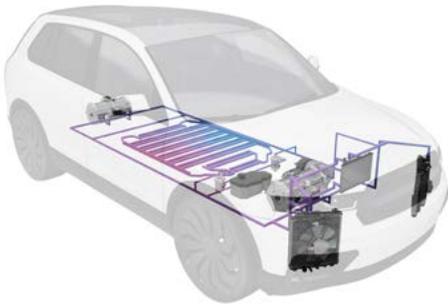


DuPont Hydrolysis-Resistant, Electrically-Friendly Materials for Propulsion Cooling System Applications



While cooling systems still feature prominently in ICEs (internal combustion engines), electric and hybrid electric vehicle technologies add new complexities for propulsion cooling components. Thermal management systems are essential for high-voltage batteries and e-motors, as well as various power electronics. Many designers choose liquid coolant systems to manage heat, and these types are on the rise globally.

While liquid cooling is efficient, the cooling system components must be designed to stand up to extended periods of contact with fluids - including water, glycol, auto transmission fluids, and dielectric fluids used as coolants.

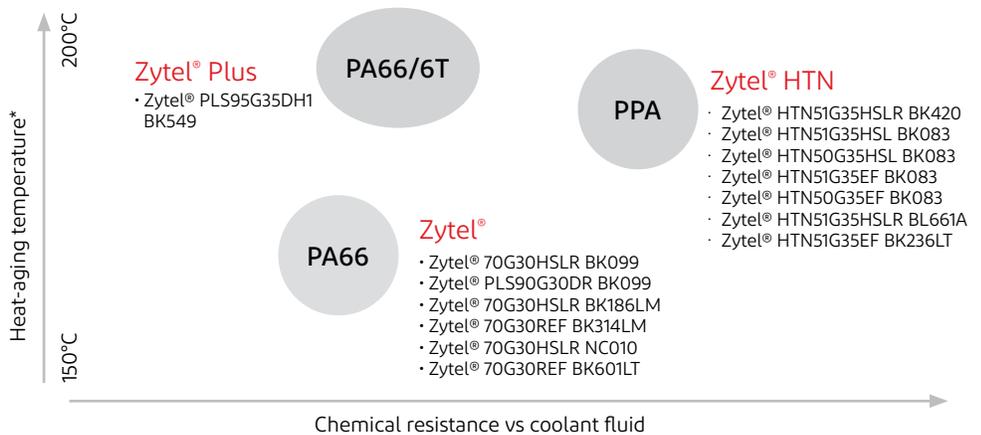
Mission Critical, Proven Performance

Automotive designers face a critical challenge in developing these systems because they directly affect the vehicle's performance and durability. The best answer is to use hydrolysis-resistant materials that are electrically friendly (EF) and heat-stabilized at the component level. When in contact with EV fluids, the low ion elution of EF materials prevents extractables from contaminating coolant fluids.

To that end, DuPont has developed a proven portfolio of nylon materials based on various chemistries that cover a range of needs for applications including electrically driven water pumps, oil pumps, and water multi-control valves /distributors. These materials are specifically designed to increase the durability and safety of components for efficient thermal management of internal combustion engines and critical components of HEVs and BEVs.

The portfolio consists of both Zytel® PA66 and Zytel® HTN and addresses different temperature and chemical-resistance requirements, the need for laser marking on black materials, laser welding, jump port for complex designs, and requirements for dielectric performance.

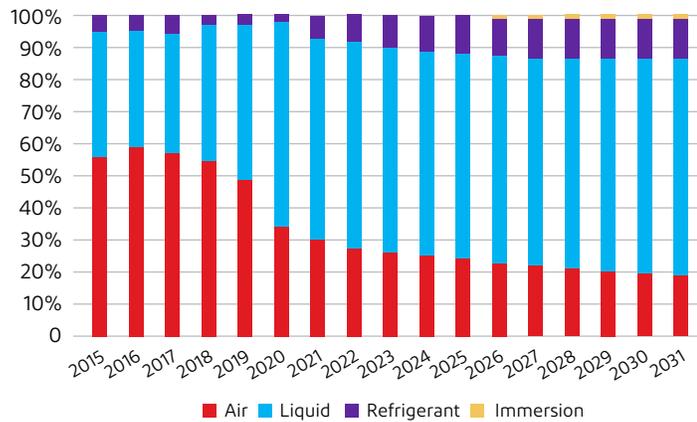
Portfolio of Hydrolysis-Resistant, Heat-Stabilized Materials



Source: DuPont

*Heat-aging temperature (based on retention of 50% of the tensile strength after 3000h)

BEV & PHEV Passenger Cars Thermal Management by kWh



Source: DuPont

Robust Cooling Needs for EVs

As the above graph indicates, industry forecasts call for an increase in liquid, refrigerant, and immersion cooling scenarios through 2031. This parallels the rise in electric vehicle production because the needs for cooling in EVs are more robust. Electric vehicles, specifically HEVs, require thermal management systems that control more than in ICEs – including a combustion engine, battery, traction motor, and power electronics.

There is also more prolonged exposure to coolant than in ICEs. This is because batteries need thermal management while charging and also when the vehicle is not in operation, especially if the temperature is very low.

Cost-Effective Materials That Perform

Zytel® products are well-recognized and comply with automotive OEM specifications. Designers and engineers rely on this family of innovative plastics for demonstrated performance, including:

- Hydrolysis and chemical resistance to a spectrum of liquids – transmission fluid, water-glycol, and dielectric fluids
- Electronic and electrically friendly solutions to prevent metal corrosion and pollution of coolant fluids
- Elevated mechanical properties
- Resistance to thermal shock for extended component life
- A maximum comparative tracking index (600V) and high flow for miniaturization and design flexibility
- High dielectric strength over temperature for increased safety
- Laser welding grades
- Laser marking capability for easy part traceability
- Increased durability (up to 20k hours)
- Improved dimensional stability

For more information, contact your DuPont representative.

dupont.com



DuPont™, the DuPont Oval Logo, and all trademarks and service marks denoted with ™, SM or ® are owned by affiliates of DuPont de Nemours, Inc. unless otherwise noted. © 2022 DuPont.

The information set forth herein is furnished free of charge and is based on technical data that DuPont believes to be reliable and falls within the normal range of properties. It is intended for use by persons having technical skill, at their own discretion and risk. This data should not be used to establish specification limits nor used alone as the basis of design. Handling precaution information is given with the understanding that those using it will satisfy themselves that their particular conditions of use present no health or safety hazards. Since conditions of product use and disposal are outside our control, we make no warranties, express or implied, and assume no liability in connection with any use of this information. As with any product, evaluation under end-use conditions prior to specification is essential. Nothing herein is to be taken as a license to operate or a recommendation to infringe on patents.