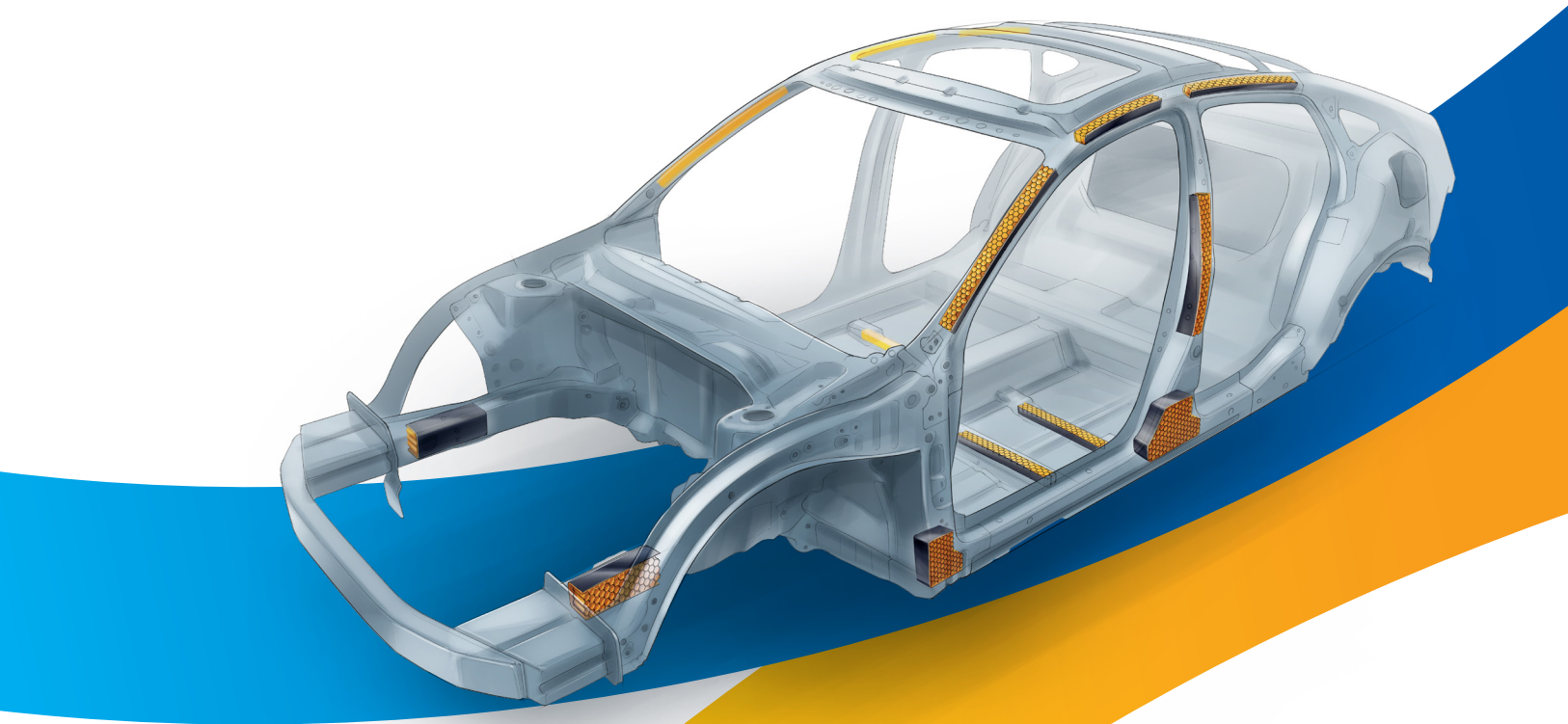
NORYL™ RESIN AUTOMOTIVE SOLUTIONS

FOR STRUCTURAL, ELECTRIC VEHICLE BATTERY, ELECTRIC VEHICLE PROTECTION, AND INLINE PAINTING APPLICATIONS



CHEMISTRY THAT MATTERS™

NORYL™ AND NORYL GTX™ RESIN AUTOMOTIVE SOLUTIONS

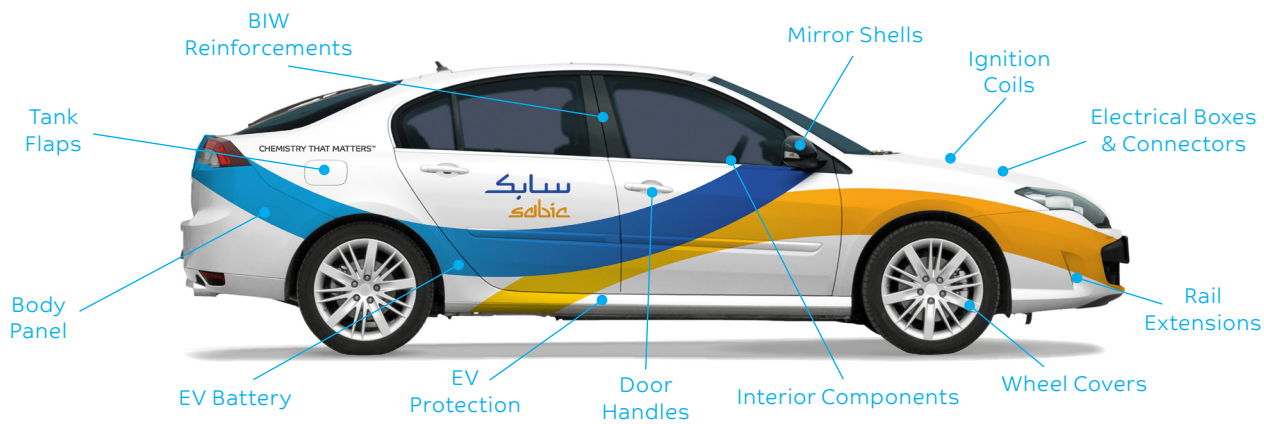
NORYL™ AND NORYL GTX™ RESINS CAN OFFER UNIQUE SOLUTIONS TO THE AUTOMOTIVE INDUSTRY

The NORYL™ resin family consists of multiple blends of polyphenylene ether (PPE) with complementary thermoplastics. NORYL resin is an amorphous blend of PPE with polystyrenes and it is widely used in ignition coils, sensors and battery housings. NORYL GTX resin is a semi-crystalline blend with polyamides and offers multiple commercialized solutions across internal combustion engine, hybrid and electric vehicles.

NORYL GTX™ resin combines the inherent benefits of PPE (robust flame retardance, heat resistance, excellent dimensional stability, low creep) with the benefits of PA (chemical resistance, flow and impact resistance). The result is a chemically resistant material with the stiffness, impact resistance and heat performance required for inline painting.

The low density of unfilled NORYL GTX resin can provide part-weight savings of up to 25% over glass or mineral filled resins.

Additionally, the low specific gravity of NORYL GTX resin makes it a candidate resin for significant lightweighting versus steel. Potential applications for steel replacement include exterior body panels, in or online painted surfaces, and battery protection.



NORYL GTX™ RESIN: RAIL EXTENSIONS

RAIL EXTENSIONS PLAY A CRUCIAL ROLE IN ENERGY ABSORPTION DURING FRONT AND REAR CRASHES

POTENTIAL BENEFITS OF NORYL GTX™ RESIN VS. STEEL

- **Weight reduction of 50% vs. steel in some cases – without compromising performance**
  - Up to 3.5 kg per vehicle
  - 2 kg weight out from bumper
- **Part integration - ease of assembly**
  - Reduced overall tooling cost
  - Reduced total system cost
  - Single tool for LH & RH
- **Comparable low-speed and high-speed crash performance**
  - 20% better front crash performance
  - Meets NVH (noise, vibration and harshness) and towing requirements
- **E-coat Capable**
- **Potential to reduce packaging space**

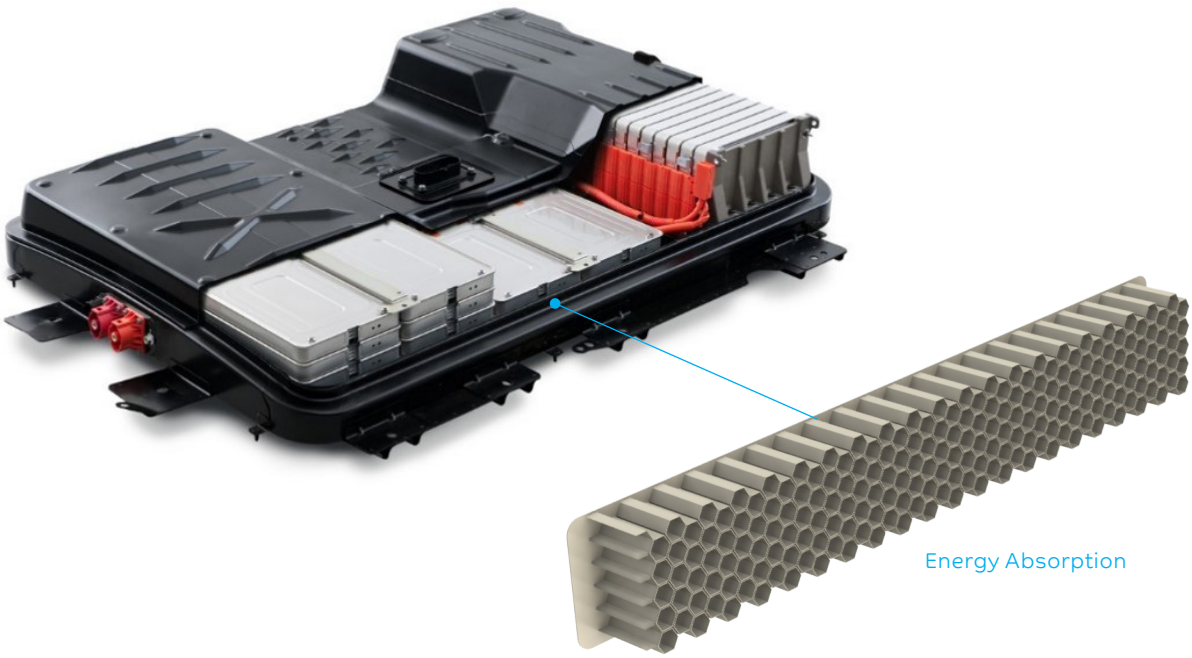
MAJOR FUNCTIONS OF RAIL EXTENSIONS

NORYL GTX™ RESIN: LIGHTWEIGHT BATTERY PROTECTION SOLUTIONS FOR ELECTRIC VEHICLES

POTENTIAL BENEFITS OF NORYL GTX RESIN

- **Up to 40 to 60% weight reduction compared to multi-piece metal reinforcement**
  - Up to 20 kg weight out
- **High efficiency of energy absorption**
  - Can be tuned for desired force level and balance strength & stiffness
- **Single piece solution, ease of assembly, e-coat capable**
  - Metal flanges over-molded with plastic honeycombs – direct welding to rocker
- **Cost competitive**
  - Significant weight out at comparable cost vs incumbent metal solutions

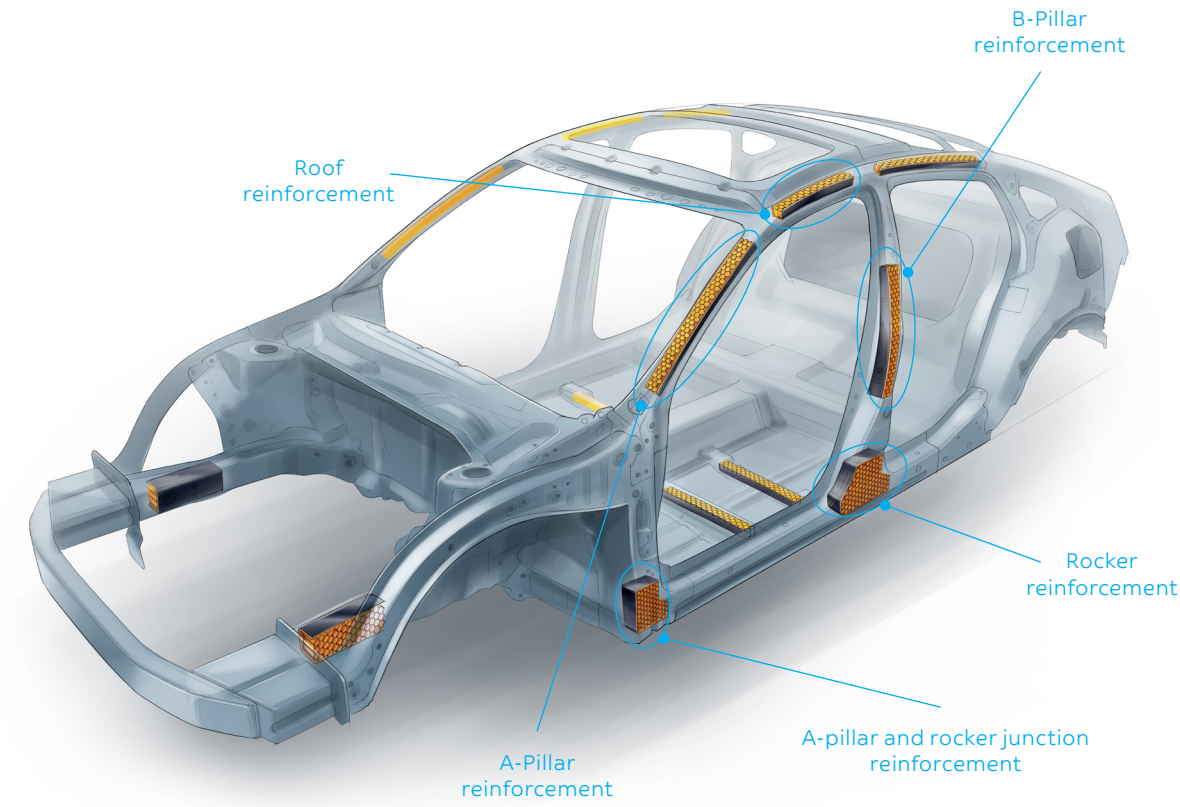
CRASH ELEMENTS DESIGNED TO PROTECT VEHICLE BATTERY DURING IMPACT



NORYL GTX™ RESIN: LIGHTWEIGHT BODY IN WHITE REINFORCEMENT SOLUTIONS

POTENTIAL BENEFITS OF NORYL GTX RESIN

- Metal-plastic hybrid solutions for reinforcement in BIW
- Up to 30-40% mass reduction from each reinforcement
- Comparable performance to high strength steel
- Ease of assembly
- 5-10 kgs total weight saving potential from 10-12 reinforcements in BIW
- Heat resistance that withstands the e-coat painting process



NORYL GTX™ RESIN AUTOMOTIVE SOLUTIONS

DESIGN WITH CONFIDENCE

Inherently conductive NORYL GTX™ resins offer automotive OEMs major design advantages for large, high-precision body panels and complex fenders by allowing for existing process integration including high-heat inline painting systems... all while providing outstanding aesthetics and performance.

NORYL GTX™ conductive resins have a low coefficient of thermal expansion (CTE) allowing for good dimensional stability and flush management with other plastic and metal adjoining parts.
Many grades in this resin family are designed to withstand temperatures in excess of 180 degrees C to meet the demanding requirements of e-coat paint lines.

Specifically developed for on-or-inline painted fenders and exterior body panels, this unique thermoplastic material may also be utilized for smaller parts such as tank flaps, grilles and mirror housings in primerless electrostatic painting, powder coat systems, and solvent-based paint systems.

SABIC'S PREDICTIVE ENGINEERING CAPABILITIES FOR THE AUTOMOTIVE INDUSTRY

SABIC offers industry-leading engineering support to the automotive industry through our Global Application Technology (GApT) capabilities. From concept development, to simulation and prototyping, and even final part testing, we work alongside our customers to accelerate the material selection process and help increase speed to market. Our predictive engineering capabilities address both EV and ICE vehicle development needs, and are utilized worldwide by engineers at major OEMs and many emerging manufacturers.

SABIC'S CAPABILITIES	VALUE TO THE INDUSTRY
Thermal Management • Conduction, convection and radiation heat transfer simulation • Natural/forced cooling • Multi-phase flow simulation	• Optimizing EV battery cell function and battery pack cooling • Under the hood and exterior part life optimization • Headlamp thermal simulations – BMC replacement & LED heatsink lightweighting • Thermal management of electronic components – aluminum / magnesium replacement • Fender paint cycle and sun load simulation – steel replacement / lightweighting
Structural analysis • Static and dynamic simulations • NVH analysis • Thermo-mechanical failure prediction (CTE)	• Lightweighting • Design optimization for various structural elements • Design & evaluation of continuous composite structures • Minimizing vibration and noise in the cabin • Improving crash-worthiness and safety of the vehicle • Fatigue & creep evaluation of structures / substructures
Acoustics	• Designing of motor covers and firewalls with optimized dampening • Prediction of sound transmission/loss for materials used throughout the vehicle • Noise emission of assemblies
Advanced mold filling	Paint elimination, tooling cost reduction, strain identification, impact identification on structural performance based on residual stress / fiber orientation mapping, two-shot over molding, metal insert over molding, injection compression molding, gas assisted injection molding

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