

IAF SPACE PROPULSION SYMPOSIUM (C4)  
Propulsion System (1) (1)

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VINCI UPPER STAGE ENGINE DEVELOPMENT, TEST, QUALIFICATION, AND  
INDUSTRIALISATION STATUS FOR ARIANE 6**Abstract**

The Vinci engine development was initially intended for the application to the A5ME upper stage. Following the decision of the European Ministerial Conference in 2014, it is now re-directed towards the application for the new Ariane 6 upper propulsion module (ULPM).

The Vinci engine concept utilizes the thermodynamic expander cycle without a gas generator, for which the heat pick-up of the regenerative cooling of the combustion chamber is of utmost importance. The chamber is designed based upon the highly successful HM7-B and Vulcain thrust chambers from Ariane 1 to Ariane 5-ECA and further experimental projects. New design features are incorporated for the two main objectives of Ariane 6: market-compatible costs and performance

In order to achieve the versatility for various different missions like MEO, GTO, constellations, etc., the chamber is re-ignitable by help of an electric igniter. This igniter was modified for Ariane 6 with the intention of cost reduction. Up to 4 ignitions during the mission are required for the variety of mission profiles. The nozzle extension is a radiatively-cooled ceramic material concept. The interface to attach it to the combustion chamber is a novel design to accommodate the rather different thermal behaviour of this ceramic attached to the metallic chamber.

The turbopumps generate up to more than 300 bar pressure for the hydrogen. New manufacturing technologies are utilized to reduce the manufacturing effort. The engine will use measurements at the injection head to precisely regulate the thrust and mixture ratio in a closed-loop control system to reduce the residuals in the stage tanks at final shut-down.

Tests of the dynamical behavior of the structure were performed and demonstrated margins to the expected mechanical loads during the flight. Hot tests were performed to characterize the behavior of the engine and its various components under simulated vacuum conditions in flight. Those tests demonstrate the correct function of the engine design. The formal qualification is planned for begin of 2019. Further testing on stage-level in 2019 will confirm specific requirements. This all is aimed to support the planned first flight of Ariane 6 on 16 July 2020.

The serial manufacturing of engine and its components is prepared aiming at about one engine each month for serial operation of the Ariane 6 launcher. This includes qualification of all manufacturing processes as well as establishing modern manufacturing controls.

The full-length paper presents an overview of the development and qualification status.