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CARBON-CARBON NOZZLE EXTENSION ASSEMBLY FOR THE RL10 ENGINES

Abstract

A translating nozzle extension assembly, the largest ever built, was selected in 1995 by Aerojet Rocketdyne (AR) to achieve the performance required of the RL10B-2 cryogenic rocket engine as the upper stage of the Boeing Delta III and Delta IV EELV launch vehicles. The extension is nearly 100 inches (2.5 m) in length with an exit diameter of just over 84 inches (2.1m). The European company Airbus Safran Launchers designed and manufactured the extendable Nozzle Extension (NE), while AR retained the responsibility of the Nozzle Extension Deployment System (NEDS).

The extendable Nozzle Extension design, composed of three cones, is made of Novoltex® Sepcarb® material. This three-directionally reinforced (3D) carbon-carbon (C-C) material is composed of a polyacrylonitrile (PAN) based carbon preform to which a carbon matrix is added by the chemical vapor infiltration (CVI) process. The Nozzle Extension has been manufactured in large quantities in the past years and now flies regularly on Delta IV launches all successful.

A few years ago, the RL10C engine, the latest newcomer in the RL10 family developed by AR, has been selected by ULA to power the Atlas V upper stage in its RL10C-1 version, and more recently by NASA as the engine for the Evolved Upper Stage (EUS) of the Space launch System (SLS) in a novel four engine configuration.

The paper will address the main features of the Nozzle Extension for each of the variants, showing how the newer versions benefited from the achievements obtained on the RL10B-2 NE. It will also provide insight into future perspectives