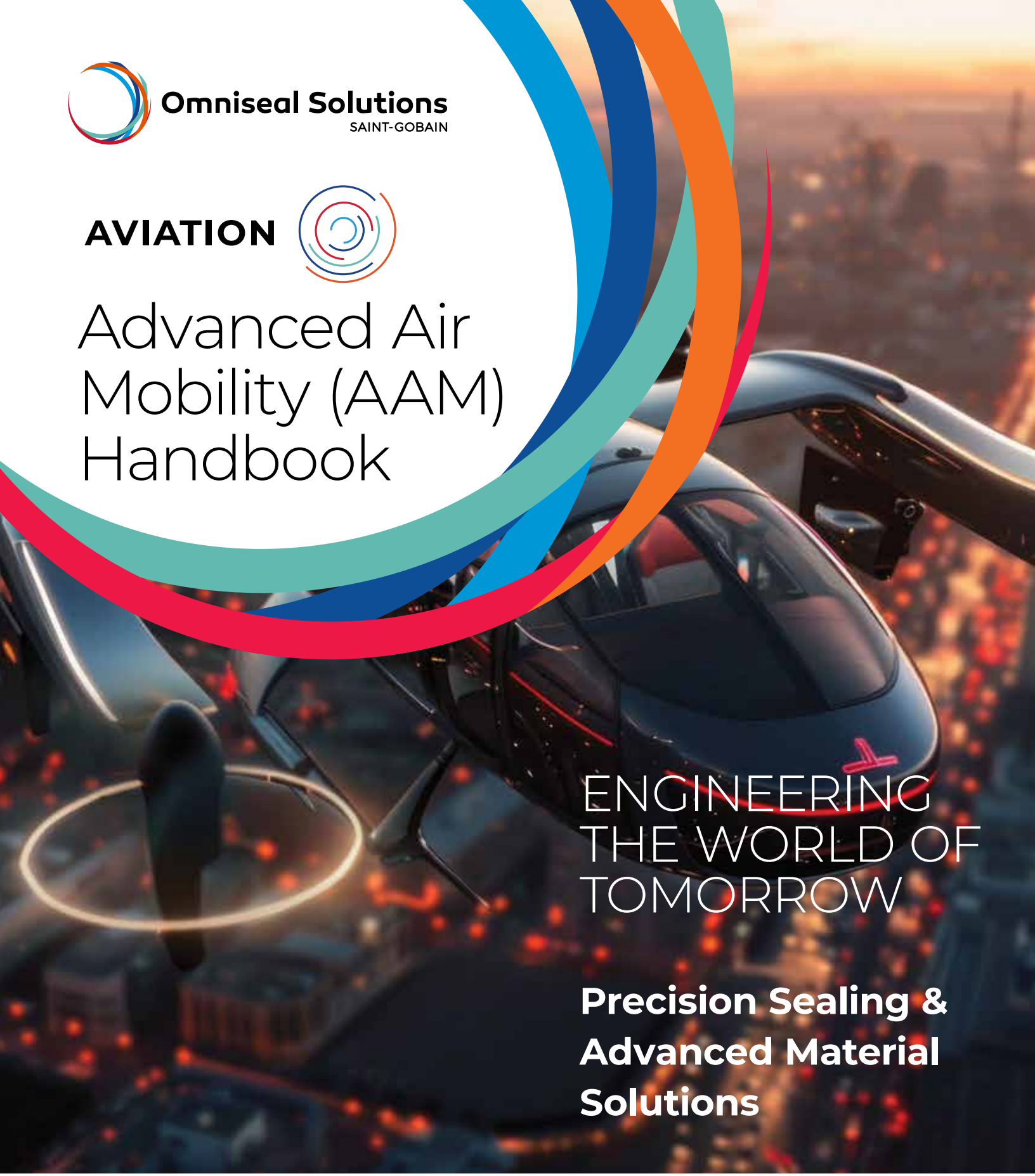
Omniseal Solutions
SAINT-GOBAIN

AVIATION

Advanced Air Mobility (AAM) Handbook



ENGINEERING THE WORLD OF TOMORROW

Precision Sealing & Advanced Material Solutions

BEYOND
the boundaries of possible

SAINT-GOBAIN

A KEY PARTNER & COLLABORATOR IN THE AVIATION INDUSTRY

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”.

This collaborative spirit has led us to be specialists in engineering and manufacturing many precision sealing and advanced material solutions for rapidly evolving markets such as Electric Vertical Take-off and Landing (eVTOL) aircraft, which are poised to revolutionize the world of aviation and our future mobility.

How does Advanced Air Mobility (AAM) affect our daily lives and communities? From urban air transport to logistics and emergency medical services, they are proving to support sustainability, mobility, time efficiency, accessibility, and connectivity.

AAM BENEFITS: SAFE, QUIET, GREEN & ECONOMICAL

- Reduced need for vehicle traffic within urban core
- Increased range of access to the urban core
- Increased utility of airport infrastructure
- Additional transportation options (social equity)
- Integration with existing commuter transit and roads
- Safe mode of transportation with low emissions

FUTURE TECHNOLOGY FOR US ALL

TECHNOLOGY ADVANTAGES THAT TAKE YOU FARTHER

A WEIGHT OFF YOUR SHOULDERS

One of the most persistent and challenging issues in advanced air mobility and eVTOL design is meeting stringent weight requirements – a requirement well known in aircraft manufacturing – but not as simple to solve.

Since the genesis of aviation, technical teams have explored novel space and weight-saving solutions, promising cross-compatibility with emerging technologies. Aircraft sealing and material solutions are one example that are enabling the reliable and safe operation of key advanced air mobility systems. Omniseal Solutions has worked closely with customers to customize solutions to handle existing and future high-performance requirements, moving them ahead as industry leaders.

A HANDLE ON HIGH PRESSURE & HIGH TEMPERATURE

To solve high pressure and high temperature (HPHT) stringent requirements, our jet engine and gas turbine seals provide tight and consistent sealing control capable of withstanding high pressures and temperatures, ensuring optimal performance in extreme operating conditions. Our Omniseal® spring-energized seals and metal seals, in particular, have proven to be invaluable, where conventional seals might fail due to the demanding environment.

A CUSTOMIZATION THAT COUNTS

Our polymer jacket and spring material or metal ring with coating are customized for precision, including the ability to adjust spring loads as required. These unique designs and materials provide outstanding thermochemical compatibility and high-speed dynamics. These are all critical criteria when it comes to pushing the performance boundaries of advanced air mobility systems.

Global Capabilities & Services

A WORLD PARTNER OF ENGINEERING & MANUFACTURING EXPERTS

How does our business add value and impact to your missions and goals? One of our strengths is our global history and longevity in the aviation industry, having provided over millions of polymer seals, metal seals, polyimides, thermoplastics, composites and polymer materials for applications in commercial and military aircraft; helicopters; eVTOLs, and hybrid electric vehicles.

A global presence with 17 manufacturing plants, 8 R&D transversal centers and technical teams with many years of experience, we can provide global reach as well as local support with top industrial standards such as AS9100D.

Design Support
Our relentlessly dedicated engineers problem solve and collaborate to create custom solutions for lifetime confidence.

Simulation
With simulation services, we help customers understand how a prototype will react in working conditions and its impact in the world.

Assembly
From molding to assembly, our operating teams have the machines and knowledge to deliver consistent and high quality parts.

Installation Tools
To prepare for success, our technical team provides detailed video and written installation guides. We also design specific tools based on expertise of application performance.

Fast Sample Delivery
Time is critical so if you need a sample quickly, you can depend on our rapid response and delivery along with follow up technical advice.

Rapid Prototyping
Since your application may be new or in development, you can request a custom designed prototype that is delivered at your premises when you need it.

In-House Testing
From analysis of raw materials to testing samples and verification, our R&D and technical teams support all validation processes.

Solving Your Challenges

CREATIVE, UNIQUE, PROVEN & CUSTOM ENGINEERING

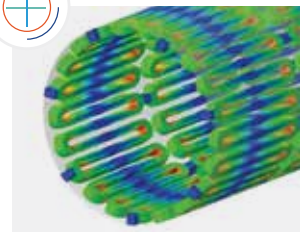
What is Omniseal Solutions known for? We protect critical systems with custom material formulations and precision designs. From polymer powders to complex assemblies, our solutions are designed to handle extreme environments.

CREATIVE MATERIALS

- Materials and formulations that are developed for an extensive range of applications
- Broad temperature / pressure range
- Wide chemical compatibility
- Certification for extreme conditions

CUSTOM DESIGN

- Permanent development and validation of new solution designs
- Pre-validation testing
- Co-development with customers for optimum performance



UNIQUE SIMULATION EXPERTISE

- Simulation tools development
- Test-based material models
- Simulation engineering services

PROVEN PROCESS EXPERTISE

- Injection molding
- Compression molding
- Machining
- Stamping
- Direct Forming
- Skiving

PROTECTING YOUR CRITICAL SYSTEMS

PROPELLER & TRANSMISSION SYSTEMS

Environmental Shaft Seals
Gearboxes
Rotorhead Seals
Electric Propulsion Unit (EPU)

FLIGHT CONTROL SYSTEMS

Primary Control Actuators
Secondary Control Actuators

CREATING PRECISION SEALING SOLUTIONS TOGETHER

Aviation customers have trusted our business for decades to protect their systems, using our custom sealing components that solve many application challenges such as aggressive media, high temperature, high pressure, high speed, and leakage rate. With our diverse portfolio of proven solutions, our sealing knowledge and experience have grown with our customers so they can go beyond in present and future technologies. Together, we partner to engineer the world of tomorrow efficiently, safely, and with confidence.

Omniseal® Spring-Energized Seals

- Temperature range: -254 to 365°C
- UHV to 15,000 psi (1035 bar)
- Broad chemical compatibility
- 3mm to 6m size

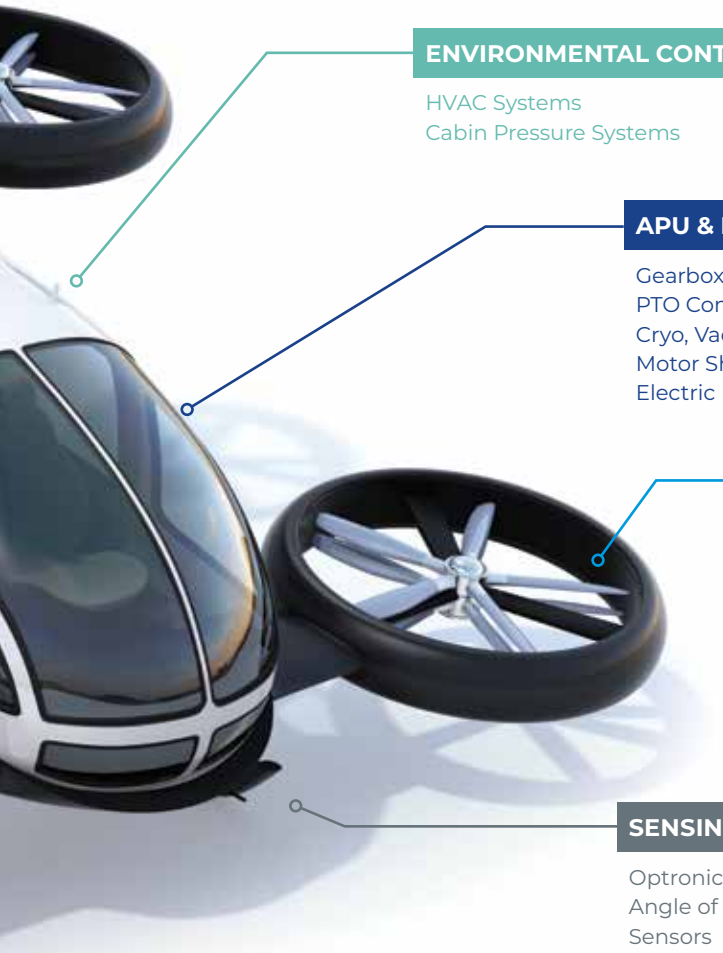
Omniseal® Metal & Boss Seals

- Temperature range: -269 to 1150°C
- Leak Rates: < 10^{-10} cc/sec
- Vacuum to 100,000 psi (6894 bar)
- All fluids and gases

Omniseal® Rotary Lip Seals

- Temperature range: -55 to 230°C
- Low friction and wear in dry abrasive media
- High speed rotary applications

Our polymer and metal solutions are used in many critical systems for sealing, wear, and friction control.



ENVIRONMENTAL CONTROL SYSTEMS (ECS)

HVAC Systems
Cabin Pressure Systems

APU & HYBRID POWER SYSTEMS

Gearboxes
PTO Components
Cryo, Vacuum & Liquid Hydrogen Seals
Motor Shaft Lip Seals
Electric Propulsion Unit (EPU)

POWER ELECTRONIC SYSTEMS

Power Converters
Electric Systems
Vacuum Rotary Shaft Seals for Superconductivity

SENSING SYSTEMS

Optronics
Angle of Attack
Sensors

CREATING ADVANCED MATERIAL SOLUTIONS TOGETHER

Formulating unique and advanced materials is one of the technology advantages we are known for in the aviation industry. Since aviation is a fast growing market, requirements and regulations are changing at the same rapid pace. By working closely together with you and understanding your present and future needs, we can create material solutions that ensure reliability, provide high performance and manage extreme conditions. Our materials can “weather” any challenge you face.

RULON® FLUOROPOLYMERS

- Temperature range: -250°C to 288°C
- Broad chemical compatibility
- Low deformation under load
- Self-lubrication
- > 1000 formulations

HYCOMP™ COMPOSITES

- Carbon/Glass fiber re-enforced
- Very high mechanical strength
- Temperature up to 315°C
- High stiffness & lightweight

MELDIN® HT THERMOPLASTICS

- Engineered Thermoplastic
- Temperature range: -250°C to 280°C
- All volume coverage
- IT6 tolerance control, 0 ppm in Million part volume

MELDIN® POLYIMIDES

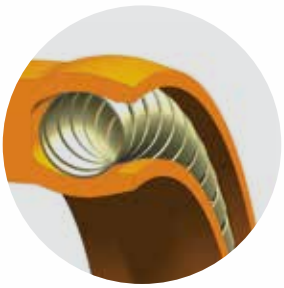
- Temperature range: -250°C to 320°C
- High strength at high temperatures
- Wear resistance under high load
- High thermal-oxidative stability

POWER ELECTRONIC SYSTEMS

Power Converters
Electric Systems
Vacuum Rotary Shaft Seals for Superconductivity

IBG

Close to increasing highest temperatures in the engine, HTS oil is mandatory, elastomer-based seals are ruled out



Omniseal® Spring-Energized Seal

High spring load with small deflection

Extremely low leak rate

High performance polymer inert to all known standard oils

A90 material available for high temps

Based seals are ruled out

Versatile

Like-to-like groove fit for O-Ring replacement

Lifetime performance superior to elastomer seals

Lower cost & weight for larger diameters

PROVEN SUCCESS IN CRITICAL SYSTEMS & APPLICATIONS

Omniseal® Polymers

Internal Gearbox Seal

Solution
Omniseal® Spring-Energized 103A Seal

High performance A08, A10, A21 and A90 polymer materials are preferred

Specifications
Nominal ID of seals between 0.25" and 6" (6.35 to 150mm)

Seal can be installed in closed or reduced gland

Low pressures

Typical Temperature:
-55 to 350°C (-65 to 665°F)

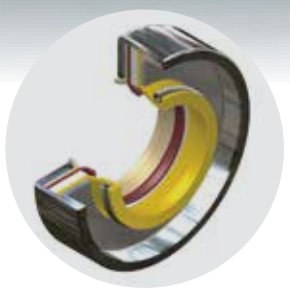
Media
Compatible with air and aerospace oils

POWER ELECTRONIC SYSTEMS

Power Converters
Electric Systems
Vacuum Rotary Shaft Seals for Superconductivity

Generator in Hybrid Engine

Generator shaft rotates at variable speeds, up to high surface speeds. High tightness on complete speed range required.



Omniseal® Rotary Lip Seal

Omniseal® rotary lip seal has an extremely tough, long wearing jacket material and a good resistance to wear

Extended Operations

Long seal life minimizes down time

PTFE lip seals able to run dry in case of loss of lubrication

PROVEN SUCCESS IN CRITICAL SYSTEMS & APPLICATIONS

Omniseal® Polymers

Hybrid Engine Generator Seal

Solution
Omniseal® Rotary Lip Seal

Specifications
Dynamic sealing between seal and rotating shaft

Static sealing between seal and housing

Very low leakage, with seal lasting entire lifetime

Lip seal low friction leading to reduced energy consumption

Typical Temperature:
-40°F to 302°F (-40°C to 150°C)

Rotation
High speed rotary capabilities, up to 11.500 RPM (44 m/s)

Media
Compatible with aerospace fluids: oil

POWER ELECTRONIC SYSTEMS

Power Converters
Electric Systems
Vacuum Rotary Shaft Seals for Superconductivity

Harsh Conditions

Possible dirt, dust and abrasive particles

Different running conditions: switches between dry periods, wet environment, abrasive environment

Omniseal® Rotary Lip Seal

Omniseal® rotary lip seal has an extremely tough, long wearing jacket material and a good resistance to wear

Extended Operations

Long seal life reduces downtime

In case of loss of lubrication, seals are still able to run dry

PROVEN SUCCESS IN CRITICAL SYSTEMS & APPLICATIONS

Omniseal® Polymers

Electric Motor Environmental Seals (bearing protection)

Solution
Omniseal® Rotary Lip Seal

Specifications
No allowable leakage

35.000 hours lifetime required

Low pressure, only slight differential pressure due to temperature differences

Lip seal low friction leading to reduced energy consumption

Typical Temperature
-60°F to 250°F (-51°C to 120°C)

Rotation
up to 12.000 RPM, surface speed up to 40 ft/s (12 m/s)

Media
Compatible with environment (salt spray, rain, de-icing agents, sand, dirt, dry, ...)

FLIGHT CONTROL SYSTEMS

Primary Control Actuators
Secondary Control Actuators

Electromechanical Actuation

Low friction solution for reciprocating movement

Compatible with aerospace fluids like hydraulic oils, de-icing fluids, fuels

Omniseal® Spring-Energized Seal

Low sensitivity to thermal aging of polymer material on the Omniseal® jacket provides better sealing control and lifetime confidence

Seals can be custom designed to meet low friction requirements

Easy Installation

Seals can be designed for existing glands

Seals can be installed into closed and reduced glands

PROVEN SUCCESS IN CRITICAL SYSTEMS & APPLICATIONS

Omniseal® Polymers

Electromechanical Actuation Seal

Solution
Omniseal® Spring-Energized Seal

Specifications
Low friction seals for reciprocating movement

Provides static sealing between seal and housing

Provides dynamic sealing between seal and moving shaft

Typical Temperature
Temperature range from -50°C up to 150°C (-60°F up to 300°F)

Typical Movement
Reciprocating movement with a speed of 0.01 m/s (2 ft/min)

Media
Hydraulic oil, de-icing fluids, cleaning fluids, oils (including HTS grades), fuels

FLIGHT CONTROL SYSTEMS

Primary Control Actuators
Secondary Control Actuators

Engine Actuation

Metal casing provides tight control and wear protection since the part is submitted to friction & wear from vibration and sliding motions, immersed in jet fuel

Relatively High temperature are reached up in the actuators

Meldin® Polyimide

Meldin® Polyimide parts have excellent mechanical performance with a good compromise between the wear resistance, its creep resistance & its coefficient of friction

Compatible with aviation fuels

Self lubrication allows low sulfur fuel grades, like SAF

Lower Weight & Durability

Carbon filled polymers are lighter than metals, reducing weight and combining wear and friction resistance qualities

Self lubrication increases durability and lowers coefficient of friction

PROVEN SUCCESS IN CRITICAL SYSTEMS & APPLICATIONS

Meldin® Polyimides

Fuel Driven Actuators & Fuel Control Valve Bushings & Split Rings

Solution
Meldin® 7500 Bearing

Specifications
Structural part for shaft guiding, high creep resistance

Low friction & wear

Compatible with fuel immersion

Tight tolerances

Typical Temperature
Up to 135°C (280°F) or higher

Media
Aerospace grade fuels

ENVIRONMENTAL CONTROL SYSTEMS (ECS)

HVAC Systems
Cabin Pressure Systems

Environmental Control Systems

ECS are complex with multiple suppliers and many metal parts

Glass Filled PEI

Potential weight savings of 40% over aluminum and 75% over stainless steel and titanium due to lower density of composite

Valve Body Housing

Using complex injection molding with integrated finish machining and bonded aluminum sleeve assembly, enables a reduced complexity and weight savings

PROVEN SUCCESS IN CRITICAL SYSTEMS & APPLICATIONS

Meldin® Polyimides

Valve Body Housing Injection Molded Parts

Solution
Meldin® 3200 Injection Molded Part

Specifications
Couples inlet to outlet sections of the system, and houses butterfly plate for pressure control

Hybrid design for burst pressure consideration

Typical Temperature
Up to 150˚C (300˚F)

Media
Hot Air

ENVIRONMENTAL CONTROL SYSTEMS (ECS)

HVAC Systems
Cabin Pressure Systems

Hot Air Valve

High temperature application

Accommodation of thermal dilatation and strain

Omniseal® Spring-Energized Seal

Excellent for static or dynamic sealing, with extremely low leak rate and long lifetime

Low sensitivity to thermal aging of polymer material

Low Weight & Flexible Design

Seal can be installed in multiple applications, without changing the design

Lower cost & weight for larger diameters

PROVEN SUCCESS IN CRITICAL SYSTEMS & APPLICATIONS

Omniseal® Polymers

Air Management Bleed Air Valve Seals

Solution
Omniseal® Spring-Energized 103A & 400A Seals

A08 & A10 are preferred materials

Static, Reciprocating & Rotary Seals

Specifications
Nominal ID of seals between 0.25” and 10” (6 To 254 mm)

Typical Temperature
-54 to 288°C (-65 to 550°F)

Typical Pressure
7 PSI to 85 PSI (0.5 to 6 bars)

Media
Hot Air

ENVIRONMENTAL CONTROL SYSTEMS (ECS)

HVAC Systems
Cabin Pressure Systems

Customer Challenge

High air temperature sealing solution with strong thermal resistance to deliver the heat only at expected places with minimal losses

Meldin® Polyimide & Omniseal® Flat Gasket

Meldin® polyimides & high performance polymers are able to sustain bleed air temperatures

Assembly with Omniseal® seal replaces 2 different components for easier integration

Comfort and Safety

The combination of Meldin® polyimides (thermal insulation) & Omniseal® seals (excellent sealing) enable low heat loss for efficient de-icing

PROVEN SUCCESS IN CRITICAL SYSTEMS & APPLICATIONS

Meldin® Polyimides

Wing Deicing Duct Sealing Gaskets

Solution
Meldin® 7001 Polyimide & Omniseal® Flat Gasket

Specifications
Heat transfer from bleed air tube to wing structure not allowed

Structural integrity required at elevated temperatures

Excellent ductility for long life

Thermal Properties
Excellent thermal insulative properties & low thermal conductivity

SENSING SYSTEMS

Optronics
Angle of Attack
Sensors

Sensor Seal

More tightly controlled and consistent friction while also having no stiction give large advantage over elastomer seals

Omniseal® SRII

Multiple energizers can be used in larger glands to fit into existing hardware without sacrificing precision fit

Polymer Materials

Self-lubricating anti-wear properties of recommended Fluoroloy® materials of the Omniseal® jacket allow dry installation and operation and superior lifetime

PROVEN SUCCESS IN CRITICAL SYSTEMS & APPLICATIONS

Omniseal® Polymers

Equipment Angle of Attack Sensor Seals

Solution
Omniseal® Spring-Energized SRII Seal

A42 and A49 are preferred materials

Specifications
Nominal ID of seals between 0.1" and 1" (2.54 to 25.4 mm)

Pressure from 1 PSI to 13 PSI (0.1 to 0.9 BAR)

Rotary Seal

Typical Temperature
-54 to 85°C (-65 to 185°F)

Media
Air, Dust, Moisture, De-Icing Solution

SENSING SYSTEMS

Optronics
Angle of Attack
Sensors

Sensor Gimbal

A more tightly controlled and consistent friction, while also having no stiction, provides a major advantage over elastomer seals

Omniseal® Spring-Energized Seal

Self-lubricating anti-wear properties of recommended Fluoroloy® materials of the Omniseal® jacket allow dry installation and higher lifetime confidence

High Reliability

Like to like groove fit for O-ring replacement

Leakage and friction testing available

PROVEN SUCCESS IN CRITICAL SYSTEMS & APPLICATIONS

Omniseal® Polymers

Equipment Sensor Gimbal Seals

Solution
Omniseal® Spring-Energized APS & 400A Seals

Specifications
Nominal ID of seals between 2 and 10" (50 to 250 mm)

A01, A15 and A49 are preferred materials used

Low, tightly controlled friction

Pressure 3 to 20 PSI (0.21 to 1.38 BAR)

Typical Temperature
-55 to 80°C (-65 to 180°F)

Media
Compatible with environmental air, dirt, dust, water

PROPELLER & TRANSMISSION SYSTEMS

Environmental Shaft Seals
Gearboxes
Rotorhead Seals
Electric Propulsion Unit (EPU)

Harsh Conditions

Possible dirt, dust and abrasive particles

Critical part (Rotorhead)

Long life time

Omniseal® Spring-Energized Seal

No stick-slip effect

Lower coefficient of friction

Compatible with any aerospace fluid

No leakage

Improved Reliability

Improved sealing of grease

Seals able to run dry in case of loss of lubrication

Immediate capability of dampers

PROVEN SUCCESS IN CRITICAL SYSTEMS & APPLICATIONS

Omniseal® Polymers

Helicopter Rotorhead Amper Seals

Solution
Omniseal® Spring-Energized 103A Seal

Specifications
Dynamic sealing between seal and sliding shaft

Static sealing between seal and housing

Very low leakage

Pressure up to 2000 PSI (140 BAR)

Typical Temperature
-65F to 160°F (-54°C to 71°C)

Media
Compatible with aerospace fluids (for instance glycol)

PROPELLER & TRANSMISSION SYSTEMS

Environmental Shaft Seals
Gearboxes
Rotorhead Seals
Electric Propulsion Unit (EPU)

Harsh Conditions

Possible dirt, dust, and bearing particles in oil

Possible loss of lubrication

Eccentric sealing conditions

High load overhung loads

Wide temperature extremes

Omniseal® Rotary Lip Seal

Omniseal® rotary lip seal has an extremely tough, long wearing jacket material and a good resistance to wear

Extended Operations

Long seal life reduces down time

Seals able to run dry in case of loss of lubrication

PROVEN SUCCESS IN CRITICAL SYSTEMS & APPLICATIONS

Omniseal® Polymers

Helicopter Vertical & Horizontal Hinge Pin Seals

Solution
Omniseal® Rotary Lip Seal

Specifications
Dynamic sealing between seal and rotating shaft

Static sealing between seal and housing

Lateral movement support required

No allowable leakage

1000 hours lifetime required

Pressure 14 to 35 PSI (1 to 2.4 BAR)

Typical Temperature
-60F to 200°F (-51°C to 90°C)

Rotation
High speed rotary capabilities

Media
Compatible with aerospace fluids

PROPELLER & TRANSMISSION SYSTEMS

Environmental Shaft Seals
Gearboxes
Rotorhead Seals
Electric Propulsion Unit (EPU)

APU & HYBRID POWER SYSTEMS

Gearboxes
PTO Components
Cryo, Vacuum & Liquid Hydrogen Seals
Motor Shaft Lip Seals
Electric Propulsion Unit (EPU)

Minimum Energy Consumption

Minimal frictional torque reduces energy usage

Omniseal® Rotary Lip Seal

In dynamic and static conditions, this rotary lip seal offers leak tight protection over a long lifetime, while reducing frictional torque to the minimum

The compact and efficient design saves space and weight

Extended Operations

Longer maintenance cycle reduces operation cost

PROVEN SUCCESS IN CRITICAL SYSTEMS & APPLICATIONS

Omniseal® Polymers

Electric Propulsion Unit (EPU) Seals

Solution
Omniseal® Rotary Lip Seal

Specifications
Pressure 0 to 1 PSID

Minimum to no leakage

Lifetime: 20,000 to 35,000 hours

Lip seal low friction leading to reduced energy consumption

Typical Temperature
-40F to 300°F with proprietary Fluoroloy® material

Rotation
up to 12.000 RPM, surface speed up to 100 ft/s (30 m/s)

Media
Compatible with aircraft turbine engine lubricating oil such as MIL-PRF-7808 & MIL-PRF-23699

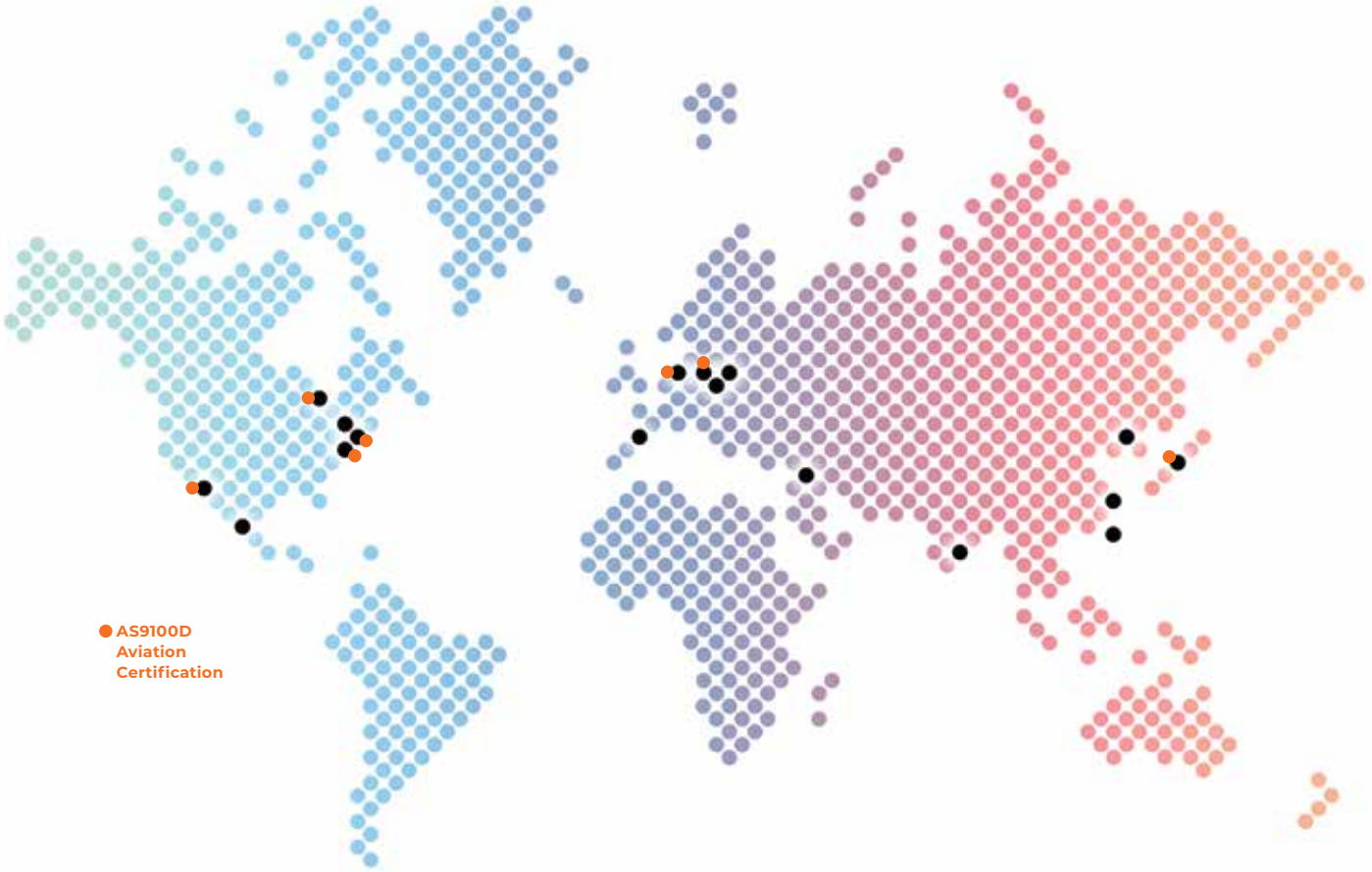
MAKE A CONNECTION TODAY

Searching for more resources and technical expertise?
Scan the below QR codes, or view our world map to contact one of your local experts!

INDUSTRY & SOLUTION HANDBOOKS

SOCIAL MEDIA & TECHNICAL CENTER

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; Vimercate, Italy; 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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