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LAUNCH KIT

December 2020

VS24

FalconEye

esa

FALCON EYE
AIRBUS ThalesAlenia Space

cnes
CENTRE NATIONAL D'ÉTUDES SPATIALES

FLIGHT VS24: ARIANESPACE AT THE SERVICE OF AN EARTH OBSERVATION PROGRAM FOR THE BENEFIT OF THE UNITED ARAB EMIRATES

For its eighth launch of the year and the third Soyuz flight of 2020, Arianespace will orbit the FalconEye satellite.

FalconEye is a high performance optical Earth observation satellite system for the Armed Forces of the United Arab Emirates (UAEAF) manufactured by the consortium of Airbus Defence and Space and Thales Alenia Space.

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FalconEye

The satellite is equipped with an Earth observation payload, with very-high-resolution optical capabilities and completed by a ground system for monitoring, receiving and processing images. It will be controlled and managed by Emirati operators.

The FalconEye satellite, to be orbited by Flight VS24, will be the space component of the system, and will have a dual mission: support the needs of UAE Armed Forces and provide commercial imagery for the market. Weighing approximately 1,190 kg at launch, it will be placed in a Sun-synchronous orbit at 611km from the Earth.

FalconEye will be the 98th Earth observation satellite launched by Arianespace.
Earth observation missions represent more than 13% of the total number of satellites launched by Arianespace.

FalconEye is built by a the consortium led by Airbus Defence and Space and Thales Alenia Space
As industrial prime contractor prime contractor, Airbus Defence and Space was in charge of the platform and satellite design, integration and tests.
Thales Alenia Space, as co-prime, designed and supplied the high performance payload including the high resolution optical instrument and the image chain subsystem.

In the 40 years since Arianespace's creation, the launch services company has maintained a fruitful cooperation with Airbus. FalconEye will be the 129th Airbus Defence and Space satellite to be launched by Arianespace. There currently are 19 Airbus Defence and Space satellites in Arianespace's backlog.

FalconEye will be the 164th satellite manufactured by Thales Alenia Space to be launched by Arianespace. There currently are five Thales Alenia Space satellites in Arianespace's backlog.

FalconEye will be the 23rd cooperative mission launched by Arianespace that has brought Airbus Defence and Space together with Thales Alenia Space.

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MISSION DESCRIPTION

The 24th Soyuz launch from the Guiana space center (CSG) will place its satellite passenger into Sun-synchronous orbit (SSO).

The launcher will be carrying a total payload of approximately 1,340 kg.

The launch will be performed from the Soyuz launch complex (ELS) in Sinnamary, French Guiana.

DATE AND TIME

Liftoff is scheduled for **Tuesday, December 1, 2020** at exactly:

> **08:33:28 p.m.**, in Washington D.C., USA,
> **10:33:28 p.m.**, in Sinnamary, French Guiana,
> **01:33:28**, Universal Time (UTC), on December 2,
> **02:33:28 a.m.**, in Paris, France, on December 2,
> **05:33:28 a.m.**, in Abu Dhabi, United Arab Emirates, on December 2.

MISSION DURATION

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

58 minutes and 45 seconds.

TARGETED ORBIT

Sun-synchronous orbit at 611 km.

THE LAUNCH AT A GLANCE

Following liftoff from the Guiana space center, the powered phase of the lower three Soyuz stages will last approximately 8 minutes. The launcher's third stage will then be separated from the upper composite, which comprises the Fregat upper stage and the satellite. The three lower Soyuz stages and the payload fairing will then fall into the sea.

Fregat will carry out three main powered phases.

The FalconEye satellite will be released at 58 minutes and 45 seconds after liftoff.

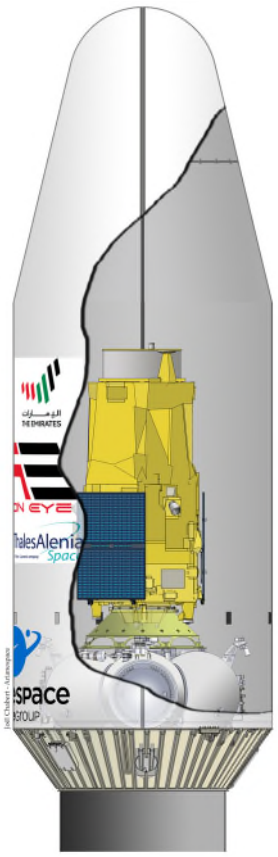
At the end of the mission, one additional firing of the Fregat engine will place this upper stage into a re-entry orbit.

SOYUZ PAYLOAD CONFIGURATION

> **Payload:** FalconEye

Mass at liftoff: 1,190 kg.

> **ST fairing**



SOYUZ LAUNCH VEHICLE

The Soyuz launch vehicle family has provided reliable and efficient launch services since the start of space exploration. Soyuz rockets, which launched both the first artificial satellite and the first human into space, have performed more than 1,925 launches to date. Today, Soyuz is used for manned and unmanned flights to the International Space Station, as well as Russian government launches and commercial launches.

Introduced in 1966, Soyuz has been the workhorse of the Soviet/Russian space program. As the only manned launch vehicle in Russia and the former Soviet Union, Soyuz meets very high standards of reliability and robustness.

The first launch of the Soyuz 2-1a version on November 8, 2004 from the Plesetsk cosmodrome represented a major step in the Soyuz launch vehicle's development program. This modernized version, also used to successfully launch MetOp-A on October 19, 2006 from the Baikonur cosmodrome, features a digital control system providing additional mission flexibility; it also enables control of the launch vehicle fitted with the 4.1-meter ST payload fairing. This was a necessary step towards the next-generation Soyuz 2-1b launcher, the culmination of a joint European/Russian upgrade program. It adds a more powerful third stage engine, significantly increasing the launcher's overall performance.

The upgraded Soyuz 2-1b launch vehicle's inaugural flight was successfully performed from Baikonur cosmodrome on December 27, 2006, orbiting the Corot scientific spacecraft for the French CNES space agency.

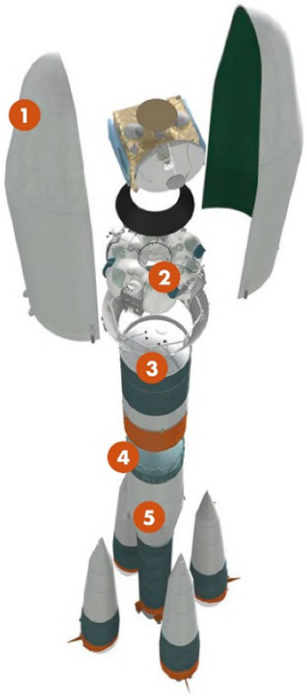
The decision of the European Space Agency to introduce Soyuz launch capability at the Guiana space center (CSG) in French Guiana marked a major step forward in expanding the range of missions. With the introduction of Soyuz at CSG, this famed medium-lift Russian launch vehicle is now an integral part of the European launcher fleet, together with the heavy-lift Ariane 5 and the lightweight Vega. Offered exclusively by Arianespace to the commercial market for launches from CSG, Soyuz becomes Europe's standard medium-lift launcher for both government and commercial missions.

In October 2011, Arianespace successfully launched the first Soyuz rocket from the Guiana space center, orbiting the initial two satellites in the Galileo constellation.

The Samara Space Center in Russia continues to produce Soyuz launchers. Because of sustained demand from the Russian government, International Space Station requirements and Arianespace's commercial orders, Soyuz is being produced at an average rate of 15 to 20 launchers per year. The manufacturer also can rapidly scale up to accommodate market demand. In fact, annual Soyuz production peaked in the early 1980s at 60 vehicles per year.

Soyuz is a reliable, efficient, and cost-effective solution for a full range of missions, from LEO (Low Earth Orbit) to interplanetary trajectories to Mars or Venus. Offering an unrivaled heritage, Soyuz already has performed almost every type of mission, from launching telecommunications, Earth observation, weather and scientific satellites to manned spacecraft. It is a very scalable and flexible launch vehicle.

The Soyuz version currently offered by Arianespace is a four-stage launch vehicle composed of: four boosters (first stage), a central core (second stage), a third stage, and the restartable Fregat upper stage (fourth stage). It also includes a payload adapter/dispenser and fairing.



SOYUZ

1 - Fairing
2 - Fregat upper stage
3 - Third stage
4 - Central core (2nd stage)
5 - Boosters (1st stage)

BOOSTERS (FIRST STAGE)

The four cylindrical-conical boosters are assembled around the central core. The booster's RD-107A engines are powered by liquid oxygen and kerosene, which are the same propellants used on each of the lower three stages. The kerosene tanks are located in the cylindrical part and the liquid oxygen tanks in the conical section. Each engine has four combustion chambers and four nozzles. Three-axis flight control is provided by aerofins (one per booster) and steerable vernier thrusters (two per booster). Following liftoff, the boosters burn for approximately 118 seconds and are then jettisoned. Thrust is transferred to the vehicle through a ball joint located at the top of the conical structure of the booster, which is attached to the central core by two rear struts.

CENTRAL CORE (SECOND STAGE)

The central core is similar in construction to the four boosters, with a special shape to accommodate the boosters. A stiffening ring is located at the interface between the boosters and the core. This stage is fitted with an RD-108A engine, also comprising four combustion chambers and four nozzles. It also has four vernier thrusters, used for three-axis flight control once the boosters have separated. The core stage has a nominal burn time of 286 seconds. The core and boosters are ignited simultaneously on the launch pad, 20 seconds before liftoff. Thrust is first adjusted to an intermediate level to check engine readings. The engines are then gradually throttled up, until the launcher develops sufficient thrust for liftoff.

THIRD STAGE

The third stage is linked to the central core by a latticework structure. Ignition of the third stage's engine occurs approximately two seconds before shutdown of the central core engine. The third stage engine's thrust enables the stage to separate directly from the central core. Between the oxidizer and fuel tanks is a dry section where the launcher's avionics systems are located. The third stage uses either a RD-0110 engine in the Soyuz ST-A (2-1a) version, or a RD-0124 engine in the ST-B (2-1b) version.

FREGAT UPPER STAGE (FOURTH STAGE)

Flight qualified in 2000, the Fregat upper stage is an autonomous and flexible stage that is designed to operate as an orbital vehicle. It extends the Soyuz launcher's capability, now covering a full range of orbits (LEO, SSO, MEO, GTO, GEO and Earth escape). To ensure high reliability for the Fregat stage from the outset, various flight-proven subsystems and components from previous spacecraft and rockets are used. The upper stage consists of six spherical tanks (four for propellants, two for avionics) arranged in a circle and welded together. A set of eight struts through the tanks provide an attachment point for the payload, and also transfer thrust loads to the launcher. The upper stage is independent from the lower three stages, as Fregat has its own guidance, navigation, attitude control, tracking, and telemetry systems. The stage's engine uses storable propellants – UDMH (unsymmetrical dimethyl hydrazine) and NTO (nitrogen tetroxide) – and can be restarted up to 20 times in flight, thus enabling it to carry out complex missions. It can provide the customer with three-axis or spin stabilization of their spacecraft.

The Fregat upper stage is encapsulated in a fairing with the payload and a payload adapter/dispenser.

THE FAIRING

Soyuz launchers operated by Arianespace at the Guiana space center use the ST fairing with an external diameter of 4.1 meters and a length of 11.4 meters.

ROSCOSMOS AND THE RUSSIAN LAUNCHER INDUSTRY

The Roscosmos State Corporation for space activities is responsible for license allocations and intergovernmental relations. It is the launch authority in charge of range operations. RKTs-Progress (the Samara Space Center) is responsible for the design, development, and manufacture of launch vehicles, including the Soyuz launch vehicle's first, second, third stages and fairing. It also integrates vehicle stages and handles flight operations. NPO Lavochkin manufactures and integrates the Fregat upper stage, and is responsible for its launch operations. TsENKI is in charge of launch planning and the provision of associated services, including systems engineering, the design, and technical and operational management of the launch pad and associated facilities dedicated to the Soyuz launcher.

COUNTDOWN AND FLIGHT SEQUENCE

The countdown comprises all final preparation steps for the launcher, the satellite and the launch site. If it proceeds as planned, the countdown leads to the ignition of the core stage engine and the four boosters.

TIME			EVENTS
- 5 hrs.	00 min.	00 s	Meeting for launcher fueling authorization
- 4 hrs.	30 min.	00 s	Launch vehicle fueling begins
- 1 hr.	35 min.	00 s	End of fueling operations
- 1 hr.	10 min.	00 s	Mobile gantry removal
	- 5 min.	09 s	Key on start
	- 5 min.	00 s	Fregat transfer to onboard power supply
	-2 min.	25 s	Upper composite umbilical drop-off command
		- 40 s	Ground-onboard power transfer
		- 28 s	Lower stage umbilical mast retraction
		- 16 s	Ignition
		- 14 s	Preliminary thrust level
		- 01 s	Full thrust level
H0		00 s	**Liftoff**
	+ 1 min.	58 s	Jettisoning of boosters (first stage)
	+ 3 min.	59 s	Jettisoning of fairing
	+ 4 min.	47 s	Separation of central core (second stage)
	+ 8 min.	48 s	Separation of third stage
	+ 9 min.	49 s	First Fregat burn
	+ 17 min.	12 s	First Fregat burn cut-off
	+ 54 min.	51 s	Second Fregat burn
	+ 55 min.	24 s	Second Fregat burn cut-off
	+ 58 min.	45 s	**Separation of FalconEye**
+ 1 hr.	50 min.	55 s	Third Fregat burn
+ 1 hr.	51 min.	56 s	Third Fregat burn cut-off
+ 1 hr.	58 min.	43 s	End of the Arianespace mission

ARIANESPACE AND THE GUIANA SPACE CENTER

ARIANESPACE, THE EUROPEAN LAUNCH SERVICES COMPANY

Arianespace was founded in 1980 as the world's first commercial launch 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 650 launch contracts and launched more than 700 satellites. More than half of the commercial satellites now in service around the globe were launched by Arianespace.

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 Tokyo, Singapore and Washington, D.C. Arianespace offers launch services of any mass, to any orbit, at any time. These services call on three different 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 Russian cosmodromes in Baikonur and Vostotchny.

> The Vega light-lift launcher, operated from the Guiana space center.

THE GUIANA SPACE CENTER: EUROPE'S SPACEPORT

For more than 50 years, the Guiana space center, Europe's spaceport in French Guiana, has offered a complete array of facilities for rocket launches. It primarily comprises the following:

> CNES, the French space agency, 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 ArianeGroup. 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), CNES, and Arianespace. ESA was 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 5, Soyuz and Vega.

For Soyuz, Arianespace supervises the launcher's integration and functional checks in the MIK facility, carried out by RKTs-Progress for the three lower stages, and by NPO-Lavochkin for the Fregat upper stage. It also coordinates Fregat propellant loading operations in the Fregat fueling facility (FCube), and satellite preparations in the EPCU payload preparation facility operated by CNES/CSG. Arianespace then integrates the satellite(s) on the Fregat stage in the S3B building, transfers the launcher and upper composite to the Soyuz launch zone and, along with the Russian entities in charge of the launcher, conducts the final countdown and liftoff operations from the Soyuz launch center (CDLS). Arianespace deploys a top-flight team and technical facilities to prepare launchers and satellites for their missions.

Building on this unrivalled expertise and outstanding local facilities, Arianespace is now the undisputed benchmark in the global launch services market.