Omniseal Solutions
SAINT-GOBAIN

Space Industry Handbook

Beyond the boundaries of
POSSIBLE

SAINT-GOBAIN

Fuel & Oxidizer Tank

Application: Flange and chamber joints, lining of fuel and oxidizer tank door

- Fluid: Fuel (LH2, Hydrazine, MMH, UDMH, RP-1, etc.) and Oxidizer (LOX, GOX, Peroxide, Nitrogen Tetroxide, Oxygen Difluoride, etc.)
- Temperature: -253°C to +38°C (-424°F to +100°F)
- Pressure: Up to 21 bar (300 psi)
- Sealing: Static face seal

Our Product: Omniseal® seal

Our Key Value:

- Cryogenic sealing of very large diameter areas
- Seal manufacturing not constrained by diameter of the seal ranging up to several feet
- Proven RACO® seal design

Landing Gear

Application: Landing gear shock-strut

- Fluid: Pressurized gas
- Temperature: Up to +149°C (+300°F)
- Pressure: > 70 bar (1,000 psi)
- Sealing: Dynamic rod/piston seal of dithering and oscillating motion

Our Product: Omniseal® rod/piston seals and Meldin® bushings

Our Key Value:

- Fluid power sealing in high pressure environment
- Lightweight, high-temperature polyimide components replacing metal bushings

Thruster

Application: Hypergolic fluid injection in payload thrusters

- Fluid: Monomethyl hydrazine (MMH) and nitrogen tetroxide (TTO)
- Temperature: +10°C to +38°C (+50°F to +100°F)
- Pressure: 21 bar (300 psi)
- Sealing: Static rod/piston seal

Our Product: Omniseal® seal

Our Key Value:

- Fluid compatibility with corrosive, toxic and difficult to handle hypergolic fluids

Sub-orbital Launch Vehicle

Application: Valves in methane fuel lines

- Fluid: Natural gas
- Temperature: -73°C to +204°C (-100°F to +400°F)
- Pressure: 172 bar (2,800 psi)
- Sealing: Static

Our Product: Omniseal® seal

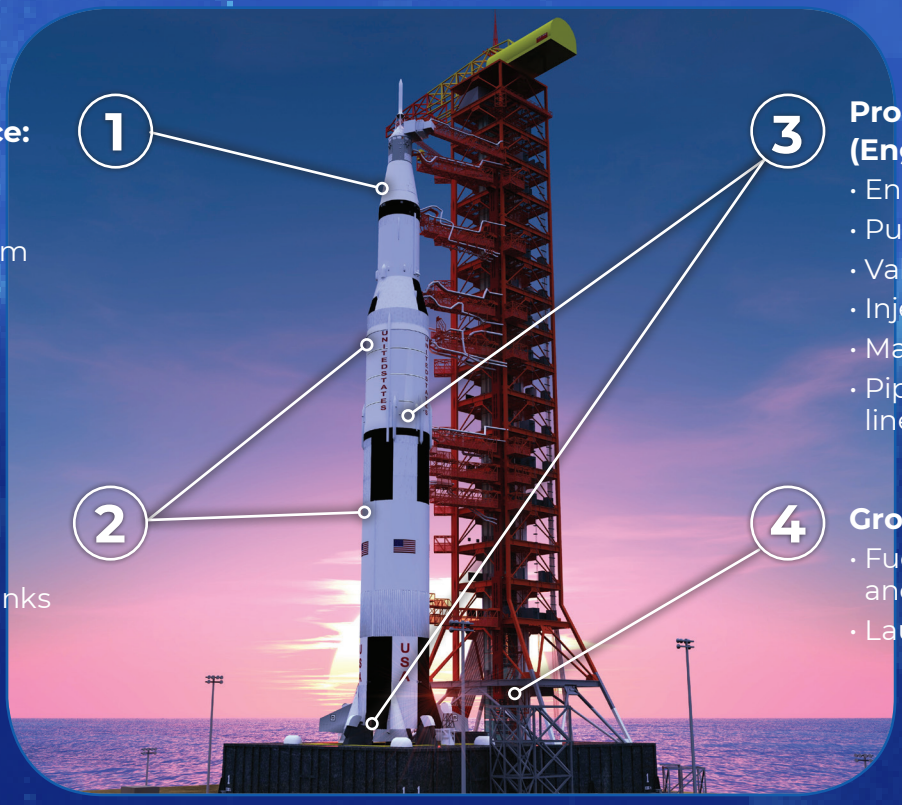
Our Key Value:

- High pressure sealing in low temperature
- Sealing in a wide temperature range

GOING BEYOND WITH SEALING & MATERIAL SOLUTIONS

Payload & Guidance:
- Spacecraft
- Satellite
- Launch abort system

Structure & Tanks:
- Frame
- Fuel and oxidizer tanks
- Landing gears



Propulsion (Engines & Auxiliaries):
- Engines
- Pumps
- Valves
- Injectors
- Manifolds
- Pipes, ducts, flanges, feed lines and actuators

Ground Support System:
- Fuel & oxidizer storage and delivery
- Launch pad

OUR SPACE JOURNEY

From manned and unmanned space programs to countless other sub-orbital, orbital and outer space programs...

From our Omniseal®, RACO® and TEC Ring seals with Fluorocarbon Company, Furon and now Omniseal Solutions™.

Project Mercury (1959-1963)

Project Gemini (1963-1966)

Apollo Program (1961-1972)

Viking Program (1975)

Space Shuttle Program (1981-2011)

Mars Exploration Program (1993-ongoing)

Space Launch System SLS (2011-ongoing)

Supporting all major space projects from civil to military to commercial and emergent space.

Proven in the Past...

Building upon three initial unique designs (Omniseal®, RACO® and TEC Ring seals), we have been recognized as a leading designer and manufacturer of high-performance spring-energized seals that provide improved sealing performance over soft elastomeric seals and hard metal gaskets in applications involving cryogenic liquid propellants in various rocket engine programs. Our Meldin® thermoset polyimide material is ideal as finished machined components in high temperature as well as a lightweight and dimensionally stable bushing, piston ring, guide ring, split ring type applications and other custom shapes.

... Prepared for the Future

Valves

Application: Valves in flow control and fluid handling

- POGO suppression, engine control, anti-blowout, isolation, throttle, cryogenic, OIV, FIV, ball valves, butterfly valves, relief valves, check valves, main valves, etc.

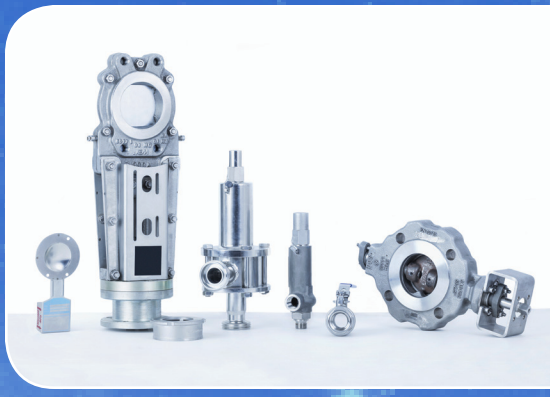
Application conditions:

- Fluid: Fuels and oxidizers, hypergolic fuels, etc.
- Temperature: Cryogenic to a few hundred degrees F
- Pressure: Up to a few thousand psi
- Sealing: Reciprocating rod/shaft seal and static face seal

Our Product: Omniseal® seal

Our Key Value:

- Cryogenic sealing
- Low friction and wear in oscillating/vibrating environments
- Seal design prevents seal blowout



Fluid Transfer Line

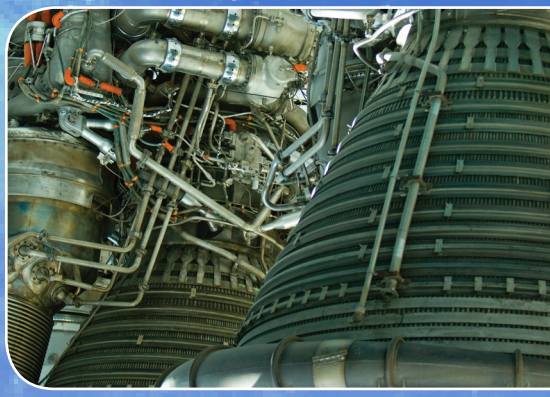
Application: Slip joint ducts and fittings

- Fluid: Helium, O2, H2, N2, etc.
- Temperature: -112°C to +213°C (-170°F to +416°F)
- Pressure: 55 bar (800 psi)
- Sealing: Static seat seal, dynamic rod/piston seal and bushing

Our Product: Omniseal® seal with guide rings and Meldin® components

Our Key Value:

- Able to withstand oscillation and vibrations
- Lightweight polyimide replacing metal bushing



Space Exploration Vehicle

Application: Analytical chemistry equipment

- Fluid: Martian atmosphere, Sulfur Hexafluoride (SF6)
- Temperature: -130°C to +120°C (-202°F to +248°F)
- Pressure: Up to 1 bar (14 psi)
- Sealing: Static rod/shaft seal

Our Product: Omniseal® seal and Rulon® ball bearings

Our Key Value:

- Sealing over a wide temperature range
- Wear and abrasion resistance in harsh sand/dust environment

Rocket Motor

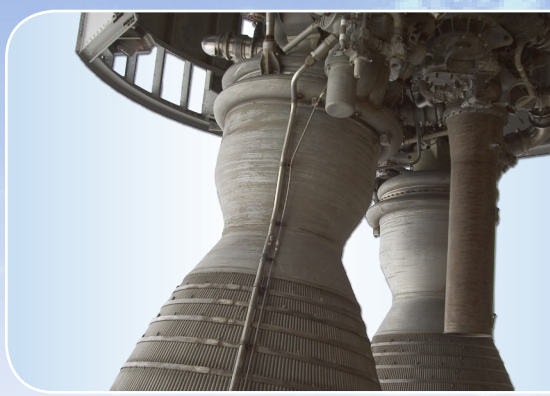
Application: Port to tube fitting

- Fluid: Hypergolic and cryogenic
- Temperature: -240°C to +260°C (-420°F to +500°F)
- Pressure: 172 bar (2,500 psi)
- Sealing: Static face

Our Product: Metal Boss Seal

Our Key Value:

- Temperature capability from -269°C to +816°C (-453°F to +1,500°F)
- PTFE coated metal jacket and crush ring for robust sealing



OUR ADDED VALUE IN SPACE APPLICATIONS

Cryogenic Sealing

- Omniseal® spring-energized seals provide excellent cryogenic sealing (T < -150°C/-238°F)
- Omniseal® metal C-Seals and spring-energized C-Seals are available for extremely tight leakage requirements or thermal cycling to high temperatures (> +300°C/+572°F)

Chemical Compatibility

- Omniseal® seals are inert to almost all chemicals and compatible with aggressive and corrosive fuels without swelling
- LOX cleaning and clean room assembly

Low Friction and Wear & Light Weight

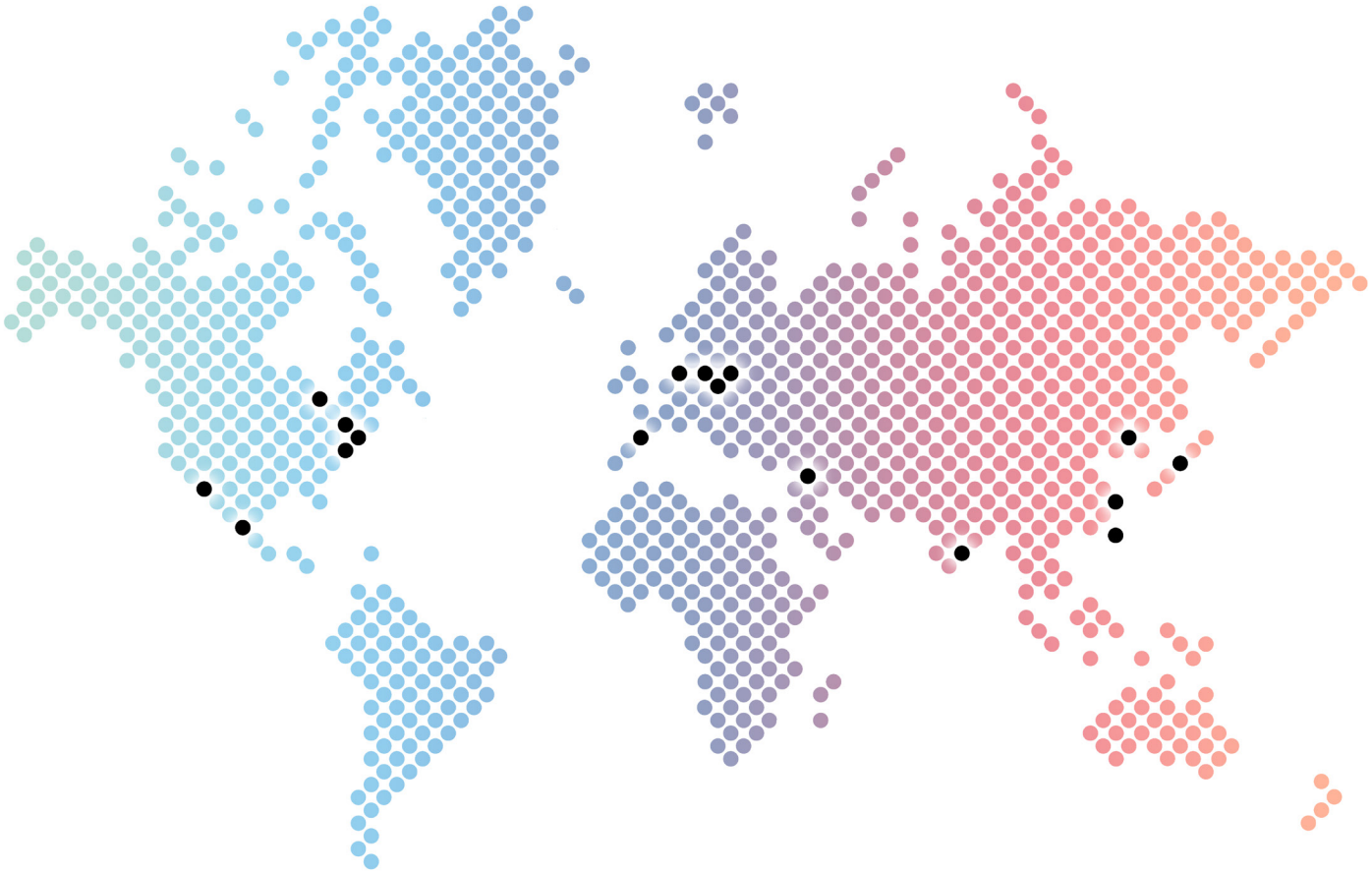
- Seals offer the lowest CoF
- Excellent wear characteristics
- Excellent in oscillating/vibrating and high pressure engine environments
- Light weight compared to other seal options and bushings

Proven Pedigree

- Numerous historical launch programs
- RACO® seal referenced in NASA Reliability Preferred Practices: PRACTICE NO. PD-ED-1208, Static Cryogenic Seals for Launch Vehicles

Solutions		Main Features
OMNISEAL® POLYMERS	High-Performance Spring-Energized Seals	• Temperatures from -210°C to +316°C (-346°F to +600°F). • Pressure: Vacuum up to 3,448 bar (50,000 psi). • Low and controlled friction. • Broad chemical resistance.
	High-Performance PTFE Rotary Shaft Seals	• Temperatures from -53°C to +232°C (-65°F to +450°F). • Shaft speed in excess of 36 m/s (7,000 fpm). • Pressures up to 35 bar (508 psi).
RULON® FLUOROPOLYMERS	High-Performance Fluoropolymer Compounds	• Temperatures from -268°C to +316°C (-450°F to +600°F). • Low friction, high wear life and broad chemical resistance.
MELDIN® POLYIMIDES	High-Performance Thermoset Polyimide Materials	• Temperatures from cryogenic through +316°C (+600°F), intermittently up to +482°C (+900°F). • Superior strength and rigidity combined with self-lubrication properties.
OMNISEAL® METALS	High-Performance Metal Seals	• Temperatures from cryogenic up to +1,093°C (+2,000°F). • From ultra-high vacuum to 6,894 bar (100,000 psi). • Leakage performances as low as 10^{-10} sccs with GHe

ONE GLOBAL TEAM... A DEDICATED CUSTOMER FOCUS



GLOBAL & LOCAL PRESENCE

With 17 manufacturing facilities in 10 different countries, Omniseal Solutions™ is a diverse group that is committed to being customer centric.

Contact our team of experts for more information. We have local resources to support you!

- **Americas:** Garden Grove, CA, USA; Bristol, RI, USA; Orange, CT, USA; Cleveland, OH, USA; Northboro, MA; Saltillo, MX
- **Europe:** Kontich, Belgium; Mechelen, Belgium; Vimercate, IT; La Rioja, Spain; Kolo, Poland; Willich, Germany
- **Asia:** Shanghai, China; Bangalore & Chennai, India; Suwa & Tokyo, Japan; Seoul & Incheon, South Korea; Taipei, Taiwan

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