

## COMPARATIVE TABLES

	Density	Tensile yield point (MPa)	Specific yield point (MPa/kg)	Tensile Young's Modulus (GPa)	Melting point (°C)	Thermal conductivity (W/m.K)	Coefficient of linear expansion ( $\times 10^{-6}/^{\circ}\text{C}$ )
<b>Composite</b> (depending on glass content)	1.6 / 2.1	100/1400	62/666	12/40	na	0,50	5/10
<b>Steel</b>	7.85	200/1300	25/165	210	1425	26/46	10/18
<b>Aluminum</b>	2.70	100/400	37/148	70	500/660	170/237	27

Compared to the two most-used metals in the railway industry, composites achieve a weight saving for equal mechanical strength and performance, as well as acting as electrical and thermal insulators.

Combined with honeycomb or foam core materials, composites can achieve densities of less than one, and obtain very high flexural strength and stiffness ratios. As far as electrical resistance goes, steel and aluminum are both conductors with levels around  $10^9 \Omega\cdot\text{m}$ , compared to the insulating properties of composite materials with levels of the order of  $10^{12} \Omega\cdot\text{m}$ .

	Characteristics	Composites	Aluminum	Steel
<b>Conception</b>	Complex shapes / flexible design	yes	limited	no
	Integration of components	yes	no	no
	Assembling and joining	good (adhesive bonding or mechanical)	average (welding or mechanical)	average (welding or mechanical)
	Weight saving on structures	yes	yes	no
<b>Safety and comfort</b>	Fire resistance	very good for fire resistant composites	limited*	good*
	Electrical insulation	yes (avoiding grounding)	no	no
	Thermal insulation	yes	no	no
	Sound insulation/damping of vibrations	yes	no	no
<b>In use and lifetime</b>	Mechanical performance / specific weight	very good	good	good
	Corrosion resistance	yes	average	no
	Easy maintenance	yes	yes	no
	Durability	very good	good	average
	Life cycle cost	very good	average	poor

(\*) : In fact composites have better fire resistance than metals if structural stability is taken into account.

**TO FIND OUT MORE, GO TO [www.gpic.fr](http://www.gpic.fr)**

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Member of the French Plastic Federation and of the European Composite Industry Association (EuCIA)

**GPIC**

GRUPEMENT DE LA PLASTURGIE INDUSTRIELLE ET DES COMPOSITES

## COMPOSITE MATERIALS IN THE RAILWAY INDUSTRY

### MATERIALS WITH UNDENIABLE ADVANTAGES

The rail sector is currently enjoying favourable growth in both rolling stock (regional trains, high speed trains ...) and in infrastructure applications.

Through their intrinsic properties, composites - materials made from thermosetting resins with glass fibre reinforcement - have made inroads in this market sector

These materials offer many possibilities:

- integrated design functional features
- reduced track wear ; axle weight limited to 17 tonnes (SNCF)
- increased payload
- low maintenance
- corrosion resistance
- energy savings

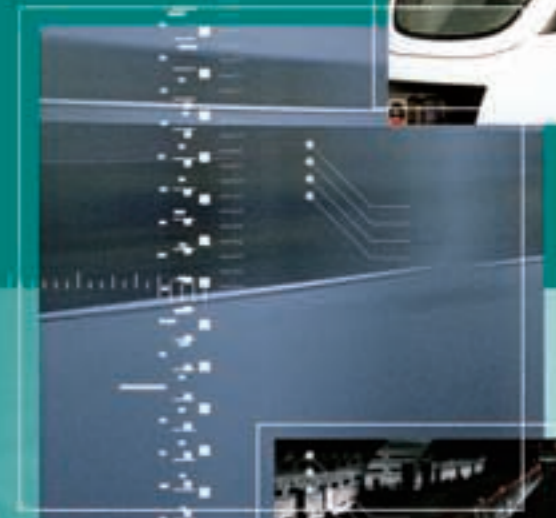
They have good thermal and acoustic performance and comply with the fire and smoke requirements of French and European standards.

For all these reasons, composite materials will become increasingly important in design offices and with OEMs.

The French Group of Composite Processors (GPIC), part of the French polymer processors trade association, brings together leading companies in the design and manufacture of composite parts for the rail industry.

This pamphlet highlights the strength of composite materials in the rail sector through some innovative applications.

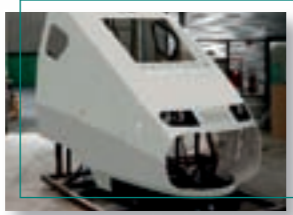
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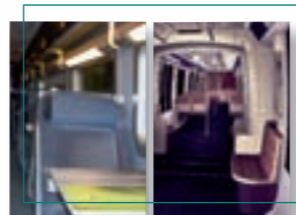
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# COMPOSITE MATERIALS IN THE RAILWAY INDUSTRY



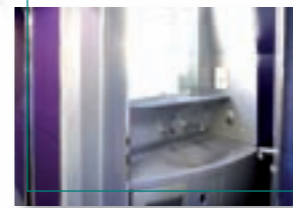
## Front Ends

- maximum design adaptability with optimised strength to weight ratio
- integrated function
- aesthetical design



## Carriages

- seats, table tops, luggage racks, ceiling liners, interior panels
- fire resistance
  - seat ergonomics
  - functionality
  - weight saving



## Sanitary blocks

- design / aesthetics
- modular design
- weight saving



## Roof-mounted lockers

- electrical insulation
- highest strength to weight ratio
- good ageing and weather resistance



## Signal lights boxes

- electrical insulation
- weather resistant
- mechanical strength

## Drivers control panel

- modular design
- design flexibility
- electrical insulation



## Third rail

- UV, fire and corrosion resistance
- impact resistance
- electrical insulation

## Drainage channels

- weight saving
- easy handling



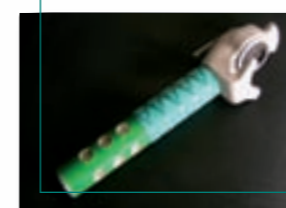
## Fishplates for live rails

- lightweight
- very high electrical insulation
- no maintenance (corrosion resistant)



## Cables ducts

- electrical insulation
- easy installation
- accepts variable support intervals
- fire / smoke performance



## Braking control

- light weight control tools
- reduced noise level for operators
- increased efficiency

## Level crossing barriers

- corrosion resistance
- weight saving / flexibility



## Mainframe side protection

- high strength to weight ratio
- electrical insulation
- integrated functional design possibilities



## Seats shells (metro and trams)

- comfort and aesthetics
- fire / smoke performance
- vandal-proof



## Trackside traffic control boxes

- electrical insulation
- fire resistance
- mechanical strength