
DUPONT™
The hidden threat with potentially the biggest impact on every oil and gas operation.
Kalrez® The original.

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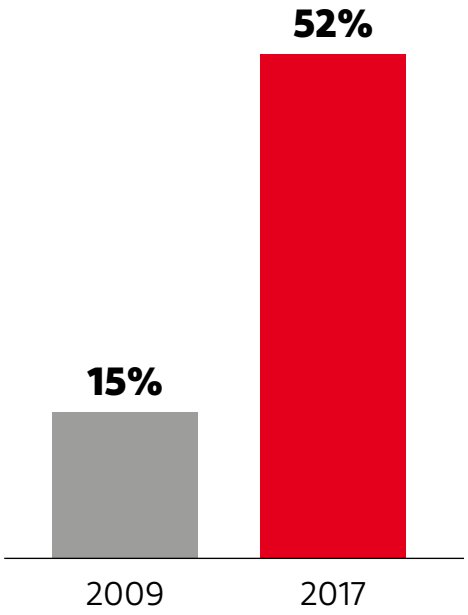
Engineering reliable performance for demanding environments.

Oil production has been pushed into more extreme conditions and harsher environments, like ultra-deep water in the Gulf of Mexico. Newer technologies enable such operations, but they also offer less margin for error.

An average offshore platform experiences 27 days per year of unplanned downtime. That equates to costs of $38 million[1]. **Demands on equipment have never been so critical.**



Oil Production percentage from ultra-deep operations US waters in the Gulf of Mexico[2]

Even the most complex operations rely on the smallest parts

From production and completion equipment through to drillstrings, compressors and pumps, every piece of equipment has to be operating as efficiently as possible. It's vital that they can be relied on. And that includes the seals inside them. If a simple seal breaks down, then an entire operation could break down. And that could be costly.

Why seals could potentially have the biggest impact on oil and gas operations

In today's oil and gas environments, seals are potentially the most critical element in your equipment that can be easily overlooked.

DuPont™ Kalrez® OG193 - the original FFKM seal specifically for the oil and gas industry

DuPont offers solutions for safety and low maintenance in extreme operational conditions – where quality matters. We have further engineered Kalrez® creating an exceptional product to perform specifically in oil and gas, meaning easier installation and greater performance to cope with the industry's most stringent demands.

With different operational challenges to overcome in ensuring optimal performance, DuPont™ Kalrez® OG193 parts are an ideal fit for various applications in both upstream and downstream. Kalrez® OG193 also demonstrates the perfect qualities in all energy applications requiring perfluoroelastomers chemical resistance coupled with rapid gas decompression (RGD) performance and high strength.

Kalrez® OG193 parts – product specs

TABLE 1: Typical Physical Properties1	**Kalrez® OG193 parts**
Color	Black
Hardness, Shore A2	95
50% Modulus3, MPa (psi)	11.5 (1670)
Tensile Strength at Break3, MPa (psi)	20.0 (2900)
Elongation at Break3, %	100
Compression Set4, %, 70 hrs. at 204 °C (400 °F)	21
Upper Service Temperature5, °C (°F)	250 (482)
Low Temperature Sealing6 °C (°F)	-31 (-24)
Rapid Gas Decompression7	Pass
ISO 23936-2 Standard	0000-0000-0000
ISO 23936-2 Free Flow	0000-0000-0000

1 Not to be used for specification purposes
2 ASTM D2240 (slab test specimens)
3 ASTM D1414 (AS568 K214 O-ring test specimens)
4 ASTM D395B (AS568 K214 O-ring test specimens)
5 DuPont proprietary test method (anaerobic conditions)
6 DuPont proprietary test method
7 Externally tested in certified lab, under ISO 23936-2 guidelines

Perfluoroelastomer (FFKM) parts for oil and gas – a complex choice

Selecting the most appropriate perfluoroelastomer (FFKM) parts for oil and gas applications has traditionally involved a series of compromises. These have typically included:

- RGD performance or high sealing capabilities
- Easier installation or extrusion resistance
- High chemical resistance or low temperature performance
- Technical limitations in the cross-section thickness of seals and massive parts

Improved productivity and efficiency

Kalrez® OG193 is a 95 durometer FFKM part that exhibits an excellent balance of properties for oil and gas applications combining RGD performance and chemical resistance with low temperature capability and thermal stability.

Key performances:

- RGD – ISO 23936-2
- Sour ageing ISO 23936-2
- Extrusion resistance
- Low temperature

RGD performance and high sealing capabilities

Rapid gas decompression can cause structural failure in the form of blistering, internal cracking, and splitting. This is caused when the gas pressure applied on the seal is reduced quickly enough so that the gas entrapped in the elastomer cannot migrate out. The most damaging gas for non-metallic materials and more particularly elastomers is carbon dioxide mostly because it acts as a solvent and induces high swell in elastomers.

ISO 23936-2 Test results

Compound	Kalrez® OG193	Kalrez® OG193
Fixture type	Gas-Trap	Free-Flow
Elastomer type	FFKM	FFKM
Specimen	AS568-325 O-Ring	AS568-325 O-Ring
Squeeze	13.8%	13.7%
Gland fill	80.7	80.6
O-ring Score		
1	0000, 0000	0000, 0000
2	0000, 0000	0000, 0000
3	0000, 0000	0000, 0000
4	0000, 0000	0000, 0000
Results	**PASS**	**PASS**

Test standard - ISO 23936-2 Annex B

Gas Mix	10%CO2 / 90%CH4
Test temperature	100 °C (212°F)
Test pressure	150bar + 10bar - 5bar
Test exposure period	68hrs initial hold followed by 6hrs and 12hrs holds
Pressure Release	8 release cycles at 20 bar (290psi)/min
Groove fill	80 - 85% groove fill
Squeeze	(14.5+/-3) % radial squeeze
Duplication	4 O-Ring of each compounds for each fixture type (8 total)
Analysis	Cross section to evaluate damage, grade per 23936-2
DAQ	Digital temperature and pressure data acquisition

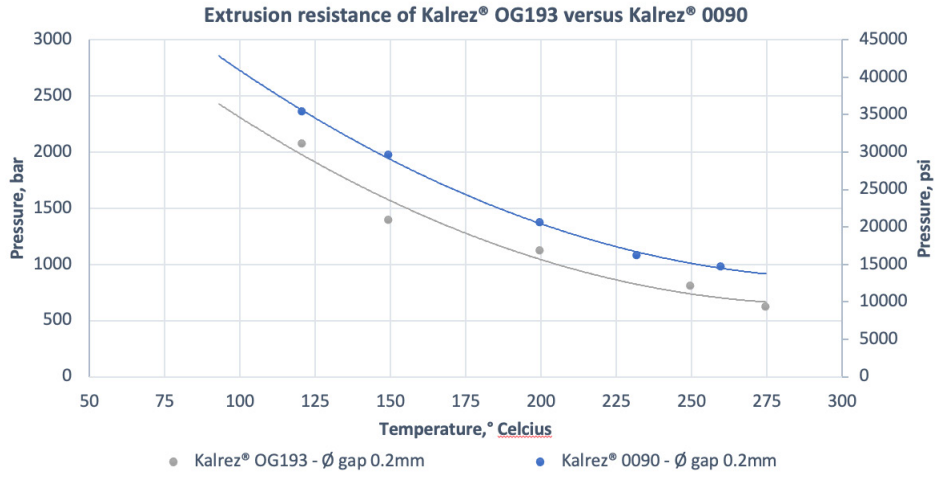
In an ISO 23936-2 test performed at a third-party laboratory, Kalrez® OG193 parts exhibited a high RGD performance even in substantially more aggressive conditions than required by ISO 23936-2. A RGD cycling test was carried out in conditions including 10% carbon dioxide (CO2) and 90% nitrogen (N2), a temperature of 150°C, and a decompression rate of 127bar/min over five cycles. These conditions represented a 50% higher temperature and a six times higher decompression rate than required by ISO 23936-2. Following the tests, no blisters or cracks were found on the eight tested o-ring sections.

In a compression stress relaxation test at 90°C, exposure to multi-phase sour fluid and 20% compression, Kalrez® OG193 o-rings demonstrated more than three times the required sealing force.

Easier Installation and extrusion resistance

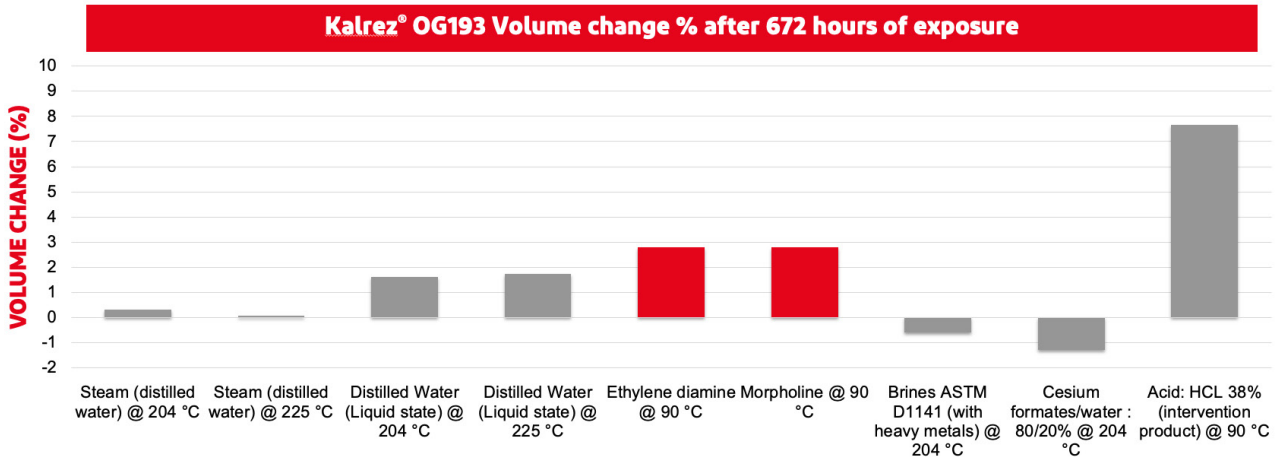
Elongation at break tests indicate Kalrez® OG193 has a high elongation at break over in-kind competition, reducing downtimes. In high pressure and temperature extrusion resistance tests on o-rings using silicon oil as a test media, Kalrez® OG193 exhibited an excellent diametrical gap extrusion resistance of 0.2mm.

Extrusion resistance test
Diametrical clearance gap of 0.2mm



Chemical resistance and lower temperature

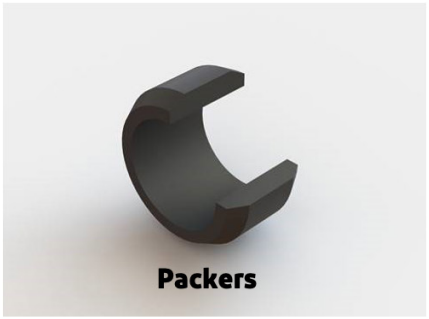
In resistance to chemical media tests, Kalrez® OG193 showed less than a 3% volume change in amines, which are the main components of corrosion inhibitors, and below 10% in hydrochloric acid, which is sometimes used in well intervention.



External testing in multiphase sour fluid showed Kalrez® OG193 exhibited a change in elongation at break well within the allowable +/-50% range after 42 days of exposure at 215 °C in the specified fluid. Low temperature sealing tests using nitrogen gas with a pressure of 0.4MPa – 60psi* showed Kalrez® OG193 parts maintained sealing until -31°C (-24°F), some 10 °C lower than Kalrez® 0090.

Technical solutions for the cross-section thickness of seals and massive parts

Kalrez® OG193 offers excellent versatility that allows it to be used for a variety of key parts including o-rings, packers, bonded seals, chevron stacks, t-seals, and many others. It is an ideal fit for various applications in both upstream and downstream - all applications where larger section thickness together with chemical resistance, RGD performance, and high strength are a must.



Seal performance in demanding conditions

In today's oil and gas environment, seals are potentially the most critical element in your equipment that can be easily overlooked. With oil and gas production increasingly pushing into deep water, the demands on your equipment are becoming more extreme. Choose a seal that's specifically designed to cope in these demanding environments.

Kalrez® OG193. Reliable sealing performance for complete peace of mind.

For more information on Kalrez® OG193, visit our website: **https://www.dupont.com/kalrez.html**

1. Source: Kimberlite Research, published at https://www.hint-global.com/2021/03/18/blog-1/
2. Source: The Verge "Offshore Drilling has dug itself a deeper hole since Deepwater Horizon", April 20th, 2020. https://www.theverge.com/2020/4/20/21228577/offshore-drilling-deepwater-horizon-10-year-anniversary

*Pressure applied at ambient and temperature is reduced until leak detection