

OVERVIEW

FREUDENBERG
OIL & GAS TECHNOLOGIES

 **FREUDENBERG**
INNOVATING TOGETHER



The Freudenberg Group established Freudenberg Oil & Gas Technologies to leverage its years of experience and innovation in sealing technology to provide differentiated seal products for demanding energy applications. Today Freudenberg Oil & Gas Technologies is a global provider of innovative sealing solutions and products to the upstream oil and gas industry. We provide a full range of solutions that include elastomeric seals, engineered thermoplastic seals, metal seal rings and connector solutions for demanding offshore and subsea applications, along with gaskets and packing sets. We utilize our Materials Development and Product Testing Lab to develop and perform in-house analysis for our solutions and proprietary customer projects.

Our engineer-designed products and custom solutions have been implemented in many demanding market segments, including:

- Drilling/BOP (pressure control) products
- Offshore oil & gas platforms
- FPSOs
- Flowlines and subsea installations
- Wellhead products
- Downhole/completions products
- Fracturing services
- Well workover equipment



SEALING TECHNOLOGIES & SOLUTIONS FOR THE UPSTREAM OIL & GAS INDUSTRY

Unsurpassed Materials Expertise

- Extensive materials research and development for elastomers and plastics
- Experience with a wide range of materials to provide optimal solutions
- Solutions for the most challenging environments
- Custom-engineered elastomeric and plastics sealing solutions
- Experienced engineering staff works directly with customers from concept to delivery
- Sealing system designs ensure highest possible performance and ease of installation

Operational Excellence

- Best practices used in manufacturing processes
- Global systems for advanced productivity, quality and responsiveness
- Behavior-based health and safety programs
- Outstanding record of HSEQ performance

Rigorous Analysis and Testing

- Sour gas lab tests materials exposed to a broad spectrum of gases and fluids
- Thermal cycling lab for product function testing
- State-of-the-art HPHT lab (15,000 psi at 430°F)
- Material properties lab equipped to conduct a wide variety of tests
- Product testing lab enables API 16A testing to 15,000 psi o



Our Materials Development & Product Testing Lab enables us to perform product verification testing and analysis in-house for our solutions and customer projects.



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Freudenberg Oil & Gas Technologies

Advanced Thermoplastics

- Tetrex® PEEK Injection molding, in-house
- Unitized™ Seal
- Engineer-Designed Sealing Solutions
- High Performance Machined Plastics
- Seal Stacks
- Back up Rings
- Prototyping, Custom products



Petroleum Elastomers

- GAZGUARD® RGD-resistant materials
- BOP Products
 - Annular Elements
 - RAM Packers
 - Shear Packers
 - Stripper Packers
 - Top Seals
 - Bonnet Seals
- Engineer-Designed Seals
 - FS Seals
 - T Seals
 - Spring Seals
- Custom Rubber Molding



Metal Sealing Solutions

Metal-to-Metal Seals

- Duoseal®
- SPO® Compact Flange
- Techlok® Connector
- Optima® ROV Subsea Connector
- Flangelok®
- FlexlokMTM™ Seal

Engineer-Designed Sealing Solutions

Standard Seals & Gaskets

- API Ring Joints
- Spiral Wound Gaskets

Materials Development & Product Testing

Test Facility in Houston (USA) capabilities:

- Sour Gas (H2S)
- HPHT
- Thermal Cycling
- Material Properties
- Product Test Area

Rubber Mixing, Custom Recipes

Test Facility in Port Talbot (UK):

Extensive Product Integrity Testing



ADVANCED THERMOPLASTICS

Upstream applications are encountering higher temperatures and pressures and more chemically aggressive conditions. This makes high performance plastics a good material fit with chemical, electrical, wear, hydrolysis and temperature-resistant properties.

We utilize engineered designs, advanced manufacturing, product and material testing, material development, prototyping, and custom molding and machining of high performance plastics to provide our customers with robust solutions.

Processes/Production Capabilities:

- Custom high performance thermoplastic components in variety of sizes
- Large range of tool capabilities to machine intricate components and large diameter parts
- Precision prototyping and production parts
- CNC Lathe, Tool Centers and CAD/CAM capabilities
- Complete seal stack solutions for the most demanding applications and environments

Full range of materials

- Custom and standard solutions are available in a wide range of high-performance plastics.
- Some highlights:
 - Tetrex® PEEK-injection molding, billets, in-house
 - All PTFE is molded in-house
 - Engineering staff available to make recommendations on material for your sealing challenge

Products and Applications:

We offer our patented thermoplastic seal solution – the Unitized™ Seal – for high pressure, challenging applications such as multi-stage hydraulic fracturing. The compact design requires less space than traditional seal stacks, and reduces error in installation, making it ideal for uses such as a critical component in a ported fracturing sleeve.

PRODUCTS:

- Tetrex® PEEK Injection molding, in-house
- Unitized™ Seal
- Engineer-Designed Sealing Solutions
- Custom Solutions and Prototyping Parts
- Seal Stacks
- Back up Rings
- Prototyping, Custom products



Engineered Custom Products

PETROLEUM ELASTOMERS

Freudenberg Oil & Gas Technologies offers products and elastomers for many application needs.

For pressure control, we maintain an extensive inventory of standard BOP elements, with the capabilities to produce some uncommon profiles.

We offer Engineered Seal Solutions in standard profiles such as FS Seals and O-Rings, as well as custom solutions.

Our Custom Molded Capabilities include:

- | | |
|----------------------------|---------------------------|
| Product / Solution Design | Comprehensive Tool Design |
| Rubber Compression Molding | Rubber Transfer Molding |

Full range of materials

Our portfolio of elastomeric compounds includes natural rubber and standard mixes from commercial to high-performance grades, including GAZGUARD® - our patented RGD-resistant compound. For additional materials information, please visit www.fogt.com.

Products and Applications

Pressure control:

We maintain an extensive inventory of standard BOP elements, with the capabilities to produce some uncommon profiles.

We offer ram packers, top seals, bonnet seals and seal kits for most ram type BOPs, and offer spherical elements as well.

Customer Rubber molding

Our Custom Molded solutions include:

Product / Solution Design

Bonded Seals

Packers:

Oil Swell

Water Swell

Air Inflatable

Elements

Engineered Elastomeric Solutions

S-seals

FS-seals

T-seals

O-rings

V-rings

Custom Machining

METAL SEALING SOLUTIONS

Products and Applications:

Vector Optima® Subsea Connector

- Utilizes revolutionary, patented, Vector Duoseal® technology to seal pipe contents, and seal out sea water
- Engineered into a wide range of complete subsea solutions
- Efficient & Compact – reduces initial cost & installation time
- Engineered for remote operation in deep water
- Unique angular & radial alignment capacity ensure accurate alignment

Vector SPO® Compact Flange

- Proven solution that is both lighter and smaller as an alternative to conventional ASME flanges
- Maintenance free, no re-tightening of bolts required
- Proprietary and superior sealing and load bearing capabilities
- Static connection – only flange meeting strict design requirements in DNV-OS-F201 (Dynamic Risers) and ISO 13628-7
- Wide range of pressure classes

Vector Techlok® Clamp Connector

- Up to 75% lighter and significantly smaller than comparable ANSI or API flange
- Significant technology advantages for new and replacement topside projects
- Only 4 bolts to tighten –instead of up to 24 on a conventional flange– with no bolt holes to align
- 360° orientation around the pipe
- Smaller – close piping and hook-up arrangements with typically 25% smaller clamp diameter; typically 40% shorter connection length
- Where piping system utilizes exotic materials only the hubs need to be made in the same generic material

We also offer standard Metallic Seals & Gaskets, including:

- Metal ring joints
- Spiral wound gaskets
- IX gaskets
- Pressure-test gaskets

MATERIALS DEVELOPMENT & PRODUCT TESTING LAB

The Freudenberg Group has more than 80 years of seal innovation, and is focusing that expertise on the upstream oil and gas industry. We opened a 14,000-sqft Materials & Products Test Facility in 2012, enabling development – and verification– of a range of sealing solutions.

Leveraging extensive R&D capabilities and resources to develop new proprietary elastomer compounds and engineered plastics

Testing of innovative and custom sealing solutions in-house

14,000-sqft Materials & Products Test Facility

Designed for development – and verification– of virtually unlimited range of sealing solutions

Capabilities:

Mixing custom rubber recipes

Product test bunker

Test labs for:

Sour Gas (H₂S)

HPHT

Thermal Cycling

Material Properties

Engineer-Designed Sealing Solutions

Seal stacks utilizing specialized elastomers and high-performance plastics

Custom spring-energized seals

Testing for proven solutions

Designs for performance, repeatability and ease of installation



Materials Development – Mixing Lab

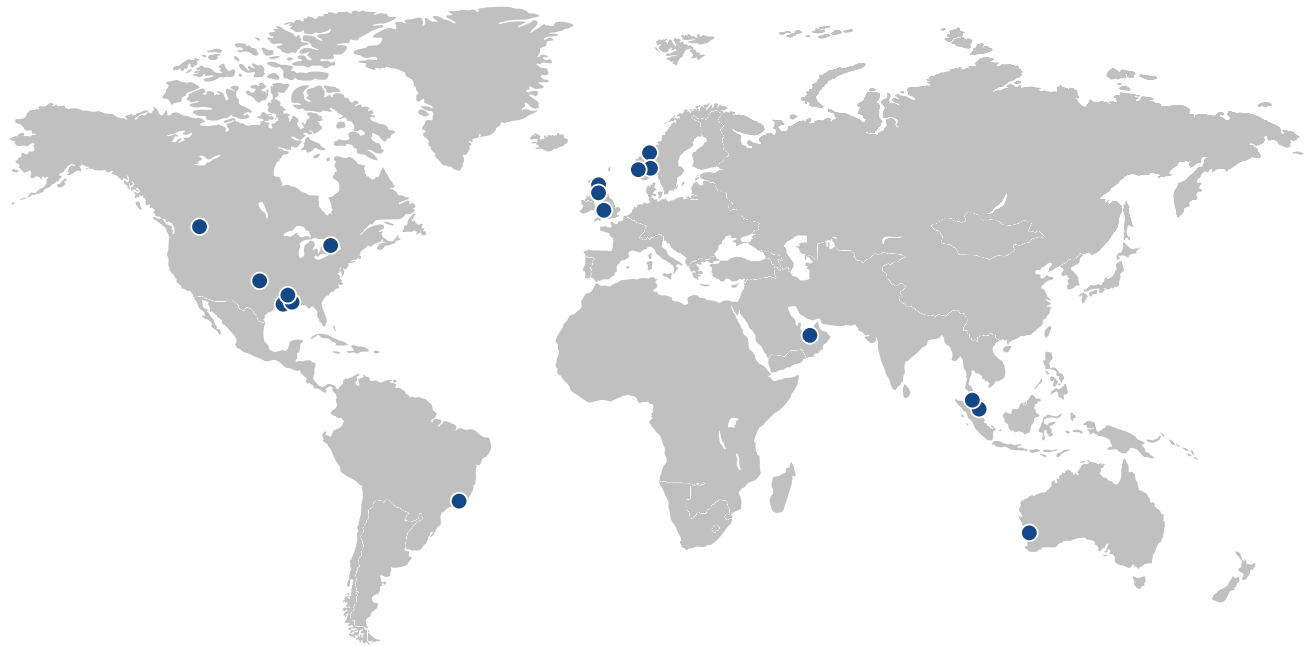


Product Test Bunker

TRADITION OF FREUDENBERG

The Freudenberg Group is a family owned company with over 160 years of experience. A global company with more than 120 manufacturing facilities in 55 countries, the Group provides solutions for the aerospace, medical, automotive, chemical processing, pharmaceutical, semiconductor, industrial, oil and gas, and energy markets. Through a commitment to quality and emerging technologies, customers are provided with innovative products and business solutions to elevate them beyond their current challenges.





UNITED STATES

AUSTRALIA

MALAYSIA

UNITED KINGDOM

BRAZIL

NORWAY

UNITED ARAB EMIRATES

CANADA

SINGAPORE