

Cadillac's huge step forward

For the 2002 season, the factory-backed Cadillac Le Mans Series effort was coming off two unsuccessful years in which it had underperformed and struggled with an uncompetitive car. But there was cause for optimism because of changes in the team. An all-new car designed by Nigel Stroud promised improved performance over the old Riley & Scott-supplied car. McLaren Engines continued to refine the car's twin-turbo 4.0-L Northstar V8.



For the 2002 season, Cadillac introduced an all-new car featuring the minimalist bodywork philosophy employed by the top teams to minimize drag while contributing downforce.

The carbon-fiber tub supplied by David Price Composites (DPC) is made using a new process that makes the car lighter. And in contrast to the traditional upper- and lower-halves that are glued together, DPC made the Cadillac tub with a "wrap around" design for greater strength, according to Dave Spitzer, Cadillac Le Mans Prototype (LMP) Integration Manager.

"The new chassis is a huge step forward," said Spitzer. "It allows more efficient scavenging of the front underwing." And where the old car was a bit heavy, the new design is as spare as possible to allow for future flexibility. "It is designed to the absolute minimum, within the rules, so we can go back and make changes," said Spitzer.

The team is proud of the packaging of the front suspension. "To meet the regulation for front crush, we packaged the suspension on the front of the front bulkhead," Spitzer said. "To access front suspension, you just remove front crush structure," he added.

Traditionally, the master cylinders mount to the front bulkhead, just ahead of the pedals. But the raised nose on modern race cars leaves space under the driver's feet, and Stroud's design for the Cadillac LMP exploits this space by mounting the master cylinders backwards and below the pedals. Fluid reservoirs mount remotely behind the dashboard area. Getting the master cylinders out of the extreme front of the car leaves them much less vulnerable to crash damage, and other teams are looking at adopting the approach; brake hardware supplier AP is offering an off-the-shelf pedal box assembly with low-mounted master cylinders.

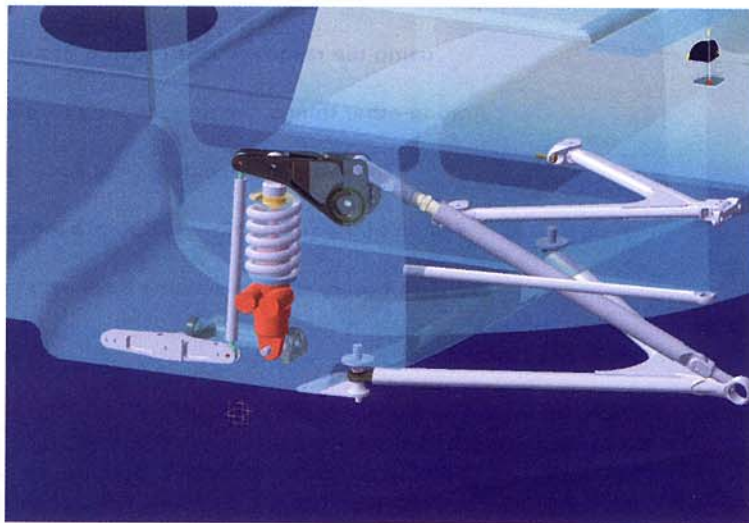
The new tub design includes a cavity between the engine and the cockpit to hold the oil tank for the engine's dry sump system. Standard practice has been to integrate the oil tank into the transmission bell housing, but in the interest of simplicity and speedy Audi-like gearbox swaps, Cadillac moved the oil tank ahead of the engine.

"Now the car breaks at the front of the gearbox for disassembly," Spitzer said. "Seven or eight fasteners and quick disconnects, and that is it."

So how quickly can the Cadillac team change the rear end of the car now? "I can tell you exactly," said Spitzer. "We tested at Road Atlanta and did some rear end changes—and did it in 5:20. The best Audi has done is about 4:30. We were looking at under six minutes as being a reasonable goal." Circumstances conspired against the team, so it wasn't able to demonstrate that ability during a race because of additional damage when the rear end needed to be changed. "We know exactly what that takes; we haven't

quite executed yet," Spitzer said. "That's not magic; it is just attention to detail and execution."

Inside the Cadillac-designed gearbox housing is a sequential transverse six-speed gearbox provided by Xtrac. For 2002, the team upgraded to a Megaline steering wheel-mounted paddle shift system. The old motorcycle-style sequential shifter was very good, but the paddle shifter reduces the opportunity for driver error. "The biggest thing is consistency when you get in traffic or the driver might be fatigued,"



To maximize aerodynamic efficiency at the front of the car, packaging must be very tight. The Cadillac's front suspension consists of the shock, spring, and anti-roll bar attached to the front of the tub to stay out of the airflow.

Spitzer said. "It offers a little in terms of speed of shift. We went after it to keep the drivers hands on the wheel so he can focus on driving into the corner. You can attack the corners a little bit more. The difference is not a huge amount of lap time."

If the stopwatch can barely tell the difference with the paddle shifter, the mechanics can. "At the end of the 24 Hours of Le Mans, there was no damage to the gears," Spitzer reported. But surely the team wouldn't consider reusing gears that had already run a 24-hour race, would it? "They could go back in for a race up to 10,000 km," he said. "The paddle shifter makes everything easier on the crew."



Each of the different colors represents different parts of the Cadillac's composite "tub" assembly. Notice how the gray wraps completely around the front of the chassis with no seams. Bonded to this main component are panels for the center spine, dash bulkhead, and additional strength in the area of the roll hoop.

That doesn't mean the pneumatic shifter bolted onto the car without any trouble. "The biggest problem has been in calibration with the **Bosch** engine management system," said Spitzer. "That has been a bit of a challenge. It all worked right away, but it didn't work the way we wanted, so there has been a lot of development." The problems were nothing obvious to the casual observer. "We are looking for milliseconds and improved shift quality," he said.

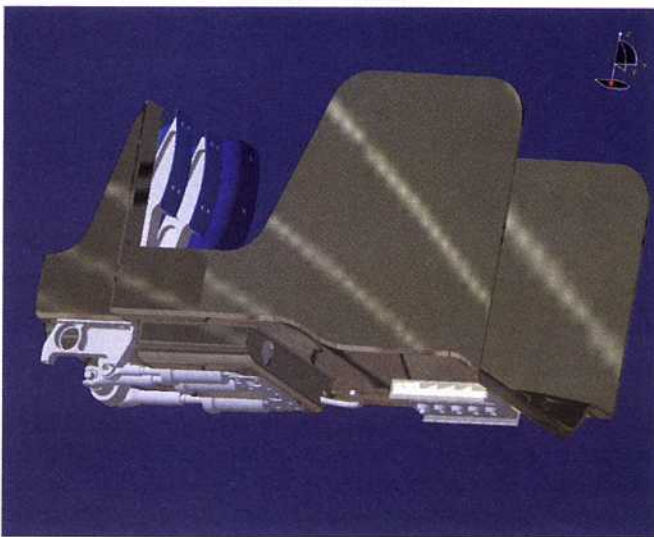
The twin-turbo V8 picked up 15 hp (11 kW) for 2002 to just over 600 hp (448 kW), thanks to new heads borrowed from GM's Opel German Touring Car program. The company's Cadillac LMP, Opel touring car, and Chevrolet Indy car engines are all closely related variants of the same basic engine. The Indy engine uses special heads optimized for the methanol fuel specified by series rules, but the newly developed Opel head was quite close to the ideal design sought by the Cadillac team, so it made for a cost-effective upgrade. "We looked at the Opel head, and it had 90% of what we wanted," said Spitzer. "So we called our friends in Germany and they sent us some parts."

The new heads, combined with tweaks to the Bosch engine management system, boosted fuel economy enough to let the Cadillac LMP run an additional lap at Le Mans between pit stops. The changes slightly lowered the rpm at which the engine developed peak power, and the engine management software addressed engine detonation more aggressively; these two factors combined to boost the car's efficiency enough to reach 13 laps at Le Mans without stopping. Previously, calculations showed the car would run out after 12.8 laps, forcing the team to pit at 12-lap intervals.

The wheel hub carriers show innovations. In place of the usual welded and fabricated steel used to withstand the high loads over long endurance races, the 2002 Cadillac LMP featured cast stainless steel uprights.

"When you get away from fabricating, you get away from the problems of welds, and you get lighter weight," said Spitzer. The special lost wax in a foam mold process was developed for casting titanium uprights for Formula One cars and was adapted to stainless steel for the sturdier sports cars.

The car's **Kayaba** electric power steering system has been "perfected," said Spitzer. Electric power steering helps reduce driver fatigue over long race distances, but unlike hydraulic systems, doesn't sap engine power at high engine speeds and eliminates a hydraulic system from the car.



A pedal box assembly was created for the Cadillac to make room for the front suspension, to keep the front of the tub compact for aerodynamic efficiency, and to maintain serviceability. The entire assembly, with pedals in front and master cylinders underneath, can be moved fore and aft in seconds, and removed in about one minute.

Dampers are supplied by **Sachs**, and the team has developed its setup with tests on seven-post chassis rigs through the season. Some of the latest testing has been for suspension compliance and kinematics, according to Spitzer. For this testing, the shocks are replaced with solid rods so the suspension can't move. Known loads are applied and suspension deflection is measured, so the team knows how the car responds to heavy cornering loads.

It remains to be seen what will become of the Cadillac cars for 2003 now that factory support has been withdrawn. **aei**