2005 Shelby GR-1 CONCEPT Special Features

- Fully engineered, production-feasible, drivable
- Modified Ford GT chassis
- Increased legroom and footroom
- Dream Team II collaboration
- Virtual tools; production-quality hardware

BALANCING DESIGN, CAPABILITY, USABILITY IN A PRODUCTION-FEASIBLE CONCEPT

Much like the original Ford GT concept and last year's Shelby Cobra concept, the GR-1 was meant from the outset to be a fully engineered, production-feasible, drivable, road-going project vehicle.

Helping that cause is a high level of commonality with the Ford GT and last year's Ford Shelby Cobra concept.

The GR-1 starts with a modified version of the aluminum chassis from the rear-engine Ford GT. The bulk of the rear structure is made from slightly modified Ford GT components, including the massive, trellis-like cast aluminum suspension nodes, the rear rails and bumper beam, a major cross-member and the brackets used to mount the transmission.

The center portion of the space frame also has a high degree of Ford GT commonality, with major aluminum extrusions based heavily on existing pieces. At the front of the coupe, the team incorporated the extruded main rails, steering rack cross-member, crash-management sections and the bumper beam from the Ford GT.

"Building a concept car with this level of sophistication is easy when you have a world class supercar like the Ford GT to start from," said Phil Martens, group vice president, Product Creation. "This commonality and re-use goes hand-in-hand with our speed and cost efficiency."

While the Ford Shelby GR-1 concept shares a significant amount of technology with the Ford GT and the Shelby Cobra concept, there were several unique engineering challenges that were met head-on by the team.

The six-speed manual transmission had to be packaged in a way that would not compromise the occupant footwells. "One of the unique solutions we delivered for the GR-1 was the design, engineering and development of a torque-tube driveline, which allows placement of the transmission in the rear of the car, outside of the occupant zones," says Manfred Rumpel, manager, Ford Advanced Product Creation.

Mounting the transmission in the rear helped to distribute the vehicle's weight more evenly, increased the foot well area from 16.5 inches to 21.7 inches, and resulted in almost three more inches of legroom than in similar performance vehicles.

The torque-tube driveline and rear-mounted transmission are examples of the functional considerations that were addressed in this concept car, which represents a successful collaboration between corporate design and engineering at Ford Motor Company. In the past, engineering was rarely involved in show car projects.

"Even today, some people think that if Engineering is involved we'll impede creativity by wanting to impose all sorts of functional requirements," says Mark Bergdahl, supervisor, Chassis and Powertrain Systems Architecture at Ford APC. "Well, in this case, we imposed many, many functional requirements. But it was a collaborative effort with Corporate Design and we were able to co-exist and deliver an extremely beautiful and functional product. I'd like to think this set a precedent, and that this is how we'll do show cars in the future – with that mindset."

DREAM TEAM II

Following the "Dream Team" that developed the Ford GT, the Shelby GR-1 group became known as "Dream Team II." Like the Ford GT project team, it included key suppliers in a fully integrated effort.

Those suppliers included Aria, in California, the body exterior and interior builder; Techno Sports, the running chassis builder; tire supplier Goodyear, who also formed a joint effort with Siemens VDO to develop the Tire IQ™ system; Metro Technologies, builder of the aluminum spaceframe; Sparco of Italy, who provided seats, steering wheel and foot pedals; Stewart Warner Performance, supplier of the instrument cluster gauges; ZF of Germany, who provided the steering gear and pump; and Superform Aluminum, a UK-based company with a subsidiary in California, who produced the body panels using the same process that was used on the Ford GT.

"We actually did tools and dies to form these exterior aluminum body panels using the production process," Bergdahl pointed out.

In fact, the team applied Ford's Product Development System (FPDS), which defines tasks and deliverables for production vehicle programs, but has never before been applied to a show car. This meant that production level processes for engineering, design, parts procurement and ordering were used early in the development of the GR-1 show car to produce a very high quality product.

The team believed their production-feasible approach made sense, because right from the beginning they knew that limited-volume production was a possibility. They believe their approach has allowed them to shave a full year off the time it would take to put the GR-1 into production.

VIRTUAL REALITY

Virtual analysis tools, including computer-aided engineering (CAE) and computer-aided design (CAD), were used extensively in the Ford Shelby GR-1 project. These tools, which are continually becoming more refined and accurate, helped achieve time savings and cost savings, and what Bergdahl refers to as "first-run capability."

"With a show car, you have to get it right the first time," he says. "Your sample size is one, and you have no second chances given the compressed timeline on a show car. So CAE and CAD were instrumental in the success of this program, and allowed us to achieve the five-month timing."

The GR-1 team used CAE tools for vehicle dynamics simulations and computational fluid dynamics analyses. They did finite element structural analyses, most notably on the aluminum space frame, and also chassis elasto-kinematic analysis, looking at how the suspension performs under different loads and in different wheel travel situations.

The team used CAD to do extensive 3D packaging work, which allowed them to achieve a very high level of production-representative integration for such primary systems as the chassis, powertrain, braking system, suspension, and the fuel, electrical and climate control systems. When it came to building the hardware, everything fit together just the way it was planned.

"Our hardware fabrication was based on manufacturing tolerance blueprints," Bergdahl says, "and ultimately we did a complete vehicle build. If you just look at the running chassis, you can tell there is something special about this one. Everything looks like it's in the right place, where it should be. Things are nicely integrated, and typically that does not happen on a show car."

QUALITY OF EXECUTION

The Ford Shelby GR-1's extremely high level of component fabrication and build quality was the most satisfying result for the engineering team.

"The ultimate litmus test for an engineer is in the hardware," Bergdahl says. "You can do all the CAD work and virtual work that you want, but it really doesn't mean very much until you build it and drive it and show you've delivered the product as planned. Everybody on our team deserves a lot of credit for achieving that level of hardware quality on a show car."

For this reality based concept car, the ultimate test was a session at Ford's Michigan Proving Grounds. The team spent several days doing a lot of dynamic vehicle development, including shock, stabilizer bar and spring tuning, and a variety of testing and development work to make sure they had a competent driver's car that would handle well and be safe to drive at high speeds on a test track. That puts the GR-1 approximately a year ahead of where the Ford GT was at show car time.

Asked about their ultimate measure of success for this project, the team is unanimous: "Production approval!"

And this car, more than any other concept car Ford has ever done, is ready and several steps ahead if production becomes a reality.

FORD & SHELBY: Together again

Carroll Shelby didn't enter his first automobile race – a quarter-mile drag meet – until he was nearly 30 years old. But the hot rod Shelby drove to the finish line that day in 1952 was powered by a Ford V-8.

More than a half-century later, Shelby is one of the most recognized names in performance car and racing history and is back in the Ford family producing concept and production performance cars and trucks.

Shelby's first Ford derivatives were the legendary Cobras and Shelby Mustangs of the 1960s. Today, he is one of the key collaborators on the "Dream Team" that built the 2005 Ford GT and the Ford Shelby Cobra and Shelby GR-1 concept vehicles. He recently announced that his specialty car company will produce a limited-edition Shelby Ford Expedition for sale through select Ford dealers in 2005.

For its part, Ford began to stoke the passions of enthusiasts again by unveiling the all-new, all-modern Ford Shelby GR-1 concept car at the 2004 Pebble Beach Concours d'Elegance, signaling more excitement in the future for Ford and Shelby.

"Carroll's input is reflected in the performance underpinnings of this concept," says J Mays, group vice president of Design and chief creative officer. "I see the Ford Shelby GR-1 concept as a gift to Carroll. We took the chassis he helped create and put this fantastic body on it."

THE LEGEND BEGINS

Shelby may have started late, but he was a winner from the beginning. Just two years into his driving career, Aston Martin's racing manager, John Wyer, recruited him to co-drive a DB3 at Sebring. Within months, the chicken farmer from Texas was mixing it up with the likes of Juan-Manuel Fangio, Phil Hill and Paul Frère. He won Europe's prestigious 24-hour endurance race at Le Mans in 1959, driving an Aston Martin DBR1 with Roy Salvadori.

Early in 1962 Shelby drove his second Ford-powered race car. It was the first mockup for the Cobra, Shelby's now-legendary marriage of a lightweight British roadster body with a small-block Ford V-8. By January 1963, he had homologated the car under the FIA's GT Group III class, and that month a Cobra won its first race, beating a field of Corvette Stingrays at Riverside, California.

In January 1965, Ford hired Shelby to lend his expertise to the GT40 campaign. Three cars had run the 1964 24 Hours of Le Mans, but none of them finished. Shelby began work on installing the more reliable 7-liter stock-car engine in what would be known later as the GT40 Mark II. It proved to be considerably faster than the Mark I, and, although 1965 was another unsuccessful year at Le Mans, GT40 had become, in just two seasons, a strong contender.

Ford and Shelby tested the GT40 Mark II extensively – both in the wind tunnel and on a special dynamometer that simulated a 48-hour run of the Le Mans circuit. At the start of the 1966 season, GT40 began a four-year domination of endurance racing.

While Ford and Shelby took on Ferrari at Le Mans, they fought Corvette at home. The first effort was the legendary Shelby Cobra, a Ford-powered and Shelby-engineered derivative of the AC Ace. Production of the vehicle, which had a tremendous weight advantage over the Corvette, began in June 1962 and continued through March 1967.

THE SHELBY MUSTANG

In August 1964, Ford asked Carroll Shelby to develop a street-legal, high-performance Mustang to compete against the Corvette in SCCA B-production road racing. Shelby-American, Carroll Shelby's Californian racing shop, completed its first Mustang GT350 by September.

The 1965 Shelby Mustang GT350 was a fastback production model with a functional scoop in its fiberglass hood and 306 horsepower from the 289-cubic-inch V-8 underneath – an increase of 35 horsepower over the stock Ford engine. Suspension upgrades included a larger front stabilizer bar, Koni shocks and rear traction bars. Other race-ready features included competition safety belts, a large oil-pressure gauge, tachometer and a trunk-mounted battery. It sold for $4,000 and was instantly recognizable by its Wimbledon White paint and blue GT350 side stripes along the rocker panels.

For 1966, the GT350 was offered in white, red, black, green and blue, and Hertz purchased nearly 1,000 special 1966 GT350H weekend "rent-a-racer" models. In the 1967 model year, the Shelby Mustangs sported unique fiberglass bodywork that extended the front end with an aggressive dual scoop and finished the trunk lid with an integrated spoiler.

But most important in 1967 was the new GT500, a big-block version with 355 horsepower. More than 2,000 of those 428-cubic-inch Mustangs were delivered in the first model year.

1968 was the first year the name "Cobra" was officially used on a Shelby Mustang. That year, a convertible body style also became available. Although the Shelby Cobra GT350 was essentially unchanged, later GT500s were powered by the new "Cobra Jet" 428 engine and thus became the GT500KR, for King of the Road.

For 1969, the penultimate year of the Shelby Mustang, the engine choices included the optional 351 Ram Air engine, and the bodywork incorporated a total of nine scoops – five on the hood, one at the front of each fender and one on each quarter panel. In 1970, with sales slowing, the final Shelby Mustangs built for 1969 were updated to 1970 specifications and sold, ending the famed run.

KEY MOMENTS IN THE HISTORY OF FORD AND CARROL SHELBY

January 1952:	Carroll Shelby enters first race at the wheel of a Ford-powered hot rod.
February 1962:	Shelby tests his first Ford-powered AC 260 Roadster – the car that would become the Shelby Cobra.
March 1962:	Shelby-American begins operations in Venice, California.
June 1962:	Cobra production begins.
August 1964:	Ford asks Shelby to develop a high-performance Mustang derivative.
September 1964:	First Shelby prototypes are built.
January 1965:	The 1965 Shelby GT350 is introduced. Ford hires Shelby American to oversee the GT40 program.
November 1965:	Hertz begins buying GT350H versions for its "rent-a-racer" program.
June 1966:	Ford GT40 Mark II wins Le Mans.
November 1966:	First 1967 Shelby GT500s are delivered.
June 1967:	Ford and Shelby American again win Le Mans.
November 1967:	1968 Shelby Mustang convertibles debut.
November 1968:	1969 model-year production begins.
September 1969:	Shelby Mustang production ends.
February 1970:	Ford and Shelby end their long-term racing agreement.
March 2001:	Shelby is invited by Ford to consult on new GT40 concept for 2002 NAIAS.
March 2002:	Ford gives green-light to production of Ford GT based on the concept.
April 2003:	Ford invites Shelby to collaborate on a concept car that pays homage to the original Shelby Cobra.
January 2004:	Ford Shelby Cobra steals the show at 2004 North American International Auto Show in Detroit.
January 2004:	Ford asks Shelby to consult on a follow-up concept.
June 2004:	Shelby announces plans to build a limited edition Shelby Ford Expedition.
August 2004:	Ford unveils the Ford Shelby GR-1 concept at Pebble Beach.

EVERYTHING YOU NEED TO KNOW ABOUT YOUR TIRES

The Ford Shelby GR-1 concept car is equipped with Tire IQ™, an enhanced tire monitoring system developed by Siemens VDO and Goodyear. This is the first application of the technology in a show

vehicle.

Tire IQ™ advances the state of the art in tire pressure monitoring systems by several levels because of the quantity and variety of information it can provide, and its innovative driver interface.

The system monitors and displays real-time data on pressures and temperatures for all four tires. It also stores data for each individual tire that includes tire type and OEM part number, tire mileage, mileage at low pressure and/or high speed, tire position and rotation history, and run-flat zero-pressure mileage.

The display on the car's instrument panel consists of a circular TFT screen with an overhead view of the car in the center. For each wheel, a digital readout shows real-time tire pressure in psi. When a tire is at its correct pressure, the number is in green. This changes to yellow, for caution, if the pressure falls below 30 psi. If the pressure falls to 24 psi or below, the number's size enlarges and its color changes to red, indicating a warning. In a warning situation, a background vehicle animation rotates to highlight the tire that needs attention.

Tire temperatures for all four tires are displayed in color-coded bands at the outer edges of the screen. Seven colors, from blue (cold) through green, yellow, light orange, darker orange, red, and purple (very hot) allow quick and simple interpretation by the driver.

The system also has a secondary screen that displays the car's lateral acceleration in turns, and its longitudinal acceleration during acceleration and braking. During acceleration, the g-force number being generated is displayed in front of the car on the circular TFT display. The car also is animated to pitch rearward during acceleration. Braking g-forces are displayed at the rear of the car, and the car graphic is animated to pitch forward during braking. Lateral acceleration g-forces are displayed simultaneously with the longitudinal numbers – right-turn forces on the right side of the car and vice-versa. The car also is animated to rotate right or left when it is turned in that direction.

In addition to the instrument panel displays, components of the Tire IQ™ system include a ring antenna that is permanently molded to the inside bead of a cured tire, with a "tag" temperature and pressure sensor attached. This unit sends radio frequency signals to a transceiver mounted on the suspension next to the tire, which in turn communicates with the car's electronic control module (ECU). Part of the ECU is dedicated to data storage and display for the Tire IQ™ system.

In addition to the system's innovative display of real-time tire pressure and temperature information, Tire IQ™'s advantages include its ability to store tire history in on-board memory, and the fact that the sensors are powered by RF transceivers and do not require batteries. Most of today's systems have battery-powered sensors in the valve stem, which means that not only do batteries need to be replaced, the units also are in a vulnerable position. The construction of Tire IQ™'s antenna ring and tag, molded inside the tire bead, protects the unit from damage. Because it is molded to a cured tire, there is no deviation from standard tire manufacturing processes.