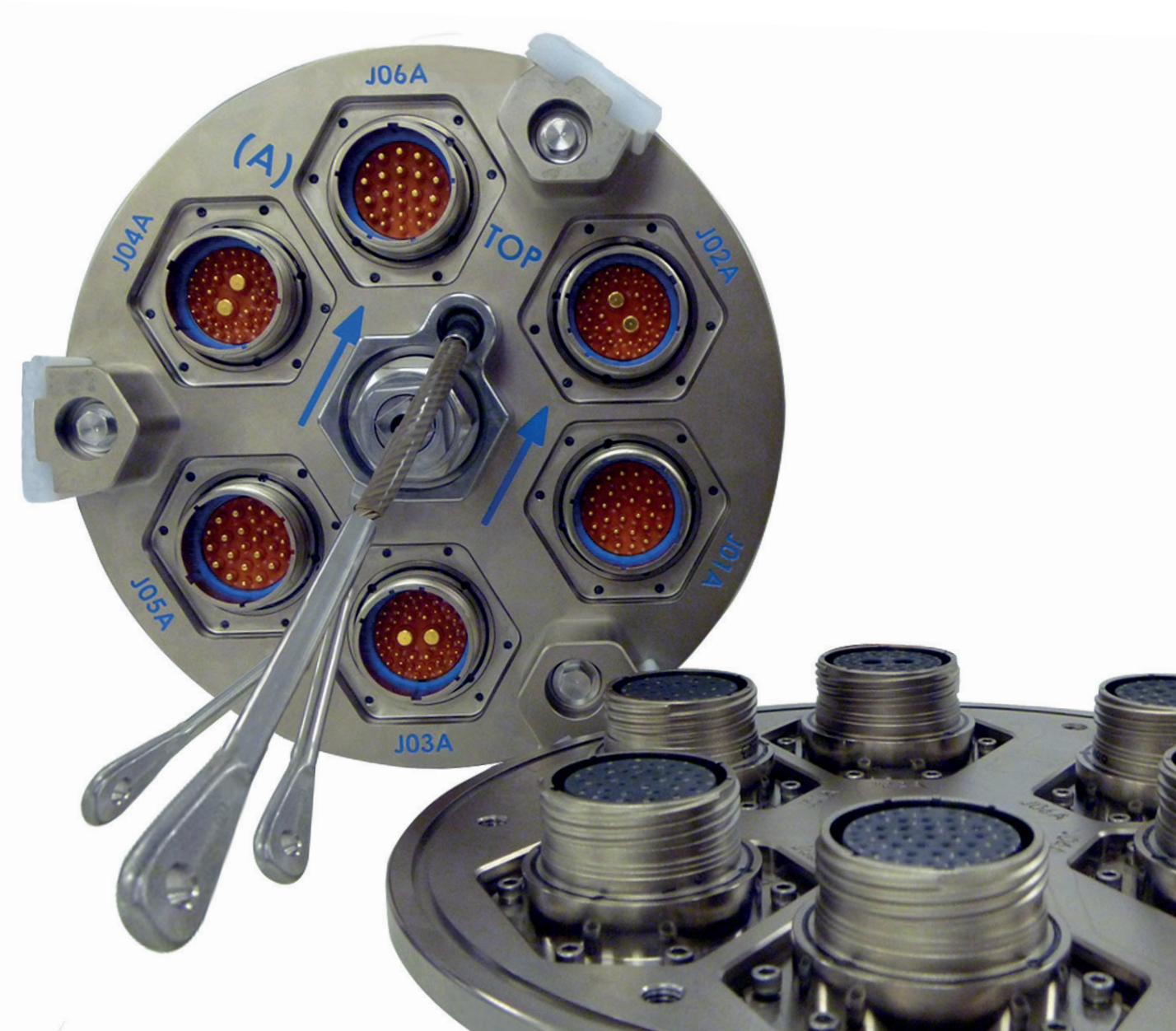
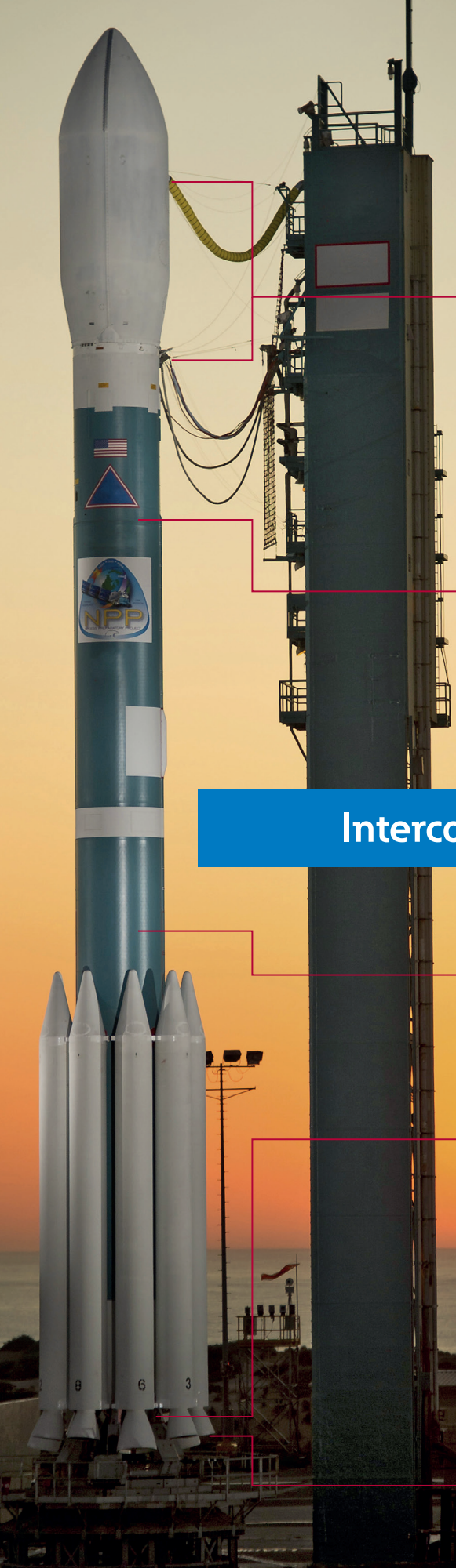


## Space and launch connectors, cables and non-explosive actuators



*Powering Business Worldwide*



#### Launch umbilical solutions

Mechanically, electrically and redundantly activated configurations.



#### Interstage-separation connectors

Locking sleeve, lanyard, or electrically-activated separation mechanisms in circular and raceway configurations.

## Interconnects and release mechanisms



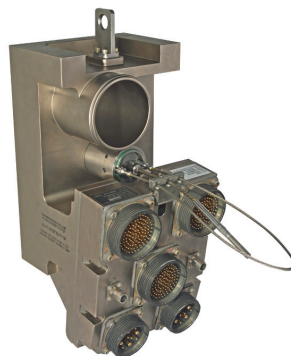
#### Cryogenic connectors

Fuel-monitoring solutions are rated for temperatures as low as -452°F (-269°C).



#### High-temperature disconnects

Ceramic inserts facilitate withstanding 5000°F (2760°C) exhaust plumes.



#### Highly-integrated umbilicals

Electrical, fluid and pneumatic connectivity with redundant-lanyard separation.



### Non-explosive actuators

Separation nuts, pin pullers, tension and cable releases and integrated solutions.



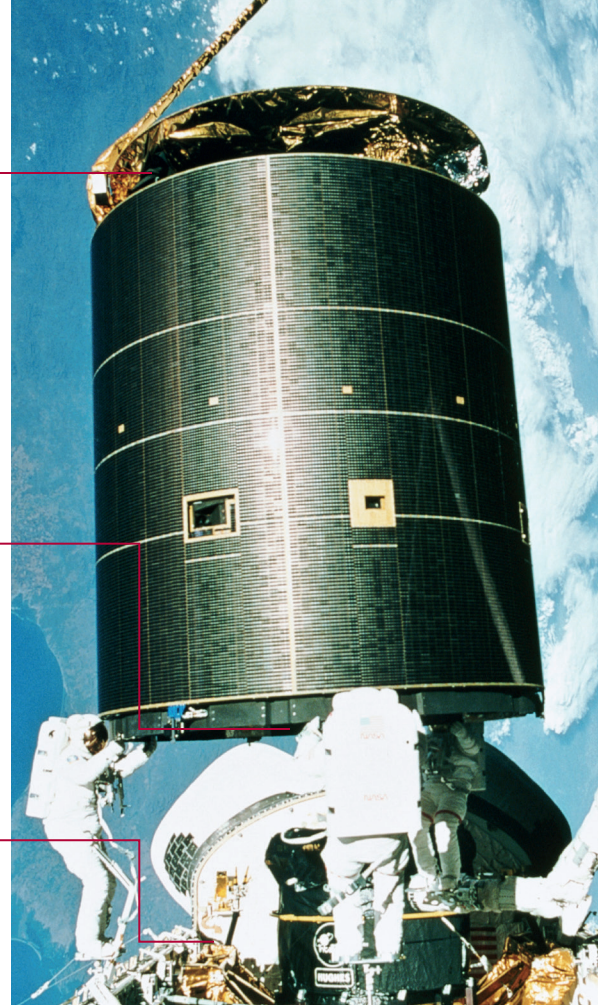
### Low imparted shock solutions

Load-balanced designs compensate for mating and demating misalignments.



### NASA SSQ 21635 NATC

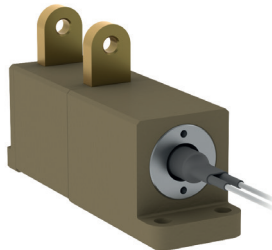
Available in 53 standard contact patterns including bussed configurations.



## From launch pad to mission payload

### Cell-bypass switches

Reroutes power in response to failed battery or solar-panel cells.



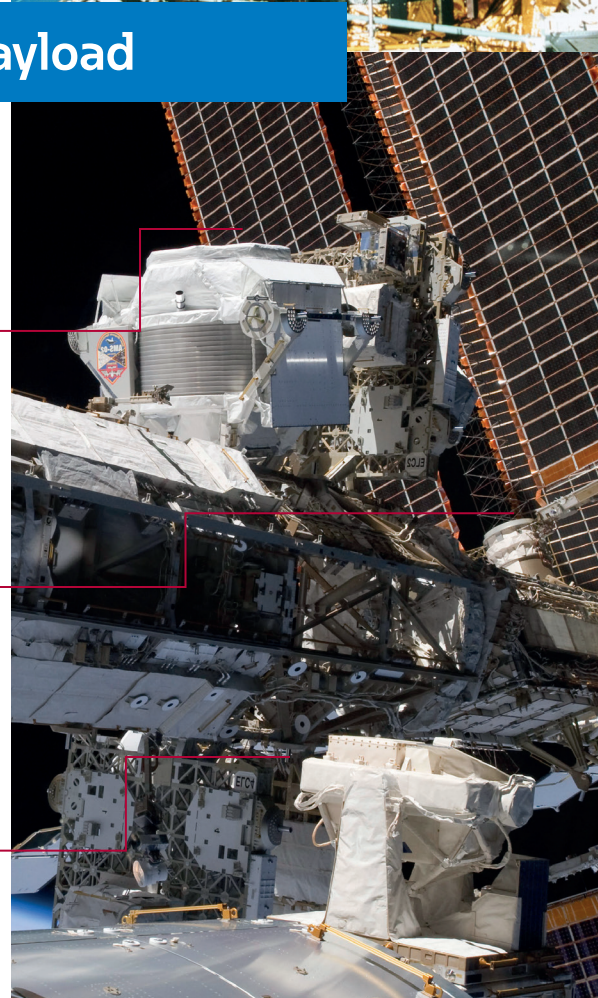
### Blind mate, rack and panel

Heritage includes solar panel, robotic arm and science-module applications.



### Cable assemblies

End-to-end connectivity solutions for applications ranging from high-current power to high-speed data.

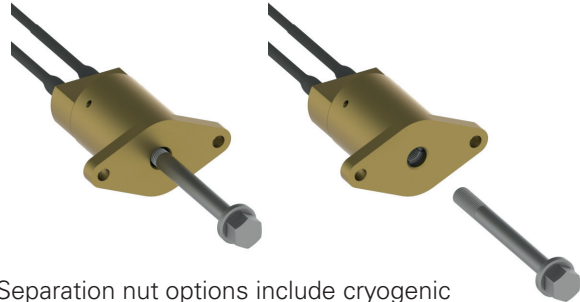


# Over 45 years of non-explosive release-mechanism heritage

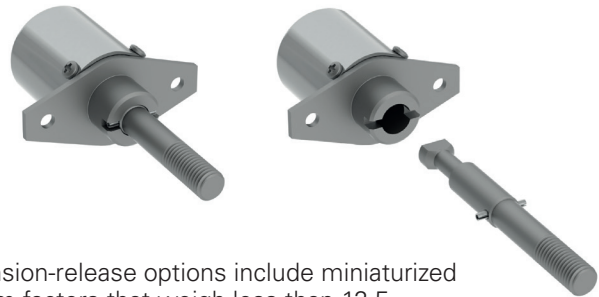
Eaton's release mechanisms utilize non-explosive actuators to provide rapid releases with low power consumption across a wide range of temperatures. Additional features include:

- Over 45 years of flight heritage
- Fragment and debris-free operation
- Electrical compatibility with pyro-activation circuits
- No precautions for explosive materials required
- Field-refurbishment capabilities significantly reduce actuator related test and qualification costs

Heritage-proven products and custom capabilities position Eaton as a primary source for space and launch solutions



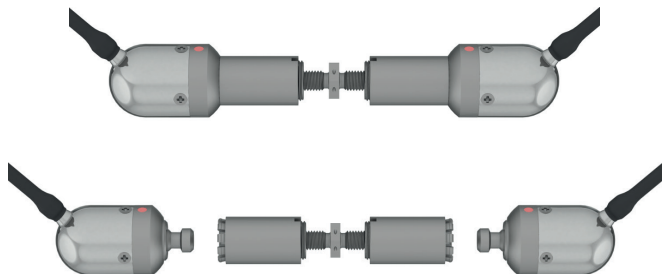
Separation nut options include cryogenic ratings, nickel platings, and a wide range of mounting and cable configurations.



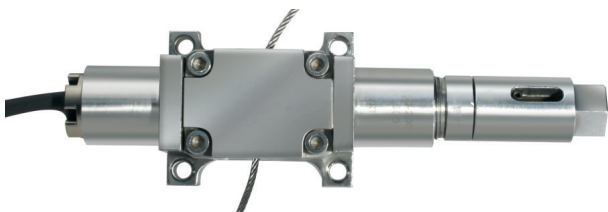
Tension-release options include miniaturized form factors that weigh less than 12.5 grams (0.44 ounces).



Pin-puller heritage includes single and redundant configurations with shielded cables and connector assemblies. Compression releases (no internal springs) are also available.



Tension links function as clamp fasteners until redundant initiators release their actuator shafts to facilitate separation in V-band (Marman) clamp applications.



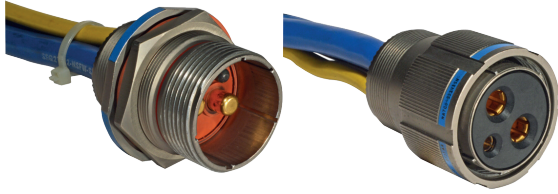
Cable release options include field-resettable initiators (right end of solution depicted above) that enable multiple test releases without the need for actuator refurbishment.



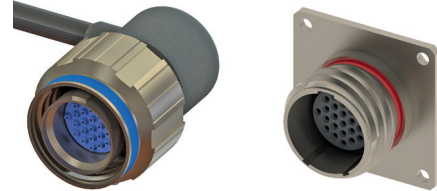
Cell-bypass switches reroute power in response to failed battery and solar-panel cells with lower voltage drops than diode-bypass systems and higher reliability than relays.



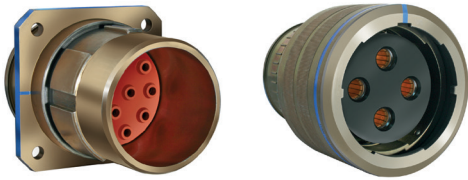
## An extensive array of space rated, mil-circular connectors



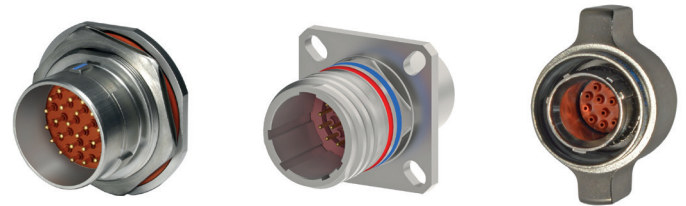
NASA SSQ 21635 NATC connectors are available in 53 standard contact patterns including MIL-DTL-1553 high speed data and bussed configurations.



Micro-military circular connectors incorporate latest-generation designs to deliver significantly smaller sizes, lower weights and higher contact densities that MIL-DTL-38999 solutions.



Power-Breech™ connectors are rated up to 900 amps. These shell size 33 – 57 solutions utilize MIL-DTL-38999 Series IV derived coupling mechanisms.



MIL-DTL-38999 solutions include hermetic and filtered receptacles and ergonomic Wing-Lok™ plugs designed for rapid engagements even when wearing bulky space gloves.

## Rectangular connectors



The space grade D-Sub and microcomp series are compact connectors ideally suited to answer to miniaturization and weight saving trends in spatial applications.

## Robotic solutions



The space grade 8976 (rectangular) and 8977 (circular) series have been designed to perform robotic connections and quick release disconnections in space environment.

## Custom cables and wiring harnesses

Eaton can provide custom cables and wiring harnesses for turnkey design, collaborative co-development, or build-to-print programs.

End-to-end connectivity capabilities include:

- Application-specific solutions for high currents and voltages, Ethernet, and RF applications
- Single and multiple-layer foil and braided EMI/RFI shielding
- Extreme temperatures, shock, vibration, radiation, corrosive media and vacuum
- Integrated fluid and gas delivery and cable separation
- NASA NHB 5300 soldering and NASA-STD-8739.4 cable manufacturing compliances



In-house capabilities include overmolding and continuous fabric and metal braidings.

# Electrically and mechanically-initiated separation capabilities



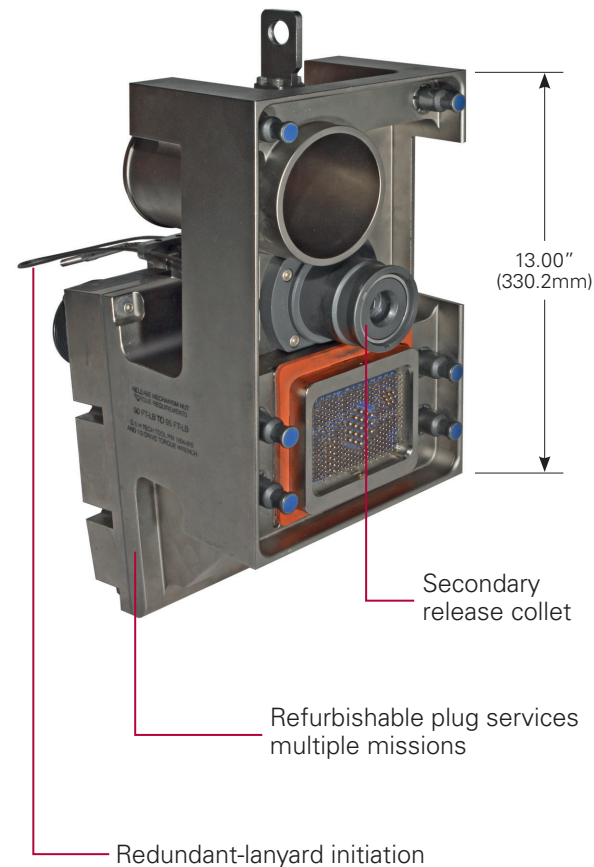
The pin puller depicted on the right end of the cable assembly facilitates electrical initiation for this umbilical connector. Mechanical redundancy is facilitated by the lanyard attached to the plug assembly.

The umbilical connector described below has extensive flight heritage connecting first propulsion stages to gantries. Redundancy is facilitated by dual lanyards activating primary and secondary-release collets.

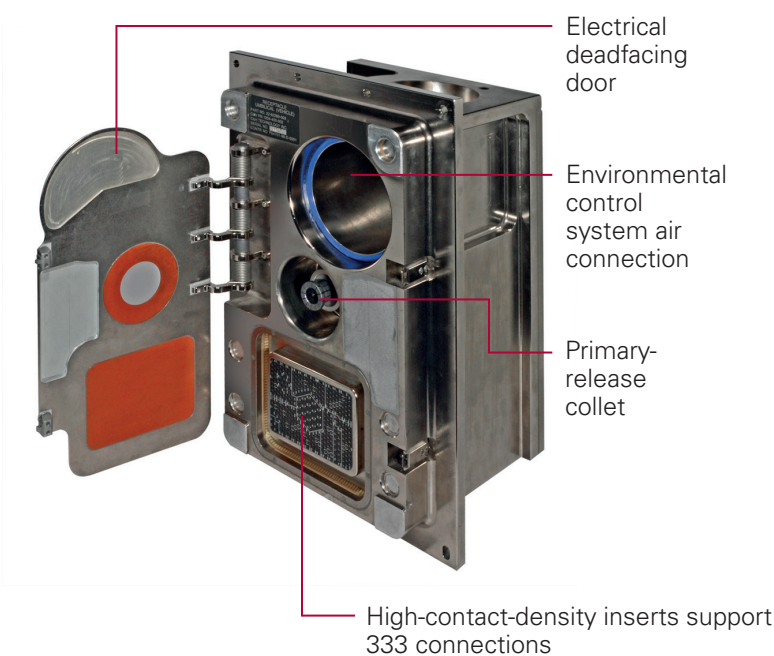


This redundant-lanyard-release connector utilizes MIL-DTL-38999 Series III compliant coupling threads and supports low pull force, off-axis releases.

## Umbilical-cable plug



## Launch-vehicle receptacle



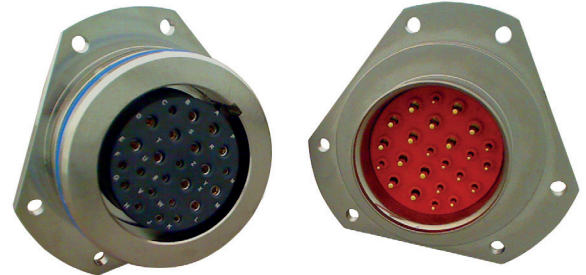


# Innovative engineering facilitates cost effective, reusable solutions

Eaton's custom-solutions capabilities enable quick-turn development of cost-effective and reliable space-rated solutions that are reusable, serviceable, and upgradeable.

One example of Eaton's track record of innovation is the launch-vehicle umbilical connector described below.

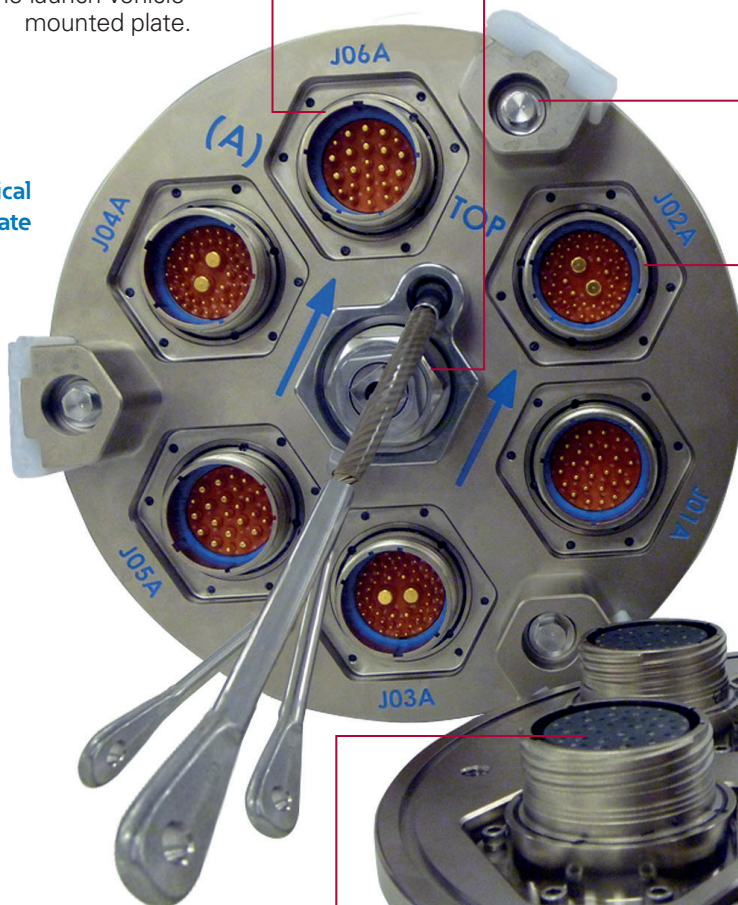
- MIL-DTL-38999 Series III derived shells and inserts reduce costs and leverage proven reliability and availability. Inserts can be upgraded to support changing mission requirements.
- A resettable release mechanism was developed based on a separation-nut design with over 40 years of flight heritage.



Anti-binding, roll-off shell designs are utilized on plate-to-plate connector engagement surfaces.

Connector pins mate with the umbilical cable. The opposing ends of these feedthroughs mate to the launch-vehicle-mounted plate.

Umbilical cable plate

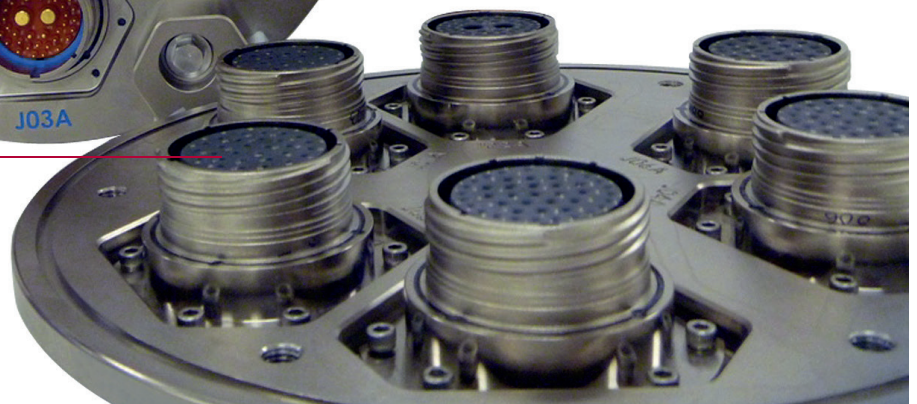


Connector sockets mate with the launch vehicle's wiring harness. The opposing ends of these feedthroughs connect to the umbilical-cable plate.

## Umbilical-separation sequence

- 1** Lanyard-actuated separation nut with double-shear dowel pin redundancy initiates umbilical separation.
- 2** Force-balanced spring towers work in conjunction with an ejector plate located in between the two connector plates to power separation.
- 3** The six sets of connectors simultaneously demate facilitating damage-free decoupling and reusability.

Launch vehicle mounted plate



Environmentally-sealed feedthroughs and mounting plate protect expensive avionics equipment against water intrusion during splashdown.

