

Space Launch Report: Ariane 5 Data Sheet

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Ariane 5

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Ariane 5G+ (L518/V158) Orbiting Rosetta in 2004 (Click for Larger Image)

Ariane 5 was developed by the European Space Agency to replace Arianespace's Ariane 4 commercial satellite launcher. The big rocket was originally sized to launch a pair of satellites each weighing 2 to 3 metric tons (tonnes) to geosynchronous transfer orbit (GTO). It was subsequently upgraded to handle dual 4 to 5 tonne payloads.

Ariane 5 uses 2.5 stages and four propulsion units. At liftoff, its twin segmented solid motors provide more than 500 tonnes thrust each to augment the single core stage Vulcain LOX/LH2 engine's 110 tonnes of thrust. The original Ariane 5 G ("Generic") version used a hypergolic EPS second stage with a 2.6 tonne thrust Aestus engine.

Ariane 5 ECA uses an "E" ("Evolution") core stage, powered by an upgraded Vulcain 2 of 138 tonnes thrust, and an ESC-A upper stage.

ESC-A is an upgraded Ariane 4 LOX/LH2 third stage with a 6.4 tonne thrust HM7B engine. Slightly upgraded solid motors were also developed to power the "E" vehicles. Ariane 5 ECA can boost about 10 tonnes to GTO, including satellite adapter hardware. It stands nearly 58 meters tall with a long payload fairing.

Future plans call for development of a new 15 tonne thrust, restartable Vinci engine to replace the HM7B engine. The reengineered stage, named ESC-B, will create an upgraded Ariane 5 ECB capable of lifting 12 tons to GTO. Ariane 5 ECB may enter service in 2017 or 2018.

A fourth Ariane 5 variant, named Ariane 5 ES(V) (also called Ariane 5 "Versatile"), flew for the first time in March 2008. This version uses the "E" core stage and the same solid rocket boosters as the Ariane 5 ECA. Ariane 5 ES(V) uses an Aestus-powered storable propellant (EPS-V) stage that can carry as much as 10 tons of propellant, 0.3 tons more than the initial model, although smaller propellant loads are used for low earth orbit missions. Unlike earlier "G" model EPS stages, the "ES(V)" EPS-V stage can be restarted. Ariane 5 ES(V) was developed to launch Europe's 20 ton ATV automated cargo carrier to the International Space Station (ISS).

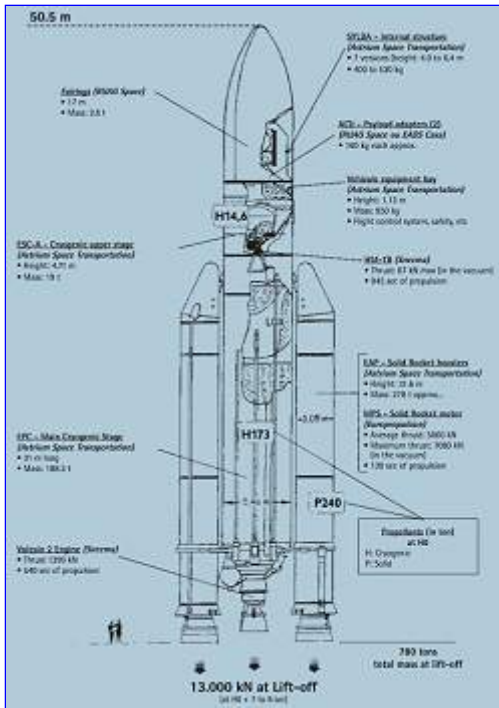
Two interim G-series models appeared during the G to E transition period. Ariane 5G+ was a standard Generic model topped by the 10-ton propellant EPS upper stage that flew during 2004. Ariane 5GS added the improved E-class solid motors to the G+ configuration.

Ariane 5 ECA Drawing (Click to Enlarge). 50.5 meter height assumes

13.8 meter fairing.

Ariane 5's solid boosters are produced adjacent to the new ELA-3 launch site at Kourou Space Center, stacked in a dedicated building on a launcher platform, then rolled to the launcher integration building. There, the first and second stages are mated. Although the site is designed to support 6-8 Ariane 5s per year, only 3 were launched each year during the 2002 to 2004 period.

Ariane 5 qualification testing began inauspiciously on 4 June 1996, when Ariane 501 exploded 39 seconds after launch from Kourou. A guidance system failure was blamed. Successor Ariane 502 made it to orbit on 30 October 1997, but first stage roll-control problems caused a slight loss of velocity and the test payloads fell just short of their planned geosynchronous transfer orbit (GTO). Ariane 503 finally qualified the vehicle with a successful flight on 21 October 1998. All three of the test flights carried dummy or experimental payloads. Ariane 504 inaugurated commercial service on 1999 December 10 when it orbited ESA's 3,764 kg X-Ray Multi-Mirror spacecraft. The Ariane 5 G/G+/GS series ended its run in 2009 after achieving 22 successes in 25 attempts and ending with 15 consecutive successes.



A failed Vulcain-2 engine doomed the inaugural Ariane 5 ECA flight (Ariane 517) on December 11, 2002, destroying the Hotbird 7 communications satellite. After an extensive Vulcain-2 redesign and testing effort, Ariane 5 ECA finally flew successfully on February 12, 2005 when Ariane 521 boosted XTAR-EUR and MaqSatB2 into GTO. By early 2014, the Ariane 5 ECA series had achieved 41 consecutive successes after the single, inaugural failure, establishing itself as one of the world's most reliable launch vehicles.

The first Ariane 5 ES flight, the March 9, 2008 V-181 mission, successfully orbited 19.012 tonne ATV-1 "Jules Verne" into a 51.6 deg low earth orbit.

Vehicle Configurations

	LEO Payload (metric tons) (800 km SSO) (500 km ISS)	GTO Payload 1500 m/s to GEO* (metric tons)	Configuration	Liftoff Height (meters) Short/Medium/Long Fairing	Liftoff Mass (metric tons)
Ariane 5G	9.5 t (SSO)	6.64 t	G Core + 2 SRB + EPS	46.1/47.2/50.4 m	720 t
Ariane 5 ES(V)	15.7 t (SSO) 19.3 t (ISS)	7.575 t	E Core + 2 SRB + EPS-V	46.1/47.2/50.4 m	760 t
Ariane 5 ECA		10.05 t	E Core + 2 SRB + ESC-A	49.5/50.55/54.7 m	780 t
Ariane 5 ECB		12 t	E Core + 2 SRB + ESC-B	49.5/50.55/54.7 m	~800 t

* GEO: Geosynchronous Earth Orbit

Vehicle Components

	SRBs EAP-G (EAP-E)	Cryo Core (EPC) Generic ("G")	Cryo Core (EPC) Evolution ("E")	EPS (EPS-V)	ESC-A	ESC-B
Diameter (m)	3 m	5.4 m	5.4 m	5.4 m	5.4 m	5.4 m
Length (m)	31.6 m	30.5 m	30.5 m		4.711 m	
Propellant Mass (tons)	237 t (240 t)	158 t	175 t	9.7 t 10 t (V)	14.9 t	25 t
Total Mass (tons)	268 t (278 t)	170 t	189 t	10.9 t 11.3 t (V)	19.44 t	
Engine		Vulcain	Vulcain 2	Aestus	HM7B	Vinci
Fuel		LH2	LH2	MMH	LH2	LH2
Oxidizer		LOX	LOX	N2O4	LOX	LOX
Thrust (vac tons)	509.9 t	112.167 t	137.662 t	2.957 t	6.424 t	15.3 t
ISP (vac sec)	274.5 s	431.2 s	431.2 s	321 s	446 s	466 s

Burn Time (sec)	130 s	600 s	540 s	1000 s (V)	945 s	
No. Engines	1	1	1	1	1	1

Vehicle Components, Cont'd

	VEB	Sylda 5	Speltra	Short Fairing	Medium Fairing	Long Fairing
Diameter (meters)	5.4 m		5.4 m	5.4 m	5.4 m	5.4 m
Length (meters)	1.56 m		7 m	12.7 m	13.8 m	17 m
Mass (tons)	1.9 t	0.425-0.5 t	0.716-0.822 t	2.00 t	2.13 t	2.5 t

Ariane 5 Launch History

DATE	VEHICLE	ID	PAYLOAD	MASS (t)	SITE*	ORBIT**
04/06/96	Ariane 5G	L501	V89/Cluster FM1-4	4.80	KO 3	[FTO] [1]
10/30/97	Ariane 5G	L502	V101/MaqSat H/B/Teamsat	4.98	KO 3	[EEO] [2]
10/21/98	Ariane 5G	L503	V112/Maqsat 3/ARD	5.40	KO 3	GTO [3]
12/10/99	Ariane 5G	L504	V119/XRMM	3.80	KO 3	HTO
03/21/00	Ariane 5G	L505	V128/Insat 3B/Asiastar	4.836	KO 3	GTO
09/14/00	Ariane 5G	L506	V130/Astra-2B/GE-7	5.30	KO 3	GTO
11/16/00	Ariane 5G	L507	V135/PAS-1R/AmSat-3D	5.608	KO 3	GTO
12/20/00	Ariane 5G	L508	V138/Astra 2D/GE-8	3.701	KO 3	GTO
03/08/01	Ariane 5G	L509	V140/Eurobird/Bsat-2a	4.368	KO 3	GTO
07/12/01	Ariane 5G	L510	V142/Artemis/BSat2B	4.403	KO 3	[EEO] [4]
03/01/02	Ariane 5G	L511	V145/Envisat	8.111	KO 3	LEO/S
07/05/02	Ariane 5G	L512	V153/Stellat 5/NStar C	5.72	KO 3	GTO
08/28/02	Ariane 5G	L513	V155/Atlantic Bird 1/MSG 1	4.72	KO 3	GTO
12/11/02	Ariane 5 ECA	L517	V157/HotBird 7/Stentor	5.547	KO 3	[FTO] [5]
04/09/03	Ariane 5G	L514	V160/Insat 3A/Galaxy 12	4.708	KO 3	GTO
06/11/03	Ariane 5G	L515	V161/Optus C1/BSat 2C	6.023	KO 3	GTO
09/27/03	Ariane 5G	L516	V162/Insat 3E/eBird/SMART 1	4.635	KO 3	GTO
03/02/04	Ariane 5G+	L518	V158/Rosetta	3.011	KO 3	HCO
07/18/04	Ariane 5G+	L519	V163/Anik F2	5.950	KO 3	GTO
12/18/04	Ariane 5G+	L520	V165/Helios 2A	4.2	KO 3	LEO/S
02/12/05	Ariane 5 ECA	L521	V164/XTAR-EUR/MaqSat B2	7.379	KO 3	GTO
08/11/05	Ariane 5 GS	L523	V166/iPStar 1	6.485	KO 3	GTO
10/13/05	Ariane 5 GS	L524	V168/Syracuse3A/Galaxy15	5.758	KO 3	GTO
11/16/05	Ariane 5 ECA	L522	V167/Spaceway2/Telkom2	8.095	KO 3	GTO
12/21/05	Ariane 5 GS	L525	V169/MSG-2/Insat-4A	5.115	KO 3	GTO
03/11/06	Ariane 5 ECA	L527	V170/Hotbird 7A/SpainSat	7.78	KO 3	GTO
05/27/06	Ariane 5 ECA	L529	V171/Satmex 6/Thiacom 5	8.23	KO 3	GTO
08/11/06	Ariane 5 ECA	L531	V172/Syracuse 3B/JCSAT 10	7.80	KO 3	GTO
10/13/06	Ariane 5 ECA	L533	V173/DirecTB9S/OptusD1	8.18	KO 3	GTO
12/08/06	Ariane 5 ECA	L534	V174/Wildblue 1/AMC-18	6.82	KO 3	GTO
03/11/07	Ariane 5 ECA	A535	V175 Skynet 5A/Insat 4B	7.67	KO 3	GTO
05/04/07	Ariane 5 ECA	A536	V176 Astra 1L/Galaxy 17	8.60	KO 3	GTO
08/14/07	Ariane 5 ECA	A537	V177 Spaceway 3/BSAT 3A	8.06	KO 3	GTO
10/05/07	Ariane 5 GS	A526	V178 Intelsat 11/Optus D2	4.85	KO 3	GTO
11/14/07	Ariane 5 ECA	A538	Skynet5B/StarOne (V179)	8.735	KO 3	GTO
12/21/07	Ariane 5 GS	A530	V180/RAScom 1/Horizons 2	5.464	KO 3	GTO

03/09/08	Ariane 5 ES	L528	V181/ATV-1 Jules Verne	19.01	KO 3	LEO/ISS
04/18/08	Ariane 5 ECA	L529	V182/VINASAT 1/StarOne C2	6.74	KO 3	GTO
06/12/08	Ariane 5 ECA	L540	V183/Skynet5C/Turksat3A	7.75	KO 3	GTO
07/07/08	Ariane 5 ECA	L541	V184/ProtoStar 1/BADR 6	7.537	KO 3	GTO
08/14/08	Ariane 5 ECA	L542	V185/Superbird 7/AMC 21	7.27	KO 3	GTO
12/20/08	Ariane 5 ECA	L543	V186/Hotbird9/W2M	8.34	KO 3	GTO
02/12/09	Ariane 5 ECA	L545	V187/Hotbird 10/NSS 9	7.422	KO 3	GTO
05/14/09	Ariane 5 ECA	L546	V188/Herschel/Plank	5.32	KO 3	HTO
07/01/09	Ariane 5 ECA	L547	V189/TerreStar 1	6.91	KO 3	GTO
08/21/09	Ariane 5 ECA	L548	V190/JCSAT 12/Optus D3	4.5	KO 3	GTO
10/01/09	Ariane 5 ECA	L549	V191/Amazonas 2/GMS	8.0	KO 3	GTO
10/29/09	Ariane 5 ECA	L550	V192/NSS 12/Thor 6	8.675	KO 3	GTO
12/18/09	Ariane 5 GS	L551	V193/Helios 2B	4.2	KO 3	LEO/S
05/21/10	Ariane 5 ECA	L551	V194/Astra3B/COMSATBw2	7.97	KO 3	GTO
06/26/10	Ariane 5 ECA	L552	V195/Arabsat5A/COMS1	7.4	KO 3	GTO
08/04/10	Ariane 5 ECA	L554	V196/RascomQAF1R/COMS	6.25	KO 3	GTOS
10/28/10	Ariane 5 ECA	L555	V197/W3B/BSAT 3b	7.43	KO 3	GTO
11/26/10	Ariane 5 ECA	L556	V198/Intelsat17/Hylas1	8.08	KO 3	GTO
12/29/10	Ariane 5 ECA	L557	V199/Hispasat1E/KoreaSat6	8.17	KO 3	GTO
02/16/11	Ariane 5 ES	L544	V200/ATV-2 Johannes Kepler	19.7	KO 3	LEO/ISS
04/22/11	Ariane 5 ECA	L558	VA201/Yahsat1A/IntelsatND	8.97	KO 3	GTO
05/20/11	Ariane 5 ECA	L559	VA202/ST2/GSAT 8	8.19	KO 3	GTO
08/06/11	Ariane 5 ECA	L560	VA203/Astra 1N/BSat 3c	8.26	KO 3	GTO
09/21/11	Ariane 5 ECA	L561	VA204/Arabsat 5C/SES-2	7.85	KO 3	GTO
03/23/12	Ariane 5 ES	L553	VA205/ATV-3 Edoardo Amaldi	19.714	KO 3	LEO/ISS
05/15/12	Ariane 5 ECA	L562	VA206/JCSAT13/VINASAT2	7.5	KO 3	GTO
07/06/12	Ariane 5 ECA	L563	VA207/Echostar 17/MSG 3	8.13	KO 3	GTO
08/02/12	Ariane 5 ECA	L564	VA208/Intelsat 20/Hylas2	9.4	KO 3	GTO
09/28/12	Ariane 5 ECA	L565	VA209/Astra 2F/GSat 10	9.4	KO 3	GTO
11/10/12	Ariane 5 ECA	L566	VA210/Eutlst21B/Star1-C3	8.24	KO 3	GTO
12/19/12	Ariane 5 ECA	L567	VA211/Skynet 5D/Mexsat 3	7.80	KO 3	GTO
02/07/13	Ariane 5 ECA	L568	VA212/Amazonas 3/Azerspace	9.265	KO 3	GTO
06/05/13	Ariane 5 ES	L592	VA213/ATV-4 Albert Einstein	19.89	KO 3	LEO/ISS
07/25/13	Ariane 5 ECA	L569	VA214/Alphasat XL/Insat 3D	8.77	KO 3	GTO
08/29/13	Ariane 5 ECA	L570	VA215/Eutelsat 25B/Gsat 7	8.96	KO 3	GTO
02/06/14	Ariane 5 ECA	L572	VA217/ABS2/Athena-Fidus	9.41	KO 3	GTO
03/22/14	Ariane 5 ECA	L571	VA216/Astra 5B/Amaz. 4A	8.662	KO 3	GTO
07/29/14	Ariane 5 ES	L593	VA219/ATV 5	19.926	KO 3	LEO/ISS
09/11/14	Ariane 5 ECA	L573	VA218/Measat 3b/Optus 10	9.157	KO 3	GTO
10/16/14	Ariane 5 ECA	L574	VA220/Intelsat 30/Arsat 1	9.293	KO 3	GTO
12/06/14	Ariane 5 ECA	L575	VA221/DirectTV 14/GSAT 16	9.48	KO 3	GTO
04/26/15	Ariane 5 ECA	L576	VA222/Thor 7/Sircal 2	9.00	KO 3	GTO
05/27/15	Ariane 5 ECA	L577	VA223/DirectTV 15/SkyMex 1	9.20	KO 3	GTO
07/15/15	Ariane 5 ECA	L578	VA224/Star One C4/MSG 4	7.608	KO 3	GTO
08/20/15	Ariane 5 ECA	L579	VA225/Eutlsat 8WB/Intlsat 34	9.082	KO 3	GTO
09/30/15	Ariane 5 ECA	L580	VA226/SkyMuster/Arsat2	9.417	KO 3	GTO
11/10/15	Ariane 5 ECA	L581	VA227/Badr 7/GSAT 15	8.962	KO 3	GTO
01/27/16	Ariane 5 ECA	L583	VA228/Intelsat 29e	6.552	KO 3	GTO
03/09/16	Ariane 5 ECA	L582	VA229/Eutelsat 65 West A	6.564	KO 3	GTO
06/18/16	Ariane 5 ECA	L584	VA230/Ecstar 18/BRIsat	9.84	KO 3	GTO
08/24/16	Ariane 5 ECA	L586	VA232/Intelsat 33e&36	9.853	KO 3	GTO
10/05/16	Ariane 5 ECA	L585	VA231/SkyMuster 2/GSAT 18	9.809	KO 3	GTO
11/17/16	Ariane 5 ES	L594	VA233/Galileo 15-18	2.865	KO 3	MEO
12/21/16	Ariane 5 ECA	L587	VA234/StarOne D1/JCSAT 15	9.841	KO 3	GTO
02/14/17	Ariane 5 ECA	L588	VA235/SkyBrasil 1/Telkon 3S	9.550	KO 3	GTO

05/04/17	Ariane 5 ECA	L589	VA236/SGDC, Koreasat 7	9.415	KO 3	GTO
06/01/17	Ariane 5 ECA	L590	VA237/ViaSat2/Eutlsat 172B	9.969	KO 3	GTO
06/28/17	Ariane 5 ECA	L591	VA238/Hellasat 3/GSAT 17	9.257	KO 3	GTO
09/29/17	Ariane 5 ECA	L5100	VA239/Intelsat 37e/BSAT 4a	9.958	KO 3	GTO
12/12/17	Ariane 5 ES	L595	VA240/Galileo 19-22	2.86	KO 3	MEO

01/25/18	Ariane 5 ECA	L5101	AV241/SES 14/Al Yah 3	8.218	KO 3	[EEO][6]

- [1] First Ariane 5 test flight. Control lost 37 seconds after liftoff at 3.7 km altitude, causing vehicle break up and destruction. Inertial Reference System failed due to a software exception resulting from floating point Operand error. Cause was result of specification and design errors in the software of the inertial reference system, due to decision to reuse Ariane 4 flight software.
- [2] First stage rolled causing Vulcain main engine to shut down 10-20 seconds early. Test flight payloads were left near 535 x 26,631 km x 7.79 deg orbits, lower than planned GTO.
- [3] Successful test flight put 2.6 tonne Maqsat 3 dummysat into GTO. The 2.8 tonne Advanced Reentry Demonstrator (ARD), released after Stage 1 separation, flew a suborbital reentry test to 830 km apogee, splashed down 1 hour 41 minutes after liftoff in the Pacific Ocean between the Marqueses and Hawaii, and was recovered a few hours later.
- [4] Storable Propellant Stage (EPS) Stage 2 Aestus engine burned at only 80% thrust and cutoff 80 seconds early, leaving payload in 592 x 17,528 km x 2.9 deg orbit, far from planned 858 x 35,853 km x 2 deg geosynchronous transfer orbit. Cause identified to be combustion instability at Aestus ignition, which led to low thrust and premature depletion of N2O4 or MMH propellant. Water vapor in propellant lines may have caused instability.
- [5] First Ariane 5 ECA failed when Vulcain 2 core engine suffered cracked cooling tubes. Failure in engine began at T+96 sec. Thrust fluctuations began at T+178 sec. RSO at T+456 sec.
- [6] Telemetry lost at Stg 2 ignition. Orbits had 20 deg inclination rather than 3 deg, and slightly lower than planned apogee.

References

Ariane 5 User's Manual, Arianespace, November 2004
V-181 Press Kit, Arianespace, March 2008

Last Update: January 25, 2018