WHITEPAPER

LEVITEX® REVOLUTIONIZES ENGINE SEALS

GAS-LUBRICATED MECHANICAL FACE SEALS FOR CRANKSHAFTS REDUCE FRICTION BY 90% AND CO_2 EMISSIONS BY 0.5-1 G/KM

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GAS-LUBRICATED MECHANICAL FACE SEALS REDUCE CO_2 EMISSIONS

THE LEVITEX CRANKSHAFT SEAL COMBINES LOW CO_2 VALUES WITH HIGH LOAD CAPACITY AND A LONG LIFESPAN

Initial situation
The European Union has set the goal of reducing overall CO_2 emissions for newly registered cars to 95 g of CO_2/km by the year 2020. Among other things, frictional losses in the engine and drive train must be reduced to achieve this objective. This includes the crankshaft seal on the engine side. It is typically a radial shaft sealing ring that creates the seal for the rotating crankshaft at the housing. An oil film supplied by various devices minimizes the sealing ring's contact with the shaft.

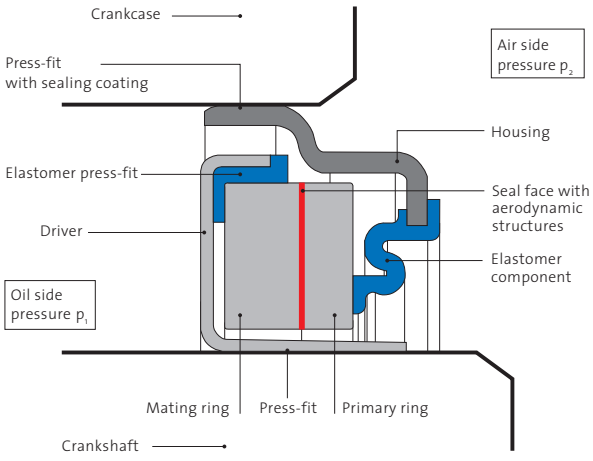
In the case of an elastomer radial shaft sealing ring, a specially designed seal edge conveys and steers the oil. One disadvantage is that this can lead to reduced lubrication on the air side (crankcase) , and thus to the sealing ring's direct contact with the shaft. The results are increased frictional losses and possible overheating of the seal at high rotational speeds.

In contrast, sleeve sealing rings made of polytetrafluoroethylene (PTFE) can also be used at lower lubrication levels and are chemically and thermally resistant. But they still have a performance deficit of 0.5 to 1 g of CO_2/km. As a result, there is a demand for a new technology that can reduce overall CO_2 emissions sustainably.

The Freudenberg solution
The gas-lubricated mechanical face seal is a very low-friction solution. It has already proved successful in turbochargers in the auto industry. This type of seal has been known for more than 40 years in industry. The difference from standard seals is that its two slide surfaces are separated by a thin cushion of air during operation and not by an oil film. The advantage: Frictional losses are reduced because the air's viscosity is much less than that of the oil. Freudenberg Sealing Technologies has further developed this technology under the Levitex brand name. The company has also greatly simplified it and adapted it to the severe conditions and the small amount of installation space available at the crankshaft.

With the new Levitex seal, the loss of performance for a crankshaft seal is up to 90 percent less than for a standard PTFE seal. The remaining friction is solely due to air shear. This results in less fuel consumption, less wear and a longer service life. The CO_2 emissions at the sealing point decline to less than 0.1 g/km from 0.5 to 1 g under the NEDC (New European Driving Cycle).

Furthermore, the new Levitex gas lubricated mechanical face seal is extremely resistant to pressure. This quality is playing an increasingly important role in light of the demand for seals with higher pressure resistance in today's advanced engines. Leading European manufacturers are already testing the first prototypes.



Schematic cross-section Levitex Generation 2

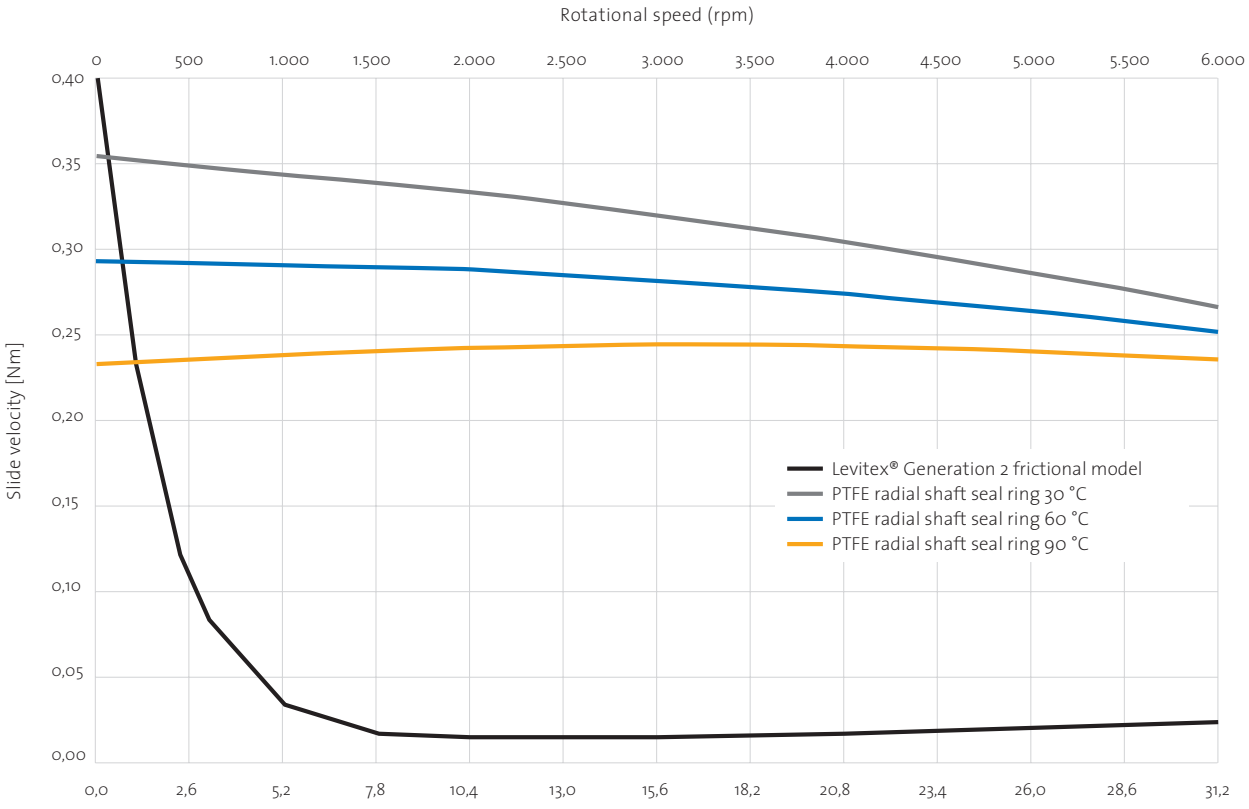
Independent measurements confirm much lower friction
The gas-lubricated mechanical face seal Levitex consists of a stationary and a rotating unit. The static unit includes the primary ring, which is vulcanized onto the housing with an elastomer component. The mating ring on the oil side and the driver, which centers it, are affixed to the crankshaft and form a rotating unit. The axial force necessary for leak tightness and functionality results solely from the particular shape of the elastomer component and its deflection during installation. It presses the primary ring on the mating ring.

During dynamic operation, a cushion of air forms between the primary ring and the mating ring, separating them. Aerodynamic grooves on the seal face create the cushion of air, building up drag flow pressure during rotation. The primary and the mating rings are given a coating to reduce wear and friction for operation from a standstill.

Independent measurements of the new Levitex seal on a seal test stand show greatly reduce friction even at low rotational speeds. Compared to a low-friction PTFE seal (POP) and a standard PTFE seal, the measured frictional torque is 0.2 or 0.3 Nm lower. That means less fuel consumption and less CO_2/km.

FACTS AND BENEFITS OF THE NEW LEVITEX SEAL AT A GLANCE

- Gas-lubricated mechanical face seal for crankshaft diameters of 85 and 90 mm
- Suitable for operating temperatures of -40 to +150 °C
- Long service life
  – Coating for wear and friction reduction
  – Reduced frictional torque
- Load capacity
  – High pressure resistance for applications in today's advanced engines
- Environmentally friendly
  – Reduction in CO_2 emissions of about 0.5 to 1 g/km



Frictional torque PTFE radial shaft seal ring Levitex Generation 2

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About Freudenberg Sealing Technologies
Freudenberg Sealing Technologies is a supplier, development and service partner for customers in different market segments, such as the automotive industry, civil aviation, mechanical engineering, shipbuilding, food and pharmaceuticals, and agricultural and construction machinery.

Based on the Simmerring which was developed by Freudenberg in 1929, Freudenberg Sealing Technologies has built up a broad and continuously expanding range of seals and vibration control technology products – from customized solutions to complete sealing packages. Together with its partners NOK Corporation, Japan, Sigma Freudenberg NOK, India and NOK-Freudenberg Group China, Freudenberg Sealing Technologies has formed a global network with the aim of offering products of the same high quality. The NOK-Freudenberg Group China is a 50:50 Joint Venture between the Japanese NOK Corporate and Freudenberg.

In addition, Freudenberg Schwab Vibration Control, Dichtomatik and Corteco fall under the Freudenberg Sealing Technologies umbrella. Freudenberg Schwab Vibration Control is a leading supplier of technology for vibration control components, wind energy solutions, agricultural and construction machinery and other industries. Dichtomatik is Freudenberg's sales organization in the market for technical seals. Corteco is the Freudenberg Group specialist for the Independent Automotive Aftermarket specializing in spare parts for seals and vibration control as well as service parts such as cabin air filters. As Freudenberg's largest Business Group, Freudenberg Sealing Technologies generated sales of about € 2.3 billion in 2015 and employed more than 15,000 people.

The company is part of the global Freudenberg Group which, with its Business Areas Seals and Vibration Control Technology, Nonwovens and Filtration, Household Products as well as Specialities and Others, generated sales of more than € 7.5 billion in 2015 and employed approximately 40,000 associates in around 60 countries.