Application of Fibre Steering Technology for Innovative Composite Launcher Structures

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Carbon Fibre Reinforced Plastic (CFRP) technologies are being developed for application in launcher structures at Airbus Defence and Space Netherlands in collaboration with Netherlands Aerospace Centre (NLR) and industrial partners. The Engine Thrust Frame (ETF) of Ariane 6 upper stage is selected as reference structure for development of these technologies. The ETF has a conical shape with a transition to a cylindrical shape. The Vinci engine is mounted to the cone cap which is connected to the conical part of the engine frame. The cylindrical part of the ETF skirt is connected to the liquid oxygen tank. In the current aluminium design the conical and cylindrical shapes consist of separate parts connected by a ring. For the CFRP design both shapes are combined into one part.

In frame of the ESA's Future Launchers Preparatory Programme, the maturity of the ETF design with CFRP material is increased to a Technology Readiness Level close to 6. For this purpose, a geometrically scaled CFRP demonstrator of the Ariane 6 ETF has been designed, manufactured and tested at cryogenic environment. The design of the demonstrator has been derived from a full scale design by means of analysis. The ETF skirt is designed based on variable stiffness approach by actively steering of tows during the fibre placement with AFP. This approach is used to increase the structural performances of the ETF design. Application of fibre steering technique in the laminates considerably increases the structural performances of the ETF.

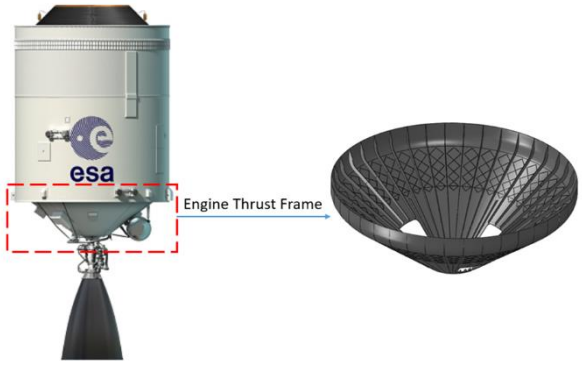

Figure 1: Ariane 6 Upper Stage (left) and CFRP Thrust Frame design (right)

(a) (b) (c)

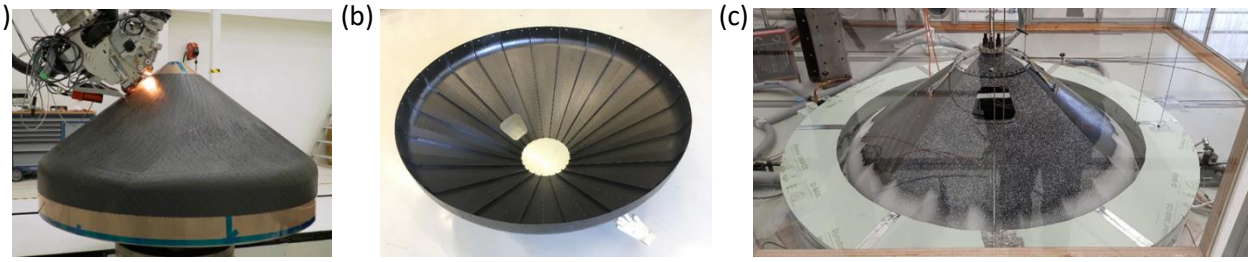

Figure 2: (a) Fibre placement of the engine frame demonstrator with steered fibre (source: NLR), (b) manufactured demonstrator and (c) Demonstrator test setup at cryogenic environment.