min 08 s	Fairing separation
+ 00 h 06 min 42 s	3rd stage (Zefiro-9) separation
+ 00 h 07 min 52 s	1st ignition of AVUM
+ 00 h 14 min 09 s	1st cut-off of AVUM
+ 00 h 40 min 37 s	2nd ignition of AVUM
+ 00 h 42 min 02 s	2nd cut-off of AVUM
+ 00 h 42 min 49 s	**Separation of OPTSAT-3000**
+ 00 h 52 min 04 s	Separation of VUP
+ 00 h 53 min 05 s	3rd ignition of AVUM
+ 00 h 54 min 03 s	3rd cut-off of AVUM
+ 01 h 35 min 20 s	4th ignition of AVUM
+ 01 h 36 min 24 s	4th cut-off of AVUM
+ 01 h 37 min 17 s	**Separation of Venµs**
+ 01 h 47 min 19 s	5th ignition of AVUM
+ 01 h 48 min 37 s	5th cut-off of AVUM

MISSION PROFILE



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 is a subsidiary of Airbus Safran Launchers, which holds 74% of its share capital; the balance is held by 17 other shareholders from the European launcher industry. Since the outset, Arianespace has signed over 530 launch contracts and launched 550-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 2016.

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 700 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 comprises primarily 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 (ECPU) – in particular, 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 CNES (Centre National d'Etudes Spatiales) 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.

CNES 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 also is 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 implemented by ELV/Avio, the production prime contractor. At the same time, Arianespace coordinates the preparation of satellites in the payload preparation facility (EPCU) operated by CNES/CSG, handles the integration of satellites and preparation of the payload composite up to its transfer on the launcher to the Vega launch zone (ZLV), and also works with ELV/Avio teams in charge of the launcher to conduct the final countdown and launch from Launch Control Center No. 3 (CDL3).

Arianespace deploys a top-flight team and technical facilities to get launchers and satellites ready for launch. Building on this unrivalled expertise and outstanding facilities in French Guiana, Arianespace is the undisputed benchmark in the global launch services market.