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MEETING THE LATEST CHALLENGES OF HOLD-DOWN AND RELEASE MECHANISMS (HDRM):  
COMBINING FLIGHT HERITAGE AND INNOVATION INTO AN INTEGRATED APPROACH

**Abstract**

Facing always more challenging objectives, the Space market calls for lighter, cost effective, easy handling and versatile solutions. Besides the long-proven advantages of pyrotechnics (high energy density in a reduced space, unmatched reliability over time and milliseconds functioning time), Pyroalliance offers mechanical assemblies called HDRM (Hold-Down and Release Mechanism) based on flight proven bricks upgraded with increased performances and combined together to fulfil several functions otherwise possibly fulfilled by separated components (initiator, separation nut, cone part bolt catcher on satellite side, cup part on dispenser side, tension monitoring). Compared to other architectures, this integrated approach brings the following advantages:

- Lower induced shocks
- Reliability
- Up and Down scalability
- Great compactness
- Lightweight and lower operational cost
- Adapted to streamlined production
- Plug and play with pre-tension option

This HDRM solution brings in Initiators, Separation Nut, Cup/Cone and Bolt Catcher, everything being tight together and pre-tensioned with the possibility to monitor the tension value during storage. Based on many customers' requests whether for conventional satellites or mega-constellations, we understand that HDRMs need to cover more stringent stiffness requirements, extensive shearing and axial load requirements while keeping shock levels down. Pyroalliance experience in the two abovementioned markets naturally induces the capability to combine heritage on both the lower and upper part of the HDRM. Thanks to an extensive R&D activity, we are able to upscale and downscale our low-shock reference so as to serve:

- Appendix release applications with M6 devices (antennas and booms)
- Heavy GEO satellite release applications with M20 devices (high load capacity for stacked satellites)

The main benefits of this new concept lays in its high level of reliability, ease of use and rapidity of integration of the HDRM between dispenser and satellite, cost efficiency and a flight proven experience of almost 10 000 Separation Nuts delivered over the years with a 100% success track record. An additional cost benefit will result from the Out of Pyro Class 1 labelling and the non-necessity to have any specific carrier, storage area or handling procedures (no need for specific training in pyrotechnics depending on the customer company policy). In this paper, authors will present the detailed advantages of all available new features, the status of already qualified products as well as the recent R&D activities performed through prototyping and testing and their envisaged implementation roadmap for the different envisaged modules.

Keywords: Hold and Release, HDRM, Mechanisms, Pyrotechnics