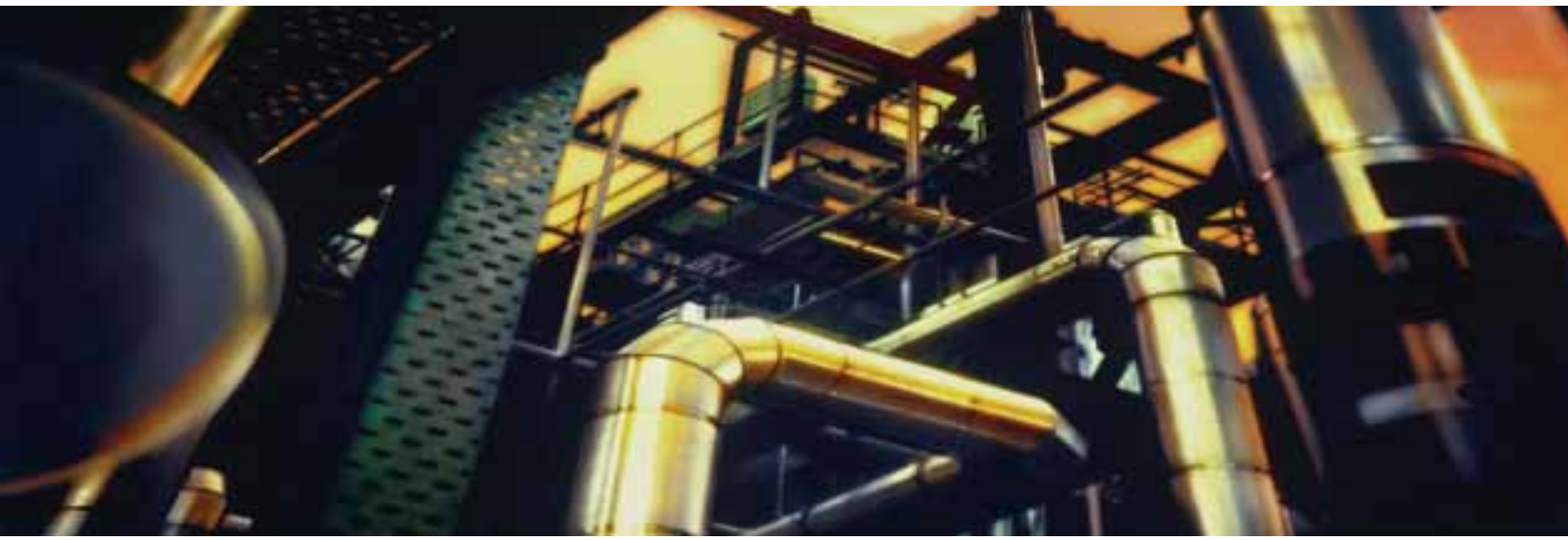


Kalrez® perfluoroelastomers parts for

# reliable, long-term sealing

## in extreme chemical and thermal environments

Kalrez®

From DuPont Performance Elastomers

## You can rely on

# Kalrez® sealing solutions

## in the harshest processing environments

**Engineered for optimum performance**
For over 30 years, DuPont and DuPont Performance Elastomers have been relentless in pursuing improvement in the manufacture of perfluoro-elastomer parts. Elastomeric parts typically consist of three components: a polymer chain (the backbone of the elastomer), a crosslinking system (which links the polymer chains together and is the key to elasticity and sealing performance), and a filler system (used to enhance mechanical properties). Based on our extensive experience, DuPont Performance Elastomers adjusts these components to optimize seal performance.

**Reduce maintenance costs**
Kalrez® parts help stretch your mean time between repair (MTBR) and lower your maintenance costs. Their durability minimizes unscheduled downtime while letting you extend time between routine inspections and replacement cycles for critical components.

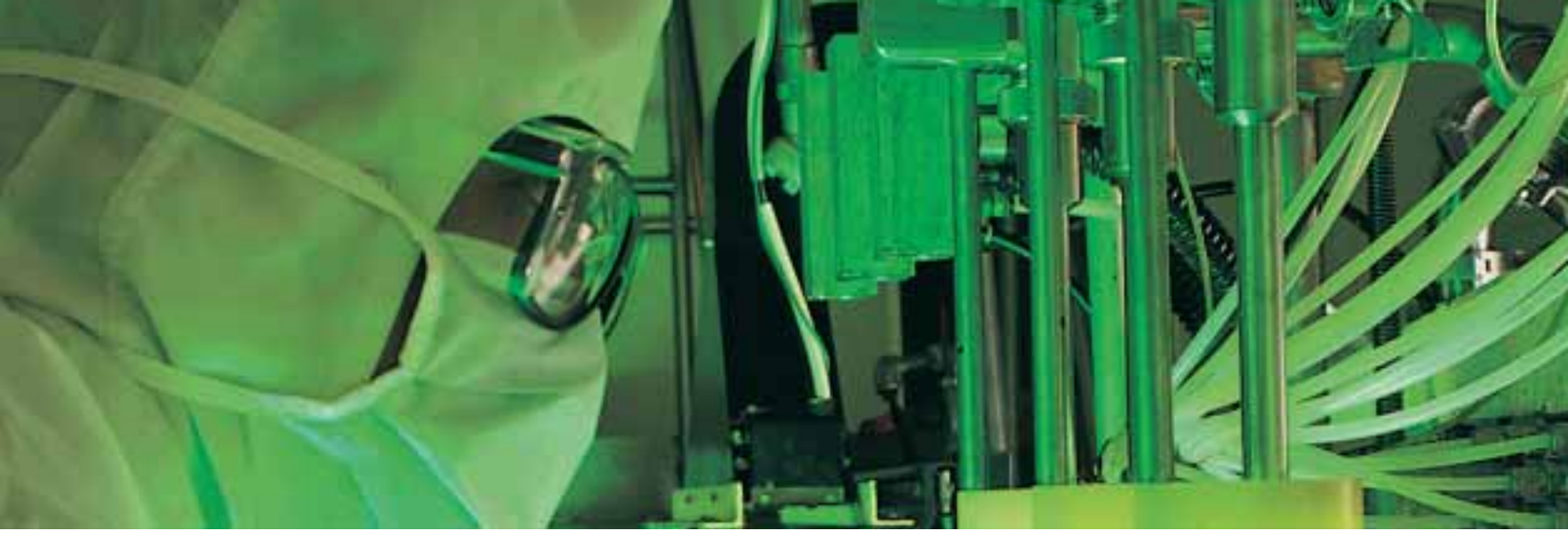
**Increase productivity**
By reducing the frequency of seal changes, repairs and inspections, you can increase process and equipment uptime for greater productivity and yield.

**Increase safety**
Lasting longer and performing better than other elastomers, Kalrez® helps reduce the risk of chemical exposure from seal failure.

**Reduce fugitive emissions**
Kalrez® and Kalrez® Valve Stem Packing Systems can help you reduce leaks and fugitive emissions for improved compliance with environmental regulations. Because Kalrez® parts maintain their sealing integrity, you reduce your risk of environmental non-conformance.

**Maintain process purity**
Kalrez® parts help prevent process contamination by:
- Resisting degradation in harsh chemicals
- Maintaining sealing force at high temperatures to reduce leakage
- Containing fewer ingredients that extract into the process
- Providing lower outgassing in vacuum sealing
- Meeting stringent FDA regulations for purity and cleanliness

**ISO 9001 quality assured with full traceability**
Kalrez® parts are made only by DuPont Performance Elastomers, a fully integrated manufacturer of Viton® fluoroelastomers and Neoprene rubber polymers, as well as perfluoroelastomer parts. Kalrez® parts are manufactured in ISO 9001 quality certified facilities and packaged in a bar-coded bag for full traceability.



## Kalrez® offers

# the best products

## for your application needs

The Kalrez® product line has been specifically designed to deliver outstanding performance in aggressive process environments. Whether it's resistance to acids, amines, ultrapure de-ionized water, strong bases or high temperatures, by selecting the Kalrez® compound that is best suited to a specific application, manufacturers can improve seal performance in their operating environment.

**Broad chemical and temperature resistance in chemical/hydrocarbon processing**

Processing environments in chemical and hydrocarbon plants are running hotter, longer and with more aggressive chemicals. In order to increase meantime between repair (MTBR) and improve safety, Kalrez® has been the product of choice. The industry standard has long been Kalrez® 4079, but increasing demands on production have called for new products with even greater performance capabilities. Today, the Kalrez® Spectrum™ family of products expands on the chemical and thermal properties of Kalrez® 4079 to better meet the requirements of these applications.

**Purity in food and pharmaceutical**

The regulatory requirements of the food and pharmaceuticals industries require increased awareness and stricter guidelines regarding product safety. Kalrez® parts for pharmaceutical applications offer cleanliness and chemical inertness with the resilience of a true elastomer. With its combination of thermal and chemical performance and rubber-like sealing ability, Kalrez® offers the pharmaceutical industry a new level of protection against contamination and seal failure.

**Semiconductor**

Kalrez® parts help reduce the total operating cost of semiconductor equipment by providing longer seal life and increasing meantime between repair. Elastomeric materials can be a source of contamination due to particle generation, outgassing, permeation, etc. Kalrez® seals offer exceptional chemical and thermal resistance to significantly reduce contamination. Kalrez® Sahara™ parts were specifically designed to prolong seal life in dry semiconductor processes, like etching, ashing and chemical vapor deposition (CVD). Specific compounds are also available for thermal and wet environments.

**Other demanding applications**

Because of its exceptional chemical and temperature resistance, Kalrez® was first used in aerospace and downhole applications. Its outstanding resistance to fuels, additives, lubricating oils and corrosive chemicals has made Kalrez® the product of choice in the most aggressive environments where seal failure is unacceptable.

## Kalrez® delivers the

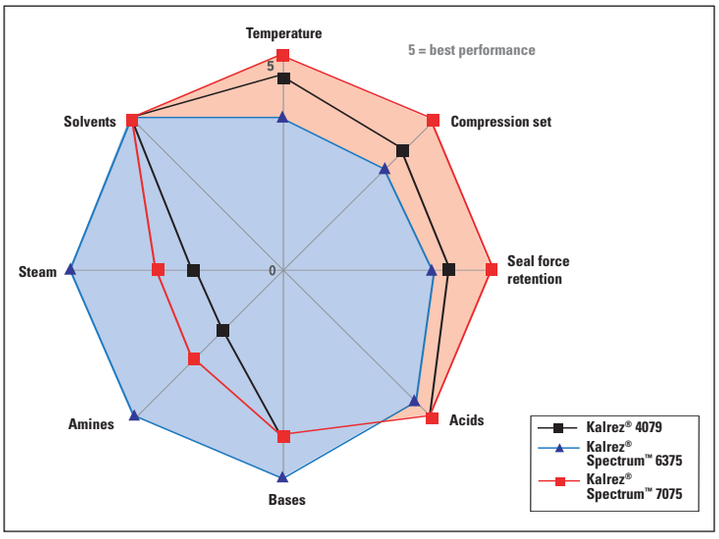
# broadest chemical resistance

## across the board

**Superior chemical resistance to more than 1800 chemicals**

Kalrez® perfluoroelastomer parts have virtually universal chemical resistance. They withstand attack from more than 1,800 chemicals, solvents and plasmas. Standardizing on Kalrez® products for broad chemical resistance reduces your need to keep multiple materials on the shelf, thus lowering cost of inventory.

**Advancements in polymer technology have improved chemical resistance of elastomers**




**Minimal swell**

Chemically induced swelling can cause O-rings and sealing components made of other rubbers to expand out of retaining grooves, resulting in seal failures. Kalrez® parts resist extreme volume swell when exposed to a wide variety of chemicals and solvents, including concentrated nitric acid, sodium hydroxide, ethylene diamine and steam.

**Optimizing chemical resistance and seal performance**

In order to maximize seal performance in specific applications, DuPont Performance Elastomers continually develops new products as emerging needs are discovered. In chemical and hydrocarbon processing, a family of products called Kalrez® Spectrum™ are available for better overall chemical resistance and higher thermal stability. This combination gives processors a larger operating window for additional chemical usage and higher temperature excursions. For more specific information about the chemical compatibility of Kalrez® parts, consult the DuPont Performance Elastomers Chemical Resistance Guide or the Kalrez® Application Guide available on our website or contact your Kalrez® parts authorized distributor.

## Kalrez® performs in

# high temperature

## applications and processes

**Service temperature range up to 327°C**

Even after long-term exposure to temperatures up to 327°C (620°F), Kalrez® retains its elasticity and recovery properties better than other high-temperature elastomers. Its high-temperature properties, coupled with near universal chemical resistance, enable Kalrez® parts to withstand an extremely broad range of process media.

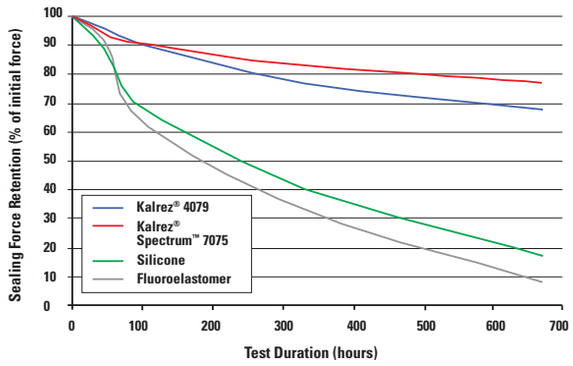
**Maintains sealing force to keep seals tight**

As proven in ISO 3384 tests, Kalrez® outperforms other elastomers when it comes to sealing force retention, a measure of seal life. Even under harsh and aggressive conditions, Kalrez® will retain its sealing force longer. And thanks to its true-rubber resiliency, Kalrez® prevents leaks caused by creep, a major problem with PTFE.

**Low compression set**

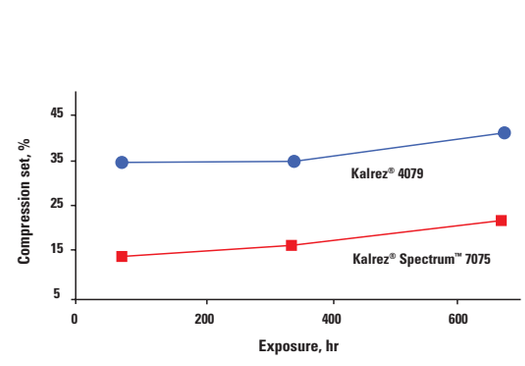
Kalrez® parts exhibit low compression set, maintaining their elastic recovery to maintain tight seals over the long haul. Because Kalrez® parts recover better under compression than other perfluoroelastomers, they maintain their shape better under prolonged stress.

**Sealing force retention at 204°C**

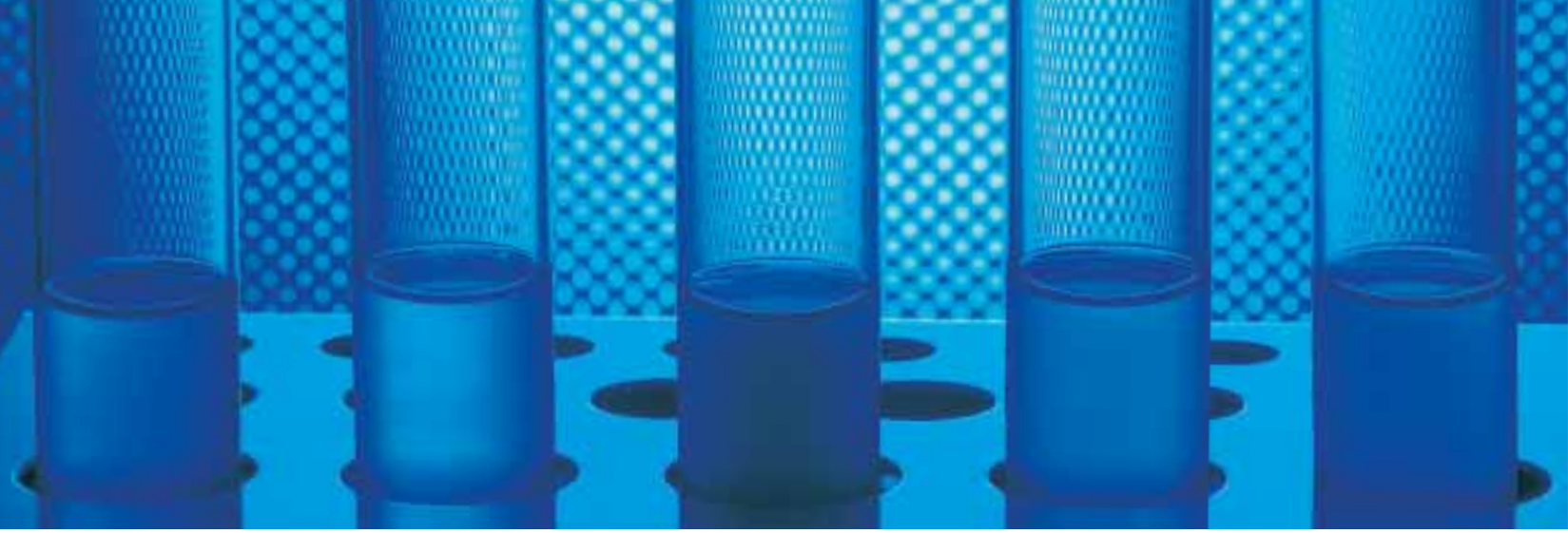



Test method: ISO 3384: 1991, method A, 214 O-ring

**Compression set at 204°C**




Test method: D395B, 214 O-ring



## Kalrez® increases mean time between repair and

# prolongs seal life

## in tough chemical and hydrocarbon processes

**Kalrez® provides long seal life in chemical and hydrocarbon processing**

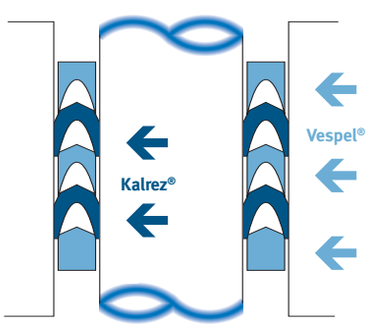
In pumps, valves, mechanical seals or analytical equipment, Kalrez® perfluoroelastomer parts are proving their value year in and year out. Their long-term resistance to the harshest chemicals and the highest temperatures makes them resistant to swelling and embrittlement, a leading cause of premature seal failure. Whether it's O-rings, custom shapes or valve stem packing, Kalrez® parts can improve your productivity, control fugitive emissions and reduce costly seal failures.

**Kalrez® KVSP™ valve stem packing system reduces friction**

In either manual or automatic controls, you can improve valve performance, reduce maintenance costs and limit fugitive emissions to less than 10 ppm with Kalrez® KVSP™. Kalrez® KVSP™ is a combination of Kalrez® V-rings and Vespel® backup components that can handle temperatures up to 288°C. They provide a self-adjusting, maintenance-free alternative to graphite and PTFE (polytetrafluoroethylene) packing systems.

Through reduced friction, Kalrez® KVSP™ improves process control variability, resulting in improvements to both yield and product quality. Friction data proves that Kalrez® KVSP™ performs at levels comparable to PTFE packing sets. No valve modifications are necessary and adjustments are rarely needed after installation to make Kalrez® KVSP™ an important upgrade to valve performance.

**Kalrez® KVSP™ reduces fugitive emissions and improves process control**




- Tested up to class 600 per ANSI/FCI 91-1-1994
- Certified according to TA Luft requirements
- Meets requirements of Pressure Equipment Directive PED97/23/EC

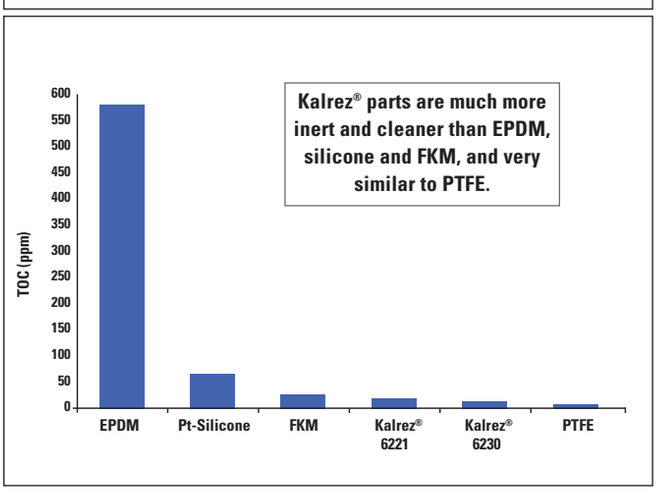
## Kalrez® delivers

# integrity and purity

## in pharmaceutical processes

With its combination of thermal and chemical performance, and its rubber-like sealing ability, Kalrez® parts offer the pharmaceutical industry a new level of protection against process contamination and seal failure. Similar to PTFE in cleanliness, heat and chemical resistance, Kalrez® has the resilience and compressive strength of frequently used sealing materials such as ethylene propylene polymers (EPDM), fluoroelastomers (FKM) and silicone rubber. Black and white Kalrez® compounds have been developed to meet the unique sealing needs of today's pharmaceutical and biopharmaceutical manufacturing processes for increased purity and sealing integrity.

**Kalrez® 6221 and 6230 have extractable levels comparable to PTFE**




EPA method 415; TOC tests performed on 1" sanitary seals, immersed in 50 mL of sterile WFI at 100°C/24 hrs. The solution was then diluted to 100 mL and analyzed.

**FDA and USP compliancy**

The U.S. Food and Drug Administration (FDA) confirmed the compliance of Kalrez® 6221 and 6230 for repeated use in contact with food by Food Contact Notification (FCN) 000101. FCN 000101 was established through the FDA Premarket Notification Process for food contact substances as described in section 409(h) of the Federal Food, Drug, and Cosmetic Act (21U.S.C. 348(h)) and is the primary method by which the FDA authorizes the use of food additives that are food contact substances. FCN000101 requires materials to have extractable levels less than 0.2 mg/in$^2$. Designated Kalrez® compounds have been tested in accordance with United States Pharmacopeia Class VI (USP Class VI) and met those requirements. Designated Kalrez® compounds also comply with the requirements in U.S. FDA regulation 21 CFR 177.2600 and the extractive requirements of 21 CFR 177.2400 CFR 177.2400 (d) (1).

Please see back cover of this brochure for additional information.

## Meet and exceed challenging

# semiconductor needs

## with low contamination Kalrez® parts

Seals in wafer manufacturing are subject to process conditions that challenge seal performance. Chemical resistance that is nearly universal, coupled with superior high-temperature properties, enables Kalrez® parts to withstand virtually any process media – including plasmas – at elevated temperatures.

In addition to providing superior chemical resistance and thermal stability, Kalrez® UltraPure™ parts, designed specifically for semiconductor applications, offer lower contamination in reactive plasmas and cleaning gases, improved vacuum-sealing performance and lower outgassing. In addition, Kalrez® UltraPure™ parts are manufactured under clean-cell conditions and specially cleaned and double packaged at Class 100 workstations. Kalrez® provides long-term reliability in plasma, gas deposition, thermal and "wet" processing applications, such as:

- Etching, ashing, HDPCVD, PECVD
- Diffusion, LPCVD, RTP, lamp annealing
- Wet etching, cleaning, photoresist stripping, copper plating

Kalrez® parts specifically developed for the semiconductor industry are available in standard AS568 O-ring sizes as well as metric and JIS O-ring sizes. Sheet stock and custom geometries are available for die-cut gaskets or custom development.

**Field proven in all semiconductor processes**

- Over 50,000 wafers processed in a high-energy oxygen plasma asher without a slit valve seal change
- Over 400 wafer batches (6 months) in a 250°C nitride LPCVD tube furnace
- 4x improvement in seal life and reduced seal sticking vs. silicone in a 300°C nitride process
- Doubled seal life in a metal etch process compared to other perfluoroelastomers
- Seal life improved 10x over silicone in a plasma asher door seal at 130°C
- Lower ionic extractables in a 100°C wet chemical pump application
- Over 6 months seal life in a large slit valve for Liquid Crystal Display processing etcher
- Over 3 months seal life in a 280°C diffusion furnace application
- 8 months seal life (35% more than competitive custom slit valve seal) for Kalrez® TriLobe™ in aTEOS PE-CVD process
- Doubled seal life with a Kalrez® seal in a plasma asher
- 8x to 14x improvement in seal life (over 3 months) compared to a competitive perfluoroelastomer in plasma asher showerhead seals
- Doubled seal life compared to a competitive perfluoroelastomer in a PECVD slit valve application
- Best overall performance in LPCVD using ClF3 cleaning gas (lower outgassing and particle generation)

## Kalrez® parts provide

# superior performance

## in other extreme environments

**Aircraft and aerospace**

The ability to withstand extreme temperatures makes Kalrez® parts ideal for use in aircraft and aerospace applications. Kalrez® parts also withstand aggressive aerospace fluids, including jet fuels, engine lubricating oils, hydraulic fluids, rocket propellants and oxidizers.

Kalrez® has proven its superior performance for more than 30 years in such applications as:

- Aviation, marine and industrial gas turbine engines
- Auxiliary power units
- Hydraulic actuators
- Bleed air valves and fittings

**Oil and gas**

Kalrez® parts stand up to severe downhole conditions – from high pressures and temperatures, to aggressive sour gas and corrosive fluids. Blistering heat, corrosive fluids and toxic gases can destroy the physical properties and sealing performance of other materials.

Field-proven across the industry in applications such as:

- Tubing-to-packer seals
- Subsurface safety valves
- Logging boots
- Casing tie-back seals
- Survey tool seals
- Slip-joint seals

## From technical assistance to fast, reliable supply

# you get more

## than just a product

**Worldwide technical support and testing facilities**
We help you with the technical assistance and support you might need to achieve optimum results in the shortest possible time. Our worldwide R&D expertise can help you with:

- Compound selection and seal design
- Application testing and development
- Failure analysis
- On site training

**Fast delivery**
Upon agreement and request, standard O-rings and make-to-stock parts can be delivered within 48 hours to most European and North American destinations. Ask our Sales and Customer Service Representatives to find out more.

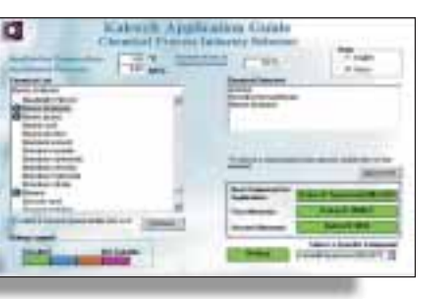
**In any shape you want**
- Standard O-rings in AS-568, metric and JIS sizes
- Customized O-rings in various cross-sections and diameters
- Valve seats, diaphragms, gaskets, packer seals, T-seals, column fittings, custom shapes
- Kalrez® KVSP™ Valve Stem Packing System

**Customer-tailored solutions – Finite Element Analysis (FEA)**
Advanced Finite Element Analysis offers single-source analysis capability. From designing new seal shapes with concurrent analysis to groove geometry optimization, FEA gives unequalled flexibility. It shortens your product development lead times and brings innovative solutions to the market.

**Worldwide presence and network of reliable distributors**
Kalrez® parts are readily available through an extensive network of worldwide-authorized distributors. Our authorized distributors can give you the technical assistance needed to help solve your sealing problems. For a complete list of authorized distributors, please contact DuPont Performance Elastomers.

**Latest updates**
We provide our customers with the latest information about sealing performance.
**Visit our website www.dupontelastomers.com** and read or download the latest product information. Check out the DuPont Performance Elastomers Chemical Resistance Guide – an online tool that rates the chemical resistance of all elastomers, including Kalrez® and Viton®, in a variety of chemicals.
For more specific information on Kalrez® including seal design, contact us about the Kalrez® Application Guide, a unique interactive software program.

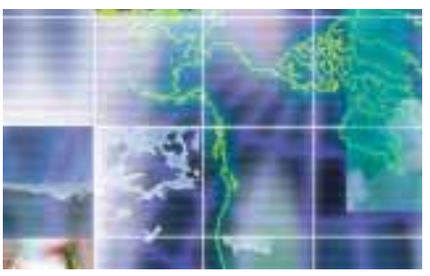
**Visit the Chemical Resistance Guide on:**
**www.dupontelastomers.com**

**Technical support for achieving optimum results**

Depend on DuPont Performance Elastomers for the support you need to achieve optimum results in the shortest possible time. Our worldwide R&D and application expertise can help you with:

- Process development
- Application testing
- New application development



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