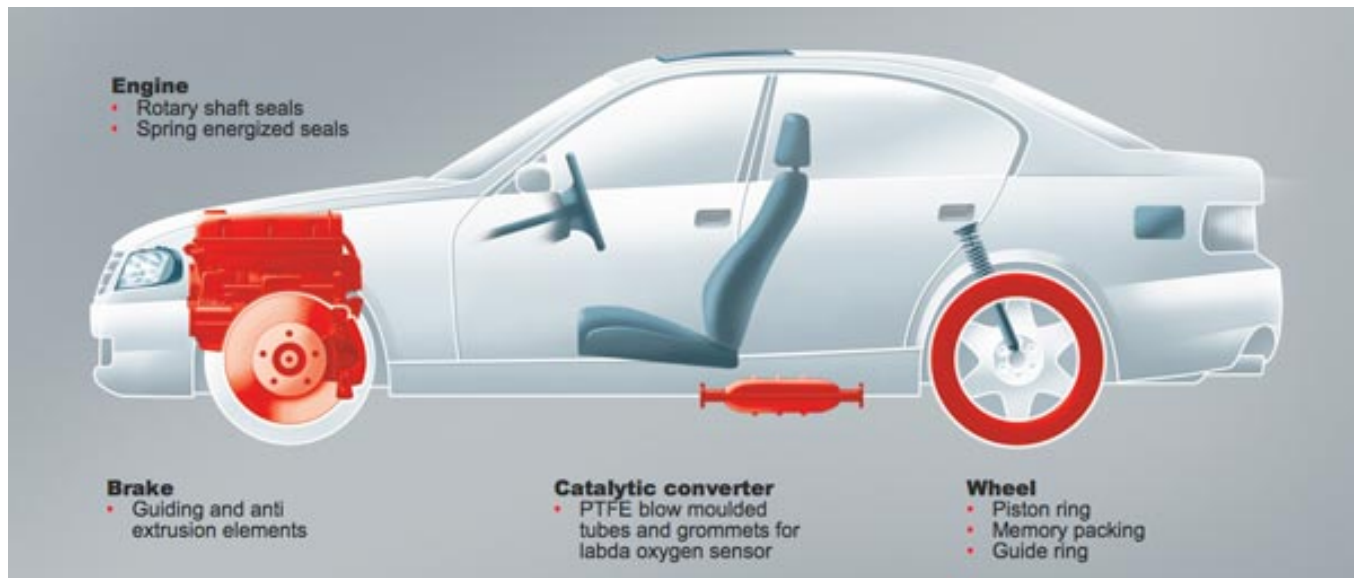


## Where Other Materials Fail



PTFE Applications in Automotive Engineering

## Versatile Uses of PTFE High-Performance Plastics in Automobiles

As an innovation in the area of PTFE, a new material, Moldflon, recently opened up the opportunity to manufacture PTFE parts by means of injection-molding technology. Particularly with high volumes, this represents an economically attractive alternative. The following article describes some areas of application in the automotive sector.

Technological progress and rising demands made on assembly components increasingly often require the use of the high-performance plastic PTFE (polytetrafluoroethylene). Properties like a wide temperature band from  $-50^{\circ}$  to  $+280^{\circ}$  °C, universal chemical resistance as well as extremely high wear resistance in no-lube service expand the range of possible solutions available to developers and enhance the level of safety compared with other plastics such as elastomers. In the area of PTFE, ElringKlinger's new "Moldflon" material opens up the opportunity to manufacture PTFE parts by means of injection-molding technology. Particularly with high volumes, this represents an economically attractive alternative

### Gasoline High-Pressure Direct Injection

With gasoline direct injection engines, the air-fuel mixture is generated directly in the combustion chamber. The fuel is directly injected into the combustion chamber by high-pressure injectors, resulting in higher engine power output, reduced fuel consumption and lower emissions. With new gasoline direct injection systems, a high-pressure pump generates fuel pressures of up to 200 bar, which are then led directly to the high-pressure injectors. The injectors meter and spray (atomize) the fuel into the combustion chambers. PTFE seals are used in the high-pressure pumps as well as in the high-pressure injectors and have to meet the following requirements:

- high wear resistance due to extreme axial piston speeds
- high pressure stability
- piston speeds of up to 3 m/s
- wide service temperature range from  $-40^{\circ}$  to  $+150^{\circ}$  °C

- very good sliding properties to avoid frictional losses
- special seal geometries enabling media separation between fuel and engine oil
- chemical resistance to all standard fuels and engine oils.

These extremely high requirements can only be met by sealing materials offering very high levels of wear resistance as well as pressure and temperature stability. PTFE as a base material delivers the requisite chemical resistance and good sliding properties. Various filler combinations of anorganic and organic substances ensure wear resistance and pressure stability. The use of PTFE seals featuring various geometries and made from highly wear-resistant PTFE compounds guarantees reliable sealing performance over a very long service life of 6,000 operating hours.

### **Oxygen Sensors for Catalytic Converters**

Oxygen (lambda) sensors are used in the exhaust system of internal combustion engines. The sensor provides information as to whether the air-fuel mixture needs to be adjusted such that it becomes richer (higher ratio of fuel) or leaner (higher ratio of air). This enables optimum control of the air/fuel mixture. Due to the extremely high temperatures in the area of the catalytic converter, which may amount to as much as 300°C, highly temperature-resistant plastics are required for wiring troughs and protection tubes. For these applications, PTFE offers ideal benefits:

- temperature resistance up to 300 °C
- very good chemical resistance to exhaust gas components, engine oils and degreasers
- very good electrical insulation properties
- high dimensional stability of the PTFE grommet against pressure
- high reverse bending strength of the molded PTFE tubes.

The following assembly components are used in this application: the PTFE grommet serves as a wiring trough and as electrical insulation of the wiring inside the oxygen sensor. Very often, dimensionally stable PTFE/glass fiber compounds are used for this purpose, as they provide very good insulation and pressure stability under temperature loads. The molded PTFE tubes are used as bending protection for cables and wiring as well as for sealing against external influences like water spray, degreasers and engine oil. The PTFE tubes are made using a special blow-molding process. The blanks are paste-extruded PTFE tubes, which are then blow-molded into the desired shapes in special molds.

### **Seals for Air Spring Compressors**

Air spring compressors are used to generate the compressed air which is required for air (pneumatic) suspension and automatic level control systems in automobiles. The air suspension serves to enhance ride comfort. In addition, the ride height of cars traveling at higher speeds can be lowered to improve the vehicle's road-holding ability and thus safety. Particularly with station wagons and commercial vehicles, automatic level control or self-leveling systems ensure consistent ride height and thus the same spring rates, even in case of high payloads, which clearly improves the vehicle's handling. The following requirements must be met by the sealing elements: temperature resistance from -40° to +200°C, compression pressure up to a maximum of 22 bar, service life up to 1000 hrs, no-lube operation. A distinction is made between wobble-plate and reciprocating piston compressors. On account of the high compression the sealing elements used in either system are exposed to temperatures of up to 200 °C. This represents a major challenge for the material, which is subjected to high temperatures in conjunction with high pressure loads. But even at -0 °C and at an altitude or elevation of 4000 m, the compressor has to provide the specified pressure within a certain space of time. If this time frame is exceeded, a failure message will be triggered in the car, resulting in an unscheduled visit to the garage. Thanks to high-performance PTFE materials, these challenges can be successfully met today. With standard PTFE compounds available on the market, this would not be able possible.

### **ABS/ESP Braking Systems**

ABS/ESP braking systems use piston pumps to actuate the braking function.

These systems use sealing and guide rings, which have to perform the dual function of guiding the pump piston and sealing the brake fluid against the atmosphere. The components have to meet the following requirements:

- pressures up to a maximum of 200 bar
- temperatures from -40° to +130 °C

- media resistance to standard brake fluids
- low friction.

The braking function is of vital importance in a vehicle. For this reason, all PTFE components used in braking systems are safety-critical components, and process-capable production is compulsory. All relevant geometry and material data is subject to documentation. The pump's function requires very narrow tolerances of the PTFE assembly components. These ensure constant friction of the pump piston across the temperature range.



Endurance wear test rig for radial shaft seal rings.

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