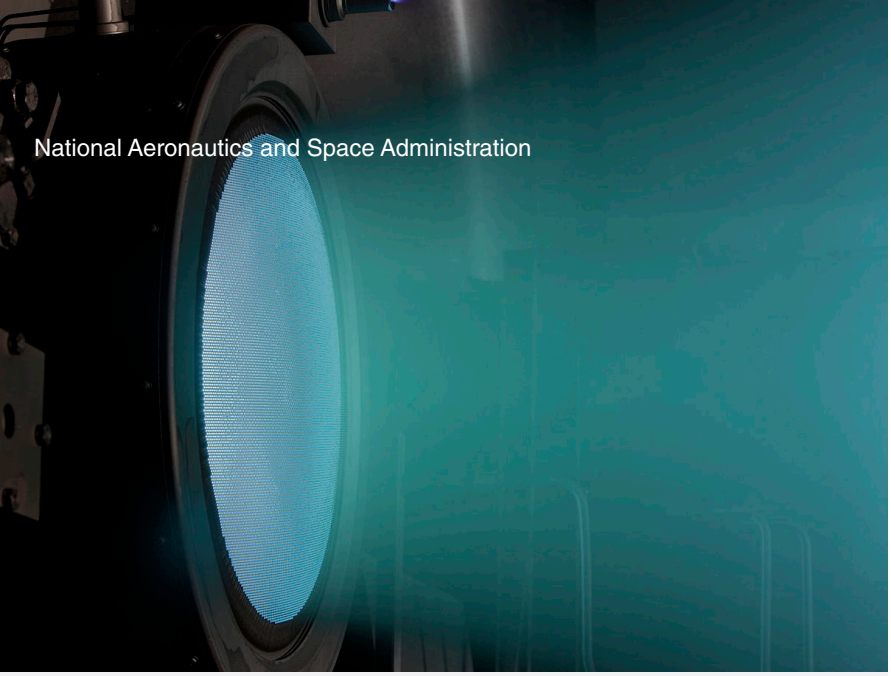


National Aeronautics and Space Administration

Propulsion

Non-Pyrotechnic Zero-Leak Normally Closed Valves

Simple, low-risk, zero-leak seal in a liquid propulsion system

Until now, the predominant normally closed valve assembly available for the Aerospace Industry was the pyrovalve. Despite their widespread usage in spacecraft fluid systems, pyrovalves have an unacceptable failure rate. Pyrovalves have been known to leak, allowing propellant to escape from the system into space, or, even worse, causing engine firings that could ultimately cripple the spacecraft. To replace the pyrovalve, NASA developed the Nitinol-Actuated Normally Closed Valve Assembly, a type of zero-leak valve designed for liquid propellant service on in-space propulsion systems.

BENEFITS

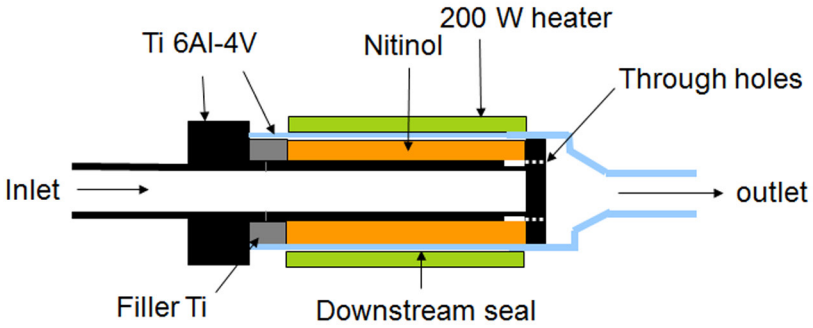
- Simple, safer design—NASA's nitinol-actuated normally closed valve invention uses a non-explosive actuator, and is therefore intrinsically safer than the explosive actuator used in a pyrovalve
- Zero-leak valve—the Valve Assembly has been proven to consistently seal a valve at a leak rate of 10-6 seconds, offering a cast improvement over the pyrovalve
- Adaptable—Nitinol has also been proven effective as an actuator in a normally closed valve

technology solution

THE TECHNOLOGY

The first prototype valve was designed for high pressure [5,000 psi (≈34.5 MPa)] and low flow, typical requirements for pressurant gas valves in liquid propulsion systems. It is possible to modify the dimensions to make low-pressure models or high-flow models, for use downstream of the propellant tanks.

During manufacture, a Nitinol bar is compressed to 93 percent of its original length and fitted tightly into the valve. During operation, the valve is heated until the Nitinol reaches the transition temperature of 95 °C; the Nitinol "remembers" its previous longer shape with a very large recovery force causing it to expand and break the titanium parent metal seal to allow flow. Once open, the valve forever remains open.



Valve schematic

APPLICATIONS

- NASA's NOVA is a drop in replacement of the currently used pyrovalve on all chemical propulsion systems

PUBLICATIONS

U.S. Patent 8,499,779

More Information

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