From watches to oil platforms:

The best design and material for seals depends on the application.

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Seals are key components of designs all around us. They hermetically close two units with uneven surfaces, or facing surfaces in motion. Seal forms include simple rings, specialized profiles, or those that are part of bearings. But how do seals in applications differ?

"The choice of design and material used for seals depends on a number of factors," explains Nils Levin, materials consultant. The choice of material must address working temperature, resistance, mechanical strain, environmental situation, abrasion, and lifespan. Seals made of natural rubber, conventional elastomer compounds, or perfluoroelastomers offer excellent mechanical properties for a range of applications, including aerospace, food and beverage processing, and in rotary and high-pressure pneumatic and hydraulic applications, for example.

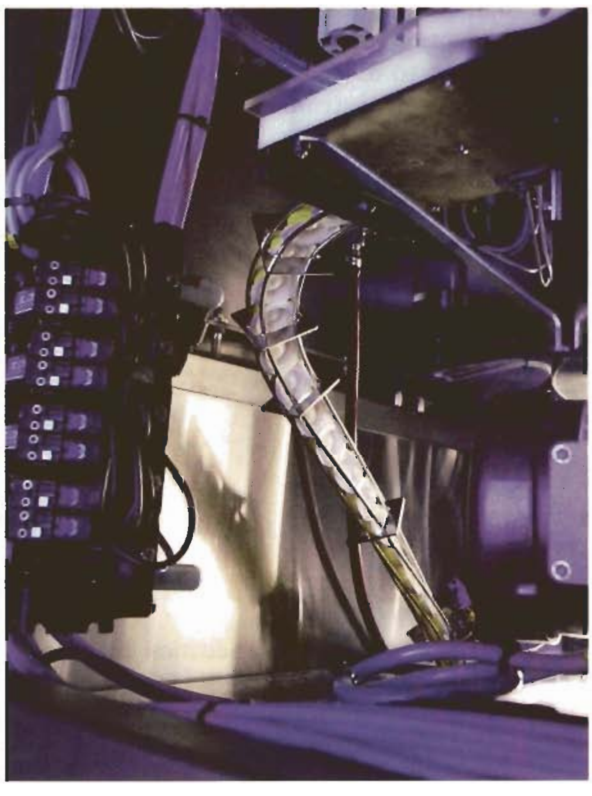
In contrast, polyurethane seals offer effective abrasion resistance and also provide an effective barrier against oil and fuel and are often used in high-pressure hydraulic systems. "PTFE is a high temperature-resistant thermoplastic material that can withstand temperatures exceeding 260°C, has particularly good resistance to chemical corrosion and offers very low friction," Levin adds.

Seals can be manufactured in a variety of ways, depending on their design and function. Molded seals include O rings and radial and shaft seals where an elastomer lip is bonded to a metal ring. V-shaped seals are often used in hydraulic systems where the rubber may be textile-reinforced to withstand high pressure. Long extruded seals are used to seal doors and windows and are often made by a co-extrusion of two materials. Diaphragms are often punched from continuous cured rubber sheeting and are sometimes reinforced with textiles.

Eliminating contamination

Food and beverage production is one of the most challenging environments for seals. Here, seals must function under highly regulated conditions to ensure safety and eliminate as much risk of contamination as possible. Too, the materials must resist a broad variety of process media, the rigors of severe cleaning regimes, and must comply with all major standards while offering unrivalled chemical resistance and biocompatibility.

Temperatures in food and beverage applications range from cryogenic up to 617°F, so seals here have properties specific to industry requirements, such as being water-repellent, and the ability to minimize biofilm build-up and release.



Facing offshore challenges

The oil and gas industry is another challenging environment for seals. Exploration, offshore and onshore production, upstream, midstream and downstream, seals must withstand destructive and aggressive chemicals and gases, abrasive media, intense temperatures, and high pressure.

Seals in oil and gas industries must resist temperatures from cryogenic up to 850°C.

Some seals for the oil and gas industry minimize maintenance and maximize

The tiny O-ring seals used in precision applications like watches are often prone to developing electrostatic charge. They require precision production and assembly instruments.

life-of-well sealing integrity, whether a seal is 1.2 mm or 3 m in diameter. These seals must withstand temperatures from cryogenic up to 850°C, numerous chemicals, and steam and explosive decompression.

Seals on food and beverage production lines must resist biofilm buildup, as well as extreme temperatures.

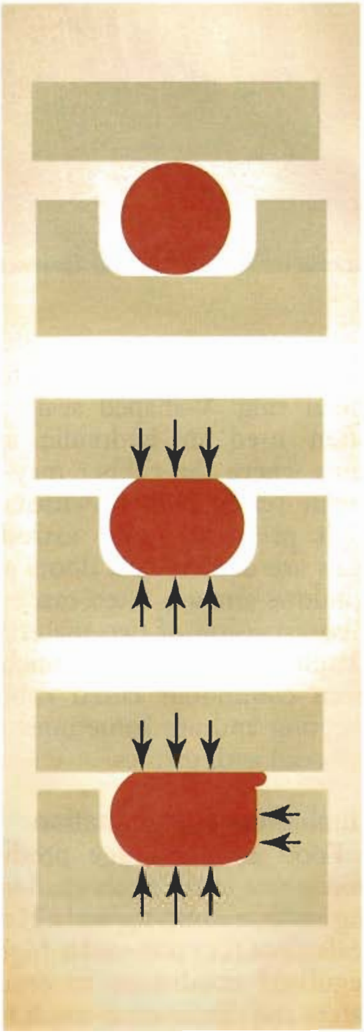
Precision on a minute scale

Producing the tiny O-ring seals used in precision industries like watch making requires precision instruments from production to assembly.

The smallest of these miniature seals has a cross-section diameter of just 0.3 mm with a 0.25 mm inside diameter — which means that 10,000 of them can be held in the palm of one's hand. Almost a billion of these mini-rings are worn on millions of wrists around the world.

The production and assembly lines turning out the tiny rings are custom-made and highly specialized, as their inherent flexibility (and the fact they're often electrostatic) makes their assembly into systems trickier.

For more information, visit trelleborg.com.



Courtesy Lönegard

Sealing is obtained by deforming O rings in a groove. Higher pressures even press O rings against one side of the groove.

Giant seals protect St. Petersburg from flooding

Last January, St. Petersburg was flooded for the 302nd time in its 303-year history. The water level rose more than 2 m above normal, flooding some of the streets bordering the waterfront.

St. Petersburg is located where the Neva River flows into the Gulf of Finland, so when strong winds in the Gulf blow eastwards, they prevent the Neva from flowing westward. In this situation, waters can rise in only a few hours, and threaten St. Petersburg's 4.6 million people and historical sites.

Vladimir Vasilijev, area sales manager, and Peter Stello, the managing director of Trelleborg Bakker, explain the project.

So, to protect its people and cultural treasures from flooding, a 25-km storm flood barrier is being constructed to include a number of 40 x 7-m seals from Trelleborg.

In 1979, the Soviets began the construction of a storm flood barrier across the Gulf of Finland, but the project had to be abandoned a few years later for financial reasons. Then in 2003, Russian President Vladimir Putin, a native of St. Petersburg, ordered the project to restart.

The storm flood barrier consists of a 25-km dam, six discharge sluices, and two navigation channels. The main channel is 200 m wide and will be sealed using two 130-m curved doors. These structures will normally rest in curved dry docks on either side of the channel. When needed, the docks will be flooded and the doors floated to closure. As the barrier will be part of the ring road around the city, a tunnel (17 m under the flood gates) has been designed to pass under the main channel.

In the 1980s, all 15 tunnel sections were constructed without being connected. "Our contribution is the design of a sealing system that connects the tunnel sections. We are more or less supplying the missing links," says Erwin Brakenhoff of Trelleborg Bakker, part of Trelleborg Engineered Systems.

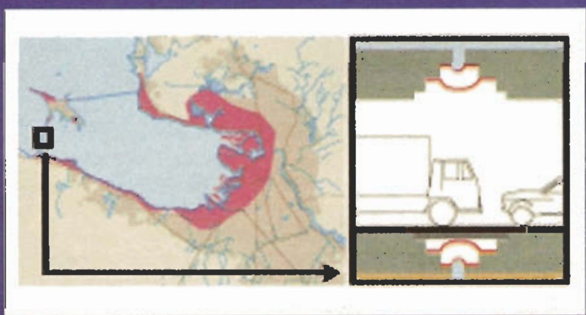
"The seals are sufficiently resistant, to protect the tunnel from water gushing in under high pressure," adds Vladimir Vasilijev, Trelleborg Bakker's area sales manager in Moscow. "At the same time, they are flexible enough to allow movement by the tunnel sections."

The components are called *Omega* seals because of their cross section.

"Once the seals are laid, it will be impossible to reach and repair them. So they're made to provide resistance for the next hundred years," says Vasilijev. The seals were manufactured in the Netherlands, at Trelleborg Bakker's factory in Ridderkerk, outside Rotterdam. Construction of the St. Petersburg dam is scheduled to finish in 2008. So, January's flood may hopefully be the last in St. Petersburg's history.

This is the first time that Omega seals have been used in a tunnel like that in St. Petersburg. It is a *cut-and-cover* tunnel — a hole is dug, the tunnel is constructed bit by bit, and then covered with sand. Unique too is that the tunnel includes a double sealing system, with an outer Omega seal and another for backup.

The Omega seals will withstand high water pressure, relatively large displacements in all three directions, and temperatures from $^-30°$ to $^+70°$ C.



The storm flood barrier will be part of the ring road around the city, so a tunnel passes under the main channel.