Trelleborg Sealing Solutions is a leading supplier of advanced sealing solutions to automotive Original Equipment Manufacturers (OEMs) and their component suppliers. We are able to match the high volume, stringent quality and advanced delivery demands of the industry on a global level. Our local engineering and development support teams work with customers to develop innovative solutions to meet automotive application challenges. Customers are supported by a worldwide network of expertise and strategically located manufacturing and logistic centers.

**Local Presence, Global Reach**

Trelleborg Sealing Solutions offers an exceedingly comprehensive sealing portfolio – a one-stop-shop providing the best in elastomer, thermoplastic, PTFE and composite technologies. Our solutions are featured in virtually every application conceivable within the aerospace, automotive and industrial industries.

**SEAL THROUGHOUT THE VEHICLE**

Seals are used throughout today’s passenger cars. These include O-Rings that withstand high pressures in shock absorbers, sophisticated gaskets in electronic control units (ECUs), safety critical custom-molded components in braking systems and seals that withstand extreme temperatures, pressures and aggressive media in fuel injectors.

With over 60 years of experience, Trelleborg Sealing Solutions is a leading global supplier of high quality sealing solutions, custom-made to meet the demanding needs of the automotive industry.

**MEETING DEMANDING REQUIREMENTS**

As the demands from today’s OEMs and their component suppliers become more challenging, Trelleborg Sealing Solutions constantly develops new materials and products to meet ever-changing needs.

Our solutions can contribute to reaching vehicle design targets for requirements such as lightweighting, efficiency, recyclability and lowering overall costs. This is achieved by adapting our offerings to new technologies such as electronic controls, bio-fuels, advanced ride controls and sophisticated fuel systems.

Our sealing expertise and solutions provide uncompromising reliability in safety critical applications. Our seals are designed with low friction characteristics which optimize rotating linear movements, and features which allow superior sealing of lubricants while excluding external media and protecting equipment components from environmental damage.

Having worked on so many major vehicle platforms worldwide, our experience and ingenuity is key to providing the optimal sealing solution for your application.

**LOCAL AND GLOBAL**

Wherever a product is originally designed, we can meet your local market demands through our global R&D, sales and logistics centers. The global strength of Trelleborg Sealing Solutions offers high quality standards through select manufacturing sites, delivered to you through our global and local network. This means that we meet your global production and logistics needs while keeping our focus on your local market.

**INNOVATIVE ONLINE TOOLS**

Read the book. See the movie. Now you have the brochure, why not check out our automotive films on YouTube or at www.tss.trelleborg.com/films

Trelleborg Sealing Solutions offers a range of cutting-edge online services and tools available on our website and via apps for Android and iPhone

- Full range of Catalogs and Brochures
- Sealing Solutions Configurator
- CAD Service
- O-Ring Calculator
- Converter

www.tss.trelleborg.com/tools

Trelleborg Sealing Solutions in General

Trelleborg Sealing Solutions offers an exceedingly comprehensive sealing portfolio – a one-stop-shop providing the best in elastomer, thermoplastic, PTFE and composite technologies. Our solutions are featured in virtually every application conceivable within the aerospace, automotive and industrial industries.

- Over 80 facilities worldwide
- Internationally linked design and application centers
- Seven strategically positioned materials and development laboratories
- More than 20 manufacturing sites
Application Overview

A wide variety of sealing solutions are used throughout today’s passenger cars. These are specially developed to continuously meet the most challenging needs of today’s OEMs and their component suppliers.

**Battery**

**Challenge:** Extend battery life  
**Solution:** Ventseal  
**Added Value:** Combines a seal and pressure relief valve function in one product

**Electronic Control Units**

**Challenge:** Keep external media and water away from sensitive electronics  
**Solution:** Specially designed rubber-to-metal bonded Rubore® Seals  
**Added Value:** Allows reliable automated assembly, significantly lowering manufacturing costs

**Thermal Management**

**Challenge:** Poor lubrication of water glycol mix and need for tight tolerances  
**Solution:** Special rotary seals, Rubore® Seals, gaskets, O-Rings, PTFE components  
**Added Value:** Precision custom-made seals meet tolerance and application requirements

**Fuel Injection**

**Challenge:** Effective performance in high pressure and low temperature conventional and bio-fuel applications  
**Solution:** O-Rings, custom-made gaskets, PTFE square-cut rings  
**Added Value:** Specially formulated low temperature materials

**Exhaust Gas Recirculation (EGR) System**

**Challenge:** Ensure the effective operation of the recirculation air valve  
**Solution:** Specialized EGR seal  
**Added Value:** EGR systems are used in direct injection diesel engines to reduce the amount of NOx. Mechanical valves, actuated by electrical devices, control the exhaust flow. The valve is sealed either with a PTFE or an elastomer sealing solution.

**Braking**

**Challenge:** Ensure the operation of brakes; the ultimate safety critical application  
**Solution:** O-Rings, custom molded parts  
**Added Value:** Separate mixing lines for compounds to ensure material quality

**Ride Control**

**Challenge:** Enhance vehicle performance including the suspension compound and shock absorbers  
**Solution:** Twinseal, O-Rings, Buffer Ring, Back-up Rings, Vaneseal  
**Added Value:** Superior ride with an added leveling function

**Safety Components**

**Challenge:** Absolute quality  
**Solution:** Custom 2-Component Parts  
**Added Value:** Reduces assembly risk, 100% in-process quality checks on a fully automated line

**Air Conditioning**

**Challenge:** Prevent leakage of refrigerant from air conditioning lines and ensure compressor performance  
**Solution:** O-Rings, PTFE seals, rotary seals  
**Added Value:** Materials compatible with refrigerants and low friction dynamic seals

**Electrical System**

**Challenge:** Protect the wiring harness and sensors from environmental damage  
**Solution:** Custom-made housing cover in thermoplastic material or in combination with silicone 2-component parts  
**Added Value:** Automated assembly provides 100% quality control in process

**Drivetrain and Transmission**

**Challenge:** Low friction and wear resistance needed for long life  
**Solution:** Rotary seals, Slydring®, Back-up Rings, O-Rings, gaskets  
**Added Value:** Fuel efficiency improvements and effective mounting, even in limited space

**For more details on products and materials, check out our application highlights.**
A wide variety of sealing solutions are matched to the demanding conditions of automotive applications. Here we explore some of these in detail.

**Fuel Systems**

Running at extreme temperatures and high pressures, secure and reliable sealing is required throughout the fuel system – in the fuel injectors, the common rail system, the fuel lines and fuel tank.

**Requirements for sealing the fuel system**
- Operate in a wide temperature range, very low to very high
- High pressure performance
- Optimized performance for efficient engine operation

**Sealing solution**
A range of seals are available for the different sealing environments within the fuel system, composed of specialized materials that have been engineered to withstand gasoline, diesel and bio-fuels, as well as temperature and pressure extremes.

- Trelleborg products: O-Rings, engineered molded components, reinforced diaphragms, PTFE based square-cut rings
- Special low temperature material
  - Trelleborg Sealing Solutions has developed a fluoroelastomer sealing compound for fuel injection applications that performs at extremely low temperatures.

**Ride Control**

The objective of ride control systems is to combine steering stability with good handling characteristics while maximizing passenger comfort. The ride control system incorporates the suspension system and shock absorbers.

**Requirements for sealing ride control**
- Low friction avoiding stick-slip
- Wear resistant
- Chemical resistant

- **Twinseal:** Very low friction rod seal
- **O-Rings:** Low temperature flexibility
- **Buffer Rings:** Avoids metal-to-metal contact and reduces leakage
- **Back up Rings:** Supports O-Rings in high pressure situations
- **Vaneseal:** Specialty sealing

**Electronic Control Unit (ECU)**

Sophisticated electronics that control key functions of the car are housed in the metal/plastic box of an ECU. Often situated in the engine compartment or other areas subject to environmental conditions, good sealing is vital as failure is not an option.

**Requirements for sealing ECUs**
- Effective sealing of casings to reliably exclude any media that may affect sensitive electronics
- Materials must stand up to the harsh conditions of the engine including temperature extremes and salt spray from the road
- Low media permeation, for example from transmission oil

**Sealing solution**
The Rubore® Cover Seal integrates the seal and ECU cover into one single unit, thereby eliminating costly manual installation. This results in a perfect solution at a reduced cost. In addition, integrating the ECU cover and the seal in the Rubore® Cover Seal reduces the number of parts, minimizing logistics, assembly and administration costs. Full elastomer gaskets are also available for a wide variety of applications. In-house testing of permeation is available.

- **Trelleborg products:** Engineered molded components, Rubore® Seals, O-Rings
- **Special low temperature material**
  - Trelleborg Sealing Solutions has developed a fluoroelastomer sealing compound for fuel injection applications that performs at extremely low temperatures.

→ See Material Spotlight on page 12 for more information
# Safety Systems

Today’s cars include a wide range of safety solutions, including airbags installed to surround the front and rear seats, to protect drivers and passengers.

**Requirements for sealing airbags**
- Absolute quality throughout production over very high volumes
- Small seals with tiny flash-free holes

**Sealing solution**
Trelleborg Sealing Solutions capabilities in liquid silicone rubber injection molding technology are used to produce safety critical components, completely flashless, in a clean and fully automated process.

*In a proprietary co-injection process, a technical thermoplastic and a silicone are formed into a fully bonded high-precision composite. This 2-component seal runs 24/7 to meet high volume demands. Inspection is built into the process with a 100 percent check online.*

**Trelleborg products:**
- Sensor covers

→ See Technology Spotlight for more information on page 12

# Drivetrain and Transmission

The drivetrain and transmission of a vehicle adapts the output of an engine to the drive wheels. Engines operate at relatively high rotational speeds and the transmission reduces that speed to the slower wheel speed, increasing torque in the process.

**Requirements for sealing transmission and axle systems**
- Advanced rotary sealing solutions
- Low friction to optimize the transmission’s operation
- Outstanding wear resistance to extend transmission life
- Resistance to the lubricants within the transmission

**Sealing solution**
Complex sealing configurations combine a number of advanced seals that seal in lubricants, prevent ingress of external media and, with unrivalled low friction, allow maximum performance in rotary applications.

**Trelleborg products:**
- Turcon® Roto L, Slydring®, Back-up Rings, O-Rings, X-Rings, Rubore® Seals, gaskets

Specialty rotary sealing
The unique Turcon® Roto L Seal is ideal for tire inflation systems and other drivetrain applications.

→ Find out more in the Technology Spotlight on page 12

# Thermal Management

Engines operate at high temperatures, and to maximize the life of certain engine components, they must be cooled using fluid that goes through the radiator.

**Requirements for sealing engine cooling systems**
- Operate in combination with high rotational speeds and high pressure
- Reliable low-friction sealing to reduce CO₂ and save fuel
- Withstand coolants and lubricants and operate in poor lubrication conditions

**Sealing solution**
Specialized seals manufactured using the Rubore® Seal technology or standard full elastomer gaskets, provide custom-made solutions with extended sealing life.

**Trelleborg products:**
- Rubore® Seals, gaskets, O-Rings
Air Conditioning

A car’s air conditioning system is complex, with a multitude of O-Rings running throughout the pressure lines to and from a belt-driven/electric compressor. Every connection point needs to be sealed.

Requirements for sealing air conditioning systems
- Operate under relatively high pressure
- Fit into small installation spaces
- Minimized wear to maximize seal life
- Fulfills environmental legislation for zero-leakage requirements

Sealing solution
Custom-designed engineered molded components can incorporate multiple parts into a single product, allowing installation into the limited space available in air conditioning systems. Materials are engineered to prevent stick-slip and extend seal and system life where air conditioning use is limited.

Trelleborg products:
O-Ring, special PTFE rotary seals

Brakes

Being the most safety critical component of all automotive applications, it is vital that the brakes will activate instantaneously when needed.

Requirements for sealing brakes
- Consistent quality over high volumes
- Media resistant to brake fluids

Sealing solution
The quality of braking components is ensured with materials specially compounded on mixing lines dedicated to brakes.

Trelleborg products:
O-Rings, custom molded components

Battery

The battery provides power to a number of critical systems in the car and without it, the vehicle is inoperable. Start-stop options, as well as hybrid powertrains used to minimize emissions, have challenging impacts on new battery technologies. Drivers expect to start their car whatever the weather; first time, every time. For that kind of operational dependability, reliable sealing and battery venting is needed.

Requirements for sealing batteries
- Outstanding reliability
- Extended seal life
- Operation in extreme temperatures

Sealing solution
The Ventseal is specially designed for locked container applications such as batteries. It combines a seal and pressure relief function all in one product.
Hundreds of seals are used throughout the modern vehicle. They vary from simple O-Rings to custom engineered components, from advanced Turcon® geometries to robust rotary options. Here we highlight unique product technologies and materials primarily used within the automotive industry. For information on our full range of products for automotive applications, please visit our website at www.tss.trelleborg.com/automotive

**Technology Spotlight – Rubore® Seals**

A unique advanced technology to create a sandwich composite material combining rubber, PTFE and metal layers; Rubore® Seals provide real benefits to customers.

Rubore® Seals are ideal for numerous vehicle applications including electronic control units, sensors, flange connections, pumps, automatic transmissions, electric motors, gear boxes, engine blocks, shock absorbers, clutches and suspension parts.

- **Reduces weight**
  The dimensional stability of Rubore® Seals allows for the design of thinner metal walls which leads to significant weight reductions compared to using full elastomer seals.

- **Compensates for roughness**
  The Rubore® technology is an effective way to cope with uneven surfaces and pinholes on metal parts. This eliminates the need for surface finishing and significantly reduces process steps and costs.

- **Lower handling costs**
  The stiffness of Rubore® Seals saves assembly time and lessens logistic requirements, lowering overall manufacturing costs.

- **Easy assembly**
  Assembly speed is increased and made easier through the stiffening of the elastomer component by the metal layer.
Technology Spotlight – Turcon® Roto L

Turcon® Roto L seal is the first ever active seal and is engineered to extend seal life on axle systems. Uniquely, it only seals when sealing is required. This reduces friction to lower fuel consumption and thereby conserves energy. It is ideal for sealing in drivetrain applications, such as the Central Tire Inflation Systems (CTIS).

Features and benefits
- Extended seal life
- Operates only when required
- Total system life sealing
- Low friction
- Minimal friction when not pressurized
- Capable of constant activation
- Saves energy
- Improved safety
- Minimizes wear
- Operates only when required
- Total system life sealing
- Low friction
- Minimal friction when not pressurized
- Capable of constant activation
- Saves energy
- Improved safety
- Minimizes wear

Material Spotlight – Specialized Materials

Relying on decades of experience and working with leading equipment manufacturers and end users around the globe, we have developed a portfolio of materials that are ideal for automotive applications. From basic elastomer grades to leading edge high specification compounds, our innovative sealing materials help optimize performance while ensuring sealing integrity.

XLT – THE NEW, TOUGHER FKM SERIES

The XLT family is the latest innovative series of low temperature peroxide-cured fluororubber elastomer grades from Trelleborg Sealing Solutions. XLT has been designed to specifically meet the challenging demands of automotive applications and is useful within high pressure direct injection applications.

Automotive trends affecting elastomer sealing materials
- Fuel changes – Materials need to be resistant to bio-fuel that are more aggressive to elastomers than traditional fuels.
- Stringent emission regulations – Seals must withstand different media, such as AdBlue, used for selective catalytic reduction.
- Greater efficiency – Materials must be resistant to a wider temperature range and pressure extremes.

Benefits of the XLT series
- Retraction (TR10) values ranging from -30 °C to -45 °C / -22 °F to -49 °F
- Increased chemical resistance especially against aggressive ethanol and methanol fuel mixtures
- Increased sealing capability in aggressive environments, for example, in engines
- Excellent retention of mechanical properties

Typical applications:
High pressure direct fuel injection

Testing of the new generation XLT materials in bio-fuel applications has proven that this family of materials outperforms and extends the temperature performance capability of traditional fluorocarbon elastomers, with comparably low volume swell and good retention of physical properties. They also demonstrate excellent chemical resistance against most media including more aggressive ethanol / fuel and methanol / fuel mixtures.

Optimized low temperature behavior
With TR10 values reaching -45 °C / -49 °F, excellent sealing capability is achieved, outperforming other fluorocarbon elastomers.

Superior chemical and fuel resistance
Typical results demonstrate the excellent fluid resistance of the XLT range in automotive reference fuels.

VOLUME SWELL, %
(aged for 168 hrs @ +60 °C/+140 °F)

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VOLUME SWELL, %
(aged for 168 hrs @ -60 °C/-140 °F)

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VOLUME SWELL, %
(aged for 168 hrs @ -80 °C/-176 °F)

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XLT / V9T3G, V8T3G
- High efficiency – Materials must be resistant to a wider temperature range and pressure extremes.
- Increased chemical resistance especially against aggressive ethanol and methanol fuel mixtures
- Increased sealing capability in aggressive environments, for example, in engines
- Excellent retention of mechanical properties

Typical applications:
High pressure direct fuel injection

The XLT family exhibits superior chemical and swelling resistance equivalent to a high fluorine terpolymer (70 % F*), but with exceptional low temperature performance, down to -49 °C / -49 °F TR10.

*Indicates fluorine content
The automotive industry demands specialist services from its suppliers. For seals, this ranges from the way orders are processed, to the way the seals are finished, packed and delivered. Meeting these requirements is vital to effectively supply components globally wherever the customer wants them, when they want them, in high volume.

**Turcon® M12 – High performance PTFE**

Turcon® M12 from Trelleborg Sealing Solutions is a PTFE based sealing material whose performance is unrivalled in key hydraulic sealing characteristics, such as friction, wear and high pressure operation.

Comprehensive testing has shown that no other PTFE based material can give such universally exceptional performance. Turcon® M12 is now recommended by Trelleborg Sealing Solutions as the material of choice for a wide variety of automotive hydraulic applications including:

- Cylinders for convertibles
- Shock absorbers
- Active body control

**Automotive trends affecting polytetrafluoroethylene (PTFE) based sealing materials**

Our Turcon® M12 PTFE based compounds have been developed in response to challenging vehicle applications.

- Pressures are increasing and require more stable fillers for improved extrusion resistance.
- With higher performance requirements, stick-slip needs to be avoided.
- To provide less wear and prevent micro scratching to the surface, friction must be minimized.

**Benefits of Turcon® M12**

- Avoids scratching on counter surfaces
- Low friction gives smooth movement
- Withstands high system pressure
- Outstanding wear resistance
- Good resistance to extrusion
- Resistant to virtually all media including a broad range of lubricants
- Extends seal life

**2-Component parts**

In a proprietary co-injection process, a technical thermoplastic and a silicone are formed into a fully bonded high-precision composite, creating the 2-component part. This fully automated process makes Trelleborg Sealing Solutions a market leader in Liquid Silicone Rubber (LSR) injection molding and 2-shot processing capabilities. If requested, 2-Component parts can be produced in state-of-the-art cleanrooms which offer completely flawless parts for use within safety critical applications.

**Automotive trends affecting liquid silicone rubber (LSR) injection molding**

- Lighter weight components
- Increasingly sophisticated on-board electronic systems
- Increasing driver safety features
- Increasing driver comfort features

**Benefits of 2-Component part solutions**

- Greater design latitude
- Feasibility of complex and micro components
- Excellent sealing function of the composite
- Elimination of the risk and costs associated with secondary assembly
- Significantly reduced TCO (Total Cost of Ownership)

**2-Component solutions with LSR**

- Thermoplastic in combination with LSR
  - LSR co-injection or over-molding with a select range of technical thermoplastic substrates such as:
    - PA
    - PBT
    - PSU
    - PPS/PPE
    - POM

- LSR in combination with LSR
  - Co-injection or Over-molding of dissimilar types of silicone into composite parts with varying properties such as:
    - Hardness
    - Color
    - Surface properties
    - Electro-conductive properties
Flexclean™ – Technical cleanliness for seals

Trelleborg Sealing Solutions has three technical cleanliness standards based on accepted international standards:

1. Defined particulate cleanliness
   As components and assemblies become smaller, more complex and have higher efficiency, functional density is increased. This narrows tolerances and makes component parts more sensitive to particle contamination.

2. Freedom from paint wetting impairment substances
   Clean components are a particular requirement within the lacquering process. The surface to be lacquered, as well as the smallest components within the painting system, have to be free from any contamination that may cause disturbances or disorders in the lacquered wettings.

3. Class 5 cleanroom quality, ISO 14644 – 1
   Some automotive components, such as electronic parts, require the ultimate in clean production, with the slightest contamination, even from airborne particles, potentially affecting component function. This is eliminated using cleanroom production where the concentration of airborne particles is controlled.

Flexcoat™ – Friction-free running

Trelleborg Sealing Solutions has developed a number of specialty coatings that improve the friction performance of elastomer seals. Choosing one of these has the following benefits:

• Saves time and enhances safety and security in automated assembly
• Cleaner process reduces associated time and cost of maintenance
• Ensures shorter process-flow times
• Increases opportunities for the use of simple and cost-effective elastomer seals
• Extends service life through improved wear properties
• UV coating indicators for automated detection
• Color coated for easy identification

Special Packaging

TUBE / MANDREL PACKAGING

- Transparent plastic tubes or paper mandrels
- Different colors and sizes available
- Any kind of seals particularly for critical geometries
- The tube can be mounted directly into the feeding station in the production line at the customer’s production site
- Resistant to environmental conditions and mechanical damage (e.g., transportation, water, dust, etc.)
- Improve packaging costs with reusable packaging

BLISTER PACKAGING

- Different variations of shapes and sizes
- Transparent or black PET materials available
- Various thickness from 3 to 6 microns
- Provides seals with special protection
- Offers cost effective packaging solutions and is recyclable
- Resistant to environmental conditions and mechanical damage (e.g., transportation, water, dust, etc.)
- Easy to store, stack and use in automated environments

EDI – EFFECTIVE ORDER HANDLING

Trelleborg Sealing Solutions has invested heavily in EDI (electronic data interchange) infrastructure to match its customers’ demands for data transfer. Customers’ orders and delivery schedules are directly transmitted to our enterprise resource planning (ERP) system. A manual input is no longer necessary, saving time and making order scheduling more accurate.

Automated Inspection and Quality

- Fully automated visual inspection, including dimensions and surface properties
- High flexibility with reliable quality and 100% quantity control
- Facilities are certified to ISO 9001:2008 and ISO/TS 16949:2009
- Identifies and controls irregular profiles with reference to the basic profile
- Inspects up to five parts per second
- Six camera and 360° sensor inspection capabilities provide inner and outer diameter analysis of each seal
Trelleborg is a world leader in engineered polymer solutions that seal, damp and protect critical applications in demanding environments. Its innovative engineered solutions accelerate performance for customers in a sustainable way. The Trelleborg Group has local presence in over 40 countries around the world.

WWW.TSS.TRELLEBORG.COM/AUTOMOTIVE