

Defying hot gear oil



A platform made of glass-reinforced hydrolysis-resistant DuPont™ Zytel® nylon located in the sump (or oil pan) of DaimlerChrysler's 7G-Tronic automatic gearbox holds all the components of the fully integrated gear-shift control system. A flexible printed circuit based on DuPont™ Pyralux® polyimide laminate transmits the electrical signals between the electronics, the sensors and the actuators.

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The platform, made of DuPont Zytel® nylon, holds the components of the complex 7G-Tronic automatic gear-shift control system. The cutaway drawing of the gear-box (inset, lower right) shows the location of the platform in the sump, where it is bathed in hot gear-oil.

One hardly notices when the new Mercedes-Benz S-Class changes gears. Only the dashboard rev counter provides evidence of what goes on in the 7G-Tronic automatic gearbox, which is standard on eight-cylinder models and is an option on some other models. The seven speeds lower fuel consumption and noise levels, and deliver more dynamic intermediate sprints than conventional five-speed automatic gearboxes.

Co-operation All the Way

The control system which initiates gear shifts and manages their sequence is mounted on a platform located in the gearbox's oil sump or oil pan. This complex-shaped platform, about 40 cm (15.7 inches) long and 25 cm (10 inches) wide, is injection-molded to close tolerances using a special grade of DuPont™ Zytel® nylon.

It carries the electronics, as well as various magnetic valves, sensors and floats. These components, the gearbox-connector and the electronics communicate via a flexible printed circuit board made by Freudenberg Mektac Europe, based on DuPont™ Pyralux® polyimide carrier laminate. With their ability to withstand lubricants and high temperatures, both the platform and the laminate contribute to the unit's reliable operation even when it

is immersed in gear oil in high temperatures of up to 140 degrees C (250 degrees F).

The whole module was developed and is supplied by Siemens VDO. Geiger technik molds the platform and other plastics parts.



Left: The platform of Zytel® seen from the underside. Right: the flexible circuit, based on a Pyralux® carrier laminate.

Dimensional Stability at High Temperatures

"Together with our development partners, we chose DuPont™ Zytel® LM70G35 HSLX as the material which meets the tough requirements of this demanding application," comments Gerhard Lepsien, key account manager at Geiger technik. "This heat-stabilized PA 66 nylon with 35 percent glass-reinforcement is highly resistant to hot gear oil with its aggressive additives. Its very good dimensional stability

is a major prerequisite for ensuring that the control electronics on the platform work reliably at any operating temperature.

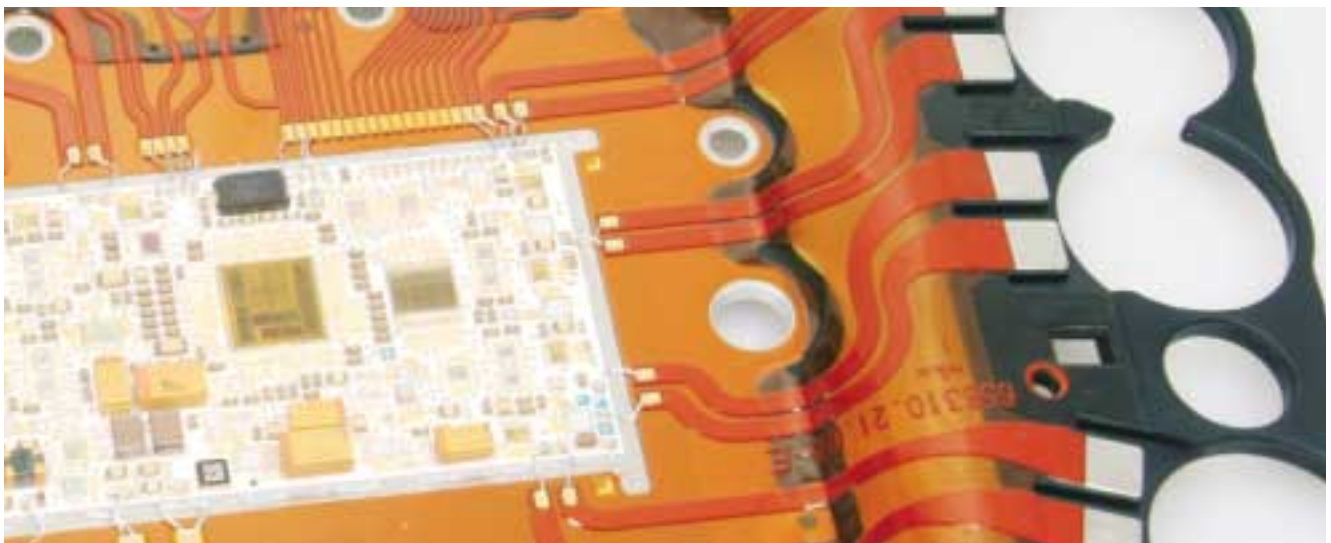
The combination of high stiffness and elasticity allows snap-fits to be integrated, and this type of Zytel® can also be laser-printed, which is a requirement by Siemens VDO.

"We worked in close partnership with DuPont from the very beginning of the module's

development," Lepsien continues. "This enabled us to influence decisions from a processing point of view at an early stage, so that the part and the mold were optimally matched. DuPont helped us with mold-fill simulations and warpage analyses when evaluating different gating variants. The result is that we can keep to the very close tolerances of this big part without difficulty."

Flexible Circuit

Hard-disk drives and single-lens reflex cameras are among the best-known applications of flexible circuit boards (so-called flex-films) — applications in which three-dimensional circuits have to be squeezed into a very limited space. The Mektec Group, a leading flex-film developer and manufacturer, has made this technology available to numerous other industrial applications. .



A flexible Pyralux® laminate, based on Kapton® polyimide film, connects the electronic control unit with other components of the gear-shift system like valves, sensors and floats.



The 7G-Tronic automatic gear-shift system is standard on eight-cylinder models in Mercedes-Benz S-Class cars and an option on some other models.

These include control circuits for automatic gear-boxes, of which DaimlerChrysler's 7G-Tronic is a state-of-the-art example. Mektec uses DuPont™ Pyralux® polyimide film for a major part of its production.

The Pyralux® carrier laminate consists of Kapton® polyimide film and a high-temperature acrylic adhesive.

Onto this a company in the Mektec group laminates a copper film. Then, after etching, a second insulating layer of Kapton® polyimide film with the same adhesive is laminated onto the first. Following lamination, the back of the flex-film is laminated onto a rigid aluminum plate in the electronics system of the 7G-Tronic automatic gearbox.

To save room, the front is sealed directly onto the platform of Zytel®, so that the film with the platform forms an oil-proof housing for the electronics.

"Polyimide-based flex-boards meet our toughest specifications in many respects," comments Dr. Harald Schenk, development manager at Freudenberg Mektec.

"They withstand extreme temperature variations and, being highly flexible, they can take high dynamic stresses. They withstand aggressive media such as gear-oil, brake-fluid or diesel fuel, and components can be mounted on them using standard processes.

Because they can be bent and folded in three dimensions, and thanks to their thinness and light weight, complex mechanical and electronic functions can be squeezed into a very small space. Their use results in valuable cost- and time-savings. This obviates numerous wiring and component assembly operations."



At the board's outer edges the Pyralux® laminate is connected to sensors or actuators

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