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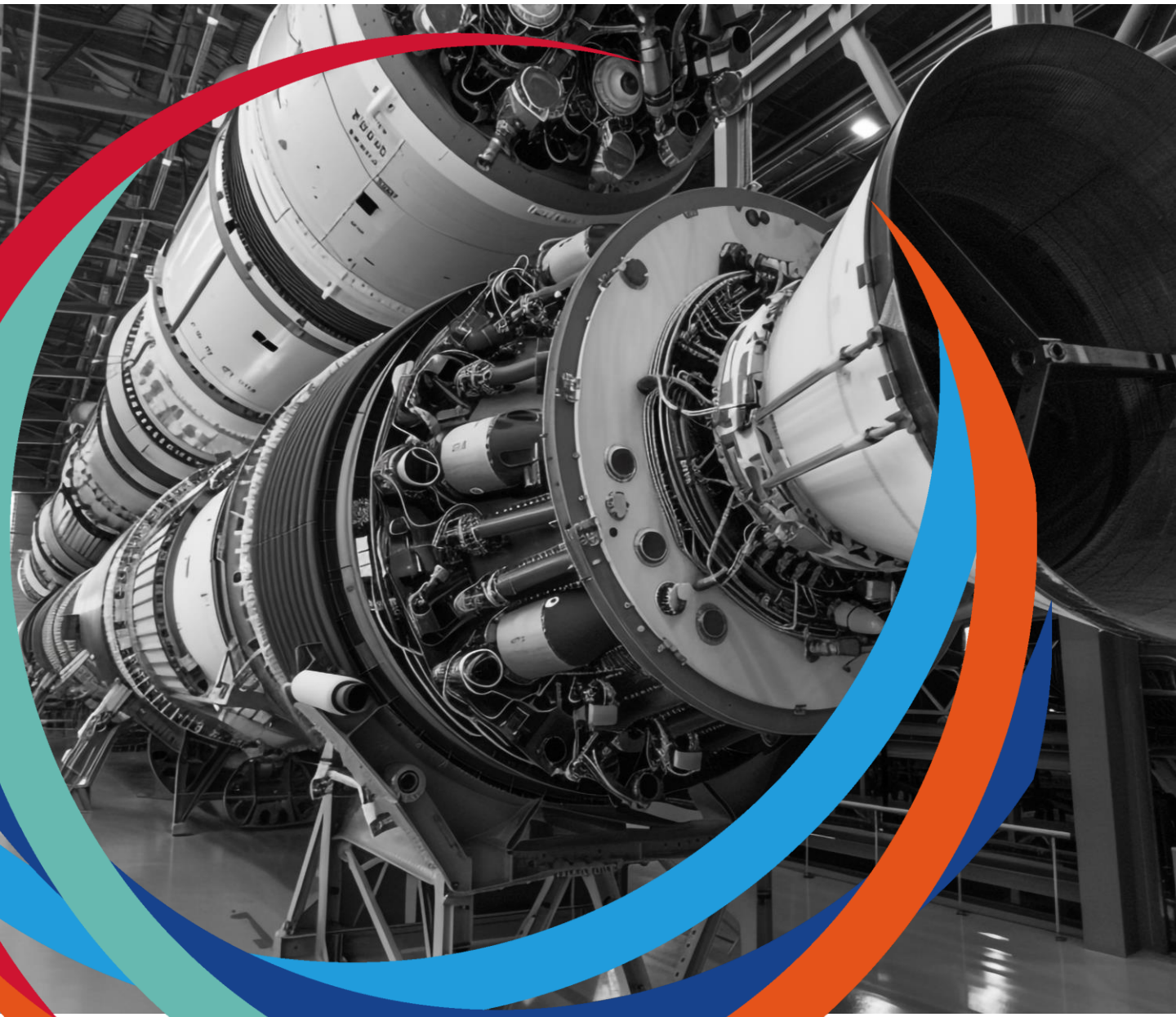
SPACE CASE STUDY

PFAS FREE* POLYMER SEAL FOR CRYOGENIC & HIGH TEMPERATURE VALVES



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OMNISEAL® SPRING-ENERGIZED SEALS

PFAS-Free* Polymer Seal For Cryogenic & High Temperature Space Valves

March 2024

CRYOGENIC EXTREME ENVIRONMENT WEAR & FRICTION HIGH TEMPERATURE

Environment

One of the most challenging environments in space involves liquid oxygen (a cryogenic propellant) used in launch vehicles. Valves within the rocket's fluid control systems are critical in ensuring a safe and successful mission as they regulate the flow of propellants and encounter cryogenic to very high temperatures conditions. Handling these demanding requirements along with high pressure, speeds, loads, and installation procedures can be challenging for engineers who design these critical valves and their components, particularly relating to sealing elements. Valve failure can lead to catastrophic consequences.

Challenge

As propulsion system design becomes more compact, the requirements on each element increases: temperature ranges go to both extreme temperatures, from -340°F to 750°F (-207°C to 398°C) with pressures up to 200 bar but still need to ensure a low friction. For the last criteria, successful control depends on the correct operation of the valve over its lifetime, conditioning the regulation of fluid and thus the functionality of the launch vehicle combustion and engine. Finding a proper material to withstand such a wide range of temperatures and LOX media can be challenging. As a dynamic system, self lubricating properties are a major requirement for the sealing element. However, growing regulations over PFAS materials bring on another challenge to the supply chain security of rocket manufacturers, and a PFAS-Free* solution is becoming an emerging request and consideration.

**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.*

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Solution

The Omniseal® PFAS-Free* 103A spring-energized seal is a custom-design sealing solution that is engineered to handle the natural shrinkage and dilatation of polymers used in seal jackets at cryogenic to very high temperatures. For this demanding valve application, Omniseal Solutions' technical team developed a new polyimide-based material, the G45, with temperature resistance above the required 320°C requirement. Addressing a growing concern of the space industry, this material is manufactured using PFAS-Free* material. A new design geometry was adopted to accommodate for different mechanical behavior. Through iterations of design, simulation, prototyping and testing, we were able to qualify the material and component.

From cryogenic to high temperatures, Omniseal® PFAS-Free* spring-energized seals protect your valves over the long range and deep into space.

Benefits

- Friction control
- Low leakage in cryogenic to high temperature (above 350°C)
- Limits polymer shrinkage effect
- 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*.

Looking for other options?
Try our Assessment Tool!

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