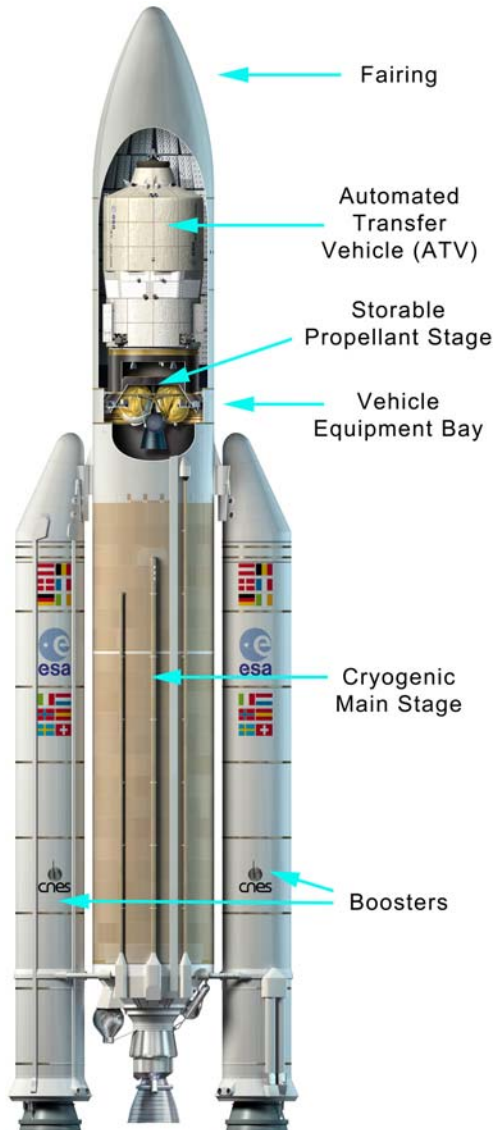


Ariane 5 ES ATV



Artist's impression of Ariane 5 ES ATV (cutaway view)
(Image: ESA/D. Ducros)

The Ariane launcher came into service with Ariane 1 in 1979. Following its development through Ariane 2, Ariane 3 and Ariane 4, the Ariane 5 made its first launch from the European Spaceport in Kourou, French Guiana in December 1999 with ESA's XMM satellite. Since it became operational Ariane 5 has launched satellites for communications, Earth observation and scientific research.

All Ariane 5 versions are composed of a central core stage to which two solid rocket boosters are attached. On top of this, different upper stage configurations are integrated. The ES ATV version

of the Ariane 5 has been designed to place the ATV into a 260 km circular low Earth orbit inclined at 51.6°. From this orbit the ATV will use its own propulsion system to automatically reach and dock with the International Space Station (ISS).

The Ariane 5 ES ATV is 53 m in height, has a diameter of up to 5.4 m and a mass of 760 tonnes at lift off. It is composed of the same lower sections as an Ariane 5 ECA using the same boosters and the same cryogenic main stage equipped with the improved Vulcain 2 engine. The upper composite is composed of a re-ignitable Storable Propellant Stage and a new reinforced vehicle equipment bay as it will be placing more than twice the payload mass of any previous Ariane 5 launch into orbit.

Boosters

The Ariane 5 solid propellant boosters are the largest solid rocket boosters ever produced in Europe. Weighing 37 tonnes each when empty, they are 31 m high and 3 m in diameter. Each booster consists of a steel casing enclosing three segments and can contain in total about 238 tonnes of propellant. Although the casings are only 8 mm thick, they can resist pressures of up to 64 bar. Ariane-5 boosters provide 1100 tonnes of thrust, roughly 92% of the total thrust at liftoff.

The propellant has three main constituents:

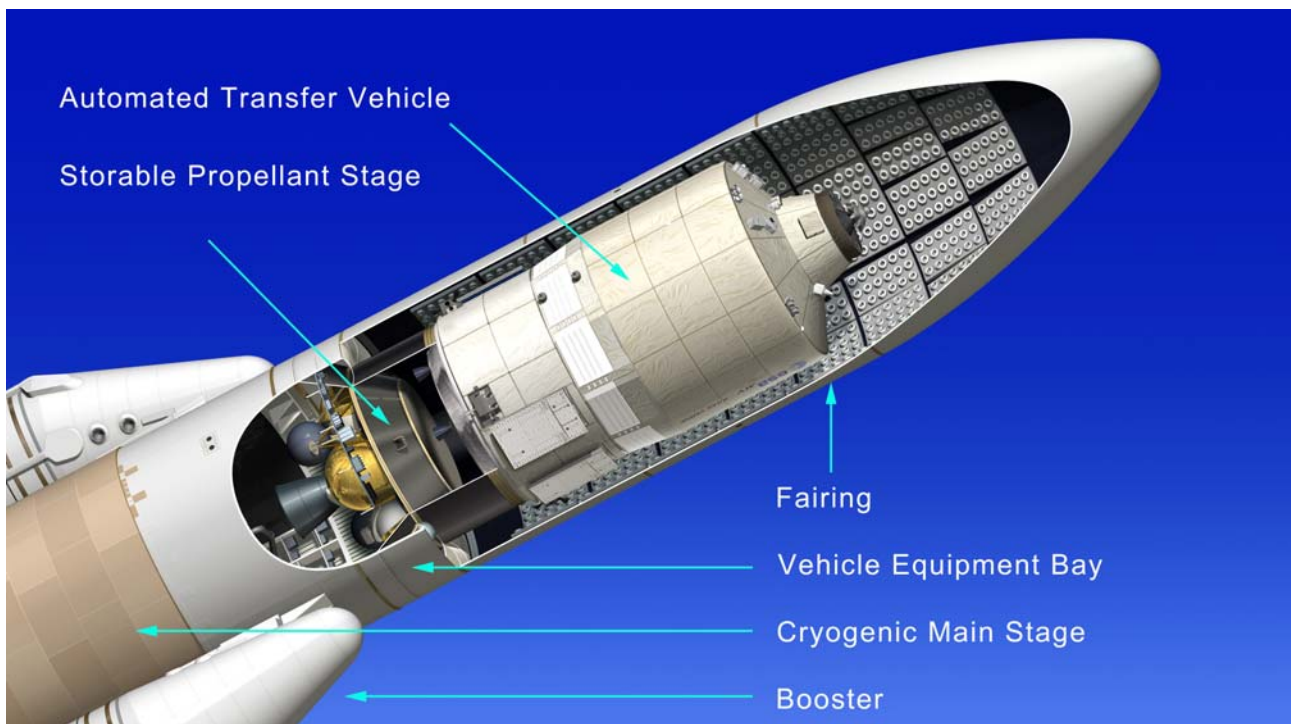
- ammonium perchlorate: the oxidiser
- aluminium powder: acts as the reducer
- polybutadiene: binder and catalyser

At the base of each booster is the solid rocket engine nozzle. This can be swivelled up to 7.3° degrees around its axis to vary the direction of thrust. Approximately 132 seconds after liftoff, at an altitude of 60 km, pyrotechnic devices free the boosters and separation rockets distance the spent boosters from the main stage. The boosters eventually fall into the Atlantic Ocean where they are recovered.

Cryogenic Main Stage

Ariane 5's cryogenic main stage is 30.5 m high with a diameter of 5.4 m. When empty it weighs only 12.5 tonnes and approximately 170 tonnes when full of propellant. It is essentially composed of an aluminium tank with two compartments: an upper compartment for liquid oxygen with a capacity of 120 m³ and a lower compartment for liquid hydrogen with a capacity of 390 m³.

Launcher



Artist's impression of Ariane 5 ES ATV upper composite (cutaway view) (Image: ESA/D. Ducros)

At the base of the Cryogenic Main Stage is the Vulcain engine which delivers a thrust in the order of 130 tonnes and operates for just under 10 minutes after launch. It provides 8% of the total thrust needed at liftoff and the full thrust after booster separation and before ignition of the upper stage. Two high-speed turbopumps force the cryogenic propellants into the combustion and thrust chamber at high pressure at a rate of 235 kg/sec. During the ascent, the engine nozzle can be swivelled to control the launcher's trajectory.

Storable Propellant Stage

The Storable Propellant Stage or upper stage is 3.35 m high with a diameter ranging from 3.94 m at the bottom to 2.62 m at the top. It weighs roughly 11 tonnes when fully loaded. The mission of the upper stage will be to provide the extra energy to inject the ATV into the target orbit following main stage separation. The upper stage is essentially composed of a supporting structure, two pairs of propellant tanks and an 'Aestus' engine. The propellants used in the upper stage are monomethyl hydrazine and nitrogen peroxide. The pressure-fed Aestus engine can swivel along two axes through a maximum angle of 16°.

Vehicle Equipment Bay

The Vehicle Equipment Bay is often called the 'brains' of the launcher. Situated on top of the

cryogenic main stage, it interfaces directly with the upper stage. The vehicle equipment bay is a big cylindrical 'basket' 5.4 m in diameter. It stands 1.56 m tall and weighs 1,300 kg without propellant. The Storable Propellant Stage sits in its centre.

The Vehicle Equipment Bay can autonomously orchestrate the systems required to control a flight such as engine ignition, separation of the boosters, the upper stage, and operation and release of the individual payloads.

One of the features of the equipment bay is an independent attitude control system that can direct the launcher throughout its propulsion phases to reach the required orbit.

Fairing

The conical-shaped fairing is positioned on the very top of the Ariane 5 launcher and consists of two half shells connected by the vertical separation system. Externally it is made of carbon-covered aluminium honeycomb panels of variable thickness. Its function will be to protect the ATV as the launcher rises from the launch pad through the atmosphere to an altitude of approximately 100 km. Once the launcher leaves the Earth's atmosphere, approximately three minutes after lift off, the fairing is jettisoned.