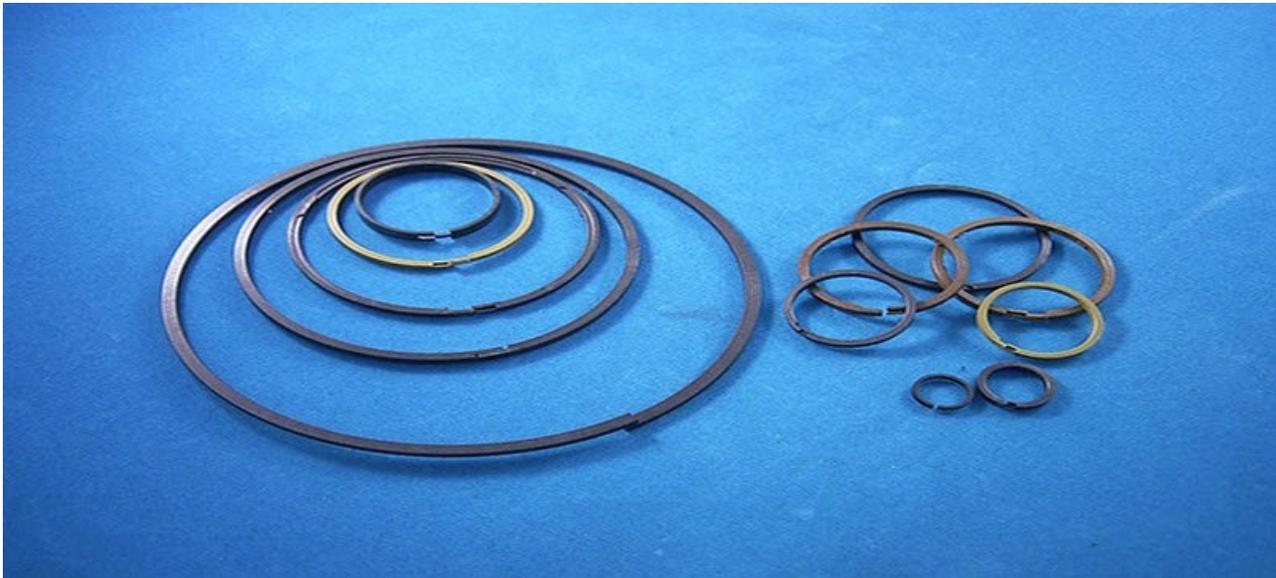


An Introduction to Rectangular Seals and Their Automotive Applications

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The three most important factors that seals working in critical automotive applications must address are: high speeds, high pressures and high temperatures. A type of seal that handles these factors are rectangular seals, so called for their rough rectangular shape, and they are used for rotating connections used when there is pressurized oil or fluid that must be transmitted between a stationary and rotating part.

Rectangular seals are used in rotating actuators such as clutches and pistons in automotive transmissions as well as in engines and oil pumps in order to protect the oil pressure supply. These seals have been specially designed for use in internal applications to withstand pressures exceeding one bar and fluid speeds above five meters per second for high volume applications.

Rectangular seals save space and money, therefore further improving their worth. At mere millimeters wide, they manage pressure and speed requirements that often cannot be met using other options, and offer low drag torque or parasitic losses from friction (due to pumping/throttling, friction between piston rings and cylinders or other factors). Other operating benefits include low leakage performance and assistance in lowering fuel consumption and emissions in engines and transmissions. As these parts are made using injection molding, they are able to be equipped with additional features such as

fixtures or lubrication channels.

Saint-Gobain Seals makes a series of rectangular seals that are produced using chemically robust, high performance thermoplastics (e.g., Meldin[®] material and others). This ensures a resistance to chemicals common in automotive applications. Rectangular seals are increasingly being used as an alternative to metal and other design options for use in high volume applications.

Rectangular Seals Keep Automobiles Moving

Rectangular seals are used in a myriad of applications including clutches, oil pumps, variable valve trains in engines and every type of transmissions — from planetary automatic transmissions (AT), to continuous variable transmissions (CVT), dual clutch transmissions (DCT), dedicated hybrid transmission (DHT), and more.

There are many options for transmissions nowadays, with the number of gears reaching seven for manual and up to 11 for automatic transmission. For these applications, seals are used to assist in converting power from the engine into the necessary speed and torque of the drivetrain, which can vary with the actual driving conditions.

This means that seal components have to withstand high temperatures due to frictional heat arising from operation and the pumping of fluids. Rectangular seals are ideal for use in the oil pressure supply of rotating actuators like clutches and pistons in transmissions, as they can resist high speeds and pressures that aren't able to be sealed by radial shaft or other special types of lip seals. The design of the seal also saves space, is robust and minimizes losses due to friction.

As well as being used in transmissions for conventional and self-driving vehicles, Meldin[®] rectangular seals are rigid and dimensionally stable enough to meet the strict requirements needed for use in [transmissions for high-end sports cars](#).

Typical operating conditions in a conventional automobile may have an engine speed of 6,000 RPM (maximum), temperatures up to 248 °F (120 °C) and pressures of 15 to 20 bar. However, [rectangular seals](#) in sports cars must be able to withstand engine speeds of 11,000 RPM, temperatures reaching 302-338 °F (150-170 °C) and pressure tolerances of 435 psi (30 bar). These seals are relied on to perform consistently over their lifetime, and provide a secure precise fit to minimize oil leakage and increase fuel efficiency.

With the numbers of both full and part autonomous drive automobiles, where the speed

or direction of the vehicle is automatic and requires no input from the driver, continuing to grow, there is a corresponding increase in the number of automatic transmissions worldwide and thus higher demands and volume of rectangular seals.

A Leader in Rectangular Seal Development Standards

Saint-Gobain Seals has over 40 years of experience in developing seals for the automotive industry, making them an obvious choice by Tier 1 automotive manufacturer Ford to develop guidelines for use in evaluating rectangular seals in the design and early stage of transmission development. It is important such guidelines are set, so that designs have a practical framework for decision making and are not started from scratch. On top of this, because of Saint-Gobain's decades of design engineering experience, they have been asked to develop additional types of guidelines such as the one to a key oil and gas customer for [isolation valves](#).

The following chart was developed to assist Ford, as well as any other Tier 1 and Tier 2 companies that require a framework, in which seals would best suit their application.

The illustration shows how the recommended materials used in the development of rectangular seals depends on diameter of the seal (shown along the top, x-axis) and the pressures that it will have to withstand (on the y-axis). For example, if you are looking to develop a seal with low pressure requirements with a 50 inch diameter, the best choice may be Meldin[®] 73-000 with polyamide-imide (PAI) due to its superior mechanical properties at very high temperatures (up to 275 °C). An alternative option could be Meldin[®] 55-100, with excellent thermal resistance, strong mechanical properties and chemical resistance.



Below are several other factors that should be considered when selecting a **seal**. These are the three best opportunities to enhance performance when seals come into contact with these parts.

- **Joints:** In rectangular seals there is a joint that can be opened and closed when in use to accommodate assembly, thermal expansion, moisture absorption and other factors. The precision of this joint dominates its leakage performance. For the best performance it is recommended to use a 2T shaped design. These “T-shaped” joints reduce the risk of the joint fingers blocking one another (the finger lengths in 2T joints are shorter than those in 2L and are more robust), and because of the lower clearance between joint fingers, the seal to reach lower leakage values. In certain applications, a 2L can also be used.
- **Mating parts:** Mating parts are also a key consideration for automotive suppliers looking for the best efficiency and low drag torque losses in seal performance. In order to reduce friction, it is necessary for automotive suppliers to reduce diameter. Additionally, to leverage hydrostatic balance and force to lower drag torque, the clearance between the bore and shaft and edge break at the groove’s edge should be minimized.
- **Counter faces:** The seal’s wear is a key factor in the overall lifetime of the application, with the most crucial component usually being the counter surface. Rectangular seals can run on non-hardened counter faces without a problem. By not hardening surfaces, the roughness value may be higher, and could be a cost saving for the manufacturer. However, if the hardening must be lower for another reason e.g. if a bearing or a gear is located near the seal's groove, it can still lead to higher production costs.

While the automotive industry is increasingly moving toward leveraging aluminum to save weight to reduce potential losses in acceleration and braking, it is also highly prone to wear. Meldin[®] 73-000 and Meldin[®] 55-000 high-performance plastics are hard and lightweight and may be substantially more wear resistant than aluminum. Saint-Gobain Seals are recommending Tier 1 and 2 companies who design with aluminum to reach out to them or other expert developers before they make a decision to obtain the best seal options.



This information has been sourced, reviewed and adapted from materials provided by Saint-Gobain Seals.

For more information on this source, please visit [Saint-Gobain Seals](#).

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We have more than 50 years of manufacturing experience and an established global presence with strategic sites in Garden Grove, California, USA; Kontich, Belgium; and Minhang, Shanghai, China. The majority of seals and polymer components manufactured are custom designed and matched with the best materials to provide precise fit and lifetime confidence in your application.

Saint-Gobain Seals strives to meet your needs -- from our fast and efficient customer service staff to our design engineers and R&D team who solve critical problems -- we want to be your industry expert when it comes to seals and polymer components.

**Critical parts
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