

It's on the Way: The World's First Purpose-Built Law Enforcement Vehicle



The Carbon E7 debuted at the 2008 International Association of Chiefs of Police Conference in November 2008 and is currently being shown in cities throughout the U.S. on the 2009 "Pure Justice" Tour. Image courtesy of Carbon Motors.

An Atlanta startup's highly integrative design streamlines production and emphasizes user-friendly ease of operation. By forgoing the cost of a traditional paint line, the manufacturer expects to save millions of investment dollars.

In 2003, two of the founders of **Carbon Motors** (www.carbonmotors.com) performed an exhaustive study to determine if a need existed for a "purpose-built" police patrol vehicle—one that was constructed from design to final assembly while keeping in mind the police officers that would be using it. The three main concerns would be safety, integration of law enforcement equipment, and overall performance. Not only was the performance of the engine in question, but also the automobile's strength and durability.

"We decided to find out exactly what law enforcement wanted in a vehicle," said Alan Bratt, the executive vice president and chief production officer for Carbon Motors, a homeland security startup in Atlanta, Georgia, and the developer of the world's first purpose-built law enforcement vehicle, the Carbon E7. "Initially, we identified 88 critical requirements that have subsequently been expanded, based on further input from the law enforcement community. If you look at today's offerings, they are basically family passenger sedans that have been adapted for patrol use. They were never intended for the arduous usage that law enforcement

Carbon's E7 was designed with input from law enforcement experts and comes fully equipped with a comprehensive suite of purpose-built, performance and safety features, utilizing the latest advancements in defense and law enforcement technology. It includes an ergonomically correct cockpit; a high-power, clean-diesel engine capable of running on biodiesel (providing 40 percent improvement in fuel efficiency) that will accelerate the vehicle from 0 to 60 mph in 6.5 seconds with a governed top speed of 155 mph; integrated external and internal surveillance capabilities; radar; LoJack; an automatic license plate recognition system; radiation and biological threat detectors; and 360-degree, built-in LED emergency lighting.

submits them to. We wanted an automobile much more suited to law enforcement applications."

For the new Carbon E7, a primary concern was how to integrate complex law enforcement equipment into the vehicle in a user-friendly manner. "We've integrated all of the emergency lighting into the profile of the car, so there's no light bar on top," Bratt explains. "Lights are on the front and sides and rear of the roof, plus there are side markers, front lamps in the bottom of the windshield, and fog lights fully packaged within the vehicle's profile."

Likewise, the E7 has integrated pushbars, so there's no requirement to add heavy iron bars across the front of the car

“Some of the cars that we’ve seen have had their airbags turned off because if they use the pushbar, there is a risk that airbags will deploy,” says Bratt. “Our pushbars, which incidentally will be mounted front and rear, will have a plastic exterior and structural foam inner core. They will be mounted on shock absorbers so they won’t damage the subject vehicles and will be recognized by the vehicle’s electronics to avoid unintended deployment.”

Another innovation is the use of a lightweight extruded aluminum space frame. Designed and manufactured by **Hydro Aluminum** (www.hydroaluminum.com), of Sydney, Ohio, the space frame is designed to handle a 75-mph rear impact. Bratt says that there have been a number of deaths and injuries associated with officers pulling over to the side of the road and then impacted from the rear because some drivers are mesmerized by emergency lighting. “We’re undertaking a lighting study with Georgia Tech to understand the effects of lighting,” Bratt affirms. “We’re working with our lighting supplier to come up with lighting patterns and arrays that will obviate that difficulty.”

Adding the lighting into the vehicle improves streamlining and reduces aerodynamic drag. The company vice president says that testing conducted by the Michigan State Police regarding light bars indicated that some current vehicles were unable to achieve the published maximum top speed simply as a result of carrying the light bars on the top. “Light bars disturb the smooth air flow over the top of the car,” he said.

Not only will the aluminum frame give the car strength and lightness, it’s a technology that suits production of a vehicle with a market of about 50,000 units per year. “We can’t really do that economically with a sheet metal stamped body,” Bratt points out. “The thermoplastic exterior is highly resistant to

dents and abrasion. And parts will come out of the mold with the color on, so we avoid having a paint shop, which is much more environmentally friendly. We’re going to use an assembly system known as FASTplant[®], designed and patented by Durr, one of the world’s largest assembly equipment suppliers. It comprises a series of carriers mounted on a self-contained assembly system that is extremely flexible, can be expanded to provide additional capacity as demand increases, and will use team techniques for vehicle assembly.”

Safety is one of the most important of the three main concerns that Carbon Motors is addressing with its E7, a demonstration model of which is currently being shown in cities throughout the U.S. on what the company has dubbed the “Pure Justice” tour. One example that Bratt cited is the way that current exterior spotlights are installed on the “A” pillar, with the handle protruding into the interior head swing area. “A 45-degree offset impact is directly in the driver’s headline,” states Bratt. “We have met officers who have forehead scars to testify to the danger of that single piece of equipment.”

Ergonomics is considered a major element for driver comfort and the vehicle’s ease of operation. Georgia Tech also worked with the company to lay out the ergonomic array of the data and controls. “In existing patrol cars, computers are often mounted in intrusive locations,” says Bratt. “We’ve integrated all the computer functionality into the vehicle, so it doesn’t have to be added as an aftermarket piece of equipment. We’ve also added a secondary display above the automotive instrument cluster so that the driver can get the information off the main screen at eye level, without having to take his eyes off the road.”

Also enlisted for ease of operation are three different types

of communications systems. Bratt explains that in the E7, there will be no loose microphones on seats or hanging on mirrors. Instead, microphones are embedded in the steering wheel, and the computer and all other critical systems can be voice activated. Second-level switches and controls are incorporated on the steering wheel, and a backup system, comprising hard switches, is sited on the center console. "We've done this to accommodate different officer preferences," Bratt adds.

Carbon Motors believes that another aspect of officer safety and comfort is ergonomic design of seats. "We've had the seat redesigned with the area around the waist of the driver cut away in such a way that it will accommodate his or her duty belt," says Bratt. "And it will allow the seat belt to sit in the correct position. In most police cars, the seat forces them forward on the cushion, and the belt cuts high across the spleen area, rather than across their lap. And it also blinds access to their pistol. So by cutting away the area around the waist, the officer is able to sit more comfortably with the seat belt in its correct position, and have easy access to his or her weapon. We've actually had a 6-foot 10-inch officer sit in the vehicle and tell us he was amazed how comfortable and spacious it is."

The company has also relocated the rear belt to the center of the vehicle rather than on the extremes. "And we added a buckle stow device on the divider, so the officer doesn't have to reach across the prisoner to lock the seat belt," says Bratt. "Rear seats are designed so that a handcuffed prisoner can sit comfortably, but it will be much more difficult for them to struggle free."

It's becoming more apparent as the price of fuel rises, Bratt says, that cars performing in the 6-to-12 miles per gallon range—like most patrol cars—are unaffordable. The company's

designers want to install an engine that will achieve a significant improvement in fuel consumption. "All the diesel engines that have been introduced and engineered in Europe have made significant improvements in fuel efficiency," Bratt maintains. "These engines will run on low-sulfur diesel fuels and will have biodiesel capability. I can't tell you too much about the engine because the supplier wants to introduce it to the world themselves when the time comes. But I can say that it is a 300 horsepower, 420 lb-ft torque, twin sequential Diesel that will accelerate the car from zero to 60 miles per hour in 6.5 seconds, and have a governed top speed of 155 miles per hour."

The manufacturer is designing the E7 to be as recyclable as possible. With an aluminum frame and thermoplastic panels, the car can be recycled at the end of its life. "We don't intend initially to export these cars to Europe, but there is a directive there that we have used as a guideline for end-of-life treatment," says Bratt. "They're looking for 95% of the vehicle to be 100% recyclable, and we believe it's probable that the U.S. will adopt something similar. We're an environmentally-conscious company and are keen to take this responsible approach."

Carbon Motors will close-loop these vehicles to prevent their getting into the public domain via the normal route, where ex-police vehicles get bought up at auctions and are then used for all sorts of criminal purposes. "One of the original 88 requirements was that the cars don't get into the public's hands," Bratt continues. "We'll bring the vehicles back into our system, refurbish them, and resell them onto perhaps a lighter-duty application, but still only to a bonafide law enforcement agency. Then, at the eventual end of life, we'll dismantle and completely recycle the components."



Soliant Fluorex® paintfilm is available in any color including metallics, pearlescents, special effects and chrome. Image courtesy of Soliant LLC.

The First Car to Use Paint Film on its Entire Exterior Surface

The Carbon Motors E7 law enforcement vehicle will be the world's first car produced with a 100-percent paintfilm thermoplastic exterior. Soliant Fluorex® Paintfilm (from Soliant LLC) will be used in the vehicle's production; it's said to demonstrate excellent durability, as well as chip, weather, and chemical resistance, and is currently on over fifty million components worldwide, according to Soliant.

Many major automotive OEMs are already using Soliant Fluorex® Paintfilm on exterior components such as fascias, door steps, rocker panels, stone guards, body side moldings, "A" pillars, roofing strips, and window surrounds. But this is reportedly the first time that an entire automotive exterior surface with paint film will be produced, primarily because legacy automakers have infrastructure for traditional paint and may be reluctant to change.

"Our law enforcement officers deserve the best technologies, and we have to be both fiscally responsible and environmentally conscientious with our manufacturing," said Alan J. Bratt, executive vice president and chief production officer of Carbon Motors Corporation. "Including Soliant Fluorex® Paintfilm technology in our supply base brings added value to our vehicles, streamlines production, and enhances environmental sustainability."

The exterior body panels for the Carbon Motors E7 law enforcement vehicle will be produced with combined technology from Soliant and BASF, a major global chemical company. The thermoplastic body panels will include an enhanced UV-cured film technology with added scratch and mar resistance, allowing for the coating of a vehicle to be held to a minimal cost with less of an environmental impact.

Soliant (www.paintfilm.com) says that in addition to being durable, the Paintfilm preserves the appearance of the vehicle exterior because it won't fade or peel over time. Paintfilm is also chip-resistant as it has an adhesive layer bonding it to the plastic substrate. Gravelometer tests comparing paint film panels to paint panels are said to exemplify the substance's durability in extreme abrasive conditions.

A paint line is typically 40 percent of the cost of a new car production plant, according to Soliant. The floor space required for a paint line can reportedly range from 30 to 40 percent of the plant, and many of the bottlenecks in manufacturing originate in the paint line. The environmental compliance issues associated with paint can also significantly drive up costs.

"We knew from the start we did not want a paint shop," said Bratt. "Carbon Motors Corporation will save millions in investment using Paintfilm and forgoing the cost of a traditional paint line."

The company also points out that Paintfilm uses less energy than paint. Another manufacturer using paint film estimated saving 23 gigawatt hours (GWh) of energy, which is equal to 13,200 barrels of petroleum. Their water savings in a year using Paintfilm reportedly totaled 115,000 tons.

"Our calculations indicate that the electrical power savings achieved using Paintfilm instead of paint is 150,000 megawatt hours (MWh) per year, which is the equivalent to the power consumption of 17,000 average U.S. homes," said Bratt.