Lamborghini Carbon Fiber Technology
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MOTOR TREND

We Say...

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TECHNOLOGUE

Once-exotic carbon fiber inches toward the mainstream

Time has long been carbon fiber's enemy. The time a preimpregnated sheet of woven carbon fiber can spend at room temperature before it starts to set up; the time it takes to lay up a structure of this "pre-preg" in a mold; the time it then spends in an autoclave at 220-350 degrees F and 100 psi pressure. Sure, the weight savings were impressive (at least 50 percent relative to steel and 30 percent versus aluminum), but the labor cost and cycle time suited exotics only.

Lamborghini has been hard at work improving the production viability of carbon fiber since introducing the first such part on an automobile (the Countach QV's front bumper). Its Advanced Composite Structures Laboratory is located on the University of Washington Seattle campus and has helped develop new ways of using this miracle material that can rival aluminum's cycle time and cost. New resins and curing procedures have resulted in "forged" carbon-fiber parts that can yield a class-A paint finish or replace a forged aluminum control arm. Thermoset resins can accept friction-welded fastening tabs, and the parts can directly replace sheet-aluminum parts in applications such as floorpans or underbody panels. Pliable resins allow CarbonSkin to replace leather trim as a thinner, tougher material that's up to 30 percent lighter. New robotic procedures promise to make pre-preg more affordable, and the lab has produced CF parts that incorporate solar-charged batteries and radio-frequency ID controllers inside the laminate, so a load-bearing part can provide lighting or report real-time stress without wires attached.

Closer to proletarian pricing will be BMW's forthcoming i3 EV, which features a carbon-fiber passenger cell bonded to an aluminum chassis that absorbs front and rear crash energy and carries the battery, motor, and optional range-extender. Much of the cost savings here comes from dramatically reducing the number of parts and hence the assembly time, and by adapting conventional tooling that can quickly produce carbon-fiber parts. The body-side aperture, for example, is composed of nine preformed CF parts injected with resin at 212 degrees F at 1160 psi and cured in minutes. And those preforms are each made up of various layers of unidirectional CF dusted with dry epoxy that, when pressed lightly in 400-degree dies, cures just enough to "weld" the dry mats together in a useful shape. BMW goes a step further in collaborating with SGL to make carbon-fiber filament in Moses Lake, Washington, using hydroelectric power. White crude-oil-based polyacrylonitrile thread is "carbonized" by passing through five ovens of varying temperatures up to 1300 F. These 7-micron filaments are bundled into the strands or "tows" of 3000-12,000 filaments each that you see woven or aligned in CF fabrics.

Both Lamborghini and BMW have invested heavily in CF repair practices, with the former adapting Boeing's "flying doctor" approach of dispatching experts to repair vehicles in the field. BMW is striving to match the insurance rating of the 1 Series, so it's developed special tools, patch panels, and procedures to allow dealer personnel to affect body repairs.

ACSL director Paolo Feraboli doesn't foresee Lambo's cousin VW making Golfs of CF, but when it replaces aluminum in Audis at BMW i3 prices ($40s), he'll have earned his keep. ■

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