

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS (D2)
Future Space Transportation Systems (4)

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THE SKYLON D1 CONFIGURATION

Abstract

The development of SKYLON has been on going for over 20 years, but for the last 16 years the system level design has been held at the C1 configuration. In order to incorporate the technology advances and improved market analysis since 1994, a redesign exercise has been conducted to revise the SKYLON system to the D1 configuration. This exercise is foreseen as the final systems design revision prior to proceeding with the full SKYLON development programme.

As a result of a re-examination of the launch market, supported by a validation exercise at the end of 2009, several changes have been made to the payload accommodations. The most significant change is the increase in mass to a 300 km equatorial orbit to 15 tonnes. The structural and electrical interfaces have also been defined in more detail with a heavy emphasis on robust designs that work with minimum payload/vehicle interface analysis and allow fast integration.

The new payload mass has been accommodated by a combination of an increase in gross take off mass, the incorporation of a more advanced version of the SABRE combined cycle engine, and several areas where improvements in technology over the C1 assumptions have been established.

The key technical challenge with the D1 design, as with all previous configurations of SKYLON and its processor HOTOL, was trim during both ascent and descent. During air-breathing ascent C1 only took hydrogen from the rear tank thus causing the centre of mass to track forward matching the movement of the centre of pressure, on D1 this approach did not prove viable as the mass flow rate was too low. There was also a requirement on D1 to improve the range of payload centre of mass movement which created a challenge for the pitch control during re-entry. These changes prompted several new approaches to the vehicle's control during aerodynamic flight.

The SKYLON D1 design is defined to a high level of detail. It shows superior operational performance over the earlier C1 configuration, while only using technologies that are at Technical Readiness Level 4 (TRL4) or higher and using a mass margin philosophy consistent with AIAA guidelines.