

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS (D2)
Upper Stages, Space Transfer, Entry and Landing Systems (3)

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THE FLUYT STAGE: A DESIGN FOR A SPACE-BASED ORBIT TRANSFER VEHICLE

Abstract

The development of the Skylon spaceplane will lead to an increase in the number of technically and economically feasible space missions by enabling low-cost single-stage to orbit delivery of payloads. A key element in determining the D1 configuration of the Skylon vehicle is the design of the supporting space-based infrastructure and in particular an Orbital Transfer Vehicle (OTV). The underlying rationale for operating a space-based OTV is to reduce the cost of placing payloads in their intended orbits and also to enable more ambitious space missions. These missions would involve the delivery of payloads from low-Earth-orbit (LEO) into a diverse range of planetary and interplanetary orbits, further enhancing the achievable mission range and flexibility of the Skylon launcher system.

This paper outlines the initial feasibility study and system requirements for a space-based OTV named Fluyt. A preliminary vehicle configuration is presented which incorporates the existing Vinci rocket engine (currently under development for the upper stage of the Ariane 5 launcher) using the same LH2/LOX propellant combination as Skylon. Size and mass limitations are imposed on the components used within the design of Fluyt to validate the D1 Skylon payload bay. The driving requirement of Fluyt is to be capable of transferring 15 tonnes of payload from LEO into geostationary-Earth-orbit (GEO), with the criteria of being fully reusable and permanently based in space, including on-orbit refuelling and maintenance. This is a departure from current practice in which a fully fuelled upper stage is carried to orbit by the launch vehicle and is used for the final part of the transfer, after which the stage is discarded.

The outcome of this study verifies that it is possible to construct and operate a reusable space-based OTV (based on the Skylon D1 launcher system and using existing technology) that can deliver 15 tonnes of payload to GEO, providing that the OTV is built in two sections which are then assembled on-orbit. Although designed for the GEO mission, as a propulsion module the Fluyt stage could also have a significant role in future space missions. This could include more energy demanding missions such as Cis-Lunar and manned Mars exploration. Vehicles of this category could be constructed using a modular approach by integrating multiple elements of the Fluyt stage at an orbiting assembly facility based in LEO.