

Achieving Safe and Lightweight Aircraft with Polymer-Based Thermal Isolator Technologies

Technical Case Study
Aerospace Market



Progress beyond



As one of the most technologically advanced environments in modern science, the aerospace industry faces a range of unique challenges that continue to drive the need for constant material innovation. Despite transformative efforts toward digitization, the aviation manufacturing realm continuously grapples with balancing

the timely delivery of high-quality, cost-effective solutions to meet high-stakes safety and reliability requirements. With an extensive history of constructive collaboration, the evolving partnership between Solvay and Drake Plastics addresses these most vital demands of aerospace design and engineering.

Safety and Lightweighting in Aerospace Manufacturing

Aerospace engineers turn to material solution developers, as aircraft components must safely and reliably deliver a range of capabilities in extremely harsh conditions, including arduous speeds, pressure, heat, chemicals, and lightning strikes. These materials must remain infallible, upholding their structural, mechanical, and design integrity to minimize part failure and ground time for maintenance.

Additionally, the aerospace manufacturing industry is under constant examination for its environmental and ecological footprint, and OEMs require new, inventive solutions to reduce weight and meet these ambitious eco-efficiency targets.

The Rise of the Composites and High-Performance Polymers in Aircraft Design

As a result of the drive for lighter, safer high-performance aircraft, components made of specialty polymers and composite solutions are on the rise and are here to stay. By incorporating a plastic element into these designs, the parts can provide similar, if not enhanced, structural strength when compared to conventional metallic alloys, but at a significantly lighter weight.

Versatile Material Solutions for Improved Dependability

The high-impact resistance, thermal stability, and damage tolerance of polymer-based aerospace solutions enable improved dependability in emergency situations and harsh environments. Additionally, polymer and composite applications resist fatigue and corrosion substantially better than traditional metals while simultaneously providing ease of assembly, design freedom, and tremendous innovation potential during processing and production.

As a leading developer of composites and high-performance polymers for aerospace applications, Solvay offers the industry's broadest portfolio of tailored alternatives to empower lighter and safer aircraft manufacturing and design.

High-Performance Polymers for Thermal Isolation

Unlike Aluminum skinned aircraft that shed lightning strikes, composite-based planes dissipate that energy, accomplished with a layer of [lightning-strike-protective surfacing films](#). Heat sinks are placed around

interrupted sections of the hydraulic lines, allowing the energy from lightning strikes to be safely dissipated and not transmitted through the hydraulic tubing.

Composites make up 50% of the weight of most modern commercial aircraft structures and are exceptionally strong and stiff, so long as they are kept at or below their service temperatures.

50%
COMPOSITES

Successfully separating cold and hot components is integral to the safety and lightweighting of modern aircraft. One of the ways to shed weight on an aircraft is to run the hydraulic lines for flight controls through, instead of around, the fuel tanks. Hydraulic isolator assemblies are a crucial component in making this system possible. Accordingly, this configuration requires a material with the ideal combination of low thermal conductivity and electrical insulation with impressive strength and temperature resistance.

Outside of the vital and requisite properties of aircraft safety and performance, thermal isolators offer three primary purposes:



LIGHTWEIGHTING



**HEAT
TOLERANCE**



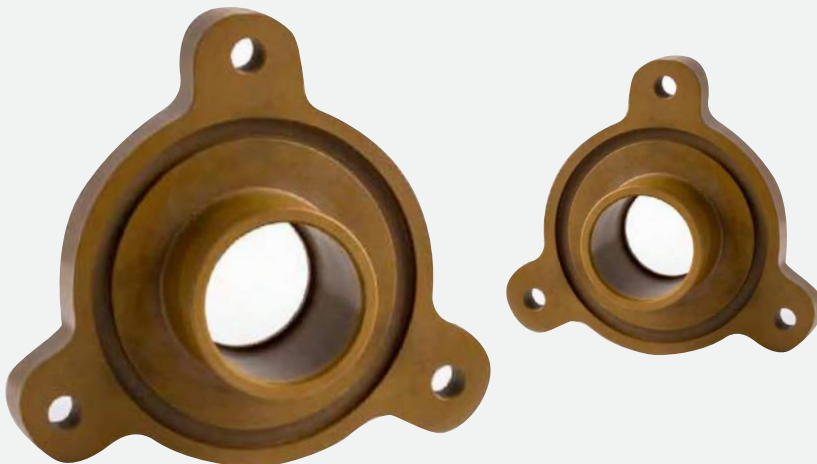
**LIGHTNING STRIKE
COMPRESSION**

TORLON® PAI: For Thermal Isolators

Solvay, a leading polymer and composite material solutions provider for the aerospace industry and [Drake Plastics](#), an innovative developer of machined and molded applications, worked in collaboration to develop the optimal polymer-based solution for aircraft thermal isolator technology.



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TORLON® PAI →

After testing PEEK materials that proved unfit due to their softening point margins and long-term creep resistance, the partnership elected **Torlon® PAI** for its optimal combination of thermal conductivity, electrical insulation, high strength, and high-temperature resistance. Torlon® PAI offers a Tg over 270°C, which leaves the desired margin of thermal safety from excursion temperatures.

The low thermal conductivity of Torlon® (0.26 W/ mK compares to 16.3 W/ mK for 316 SS and 45 for steel as reference points) ensures low BTU per hour transmission of heat, which is imperative for a thermal isolator hydraulic assembly, as it remains in constant direct contact with jet fuel. The thickness of Torlon® thermal isolators was designed and controlled in manufacturing to precise tolerances to isolate heat from transmitting to the composite structures.

High-Performance Polymers for Thermal Isolation

Both unreinforced Torlon® PAI and 30% glass fiber reinforced Torlon® serve as thermal isolators in these systems.

Material		Thermal Conductivity (w/m-K)
Aluminum Alloy		150
Copper		390
Granite		2.79
Lead		35.3
Rubber		0.2
Silica		1.3
Stainless Steel		15
Torlon® PAI	Solvay Material	0.26 - 0.80
Ketaspire® PEEK	Solvay Material	0.1 - 0.3
Amodel® PPA	Solvay Material	0.4 - 1.6
Ryton® PPS	Solvay Material	0.3 - 1.1

Opportunities for Assembly Enhancement

While Torlon® PAI-based thermal isolators showcase outstanding electrical isolation, insulation, strength and thermal range, the experts at both Solvay and Drake Plastics are receptive to the potential for enhancement.

Moisture absorption, for instance, remains a key focal point for thermal isolators, as protective primers applied prior to assembly often mitigate long-term moisture absorption capacity. Producers of these composite assemblies will continue to seek new and innovative techniques to increase thermal isolator dependability and achieve a guaranteed 30-year lifecycle expectancy.

About Torlon® PAI

Recognized as the highest-performance—yet melt-processible—thermoplastic, Torlon® PAI's ability to be easily extruded into the optimal shape provides aircraft engineers with unrivaled design flexibility. Torlon® PAI affords unparalleled toughness and dielectric strength at extremely high temperatures and exhibits superior impact resistance compared to conventional polymers.

Key Properties

- Unsurpassed wear resistance in dry and lubricated environments
- Exceptional strength and stiffness up to 260°C (500°F)
- Extremely low-temperature toughness and impact strength
- Excellent resistance to wear and creep under load
- Resistance to most chemicals including strong acids and most organics
- Excellent compressive strength and extremely low CLTE
- Low flammability and smoke generation



Progress beyond

[Solvay](#) will continue its ongoing partnership with Drake Plastics to empower the aerospace industry with safe, lightweight alternatives to traditional metallic components. Solvay is a science company offering composite and specialty materials solutions for a wide range of markets including battery, aerospace and automotive. With more than 21,000 employees in 63 countries, Solvay bonds people, ideas and elements to reinvent progress.



[Drake Plastics Ltd. Co.](#), a Solvay-approved Torlon® PAI, Ketaspire® PEEK, Ryton® PPS and Avaspire® PAEK extruder and injection molder, offers over 25 years of industry-leading experience, delivering unmatched capabilities and competence in extruding, injection molding, post-processing and machining ultra high-performance polymers.

Safety Data Sheets (SDS) are available by emailing us or contacting your sales representative. Always consult the appropriate SDS before using any of our products.

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