Stock shapes

# High performance and engineering plastic solutions for the oil and gas industry

# Plastics in application: Oil and Gas industry

Nowadays, technical plastics have a major contribution to make towards improving existing solutions because modern materials offer a wider range of benefits. These benefits include:
→ Weight reductions
→ Corrosion resistance
→ Thermal decoupling and
→ Minimised noise emissions
The progress currently being made in the oil and gas field is largely due to the use of modern materials.

Ensinger has a range of over one hundred high performance and engineering plastic materials, offering a variety of properties that benefit a wide range of applications, including those within the oil and gas sector. Materials from within the range are being used increasingly in HPHT applications.

***Ensinger's expertise in developing and manufacturing high performance and engineering plastic materials has enhanced its product portfolio to suit a wide range of different applications.***

With a number of worldwide production facilities, Ensinger has a vast knowledge of plastic material production, with techniques that include:
→ Extrusion
→ Casting
→ Compression moulding
→ Injection moulding
→ Compounding
→ Spin Moulding
→ Machining

### *Hydrophone housing*

Engineering plastics are often used in such devices as they benefit from key factors such as impact resistance, strong chemical resistance, dimensional stability and acoustic properties.

### *Seals and back up rings*

In areas of pressure such as the circulation system materials within the Ensinger TECAPEEK family are the perfect choice due to their novel characteristics and behaviours in such demanding environments.

### *Remotely Operated Vehicles (ROV)*

ROVs used for offshore inspections are widely made with Polyolefines due to their light weight, high impact properties and cost effectiveness.

### *Bushings and gears*

Typically in the pumping systems above ground where TECAST (Cast Nylon) can benefit from its high degree of toughness, strength and good sliding properties.

Ensinger's range of materials is also suitable for use in valve seats, thrust washers, compressor components, logging tools and gear applications within the oil and gas field.

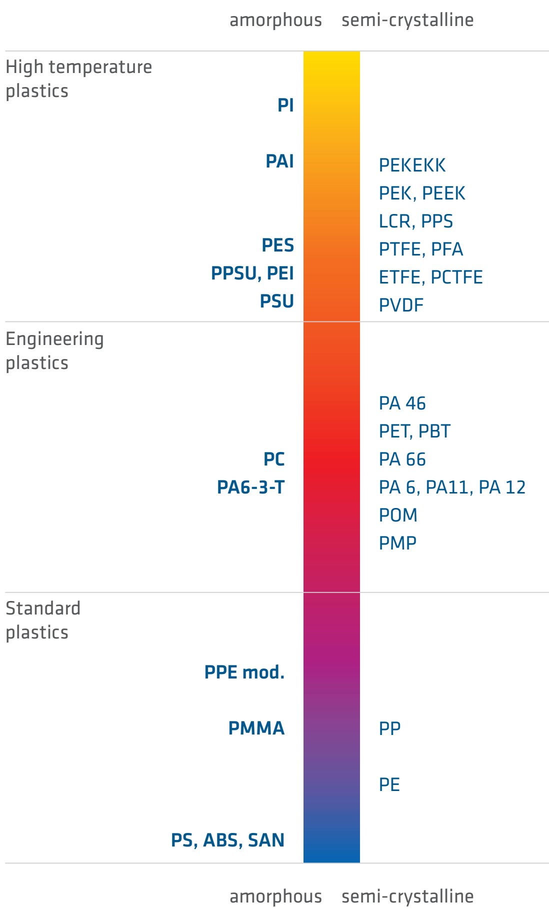
As well as oil and gas, Ensinger's products are suitable for use in a variety of alternative energy markets including, photovoltaic, wave and tidal, fuel cells, bio fuels and hydropower technology.

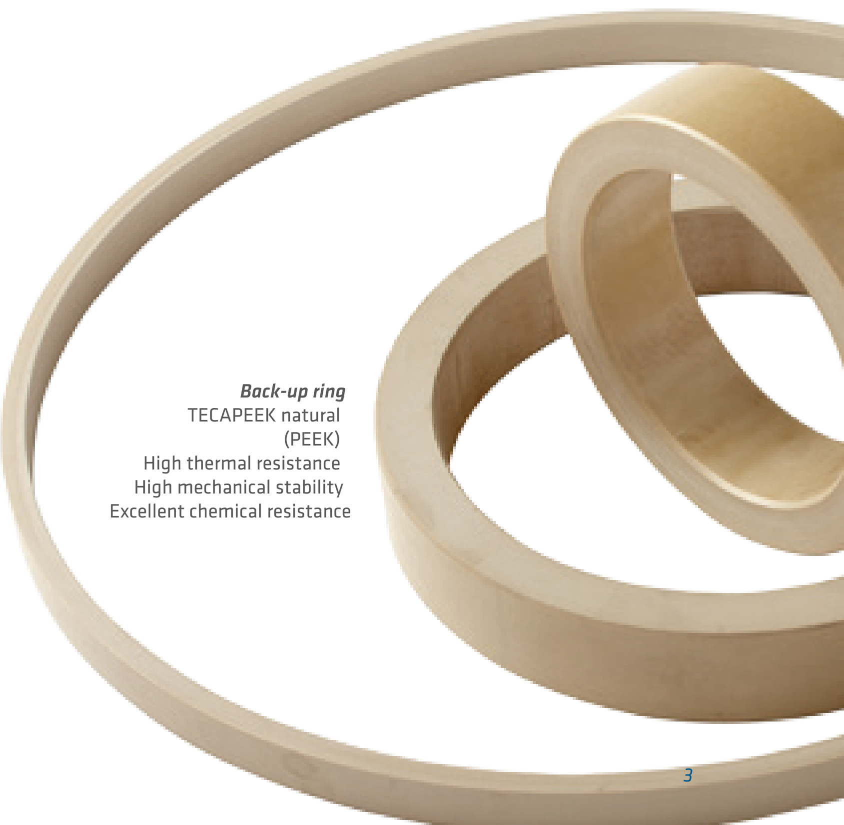


### *Typical applications of technical plastics in the oil and gas industry*

| | | Sub-sea connectors | Seals | back-up rings | Valve seats | Hydrophone housings | Covers | Bushings | Wire Rope Sheaves | Winch Drum Shells | Components for ROVs | Framework for ROVs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TECAPEEK natural | PEEK | ● | ● | ● | ● | | | | | | | |
| TECAPEEK GF30 natural | PEEK | ● | ● | ● | ● | | | | | | | |
| TECATRON natural | PPS | ● | | | | | | | | | | |
| TECAFORM AH natural | POM-C | | | | | ● | ● | | | | | |
| TECAFORM AD natural | POM-H | | | | | ● | ● | | | | | |
| TECAST T natural | PA 6 C | | | | | | | ● | ● | ● | | |
| TECAFINE PP natural | PP | | | | | | | | | | ● | ● |
| TECAFINE PE natural | PE | | | | | | | | | | ● | ● |

### *Classification of plastics*



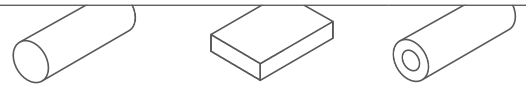



*Back-up ring*
TECAPEEK natural (PEEK)
High thermal resistance
High mechanical stability
Excellent chemical resistance

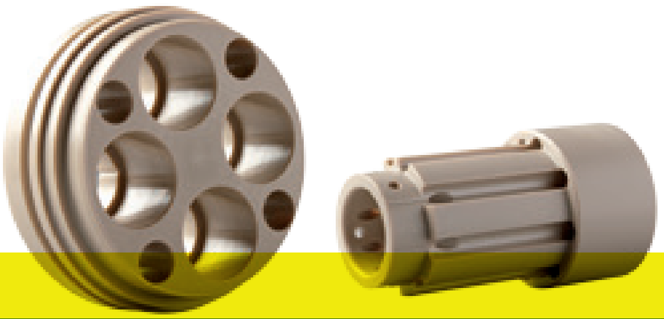
# Product portfolio for the oil and gas industry

### *Material availability*

Ensinger has over one hundred high performance and engineering plastic materials within its portfolio available in either rod, sheet or tube. Materials can be modified with certain fillers to enhance the properties and make them perfectly suited for specific applications. The following table displays the range of shapes and sizes available within material ranges that are typically used within oil and gas applications.



| *Ensinger Trade Name* | *Polymer Name* | *Rod (dia)* | *Sheet (thickness)* | *Tube (OD)* |
|---|---|---|---|---|
| ***TECASINT*** | PI | 6-100 mm | 5-100 mm | |
| ***T SERIES*** | PEEK/PBI | Please contact us for details of availability | | |
| ***TECATOR*** | PAI | 5-100 mm | 1-40 mm | 40-360 mm |
| ***TECAPEEK*** | PEEK | 3-200 mm | 5-100 mm | 40-360 mm |
| ***TECATRON*** | PPS | 10-60 mm | 10-70 mm | |
| ***TECASON*** | PSU/PPSU | 8-150 mm | 10-80 mm | |
| ***TECAPEI*** | PEI | 8-150 mm | 10-80 mm | |
| ***TECAST*** | PA 6 C | 50-800 mm | 8-200 mm | 50-600 mm |
| ***TECAMID*** | PA 6/PA 66 | 4-250 mm | 5-100 mm | 25-300 mm |
| ***TECAFORM*** | POM | 3-250 mm | 5-150 mm | 20-505 mm |
| ***TECAPET*** | PET | 10-180 mm | 8-100 mm | |
| ***TECANAT*** | PC | 3-250mm | 10-100 mm | |



*Sub-sea connectors*
TECAPEEK natural
(PEEK)
Good electrical insulation
High dimensional stability
Excellent chemical resistance

*Framework for ROV*
TECAFINE PP natural
(PP)
Light weight
High impact properties
Cost effective





# Regulations

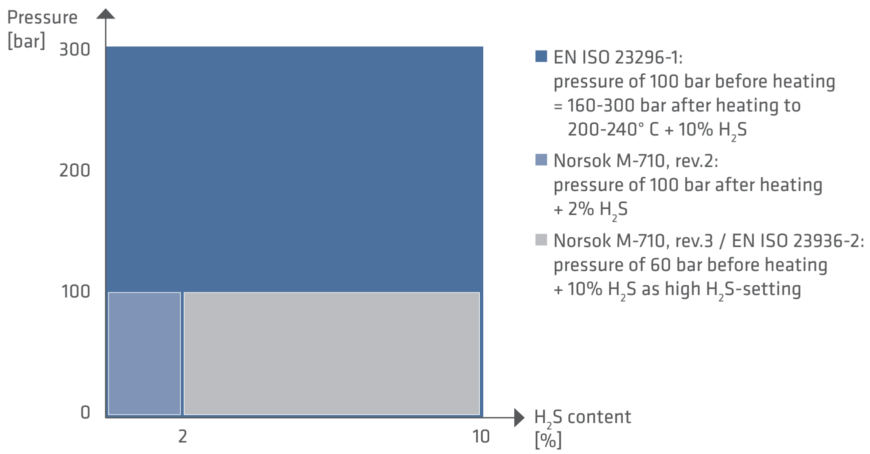
EN ISO 23936 as a whole presents general principles and gives requirements and recommendations for the selection and qualification, and gives guidance for the quality assurance, of non-metallic materials for service in equipment used in oil and gas production environment, where the failure of such equipment could pose a risk to the health and safety of the public and personnel or to the environment. The intent of part 1 of EN ISO 23936:2009 is to define requirements and recommendations for the selection and qualification of thermoplastic materials for service in equipment used in oil and gas production. The technical requirements for qualification of thermoplastic materials in oil and gas environments are described in Annex B.[1]

The NORSOK standards are developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for petroleum industry developments and operations. The polymer materials covered by the NORSOK standard M-710, Edition 3, September 2014 are elastomers and thermoplastics used for offshore oil and gas production.[2]

Both standards require quality control tests such as specific gravity, hardness, tensile property and elongation tests, as well as chemical resistance test procedures for the qualification of thermoplastic materials exposed to fluids at elevated pressures and temperatures over an extended period of time.

There are no significant differences between EN ISO 23936-1 and NORSOK M-710 for the evaluation of thermoplastics regarding sour fluid resistance. The test fluids and their distribution in the vessel are the same in each, as are the acceptance criteria. The main practical difference is that ISO requires (100 ± 10) bar of the test gas mixture to be added at room temperature before the vessel is heated to test temperature. In NORSOK M-710, the pressure requirement is (60 ± 5) bar. However, there is no reason that 100 bar cannot be specified as a NORSOK M-710 test pressure; the key condition is "to start each ageing period with the same quantity of the sour gas mixture present in the vessel". There is more $H_2S$ present in the vessel in an ISO exposure test, which will have an, as yet, unquantified impact on performance; based on Element experience, it is not anticipated to be significant in the time periods employed herein.[3] So testing according to the conditions given in EN ISO 23936-1 also gives information about the compliance with NORSOK M-710.

Comparison of settings in EN ISO 23936-1 and NORSOK M-710




[1]Source EN ISO 23936-1:2009: Petroleum, petrochemical and natural gas industries – Non-metallic materials in contact with media related to oil and gas production – Part 1: Thermoplastics
[2]Source NORSOK M-710, Edition 3, September 2014: Qualification of non-metallic materials and manufacturers, Polymers
[3]Source Element Materials Technology, Laboratory

# Quality assurance / Traceability

***The Ensinger quality assurance system monitors our high-performance plastic products continuously from the time of arrival of the incoming resin through to their delivery as semi-finished products. This allows us to guarantee the highest pos¬sible standard of product quality and to minimize defects and complaints. This quality assurance process entails the performance of various tests at every stage of the work process.***

***The raw materials are processed to stock shapes in accordance with manufacturer's instructions. The production processes and specifications used are suitably documented. An effective system of quality assurance and quality control is set out within the EN ISO 9001 certification.***

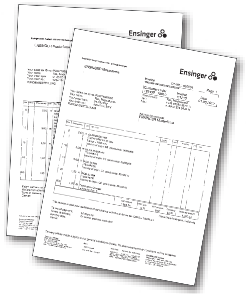
***Due to product coding and statements of conformity Ensinger has direct traceability of the delivered semifinished product.***

***1. Invoice / delivery note***

The order and invoice number is shown on the invoice / delivery note, for semi-finished products the batch num ber is also shown on the delivery note. This allows goods to be traced back using these numbers. A certificate to EN ISO 10204 is issued on an order-specific basis.

*Customer · Order · Invoice*
*988885 · 123456 · DRA12345*

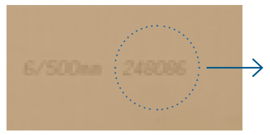
Production number 248086





***2. Semi-finished products***

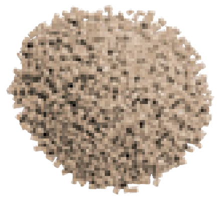
The production and manufacturing number is located on the semi-finished product. Starting with the production or manufacturing number, data from the production process can be traced (production data, production protocol, control cards).



Production number

***3. Compounds***

The lot number of the compound can be determined from the production/manufacturing number of the semi-finished product.



***4. Raw materials***

The lot number of the compound is traceable back to the formulation and so to the delivered raw material batch, the relevant raw material specification and the safety data sheet.

***Key facts at a glance***

***Ensinger secures foolproof traceability from the delivery note to the raw material.***



# FAQs:

***What is the difference between testing with distilled water and seawater?***

Both standards, EN ISO 23936 and NORSOK M-710 specify testing with distilled water, although using the seawater might tend to get nearer to the real environment. According to comparison tests performed by Victrex, using both seawater and distilled water in various ageing tests, no major differences between the two environments could be observed.[4]

***What is the influence of different calculation methods for the lifetime estimation via Arrhenius curves (based on maximum stress or tensile modulus)?***

Modulus rises early in each exposure situation, stabilizing after 3-4 weeks; annealing is believed to be the cause. Maximum stress exhibits a largely linear reducing trend with time, with increased exposure temperature increasing the rate of change. Strain at break follows the same pattern, but more data scatter is apparent. For unfilled products, which yield when tensile tested to failure, the optimum property for life estimation is maximum stress. Maximum stress is yield stress initially. Tensile modulus is not a good indicator of material deterioration, being calculated at very low strain. Break strain is a possibility but is subject to more scatter than maximum stress. Linear regression analysis allows the time to attain a 50% reduction in stress level to be calculated, and these times are used as input to the Arrhenius equation for the lifetime estimation.[5]

***How do NORSOK M-710, Edition 3 and EN ISO 23936 correlate?***

As a result of the joint industry effort to prepare EN ISO 23936-2 dealing with qualification of elastomers, NORSOK standard M-710, Edition 3 refers to the requirements in EN ISO 23936-2:2011 for elastomers. For thermoplastic materials, the qualification requirements are given directly in the NORSOK standard and aligned with requirements and format in EN ISO 23936-2. The thermoplastics part EN ISO 23936-1:2009 is considered as informative.

***Is there a list of NORSOK qualified materials available?***

There does neither exist, nor are there currently plans to introduce a NTS/NORSOK qualification or approval strategy or a public listing of qualified manufacturers in this regard.[6]

[4] Victrex plc
[5] Element Materials Technology, Laboratory
[6] NORSOK M-710, Edition 3, September 2014: Qualification of non-metallic materials and manufacturers, Polymers

***Do you have any other questions?***

***Please do not hesitate to contact our technical service: techservice.shapes@de.ensinger-online.com or by telephone on +49 7032 819 101***

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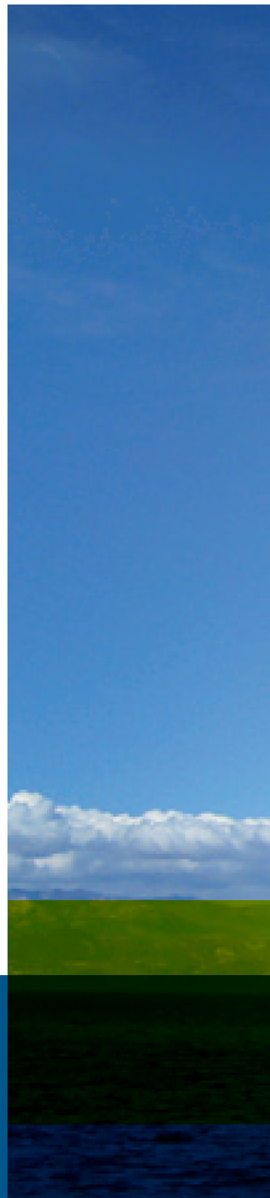

*Thermoplastic engineering and high-performance plastics from Ensinger are used in every important sector of industry today. Their economy and performance benefits have seen them frequently replace classically used materials.*

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