

SPACE PROPULSION SYMPOSIUM (C4)
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VINCI ENGINE THERMO-STRUCTURAL COMPOSITE NOZZLE EXTENSION FOR ARIANE 6

Abstract

The VINCI engine thermo-structural composite Nozzle Extension for Ariane 6 is designed and manufactured by Airbus Safran Launchers on Le Haillan site in France.

The Nozzle Extension channels the combustion chamber gas flow, sustains the thrust and provides the highest possible Isp with the minimum mass.

It is 1872 mm high with an inlet diameter of 655 mm (Σ 22.5) and an exit diameter of 1820 mm (Σ 174).

It is composed of two radiative thermo-structural cones, the aft cone in Carbon/Carbon-Silicon Carbide and the forward cone in Carbon/Carbon with an oxidation protection.

The A6 design has been simplified wrt to the A5ME design: it has only 2 cones (instead of 3) and is no longer deployable in flight. This allowed simplifying the junction between the 2 cones and reducing the mass and the recurring cost.

As of today, three development hardware's have been manufactured within the A5ME frame: S1, a fixed forward cone and two complete Nozzle Extensions: NE1 and NE2. One Nozzle extension has been manufactured with the A6 design (NE3) and two more Nozzle extensions are under manufacturing (NEQ and FM1).

Since 2006, S1, NE1 and NE2 successfully participated to a total of seven full-scale altitude simulation test campaigns at the DLR test bench P4.1 and to two Engine Dynamic test campaign in Snecma Vernon and IABG.

During the hot tests at P4.1, more than six life durations have been demonstrated for the aft cone of NE2 and five life duration for the forward cone of NE2. The maximum external temperature reached was approximately 1710K, 300K below the demonstrated capability of the aft cone material. The full Nozzle Extension also demonstrated its ability to sustain transient start-up and shut-down loads.

The first full-scale altitude simulation test qualification campaign M6 at P4.1 with the first Qualification Nozzle Extension NE3 will span from March 2017 to September 2017. The dynamic qualification campaign EDQ at IABG with the second Qualification Nozzle Extension NEQ will span from June to July 2017. The second full-scale altitude simulation test qualification campaign Q1 at P4.1 with the second Qualification Nozzle Extension NEQ will span from October 2017 to February 2018.

The successful tests already performed demonstrate the interest and robustness of the design solutions selected for the highly demanding operating conditions and confirm the composite Nozzle Extension's contribution to the overall performance of the VINCI engine.