



Oil & Gas Industry
Survey







Introduction

Sealing Technology in the field of Oil & Gas Industry

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 20 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 oilfield equipment you can rely on 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 25.000 p.s.i. 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 -50 °F (-46 °C) and 365 °F (180 °C). However, these can easily be extended (in both directions) for special applications.
- 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.

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 a just-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 of problems utilising in-house material technology, Finite Element Analysis and rig testing along with our many years of expertise in the industry.

Mother Nature has kept hydrocarbons safely sealed. ECONOMOS® does the same.

ew Materials

Compliant Oil & Gas sealing materials

The correct selection of a sealing material for a specific application is one of the key factors in regard to safe and efficient operation. One of the difficulties is the variety of fluids that need to be controlled in the oil industry such as aromatic and naphthenic hydrocarbons, corrosion inhibitors, acids, drilling and completion fluids, brines, carbon dioxide and hydrogen sulfide.

The combination of these fluids with high pressure and high temperature only allow materials of highest quality and integrity to be used.

A variety of polymers are used in the oil and gas industry. Basically, they can be separated into four groups:

1. Elastomers
2. Thermoplastic elastomers
3. PTFE and its compounds
4. Thermoplastics

To date elastomers are probably the most frequently used materials for oilfield applications. Different types of elastomers are available. For most of the applications NBR (nitrile rubber) or HNBR (hydrogenated nitrile rubber) are selected. Higher chemical resistance can be provided by fluorinated elastomers (FKM/FPM, TFE/P, FFKM) whereby the chemical resistance increases with increased Fluorine content.

In some applications elastomers alone do not provide sufficient sealing capabilities. In these cases other high quality materials such as PTFE or even PEEK need to be selected either in combination with elastomers for anti extrusion purposes or even as a sealing material itself.

However, ECONOMOS® has developed high quality thermoplastic elastomers and is able to provide oilfield compatible Polyurethanes. Although limited in high temperature applications, specialist polyurethane grades offer vastly superior abrasion and extrusion resistance combined with high compatibility to oilfield fluids, including sour gas.

In addition to oilfield polymers, for some applications spring loaded seals are used and the spring material also has to meet special requirements. ECONOMOS® provides only spring material in accordance to NACE MR-0175 when used in sour environments.

All the materials listed have been designed and developed by ECONOMOS® in our R & D laboratories and in conjunction with renowned universities. The Rubber materials are compounded to our exacting formulae by respected quality approved companies. The thermoplastic materials are manufactured in-house by our own chemists, and the PTFE materials are compounded by our group subsidiary SODEPI in France.

Compliant materials for Oil & Gas Industry

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Rubber materials
Key mechanical properties
and media resistances
are shown on
pages 16 and 17



O-Rings made of ECORUBBER 2-90A-b

ECORUBBER 1	(NBR, 85 shore A)
Colour	black
Properties	Standard grade, good chemical resistance
ECORUBBER 1-85A-b-LT	(NBR, 85 shore A)
Colour	black
Properties	Low temperature grade, outstanding cold flexibility
H-ECORUBBER	(HNBR, 85 shore A)
Colour	black
Properties	Standard grade with good mechanical & chemical properties
H-ECORUBBER-85A-b-LT	(HNBR; 85 shore A)
Colour	black
Properties	Low temperature HNBR
H-ECORUBBER-93A-b	(HNBR, 93 shore A)
Colour	black
Properties	High pressure resistant grade
H-ECORUBBER-85A-b-ED	(HNBR, 85 shore A)
Colour	black
Properties	Explosive decompression resistant grade
H-ECORUBBER-85A-b-ED/LT	(HNBR, 85 shore A)
Colour	black
Properties	Explosive decompression resistant low temperature grade
ECORUBBER 2	(FKM, FPM, 85 shore A)
Colour	brown
Properties	Standard grade with good chemical resistance
ECORUBBER 2-75A-b-C	(FKM, FPM, 75 shore A)
Colour	black
Properties	Softer grade, good wear characteristics
ECORUBBER 2-75A-b-perox	(FKM, FPM, 75 shore A)
Colour	black
Properties	High chemical and heat resistance
ECORUBBER 2-80A-b	(FKM, FPM, 80 shore A)
Colour	black
Properties	Large diameter grade
ECORUBBER 2-90A-b	(FKM, FPM, 90 shore A)
Colour	black
Properties	High pressure and extrusion resistance

OVERVIEW

Compliant materials for Oil & Gas Industry

Material overview

Rubber materials
Key mechanical properties
and media resistances
are shown on
pages 16 and 17



Spring seal made of Viton Extreme



O-Rings made of Ecorubber 3 and Fluorosilicone

ECORUBBER 2-95A-b (FKM, FPM, 95 shore A)

Colour black

Properties Very hard grade for special applications

ECORUBBER 2-85A-b-ED (FKM, FPM, 85 shore A)

Colour black

Properties Explosive decompression resistant grade with outstanding mechanical characteristics

VITON EXTREME (FKM, FPM, 88 Shore A)

Colour black

Properties outstanding chemical resistance

ECOFLAS-80A-b (TFE/P, 80 shore A)

Colour black

Properties Outstanding resistance to steam, corrosion inhibitors, glycol, sour gas

ECOPERFLUORO (FFKM, 73 Shore A)

Colour black

Properties Best chemical and temperature resistance

ECORUBBER-3 (EPDM, 85 shore A)

Colour black

Properties Standard grade with good mechanical properties, recommended for steam injection

ECORUBBER 3-93A-b (EPDM, 93 shore A)

Colour black

Properties High pressure resistant grade

FLUROSILICONE 83A-rb (MFQ, 83 shore A)

Colour reddish brown

Properties Outstanding chemical resistance

Compliant materials for Oil & Gas Industry

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Thermoplastic elastomers
Key mechanical properties
and media resistances
are shown on
page 19

ECOPUR® Colour properties	(TPU/TPE-U, 95 shore A) green Good chemical resistance, recommended for hydraulic applications (e.g. actuators)
H-ECOPUR® Colour properties	(TPU/TPE-U, 95 shore A) red Outstanding chemical resistance, H ₂ S resistant
S-ECOPUR® Colour properties	(TPU/TPE-U, 95 shore A) charcoal grey Outstanding sliding behaviour, similar mechanical & chemical properties as H-ECOPUR®
T-ECOPUR® Colour properties	(TPU/TPE-U, 95 shore A) blue Low temperature grade, excellent cold flexibility, limited chemical resistance
X-ECOPUR®-57D Colour properties	(TPU, 57 shore-D) dark-green Increased pressure & extrusion resistance, recommended for composite seals, chemical resistance similar to ECOPUR®
XH-ECOPUR®-60D Colour properties	(TPU, 60 shore-D) dark-red Increased pressure & extrusion resistance, recommended for composite seals, chemical resistance similar to H-ECOPUR®
XS-ECOPUR®-57D Colour properties	(TPU, 57 shore-D) charcoal-grey Increased pressure & extrusion resistance, recommended for composite seals, chemical resistance similar to S-ECOPUR®



ECO-Flange seals made of H-ECOPUR®

OVERVIEW

Compliant materials for Oil & Gas Industry

Material overview

PTFE and its compounds
Key mechanical properties
and media resistances
are shown on
page 18

ECOFLON 1
Colour
properties

(PTFE, virgin)
white
High chemical resistance

ECOFLON 2
Colour
properties

(PTFE, 15 % glass, 5 % MoS₂)
charcoal-grey
Good mechanical characteristics

ECOFLON 3
Colour
properties

(PTFE, 40 % bronze)
bronze
Good tribological properties, high pressure resistance

ECOFLON 4
Colour
properties

(PTFE, 25 % carbon)
black
high wear & pressure resistance

ECOFLON 5
Colour
properties

(PTFE, modified)
white
Unfilled, modified, increased pressure and creep resistance

In addition ECONOMOS® is offering a wide range of organic and inorganic compounds such as PTFE + glass, PTFE + graphite (steam injection), PTFE + EKONOL, PTFE + PI, PTFE + PEEK, etc..

For any further assistance please contact your local ECONOMOS® office.



Stem packing made of ECORUBBER and ECOFLON 1



material overview

Thermoplastics
Key mechanical properties
and media resistances
are shown on
page 18

ECOMID	(PA)
Colour	natural, green, grey, reddish brown, black (depending on variety)
Properties	Good mechanical properties, glass filled grades for increased pressures available, Not to be used in water or moist environments
ECOTAL	(POM)
Colour	natural (white) / black
Properties	Good mechanical characteristics; glass filled grades for increased pressures available
ECOPPS	(PPS)
Colour	brown, dark blue (depending on variety)
Properties	Outstanding hardness and modulus, high chemical and thermal resistance
ECOPAEK	(PEEK)
Colour	cream, black (depending on variety)
Properties	Exceptional mechanical, chemical & thermal resistance, glass and carbon filled grades for high pressure applications

ECONOMOS® offers a wide range of specialist thermoplastic materials for guide rings, back-up rings, etc.

For any further assistance please contact your local ECONOMOS® office.



Chevron packing made of ECOTAL and H-ECOPUR®



ECONOMOS
special material
H-ECOPUR®

One of the most critical substances that the oil industry has to deal with is hydrogen sulfide, H₂S, commonly called sour gas. Basically all materials in the oilfield are classified either sour gas resistant or not.

H-ECOPUR®, a sour gas resistant Polyurethane developed by ECONOMOS®, is one of our most outstanding materials and is replacing more and more standard materials in the oil industry.

The sour gas compatibility of H-ECOPUR® (compared to hydrogenated nitrile rubbers and fluorocarbon rubbers) has been extensively tested at an independent laboratory. The test requirements have been selected in accordance to NORSOK M-710, indeed some of the requirements have been exceeded. Tests have been performed in two different media at elevated pressure and temperature and the immersion period has been six weeks (1000 h).

Summarizing the test results it can be said that, after being exposed to sour gas for six weeks, H-ECOPUR® shows:

- no change in hardness
- 75 % less volume change than commonly used oilfield elastomers
- superior retention of tensile properties compared to standard materials

Because of the combination of its excellent resistance against sour gas environments and its superior mechanical properties (e.g. high wear resistance, high extrusion resistance) H-ECOPUR® is excellently suited to replace other commonly used sealing materials, this has been proven in many different applications already.

A detailed technical paper is available upon request.



Properties

Properties	Test Method	Unit	H-ECORUBBER types					ECORUBBER 3	ECORUBBER 3	ECORUBBER 1
			Standard	85A-b-LT	93A-b	85A-b-ED	85A-b-ED/LT	93A-b	93A-b	NBR
			H-NBR Standard grade	H-NBR Low temp. grade	H-NBR Hard grade	H-NBR ED grade	H-NBR ED+low temp. grade	EPDM Standard grade	EPDM Hard grade	Standard grade
Colour	-	-	black	black	black	black	black	black	black	
Density	53479	g/cm ³	1,22	1,21	1,23	1,38	1,39	1,22	1,17	1,31
Thermal Properties										
Glass transition temperature (1)	-	°C	-27	-38	-19	-31	-31	-47	-46	-23
Max. service temperature	-	°C	150	150	150	150	150	150	150	100
Min. service temperature	-	°C	-25	-40	-20	-30	-30	-50	-50	-30
Mechanical Properties										
Tensile test (2)										
- tensile strength (3)	53504	MPa	18	20	25	20	15	12	15	16
- elongation at break (3)	53504	%	180	210	120	240	240	110	110	130
- 100% modulus (3)	53504	MPa	10	9	20	12	10	9	13	11
Compression set (4)										
- after 22h at 100°C	53517	%	22	25	15	17	21	15	13	15
- after 22h at 175°C	53517	%	-	-	-	-	-	-	-	-
Tear strength	53515	N/mm	30	15	25	30	25	15	19	20
Abrasion	53516	mm ³	90	95	110	110	135	120	95	90
Durometer hardness Shore A (5)	53505	-	85	85	93	85	85	85	93	85
Durometer hardness Shore D (5)	53505	-	33	30	48	41	35	34	41	36
Chem. & Environm. Resistance (6)										
Acids										
- inorganic diluted			0	0	0	0	0	+	+	0
- inorganic concentrated			-	-	-	-	-	+	+	-
- organic diluted			+	+	+	+	+	+	+	+
- organic concentrated			-	-	-	-	-	+	+	-
Alkalies - general			0	0	0	0	0	+	+	0
Alcohols - general (exc. Methanol)			+	+	+	+	+	+	+	+
Biocides										
- diluted			+	0	+	0	0	+	+	+
- concentrated			-	-	-	-	-	-	-	-
Brines - general			0	0	0	0	0	+	+	0
Carbon dioxide			+	+	+	+	+	0	0	+
Corrosion inhibitors										
- amine based			+	0	+	0	0	+	+	-
- potassium based			0	0	0	0	0	+	+	-
Crude oil										
- sweet			+	+	+	+	+	-	-	+
- sour; up to 5% H2S			0	0	0	0	0	-	-	-
- sour; above 5% H2S			-	-	-	-	-	-	-	-
Drilling mud										
- diesel based			+	+	+	+	+	-	-	0
- ester based			-	-	-	-	-	-	-	-
- mineral oil based			+	+	+	+	+	-	-	+
- silicate based			+	+	+	+	+	0	0	0
Glycols - general			+	0	+	0	0	+	+	+
Hydraulic fluids										
- mineral oil based			+	+	+	+	+	-	-	+
- HFA (water - oil emulsion)			+	+	+	+	+	-	-	+
- HFB (oil - water emulsion)			+	+	+	+	+	-	-	0
- HFC (water - glycol)			+	+	+	+	+	+	+	+
- HFD (water free)										
HFD-R			-	-	-	-	-	+	+	-
HFD-S			-	-	-	-	-	-	-	-
HFD-U			0	0	0	0	0	-	-	0
Hydrocarbons										
- aliphatic			+	+	+	+	+	-	-	+
- aromatic			0	-	0	-	-	-	-	0
Hydrogen sulphide			+	0	+	0	0	+	+	-
Methanol										
- diluted			+	+	+	+	+	+	+	+
- concentrated			+	0	+	0	0	0	0	0
Natural gas			+	+	+	+	+	-	-	+
Sea water			+	+	+	+	+	+	+	+
Solvents										
- Toluene			-	-	-	-	-	-	-	-
- Acetone			-	-	-	-	-	+	+	-
- MEK			-	-	-	-	-	+	+	-
Steam										
- general			-	-	-	-	-	+	+	-
Water										
- general			+	+	+	+	+	+	+	+
- produced			+	+	+	+	+	+	+	0
- treated			+	+	+	+	+	+	+	0

See the legend at page 30

ECONOMOS Thermoplastics

Properties	Test Method ISO / EC	Unit	ECOFLON 1	ECOFLON 2	ECOFLON 3	ECOFLON 4	ECOFLON 5	ECOMID PA 6 G	ECOTAL POM - C	ECOPPS PPS	ECOPAEEK PEEK
			PTFE	PTFE + 15% glass fibre+ 5% MoS2	PTFE + 40% Bronze	PTFE + 25% Carbon	PTFE modified				
Colour	-	-	white	dark grey	bronze	black	white	black	natural /black	beige	grey
Density	1183	g/cm ³	2,17	2,25	3,0	2,1	2,16	1,15	1,41	1,35	1,32
Thermal Properties											
Melting temperature	-	°C	327	327	327	327	327	220	165	280	340
Glass transition temperature (1)	-	°C	-	-	-	-	-	-	-	-	-
Max. allowable service temp. in air:											
- for short periods (2)	-	°C	300	300	300	300	300	170	140	260	310
- continuously for 5.000 / 20.000 h (3)	-	°C	- / 260	- / 260	- / 260	- / 260	- / 260	105 / 90	115 / 100	- / 220	- / 250
Min. service temperature (4)	-	°C	-200	-200	-200	-200	-200	-30	-50	-	-60
Mechanical Properties											
Tensile test (5)											
- tensile stress at yield / at break (6) +	527	MPa	- / 27	- / 18	- / 22	- / 15	- / 30	85 / -	68 / -	95 / -	110 / -
++	527	MPa	- / 27	- / 18	- / 22	- / 15	- / 30	65 / -	68 / -	95 / -	110 / -
- tensile strain at break (6) +	527	%	300	200	280	180	360	25	35	15	20
++	527	%	300	200	280	180	360	> 50	35	15	20
- tensile mod. of elasticity (7) +	527	MPa	400 - 700	-	-	-	-	3.500	3.100	3.450	4.400
++	527	MPa	400 - 700	-	-	-	-	1.800	3.100	3.450	4.400
Compression test (8)											
- compr. stress at 1 / 2 / 5 % nominal strain (8)	604	MPa	- / 8 / -	- / 14 / -	-	-	-	26 / 51 / 92	19 / 35 / 67	-	29 / 57 / -
Shore hardness D (3 / 15 s)	868	-	57 / -	60 / -	64 / -	65 / -	59 / -	-	-	-	-
Chem. & Environm. Resistance (9)											
Acids											
- inorganic diluted			+	+	+	+	+	0	0	+	+
- inorganic concentrated			+	-	0	-	-	-	-	0	-
- organic diluted			+	+	+	+	+	0	0	+	+
- organic concentrated			+	+	+	+	+	0	0	+	+
Alkalies - general			+	0	0	0	0	0	0	+	+
Alcohols - general (excl. Methanol)			+	+	+	+	+	+	+	0	0
Biocides											
- diluted			+	+	+	+	+	+	+	+	+
- concentrated			+	+	+	+	+	-	0	+	+
Brines - general			+	+	+	+	+	0	+	+	+
Carbon dioxide			+	+	+	+	+	+	+	+	+
Corrosion inhibitors											
- amine based			+	+	+	+	+	+	+	+	+
- potassium based			+	+	+	+	+	0	+	+	+
Crude oil											
- sweet			+	+	+	+	+	+	+	+	+
- sour; up to 5% H2S			+	+	+	+	+	+	+	+	+
- sour; above 5% H2S			+	0	+	0	0	0	+	+	+
Drilling mud											
- diesel based			+	+	+	+	+	+	+	+	+
- ester based			+	+	+	+	+	+	+	+	+
- mineral oil based			+	+	+	+	+	+	+	+	+
- silicate based			+	+	+	+	+	+	+	+	+
Glycols- general			0	0	0	0	0	0	+	+	+
Hydraulic fluids											
- mineral oil based			+	+	+	+	+	+	+	+	+
- HFA (water - oil emulsion)			+	+	+	+	+	+	+	+	+
- HFB (oil - water emulsion)			+	+	+	+	+	+	+	+	+
- HFC (water - glycol)			+	+	+	+	+	0	+	+	+
- HFD (water free)											
HFD-R			+	+	+	+	+	+	+	+	+
HFD-S			+	+	+	+	+	+	+	+	+
HFD-U			+	+	+	+	+	+	+	+	+
Hydrocarbons											
- aliphatic			+	+	+	+	+	+	+	+	+
- aromatic			+	+	+	+	+	+	+	+	+
Hydrogen sulphide			+	0	+	+	0	-	+	+	+
Methanol											
- diluted			+	+	+	+	+	+	+	+	+
- concentrated			+	+	+	+	+	-	+	0	+
Natural gas			+	+	+	+	+	+	+	+	+
Sea water			+	+	+	+	+	+	+	+	+
Solvents											
- Toluene			+	0	+	+	+	+	+	-	+
- Acetone			+	+	+	+	+	+	+	+	+
- MEK			+	+	+	+	+	+	0	0	+
Steam			+	+	+	+	+	-	-	+	+
Water											
- general			+	+	+	+	+	0	+	+	+
- produced			+	+	+	+	+	0	+	+	+
- treated			+	+	+	+	+	0	0	+	+

ECONOMOS Thermoplastic Elastomers

Properties	Test Method	Unit	ECOPUR*	H-ECOPUR*	S-ECOPUR*	T-ECOPUR*	G-ECOPUR*	X-ECOPUR*	XH-ECOPUR*	XS-ECOPUR*
			TPU	TPU	TPU	TPU	TPU	-57D TPU	-60D TPU	-57D TPU
Colour	-	-	green	red	antracithe	blue	red	dark green	dark red	dark grey
Density	53479	g/cm ³	1,2	1,2	1,24	1,17	1,2	1,21	1,22	1,26
Thermal Properties										
Glass transition temperature (1)	-	°C	-	-	-	-	-	-	-	-
Max. service temperature	-	°C	110	110	110	110	110	110	110	110
Min. service temperature	-	°C	-30	-20	-20	-50	-30	-30	-20	-20
Mechanical Properties										
Tensile test (2)										
- tensile strength (3)	53504	MPa	40	50	50	50	45	50	53	45
- elongation at break (3)	53504	%	430	330	380	450	280	380	350	350
- 100% modulus (3)	53504	MPa	12	13	17	12	11	18	20	24
Compression set (4)										
- after 24h at 70°C / 20% deformation	-	%	30	27	25	-	30	27	26	24
- after 24h at 100°C / 20% deformation	-	%	35	33	30	-	40	33	30	30
- after 70h at 70°C / 20% deformation	-	%	20	20	-	20	20	-	-	-
Tear strength	53515	N/mm	100	100	120	80	40	120	140	160
Abrasion	53516	mm ³	18	17	17	15	25	20	20	20
Durometer hardness Shore A (5)	53505	-	95	95	95	95	95	97	97	96
Durometer hardness Shore D (5)	53505	-	48	48	48	48	47	57	60	57
Chem. & Environm. Resistance (6)										
Acids										
- inorganic diluted			-	+	+	-	0	-	+	+
- inorganic concentrated			-	-	-	-	-	-	-	-
- organic diluted			0	+	+	0	0	0	+	+
- organic concentrated			-	0	0	-	0	-	0	0
Alkalies - general			-	0	0	-	0	-	0	0
Alcohols - general (except Methanol)			-	+	+	-	0	-	+	+
Biocides										
- diluted			0	+	+	0	+	0	+	+
- concentrated			-	-	-	-	-	-	-	-
Brines - general			0	+	+	0	+	0	+	+
Carbon dioxide			0	+	+	0	+	0	+	+
Corrosion inhibitors										
- amine based			-	0	0	-	0	-	0	0
- potassium based			0	+	+	0	+	0	+	+
Crude oil										
- sweet			+	+	+	+	+	+	+	+
- sour; up to 5% H2S			0	+	+	0	+	0	+	+
- sour; above 5% H2S			-	+	0	-	-	-	+	0
Drilling mud										
- diesel based			0	+	+	0	0	0	+	+
- ester based			-	0	0	-	0	-	0	0
- mineral oil based			+	+	+	+	+	+	+	+
- silicate based			0	+	+	0	+	0	+	+
Glycols- general			-	0	0	-	0	-	0	0
Hydraulic fluids										
- mineral oil based			+	+	+	+	+	+	+	+
- HFA (water - oil emulsion)			-	+	+	-	0	-	+	+
- HFB (oil - water emulsion)			-	+	+	-	0	-	+	+
- HFC (water - glycol)			-	0	0	-	0	-	0	0
- HFD (water free)										
HFD-R			-	-	-	-	-	-	-	-
HFD-S			-	-	-	-	-	-	-	-
HFD-U			0	+	+	0	+	0	+	+
Hydrocarbons										
- aliphatic			+	+	+	+	+	+	+	+
- aromatic			-	-	-	-	-	-	-	-
Hydrogen sulphide			-	+	+	-	+	-	+	+
Methanol										
- diluted			0	+	+	0	-	0	+	+
- concentrated			-	-	-	-	-	-	-	-
Natural gas			0	+	+	0	+	0	+	+
Sea water			-	+	+	-	0	-	+	+
Solvents										
- Toluene			-	-	-	-	-	-	-	-
- Acetone			-	-	-	-	-	-	-	-
- MEK			-	-	-	-	-	-	-	-
Steam			-	-	-	-	-	-	-	-
Water										
- general			-	+	+	-	0	-	+	+
- produced			-	+	+	-	0	-	+	+
- treated			-	0	0	-	0	-	0	0



Standard S01-P seal, H-ECOPUR®



S35-P made of H-ECOPUR®



Special seal, ECOFLON 2



Flange seal, H-ECOPUR®



K20-R made of H-ECORUBBER



Special K02 seal made of H-ECOPUR®

Special applications for the oil & gas industry

ECONOMOS® produces a large variety of seals and seal kits for equipment and tools in the oil and gas industry. The requirements are not only for standard seals but also for special applications and, of course, all produced in dedicated oil and gas media resistant materials.



Roller cone bit



Mud pump



Xmas tree

Typical applications:

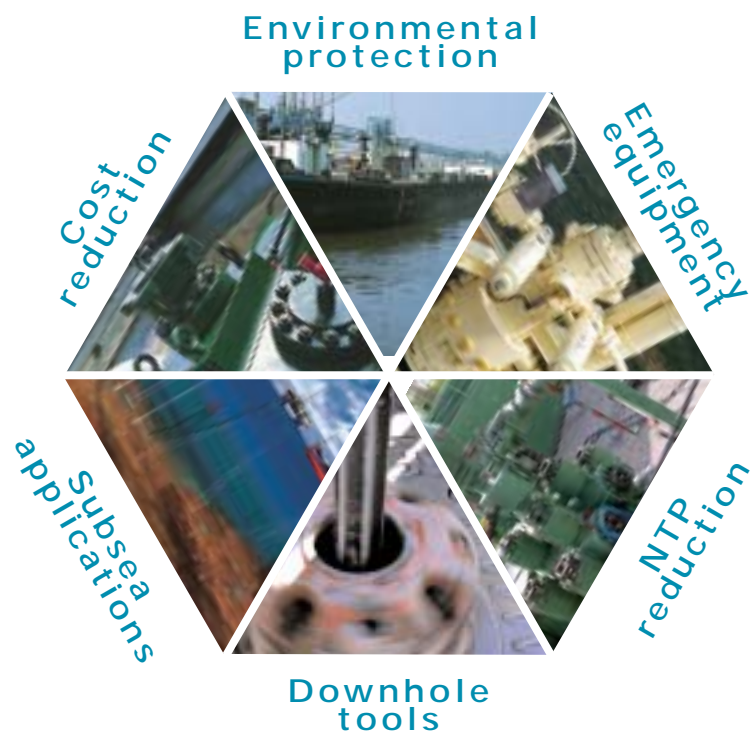
ACTUATORS	Wipers, Piston seals, Guide rings, O-rings
PUMPS	Rotary seals, Multi-lip seals, Piston seals, Wipers, O-rings
VALVES	Seat seals, Stem seals, Flange seals
SEAL KITS	Various products - OEM & MRO
DOWNHOLE TOOLS	O-rings, Back-up rings, T-seals, Loaded U cups
PIPE SYSTEMS	D-rings, O-rings, Clamp seals, Pigs
O-RINGS	H-NBR, FKM 1, FKM 2, EPDM, Urethane

For any application we can supply standard, special seals or customised sealing solutions.

Optimized ECONOMOS® solutions

For many years the ECONOMOS® Group has been providing technically advanced system solutions to meet the needs of applications and processes in the Oil & Gas industry. This focus has led to the development of products and materials specifically engineered, designed, and proven to meet the demands of your operation. After a detailed study of your system and your needs, we will review our comprehensive list of standard products and, if the application demands non-standard products, we can tailor a customized solution. The unique ECONOMOS® total service concept can manufacture - on demand - without tooling costs or delays - a solution which will provide considerable advantages over conventional arrangements.

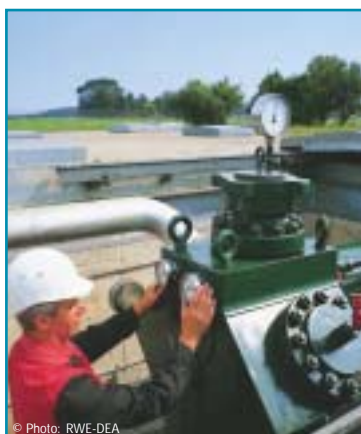
The following pages will give you a flavour of our capabilities in providing customized solutions for your equipment or process.



PRO

Test cost reduction Before any equipment is allowed to leave the manufacturing or refurbishment facility, it has to undergo several tests. Testing cannot be eliminated, but costs for it can be reduced.

The ECOFLANGE test seal



© Photo: RWE-DEA
Xmas tree at location

In order to reduce the associated costs either test procedures need to be shortened, which might have an impact on quality or the usability of the input material need to be extended.

Any Equipment that will be installed in the field is subject to prior testing. This testing is not only time consuming but also requires the input of material that does increase the overall costs for testing.



Solid block Xmas tree on test rig



ECO-Flange seal made of H-ECOPUR®

ECONOMOS® has designed a special sealing solution, which replaces all standard API ring gaskets (R, RX and BX). This seal can be reused up to 30 times for testing purposes which significantly drives the testing cost down.

Environmental Protection

There is almost no other industry than the oil and gas industry that is forced to protect the environment whilst working economically. ECONOMOS® does its utmost to support our customers in this respect.

Solutions for tanker loading and offloading devices



© Photo: OMV

Tanker loading at docklands

When loading and offloading oil tankers the flow line is constantly moving (waves, weight change of the tanker), whereby sealing integrity needs to be maintained. This is not only because of economic reasons but also because of avoiding environmental pollution.



Swivel joint

In addition, any sealing solution needs to fulfill the requirement of being easily handleable without the risk of damage during installation.



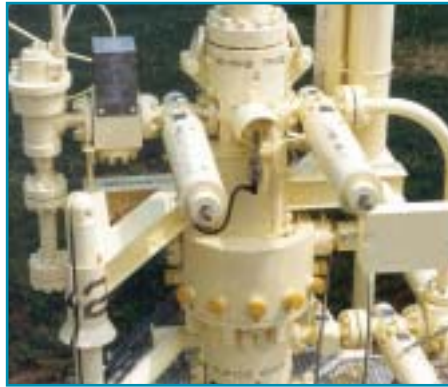
Special combination of S19 / K19 double acting seal

As a result of intense investigations a reliable customized sealing solution has been developed, which increased the integrity of the seal and dramatically reduced the drop out rate because of installation damage.

Emergency Equipment

Many regulations have been developed with regard to emergency situations occurring. These also include special equipment that is only installed to safely handle an emergency situation.

Seals for emergency shutdown valves



Actuated wing valve on subsea tree

In a typical application a seal has to bypass a pressure inlet port that is pressurized to 5.000 psi. This operation caused a hole to be punched into the original competitor seal.

An emergency shutdown valve, even if not used in normal operations, needs to function 100% reliably if activated. No failure is allowed, since this could have serious consequences to the environment and health.



© Photo: RWE-DEA

actuated production wing valve



Special K02 seal made of H-ECOPUR® with a back-up ring made of ECOTAL

By introducing H-ECOPUR® and selecting the correct seal profile, the seal suffered no operational damage, and sealing capability was maintained in all cases.

NPT reduction Drilling offshore is a very cost intense operation. Therefore it is of utmost interest to reduce operating costs. One of the negative influencing factors is the occurrence of "Non Productive Time" - NPT, meaning an unnecessary rig or equipment shut down.

Seals for offshore mud pump



Onshore mud pump

One of the keys for a continuous drilling operation is the performance of the mud pump.

During normal drilling operations, mud pumps have to work 24 hours a day, 7 days a week. And therefore piston seals are traveling hundreds of miles continuously.



Offshore drilling rig

Although NPT is unpleasant when working onshore, it is even worse when operating offshore. In this case failure of a 'simple' seal can have tremendous consequences. The costs NPT can cause bear no relation to the costs of a reliable seal.



Standard S01-P seal

ECONOMOS® is able to offer a wide range of different profiles for piston seals. Because of its excellent mechanical properties and its compatibility with different mud types (water or oil based) H-ECOPUR® is successfully used in offshore mud pumps.

FOO

Downhole tools Over recent years, significant developments of different downhole tools have taken place. Downhole tools are not only used to increase drilling performance, but also emergency tools are available.

Seals for an expandable Casing tool



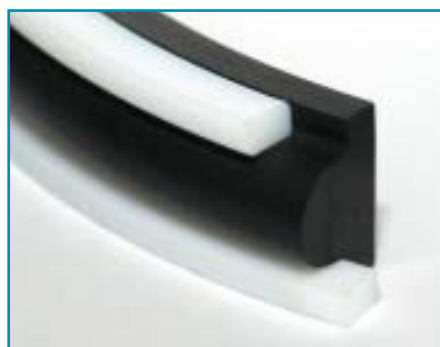
Kelly bushing

One of the severest environmental conditions a seal needs to withstand when drilling for hydrocarbons, is found downhole. It is not only the combination of high pressure and high temperature, but also the sometimes, unforeseeable, mixture of aggressive wellbore fluids.

Downhole tools, although their use is often a cost intensive operation, can help significantly in reducing overall drilling costs, provided the tools are performing well. The performance of the tool often depends on the functionality of its hydraulic system, hence it depends on the performance of a seal.



Roller cone bit



K20-R made of H-ECORUBBER

ECONOMOS® seals can be found in a variety of different downhole tools. Apart from standard seals we are also able to provide customized sealing solutions in order to meet the requirements of all different applications.

Subsea applications One of the most difficult environments to operate in is subsea. Even simple operations are getting difficult and overall they are getting more expensive.

Seals for a subsea connector



© Photo: RWE-DEA

Schematic drawing of subsea installations

Any hydraulic connection is only as good as the seals used for it. For subsea equipment only the most reliable materials and profiles can be used. In some cases (like in this application), pressures up to 15.000 psi need to be controlled.

Sometimes it is not the sealing itself that causes problems, but the method of installation. It has been observed several times that 'normal' seals are damaged and not able to operate as required after a pressurized port has been bypassed.



Umbilical connection



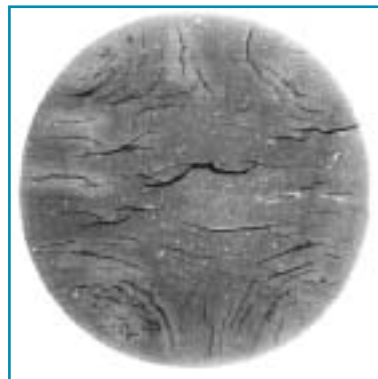
S35-P (made of H-ECOPUR®)

ECONOMOS® successfully installed a S-35 seal made of H-ECOPUR®, which fully retained the sealing capability (15.000 psi) after a pressurized port has passed the seal.

The S-35 profile especially was designed to replace O-rings.

Explosive decompression Explosive decompression (ED) damage is the name given to the growth of internal cracks in elastomer seals when previously applied gas pressure is quickly reduced from high to low. Cracks may grow and blisters form and may burst. These cracks and blisters may be evident on the surface of the seal, they may be internal, or only detected by magnification. The picture below shows severe internal fracturing of an elastomer O-ring due to poor ED resistance.

Such ED is influenced by permeability characteristics, availability of fracture sites and their elastic growth to a certain critical point (modulus dependent) and crack growth above this point (dependent on tearing energy).



Microscopic image of fractures (of an O-ring) due to ED

ED damage is increased by

- high gas pressure
- high gas concentration in the elastomer
- fast decompression rates
- high temperatures and
- repeated decompression cycles

ED is decreased by

- lower gas pressures
- high seal constraints
- high gas diffusion rates
- high modulus and
- high tear strength
- small number of imperfections and defects

At the ECONOMOS® R&D department we are able to test various materials according to NACE and NORSOK standards and therefore we can offer a wide range of ED resistant materials.





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