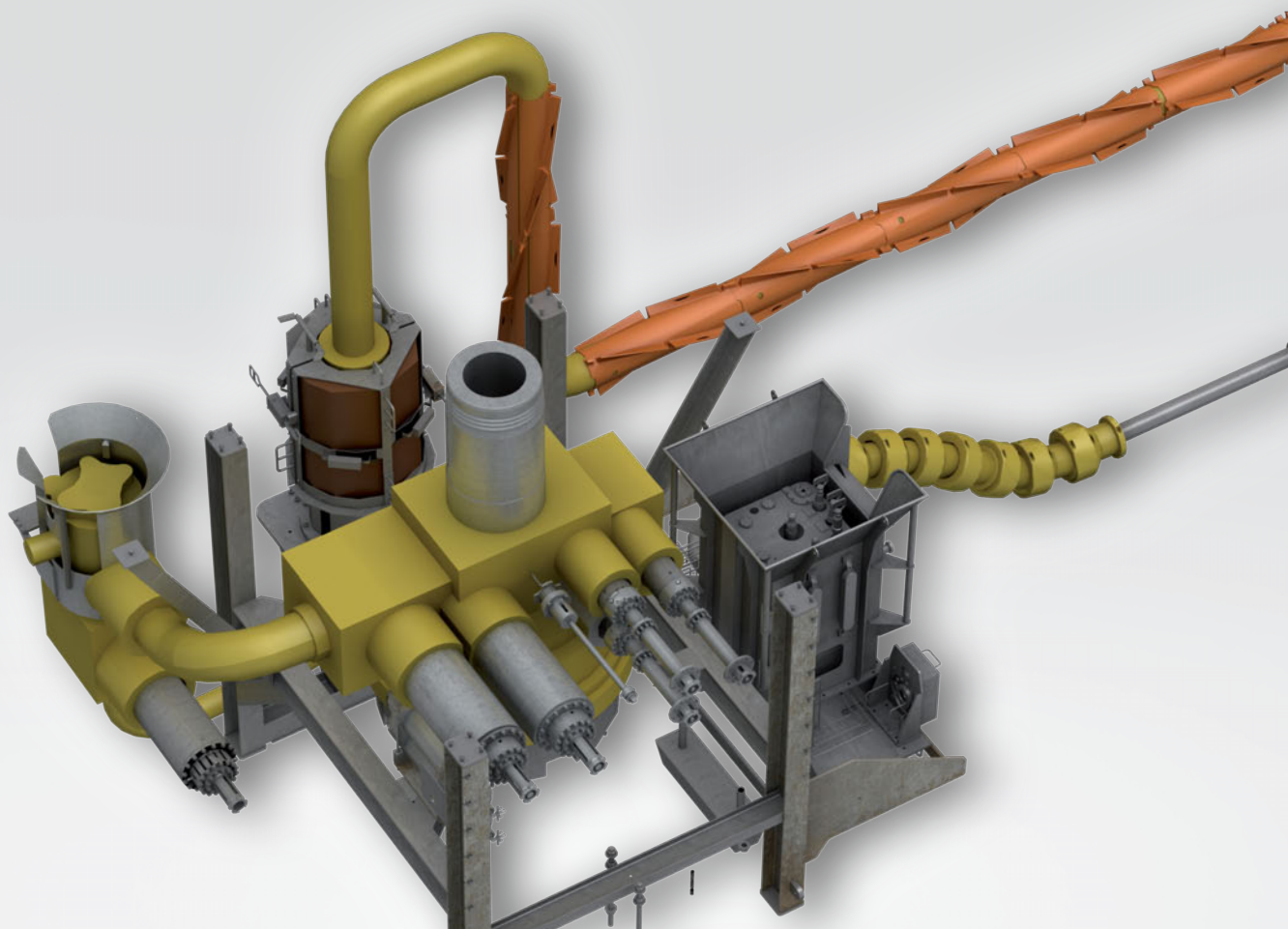


Norsok M-710 Approved Materials





Engineered to Standard

As a global developer and manufacturer of sealing elements and bearings for the oil & gas industry, it is imperative that our materials comply with international standards such as Norsok. Trelleborg Sealing Solutions has, with its 21 compounds, one of the largest and most comprehensive selections of fully approved Norsok M-710 materials on the market. Our range includes best-in-class formulae over all material types, designed specifically to meet demanding oilfield conditions.

Global but Local

Wherever you are in the world, we speak your language and can offer you unparalleled technical support to optimize the performance, service life, reliability and safety of your oil & gas equipment.

NORSOK APPROVED

The Norsok M-710 specification underlines the need for oilfield equipment OEMs to achieve higher levels of quality and compatibility for non-metallic seals used in oilfield equipment operating anywhere in the world. What started with mainly Norwegian or European requests for Norsok M-710 approved materials has now extended across the globe, making Norsok into an internationally recognized standard. Our worldwide network of marketing companies has the flexibility to handle local requirements and reduce lead times significantly.

NORSOK M-710 – Qualification of non-metallic sealing materials and manufacturers (Rev. 2, Oct. 2001) – requires that all sub-components of oilfield equipment must be approved to stated specifications. Specifically, individual seal materials are rigorously tested and approved based on numerous criteria such as Explosive Decompression Resistance (EDR), sour and sweet gas aging, compression set tests, and material property tests. The testing is done to ensure adequate safety, added value and cost effectiveness for existing and future petroleum industry developments.

The standard defines the requirements for critical non-metallic (polymer) sealing, seat and back up materials for permanent use subsea, including well completion, trees, control systems, wellheads and valves. The standard also applies to topside valves in critical gas systems. One of the main differences from previous approvals is that all individual components within an assembly must meet and be approved to Norsok standards, rather than just the complete assembly.

Tested for Compliance

SOUR & SWEET GAS AGING

Test conditions are simulated to be representative of the seal application environment in both sour and sweet service conditions (Tables A.1/ C.1 – A.2/ C.2 respectively). Three temperatures are simulated to accelerate results for extrapolation, all of which are higher than service conditions. After heating the gas to the required temperature, 1,450 psi / 10 MPa of pressure is applied. Exposure time takes into account the length of time required to reach saturation and is sufficient to allow reliable extrapolation of results. A minimum of 30 samples are tested. Measurements are taken for sample dimensions, volume and weight prior to exposure. After testing, sample volume and weight are measured again, tensile properties are tested and the sample is visually inspected for damage.

Table A.1 / C.1

Test conditions for sour service conditions (From NORSOK Standard M-710)

Volume %	Composition
30	3% CO ₂ , 2% H ₂ S, 95% CH ₄
10	Distilled water (conductivity < 5 µS)
60	70% heptane, 20% cyclo hexane, 10% toluene

Test conditions for sour service conditions (From NORSOK Standard M-710)

Volume %	Composition
30	3% CO ₂ , 97% CH ₄
10	Distilled water (conductivity < 5 µS)
60	70% heptane, 20% cyclo hexane, 10% toluene

What is Explosive Decompression?

Gas or gas mixtures in contact with elastomer surfaces can be absorbed under pressure. At high pressure, absorbed gas is in a compressed state. When external pressure is reduced, either rapidly or over a relatively short period of time, the compressed gas rapidly expands within the elastomer. This can lead to crack initiation within the body of the elastomer. These cracks propagate internally and this can cause void formation or cracks to appear on the elastomer surface that significantly reduce seal integrity.

EDR TESTING

Three variables are tested; media, temperature and pressure. Three media options are available (table B.1), the media selection is dependent on proposed well conditions.

Temperatures can be tested at +212 °F, +302 °F or +392 °F / +100 °C, +150 °C or +200 °C. The material is heated to this temperature progressively, and held for 10 minutes. After this, pressures of 2,175 psi, 2,900 psi or 4,351 psi / 15 MPa, 20 MPa, 30 MPa are applied. The sample is then depressurized at a rate of 290-580 psi/min / 2-4 MPa/min, and cooling is only allowed following this.

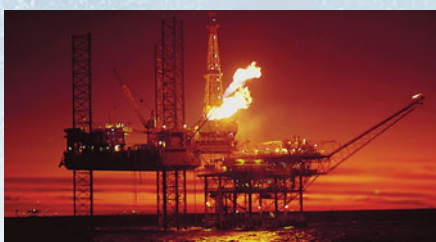
Cycles of pressurization and depressurization are applied to the sample. Exposure to these conditions must be for at least 72 hours. The sample is then analyzed by microscopy and a rating is applied, summarizing the observed damage to the test sample.

Table B.1

Test media for EDR testing (From NORSOK Standard M-710)

Sweet/Sour Wells/ Low CO ₂	Sweet/Sour Wells/High CO ₂	CO ₂ Injection Wells
3% CO ₂ , 97% CH ₄	10% CO ₂ , 90% CH ₄	100% CO ₂

All materials were involved in rigorous independent tests, undertaken and supervised by MERL – Materials Engineering Research Laboratory, a respected independent laboratory in the United Kingdom.



NORSOK M-710 Approved Materials

Our extensive range of innovative seal materials and continuous material development helps us deliver exceptional sealing integrity to international, industry-recognized standards. Any size of O-Ring (standard or custom) is available alongside custom-molded seal designs and bonded products. These are available in materials ranging from basic elastomers grades to leading edge, high specification compounds. Our innovative sealing materials help reduce downtime and improve production efficiency by extending seal life.

Relying on decades of experience, working with leading equipment manufacturers and end users around the globe, we have developed a portfolio of materials suitable for the oil & gas industry and have taken the time to guarantee NORSOK M-710 standards are being met. To ensure outstanding performance, Trelleborg Sealing Solutions has invested heavily in research to identify the optimum compound for each application.



ELASTOMERS

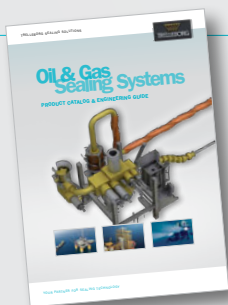
Engineered for demanding conditions

Advanced elastomers specially developed for oil & gas applications

XploR™ H9T20	-13 °F to +320 °F -25 °C to +160 °C	Offering good abrasion resistance, this XploR™ Hydrogenated Nitrile Butadiene Rubber (HNBR) elastomer is one of the more popular choices for EDR service conditions.
XploR™ V9T20	-4 °F to +392 °F -20 °C to +200 °C	Our standard XploR™ Fluoroelastomer (FKM) EDR elastomer for use in applications such as valves, subsea equipment and downhole tools.
XploR™ V9T22	-22 °F to +446 °F -30 °C to +230 °C	Specially developed XploR™ FKM elastomer offering high and low temperature EDR capability.
XploR™ V9T82	-54 °F to +392 °F -48 °C to +200 °C	Specially developed to work in ultra-low temperature EDR applications, offering unrivalled performance beyond standard FKM EDR elastomers. Currently only approved to M-710, Annex B, RGD resistance.
XploR™ J9513	-4 °F to +464 °F -20 °C to +240 °C	The first perfluoroelastomer (FFKM) to achieve the NORSOK M-710 approval, its combination of excellent EDR resistance and high temperature capability makes it a technology leader.



More Information



For more information on these materials, and to help design a sealing configuration to suit your requirements, consult the Oil & Gas Sealing Systems Product Catalog & Engineering Guide, or contact your local Trelleborg Sealing Solutions marketing company.



For more details on the products and to see some applications in action, visit: tss.trelleborg.com/films

PEEK – POLYETHERETHERKETONE

Exceptional wear characteristics

Ideal for slow rotating or linear situations where high wear resistance is required



HiMod® 550	-65 °F to +500 °F -54 °C to +260 °C	Standard virgin PEEK compound, used in Back-up Rings, support rings and light duty bearing applications.
HiMod® 914	-65 °F to +500 °F -54 °C to +260 °C	Developed specially to give excellent chemical resistance and good thermal properties in bearing and Back-up Ring applications.
HiMod® 921	-65 °F to +500 °F -54 °C to +260 °C	Highly lubricated, medium-modulus compound providing good chemical resistance, lower friction and good mechanical and thermal properties in bearing applications.
HiMod® 924	-65 °F to +500 °F -54 °C to +260 °C	High modulus compound providing low thermal expansion and high mechanical properties in bearing and Back-up Ring applications.
HiMod® 960	-65 °F to +500 °F -54 °C to +260 °C	Standard virgin PEEK compound, used in Back-up Rings, support rings and light duty bearing applications.
Zurcon® Z43	-65 °F to +500 °F -54 °C to +260 °C	Our preferred Back-up Ring and support ring material used in high pressure and temperature applications.
Zurcon® Z431	-65 °F to +500 °F -54 °C to +260 °C	Standard virgin PEEK compound produced in Europe, can be used as light duty bearings, for Back-up Rings or as part of sealing assembly.

PTFE – POLYTETRAFLUOROETHYLENE

Excels in virtually all oilfield applications

Exceptional performance against the most important sealing characteristics; wear, friction and high pressure operation with virtually universal chemical compatibility. Turcon® inherently demonstrates excellent EDR due to the high crystallinity, low gas solubility and granular morphology of PTFE based materials. TFMs are modified PTFE polymers that offer slightly greater temperature resistance.

Turcon® T05	-328 °F to +500 °F -200 °C to +260 °C	Offers gas-tight sealing with long service life.
Turcon® T07	-328 °F to +500 °F -200 °C to +260 °C	One of our preferred materials for downhole tool service, it has excellent wear and abrasion resistance.
Turcon® T12	-328 °F to +500 °F -200 °C to +260 °C	Suitable in poor lubrication and gives very good performance in many different valve applications.
Turcon® T24	-328 °F to +500 °F -200 °C to +260 °C	Used as a rotary seal compound, ideal for slow rotation applications or poorly lubricated applications.
Turcon® T29	-328 °F to +500 °F -200 °C to +260 °C	Offers excellent performance in rotary or linear applications, however not recommended for sealing against gases.
Turcon® T42	-328 °F to +500 °F -200 °C to +260 °C	Good for service in hydraulic systems and has good dielectric properties.
Turcon® T99	-328 °F to +500 °F -200 °C to +260 °C	Our preferred compound for dry running or poorly lubricated applications.
Turcon® M12	-328 °F to +500 °F -200 °C to +260 °C	Unrivalled across-the-board performance with excellent low friction characteristics and exceptional wear resistance in high pressure systems.
TFM Q2J	-328 °F to +550 °F -200 °C to +288 °C	Offers greater stability at elevated temperatures, often used in conjunction with other sealing elements such as V-Stacks and Turcon® Variseal®.
TFM M02	-328 °F to +550 °F -200 °C to +288 °C	A natural TFM grade used in many cryogenic applications due to its relative flexibility and resilience at ultra-low temperatures.

Contact your local marketing company for further information:

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Bulgaria – Sofia (Belarus, Romania, Ukraine)	+359 (0) 2 969 95 99	Brazil – São José dos Campos	+55 12 3932 7600
Croatia – Zagreb (Albania, Bosnia and Herzegovina, Macedonia, Serbia, Montenegro)	+385 (0) 1 24 56 387	Canada – Etobicoke, ON	+1 416 213 9444
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Denmark – Copenhagen	+45 48 22 80 80	Canada West – Langley, BC	+1 604 539 0098
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Middle East GCC Region (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates)	+91 (0) 80 2245 5157



Trelleborg is a world leader in engineered polymer solutions that seal, damp and protect critical applications in demanding environments. Its innovative engineered solutions accelerate performance for customers in a sustainable way. The Trelleborg Group has local presence in over 40 countries around the world.