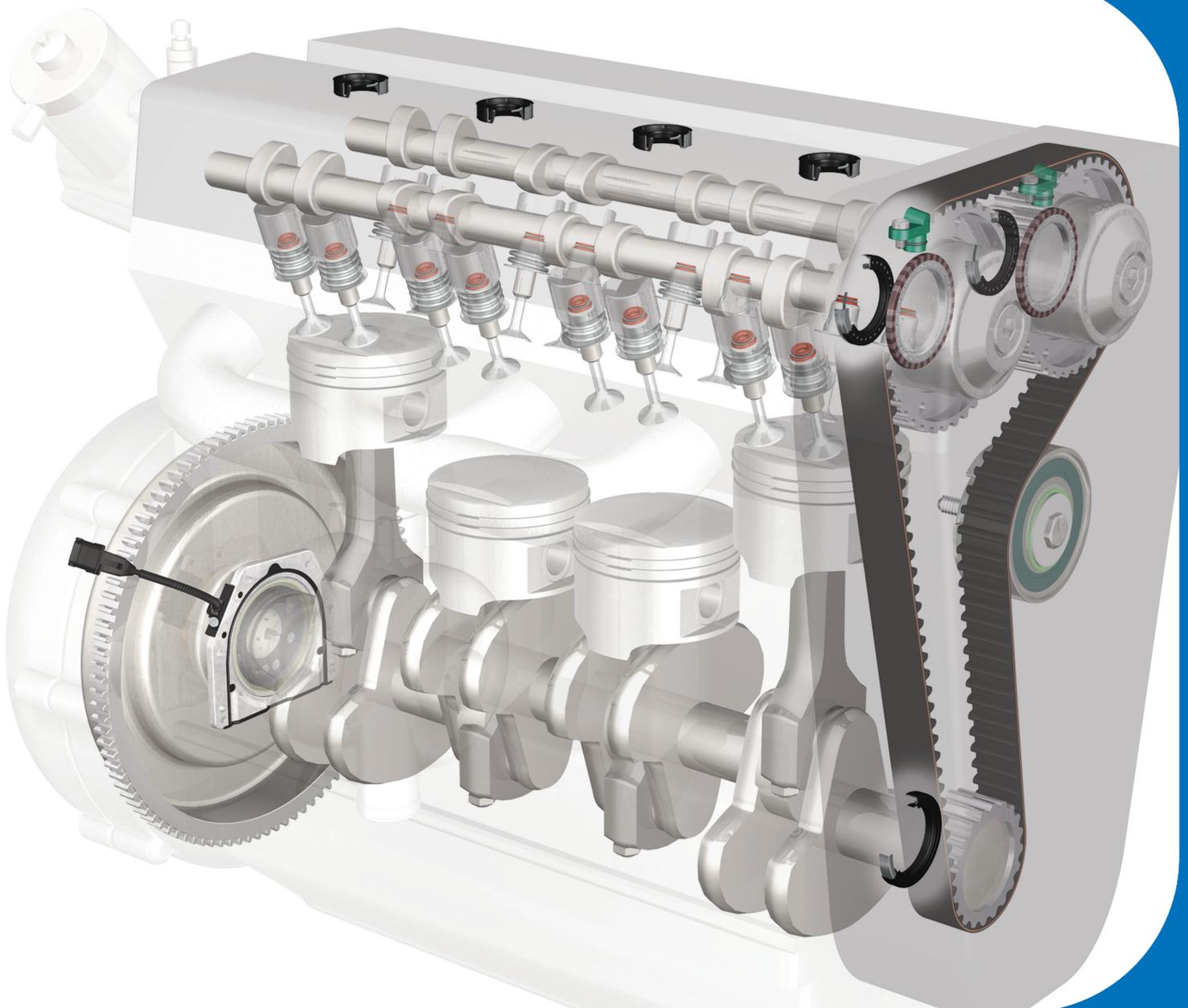


Engine seals





Engine shaft seals

SKF offers a wide range of engine shaft seals which provide optimum performance for automotive applications. Our extensive testing capabilities enable us to provide advanced and reliable products. SKF shaft seals are available for engine crankshafts and camshafts as well as for auxiliary units.

A variety of outer diameter designs are available for optimal installation and retention of the seal. For particularly difficult operating conditions, SKF can also provide a number of alternative seal designs that include specialized dust exclusion features.

SKF engine shaft seals provide optimum performance under the most extreme operating conditions.

Custom seals are available for applications where any of the following conditions exist:

- Significant misalignment
- Aggressive lubricants
- High level of external contamination
- Extreme temperatures and pressures
- Very high speeds

Depending on the application and operating conditions, SKF can offer a variety of seal designs. In addition, all of the lip features shown on the following pages can be integrated into special custom designs, e.g. plastic bayonet fitting and SKF Rotostat sealing module.

The matrix below provides an overview of the major seal types and the typical applications of each. All shaft seals can be integrated into an SKF Rotostat sealing module.

Shaft seal application matrix

	Typical vehicle		Application			
	Light vehicle	Heavy duty	Camshaft	Crankshaft front	Crankshaft rear	Auxiliary shaft
Spring loaded FKM seal	X	X	X	X	X	X
PTFE 3rd generation	X	X	X	X	X	X
PTFE 4th generation	X		X	X	X	(X)
SKF Low Friction Engine Seal	X		X	X	X	(X)
PTFE cassette seal		X		X	X	

(X) for heavy-duty also

Spring loaded FKM sealing lip

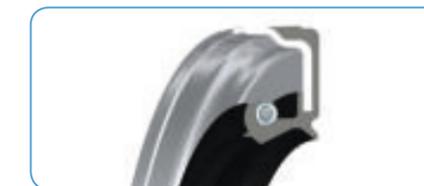
The conventional spring loaded sealing lip design using FKM elastomer provides excellent sealing performance and has been the standard for many years. The function of the spring is to provide positive contact with the shaft under a wide range of operating conditions. It also compensates for wear. The sealing lip incorporates hydrodynamic features to support the sealing function by pumping oil back into the engine. A wide selection of dust lips are available to minimize the ingress of contaminants.

Advantages of the spring loaded FKM radial lip seal:

- Improved reliability
- Extended service life
- Ease of installation and secure retention
- Excellent fluid resistance
- Wide temperature and pressure range

PTFE sealing lip

In addition to the spring loaded FKM sealing lip designs, SKF engine shaft seals are also available with a polytetrafluoroethylene (PTFE) sealing lip, utilizing a PTFE wafer. This robust seal provides optimum performance



Spring loaded FKM seal

for the higher temperatures and more aggressive fluid environments of all rotating shafts in engines. The PTFE wafer is permanently bonded to the seal, so there is virtually no risk of bypass leakage.

SKF has a long history of using PTFE for sealing solutions, enabling us to develop advanced designs using leading-edge technology. SKF offers two basic PTFE seals. In addition to the standard concept (PTFE 3rd generation), SKF provides a version with the sealing lip reversed (PTFE 4th generation). Both seals are highly reliable. However, the 4th generation is easier to install.

The advantages of SKF PTFE seals are:

- Superior chemical resistance for most aggressive oils and fluids
- Wider temperature range than FKM seals
- Lower friction and power loss compared to spring loaded designs
- Helps overcome shaft deficiencies because of a long lip lay-down
- Excellent dry-running capability
- Reduced shaft wear

These advantages enable significantly longer service life.



3rd generation PTFE seal



4th generation PTFE seal

Low friction elastomer sealing lip

The new low friction seal has been developed to meet automotive industry targets for fuel efficiency and reduced emissions. The low friction elastomer sealing lip design is based on the wafer technology used for PTFE shaft seals. However, these seals use a specially formulated FKM material with improved compression and relaxation properties to compensate for the lack of a spring. The result is a seal design that provides very low friction and long service life.

Advantages of SKF Low Friction Engine Seals:

- Low friction and power loss to help minimize fuel consumption and CO₂ emissions
- Outstanding sealing security for long life
- Gas tight sealing lip for the engine air leak down test
- Highly effective and long-lasting even at high-speeds
- Good ability to accommodate eccentricity and dynamic run-out
- Good dry-running ability
- Minimal shaft wear

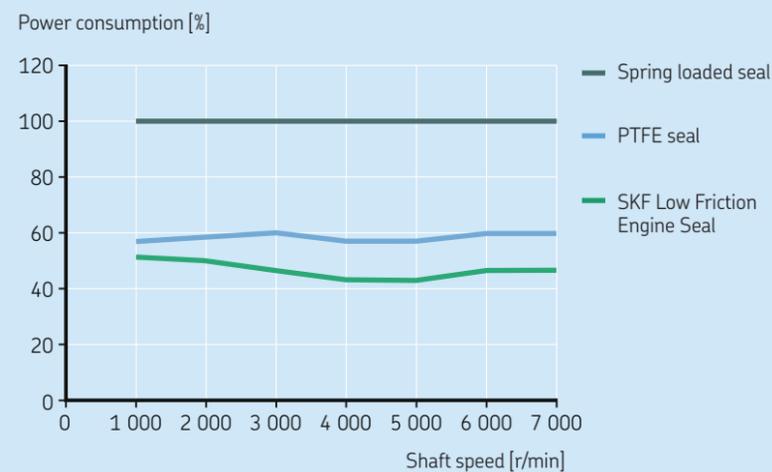


SKF Low Friction Engine Seal

SKF has developed a powerful tool to simulate the real life influence of friction reduction in the powertrain and driveline of vehicles. The SKF Vehicle Environmental Performance Simulator (VEPS) takes vehicle data running in standard drive cycles (e.g. the European NEDC cycle) and can calculate the savings of CO₂ emissions and fuel economy.

Compared to conventional elastomer shaft seals, VEPS calculates that a saving of 1.04 g/km is achieved when all engine shaft seals are replaced with the SKF Low Friction Engine Seal. This has been calculated for a popular D class car with manual transmission and spark ignition engine running in the NEDC cycle.

Comparison of power consumption of shaft seals



Cassette seals

Trucks and off-highway vehicles most frequently operate in dirty, dusty and wet environments. For these types of applications where long service life is critical, SKF recommends the use of cassette seals.

Axial cassette seals

The axial cassette seal is an innovative and robust solution using an axial sealing lip with a garter spring instead of a radial sealing lip. The garter spring provides a constant axial load. The axial lip rides on a flinger/wear sleeve on which an additional radial lip runs.

Axial cassette seals add value by delivering the following advantages:

- Hydrodynamic features designed to improve sealing performance
- Cassette solution protects the seal during transport and handling
- Able to accommodate static and dynamic misalignment
- Accommodates thermal expansion and axial movement
- High tolerance on radial movement of the shaft
- Optional felt dirt excluder and cassette design provide better protection against contaminants

PTFE cassette seals

Under normal operating conditions, non-cassette seals, like the ones described earlier, will meet the needs of most car and truck applications. However, for particularly harsh operating environments, like those found in off-highway applications, unique solutions are often necessary. When the presence of water and mud is likely, PTFE cassette seals, which optionally use a conical PTFE wafer and an axial PTFE contacting dust lip, are an excellent solution. The wear sleeve, which is part of the cassette, helps to protect the seal to provide an additional layer of protection.



PTFE cassette seal



Axial cassette seal



SKF Rotostat sealing module

The SKF Rotostat sealing module is a combination of dynamic and static seals bonded directly to a carrier or retainer, allowing for multiple components to be combined into one ready-to-install sealing unit for crankshafts. This includes a rotary shaft seal, a retainer, static seals between the retainer and engine block/oil pan and centring dowel pins. SKF has extensive production experience with SKF Rotostat sealing modules, enabling us to develop advanced designs which can be tailored to individual application requirements.

SKF Rotostat sealing modules provide the following benefits:

- Design flexibility to be able to use all previously described sealing lips
- Leak paths reduced by 50%
- One-piece design reduces installation time and errors
- Self-centring to cylinder block by integrating dowels into the retainer
- Reduce weight by up to 30% compared to an assembled die-cast retainer
- T-joint gasket feature improves sealing at the interface between SKF Rotostat, engine block and oil pan
- Ability to integrate with sensors

SKF Rotostat sealing module with sensor

Further developments of the successful SKF Rotostat sealing module have focused on the integration of magnetic trigger wheels for engine management. The basic function of the sensor is to provide input on speed and angular position of the crankshaft for engine, fuel and transmission management systems.

The system provides high accuracy, as the torsional vibration of the crankshaft is at a minimum at the flywheel (the location of the module). In addition, SKF can offer magnetized trigger wheels of high resolution which allow for a reduction of angular errors.

Depending on the application environment, the trigger wheel can be designed to also function as the seal counterface.

In addition to the advantages of the conventional SKF Rotostat sealing module, the integration of a sensing system provides the following advantages:

- Pre-assembled complete module with sensor and trigger wheel for reliable and easy installation
- Total system development and responsibility provides compatibility between the sensor and trigger wheel
- Locating the sensor outside the crankcase avoids cable sealing problems and simplifies replacement
- Improved system accuracy using magnetic trigger wheels to optimize vehicle management systems



Magnetic trigger wheels

Trigger wheels are typically found on camshafts and crankshafts. As the shaft turns, these wheels provide magnetic signals to a sensor that is connected to the vehicle's central control unit. Using these signals, the central control unit can determine the speed and angular position of the shaft. Today, SKF can supply trigger wheels with or without sensors as standalone units for camshafts, or as an integrated SKF Rotostat sealing module for crankshafts.

SKF magnetic trigger wheels provide the following advantages:

- High pitch precision for accurate sensing and optimum engine control
- Magnetic signal enables reduced size and cost of the sensor
- Simplified installation:
 - All components integrated into the sealing module
 - Available as a system complete with sensor
- Trigger wheel may be used as the seal counterface for a cassette system
- Different magnetic pole patterns available at no additional cost
- Excellent chemical resistance and temperature range for long service life
- High signal strength reduces sensitivity of the wheel to sensor air gap

Valve stem seals

Valve stem seals provide a defined metering rate of oil to the valve stem interface of internal combustion engines to lubricate the valve guide and minimize engine emissions. SKF valve stem seals are available for diesel and gasoline engines with or without boosting.

SKF offers two standard designs of "state-of-the-art" valve stem seals:

- Non-integrated seal (Type VSS): fulfils the function of oil metering
- Integrated seal (Type VSI): incorporates a spring seat to prevent cylinder head wear resulting from valve spring movement

The designs of SKF valve stem seals provide a number of excellent dynamic sealing characteristics:

- Flexible lip to allow valve stem movement and static eccentricity
- Lip stabilized by bonded reinforced ring
- Constant radial force through use of a tempered garter spring

As a European market leader in valve stem seals, SKF can offer the following advantages:

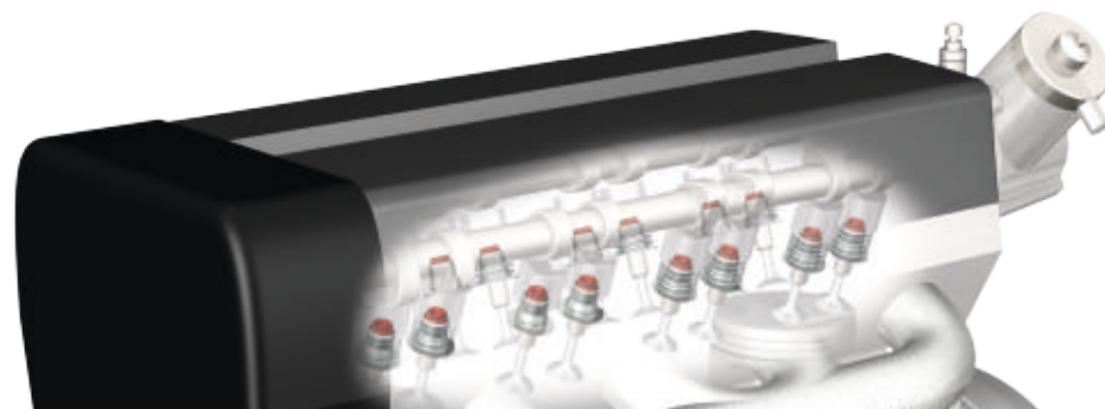
- Consistent oil metering and long service life for optimum valve lubrication and minimum engine emissions
- Develop seals to specific customer requirements or use standard seals
- Excellent chemical resistance
- Ability to accommodate a wide range of temperatures
- High wear resistance



Non-integrated designs



Integrated design



High pressure valve stem seals

In addition to the standard designs described on the previous page, SKF has developed a new valve stem seal design for high pressure engine applications. The high pressure in the manifolds can arise through engine downsizing using high boost pressures as well as back pressure from the exhaust system. In heavy-duty vehicles (trucks and buses), very high pressures can arise when an exhaust brake is in operation. High pressure valve stem seals improve the quality of emissions and enhance engine operation by withstanding higher pressures in the exhaust and intake ports of the engine, while maintaining their primary function as an oil metering device.

Because an additional sealing lip adds friction to the system, SKF has included special design features to minimize this increase by fine tuning the geometry and using a patented beaded lip feature which captures an oil film under the pressure lip.

The design characteristics of the high pressure valve stem seal provide excellent dynamic sealing abilities:

- Independent pressure lip allows the main lip to function under high pressure for consistent oil metering
- Reduced risk of valve stem scuffing and guide wear as optimum lubrication is maintained under pressure
- Special static seating design avoids popping off under pressure – a groove is required in the valve guide
- Minimum blow-by of exhaust gases leaking past the seal
- Design features incorporated to provide lowest friction even with the addition of an additional sealing lip.

In addition to all the benefits of existing SKF valve stem seal technology, the new high pressure valve stem seal design enables cost savings in the engine blow-by system. The blow-by gas volume is reduced as the sealing lip does not open. This means that capacity and size of the oil separation unit can be decreased.

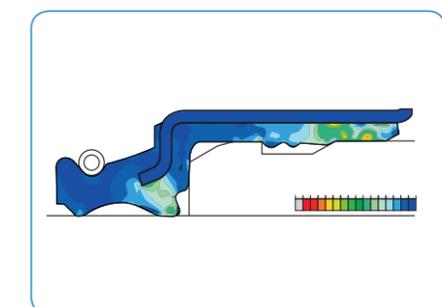
For additional information, see the *Valve stem seals* dedicated product brochure.



Non-integrated designs



Integrated design



Additional engine sealing solutions

Spark plug and injector tube seals

SKF offers static seals that can accommodate a high degree of misalignment for sealing spark plugs in gasoline engines, for solenoids, or for injectors in diesel engines.

To improve power and efficiency, the position of the spark plug or the injector is typically the centre of the combustion chamber. These components typically pass through the cylinder head cover. Because it is necessary to retain oil inside these covers, a special seal is required. SKF has designed a unique seal for these applications, providing the following advantages:

- Easy servicing as the cover does not have to be removed for unit access
- The moulded-in spring design seals under high misalignment conditions and prevents the spring from popping off during installation
- The rubber coated seal is resistant to corrosion
- Increased temperature range over standard materials



Spark plug tube seal

PTFE shaft seals for auxiliary units

Due to increases in fuel economy and reductions in emissions and CO₂, the automotive industry is moving to downsize engines while at the same time maintaining or even increasing power output. This is leading to increased use of boosting and high pressure direct fuel injection.

SKF is addressing the sealing needs in these applications with PTFE shaft seals for injection pumps and superchargers.

These shaft seals utilize a specially formulated PTFE wafer for optimum running with little lubricant and in the presence of fuel (diesel, gasoline or alternative fuels).

Advantages of PTFE shaft seals in these applications are:

- Improved resistance to fuels and lubricants
- Wider temperature range than elastomers
- Low friction, power loss and shaft wear through special PTFE formulations
- High pressure resistance



PTFE shaft seal

Bayonet shaft seals

The bayonet shaft seal is a special design used when high installation forces are to be avoided. The radial static seal on the outside diameter is replaced by a flexible axial static seal. In this case, the fixing is performed with a plastic bayonet, similar to the system for camera lenses.



Sealing Solutions from SKF

In addition to engine seals, SKF products provide complete automotive sealing solutions for transmission, driveline, steering and suspension systems. This single source approach is possible through a worldwide network offering one-source accountability. In all SKF sealing concepts, there is a strong focus on minimizing friction, either to minimize CO₂ emissions and fuel consumption or to improve the functional characteristics.

Global availability

SKF has the commitment and global resources to support the unique requirements of its customers' operations. With a global operations footprint, SKF offers sealing solutions for rotating and reciprocating applications from prototype to serial production close to its customers.

Engineering and R&D

SKF uses the Design for Six Sigma (DFSS) methodology to develop best-in-class products and manufacturing processes. With increasing pressure to save development time and cost, SKF engineers also benefit from a proprietary and newly designed software which helps SKF designers to simulate sealing performance under a variety of conditions to receive confirmation of seal design suitability.

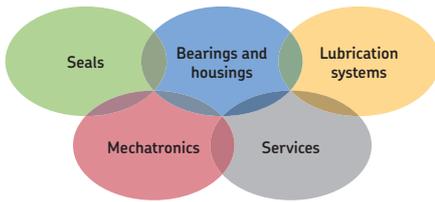
Materials

The selection and development of suitable materials is a critical element in sealing technology. Seals must resist increasingly high temperatures, forces and pressures. Specific media, alternative fuels or lubricant properties must also be considered to provide the right solution for specific customer application requirements. Newly developed materials include elastomers that provide lower friction or withstand a wide operating temperature range.

Testing and analysis

SKF has a global network of testing facilities which are equipped to fully validate the function and performance of engine seals. Advanced testing, such as key life testing which uses test profiles and operating conditions taken from real applications, is available as well as testing in customer components and assemblies. All tests are conducted using final application requirements to represent end user working conditions.





The Power of Knowledge Engineering

Combining products, people, and application-specific knowledge, SKF delivers innovative solutions to equipment manufacturers and production facilities in every major industry worldwide. Having expertise in multiple competence areas supports SKF Life Cycle Management, a proven approach to improving equipment reliability, optimizing operational and energy efficiency and reducing total cost of ownership.

These competence areas include bearings and units, seals, lubrication systems, mechatronics, and a wide range of services, from 3-D computer modelling to cloud-based condition monitoring and asset management services.

SKF's global footprint provides SKF customers with uniform quality standards and worldwide product availability. Our local presence provides direct access to the experience, knowledge and ingenuity of SKF people.

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PUB SE/P2 10731/2 EN · October 2013

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