

**High-grade seals for the oil and gas industry** Safety and reliability are fundamental requirements in the oil and gas industry. The components used in the engineered ball valves that the Houston, Texas, based company Cameron International Inc designs and manufactures at its plant in Voghera, Italy, are subjected to severe testing prior to approval. Angst + Pfister codesigned and supplied the perfect O-Ring solution for a severe service gas project in Qatar. Testing was required of the seals to ensure the seals would stand up to the cocktail of chemicals that is going to be injected to reduce pipeline corrosion. Unfortunately the chemical cocktail attacks normal elastomeric seal materials.

The Valves & Measurement division of Cameron designs and manufactures highly reliable valves that keep Cameron in a leading worldwide position in the oil and gas installations market. The specifications of this large natural gas subsea pipeline project in the Middle East posed new challenges for Cameron's engineered ball valves due to the chemical attack on non-metallic components by the corrosion inhibitors. To solve this difficulty the team in Voghera, Italy, enlisted the services of Angst + Pfister to find a solution.

#### Highly demanding technical requirements

This upstream gas project required the technologically sophisticated ball valves designed by Cameron to employ a secondary sealing system made of elastomer O-Rings to enhance their safety and reliability. The elastomer compound used must meet very demanding criteria:

- Chemical inertness to heavy concentrations of hydrogen sulfide (H<sub>2</sub>S).
- Chemical inertness to several cocktails of inhibitors utilized to protect internal metal surfaces from degradation.
- Anti-explosion properties that resist rapid gas decompression.
- Extended operating temperature range (-29°C to +104°C).
- Design pressures up to 345 bar.

These requirements are extremely demanding. The O-Rings have to work in this very corrosive environment and have to withstand high pressure. There are very few tougher environments than this gas field where unprocessed wet sour gas is being transported from the platforms to the onshore facility.

#### Specialized engineering support was called for here

Combining the gas anti-explosion decompression property with the low operating temperature is a very difficult trade-off for any compound, and when it comes to the additional chemical resistance requirement, the available choices were even more limited. Angst + Pfister assessed its landscape of over 2,000 compounds and identified a special FFKM perfluoroelastomer as being capable of withstanding the specified operating conditions. Its chemical, physical, mechanical and tribological properties offered a solution that fully met Cameron's expectations. An independent laboratory in the UK that specializes in elastomer testing confirmed the extraordinary properties of this unique FFKM compound and provided Cameron with results to prove suitability of the material for the application following chemical and temperature testing.



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The demands of the oil and gas industry go well beyond the norm. Angst+Pfister developed an elastomer for the Texas-based Cameron company able to withstand the most extreme conditions.

**Project task accomplished** Angst+Pfister also devised an expedient seal production solution and controlled the quality across the entire process. The seals had to be designed and manufactured in customized sizes with diameters ranging from 100 mm to 1,500 mm. The different O-Ring sizes required different production equipment, so the O-Rings were manufactured at two different plants across the globe. A special pre- and postmolding test procedure was performed to verify consistently identical production results.

**Application expertise coupled with the right elastomer compound resulted in success.**

**Core engineering competencies focused on delivering solutions** Angst+Pfister also provided Cameron with engineering support for designing the seals. Additionally, by managing the tooling and parts production in the two different plants, Angst+Pfister provided procurement efficiency to Cameron. Integrated supply chain management satisfied the requirement calling for special individual packaging for the parts. Cameron's engineered ball valves equipped with Angst+Pfister O-Rings are now deployed in the offshore and onshore export pipelines for the Middle East natural gas project.

**Additional application possibilities** Cameron confirms that the existing secondary sealing system used in the valves on previous phases of this project would not have stood up to this new cocktail of chemicals for this phase and the solution that Angst+Pfister came up with fulfilled the design and manufacturing needs for this project. The solution is also proving to be beneficial in other services and gaining acceptance by major oil companies.



This Angst+Pfister solution is approved by NORSOK M-170.