Hold-Down and Release Mechanisms

Technology Overview

FUSE-WIRE TECHNOLOGY Glenair non-pyrotechnic hold-down and release mechanism technology is based on a fusable wire-actuated separation nut design, increasingly popular for its reliability and low-shock release action. Fuse wire-actuated nut technology has the added benefit of being partially reusable and refurbishable post-deployment.

LEGACY HDRM DEVICES A broad range of hold down release mechanism technologies have been historically used to deploy satellites and appendages (solar arrays, antenna reflectors, radiators, instruments, doors, sensors, booms, and so on) in space. Most of these technologies relied on non-reusable (explosive/pyrotechnic) designs that suffered from a broad range of deficiencies, including susceptibility to electromagnetic interference, problematic synchronization of release with mission requirements, high-shock release action, and significantly, the inability to reuse or refurbish the device during test. Glenair HDRMs solve every one of these problems.

HDRM FUNCTIONALITY The Glenair family of HDRM / pin pullers are non-pyrotechnic release mechanisms with the ability to carry defined tensile preloads until fuse-wire release is initiated with an electrical current applied to the actuation circuit, at which time the restraint wire—wrapped under tension—unwinds, initiating actuation and releasing the associated preload. Any potential energy release during actuation is fully countered by the measured delivery system.

KEY COMPONENTS All three key components of Glenair HDRMs (preloading assembly, release actuator, and load-carrying structure) may be packaged according to specific customer requirements including connectorization in place of wire leads. Electrical initiation current level is also configurable, with no amperage upper limit. Packaging options include cylindrical or rectangular housings, lightweight materials, unique shapes and profiles, non-standard mounting dimensions and more.

PERFORMANCE Glenair HDRMs are immune to all forms of EMI or ESD, and capable of easily sustaining significant defined preloads—with release deployment times comparable to conventional explosive actuators. Near-simultaneous release of multiple HDRMs is ±7 msec with 3.5A supplied as a nominal current (within the same temperature range). Improved simultaneity is achieved with the application of higher-current initiation.

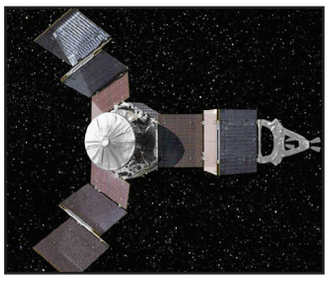
FLIGHT HERITAGE Glenair HDRMs have achieved flight heritage and are now marketed by the company with TRLs of 9. Consult the factory for test reports and TRL qualification levels for specific devices.

SCALABLE DESIGNS: FROM CUBESATS TO 20,000 POUND PAYLOADS

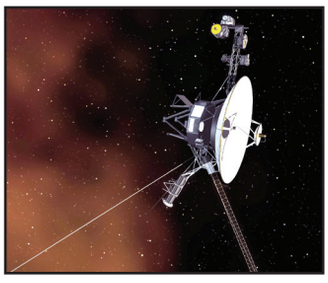
- **Fuse-wire based technology**
- **Redundant or non-redundant actuation circuit**
- **Space-rated and screened materials**
- **Configurable electrical initiation with no (amperage) upper limit**

Catalog and custom solutions available, including redundant- and non-redundant HDRMs, power draw resistor-equipped units, and connectorized solutions with space-grade micro miniature Series 806 Mil-Aero connectors.

DEPLOYMENT APPLICATIONS

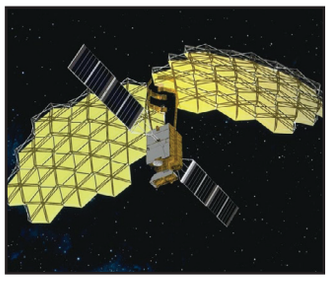


Solar Arrays



Booms and Masts

Antennas



Reflectors

Technology Overview

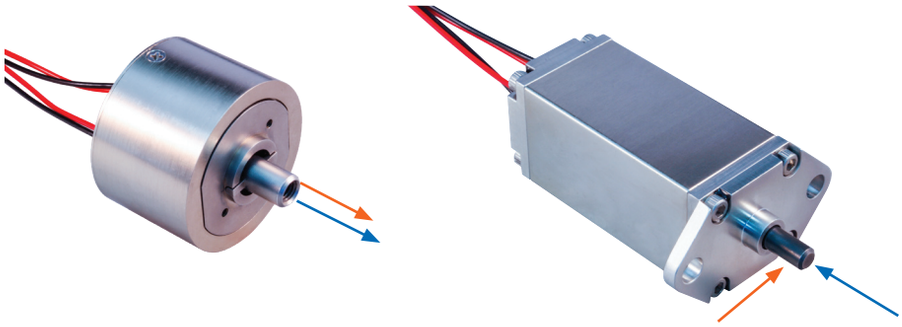
ATTACHMENT AND PRELOAD OPERATION FOR RELEASE-ROD-EQUIPPED HDRMS

HDRM preload ensures a secure and stable hold during launch and a reliable, predictable release in space. The preload measurement, such as 2500 lbs, represents the maximum force that the HDRM can hold and release at time of deployment. The units can exceed the rated preload during vibration and shock but cannot exceed the rated preload during release. Preload is applied during the installation process after the HDRM has been attached to the main structure using the threaded mounting points on the underside of the device. The physical attachment of the deployable payload to the HDRM is accomplished by affixing a threaded tie rod from the payload directly to the release rod in the HDRM.

GS22759-44 XL-ETFE WIRE

Glenair MIL-STAR GS22759-44 is a space-grade cross-linked ETFE hookup wire with a silver-plated copper alloy core IAW MS22759/44. XL-ETFE is preferred for space use due to this insulator material's ability to mitigate white plague corrosion. Silver plating is preferred for space applications due to its superior conductivity and low resistance. Customers may specify 80 microinch thick silver plating (Mod Code 1450) for additional protection against red plague corrosion.

AXIAL VS. SHEAR PRELOAD ORIENTATION IN HDRM DEVICES



Red arrows indicate the preload or applied force direction into the HDRM device. Blue arrows indicate the direction of motion when the HDRM is actuated (released).

AVAILABLE TECHNICAL DOCUMENTATION

Glenair is able to supply complete documentation for both its North American series 06 and EU series GSS HDRMs where applicable including

- Post ground test refurbishment instructions
- Qualification and acceptance test reports
- FMEA and reliability reports
- 2D dimensional and 3D CAD models

HDRM GROUND TESTING

Glenair HDRMs with fuse wire initiators support two distinct testing configurations for ground validation of system readiness and functionality: mechanical release testing and electrical initiation testing.

Glenair mechanical release test unit HDRMs are used for verification of preload capacity and mechanical disengagement action without consuming or damaging fuse wire or initiator hardware. This test simulates the release function by mechanically triggering the separation mechanism—via the simple turn of a wrench—enabling repeatable tests of the hold-down interface, latch response, and structural integration.

The replaceable initiation kit is designed to support full electrical testing, where the actual fuse wire initiator function is energized and expended as in a live deployment. This process ensures complete end-to-end functionality of the electrical initiation path—including redundant circuit power routing, thermal response, and fuse wire separation—but requires replacement of the consumable initiator components after each test.

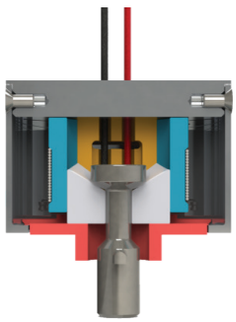
Together, these two testing methodologies ensure comprehensive verification of both mechanical and electrical aspects of HDRM performance.

Mechanical release test unit for ground testing of static load and release function.

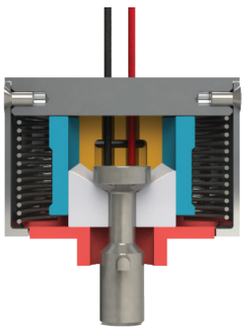
Technology Overview

CONCEPT OF OPERATION: MEDIUM-DUTY HDRMS

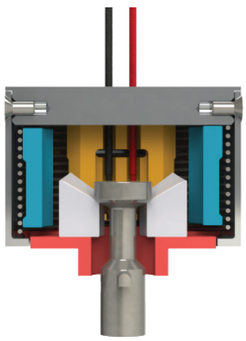
In non-pyrotechnic HDRMs, the planned release of the deployable satellite/payload is activated by a pre-determined value of electrical current to a fuse-wire system which causes the wire to break under tension and allows a pre-loaded mechanical bolt to actuate.



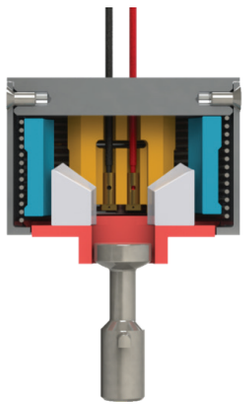
Restrained Condition



Electrical current applied, wire breaks under tension



Mechanical bolt begins actuation



Bolt extracts, releasing the payload

REFURBISHMENT OF SINGLE-EVENT HDRMS WITH NEW INITIATOR UNITS

Hold-Down and Release Mechanisms are typically subjected to multiple cycles of ground test prior to flight. The refurbishment, or rebuilding of a single-event HDRM with a replaceable initiator is easily accomplished in the field by trained personnel. In the case of light and medium duty HDRMs, a single set or grub screw is removed and the spent initiator kit is extracted from the device. The technician then re-packs the initiator unit with release bolt and wedge pieces, and the entire subassembly is inserted into the HDRM housing to be fixed in place once again with the set screw. Heavier-duty HDRMs use four top-of-unit fasteners in place of the single set screw.