



**OFTEN INVISIBLE
ALWAYS ESSENTIAL**

FREUDENBERG SEALING TECHNOLOGIES
Aerospace Division Overview

Key Figures for the Freudenberg Group



~€ 12.00 bn
Sales in 2025



~52,000
Employees



Global presence
in approx. 60
countries
worldwide



Highly diversified
Group of companies,
some companies with
>€ 1 bn in sales



5.1%
R&D ratio



€ 1.13 bn
Operating profit

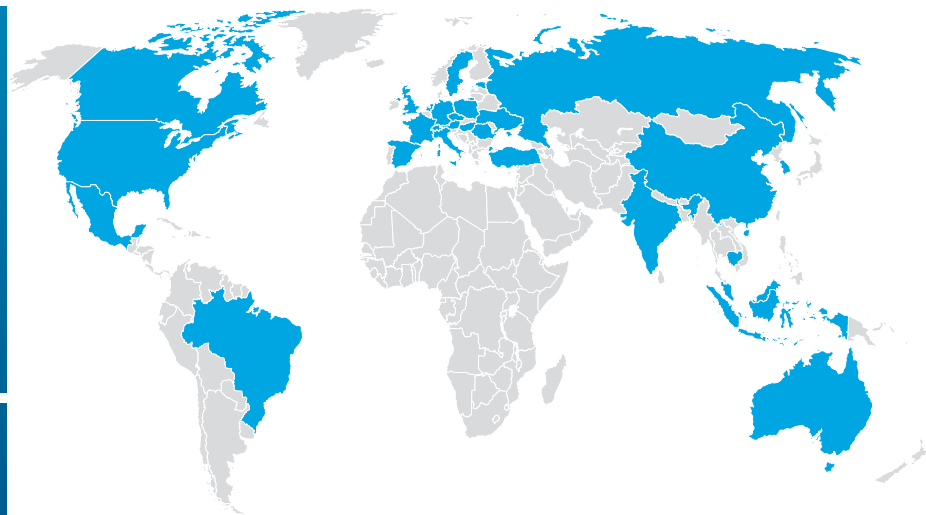


100%
Family owned



Founded by
Carl Johann
Freudenberg
in 1849

A Global Corporation Doing Business on a Regional Basis



FREUDENBERG-NOK SEALING TECHNOLOGIES

- Joint Venture with Nok Corp. (Japan)
- Headquartered in Plymouth, Michigan. (USA)
- More than 20 sites in North and South America.

FREUDENBERG SEALING TECHNOLOGIES

- Headquartered in Weinheim (Germany)
- More than 50 sites across Europe
- More than 20 sites in Asia/Australia

Global Aerospace Business Locations



Freudenberg - Portfolio

Components+



DIAvent®
Pressure
Management



Encoder



Conductive
Seals



EMI Shielding
2K Covers



3D Gap Pad
(Thermal
Interface)



Plug & Seal
with Sensor

Components



Static
Seal



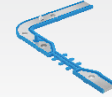
Dynamic
Seals



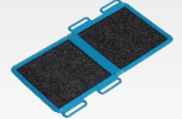
Plug & Seal



Accumulators



Gaskets



Seal on Gas
Diffusion Layer

Services



Testing



Simulation



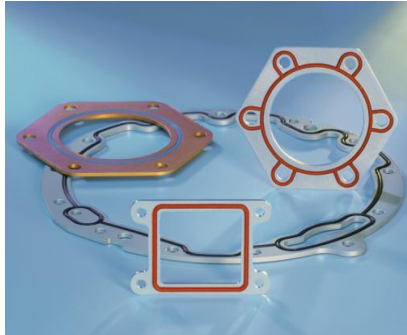
Rapid Prototyping

Aerospace Market – Products

O-rings



Plate Seals
and Gaskets



Oil Seals (Simmerring®)



Aerodynamic Airframe
Components



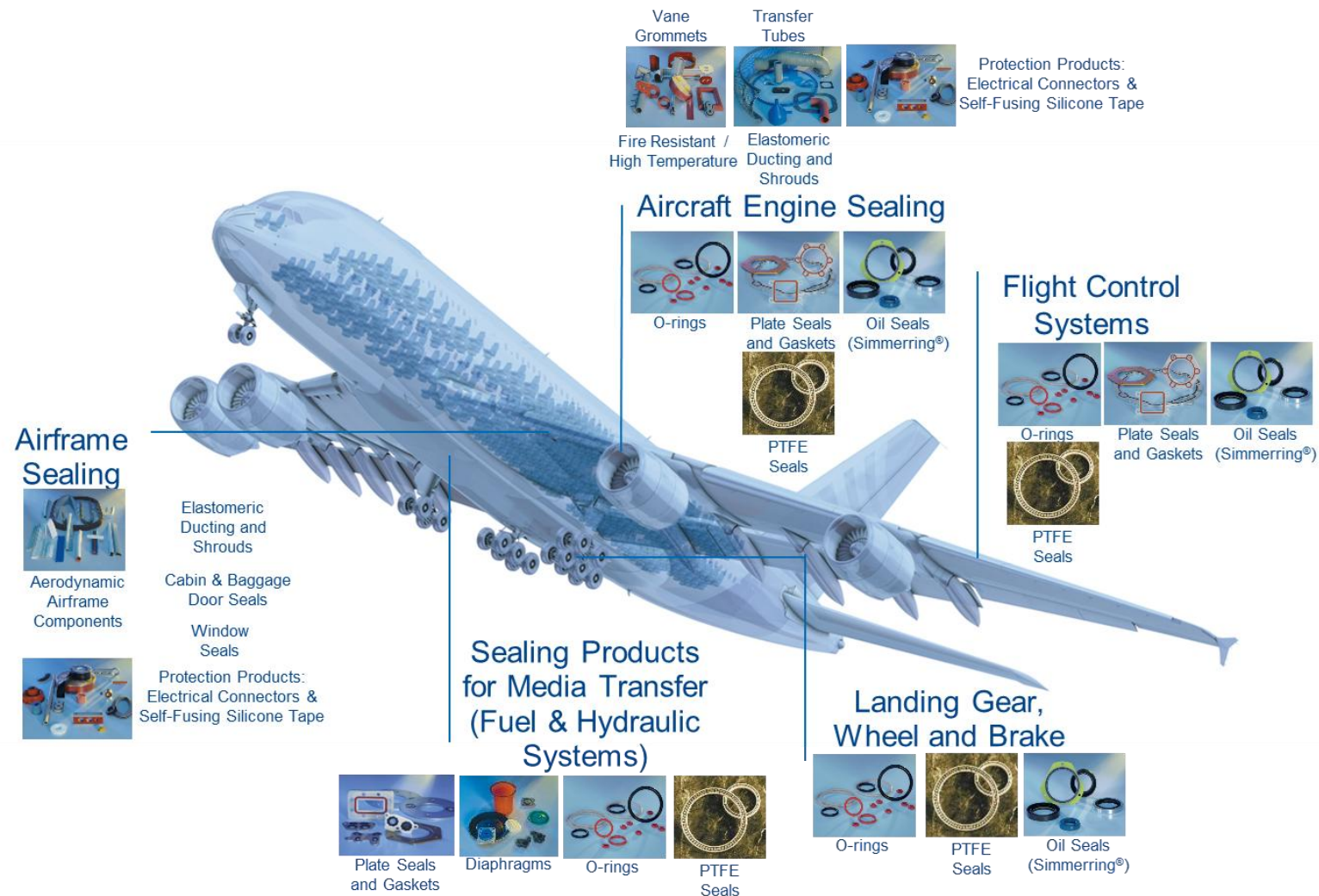
Fire Resistant /
High Temperature



Diaphragms



Industry Expertise – Commercial Aircraft



O-Ring Division

Industry Products: Santa Ana, California



- Established: 1975 (as ISC, acquired by FNGP 1998)
- Plant Size: 39,000 sq. ft.
- Total Employees: Over 146
- Certifications: AS9100, EN9100, Nadcap25, A2LA Lab EASE (European Aerospace Consortium), NSF
- 12,000 active part number, 5,000 tools,
- 65 Mio pieces O-ring/year



Products Manufactured:

- O-Rings
- Molded shapes

Molding Technologies:

- Compression
- Injection

Compounds:

High quality standard and custom seals in:

- Simriz® Perfluoroelastomer
- Fluorocarbon
- EPDM
- Silicon / Fluorosilicone
- NBR / HNBR

Performance+

Partnering for a Stronger Future

RTX supplier Platinum award 2023-2025

Markets Served:

- Aerospace
- Energy
- Processing industry
- Oil & Gas
- Power Engines / Trans.
- and other industries

O-Rings

Santa Ana, CA.

Product Offering

- AS568 & NSA O-Rings
- D-Rings
- X-Rings



Wide Range of Materials

- Fluorocarbon Elastomers
- Specialty Fluorocarbons
- Perfluoroelastomers (FFKM)
- Fluorosilicones
- Silicones
- Nitriles
- HNBRs
- Perfluoroether
- EPDMs





PERFLUOROELASTOMER (FFKM) SEALS

Simriz® perfluoroelastomer materials developed by Freudenberg Sealing Technologies are designed for thermal stability and almost universal protection against chemical substances and deliver superb sealing performance.

Material properties	134	481	484	485	491	495	498	501	502
Color	Black	Black	Black	Black	Black	Black	Black	Black	Black
Hardness (Shore A)	90	70	75	75	70	75	80	75	90
Temperature (static)	-15 – +230 °C	-30 – +230 °C	-10 – +230 °C	-15 – +230 °C	-20 – +230 °C	-15 – +230 °C	-5 – +320 °C	-5 – +320 °C	-5 – +320 °C
Tensile Strength (MPa)*	21,5	17,1	22,1	18,5	14,3	16,8	18,8	13,6	29,6

*Test values were generated using 2 mm test panels

SIMRIZ® 501

Exceeds AMS7257

Up to +320° C

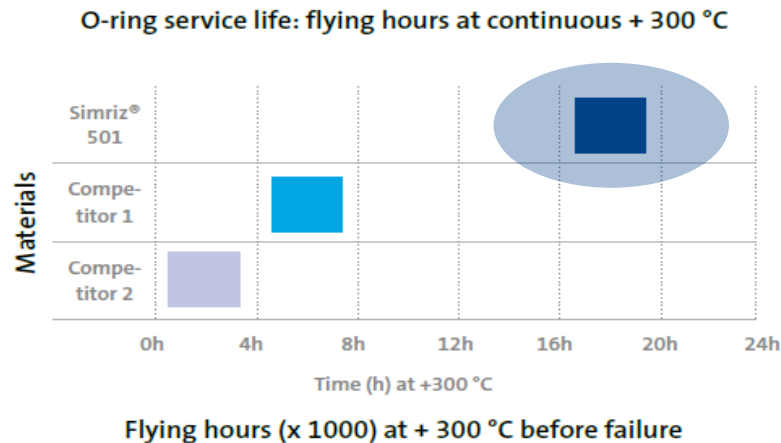
75 SIMRIZ® 501 PREMIUM MATERIAL FOR THE AEROSPACE INDUSTRY

75 Simriz® 501 far exceeds the requirements of AMS7257. The material is resistant to high temperatures – in the air up to +320 °C – as well as in fuels, turbine and hydraulic oils. Its superlative temperature properties are particularly evident in the compression set, which is far below the required limit both in air and in tested media. This results in a very long service life for seals made from Simriz® 501.

TYPICAL APPLICATIONS

Suitable applications for effective use of 75 Simriz® 501 include:

- Bleed air management systems
- Gas turbine lubrication
- High-temperature propulsion units
- Control devices featuring strong oxidizing



Simriz® performs better than tested competitor materials in aerospace applications at +300 °C. With more than twice the maintenance interval, the material is a cost-effective solution.

Fluid Power Industry

Industry Products: Troy, Ohio



- Founded in 1980's as PTFE seal producer
- Total Employees: Over 120
- Materials: PTFE (~70), PA (6), TPU (8), TPE (2)
- Certifications: ISO9001, ISO/TS 16949, ISO 14001, ISO 45001
- Services: Application Engineering



Manufacturing Processes:

Primary Processes

- Compression Molding
- Extrusion PTFE Rod
- Injection Molding
- Injection Metal Overmolding
- Precision Net Molding
- Post Curing

Markets Served:

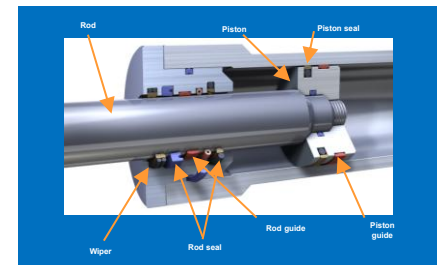
- Aerospace
- Automotive
- Industrial
- Agriculture
- Energy
- and other industries

PTFE Products:

- Banded Pistons
- Piston Banding Washers
- Pistons and Rod Seals
- Ball Valve Seals
- Internal Rotary Seals
- Machined Shapes
- and other industries

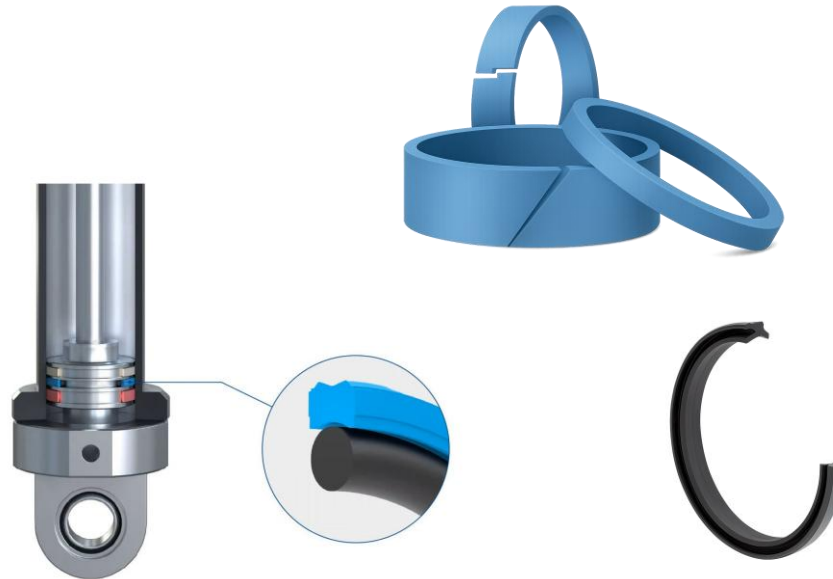
Fluid Power - Products

Troy, Ohio, USA



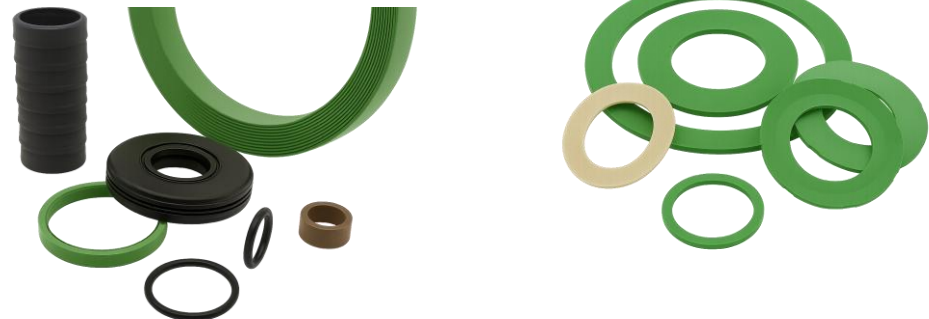
Thermoplastic Products

- Rod & Piston Seals
- Wear/Guide Bands
- Buffer Seals
- Snap-in Rod Wipers
- Metal Encased Rod Wipers
- Machined Seals
- Custom sizes and shapes



PTFE Products

- Banded Pistons
- Piston Banding Washers
- Piston and Rod Seals
- Internal Rotary Seal Rings
- Ball Valve Seals
- Machined Shapes

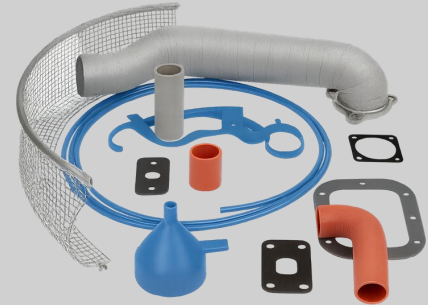


Precision Low Pressure Industry

Industry Products: Tillsonburg, Ontario, Canada



- Established: 1951, Greenfield in 1976, 60+ years
- Plant Size: 44,000 sq. ft.
- Total Employees: 130
- Certifications: AS9100 Rev C, ISO9001 for design, Nadcap Approved
- 1,200 active part numbers



Products Manufactured:

- Fire seals
- Airframe seals
- Protection products
- Media transfer
- Plate seals and gaskets

Molding Technologies:

- Injection molding
- Compression molding
- Extrusion

Performance

- Quality – 0.6ppm
- OTD – 98.6%

Markets Served:

- Aerospace
- Energy
- Off Road
- Automotive
- Appliance
- Other Industries

Precision Low Pressure Industry

Industry Products: Tillsonburg, ON.



Protection

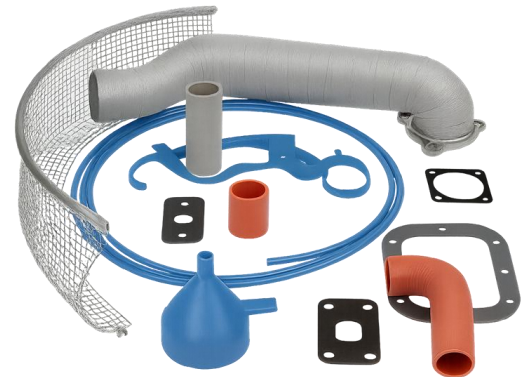
- We design and manufacture product that are designed to protect components Electrical connectors.
 - Wire harness insulation
 - Clamp blocks for tubing
 - Avionics EMI hatch seals
 - Fuel igniter grommets
 - Engine vane grommets
 - Silicone tape
 - Boots / bellows



FREUDENBERG-NOK
SEALING TECHNOLOGIES

Media Transfer / Sealing Products

- Our ability to contain media includes flexible ducting that offers weight and cost savings over metallic offerings.
 - DC generator inlet ducts
 - Ventilation ducting
 - Air inlet screens
 - Transfer tubes
 - Inlet plenum seals
 - Flexible couplings



FREUDENBERG-NOK

Air inlet/Exhaust seals & Fire barriers

Tillsonburg, Ontario, Canada

Changes to FAA/Transport Canada requirements resulted in the original construction of “Fire Seals” no longer being compliant. This is primarily due to new vibration and Jet A burn requirements, and closer scrutiny on the test in actual application vs analysis/similarity. EU is now also starting to enforce replacement of propane with Jet A.

This has to do with the use of multiple layers of ceramic fabrics, insulation of surrounding components, and extra guarding.

The EVOLUTION of Fire Sealing to pass 15 min x 2000F Flame

- Fiberglass reinforced flame retardant silicone
- Multiple layered fiberglass reinforced silicone
- Introduction of Aramid fabric (Nomex)
- Introduction of Ceramic fabric (Nextel)
- Multiple layers of Ceramic and Aramid fabrics



Precision Low Pressure Industry

Industry Products: Tillsonburg, ON.



Fasteners

- The sealing elements for NAS1523 Fastener Seals are available in a variety of AMS/Mil-Spec elastomers including.
 - Nitrile
 - Fluorocarbon
 - Silicon
 - Fluorosilicone
 - Metals: Aluminium, stain steel
 - Chrome molybdenum steel.

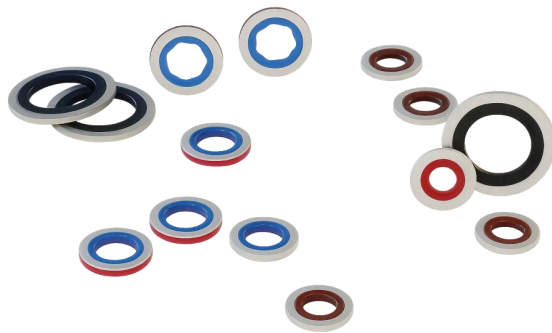
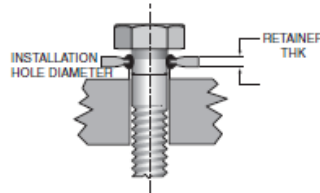
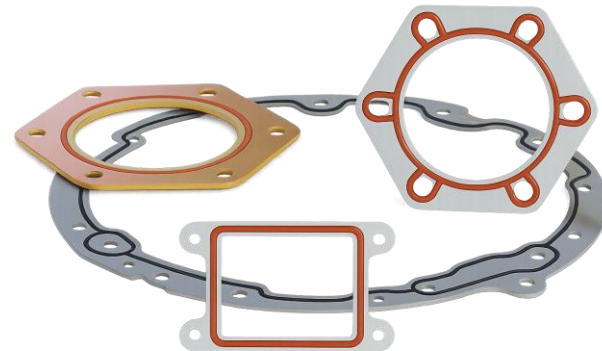


Plate Seals & Gasket

- Design and manufacture of Plates seals and gaskets for jet fuel, Hydraulic, and Turbine systems, APUs, etc.
 - Metal/plastic carrier with
 - Groove Molded
 - Edge Molded
 - Fluorosilicone, FKM, EPDM,
 - NBR Aerospace materials
 - Wide variety of metals.

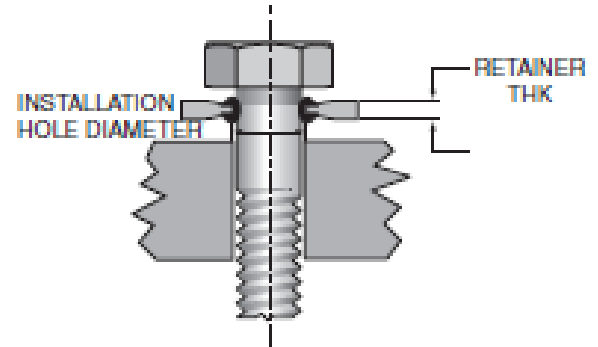
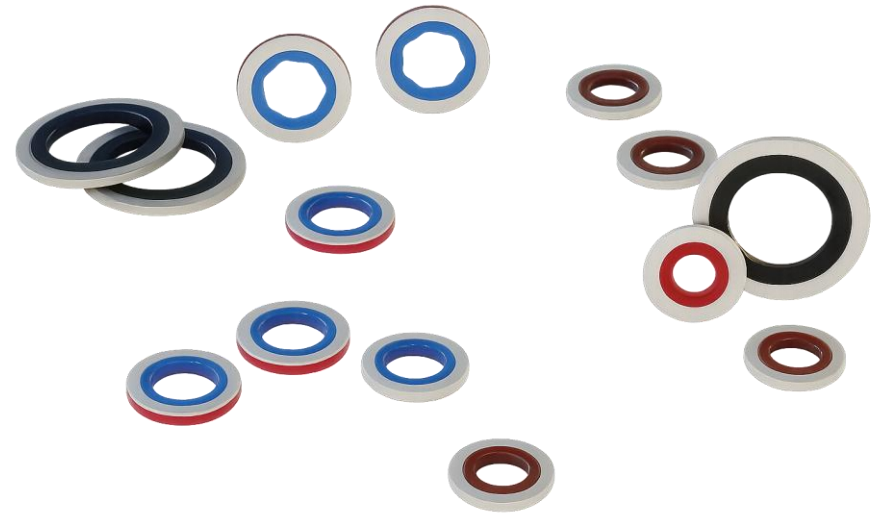


NAS1523 Fastener seals

Freudenberg–NOK NAS1523 Fastener Seals are **metal retainers** with an integrated elastomer sealing element. These versatile fasteners have a wide range of uses for many aerospace, automotive, and industrial applications.

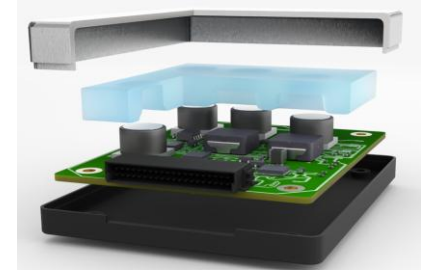
The sealing elements for NAS1523 Fastener

Seals are available in a variety of AMS/Mil-Spec elastomers including; nitrile, fluorocarbon, silicone, and fluorosilicone. These elastomers are mechanically and chemically bonded to the metal ring. Fastener metals include aluminum, stainless steel, and chrome molybdenum steel. NAS1523 Fastener Seals positively seal all types of fasteners and are pressure tested to aerospace NAS1523 specifications.



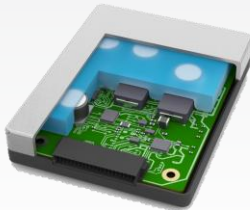
FST Product Portfolio for Thermal Interface Material

- Optimized **heat transfer** and uniform pressure distribution in a single component, enabled by a customized **3D geometry**, combined with excellent **electrical insulation** & high flame resistance
- **Thermal Interface Materials** must fulfill three core requirements to ensure performance, safety and lifetime reliability: **Electrical Insulation - Thermal Conductivity - Tolerance Compensation**



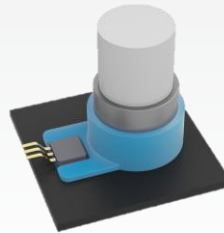
Thermal Cooling

- Connection between heat source and heat sink
- Optimized Heat Flow



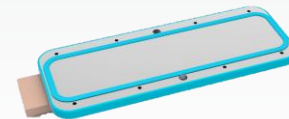
Thermal Sensing

- Heat as a thermal information
- Avoiding short circuits
- Reducing information loss



2K Thermal Interface

- Functional integration and large tolerance compensation between connected components
- Thermoplastic housings, frames, connectors or coolers with integrated TIM
- Lower contact resistance



Freudenberg-NOK Sealing Technologies

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