ariane 5

→ EUROPE'S HEAVY LAUNCHER

European Space Agency

The Ariane 5 launch system is the cornerstone of Europe's independent access to space. Its reliability, availability and affordability are based on a strategy where a significant part of the costs is financed through commercial activity. Ariane 5 is launched six to seven times each year, of which only one or two are for institutional missions.

This strategy has proven to be highly successful for more than 30 years. The successive versions of the first generation of rockets (Ariane 1 to Ariane 4) launched 50% of all commercial satellites.

Ariane 5 maintains this performance, representing one of the most reliable launchers in the world at an affordable price for Europe.

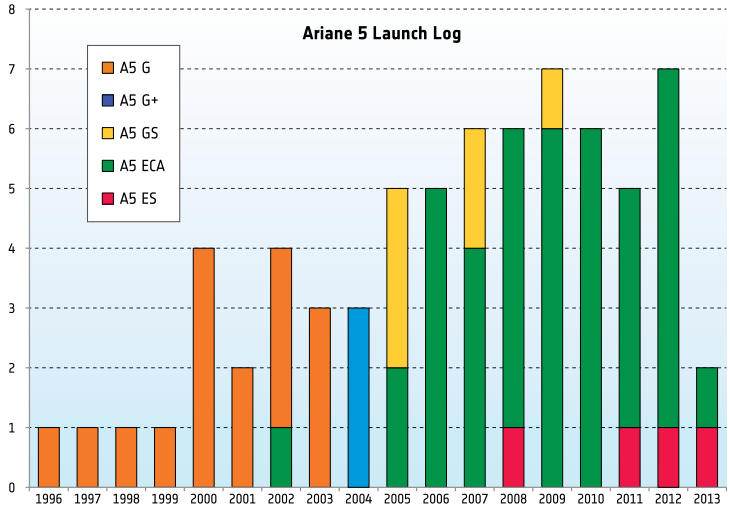
Ariane 5 is an ESA programme with the participation of 12 ESA Member States.

Ariane 5 represents a major evolution of the Ariane family. It is more powerful and uses more advanced technologies.

Today's operational Ariane 5 launcher has two configurations:

- Ariane 5 ECA, the geosynchronous transfer orbit (GTO) workhorse, mostly delivers communications satellites;
- Ariane 5 ES is used for versatile missions, such as the Automated Transfer Vehicle and soon Galileo, respectively, in low and medium orbits.

Three successive generic versions, A5 G, A5 G+ and A5 GS, are retired from service.
The Ariane 5 launch log to June 2013 counts: 16 Ariane 5 G, 3 Ariane 5 G+, 6 Ariane 5 GS, 40 Ariane 5 ECA and 4 Ariane 5 ES, for a total of 69 launches.



ARIANE 5 ECA

The launch performance of Ariane 5 ECA for GTO injection missions has improved over time. The initial performance was about 9.2 t, including the payload internal carrying structure Sylda 5*, adapters and satellites, and is today at 10 t.

Since 2002, the Ariane 5 ECA has been launched 40 times.

*Sylda 5: Système de Lancement Double Ariane 5, 4.6 m diameter, 4.9 m up to 6.4 m high.

Ariane 5 consists of three parts

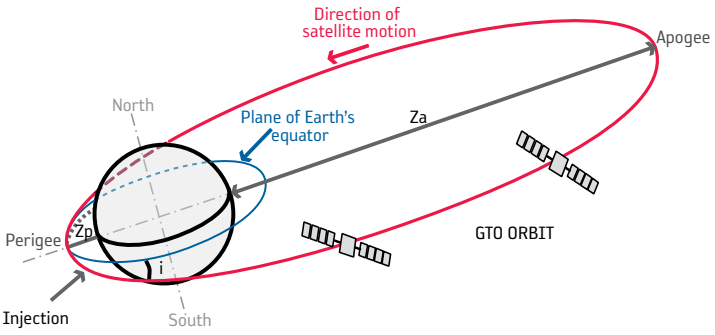
The launcher upper part comprises:
- Fairing, protecting the payload during atmospheric flight (5.4 m diameter, 17 m high);
- Dual launch structure (Sylda 5), accommodating lower and upper satellites.

The upper composite comprises:
- Cryogenic upper stage (ESCA: Etage Cryotechnique Supérieur) with 14.7 t of propellant (liquid hydrogen and oxygen) and the HM7B engine providing 6.5 t of thrust;
- Vehicle Equipment Bay (VEB), 'the brain', providing autonomous control of all the systems during all mission phases;
- Supporting structure interfacing with the payload.

The lower composite comprises:
- Two solid rocket boosters (EAP: Etage d'Accélération à Poudre): 3 m diameter, 31 m high, each with 240 t of propellant, providing together 1200 t at liftoff;
- Cryogenic main core stage (EPC: Etage Principal Cryotechnique): 5.4 m diameter, 30 m high, containing 175 t of propellant (liquid hydrogen and oxygen) with the Vulcain 2 engine providing 136 t of thrust;
- Total liftoff thrust is approximately 1340 t.

TYPICAL ARIANE 5 ECA LAUNCH SEQUENCE (GTO MISSION)

Launch sequence	Timing	Launch events	Altitude
H0	0 : 00 : 00	Vulcain 2 ignition	(km)
H0 + 7 s	0 : 00 : 07	EAP ignition and liftoff	0
H0 + 143 s	0 : 02 : 23	EAP separation	69
H0 + 191 s	0 : 03 : 11	Fairing separation	107
H0 + 541 s	0 : 09 : 01	EPC separation	178
H0 + 1487 s	0 : 24 : 47	ESCA shut down	640
H0 + 1645 s	0 : 27 : 25	**Separation of 1st satellite**	1036
H0 + 1781 s	0 : 29 : 41	Separation of Sylda	1456
H0 + 2087 s	0 : 34 : 47	**Separation of 2nd satellite**	2585
H0 + 2976 s	0 : 49 : 36	End of launcher mission	6340



ARIANE 5 ES

The Ariane 5 ES version is an evolution of the initial Ariane 5 generic vehicle. With a more powerful lower composite, identical to the one used on Ariane 5 ECA, it reuses a small storable propellant stage (EPS: Etage à Propergols Stockables) that has been upgraded and tested in flight to allow reignition and long coast phases.

These capabilities are mandatory to perform missions such as the delivery of the Automated Transfer Vehicle into its rendezvous orbit with the International Space Station or the injection of the cluster of four Galileo satellites into their operational orbit.

The reignition capability of the upper stage is also required to vacate the injection orbit after releasing the payload. This guarantees a controlled and safe deorbiting of the empty stage and an operational orbit free of any major debris.

The launcher configuration consists of three parts:

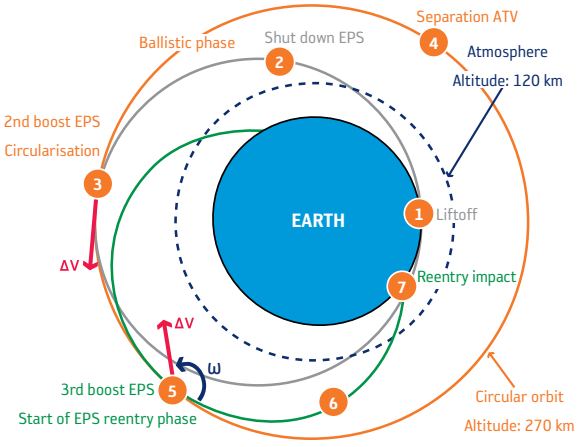
The launcher upper part comprises:
- Fairing, protecting the payload during atmospheric flight;
- Dedicated structure accommodating the heavy payload or providing multiple-satellite release capability.

The upper composite comprises:
- EPS containing 10 t of storable propellant (MMH: monomethyl hydrazine and N2O4: nitrogen tetroxide) with the Aestus engine providing 2.7 t of thrust;
- The Vehicle Equipment Bay (VEB), 'the brain', providing autonomous control of all the systems during all mission phases;
- Supporting structure interfacing with the payload.

The lower composite is identical to that used on Ariane 5 ECA.

ARIANE 5 ES LAUNCH SEQUENCE (ATV-1 MISSION, LEO)

Launch sequence	Timing	Launch events	Altitude
H0	0 : 00 : 00	Vulcain 2 ignition	(km)
H0 + 7 s	0 : 00 : 07	EAP ignition and liftoff	0
H0 + 138 s	0 : 02 : 18	EAP separation	61
H0 + 209 s	0 : 03 : 29	Fairing separation	107
H0 + 540 s	0 : 09 : 00	EPC separation	133
H0 + 547 s	0 : 09 : 07	1st boost EPS	134
H0 + 1030 s	0 : 17 : 10	Shut down EPS / ballistic phase	146
H0 + 3730 s	1 : 02 : 10	2nd boost EPS	270
H0 + 3760 s	1 : 02 : 40	Shut down EPS	270
H0 + 3999 s	1 : 06 : 39	**Separation ATV**	273
H0 + 8667 s	2 : 24 : 27	3rd boost EPS	261
H0 + 8683 s	2 : 24 : 43	Shut down EPS	261
H0 + 8937 s	2 : 28 : 57	Start of EPS reentry phase	255



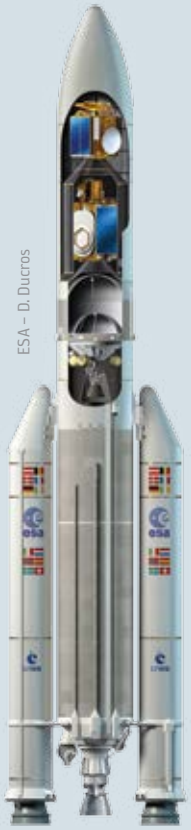
ADAPTED ARIANE 5 ME

Following the November 2012 ESA Council meeting at ministerial level in Naples, Italy, Ministers secured investments for detailed definition studies of the new Ariane 6 launcher activities on the Adapted Ariane 5 ME, with the goal of developing as many commonalities as possible between the two vehicles.

To limit the overall development cost, time and risk for the combined development of the Adapted Ariane 5 ME and Ariane 6, upper stage commonality assessments are being made. These are considering technical and organisational changes, aimed at increasing its competitiveness.

One of the first decisions has been to keep the Adapted Ariane 5 ME upper stage and fairing diameters at 5.4 m. The objective is to maximise commonalities, while avoiding to delay the entering into service of the two launchers and striving to keep the minimum recurring cost for Ariane 6. This will be reflected in the Adapted Ariane 5 ME design and production facilities as well as the Ariane 6 design targets.

The qualification flight of this modernised version of Ariane 5 is scheduled for mid 2018, followed by a gradual introduction into service.



ESA – D. Ducros

The launcher configuration consists of three parts:

The launcher upper part comprises:

- Longer fairing, protecting the payload during atmospheric flight (5.4 m diameter, 20 m high);
- New longer dual launch structure (Sylda 5) accommodating the lower and upper satellites (4.6 m diameter, 8 m high).

The upper composite comprises:

- New cryogenic upper stage containing 28 t of propellant (liquid hydrogen and oxygen) with the new-technology Vinci engine providing 18 t of thrust and reignition capability;
- New Vehicle Equipment Bay (VEB), controlling the vehicle during all mission phases;
- New supporting structure interfacing with the payload.

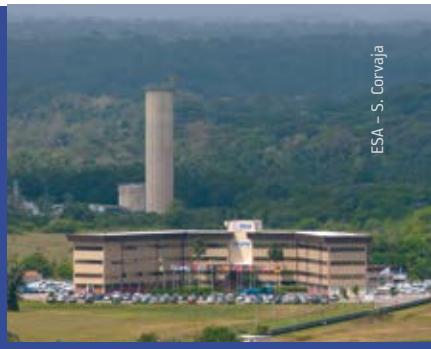
The lower composite is identical to that on Ariane 5 ECA.

ARIANE 5 LAUNCH FACILITIES

A typical launch campaign lasts between one and a half and two months. The elements of the launcher are assembled in the integration building (BIL: Bâtiment d'Intégration Lanceur).

The vehicle is then transferred to the final assembly building (BAF: Bâtiment d'Assemblage Final) for payload integration before its journey to the launch pad (ZL 3: Zône de Lancement 3).

Final launch preparations are controlled from the launch centre (CDL 3: Centre de Lancement 3) located 2.5 km from the pad.



ESA – S. Corvaja

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