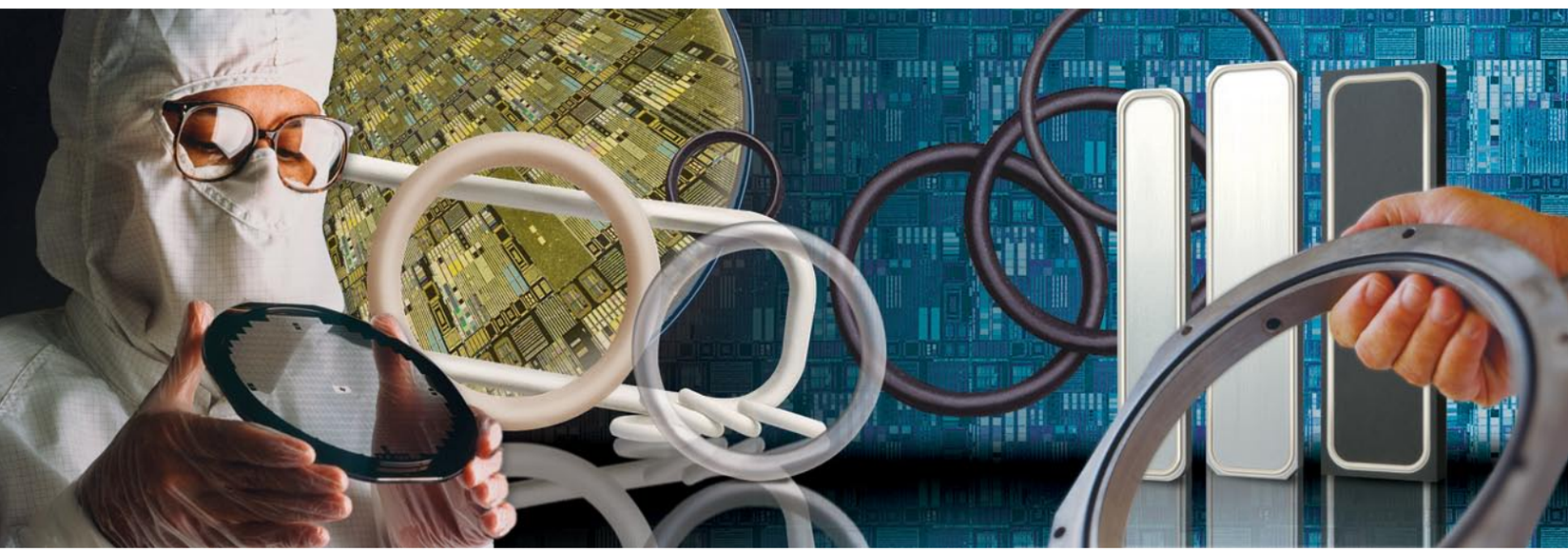


Kalrez® seals for proven reliability in

aggressive wafer processing environments

Kalrez®

From DuPont Performance Elastomers

Kalrez® delivers

outstanding plasma, chemical, and thermal resistance

In sealing applications that involve aggressive media and temperature extremes, Kalrez® perfluoroelastomer parts can outperform and outlast other sealing materials by a wide margin (Figure 1). The polymer's outstanding level of chemical and thermal stability has been proven over a 30-year history of success where seals, O-rings and other components of Kalrez® are known for reliable, long-term service in a wide range of industrial and semiconductor-grade chemicals.

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.

As a class of materials, perfluoroelastomers (FFKMs) exhibit improved thermal stability compared to fluoroelastomers and silicone. Among these, Kalrez® is in a class by itself: it retains properties like elastic recovery and sealing force far better than other heat-resistant elastomers including alternative perfluoroelastomer types — even after long-term exposure at temperatures as high as 327°C.

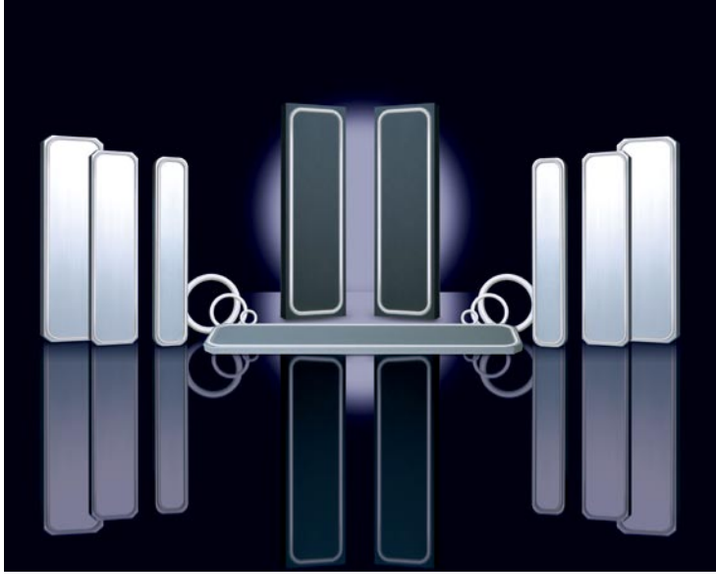
Figure 1. How Kalrez® Compares with Other Elastomers*

	Ethylene propylene	Silicone	Fluorosilicone	Fluoroelastomer	Perfluoroelastomer
ASTM Code	**EPM**	**VMQ**	**FVMQ**	**FKM (Viton®)**	**FFKM (Kalrez®)**
Max. continuous service temp.*	135°C	200°C	200°C	200°C	327°C
Hardness durometer (Shore A)*	40 to 80	40 to 75	40 to 80	55 to 95	55 to 95
Compression set*	G	VG	G	VG	G
Alcohols	E	E	E	E	E
Alkalis	VG	R	R	N	E
Ammonia	G	VG	N	N	E
Chlorine	N	N	VG	E	E
Concentrated acids	R	N	G	VG	E
Fluorinated gases	N	N	G	VG	VG
Halogenated solvents	N	N	VG	VG	VG
Hydrofluoric acid	N	N	R	G	E
Hydrogen bromide	N	N	R	E	E
Ketones	G	N	N	N	E
n-Methyl pyrrolidone	N	N	R	G	E
Oxygen	G	E	G	VG	E
Ozone	VG	E	E	E	E
Piranha	N	N	N	VG	E
Reactive plasmas	N	G	VG	VG	E
Silane	R	G	G	E	E
Standard clean 1	G	R	G	G	E
UPDI water	VG	G	G	VG	E

KEY E = Excellent
VG = Very Good
G = Good
R = Reasonable
N = Not Recommended

*Data has been drawn from DuPont Performance Elastomers tests and industry sources. Data is presented for use only as a general guide and should not be the basis of design decisions. Contact DuPont Performance Elastomers for further information.

A comprehensive table of Kalrez® compatibility ratings in all current semiconductor process chemicals is available from your authorized Kalrez® distributor or our website.



Kalrez® parts can improve yields and

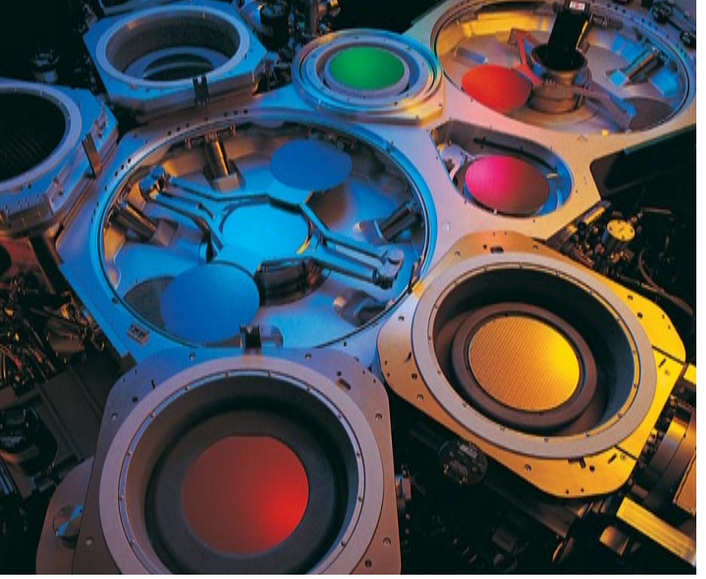
reduce cost of ownership

The success of Kalrez® perfluoroelastomer parts are field proven in the manufacture of semiconductors, where processing steps can involve extremes of plasma, chemical, and thermal exposure. Since purity is critical to high wafer yield, reducing contamination from particulates, outgassing and extractables caused by seal deterioration are major goals of semiconductor fabricators. Whether it's in plasma and gas deposition, thermal or wet environments, manufacturers gain seal reliability and process purity that is backed by more than 30 years of success with Kalrez®.

Kalrez® parts are manufactured in ISO 9000 registered facilities and are available in a wide variety of finished products — from conventional seal shapes, bonded door seals to custom geometries. Various Kalrez® compounds are available that can meet the performance demands of specific equipment and processing applications.

FIELD PROVEN IN SEMICONDUCTOR PROCESSES

Application	Process Environment	Incumbent Performance	Kalrez® Results
Gas box, shower head and plate seal	PECVD — TEOS and O_2 at 400°C and ~3000 watts with cleaning chemistry of NF_3 plasma at 3500 watts	Competitive FFKM (A2) failed after 20,000 wafers due to cracking and excessive leakage	Kalrez® Sahara™ 8085 improved production to over 25,000 wafers versus competitive FFKM
Slit valve door seal	PECVD — TEOS, O_2, N_2, Helium and cleaning chemistry NF_3 Plasma, C_2F_6, N_2	Competitive FFKM (A11) bonded door seal failed after only 16,500 wafers cycles	Kalrez® Sahara™ 8085 generated 4 times fewer particles after 40,000 wafer cycles
Turbo gate O-ring	HDPCVD — SiH_4 and O_2 at 150°C with cleaning chemistry of NF_3 plasma	Competitive FFKM (A2) failed after 10,000 wafers due to excessive particles	Kalrez® Sahara™ 8085 improved production to over 20,000 wafers versus competitive FFKM
Slit valve door seal	Ashing — O_2 and N_2 greater than 80°C	Silicone O-rings failed every 2–3 days from radial cracking, hardening and particles	Kalrez® Sahara™ 8085 O-ring performed with minimal particle generation for one year
Chamber lid and showerhead seal	SACVD — TEOS, Ar, O_2 at 100–250°C with chamber pressure of 200–600 Torr and NF_3 cleaning gas	Incumbent products cracked causing leakage after 30,000 wafers	Kalrez® 8002 improved wafer production 50% with no performance problems and lower particle generation
E-Chuck top ring	HDPCVD — SiH_4, O_2, He at 200°C at 10 milliTorr with NF_3 cleaning gas	Competitive FFKM (A11) caused leakage after 50,000 wafers	Kalrez® 8002 improved wafer yeild over 50% with almost no seal erosion
Gas box, shower head and foreline	PECVD — TEOS, TMB, O_3 at 1000 W and C_3F_8 cleaning gases at 2000 W	Competitive FFKM (A2) showed signs of cracking and leakage after 20,000 wafer PM	Kalrez® 8002 evaluated after 22,000 wafer cycles with no sign of cracking and leakage
O-rings, wafer lip seal, robot arm suction cup	Electrochemical plating (ECP) process — O_3, H_2SO_4, $CuSO_4$, citric acid, UPDI, at 100°C	Seal degradation of FKM caused sticking which resulted in contamination/metallic residue on back side of wafer	Kalrez® 6375UP demonstrated the best chemical compatibility and lowest extractibles compared to competitive FFKMs (A17 and B4), FKM and EPDM



Kalrez® parts lower particle generation in

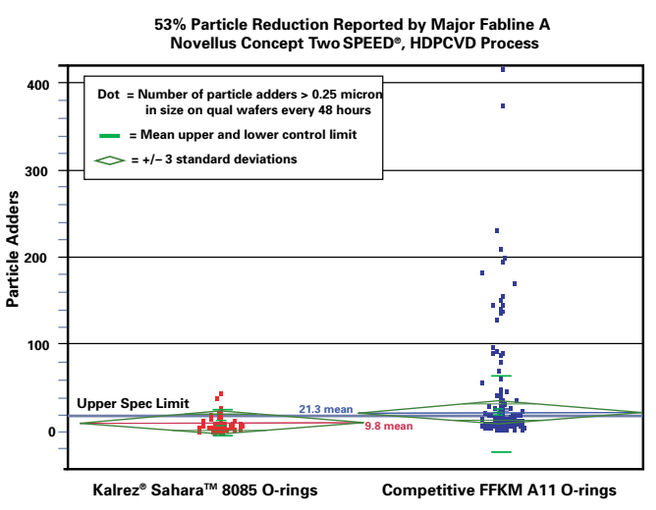
plasma and gas deposition

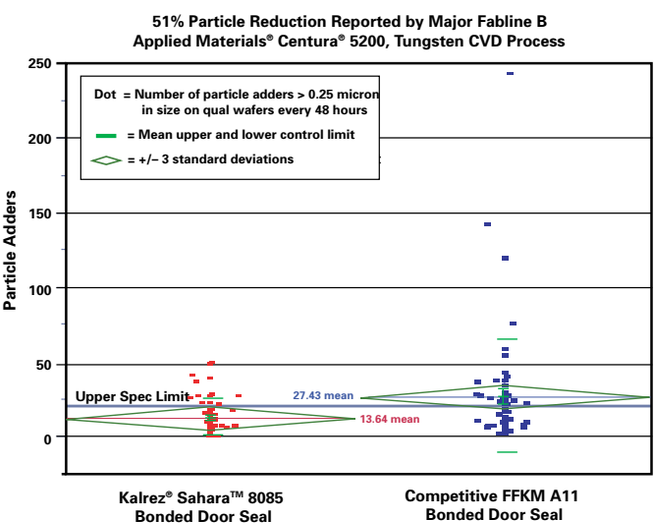
Etching • Ashing • HDPCVD • PECVD • SACVD • PVD • Metal CVD

Kalrez® perfluoroelastomer parts are used in plasma and gas deposition because of their exceptional resistance to aggressive media. Prolonged exposure to reactive plasmas can degrade the seal's surface causing particle generation to occur before sealing functionality is lost. The ideal seal for plasma applications, therefore, would resist surface degradation and maintain its functionality.

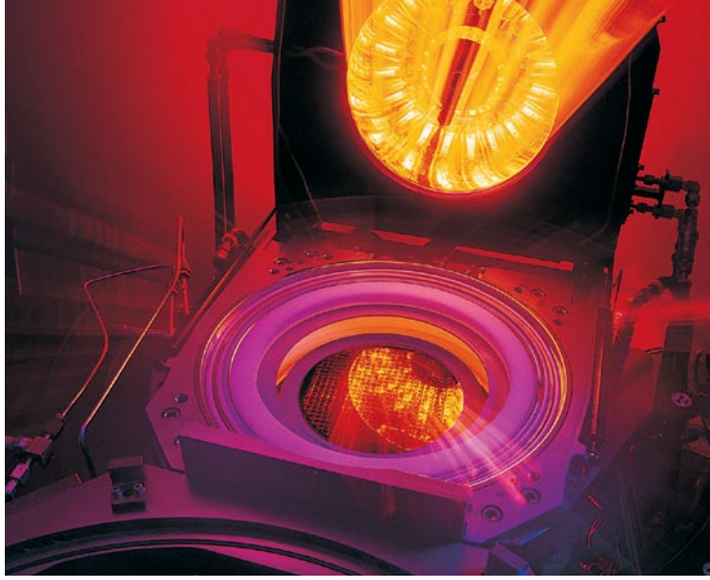
Kalrez® perfluoroelastomer parts offer excellent chemical resistance to a wide range of process and cleaning gases used in plasma and gas deposition processes. New proprietary developments have resulted in products that exhibit reduced particle generation based on reports from major Fablines in HDPCVD and Tungsten CVD (Figures 2 and 3). Kalrez® parts offer reduced particle generation, extended seal life and increased equipment reliability. This translates to improved wafer yields and reduced cost of ownership.

Figures 2 and 3. Kalrez® Sahara™ 8085 Helps Reduce Particle Adders*





** Data reported by Semiconductor Fablines*



Kalrez® parts help reduce outgassing and contamination in

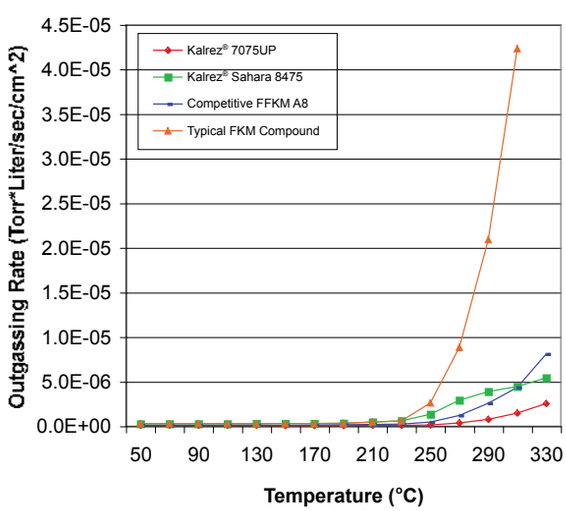
thermal and wet applications

LPCVD • Oxidation Diffusion Lamp Anneal • RTP

High temperatures can cause elastomeric seals to become hard and brittle. When this occurs, their cross-linking structure, the key to their elasticity, becomes irreversibly damaged. This loss of elasticity makes effective sealing impossible. In addition, elastomers can degrade under high temperatures causing outgassing and process contamination. The result is unscheduled downtime, or even worse, product loss. Thermal processes need seals that resist not only the process chemicals, but also the extreme temperatures required.

Kalrez® parts retain their sealing force longer and reduce problems caused by sticking and outgassing. They reduce equipment downtime, increase yield and improve process reliability.

Figure 4. Total Outgassing Rate Versus Temperature*



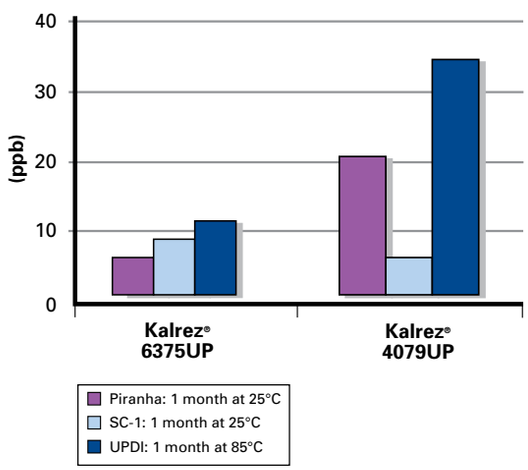
** DuPont Performance Elastomers Proprietary Test Method using AS568 K214 O-ring test specimens.*

Etching • Stripping • Copper Plating Cleaning • Photolithography

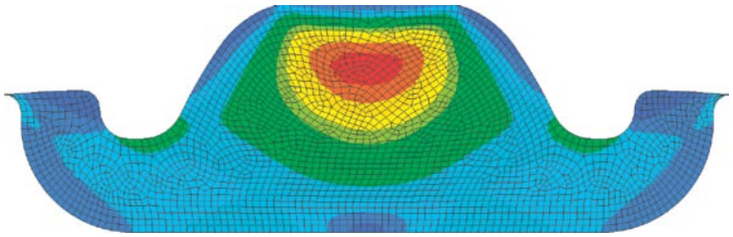
To transform raw semiconducting materials into a useful device requires hundreds of chemical processing steps. A significant number of these steps involve aggressive acids, solvents (including amines), and bases used to clean, rinse, etch or strip unwanted materials and contaminants from the wafer surface. These chemicals can attack elastomeric seals causing them to swell and degrade or to leach undesirable metallic and ionic extractables that affect integrated circuit functionality.

Kalrez® parts are designed to reduce extractables in the harshest chemicals. Kalrez® parts can last longer and produce fewer contaminants than other "off-the-shelf" products, to help improve wafer yield in wet processing.

Figure 5. Total Metallic Extractables by ICP-MS*



** DuPont Performance Elastomers test method*



Kalrez® provides

applications support

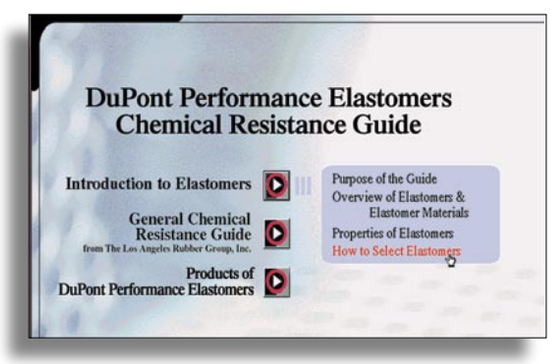
Comprehensive technical service is available globally from DuPont Performance Elastomers. Our laboratories in the U.S., Europe and Japan are equipped to run a variety of performance and analytical tests for product development, seal design or failure analysis. Capabilities include FTIR, ESCA, SEM, EDX and other analytical tests, long-term seal force retention and compression set, outgassing, vacuum and permeability, and polymer identification.

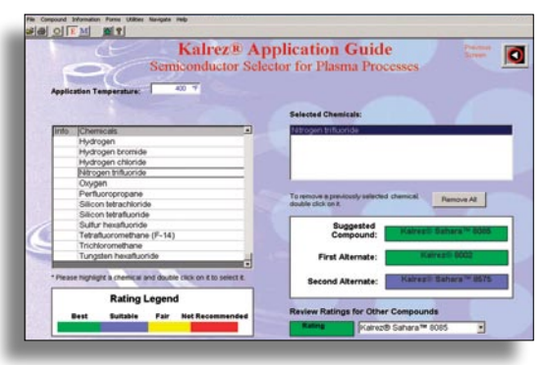
Advanced Finite Element Analysis (FEA) capabilities are available to help design new seal shapes by calculating stress patterns, optimizing compound selection and groove geometry, and accurately modeling part performance in service. Use of FEA can significantly shorten development lead times and produce innovative solutions for long-term sealing performance.

On-site seminars can be held at your facility to allow design, maintenance and process engineers to learn more about elastomeric materials and discuss specific sealing problems that may occur in wafer processing equipment. Contact DuPont Performance Elastomers about potential seminars.

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.





Kalrez® UltraPure™ parts are specially cleaned and double packaged at Class 100 workstations. Independent laboratory results clearly show that this post-cleaning and packaging significantly reduces particle and surface contamination.

Visit www.dupontelastomers.com/kalrez

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