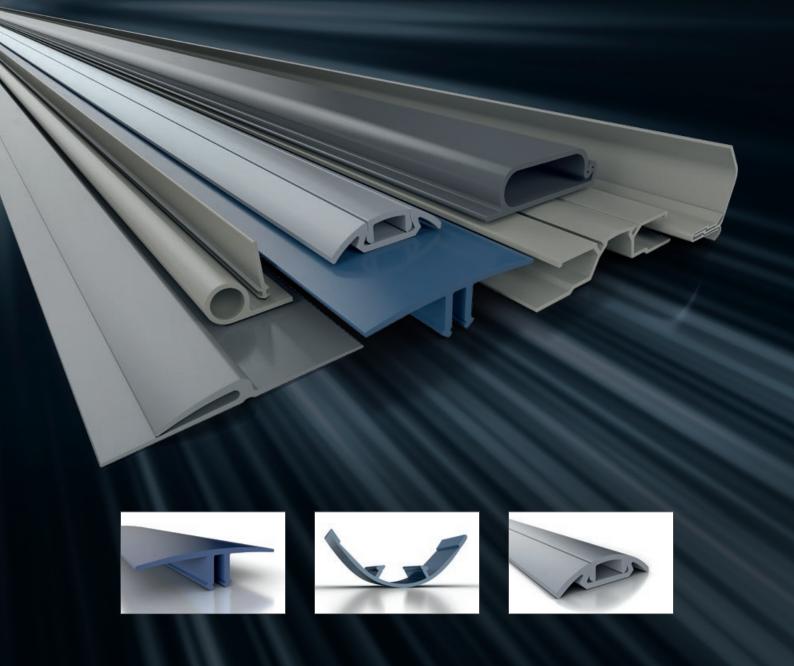


# Thermoplastic Aerospace Interior Profiles





Trelleborg Aerospace is a global leader in development, manufacturing and supply of seals and airframes to the aerospace industry and our solutions feature on virtually every aircraft platform in the world.

In partnership, we work with major aircraft original equipment manufacturers (OEMs) from concept to production and in the aftermarket, we play a significant role in supporting maintenance repair overhaul (MRO) operators.

Critical to aerospace applications is making sure that solutions meet the performance criteria required. Trelleborg Aerospace offers unique advanced capabilities to support its customers through product design to proving a solution in an application.

An important part of our offering is for aircraft interiors, providing thermoplastic profiles that ensure passenger, protection of the plane and a pleasing aesthetic appearance.

### Trelleborg Aerospace – Your local presence around the globe



# Extruded sealing profiles

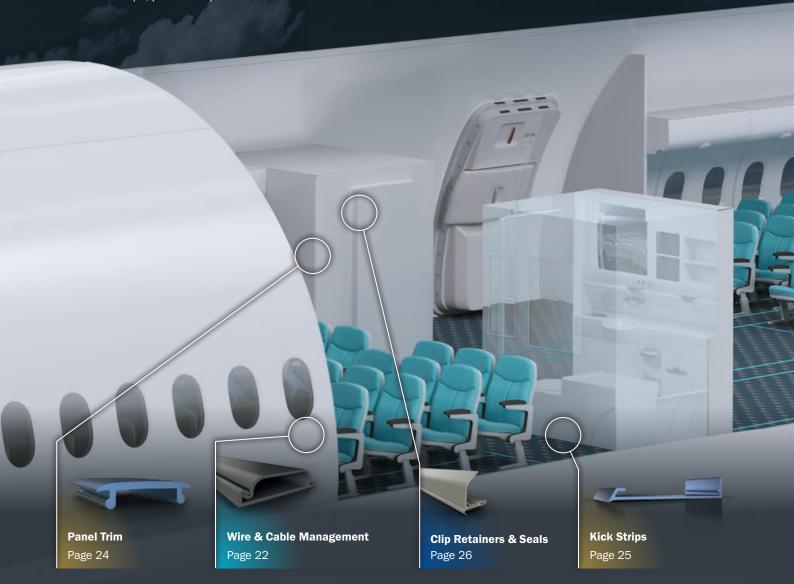
All aircraft interiors have gaps, seams and areas that are unsightly or present a potential hazard to air travelers. In the average plane, an estimated 700 to 900 kilograms of thermoplastic and elastomer extrusions fill, cover and manage these gaps.

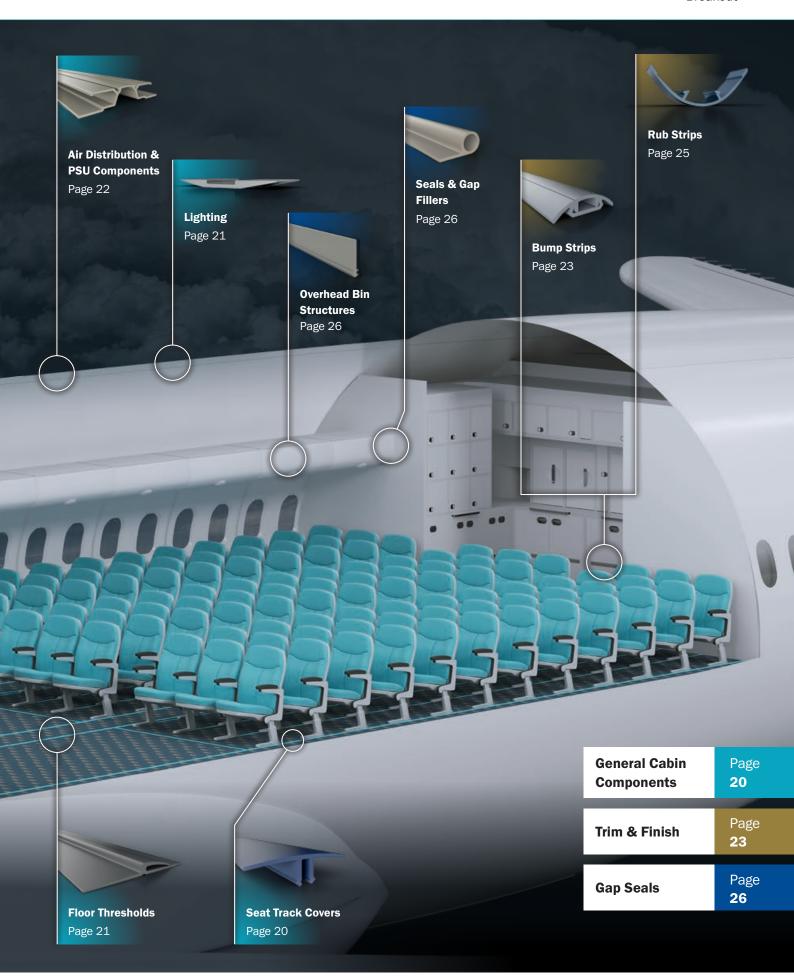
### **Safety and Protection**

Extruded profiles help ensure safe movement throughout the cabin and cockpit, protect the plane's interior structure from

damage due to repeated passenger traffic, and provide a pleasant aesthetic experience for the passenger. Applications include seat track covers, bump or rub strips and gap sealing, as well as floor transition thresholds and wire insulation.

Trelleborg produces extrusions in semi-finished lengths, as well as fully fabricated products for original equipment manufacturers (OEMs), maintenance repair and overall (MRO) operators and aftermarket customers.





# Manufacturing capabilities meeting customer needs

### The extrusion process

Plastic and rubber extrusion is a medium to high-volume manufacturing process in which raw material is melted and formed into a continuous profile. This process starts by feeding plastic or rubber material from a hopper into the barrel of the extruder. The material is gradually forced through a die, which shapes the material into a profile that hardens during cooling and vulcanization. Profiles produced include clip retainers and seals, panel trim, wire and cable management, kick strips and wire insulation.

### **Custom Design Capabilities**

Trelleborg Aerospace utilizes decades of experience in aerospace seal development to provide custom-designed interior gap seals and fillers for aircraft applications, both interior and exterior. Working jointly with our customers to meet required performance parameters and the defining functional and spatial requirements is an area where Trelleborg Aerospace excels.

This ability to design-to-spec along with internal modelling and testing capabilities make Trelleborg a unique partner for total aerospace solutions.

### **Co-Extrusion**

Trelleborg Aerospace has capabilities in co-extrusion, making a profile out of two materials with different durometers, to create one single extrusion piece. The materials of different hardnesses each feed through separate dies and then meet in a mating die, which locks them together permanently before curing. Co-extrusion allows for unique profiles with versatile and robust applications in effectively sealing gaps.

### **Custom Fabrication Capabilities**

In addition to providing stock elastomer and plastic profiles, Trelleborg Aerospace produces application-specific fabricated items to meet specific customer requirements using advanced finishing capabilities.

- Waterjet Cutting
- Ultrasonic Welding
- Painting

- Adhesives
- Decorative
- Notching

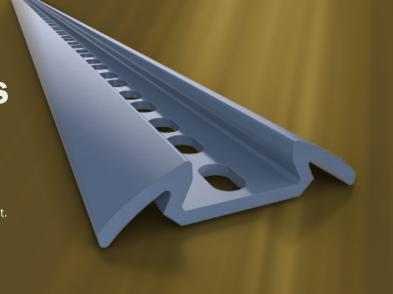
Assembly

- Heat Forming
- Application
- Cutting
- Texturing
- Drilling
- Slip-Coat

### **Additional processes**

### **Machining & Secondary Operations**

Many components require some level of machining to meet final dimensions. Typical operations that can be performed in the machining stage include milling, grinding, cutting, punching, and lathing where the part, tool or both rotate to finish the component. Part marking and surface treatment may also be completed as secondary operations.



### The right option for the application

In some cases extrusions are not the best option to produce an interior component. Trelleborg Aerospace uses additional manufacturing techniques to compliment its extrusion offerings.



### **Compression Molded Parts**

Custom technical, high-precision, multi-material and complex molded parts are formed under pressure until the material reaches the desired shape. This process has a lower cost of tools and shorter tooling lead time, with less material scrap than injection or transfer molding methods.



### **Additive Manufacturing**

Trelleborg is at the forefront of additive manufacturing, better known as 3D printing. This rapid prototype technology is paving the path to gain approval on "flyaway" parts quickly.



Utilized for bezels, brackets, vents, decorative surfaces, for example, this robust and efficient manufacturing process makes fully bonded custom solutions possible. It produces flashless parts, consistency in thickness and quality, as well as delicate parts formed reliably every time. Additionally, parts can include blind sections, undercuts, and a variety of surface finishes.



### **Parts Assembly & Kitting**

Our packaging and labeling solutions aim to support OEMs, the aftermarket and MRO industries. They are customized to meet specific needs and can incorporate branding. Additionally, individual parts can be assembled together into a more complete component. Both of these options make fitment easier, more accurate and cost-effective.

# Supporting product development

Critical to aerospace applications is making sure that solutions meet required performance criteria. Trelleborg Aerospace offers unique advanced capabilities to support its customers through product design to proving a solution in an application.

### **Testing Capabilities**

- Flammability Booth for Vertical, Horizontal, and 45 Degree Flammability Testing
- · Tensile / Flexural Testing
- Elongation
- Durometer Testing
- · Color Validation (Visual & Spectrophotometer)
- Dimensional Analysis
- Microscopy Examination
- · Melt Flow / Rheometry
- Ash Testing Carbon Content
- Thermostability Testing (Shrinkage Rate)
- · Material Flow & Stress Analysis
- Falling Dart Impact Testing
- Hydroscopy Testing (Moisture Analysis)
- Flame, Smoke and Toxicity (FST) per FAA FAR 25.853

### Our materials testing focuses on:

- Improvement of a part's material performance
- Comparison to part specification to check manufactured quality
- Analysis of seals and hardware to determine part condition, including areas of contamination

To complete these investigations, the Materials Laboratory can verify the following through thermal, microscope, mechanical/physical, and chemical analysis:

- · Base polymer
- · Compositional breakdown of material
- Filler identification, content, and contaminant (pigment, mineral, carbon black, etc.)
- · Glass transition and melt point
- Elemental analysis (presence of metals like tungsten or iron)
- Density & specific gravity
- Hardness







# Product highlights

### Let there be light

The ambiance of an aircraft interior relies on comfort, cleanliness, colors, and more, but lighting effects the perception of all of these. Lights feature in strips on the ceiling of an aircraft's cabin, overhead in reading lights, and in surrounding areas such as inside the luggage bins or to highlight important buttons or electrical ports.

Light lenses need a level of transparency as well as a colorful hue and this is demanding to fabricate. Transparency is difficult to measure and even more difficult to describe during development, so additional collaboration is necessary between the customer, Trelleborg and its material supplier network.

### Take a seat

Trelleborg's products are visible everywhere you look in the interior of a plane. When a passenger is in their seat they can see many components supplied by Trelleborg, from parts in luggage storage bins and service unit panels overhead, flooring thresholds and seat track covers underfoot, and other surrounding items such as window shade assemblies and protective corner coverings on walls.





### A little flushed

In an aircraft's washroom the toilet seat and its lid assemblies are some of the most technically problematic injection molded parts
Trelleborg produces. Due to extremely high visibility to the passenger, potential bacterial buildup and frequent cleaning with harsh chemicals, they need to have one of the best surface finishes of any interior component.

Trelleborg Aerospace has invested research and development time into making improvements on tooling to achieve and go beyond required standards.



### What's the hole for?

When you open and close the shade on an airplane, there is a little hole in the window. What is it for?
Trelleborg Aerospace is in a good position to answer this question, as we produce complete window frame and shade assemblies for airplanes. At altitude, the pressure outside of the

plane is low, and the cabin is maintained at a higher pressure and temperature for passenger safety and comfort. In order to balance that pressure differential, airplane windows have several windowpanes with layers of air between them. The hole in the center windowpane, called a "bleed hole", allows the inner panel to remain uncompromised to pressure and temperature imbalances, protecting the passengers.



# Materials specific to application requirements

The materials in an aircraft's interior must stand up to transporting thousands of passengers each month. In the cabin they need to withstand the daily wear and tear of travellers walking up the aisle, sitting, standing and moving round the cabin, using the lavatories and packing luggage into the overhead bins.

In cargo holds the materials have to endure hundreds of bags being loaded in and out of them every trip. That means materials must not only have an aesthetic appearance, but they also have to be very tough and in addition meet safety standards such as the flammability, smoke, and toxicity requirements of FAR25.853.

Trelleborg Aerospace utilizes partnerships with key material providers to provide plastic and rubber materials suited to the requirements of all aerospace interior sealing profile applications.

### **Testing Capabilities**

- Material test fluid compatibility
- Horizontal and vertical ignition testing
- Durometer Testing
- Smoke density testing for cabin materials





### **Plastic profile materials**

Materials for aircraft interiors are expected to meet a number of demanding requirements. To withstand the constant abuse from passengers and cargo, materials must be tough and provide a satisfactory appearance to the aircraft cabin.

Additionally, materials used in the cabin are required to meet the Flammability, Smoke, and Toxicity requirements of FAR25.853. Trelleborg Aerospace utilizes partnerships with our key material providers to develop expertise in fabricating materials which meet these requirements.

### Plastic Material for profiles include:

- Polyvinyl Chloride (PVC)
- Thermoplastic Polyurethane (TPU)
- Polycarbonate (PC)
- Polyetherimide (PEI)
- Polyethylene (HDPE & LDPE)
- Thermoplastic Vulcanisate (TPV)
- Polyamide (PA) / Nylon

Typical Extruded Thermoplastic Materials					
Base Polymer	Shore D	Reference Airframer Specifications	Common Applications		
Thermoplastic Polyurethane (TPU)	71	Boeing BMS8-424, CDM005	Seat track covers, cable covers, panel edge trim		
Polyetherimide (PEI)	N/A	Boeing BMS8-321, CDM05	Air distribution, PSU rails, structural components		
Polycarbonate (PC)	N/A	Boeing BMS8-251, CDM005	Seat track covers, lighting lenses, trim covers		
Polyamide (Nylon) (PA)	N/A	Boeing BMS8-270 Airbus AIMS04-01-004	Seat track covers, raceways, carpet thresholds		
Polyvinyl Chloride (PVC)	70 & 90	Boeing BMS8-137, CDM005	Flooring transitions, trim buffers, interior seals		
Polyphenylsulfone (PPSU)	N/A	-	PSU rails, stow bin components		

### Typical Profile Materials - Rubber

**Rubber Material Capabilities include:** 

- Ethylene Propylene Diene Monomer (EPDM) & EPDM Sponge
- Silicone & Silicone Sponge, Vinyl Methyl Silicone (VMQ) and Fluoro Vinyl Methyl Silicone (FVMQ)
- Nitrile Rubber (NBR)
- Polychloroprene (CR)

### **Typical Extruded Elastomer Materials**

Base Polymer	Shore A	Industry Specifications	Reference Airframer Specifications	Characteristics and Common Applications
EPDM	60	NA	Boeing BMS1-50*	Rain Erosion Shield
	70	NA	DAN 1192	Resistant to phosphorous
Silicone (VMQ)	55	NA	Boeing BMS1-72*	Pigment-able silicone for interiors
	50	NA	Boeing BMS1-52*	Aircraft pressure seals, filler rod
	50	NA	DAN 1106	Self-extinguishing MVQ-elastomer
	70	NA	DAN 1107	Self-extinguishing MVQ-elastomer
	Various	A-A-59588	NA	P-Seals, D-Seals, Misc. Gap seals
	Various	AMS3301, AMS3302, AMS3304, AMS-R-6855	NA	P-Seals, D-Seals, Misc. Gap seals
	Various	ASTM D1056, ASTM D2000	NA	P-Seals, D-Seals, Misc. Gap seals

<sup>\*</sup> Trelleborg Aerospace has BAC5071 fabricator approval for BMS materials

### **Complying with standards**

Aerospace standards observed today ensure the quality of products and the safety of passengers and crew on every aircraft built. Trelleborg upholds and complies to these standards for every product manufactured in our goal to protect the essential.

### **Profile Design Standards**

Trelleborg Aerospace applies design standards for build-to-specification development. Current tolerancing and dimensioning practices for thermoplastic extrusion observe DIN 16941 Class 3 Group A which specifies linear dimensional tolerances for external dimensions, internal dimensions, step dimensions, diameters, etc. This tolerance may be indicated on drawings by: "DIN 16941 – 3A".

For extruded thermoplastics Trelleborg Aerospace recommends that additional consideration must also be placed on the straightness of extruded products to ensure feasible installation. Trelleborg Aerospace recommends a tolerance of  $\pm 0.050$  per foot of extruded length for profile straightness.



Trelleborg Aerospace is licensed and approved

We provide BAC1521 and BAC1522 plastic extrusions for the commercial aftermarket and OEM. Our extruded profiles are manufactured under our AS9100 quality system, allowing for maintaining industry leading tolerances and quality.

Recommended DIN 16941 (Class 3, Group A) Tolerancing for Thermoplastic Extrusion						
Nominal Dimension (mm)		Nominal Dimensi	on (in)**	Tolerance (mm)	Tolerance (in)**	
Above	Up to & Including	Above	Up to & Including	Class 3A (±)	Class 3A (±)	
0	3	0	0.12	0.4	0.016	
3	6	0.12	0.24	0.6	0.024	
6	10	0.24	0.4	0.7	0.028	
10	18	0.4	0.7	0.8	0.031	
18	30	0.7	1.2	1.0	0.04	
30	50	1.2	2.0	1.2	0.047	
50	80	2.0	3.1	1.5	0.059	
80	120	3.1	4.7	1.9	0.075	
120	180	4.7	7.1	2.3	0.091	
180	250	7.1	9.8	2.8	0.110	
250	320	9.8	12.6	3.5	0.138	
320	-	12.6	-	1.4%	0.0551%	

\*\* Unit conversions are per NIST Special Publication 1038

### **Meeting Tolerances**



### **Tolerances**

Extruded rubber products generally require greater tolerances in manufacturing than those produced by molding since the extruded rubber may experience shrinkage, deformation and die swell. Current tolerancing and dimensioning practices employ ISO 3302-1 which specifies classes of dimensional tolerances and their values for extrusions in solid rubber. The relevant test methods necessary for the establishment of compliance with ISO 3302-1 are also specified within this standard.



### Recommended ISO 3302-1 Tolerancing for Elastomer Extrusion

Nominal Dimension (mm)		Nominal D	Nominal Dimension (in)**		Tolerance (mm)		Tolerance (in)**	
Above	Up to & Including	Above	Up to & Including	Class E2 (±)	Class E3 (±)	Class E2 (±)	Class E3 (±)	
0	1.5	0	0.06	0.25	0.40	0.01	0.016	
1.5	2.5	0.06	0.1	0.35	0.50	0.014	0.02	
2.5	4.0	0.1	0.16	0.40	0.70	0.016	0.028	
4.0	6.3	0.16	0.25	0.50	0.80	0.02	0.032	
6.3	10.0	0.25	0.4	0.70	1.00	0.028	0.04	
10.0	16.0	0.4	0.64	0.80	1.30	0.032	0.052	
16.0	25.0	0.64	1.0	1.00	1.60	0.04	0.064	
25.0	40.0	1.0	1.6	1.30	2.00	0.052	0.08	
40.0	63.0	1.6	2.5	1.60	2.50	0.064	0.10	
63.0	100.0	2.5	4	2.00	3.20	0.08	0.128	
100.0	-			2%	3.2%	0.08%	0.128%	

\*\* Unit conversions are per NIST Special Publication 1038

# Unique color matching for perfect aesthetics



The interior of an airplane is visible to the crew and passengers at all times, throughout the cabin, lavatory, galley and cockpit. Each airline and model of plane have a unique visual appeal determined by the quality of the components onboard.

Trelleborg Aerospace boasts unique color matching capabilities of interior components utilizing a visual inspection light booth and spectrophotometer, meaning we can offer interior components in virtually any color from a simple color swatch.

### **Color options**

Interior Components are available in a wide range of colors, including the representative samples shown to the left.

In-line pigment mixing allows for rapid changeover of colors and co-extrusion capabilities means rigid and semi-rigid materials can be extruded together.



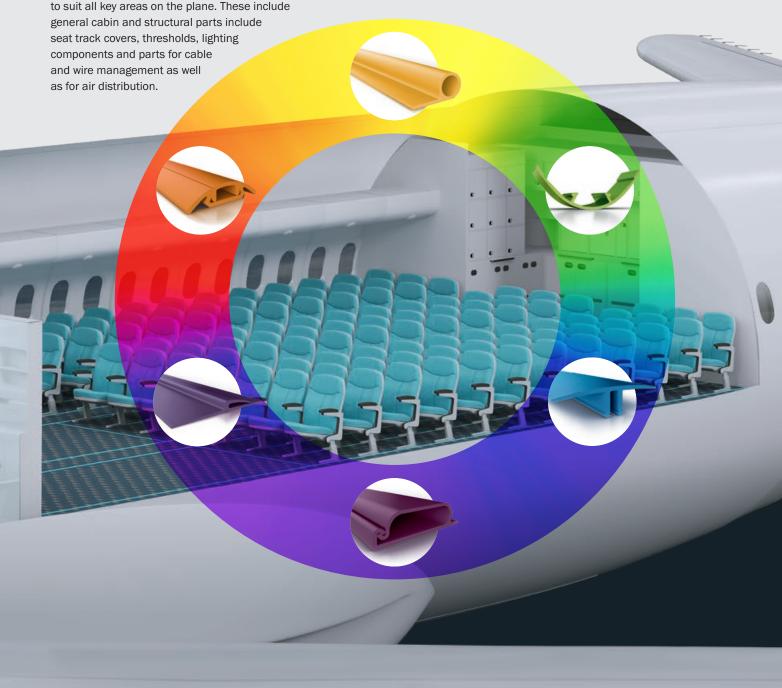
Approved by OEMs Boeing and Airbus in color matching, our processes comply to strict industry standards.

## Profiles designed for aesthetics and function

Each different application within the interior of an aircraft needs to have a profile fitting perfectly in a gap to provide a seamless aesthetic appearance that is both durable and hard wearing. Based on its extensive experience providing interior components to the industry, Trelleborg Aerospace offers standard profiles to suit all key areas on the plane. These include

Trim and finish components include bump strips, panel trims, kick strips and rub strips. In addition, there are gap seals.

The key standard profiles listed cover the majority of applications but for special requirements our engineers will work with customers to develop parts for specific needs.



## **Profile Applications**

### **GENERAL CABIN COMPONENTS**

Throughout the aircraft cabin are general components which contribute to safety, management, and cover features like seat tracks, flooring transitions, and overhead panels. These types of coverings usually span the length of the aircraft.

### Page 20 Seat Track Covers

Used to cover unsightly metal seat tracks where the aircraft seats are attached to the floor, seat track components act as a cosmetic and protective cover to ensure tracks are properly married to the carpet.

### Page 21 Floor Thresholds

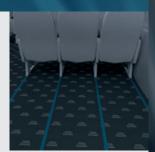
Carpet thresholds fill gaps between transitions in flooring throughout the aircraft. They assist in securing the edges of carpets and protecting against damage from passengers and cargo.

### Page 22 Wire and cable management

Wires and cables run throughout the length of the aircraft and risk entanglement and damage if not encased in a protective guide. Profiles restrain and protect essential wires that support critical functions.

### Page 22 Air distribution & PSU Components

Passenger service units (PSUs) are directly involved in the comfort and aesthetics observed by aircraft travelers. Components involved in air distribution and lighting within the PSU serve to enhance the travel experience while on the aircraft.

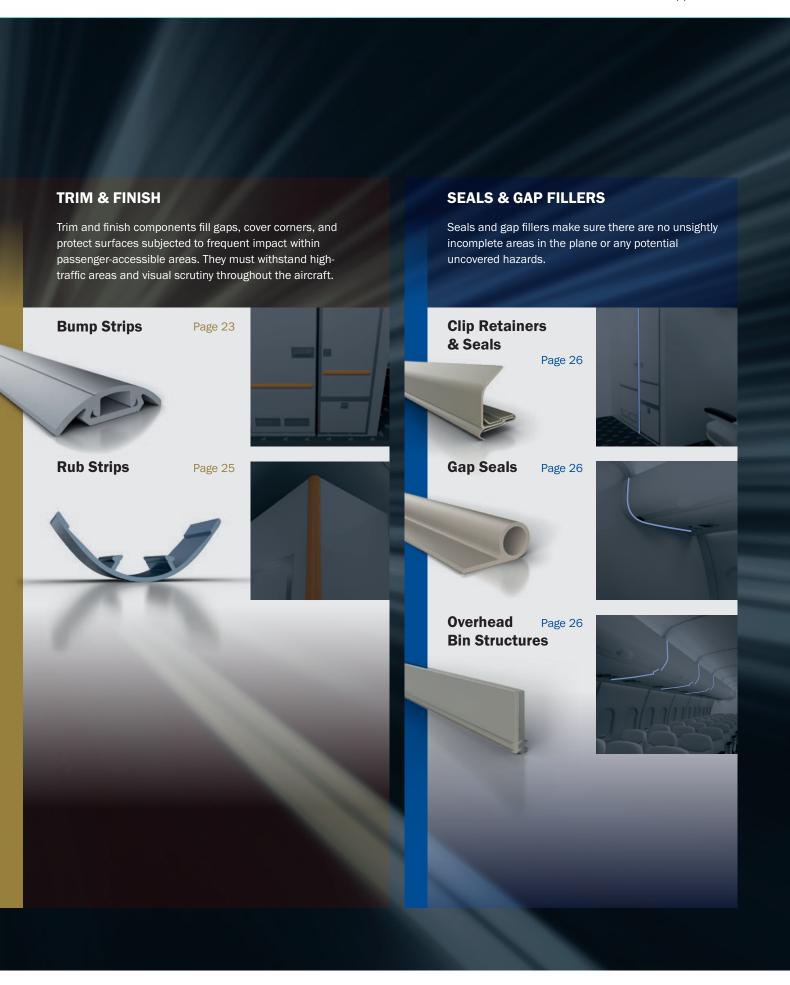




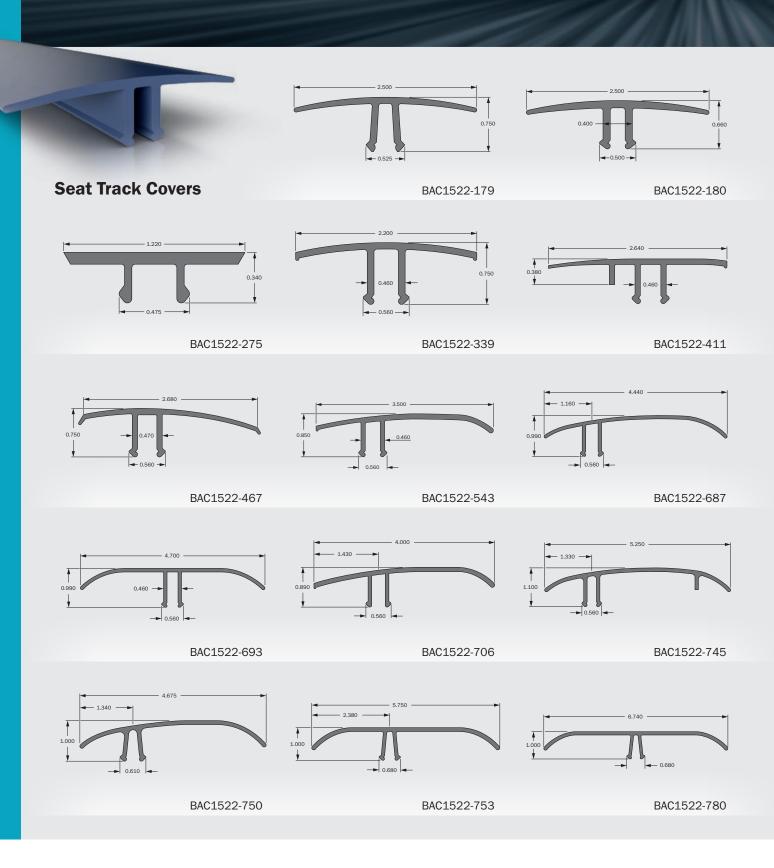


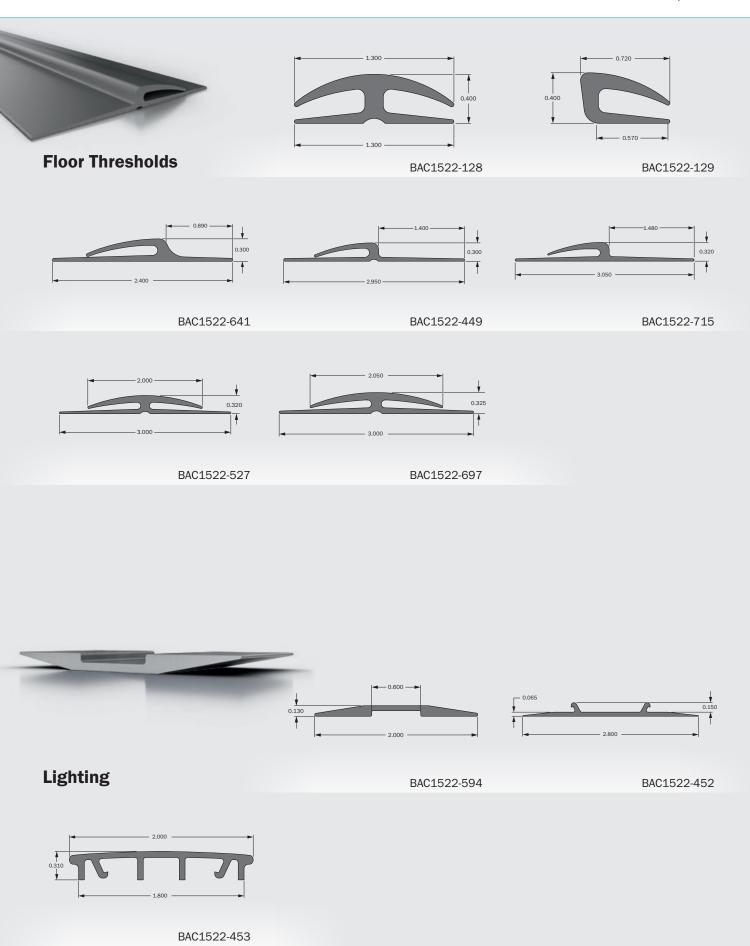


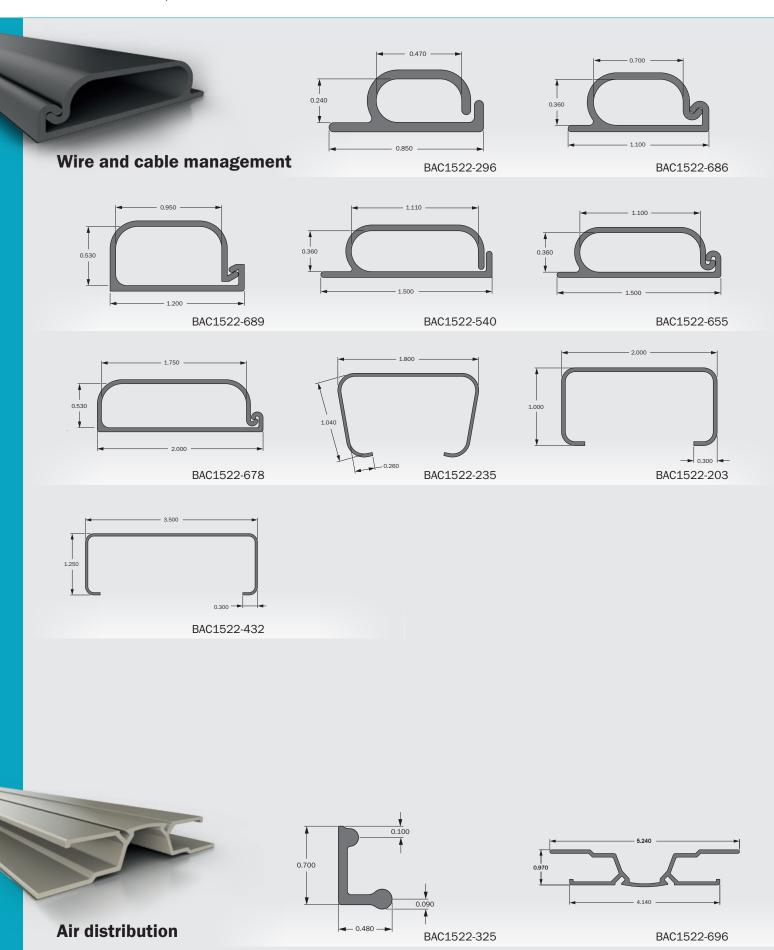




### General Cabin Components

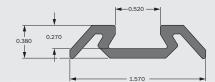


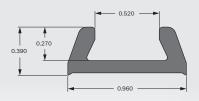




### Trim & Finish



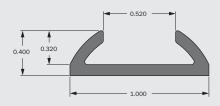


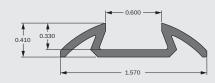


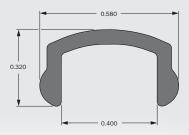
### **Bump Strips**

BAC1522-381

BAC1522-398



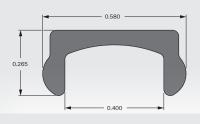


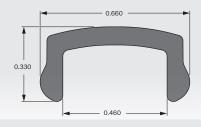


BAC1522-616

BAC1522-546

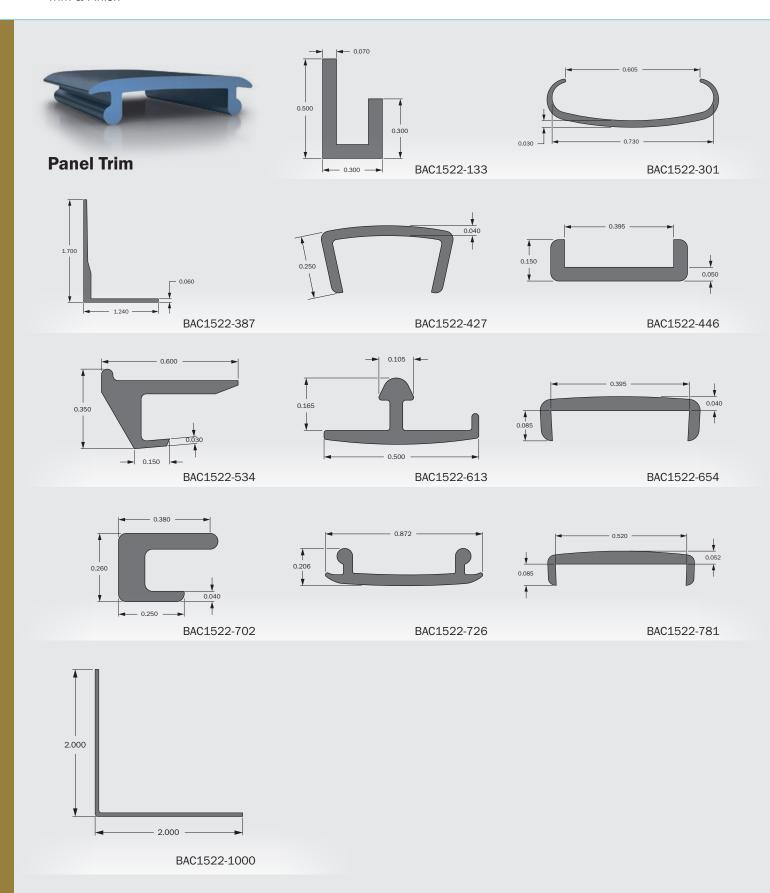
BAC1522-651

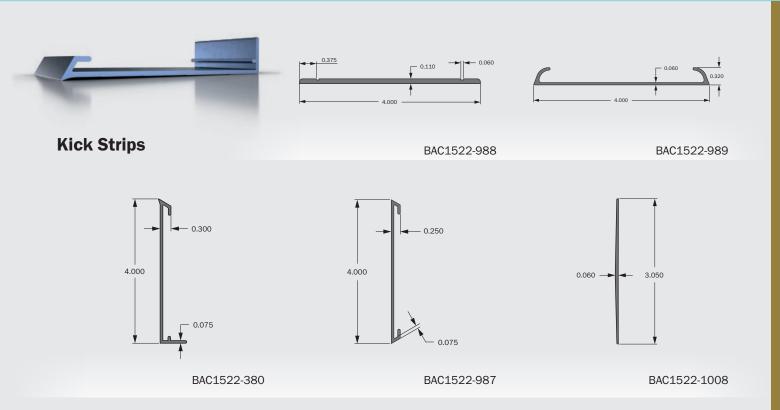




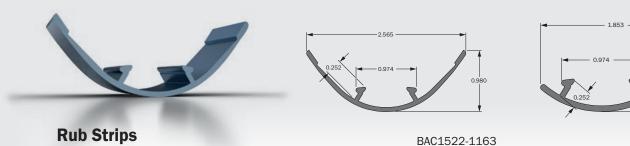
BAC1522-1003

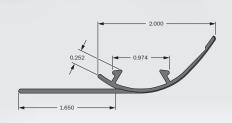
BAC1522-547





BAC1522-1163





BAC1522-1166

BAC1522-1167

# Gap Seals **Seals & Gap Fillers** BAC1522-738 BAC1522-101 - 0.690 -1.290 0.160 BAC1522-751 **Overhead Bin Structures Clip Retainers & Seals**

### Trelleborg Aerospace Resources

Trelleborg Aerospace offers a full portfolio of solutions and services for virtually all aerospace applications. Materials and products can be used in any type of aircraft and our products are designed to provide maximum efficiency to customers. In addition to our experience in the aerospace industry, we are also able to offer solutions based on industrial technology where full aerospace certification is not required.



Onboard Systems



Engineered Thermoplastic Aerospace Solutions



Thermoplastic Aerospace Interior Profiles



tic Polymer
Solutions
les for Space



Polymer Solutions for Hydrogen Aircraft



Advanced
as Air Mobility



Ground Support Equipment



Conductive and Shielding Solutions



Airframe and Engine Sealing Capabilities



Aerospace Sealing Systems



Trelleborg is a world leader in engineered polymer solutions that protect essential applications in demanding environments. Its innovative solutions accelerate performance for customers in a sustainable way.

Trelleborg Sealing Solutions is a leading developer, manufacturer and supplier of precision seals, bearings and custom-molded polymer components. It focuses on meeting the most demanding needs of aerospace, automotive and general industrial customers with innovative solutions.

WWW.TRELLEBORG.COM/SEALS











facebook.com/TrelleborgSealingSolutions youtube.com/TrelleborgSeals linkedin.com/company/trelleborg-aerospace instagram.com/trelleborgsealingsolutions

Version no. 9900217GBGL0325