



SPACE CASE STUDY

PFAS FREE* POLYMER SEAL FOR CRYOGENIC VENT VALVES





OMNISEAL® SPRING-ENERGIZED SEALS

PFAS-Free* Polymer Seal For Cryogenic Vent Valves

March 2024

CRYOGENIC EXTREME ENVIRONMENT WEAR & FRICTION

Environment

Several challenging and extreme conditions affect venting components that regulate the flow of propellants in space rockets: 1) cryogenic temperature, 2) frequent movement to adjust the flow of media without lubrication, 3) subject to liquid oxygen (a very harsh chemical component), and 4) significant pressures (beyond 300 bar). As critical parts of a rocket's safety and operation, vent valve failure can lead to catastrophic consequences. Therefore, several propulsion systems integrate vents to avoid accumulation of propellant in certain areas of the valve.

Challenge

Achieving low leakage valve sealing at cryogenic temperature requires good contact from a sealing element as well as sealing material conformability with reduced friction, in order to avoid premature wear or malfunction. Adding vents to the rocket valve prevent media accumulation behind some areas in the propulsion system - a critical place that needs to be sealed from the other chambers. However, this vent creates a local high-pressure point (300 bar), which may lead to extrusion with existing, standard materials. The challenge then becomes finding a high-performance material that not only withstands a wide range of temperatures and LOX media but also provides self-lubricating properties, good contact with hardware, and a resistance to extrusion. Compounding this issue are growing PFAS regulations that impact the supply chain security of rocket manufacturers. This is why a PFAS-Free* solution is gaining positive consideration and acceptance.

**PFAS-Free here means we do not intentionally add PFAS material in the product, but does not exclude the possibility of traces, as these materials are common in the environment.*

Solution

Through iterations involving simulation, prototyping and testing with space customers, Omniseal Solutions' engineers designed a unique sealing solution that was based off our proven Omniseal® spring-energized seal. By combining a recently developed proprietary material (G45), with a custom design, the sealing solution can handle the natural shrinkage and dilatation of polymers used in seal jackets at cryogenic temperature. The seal's self-lubricating properties allow for friction control while its mechanical properties prevent the extrusion of the seal in the vent, preserving the functionality. Made-out of PFAS-Free* material, this sealing solution addresses a growing concern of the industry to find PFAS alternatives with the same high performance in extreme conditions.

Low leakage valve
sealing is an extreme
cryogenic challenge in
space vents ... solved
through Omniseal®
PFAS-Free*
spring-energized seals.



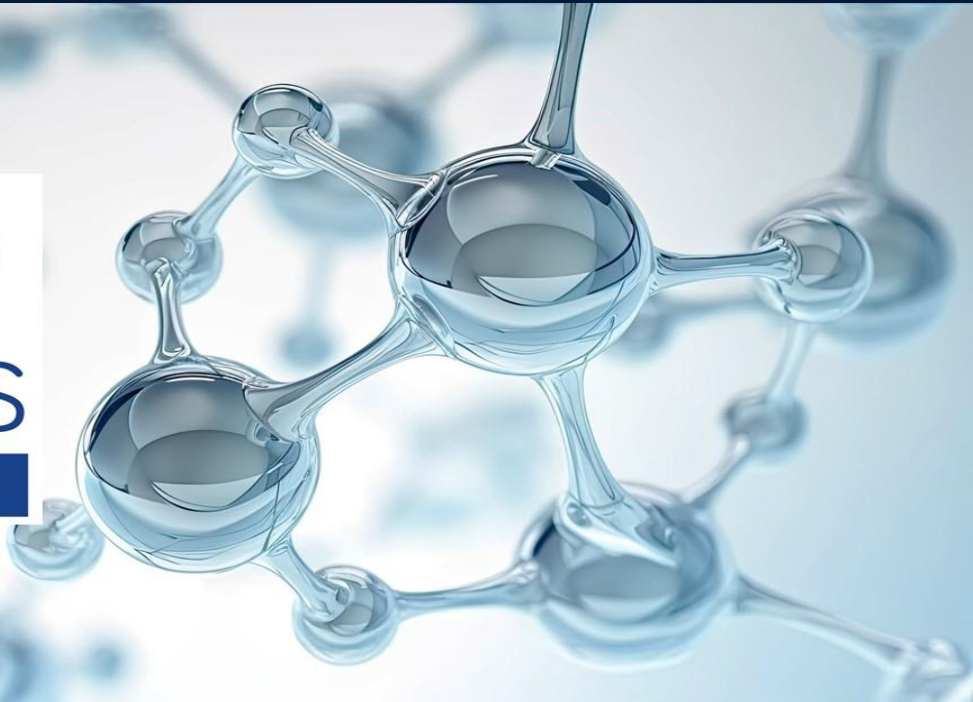
Benefits

- Friction control
- Low leakage at cryogenic temperatures
- Prevent extrusion in vent holes
- PFAS-Free* solution

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Design Expertise & Tailor-made Solutions for Your Critical Applications

Omniseal Solutions is a global engineering leader with over 65 years of historical legacy, relentlessly dedicated to the design and manufacture of precision sealing and wear control solutions that protect critical applications in the most demanding environments and passionately driven to push *Beyond the Boundaries of Possible*.



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