SAINT-GOBAIN SEALS

Oil & Gas Industry
Subsea

Since the recent fall of oil prices, O&G majors have developed new strategies to lower break-even costs and reduce cycle times of their deepwater projects. A key contributor was a systematic effort to standardize subsea trees and components. Meanwhile, there is a shift towards more extreme pressure/temperature operating conditions pushed by production from more complex reservoirs.

To meet and exceed customer demand for high-performance sealing solutions, we drew from the best of R&D investments as well as our broad experience addressing extreme pressure and temperature conditions.

We provide our customers with pre-validated and field-proven sealing solutions delivering reliable fluid control for the most critical applications.

<table>
<thead>
<tr>
<th>KEY APPLICATIONS</th>
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<tbody>
<tr>
<td>Subsea ball, gate, choke valves</td>
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<tr>
<td>API 17D subsea wellhead and</td>
</tr>
<tr>
<td>Christmas tree equipment</td>
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Floating Equipment

In fluctuating market conditions, Floating Production, Storage and Offloading (FPSO) vessels demonstrate inherent advantages compared to other floating production system types: operating flexibility, range of water depth, conversion possibilities, and storage capacity range. With other offshore facilities, FPSO technical characteristics are still impacted by fluid viscosity, pressures and temperatures that could lead to more complexity and technical challenges for the topside equipment.

To meet with harsher reservoir conditions, HPHT FPSO turret swivel stacks systems are being developed to cope with the above operating condition challenges that push the limits of existing sealing solutions.

Consequently, we have developed a cost-effective, flexible and highly scalable technique to manufacture large diameter sealing systems, incorporating anti-extrusion rings in Meldin® 5000 series (proprietary PEEK based materials) without any limitations in diameters.

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<td>Production and utility swivels</td>
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In the 1970s, Saint-Gobain Seals introduced OmniSeal® spring-energized seals to the oil and gas market in order to solve reliability and durability problems caused by the severe limitations of elastomeric seals. These spring-energized seals, which had already proven themselves extensively in the aerospace industry, addressed critical issues including aggressive media, sour gas environment, resistance to rapid gas decompression and extreme operating conditions. This additional experience inspired the Saint-Gobain Seals to design a series of innovative sealing solutions that consistently and reliably met the ever-increasing requirements of high-performance equipment manufacturers.

**Proven in the Past...**

**... Prepared for the Future**
**Cryogenic**

Driven by industry standards, strict regulations and end user demands, manufacturers of cryogenic valves and transfer equipment are faced with the daunting responsibility of finding sealing solutions that cope with low leakage challenge requirements while lowering operating costs.

We have developed a new generation of bespoke OmniSeal® spring-energized seat seals for cryogenic trunnion mounted ball valves (TMBV) compliant with the most stringent industry standards such as SHELL MESC SPE 77-300. These are ideal solutions for the LNG value chain: export and import terminals, carriers, bunkering and small scale logistics.

### Key Applications

<table>
<thead>
<tr>
<th>Cryogenic valves</th>
<th>Cryogenic hoses</th>
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<tbody>
<tr>
<td>Cryogenic pumps</td>
<td>Cryogenic breakaway couplings, ERS, QCDC</td>
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<tr>
<td>Cryogenic rotary swivels for LNG, LPG, LEG</td>
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### Key Benefits

- No need for secondary seal
- Self-energized solution, does not need to be compressed axially
- Simplified hardware design
- Lower operating torques / forces, long life
- Easier installation compared to compression packings

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**Surface**

For leading oil and gas surface systems equipment manufacturers, we are very much the expert of choice for field-proven sealing solutions in numerous surface applications in conventional and unconventional areas. Our innovative solutions comply with industry standards such as PR2 test procedure as per API 6A annex F and the most stringent fugitive emission specifications. Designed to minimize cost, enhance lifetime and ensure safety, we help you reach sustainable performance excellence.

### Key Applications

<table>
<thead>
<tr>
<th>API 6D pipeline valves</th>
<th>API 6A valves for wellhead and Christmas tree equipment</th>
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<tr>
<td>Downhole tools</td>
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**Fugitive Emission Valves**

Major energy companies have made big investments in natural gas in recent years, steadily growing their production volumes. Methane, the main component in natural gas, is a potent greenhouse gas that has drawn negative attention due to fugitive emissions leaking into the atmosphere.

In response, O&G majors recently signed a set of guiding principles, committing to drive down methane emissions to ensure that natural gas continues to play a critical role in helping meet future energy needs.

Our response to the critical need for low fugitive emissions from valves was to develop a range of high-performance stem sealing systems for ON/OFF and CONTROL valves that pass leakage tightness of Class A according to the ISO 15848-1 standard from -50°C to +200°C.

### Key Benefits

- No need for secondary seal
- Self-energized solution, does not need to be compressed axially
- Simplified hardware design
- Lower operating torques / forces, long life
- Easier installation compared to compression packings
Critical Parts Protecting Oil & Gas Core Systems

Over four decades, Saint-Gobain Seals has built unique expertise in designing high-performance sealing systems and polymer components that meet and exceed the continuously increasing performance requirements for extreme temperatures, high pressure and fugitive emissions.

We support our customers with strong technical competencies in design engineering, testing and R&D tools such as finite element analysis using our proprietary thermoplastic material models.

Our thermoplastic materials are certified in accordance with API 6A specification (ISO 10423) Appendix F.13.5.2 relating to sour fluid (FF/HH) resistance and with NORSOK M710, rev3 up to 25% H2S / 200°C.

<table>
<thead>
<tr>
<th>Testing Capabilities</th>
<th>Applications</th>
<th>Test Protocol</th>
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<tbody>
<tr>
<td>HPHT</td>
<td>Surface or Subsea Valve Stem Seal</td>
<td>Compliant with PR2 test procedure as per API 6A annex F and API 17D</td>
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<tr>
<td></td>
<td>Surface or Subsea Valve Seat Seal SPE / DPE</td>
<td>Compliant with PR2 test procedure as per API 6A annex F and API 17D</td>
</tr>
<tr>
<td>Fugitive Emission</td>
<td>Surface Valve Stem Seal</td>
<td>Compliant with ISO 15848-1</td>
</tr>
<tr>
<td>Cryogenic</td>
<td>Trunnion Mounted Ball Valve Seat Seal</td>
<td>Compliant with SHELL SPE 77-300, ISO 28921-2, BS 6364</td>
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Our Core Competencies:

- Resistance to HPHT conditions
- Excellent chemical resistance
- Cryogenic static and dynamic sealing
- Low Fugitive Emission
- Long durability

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<tr>
<th>Products</th>
<th>Main Features</th>
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| **High-Performance Spring-Energized Seals** | - Temperatures from -253°C to +365°C (-424°F to +690°F)  
- Pressure: Vacuum up to 3,448 bar (50,000 psi)  
- Low and controlled friction  
- Broad chemical resistance |
| **High-Performance PTFE Rotary Lip Seals** | - Temperatures from -53°C to +232°C (-65°F to +450°F)  
- Shaft speed up to 60 m/s and beyond in special cases  
- Pressures up to 35 bar (508 psi) |
| **High-Performance PTFE Filled Compounds** | - Temperatures from -268°C to +316°C (-450°F to +600°F)  
- Low friction, high wear life and broad chemical resistance |
| **High-Performance Thermoset Polyimide Materials** | - Temperatures from cryogenic through +316°C (+600°F) intermittently up to +482°C (+900°F)  
- Superior strength and rigidity combined with self-lubrication properties |
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