

Airframe and Engine Sealing Capabilities



Manufacturing Facilities for Airframe Sealing Products

Situated around the world to support our customers, Trelleborg Sealing Solutions has four upgraded and expanded, state-of-the-art airframe seal manufacturing facilities. Production sites have been moving from low volume single piece manufacturing to high quantity mass production that meets the market demands for parts and efficiency. The sites have numerous accreditations such as ISO 9001, AS/EN9100 and Nadcap, in addition to Airbus and Boeing certifications.



Northborough, Massachusetts, US

Cadley Hill, UK

Condé-sur-Noireau, France

Shanghai, China

Extensive Global
**Manufacturing
Capacities**

Dedicated
Service

Full
**Testing and
Qualification**

Meeting Virtually All
**Industry
Approvals**

Trelleborg Sealing Solutions is one of the world’s leading developers, manufacturers and suppliers of precision seals and bearings, and is market leading in polymer sealing technology for the aerospace segment, with products on virtually all modern aircraft platforms and 60 years experience in design of sealing systems. It supports the industry worldwide with products from its own manufacturing sites and a dedicated Aerospace Hub structure.

COMMITMENT TO CUSTOMERS’ NEEDS LONG-TERM

The aim of Trelleborg Sealing Solutions is to facilitate customers in achieving cost-effective, durable solutions that match their specific business requirements and needs.

SEALING TECHNOLOGY

Trelleborg Sealing Solutions offers an outstandingly 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 industry.

LOGISTICS

We will be the supply partner of first choice for aerospace original equipment and after market manufacturers, working globally through our local teams. Innovative services, such

as Direct Line Feed, Kanban and Seal Scan automated replenishment ensure that products are where you need them, when you need them. We will build long-term partnerships with customers and suppliers by providing leading technology and excellent service.

A WORLDWIDE PRESENCE

We are uniquely placed to offer a dedicated design and development service for sealing solutions, globally servicing, supporting and supplying our customers through an unrivaled international network:

- Seven Aerospace Hubs, strategically placed in North America, Europe and Asia
- More than 20 manufacturing sites
- Eight specialized materials and development laboratories
- Internationally linked design and application centers

THE TRELLEBORG GROUP

Trelleborg Coated Systems

Leading global supplier of unique customer solutions for polymer-coated fabrics deployed in a variety of industrial applications.

Trelleborg Offshore & Construction

Leading global supplier of polymer-based critical solutions for deployment in highly demanding environments.

Trelleborg Industrial Solutions

Market leader in such industrial application areas as hosesystems, industrial antivibration solutions and selected industrial sealing systems.

Trelleborg Wheel Systems

Leading global supplier of tires and complete wheels for agricultural and forestry machines, forklift trucks and other material handling vehicles.

Trelleborg Sealing Solutions

One of the world’s leading developers, manufacturers and suppliers of precision seals. It supports its aerospace, industrial and automotive customers through over 20 production facilities and more than 50 marketing companies globally.

Products for the Next Generation of Efficient Aircraft

Trelleborg Sealing Solutions manufactures and supplies a wide range of products for airframes and engines to optimize the efficiency and safety of the next generation of efficient aircraft.



Thrust Reverser Seals

Eliminate unnecessary loss of power during flight and resist high temperatures



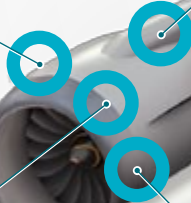
Bleed Air (KISS) Seals

Fabricated tubes and bellows, including metal inserts if necessary, handle the flows of hot air from the engine



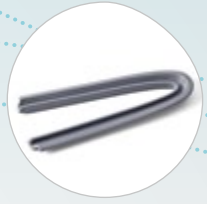
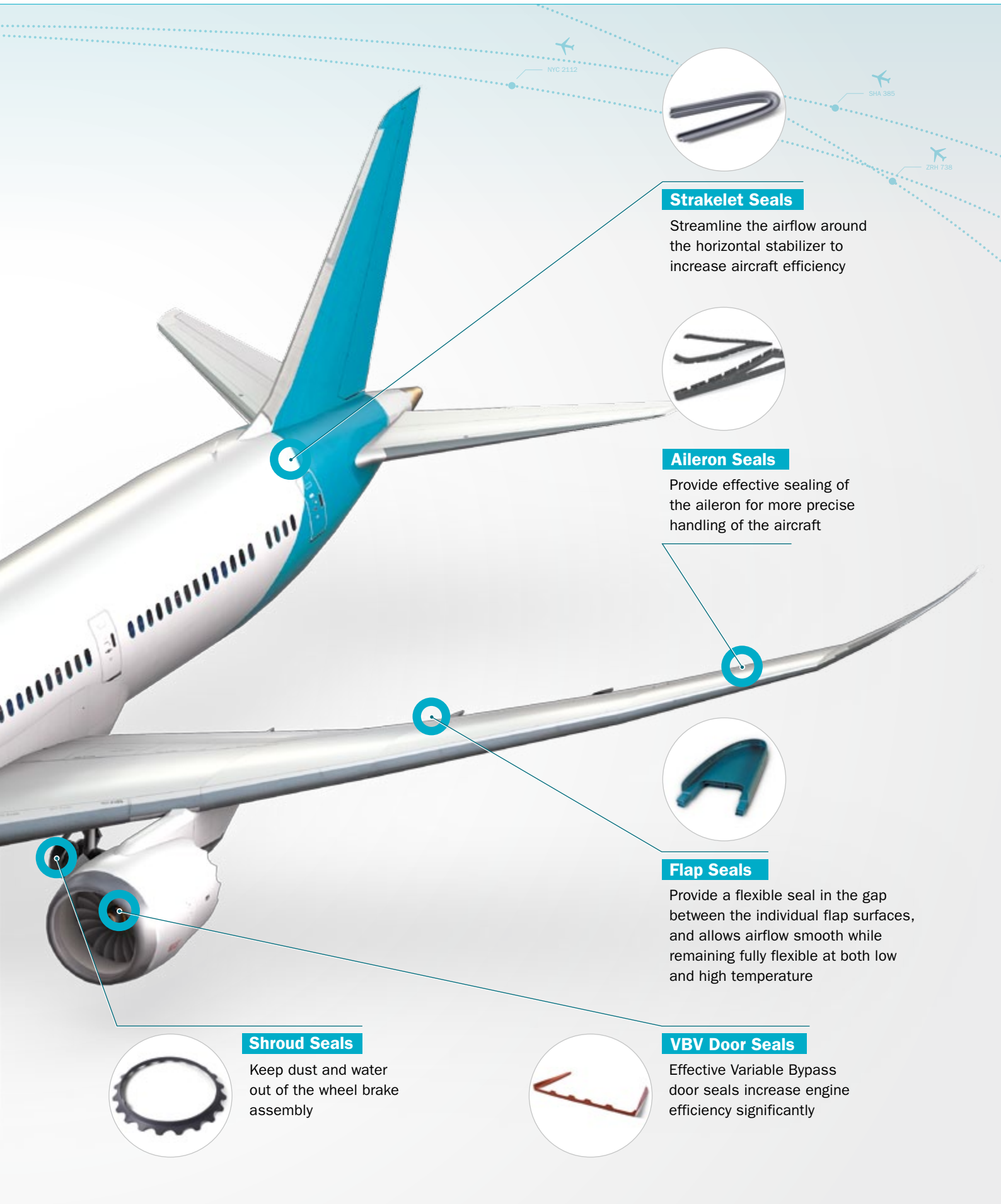
Engine Pylon Seals

Prevent ingress of contaminants and minimize aircraft surface gaps to maximize aerodynamic efficiency



Fire Seals

Manufactured from high temperature fire resistant materials, fire seals contain fire within localized areas to prevent flame spread



Strakelet Seals

Streamline the airflow around the horizontal stabilizer to increase aircraft efficiency



Aileron Seals

Provide effective sealing of the aileron for more precise handling of the aircraft



Flap Seals

Provide a flexible seal in the gap between the individual flap surfaces, and allows airflow smooth while remaining fully flexible at both low and high temperature



Shroud Seals

Keep dust and water out of the wheel brake assembly



VBV Door Seals

Effective Variable Bypass door seals increase engine efficiency significantly

Aerodynamic Seals: Turel[®] Aeroflex

Trelleborg Sealing Solutions has long been involved in the design and supply of aerodynamic seals, such as trailing edge (flap) seal packages. Our capabilities include elastomer and composite parts, and seals with specific conductive properties, as well as aircraft and helicopter door and hatch seals.

WING SEAL PACKAGE

Trelleborg Sealing Solutions supplies hundreds of different parts for wings ensuring quality, precision and on-time delivery.



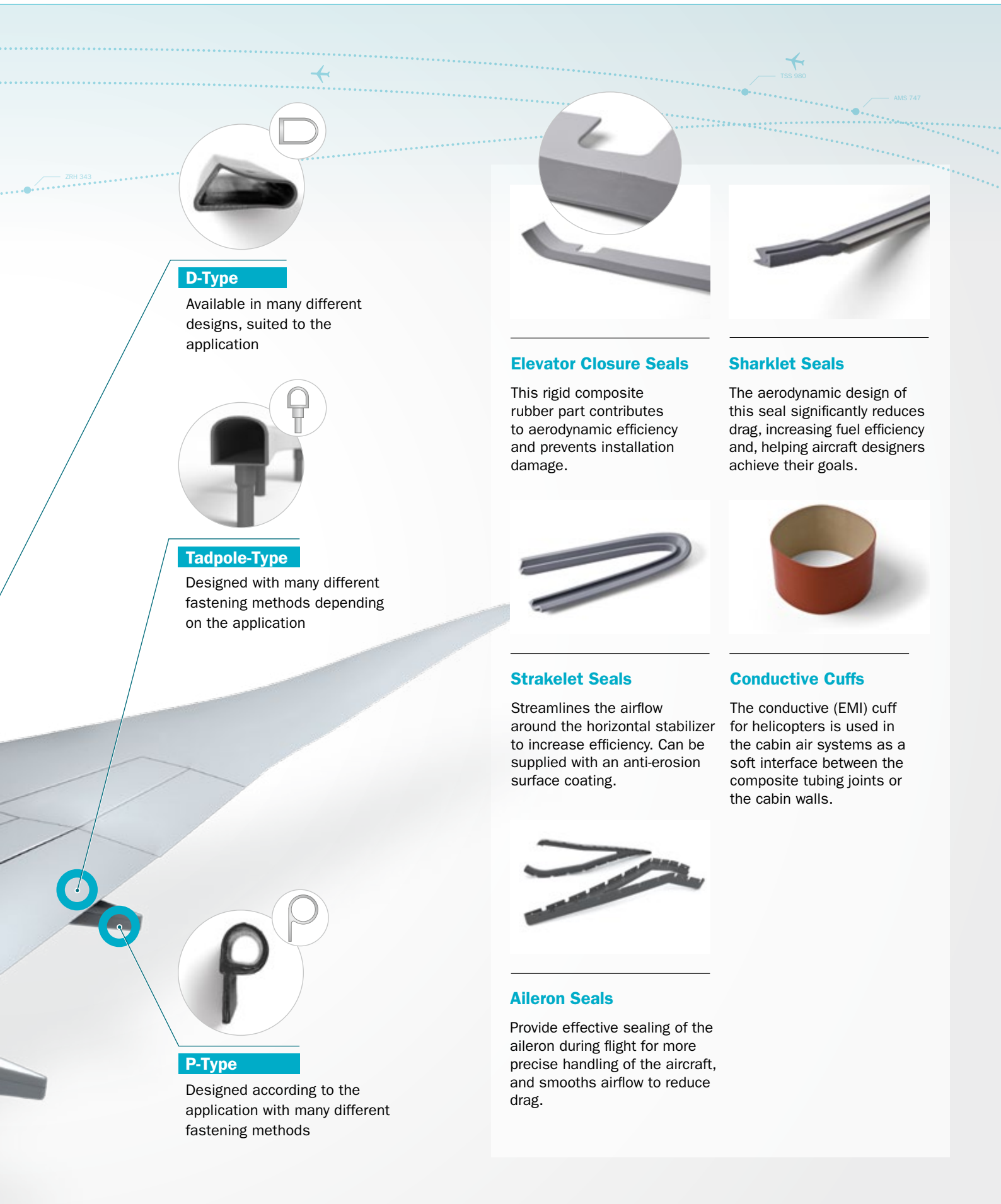
Flap Seals

The front and rear ends of the flap seals are complicated parts that may include metal and/or composite parts covered with fabricated elastomers and low friction surface treatments



Slat Aperture Seals

Located on the front edge of the wing, slat aperture seals must work at very low temperatures and seal the wing airflow to eliminate loss of lift



D-Type

Available in many different designs, suited to the application



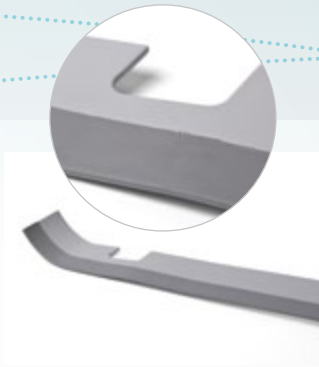
Tadpole-Type

Designed with many different fastening methods depending on the application



P-Type

Designed according to the application with many different fastening methods



Elevator Closure Seals

This rigid composite rubber part contributes to aerodynamic efficiency and prevents installation damage.



Sharklet Seals

The aerodynamic design of this seal significantly reduces drag, increasing fuel efficiency and, helping aircraft designers achieve their goals.



Strakelet Seals

Streamlines the airflow around the horizontal stabilizer to increase efficiency. Can be supplied with an anti-erosion surface coating.



Conductive Cuffs

The conductive (EMI) cuff for helicopters is used in the cabin air systems as a soft interface between the composite tubing joints or the cabin walls.

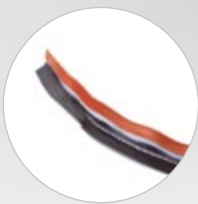
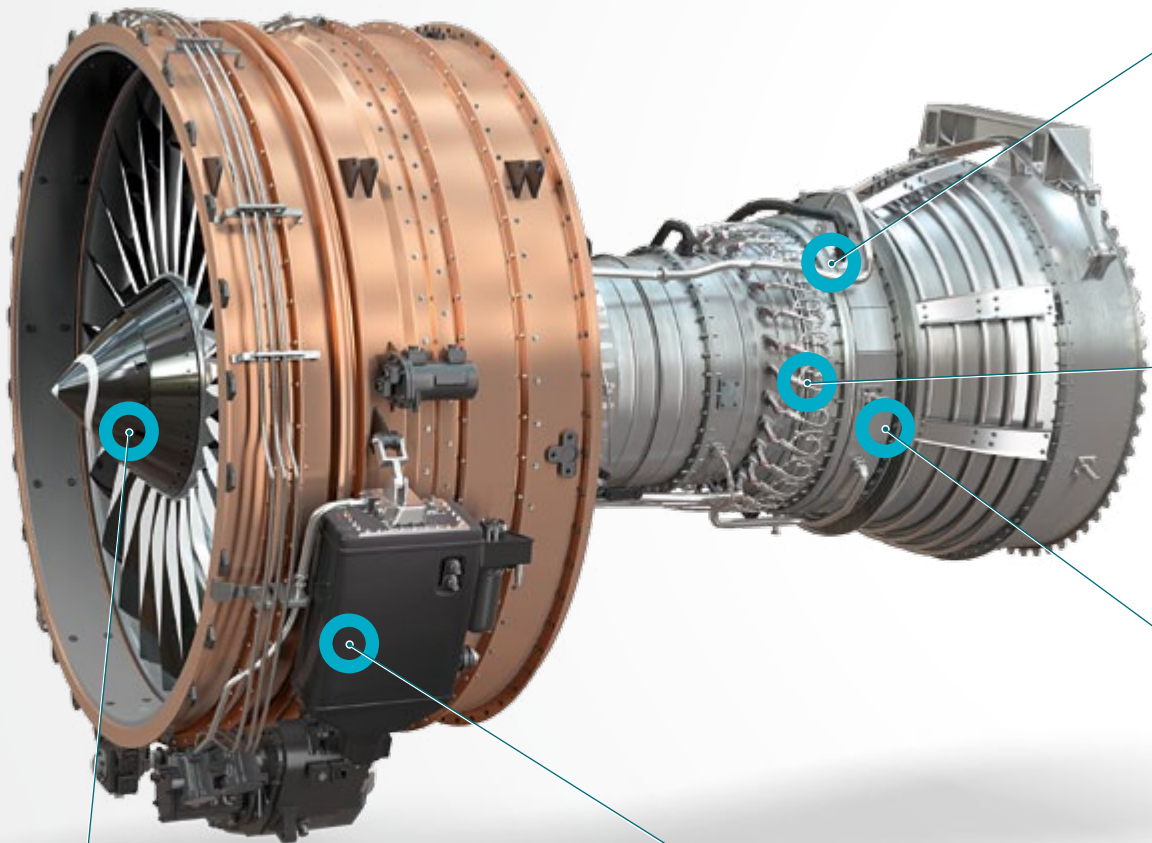


Aileron Seals

Provide effective sealing of the aileron during flight for more precise handling of the aircraft, and smooths airflow to reduce drag.

Engine and Pylon Seals: Turel® Fireflex

Trelleborg offers a wide product range suitable for use in and around aircraft engines. From thrust reverser door seals to VBV door seals, complexity, size and design depend heavily on the application. Typical requirements include fire resistance, media resistance, operation within a wide temperature range and long lasting flexibility.



Blade Seals

Fan blade seals are located at the base of the fan blades and close the gap between the blade and the filler platform efficiently to improve the airflow through the engine to reduce fuel consumption.



Specialty Elastomers

Isolast® perfluoroelastomer material and AeroXLT™ (low temperature fluoroelastomers) can be molded to any shape and work under extreme temperatures.



Flexible Hosing

Allows connected tubing to expand and move during the engine's working cycle. Reinforced layers provide a service life that matches other engine components.



Duct Seals

Flexible joints allow bleed air from the engine into auxiliary systems like cabin heating and deicing even at high deflections during strong air turbulence.



Bleed Air (KISS) Seals

Designed to handle the hot engine bleed air, these seals tolerate the air used in deicing and cabin heating, up to temperatures of +300 °C / +572 °F. As part of the qualification, these seals must withstand the flow of hot engine air during the whole aircraft service life.



Himod™ Engineered Plastic Components

A wide range of highly advanced plastic materials are designed to have a high temperature capability up to +260 °C / +500 °F with low friction and high bearing load capacity. Compared to metal bearings, the advantages include vibration damping, lower weight, and soft wear particles that do not interfere with seal function.



VBV Door Seals

Trelleborg Sealing Solutions has the expertise to develop complex solutions, such as these Variable Bleed Valve (VBV) door seals that contribute significantly to the improved fuel economy of next generation engines.



Thrust Reverser Seals

Fire resistant seals on the thrust reverser doors withstand extreme temperatures and high airflows due to fabric reinforcement in exposed areas.

Specialized Sealing Capabilities

Trelleborg is rapidly expanding the product portfolio for aircraft and engine sealing, utilizing extensive engineering, seal design and polymer expertise to create products that reach beyond traditional sealing.

Access Cover Plate Seals

Designed to provide reliable long-term static sealing and easy self-supporting installation in the seal groove. They are resistant against the most common fluids, such as fuel, hydraulic oil and deicer.



Diaphragms & Bellows

With the correct combination of design, material & reinforcement, we can provide extended lifetime compared to traditional designs.



AMS 347

BER 388



HiMod® Bearings

High temperature capability (up to +260 °C / +500 °F) with low friction and high bearing load capacity. Compared to metal bearings the advantages include vibration damping, low weight, and soft wear particles that do not interfere with the seal function.



Bonded Seals & Gaskets

Standard or customized Bonded Seals represent a combination of metal carrier and elastomer sealing lip directly vulcanized onto the metal part. These components ensure products are connected reliably and securely held.



Clamp Blocks & Grommets

Custom made clamp blocks, in aircraft-grade materials, securely support fuel & hydraulic lines in all parts of the aircraft. They isolate against vibration and allow minor axial and angular movement to avoid fatigue.



Rotary Seals

A full range of rotary seals is available for use in gearboxes and output shafts. Speed and pressure range vary with type, such as Radial Oil Seals for low pressure/high speed and Varilip® PDR for high pressure/low speed use.



HiMod® Flat Gaskets

The HiMod® range satisfies the requirements of most gasket applications within the aerospace industry. Our products rely on our experience with rubber, flexible graphite, expanded metal and mica. Our gaskets are commonly used in engines, APUs, anti-ice systems and other high temperature static applications.



Turcon® Slipperseals & Spring-energized Seals

Trelleborg Sealing Solutions is the market leader in seals for hydraulics and actuation. Standard solutions have also been developed for fueldraulics and high temperatures. The use of multiple sealing elements and bearings enable Trelleborg Sealing Solutions to offer "sealed for life" systems for many applications.



Wills Rings® O, C & Other Metallic Seals

Suitable for extreme working conditions, like the cryogenic temperatures of a rocket engine or the extremely high temperatures of jet engines, Wills Rings® are available in several different designs with varying grades of loading and different coatings to meet even the most stringent leakage requirements.

Engineering & Qualification

CATIA V and other CAD tools are essential for Trelleborg Sealing Solutions designers and are used to communicate the shapes of parts and surrounding hardware precisely and reliably. On-site design at customer facilities is offered for more complicated seal geometries, as well as dedicated project management to ensure a timely delivery of the end product.

FEA techniques have been developed to replicate the performance of elastomer materials under both high and low temperature scenarios. Special models developed by us allow the effects of reinforcing fabrics to be observed, leading to a more efficient design process.





TSS 7502

NYC 140

RAPID RESPONSE

3D printing is used to produce prototypes that replicate fit and form. Trelleborg uses numerous materials for print and in some cases can create prototypes which represent some elements of the sealing function.

Early in the development life cycle, Trelleborg Sealing Solutions can test fit, form and some functional elements, significantly reducing time spent in the design phase and risk of design failure. Tooling can also be manufactured using 3D printing, reducing cost, risk and lead time in the design phase.

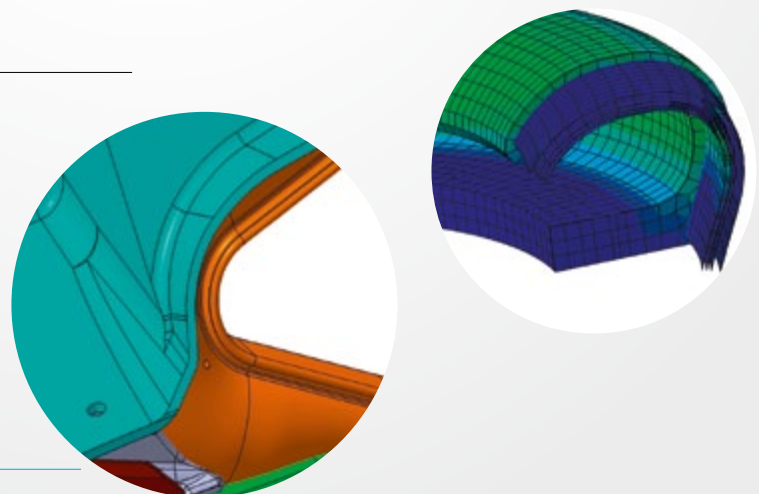
PROJECT MANAGEMENT & QUALIFICATION:

Trelleborg Sealing Solutions offers full service project management, engaging with the customer at the concept and design stage and managing all subsequent steps. These include definitions of parameters, selection of design and materials, CAD design and FEA modeling, prototyping, testing and qualification of the products, as well as new product introduction.

ACCUMULATED DESIGN KNOW-HOW (COD)

Trelleborg Sealing Solutions has concentrated aerospace activities in dedicated Aerospace Hubs, enabling knowledge sharing of products and solutions and guaranteeing a thorough understanding of the requirements and industry landscape.

This has allowed our engineers to build up a unique and wide experience to develop efficient and reliable seals that meet market needs, today and in the future. Frequently used successful solutions are typically developed into Concensus of Design (COD) solutions, which form the basis of guidelines for starting new seal designs for customers.

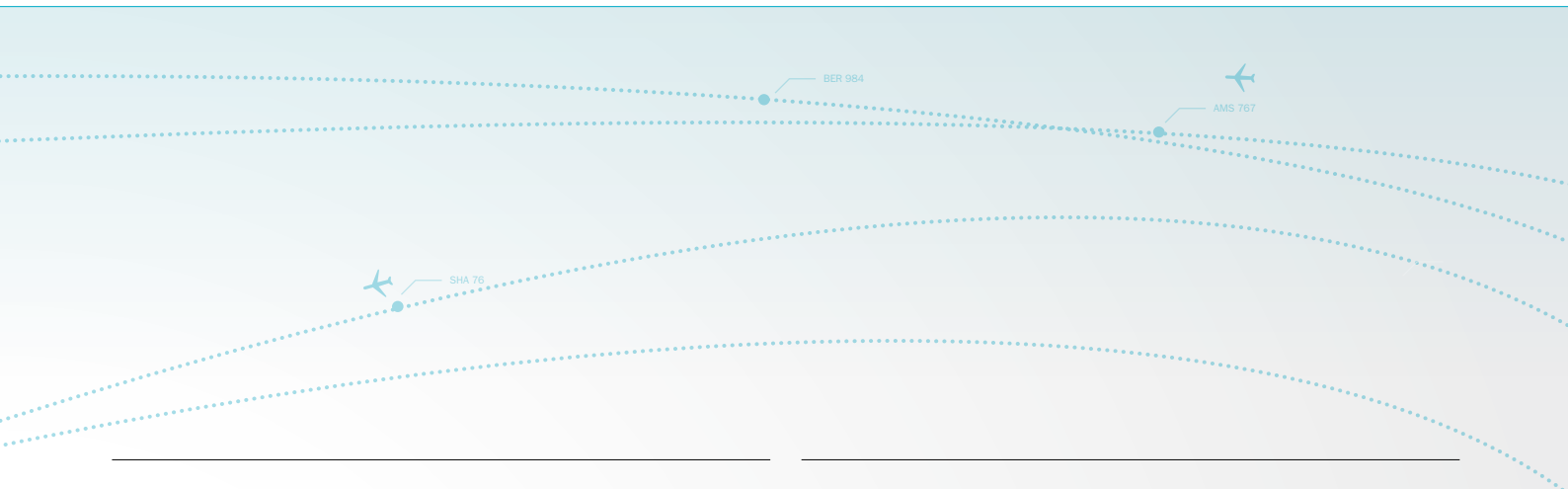


State-of-the-art processes and programs make product development more reliable and rapid.

In-house Testing Capabilities

Functional testing of the seal is essential in order to prove that specific requirements are met or exceeded. Trelleborg Sealing Solutions offers a range of test facilities and processes.





ENDURANCE TESTING

Typically a deflection test mimics the movement that the seal will see in the actual application, as well as the temperatures and pressures it will work under in the real world. Combined with our FEA capabilities it allows our designers to identify the optimum position of the reinforcement fabrics.

FIRE TESTING

Fire seals are required to conform to ISO 2685 and AC 20-135 performance standards, namely an ability to withstand temperatures of +1100 °C / +2012 °F for 15 minutes. Our fire seals are compliant with this standard and tests show them to be capable of withstanding temperature extremes for a period of 30 minutes.

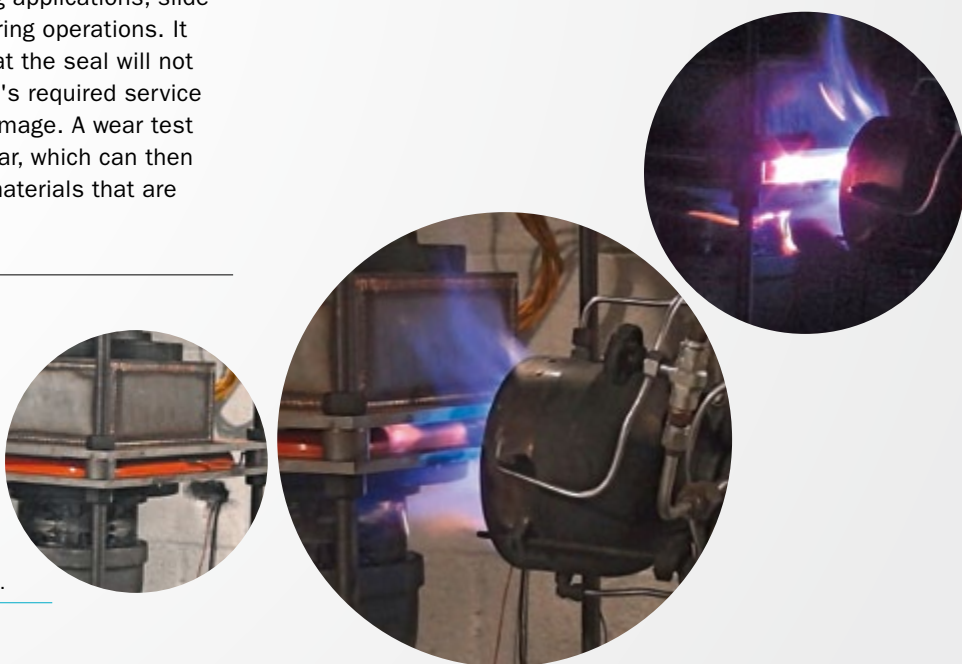
FRICITION TESTING

As some of the drive systems rely on friction to determine if the actuators are functioning properly, it is of high importance that the seals offer constant low friction over the full lifetime of the system. Trelleborg's unique knowledge of low friction materials allows us to offer solutions with constant and long lasting friction values.

Trelleborg Sealing Solutions maintains their success in advancing aerospace fire seal technology due to extensive material development programs and the ability to customize the seal design to precisely match specific application and installation parameters. Proprietary designs developed internally and tested in our in-house fire test facility significantly outperform all generic seal options available to the aerospace market.

WEAR TESTING

Many of the seals, especially in the wing applications, slide across sections of the aircraft wings during operations. It needs to be proven and documented that the seal will not damage the aircraft skin during the seal's required service life and it will last without significant damage. A wear test will clearly determine areas prone to wear, which can then be reinforced by low friction, non-stick materials that are embedded into the elastomer material.



Testing is vital to ensuring seal performance in aircraft.

Manufacturing & Material Qualifications

Eight Trelleborg Sealing Solutions research and development centers are constantly working on developing new products and materials to match the fluid and environmental challenges that seals are subjected to in the harsh aerospace environment. Enhanced chemical compatibility, expanded temperature capability and reduced weight are key goals within our development strategy, which means that our material selection is changing and expanding as materials are recertified and added.



Material Approvals

Airbus Materials:

ABR 9-0142 (Family)
A-A-59588 (Family)

Boeing Materials:

BMS 1-54
BMS 1-53
BMS 1-57
BMS 1-72
BMS 1-74
BMS 1-76
DPD/MBD

Other:

MIL-R-25988 (Family)
MIL-G-83528 CL B GR60
UL-94 (Family)
MCS8003H (Family)
EMS73067 (Family)
ES-1943
ES-1073
ES-1098
ES-1456
ES-1166
AMS7257
AMS25988
NAS1613

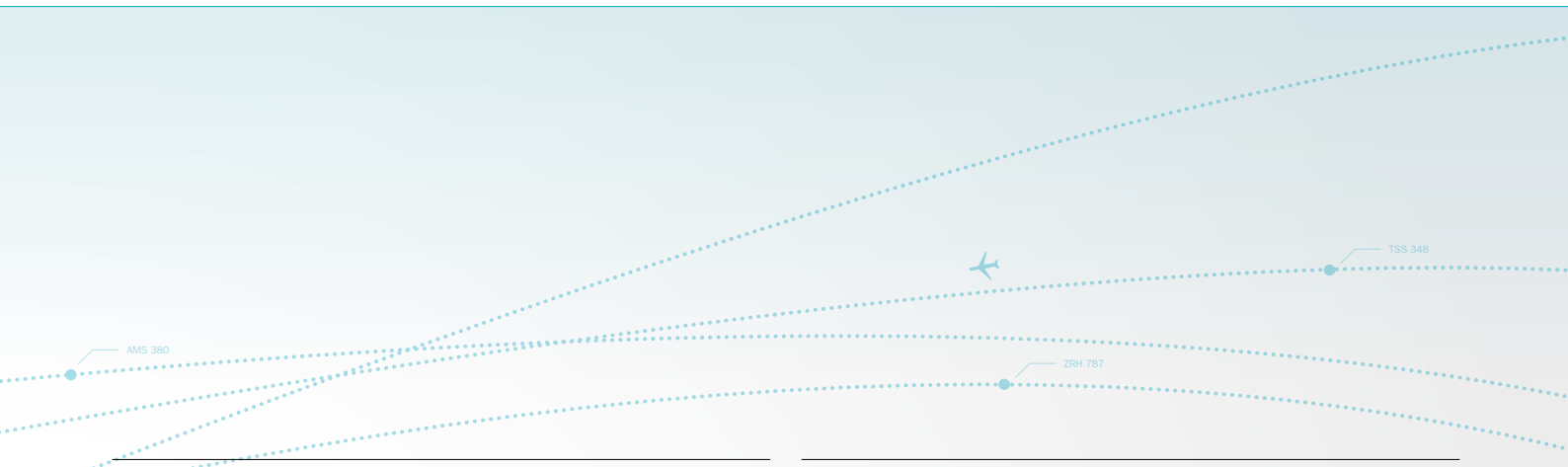
Customer Approvals



Value Added Services

Trelleborg Sealing Solutions has developed a number of services aimed at reducing the cost of purchase for smaller parts like seals and bearings. Working via Direct Line Feed and Customer Portals, we reduce the paperwork to a minimum while making sure that the right parts are delivered at the right time and place. We also offer training courses in sealing technology and seal installation to increase customer knowledge.





LOGISTICS & SHIPPING

Many companies consider seals and bearings to be “C” class components. Generally procurement of these can be difficult to handle and can cause major disruption to production lines if not available in the right quantities at the right time. Trelleborg Sealing Solutions has developed services to make procurement of seals and bearings easier for customers.

For instance, we offer special delivery services such as Direct Line Feed (DLF), which provides products directly to the customers, production lines and guarantees product availability at all times. We also work to agreed stock levels and defined Kanban signals to drive replenishment. Reusable containers limit the impact on the environment by reducing paper and plastic packaging.

Seal Scan is the Trelleborg Sealing Solutions automated replenishment system, which generates orders and replenishes stock at the customers location by scanning dedicated bar codes. It reduces the workload for the customer and ensures that parts are available for production. We are also experienced in receiving orders through customer portals to provide services based on your needs.

PACKAGING

Single bag & tag, as well as kitting of seal sets for specific applications is offered as part of the Advanced Delivery System. Kitting reduces the part count and costs of ordering for the customer. It also means that once assembly has started, it can be finished on time as all the necessary parts are in the kit.

TRAINING

Training courses on installation, seal assembly and general seal knowledge are offered to customers. This increases the knowledge of the customer's technical teams and can lower costs, for instance, by reducing scrap and increasing 'right first time' installation.

AFTERMARKET SUPPORT

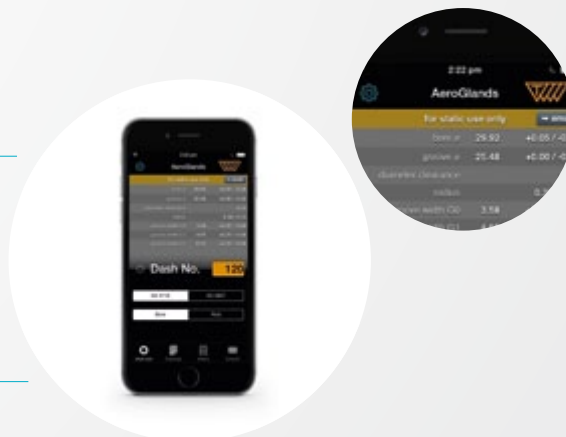
Trelleborg Sealing Solutions Global Aerospace Distribution group, along with our preferred distributor network, allows global aircraft fleet support and life-cycle management to ensure seal and bearing parts are available, at the right time and the right global location.



ONLINE TOOLS

To facilitate the work of design engineers, Trelleborg Sealing Solutions has developed a range of online and mobile tools. The Aerospace Groove Selector provides easy access to the AS4716 and AS5857 groove dimensions and tolerances, and the Unit and Hardness Converter helps engineers to switch effortlessly between many units.

To view the full range of digital tools, visit tss.trelleborg.com, or search in the App Store or Google Play for "Trelleborg".





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.

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