SAFETY+ AESTHETICS
LIGHTWEIGHT, FIRE SAFE THERMOPLASTIC MATERIALS FOR RAILWAY INTERIORS
COMBINING THERMOPLASTICS EXPERTISE WITH IN-DEPTH KNOWLEDGE OF THE INDUSTRY STANDARDS, REGULATIONS AND TRENDS, SABIC’S INNOVATIVE PLASTICS BUSINESS IS COMMITTED TO KEEPING ITS CUSTOMERS IN THE TRANSPORTATION INDUSTRY AT THE LEADING EDGE OF MATERIALS AND PROCESSING TECHNOLOGIES.

SABIC OFFERS HIGH PERFORMANCE, ENGINEERING THERMOPLASTICS PORTFOLIO INCLUDING RESINS, SHEETS, FILMS AND COMPOSITES, SPECIFICALLY DESIGNED FOR RAILWAY INTERIORS THAT CAN MEET INDUSTRY STANDARDS AND FIRE RESISTANCE REGULATIONS; MAY REDUCE OVERALL SYSTEM COSTS; AND ENHANCE THE AESTHETICS, SAFETY AND COMFORT OF THE TRAIN CABIN ENVIRONMENT.
SAFETY, AESTHETICS & PERFORMANCE

Today’s public transportation industry is increasingly focused on safety. To create differentiated designs for new rail carriages or when refurbishing old ones, manufacturers are seeking the latest material solutions that not only meet current and upcoming safety regulations but also provide additional benefits ranging from durability and anti-vandalism protection to improved aesthetics, lower weight and system cost reduction.

Currently, fire safety regulations for rail interiors vary across the EU. Although there is a move towards standardization through the EN 45545-2:2013 standard regulation, manufacturers currently must contend with a range of requirements from one nation to another. SABIC has proactively developed and independently tested several materials designed specifically for compliance with the new standard.

SABIC offers a number of materials for railway interior applications that conform to leading European fire safety norms and supports increased material needs for
• Weight reduction
• Increased fire safety
• Graffiti resistance
• Vandalism resistance
• Lower system cost
• Design freedom
• Easy reparation
• Paint reduction
LIGHTWEIGHT MATERIALS COMPLYING WITH INDUSTRY STANDARDS

The broad portfolio of materials for the rail interiors sector manufactured by SABIC’s Innovative Plastics strategic business unit can help manufacturers meet evolving fire safety requirements while delivering additional advantages. The company offers a one-stop shop comprising new plastics solutions, assistance with materials and process selection and technical support services worldwide.

SABIC offers a broad portfolio of engineering resins, sheet, film and composite materials for interior applications that conform to leading European fire safety norms and with EN 45545-2:2013 regulation.

SABIC’S SHEET PORTFOLIO
- ULTEM™ R16SG29 sheet R1 and R6 (2, 3, 4 mm) at HL3
- LEXAN™ F2000 sheet in clear & opal white R4 (2, 3, 4 mm)
- LEXAN™ H6500 sheet R1 and R6 (3, 4 mm) at HL2

SABIC’S RESIN PORTFOLIO
- ULTEM™ resin
- LEXAN™ resin
- LEXAN™ FST resin
- NORYL™ low smoke resins
- CYCOLOY™ resin

RAILWAY PASSENGER SAFETY & REGULATORY OVERVIEW

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OC = Operation Category related to passenger escape time
(OC 1 = shortest escape time, OC 4 = longest escape time)
DC = N, A, D, S = Design Category related to type of vehicle
A = Automatic train
D = Double deck vehicle
S = Sleeping and couchette vehicle
N = Standard vehicles
HL = Hazard Level (HL1 = lowest, HL3 = highest hazard level)
HL3 = most stringent regulations regarding flame, smoke, toxicity and heat release.
R1 = Requirements for interior components such as ceiling and sidewalls
R4 = Requirements for back shell and base shell of passenger seats
R22 = Requirements for electro-technical applications and connectors
WEIGHT OUT & PART INTEGRATION

Engineering thermoplastics solutions from SABIC can help manufacturers address the growing demand for sustainability, lower system costs, improved durability and comfort and design innovation. Compared to metal, thermosts and glass, these materials can significantly lower system costs through consolidation of parts to streamline production, avoidance of secondary operations such as painting and coating, machining and polishing, and lower shipping costs by reducing weight.

**ULTEM™ R16SG29 sheet** is based on SABIC’s polyetherimide (PEI) resin and features inherent flame retardancy and low smoke emission. It complies with the new EN45545-2 norm at the highest level (Hazard Level 3) for R1 & R6 applications (Requirements for interior components) across all four occupational categories at 1.2,3 and 4mm. ULTEM R16SG29 sheet delivers excellent impact resistance and chemical resistance for easy cleaning, anti-graffiti performance and long use of life.

**LEXAN H6500 sheet** is an opaque, solid, low-gloss PC/ABS blend that delivers high stiffness for railway sidewalls, tables and seating. Its sustainable flame retardant performance meets the requirements of the Restriction of Hazardous Substances (RoHS) directive and it delivers non-chlorinated and non-brominated product technology. In addition to EN 45545-2 R6 (seating) and R1 (side wall panels), LEXAN H6500 sheet complies with current European standards including the French NF F16-101 M1/F1 norm (at 2-4 mm). The material can be thermoformed at a lower temperature than traditional PC materials. Its molded-in color capability can help avoid the cost and environmental hazards of secondary painting and provides excellent aesthetics.

**LEXAN F2000 sheet**, available in clear transparent and translucent opal white colors, is a flame retardant, lightweight product that can be an excellent choice for light diffusers and light covers. It offers ease of processing, excellent formability and can help achieve part integration in train ceilings with light diffusers. It complies with EN 45545-2 standard for R4 (Requirements for lighting components), German DIN 5510 S4 SR2 ST2 norms at 3 mm and French NF F16-101 M2 F2 rating at 2-8 mm.

**Eurostar international train selected LEXAN sheet for its light diffusers.**
Anticipating the implementation of the pan-European norm for fire safety in rail interiors, SABIC has introduced two new LEXAN™ sheet products to its materials portfolio. These new products include LEXAN H6500 sheet, a new PC/ABS sheet grade that complies with the upcoming EN 45545-2 harmonized standard, and LEXAN H6200 sheet, a new grade that complies with Germany’s DIN norm including LEXAN H6206M sheet which meets NF F 16.101/102 M1/F2 (at 3-4mm). Both products have been engineered to help rail customers meet growing demand for enhanced sustainability and advanced thermoplastic technologies with non-chlorinated and non-brominated flame retardance that enhance the design and development of rail interior applications.

LEXAN H6006 sheet is a high-modulus PC/acylonitrile-butadiene-styrene (PC/ABS) product that meets the Polish norms for side wall and ceiling applications (PN -K-02512, PN -L-02501, PN -K-02505) and UIC 564-2, Annex 7-11-15 at 3 and 4 mm. LEXAN H6006 sheet provides environmentally responsible flame retardance according the German DIN-VDE 0472 part 815 norm.

Potential applications include sidewalls, tables and seating.

LEXAN H6200 sheet, which complies with the German DIN 5510 norm: S3 SR2 ST2 at 3 mm and S4 SR2 ST2 at 4 mm, offers an attractive cost-benefit balance with less-demanding requirements. It delivers excellent impact performance at low temperatures (ductility down to -20C), good colorability and excellent thermoforming at lower temperatures than standard PC materials.

Compared to metal, thermosets and glass, both new LEXAN sheet materials can significantly lower system costs through consolidation of parts to streamline production, avoidance of secondary operations such as painting and coating, machining and polishing, and lower shipping costs by reducing weight.

Masterplex selected LEXAN™ sheets to create the Italian railway’s most challenging interior feature, a train ceiling complete with light diffusers.
LEXAN™ FST3403 (flame-smoke-toxicity) polycarbonate (PC) copolymer is the first thermoplastic resin solution for rail seating applications to meet the strictest fire safety requirements under the EN 45545-2 standard. LEXAN FST3403 copolymer – developed specifically for seat back shells and side covers – achieved the highest possible hazard level rating (HL3) under EN 45545-2. In addition to its exceptional heat release, smoke density and toxicity performance, documented by independent laboratory testing, the LEXAN FST copolymer provides high flow capabilities that enable large parts, such as seat back shells, to be injection molded without marks, texture defaults, flow lines and other surface defects. Another aesthetic benefit of the copolymer is its ability to be custom colored, which avoids the need for secondary painting.

LEXAN™ EXL resin demonstrates durability in railway seating designed for Très Grande Vitesse (TGV) – the French railway high-speed trains. COMPIN chose this super-tough polycarbonate resin with added impact performance and low temperature ductility. LEXAN EXL resin maintains impact ductility after outdoor exposure, demonstrating good weatherability. It also has a low temperature ductility to -60°C. This resin’s flame retardancy conforms to Blue Angel and TCO99 standards and resists a variety of industrial and consumer chemicals. LEXAN EXL resin also has a 20 - 40% reduction in cycle time processability. This resin exhibits good flow properties, extensive color capability, and I3-F2-M2 ratings that meet the French Railways standards (NF F16101 & NF F16102). It also matched the customer’s specific requirement for a particular shade of grey (gris 150 sable). This, plus its light-weight, makes LEXAN EXL resin a great materials candidate for various railway seating parts.

NORYL™ NH6010B resin, offers low smoke density (ASTM E662 test) and toxicity (NF X 70-100 test) values compared to metal conduits, while remaining economically viable. This can be a critical advantage in transportation applications, as the first four minutes after the start of a fire are considered crucial in terms of occupant survival. Materials that generate low smoke in this short span can help facilitate passengers’ exit to safety. With increasing awareness about environmental concerns, Fraenkische Rohrwerke (Germany), manufacturer of electrical conduit and drainage systems, introduced a range of halogen-free conduits based on NORYL™ NH6010B non-halogenated resin offering low smoke, toxicity, and flame performance to comply with IEC 61386, the European Union (EU) standard for electrical conduit and suitable for extrusion or injection molding.
**CYCOLOY™ resins** are amorphous PC/ABS blends that offer the superior mechanical properties and heat resistance of polycarbonate (PC) resins combined with the excellent processability of ABS materials. In addition, CYCOLOY resins offer non-brominated and non-chlorinated FR systems, odorless solutions and superior heat aging and color stability properties versus comparable ABS materials.

**Generic property comparison**

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<tr>
<th>PROPERTY</th>
<th>ABS MATERIALS</th>
<th>PC/ABS</th>
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<td>Halogen free FR</td>
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<td>Low emission / odorless</td>
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<td>Heat aging</td>
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<td>Color stability</td>
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**ULTEM™ resin** fibers spun may address your need for inherent flame resistance; low smoke toxicity; aesthetic. For railway interior fabrics and panels, ULTEM polyetherimide (PEI) resin from SABIC has the high-temperature performance and inherent flame resistance manufacturers need to meet the increasing challenges of stringent flame resistance and low FST (Flame, Smoke and Toxicity) regulations. Plus, with great aesthetic qualities and good dyeability, it’s a smart way to achieve both compliance and appearance at the same time. This advanced amorphous polymer allows woven fabrics to be colored using conventional exhaust dying techniques, resulting in exceptional colorfastness and high tolerance to UV light. ULTEM resin also offers lightweight advantages along with outstanding mechanical integrity at elevated temperatures, and can be blended with other fibers for an optimal balance of performance and cost.

For first-class railcars’ tough, new seat back shells and side panels, Grammer Railway Interior GmbH has selected SABIC’s new LEXAN™ FST copolymer – which meets requirements for the highest hazard level (HL3) for R5 under Europe’s upcoming CEN/TS 45445-2 harmonized standard for fire safety.
ANTI-VANDALISM

For passenger comfort and overall usability, thermoplastics from SABIC provide ease of cleaning, protection against graffiti and high impact performance to resist vandalism.

SABIC’s new, upcoming product series called LEXAN™ KF SHEET is an opaque products with outstanding anti-graffiti properties that meets the stringent requirements of the German rail standard, the French rail standard and the Italian rail standard. LEXAN KF sheet series can also provide very good chemical resistance properties by meeting the French norm NF F 31-112 (anti-graffiti), making them an excellent choice to replace polyvinyl chloride (PVC), polyester, vinyl ester or phenolic fiber-reinforced plastic (FRP) materials used in many interior train applications including interior panels, window frames, ceilings and other large interior parts.

LEXAN™ MARGARD™ MRSFR sheet is an excellent way to reduce railcar weight by replacing traditional glass, offering excellent abrasion resistance behavior combined with excellent chemical resistance. The product complies with the German rail standard, the French rail standard and the Italian rail standard. Additionally, Lexan Margard sheet can provide reduced weight, high impact strength and forced entry protection, graffiti resistance, excellent flame retardance, high impact strength and UV- and abrasion resistance. LEXAN MARGARD MRSFR sheet can be an excellent candidate for the compartment partitions.

Coated, transparent LEXAN MARGARD Sheet has been chosen by TOHO SHEET & FRAME CO., LTD, a leading Japanese converter, for the double glazing of side windows of The JAPAN RAILWAYS HOKKAIDO.

Italian railways compartment separators using LEXAN Margard sheet.
## THERMOPLASTICS ADDRESS TRENDS

### Ceilings & Side Walls

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### Lighting, Electrical & Signage

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### Polycarbonate & PC/ABS FR – Transportation

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- H13 @ 2mm
- H13 @ 2mm
- 14/92/172 @ 2.4mm
- M1 / T1 @ 2mm
- @ 1.5mm
- @ 1.5mm
- @ 1.5mm @ 1.5mm

- H6.1 @ 2.3mm
- H6.1 @ 2.3mm
- in progress

- S4 / S1 / S2 @ 2.3mm
- S4 / S1 / S2 @ 2.3mm
- S4 / S1 / S2 @ 2.3mm
- S4 / S1 / S2 @ 2.3mm

- F1 @ 2mm
- F1 @ 2mm
- F1 @ 2mm
- F1 @ 2mm

- M1 / T1 @ 3mm
- M1 / T1 @ 3mm
- M1 / T1 @ 3mm
- M1 / T1 @ 3mm

- @ 0.25mm
- @ 1.5mm
- @ 2.5mm
- @ 3mm

- Hl3 @ 3-4mm
- Hl3 @ 2-3mm
- Hl3 @ 2-4mm

- Flanme retardent, extrusion & injection moulding
- Flame retardent, uv stabalized
- Flame retardent, natural

- Noril NH6010b resin
- Noril Env131 resin
- norYl Env131 resin

- Flame retardent, natural
- Flame retardent, extrusion, extrusion & injection moulding
- Flame retardent, extrusion, extrusion & injection moulding, mould release

- norYl nH6010b resin
- norYl Env131 resin
- ulTEm 1000 resin

- Flame retardent, extrusion, fire retardent extrusion & injection moulding
- Flame retardent, injection moulding
- Flame retardent, injection moulding

- ulTEm 1010 resin
- ulTEm 1010 resin
- ulTEm 2300 resin

- Flame retardent, extrusion, injection moulding
- Flame retardent, extrusion, injection moulding
- Flame retardent, injection moulding

- lExAn T lux7630C resin
- lExAn 2034 resin
- lExAn Ex9332T resin

- Flame retardent, extrusion, injection moulding
- Flame retardent, injection moulding
- Flame retardent, injection moulding

- lExAn 945Au resin
- lExAn 945Au resin
- lExAn Ex9332T resin

- Flame retardent, extrusion, injection moulding
- Flame retardent, injection moulding
- Flame retardent, injection moulding

- LDAX L9031 resin
- LDAX L9031 resin
- LDAX L9031 resin

- Flame retardent, extrusion, injection moulding
- Flame retardent, injection moulding
- Flame retardent, injection moulding

- lExAn 945Au resin
- lExAn 945Au resin
- lExAn Ex9332T resin

- Flame retardent, extrusion, injection moulding
- Flame retardent, injection moulding
- Flame retardent, injection moulding

- lExAn 945Au resin
- lExAn 945Au resin
- lExAn Ex9332T resin

- Flame retardent, extrusion, injection moulding
- Flame retardent, injection moulding
- Flame retardent, injection moulding

- lExAn 945Au resin
- lExAn 945Au resin
- lExAn Ex9332T resin

- Flame retardent, extrusion, injection moulding
- Flame retardent, injection moulding
- Flame retardent, injection moulding

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<tr>
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<th>OPAQUES</th>
<th>TRANSPARENTS</th>
<th>POLYCARBONATE FR</th>
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<td>Flame retardent, extrusion, UV stabilized, available in Opal White</td>
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<td>Flame retardent, + 30%gF</td>
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<td>Flame retardent, + 20%gF, improved chemical resistance, mould release</td>
<td>Flame retardent, injection moulding</td>
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<td>ULTEM CR5201R resin</td>
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<td>Noril 59W131 resin</td>
<td>LDAX LUX 7630 resin</td>
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<td>- H13 @ 2mm</td>
<td>- 14/92/172 @ 2.4mm</td>
<td>- M1 / T1 @ 2mm</td>
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- H6.1 @ 2.3mm
- H6.1 @ 2.3mm
- in progress

- S4 / S1 / S2 @ 2.3mm
- S4 / S1 / S2 @ 2.3mm
- S4 / S1 / S2 @ 2.3mm
- S4 / S1 / S2 @ 2.3mm

- F1 @ 2mm
- F1 @ 2mm
- F1 @ 2mm
- F1 @ 2mm

- M1 / T1 @ 3mm
- M1 / T1 @ 3mm
- M1 / T1 @ 3mm
- M1 / T1 @ 3mm

- @ 0.25mm
- @ 1.5mm
- @ 2.5mm
- @ 3mm

- Hl3 @ 3-4mm
- Hl3 @ 2-3mm
- Hl3 @ 2-4mm

- Flame retardent, extrusion & injection moulding
- Flame retardent, uv stabalized
- Flame retardent, natural

- norYl nH6010b resin
- norYl Env131 resin
- norYl Env131 resin

- norYl nH6010b resin
- norYl Env131 resin
- norYl Env131 resin

- lExAn 945Au resin
- lExAn 945Au resin
- lExAn 945Au resin

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### OPAQUES

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### TRANSPARENTS

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**Meets ASTM E162 flamespread index of 100 or less**

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**CEILINGS & SIDE WALLS**

- **Ceilings & Side Walls**
  - Ceiling
  - Window Frame
  - Wall Cladding
  - Wall Decoration
  - Partitions
  - Draft Screens
  - Overhead Luggage Racks
  - Drivers Desk
  - Sun Blind
  - Air Ducting
  - Containers & Compartment
  - Interior Surface Gangways
  - Tables - including bottom surface
  - Enclosures for electrical equipment
  - Passenger Info Devices

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**SEATS & ARM RESTS**

- Seat Backs - Back & Base Shell
- Tray Tables
- Arm Rests

---

**LIGHTING - ELECTRICAL & SIGNAGE**

- Light Diffusers
- Vertical Cover Strips - On Walls
- Lamp Coverings
- Connectors & Electrotechnical Applications
- Cable Channels
- Lighting Covering

---

**SPECIFICATIONS & NORMS**

- Euro EN 45545-2:2013 R1 Interior Surfaces
- Euro EN 45545-2:2013 R4 Light Diffusers
- Euro EN 45545-2:2013 R6 Passenger Seat Shells
- Euro EN 45545-2: 2013 R22 Connectors & Electrotechnical applications
- DE DIN 5510-2:2009
- FR NF F 16-101 /-102
- FR Anti-Graffit NF F 31-112 SNCY
- IT UNI CEI 11170-3
- POL PN-K02511 & UIC642-0, Annex 7-11-15
- USA ASTM E162 - Flame Spread Index Is
- USA ASTM E662 - Optical Smoke Density
- USA ASTM E1354 - Heat Release @ 50 kW/sq.m
- INT Smoke Toxicity - BSS 7239, SMP800C
- INT UL 94 V0
- INT UL 94 V0
- INT UIC 542-0 App 11 & 15
- RUS GOST 12.1.044-99 (ISO4589-84)
- DE ECO FR - Chlorine & Bromine Free

**Meets ASTM E162 flamespread index of 100 or less**
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