In Flight
Evonik solutions for the aviation and aerospace markets
Evonik is one of the world’s leading specialty chemical companies. Profitable growth and sustained value creation form the heart of our strategy. Around 80 percent of sales come from leading market positions, which we plan to expand further. We concentrate on high-growth megatrends, especially health, nutrition, resource efficiency and globalization.

Evonik manufactures an ever-expanding range of advanced, long service life polymers and composite materials to meet the critical demands of the Aviation and Aerospace Industries. You’ll find our high performance materials on nearly every takeoff and landing, inside and out. Evonik materials provide key OEMs and supply chain partners with the design freedom needed to engineer high quality, unique products with high fatigue performance.

We’re ranked high as an innovation partner because we understand changing technical requirements and strive to offer next generation aviation materials. Evonik supports ongoing product development efforts focused on weight reduction, impact resistance and fuel savings while lowering production costs and maintaining reliability and safety.

Evonik. Power to create.
Evonik products in flight

**ALBIDUR®**

The ALBIDUR® core-shell toughening technology for thermosetting resins used in aircraft manufacturing, like epoxy resins or cyanate ester resins, improves significantly the toughness of fiber-reinforced composite parts or structural adhesives. This improvement is provided from -100 °C up to the maximum usage temperature of the thermosetting resins. Furthermore the fatigue performance is increased significantly, thus enhancing service life. Shrink is reduced and the glass transition temperature \(T_g\) of toughened resins is not affected.

ALBIDUR® products consist of reactive resins, in which fully cured silicone rubber particles with a defined size of 0.1 - 3 µm are finely dispersed. These rubber particles have an organic shell structure comprising reactive groups. The typical addition levels are around 10 wt%, depending on the system to be modified.

**ALBIPOX®**

ALBIPOX® rubber-modified epoxy resins are used as tougheners for epoxy prepregs for aerospace applications. They increase toughness, reduce microcrack formation in fiber-reinforced composites or structural adhesives. Furthermore they improve fiber wetting and adhesion to aluminum substrates. Some specialty grades are designed as tackifiers to improve the workability of epoxy prepregs and reduce manufacturing costs. They are a vital part of the toolbox of resin formulators.

**CALIDUR®**

CALIDUR® represents a new class of thermoset matrix resins. It combines the advantages of phenolic and high TG epoxy resins:

- Intrinsic FST performance
- High TG
- Shelf-stable at 8°C
- Formaldehyde-free and non-volatile system
- Very beneficial compressive and shear behavior

CALIDUR® laminates feature greater flame resistance than those based on epoxy resins, thus opening the door to formaldehyde-free aerospace interior components. Due to thermoplastic behavior below curing temperatures it is possible to process CALIDUR® like a thermoplastic resin. CALIDUR® features a broad range of curing temperatures, resulting in high glass transition temperatures and a high thermal oxidative stability. The cured resin is characterized by chemical resistance against organic solvents and fluids, such as jet fuels and hydraulic fluids.

**CALIDUR®**

CALIDUR® represents a new class of thermoset matrix resins. It combines the advantages of phenolic and high TG epoxy resins:
COMPIMIDE®

COMPIMIDE® bismaleimide resin family represents a full range of thermosetting matrix resins and specialties developed for the production of high-performance composites, mostly for aerospace applications. Heat resistant COMPIMIDE® bismaleimide matrix resins are characterized by their high glass transition temperature (Tg), thus offering excellent performance in hot and wet conditions, retention of mechanical properties up to 250°C, superior flame and radiation resistance, low smoke and toxicant emissions, and easy processing.

Typical processing techniques include prepregging (from the melt, solution, or suspension), resin transfer molding (RTM), filament winding, compression molding, powder coating, and pultrusion. The COMPIMIDE® bismaleimide product group comprises bismaleimide monomers, toughening modifiers, and formulated bismaleimide resins.

EUROPLEX®

EUROPLEX® Polyphenylsulfone (PPSU) extruded sheets are utilized to create endless design and décor possibilities for aircraft cabin components. Both opaque and transparent sheets meet the strict FST (Flame/Smoke/Tox) requirement according to FAR 25.853 and ABD 0031, and OSU Heat Release Test [FAR 25.853 (d)]. Along with its flammability properties, it offers high chemical and impact resistance. PPSU can be processed with customary forming equipment for everything from window shades and seating to large scale components such as side wall dividers for galleys and lavatories.

NANOPOX®

Evonik is the leading manufacturer of surface-modified silica nanoparticles in epoxy resins. They are used in many fiber-reinforced composites and structural adhesives for aerospace applications. Modulus and strength are significantly improved. Compressive strength is increased and, most important, fatigue performance is significantly higher – thus enhancing service life.

The NANOPOX® products are concentrates of nanosilica in epoxy resins. Due to their small size and the absence of larger aggregates, the nanoparticles can easily penetrate all fiber structures without comprising the impregnation by increased viscosities. All state-of-the-art process technologies like resin infusion, RTM, VARTM etc. can be applied. Nevertheless these products are suitable for prepreg manufacturing as well.
**PLEXIGLAS®**
PLEXIGLAS® is an acrylic sheet based on methacrylate chemistry (PMMA) for military and commercial aircraft glazing/transparencies. It’s weatherable, half the weight of glass and offers outstanding impact resistance. PLEXIGLAS® is manufactured using equipment reserved for aviation acrylic products and is subjected to the most rigorous optical inspection in the industry. Our aviation grade sheets are also the largest in the industry (2 m x 3 m) and deliver superior optical quality and thickness tolerance in monolithic production.

PLEXIGLAS® is U.S. Navy QPL’d MIL PRF 8184, Mil PRF 5425, and meets the LP-391, as well as all other worldwide required specifications like AECMA, DTD or DIN 65321. The material can be easily cut, sawed, machined, thermoformed and cemented.

Evonik Industries is a worldwide manufacturer of PMMA products sold under the PLEXIGLAS® trademark on the European, Asian, African and Australian continents and under the ACRYLITE® trademark in the Americas.

**P84®**
P84® Polyimide (PI) is a high performance polymer combining excellent physical properties with high temperature and chemical resistance. As solution in polar aprotic solvents, it can be used to make anti-friction coatings or insulating layers for aerospace electronics due to its low dielectric constant or high dielectric strength. In fiber form, P84® is typically used for applications ranging from protective clothing for pilots to aerospace insulation and sealing materials.

**ROHACELL®**
ROHACELL® Polymethacrylimide (PMI) structural foam has been used in fiber-composite technology for more than 40 years. It increases stiffness of composite structures and provides extremely robust and durable composites compatible with all common thermoset and thermoplastic polymers. ROHACELL® delivers excellent mechanical properties over a wide temperature range, even at low densities and high temperature resistance up to 220°C. It has unique compressive creep behavior and dynamic strength and cell sizes that can be selected for each processing method. It will not add unnecessary weight since this 100 percent-closed-cell foam uptakes resin only in the exposed cut cells at the surface. Versatile, the foam can be CNC milled or thermoformed into complex geometries. All foam combined with common resin systems is suitable for autoclave, press, vacuum infusion, RTM and VARTM.
VESTAKEEP® PEEK polymer

VESTAKEEP® Polyether ether ketone (PEEK) is a high-performance thermoplastic polymer ideal for manufacturing long-lasting components for use in the toughest conditions. Tight tolerance parts can be produced via traditional molding and extrusion to withstand high temperature, chemical and conductive environments. Thanks to higher ductility and molecular weight, mechanical advantages such as higher elongation at break, higher impact strength and lower notch sensitivity can be achieved across elevated temperature ranges. This is a clear advantage in both fabrication and longevity. Inherent flammability properties and robust performance make it an ideal choice for aerospace applications.

VESTAKEEP® is also used as a resin matrix for thermoplastic composite unidirectional fiber tapes and fabric prepregs. Excellent fatigue, impact, and creep behavior are achievable for continuous use at elevated temperatures to 250°C. Its lower weight combined with high mechanical strength make it a suitable replacement of traditional thermosets and metals.

Additionally, VESTAKEEP® is available as a specially formulated ultra fine powder for use in Additive Manufacturing (Selective Laser Sintering). Selective Laser Sintering is layer-based manufacturing that does not use molds or tools to create parts. Improved design freedom, part consolidation, metal replacement and cost reduction are possible. High temperature VESTAKEEP® is the solution for hot air ducting, clips and brackets in a wide variety of commercial and military applications.

VESTAMID®

Specialty VESTAMID® heat stabilized Polyamide 12 (PA12) compounds contain a non-migrating flame retardant, free of halogens and phosphorous. In compliance with the flammability requirements of FAR 25.853 and ABD0031, they are especially suited for aircraft interior parts. Airframe OEMs have achieved significant weight savings by replacing phenolic materials with these compounds. They can be used for extrusion and injection molding.

VESTOSINT®

VESTOSINT® Polyamide 12 (PA 12) are ultra fine powders for Additive Manufacturing. VESTOSINT® provides dependable quality and repeatability of processing. It offers mechanical properties that enable complex geometry for optimum design freedom, part consolidation and simplified logistics. Ultra-flexible grades offer eight times the flexibility and five times the tensile strength versus competitive grades.
Helicopter applications

ALBIDUR®, ALBIPOX®, NANOPOX® exterior
1. Main rotor blade
2. Tail boom and structural stiffeners/stringers
3. Main cabin (prepregs)

ALBIDUR®, ALBIPOX®, NANOPOX® interior
4. Doors, walls and ceilings
5. Structural adhesives for composite bonding
6. Floor panels

COMPIMIDE® bismaleimides structural applications
7. Engine inlet and pylon cowling
8. Tail boom and skins for structural stiffeners/stringers
9. Nacelle and cowling components

EUROPLEX® interior
10. Cockpit instrument panels
11. Doors, walls and ceilings

PLEXIGLAS® exterior
12. Cockpit instrument panels
13. Windshields/windows

ROHACELL® exterior
14. Engine inlet and pylon cowling
15. Horizontal stabilizer
16. Main rotor blade
17. Radome/forward cowling
18. Skids
19. Tail boom and structural stiffeners/stringers
20. Tail rotor blade

ROHACELL® interior
21. Floor panels

VESTAKEEP® exterior
22. Secondary structures/flooring

VESTAKEEP® interior
23. Latches, handles, hinges and mechanical parts

VESTAMID® interior
24. Interior profiles/rub strips

VESTOSINT® interior
25. Additive manufacturing: brackets, clips and ducts
Aircraft applications

**ALBIDUR®, ALBIPOX®, NANOPOX® exterior**
1. Toughening agent for composites
2. Fuselage (prepregs)
3. Wings (prepregs, structural adhesives)
4. Tail fin (prepregs, structural adhesives)

**ALBIDUR®, ALBIPOX®, NANOPOX® interior**
5. Toughening agent for composites
6. Structural adhesives for aluminum and composites
7. Primary floor structures (laminates)
8. Secondary floor structures

**CALIDUR®**
9. Cargo container
10. Secondary structure
11. Air ducts

**COMPIMIDE® bismaleimides**
structural applications
12. Engine cowling/doors
13. Flap fairings
14. Radome
15. Leading edge
16. Nacelle
17. Engine inner fixed structures:
   thrust reverser/soundproof panels/ducting

**EUROPLEX® interior**
18. Cockpit instrument panels
19. Cabin lighting covers
20. Window shades and dust covers
21. Galleys, partitions, lavatories, sidewalls, seats and tray tables

**P84® NT powder exterior**
19. Sealings, bearings, bushings and guidances
20. Toughening agent for composites

**P84® interior**
21. Anti-friction/insulating coatings electronics
22. Sealing materials

**PLEXIGLAS® exterior**
23. Aircraft canopy/view windshield
24. Cockpit instrument panel
25. Wingtip lens

**PLEXIGLAS® interior**
26. Dust covers
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Evonik products in space

Evonik foam products and matrix resins continue to play a vital role in the global space launch vehicle construction market.

**COMPIMIDE®**

Extensive applications of COMPIMIDE® bismaleimides in the modern spacecraft design include both structural parts and thermal protection/insulation in launch carriers, satellites, and multiple reentry vehicles.

**ROHACELL®**

ROHACELL® foam cores offer unparalleled strength-to-weight ratio. It’s the preferred core designed in and specified for producing high performance sandwich composite structures in launch vehicles including payload and payload adapter fairings, interstages, nose cones and thermal protection shields.
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