# Electric Vehicles Creating demand for Specialty Thermoplastics Compounds

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## Abstract

Lightweight materials are paramount in the construction of electric vehicles since they are helpful in increasing the range of vehicles. With electric vehicles making inroads into the mainstream, the market for these materials is growing at a much faster pace. Growing demand for light weighted automotive components, higher heat and electrical resistance is forcing plastic industry to their current boundaries. The development of this new design incorporates a persistent drive towards manufacturing more powerful, higher thrust, lighter weight, fuel efficient engines in the electric vehicles, accompanied with decline in noise and emissions. Furthermore, recently, government of various countries are taking up initiatives in order to promote the development as well as purchase of electric vehicles so as to reduce the dependency and stress over natural fuel resources.

## Introduction

Polymers for Automotive components in Internal Combustion engines driven vehicles have been traditionally developed meeting various functional requirements like long term heat ageing, chemical resistance against oils and fuels, UV resistance, flammability, Fatigue, Creep etc.

With Electric vehicles on the horizon, there would be new requirements, of higher heat and electrical resistance. These New trends in Auto industry would create more demands for speciality engineering polymers.

These changes will influence usage of engineering plastics in the auto industry for both electric and autonomous vehicles.

Key reasons Automotive manufacturers are preferring Plastics in Electric Vehicles:

- Lighter weight of component
- Compatible properties addressing specific functional requirements
- Equivalent Strength and safety performance as metals
- Cost economics

- Complex shapes and geometries and Part integration

## Potential Applications

Speciality Polymers for applications like electrical connectors and enclosures for the many electrical and electronic systems/components are getting attention from the OEM's and Tier-1's.

- **Connectors**

| Code | |
|---|---|
| Grade | DAFNETEC PPS G12 |
| Polymer | PPS |
| Application | Injection moulding |

Glass fibers and mineral filler reinforced.

- **Battery Enclosure**

ISC

| Code | |
|---|---|
| Grade | DAFNETEC PPS P08 |
| Polymer | PPS |
| Application | Injection Moulding |

40% Glass Fibers. Excellent heat and chemical resistance, inherently flame-retardant. High mechanical resistance at elevated temperature.

In electric vehicles, Batteries & electronics make cars heavier. In EV's, the traditional engines get eliminated. However Plug-in hybrids have a challenge as they have components from both, gasoline- and electric-powered cars.

From electric cars, and finally to autonomous vehicles, shows a considerable prominence on plastics for electrical and electronic components. These parts can be Insulators for the busbars connecting battery cells with high-voltage components, as well as battery enclosures made with thermoplastic composites.

- **Insulator for Bus bars**

Dafnetec®
PPA – PPS

PPA (High – heat / high melting point Polyphthalamides)
- Glass Fiber
- Carbon Fibers

PPA + PA66
- Glass Fiber reinforced

PPS
- Glass Fiber
- Glass Fiber + Mineral Filler

Consumer electronics and auto industry needs seem to converge now on account of more electronics getting in the car.

In high-voltage, high-heat applications like traction motors and power modules, material with a Glass transition temperature of 150 degree Centigrade would be needed to bear the heat.

- **Power Distribution**

## DAFNEMID 66XF P07/T

FLAME RETARDANT PA66 WITHOUT HALOGENS, UL'94 VO CLASS 0,8 MM, 35% GLASS FIBER REINFORCED, HEAT STABILIZED

Applications like connectors which are connected to all the sensors in a vehicle are some of the examples.

In an electric car the high voltage shielding is another challenge. Components such as the electric motor can reach voltages of 400 to 600 V, versus 12 or 48 V for vehicles today. The higher voltages can lead to electrical arcing and radio-frequency interference problems.

A lot of interference with signals can happen in a vehicle, everything from the GPS, automatic door opener, the radio, rear-view camera etc.

Automakers are now using metal because it is a simple solution to shielding problems. Gradually these applications will start moving towards thermally conductive polymers. If we can create polymer meeting these requirements it can cut down additional weight in an EV and promote part integration eliminating assembly steps.

In case of autonomous vehicles, OEM's will need plastics for all the new cameras, radar, Light Detection and Ranging and sensors on the vehicles.

The criticality of functioning of connectors in sensors in Autonomous is very high. As the reliability and durability of sensors is based on the signals conveyed through connectors.
A need for speciality polymers meeting the functionalities of dimensional stability, zero moisture absorption, heat resistance and strength is of prime importance. Polymers like PPS would perform better in such cases versus polyamides.

## Conclusion

The increasing usage of automotive electronics generates a need for Thermal management, signifying the usage of thermally and electrically conductive plastics with special properties.

With high voltage systems in place in a car, the safety factor comes into prominence as risk of fire increases significantly thus promoting flame retardants plastics.

EMI shielding of electronic enclosures housing electronic systems is the need of the hours and plastics score over metal when it comes to lightweight and meeting other properties.

The above applications would be come into prominence once the demand for EV's start increasing and OEM's start realising the importance of mileage in EV's.

Appendix:

References:

Part Pictures from Google Images

Technical Data sheets:

# ISO Datasheet

| | |
|---|---|
| Code | |
| Grade | DAFNETEC PPS P08 |
| Polymer | PPS |
| Application | Injection Moulding |

40% Glass Fibers. Excellent heat and chemical resistance, inherently flameretardant.
High mechanical resistance at elevated temperature.

| *Properties* | *Method* | *Unit* | *Value* |
|---|---|---|---|
| Physical | | | |
| Density at 23°C | ISO 1183 | g/cm3 | 1,66÷1,68 |
| Mould Shrinkage (%) | Internal | % | 0,2÷0,4 |
| Moisture Absorption 23°C/50% r.h | ISO 62 | % | 0,02 |
| Thermal | | | |
| Vicat B50 | ISO 306 | °C | 255 |
| HDT, B (0.45 MPa) | ISO 75 | °C | 280 |
| HDT, A (1.82MPa) | ISO 75 | °C | 270 |
| Heat resistance –ball test | IEC 60695-10-2 | °C | >190 |
| Thermal Conductivity | ISO 22007-2 | W/(m*K) | 0,33 |
| Mechanical at 23 °C | | | |
| Tensile stress at break | ISO 527 | MPa | 170 |
| Tensile elong. at break | ISO 527 | % | 1,5 |
| Flexural Modulus | ISO 178 | MPa | 15200 |
| Flexural strength | ISO 178 | MPa | 260 |
| Izod notched impact strength (23°C) ISO | ISO 180/1A | KJ/m2 | 10 |
| Charpy unnotched impact strength (23°C) | ISO 179/1eU | KJ/m2 | 40 |
| Rockwell Hardness (scale L) | ISO 2039/2 | | 108 |

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AUTOTECH SIRMAX

# SIRMAX

ISO Datasheet

| Flammability | | | |
|---|---|---|---|
| Flammability class (1,6 mm) | UL 94 | | V0 |
| Flammability class (1,0 mm) | UL 94 | | V0 |
| Glow Wire Flammability Index GWFI (1-2,0 mm) | IEC 60695-2-12 | | 960 |
| Glow Wire Flammability Index GWIT (1-2,0 mm) | IEC 60695-2-12 | | 875 |
| **Electrical** | | | |
| Comparative tracking index CTI | IEC 60112 | V | 125 |
| Surface Resistivity | IEC 93 | Ohm | 7E15 |
| Volume Resistivity | IEC 93 | Ohm*cm | 2E14 |
| Dieletric Strength | IEC 60243 | KV/mm | 16 |
| Dieletric Factor | IEC 60250 | / | 4 |
| Dissipation Factor | IEC 60250 | / | 0.002 |

| *Regulations compliance* | |
|---|---|
| RoHS compliance status: | Compliant |
| UL listed file nr: | |
| Water contact approvals: | |
| Food contact status: | |

Revision number/date: 12/10/2018

[1] Moulding shrinkage is not an intrinsic property of plastics. It also depends on moulding parameters. The values reported have been calculated in the direction parallel to the flow in a 4.0 x 10.0 x 170 mm sample.

### Disclaimer

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AUTOTECH SIRMAX

# SIRMAX

ISO Datasheet

| | | |
|---|---|---|
| Dafne | Code | |
| | Grade | DAFNETEC PPS G12 |
| | Polymer | PPS |
| | Application | Injection moulding |

Glass fibers and mineral filler reinforced.

| Properties | Method | Unit | Value |
|---|---|---|---|
| **Physical** | | | |
| Density at 23°C | ISO 1183 | g/cm3 | 1,96-1,98 |
| Mould Shrinkage (%) | INTERNAL | % | 0,1-0,3 |
| Water absorption | ISO 62 | % | 0,02 |
| **Thermal** | | | |
| Vicat B50 | ISO 306 | °C | 255 |
| Ball Pressure Test | IEC 60695-10-2 | °C | >190 |
| Thermal conductivity – through-plane | ISO 22007-2 | W/(m*K) | 0,45 |
| HDT, A (1.80 MPa) | ISO 75/Af | °C | 265 |
| HDT, B (0.45 MPa) | ISO 75/Af | °C | 275 |
| **Mechanical at 23 °C** | | | |
| Flexural Modulus (23°C - 2 mm/min) | ISO 178 | MPa | 17500 |
| Flexural strenght (23°C - 2 mm/min) | ISO 178 | MPa | 180 |
| Tensile stress at break (23°C-50 mm/min) | ISO 527-2 | MPa | 120 |
| Tensile elong. at break (23°C-50 mm/min) | ISO 527-2 | % | 1,4 |
| Rockwell hardness (L scale) | ISO 2039-2 | | 107 |
| Izod notched impact strength (23°C) ISO | ISO 180/1A | KJ/m² | 11 |
| Izod unnotched impact strength (23°C) | ISO 180/1U | KJ/m² | 20 |
| **Flammability** | | | |
| Glow Wire Flammability Index GWFI (1,0 mm) | IEC 60695-2-12 | °C | 960 |
| Glow Wire Flammability Index GWFI (2,0 mm) | IEC 60695-2-12 | °C | 960 |
| GlowWire Ignition Temperature GWIT (1,0 mm) | IEC 60695-2-13 | °C | 875 |
| GlowWire Ignition Temperature GWIT (2,0 mm) | IEC 60695-2-13 | °C | 875 |
| Flammability class (1,6 mm) | UL94 | | V0 |
| **Electrical** | | | |
| Surface resistivity | IEC 60093 | Ohm | 4E15 |
| Volume resistivity | IEC 60093 | Ohm*m | 1,6E14 |
| Dielectric strength | IEC 60243 | KV/mm | 14 |
| Comparative tracking index CTI | IEC 60112 | V | 150 |
| **Processing Conditions** | | | |
| Melt Temperature Range | ISO 294 | °C | 295-345 |
| Mold Temperature Range | ISO 294 | °C | 130-150 |
| Injection Velocity | ISO 294 | | MEDIUM |

SIRMAX. ISO Datasheet

| | | | |
|---|---|---|---|
| Drying Temperature | | °C | 130-150 |
| Drying Time | | Hour | 2-4 |
| *Regulations compliance* | | | |
| RoHS compliance status: | COMPLIANT | | |
| EN71: | | | |
| UL listed file nº: | | | |
| Water contact approvals. | | | |
| Food contact status: | | | |

Revision number/date: 0 jun 17

[1] Moulding shrinkage is not an intrinsic property of plastics. It also depends on moulding parameters. The values reported have been calculated in the direction parallel to the flow in a 4.0 x 10.0 x 170 mm sample.

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