# LIGHTWEIGHT+ COMPLIANT

## Next Generation Solutions for Aircraft Interior Designers

CHEMISTRY THAT MATTERS™

# A GLOBAL SOLUTIONS PROVIDER

The value we offer begins with our commitment to drive the success of our customers. We're here to support – on the ground, in the air and for the long run. We understand that the advanced materials we provide are only as good as the innovations they empower the industry to implement. Our global footprint, backed by innovation and application development support, enables SABIC to help our customers achieve their commercial ambitions. Together we can redefine the limits of performance, safety and compliance, helping to shape the solutions for the aircraft interiors industry.

# INNOVATING FOR CUSTOMER SUCCESS

We believe that SABIC customers deserve the full benefit of every advantage our enterprise can offer.

After all, our success is defined by our customers' success. And with more than 80 years of experience pioneering advanced engineering thermoplastics, SABIC is positioned to help create new opportunities for growth, breakthrough designs and sustainable solutions.

We invite designers and OEMs to move their best ideas forward with the new materials at their disposal: materials that combine precise performance qualities with improved processability and uncompromised compliance.

We offer extensive experience to our customers in a variety of ways:

- Material solutions, including forms, to help drive innovation and market leadership.
- Design and engineering competencies, to optimize system cost reduction
- Unwavering commitment to building long-term relationships with ingenuity, trust and continuous improvement.

It's what we strive for and work to deliver…

Excellence and nothing less.

# EXPERIENCE THAT MATTERS

SABIC has been a strategic solution provider for the aircraft interiors industry from the beginning, pioneering new material technologies to make aircraft lighter, more efficient, enjoyable, comfortable, safer and more sustainable.

As demonstration of our long-term commitment to the aircraft interiors industry, SABIC continues to invest in game-changing thermoplastic resins, sheets, foams, films, fibers and composite technologies that offer the advanced material solutions our customers demand. If you believe that we're standing at the threshold of a new era in aviation design, you're not alone. SABIC's portfolio of solutions and advanced materials can help change the rules on weight reduction, impact and chemical resistance, heat performance, smoke and toxicity, cabin noise and flame retardancy.

We help our customers with innovative solutions to the industry's most pressing challenges:

- Lower system weight for increased fuel efficiency
- Reduced operational and maintenance costs
- Design flexibility
- Improved durability
- Lower cabin noise
- Enhanced passenger safety
- Compliance with FAA, Boeing and Airbus specifications

It's all part of our commitment to serve the aircraft industry with product innovations and business support to achieve new heights in safety, efficiency and profitability.

## CONTENTS

# WHERE COMPLIANCE IS KEY

When it comes to limiting flammability, smoke release and toxicity, aircraft manufacturers demand more from their materials. SABIC offers a complete selection of advanced thermoplastic solutions designed to enable designers and OEMs to attain unprecedented levels of safety and compliance without compromising performance.

## A RANGE OF OSU (HEAT RELEASE)-COMPLIANT MATERIALS

SABIC has a wide range of materials that comply with OSU requirements and span a variety of viscosities for injection molding, extrusion or blow molding, as well as foam and fiber processing.

They include:

### OSU-COMPLIANT RESINS, COMPOUNDS, FOAM AND FIBER

ULTEM™ 9085 resin

THERMOCOMP™ EC00X series compounds

LEXAN™ FST series resins, opaque and transparent

ULTEM AR9000 series resins

ULTEM XP060 rigid foam boards

ULTEM fiber

### OSU-COMPLIANT SHEET AND FILM

LEXAN XHR5000 sheet

LEXAN XHR2000 series sheet

LEXAN XHR LIGHT series sheet

LEXAN XHR6000 series sheet

LEXAN FR60 film

LEXAN XHR A13 film

JET PANEL™ sheet

# CABIN INTERIORS

## STRONG, LIGHTWEIGHT SOLUTIONS FOR CABIN INTERIORS

WINDOWS AND DOORS

LIGHTING AND SIGNAGE

PASSENGER SERVICE UNITS

OVERHEAD STORAGE UNITS

PROFILE EXTRUSIONS AND TRIMS

Going beyond the state of the art with smarter designs and better materials has led to aircraft today that are lighter, more fuel efficient, more comfortable and safer than ever.

Building upon the outstanding performance of LEXAN™ polycarbonate resins and flame-resistant ULTEM™ resins, SABIC is expanding its portfolio of material solutions to help aircraft designers develop the next generation of interior components.

### LEXAN RESIN, SHEET AND FILM

Already a familiar fixture aboard today's aircraft, LEXAN polycarbonate is a tried and true performer, especially when it comes to tough durability, clarity and aesthetic appeal.

### LEXAN FST RESIN SERIES AND LEXAN XHR6000 SERIES SHEET

Available in both resin and sheet form, this engineering plastic breakthrough combines the processing window and aesthetic flexibility of polycarbonate with the heat release, fire, smoke and toxicity compliance of PEI resins. It's available in custom colors and can address a wide range of performance targets – from enhanced chemical resistance to high ductility to rugged durability and UV stability.

Extremely low heat release and potential for significant weight-out, revolutionary **LEXAN XHR 6000 sheet** series can deliver superior weight-out of up to 12 percent vs. solid polyvinyl chloride (PVC)/polymethyl-methacrylate (PMMA) products while fully complying with regulatory requirements (FAR 25.853), meeting major OEM toxicity specifications for cockpit linings, window surrounds, door shrouds, and other interior components. Available in a variety of densities and colors, including suede, polished, and a super low gloss velvet texture, LEXAN XHR sheet series can reduce production costs, eliminate paint and withstand punishment in high-abuse applications.

# CABIN INTERIORS

## LEXAN™ XHR 2000 SHEET SERIES

This 2015 Crystal Cabin Award winner is SABIC's latest breakthrough, further underscoring our commitment to delivering innovative solutions. LEXAN XHR2000 is a transparent sheet, available in uncoated and hard coated variations, complying with FAR 25.853 and OEM toxicity while offering 80% light transmission at 2mm thickness, chemical resistance and excellent scratch/mar-resistance. This clear compliant sheet facilitates the design of large transparent components such as security partitions, oversized windows, trolleys, monitor covers and self-service refreshment stations.

## JET PANEL™ SHEET

Made with LEXAN XHR2000 sheet, JET PANEL sheet is the first ever fully customizable transparent polycarbonate sheet product that meets stringent heat release, flame, smoke and toxicity requirements for cabin interiors. It is available in variety of custom colors, textures and virtually limitless decorative designs that greatly expand options for unique cabin interior designs.

**LEXAN XHR5000 sheet**, utilizing a copolymer formulation for added opacity, was designed for multi-layer aircraft window shade systems requiring robust flame-smoke-toxicity (FST) properties and high opacity. This new product helps to improve the cabin environment with a high quality appearance and enhanced room-darkening properties. Supplied as a white-pigmented cap layer over a black base, LEXAN XHR 5000 sheet is engineered as a robust yet lightweight substrate to be laminated with decorative films and then thermoformed.

Transparent **LEXAN F2000A, 9600 and F2100 series sheets** have excellent flame, smoke and toxicity characteristics along with high-impact strength, making them excellent candidates for applications such as post-decorated transparent thermoformed parts, light diffusers, racks and signs. Imagine what you can do with tough clarity and vertical burn compliance.

SABIC's LEXAN sheet portfolio also contains a broad range of materials for clear and tinted options with added durability and chemical resistance. **LEXAN MRAC** and **LEXAN FMR604 sheets** are optical grades with proprietary coatings for maximum service life.

With its ability to be draped or thermoformed into complex 3D shapes with no loss of performance or property retention, **LEXAN F6000 sheet** is an excellent replacement for solid PVC-based sheet products – and it's up to 12% lighter. **LEXAN F6006 sheet** offers a suede-like finish, while our velvet texture **LEXAN F6005 sheet** provides a low-gloss effect.

Our lightweight thermoplastic materials also help to reduce emissions for the airlines, who use these materials in aircraft interiors—seats, storage and galley equipment – to help achieve weight savings that may result in significant benefits. Reducing just one kilogram of weight on every commercial flight would save approximately 2,300 metric tons of fuel and 7,200 metric tons of $CO_2$ emissions per year[1]. SABIC's high performance technologies for the aircraft industry can help to deliver important benefits.

As a specific example, on an aircraft with 190 seats, using LEXAN F6000 sheet instead of solid PVC/acrylic products for seating components could reduce weight by approximately 23 percent up to 53kg. Plus, it comes in range of seemingly limitless and attractive custom colors including metallic.

## LEXAN XHR FILM

**LEXAN XHR film** provides the same burn performance offered by LEXAN FST resin series in thin-film form. This film offer engineers and product developers a film grade that helps maintain – or possibly add – robustness in multilayer constructions. **LEXAN XHRA13** film may be used as an adhesive for ULTEM foam or as backing layers for fabrics for added performance. It may also be considered for other film applications requiring strict OSU heat release compliance, vertical burn performance, low smoke generation and toughness. Standard gauges available include 50, 75, 125, 175 and 375 microns; other gauges may be available upon request.

## LEXAN RESINS

Other LEXAN resins feature aesthetic choices from crystal clear to bright color pigmentation. For example, **LEXAN CFR5630** is flame retardant resin available in clear and custom colors that may be used for small lenses. **LEXAN CFR5630D** is SABIC's aerospace grade for LED lighting, offered in five different diffusion options.

Free yourself to innovate with the many material advantages LEXAN polycarbonate resin, sheet and film can bring to support weight reduction, improved performance and safety, styling and environmental benefits.

Think SABIC.

[1] "The Aviation Sector's Climate Action Framework" November 2015. Air Transport Action Group (ATAG). Or http://aviationbenefits.org/media/136876/CATF_Version-One_WEB.pdf

## FLAME-RESISTANT ULTEM™ RESIN AND SHEET

As the demand to meet the challenges of today's commercial and military aircraft industries grows, so does the list of game-changing solutions from SABIC. Aircraft designers and OEMs around the world are challenged to create compliant products that can withstand heat without sacrificing stability and aesthetic flexibility. SABIC's line of ULTEM resins offers compliant solutions for precise performance needs.

**ULTEM 9085 resin** is a next generation product that goes beyond compliance with better flow, improved impact performance, lower processing temperatures and a wider processing window – all while maintaining its high modulus and heat resistance. For customers, that means key advantages like thinner walls, lower system cost and lighter weight. **ULTEM 9075 resin** is a product with a proven track record in the aircraft industry for use in many cabin interior applications such as passenger service units and window frames. For extruded profiles, **ULTEM 9076 resin** has lower flow behavior, allowing an improved processing window.


SABIC provided parts made from ULTEM™ 1668 sheet to Airbus for the development of Adder cabin dividers.

Goodrich Hella Aerospace Lighting System's passenger service unit using ULTEM™ resin

Vaupell Industrial Plastics aircraft video display molded from ULTEM™ 9075 resin

# CABIN INTERIORS

## CABIN INTERIOR CASE STUDIES

Leading industrial designer Patrick Lindon selected lightweight, transparent **LEXAN™ F2000A sheet** to create his in-flight brochure racks for **Bucher Leichtbau AG.** Among other key properties, the sheet provides compliance with FAR 25.853 flame and smoke requirements and ABD0031 toxicity limits at 2 mm and 3 mm.


**PECO Manufacturing** used an integrated structural design which consolidated parts and eliminated a main frame requirement in order to reduce the footprint of its passenger service unit. **ULTEM™ 9085 resin's** improved flow enabled thinner walls, and the result was a 30% smaller unit with considerable weight savings, which provided more headroom to accommodate the new platform design. **LEXAN™ FST9705 resin** with integral colors was used for the visual "touch points" of the assembly's light and air movement components.

**LEXAN™ F6000 sheet** was specified by **Pilatus Aircraft Ltd.**, a world leading manufacturer of single engine turboprop aircraft and pilot training systems, to create its new state of the art cockpit. The material gives the OEM superior processability vs. thermosets, excellent colorability, dimensional stability and compliance with industry safety requirements.

# SEATING

## INNOVATIVE AND COMPLIANT: ADVANCEMENTS FOR NEXT GENERATION SEATING

SEAT CLADDING

METAL REPLACEMENT

ARM AND FOOT RESTS

SEAT BACK SHELLS

TRAY TABLES AND ARMS

CENTER CONSOLES

VIDEO BEZELS AND SCREEN COVERS

Seating has long been a focal point for passenger comfort and safety and for cabin aesthetics. At the same time, seating components offer a premiere opportunity to reduce weight without compromising strength, stability and durability. SABIC's focus is here, too, with materials and design recommendations to help manufacturers translate designs utilizing metals, to updated designs using thermoplastics.

### CARBON FILLED ULTEM RESIN

When it comes to replacing airline grade die-cast aluminum in semi-structural supports, SABIC's carbon-filled ULTEM™ resin materials can provide a step up. Their excellent stiffness and flow characteristics allow for thin-walled molded parts that can reduce weight up to 20% while significantly increasing strength. **THERMOCOMP™ EC00X series compounds** can change the way you think about arm and foot rests, tray table arms, and support structures– nearly any application where lightweight, solid support is required.

### ULTEM FOAM

Lower weight systems hold the key for improving aircraft efficiency and performance. SABIC can help unlock your ideas with a solution that has the inherent flame, smoke and toxicity performance of ULTEM resin, but at a density up to 30 times lower than the resin itself. **ULTEM foam** offers designers and OEMs new opportunities to shed weight without sacrificing performance or compliance. It's formed by extruding ULTEM resin into a rigid foam board that is then used as the core in multi-layer systems. The foam is available in density ranges from 60 kg/m$^3$ to 110kg/m$^3$ to accommodate precise application demands. Compared to conventional aramid honeycomb systems, ultralight ULTEM foam offers full FST and OSU compliance, lower moisture absorption, better energy absorption properties, low dielectric loss and ease of manufacturing.

ULTEM FOAM (XP060) — TYPICAL FOAM PROPERTIES

| | | | |
|---|---|---|---|
| Physical properties | Density | lbs/ft$^3$ (kg/m$^3$) | 3.8 (60) |
| Mechanical properties | Compressive strength | psi (MPa) | 100 (0.7) |
| | Compressive modulus | psi (MPa) | 6700 (46) |
| | Shear strength | psi (MPa) | 120 (0.8) |
| | Shear modulus | psi (MPa) | 2800 (19) |
| Flammability | 60s vertical burn | FAR 25.853 | Pass |
| | Smoke density | FAR 25.853 | Pass |
| | Toxicity | BSS or ABD | Pass |
| | OSU heat release | FAR 25.853 | <65/65 |
| | Insulation radiant panel | FAR 25.856 | Pass |

Product properties shown are indicative and not for specification purposes

# SEATING

## FLAME-RESISTANT ULTEM™ FIBERS AND FABRICS

If every fiber and fabric on an aircraft interior delivered intrinsic flame resistance along with low smoke and toxicity, imagine how safe – and easy – that would be. SABIC's ULTEM resins can help make it possible. Tough, compliant and easily processed, they can be spun into fibers or converted as a solvent-spun hollow fiber or membrane. Available in staple, multifilament or spun yarn, the resin features solid stability at high temperatures, combined with chemical resistance and heat release. In addition, fibers and fabrics made from ULTEM resin can be dyed and show good color stability, even after repeated exposure to UV and washing.

With high-performance, flame-resistant fiber technology from SABIC, you can change the way you think about aircraft interiors and design a new standard of passenger safety and cost-effective compliance.

The ULTEM product line also offers a wide variety of select grades engineered for targeted properties that can meet the specific needs of applications with distinct performance and processing requirements.

## LEXAN™ SHEET MATERIALS FOR SEAT CLADDING

With its extremely low heat release and potential for weight-out, **LEXAN XHR 6000 sheet series** can deliver light-weighting of up to 12 percent vs. solid PVC/PMMA products for better fuel economy while fully complying with FST requirements (FAR 25.853) of major airlines for seating. It can be color-matched in sheet and resin form for color coordinated thermoformed and injection-molded parts. Available in more than 250 colors, and with textures such as suede, polished, and a super low gloss velvet, which brings low gloss aesthetics after thermoforming, LEXAN XHR sheet can reduce production costs, eliminate paint and withstand punishment in high-abuse seating applications.

*Aviation Week* magazine recognized lightweight ULTEM foam with its annual Innovation Challenge Award for "representing the best in class, potential game changing innovation."

ULTEM FIBER (2640dtex/1200f) — TYPICAL FIBER PROPERTIES

| | | | |
|---|---|---|---|
| Mechanical properties | Tensile Strength | cN/dtex | 2.5 |
| | Tensile Modulus | cN/dtex | 30 |
| | Elongation at Break | % | 70 |
| Thermal & FR properties | Glass Transition Temp. | °C | 215 |
| | Shrinkage at 180°C | % | <3 |
| | LOI | % | 31 |
| | Low Smoke Density | Ds(4min) | 0.2 |
| Other | Dyability (possible to use a disperse dye like a PET) | | |
| | Thermoplastic (matrix polymer for composite) | | |

Product properties shown are indicative and not for specification purposes

Achieving significant weight-out is increasingly possible with **LEXAN™ LIGHT sheet series.** The LEXAN LIGHT sheet series is complementary to the LEXAN XHR6000 solid sheets and exhibits up to 40% weight reduction vs solid PVC/PMMA sheet while complying with regulatory and OEM toxicity requirements, resulting in greater fuel efficiency and reduced $CO_2$ emissions. LEXAN LIGHT sheet series is made with an innovative lightweight closed cell foam, encapsulated with solid outer layers and can be thermoformed into 3D shaped parts with very thin walls. Some potential applications using the LEXAN LIGHT sheet series are seatbacks, kick panels, side panels, tray tables and magazine holders.

Exceptionally tough LEXAN F6000 sheet meets the aircraft industry's demands for high impact strength, excellent resistance to heat, flame and UV, and for outstanding dimensional stability at elevated temperatures. The material is available in custom colors for seating applications that require high aesthetics. LEXAN sheet can be easily formed into complex shapes with standard thermoforming equipment. This material offers compliance with FAR 25.853 for flame and smoke, and Airbus/ Boeing toxicity requirements for seating applications. LEXAN F6000 sheet offers light weight – 1.21 gr./cm³ and can sustain texture retention after forming.

Versatile **LEXAN CFR5630 resin** is a candidate for small opaque parts such as window and seating components.

EADS Sogerma's first and business class seats use SABIC's LEXAN™ sheet.

# SEATING

## SEATING CASE STUDIES

**Geven S.p.A.**, the leading aircraft seating and interior solution provider, chose LEXAN™ XHR sheet for Caribbean Airlines' "Armonia" interiors, designed by Giugiaro. Challenged to limit seat weight to a maximum of 9kg (19.8lbs), the design team selected LEXAN XHR as the best material solution due to its excellent processability, lightweight strength and compliance with stringent flame, smoke, heat release and toxicity requirements.

**National Nonwovens** develops innovative composite solutions for the aerospace industry. A leader in needle punch technology, the company produces lightweight materials found in thermal, acoustic and vibration dampening insulation blankets and makes fire retardant products for seating structures. National Nonwovens uses ULTEM™ fibers to enhance composite attributes for low smoke density and toxicity, improved flame resistance, low heat release and low moisture absorption.

**SICMA Aero Seat**, a business unit of ZODIAC AEROSPACE, selected LEXAN™ XHR sheet for their new business class aircraft seating due to the material's FST and OSU65/65 heat release compliance, excellent processing and beautiful color. The new LEXAN XHR sheet not only provides superior weight-out of up to 12 percent vs. traditional polyvinyl-chloride/ acrylic products, but also offer better weight-out for fuel economy while meeting current and future OSU requirements for aircraft seating, cockpit linings, window surrounds, door shrouds, and other interior components.

When seeking a material that could help reduce the high cost and extensive time required to develop new thermoformed components, **C&D Zodiac** chose LEXAN XHR6000 sheet. It can be thermoformed at lower temperatures which means C&D could take advantage of texture in the sheet rather than texturing the mold, while meeting regulatory and OEM requirements for flame, smoke, toxicity and heat release. The sheet, which is available in a bright-white and custom colors, offered the benefit of eliminating a secondary paint operation or addition of a cap layer.

# GALLEYS AND MONUMENTS

## STRONG, LIGHTWEIGHT SOLUTIONS FOR SERVICE AND COMFORT

GALLEY INSERTS

COUNTERS AND SINKS

MIRRORS

TROLLEYS

MONUMENTS

LAVATORY SYSTEMS

In the challenging environment of food distribution and storage equipment, the powerful chemical resistance of **ULTEM™ 9090 resin** can deliver low heat release as well as stand up to the punishment of cleaning agents and high-temperature repeated washings.

**ULTEM AR9300 resin** is glass-filled for large parts such as crew communication doors, brackets and other areas where stiffness and strength are required, while maintaining critical FAR and OSU heat release requirements. Its low heat release and increased mechanical performance offer heat stability for galley inserts and oven doors.

Our **ULTEM 2300F resin** provides food contact compliance, which is typically required for galley insert applications, in addition to complying with stringent flame, smoke and toxicity performance requirements.

**LEXAN™ XHR6000 sheet** provides superior weight-out of up to 12 percent vs. solid PVC/acrylic products, providing better weight-out for fuel economy while meeting current and future OSU requirements for aircraft cockpit linings, beverage carts, door shrouds, and other galley components. LEXAN XHR sheet offers FST and OSU65/65 heat release compliance and excellent processing with a range of colors.

**JET MIRROR™ sheet** is an excellent candidate for reflective surfaces. Made from LEXAN sheet, JET MIRROR sheet has proprietary abrasion-resistant coating on one side, with a metallized finish on the other, providing exceptionally high reflective values. Virtually unbreakable and weighing less than tempered glass, JET MIRROR sheet meets vertical burn standards and is easily fabricated.

## GALLEYS AND MONUMENTS CASE STUDY

ULTEM™ resin was the material of choice to replace metal in more than 30 parts on **Sell Cabin Interior's** New Generation Oven†. The material not only saved weight and reduced costs through parts consolidation, it offered the company flexible freedom of design and exceptional aesthetic color matching.


EXIT

# HIDDEN SPACES

## IN HIDDEN SPACES, HIGH PERFORMANCE MATERIALS ENHANCE SAFETY AND REDUCE COSTS

WIRING AND FIXATIONS

CONNECTORS

CONDUITS

DUCTING

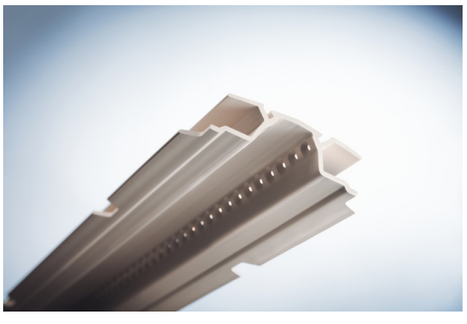
INSULATION

BRACKETING

Although largely unseen, an aircraft's "hidden spaces" are home to ductwork, insulation and structural supports that are key to safety and passenger comfort.

### EXTEM™ RESIN

**EXTEM resins** deliver industry-leading resistance to extreme heat and chemicals. Their superior strength and stiffness along with great dimensional stability allow thinner wall designs that can reduce part weights and fuel consumption. They are inherently flame-retardant and offer excellent processability. And, these resins can take the punishment: for example, **EXTEM UH1019 resin** is the first unfilled thermoplastic to achieve a continuous use temperature rating of up to 260°C according to UL746B with good high-end performance.



Pexco used aircraft-compliant materials for its air transfer profile (ULTEM™ resin) and its lighting lens (LEXAN™ resin).

## LNP™ COMPOUNDS

Drawing from more than 20 base resins and countless high-performance additives, customers can dial in their own formula to meet the demands of virtually any application. By combining advanced materials and technologies with industry-leading know-how, **LNP compounds** can give designers the freedom they need to innovate and lead the industry to new levels of safety, comfort and performance.

LNP compounds offer material of choice solutions for weight reduction, parts consolidation, elimination of secondary operations and improved performance, durability and aesthetics. Closely tuned engineering attributes can be formulated to meet specific demands, from strength and stiffness to weight, flow properties, chemical and heat resistance, dimensional stability, shielding, static control, lubricity or even to deliver antimicrobial effects.

For example, **THERMOCOMP™ compounds** can enhance nearly any base resin for mechanical properties in even the most demanding heat and chemical environments, and offer a sound solution for metal replacement in tray table arms and structural supports.

When increased resistance to chemicals is required, **ULTEM™ CRS resins** may offer the benefit of increased performance versus our standard ULTEM resins, while meeting flame, smoke and OEM toxicity requirements. Today, these materials are often used in connectors located in hidden spaces.

## HIDDEN SPACES CASE STUDY

Exciting 3D printing technology allows design and manufacturing engineers to produce fully functional parts that can be used for either advanced prototypes or end use – without the cost or lead time of traditional tooling. The additive manufacturing process uses SABIC's ULTEM 9085 resin to produce small production runs, building parts layer by layer from the bottom up.

Taylor-Deal Aviation used filaments made from ULTEM™ 9085 resin and additive manufacturing technology to create an air duct offering light weight, flame resistance and toughness.

# INNOVATION OPPORTUNITIES

## INNOVATION + DESIGN OPPORTUNITIES PUSH THE BOUNDARIES ON DESIGN CREATIVITY, WEIGHT-OUT AND SYSTEM COST REDUCTION

SIDEWALLS AND PARTITIONS

CEILING PANELS

OVERHEAD STORAGE BINS

FLOORING

GALLEY CARTS

3D PRINTED SEAT

### COMPOSITES, SHEET MATERIALS AND HONEYCOMBS

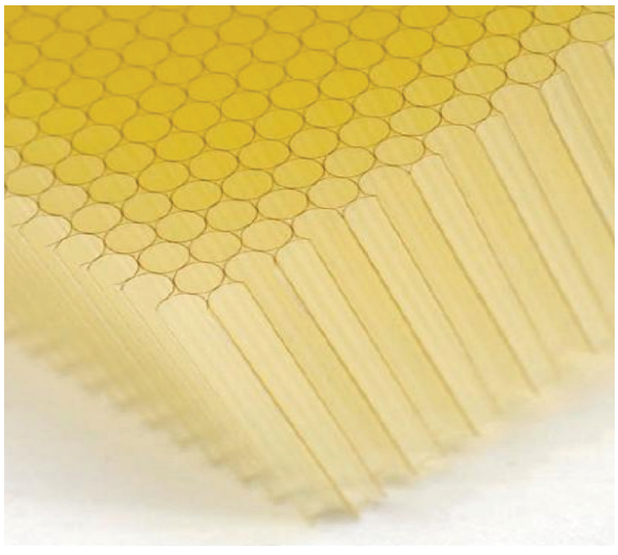
At the heart of successful aircraft design is the ability to shed weight without sacrificing performance or compliance. SABIC offers the building blocks for innovative composite solutions that allow designers and manufacturers to go beyond the limits of traditional aircraft materials.

### FIBER-REINFORCED CETEX† PEI LAMINATES

Developed specifically for aerospace applications, Cetex continuous fiber-reinforced thermoplastic laminates offer a cost-effective alternative to the labor-intensive, hand lay-up of thermoset prepregs. Developed by TenCate B.V. in the Netherlands, these composite sheets rely on ULTEM™ resin technology to achieve excellent performance for fire, smoke, toxicity and heat release. But the benefits don't stop there. Cetex PEI laminates weigh up to 30% less than conventional laminates and come in a wide variety of custom colors – from near white to black. That means that applications such as storage bins, flooring and galley carts can be manufactured without secondary paint/powder coating operations. And if a decorative paint is required, the ULTEM-based composite requires no primer, so customers can realize up to a 75% reduction in paint requirements when using the complete system.

### TUBUS BAUER HONEYCOMBS

When Tubus Bauer, a leader in thermoplastic honeycomb-core technology, sought to achieve more stringent FST standards, it partnered with TenCate Advanced Composites B.V. to move beyond traditional polycarbonate and polypropylene with Cetex laminates. SABIC worked with the two companies to develop lightweight honeycomb panels using ULTEM resin at the core, replacing aluminum and thermoset resins to allow the entire panel to be thermoformed. The ultra-lightweight design not only delivered exemplary compliance, it eliminated costly secondary operations.



## A FOCUS ON DESIGN

Facing the challenge of balancing creativity with "flyability?" Have an idea for a breathtaking new approach, but wonder if the available materials are up to the task? Consult with SABIC. We can help you understand the pros and cons, capabilities and limitations of various materials so that the solution you propose is not only distinctive but *doable*.

## COLOR XPRESS™ SERVICES

In addition, we understand that aesthetics are key elements to build brand and enhance passenger experience. That's why we have color and special effects labs our customers can visit in the Netherlands, the USA and China to provide a wide variety of services such as color matching, color chips or molded items for testing and prototying, and global color management to drive worldwide consistency for your colors.

## CUSTOM AESTHETICS

SABIC's new JET PANEL™ sheet, based on our 2015 Crystal Cabin Award winning LEXAN™ XHR transparent sheet, allows designers nearly unlimited options when it comes to creating custom aesthetics. It's the first fully-customizable and fully-transparent material that complies with FAR25.853, OSU 65/65 heat release requirements and OEM specifications. Delivering up to 80% light transmission, JET PANEL sheet comes in a variety of colors and textures and can be further customized with different effects to greatly expand design options for cabin interiors.

## ADDITIVE MANUFACTURING AND RAPID PROTOTYPING

**ULTEM™ 9085 resin** is a proven performer in additive manufacturing. Strong, lightweight, flame-retardant ULTEM 9085 resin helps to address one of the biggest challenges for aircraft OEMs – the ability to produce small volume parts, even those with complex geometries, quickly and cost-effectively. Additive manufacturing creates three-dimensional parts directly from computer aided design files, layer-by-layer, for use in design verification, prototyping, development and manufacturing.

## INSPIRING DESIGN

Airlines want to create a better experience and comfort for passengers while reducing weight and fuel costs. SABIC's 3D-printed prototype extends what's possible in aircraft interiors. Using an ergonomically advanced design licensed from Studio Gavari, SABIC printed an airplane seat using filaments made from ULTEM 9085 resin. This material is highly compatible with 3D printing and meets the aircraft industry's strict flame, smoke and toxicity demands. Using 3D printing also enabled the design to be rapidly prototyped and produced with fewer than 15 components compared to the 150-200 in a typical airplane seat.

## PROPERTIES OF KEY PRODUCTS FOR AIRCRAFT INTERIORS[1]

### INJECTION MOLDING AND PROFILE EXTRUSION RESINS

| TYPICAL PROPERTIES | UNITS | TEST METHOD | ULTEM™ 1000 RESIN[2] | ULTEM 2300 RESIN[2] | ULTEM 9085 RESIN | ULTEM 9075 RESIN | ULTEM 9076 RESIN | ULTEM AR9300 RESIN[2] |
|---|---|---|---|---|---|---|---|---|
| Type | | | Unfilled | 30% Glass Fiber | Opaque | Opaque | Opaque, Extrusion profile | Opaque 30% Glass Fiber |
| **Mechanical** | | | | | | | | |
| Tensile stress | psi (MPa) | ASTM D638 | 15900 (110) | 24400 (168) | 12100 (84) | 13900 (96) | 13900 (96) | 22400 (155) |
| Tensile modulus | psi (MPa) | ASTM D638 | 519000 (3580) | 1349000 (9300) | 498000 (3440) | 479000 (3300) | 479000 (3300) | 1299000 (8960) |
| Tensile strain | % | ASTM D638 | 60 | 3 | 72 | 85 | 92 | 3 |
| Flex stress | psi (MPa) | ASTM D790 | 23900 (165) | 32900 (227) | 20000 (138) | 20900 (144) | 20900 (144) | 34900 (241) |
| Flexural modulus | psi (MPa) | ASTM D790 | 509000 (3510) | 1299000 (8960) | 423000 (2920) | 469000 (3240) | 469000 (3240) | 1399000 (9650) |
| Tensile stress | MPa | ISO 527 | 105 | 165 | 88 | 90 | 95 | 165 |
| Tensile modulus | MPa | ISO 527 | 3200 | 9500 | 3050 | 3200 | 3000 | 9500 |
| Tensile strain | % | ISO 527 | 60 | 2 | 50 | 25 | 50 | 2 |
| Flexural stress | MPa | ISO 178 | 160 | 225 | 90 | 130 | 135 | 225 |
| Flexural modulus | MPa | ISO 178 | 3300 | 8500 | 2750 | 3200 | 3000 | 8500 |
| **Impact** | | | | | | | | |
| Izod impact, notched, 23°C | ft-lb/in (J/m) | ASTM D256 | 1 (53) | 1.6 (85) | 2.1 (115) | 1.3 (69) | 1.4 (74) | 2.2 (117) |
| Izod impact, notched, 23°C | kJ/m² | ISO 180 | 6 | | 13 | 7 | 6 | |
| **Thermal** | | | | | | | | |
| HDT, 1.82 MPa | deg. F (°C) | ASTM D648 | 394 (201) | 410 (210) | 307 (153) | 372 (188) | 372 (188) | 414 (212) |
| HDT, 1.8 MPa | °C | ISO 75 | 190 | 210 | 152 | 185 | 175 | 208 |
| **Physical** | | | | | | | | |
| Specific gravity | | ASTM D792 ISO 1183 | 1.27 | 1.51 | 1.34 | 1.3 | 1.3 | 1.49 |
| Melt flow rate | g/10 min | ASTM D1238 | 9 @ 337C/6.6kgf | 5 @ 337C/6.6kgf | 8.9 @ 295C/6.6kgf | 2.4 @ 295C/6.6kgf | 1.4 @ 295C/6.6kgf | 4.2 @ 337C/6.6kgf |
| Melt volume rate | cm³/10 min | ISO 1133 | 13 @ 360°C/5.0kg | 6 @ 360°C/5.0kg | 65 @ 360°C/5.0kg | 15 @ 340°C/5.0kg | 22 @ 360°C/5.0kg | 6 @ 360°C/5.0kg |
| **Processing** | | | | | | | | |
| Processing temp. range | deg. F (°C) | | 660-750 (349-399) | 660-750 (349-399) | 630-660 (332-349) | 660-700 (349-371) | 660-700 (349-371) | 690-730 (365-388) |
| **Regulatory** | | | | | | | | |
| OSU 65/65, heat release | | FAR 25.853 | No (<100/100) | No (<100/100) | Yes (<55/55) | Yes (<55/55) | Yes (<55/55) | Yes (<65/65)" |
| 12 second vertical burn | | FAR 25.853 | Pass[3] | Pass[3] | Pass | Pass | Pass | Pass |
| 60 second vertical burn | | FAR 25.853 | Pass[3] | Pass[3] | Pass | Pass | Pass | Pass |
| Smoke density, 4 mins | | FAR 25.853 | Pass[3] | Pass[3] | Pass | Pass | Pass | Pass |
| OEM toxicity | | BSS7239 ABD0031 SMP800C | Pass[3] | Pass[3] | Pass[3] | Pass[3] | Pass[3] | Pass[3] |

1 This is not a complete list of products from SABIC. Product properties shown are indicative and not for specification purposes. Please contact your SABIC representative for detailed information such as datasheets and processing guidelines.
2 Other grades available. Please contact your SABIC representative for more details.
3 Material passes this test, however this material may not be certified from lot to lot without special designation. Please contact your SABIC representative for detailed information.

| ULTEM™ CRS5001 resin[2] | THERMOCOMP™ EC004APQ compound[2] | EXTEM™ XH1015 resin[2] | LEXAN™ CFR5630 resin[2] | LEXAN FST9405T resin | LEXAN FST9405 resin | LEXAN FST9705 resin | LEXAN ML4539 resin |
|---|---|---|---|---|---|---|---|
| "Unfilled improved chem. res." | 20% ULTEM Carbon Fiber High Modulus | Unfilled, high temperature | Opaque & Transparent | Transparent, OSU Compliant | Opaque, OSU Compliant | Opaque, OSU Compliant | Opaque & Transparent |
| | | | | | | | |
| 23900 (65) | 35500 (245) | 14900 (103) | 9800 (68) | 11100 (77) | 11100 (77) | 10400 (72) | 8900 (62) |
| 419000 (2890) | 2776000 (19140) | 496000 (3420) | 362000 (2500) | 37700 (2600) | 37700 (2600) | 379000 (2610) | NA[2] |
| 60 | 2.3 | 7 | 51 | 6 | 6 | 102 | 90 |
| 19900 (137) | 49800 (344) | 24300 (168) | 15300 (106) | 16600 (115) | 16600 (115) | 16600 (115) | 13100 (91) |
| 449000 (3100) | 2291000 (15800) | 45300 (3130) | 348000 (2400) | 391000 (2700) | 391000 (2700) | 362000 (2500) | 324000 (2240) |
| 100 | | 101 | 67 | 77 | 77 | 76 | |
| 3200 | | 3100 | 2400 | 2600 | 2600 | 2500 | |
| 50 | | 6 | 23 | 6 | 6 | 7 | |
| 110 | | 120 | 103 | 105 | 105 | 107 | |
| 2500 | | 2870 | 2500 | 2500 | 2500 | 2320 | |
| | | | | | | | |
| 1.2 (64) | 2.1 (109) | 0.8 (43) | 1.8 (100) | 2.4 (130) | 2.4 (130) | 3.6 (194) | 12 (640) |
| 8 | | 4 | 10 | 12 | 12 | 16 | |
| | | | | | | | |
| 405 (207) | 338 (170) | 455 (235) | 248 (120) | 203 (95) | 203 (95) | 249 (121) | 270 (132) |
| 200 | | 223 | 120 | 104 | 104 | 117 | |
| | | | | | | | |
| 1.28 | 1.33 | 1.31 | 1.19 | 1.33 | 1.33 | 1.34 | 1.21 |
| 4.2 @ 337C/6.6kgf | | 10 @ 337C/6.6kgf | 5.0 @ 300C/1.2kgf | 9 @ 300°C/1.2 kgf | 9 @ 300°C/1.2 kgf | 5.0 @ 300C/1.2kgf | 9.0 @ 300C/1.2kgf |
| 7 @ 360°C/5.0kg | | | 5 @ 300°C/1.2kg | 10 @ 300°C/1.2 kg | 10 @ 300°C/1.2 kg | 4 @ 300°C/1.2kg | |
| | | | | | | | |
| 660-750 (349-399) | 620-660 (325-350) | 710-770 (375-410) | 550-590 (288-310) | 470-540 (245-280) | 470-540 (245-280) | 540-580 (282-304) | 560-600 (293-316) |
| | | | | | | | |
| No (<100/100) | "Yes (<65/65)" | Yes (<55/55) | No (>100/100) | Yes (<55/55) | Yes (<55/55) | Yes (<55/55) | No (>100/100) |
| Pass[3] | Pass[3] | Pass[3] | Pass[3] | Pass | Pass | Pass | Pass[3] |
| Pass[3] | Pass[3] | Pass[3] | Pass[3] | Pass | Pass | Pass | Pass[3] |
| Pass[3] | Pass[3] | Pass[3] | Pass[3] | Pass | Pass | Pass | Pass[3] |
| Pass[3] | Pass[3] | Pass[3] | Pass[3] | Pass[3] | Pass[3] | Pass[3] | Pass[3] |

## PROPERTIES OF KEY PRODUCTS FOR AIRCRAFT INTERIORS[1]

### EXTRUDED SHEET AND THERMOFORMING PRODUCTS

| TYPICAL PROPERTIES | UNITS | TEST METHOD | LEXAN™ XHR2000 SHEET[4] | LEXAN JET PANEL™ SHEET[3] | LEXAN XHR6000 SHEET[4] | ULTEM™ 1668A SHEET | LEXAN XHRL300 SHEET[4] |
|---|---|---|---|---|---|---|---|
| Type | | | Transparent OSU compliant sheet | Decor sheet for custom aesthetics | Opaque OSU compliant co-polymer sheet | Opaque OSU compliant polyetherimide sheet | Lightweight OSU compliant co-polymer sheet |
| **Mechanical** | | | | | | | |
| Tensile stress | psi (MPa) | ASTM D638 | | NA | 10400 (72) | 13100 (90) | 5655 (39) |
| Tensile modulus | psi (MPa) | ASTM D638 | | NA | 379000 (2610) | 335000 (2310) | 197000 (1360) |
| Tensile Strain | % | ASTM D638 | | NA | 102 | 35 | 7 |
| Flex stress | psi (MPa) | ASTM D790 | | NA | 16600 (114) | 20400 (140) | 10440 (72) |
| Flexural modulus | psi (MPa) | ASTM D790 | | NA | 362000 (2500) | 460000 (3170) | 263000 (1815) |
| Tensile stress | MPa | ISO 527 | 75 | NA | >60 | | 39 |
| Tensile modulus | MPa | ISO 527 | 2500 | NA | 2300 | | 1340 |
| Tensile strain | % | ISO 527 | 101 | NA | 80 | | |
| Flexural stress | MPa | ISO 178 | 104 | NA | 100 | | |
| Flexural modulus | MPa | ISO 178 | 2330 | NA | 2300 | | |
| **Impact and Tear Strength** | | | | | | | |
| Izod impact, notched, 23°C | ft-lb/in (J/m) | ASTM D256 | | NA | 3.6 (192) | 1.4 (74) | 5 (268) |
| Izod impact, notched, 23°C | kJ/m² | ISO 180 | 28 | NA | 16 | | |
| Tear Strength - Initiation | lbf/mil (N/mm) | ASTM D1004 | NA | NA | NA | NA | NA |
| Tear Strength - Propagation | lbf/mil (N/mm) | ASTM D1922 | NA | NA | NA | NA | NA |
| **Thermal** | | | | | | | |
| HDT, 1.82 MPa | deg. F (°C) | ASTM D648 | 257 (125) | NA | 250 (121) | 189 (87) | 246 (119) |
| HDT, 1.8 MPa | °C | ISO 75 | | NA | 117 | | |
| **Physical** | | | | | | | |
| Specific gravity | g/cm³ | ISO 1183 | 1.31 | NA | 1.34 | 1.30 | 0.94 |
| **Regulatory** | | | | | | | |
| OSU 65/65, heat release | | FAR 25.853 | Yes (<55/55)" | Yes (<55/55)" | Yes (<55/55)" | Yes (<55/55)" | Yes (<55/55)" |
| 12 second vertical burn | | FAR 25.853 | Pass | Pass | Pass | Pass | Pass |
| 60 second vertical burn | | FAR 25.853 | Pass[2] | Pass | Pass | Pass | Pass |
| Smoke density, 4 mins | | FAR 25.853 | Pass | Pass | Pass | Pass | Pass |
| OEM toxicity | | BSS7239 ABD0031 SMP800C | Pass | Pass | Pass | Pass | Pass |

1 This is not a complete list of products from SABIC. Product properties shown are indicative and not for specification purposes. Please contact your SABIC representative for detailed information such as datasheets and processing guidelines.
2 For robust performance, hard coating application is recommended.
3 Data will vary based on customization.
4 Other grades available. Please contact your SABIC representative for more details.

## GLOBAL APPLICATION DEVELOPMENT TECHNOLOGY

In addition to our broad product portfolio, customers can tap SABIC's world-class technical support to design, build and test their concepts. Our Global Application Development (GApT) Centers specializing in aircraft interiors are strategically located in Shanghai, China; Bangalore, India; Bergen Op Zoom, The Netherlands; and Pittsfield, Mass., USA. The centers are home to experts, new technologies the latest advancements in materials and a wealth of historical data in a wide variety of segments and industries, encompassing design, predictive engineering, processing and part performance.

| LEXAN™ F6000 SHEET[4] | LEXAN F6L300 SHEET[4] | LEXAN F2000A SHEET | LEXAN 9600 SHEET[4] | LEXAN MRAC SHEET | LEXAN FMR604 SHEET | LEXAN JET MIRROR™ SHEET | LEXAN XHRA13 FILM |
|---|---|---|---|---|---|---|---|
| Opaque FST compliant polycarbonate sheet | Lightweight FST compliant polycarbonate sheet | Uncoated, FST compliant transparent or opal sheet | General purpose, uncoated thin gauge sheet | High scratch resistance, transparent coated sheet for flat applications | Transparent coated sheet for curved applications | Mirrorized FST compliant polycarbonate sheet | OSU Compliant co-polymer film |
| | | | | | | | |
| | 4350 (30) | | | 10000 (69) | 10000 (69) | 9500 (66) | 10400 (72) |
| | 183000 (1260) | | | 245000 (1690) | 240000 (1650) | | 379000 (2600) |
| | 24 | | | >80 | >80 | 95 | 102 |
| | 8850 (61) | | | 14000 (97) | 14000 (97) | 13500 (93) | |
| | 236000 (1630) | | | 350000 (2410) | 345000 (2380) | 370000 (2550) | |
| >60 | | >60 | >60 | | | | >60 |
| 2300 | | 2300 | 2300 | | | | 2300 |
| >100 | | >100 | >100 | | | | 80 |
| 90 | | 90 | 90 | | | | |
| 2300 | | 2300 | 2300 | | | | |
| | | | | | | | |
| | 6 (320) | | 12 (640) | 2.4 (128) | 2.4 (128) | 2.4 (128) | NA |
| 70 | | 70 | | | | | NA |
| NA | NA | NA | NA | NA | NA | NA | 0.6 (100) |
| NA | NA | NA | NA | NA | NA | NA | 0.02 (3.4) |
| | | | | | | | |
| | 259 (126) | | 145 (63) | 270 (132) | 280 (138) | 280 (138) | 250 (121) |
| 127 | | 127 | | | | | |
| | | | | | | | |
| 1.21 | 0.85 | 1.21 | 1.25 | 1.20-1.27 | 1.2-1.28 | 1.25 | 1.34 |
| | | | | | | | |
| No | No | No | No | No | No | No | Yes (<55/55) |
| Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass |

## A SABIC COMPANY

Founded in 1976, SABIC is today the first public, global multinational enterprise headquartered in the Middle East. Our products range from bulk commodity chemicals to highly engineered plastics for demanding applications. We are a leading producer of polyethylene, polypropylene, glycols, methanol and fertilizers and the world's third largest polyolefin producer.

SABIC's offerings include Chemicals, Polymers, Specialties, Agri-Nutrients and Metals, representing a vast portfolio of products and services aligned to assist customers with end-to-end solutions anywhere in the world.

From logistics to technology to innovation and support, we're here to help. Our dedicated Technology & Innovation Centers are strategically located – in Saudi Arabia, the Netherlands, Spain, the USA, India, China and Japan – ready to serve our customers and business partners with the resource they need to create lasting competitive advantages in the global marketplace.

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April 2016