



ARIANE 5

VA250

NOVEMBER 2019

TIBA-1 × Inmarsat GX5



VA250

TIBA-1
Inmarsat GX5



ARIANESPACE TO LAUNCH TWO GEOSTATIONARY SATELLITES WITH ARIANE 5: TIBA-1 AND INMARSAT GX5

On its fourth flight with Ariane 5 in 2019, Arianespace will orbit two telecommunications satellites at the service of long-term customers: TIBA-1 for Thales Alenia Space and Airbus Defence and Space, on behalf of the Government of Egypt; and the GX5 satellite for the operator Inmarsat.

Through this mission, Arianespace highlights its ability to be at the service of innovative satellite solutions for commercial and institutional needs.

VA250 will be the 250th launch of an Ariane rocket, which lifted off for the first time on December 24, 1979.

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TIBA-1

TIBA-1 is a civil and government telecommunication satellite for Egypt. It was developed by Thales Alenia Space and Airbus Defence and Space as co-prime contractors, with Thales Alenia Space acting as the consortium's lead partner.

TIBA-1 will be owned and operated by the government of Egypt.

Airbus Defence and Space supplied the platform and also assembled and tested the spacecraft. Thales Alenia Space, as lead partner, designed and built the communications payload, which will provide broadband communications in ka band.

TIBA-1 will be the fourth satellite launched by Arianespace for Egypt. It will be deployed by Arianespace into geostationary transfer orbit (GTO), subsequently transitioning to its operational orbital slot position at 35.5° East.

Airbus Defence and Space is Arianespace's direct customer for this mission, continuing a fruitful cooperation between the two companies that extends back to Arianespace's creation in 1980. TIBA-1 will be the 127th Airbus satellite launched by Arianespace, as well as the 113th main passenger on a launcher from the Arianespace family.

There currently is a total of 22 Airbus satellites in Arianespace's order book.

TIBA-1 is the 160th satellite launch by Arianespace for Thales Alenia Space, the co-prime and lead partner of this program.

Inmarsat GX5

GX5 is a mobile communications satellite built by Thales Alenia Space for Inmarsat, the world leader in global, mobile satellite communications. Inmarsat's fifth Ka-band Global Xpress (GX) satellite, GX5 will be the most advanced in the GX fleet, which in less than four years has become the gold standard for seamless, globally available, mobile broadband services.

Located in a geostationary orbit at 11° East, GX5 will deliver greater capacity than the entire existing GX fleet (GX1-GX4) combined and will support the rapid growth in customer demand for GX services in Europe and the Middle East, particularly for aviation passenger Wi-Fi and commercial maritime services.

It is equipped with 72 Ka-band fixed spot beams and 4 steerable beams to direct additional capacity where it is needed. GX5 heralds the start of an unprecedented enhancement in the overall capacity and capabilities of the GX network with a further 7 advanced payloads scheduled to launch over the next four years.

This is the 10th time that Inmarsat has chosen Arianespace's launch services, demonstrating a well-established trust – with the two companies' relationship dating back to 1981. The mission with Inmarsat GX5 comes two years after Arianespace successfully launched the "condosat" Hellas Sat 3/Inmarsat S-EAN with an Ariane 5.

The Inmarsat GX5 satellite will be the 161st satellite manufactured by Thales Alenia Space to be launched by Arianespace.

Six additional Thales Alenia Space satellites are included in Arianespace's order book.

PRESS CONTACT

Claudia Euzet-Hoyau
c.hoyau@arianespace.com
+33 (0)1.60.87.55.11



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Inmarsat GX5



MISSION DESCRIPTION

Arianespace's fourth Ariane 5 ECA launch of 2019 will place its satellite passengers into geostationary transfer orbit.

The launcher will be carrying a total payload of approximately 10,495 kg.

The launch will be performed from Ariane Launch Complex No. 3 (ELA-3) in Kourou, French Guiana.

DATE AND TIME



Liftoff is planned on **Friday, November 22, 2019** as early as possible within the following launch window:

- > **Between 4:08 p.m. and 5:43 p.m.** Washington, D.C. time
- > **Between 6:08 p.m. and 7:43 p.m.** Kourou, French Guiana time
- > **Between 21:08 and 22:43** Universal / London Time (UTC/UK time)
- > **Between 10:08 p.m. and 11:43 p.m.** Paris time, on the night of November 22
- > **Between 11:08 p.m. and 00:43 a.m.** Cairo time, during the night of November 22 to 23.

MISSION DURATION



The nominal duration of the mission (from liftoff to separation of the satellites) is:

34 minutes, 07 seconds.

TARGETED GEOSTATIONARY ORBIT



Perigee altitude
250 km



Apogee altitude
35,726 km



Inclination
5 degrees

THE LAUNCH AT A GLANCE

The launcher's attitude and trajectory are controlled by the two onboard computers located in the Ariane 5 vehicle equipment bay (VEB).

About seven seconds after start of the ignition of the main stage cryogenic engine at T-0, the two solid-propellant boosters are ignited, enabling liftoff. The launcher first climbs vertically for 13 seconds, then rotates towards the East. It maintains an attitude that ensures the axis of the launcher remains parallel to its velocity vector to minimize aerodynamic loads throughout the entire atmospheric phase until the solid boosters are jettisoned.

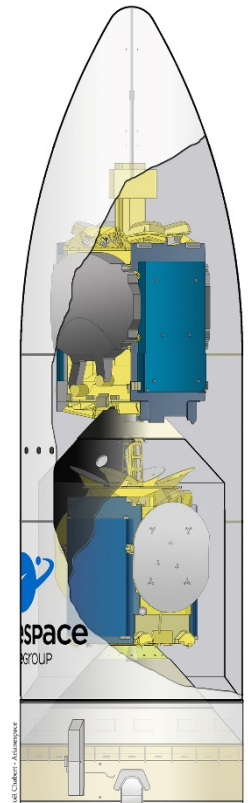
The fairing protecting the payload is jettisoned at T+200 seconds.

Once this first part of the flight is completed, the onboard computers optimize the trajectory in real time, minimizing propellant consumption to bring the launcher first to the intermediate orbit targeted at the end of the main stage propulsion phase, and then the final orbit at the end of the flight of the cryogenic upper stage.

The main stage splashes down off the coast of Africa in the Atlantic Ocean (in the Gulf of Guinea).

PAYLOAD CONFIGURATION

- > **Upper payload (CUH): TIBA-1**
Mass at liftoff: 5,600 kg.
- > **Lower payload (CUB): Inmarsat GX5**
Mass at liftoff: 4,007 kg.
- > **Long version of the payload fairing**
- > **SYLDA (Système de Lancement Double Ariane)**





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TIBA-1
Inmarsat GX5



TIBA-1 Satellite



CUSTOMER	Government of Egypt
MANUFACTURERS	Thales Alenia Space & Airbus Defence and Space
MISSIONS	Civil and governmental telecommunication
MASS AT LAUNCH	5,600 kg
PLATFORM	Eurostar 3000
ORBITAL POSITION	35.5° East
BATTERIES	1 Li-Ion battery
PAYLOAD	Ka-band
DESIGN LIFE	More than 15 years

PRESS CONTACTS

Airbus
Ralph Heinrich
Press officer
Tel: +49 (0)171 30 49 751
E-mail: ralph.heinrich@airbus.com
Website: airbus.com

Thales Alenia Space
Tarik Lahlou
Press officer
Tel: +33 (0)6 87 95 89 56
E-mail: tarik.lahlou@thalesaleniaspace.com
Website: www.thalesgroup.com

**VA250****TIBA-1
Inmarsat GX5**

Inmarsat GX5 Satellite



CUSTOMERS	Inmarsat
MANUFACTURER	Thales Alenia Space
MISSION	Mobile communications
MASS AT LAUNCH	4,007 kg
ORBITAL POSITION	11° East
PLATFORM	Spacebus 4000B2
STABILIZATION	3 axis stabilized
BATTERIES	Li-Ion battery
PAYLOAD	Ka-band
COVERAGE AREA	Europe and the Middle East
DESIGN LIFE	More than 16 years

PRESS CONTACTS

Inmarsat
Matthew Knowles and Jonathan Sinnatt
Corporate Communications
Tel: +44 (0)20 7728 1355/1935
E-mail: press@inmarsat.com
Website: www.inmarsat.com and on social @inmarsatglobal

Thales Alenia Space
Tarik Lahlou
Press officer
Tel: +33 (0)6 87 95 89 56
E-mail: tarik.lahlou@thalesaleniaspace.com
Website: www.thalesgroup.com



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Inmarsat GX5



ARIANE 5 ECA LAUNCH VEHICLE

The launcher is delivered to Arianespace by ArianeGroup as production prime contractor.

51.03 m.

Fairing

(RUAG Schweiz AG):
Height: 17 m.
Mass: 2.4 t.

780 metric tons
(total mass at liftoff)

TIBA-1

Government of Egypt
Mass: 5,600 kg.

PA - Payload adaptor (2)

(Airbus Defence and Space - SAU)
(RUAG Space AB)
Mass: approx. 220 kg.

Inmarsat GX5

Inmarsat
Mass: 4,007 kg.

SYLDA - Internal structure

Mass: 440 kg.

Vehicle Equipment Bay

Height: 1.13 m.
Mass: 970 kg.

ESC-A - Cryogenic upper stage

Height: 4.71 m.
Mass: 19 t.

HM-7B engine

Thrust: 67 kN (in vacuum).
945 sec. of propulsion.

EPC - Cryogenic main stage

Height: 31 m.
Mass: 188 t.

Propellants (in metric tons)
at T-O
H: Cryogenic
P: Solid

EAP - Solid rocket boosters

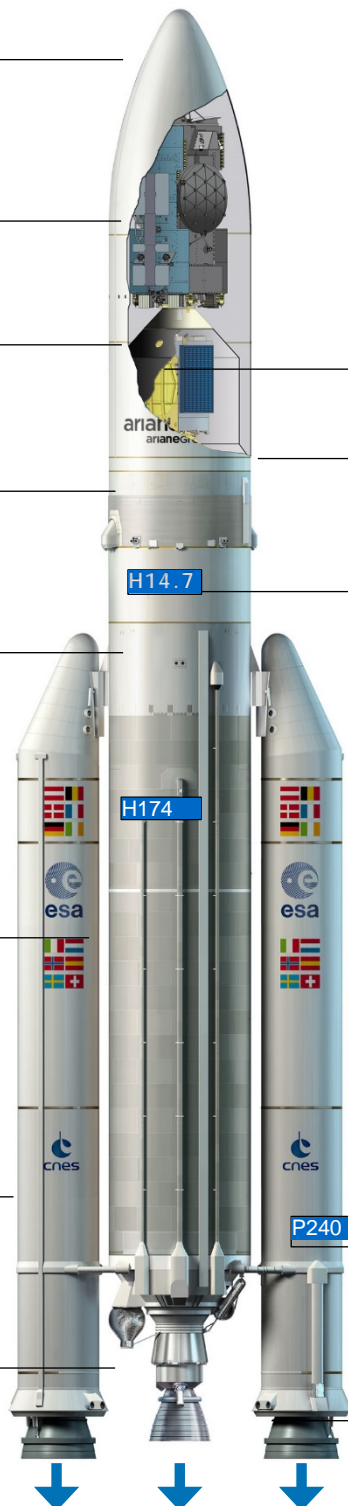
Height: 31.6 m.
Mass: 277 t. approx.

Vulcain 2 engine

Thrust: 1,410 kN (in vacuum).
540 sec. of propulsion.

MPS - Solid Rocket Motor (SRM)

Average thrust: 5,060 kN.
Maximum thrust: 7,080 kN (in vacuum).
130 sec. of propulsion.



13,000 kN at liftoff
(at T+7.3 sec.).

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Inmarsat GX5**

LAUNCH CAMPAIGN - ARIANE 5

TIBA-1 Inmarsat GX5

SATELLITE AND LAUNCH VEHICLE CAMPAIGN CALENDAR

DATE	SATELLITES ACTIVITIES	LAUNCH VEHICLE ACTIVITIES
September 4 to 5, 2019		Campaign start review EPC unpacking and erection
September 5 to 6, 2019		EAP 1 & 2 transfer to the BIL (Launcher Integration Building)
September 9, 2019		EPC/EAP integration
October 16, 2019	Arrival of TIBA-1 in French Guiana and transfer by road to the Spaceport's S5C payload preparation facility	
October 24, 2019	Arrival of Inmarsat GX5 in French Guiana and transfer by road to the Spaceport's S5C payload preparation facility	
October 29, 2019	TIBA-1 Transfer to the Spaceport's S5A payload preparation facility	Erection of ESC-A and vehicle equipment bay installation
October 30 and 31, 2019	TIBA-1 fueling operations	
November 2, 2019	Inmarsat GX5 transfer to the Spaceport's S5B payload preparation facility	Transfer from BIL to BAF (Final Integration Building)
November 4 and 5, 2019	TIBA-1 fueling operations	
November 5 and 7, 2019	Inmarsat GX5 fueling operations	
November 7, 2019	TIBA-1 integration on payload adaptor	
November 8, 2019	TIBA-1 transfer to the BAF	
November 9, 2019	TIBA-1 integration on SYLDA	

SATELLITE AND LAUNCH VEHICLE CAMPAIGN FINAL CALENDAR

DATE	SATELLITES ACTIVITIES	LAUNCH VEHICLE ACTIVITIES
Saturday, November 9, 2019	TIBA-1 integration on SYLDA Inmarsat GX5 integration on payload adaptor	
Tuesday, November 12, 2019	Payload fairing encapsulation on SYLDA (with TIBA-1 inside) Inmarsat GX5 transfer to the BAF	
Wednesday, November 13, 2019	Inmarsat GX5 integration on launch vehicle	
Thursday, November 14, 2019	Composite (Inmarsat GX5 under fairing) integration on launch vehicle	HM7B engine final inspection
Friday, November 15, 2019	Upper part flight configuration set-up	Finalization of the composite/launcher integration
Monday, November 18, 2019	General dress rehearsal	Dress rehearsal
Tuesday, November 19, 2019		Final preparation of launcher and BAF for chronology
Wednesday, November 20, 2019		Launch readiness review (LRR) Arming of launch vehicle
Thursday, November 21, 2019	Functional checkout of the satellites on the launch pad	Roll-out from BAF to the Launch Pad Launch vehicle connections and filling of the EPC liquid helium tank
Friday, November 22, 2019		Start of launch countdown, EPC and ESC-A filling with liquid oxygen and liquid hydrogen



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COUNTDOWN AND FLIGHT SEQUENCE

The countdown comprises all final preparation steps for the launcher, the satellites and the launch pad. If it proceeds as planned, the countdown leads to ignition of the main stage engine, then the two boosters, for a liftoff at the targeted time.

The countdown culminates in a synchronized sequence, which is managed by the control station and onboard computers starting at T-7 minutes.

If an interruption in the countdown results in the T-0 moving outside the launch window, then the launch will be delayed by one, two or more days, depending on the problem involved, and the solution developed.

TIME	EVENT
- 11 h 23 min	Start of final countdown
- 10 h 33 min	Check of electrical systems
- 04 h 38 min	Start of filling of EPC with liquid oxygen and liquid hydrogen
- 03 h 28 min	Start of filling of ESC-A with liquid oxygen and liquid hydrogen
- 03 h 18 min	Chilldown of Vulcain main stage engine
- 01 h 15 min	Check of connections between launcher and the telemetry, tracking and command systems
- 7 min	"All systems go" report, allowing start of synchronized sequence
- 4 min	Tanks pressurized for flight
-1 min	Switch to onboard power mode
- 05 s	Opening command for the cryogenic arms
- 04 s	Onboard systems take over

T-0	Reference time
+ 00 s	Ignition of the cryogenic main stage (EPC)
+ 07.05 s	Ignition of solid boosters (EAP)
+ 07.3 s	Liftoff
+ 12.7 s	End of vertical climb, beginning of pitch motion
+ 17.05 s	Beginning of roll maneuver
+ 32.05 s	End of roll maneuver
+ 2 min 20 s	EAP separation
+ 3 min 19 s	Fairing jettisoned
+ 7 min 30 s	Acquisition by Natal tracking station
+ 8 min 41 s	End of EPC thrust phase
+ 8 min 47 s	EPC separation
+ 8 min 51 s	Ignition of ESC-A stage
+ 13 min 13 s	Acquisition by Ascension tracking station
+ 18 min 06 s	Acquisition by Libreville tracking station
+ 23 min 08 s	Acquisition by Malindi tracking station
+ 25 min 07 s	Extinction of ESC-A stage
+ 25 min 15 s	Injection
+ 27 min 09 s	TIBA-1 satellite separation
+ 29 min 00 s	SYLDA separation
+ 34 min 07 s	Inmarsat GX5 satellite separation



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ARIANE 5 ECA MISSION PROFILE

The launcher's attitude and trajectory are entirely controlled by the two onboard computers in the Ariane 5 Vehicle Equipment Bay (VEB).

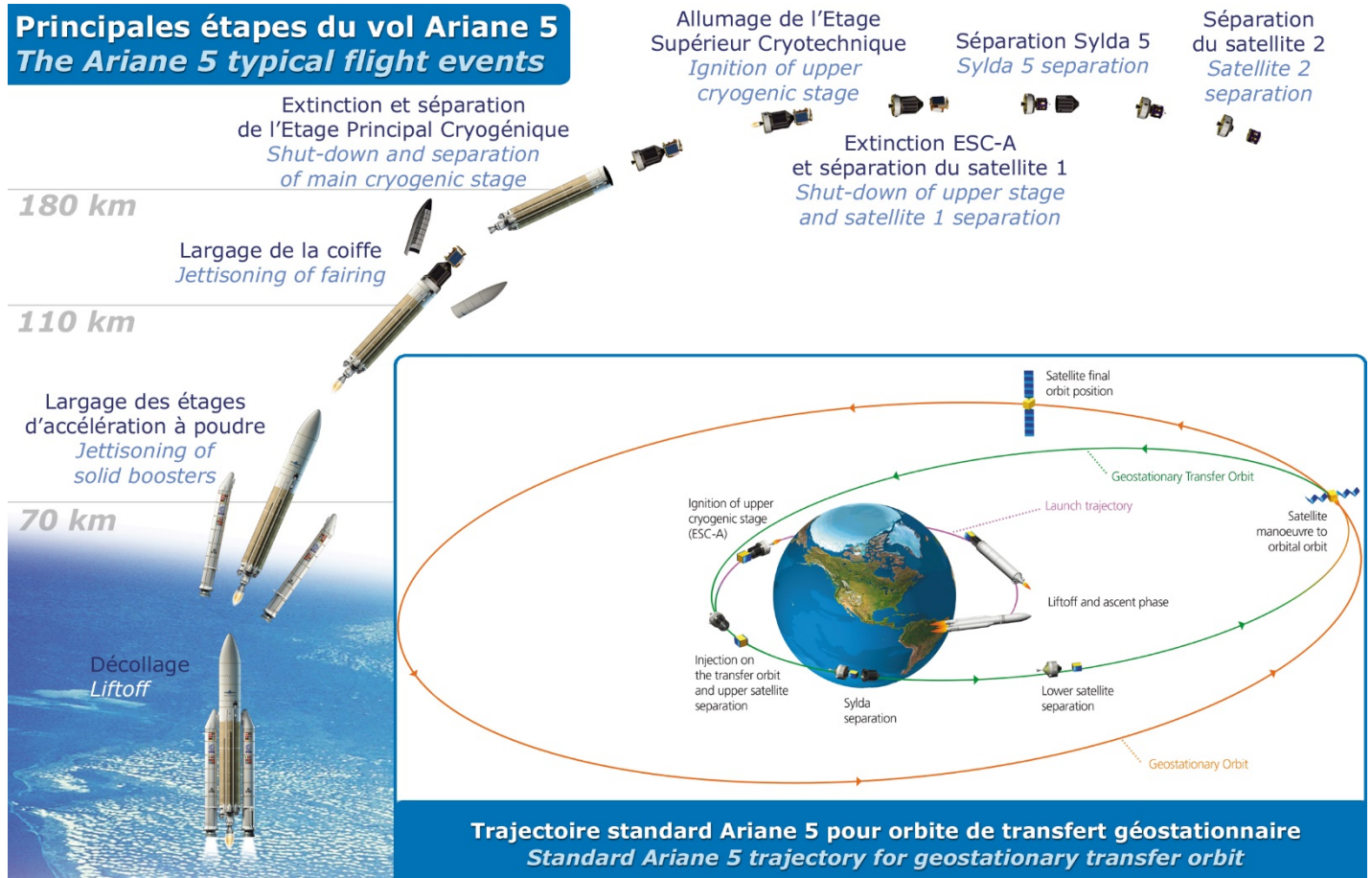
The synchronized sequence starts seven minutes before ignition (T-0). It is primarily designed to perform the final operations on the launcher prior to launch, along with the ultimate checks needed following switchover to flight configuration. As its name indicates, the sequence is fully automatic, and is performed concurrently by the onboard computer and by two redundant computers at the ELA-3 launch complex until T-4 seconds. The computers command the final electrical operations (startup of the flight program, servocontrols, switching from ground power supply to onboard batteries, etc.) and associated checks. They also place the propellant and fluid systems in flight configuration and perform associated checks. In addition, they handle the final ground system configurations, namely:

- > Startup of water injection in the flame trenches and exhaust guide (T-30 sec).
- > Hydrogen aspiration for chilldown of the Vulcain engine in the exhaust guide (T-18 sec).
- > Burn-off of hydrogen used for chilldown (T-5.5 sec).

At T-4 seconds, the onboard computer takes over control of final engine startup and liftoff operations. It:

- > Starts the ignition sequence for the Vulcain main stage engine (T-0).
- > Checks engine operation (from T+4.5 to T+6.9 sec).
- > Commands ignition for the solid boosters at T+7.05 sec for liftoff at T+7.3 seconds.

Any shutdown of the synchronized sequence after T-7 minutes automatically places the launcher back in its T-7-minute configuration.





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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 is a subsidiary of ArianeGroup, which holds 74% of its share capital; the balance is held by 15 other shareholders from the European launcher industry.

Since the outset, Arianespace has signed over 580 launch contracts and launched more than 600 satellites. More than half of the commercial satellites now in service around the globe were launched by Arianespace. The company posted sales of approximately 1.4 billion euros in 2018.

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 710 satellites to be launched.

THE GUIANA SPACE CENTER: EUROPE'S SPACEPORT

For more than 50 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 Regulux, Europropulsion, Air Liquide Spatial Guyane and ArianeGroup – all participate 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.

Arianespace supervises the integration and checks of the Ariane launcher – which is built under ArianeGroup responsibility as the production prime contractor; coordinates the satellite preparations that are performed in parallel inside the Payload Preparation Complex (EPCU) [which is operated by the Guiana Space Center - CNES/CSG], followed by the payload's integration on the launcher in the Final Assembly Building (BAF); and also works with ArianeGroup 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 ensure the launchers and their satellite 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.