

ECONOMOS

Oil and Gas industry

ED resistant materials
for extreme conditions



Introduction

SKF Economos is a global leader in providing customized sealing solutions and engineered plastics. Due to our expertise in material development and our sealing know-how, we are a respected and reliable partner of the oil industry. As a global group with over 28 subsidiary companies, we have sealing technology where it matters, from Aberdeen to Asia we are only a phone call away. As the inventors of the machined seal concept, we have taken it to new heights, whether you are an OEM or repair/refurbish oil field equipment you can rely on SKF Economos to provide quality seals and components quickly without the costs and time delays of conventional moulding tools.

There is no other industry that is challenging sealing technology in the way the oil industry does. A broad range of requirements has to be met and it is the combination of them that demands specialized high quality products.

- A wide range of more or less aggressive fluids and gases need to be controlled. Sealing materials have to be compatible with e.g. drilling and completion fluids, acids, corrosion inhibitors and sour gas.
- Selected seals may have to meet the requirements of being able to hold pressures from zero to over 1724 bar (25 000 PSI) working pressure and the lifetime requirement of the seal is in the range of years.
- A broad span of temperatures has to be covered. Typical temperatures are between -20 to $+180$ °C (-4 to $+356$ °F). However, these can easily be extended (in both directions) for special applications (-45 to $+220$ °C, -50 to $+428$ °F).
- Sealing integrity is not only mandatory because of economic reasons. Equipment failure can cause tremendous harm to the environment and human life.

We understand these issues and, as a supplier of high quality, high reliability products to the industry, we provide our wealth of field experience and fundamental knowledge in sealing technology to support our customers' operations and to reduce NPT and extend the life of your equipment.

SKF Economos is able to provide industry standard sealing and engineering plastic solutions to our customers and have the capability of shipping single pieces, small and large quantities all on an in-time basis.

Our engineers also have the competence and experience to create custom-made products. We can engineer solutions to overcome the most complex problems utilising in-house material technology, Finite Element Analysis and rig testing along with our many years of expertise in the industry.

Materials in respect to Explosive Decompression (ED)

When elastomers are exposed to high gas pressures for a certain period of time and if this pressure is released quickly, internal cracks and/or blisters may occur.



This phenomena is known as Explosive Decompression (ED). Cracks and blisters may be evident on the surface of the seal, they may be internal, or they may only be detected by magnification.

Such ED is influenced by permeability characteristics, possibility of local defects and their elastic growth to a certain critical point (modulus dependent) and crack growth above this point (dependent on tearing energy). As a supplier of high quality products to the Oil and Gas industry, SKF Economos undertakes comprehensive testing of its materials in respect to ED.

Some test results of the following materials are reported in this document. These tests were carried out at SKF Economos GmbH in accordance with well known test standards for ED tests for elastomeric materials for the Oil and Gas industry.



Oil and Gas industry



X-mas tree



Flangeseal, H-Ecopur

Test results

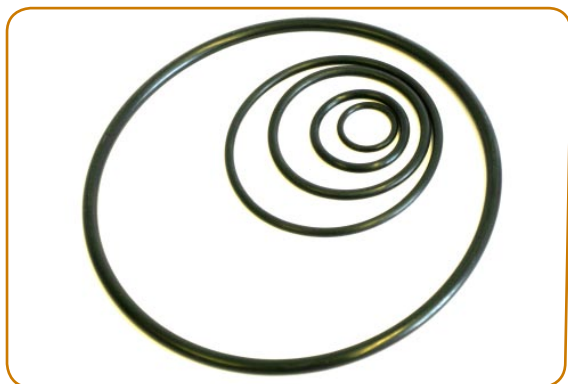
International test standards	H-Ecopur	SKF Ecorubber-H-85A-b-ED	SKF Ecorubber 2	SKF Ecoflas 85A-b-ED
Test properties				
NACE TM 0192-2003				
Rating (internal and external)	1*	1*	1*	1*
Change of cross sectional diameter	0%	0%	0%	0%
Change of durometer hardness Shore A	0%	0%	0%	0%
NACE TM 0297-2002				
Rating (internal and external)	1*	1*	1*	1*
Change of cross sectional diameter	0%	14,1%	2%	0,7%
Change of durometer hardness Shore A	+2%	-1%	-7%	+1%
Change of tensile strength σ	-29%	-28,5%	-17%	+25,7%
Change of elongation at break ϵ	+7%	-37%	-13%	+15,7%
Change of modulus at 100% elongation	-25%	-38%	-33,1%	-10%
NORSOK M-710 rev. 2				
Rating, 150 bar, 0% compression (examination of 4 cut sections)	0000*	2111*	1000*	0000*
Rating, 150 bar 20% compression (examination of 4 cut sections)	0000*	1110*	1110*	1000*
Rating, 300 bar, 20% compression (examination of 4 cut sections)	0000*	2221*	3111*	1110*

* visual rating system see Annex 1

Annex 1

- 1) Visual rating system according to NACE TM

Rating	Description of damage
1	No visible damage
2	Minimal damage confined to the surface (few blisters and cracks)
3	External and internal damage (many blisters and cracks)
4	Extensive damage, fragmentation



SKF Economos O-rings

Annex 1

- 2) Visual rating system according to NORSOK

Test specimen should be cut four times at 90°. Each cut section should be examined according to the rating below. The four ratings for each cut section will be combined to a four digit number, representing the performance of the material.

Rating	Description of damage
0	No internal cracks, holes or blisters of any size.
1	Less than 4 internal cracks, each shorter than 50% of the cross section, with a total crack length less than the cross section.
2	Less than 6 internal cracks, each shorter than 50% of the cross section, with a total crack length of less than 2,5 times of the cross section.
3	Less than 9 internal cracks, of which max. 2 cracks may have a length between 50% and 80% of the cross section.
4*)	More than 8 internal cracks, one or more cracks longer than 80% of the cross section.
5*)	Crack(s) extending across the whole section or complete separation of the seal into fragments.

*) Seals with rating 4 or 5 are not acceptable

Test procedure

1) NACE TM 0192-2003

Tests have been performed on uncompressed (free-state) test specimens.

Test parameters

Test specimen: O-ring 37,47 × 5,33 mm (BS 325)
Medium: 100% CO₂
Temperature: 25 °C
Pressure: 52 bar (750 PSI)
Exposure time: 24 hrs
Pressure release rate: < 1 min

2) NACE TM 0297-2002

Tests have been performed on uncompressed (free-state) test specimens.

Test parameters

Test specimen: O-ring 37,47 × 5,33 mm (BS 325)
Medium: 100% CO₂
Temperature: 100 °C
Pressure: 69 bar (1000 PSI)
Exposure time: 24 hrs
Decompression rate: 69 bar/min (1000 PSI/min)

3) NORSOK M-710 rev.2

Tests have been performed with (20%) and without compression of the test specimen.

Test parameters

Test specimen: O-ring 37,47 × 5,33 mm (BS 325)
Medium: 10% CO₂ and 90% CH₄
Temperature: 100 °C
Pressure: 150 bar (2175 PSI) or doubled pressure 300 bar (4350 PSI)
Initial exposure time: 72 hrs
Decompression rate: 30 bar/min
Number of repeated cycles: 10

Tests have been performed according to the following standards:

1 NACE Standard

TM 0192-2003
evaluating elastomeric materials in carbon dioxide decompression environments

TM 0297-2002

effects of high temperature, high pressure carbon dioxide decompression on elastomeric materials

2 NORSOK Standard M-710 rev.2

qualification of non-metallic sealing materials and manufactures;
Annex B
test media, conditions, equipment and procedures for rapid gas decompression testing of elastomeric materials

Evaluation of the tests has been performed as visual inspection with a rating according to the respective standards. The respective rating systems can be found in Annex 1 to this document.



Testing equipment, R & D

Oil and Gas industry

Being totally committed to customer service and support, SKF Economos offers a unique service package to the Oil and Gas industry. Our global presence can be found in more than 28 countries around the world. SKF Economos provides a comprehensive network of local manufacturing facilities which offer:

- Fast response times
- Machined seals
- Moulded seals
- Customized sealing solutions
- Standard sealing solutions
- Technical advice and support (material/profile selection)
- Latest material technology
- Any type of gasket (RTJ, Spiral wound, flat...)
- Full service capability

The Oil and Gas competence centres were founded to meet the specific requirements of the Oil and Gas industry, which has an extremely challenging sealing technology and is unlike any other industry. It comprises of strategically located branches around the world, which are fully dedicated to Oil and Gas.

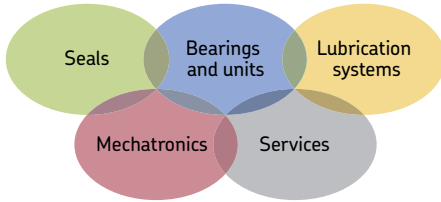
Any centre location, offers a full range of sealing products. This includes special and standard sealing solutions, for example wellheads & trees, downhole tools, connectors, pipeline valves and actuators - in fact, almost any sealing application. All of them are equipped with state-of-the-art CNC seal production centres (the SKF Economos Seal-Jet system) which guarantees quick turn around.

Additionally, any type of standard gasket, RTJ, flat, spiral wound, etc. can be supplied along with other flat seals manufactured in our water cutting unit (the SKF Economos Water-Jet system) as well as custom made engineered plastic parts, made of high performance materials which meet all industry requirements.

We offer advice at any stage of a project regarding material and profile selection, often saving time, money and vital engineering resources. If required, we provide Finite Element Analysis information for your application and have an extensive engineering department within the group, offering full technical support for any application.



Mother Nature has kept hydrocarbons safely sealed. SKF Economos does the same!



The Power of Knowledge Engineering

Drawing on five areas of competence and application-specific expertise amassed over more than 100 years, SKF brings innovative solutions to OEMs and production facilities in every major industry worldwide. These five competence areas include bearings and units, seals, lubrication systems, mechatronics (combining mechanics and electronics into intelligent systems), and a wide range of services, from 3-D computer modelling to advanced condition monitoring and reliability and asset management systems. A global presence provides SKF customers uniform quality standards and worldwide product availability.

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