

GAZGUARD™

Certified Solutions for Rapid Gas Decompression

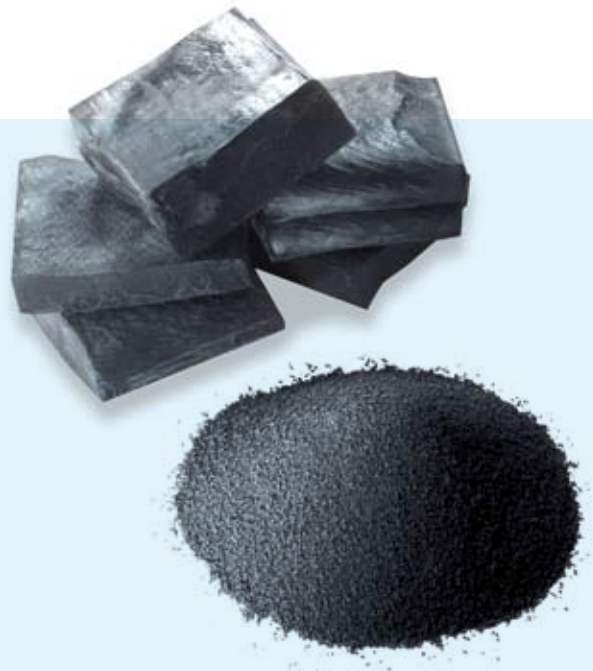


GAZGUARD™



Freudenberg Oil & Gas is the market specialist for demanding sealing applications in the oil and gas industry and unites proven application knowledge with leading sealing expertise for a need-oriented range of services at the highest level. Worldwide.

Leading Sealing Solutions for Rapid Gas Decompression



GAZGUARD™

Freudenberg Oil & Gas completely covers your requirements for reliable sealing solutions. Our knowledge of the oil and gas industry enables our customers to optimally adapt their sealing solution to the requirements for reliable, efficient and cost-effective processes. Freudenberg Oil & Gas offers a complete range of services based on the latest technologies for producers as well as system providers. Our core competence is in the development of both standardised, customer-specific and application-specific sealing materials and solutions that ensure maximum functional reliability, even under the most extreme conditions.

GAZGUARD™ – a new generation of innovate RGD compounds

Rapid gas decompression can cause severe damage to elastomer seals if these are not properly designed. This has dire consequences for operational safety and economic work.

As globally leading specialist for elastomer materials technology, Freudenberg Oil & Gas has developed GAZGUARD™ – a new, innovative generation of materials to resist rapid gas decompression reliably. GAZGUARD™ compounds are certified according to Norsok M-710 RGD and sour gas, proving their exceptional physical and chemical durability and resistance to rapid gas decompression. Our GAZGUARD™ products also offer reliable performance for a wide range of applica-

tions at high and low temperatures and with aggressive media, under extreme environmental conditions and mechanical strain: all our standard products (o-rings, spring and t-seals) are or will be tested according to ISO 10423/API 6A immersion test, fixture test and pressure temperature cycling (PR2). The existing GAZGUARD™ range with its HNBR and FKM compounds is currently being extended by a large number of other materials, such as FKM cryogenic materials, Aflas® and other RGD types.

Freudenberg Oil & Gas offer not only the GAZGUARD™ range, but also a globally leading programme of standard materials such as:

A large range of standard materials

- | | | |
|--------|------------|--------------|
| ■ NBR | ■ EPDM | ■ POM |
| ■ HNBR | ■ Silicone | ■ PA |
| ■ FKM | ■ PTFE | ■ And others |
| ■ FFKM | ■ PEEK | |

GAZGUARD™ 453702 HNBR RGD approved

General description

Synthetic, peroxide cured hydrogenated medium acrylonitrile elastomer. This high performance grade has been compounded to offer superior rapid gas decompression (RGD) resistance and is ideal for high pressure gas applications in the Oil and Gas sector.

Properties

In addition to similar resistance to conventional compounds in oils and fuels, the material has enhanced mechanical properties and abrasion resistance, excellent resistance to oxygen and ozone weathering and higher temperature capabilities. Colour: black.

Temperature capability

-25 °C (-13 °F) to +160 °C (320 °F) in air (higher temperatures possible in non oxidising media).

o-rings (AS 316) 21,59 x 5,33 squeezed with 15% nominal compression	
Minimum sealing temperature	-35 °C
N ₂ -pressure	140 +/-5 bar 150 bar pressure is applied before cooling

Initial Property		Units	Typical value
Hardness	(ISO 48)	IRHD (method V)	88
Tensile strength	(ISO 37 / ASTM D 412)	MPa Psi	36 5220
Elongation at break	(ISO 37 / ASTM D 412)	%	217
Modulus at 100% elongation	(ISO 37 / ASTM D 412)	MPa Psi	13 1885
Tear strength	(ISO 34-1)	kN/m pound/inch	48 274
TR10	(ISO 2921)	°C (°F)	-15 (5)
DSC	(DIN 53765)	°C (°F)	-23 (-11)
Gehman T70 Modulus	(ISO 1432)	°C (°F)	-28 (-18.5)
Compression set (ISO 815 / ASTM D 395)	24 h @ 150°C (302°F)	%	23
	70 h @ 150°C (302°F)	%	35

Air ageing: 72 hours @ 150 °C (302 °F)			
Change in hardness	(ISO 48)	IRHD	4
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-12
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-23
Change in volume	(ISO 1817)	%	-2

Fluid immersion testing: Oil No 1 (ASTM #1) 72 hours @ 150 °C (302 °F)			
Change in hardness	(ISO 48)	IRHD	1
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-7
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-6
Change in volume	(ISO 1817)	%	1.5

Fluid immersion testing: Oil No 3 (IRM 903) 72 hours @ 150 °C (302 °F)			
Change in hardness	(ISO 48)	IRHD	-9
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-9
Change in elongation at break	(ISO 37 / ASTM D 412)	%	1.5
Change in volume	(ISO 1817)	%	15.5

Fluid immersion testing: Simulated sea water (DIN 50905) 72 hours @ 100 °C (212 °F)			
Change in hardness	(ISO 48)	IRHD	0
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-9
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-2
Change in volume	(ISO 1817)	%	1

Fluid immersion testing: 96% Methanol + 4% Water 72 hours @ 40 °C (104 °F)			
Change in hardness	(ISO 48)	IRHD	-8
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-24
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-12
Change in volume	(ISO 1817)	%	12

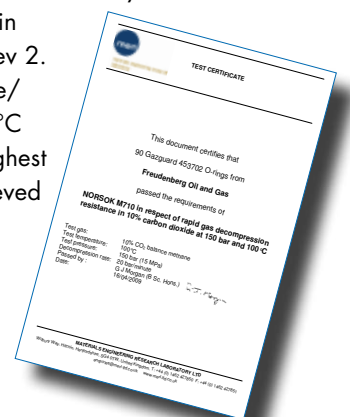
Fluid immersion testing: Transaqua HT® 168 hours @ 100 °C (212 °F)			
Change in hardness	(ISO 48)	IRHD	-2
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-7
Change in elongation at break	(ISO 37 / ASTM D 412)	%	0.5
Change in volume	(ISO 1817)	%	4

Fluid immersion testing: McDermid Oceanic® HW 443 168 hours @ 100 °C (212 °F)			
Change in hardness	(ISO 48)	IRHD	0
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-10
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-6
Change in volume	(ISO 1817)	%	2

Fluid immersion testing: McDermid Oceanic® HW 525 168 hours @ 100 °C (212 °F)			
Change in hardness	(ISO 48)	IRHD	-7
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-13
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-3
Change in volume	(ISO 1817)	%	14

Rapid Gas Decompression (RGD) validation:

The compound has been subjected to full 10 cycle RGD testing at independent test facility in accordance with Norsok M-710 rev 2. Test conditions were 90% Methane/ 10% Carbon dioxide gas at 100 °C and 150 bar test pressure. The highest possible rating of 0000 was achieved with no visible external or internal damage. A certificate is available on request.



GAZGUARD™ 453026 FKM RGD approved

General description

Peroxide cured and carbon black reinforced Fluorocarbon Terpolymer based compound and offers excellent resistance to Rapid Gas Decompression (RGD). GAZGUARD™ 453026 has been designed with outstanding mechanical properties for this polymer type.

Properties

In addition to excellent resistance to a wide range aliphatic and aromatic hydrocarbons and solvents, GAZGUARD™ 453026 offers good compression resistance and high elongation coupled with good extrusion resistance and optimised performance in high pressure gas applications. Colour: dark grey.

Temperature capability

-13 °C (+9 °F) to +210 °C (+410 °F) in air (higher temperatures possible in non oxidising media).

o-rings (AS 316) 21,59 x 5,33 squeezed with 15% nominal compression	
Minimum sealing temperature	-28 °C
N ₂ pressure	140 +/-5 bar 150 bar pressure is applied before cooling

Initial Property		Units	Typical value
Hardness	(ISO 48)	IRHD (method V)	89
Tensile strength	(ISO 37 / ASTM D 412)	MPa	18.2
		Psi	2639
Elongation at break	(ISO 37 / ASTM D 412)	%	207
Modulus at 100% elongation	(ISO 37 / ASTM D 412)	MPa	9.6
		Psi	1392
TR10	(ISO 2921)	°C (°F)	-12 (10)
DSC	(DIN 53765)	°C (°F)	-19 (-4)
Gehman T70 Modulus	(ISO 1432)	°C (°F)	-16 (3.2)
Compression set (ISO 815 / ASTM D 395)	24 h @ 200 °C (392 °F)	%	25
		70 h @ 200 °C (392 °F)	%

Air ageing: 72 hours @ 250 °C (482 °F)			
Change in hardness	(ISO 48)	IRHD	2
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-28.5
Change in elongation at break	(ISO 37 / ASTM D 412)	%	19.5

Fluid immersion testing: Fuel C (ASTM #1) 72 hours @ 23 °C (73 °F)			
Change in hardness	(ISO 48)	IRHD	0
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-15
Change in elongation at break	(ISO 37 / ASTM D 412)	%	6.5
Change in volume	(ISO 1817)	%	2

Fluid immersion testing: Oil No 3 (IRM 903) 72 hours @ 150 °C (302 °F)			
Change in hardness	(ISO 48)	IRHD	2
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-10
Change in elongation at break	(ISO 37 / ASTM D 412)	%	5
Change in volume	(ISO 1817)	%	1.5

Fluid immersion testing: Oil Nr. 1 (ASTM #1) 72 hours @ 150 °C (302 °F)			
Change in hardness	(ISO 48)	IRHD	1
Change in tensile strength	(ISO 37 / ASTM D 412)	%	1
Change in elongation at break	(ISO 37 / ASTM D 412)	%	1.5
Change in volume	(ISO 1817)	%	0

Fluid immersion testing: Water 72 hours @ 98 °C (208 °F)			
Change in hardness	(ISO 48)	IRHD	1
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-14
Change in elongation at break	(ISO 37 / ASTM D 412)	%	9
Change in volume	(ISO 1817)	%	3.5

Fluid immersion testing: 96% Methanol/4% Water 72 hours @ 40 °C (104 °F)			
Change in hardness	(ISO 48)	IRHD	-13
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-37.5
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-12.5
Change in volume	(ISO 1817)	%	8

Rapid Gas Decompression (RGD) validation:

The compound has been subjected to full 10 cycle RGD testing at independent test facility in accordance with Norsok M-710 rev 2. Test conditions were 90% Methane/10% Carbon dioxide gas at 100 °C and 150 bar test pressure. The highest possible rating of 0000 was achieved with no visible external or internal damage. A certificate is available on request.



GAZGUARD™ 453029 FKM LT RGD approved

General description

low temperature, peroxide cured FKM Tetrapolymer, carbon black reinforced. This high performance grade has been compounded to offer excellent resistance to Rapid Gas Decompression (RGD) and superior sealing performance at low temperature.

Properties

In addition to excellent resistance to a wide range aliphatic and aromatic hydrocarbons and solvents, GAZGUARD™ 453029 offers good compression resistance and high elongation coupled with good extrusion resistance and optimised performance in high pressure gas applications. Colour: black.

Temperature capability

-30 °C (-22 °F) to 200 °C (392 °F) in air
(lower temperatures possible depending on application).

o-rings (AS 316) 21,59 x 5,33 squeezed with 15% nominal compression	
Minimum sealing temperature	-42 °C
N ₂ pressure	140 +/-5 bar 150 bar pressure is applied before cooling

Initial Property		Units	Typical value
Hardness	(ISO 48)	IRHD (method N)	88
Tensile strength	(ISO 37 / ASTM D 412)	MPa	21.4
		Psi	3045
Elongation at break	(ISO 37 / ASTM D 412)	%	175
TR10	(ISO 2921)	°C (°F)	-28 (-20)
DSC	(DIN 53765)	°C (°F)	-31 (-24)
Gehman T70 Modulus	(ISO 1432)	°C (°F)	-32 (-25.6)
Compression set (ISO 815 / ASTM D 395)	24 h @ 200 °C (392 °F)	%	20
	70 h @ 200 °C (392 °F)	%	26

Air ageing: 72 hours @ 250 °C (482 °F)			
Change in hardness	(ISO 48)	IRHD	2
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-25
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-2

Fluid immersion testing: Fuel C (ASTM #1) 72 hours @ 23 °C (73 °F)			
Change in hardness	(ISO 48)	IRHD	-3
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-28.0
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-13.0
Change in volume	(ISO 1817)	%	6.0

Fluid immersion testing: Oil No 3 (IRM 903) 72 hours @ 150 °C (302 °F)			
Change in hardness	(ISO 48)	IRHD	0
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-2.5
Change in elongation at break	(ISO 37 / ASTM D 412)	%	9.0
Change in volume	(ISO 1817)	%	2.0

Fluid immersion testing: Oil Nr. 1 (ASTM #1) 72 hours @ 150 °C (302 °F)			
Change in hardness	(ISO 48)	IRHD	2
Change in tensile strength	(ISO 37 / ASTM D 412)	%	1.0
Change in elongation at break	(ISO 37 / ASTM D 412)	%	1.0
Change in volume	(ISO 1817)	%	0.5

Fluid immersion testing: Water 72 hours @ 98 °C (208 °F)			
Change in hardness	(ISO 48)	IRHD	0
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-5.5
Change in elongation at break	(ISO 37 / ASTM D 412)	%	14.0
Change in volume	(ISO 1817)	%	3.0

Fluid immersion testing: 96% Methanol/4% Water 72 hours @ 40 °C (104 °F)			
Change in hardness	(ISO 48)	IRHD	-9
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-32.5
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-11.0
Change in volume	(ISO 1817)	%	14.0

Rapid Gas Decompression (RGD) validation

The compound has been subjected to full 10 cycle RGD testing at MERL UK independent test facility in accordance with Norsok M-710 rev 2. Test conditions were 90% Methane/ 10% Carbon dioxide gas at 100 °C and 150 bar test pressure. The highest possible rating of 0000 was achieved with no visible external or internal damage. A certificate is available on request.



GAZGUARD™ 453713 HNBR LT RGD

General description

peroxide low acrylnitrile, peroxide cured HNBR elastomer, carbon black reinforced. Designed to offer the best low temperature sealing performance in oil and gas applications combined with good resistance to Rapid Gas Decompression (RGD) and superior mechanical properties alternative low temperature elastomers.

Properties

In addition to similar resistance of conventional low nitrile compounds in oils and fuels, this HNBR compound has enhanced mechanical properties and abrasion resistance, excellent resistance to oxygen and ozone weathering and higher temperature capabilities. Colour: black.

Temperature capability

-40 °C (-40 °F) to 150 °C (302 °F) in air (lower temperatures possible depending on application).

o-rings (AS 316) 21,59 x 5,33 squeezed with 15% nominal compression	
Minimum sealing temperature	-54 °C
N ₂ pressure	140 +/-5 bar 150 bar pressure is applied before cooling

Initial Property		Units	Typical value
Hardness	(ISO 48)	IRHD (method V)	86
Tensile strength	(ISO 37 / ASTM D 412)	MPa	19
		Psi	2775
Elongation at break	(ISO 37 / ASTM D 412)	%	140
Modulus at 100% elongation	(ISO 37 / ASTM D 412)	MPa	15
		Psi	2175
TR10	(ISO 2921)	°C (°F)	-36 (-33)
DSC	(DIN 53765)	°C (°F)	-44 (-49)
Gehman T70 Modulus	(ISO 1432)	°C (°F)	-49 (-56)
Compression set (ISO 815 / ASTM D 395)	24 h @ 150 °C (302 °F)	%	20
	70 h @ 150 °C (302 °F)	%	30

Air ageing: 72 hours @ 150 °C (302 °F)			
Change in hardness	(ISO 48)	IRHD	8
Change in tensile strength	(ISO 37 / ASTM D 412)	%	2
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-19.5

Fluid immersion testing: Oil No 1 (ASTM #1) 72 hours @ 150 °C (302 °F)			
Change in hardness	(ISO 48)	IRHD	2
Change in tensile strength	(ISO 37 / ASTM D 412)	%	4
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-18
Change in volume	(ISO 1817)	%	1

Fluid immersion testing: Oil No 3 (IRM 903) 72 hours @ 150 °C (302 °F)			
Change in hardness	(ISO 48)	IRHD	-22
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-19.5
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-30
Change in volume	(ISO 1817)	%	30

Fluid immersion testing: Simulated sea water (DIN 50905) 72 hours @ 100 °C (212 °F)			
Change in hardness	(ISO 48)	IRHD	2
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-1
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-1.5
Change in volume	(ISO 1817)	%	-1.5

Fluid immersion testing: 96% Methanol + 4% Water 72 hours @ 40 °C (104 °F)			
Change in hardness	(ISO 48)	IRHD	-6
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-23
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-31
Change in volume	(ISO 1817)	%	5

Fluid immersion testing: Transaqua HT® 168 hours @ 100 °C (212 °F)			
Change in hardness	(ISO 48)	IRHD	-2
Change in tensile strength	(ISO 37 / ASTM D 412)	%	2.5
Change in elongation at break	(ISO 37 / ASTM D 412)	%	13.6
Change in volume	(ISO 1817)	%	-0.5

Fluid immersion testing: McDermid Oceanic® HW 443 168 hours @ 100 °C (212 °F)			
Change in hardness	(ISO 48)	IRHD	-2
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-2.5
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-9
Change in volume	(ISO 1817)	%	-1.6

Fluid immersion testing: McDermid Oceanic® HW 525 168 hours @ 100 °C (212 °F)			
Change in hardness	(ISO 48)	IRHD	-14
Change in tensile strength	(ISO 37 / ASTM D 412)	%	-12.5
Change in elongation at break	(ISO 37 / ASTM D 412)	%	-20
Change in volume	(ISO 1817)	%	13.7

NORSOK M-710 RGD



Conditions	
Gas	10/90 mol% CO ₂ /CH ₄
Temperature	100 +/- 2 °C
Pressure	150 +5/-0 bar
Number of cycles	10
First cycle soak period	72 – 76 hours
Cycle 2 – 10 soak interval	23 – 24 hours
Decompression rate	20 bar/minute
Hold period between cycles	1 hour

NORSOK M-710 was developed specifically for the qualification of vital sealings with polymer materials and for seat and back-up materials for permanent subsea applications. Two requirements are particularly important – chemical resilience and rapid gas decompression.

M-710 offers quite a wide testing range with many conditions that can be aligned accurately with the requirements of very different application parameters and different materials.

Description

- No internal cracks, holes or blisters of any size. **0**
- Less than 4 internal cracks, each shorter than 50% of cross section with a total crack length less than the cross section. **1**
- Less than 6 internal cracks, each shorter than 50% of cross section with a total crack length less than 2.5 times the cross section. **2**
- Less than 9 internal cracks of which max. 2 cracks can have a length between 50% and 80% of the cross section. **3**
- More than 8 internal cracks or one or more cracks longer than 80% of the cross section. **4**
- Cracks going through cross section or complete separation of the seal into fragments. **5**

Rating



NORSOK M-710 Sour Test

NORSOK M710 'Non-Metallic Sealing Materials and Manufacturers Qualification' for elastomer materials.

Developed for qualification of "critical non-metallic (polymeric) sealing, seat and back-up materials for permanent subsea application", the major performance features of NORSOK M-710 are its chemical aging and rapid gas decompression (RGD) resistance.

The M-710-range is wide enough so that the right testing conditions and samples can be selected for each application. Currently, there are no known upper service temperature and pressure limits.

Our test conditions:

Material	Test temperatures	Test pressure
HNBR	140 °C (284 °F)	100 bar (1450 psi)
	160 °C (320 °F)	
	180 °C (356 °F)	
FKM	180 °C (356 °F)	100 bar (1450 psi)
	200 °C (392 °F)	
	220 °C (428 °F)	

Using the aging results, the service life of materials in sour H₂S-containing environments can be estimated as well as their suitability for application in such environments. This document will briefly outline an accelerated elastomer aging programme (sour).

According to the standard, chemical aging is to be performed at least three temperatures above the service level, so that the results can be extrapolated back to the (lower) service temperature. If applicable, the Arrhenius principle is to be used.

Replicate material samples are exposed to the aging environment as required, pursuant to the standard or other stipulation:

Standard test fluid		
Volume (%)	Composition	
30	2% H ₂ S, 3% CO ₂ , 95% CH ₄	Gas phase
10	Distilled water (conductivity < 5 µS)	Fluid phase
60	70% heptane, 20% cyclohexane, 10% toluene	

While hydrocarbon liquid is used as a substitute for average crude oil, its viscosity is far lower than that of many crude oils. This may affect the amount that elastomers can absorb. If crude oil is to be used for the tests, it will be provided by Freudenberg.

Acceptance Limits

Property changes acceptable for elastomers, as listed in the NORSOK standard:

Hardness	+10/-20 units (+5/-20 units when the initial hardness is 90 Shore A)
Swelling	+25/-5%
Tensile strength, elongation and modulus	+/-50%

Using mechanical property results, service life data can be extrapolated using the Arrhenius principles in those cases where they apply.



ISO 10423

ISO 10423 F.1.13 Immersion Test

The materials physical and mechanical properties are measured before and after it is exposed to the standard test fluid, temperature and pressure.

Under the assumption that acid fluids are involved, we used material classes DD/EE (10% H₂S, 5% CO₂, 85% CH₄ gas).

95% of container volume	60%	70% Heptane, 20% cyclohexane, 10% toluene hydrocarbon mix	Fluid phase
	40%	water	
5%		10% H ₂ S, 5% CO ₂ , 85% CH ₄	Gas phase

Test features

- Temperature: 130 °C
- Pressure: 69 bar (1000 psi)
- Exposure time: 160 hours

Material mass, volume, hardness and tensile properties deviations are measured.

Property changes acceptable for elastomers, as listed in the Norsok standard:

Hardness	+10/-20 units (+5/-20 units when the initial hardness is 90 Shore A)
Swelling	+25/-5%
Tensile strength, elongation and modulus	+/-50%
Visual inspection	The material shall show no tendency towards dissolution, cracking, blistering or physical deformation



ISO 10423 F.1.13 Fixture Test

In contrast to the immersion test, fixtures must be designed and built for this test to simulate service use. In them, the seals are pressurized and subjected to in-situ performance assessment. The same media is used as in the ISO 10423 immersion test.

A band heater is used to achieve the test temperature. Leakage measurements are performed throughout the working time of 160 hours, after which the temperature is lowered again and the pressure is relieved manually.

Pressure integrity tests are performed using gas (nitrogen) at 10,000 psi at ambient temperature over a holding time of 1 hour. Leakage is within acceptable limits if the leakage rate is below 20 cm³/hour. Pressure is relieved at 400 psi/minute.

Then, the fixture temperature is decreased, and pressure integrity tests are performed using gas (nitrogen) at 10,000 psi at ambient temperature over a holding time of 1 hour. Leakage is within acceptable limits if the leakage rate is below 20 cm³/hour. Pressure is relieved at 400 psi/minute.

ISO 10423 F.1.11 Temperature/Pressure Cycle (-18 °C to 121 °C)

The pressure/temperature cycle pursuant to ISO10423 sect. F.1.11 will be applied for two sets of seals.

Seal leakage will be documented using a leakage detector. Pursuant to ISO 13679:2002 sect 8.2.2., acceptable leakage rates are at 3.6 ml/hour if the rate does not increase during stabilisation. There must not be any detectable leakage during the holding period.

Test temperature range	-18 °C to +121 °C
Test gas	nitrogen

Pressure tests are performed over 8 pressure cycles of up to 10,000 psi. Heating/cooling tests are performed over 6 cycles of raising the temperature to 121 °C and lowering it to -18 °C.

GAZGUARD™ Sealing solutions



GAZGUARD™ RGD compounds are the best choice for many elastomer sealing solutions in the Oil & Gas-Industry. Our O-Rings, T-Seals, Spring Seals or FS-Seals show extraordinary reliability and functional safety where sophisticated solutions for protection from explosive decompression are required.

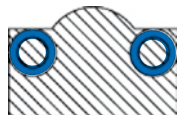
O-Rings

Freudenberg Oil & Gas offer certified quality sealings for static and dynamic applications in many different materials. Our products are characterised by great pressure and temperature stabilities. They are available in many different designs and AS 568B standard dimensions.



Spring-Seal

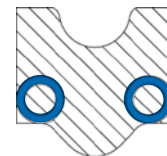
Freudenberg Oil & Gas Spring Seals are mostly used in stab and static applications with high cyclic pressure and temperature peaks of up to 10,000 psi and 210 °C (410 °F). Traditional sealing solutions cannot provide adequate safety here. The integrated spiral spring ensures high pressure resilience and a tight seat in the installation space. Fitted in original o-ring grooves with back up rings. Used for many oil and gas applications like wellheads, down-hole and surface equipment. Supplied in sizes for AS 568B standard o-ring housing. Custom sizes are also available.



FS-Seal

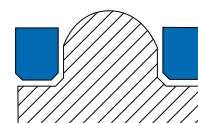
The FS-Seal is designed as a casing head seal and particularly suitable for installation situations with large tolerances and rougher surfaces. Its special design enables bridging larger

extrusion gaps. The internal seal bulge provides higher sealing contact stresses, while the curved recess on the back controls the amount of compression on the seal element. Available in sizes for API 5 CT casings.



T-Seal

T-Seal combines an elastomer T-shaped component with two back up rings. T-Seal has been designed for effectively sealing applications subjected to extreme pressure and temperature, oilfield media, rough mechanical conditions and extrusion clearances and it is an excellent solution for dynamic duties and piston- and rod-applications. Supplied in sizes for AS 568B standard o-ring housing. Custom sizes are also available.



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