High-Purity Solutions for Semiconductor Manufacturing







PROTECTING THE ESSENTIAL

Pure & Performance-Driven Solutions

The semiconductor industry presents endless opportunities for innovation and advancement. From driving miniaturization on the wafer to ensuring seamless operations in demanding environments, Trelleborg Sealing Solutions stands out as a trusted partner, delivering cutting-edge solutions to meet these needs.

ACCELERATING INNOVATION

As trends promising huge growth, such as Artificial Intelligence (AI), 5G, machine learning and high-performance computing, drive semiconductor manufacturers' innovation, accelerating time to market while reducing total cost of ownership is becoming even more critical. Miniaturization has brought feature sizes down to the smallest imaginable, while architectures are continually becoming ever more sophisticated.

Achieving high yields at acceptable costs is increasingly challenging for chipmakers, intensifying demands on high-tech seals and complex elastomer components in advanced processing equipment. As product dimensions shrink, sensitivity to contamination rises, making cleanliness and purity critical. Aggressive chemicals and plasmas under extreme conditions create harsh environments, where robust sealing technologies are essential to maintain process yield.

MEETING DEMANDS WITH CUTTING-EDGE SOLUTIONS

With continuous global growth and material developments, Trelleborg Sealing Solutions combines decades of engineering and applications experience with innovation to provide high-precision, sealing solutions tailored for evolving requirements of semiconductor manufacturing.

Our approach bridges global experience with responsive local support, ensuring you receive not just exceptional products, but a dedicated partnership throughout every stage – from initial design to large-scale production. This integrated strategy helps maximize productivity, reduce downtime and support long-term process reliability.



CORE CAPABILITIES

- Local technical expertise with global engineering resources
- Dedicated support from concept through the product lifecycle
- Rapid design and prototyping to accelerate time to market
- Design and development supported by Finite Element Analysis (FEA) and lifetime simulation
- Advanced materials custom-developed for demanding applications
- Scalable, high-quality production across all regions
- Cleanroom manufacturing in environments up to ISO 6 standard
- Commitment to continuous innovation and industry-leading solutions

PORTFOLIO FEATURES

- Designed for the most demanding semiconductor applications
- Ultra-high purity materials with minimal outgassing for critical plasma processes
- Outstanding plasma and chemical compatibility
- Proven durability under extreme temperature conditions
- Long-term reliability ensures high process yield
- Low trace metal particulation
- Long-lasting performance to minimize system downtime
- Consistent performance in critical environments

ISOLAST® PUREFAB®

We offer a comprehensive portfolio of advanced Isolast® PureFab® perfluoroelastomers (FFKMs), featuring high-temperature stability, high purity, ultra-low trace metal content and excellent plasma resistance. These materials reduce particle generation and outgassing in high vacuum environments, helping end-users extend maintenance cycles and maximize process yield.



Product Highlights

Our comprehensive product portfolio delivers the reliable, high-performance sealing solutions that power semiconductor innovation.

O-RINGS

O-Rings are widely used due to their flexibility, ease of use and low production cost. Ideal for various static applications, they work as single sealing elements or as energizers for two-component seals and wipers. Our advanced materials ensure exceptional sealing performance in critical semiconductor processes. We produce O-Rings in a full range of sizes.



FLEXIMOLD™

With our proprietary FlexiMold™ technology, we manufacture high-precision, large diameter O-Rings and other seal profiles, which demonstrate the full visual and dimensional integrity of a molded product. Produced without the need for a dedicated tool, our flexible tool set-up minimizes lead times and costs.



BONDED SLIT VALVE DOOR SEALS

The semiconductor manufacturing process requires frequent wafer transfers through valves. The Bonded Slit Valve Door Seal, made from Isolast® PureFab® FFKMs or similar elastomers and bonded to a metal door, enhances seal life and performance. Its rubber-to-metal bonded design reduces abrasion and particulation compared to conventional O-Rings, eliminating installation errors, minimizing particle generation and significantly extending service life.



CMP MEMBRANES

Chemical mechanical polishing (CMP) is a fabrication process used to achieve highly smooth and planar surfaces on silicon wafers. Our range of high-precision CMP membranes ensure wafer planarity, uniform polishing and maximum durability during the critical CMP process. CMP membranes are manufactured in both high consistency silicone rubber (HCR) and liquid silicone rubber (LSR) due to their flexibility, chemical compatibility and ability to withstand the harsh conditions of the CMP process.

COMPLEX MOLDED PARTS

We collaborate with customers from the design stage to create customized solutions from one or multiple materials. Our rubber-to-metal and rubber-to-plastic components enable multifunctional designs that enhance performance and reduce maintenance. Solutions include low-outgassing dampeners for vibration control in lithography and edge exclusion wafer seals that prevent electroplating solution from reaching wafer edges during immersion and high-speed spinning. Learn more about our Isolast® PureFab® seals for electrostatic chuck (ESC) applications on page 10.



VARISEAL®

Variseal® is a spring-energized, single-acting seal designed for both dynamic and static conditions. Proven in extreme gas and liquid handling, Turcon® Variseal® excels in demanding applications, including high vacuum and corrosive environments. The Variseal® NW is tailored for KF/NW flange systems in subfab applications like vacuum pumps and exhaust lines, where aggressive chemicals, high temperatures and vacuum cycling occur.



ISOLAST® K-FAB™ FLANGE SEAL

The Isolast® K-Fab™ flange seal is engineered for critical subfab applications, delivering long-term sealing and higher productivity under extreme conditions. Unlike traditional O-Rings prone to failure, it withstands high temperatures and harsh chemicals. Its optimized elastomer design uses less material, improving thermal properties and eliminating issues like thermal expansion and groove overfill.



AIRSEAL

Airseals are inflatable seals made from high-grade Ethylene Propylene Diene Rubber (EPDM) and silicone rubber materials. They are used on load locks and access doors in advanced vertical furnaces. The inflatable seals withstand both vacuum and positive pressure and replace traditional flat gaskets and O-Rings.



TURCON® VARILIP® PDR

Characterized by low friction and stick-slip-free running, the Turcon® Varilip® PDR reduces temperature generation, permits higher peripheral speeds and lowers power consumption. Tests show that this seal requires only around 50 percent of the torque of a radial shaft seal when running in Fomblin® oil, commonly used in semiconductor vacuum pumps. This results in a long-service life, maximizing mean time between planned maintenance cycles for greater productivity.



WILLS RINGS® METAL SEALS

We produce Wills Rings® metal seals, in O or C cross-sections. Controlled-compression type face seals, for static use only, they are designed for use in extreme conditions where the capabilities of polymeric seals are exceeded. Wills Rings® can be supplied in a wide range of metals and can be coated or gas-filled to suit their specific semiconductor application.



ENGINEERED POLYMER SOLUTIONS

Engineered high-performance plastics are ideal for many semiconductor applications, such as wafer processing and handling. Parts can be combined with other machined parts and seals to make sub-assemblies, which improve performance and simplify product assembly processes. Plastic injection molded and machined parts are ideal for use as inserts for products such as overmolded Isolast® FFKM wafer carrier seals, where increased rigidity is needed to ease product assembly or to obtain improved stability.



SEAL-GLIDE®

Coatings and surface treatments improve the stiction and friction characteristics of elastomer seals. They enhance wear resistance, support sealing in some dynamic applications and help reduce sticking force between seals and mating surfaces in critical semiconductor applications. Our Seal-Glide® coating and surface treatments include options specifically designed for use in semiconductor manufacturing applications.



Isolast® PureFab®

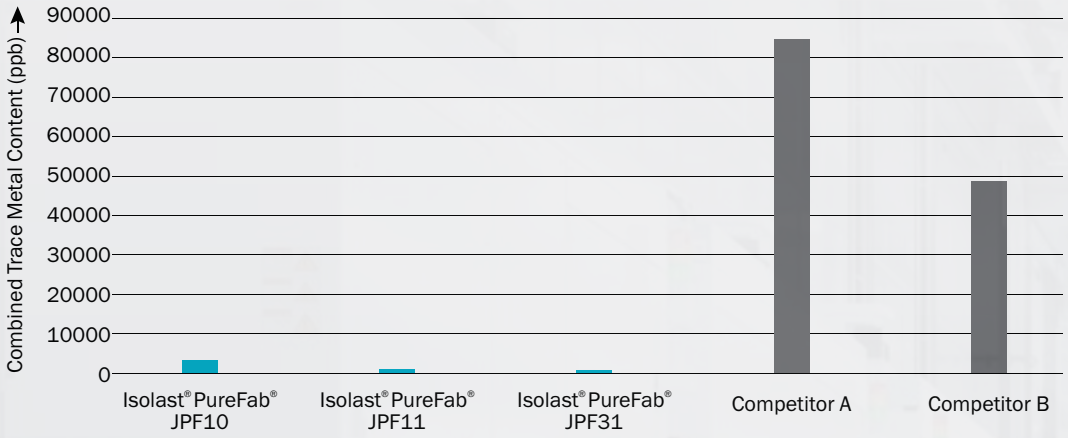
The Isolast® PureFab® portfolio represents the next generation of ultra-clean FFKM sealing solutions, purpose-built for the rigorous demands of advanced semiconductor manufacturing.

The enhanced PureFab® range delivers superior material consistency, traceability and global availability, to support critical process environments. By minimizing particle generation and reducing contamination risks, PureFab® compounds improve yield, extend maintenance cycles and lower the total cost of ownership in leading-edge fabs.

A GLOBAL BENCHMARK FOR PURITY AND RELIABILITY

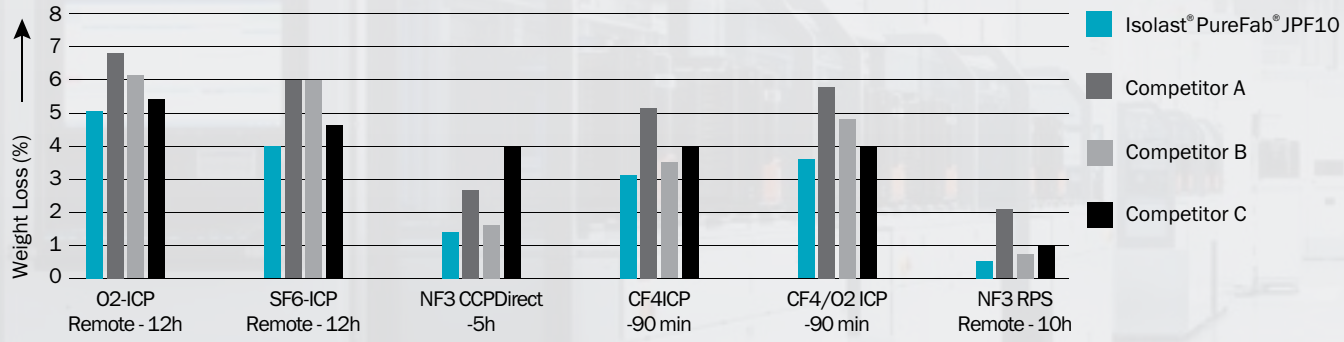
Building on decades of materials science expertise, the Isolast® PureFab® family is more than a material; it's a global standard for performance. Our global development and manufacturing capabilities ensure every PureFab® seal is produced consistently worldwide, from prototype to high-volume production. With dedicated local support, cleanroom-controlled production and advanced validation capabilities, PureFab® continues to set the benchmark for purity, reliability and innovation.

COMBINED TRACE METAL CONTENT BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY (ICP-MS) - (ASH)



Engineered for purity – Isolast® PureFab® minimizes trace metals to meet the toughest semiconductor requirements.

WEIGHT LOSS UPON PLASMA EXPOSURE (%)



Outstanding plasma resistance ensures long seal life and reliable performance in aggressive etch and deposition processes.

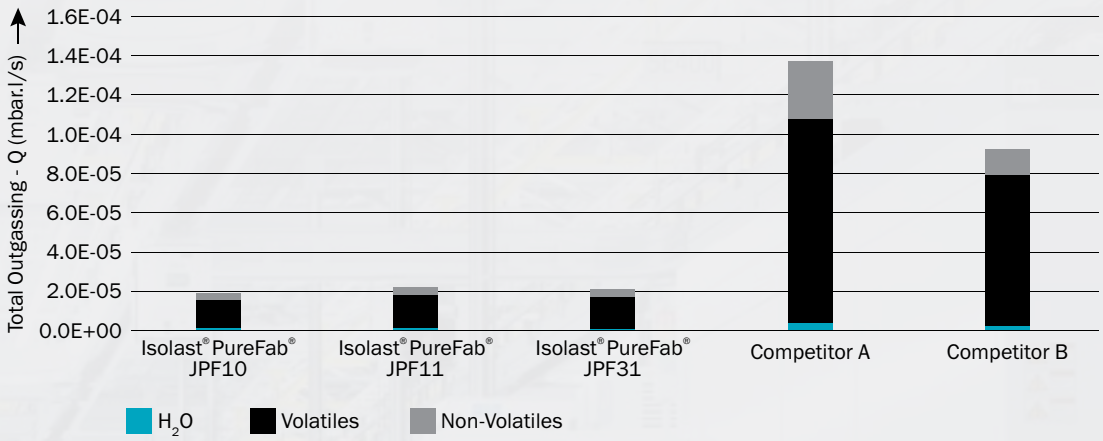
ENGINEERED FOR DEMANDING APPLICATIONS

Isolast® PureFab® FFKM compounds are designed to excel in the toughest high-end semiconductor processes, including plasma, deposition, etch and thermal applications. These materials combine ultra-low outgassing, exceptional purity and high thermal stability to deliver long-lasting performance. Whether optimizing uptime in atomic layer deposition (ALD) or maintaining reliability in aggressive etch conditions, Isolast® PureFab® delivers unmatched resilience and process compatibility.

Isolast® PureFab® Characteristics

- Superior mechanical strength and long-term sealing performance
- High chemical compatibility for both wet and dry process environments
- Low compression set for reliable sealing under demanding conditions
- Lower total cost of ownership through extended service life
- High material purity to prevent contamination in critical applications
- Outstanding thermal stability across extreme temperatures
- Ultra-low outgassing with excellent plasma resistance

TOTAL OUTGASSING PER O-RING



Unrivalled outgassing performance – designed to protect vacuum performance and maximize the yield.

Isolast® PureFab® Material Grades

Material Type	Material Compound	Color	Hardness (Sh A)	100% Modulus (MPa)	Compression Set (%) 72 h		Max. Operating Temp. (°C/°F)	Description
					+200 °C /+392 °F	+300 °C /+572 °F		
Organic	Isolast® PureFab® JPF10	Light brown	62	2.2	11	21	+310 °C/ +590 °F	Ultra-low outgassing, high-purity material for plasma and deposition processes
	Isolast® PureFab® JPF11	Dark auburn	71	5.0	11	36	+300 °C/ +572 °F	Long-life seals for ALD, plasma-enhanced chemical vapor deposition (PECVD), high-pressure chemical vapor deposition (HPCVD)
	Isolast® PureFab® JPF12	Light brown	68	5.0	8	15	+275 °C/ +527 °F	Premium performance in plasma and high temperatures with maximum purity
	Isolast® PureFab® JPF31	Amber Translucent	69	3.1	16	N/A	+275 °C/ +527 °F	Ultra-high purity for critical etch processes
Filled	Isolast® PureFab® JPF22	Beige	80	10.2	23	N/A	+220 °C/ +428 °F	Chemically compatible grade for wet processes, ideally suited for electro-chemical deposition (ECD)
	Isolast® PureFab® JPF23	White	75	6.7	16	37	+310 °C/ +590 °F	High-temperature plasma sealing with strong durability
	Isolast® PureFab® JPF24	White	80	8.8	21	N/A	+270 °C/ +518 °F	Cost-effective for general etch/wet use
	Isolast® PureFab® JPF25	Beige	76	8.2	13	21	+320 °C/ +608 °F	High-purity, high-temperature performance for etch/deposition
Black	Isolast® PureFab® JPF41	Black	75	7.0	19	N/A	+270 °C/ +518 °F	Versatile grade with outstanding chemical compatibility
	Isolast® PureFab® JPF42	Black	80	12.6	5	23	+310 °C/ +590 °F	Low compression set for high-temperature processes
	Isolast® PureFab® JPF44	Black	75	10.1	10	20	+325 °C/ +617 °F	Extreme thermal resistance for rapid thermal processing (RTP), oxidation

Material Solutions for the Next Generation of Chipmaking

FLUOROSURFACTANT-FREE MATERIAL SOLUTIONS

Trelleborg's Isolast® PureFab® JPF50 series FFKM and most standard fluorocarbon (FKM) materials, produced without traditional PFAS-based surfactants, deliver a more environmentally responsible option without compromising purity, chemical resistance or performance.

Available across select FFKM, FKM, polytetrafluoro-ethylene (PTFE), and other fluoropolymer families, they help semiconductor manufacturers meet regulations and sustainability goals while ensuring reliable sealing in aggressive process environments.

Material Compound	Description	Temperature Range
Isolast® PureFab® JPF50	Fully organic FFKM	-5 °C to +280 °C/ 23 °F to +536 °F
Isolast® PureFab® JPF55	Filled FFKM	-5 °C to +300 °C/ 23 °F to +572 °F
Isolast® PureFab® JPF58	Black FFKM	-5 °C to +300 °C/ 23 °F to +572 °F
VDT82	High purity FKM	-20 °C to +200 °C/ -4 °F to +392 °F
VC303	High temperature FKM	-25 °C to +230 °C/ -13 °F to +446 °F

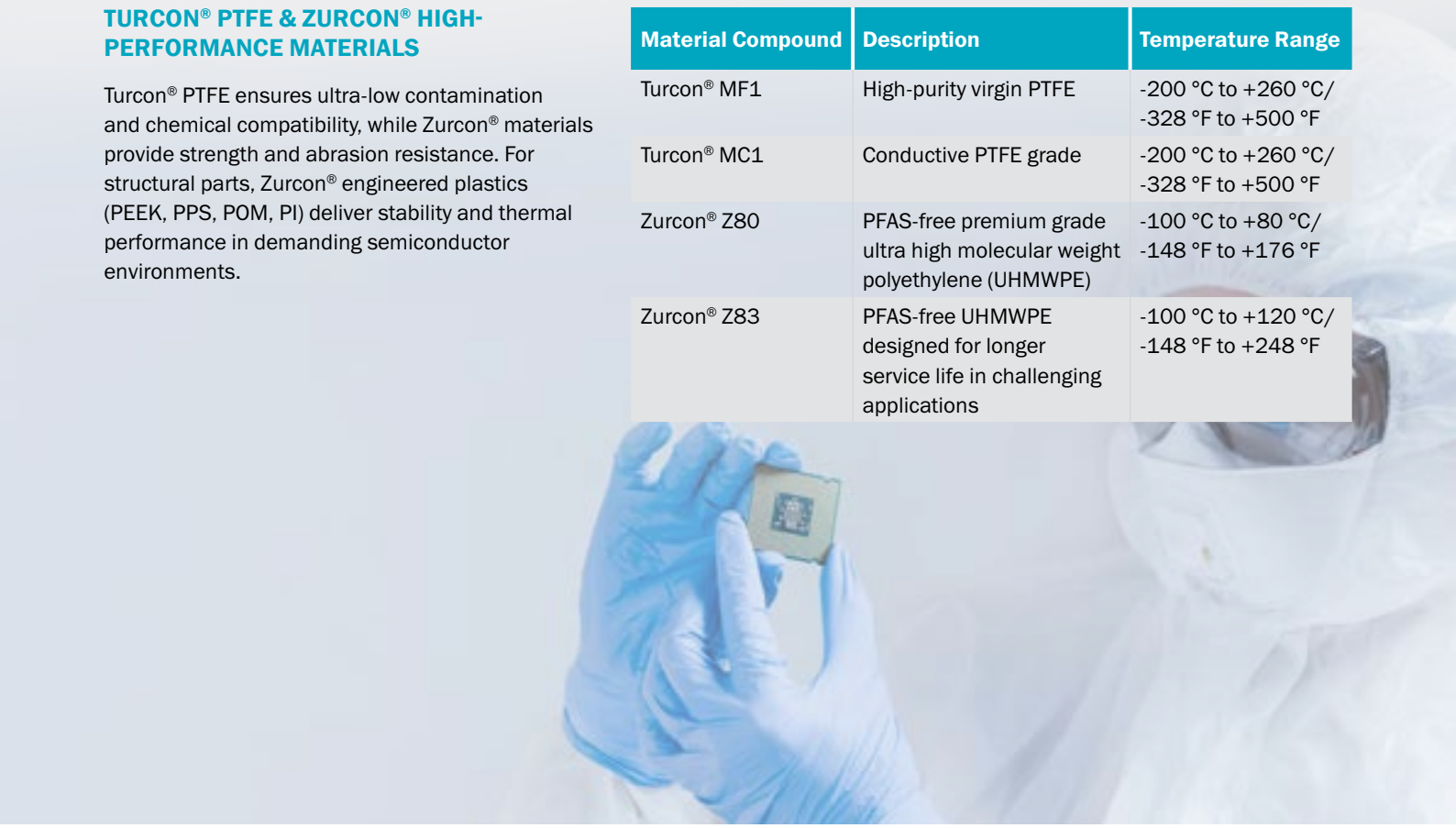
HIGH-PERFORMANCE ENGINEERED PLASTICS

Beyond sealing, semiconductor systems need high-performance plastics for structural parts and components that withstand harsh chemistries, mechanical stress and high temperatures, ensuring reliability in wafer handling, CMP and wet processes.

TURCON® PTFE & ZURCON® HIGH-PERFORMANCE MATERIALS

Turcon® PTFE ensures ultra-low contamination and chemical compatibility, while Zurcon® materials provide strength and abrasion resistance. For structural parts, Zurcon® engineered plastics (PEEK, PPS, POM, PI) deliver stability and thermal performance in demanding semiconductor environments.

Material Compound	Description	Temperature Range
Turcon® MF1	High-purity virgin PTFE	-200 °C to +260 °C/ -328 °F to +500 °F
Turcon® MC1	Conductive PTFE grade	-200 °C to +260 °C/ -328 °F to +500 °F
Zurcon® Z80	PFAS-free premium grade ultra high molecular weight polyethylene (UHMWPE)	-100 °C to +80 °C/ -148 °F to +176 °F
Zurcon® Z83	PFAS-free UHMWPE designed for longer service life in challenging applications	-100 °C to +120 °C/ -148 °F to +248 °F



Application Spotlight: Plasma Processes

Plasma processes require ultra-high purity, ultra-low outgassing and reliable sealing solutions for the harshest environments. We offer a range of polymer solutions and capabilities for PECVD, HPDCVD, ash/strip and dielectric etch/conductor etch.

ADDITIONAL APPLICATION AREAS

Wet Processes

Wet processing steps such as etching, cleaning and electrochemical plating in semiconductor manufacturing require precise control to achieve exceptional purity and maximize microchip yield.

Key required properties: Seals in these processes must offer outstanding chemical compatibility, extremely low metal and anion extractables. Maintaining a clean environment is essential for preventing contamination and preserving process integrity.

Solutions: Isolast® PureFab® materials are formulated to ensure outstanding chemical compatibility, ultra-low levels of contaminants. and reliable long-term performance, helping achieve cleaner operations and more consistent yields.

Thermal Processes

Thermal processing covers vital steps like CVD, ALD, RTP and thermal oxidation, each operating at high temperatures and within harsh chemical and UV environments.

Key required properties: Seals must endure extreme heat and harsh chemicals, limit particle and erosion rates, and maintain clean conditions to support high process yields.

Solutions: Our Isolast® PureFab® materials deliver excellent mechanical strength, chemical compatibility and low particle release, supporting reliable, clean performance in demanding thermal processing.

Showerhead

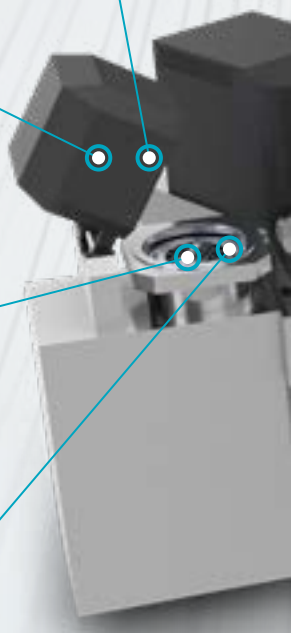
Sealing Requirements:
- Extremely high plasma resistance
- Best-in-class purity
- Low trace metal content

Trelleborg Solution: Isolast® PureFab® O-Rings

Gas Injector

Sealing Requirements:
- Compatibility with all process gases
- High purity
- Long-term reliability

Trelleborg Solution: Isolast® PureFab® O-Rings



Electrostatic Chuck (ESC)

Sealing Requirements:
- Ultra-low particle generation
- Extremely high plasma resistance
- Best-in-class purity

Trelleborg Solution: Isolast® PureFab® materials high-precision ESC seals, Turcon® Variseal® for cryogenic environments

Chamber Lid

Sealing Requirements:
- Ultra-low particle generation
- Extremely high plasma resistance
- Minimal outgassing

Trelleborg Solution: Isolast® PureFab® O-Rings, engineered molded parts

Process Gas Delivery Valve

Sealing Requirements:
- Compatible with all process gases
- High purity
- Long-term reliability

Trelleborg Solution: Isolast® PureFab® O-Rings, Turcon® Variseal®



Window/Viewport

Sealing Requirements:
- Ultra-low outgassing
- Available in various sizes and shapes

Trelleborg Solution: Isolast® PureFab® O-Rings and engineered molded parts

Wafer Support and Transfer

Sealing Requirements:
- Low stiction
- Best-in-class purity
- Bespoke shapes and designs

Trelleborg Solution: Isolast® PureFab® custom end effector pad solutions

Main Chamber Body

Sealing Requirements:
- Ultra-low outgassing
- Low permeation
- Full range of sizes including large diameters

Trelleborg Solution: Isolast® PureFab® , O-Rings, FlexiMold™ large diameter seals

Slit Valve/Gate

Sealing Requirements:
- Long-term sealing integrity
- Excellent plasma resistance
- Minimal outgassing

Trelleborg Solution: Isolast® PureFab®, Bonded Slit Valve Door Seals

Foreline Flange Seals

Sealing Requirements:
- Error-proof assembly
- High temperature capability
- Superior sealing performance

Trelleborg Solution: Isolast® K-Fab™, Turcon® Variseal® NW

Process Precursor Canister

Sealing Requirements:
- Low permeation
- High purity
- Compatible with all gases including amine-based substances

Trelleborg Solution: Isolast® PureFab® O-Rings and engineered molded parts

INTERACTIVE PLASMA PROCESSING EXPERIENCE

Discover advanced sealing solutions that improve uptime and boost yield in our interactive web section. See how we're driving progress in the industry.

www.trelleborg.com/seals/your-industry/semiconductor/dry-processing-capabilities

Application Spotlight: Subfab Process

Subfab environments demand specialized sealing solutions that can withstand extreme conditions while maintaining the ultra-clean standards essential for semiconductor success. Our targeted portfolio addresses the unique challenges of both fab and subfab applications, delivering enhanced performance that directly translates to maximum system uptime.

VACUUM PUMPS

Sealing vacuum pumps in high-tech applications comes with challenges like extreme vacuum conditions, chemical exposure, thermal cycling, mechanical wear and strict limits on outgassing and particle generation. Sealing solutions must deliver ultra-high purity, chemical compatibility and plasma resistance, thermal stability, low friction and long service life.

TRELLEBORG SOLUTION

We meet these needs with advanced solutions for dynamic and rotating applications using Turcon® PTFE-based compounds. Subfab processes benefit from materials like Isolast® PureFab®, precision designs, cleanroom manufacturing and support through FEA and lifetime simulation, ensuring reliable performance in critical environments.

- Turcon® PTFE-based compounds
- Turcon® Varilip® PDR rotary seals
- Isolast® PureFab®
- Isolast® K-Fab™



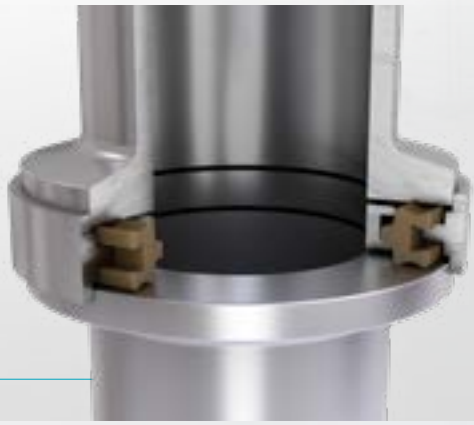
VACUUM LINES

Sealing pipe connectors in semiconductor and ultra-clean applications requires overcoming challenges such as chemical attack, thermal cycling, mechanical misalignment and the risk of micro-leakage at high pressures or vacuum. These interfaces must maintain leak-tight integrity in highly corrosive environments.

TRELLEBORG SOLUTION

To meet these critical demands, we offer high-purity, chemically compatible sealing materials such as Isolast® PureFab®, combined with precision manufacturing in cleanroom environments. Custom-engineered seals, such as Isolast® K-Fab™, ensure compatibility with various connector designs, while advanced simulation tools support reliable, long-life performance in aggressive process conditions.

- KF/NW Standard and Custom O-Ring Centering Ring Kits
- Isolast® K-Fab™
- Turcon® Variseal® NW



ABATEMENT SYSTEMS

Sealing abatement systems poses unique challenges due to continuous exposure to aggressive byproducts, high temperatures, corrosive exhaust gases and particulate-laden flows. These systems demand seals that can withstand chemical attack, thermal degradation and mechanical stress over extended service intervals.

TRELLEBORG SOLUTION

To address these conditions, we provide advanced sealing solutions made from ultra-pure, chemically compatible materials like Isolast® PureFab®, engineered for minimal outgassing and long-term reliability. Produced in cleanroom environments and supported by simulation and testing, these seals ensure consistent performance, helping to maintain safety, compliance and uptime in critical abatement operations.



- KF/NW Standard and Custom O-Ring Centering Kits
- Isolast® K-Fab™ seals
- Turcon® Variseal® NW

ISOLAST® K-FAB™ WITH PUZZLE-SHAPED DESIGN



Visit our Virtual Showroom to discover how the unique design and material of Isolast® K-Fab™ ensures optimal sealing and handling in highly demanding applications.

www.trelleborg.com/seals-showroom/?start=semiconductor_kfab

Our Global Network

UNRIVALLED GLOBAL CAPABILITIES

With deep engineering expertise and a strong track record of development partnerships, we deliver advanced sealing solutions supported by robust R&D capabilities, including FEA, simulation and comprehensive in-house testing. Through our ServicePLUS value-added services and a manufacturing footprint strengthened by our global growth, we ensure agility, innovation and localized support at every stage.

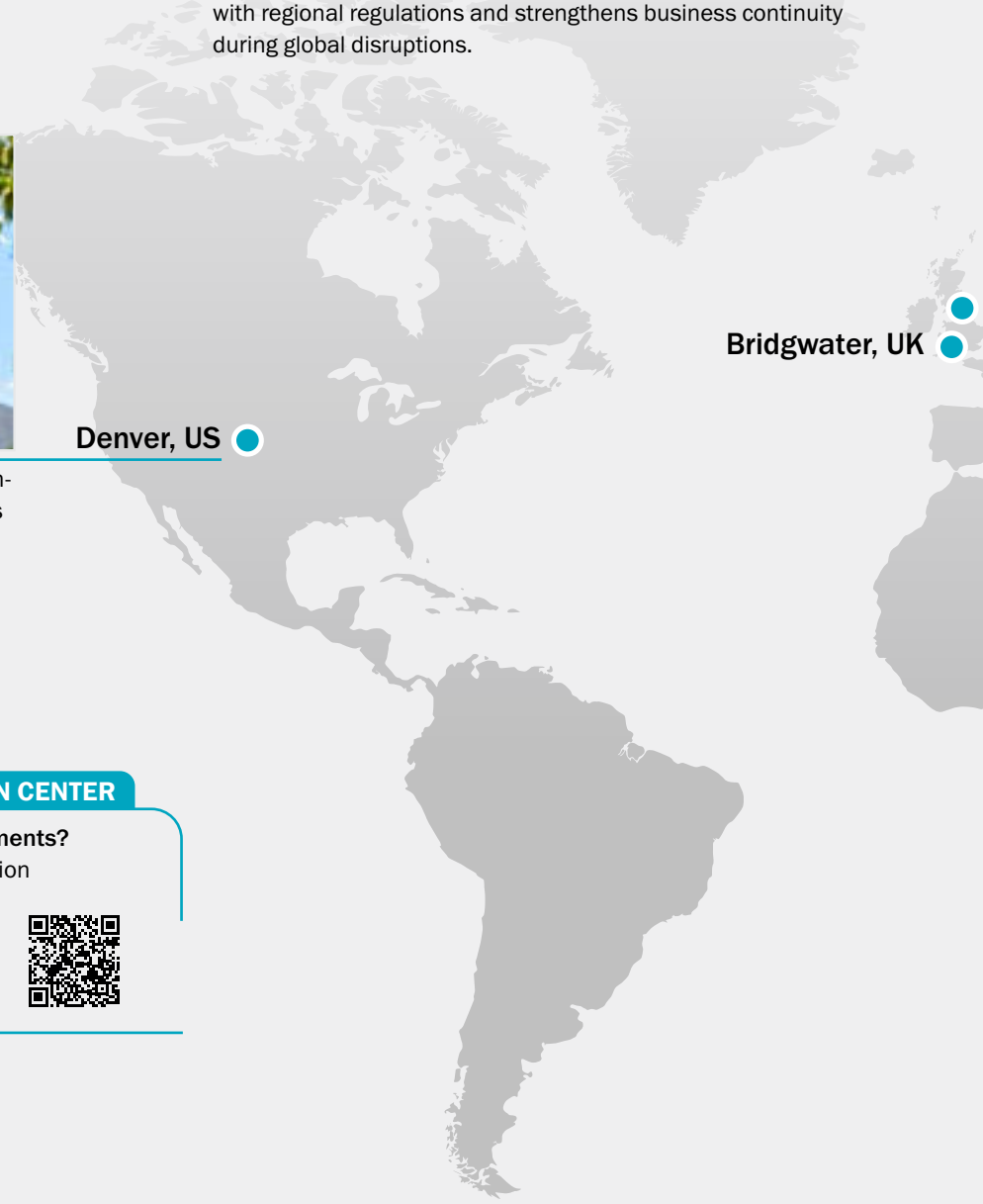
BY YOUR SIDE, WHEREVER YOU ARE

We combine global expertise with regional delivery to bring exceptional value to your business. Our extensive manufacturing network enables fast, regional production and localized sourcing, shortening lead times and enhancing flexibility.

Our *local for local* strategy ensures faster response times for design, prototyping and delivery, while reducing transportation costs and environmental impact. It also enhances compliance with regional regulations and strengthens business continuity during global disruptions.



Pioneering advancements in high-performance thermoplastics, this US facility sets the standard for innovation in development and PTFE manufacturing.



CONTACT YOUR CUSTOMER SOLUTION CENTER

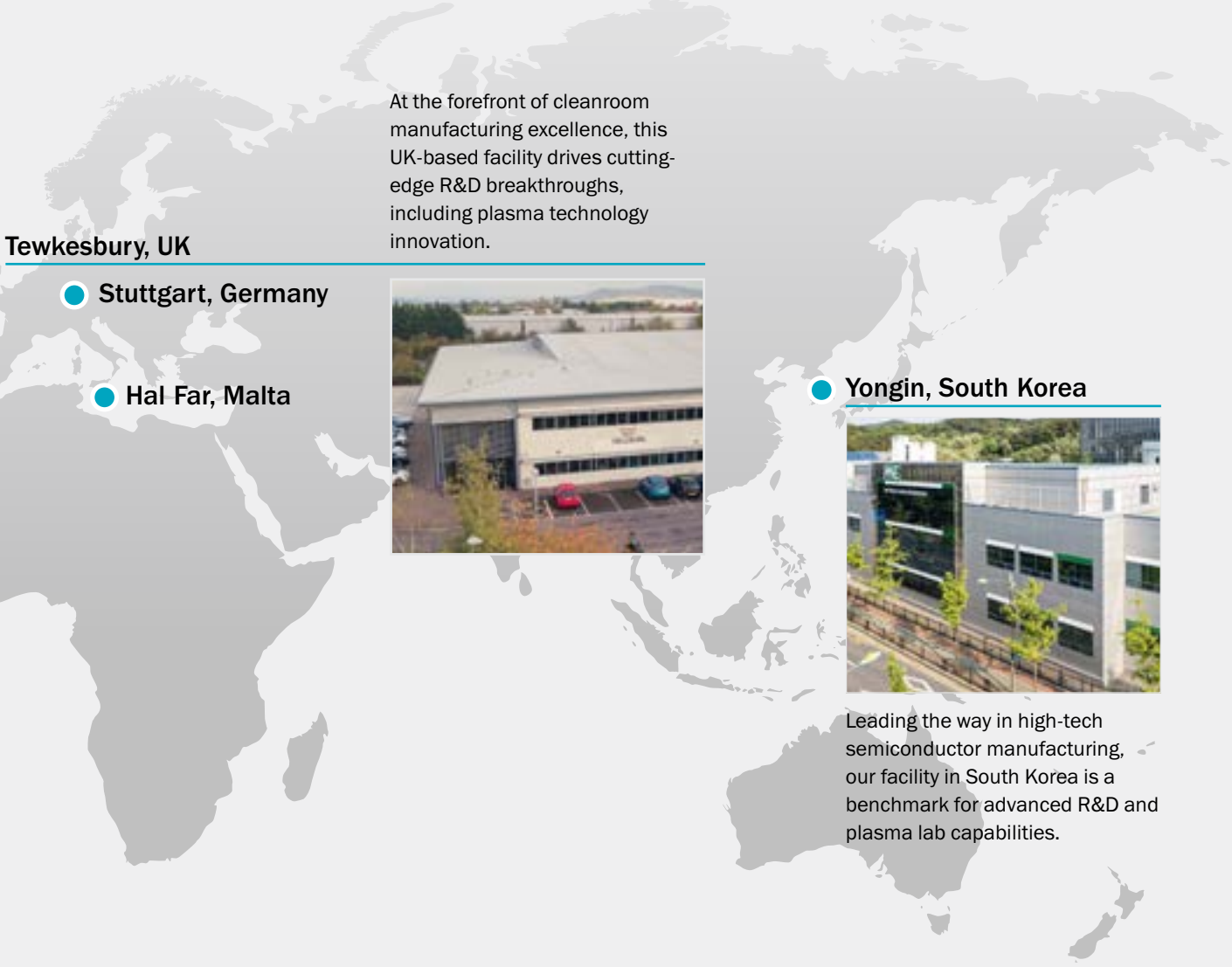
Does your application have unique requirements?
Is the operating environment of your application especially challenging?

www.trelleborg.com/seals/contact-form

FACILITIES ACROSS THE GLOBE

With over 35 manufacturing facilities worldwide, six are specifically dedicated to developing, testing and producing advanced sealing solutions for the demanding requirements of semiconductor manufacturing:

- **Yongin:** Dedicated semiconductor manufacturing and R&D testing facility including plasma lab
- **Malta:** Cleanroom manufacturing facility
- **Tewkesbury:** Cleanroom manufacturing facility and R&D testing facility including plasma lab
- **Bridgwater:** PTFE and metal seal ring manufacturing and high-speed rotary seal testing facility
- **Denver:** High-Performance Thermoplastics Technology and Development Center and PTFE manufacturing
- **Stuttgart:** Global R&D headquarters and Innovation Center



Tewkesbury, UK

At the forefront of cleanroom manufacturing excellence, this UK-based facility drives cutting-edge R&D breakthroughs, including plasma technology innovation.

Stuttgart, Germany

Hal Far, Malta

Yongin, South Korea

Leading the way in high-tech semiconductor manufacturing, our facility in South Korea is a benchmark for advanced R&D and plasma lab capabilities.

Trelleborg is a world leader in engineered polymer solutions that protect essential applications in demanding environments. Its innovative solutions accelerate performance for customers in a sustainable way.

Trelleborg Sealing Solutions combines deep materials and applications expertise with close customer collaboration to fulfil our mission as a leading provider of precision seals, bearings and custom polymer components. We focus on meeting the most demanding needs of aerospace, food and beverage, semiconductor and general industrial customers.

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If you'd like to talk to Trelleborg Sealing Solutions, find your local contact at: www.trelleborg.com/seals/worldwide

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Version no: 9900282GBG1125