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NOVEL LOW-SHOCK SEPARATION SYSTEMS FOR PAYLOAD FAIRINGS

Abstract

Payload fairings (PLF) protect the payloads from aerodynamic and acoustic pressure, heat, and environmental conditions during ground operations as well as during the initial stages of the flight. As soon as the atmosphere layers are left behind, the fairing is jettisoned from the launch vehicle to optimize its weight and thus propellant consumption. Typically, pyrotechnic separation systems are used for a controlled fracturing event in the horizontal plane as well as in the vertical plane. While such pyrotechnic separation systems have the advantages of high reliability, heritage, and design simplicity, their downside is increased cost and a high shock transferred to the adjacent structures that may impact the payload comfort.

RUAG Space in Switzerland has developed a modular, low-shock separation and jettison system for PLFs of all sizes. The system is based on newly developed discrete mechanical latching points, pneumatic actuators, and a gentle, rotational jettisoning trajectory safely guided by hinges. This solution offers a very low-shock environment during launch and allows the customer to size their payload against reduced shock loads, ultimately increasing the achievable envelope of performance/mass ratio of satellites and their components.

This study presents the most recent achievements of the development activities, funded internally and within the European Space Agency's FLPP program, which are two architectures of this modular system. One architecture employs mechanical latches for all connections of the vertical separation system (VSS) as well as the horizontal separation system (HSS), relying on the same technology for all separation locations and thus reducing complexity. First prototypes of such latches have been built and qualified, showing reliable results. In addition, a second architecture is presented, replacing all HSS latching points by one single integrated clamp band, designed to be compatible with the rotational jettisoning. By combining discrete latching points on the VSS with a clamp band for the HSS, a continuous load transfer between PLF and launcher is achieved. This continuous attachment along the HSS ring, when compared to discrete attachments, minimizes the overflux (load concentrations) into the interfacing forward structure of the launch vehicle and allows to employ the lightest possible structural design of the upper stage. In the paper the principal design and functionalities are shown, key advantages described as well as comparisons to existing state of the art separation and jettison systems are made.