



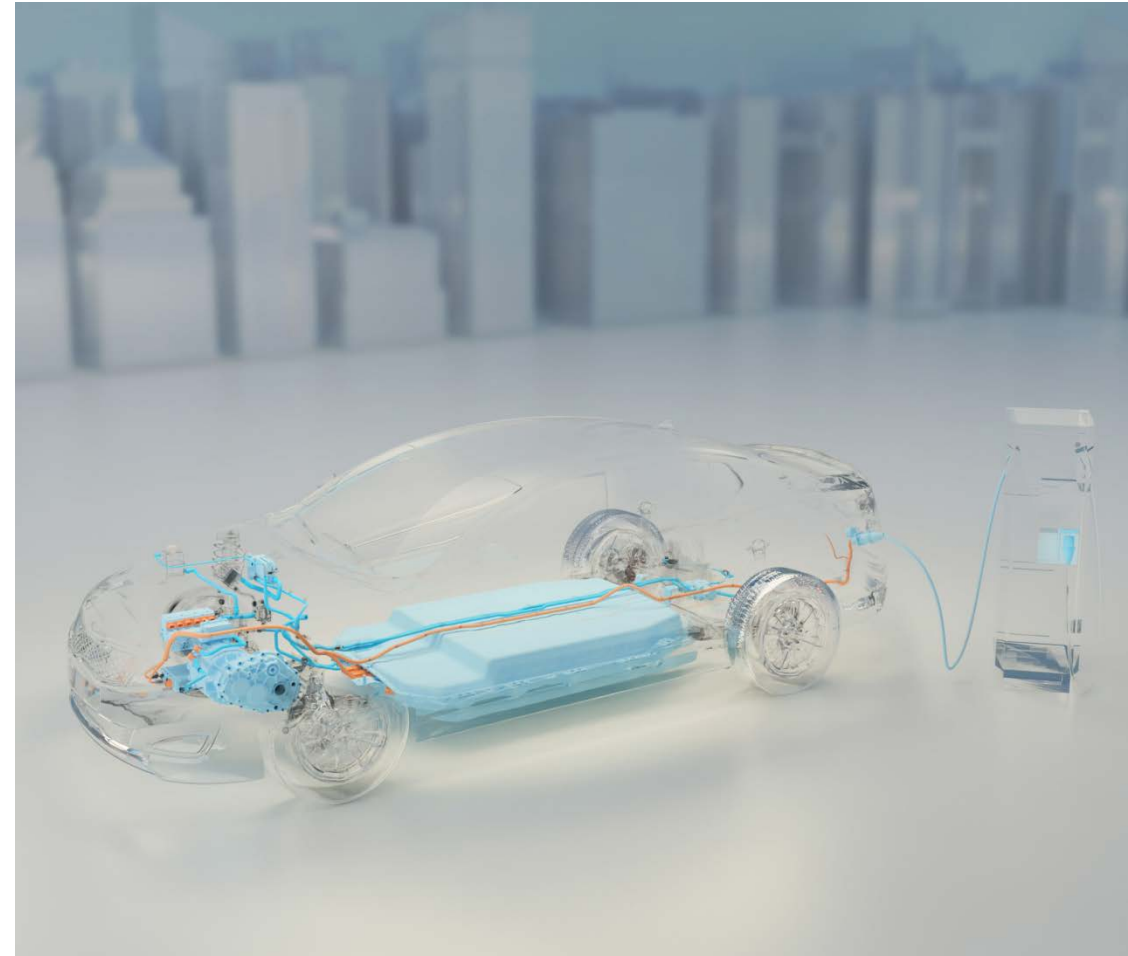
E-MOBILITY: OPPORTUNITIES AND CHALLENGES IN A GLOBAL CONTEXT

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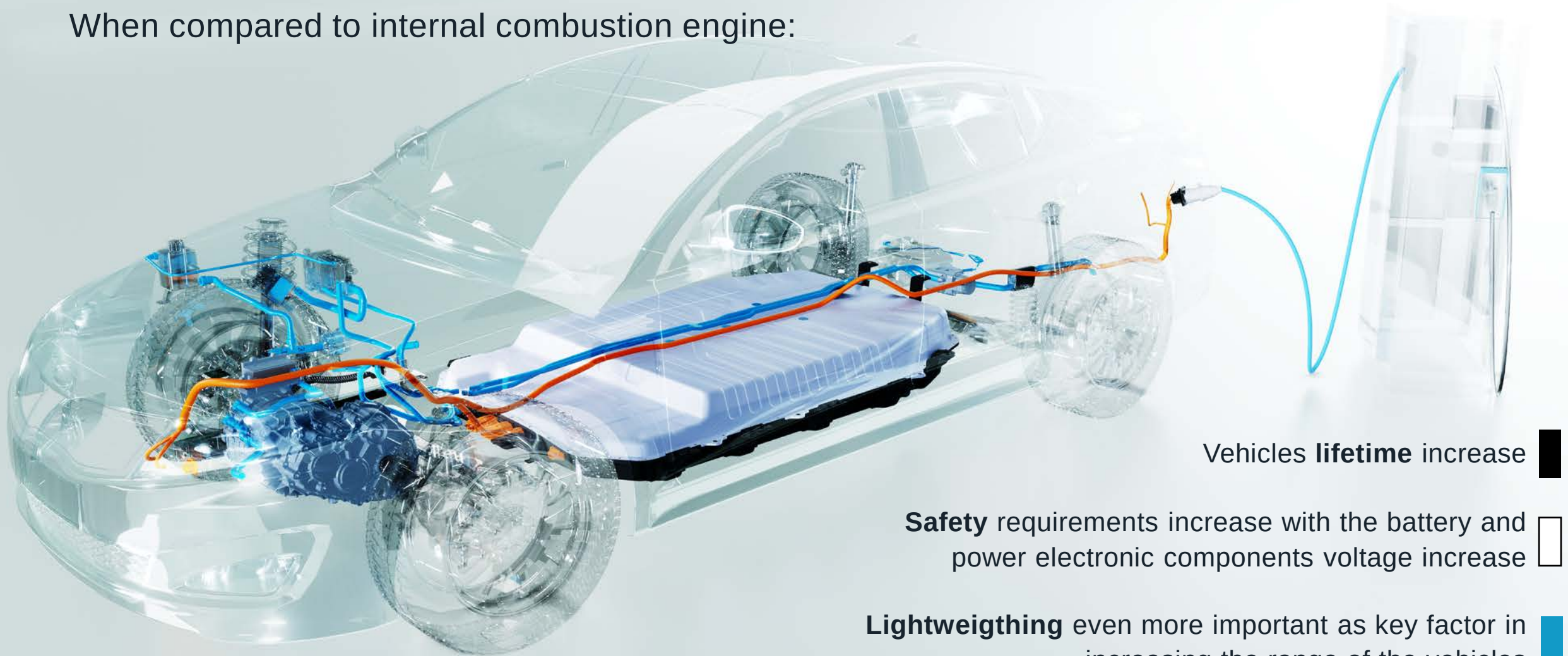
Agenda

- › E-Mobility: new opportunities and challenges with engineering polymers
- › Parts/systems technical requirements
- › Application examples



E-mobility: new challenges for engineering polymers producers

When compared to internal combustion engine:



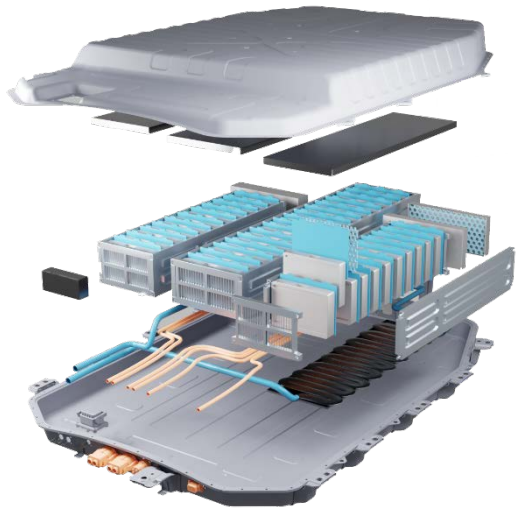
Vehicles **lifetime** increase 

Safety requirements increase with the battery and power electronic components voltage increase 

Lightweighting even more important as key factor in increasing the range of the vehicles 

KEY WORDS:

increase of COMPONENTS LIFE, RELIABILITY, SAFETY



Target systems

- › Traction Battery Pack
- › Thermal Management
- › Charging System
- › Power Electronic
- › E-motor
- › Connectivity Systems

Main requirements

- › Growing importance of lightweighting
- › Components integrity through prolonged exposure in harsh environment
- › Increasing fire safety requirements
- › Electrical insulation also in the presence of high voltage and after part ageing
- › EMC/EMI shielding to protect sensitive electronics
- › Battery protection against intrusion and impact
- › Battery lifetime, efficiency and safety
- › Electronic components duration with high voltage and high energy density
- › Protection versus contacts corrosion
- › Chemical resistance (also versus battery acids)



Application examples

Traction Battery System

Battery module cover

Main requirements :

Flame retardant

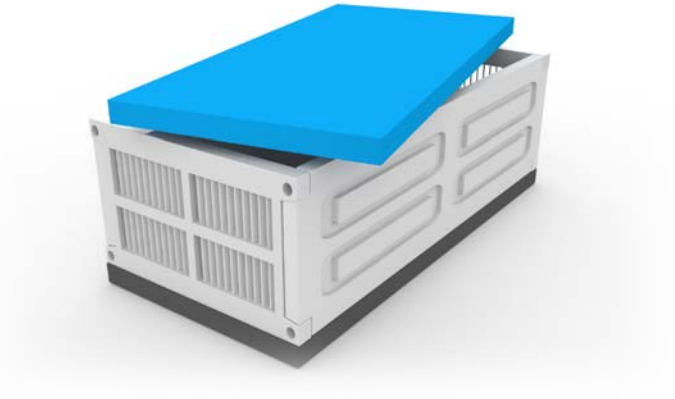
Part planarity

Easy molding

Chemical resistance (battery electrolytes, LV124)

Material:

Radiflam® A RV250HF, PA66-GF25, FR (40) UL-V0 at 0.8 mm,
CTI=600



Application examples

Traction Battery System

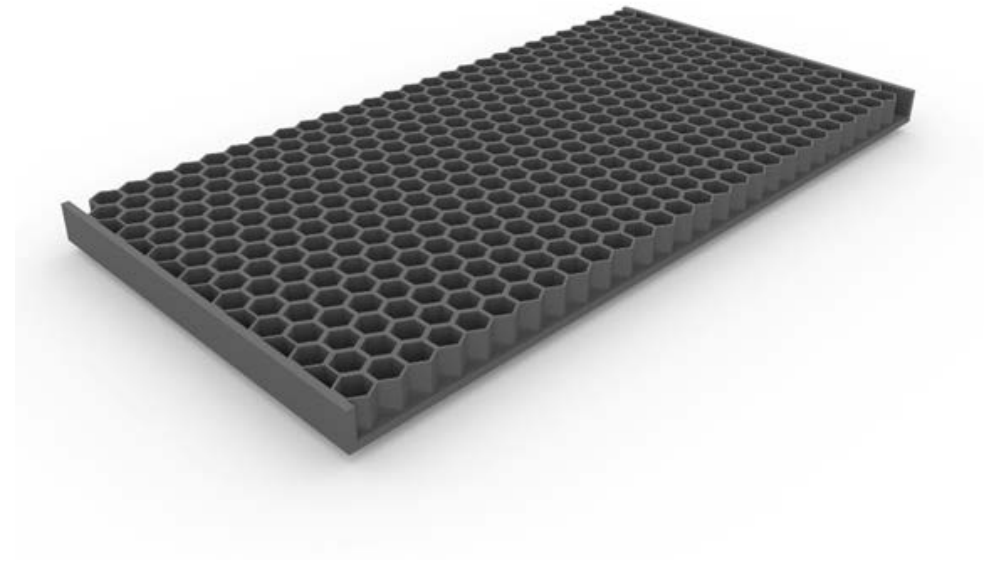
Battery carrier

Main requirements :

- Good insulation and flame retardant properties
- Part planarity
- Creep resistance
- Easy molding
- Chemical resistance (battery electrolytes, LV124)

Materials:

- Radiflam® A FR, PA66, FR (30), UL-V0 at 0.8 mm, CTI=600
- Radiflam® A RV250HF, PA66-GF25, FR (40), UL-V0 at 0.8 mm, CTI=600



Application examples

Traction Battery System

Pouch cell frame

Main requirements :

- Flame retardant
- Dimensional tolerances
- Creep resistance
- High stress
- Chemical resistance (battery electrolytes, LV124)

Material:

Radiflam® A RV350HF, PA66-GF35, FR (40), UL-V0 at 0.8 mm, CTI=600



Application examples

Connectivity System

Connectors

Main requirements :

Long exposure at high temperature

Orange colour stability (from 90 °C to > 130 °C for 1000h)

Excellent insulation properties (CTI request can be > 600V)

Excellent dielectric strength vs temperature (can be > 10 kV at 150 °C)

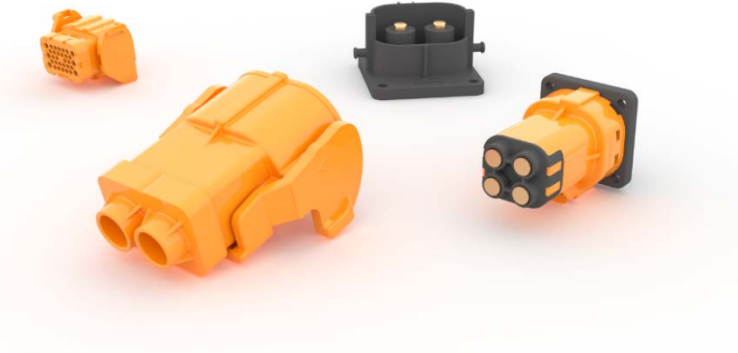
Dielectric strength retention after heat ageing

Flame retardancy UL-94 at 0,4 mm

Excellent fluidity (thin parts)

Laser marking

Low halide content to prevent circuit corrosion



Application examples

Connectivity System



Connectors

Materials:

Halogen free FR PA

Radiflam® A FR, PA66, FR (30)

Radiflam® S FR, PA6, FR(30)

Radiflam® A RV300HF, PA66-GF30, FR (40), orange colour RAL 2003

Radiflam® A FR, PA66, FR (30), orange colour RAL 2003

Halogen free FR PPA

Radiflam® Aestus T2 RV300HF, PPA-GF30, FR (40)

Hydrolysis resistant non FR PBT

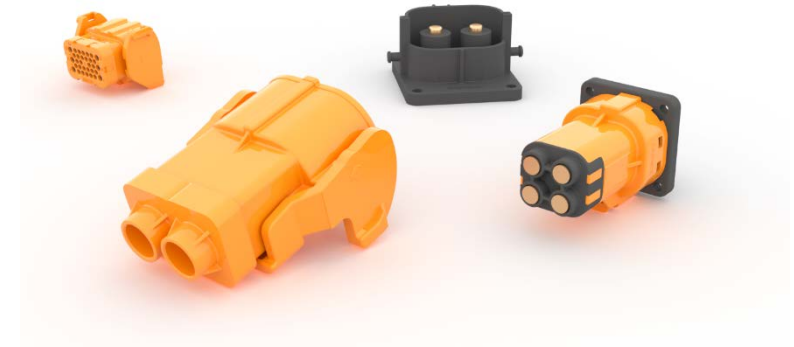
Raditer® B ERV300TKB, special products PBT's based. Improved hydrolysis resistance

Electrical neutral non FR polyamides

Radilon® A RV350KN, PA66-GF35

Radilon® S RV300KN, PA6-GF30

Radilon® S RV400KN, PA6-GF40



Application examples

Power electronic

Power electronic components

Main requirements :

- Excellent electrical insulation properties (CTI 600V) retention
- Excellent dielectric strength vs temperature (> 10 kV at 150°C)
- Flame retardancy UL-94 at 0,4 mm
- Thermal Conductivity to safeguard the integrity of the electrical and electronic components in case of excessive temperature rise
- EMI shielding
- Good mechanical properties
- Low/zero halide content

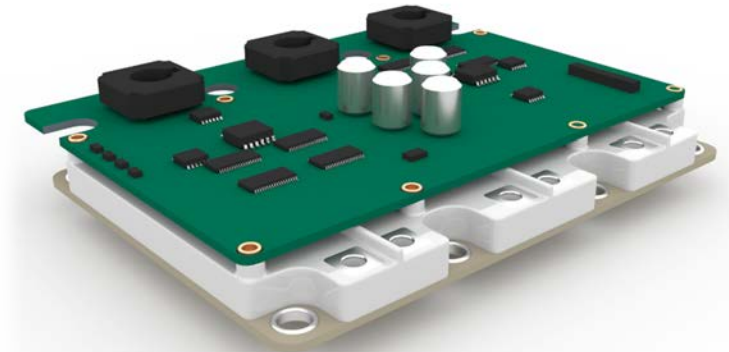
Materials:

Radiflam® A RV300HF, PA66-GF30, FR (40)

Radiflam® S RV300HF, PA6-GF30, FR (40)

Radiflam® S RV100FR, PA6-GF10, FR (61+72), thermally conductive, low smoke density and toxicity

Radiflam® Aestus T2 RV300HF, PPA-GF30, FR (40)



IGBT base (Radiflam® A RV300HF)

Application examples

Charging System

Ground Assembly Inductive Wireless charging modules

Main requirements

Flame Retardant: UL 94 V0 based on wall thickness (RADICI successful Proposal)

Tire Rolling Test: 5000KG $\pm$ 250KG Vehicle, R17 Size Tire (P225/75R15), 8 ± 2 km/Hr Speed, (est. each tire carries 1.35Ton weight)

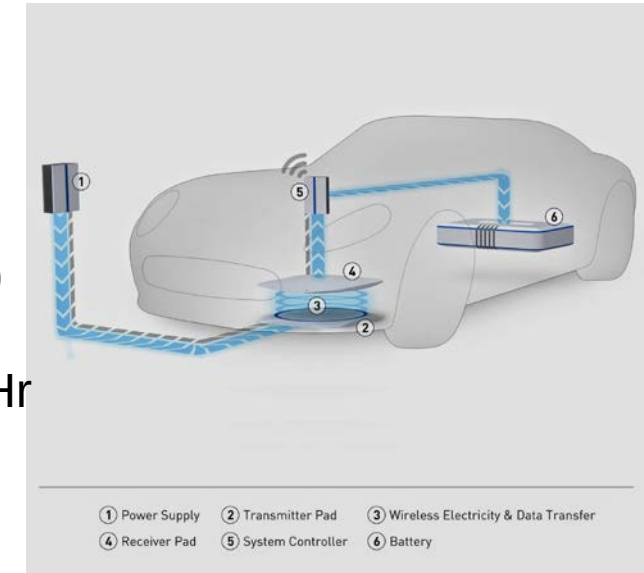
Cone Drop & Ball Drop Test

Cone : IEC61439-5:2014 Cone Weight 5Kg, Drop Height :0.4m, Impact Energy 20J

Temperature resistance requirements:

- 40 °C to + 55 °C, the actual use will generate heat, the temperature will be up to +105 °C, and the conservative temperature will be +125 °C. (the car doesn't stop properly, the coil is misaligned, and the heat generated around it will be very high.)

Aging experiments at high and low temperature will be requested



Application examples

Charging System

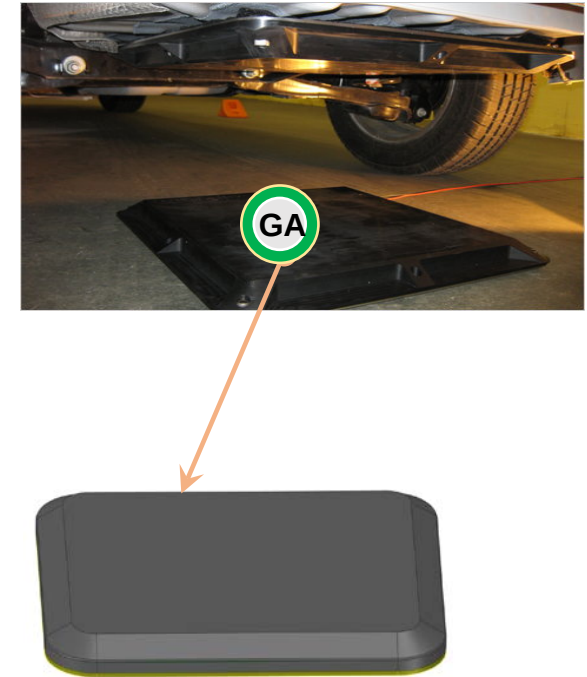
Ground Assembly Inductive Wireless charging modules

Chemical resistance: it is considered that accidental contact with organic solvents such as oil will have an impact on product structure and performance.

Hydrolysis resistance: considering the installation on the ground, in order to prevent accidents, the material should be soaked in water for 2 days without any leakage; the module must show no functional and/or visual damages.

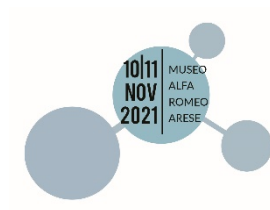
Materials:

Radiflam® A RV(k)HF, GF filled PA66, FR (40)



Conclusions

- › The evolution of the electric car towards a battery system with higher power density and greater autonomy requires materials with high and multiple characteristics
- › Durability, reliability & components safety are non-negotiable features
- › The reference standards are updated frequently and this can affect the material choice
- › It is often necessary to design new materials / solutions to optimize technical and economic performance



HIGH PERFORMANCE POLYMERS

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