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2012 MP4-12C

McLAREN MAGIC

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iPad EDITION

APRIL 2011

PLUS

TESTED: DODGE CHARGER R/T

DRIVEN: CHRYSLER 300

PREVIEW: MERCEDES' NEW SLK


OUR CARS LOOK
AGGRESSIVE
BECAUSE THEY'RE TRYING TO DEFEND SOMETHING
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ROAD&TRACK

VOLUME 62 NUMBER 08

04.11

ON THE COVER AND CONTENTS: PHOTOS BY PATRICK GOSLING, NASA & GUY SPANGENBERG


WeatherTech®
What Matters to You?
Today, America needs fresh leadership to lead us as a nation out of this economic crisis. Leadership must come not only from our political leaders but also from the average citizen. The exporting of American jobs is a trend that must be stopped and reversed. When I walk into my local hardware store, I typically find 85% of the goods for sale are manufactured 7,000 miles away. Recognizable American brands have been forced by shortsighted management and buyers at large national chains to build factories overseas just to save a lousy $.50 on a tape measure. To these ruthless buyers, it is all about the money. Rarely are product quality, the political system, human rights, animal rights and environmental costs to the planet considered, not to mention the cost to our society of exporting not only jobs, but an entire factory!
At MacNeil Automotive, we are doing our part for the American economy and for our 300 million fellow citizens and neighbors. My philosophy is that if my neighbor doesn't have a job, sooner or later I won't have a job either. For example, we used to have our All-Weather Floor Mats manufactured in England by a company that used antiquated, inefficient equipment. They made a decent floor mat for us, but we thought we could build a better floor mat for our customers using modern American technology, American raw materials and skilled American workers. So in 2007 we transferred all of our floor mat manufacturing back to the United States. Today, we build the best fitting, highest quality automotive floor mats in the world, right here in America.
Our machine shop is equipped with 17 CNC machining centers including four 4 axis mills and one 5 axis mill that produce between 30 to 50 injection and thermoforming molds per month. We have one shift of highly skilled American Journeymen toolmakers and apprentices, but our machines run 24 hours a day, 7 days a week. There is not a more efficient tool and mold making operation in the world - and guess what, it's right here in America.
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Our New American Factory
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Furthermore, all of our CNC mills are manufactured in Oxnard, CA by Haas. Our 1,000 ton injection molding machines are made in Bolton, Ontario of American and Canadian components. Our thermoforming machinery is made in Carol Stream, IL. The raw steel and aluminum billets which make up our tooling are sourced from American steel and aluminum mills such as Vista Metals in Fontana, CA. The raw materials that make up our All-Weather Floor Mats, FloorLiners, Cargo Liners and Mud Flaps are manufactured in Bellevue OH, Arlington TX, Wichita KS and Jasper TN. Our forklifts are made in Columbus IN and Greene NY. Our warehouse racking is manufactured in Tatamy PA.
At MacNeil Automotive, we are also very aware of sustainability and our responsibility to the environment. We are proactive in controlling waste and recycling all of the unused raw materials from the manufacture of our tooling and products including: aluminum, steel, rubber, TPO, TPE, paper and cardboard.
As you can see, we are as dedicated to designing, developing and manufacturing the finest automotive accessories for our consumer and OEM clients as we are passionate about supporting the American economy, preserving the American industrial infrastructure, and keeping the "money" in our family, a family of 300 million people from all over America.
Life is simple; be good to your fellow man, be kind to animals and the environment, and place building a quality product, supporting your country and your fellow American worker before profit. And, one last thing - let's all do our best to balance family time with work time as our children are the future of America.
Sincerely,
David MacNeil
Founder/CEO
MacNeil® AUTOMOTIVE PRODUCTS LIMITED
Specialists in Original Equipment and Aftermarket Automotive Accessories

FOCAL POINT

INTO THE NIGHT
With bright lights piercing the dark night, the Class 8 Ford F-150 of Juan C. Lopez, Jose Robles and Ricardo De Las Cabos motors south on its 1061-mile journey to a 3rd-place class finish in the 2010 Baja 1000. The rigorous course is but one challenge they'll face; wandering cattle are quite another.

PHOTO BY AL MERION PADRON
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Does racing truly improve the breed? After much buzz about the all-new sports car from McLaren—perhaps better known for its Formula 1 racing than its road cars—we are among the first to get behind the wheel of the 2012 McLaren MP4-12C supercar. Let's just say it was worth the wait. Scan the code above to watch our latest R&T video instantly on your smartphone. See page 12 for details on how to scan the code. You can also text "McLarenSupercar" to 44636, or find it online at RoadandTrack.com/McLarenSupercar

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ROAD AHEAD

BY MATT DeLORENZO
EDITOR-IN-CHIEF

Flights of Fancy

Since the earliest days of the automobile industry, its fortunes seem to have been inextricably linked to those of aviation. Indeed, many of the industry's earliest pioneers, from Henry Ford to Daimler's Wilhelm Maybach, were heavily involved in either building planes or parts of them, mainly engines. While Ford at one time hoped to revolutionize air travel in the same way he did motoring with the Model T, his everyman's plane, the Flying Flivver, was abandoned after a fatal test flight. Instead, he chose to concentrate on more commercial applications like the Tri-Motor.

And while flying aces like Eddie Rickenbacker had his own car company and Franklin was the first to use an air-cooled aircraft engine to power one of its cars, my favorite crossover personality from that period between World War I and II was William B. Stout. He not only built one of the first high-wing monoplanes, but also designed the Stout Scarab, a forerunner to the modern minivan.

After World War II came the jet age, and except for experiments like GM's Firebird and the Chrysler Turbine car, it seems the link between autos and planes all but disappeared. Most aircraft, including turboprops, used jet power, while cars stuck with the reciprocating engine.

But the synergy that existed between cars and planes is making a comeback. The most visible manifestation is the new HondaJet. The first FAA-conforming version was flown near the end of last year and the company expects to ramp up production next year with more than 100 orders in hand for the $4.5 million jet. You'd think Honda's involvement has grown from its long-standing history as a maker of engines for a wide range of products, from leaf blowers to Formula 1 cars. But in reality, the impetus behind the Japanese automaker's foray in the world of aviation stems less from the engines that power its new plane, but rather the materials, aerodynamics, engineering and manufacturing processes involved in producing it. And this knowledge will no doubt contribute to building better, sleeker, lighter and more efficient cars, or at least that's what the company is betting on.

Honda isn't alone in tapping into aeronautical expertise. Elsewhere in this issue, Gordon Murray, in his excellent review of the evolution of composites, freely acknowledges that many of the techniques he used to develop lightweight Formula 1 cars and later the McLaren F1 road car were inspired by aviation. That trend continues today as evidenced by McLaren, Lamborghini and Boeing having mutual interests in carbon-fiber development.

We'll see even more convergence between cars and planes in the area of electronics and perhaps even jet power, if the sexy Jaguar C-X75, which uses two small turbine engines as part of its electric hybrid powertrain, becomes a reality. That lightweight supercar can theoretically hit a top speed of 205 mph and accelerate to 62 in just 3.4 seconds. And proof once again, that in this new high-tech age, perhaps it will be aviation's role to make the automobile fly.

PHOTO BY MARC URBANO

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Tim Barker, Bruce Benedict, Héctor Luis Bergandi, Dennis Brown, Paul-Henri Cahier, Rich Chenet, Jon Dahlstrom, Ken Dallison, Jim Fets, Stephane Foulon, Barry Hathaway, Yoshihiro Inomoto, Hal Mayforth, Niles Nakaoka, Koichi Ohtani, Charles W. Queener, Allan Rosenberg, Barry Rowe, Lars Sältzer (Larson), Guy Spangenberg, Joe Troise & Frank Ansley, Jack Unruh, Bill Warner, Bryn Williams, F. Peirce Williams, Jeffrey R. Zwart

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CHIEF REVENUE OFFICER Robert G. Houghtlin III

EAST COAST 1271 Avenue of the Americas, New York, New York 10020; (212) 767-6095

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VP, Aftermarket Sales Director Rick Bisbee
Sales Assistant Megan Johns

DETROIT AUTOMOTIVE 1041 South Main Street, Suite 200, Royal Oak, Michigan 48067; (248) 291-1216

National Sales Director Melissa Homant

WEST COAST 1001 Brioso Drive, Costa Mesa, California 92627; (949) 610-0446

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Ferrari FF

Seating for four, and 4-wheel drive

Debuting at the Geneva auto show is Ferrari's 612 Scaglietti replacement, the FF. It is powered by a 6.3-liter direct-injected V-12 that sends about 650 bhp the wheels via Ferrari's 4RM all-wheel-drive technology. Penned by Pininfarina, it is the first production Ferrari to feature a shooting brake design, a 2-door wagon. Its conventional hatch opens up to 15.9 cu. ft. of storage. With the rear seats folded flat, that expands to 28.3 cu. ft., making the FF the most practical Ferrari ever.

But it's not the first all-wheel-drive Ferrari. Back in 1988, an aluminum-intensive prototype Ferrari, the 408, featured such a system and was the *Road & Track* cover car for our December 1988 issue. The only bit of technology that seemed to carry forward from the 408 prototype was its aluminum structure—that is, until now.

In typical Ferrari fashion, the FF gleans technology from other models in the lineup. It uses the latest carbon-ceramic brakes, magneto-rheological dampers, a dual-clutch transmission and the HELE (high emotion-low emission) start-stop technology borrowed from the California.

Before getting your hopes up that this all-wheel-drive Ferrari is ready to go rallying (imagine that!), it's not known at this time how much torque can be transferred to the various wheels via the new lightweight 4RM system. We hypothesize that it's similar to the one used by Lamborghini, which transfers only about 15 percent of peak torque to the front axle. This will help put the power down while exiting corners, and also add some stability in adverse weather.

Even with the new awd system, Ferrari says it has managed to give the FF a 47/53 weight distribution. As with the 408 prototype from years ago, the awd system of the FF will be tuned to avoid disrupting the rear-drive balance of the car. Back then, Ferrari engineers worked on a parallel hydraulic coupling, stating that "it wouldn't interfere with control of a car that's being held in a delicate oversteering stance. Precisely what you'd want from a high-performance all-wheel-drive layout." We can only hope this holds true for the FF because even though it's designed to be practical, carry four and not be afraid of nasty weather, it's still a Ferrari and we expect it to drive like one. —*Shaun Bailey*

It's hit and miss with Ferrari's styling at times. The FF is going to remind some of the BMW M Coupe, Mazda3, or even the Porsche 928. Good or bad we're not sure, but we're positive it's prettier than the 408.

PHOTO BY GUY MANGIAMELE

This Ferrari 408 prototype is chassis No. 78610 and is now on display at the Galleria Ferrari in Maranello. It featured a unique all-wheel-drive system and an aluminum chassis. Its styling is close to that of the Acura NSX, which debuted shortly afterward and spurred much debate.

Bonus Video and Photo Galleries
On the iPad and online: Log on to roadandtrack.com/FerrariFF

2012 MERCEDES-BENZ
SLK

RETAINING ITS CHARACTERISTIC PROportions, the redesigned 2012 SLK returns, sporting an aluminum hood and front fenders. The snub nose and center-mounted three-pointed star logo on the front pay homage to its much pricier SLS AMG brother, and the all-LED headlight design, says Mercedes, pays homage to the classic convertible roadster, the 1955 190 SL. While we don't really see the 190 resemblance, with its muscular rear haunches, broad taillights and front fender vents, the third generation is a nice progression of the SLK design.

Looks might be subjective, but technological improvements are not. Take, for instance, the new Magic Sky Control. One of three roof options, it allows the panorama vario-roof to be adjusted from transparent to dark at the touch of a button (creating shade and helping keep the cabin cool). With the top down, the Airguide wind-stop system allows the driver to rotate clear plastic pieces attached to the rollbars to help reduce the hair-tousling turbulent air—bad for the hipster going for the I-just-rolled-out-of-bed look, good for the rest of us.

An SLK250 and SLK350 will be available in its first year. The SLK250 will come equipped with the smaller 201-bhp direct-injected 4-cylinder. Fitted with the standard 6-speed manual transmission, the SLK250 is claimed to go from 0–60 mph in 6.5 seconds and achieve a combined fuel economy number of 27 mpg.

The SLK350 is powered by a completely redesigned V-6 engine with direct injection, piezo injectors and multispark ignition. Cranking out 302 bhp, the SLK350 is said to do 0–60 mph in 5.4 sec., achieving 23 mpg combined. Both models boast a 155-mph top speed.

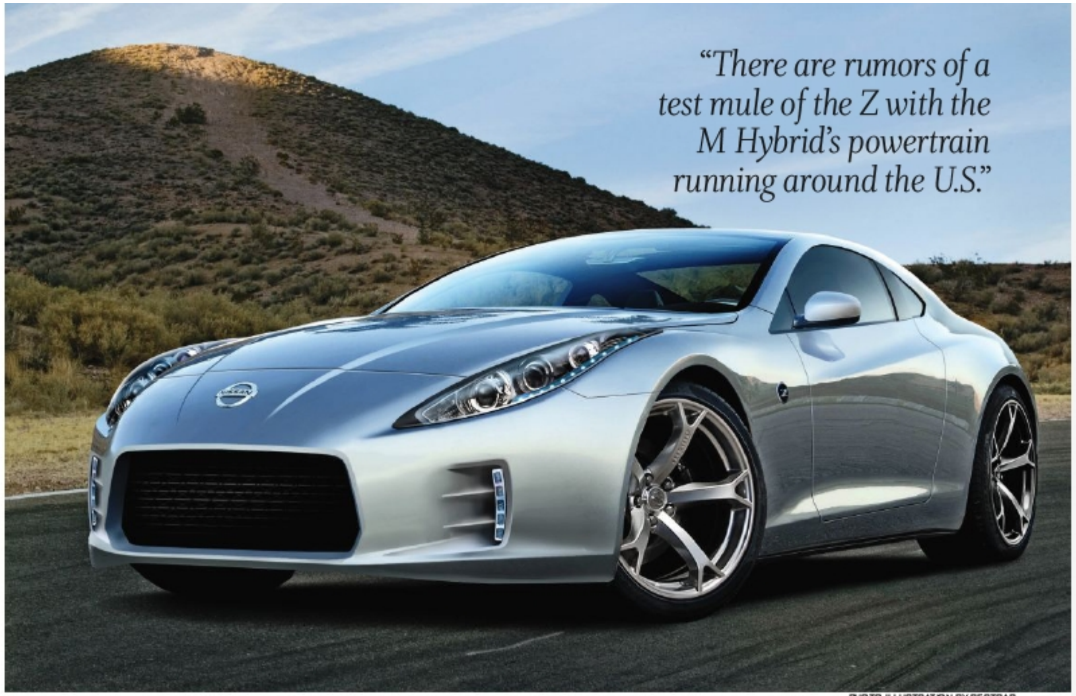
At launch this summer, the 2012 SLK350 will be the first model to hit dealer showrooms. The 2012 SLK250 bows later in the model year.—*Carter Jung*

2013 NISSAN
Z

ONE OF THE MOST POPULAR AND RECOGNIZED JAPANESE SPORTS cars ever is Nissan's Z car, and from what we've uncovered about the next-generation Z, Nissan is fully aware that this species must evolve if it intends to stay on top of the competition. Part of that evolution may include hybrid power as automakers are caught in the green wave of environmental responsibility that has become a priority.

Though nothing definite has been decided about the next Z, Nissan is experimenting with a number of different power options as you read this. Naturally, one approach on the table is a hybrid powertrain. If the next Z goes that way, it will most likely come in the form of the system currently in the Infiniti M Hybrid, which couples a 3.5-liter V-6 gasoline engine (known as the VQ35DE) with an electric motor. In the M Hybrid, the setup produces 360 bhp and about 450 lb.-ft. of torque, more than enough punch for a midpriced sports car. In the next-generation Z, fuel economy should be in the neighborhood of 30 mpg. There are rumors of a test mule of the Z with the M Hybrid's powertrain running around the U.S.

Another option that Nissan is strongly considering is a diesel engine. With Nissan's recently announced cooperation with Daimler, it has the option of putting one of Mercedes-Benz's BlueTEC engines under the hood. The most likely candidate would be the 3.0-liter turbodiesel that's currently in the Mercedes-Benz GL, or something a little bigger. There's also the chance that Nissan will offer the next-generation Z, which should hit dealerships in 2013, with a number of powertrain choices that include hybrid, diesel and gasoline-only versions. There's no word on what the car would cost just yet, but expect the price to increase slightly, especially if the Japanese yen stays at its current level, and the car continues to be built in Japan.—*Sam Mitani*



"There are rumors of a test mule of the Z with the M Hybrid's powertrain running around the U.S."

PHOTO-ILLUSTRATION BY BESTCAR

2014 MAZDA
RX-8

WHILE THINGS HAVE BEEN FAIRly quiet lately regarding Mazda's rotary-powered sports car, the RX-8, we have confirmation from various sources in Japan that Mazda is indeed working on the next-generation rotary engine dubbed the 16X. There are reports that Mazda's rotary engine development team has grown from 30 members to 60 in the last year, meaning that the Hiroshima-based company is quite serious about a new Wankel. The 16X will be much more fuel-efficient than the current Genesis rotary engine, and will probably be named the SKY-R, part of the company's new generation of lean-burning engines called the SKY Series.

The SKY-R will most likely have displacement increased by about 300 cc from the current 1.3-liter 2-rotor Wankel. Insiders say that squeezing 300 bhp from the new engine would be a breeze, but Mazda is making fuel economy a high priority so you can expect output south of that figure. Also, we heard that the engine will feature some form of assist, though we're not certain exactly what that will be. It may be an electric motor, making the next RX-8 a mild hybrid car.

The styling of this next-generation rotary sports car will be based on the Shinari concept vehicle that was shown

last summer in Italy. Therefore, the production version will look more upscale than the current RX-8, prompting rumors that Mazda is thinking of calling it the RX-9 to differentiate it from the current car, which hasn't proved very popular. Expect Mazda's flagship sports car to make its debut sometime in 2014.—*SM*

PHOTO-ILLUSTRATIONS BY BESTCAR

& Ampersand

Show Stopper: 2011 Aston Martin V8 Vantage S

:: With 10 extra horsepower, monstrous 6-piston front brakes, wider rubber, a slightly lighter curb weight and a new faster-shifting 7-speed single-clutch paddle-shift transaxle, the new Aston Martin V8 Vantage S arrives in the U.S. in late May, priced at $138,000 for the Coupe and $151,500 for the Roadster. We can't wait to drive this new driver-focused Vantage, which currently is on display at the Geneva Motor Show. We like how the S has an aggressive look like that of its V12 brother, and are pleased to report that the sweet 4.7-liter V-8 will sound better than before, thanks to revised bypass valving in the exhaust that will continue to allow the characteristic crackle under decel, which sounds so cool. In short, the S is the Vantage we'd want, but only if the gearbox is as good as Aston says it is. *–Andrew Bornhop*

Amelia Island: *It'll be a Duesey*

:: Duesenberg, Allard and Kurtis are the honored marques at this year's Amelia Island Concours d'Elegance, held March 11–13. In addition to honoring racing legend Bobby Rahal, this year's lineup includes a special program on women in racing, featuring Denise McCluggage, Janet Guthrie and Lyn St. James, as well as a panel with Dan Gurney and Brock Yates recounting their adventures on the 1971 Cannonball Run. All events are at the Ritz-Carlton, Amelia Island, near Jacksonville, Florida. More information is available at www.ameliaconcours.org. *–Matt DeLorenzo*

PHOTO BY NEIL RASHBA

5 QUESTIONS WITH Claudio Santoni

FUNCTIONAL GROUP MANAGER—BODY
McLAREN AUTOMOTIVE

Claudio Santoni came to McLaren after working at Ferrari. Given a clean sheet of paper to design a carbon-fiber tub, he took sketches to McLaren execs and was surprised to be asked to go ahead with the design concept of the 12C.

1 What are the main structural and performance advantages of using carbon fiber?

The major advantages are lightness, crashworthiness, stiffness, dimensional stability and very importantly, package. You have the freedom to design curved shapes right around the cockpit and you can really optimize the space in the cabin.

2 What are the challenges in making carbon fiber part of the vehicle?

The biggest challenge is to scale up the manufacturing process. The second is to do it in an economically affordable way. The third challenge, which is not a challenge anymore for McLaren, is to know how to use the material, how to design it and how to manufacture it.

3 What are the specific advances that allow its use in production?

The first thing is the concept. We are using a monocoque, so it is a single-piece molding integrating all the functionality, all the strength and crashworthiness into a single piece. So that means we can get away without an expensive bonding process for the primary structure. The other thing is the automation of composite manufacturing. We've chosen a resin transfer molding process with a lot of automation.

4 While you use an aluminum structure for crash protection at the front of the car, what would it take to make the entire car out of carbon fiber?

Today we have the ability to expand based on the carbon-fiber technology we learned on the 12C. Areas like the engine bay get hot. You'd need a special kind of carbon fiber to cope with the temperatures. On the base 12C you don't get a cosmetic carbon-fiber finish. For us, the philosophy is to use the carbon fiber as a structural material… that's why you don't see much carbon fiber in the car.

5 What similarities are there in the composites used by McLaren and Boeing on the 787 Dreamliner?

Different scale, different performance requirements, different mission. One of the interesting aspects that people don't always realize about composites is durability. When you compare it to an aluminum structure, the composite has a much superior fatigue life compared to aluminum.

& Ampersand

PHOTO-ILLUSTRATION BY LARSON

Porsche Cajun

When the Cayenne and Panamera were introduced, Porsche-philes groaned and proclaimed the destruction of their hallowed brand. Now, a few years on, both cars are selling as fast as they can be manufactured. Given that, it should come as no surprise that Porsche has been working on a new small utility vehicle, the Cajun—a contraction of the words "Cayenne Junior."

Based on a chassis similar to the Audi Q5's, the Cajun will be offered in a 5-door configuration, although a 3-door is possible. Unlike the Q5, the Cajun will be focused on being a "driver's" mini-ute, and will feature a lower ride height, larger and wider wheels, and a clean-sheet interior that reflects the fittings in the Cayenne. Powering the car will likely be the 211-bhp 2.0-liter TFSI engine sourced from Audi, but retuned to 265 bhp. A V-6 engine option is also a good possibility. A forthcoming Cajun S perhaps? We'd like to think so.—*Calvin Kim*

Logitech Driving Force GT Racing Wheel

If you've been playing *Gran Turismo 5* with the PlayStation controller, congratulations. Your threshold for patience and pain far exceeds ours. With the Driving Force GT racing wheel, driving is much more precise with its 900 degrees of rotation, and the realistic force feedback gives a better feel, improving response. For less than the price of a track day, you can digitally drive to your heart's content. (Check out this month's Countersteer for an aspirational goal.)—*CJ*

$150 www.logitech.com

Recaro ProSport Baby Seat

Safety first, right? Well, how about safety for your child? With its 5-point harness and energy absorbing foam, the ProSport from Recaro borrows its side-impact protection technology from motorsports and applies it to this child seat. Not only does the ProSport look cool to the paternal automotive enthusiast, it's good for children weighing 20 lb. to 90 lb. in harness mode and can accommodate one up to 59 in. tall.—*CJ*

$280 www.recarousa.com

2012 Hyundai Veloster

With the demise of the Tiburon, Hyundai was left with no affordable front-drive sports coupe. That changes this summer, when the Veloster goes on sale, priced at about $17,500. With a glass rear hatch, two doors on the passenger side and bold styling, the Veloster is tough to categorize, but Hyundai sees it competing with the likes of the Honda CR-Z.

And on the fuel-efficiency front, it will do so quite well. Equipped with a new 138-bhp 1.6-liter 4-cylinder engine, the lightweight Veloster is expected to get more than 40 mpg on the highway, fitted with either a 6-speed manual transmission or a 6-speed dual-clutch, Hyundai's first automated manual. What's more, the Veloster is packed with connectivity. Blue Link allows voice text messaging, web search downloads and turn-by-turn navigation, while a large 7-in. touch-screen allows the Veloster buyer to interact with Pandora radio, one of the most popular smartphone apps.

How does the Veloster drive? We're eager to find out.—*AB*

YOUR TURN

"If I can find $895 large in my lingerie drawer, sign me up."

Candice Ryan
Tallahassee, Florida

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Super Fast and Super Green

GO FOR THE DOUGH: It's quite possible that Hennessey has created the best supercar yet with the Venom GT (Cover Story, February 2011). Results, however, from multiple, consecutive laps around the Nürburgring will go a long way toward telling us that.

John M. Connelly, Aledo, Texas

What does it mean when I get all excited reading the First Drive on the Fiat 500, but then turn a few pages and really don't care much about the Hennessey Venom GT?

Doug Doerfler
Sandia Park, New Mexico

Who cares about Frankenstein's go kart?

Pedro Vieira
Kearny, New Jersey

PHOTO BY BRIAN BLADES

RECYCLABLE: I do appreciate the bold use of green for the test comparing the Chevrolet Volt and the Nissan Leaf (Road Test Comparison, February 2011). If you adopt this color for all upcoming articles on hybrids, electric cars and other similar vehicles, it will be easier for me to identify the sections to ignore so I can get to the cars that most readers buy R&T for: high performance and race cars. Better yet, make the enviro articles pull out so I can immediately remove them from the magazine and put them in my recycle bin.

Joe Aldern
Highland, California

OLD TECH TALK DIES HARD: Just when Dennis Simanaitis' excellent January 2011 article, "Metering the Fuel," finally helped me understand why diesels have no throttle, in this month's Ampersand ("2012 Mitsubishi Lancer," February 2011), Michael Sorvino applauds today's clean diesels' improved throttle response. Back to square one for me.

Rick Thompson
Georgetown, Kentucky

Full marks to you (and to a goodly number of other readers). Let's also break free of "giving it the gas" (unless it's CNG or H_2).—Dennis Simanaitis

MISSED THE MARK: I know there is no accounting for personal taste, especially in automotive styling. But let's get real: The "new" Dodge Charger is not much different from the previous incarnation (First Drive, February 2011). And no application of 1969 side scallops and taillamps can transform a fundamentally goofy, blubbery design into a thing of beauty. Your unabashed gushing is way off base.

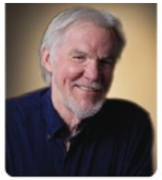
Ken Feldman
Chino Hills, California

HORSERADISH: I am not sure what was more interesting to me about the "Indy, 1912" (Feature, February 2011), the description of the 491-cu.-in. 4-cylinder engine (think of the mass moving within each of the cylinders) or the description of dinner at St. Elmo's. As a yearly exhibitor at the Fire Department Instructors Conference held each April in Indianapolis, St. Elmo's is a must for dinner. Their shrimp cocktail has more horseradish than sauce. My mouth is already watering as I wait for the 2011 conference. By the way, St. Elmo's is named after the patron saint of sailors, in response to Mr. Egan's question.

Joe Waters
Raleigh, North Carolina

Peter Egan may think he was virtually useless as a riding mechanic; however, there is no doubt that he did look cool.

Alan Arnold
Jonesboro, Arkansas



SIDE GLANCES

BY PETER EGAN
EDITOR-AT-LARGE

The Timeless 911

WHILE A BUNCH OF US WERE ON A COMPARISON test trip a few weeks ago, we parked our three high-performance Porsche 911s outside a roadhouse café near Julian, California, and went inside for a lunch of buffalo burgers and coffee. On the TV set in the corner a rerun of *I Love Lucy* was drawing the rapt attention of the regulars who sat at the bar. Fred Mertz was climbing into bed, wearing a tasseled nightcap and nightshirt and looking grumpy in what appeared to be a dismally cheap motel room. The live studio audience was howling with laughter.

I turned to Andy Bornhop and Calvin Kim, my co-drivers in this little road adventure, and said, "If someone had told me when I was a kid watching *I Love Lucy* that I'd find myself watching the same episode 55 years later in a roadside bar, I wouldn't have believed it."

We looked at the screen for a few more minutes and then I added, "The strange thing is, these shows are still better than almost anything on TV."

When we walked back out to the parking lot, I realized that the same could be said (automotively speaking) for our three new Porsches—a blue Speedster, a white Carrera GTS and a dark gray GT3 RS. The 911 series wasn't quite as old as the *I Love Lucy* show (whose last weekly episode—Wikipedia informs me—was shown in 1957), but it was close.

The first 911 was unveiled in September of 1963 at the Frankfurt Motor Show—just a few months before I got my driver's license. Since then, the car had gone through five further generations of evolutionary reshaping and mechanical refinement, yet our three brand-new water-cooled 997-generation Porsches were instantly identifiable as 911s. And they somehow managed this feat without looking the least bit dated.

How was this possible? I can't think of any other car whose basic shape has aged quite so gracefully.

Lots of vehicles look "timeless" because they're beautifully styled—MG-TCs, Bugatti Type 35s, etc.—but they look old fashioned at the same time. For instance, in recent years I've owned a couple of modern Triumph Bonneville motorcycles, which are styled to look somewhat like the 650 Bonnevilles

DAVID REINBOLD

> *"The 911 got a reputation for being both tough and fast, and if you drove one you got the impression that the people who produced it were actually paying attention."*

of the '60s, and it's quite common for people who aren't deeply immersed in Triumph lore to come up and say, "Boy, you did a nice job restoring that thing." Even though the bike is just one year old.

But the Triumph was consciously styled to evoke nostalgia, like the new Mini I had a few years ago—or the New Beetle or the even newer Fiat 500, for that matter. No one would ever mistake those cars for restored originals, however, as it's understood that they were designed as tributes to their smaller and leaner forebears, more imitative than evolutionary. Particularly the VW and Fiat, which have their engines in the wrong place.

Not the 911, though.

The big flat-6 is still stuck out there behind the transaxle, making room for the two small jump seats and roomy, modern interior that Ferry and Butzi Porsche thought critical to the car's success all those years ago, and the car still has its sloping trunk and a roofline that sweeps all the way to the rear of the car. An amazingly eye-pleasing set of arcs, set off by the subdued muscularity of the wheel arches.

I was always a fan of the 356 (I finally bought and restored one a few years ago), but the first time I saw a picture of the original 911—in this very magazine—I looked it over and instantly accepted it as the perfect 356 replacement, stunningly modern, yet still very much a Porsche. Like the E-Type Jaguar, first shown in 1961, it looked like the next obvious step—though there was nothing obvious or preordained about it. Both cars could have gone horribly wrong with a few subtle changes, yet miraculously they arrived as fully formed works of genius, with not a line out of place.

As time went on, however, the E-Type kind of lost the plot. In response to federal regulations, it got slower and less beautiful, then—with the advent of the V-12—became heavier and more luxurious, further removed from its racing D-Type roots. The British car industry didn't respond well to federal emissions and bumper laws, and you got the distinct impression they didn't have their hearts in it. Naturally, the Brits were not as fixated on smog as, say, the residents of Los Angeles, because their own smog tended to blow eastward toward Holland or France. What a happy solution! Particularly in the latter case.

Actually, I've noticed that few Europeans have a high opinion of the country immediately to their east, so westerly winds have always been considered a godsend there.

Meanwhile, Porsche engineers took a different tack. They simply put their heads down and went to work, building cleaner, more powerful engines that ran better instead of worse and integrating their 5-mph safety bumpers handsomely into the 911 bodyshell so that they looked as if they'd always been there.

On the racing front, Porsche went from strength to strength, building their fabled 917s, dominating Le Mans and the Can-Am series and winning countless GT car victories around the globe with the 911. By the late '70s, to own a 911 was to bathe in the reflected glory of the factory racing program, where competition really did improve the breed. The 911 got a reputation for being both tough and fast, and if you drove one you got the impression that the people who produced it were actually *paying attention.* In the '70s, that attitude was an almost miraculous anachronism.

My buddy John Jaeger bought a nearly-new silver 1977 911 in 1978 and we took it out and drove it all day on the winding back roads of western Wisconsin. Compared with the old British cars we'd been restoring and racing, it seemed like something built by NASA. Not quite as charming as the English article, perhaps, but it felt billet-solid and virtually indestructible, generating unearthly speed with a wonderful howl. And—for its time—it seemed to have great steering and excellent grip.

Okay, except for one bad moment where we crossed some wet railroad tracks in a curve covered with new pea-gravel and the rear end appeared out our driver's side window. Luckily, John corrected quickly, kept his foot in it, and we whipsawed back into a straight path and continued on our way. We looked at each other and shrugged. Driving too fast, I guess.

About 10 years later, I finally had a chance to drive a first-year 911S on a winding mountain road and—having driven only newer versions—must say I was somewhat taken aback by the handling of the car. The front end felt light and floaty at high speed and on initial turn-in, while the tail tried to wag the dog in quick transitions. Not the best car for changing your mind halfway through a corner. Early magazine road tests had repeatedly warned readers that the 911 was "not a car for the novice." Maybe I needed more training.

But Porsche engineers have spent the past five decades tweaking the suspension, wheelbase, tire widths, weight distribution and anti-roll bars for various models to keep the rear end living up to its name, and in later cars this high south-polar moment is essentially a non-issue. As I commented in our recent test, going off the road nowadays with a 911 is strictly a personal decision.

Although I have a slight preference for the size and balance of the Boxsters and Caymans (I never rule out getting myself another Boxster S), I have to admit that the horsepower, interior space and overall quality of the 911 have become increasingly attractive. Truthfully, every new generation of 911 I've driven has been nicer to drive on the road (and track) than the previous one—faster, more comfortable, better handling and more refined. They're high-performance exotics you can drive daily.

That certainly goes for the Porsches we just tested—curiously, on the very week that Butzi Porsche, "the father of the 911," was celebrating his 75th birthday. The Speedster, GTS and GT3 RS are simply three of the best sports cars I've ever driven. And, against all odds, they still look ageless, yet classically handsome.

Which is more than you can say for me.

If someone had told me the day I got my driver's license that almost a half-century later I'd be driving a brand-new 911 to a roadhouse with Fred Mertz on TV, I wouldn't have believed it.

COUNTER STEER

BY SAM MITANI
INTERNATIONAL EDITOR

A Breeding Ground for Future Champions

THE YEAR IS 2030. A 100-YEAR-OLD BERNIE ECCLEstone, more powerful than King Charles III and President Beiber combined, crowns a new World Driving Champion, the youngest in Formula 1 history at 12 years old. The record-setting prodigy got his start not in go karts, but with driving games, winning the Forza Cup when he was 4, then taking the Gran Turismo Championships at 6. He drove his first F1 machine at 8 and won his first "real" race when he was 10.

Sound far-fetched? Don't be so sure because based on the sophistication of the latest video games, it may not be long before we see professional racers going straight from their game consoles to the racetrack. Take for instance *Gran Turismo 5*, the latest version in the Gran Turismo series (60 million units sold worldwide) released a couple of months ago. Just when we thought the overall virtual driving experience couldn't get any more real, GT5 blew us away with even better simulations that truly deliver the sensations found in a real car.

"We have incorporated more technology into GT5 than in any of our previous games. Also, we have something called the GT Academy where our gamers can win a chance to compete in a real race in a real race car—last year, one of the [European GT Academy] drivers [Lucas Ordonez] placed 3rd in a race at Silverstone—so the era of racers starting out on simulators has already begun," Taku Imasaki, producer of GT5, said.

The other big player in this arena is *Forza Motorsport* produced by Microsoft (more than three million sales in its 6-year history). Hard-core gamers will tell you that Forza's approach is different from that of GT; while GT5 is for the serious enthusiast, Forza caters to a broad range of skill levels, from beginners to seasoned professionals.

"Our goal was to make it the best simulator out there, but we didn't want to make it for just hard-core gamers. So we provided layers to our physics engine so a child playing his or her first driving game can have fun. These layers, such as stability management, traction control and ABS, can be pulled away gradually as the driver's skill level improves. There's even a rewind function where you can turn back time," said Dan Greenawalt, creative director at Turn 10, producer of Forza.

The most popular driving game in the world is *Need for Speed*, produced by EA Sports, whose 16 games have sold more than 100 million units. Unlike GT and Forza, *Need for Speed* is about fun, with more action and role-playing mixed into the formula. That said, its latest release, *Shift 2*, goes toe-to-toe with GT and Forza where the player progresses through the ranks from amateur driver to professional racer.

With all three games, you can challenge other gamers via the internet. A company called iRacing specializes in wheel-to-wheel competition in the virtual world (see *Road & Track*, December 2008). For about a $100 per year, you compete against other members in a number of different series. Once you get fast enough, you might even share the grid with real pros like Dale Earnhardt Jr. and Alex Gurney, both iRacing fans. And the best part of iRacing is that it requires only a computer and internet connection to participate, which brings us to another big reason these virtual games have become so popular: money. It still costs a lot of money to go "real" racing (an acquaintance spent $50,000 to bankroll his son's go kart season last year), while, comparatively, it costs next to nothing to race virtually.

It seems only a matter of time before these driving games become the training ground for future racers—simulators are already used extensively by professional drivers in every racing series from NASCAR to F1—so if you're thinking of scolding your kid for playing too many video games, you may want to reconsider.

"It may not be long before we see professional racers going straight from their game consoles to the racetrack."

GARY LOCKE

Drives

- CHRYSLER 300C AWD
- MERCEDES-BENZ CLS63 AMG
- BMW 535I
- INFINITI G25
- CHRYSLER 200 CONVERTIBLE
- HYUNDAI SONATA SE 2.0T
- MAZDA5

PHOTO BY JOHN LAMM

2011 CHRYSLER 300C AWD

The reinvention of the retro-sedan

The 2011 Chrysler 300 is different in nearly every way than the 300 introduced in 2005. Many aspects of the car were changed thanks to comprehensive owner clinics and competitor benchmarking. The end result is possibly Chrysler's best sedan to date.

Back in 2005, the 300 presented a successful interpretation of a retro-style sedan. It melded old with new, and placed the body on a relatively current chassis. The interior, though, left much to be desired, and the base-level engine choices were lackluster.

For 2011, Chrysler has addressed those issues and many others, and has made the new 300 into a totally different car while retaining the all-American philosophy of the original. The base engine is a 3.6-liter V-6 that produces 292 bhp and 260 lb.-ft. of torque while our test car, a 300C with all-wheel drive, was equipped with Chrysler's tried-and-true 5.7-liter Hemi V-8 that generates 363 bhp and 394 lb.-ft. of torque. Mated to the engine is a 5-speed automatic transmission and, on our tester, an electronic all-wheel-drive system that automatically sends up to 38 percent of available power to the front wheels. When not needed, the transfer case will disengage the front axle, making the 300C AWD essentially a rear-wheel-drive car.

But beyond the powertrain, the all-new interior and exterior take top billing. Gone is the slab-sided, monochromatic interior of old. In its place lies an inviting, well-appointed setup. At the center is a huge 8.4-in. touch screen display. And while the Garmin-sourced navigation system is optional, you'll get that screen no matter what trim level you spec.

On the outside, the hard-edged masculine exterior is softened up, with hints of the 1955 300 in the fender detail. The slab-sided car of old will not be missed, but the softer front-end treatment will take some getting used to.

Driving the 300C AWD through twisting mountain roads and pothole-strewn city streets revealed the effort the Chrysler engineers put in to the 300 to flat make it better. In sum, the new 300 is quieter, better put together and features a technology package called Uconnect that puts Chrysler in the same ballpark as cars costing much more. Base model 300s will start at just under $28,000, while a 300C rear-wheel-drive model will start at $38,995. Thanks to the new refinements, we eagerly await news of the forthcoming SRT8.

—Calvin Kim

Bonus Photo Gallery
On the iPad and online: Log on to roadandtrack.com/300C


PHOTOS BY JOHN LAMM

2012 MERCEDES-BENZ CLS63 AMG

Not as sleek, still a scorcher

ON A NARROW MOUNTAIN ROAD, ONE THAT ONLY STOPS TWISTING when it starts to wind deeper into the forest with a so-so surface, the new 2012 Mercedes-Benz CLS63 AMG felt remarkably at home.

And this thing isn't tiny. The big coupe-like sedan weighs just over 4200 lb. Nor is it compact, measuring 196.7 in. long and 74.1 in. wide, about an inch wider than the standard CLS, thanks to its more athletic track. But this new Mercedes drives smaller than its dimensions suggest.

There are several suspension settings—Comfort, Sport, Sport+ and Manual. I settled on manual because, to be honest, it's simply more fun. While it sometimes felt strangely loose in everyday driving, the 7-speed multi-clutch automatic is all its name would imply when using the paddles to shift…instantly.

The CLS63 AMG features a new 5.5-liter V-8 with direct injection and a pair of intercooled turbos to produce 518 bhp at 5500 rpm and 516 lb.-ft. of torque at 1750–5000 rpm. Not enough? A performance pack raises the ante to 550 bhp and 590 lb.-ft. of torque, good for 60 mph in around 4 seconds and the quarter mile in the low 12s.

Outside, the CLS has an aggressive nose and the body is not as sleek as the previous model. Inside, the car is impressive, save for the confusing COMAND controller. Happily, you can just drive like hell and ignore it.

The new CLS comes to the U.S. in June, the AMG version arriving concurrently. Figure around $100,000 for the 518-bhp version, and an additional $10 grand if you want 550 bhp.

—*John Lamm*


PHOTO BY JEFF ALLEN

2011 BMW 535i

There are few cars for which the choice of manual or automatic transmission is really a choice. Either you feel compelled to stir a particular car's gears—or feel downright redundant doing so.

But based on recent drives, I believe the 2011 BMW 535i (price range, $50K–$60K) is exemplary of its sports sedan genre regardless of gearbox specification.

Its 6-speed manual operates crisply albeit with BMW-characteristically long throws. Ratios offer rapid acceleration as well as comfortable cruising.

The new Sport automatic transmission (a $500 option) has eight speeds, paddle or shifter actuation, dry-sump lubrication and is accompanied by BMW's start-stop feature. Its top two cogs prove their efficacy in the car's EPA highway 29 mpg. The other six ensure its twin-turbo 3.0-liter is never caught out.—*Dennis Simanaitis*

PHOTOS BY JEFF ALLEN

2011 CHRYSLER 200 CONVERTIBLE

Chrysler engineers spared no expense with the 2011 200 Convertible. The addition of chassis reinforcements and a revised suspension improved handling considerably. Gone are the creaks when scooting up steep driveways. In its place, a relatively serene and solid-feeling unibody that, combined with a standard power soft top, makes the 200 a genuine dual-purpose business and pleasure vehicle.

Our Limited trim level test car came with Chrysler's Pentastar 3.6-liter V-6 (producing 283 bhp and 260 lb.-ft. of torque), 6-speed automatic transmission and a Boston Acoustics sound system. Notable add-ons included a power retractable hardtop. We were impressed with the increase in refinement and power from the new powertrain. Base Touring cars will start at $26,445 and will come with a 2.4-liter inline-4 engine (173 bhp and 166 lb.-ft. of torque) and a cloth top. The 200 Limited model will start at $31,240.—*CK*

RGT TESTED

2011 INFINITI G25

Less power, more refined

WITH 218 BHP, THE NEW G25 SEDAN hasn't all the motive force of its 328-bhp G37 brother, but it's a good move for Infiniti. The F/M chassis, as many can attest, is superb, and not everybody is trying to win the daily Stoplight Grand Prix. I like the refined character of the new 2.5-liter V-6, which is a bit smoother than the 3.7-liter, especially at its 7500-rpm redline. What's more, I like the added economy this new V-6 brings to the G, although the improvement is not quite as much as one would expect—the G25 has EPA numbers of 20/29, whereas the G37 gets 19/27.

And the 7-speed automatic is excellent. It shifts quite smoothly in daily driving, yet comes alive with crisp upshifts and quick-blip downshifts whenever the driver is using the paddle shifters. As always, the chassis is your ally, eager to change direction with a flick of the wheel and able to oversteer a bit when powering out of turns.

Yes, that's easier to do in the G37, but the G25 is nearly as much fun, and it's a pretty well-equipped car with standard leather, HID headlamps and a rearview monitor. About the only item lacking was a nav system, now almost expected in cars of this price.

And in regard to price, the G25 starts at $32,350, although our car left the lot at $34,225, thanks largely to a $1000 sunroof. Life with a G is now bit more attainable.—*Andrew Bornhop*

List price	$32,350
Price as tested	$34,225
Curb weight	3515 lb
Engine	2.5-liter dohc 24V V-6
Transmission	7-sp automatic
Horsepower	218 bhp @ 6400 rpm
Torque	187 lb-ft @ 4800 rpm
0–100 mph	19.5 sec
0–1320 ft (1/4 mile)	15.7 @ 90.2 mph
Braking, 60–0 mph	124 ft
Braking, 80–0 mph	223 ft
Our mileage	est 21 mpg
EPA city/hwy	20/29 mpg

*Electronically limited.

0–60 MPH	0–1/4 MILE	TOP SPEED	SKIDPAD	SLALOM
7.7 SEC	15.7 SEC	145* MPH	0.87 G	65.9 MPH

0–60 MPH	0–1/4 MILE	TOP SPEED	SKIDPAD	SLALOM
6.1 SEC	14.5 SEC	146* MPH	0.83 G	65.9 MPH

R&T TESTED

2011 HYUNDAI SONATA SE 2.0T

Start with a good car, add turbo to taste

PHOTOS BY JEFF ALLEN

We were happy to see Hyundai spice up the Sonata. Although the new style is a bit polarizing, in the cut-throat world of price-friendly sedans, such style brings needed flavor into this bland segment.

The turbocharged 2.0-liter engine does its part by providing 274 bhp and 269 lb.-ft. of torque to the front-drive wheels. So whether you're a style or substance guy, it would seem Hyundai has you covered.

The all-aluminum inline-4 has a twin-scroll turbo working with direct injection and variable valve timing. Prefer economy over power? Engage Eco mode and revel in the damped throttle map that prevents you from surging into the power curve. Our two biggest gripes lie with the transmission and steering. Full throttle runs were damped by sluggish shifts, even when paddle shifting, while the electric-assist steering felt artificial and rubbery. Nevertheless, the Sonata Turbo's focus—V-6 power with 4-cylinder size and economy—remains true.

A starting price of $24,145 for our tester SE model may seem high compared to the naturally aspirated Sonata, but considering the standard level of upmarket appointments that include Bluetooth and USB/iPod integration, 18-in. wheels, keyless entry and pushbutton starting, it seems fair. After all, the turbo engine and sportier MacPherson front/independent rear suspension help bring some much-needed heat to this segment.—*CK*

List price	$24,145
Price as tested	$25,000
Curb weight	3450 lb
Engine	2.0-liter turbocharged inline-4
Transmission	6-sp automatic
Horsepower	274 bhp @ 6000 rpm
Torque	269 lb-ft @ 1750–4500 rpm
0–100 mph	14.6 sec
0–1320 ft (1/4 mile)	14.5 @ 99.6 mph
Braking, 60–0 mph	131 ft
Braking, 80–0 mph	231 ft
Our mileage	est 23 mpg
EPA city/hwy	22/33 mpg

*Electronically limited.

2012 MAZDA5

Ewww, a minivan! Wait just a second, this is a Mazda5. A pint-size mini-minivan that's enticing from a car enthusiast's viewpoint because it can carry six people, and it's available with a 6-speed manual transmission. That's a very rare combination. During the holidays, I succumbed to the need for people- and present-carrying capacity, and found myself dodging through mall parking lots and doing the long-haul with the soon-to-be in-laws.

The Mazda5 is newly freshened with the 2.5-liter inline-4 MZR engine of the Mazda6 sedan that makes 157 bhp with 163 lb.-ft. of twist, just enough to quickly propel the 3450-lb. "5." It never felt slow or cumbersome, even when equipped with the optional 5-speed automatic; in fact, it mostly felt fun and tossable like a large Mazda3. But with seating for six.—*Shaun Bailey*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2012 McLaren MP4-12C

A sports car built with F1 intensity

BY PATRICK HONG PHOTOS BY PATRICK GOSLING

PORTIMÃO, PORTUGAL—McLaren set out to develop its own series production premium sports car in 2005. Under the "Project 11" name, the car's basic parameters were laid down. Years of development followed with the same ethos held by the company's F1 team. This included one year of computer simulation before the first running mule was ever built, one million test miles around the world and around-the-clock test programs with more than 50 prototypes. Fast forward to today, and the all-new 2012 McLaren MP4-12C is finally ready. We are among the first to drive the 12C at the Portimão Circuit.

Swipe your hand underneath the handle-less door (it takes some practice), and the 12C's dihedral door opens forward and up, similar to those on the 1993 McLaren F1—still much revered today as the definitive supercar of the era. Slide inside the cockpit and the interior's simplicity of design is apparent. The 3-spoke steering wheel has no buttons or switches. Right behind it is the cantilevered shift paddle for the 7-speed twin-clutch Seamless Shift Gearbox (SSG). As is the practice in F1 cars, the paddle is pulled on the right for upshifts, and on the left for downshifts. Conversely, you can push on the left for an upshift, or push on the right for a downshift. Front and center on the instrument cluster is a large tachometer flanked by digital displays. The slender center stack flows smoothly downward, housing a portrait-format infotainment system followed by an engine start/stop button and two important dials selecting handling and powertrain settings of Normal, Sport and Track.

McLaren touts the MP4-12C to be for the road *and* track. So our first stint in the car sampled the car's civility on rough roads around Portimão. Even with handling set to Track mode, the 12C's all-around double-wishbone suspension with hydraulically linked active damping is able to soak up road imperfections with ease. But on long and winding roads is where the new McLaren really feels at home. Powering through high-speed corners, the car is never unsettled by any sudden gaps in the pavement, and communicates the event with a touch of vibration through the steering wheel just to let you know it's alive. To fully enjoy the experience, also turn the powertrain to Track mode so the 12C's 592-bhp V-8 can come to life with a more aggressive throttle map and faster shifts. At maximum boost of 17.4 psi, the powerplant winds up with a nice guttural growl.

Back at the track, the McLaren MP4-12C handles the task with confidence. According to the factory, 0-to-60-mph acceleration can be accomplished in 3.2 seconds, and in 3.0 sec. when shod with more aggressive Pirelli P Zero Corsa tires. The quarter mile is clocked at 10.9 sec. while traveling

:: The McLaren's compact instrument cluster incorporates a prominent analog tachometer. The slender center stack features just a few easy-to-operate buttons and dials. The sport seats are supportive, and hold you in place, even at wild drift angles.

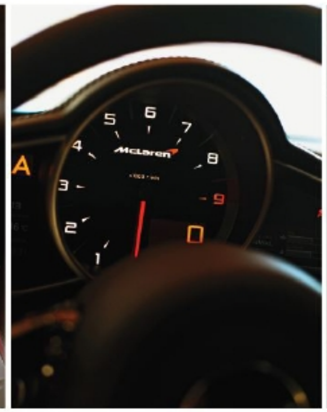


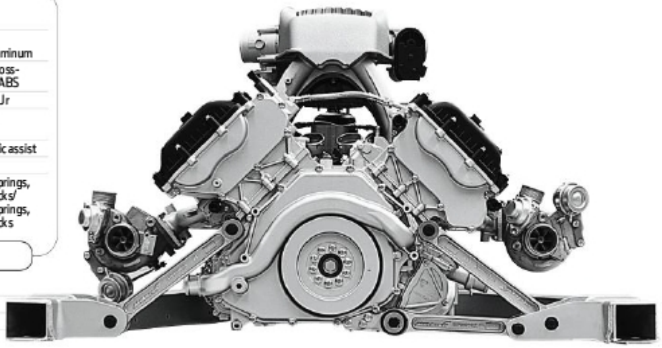
PHOTO BY JEFF ALLEN

at 135 mph; top speed is 205 mph. Impressive numbers. Yet, ripping down the front straight in excess of 155 mph, you don't quite get the real sensation of the speed because the 12C provides the utmost confidence-inspiring ride calmness for the driver. When slowing the car before the turn, ABS is helped by McLaren's Airbrake, a rear flap that rises above 59 mph to increase drag and move the car's center of pressure rearward for better grip, balance and braking stability.

Diving through corners, the 12C responds quickly to steering input with nicely balanced feedback off-center; but weighting is lighter than preferred. Mid-corner, the rear of the car stays put, even with slightly aggressive steering input or sudden throttle lift-off. If oversteer is provoked, it is easily correctable. The yaw control is always on, with a higher threshold in Track mode allowing for more driver control. Owners, according to McLaren, will be instructed on how to turn the system off completely.


PHOTO BY JEFF ALLEN

The MP4-12C has achieved all its performance targets in the same calculated fashion of its winning F1 team. It appeals to "in-the-know" car enthusiasts who prefer their supercars understated, a different path than Ferrari, which wows its customers with more emotional appeal. With a U.S. list price of $229,000, the 12C (arriving late summer) is nearly comparable to the Ferrari 458 Italia. This is the beginning of another rivalry between two giants, but this time it's not just on the track but also the road.



The 12C's twin-turbo 592-bhp V-8 engine was developed with Ricardo. Graziano helped with the car's 7-speed twin-clutch transmission featuring 70-millisecond shifts with Pre-Cog (pre-loading the clutch) and launch control.

SPECIFICATIONS

List price	$229,000
Curb weight	est 3100 lb
Weight distribution, f/r	43/57
Wheelbase	105.1 in.
Length	177.4 in.
Width	75.2 in.
Height	47.2 in.

ENGINE & DRIVETRAIN

Type	alum. block & heads, dohc twin-turbo 32V V-8
Displacement	3799 cc
Bore x stroke	93.0 x 69.0 mm
Compression ratio	8.7:1
Horsepower (SAE)	592 bhp @ 7000 rpm
Torque	443 lb-ft @ 3000–7000 rpm
Redline	8500 rpm
Fuel injection	sequential multiport
Recommended fuel	premium
Transmission	7-speed paddle-shift manual

CHASSIS & BODY

Layout	mid engine/rear drive
Body/frame	sheet molded compound, aluminum/carbon fiber & aluminum
Brakes, f/r	14.6-in./13.8-in. vented & cross-drilled discs, vacuum assist, ABS
Wheels	cast alloy; 19 x 8½J f, 20 x 11J r
Tires	Pirelli P Zero; 235/35R-19 f, 305/30R-20 r
Steering	rack & pinion, electrohydraulic assist
Steering ratio	15.1:1
Suspension, f/r	upper & lower A-arms, coil springs, hydraulically linked tube shocks/ upper & lower A-arms, coil springs, hydraulically linked tube shocks

PERFORMANCE*

0–60 mph	3.2 sec
1/4 mile	10.9 sec @ 135 mph
Top speed	205 mph

*Manufacturer claims.

The lighter carbon-ceramic brakes are optional on the 12C. More stopping power is available with the car's raised Airbrake flap, which increases drag and provides 573 lb. of downforce at 150 mph.

THE RELENTLESS PURSUIT OF WEIGHT SAVINGS

In 1981, McLaren introduced carbon-fiber monocoques to Formula 1. With the F1 (1993) and the SLR (2003) road-going supercars, it also pioneered bringing carbon-fiber chassis technology to limited-production cars. So it made sense that when McLaren set out to build a production high-performance sports car in slightly higher numbers, the company continued the lightweight design concept by utilizing carbon-fiber construction. As in aerospace, racing or road cars, taking weight out of the vehicle translates to more efficiency and performance.

At the heart of the new McLaren MP4-12C is the carbon MonoCell. Working with Carbo Tech in Austria and Toray in Japan, McLaren is able to produce a nearly complete single-piece carbon-fiber tub for the 12C in just four hours. Previously, the F1's chassis took 3000 hours and 100 people to build. It was made from prepreg (epoxy resin already infused) carbon-fiber sheets layered and formed into shape by hand, then cured in an autoclave like a Formula 1 racing car. Even for the SLR, it still required 400 hours to produce six carbon-fiber pieces that were then mated together to form the tub.

To bring the cost down and increase the speed of production, McLaren's MonoCell uses a new Resin Transfer Molding (RTM) process that can be more automated. Instead of using labor-intensive prepreg, sheets of dry carbon-fiber cloth are cut into shape and laid out in a 35-ton, 7-piece steel mold. After the tooling closes, resin is injected. For about two hours the entire carbon-fiber tub is subjected to 218 psi of pressure at 167 degrees Fahrenheit. And before the tub comes out of the mold, it spends another two hours curing at about 260 degrees F.

At this point, the unmachined MonoCell is already within 1 mm of design specifications. To ensure even tighter Formula 1-like tolerances of +/- 0.2 to 0.5 mm at the pickup points of the front and rear aluminum crash structures, the tub is sent to a computer-controlled milling machine for finishing touches. Because the RTM process can accommodate complex designs, a single-piece hollow tub incorporating different shapes and attachment points is possible, making the carbon-fiber chassis that much stronger as a single unit. According to McLaren, the MonoCell weighs 165 lb. It is some 25 percent lighter and stiffer than a comparable aluminum chassis.

For McLaren, the focus on reducing weight does not end at the carbon-fiber tub. The 12C comes standard with specially designed cast-iron brake rotors floating on aluminum carriers. These brakes are more than capable of handling regular on-road duties, but, more important, they are also 18 lb. lighter than conventional iron rotors. Of note, even lighter carbon-ceramic units are available as an option on the car. By having a lithium-ion battery onboard instead of the traditional lead-acid type, the new McLaren saves 22 lb. And in lieu of standard electrical wiring, a lighter wire with a hexagonal cross-section is employed, shaving another 8 lb. And for the car's Airbrake, a flap that rises to help slow the car down above 59 mph, engineers determined a smaller motor could be used for full deployment by raising the flap at a shallow angle, and then using aerodynamic forces to tilt the flap to a more severe angle, thereby maximizing braking assistance. The result is a 50-percent weight reduction in the mechanism, or 11 lb. Other weight-saving measures include having the exhaust pipes come straight out of the rear bodywork above the bumper to minimize length and weight. The same holds true for the radiators that are placed amidships and close to the engine, reducing pipework and coolant volume. Overall, the McLaren MP4-12C's dry weight tips the scale at 2945 lb.

One of the clearest indicators of McLaren's relentless pursuit of weight savings was its "weight down" competition held during the 12C's development. According to Chief Engineer Neil Patterson, teams from the McLaren automotive and racing groups competed to see who could best reduce the car's weight within reasonable financial constraints. Then the best practices were implemented in the final design. Who says racing doesn't improve the breed?—*PH*

Like McLaren's carbon-fiber tub, the new Boeing 787 Dreamliner also features composites for its fuselage, albeit on a much grander scale.

PHOTOS BY MARC URBAND

5 QUESTIONS WITH Mike Sinnett

VICE PRESIDENT
787 CHIEF PROJECT ENGINEER, THE BOEING COMPANY

With the upcoming 787 Dreamliner, Boeing is bringing the same lightweight technology to passenger aircraft, with 50 percent of the plane—mostly the fuselage—made of carbon fiber. We had a chance to visit Boeing with the McLaren MP4-12C, uniting two vehicles sharing similar structural DNA.

1 What are the main structural and performance advantages of using carbon fiber in your aircraft?

Carbon fiber offers a number of advantages. Because is has great strength-to-weight capability compared to traditional aerospace materials, it allows us to create more efficient designs—structurally and aerodynamically. One look at the 787's wings will demonstrate this point. Additionally, with advanced carbon-fiber composite design, we get more fatigue capability when sizing designs for static strength. This has allowed us to be more fatigue-tolerant in our designs, resulting in bigger passenger windows and a lower cabin altitude [more comfortable cabin pressure] in cruise than traditional jetliners.

2 Carbon fiber has been around for a while; what are the challenges that delayed its use in the Dreamliner?

Boeing has used composites in our airplane designs for more than 40 years. We began using advanced carbon-fiber composites in the primary structure of the 777 in 1995, so we have a lot of experience with it. The difficulty has been in making sure we have the manufacturing processes and capabilities that allow us to take full advantage of carbon fiber's capabilities, and to do this in an economical fashion.

3 What recent advances have made it possible to use greater quantities of carbon fiber?

The advances that have served us well have been in the technologies that allow automated layup of the one-piece fuselage barrels and the large wing structures. These have helped provide economical approaches that bring significant advances in quality and weight.

4 What are the limits that prevent you from using carbon fiber for your entire aircraft?

For each component in an airplane design, we carefully balance a number of requirements in the selection of the materials—weight, stiffness, manufacturability, cost, thermal stability, electrical conductivity, to name a few. In each case, the material selected provides the best balance of a multitude of requirements. In some cases, the result is carbon-fiber composite materials, in some cases it is one of a variety of metals, in some cases it is a different type of material such as fiberglass or acrylics. It all depends on the application. By weight, carbon fiber makes up about half of the 787.

5 What other materials can be used in the future that are even better than carbon fiber?

That's a tough question to answer. I'm still looking for a material system that has a higher strength-to-weight ratio than carbon fiber or metal, weighs less than air, conducts electricity, is available in large quantities, and is provided free of charge!

Also see interview with McLaren's carbon-fiber body manager, Claudio Santoni, on page 18.

PHOTO BY JOHN LAMM

1995 McLaren F1 LM (foreground) with a road-going McLaren F1.

STRUCTURAL COMPOSITES IN CARS

BY GORDON MURRAY

NATURE'S BEST-KNOWN COMPOSITE DESIGN IS THE tree. The wood, comprised of fibers and resin, gives a tree its remarkable ability to bend in the wind without snapping.

Employing the same principles, the first structural composite road car was the Lotus Elite by Colin Chapman in 1957, which used several monolithic GRP (glass reinforced plastic) moldings glued together to make a composite monocoque. Before this, both the 1950s' Ford Thunderbird and Chevrolet Corvette had used GRP for semi-structural body and body components, while Citroën employed GRP for a roof panel on the DS.

At this time some sporting goods were being made from glass composites with some carbon being used in a glass/carbon hybrid structure—fishing rods, for example.

In Britain in the late '50s and early '60s, several other low-volume car companies produced GRP monocoque vehicles such as the Rochdale Olympic, the Mini Marcos, the Midas and the Clad Crusader.

One interesting departure from GRP during this period was the Marcos sports car, which used plywood as the composite material for its monocoque chassis. Around this time, Costin also used plywood for a Formula 2 chassis; this, when most racing cars used steel tubular space frames for the primary structure. Colin Chapman's aluminum sheet monocoque in the 1963 Lotus 25 Grand Prix car, which borrowed construction from the aircraft industry, changed all that. This approach was adopted by all top-level racing cars until 1979 when I introduced structural monolithic carbon-fiber panels on the Brabham BT49 I was working on with David North. Our inspiration once more came from aerospace. A year earlier, I used a composite-stabilized aluminum panel on the BT48—just ahead of the cockpit for added stiffness. This piece was formed of two thin outer panel skins separated by a "core" of shaped aluminum ribs. A few years later, this use of stabilized or honeycomb construction using two thin sheets of carbon bonded to an aluminum core would become standard F1 practice.

In 1979, we used U.K.-based Advanced Composites to make the monolithic panels. I saw that the use of this material would spread as it was extremely stiff and light, so I approached Bernie Ecclestone, Brabham's boss at the time, about buying an autoclave and oven to make our own carbon panels. Unfortunately, autoclaves—the heated pressure vessel used to "cook" carbon structures—were way outside our budget so we ordered

What is a Composite?

A composite material usually has two components—a matrix and reinforcement. The matrix is the liquid part that is filled with the reinforcement, usually a fibrous material. The composite of liquid and fibers is normally "set" or formed by temperature and/or pressure. The liquid or resin component comes in two categories: thermosets or thermoplastics. Thermosets are more common and once set (or cured) the final shape is retained for the life of the part whereas thermoplastics can be reheated and reformed.

The most common thermoset structural composite is glass-reinforced plastic (GRP), which is made from a polyester resin reinforced with glass fibers, arranged as either random long fibers or a woven mat. The job of the matrix is to provide a molded finish to the shape and to hold the fiber in place. The matrix can be adjusted to be either stiff or tough, while the fibers carry the loads and give the part its stiffness. The most efficient composite structure is a laminate of two thin composite skins either side of honeycomb material. A single skin composite is referred to as a monolith.

Most racing cars use carbon for the fiber and epoxy resin for the matrix with a Nomex or aluminum honeycomb core as this combination produces the stiffest and lightest part.—*GM*

Recent cars featuring carbon-fiber chassis construction:

Mercedes-Benz SLR McLaren

T.25 City Car

Porsche Carrera GT

Lexus LFA

a "pressure vessel" from a company that built boilers for ships. Our autoclave was £6000 and we built the cooling system using a domestic water tank and a secondhand radiator and fan from a salvage yard. We also built a homemade oven. The autoclave was painted bright yellow, became affectionately known as the Yellow Submarine, and it still works today!

Our advance with carbon structures had a major setback in the 1980 Monaco Grand Prix when a fairly low-speed accident caused the carbon panels in the front crash box area to fail in a brittle manner. We had been increasing the use of carbon in BT49 variants but I stopped the development until we understood the problem. To analyze the failure, we conducted F1's first full vehicle crash test under controlled conditions at the BMW test center in Munich. After this we experimented with tougher matrix systems and introduced Kevlar into the carbon layout in critical areas.

In 1981 John Barnard, at McLaren working with Hercules, took the carbon usage a step further by molding a monocoque tub on a male mandrill with stabilized (honeycomb-cored) panels. The bulkheads, crash structures and roll structures were still metal, though it represented a great step forward in stiffness and safety. Gustav Brunner at ATS took the final step and made the complete chassis from carbon a few years later.

Other carbon milestones were the first structural rollbar system in the Brabham BT52 in 1983 and the first use of carbon/carbon brakes on our Brabhams in 1976—I took the idea from an article on the Concorde's brakes. We started with Dunlop (who made the SST's brakes) and then with Hitco from the U.S.A. This material was made using a long, complex process where the resin matrix was carbonized, hence the term carbon/carbon.

By the mid-1980s, carbon monocoques were the preferred choice for all top-level racing cars.

When I left F1 in 1989 to start McLaren Cars, our decision was to build the best-engineered driver's car we could. I was determined to produce the first carbon road car since I had introduced the material into F1. After interviewing many people to head our composites department, I chose Paul Martin who was the first person to sit for the interview with the right level of advanced composite knowledge. Martin and his team played a central role in introducing carbon in the McLaren F1.

It was always my intent to design the F1 as a "full" carbon car—that is, a full carbon monocoque with no metallic subframes or engine frame, carbon crash structures and carbon body. The F1 was launched in 1992 as the world's first carbon road car. We also used carbon for the clutch assembly but not for the brakes since the carbon/carbon setup did not suit road-car requirements. This would have to wait until carbon ceramics came along toward the end of the '90s.

The next change was again to come from McLaren Cars. McLaren had just won the contract from Daimler to design and build the Mercedes SLR McLaren, which was to employ advanced composite materials. Although the SLR structure was not as pure as the F1's because it used tubular aluminum frames in the engine bay, the car was more innovative in its manufacturing technology.

The F1 monocoque took several weeks to make and was comprised of a dozen pieces, which had to be bonded together at a 1992 cost of about £70,000. Because SLR volumes were set at 700 units per year, we had to develop faster processes for the monocoque and the body. Body panels were made using a resin infusion process through a carrier material in the center of the layup; the complete greenhouse was molded in one piece with hollow pillars, roof rails and headers. This "spider" structure was then bonded to the lower tub. Several other panels completed the structure with production time down to a few days and a cost of about £20,000.

The next major step in structural advanced composite construction was made in the period 2002–2004 when I had a small team of engineers working on the problem of reducing manufacturing cycle time and cost. The team came up with another RTM (resin transfer molding) process called pressed pre-preg—a process used to make sports equipment such as tennis racquets. We developed a one-piece carbon monocoque with the core in place and a cycle time of just a few hours at a cost of about £6000.

Recently at the Paris Motor Show, Lamborghini presented the Sesto Elemento concept, which gave us notice that they too are considering a move to structural composites, although from the description it would appear they have retained metal engine frames. This is probably why at 1.75 kg per bhp they haven't quite matched the 1.56 kg per bhp achieved by the McLaren F1 LM in 1996.

Bringing the story of structural composites up to date, we have Ferrari using hand lay-up pre-preg technology for special vehicles only, Lamborghini showing their future intentions with both pre-preg and pressed pre-preg systems, and both McLaren and BMW employing RTM for mass production. Still, the three core problems remain—raw material costs, process time and the handling of stress point loads.

I have been working on the high-volume, low-cost problem since 1998 and in 2007 formed Gordon Murray Design with investment from the U.S.A.-based Mohr Davidow Ventures to develop and industrialize the world's first high-volume structural composites system for the automotive industry. We've developed an actual car, the T.25, to demonstrate the concept.

We call this i-Stream (Steel tubular reinforced exoframe-advanced manufacturing) and set out to solve the three basic high-volume problems:

1) Material costs. By using glass instead of carbon for the reinforcement, relying on a low-cost compound for the matrix instead of epoxy resin and incorporating recycled paper instead of either Nomex or aluminum for the honeycomb core, we have drastically reduced raw material costs. For example, a T.25 monocoque delivered to the assembly plant is about $160.

2) Process time for i-panels is 100 seconds—the process employs low temperature and low pressure and is therefore very low energy.

3) The point load issue is solved by using a simple, low-cost steel frame to handle point loads; the stabilizing function is performed by the continuously bonded i-panels with very low unit stress in the bonded joint.

The composite panels are very "adjustable" to suit load input requirements for torsion, bending, NVH and crash. The skin thickness and glass content are variable. One more F1 racing concept is used whereby we introduce unidirectional fibers whose format and direction have been determined by the same program we used for designing modern carbon racing monocoques. The i-Stream system allows these reinforcements to be co-bonded in the same 100-sec. cycle time. This is truly F1 technology for the everyday motorist.

What direction then for the future of structural composites in our automotive world?

I think we will see more RTM carbon structures and panels for low-volume, high-price sports cars; perhaps this technology will appear in mid-price, medium-volume products sometime in the future.

As for i-Stream, our team is already working on i-Stream II, which will include advance composites for medium-volume niche products and i-Stream III, which will use totally sustainable, natural materials for composite panel construction, coming full circle to the concept of the tree.

Supercar Composites

Other supercars in the early '90s used a variety of materials for their primary structures. The Jaguar XJ220 stuck with aluminum; the Bugatti EB110 used a mixture of carbon panels, aluminum and steel; the Porsche 959 was steel; and the Ferrari F40 had a twin-tube steel frame with some composite panels. Ferrari was first to follow the McLaren F1 with a full carbon chassis in their 1995 F50.

Some companies adopted carbon for the primary structure—always a pre-preg, hand lay-up process used in racing car manufacturing with vacuum and autoclave curing. Pagani in 1998 and Koenigsegg in 2002 adopted carbon for the safety cell but used metallic subframes to manage suspension and powertrain loads. Porsche followed in 2003 with the Carrera GT, which came closer to the purity of the F1 chassis by using carbon for the engine bay structure, but they remained with steel for the front crash structure. In 2002 the Ferrari Enzo was the first road car to adopt an all-carbon approach since the McLaren F1 in 1992. The Enzo uses carbon for all its structures and bodywork.—*GM*

Lamborghini Sesto Elemento

McLaren MP4-12C

See more on this exciting new supercar online

Contributing Editor Gordon Murray *is a pioneer in advanced vehicle design. His work in Formula 1 and vision for the McLaren F1 road-going supercar as both a designer and engineer is unrivaled, even today.*

PHOTOS BY GUY SPANGENBERG, STEPHANE FOULON, JOHN LAMM & BRIAN BLADES

2011 Dodge Charger R/T

Muscle you can live with

BY CARTER JUNG
PHOTOS BY GUY SPANGENBERG
LOCATION COURTESY OF RANDY WILLIAMS, VISTA, CA

Let's say you were interested in purchasing a new car and you were in the mood for some American muscle. Mustang. Camaro. Challenger. Charger. The most obvious of the Detroit steel comes to mind, but one of them is not like the others. The Dodge Charger, with its reinterpretation in 2006, has since strayed from its original muscle car roots of the '60s. Where the others kept their coupe configurations and relatively small-ish packages (Challenger notwithstanding), the Charger got Supersized, adding a pair of doors and more than a few notches to its dimensional belt.

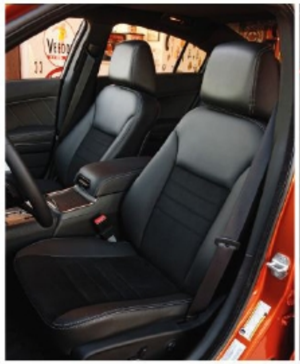
At first glance, the new 2011 Dodge Charger seems to continue the growth theme, taking an evolutionary step beyond the '06 model and adding girth. Well, it's slightly wider (a 0.5-in. increase to 75.0 in.) but 0.2 in. shorter (199.9 in.), and track widths have increased by 0.4 and 0.7 in., front and rear, respectively, with wheelbase stretched by 0.2 in. (now 120.2 in.). It's the improved stance combined with strong styling cues from the box-shaped scallops on the doors and aluminum hood that give the new Charger a bigger feel. This and the fact that the Charger was a big boy to begin with. The last one tipped the curb-weight scales at 4150 lb.; the 2011 model goes up to a whopping 4410.

Before you cry "time for a Lap Band!"—especially when compared to the lighter Mustang, Camaro, or Challenger—let's say you're in some sort of long-term relationship; a pairing that requires compromise. Suppose your significant other decides the next automobile ought to be "practical." The hefty 2011 Charger just might be your best shot at owning something more than a soulless mode of transport.

And that's sort of the epiphany I had when driving the 2011 Charger R/T. In an ideal world where men could remain forever Toys "R" Us kids, a 4-door stuffed with optional electronic safety measures like adaptive cruise control with forward collision warning, blind-spot monitoring, rear backup camera and rear park assist might not sound that appealing. Sure, the Uconnect Touch, Dodge's new touch-screen infotainment system, is pretty neat for a standard feature, but it's still a sedan—the half step between the sporty coupe and the evil minivan. But factor in reality, or a shared bank account, and two pairs of doors start to make sense.

Let's start with the basics: The Charger is not just any sedan, but a full-size one fully capable of carrying full-size adults with full-size femurs. It's that big. Heck, an NBA player could sit comfortably in the back…and with the front door fully open, it would take someone of that height to reach out and grab the handle. Despite the superhuman reach required, the cavernous interior passes the practicality test, with standard soft-touch materials, dual-zone climate controls, keyless entry and audio inputs. "Sure, it's a Charger, but like the Ford Taurus or Chevy Malibu, it comes well-equipped *and* seats five, dear." For the ace-in-the-hole: "The Charger has 15.4 cu. ft. of luggage space. The Camry has only 15.0 cu. ft. With the Dodge, we can fit more bags from Nordstrom!" Hook. Line. Sinker.

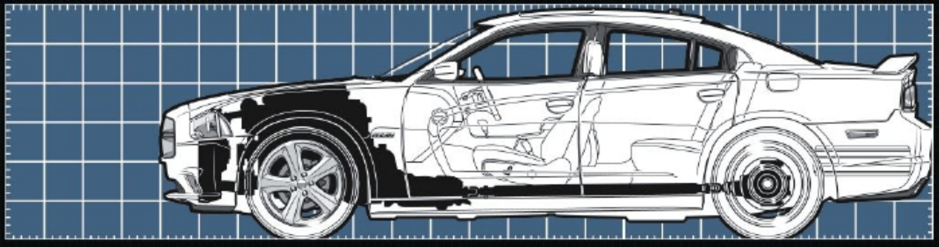
But all of those niceties come at a cost, a heavy one at that. The Challenger, the portliest of the three ponies, is almost 300 lb. lighter than the Charger. Compared with the Mustang, the waif of the group, the Charger weighs in 825 lb. heavier. Despite the mass, the 5.7-liter Hemi V-8 found in the R/T trim, rated at 370 bhp and 395 lb.-ft. of torque, propels the Charger to 60 mph in 5.2 seconds and through the quarter-mile in 13.7, beating the Mustang GT. It's also quicker than the Challenger R/T, thanks to better tires.



Who needs a clutch for a smoky burnout when there's a 5.7-liter Hemi V-8? The 395 lb.-ft. of torque and 370 bhp are more than enough to light up the Charger's rear tires, even with the exclusive 5-speed automatic.

2011 DODGE CHARGER R/T

WWW.DODGE.COM ROAD&TRACK



LENGTH	199.9 IN.	WIDTH	75.0 IN.	HEIGHT	58.4 IN.	CURB WEIGHT	4410 LB
WHEELBASE	120.2 IN.	TRACK, F/R	63.4 IN./63.8 IN.	GROUND CLEARANCE	5.1 IN.	TRUNK SPACE	15.4 CU FT

SCALE: 10 IN. (254 MM) DIVISIONS
DRAWING BY TIM BARKER

List Price: $30,170 Standard equipment: Uconnect 8.4-in. touch-screen, AM/FM/CD/DVD/MP3, USB jack, Bluetooth, heated front seats, keyless ignition, dual climate control, xenon headlamps. Options: Road & Track Pkg ($3000), Driver Confidence Pkg ($995), sunroof ($950), Adaptive Cruise Cntrl Pkg ($925), Sound Pkg ($650), Driver Convenience Pkg ($575), Navigation/Rear Camera ($450), Super Track Pkg (summer tires, 3-mode ESC, perf steering rack, perf brake pads, sport suspension) $400, Toxic Orange paint ($295), dest charge ($825). **As Tested: $39,235**

0–60 MPH	0–1/4 MILE	TOP SPEED	SKIDPAD	SLALOM
5.2 SEC	13.7 SEC	145* MPH	0.87 G	67.8 MPH

SPECIFICATIONS

ENGINE

Type/layout	iron block & alum. heads, V-8/longitudinal
Valvetrain	ohv, variable timing, chain drive w/cylinder deactivation
Displacement	5654 cc
Bore x stroke	99.5 x 90.9 mm
Compression ratio	10.5:1
Horsepower (SAE)	370 bhp @ 5250 rpm
Torque	395 lb-ft @ 4200 rpm
Redline/limiter	5700/5800 rpm
Fuel injection	elect. sequential port

ACCOMMODATIONS

Seating capacity	5
Head room, f/r	37.0 in./35.5 in.
Seat width, f/r	2 x 17.5 in./52.5 in.
Front leg room	45.0 in.
Rear knee room	25.5 in.
Seatback adj.	75 deg
Seat travel	10.5 in.
Lat. seat support	average

WARRANTY

Basic warranty	3 years/36,000 miles
Powertrain	5 years/100,000 miles
Rust-through	5 years/100,000 miles

INSTRUMENTATION

160-mph speedometer, 7000-rpm tach, coolant temp, fuel level, fuel economy

ADVANCED SAFETY

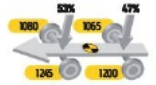
front, side and curtain airbags; traction & yaw control; brake drying

FUEL ECONOMY

Our driving	17.0 mpg
EPA city/highway	16/25 mpg
Capacity/range	19.1 gal./310 miles
Recommended fuel	midgrade

CHASSIS

Layout	front engine/rear drive
Body/frame	unit steel, alum. hood
Brakes Front:	13.6-in. vented discs/2-piston sliding calipers
Rear:	12.6-in. vented discs/1-piston sliding calipers
Assist type	vacuum, ABS
Wheels	cast alloy 20 x 8
Tires	Goodyear Eagle F1 Supercar 245/40ZR-20 99Y
Spare tire	space saver
Steering	rack & pinion, hydraulic power assist
Steering ratio	13.4:1
Steering wheel	15.3 in. diameter
Turns, lock to lock	2.6
Turning circle	37.7 ft
Suspension, f/r	upper & lower A-arms, tube shocks, coil springs, anti-roll bar/multilink, tube shocks, coil springs, anti-roll bar



Test weight with driver: 4590 lb
Weight-to-power ratio: 11.9 lb/bhp

DRIVETRAIN

Transmission: 5-speed automatic

Gear	Ratio	Overall ratio	(Rpm) Mph
1st	3.59:1	10.99:1	(5800) 42
2nd	2.19:1	6.70:1	(5800) 68
3rd	1.41:1	4.31:1	(5800) 106
4th	1.00:1	3.06:1	est (5600) 145*
5th	0.83:1	2.54:1	est (4650) 145*

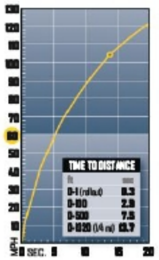
Final drive ratio 3.06:1
RPM @ 60 mph in top gear 1900
*Electronically limited.

PERFORMANCE

These scales show how the **DODGE CHARGER R/T** performs relative to other cars currently in our Road Test Summary. Identified in each category are the extreme values (better →) as well as the median values (▼) of our current test data.

ACCELERATION

	Worst	Charger R/T	Best
0–60, sec	13.3	5.2	2.8
1/4 MILE, sec	19.2	13.7	10.2
1/4 MILE, mph	70.5	104.2	142.9



TIME TO DISTANCE

ft	sec
0–1 (rollout)	0.3
0–100	2.9
0–500	7.5
0–1320 (1/4 mi)	13.7

TIME TO SPEED

MPH	SEC
0–120	19.2
0–110	15.6
0–100	12.7
0–90	10.6
0–80	8.6
0–70	6.7
0–60	5.2
0–50	4.0
0–40	2.8
0–30	2.0
0–20	1.2
0–10	0.4

BRAKING

	Worst	Charger R/T	Best
60–0, ft	143	119	106
80–0, ft	252	209	189

HANDLING

	Worst	Charger R/T	Best
SKIDPAD, g	0.72	0.87	1.12
SLALOM, mph	57.6	67.8	77.5

Balance: moderate understeer; 200-ft skidpad
Balance: mild understeer; 700-ft slalom, 100-ft spacing.

INTERIOR NOISE

LIBRARY	30
AT IDLE	48
CONSTANT 50 MPH	67
CONSTANT 70 MPH	71
MAX IN 1ST GEAR	73
JACKHAMMER	100

Sound readings in dBA.

TESTNOTES

TEST CONDITIONS: TEMPERATURE: 94°F • HUMIDITY: 18% • ELEVATION: 350 FT • WIND: CALM • LOCATION: IRVINE, CA

The Super Track Pak allows complete disabling of the ESC. Stop the car and depress the stability control button until it chimes, indicating ESC has been fully disengaged. Left-foot brake and hold engine to 2000 rpm.

Big cars are often short on brakes, and the Charger is no exception. The brake pedal is soft with long travel. This makes trail-braking difficult.

There's adequate grip from the summer tires, with moderate understeer at the limit. The steering feel is not great, and the rear end is also a little difficult to coax loose…which isn't necessarily a bad thing.

Tipping the scales at 4410 lb., the new Dodge Charger might weigh as much as a tank, but it certainly doesn't drive like one.

Those numbers might not impress the ladies, but the EPA estimates might—the V-8 Hemi with Fuel Saver Technology (the engine switches to four cylinders under light load) helps the Charger achieve an estimated 25 mpg on the highway and 16 mpg around town.

In practice, with the lack of cabin noise the Dodge doesn't seem all that fast. At full scream, the Hemi-powered Charger—helped no doubt by its stiff unibody chassis, insulation foam and dual-pane windshield and front windows—is remarkably quiet, its 73 dBA reading much lower than the figures of the Mustang, Camaro and Challenger. In fact, the Bentley Continental Flying Spur Speed and its max 79 dBA emits more of a ruckus than the Dodge.

Only after a glance at the Charger's glowing red speedometer needle does the mph register and the application of brakes come in. With 2-piston front calipers, 1-piston rears and the more aggressive brake pads of the optional Super Track Pak, the big Dodge stops from 80 mph in only 209 ft. and from 60 in 119, distances bested only by the Ford Mustang GT from our domestic trio.

Surprising is how solid the Charger feels on a canyon road. You would think it would drive like a boat and inhibit any carving of asphalt. But pushing the Dodge into a series of esses, the independent front and 5-link rear suspension work well together, augmented by the Super Track Pak's grippier 20-in. Goodyear Eagle F1 Supercar tires. The Charger has just the right amount of suspension damping to stabilize its chassis. Other than suspension benefits, the Super Track Pak comes with a 3.06 rear axle, 3-mode electronic stability control (allowing full defeat), performance steering and the aforementioned heavy duty brakes. On corner exit, staying within the powerband is important because fumbling for the right gear at full throttle with the 5-speed automatic transmission (the only gearbox available) can be a bit cumbersome.

To compare the Charger solely to other present-day muscle is a bit shortsighted, and not just because of its extra doors and generous cabin. It's much more than that. Sure, it hails from Detroit and has the distinctive aromatic musk only American steel carries, but the Charger also has an available new 292-bhp 3.6-liter Pentastar V-6 engine plus an optional all-wheel drive system, and taillights that remind us of the *Millennium Falcon*. Its sedan configuration, handsome interior finishes and options, and most important, its rear-wheel-drive layout, make the Charger the only domestic model outside of Cadillac to challenge the European makes.

Hogwash, you say? Compared with the 2010 BMW 550i tested in our last issue, not only do the two 4-doors weigh exactly the same, the Charger's performance numbers are in the same league as the 5 Series, all for $30K less. If you're looking (Far) East, the Infiniti M56 has performance numbers trumping both of these, but still rings up dollar signs on par with the Bimmer. Taking those financial facts into consideration, this makes the uniquely American Charger a sweet compromise for those of us living with hypotheticals.

R&T DIGITAL

MOBILE: *Scan this code with your smartphone to see instant video or text "ChargerRT" to 44636*

iPad EXTRA: *Tap on these icons to see video and bonus Photo Galleries.*

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SHUTTLE TEST

NASA ENDEAVOUR OV-105

Blast Off!

World's fastest commuter vehicle

BY PATRICK HONG

PHOTOS BY MARC URBANO AND NASA

IT TAKES ABOUT AN HOUR TO GET READY TO go to work in the morning. Then you stumble out of the house and get into your car. On the way to the office, you zone out a bit as you fight the morning rush. All in all, not much brainpower is needed.❖ Now imagine this: Getting up 8 to 10 hours before your drive to the office, then basically strapping onto an enormous missile that accelerates long enough to put you 115 miles up in the sky. For astronauts, having spent thousands of hours in training, and working with hundreds of people behind the scenes in NASA's Space Shuttle Program, it comes down to the most intense and exhilarating eight-and-a-half-minute commute ever.

GOING TO WORK

AT T MINUS ZERO: The space shuttle's three main engines have already fired 6.6 seconds ago, providing 1.2 million pounds of thrust (equivalent to 37 million horsepower). The temperature inside the nozzle is more than 6000 degrees Fahrenheit.

The shuttle's turbopumps spin at 37,000 rpm, feeding the thirsty engines with liquid hydrogen (at -423 degrees F) and liquid oxygen (-297 degrees F) stored inside the giant orange external fuel tank. And they pump at 1000 gal. per second, a rate that could empty an average family sized swimming pool in just 25 sec.

Standing about the same height as the Statue of Liberty but weighing three times as much, the two white Solid Rocket Boosters (SRBs) ignite in anger and push out a combined 6.6 million pounds of thrust (equivalent to 44 million horsepower). At 4.4 million pounds, the entire space shuttle stack lifts off with a power-to-weight ratio of about 18.4 horsepower per pound.

This is the point of no return. Once the boosters fire, they can't be shut off.

AT T PLUS 8 SECONDS: The shuttle clears the launch pad and accelerates past 100 mph. Mission control switches from Kennedy Space Center at Cape Canaveral, Florida, to Johnson Space Center at Houston.

For the onlookers standing at the NASA Causeway six miles away (the closest public viewing area), you first see the shuttle rise and its white exhaust plume billow out of the flame trench in silence. Moments later you hear the rocket engines and feel the crackling noise pulsating past you. The sound pressure energy level at the launch pad is about 220 decibels (dB), and at a mile away, 135, where your hearing would still be damaged.

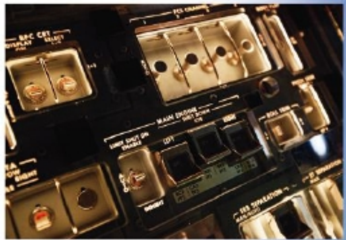
Human death occurs at around 200 dB due to intense vibration of internal organs. NASA says at 400 feet away, the heat will kill you. And at 800, the sound will. Watching the shuttle launch from six miles away doesn't seem too distant after all.

AT T PLUS 2:06 MINUTES: The shuttle climbs past 28 miles above sea level, traveling at nearly 3000 mph. Also at this point, the two boosters are jettisoned and parachuted back down to the Atlantic ocean for recovery, about 140 miles off the Florida coast.

AT T PLUS 8:30 MINUTES: After accelerating at nearly 3g (gaining 66 mph every second), the shuttle's Main Engine Cut Off (MECO) occurs. The orange external fuel tank is jettisoned and burns up over the Pacific ocean. Traveling at 17,000 mph (about Mach 26) and 65 miles above sea level, the two smaller rear rocket engines mounted on the Orbital Maneuvering System (OMS) pods fire. They push the shuttle higher into proper orbital altitude between 115 miles and 400 miles depending on the mission. Each 6000-lb. thrust OMS engine is fueled by gaseous nitrogen tetroxide and hydrazine, which combust instantaneously when they come in contact.

The astronauts have arrived at their office.

The author trades jobs for a day and pilots the space shuttle in a full-motion simulator. Don't flip the engine shut-off switch too early during launch!

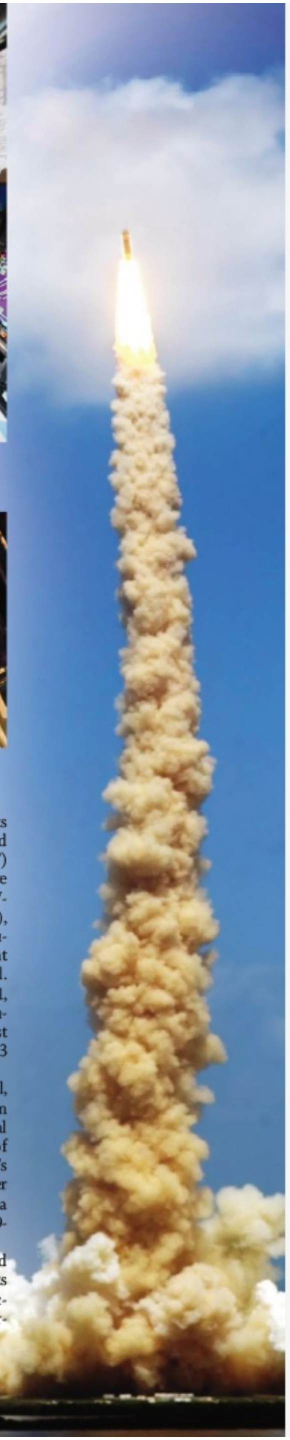


THE SPACE SHUTTLE

NASA's Space Transport System (STS) consists of the orbiter vehicle (OV)—commonly referred to as the space shuttle—the external fuel tank (ET) and two Solid Rocket Boosters (SRB). There have been a total of six orbiters built: *Enterprise* (OV-101), *Columbia* (OV-102), *Challenger* (OV-099), *Discovery* (OV-103), *Atlantis* (OV-104) and *Endeavour* (OV-105). The *Enterprise* was used for flight tests within Earth's atmosphere and never orbited. The first space flight was done by *Columbia* in 1981, *Challenger* was lost during launch in 1986 and *Endeavour* was built to replace it at an estimated cost of $1.7 billion. The *Columbia* was also lost in 2003 during re-entry, leaving only three.

Wheels down, the orbiter stands at 56.6 ft. tall, with an overall length of 122.2 ft. and a wingspan of 78.1 ft. That is slightly larger than a commercial Boeing 737-700ER jetliner, with the exception of having 39 ft. less wingspan. And while the 737's maximum takeoff weight is 171,000 lb., the orbiter can weigh 258,500 lb. at liftoff when loaded with a maximum 63,500 lb. worth of cargo in its 15 x 59-ft. payload bay.

From a distance, the shuttle wears a white and black color scheme. Take a closer look and its outer skin is comprised entirely of thermal protection tiles. Because the airframe is made primar-



ily of aluminum alloy, it can withstand only up to about 350 degrees F without melting. The vehicle needs shielding to sustain external temperatures between -200 degrees F to 200 degrees F during each 90-minute orbit around the Earth, and also as high as 3000 degrees F caused by friction when the vehicle re-enters the atmosphere.

The upper part of the shuttle wears white Low-Temperature Reusable Surface Insulation (LRSI) tiles. The bottom is covered with black High-Temperature Reusable Surface Insulation (HRSI) ones. Reinforced Carbon Carbon (RCC) panels protect the leading edges of the wings. The white tiles reflect as much heat as possible when pointed towards the sun, while the black ones shed heat faster to keep the vehicle cool during re-entry. Payload doors and the inboard section of the wings are protected by thermal blankets below the tiles. Each thermal tile measures approximately 6–8 in. square, and is about 1–3 in. thick, depending on the location, and is made mostly of silica glass fibers coated with blended glass powder. The tiles average about 2.4 lb. per cubic foot depending on the type and cost as much as $1000 each. There are approximately 24,300 tiles on the shuttle.

For landing, the space shuttle depends on three steel/aluminum struts and shocks filled with nitrogen gas and hydraulic fluid. On the nose gear, two 32 x 8.8-in. tires are inflated to 300 psi and can support 90,000 lb. together. Four 44.5 x 21-in. tires split between the two remaining main landing gears are inflated to 340 psi. Each is capable of carrying loads up to 123,000 lb.—nearly three times that of a Boeing 747 tire. Michelin in Norwood, North Carolina, makes these bias-ply tires specifically for NASA. Rated up to 258 mph, the nose gear tires are good for two landings, and the ones on the main landing gear are replaced after each use. Slowing the shuttle after touchdown are carbon brakes and a 40-ft.-diameter drag chute.

ABOARD THE SHUTTLE

A typical shuttle mission carries five to seven astronauts, but the vehicle can be configured to 11 seats if necessary. In orbit, the shuttle crew splits time between the upper flight deck, where most of the space-related activities occur, and the lower middeck, which acts mostly as living quarters.

Traveling at 17,000 mph, *Endeavour* delivers payload to the International Space Station. The rear flight deck is for docking and cargo robotic arm operations. The tires of the nose gear, above, are good for only two landings. Below: What a view!

On the flight deck, the left commander seat and right pilot seat have duplicate flight controls for use during ascent and descent. When in orbit, most of the shuttle's functions are controlled in the back panels facing the payload bay. The aft panels are divided into two sections. The ones on the left are for operating the orbiter. And the ones on the right are for operating the Remote Manipulator System (RMS), a 50-ft. articulating arm with elbows and wrists that can lift and retrieve cargo, or act as a platform for astronauts during their space

1991 NASA *ENDEAVOUR* OV-105

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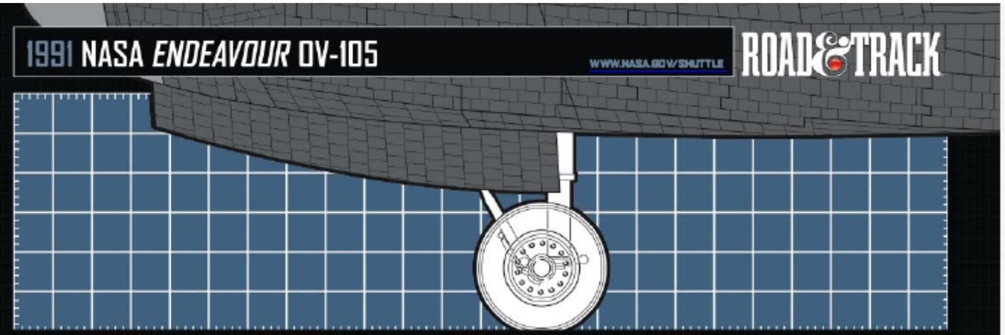
ROAD&TRACK



LENGTH	122.2 FT	WINGSPAN	78.1 FT	HEIGHT	56.6 FT	CURB WEIGHT	195,000 LB
WHEELBASE	66.7 FT	TRACK, R	22.7 FT	GROUND CLEARANCE	2.95 FT	CARGO SPACE	10,600 CU FT

SCALE: 10 IN.(254MM) DIVISIONS
DRAWING BY TIM BARKER
© ROAD & TRACK/HACHETTE FILIPACCHI MEDIA U.S. INC.

List Price: $1,700,000,000 Standard equipment: "Glass" flat-panel color displays, GPS, Upgraded Extended Duration Orbiter (EDO) plumbing & electrical systems, oven, hot/cold water dispenser, vacuum-assist space toilet, storage lockers, moon roof, airlock, crew escape system, exterior thermal protection, fuel-cell electric power generator, cabin air regeneration, 40-ft-dia. drag chute, carbon brakes. Options: external fuel tank ($40 million), two solid rocket boosters ($46 million), dest charge ($450 million per shuttle launch). **As Tested: $2,236,000,000**

0-60 MPH	0-1/4 MILE	TOP SPEED	LAT ACCEL	LONG. ACCEL
5.1 SEC	12.1 SEC	MACH 26	0.10 G	3.0 G

SPECIFICATIONS

ENGINES

Main	3 engines
Thrust per engine	394,000 lbf (12.3 million hp)
Fuel	liquid oxygen & hydrogen
Orbital maneuver	2 engines
Thrust per engine	6000 lbf (270,000 hp)
Fuel	nitrogen textroxide & hydrazine
Reaction control	16 forward, 14 rear thrusters
Thrust primary:	870 lbf (40,000 hp)
secondary:	24 lbf (1100 hp)
Fuel	nitrogen textroxide & hydrazine

ACCOMMODATIONS

Seating capacity	2 to 11
Head room, f/r	40.0 in./56.0 in.
Seat width, f/r	2 x 16.0 in./16.0 in.
Front leg room	38.0 in.
Rear knee room	29.0 in.
Seatback adj.	12 deg
Seat travel	5.5 in.
Lat. seat support	excellent—strapped in

WARRANTY

Basic warranty	30 years/>103 million miles

INSTRUMENTATION

2020 displays & controls: flight instrumentations, life support, communications, etc.

ADVANCED SAFETY

Crew escape systems at 25,000 ft: pyrotechnic hatch & escape pole; On ground: side-hatch & egress slide, flight-deck overhead window

FUEL CONSUMPTION

Main engines	1000 gal. per second
Avg mpg per mission	8.0 mpg
Capacity/range	534,900 gal./4.2 mil miles
Recommended fuel	oxygen & hydrogen

Shell NITROGEN The Official Fuel Partner of *Road & Track*

CHASSIS

Layout	rear engine/rear drive
Body/frame	aluminum with thermal tiles, carbon-carbon reinforced wingtips/aluminum
Brakes, Rear	carbon rotors
Assist type	ABS
Wheels	aluminum hub
Tires	Michelin Air
Nose:	2, 32 x 8.8, 20 ply, 258-mph speed rating
Main:	4, 44.5 x 21, 34 ply, 258-mph speed rating
Spare tire	none
Steering	electrohydraulic, steer-by-stick
Steering angle	+/- 10 degrees
Turning circle	50.0 ft
Suspension, f/r	steel and aluminum strut, gaseous nitrogen & hydraulic shocks/steel and aluminum strut, gaseous nitrogen & hydraulic shocks

Gross liftoff weight (orbiter, external fuel tank, solid rocket boosters): 4.4 million lb
Weight-to-power ratio: 0.05 lb/hp

LAUNCH PROTOCOL

T-43 Hrs	Call-to-station, countdown activated
T-6 Hrs	Load external tank (500,000 gal.)
T-3 Hrs	Astronauts depart for launch pad
T-9 Min	Final "go/no-go" launch polls
T-31 Sec	Auto launch sequence start
T-16 Sec	Active water suppression (300,000 gal. of water)
T-6.6 Sec	Orbiter main engine start
T-0	Solid rocket boosters ignition, liftoff!
T+60 Sec	Throttle up at 107 percent power
T+2:05 Min	Solid rocket boosters jettison
T+8:30 Min	MECO (Main Engine Cut Off), end of powered flight

PERFORMANCE

The acceleration scales show how the **NASA SHUTTLE** performs relative to other cars currently in our Road Test Summary. Identified are the extreme values (better →) as well as the median values (▼) of our current acceleration data.

ACCELERATION

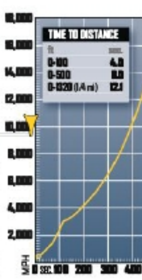
0-60, sec: 5.1 (13.3 – 2.6)
1/4 MILE, sec: 12.1 (19.2 – 10.2)
1/4 MILE, mph: 167.1→ (70.5 – 142.9)

BRAKING

230-0, ft: ←5505 (est 1774 BUGATTI VEYRON – est 1000 TOP FUEL DRAGSTER)

HANDLING

FORWARD, g: 3.0 (1.3 PORSCHE 911 TURBO S – EST 4.8 TOP FUEL DRAGSTER)
Balance: hold on tight...
LATERAL, g: 0.10 (0.0 AVERAGE HUMAN – 7.5 F-18 SUPERHORNET FIGHTER)
Balance: gyrostabilized



TIME TO SPEED
0-MACH 26 (MECO) 515 SEC
0-MACH 2 71.0 SEC
0-MACH 1 (735) MPH 44.4 SEC
0-100 MPH 8.0 SEC
0-60 MPH 5.1 SEC

INTERIOR NOISE

LIBRARY	30
MAIN ENGINE IGNITION	112*
LIFTOFF	118*
IN SPACE	62*
MAX, BOOSTER IGNITION	118*
JACKHAMMER	100

Sound readings in dBA. *Readings in dB

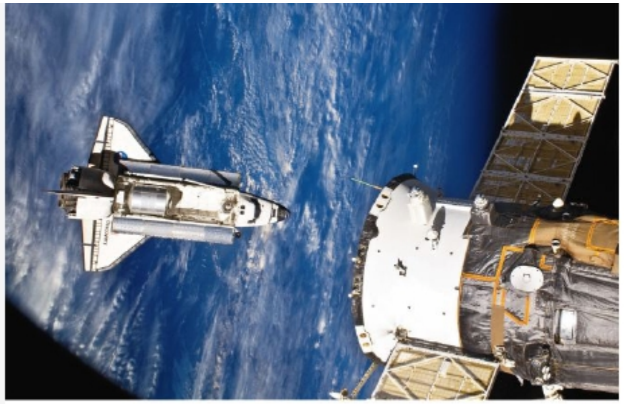
TESTNOTES

TEST CONDITIONS: TEMPERATURE: 63° F • HUMIDITY: 63% • ELEVATION: 30 FT • WIND: CALM • LOCATION: CAPE CANAVERAL, FL

During launch, the solid rocket boosters burn nearly 8800 lb of fuel per second. That means they are also losing an equivalent weight of about two Bugatti Veyrons per second.

Each solid rocket booster produces 17 times more thrust than a Boeing 747 at take-off. The gas exiting the nozzle is traveling at more than five times the speed of sound.

The shuttle's robot arm—Remote Manipulator System (RMS)—weighs about 900 lb on Earth. It can't support its own weight on the ground but can move 66,000 lb worth of cargo in space.



walks. There are more than 2020 displays and controls on the flight deck, 100 times more than in an average automobile.

At Houston's Johnson Space Center, I tried my hand-eye coordination talents in a simulator, docking the orbiter with the International Space Station as well as lifting a piece of cargo out of the payload bay. With help from Alan Fox, a 29-year NASA veteran and lead rendezvous instructor, and Fernando Galaviz, a 3-year NASA employee and facility support engineer, I was able to pulse the Shuttle's Reaction Control System (RCS) composed of 16 front and 14 aft small thrusters to guide and connect the vehicle's airlock with the one on the space station…multiple times without needing to reboot the computer! Fox commented that these small thrusters are so precise and amazingly accurate that the astronauts mostly do manual flying without much computer assistance.

Grabbing cargo out of the payload bay with the RMS is another story. Because of the three-dimensional nature of the exercise, you have to rely on video cameras mounted on the robotic arm. Understanding the correct viewing angles and how you control the arm's motion in different spatial planes is crucial. Thanks to Bill Miller, a 28-year NASA veteran and shuttle robotics instructor, I did not damage or lose any precious cargo in space.

On the shuttle's middeck, up front in the nose, resides a wall full of liquid-cooled avionics instruments. Immediately behind are storage lockers for personal items and food. Next to the orbiter's door hatch on the left is the "space toilet"—something to experience and hard to describe, and we'll just leave it at that. On the right is the "kitchen" where the astronauts prepare food. Throughout the crew compartment, there are countless Velcro strips for fixing items in place so things like pens or clipboards don't float away. Also along the walls

:: The shuttle docks with the space station. Between 6-hour space walks fixing the Hubble Telescope, astronaut Feustel looked forward to eating macaroni and cheese, which is heated in the onboard oven. Salt and pepper help fight the astronauts' dulled sense of taste.

in the middeck are spots for the crew to hang their sleeping bags at night. In total, there is 2325 cu. ft. of pressurized living space aboard the orbiter.

Astronauts can heat up their thermal stabilized food packets to 175 degrees F in the oven—typical eating temperature at home—or inject them with hot or cold water. According to Vickie Kloeris, a 25-year NASA veteran and manager of International Space Station food system, there are some 180 different menu items from which to choose. One of the crew's favorites is tortillas since they can wrap different fillings inside or dip them into various foods. And yes, Tang is still available!

How does space food taste? At Houston's Johnson Space Center, I tried out chicken fajitas, macaroni and cheese, and even a cherry blueberry cobbler. All are good, tasting similar to reheated frozen foods from your local market. Kloeris notes that eating in space is like having a head cold. Because of weightlessness, fluids inside your body rise into your head so you feel congested, dulling taste and smell senses. Astronauts bring plenty of salt, pepper and spices to liven up their entrees.

Most space shuttle missions last approximately 10 days, but plumbing and electrical upgrades allow the orbiters to stay in space for up to 28 days—and no showers, just sponge baths.

COMING HOME

The shuttle is unpowered and acts as a glider when it returns to Earth and you get only one shot at it. With the help of Darrel McGregor, a 26-year NASA veteran and simulation supervisor at the Johnson Space Center's full-motion simulator, I received a passing grade for my five tries at landing the vehicle. No one was hurt or major damage done. The computer assist via the head-up display guided me to the runway with precision. And like driving, keeping the shuttle flying smoothly means anticipating where you're going and looking ahead through the orbiter's forward cockpit window, and on a LCD panel where it shows your projected glide path versus the ideal one. The control stick is easy to operate and has a nice progressive off-center resistance.

Aboard the real shuttle in orbit, when it is ready to return home, it starts the reentry process by

5 QUESTIONS WITH Drew Feustel, Ph.D.

ASTRONAUT
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

When NASA astronaut Drew Feustel contacted us regarding his interest to take a *Road & Track* item on his upcoming STS-134 mission (currently the second-to-last confirmed space shuttle flight), we were honored. So we'll produce a very special Space Edition for him to take up into space (see roadandtrack.com/shuttle for updates).

1 What or who inspired you to become an astronaut?

At an early age, after watching the Apollo astronauts walk on the moon, I was intrigued by spaceflight and space exploration. As I grew up, I truly thought that one day my job would be to fly in space, and I had hoped (and still do) to explore other orbiting bodies in our solar system (the Moon and Mars).

2 What does it take to become an astronaut?

Hard work, determination and part luck…really. That is the best explanation for why I have been allowed to experience such an amazing journey. However, my wife, Indira, through her years of support, had more to do with achieving my goal than any other person or event. What qualifies a civilian for the astronaut program are advanced degrees, typically including a Ph.D. or M.D., and several years of work experience. Interests outside of one's trained profession are highly desirable.

3 What was your most memorable space shuttle experience?

Each and every moment of the spaceflight was incredibly memorable. Launching was like Mr. Toad's Wild Ride. Floating inside the space shuttle was magical. The very instant I peeked outside of the airlock on my first spacewalk was spectacular. I had anticipated that moment for years and when it finally occurred I was nearly speechless…my first words in space were "This is sublime!" The view of Earth is literally breathtaking, and it looks inconsequential against the blackness of space. Also seared into my memory was my first spacewalking task for the Hubble Space Telescope. I was to use a large breaker bar on a single bolt to remove the Wide Field and Planetary Camera 2, and replace it with the $132 million Wide Field Camera III. But the bolt was stuck. As a mechanic I knew there were only two possible outcomes: I was either going to break the bolt off (not the preferred result!) or it would release. Fortunately I was able to release the bolt, and subsequently keep my job.

4 What cars excite you as much, or nearly as much, as being launched into space? And why?

I like classic BMWs, the E9 Coupe and the 2002. My favorite car has always been the Lamborghini Miura. I have never driven a Miura, so I can't say what it is like to be in one. However, there is just something about the design that for me embodies what a sports car should be, especially the later SV models with the somewhat larger rear wheels. It is a car I would one day like to own.

5 We are honored to have you take *Road & Track* into space. Please tell us about this choice.

Road & Track is a magazine that brings the beauty of exotic automobiles and the world of racing to me every month. I enjoy the road test articles of both affordable and unobtainable cars, as well as the vintage pieces and racing features. I appreciate the tech articles. Dennis Simanaitis does such a fine job of detective work, and I read with patience and anticipation the work of Editor-at-Large Peter Egan. He just says it like nobody else can. Growing up in the Motor City, I have always been smitten by the automobile.

When shuttles (that's *Discovery*) fly upside down, it allows for the inspection of their thermal tiles.

flying upside down and firing its RCS thrusters to turn itself around with the tail heading first. Then the bigger OMS engines ignite for about three minutes, decreasing the speed by about 200 mph to just under 17,000 mph. At this point, the orbiter is over the Indian Ocean.

In the next 25 minutes as the shuttle enters the upper atmosphere, the RCS thrusters fire again to flip the vehicle over with its nose pointed forward and its belly facing Earth. Since all the aerodynamic control surfaces are still ineffective, the orbiter must rely on the RCS to maintain a 40-degree nose-up angle-of-attack nose-up as it descends to an altitude of 75 miles. Then the RCS is also used to perform four steep bank-and-roll S-turns to scrub off more speed. This is when the orbiter is feeling the 3000-degrees F heat buildup from friction with the atmosphere.

At about 140 miles away and 150,000 ft. of altitude, a navigation beacon guides the shuttle to the runway. Continuing to decelerate to about 1800 mph (Mach 2.5), the orbiter becomes a glider at around 83,000 ft. At 25 miles out, the commander takes control and flies around an imaginary cylinder (four miles in diameter) to line up the runway. On final approach, the shuttle is dropping like a brick at more than 166 ft. per sec., almost 20 times the sink rate of a commercial airliner. It touches down at around 230 mph and, with the drag chute deployed, takes about 5500 ft. to stop.

Not a bad day's work. The shuttle astronauts get to experience the most thrilling ride ever by commuting in mankind's fastest machine on wheels. And best of all, no traffic!

Special thanks to NASA and its public affairs office for assisting and arranging access to the Space Shuttle Program at Johnson Space Center and Kennedy Space Center.

A quick astronaut hello before getting to work.

Bonus Photo Gallery
On the iPad and online: Log on to roadandtrack.com/shuttle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TECH UPDATE

MONRONEY READING SELF TAUGHT

New car labels make for better reading than ever

BY DENNIS SIMANAITIS

ALMER STILLWELL "MIKE" MONRONEY, 1902–1980, WAS A UNITED STATES SENATOR FROM Oklahoma and, though maybe he didn't recognize himself as one, he was also an early proponent of the information age. Mike sponsored the Automobile Information Disclosure Act of 1958; and today a new car's Monroney label, as it's informally called, contains more information than ever. ❖ In particular, the latest plug-in hybrids and electric vehicles require new metrics for assessing their economy. And even a conventional car's Monroney is chock-full of this and other information. Here we'll offer examples of Monroney Reading, Self-Taught as well as background as to where these numbers come from. The U.S. Environmental Protection Agency, Ford, GM and Porsche all provided helpful insights.

NUMBERS GALORE

By law, the Monroney label includes the Manufacturer's Suggested Retail Price along with optional equipment and pricing. Engine and transmission specifications as well as standard equipment and warranty information are also listed. Safety ratings, if available, are there too.

Another section details Parts Content Information, stressing the international nature of the auto business. Factoid: The 2011 Chevrolet Volt's U.S./Canadian Parts Content is 40 percent; a Major Source listed is Korea, at 20 percent. Its Final Assembly Point is Detroit, MI, U.S.A.; the Country of Origin of its engine is Austria; its electric drive unit, Japan.

Our focus here is on another portion of the label, a car's EPA Fuel Economy and Environmental Comparisons, its City and Highway MPG estimates along with derived information on cost and comparisons with others in its size class.

This last identifier, showing up in fine print on the label, profits from amplification: Federal Regulation Title 40 Section 600.315-82 gives complete details defining Minicompact (interior volume index less than 85 cu. ft.), Subcompact (85–99.9 cu. ft.), Compact (100–109.9), Midsize (110–119.9) and Large (120 cu. ft. and greater). There are categories as well for 2-seaters, station wagons and pickups. Interior volume includes front and rear seating as well as luggage space.

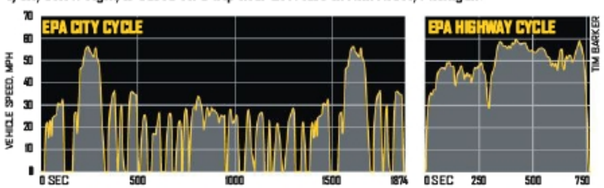
Europeans choose to arrange things alphabetically. A- and B-segments make up our Subcompact class. C-segment coincides with our Compact. D- and E-segments are essentially our Midsize; F-, our Large class.

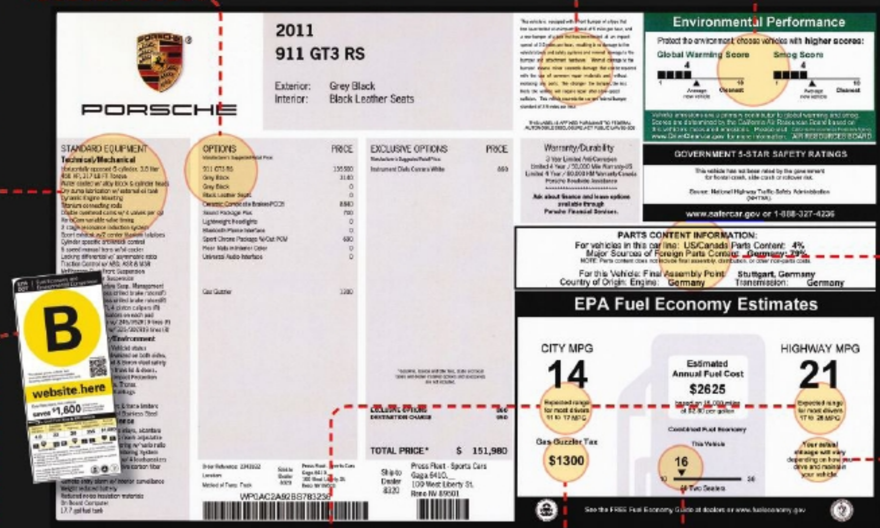
CITY, HWY, MIXED

EPA fuel economy estimates come from actual cars driven on chassis dynamometers—think automotive treadmills with drivers, or in some cases robots, following designated patterns of accelerations, decelerations, cruises and pauses. Time/speed traces of the basic EPA City Cycle and Highway Cycle are shown nearby. Factoids: Origin of the City Cycle is the LA4, an actual route around downtown Los Angeles. (See "Hybrids Part 2: Reality," R&T, March 2010, and at roadandtrack.com.) The Highway Cycle has its origin in a road trip around Ann Arbor, Michigan. Other variations of these cycles are used to incorporate higher speeds and extremes of heat (with air conditioning in use) and cold. Standard testing occurs at a balmy 68–86 degrees Fahrenheit. For the a/c portion, it's 95 deg. F; for the cold test, 20 deg. F.

Noteworthy are the City Cycle's number of stops (23) and idling time (18 percent of the 31.2-min. test). Top speed on the Highway Cycle is a modest 60 mph, though the high-speed augmentation reaches 80 mph. Also, it's worth noting that mpg values are obtained, seemingly indirectly, through measurement of the car's tailpipe emissions. It turns out this is more accurate than measuring the vol-

The EPA City Cycle, below left, simulates a trip in downtown Los Angeles. The high-speed part is on that city's Harbor Freeway; the stop-and-go after it borders USC. The Highway Cycle, below right, is based on a trip near EPA labs in Ann Arbor, Michigan.





The **Standard Equipment** listed is a manufacturer's choice; engine and transmission details are required.

Options and their costs must be shown.

Information on **crashworthiness** of front and rear bumper assemblies may be included. The current standard requires bumpers capable of withstanding 2.5-mph impact with no damage to the vehicle's body or safety systems (bumper damage is okay). Some manufacturers engineer for 5-mph impact and make note of this.

This **Environmental Performance** information relates specifically to evaluations devised by the California Air Resources Board.

Parts Content Information identifies percentage from U.S./Canada together with other major sources. Final assembly point, origin of engine and of transmission are also specified.

There is ongoing discussion (not without considerable controversy) concerning the possible assignment of **letter grades**, A+ through D, corresponding to fuel economy and CO_2 comparisons among all vehicles. That all are included in one assessment is part of the controversy. Also, note that an EV's potential A+ grade ignores the remotely generated emissions and CO_2 of its electric utility source.

City and Highway ranges **"for most drivers"** typically show a variance of +/- 17–21 percent. (The lack of a single factor is traceable in part to mpg's nonlinearity.)

Combined Fuel Economy, based on 55/45 split of City/Highway, is compared with those of other cars in the same category. Note this is the only required indication of a car's size class, here, two-seaters.

A **Gas-Guzzler Tax** is applied to cars only (not minivans, SUVs or pickups). It's a sliding scale beginning with a $1000 tax for 21.5–22.5 combined mpg rising to $7700 for less than 12.5 combined mpg. Note, though, the tax is based on unadjusted test results, not the EPA Combined MPG. Here, the GT3 RS's exhilarating performance and $1300 tax come with an unadjusted test value of around 21 combined mpg—not the post-conditioned 16 EPA Combined MPG shown elsewhere on the label.

This comment has become something of a cliché. But changes in EPA testing and data conditioning, particularly since 2008, have lessened the differences between EPA values and those of **actual driving.** Be aware that EPA MPG values are not the same as those used in Corporate Average Fuel Economy calculations. Both CAFE and EPA MPG data sets are based on the same dynamometer testing, but conditioning of data lowers the EPA MPG values by about 20–25 percent.

ume of fuel entering the engine.

The City and Highway numbers are averaged, with a 55/45 weighting, to produce the car's Combined MPG, with all three values prominently shown on the label. Something new is on the latest labels (though you may have seen it first in Tech Tidbits, R&T, May 2006): the equivalent of Combined MPG is translated into gallons/100 miles, or as we like to call it, gpc. (Conversion: gpc = 100/mpg; mpg = 100/gpc.) See that Tidbit to understand why gpc is a more logical unit. Briefly, it's a *linear* metric; mpg isn't.

As with safety evaluations and crash testing, automakers perform their own mpg programs. The government keeps everyone honest by selective confirmation of perhaps 30 percent of the tests.

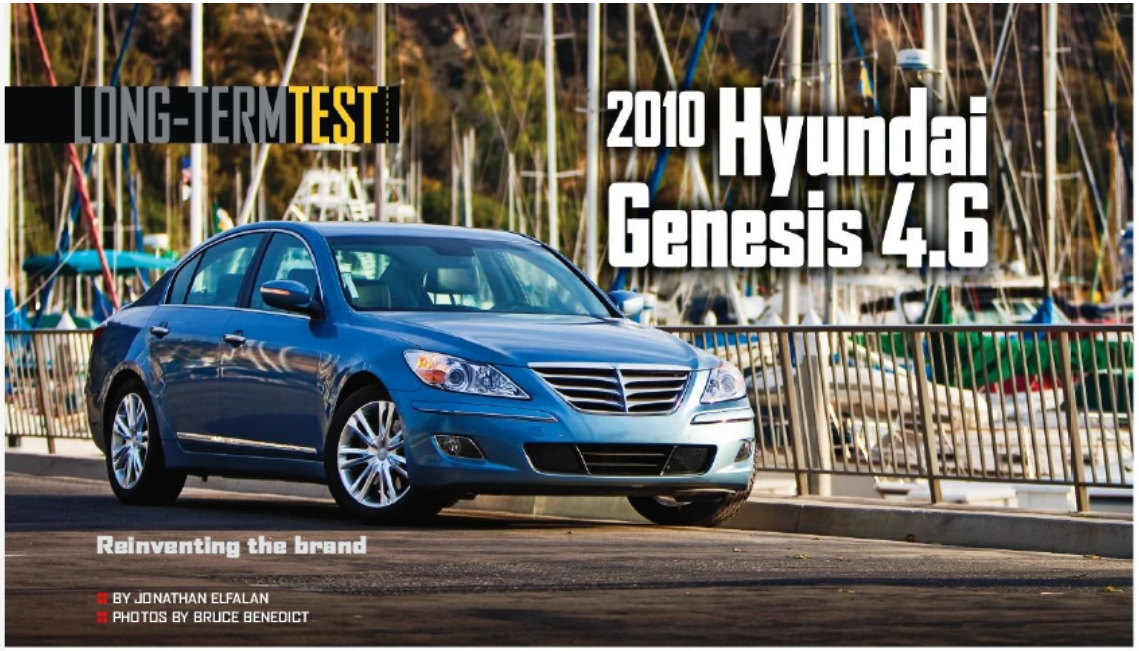
The Monroney of a BEV (battery electric vehicle) obviously contains only an All Electric portion, using similar methodology to derive an mpg equivalent. The Nissan Leaf, for instance, is rated at 99 mpge Combined, 106 mpge City and 92 mpge Highway, with the usual 55/45 weighting.

This and the Volt's All Electric 93 mpge start from measuring range on City and Highway cycles, then adjusting this downward by 0.7 to simulate the high-speed, hot and cold portions of a conventional car's testing. The Volt's result is that 35-mile All-Electric range identified on the label. Its 36 kWh/100 miles value comes from this 35 miles together with measuring the energy required to bring the battery back up to full charge. Note that total recharge energy is different from energy ending up in the car's battery, as there is energy expended in the charging process. Then, since EPA sets 1 gal. of gasoline equivalent to 33.7 kWh, that 36 kWh is equivalent to 36/33.7 or 1.07 gal. of gasoline. And 1.07 gpc is 100/1.07 or 93 mpge.

Simple? No. But thus far, EPA hasn't enough data on simulating the real-world behavior of PHEVs or BEVs. With more of them out there, the methodology may well change.

In the long run, we'd be wisest to wrest ourselves away from "mpg" in any guise. As already noted here and elsewhere, its nonlinearity gives rise to oddities galore. And its "gallon" measurement is so 20th-century liquid-centric. The most logical metric for us would be kilowatt-hours/100 miles, kWh/c, for short. It gets directly to the point: How much energy is required to go a given distance. And it's neutral about where the energy comes from: It could be kWh off the grid, a gallon of gasoline using EPA's 33.7-kWh factor, even a kg of hydrogen used in a fuel cell.

It's a new world for us all, whatever the cars we're driving.



LONG-TERM TEST

2010 Hyundai Genesis 4.6

Reinventing the brand

BY JONATHAN ELFALAN
PHOTOS BY BRUCE BENEDICT

HYUNDAI'S EXPEDIENT ROLLOUT OF ITS aggressively revamped vehicle line has undoubtedly gained it a few fans and invigorated the brand's image over the past year. From the award-winning Sonata sedan to the compelling new Equus luxury coach, the Hyundai movement we're currently witnessing was most certainly set in motion with the arrival of its Genesis range.

Eager to experience this new halo car in full, we signed up to put the top-of-the-line model—a 4.6-liter 385-bhp V-8 Sedan—through its paces for a year. Would it be the new ultimate luxe bargain of its segment or would it simply be an attractive veneer peeling off its cheap substratum the minute you drove it off the lot? Here's what we found after 34,000 miles.

From our first encounter we were impressed, like many others, with the complete package Hyundai was offering with the Genesis. Although we didn't find its exterior all that inspiring, it wasn't off-putting either. It looked to have borrowed some elements from Mercedes-Benz (hey, if you're going to borrow), none of which combined to form a unique design language, but it was a huge step in the right direction.

Scanning over the options list, there wasn't much to choose from, simply because the V-8 model came with almost everything included. The one thing we could and did add was a $3500 Technology Package (now standard on the 2011 model) that bumped our total surrounding Lexicon speaker count to 17 from 14, upgraded our navigation system to an 8-in. screen, added Smart (radar) Cruise Control, adaptive (turning) xenon headlights and a rear backup camera, among other interior comfort and convenience items. And yet among the spoils of standard leather-wrapped surfaces, wood trim, Bluetooth, iPod integration and dual climate control, we still had some trouble getting beyond the fact that there wasn't an option for a cooled passenger seat (only the driver gets one).

A couple of staffers occasionally managed to coerce some weird glitches out of the infotainment system (corrected with a cycle of the ignition), but for the most part we found the system to be sound and intuitive, albeit a little basic in appearance. But given the choice between basic and effective or pretty and overcomplicated, we'll take the former any day.

Looks like traffic is flowing very well on the 5 today...the Hyundai's satellite navigation system proved not only handy, but also easy to use and handsomely styled.

The interior of the Genesis is spacious and comfortable, and sports a pleasant layout, although some of the tactile items such as the multimedia control knob and the wood-trimmed gear selector lack a high-quality heft. That said, nothing ever broke, or felt to have loosened in tolerance on our watch, but we'd have to reserve comment on longer-term durability.

In terms of the more essential hardware, we approve of the Genesis' Tau V-8 engine and the 6-speed transmission. Power and torque aren't exactly up to our highest power-oversteer standards, but are sufficient to snap off a 5.5-second 0–60-mph run while averaging a respectable 21.1 mpg during regular driving. As for the 6-speed automatic, we commend its smooth, jerk-free operation, but we also believe that if there's a manual shift mode, it should rev-match on downshifts, a feature this transmission didn't have.

The biggest area for improvement on the Genesis, though, would have to be the electrohydraulic steering. Some complained about an overboosted, odd-centering feel while others found, especially at higher speeds, the car's front end would feel too light for comfort.

Nevertheless, given the car's premium status, we can't complain about the non-premium cost of our maintenance, or the fact that we would still have 9 years/65,925 miles left on our powertrain warranty. Or that, based on our post-test trade-in value (courtesy of *Kelley Blue Book*), our Genesis has the lowest percentage of depreciation out of the last 15 cars we've tested with the exception of the Audi R8.

Times are changing at Hyundai and the Genesis is just the beginning.

2010 Hyundai Genesis 4.6

SUBJECTIVE RATINGS

Driving excitement	3
Engine	4
Gearbox	4
Steering	3
Brakes	4
Handling	3
Touring comfort	5
Interior styling	4
Exterior styling	4
Ergonomics/controls	4
Luggage space	5
Interior durability	4
Reliability	5
Fuel efficiency*	3
Ownership cost	3

Based on a scale of 1 to 5, with 5 being best

Delivered price	$43,000
Total resale value at end of test (trade-in price from *Kelley Blue Book*)	$32,425
Total miles covered in test	34,075
Miles since last report	4375
Average miles per gal.	21.1

COSTS, OVERALL & PER MILE

Depreciation, 361 days	$10,575
Gasoline	1615gal.@$5240
Additional oil	1 quart @ $5
Routine maintenance	$710
Overall cost for 34,075 miles	$16,530
Cost per mile	49¢

REPAIRS & REPLACEMENTS

Normal/routine: Oil change, inspection, brake adjustment & tire rotation at 7500 and 22,500 miles ($100 each); 15K-mile service included all of the above plus engine air filter ($200); 30K-mile service includes everything from 15K service plus cabin air filter and engine coolant flush ($310).

Repairs: na

Unforeseen events: na

Road & Track's Fuel Economy Rating

1 less than 16 mpg
2 16 to 20 mpg
3 21 to 25 mpg
4 26 to 30 mpg
5 more than 30 mpg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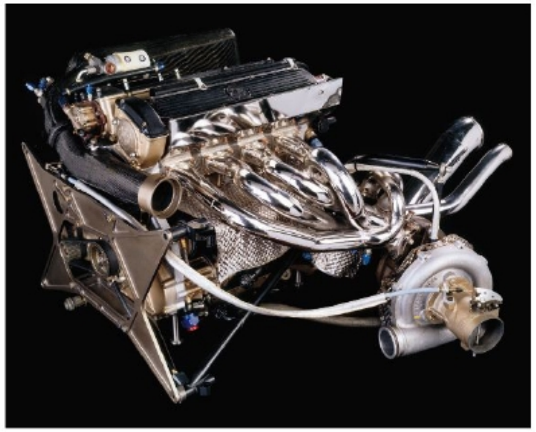
F1's Radical New Rules for 2013



:: Back in the 1980s, BMW's turbo 1.5-liter 4-cylinder F1 engine was legendary, putting out 1300 bhp in qualifying. The new engines for 2013 won't be as potent.

Grand Prix racing will enter a new era in 2013 when turbo engines return for the first time in 25 years, in conjunction with other rule changes designed to make for a more sustainable F1 future.

The push for a return to turbos began under former FIA President Max Mosley, who had long argued that the rules should encourage engine manufacturers and teams to focus R&D resources on technology that had relevance to road cars.

The theory was that not only would it be advantageous for the sport to be seen as politically correct, it would also help to ensure that engine makers could continue to justify their expensive involvements. The successive withdrawals of Honda, BMW and Toyota between December 2008 and November 2009 suggested that Mosley was right to be concerned.

At the end of 2010 a definitive set of rules was finally agreed on, and from 2013 everyone will use 4-cylinder 1.6-liter engines. The FIA aims to maintain a power output similar to that of the current engines, but with a reduction of 35 percent in fuel consumption. The rules package includes what the governing body calls "extensive" energy management and recovery systems. In an attempt to keep a lid on costs, drivers will have just five engines apiece for the whole of 2013, a figure that will drop to four in 2014.

The existing engine makers—Cosworth, Ferrari, Mercedes, Renault—have been party to the discussions and have clearly accepted that the small turbo represents a good solution, although Ferrari's enthusiasm has been a little muted.

Parity with road-car technology appears to be key, and that clearly excites the mainstream manufacturers. The hope is that others will also enter the F1 fray, with VW/Audi on top of the list of likely contenders.

One downside is the sound the new engines are likely to make. The current V-8s might not produce the same sort of music as V-12s of the past, but it's still part of the sport's magic. Even F1 boss Bernie Ecclestone has expressed his fears that the flat sound of the new turbos might be lacking in appeal.

—*Adam Cooper*

FORMULA RENAULT: An Alternate Route to F1 and IndyCar Fame

As racing series go, Formula Renault 3.5 flies under the radar. Although it slots in neatly between GP3 and GP2 and delivers the same brand of close racing, it lacks their visibility, not to mention the imprimatur of Formula 1 boss Bernie Ecclestone. Like GP3 and GP2 racers, the 1320-lb., carbon-fiber-bodied 3.5 racers are built by Dallara and incorporate F1 aerodynamics that enhance ground effects. Powered by a 425-bhp 24-valve 3498-cc Renault-badged Nissan V-6 utilizing a production block, the cars are fitted with a 6-speed semi-automatic sequential-shift gearbox with paddle shifters. There's no clutch pedal, so left foot braking's a snap. By the way, Formula Renault 3.5 cars cost about $217,000, but most drivers rent their rides from teams such as Carlin, ISR and Epsilon Euskadi. Performance-wise, a Formula Renault 3.5 car is between 8 and 12 seconds a lap slower than an F1 car at Monaco, which is the only venue the two series will share this year. In its 13 seasons, FR 3.5 has helped launch the F1 careers of numerous talented drivers including series champions Fernando Alonso, a two-time F1 World Champion, plus Robert Kubica, Marc Gené and Heikki Kovalainen as well as IndyCar's Bertrand Baguette. And while they didn't win a Formula Renault championship, other outstanding alumni include 2010 F1 World Champion Sebastian Vettel as well as IndyCar's Will Power, Justin Wilson and Enrique Bernoldi.—*Joe Rusz*

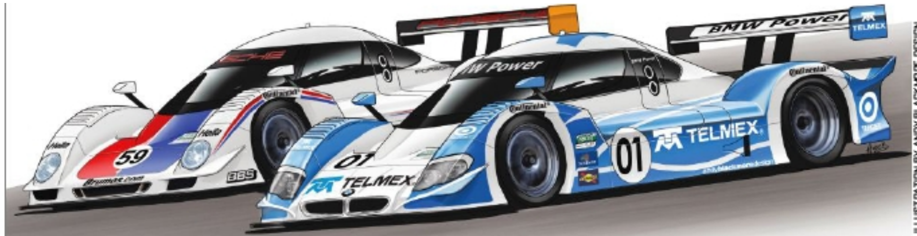


ILLUSTRATION BY ANDY BLACKMORE DESIGN

Grand-Am Grows Up

While IndyCar is throwing out its current formula in 2012 for a brand-new approach to open-wheel racing, Grand-Am has opted for a modernizing makeover filled with sex appeal.

The Grand-Am series is set for its first batch of radical changes since the Daytona Prototype and Grand Touring categories were introduced in 2002.

"Any good business continues to react to feedback from the marketplace," said David Spitzer, Grand-Am's V.P. of Competition. "In our case, we're responding to the needs of our competitors and there is a recognition that we need to address all of the ways that Daytona Prototype racing is appealing. For 2012, we're keeping the best of what we've learned so far and will make fundamental changes elsewhere."

First on the list, and after a decade-long din of complaints, the homely DP cars will go under the knife to have their cavernous cockpits reduced in width and height. Look for something more akin to what the closed-top Le Mans prototypes offer. Like the 2012 IndyCar aero kits, auto manufacturers could also have the option to build their own DP bodywork.

The next round of body changes involves the use of genuine road-car nose- and bumper-styling cues. Starting in 2012, actual grille pieces and headlight fixtures could be adopted—a first in the modern sports-car era.

"Our aim is to create a prototype body shape that is connected to the needs of the auto industry while still maintaining the look of a fantasy race car," Spitzer explained.

Paddle-shift systems, a new front crash structure, a multi-element rear wing and revised engine and cockpit cooling are all on the docket, but those aren't game-changers. Beneath the curvy new skin, the biggest mechanical change to the 2012 DP cars will be found in the engine bay. After 10 years of big, thirsty powerplants, 2012's buzzwords are "small," "turbo" and "efficient."

The current crop of 5.0-liter V-8s from Ford, Chevy, BMW and Porsche could still be pressed into service, but the option to use more relevant, production-based turbo engines and alternative fuels is a strong likelihood.

Changes to the GT category will be less evident. Grand-Am's goal is to add new marques, rather than to rewrite the rule book.

"There are a lot of different types of GT racing cars throughout the world, and it's incumbent upon us to make it easier for them to compete in Grand-Am," Spitzer continued. "Without asking them to make too many changes, we want Audi, Ferrari, Lotus, Dodge and others to bring their finest to fight each other and the current manufacturers in our series."

Grand-Am's 2012 plans are filled with smart, sane and cost-conscious measures, but one radical addition to the series could come to fruition by 2013, according to Spitzer. "We're very close to making a U.S.-based DTM series happen as a support series for Grand-Am."

Now wouldn't that be interesting…

—*Marshall Pruett*

Porsche Pandemonium

Picture 200 Porsche 911 GT3 Cup cars taking on Germany's fabled Nürburgring, and you'll understand why the inaugural Porsche Carrera World Cup is a race that's sure to go straight to YouTube. Set for June 15, the 6-lap (70.2-mile) sprint will take place prior to the start of the 39th ADAC 24 Hours, which attracts more than 200,000 spectators to the Ring's challenging Nordschleife. One thing is certain: The winning car will be a Porsche.—JR

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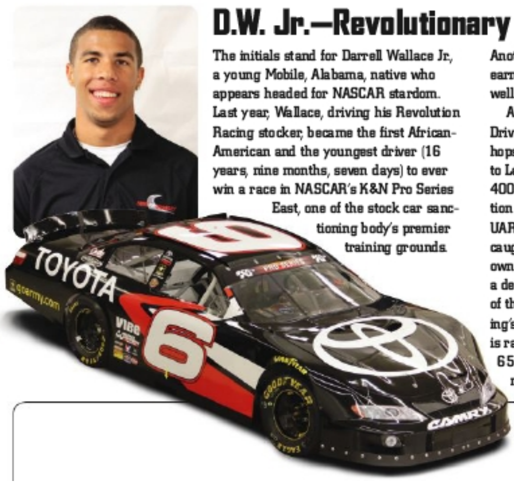
D.W. Jr.—Revolutionary Racer



The initials stand for Darrell Wallace Jr., a young Mobile, Alabama, native who appears headed for NASCAR stardom. Last year, Wallace, driving his Revolution Racing stocker, became the first African-American and the youngest driver (16 years, nine months, seven days) to ever win a race in NASCAR's K&N Pro Series East, one of the stock car sanctioning body's premier training grounds.

Another win and seven top-10 finishes earned him Rookie of the Year honors as well as 3rd place in the championship.

A standout candidate in NASCAR's Drive for Diversity program, Darrell hopscotched from go karts to Bandoleros to Legend Cars before moving up to the 400-bhp United Auto Racing Association late model stockers in 2007. As the UARA rookie of the year in 2009, he caught the attention of NASCAR team owner Joe Gibbs, who signed Wallace as a developmental driver for JGR. As one of the minority-owned Revolution Racing's stable of upcoming drivers, Wallace is racing this year in the Pro Series, his 650-bhp car carrying the colors of *Vibe* magazine.—*JR*

TOP 10 F1 DRIVERS 2010–2011

Alonso may not be World Champ, but he gets the nod as F1's top driver

BY SAM POSEY
PHOTO BY PAUL-HENRI CAHIER

THE 2010 F1 SEASON WAS AN EXhausting marathon, 19 races long. The championship lead changed nine times—a record. The three leading teams—Ferrari, McLaren and Red Bull—were like planets in outer space, each in its own orbit and totally preoccupied with F-ducts, blown diffusers and flexible wings that were the currency of speed. Each took a different approach to car design and team management, and while one or another might enjoy a momentary advantage, their performances over the long arc of the championship produced an almost identical result. It was as if a magnetic force manipulated crashes and wins to keep things close, and four drivers started the last race still in the hunt—also a record.

My friend John Love has observed that races and championships fall with odds-defying frequency to the driver whose win makes the best story. But in 2010, it was the loser's story that offered the most depth and dimension. Fernando Alonso, my choice for the No. 1 ranking, had a season that extracted the full measure of what F1 demands in these times. On one hand, he is a genuinely nice guy, while in the cockpit he's ruthless and implacable, wholly at ease with F1's culture of aggression. Beat your teammate! Push, push, push! Block anyone trying to pass you!

To get Alonso, Ferrari bought out Kimi Räikkönen's contract and agreed to make him their number one—a back-room deal that instantly marginalized the supremely talented Felipe Massa, who was making an emotional return after a life-threatening crash in 2009. Alonso led Massa home in the season opener, but as the other teams found their stride, the new F10 fell behind. By the time the team was competitive again, midsummer had come and Red Bull had five wins, McLaren four. I factor into these standings how a driver responds to adversity—a Degree of Difficulty rating—and Alonso proved his toughness during this frustrating period. Alonso clawed and scratched his way to every point. Always on the limit, he made mistakes—a massive qualifying crash at Monaco, a jumped start in China—but he kept the team's morale up with his self-confidence. Massa was almost equal in

"In the cockpit he's ruthless and implacable, totally at ease with F1's culture of aggression."

1 Alonso

2 Vettel

speed, but Alonso's mental toughness—typified by his dangerous, brazen pass of Massa down China's single-lane pit entry road—confirmed his number one status.

Hockenheim was the anniversary of Massa's accident—and the revamped F10 was ready. Like the car, Massa was fully recovered and took the lead, heading to a storybook ending—until Ferrari, acting on another of Alonso's back-room deals, ordered him to let Alonso pass. The rules forbid team tactics, but Massa, dazed, complied. Alonso was a distant 5th in the standings, 47 points back, and many wondered if eight points—the difference between 1st and 2nd in the expanded scoring system—was worth the bad publicity. But Alonso had felt the Ferrari come right, and sensed before anyone else that he had a chance at the championship. He regarded the win, and the points that went with it, as rightfully his. Like Michael Schumacher, he sees his success as fulfilling a moral imperative—what's right for Alonso is right for Ferrari, and by extension, right for the sport. Not surprisingly, Massa was devastated. After Hockenheim his season collapsed. He swallowed his pride and re-signed for 2011, despite knowing that he was offered the ride not because he's fast but because he's not as fast as Alonso.

Tainted or not, the Hockenheim points—which cost Ferrari only a wrist-slap of $100,000—propelled the Spaniard into contention. His victory at Monza, in front of Ferrari's idolatrous fans, was the emotional high point of the team's year—and a reminder of just how fast Alonso can be. Two weeks later he won in Singapore, holding off Sebastian Vettel in the nimbler Red Bull RB6. His win in South Korea was his fourth in eight races, thrusting him into the championship lead. A cautious 3rd in Brazil, he arrived in Abu Dhabi with a comfortable lead over Mark Webber.

In an unlikely scenario made possible by multiple contenders, Alonso keyed off Webber, Webber had a bad day, and Vettel leapt from 3rd place in the standings to steal the championship. The Ferrari brain trust had two Red Bulls to watch for and picked the wrong one. Abu Dhabi was a nasty shock, but Ferrari found its first real leader since Schumacher, and historically the Scuderia is at its best with a strongman in the cockpit. Winners don't lose, the saying goes, they just run out of time... and Alonso, slumped on the garage floor, was a man who would have done anything for another chance. He'll be very tough to beat in 2011.

Sebastian Vettel, my pick for No. 2, was the highest scorer in the second half of the 2009 season, but didn't win. To have unfinished business of this sort at 23 is extraordinary. He should have dominated in 2010—the Adrian Newey-designed, Renault-powered Red Bull RB6 was in a class of its own. Vettel won only three of the first 15 races and didn't score back-to-back wins until the last two. The speed was always there—he won the pole 10 times, tying the record. But he lost Hungary by failing to observe safety-car protocol, at Spa he speared Jenson Button and took out Force India's Vitantonio Liuzzi, while in Turkey he crashed trying to muscle his way past Webber. For all F1's emphasis on beating your teammate, it's etched in stone that you must not run into him. Vettel would have been in the doghouse anywhere but at Red Bull. The company's founder, Dietrich Mateschitz, regards him as his personal discovery, and Vettel rewarded him by scoring both Toro Rosso's and Red Bull's first wins.

Our second-best driver, Vettel, in arguably the fastest car of the 2010 season: the Red Bull RB6 designed by Adrian Newey.

PHOTOS BY PAUL-HENRI CAHIER AND SCHLEGELMILCH PHOTOGRAPHY

"Button and Hamilton have their differences, but they're confined to the esoterics of car setup."

Hamilton 3

My No. 3 is McLaren's Lewis Hamilton. Martin Whitmarsh, team principal, has acknowledged his man takes chances that don't always pay off—and that's fine with him. Hamilton's risk-taking grows from the deep conviction that when he's over his head his intuition will sort it out. His win at Spa, on a rainy day with conditions changing from lap to lap, called upon all his self-confidence and skill—and some luck, too, when he got off track and missed the guardrail by inches. It was the drive of the year.

McLaren prides itself on a level playing field for its drivers—equal cars, no team orders. Even when world champions Alain Prost and Ayrton Senna—bitter enemies—drove for them, McLaren stuck to its policy. In Hamilton and Button they again had two champions—only this time they became friends. Lewis had the better year. In qualifying, he trounced Button 14 to five. Button won twice before Hamilton, but then Hamilton won three and outscored Button 240 points to 214.

After his Spa win, he led the championship and looked unstoppable. But he crashed into Massa at Spa and was sideswiped by Webber in Singapore. Two races, no points—while Alonso raked in 50. It was a short slump, but I believe it cost Hamilton a second championship.

Robert Kubica is my pick for No. 4. When BMW withdrew, Kubica was left rideless, ending up at Renault in Alonso's vacated seat. The car was better than expected, and the tubular Pole qualified in the top 10 at every race but the last one. Every few races he hung onto the leaders and finished on the podium. The physical closeness of the drivers showering each other with champagne belies the harsh reality of how far Kubica is from becoming a regular on that top step. He came into F1 with Hamilton and Vettel, and seeing their success must be reassuring and excruciating. He knows he can win, but the clock ticks. If you look at F1 from his perspective you realize how few championship-caliber rides there are, and how rarely they become available. Lotus has bought a modest share of the Renault team, with plans to expand its position. But that's the future. Kubica needs a winning car, and he needs it soon.

Mark Webber is my No. 5. In midseason, he went on a tear, winning four of eight, including Monaco and Silverstone. Here's a guy who only the year before had won his first GP, after eight fruitless years in F1—and now fans were clamoring for him to be champion. But the team had different ideas: At Silverstone, they removed Webber's front wing, giving it to Vettel. The intra-team tension got to Webber. Vettel began out-qualifying him—by only tissue-thin margins, but it meant he was starting behind the young German, with little chance of passing. Webber was F1's Zeno—the closer he got to the finish the slower he went—and his crash in rainy South Korea was the mistake of a man driving over his head. Still, he went into Abu Dhabi standing 2nd in the championship, causing Alonso to focus on him and letting Vettel escape. Webber's credo is Hard but Fair. I would add Brave; in Valencia, he rode out the year's worst crash without showing a trace of fear. He's back at Red Bull and while Mateschitz may regard him as a mere journeyman, I believe Webber will again cause Vettel to radio in—as he did in Hungary—asking, "How the hell did Mark get to be leading?"

Jenson Button, 2009 World Champion, is No. 6. Button's unexpected switch from Brawn to McLaren could have led to a highly combustible rivalry like Vettel versus Webber. But his unfailing good nature kept things calm, plus he won twice early on, and there's nothing like a win to bond a driver to his team. Button is the ideal number two, or

The best drive of 2010: Hamilton, above, winning in the wet at Spa. Kubica, Webber and Button have the speed to win, but the latter two are burdened with faster teammates.

Kubica 4

Webber 5

Button 6

"Rosberg out-qualified teammate Schumacher 14 to five and outscored him 142 to 72—impressive numbers even if the Schu wasn't at his best."

7 Rosberg

8 Barrichello

maybe I should say one and a half. Button and Hamilton have their differences, but they're confined to the esoterics of car setup: Button prefers the stability of understeer while Hamilton likes the quick response of oversteer. Button is exquisitely smooth, and his two brilliant wins—both in the rain—showcased his technique. But Hamilton, trusting his instinct, is a tiny bit faster and better at coping with cars that aren't handling.

Nico Rosberg, my choice for No. 7, stepped up from Williams to the newly formed Mercedes team, where he was joined by Michael Schumacher. In the flurry surrounding the legend's comeback, Rosberg was largely ignored. When racing began, however, he scored a pair of 3rd-place finishes early on and later added another. He out-qualified Schumacher 14 to five and outscored him 142 to 72—impressive numbers even if the Schu, absent from F1 for three years,

wasn't at his best. Schumacher likes the rear of the car to pivot around the front, which calls for a "strong" front tire and a "weak" rear one. Pirelli has replaced Bridgestone as the tire supplier for F1, and first reports suggest that the Italian firm's rubber, along with a new car, will give the Schu a chance to work his old magic. If Rosberg can keep beating him, Nico could find himself winning GPs.

I rank Rubens Barrichello No. 8. Williams welcomed Barrichello as their number one, delighted to annex his 18 years of F1 experience, especially useful with limited testing. His generous spirit supported and encouraged their high-profile rookie, GP2 champion Nico Hulkenberg—even as Barrichello made sure to out-qualify him decisively, 13 to six. Hulkenberg grabbed the pole at Interlagos in the wet, a dazzling performance for which I name him Rookie of the Year. But the rapid Venezuelan, Pastor Maldonado, the Hulk's successor as GP2 champ, has dangled $15 million in front of Sir Frank, and Hulkenburg is left looking for a ride.

I include my last two picks—Kamui Kobayashi (No. 9) and Heikki Kovalainen (No. 10)—under my Degree of Difficulty heading. I know they aren't in a class with, say, Schumacher or Massa, but each produced outstanding performances despite having little to work with. Kobayashi is a fighter and as good an over-taker as there is. He finished 7th at Suzuka, coping with the pressure of racing in front of his countrymen while at the same time conducting a master class in passing. Meanwhile, in the same race, Kovalainen was showing how to *be* passed, how to stay out of the way while losing as little of your own speed as possible. Like Kubica, Kovalainen was occasionally able to latch on to a faster group—evidence that he may soon resign from the Society of the Moving Chicanes.

Summing up: 2010 offered the excitement of an exponentially complex world-championship battle. The year also saw F1 making good on its plan to reduce expenses by limiting testing, scaling back staff sizes, and restricting engine development. Mega-spending manufacturers Toyota, BMW and Honda have withdrawn, replaced by small private teams. At the FIA, the contentious Max Mosley is gone, succeeded by the far-sighted Jean Todt. Add that F1—knock on wood—hasn't seen a fatality since 1994, and I'd say the sport is in pretty fair shape. As for this coming season, a young kid in a sinewy midnight-blue car is the defending champ, and he'll be checking his mirrors for flashes of silver and red—perhaps especially red.

No love lost between old teammates: Michael Schumacher flagrantly blocked Rubens Barrichello at Hungary, nearly causing a huge crash. Rosberg, top, was often quicker than Schumacher in 2010. Barrichello out-dueled Hulkenberg, while Kobayashi fearlessly passed anybody. Kovalainen still has lots to prove.

9 Kobayashi

10 Kovalainen

PHOTOS BY PAUL-HENRI CAHIER AND SCHLEGELMILCH PHOTOGRAPHY

Return to GLORY

With its new engines, aero packages and reduced costs, IndyCar's 2012 season marks a return to a wonderfully diverse open-wheel past

BY TIM TUTTLE
PHOTO BY F. PEIRCE WILLIAMS

SWEEPING CHANGES TO DIVERSIFY THE FIELD AND contain costs are coming to the IndyCar Series in 2012. Turbocharged 2.2-liter V-6 engines will replace normally aspirated 3.5-liter V-8s. Honda—the sole supplier since 2006—has been joined by Chevrolet and Lotus, which have also announced that they will produce aerodynamic body kits. Dallara plays a unique role in this transformation, building a rolling chassis to IndyCar specifications for use by all teams and delivering a third aero body style to the series.

IndyCar teams didn't have any choices of what equipment to run from mid-2007 through this season. It was Dallara-Honda or stay home. For 2012, there will be Dallaras with Chevrolet, Lotus or Honda power. There will also be Chevrolet IndyCars and Lotus IndyCars, as the rules call for the aero kits to determine the brand of the car. When Chevrolet and Lotus committed to doing aero packages as well, IndyCar gave them the right to prevent a team from racing, say, a Chevrolet-Honda or a Lotus-Chevrolet. "It becomes too confusing for the public and it's not good for the manufacturer," explained Tony Cotman, the IndyCar 2012 Project Manager.

Meetings with prospective engine manufacturers were initiated in 2008, but when it came time to commit, Honda was alone. Last June, IndyCar's proposal called for a maximum of 2.4 liters with up to six cylinders, fitted with one or two turbos and direct injection. Two months later, though, IndyCar reduced the capacity to 2.2 liters. Moreover, the engines were mandated to be a stressed part of the chassis and run on E85 fuel. The specifications of the engines were based largely upon Honda's recommendations, as the company, along with IndyCar, wanted the powerplants to be relevant to production cars.

"If you go back to the first roundtable meetings in 2008, a bunch of German and Italian manufacturers and some domestics went around the concept of an inline-4," Honda Performance Development Technical Director Roger Griffiths said. "Honda was always the advocate of the V-6. We presented a lot of data. What the engine needs to do and the power targets are a lot easier to achieve than with a four. We shared all the data we had.

"The Germans [Volkswagen] were big advocates of the inline design because of what they were selling in Europe. We're not sure the American consumer will accept the change from a V-8 to an inline-4. And from a performance point of view, the V-6 was much more desirable. The draft of the regulations came from a lot of work we did with IndyCar, and until the last couple of months it looked like we might be the sole supplier. There have been some subtle changes and compromises to the draft."

The door is now closed for any manufacturer to come in with a 4-cylinder engine for 2012. Chevrolet is building its V-6 in partnership with Ilmor, while Lotus has teamed with Cosworth. At this point, none of the three engine makers has confirmed the number of turbos, but Honda is believed to have two, while Claudio Berro, Director of Motorsport for Lotus, says his company is "50-50" on utilizing one or two turbos.

Added Ilmor President Paul Ray: "We argued quite strongly that IndyCar should decide on one or the other, but Honda felt it gave manufacturers more options in relation to its road cars. IndyCar has told us all clearly there will be no bodywork, no aero advantage particularly, to [the turbo configuration]...There's probably a minor weight advantage, carrying it in the center of the car, if you use a single turbo."

> *"There's a lot of relevance where the series is going in relation to production cars."*
>
> Mark Kent
> Director of Racing,
> General Motors

When Honda, which has used Ilmor to build the current-generation IndyCar engine, decided to build its own powerplant for 2012, Roger Penske approached Chevrolet about rejoining the series with an Ilmor-built engine. Chevrolet liked the rules, and the prospect of selling cars to IndyCar fans. "This series is growing in interest and popularity," GM Vice President of Marketing Chris Perry said. "It provides some of the highest return on investment of any investment we conduct."

Penske offered the powerful inducement of signing a multiyear contract for his team, the winner of 15 Indy 500s and an all-time leading 147 IndyCar (under USAC, CART and IRL sanction) victories.

"We first looked at the new engine rules and the series has aligned itself closely with production cars on future emission and fuel economy regulations," General Motors Director of Racing Mark Kent said. "With a small displacement, E85, turbocharging and direct injection, we're able to meet all those standards and have cars that are still fun to drive. There's a lot of relevance where the series is going in relation to production cars."

IndyCar will regulate power levels for different tracks—up to 700 horsepower for road/street courses and 550 for ovals—by raising and lowering the turbo boost, yet the rules are left open enough for a manufacturer to gain an advantage.

"There's enough leeway to have that development freedom," Griffiths said. "One area IndyCar has not been keen to try to put too many restrictions on is the fuel system. We're keen on developing that aspect of the engines. You could see some quite interesting developments and it could make a difference [in performance]."

"Yes, there will be differences," Ray said. "It's going to be quite a bit of interesting development opportunity how we get the power at different boost levels. What we're asking out of direct injection is very complicated. Running it at 12,000 rpm is up there farther than anything that's been done before. There's a lot to learn.

"Ilmor's expertise is on the mechanical side. GM has a tremendous wealth of knowledge on direct injection, E85 and modern turbocharging. It has a lot of technological understanding to bring to the table. It's quite a good partnership and it's quite a technical challenge."

The trio of engine suppliers and IndyCar agree that a stressed engine is superior to non-stressed.

"Every [purpose-built] racing engine is a stressed part of the car," Griffiths said. "It creates an integrated structure. When you attach the suspension to the car, it allows them to work as intended. The car twists if it's non-stressed. When you make changes to the car, you can actually feel it rather than a car winding up like a coil spring. It's a much neater package," Cotman said. "Those days of the flexy flier are gone." While IndyCar has gone in that direction, there were some proponents who felt non-stressed would further reduce costs and help smaller teams not only gain entry to the Indy 500, but also compete in the complete IndyCar season schedule.

IMAGE COURTESY OF AUTOSPORT

Engine costs will be reduced for 2012, although the exact amount hasn't been specified. Honda has committed to reducing its lease up to 40 percent from the $935,000 it charged for the 2010 season—which would bring it down to $561,000. Teams are allowed 10,000 miles and receive five engines per lease.

"That's significant durability," Ray stated. "It's going to be quite a challenge. At 2000 miles, the engine has to produce within one percent of its horsepower when it's fresh. A lot of development on these engines from the first time it fires up to the first race will be on durability."

The Dallara-produced rolling chassis, which will be built in Indianapolis, will cost $349,000 and be available with bodywork for $385,000. A complete new Dallara cost $700,000 in 2010.

The aero body kits will cost $70,000 in 2012. They are comprised of front and rear wings, sidepods and engine cover. The underwing and nose will be built to IndyCar specifications.

"I believe there is enough leeway in the [aero] rules that the cars will be unique and the fans will be able to differentiate them on the track," GM's Kent said. "Once we decided we wanted to get back into the series, we saw an opportunity for us to differentiate the entire car."

Lotus, for the record, is building a facility in Indy to produce its aero kit. "The body [aero] rules are a little more open than the engine," Berro said. "Everybody will not be the same. We will have three different kits, one for road course, one for ovals and one for Indianapolis. But it's clear our priority for the first seven or eight months of this year will be the engine."

IndyCar racing has been known for its innovation and relevance to the auto industry ever since its beginning more than 100 years ago, but lost its influence in recent years.

"I think it's IndyCar energized," offered Gil de Ferran, the former Indy 500 winner who's also a member of the committee IndyCar CEO Randy Bernard formed to create the 2012 rules package. "It's like a big boost of adrenaline in every respect. I think it generates a layer of interest that previously wasn't there when you have a single-make engine and a single-make car.

"The companies getting involved in our sport are big. They are going to energize the series with promotion, with exposure, with marketing investments. Otherwise, why else would they get involved?"

"The impact of what IndyCar did was tremendous," adds Kent. "We look at the fan base and it's young, and the viewership is up tremendously. Sponsorship has doubled in the past year and that's always a good indication of the strength of the series."

THE PODIUM

R&T GUEST EDITOR:
GIANMARIA BRUNI

A Ferrari GT driver since 2007, Bruni competes with Risi Competizione, along with teammate Jaime Melo.

The Highs (and Lows) of Racing a Ferrari

ALTHOUGH LAST YEAR'S ALMS GT SEASON DIDN'T finish as well as we wanted, or how we thought it would, it was a great season. We had some fantastic races in the Risi Ferrari, some great results, and we were always in the title hunt right up to the last minute—literally!

Personally, I never made any big mistakes that caused us to lose points, and always took the car to the checker without crashing or losing it in any way, so I'm proud of my season. I put a lot of energy and time into learning new circuits and, if I don't get to race in the U.S. this year, it will be a shame to waste that experience. I finished 2nd in the Driver Championship and want to finish that last lap, go all the way and win the title.

As race fans will recall, the 2010 Petit Le Mans was a great race, but we ran out of fuel on the last lap and lost the championship. The outcome still hurts—even now.

Toni [Vilander] and I had a good week preparing for the race. We started 2nd but after 58 minutes had an issue and went to last, one lap down. We both drove so hard for the rest of the race, battling with the BMWs and Corvette. We not only caught up again, we managed to pull away. We had a good gap but then everyone knows what happened. We were doing things like triple-stinting tires on one side and double-stinting the others to save time in the pits, and such old tires made the car difficult to drive.

I feel bad for three reasons. One: We lost the race itself. Two: Ferrari lost the Manufacturer Championship, the biggest target. Three: I may never have the chance to do it again. We should have won, but that's racing.

Since then, I've helped develop the new Ferrari 458 Challenge car. Michelotto has done a very good job developing the F458, and it looks a lot faster than the F430. I think the biggest developments are the handling, gearbox and traction control, and, of course, it's beautiful to look at.

The car is a lot stiffer, more like an open-wheeler, and very precise with the steering wheel. With the 430, it was quite easy to lose the rear or miss a braking point but there's 50 percent less body movement with this car, so you can concentrate on going fast instead of thinking about body roll or losing it in a corner. I think both amateurs and professionals will find it easier to drive. A big difference is the gearbox, which is a lot faster; it changes up and down so quickly. With the 430 you have to hope you are on the right revs to accept gears, but now you get to a corner and can shift down even at the last moment. The traction control is also much better than in the 430, making it easy to exit corners. With the development of the 458 Challenge car and the test results so far, it's looking good for the new GT2 car.

Sooner or later this car will make a difference, and I think the 458 will be even better in the ALMS than the 430.

Part of Bruni's duties: Helping to develop the new Ferrari 458 Challenge car, which Bruni says is a much easier car to drive fast than the previous 430.

TECH ADVICE

The scoop on "turn-in," sudden battery death and airing down tires

BY TOM WILSON

TURNING A PHRASE: I have been an avid reader of *Road & Track* for decades, and as a car lover, I look forward to reading the reviews. I have noticed that reviewers, in describing handling characteristics, seem to use the term "turn-in" when referring to an aspect of response to steering input. I have never read the term "turn-out" in such descriptions. Maybe I've missed something, but I find this term confusing. Could you elaborate on what it means exactly?

David MacLean
Calgary, Alberta, Canada

Maybe half the fun of playing with cars is finding a common language to express what each driver feels. People who make their living doing this, notably racing crew chiefs and their drivers, find it useful to break down a car's handling into bite-size segments.

Thus, the crew chief will ask the driver what the car does when he 1) lifts off the gas at the end of a straight, 2) applies the brakes, 3) turns into the corner, 4) negotiates the mid-corner, 5) tips into the throttle on corner exit and 6) exits the corner. There are variations of these terms, but "turn-in," where the steering wheel is first turned to steer the car into the corner and toward the apex, is a critical fundamental of sorting a car's handling.

Much of the turn-in response is felt through the steering, so you could limit your thinking to turn-in as a steering term, but there is actually much more going on because turn-in is when the driver first dips into a car's cornering characteristics. Thus, everything is in play, from spring, shock and anti-roll bar responses to tire characteristics, weight distribution, chassis rigidity, and on and on. But in the inevitable engineering shorthand, the sum total of all these variables is the car's turn-in.

In magazine testing of street cars, turn-in most often refers to how immediately and accurately a car points into the corner once the driver has turned the steering wheel. You can think of it as the time it takes for the car body to roll over, the tires to take a set and the car to settle into an arc toward the corner's apex.

Like you, we've never heard of "turn-out." Such a term could describe when the car is exiting the turn, but as we've seen, there are already other terms for that period. Another possible thought on "turn-out:" It could cover a momentary reversal of the steering by the driver at any point while cornering. This is a "correction," and usually indicates a brief loss of rear traction caused by inexpert driving, bumpy pavement or most commonly from a new car reviewer's standpoint, lack of precision from fluffy suspension or steering components.

Therefore, you might hear a driver say, "It turns in okay, but requires a correction before the apex." That means the initial dive into the corner happens quickly and apparently accurately, but something is then upsetting the car, requiring the driver to turn the wheel out, opposite of the cornering direction.

Quick, accurate, linear turn-in is one aspect of a great-handling car. No one thing delivers a sharp turn-in; rather, a number of intertwined variables delivers the desired result.

QUIETLY DYING BATTERIES: Living in Phoenix, Arizona, our "3-year" batteries last only about one and a half years or so. We learn to live with that but what is very frustrating is contemporary batteries in late-model cars seem to die with no warning at all. They start fine in the morning, then are totally nonstarters in the parking garage at 4:30 p.m.; or they run fine when parked in the home garage at night but are dead in the morning. Not even a click from the starter solenoid.

If memory serves me, back in the day batteries let you know they were on their last legs by dying over some perceivable period of time, allowing you to drive to the parts store and buy a new one.

I suppose this has to do with the computers cars have now and their having some voltage threshold? Finally, is there something out there we can attach to a vehicle or its battery to give us some warning?

Steve Titus
Mesa, Arizona

What your sudden battery death sounds like to us is dirty battery connections. Although rarer today than with traditional massive battery cable ends, corrosion between the battery post and the cable end very typically results in a sudden no-start problem. Everything else electrical in the car will function fine—stereos, power windows, fuel pumps, lighting—but the starter won't give a hint of action. This is because the starter has such a high amp draw, often more than the rest of the vehicle's electrical load combined, so a marginal connection can't support the starter but will power everything else.

As for a minimum voltage requirement from automotive computers, it's far lower than a normal battery's output; the starter will not function long before the computer won't work. What modern electronically intensive cars will do is slowly drain the battery if the engine isn't run every month or so.

AIRING DOWN FOR COMFORT: I am seeking a way to improve the rather stiff ride I experience from my 2009 Cadillac CTS. Some time ago I read an article by a knowledgeable automotive writer who conducted a rather precise mileage test to determine what effect would occur by reducing the tire pressure 10 to 15 percent from the maker's recommendations on the door column.

He found an improved ride with no measurable change in fuel consumption. Please comment on this practice.

Gerald Jacobsen
Lakeside, California

Generally we agree, but let's recall that tires differ greatly, and while one tire may respond nicely to as much as a 15 percent lower inflation pressure, another may not. Much has to do with the tire's internal construction, as some rely less on air pressure for their strength than others.

Assuming you are dealing with the CTS's original-equipment Goodyears, a little less air should help the ride and not decimate fuel economy as most Goodyears seem to feature stout internal construction. If 34 psi was the original pressure that would mean 29 psi.

We must add that inflation pressures absolutely should not be lowered excessively (15 percent is as low as we'd go) because that's the path to tire overheating.

DO YOU HAVE A TECHNICAL QUESTION?
Send it to RTLetters@hfmus.com, or Tech Advice, *Road & Track*, 1499 Monrovia Ave., Newport Beach, Calif. 92663. Be sure to include your first and last name, hometown and state.

TECH TIDBITS

BY DENNIS SIMANAITIS
ENGINEERING EDITOR

Volvo Advanced Research—not an Oxymoron!

IF THE TERM "VOLVO ADVANCED RESEARCH" SOUNDS oxymoronic, you're thinking of the old days when this Swedish company was renowned for stolid—albeit solid—automotive hardware. Today, Volvo is at the leading edge with electric vehicles, fuel cells and innovative schemes for energy storage.

C30 Electric

Back last year, I sampled a Volvo C30 Electric around downtown Los Angeles. Briefly, I found this BEV version to be city-zippy, silent and fun. (See roadandtrack.com/volvoelectric for details.)

These cars have now wintered in their native Sweden—down to minus 30 degrees Fahrenheit! Into 2012, the C30 Electric demonstration fleet will be expanded to Belgium, the Netherlands and the U.S., specifically California, New York and Indiana. (Why Indiana? Ener 1, Volvo's battery supplier, has a major facility there.)

"Even in those days, these not-so-stolid Swedes were thinking well out of the box."

Range Extension by Fuel Cell

Volvo is also investigating a variation on the "range-extended EV" theme, this one employing a fuel cell rather than a conventional gasoline engine.

Jointly developed with Powercell Sweden, the unit incorporates a reformer stripping hydrogen from an on-board supply of gasoline. Fed this hydrogen, the fuel cell is highly efficient in generating its electricity that extends the car's range by as much as another 155 miles. Volvo expects to evaluate this technology in a C30 Electric by 2012.

Body by Ultracapacitor

Volvo's most innovative idea concerns energy storage—literally having portions of the bodywork acting as ultracapacitors. Like a battery, a capacitor stores electricity, only it does so electronically, not chemically.

The carbon fiber making up the ultracapacitor would be sandwiched and insulated within other composites, the fabricated component serving a dual energy-storage and structural role. Voltages aren't high, so there's no danger if the panel is damaged in an accident.

A Turbine/Electric Hybrid

At last year's Paris Auto Show, the Jaguar C-X75 impressed everyone. But guess who had a similar turbine-powered series hybrid way back in 1992? Volvo! Also shown at a Paris Auto Show, its Environmental Concept Car had a 90,000-rpm turbine (photo at left) linked to a high-speed alternator. Later (see R&T, June 1993), I drove the ECC briefly around Volvo's Southern California think tank.

Even in those days, these not-so-stolid Swedes were thinking well out of the box.

MATTI HOLTZBERG—A WIZARD OF CARBON FIBER

Back in the early 1970s, a New Jersey engineer known as Matty Holtzberg figured that carbon fiber's superb rigidity and light weight would be great for pushrods of small-block Chevrolets. In time, his Polimotor Research Inc., was offering these, connecting rods and even a complete clone of the Ford Pinto 2.3-liter inline-4. Significant portions of this engine—its block walls, piston skirts, con rods, oilpan, portions of the cylinder head—were fabricated from Torlon, a carbon-fiber-enhanced injection-molding compound devised by Amoco Chemical Co.

The Polimotor weighed less than 200 lb, produced 270 bhp and revved to 9000 rpm. A Pinto's engine weighed 415 lb. and produced 88 bhp. One of Matty's Polimotors powered an IMSA Camel Lights Lola T-616 to a pair of podium finishes in 1984–1985.

Fast forward to 2010. Now Matti Holtzberg has parlayed several carbon-fiber patents into Composite Castings Inc, his West Palm Beach, Florida, operation that has expertise in the cost-effective tooling of die-cast composite components. A carbon-fiber-optimized dohc inline-4 along the lines of Ford's Duratec 2.0 is one example. Its block, die-cast of carbon-fiber injection-molding compound, is 20 lb. lighter than its aluminum counterpart and costs only half as much. One reason for the latter is the extended life of die-cast tooling with injection-molded materials.

By the way, I first encountered Matty Holtzberg years ago when I worked at SAE. My reunion with Matti results from the carbon-fiber history elsewhere in this issue written by another wizard of this technology, Gordon Murray.

Matty? Matti? He tells me fewer people mistake his name for "Marty" with the latter spelling.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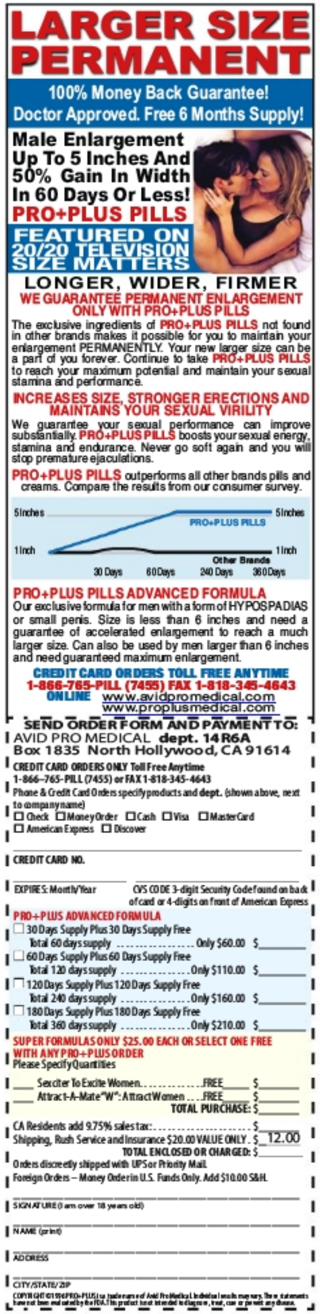
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ROAD TEST SUMMARY

ROAD TEST LEADERBOARD

0–60 MPH

	sec
1 Bugatti Veyron 16.4	2.6
2 Porsche 911 Turbo S	2.6
3 Lamborghini Murciélago LP670 SV	2.8
4 Ferrari 458 Italia	3.0
5 HKS Nissan GT-R	3.0

1/4 MI

	sec @ mph
1 Bugatti Veyron 16.4	10.2@142.9
2 Saleen S7 Twin Turbo	10.6@139.8
3 Porsche 911 Turbo S	10.7@128.9
4 Lamborghini Murciélago LP670 SV	10.9@129.4
5 Lamborghini Gallardo Superleggera	11.0@128.9

SKIDPAD

	g
1 Dodge Viper SRT10 ACR	1.12
2 Chevrolet Corvette Z06	1.06
3 Rossion Q1	1.06
4 Callaway Corvette SC606	1.05
5 Porsche 911 GT3 RS	1.04

SLALOM

	mph
1 Porsche 911 GT3 RS	77.5
2 Porsche 911 GT2	75.9
3 Chevrolet Corvette ZR1	74.9
4 Nissan GT-R Premium	74.8
5 Porsche Boxster Spyder	74.6

Data apply to the model at the time (issue date) of testing. Legend: For engine types, I is an inline design, F is a flat; V and W describe cylinder configurations; the number following the letter is the number of cylinders. An additional letter, a "t" or an "s" designates turbo- or supercharging; "d" designates diesel; "FC" designates fuel cell; "Elec" designates electric motor; **boldface**=extremes in that particular category, excluding nonproduction cars; yellow= newest entries; na=not available, na/U.S.; "CL" *Car Life* magazine; [1]automatic transmission; [2]comparison test; [3]price at time of test, some estimated; [4]estimated; [5]electronically limited; [6]DIN bhp; [7]from previous test; [8]altitude-affected; [9]aero-limited; [10]Road Test Update.

INTERPRETING THE NUMBERS: Factors that affect test numbers include air temperature, barometric pressure, condition of track surface, tune of test car. When comparing cars' performances, look for the **Significant differences** in each category, as listed below. This is the amount of difference that is meaningful.

WEIGHT of a car is generally accurate to **within 1 percent.**

ACCELERATION numbers are obtained using drop-clutch starts and lift-throttle shifts.

Significant difference: 0–60 mph, 0.3 sec.; 1/4 mile, 0.5 sec.

TOP SPEED is typically as reported by the manufacturer, but occasionally we measure it on a closed test track.

Significant difference: 5.0 mph.

BRAKING distances are initiated when the pedal is touched, and just enough effort is used to avoid wheel locking; on cars equipped with anti-lock braking systems, the ABS is fully invoked.

Significant difference: 60–0 mph, 10 ft.; 80–0 mph, 15 ft.

HANDLING is quantified two ways: The skidpad measures steady-speed cornering grip around a 200-ft.-diameter circle (run in both directions). The slalom, run through eight cones spaced at 100-ft. intervals, samples both controllability and grip during transient handling.

Significant difference: Skidpad, 0.02g; slalom, 1.0 mph.

Our FUEL MILEAGE is measured largely during urban driving and typically falls between EPA's city and highway estimates.

Significant difference: 0.5 mpg.

MAKE & MODEL	ISSUE	PRICE AS TESTED[3]	ENGINE TYPE	HORSEPOWER, SAE	TORQUE, LB-FT	CURB WEIGHT, LB	0–60 MPH, SEC	0–100 MPH, SEC	1/4 MILE, SEC @ MPH	TOP SPEED, MPH[4]	BRAKING 60–0 MPH, FT	BRAKING 80–0 MPH, FT	SKIDPAD, G	SLALOM, MPH	OUR FUEL MILEAGE, MPG
Acura TL SH-AWD	5-10[2]	$44,195	V-6	305	273	3860	5.2	13.1	13.7@102.3	130[5]	113	198	0.91	68.4	15.8
Ameritech McLaren F1	12-97	$1,131,120	V-12	627	479	2840	3.4	7.7	11.6@125.0	231	127	215	0.86	64.5	11.5
Aston Martin DBS[1]	3-09[10]	$276,140	V-12	510	420	3940	4.1	9.2	12.4@114.9	191	111	193	0.95	71.4	na
Rapide[1]	9-10	$212,445	V-12	470	443	4385	4.7	10.9	13.1@109.5	188	119	214	0.92	69.7	12.0[4]
V8 Vantage Roadster	4-10[10,2]	$157,630	V-8	420	346	3775	4.5	10.2	12.8@113.3	180[5]	119	211	0.95	72.5	10.9
V12 Vantage Coupe	1-11[2]	$193,755	V-12	510	420	3800	4.3	9.3	12.5@116.8	190[5]	106	187	0.98	73.7	13.4
Audi A5 2.0T Quattro	4-10[10]	$45,150	I-4t	211	258	3645	6.2	16.4	14.8@95.2	130[5]	118	204	0.94	68.9	21.3[4]
A8[1]	12-10	$92,925	V-8	372	328	4395	4.8	12.1	13.4@105.4	130[5]	113	200	0.88	68.7	18.0[4]
R8 5.2 FSI	1-11[2]	$170,350	V-10	525	391	3725	3.7	8.4	11.9@118.7	196	112	199	0.97	72.9	13.6
S4 Quattro	5-10[2]	$58,675	V-6s	333	325	4010	4.5	11.0	12.9@108.6	155[5]	114	202	0.96	70.1	14.4
TTS[2]	11-09	$52,075	I-4t	265	258	3235	4.6	11.8	13.2@105.2	155[5]	115	202	0.98	72.0	19.9
Bentley Cont. Flying Spur Spd[1]	8-10[2]	$226,485	W-12tt	600	553	5575	4.3	11.0	12.9@108.5	201	116	202	0.90	61.2	14.1
Continental Supersports[1]	3-10[10]	$274,055	W-12tt	621	590	4915	3.6	8.7	11.9@117.4	204	118	207	0.90	66.3	13.0[4]
BMW 335i	5-10[2]	$47,625	I-6tt	300	300	3570	4.7	11.7	13.3@105.7	150[5]	119	210	0.91	68.4	18.4
335is	3-11[10]	$57,450	I-6tt	320	332	3560	4.6	11.2	13.2@106.2	150[5]	116	204	0.93	69.0	19.0[4]
550i	3-11	$68,525	V-8tt	400	450	4410	5.0	11.4	13.4@106.8	150[5]	125	218	0.88	66.0	17.8
550i Gran Turismo[1]	7-10[2]	$74,025	V-8tt	400	450	4720	5.1	11.6	13.4@106.5	155[5]	122	220	0.89	66.7	16.0[4]
750i[1]	10-10[2]	$95,725	V-8tt	400	450	4600	4.9	11.3	13.3@108.0	155[5]	119	210	0.89	68.2	14.9
Bugatti Veyron 16.4	2-07	**$1,482,200**	W-16qt	**1001**	**922**	4470	2.6	5.5	10.2@142.9	253	111	199	0.94	68.0	9.0[4]
Buick Regal CXL[1]	2-11[10]	$35,380	I-4t	220	258	3600	7.4	18.6	15.7@92.1	149	131	238	0.83	65.4	20.5
Cadillac CTS-V Coupe	1-11[10]	$69,585	V-8s	556	551	4210	4.3	9.9	12.6@114.8	191	115	201	0.91	69.7	15.0[4]
CTS-V Sport Wagon	3-11[10]	$70,185	V-8s	556	551	4510	4.3	9.9	12.6@114.5	190	116	204	0.88	70.4	17.8
Callaway Corvette SC606	9-10	$116,560	V-8s	606	553	3445	3.8	7.8	11.8@125.3	205	**106**	193	1.05	74.2	16.0
Chevrolet Camaro 2LT Coupe	8-10[10]	$29,175	V-6	304	273	3810	5.9	14.6	14.4@99.4	118[5]	115	206	0.85	68.4	18.3
Camaro SS Coupe	8-10[2]	$36,265	V-8	426	420	3870	4.6	10.6	13.0@110.7	155[5]	119	209	0.88	68.6	16.9
Corvette Grand Sport	2-10[10]	$68,365	V-8	436	428	3360	4.1	9.2	12.4@116.5	190[5]	112	197	0.96	70.7	17.0[4]
Corvette Z06	1-11[2]	$98,010	V-8	505	470	3305	3.6	8.2	11.9@123.5	193	114	199	1.06	74.1	16.9
Corvette ZR1	6-10[2]	$121,425	V-8s	638	604	3365	3.5	7.3	11.5@128.7	205	112	194	1.04	74.9	14.0
Volt[1]	2-11[2]	$43,485	I-4/Elec	149	273	3825	8.8	28.1	16.8@82.8	101[5]	127	231	0.79	62.6	50.0[4]
Dodge Challenger R/T	10-09[2]	$38,170	V-8	376	410	4135	5.8	13.8	14.1@101.2	142[5]	136	246	0.83	62.7	20.3
Viper SRT10 ACR	4-08[10]	$98,110	V-10	600	560	3430	3.4	8.0	11.6@122.6	177[5]	109	187	**1.12**	73.4	na
Ferrari California	2-10	$200,822	V-8	453	358	3925	3.5	8.6	11.9@116.9	193	**106**	188	0.96	69.2	14.0[4]
Enzo	7-03	$652,830	V-12	650	485	3230	3.3	6.6	11.1@133.0	218	109	188	1.01	73.0	13.3
458 Italia	12-10[2]	$280,572	V-8	570	398	3490	3.0	6.7	11.0@128.5	203	112	190	1.00	73.4	13.5
Ford Fiesta SES 5-Door	11-10[10]	$19,305	I-4	120	112	2580	9.7	**33.2**	17.2@80.6	118[5]	138	24	0.82	62.2	30.0[4]
GT	12-03	$150,525	V-8s	500	500	3390[4]	3.8	8.8	12.2@121.6	190	117	199	0.99	69.5	15.0[4]
Mustang GT Premium	8-10[2]	$39,680	V-8	412	390	3665	4.6	11.3	13.2@109.3	145[5]	116	204	0.91	70.6	17.5
Mustang V-6 Coupe Prem.	8-10[10]	$33,055	V-6	305	280	3520	5.4	13.5	14.0@101.4	113[5]	115	215	0.95	69.2	20.6
Shelby GT500	10-10[10]	$55,537	V-8s	550	510	3820	4.4	9.2	12.6@118.9	155[5]	117	197	1.00	69.6	16.0[4]
Taurus SHO[1]	12-09[2]	$42,985	V-6tt	365	350	4285	5.2	12.8	13.6@103.2	133[5]	122	216	0.88	64.8	17.5
Hennessey HPE700 Camaro	4-10	$125,000	V-8s	725	741	3930	4.1	8.0	12.0@125.4	201	117	204	0.92	71.0	11.0[4]
HKS Nissan GT-R	10-10[10]	$107,000	V-6tt	638	606	3900	3.0	6.8	11.1@128.9	195	122	205	0.97	73.8	na
Honda Accord V6 EX-L Coupe	1-11[2]	$32,480	V-6	271	251	3475	6.2	15.7	14.8@96.8	130[5]	138	225	0.84	62.9	18.0[4]
CR-Z EX	12-10[10]	$22,560	I-4/Elec	122	128	2654	8.6	24.7	16.4@83.7	123	128	226	0.82	66.8	32.0[4]
FCX Clarity[1]	5-09	$600/mo.	FC	134	189	3575	8.6	27.3	16.8@84.3	100[5]	129	241	0.82	64.1	na
Hyundai Genesis Coupe Track	6-09[2]	$30,345	V-6	306	266	3470	5.7	14.7	14.4@99.1	149[5]	118	211	0.90	69.3	18.0[4]
Sonata SE[1]	7-10[10]	$25,195	I-4	200	186	3340	7.5	20.6	15.8@89.1	135[5]	128	222	0.85	65.4	26.6
Infiniti G37S Sport	5-10[2]	$40,085	V-6	328	269	3665	5.1	12.3	13.6@105.6	159	117	210	0.90	67.8	16.6
M56[1]	1-11[2]	$68,145	V-8	420	417	3930	4.6	11.0	13.1@108.7	155[5]	121	214	0.87	66.7	17.9
Jaguar XFR[1]	8-09[2]	$80,000	V-8s	510	461	4405	4.3	9.6	12.6@115.3	155[5]	117	206	0.88	66.1	16.7
XJL Supercharged[1]	11-10	$90,500	V-8s	470	424	4350	4.4	10.2	12.8@112.3	155[5]	117	202	0.87	64.8	15.3
Kia Forte Koup SX	6-10[10]	$20,090	I-4	173	168	2920	6.9	18.9	15.4@92.3	130[5]	125	220	0.89	67.2	23.0[4]
Lamborghini Gallardo Balboni	11-09	$255,295	V-10	550[6]	398	3210[4]	3.5	7.5	11.5@126.7	199	115	200	0.95	72.5	13.0[4]
Gallardo Superleggera	12-10[2]	$282,180	V-10	562	398	3470	3.0	6.8	11.0@128.9	198	109	187	0.99	74.3	11.1
Murciélago LP670-4 SV	11-09	$480,325	V-12	670[6]	487	3660[4]	2.8	6.8	10.9@129.4	209	114	193	0.97	70.0	10.0[4]
Lexus HS 250h[1]	11-09[10]	$39,150	I-4/Elec	187	138	3690	8.2	na	16.2@88.6	112[5]	126	226	0.77	63.7	28.3
IS 350C[1]	12-09[2]	$49,415	V-6	306	277	3895	5.5	13.9	14.0@100.7	141[5]	133	236	0.81	64.5	19.0[4]
LFA	7-10	$388,475	V-10	560[6]	354	3580	3.8	7.8	11.8@124.4	202[5]	112	193	1.04	74.2	16.0[4]
LS 460 Sport[1]	10-10[2]	$76,014	V-8	380	367	4545	5.6	13.5	14.1@102.3	130[5]	123	227	0.84	64.5	15.8
Lincoln MKS EcoBoost[1]	10-09[10]	$56,625	V-6tt	355	350	4440[4]	5.0	12.4	13.6@103.8	131[5]	123	214	0.90	62.6	21.4
Lotus Evora	9-10[2]	$83,520	V-6	276	258	3100	4.9	12.1	13.4@103.9	162[5]	114	198	0.99	71.9	21.8
Maserati GranTurismo Conv.[1]	9-10	$144,335	V-8	440	361	4610	4.8	11.3	13.2@107.8	176	114	197	0.87	69.7	15.3
Mazda Mazda2 Touring	11-10[10]	$16,185	I-4	100	98	2305	9.4	na	17.2@80.8	112[5]	136	24	0.83	67.8	28.6
Mazdaspeed3	2-10[2]	$25,090	I-4t	263	280	3250	6.1	14.5	14.4@99.6	155[5]	126	219	0.90	68.8	17.0
Mercedes-Benz C63 AMG[1]	6-08[2]	$63,930	V-8	451	443	3920	4.1	9.7	12.5@114.4	155[5]	113	201	0.93	69.3	15.1
C350 Sport[1]	9-07	$44,500	V-6	268	258	3630	5.8	14.8	14.3@98.2	130[5]	135	241	0.81	63.8	21.0[4]
E63 AMG[1]	6-10[10]	$93,075	V-8	518	465	4285	4.1	9.5	12.5@115.1	155[5]	119	207	0.92	68.2	15.0[4]
E320 Bluetec[2]	7-07[10]	$59,375	V-6td	208	388	3860	6.7	17.2	15.0@93.2	130[5]	129	232	0.83	62.0	24.0
E550[1]	1-11[2]	$69,625	V-8	382	391	4150	4.6	11.3	13.1@107.9	130[5]	120	212	0.86	65.1	17.4
E550 Coupe[1]	9-09	$67,225	V-8	382	391	3810	4.7	11.1	13.1@108.9	130[5]	137	**252**	0.84	63.2	15.7
SL63 AMG[1]	4-10[10,2]	$143,460	V-8	518	465	4420	4.0	9.5	12.4@115.3	186[5]	120	211	0.89	66.6	10.0
SL65 AMG Black Series[1]	3-09	$304,350	V-12tt	661	738	4215	3.9	7.9	11.8@126.3	199[5]	112	192	0.99	70.3	14.2
SLR McLaren[1]	7-05	$455,750	V-8s	617	575	3860	3.5	7.5	11.5@126.1	207	107	186	0.97	69.6	18.0[4]
SLS AMG[1]	7-10	$202,150	V-8	563	479	3795	3.6	7.7	11.6@124.3	197[6]	112	194	0.96	71.8	10.8
Mini Cooper S Clubman	7-08[10]	$29,100	I-4t	172	177	2845	6.8	18.2	15.3@92.1	139[5]	120	213	0.89	67.2	27.0[4]
Cooper S	11-07[2]	$28,850	I-4t	172	177	2665	6.4	17.7	15.0@92.6	139[5]	122	214	0.85	67.9	29.8
John Cooper Works	2-09	$31,450	I-4t	208	192	2655	6.0	14.8	14.4@98.9	147[5]	121	210	0.91	71.3	27.0[4]
Mitsubishi Eclipse GT	8-07[2]	$27,694	V-6	263	260	3570	5.9	14.7	14.5@99.3	148	121	217	0.84	63.9	19.6
Lancer Evolution MR Touring	12-09[2]	$44,234	I-4t	291	300	3690	4.6	12.1	13.2@103.6	162[5]	120	211	0.92	69.2	18.1
Lancer Evolution SE	3-11[2,10]	$36,550	I-4t	291	300	3625	4.5	12.0	13.2@104.3	162[5]	119	207	0.97	70.2	15.0[4]
Lancer Ralliart	11-08[2]	$29,915	I-4t	237	253	3540	5.4	15.1	14.1@97.2	130[5]	129	227	0.84	66.7	17.3
Nissan GT-R Premium	6-10[2]	$85,340	V-6tt	485	434	3920	3.3	8.0	11.6@120.4	193	112	190	1.01	74.8	14.4
Juke SV	12-10[10]	$21,810	I-4t	188	177	2925	7.1	18.6	15.6@91.4	125[4,5]	133	238	0.84	67.3	25.0[4]
Leaf SL-E[1]	2-11[2]	$35,430	Elec	107	207	3415	9.4	na	17.2@79.0	**92**[5]	130	231	0.81	65.5	**118.0**[4]
Maxima 3.5 SV[1]	9-08	$34,940	V-6	290	261	3610	6.1	15.4	14.6@97.7	149[5]	121	219	0.86	65.4	18.8
Nismo 370Z	9-09[10]	$39,540	V-6	350	276	3300	5.0	12.0	13.5@106.6	155[5]	123	214	0.93	69.9	19.0[4]
370Z	4-09[2]	$33,740	V-6	332	270	3360	5.2	12.8	13.7@103.9	155[5]	115	208	0.98	69.5	18.7
Porsche Boxster Spyder	3-10	$79,210	F-6	320	273	2940	4.4	10.4	12.8@109.6	166[5]	112	202	1.02	74.6	19.0[4]
Carrera GT	6-04	$460,400	V-10	605	435	3530[4]	3.6	7.0	11.3@131.6	205	124	199	0.99	71.1	11.0[4]
Cayman S	9-10[2]	$70,915	F-6	320	273	3100	4.6	10.6	12.9@108.8	172[6]	117	204	1.00	72.6	20.9
Panamera[1]	2-11[10]	$101,669	V-6	300	295	4105	5.4	13.6	14.0@101.4	160[6]	113	196	0.96	71.2	19.0[4]
Panamera Turbo	12-09	$153,615	V-8tt	500	516	4635	3.4	8.4	11.7@118.0	188	116	204	0.96	69.1	16.3
911 Carrera GTS	3-11[10]	$113,605	F-6	408	310	3380	3.8	9.0	12.1@115.4	188	109	192	0.95	72.6	21.9
911 GT2	12-08	$198,875	F-6tt	530	501	3265	3.4	7.7	11.5@123.9	204	108	187	1.03	75.9	15.0[4]
911 GT3 RS	3-11[10]	$151,980	F-6	450	317	3190	3.7	8.0	11.8@122.6	193	108	187	1.04	**77.5**	16.6
911 Speedster	3-11[10]	$204,950	F-6	408	310	3520	3.9	9.2	12.2@114.6	190	111	192	0.97	73.4	19.4
911 Turbo	6-10[2]	$149,370	F-6tt	500	480	3535	3.5	7.9	11.7@121.8	194	112	195	1.01	73.0	16.0
911 Turbo S	1-11[2]	$162,460	F-6tt	530	516	3590	**2.6**	6.3	10.7@128.9	195	107	**185**	1.02	73.3	15.1
Rolls-Royce Ghost[1]	8-10[2]	$308,350	V-12tt	563	575	5495	4.7	10.2	12.9@114.3	155[5]	119	209	0.85	60.1	16.5
Phantom[1]	8-06[10]	$346,650	V-12	453	531	**5810**	5.9	15.3	14.5@97.4	149[6]	123	219	0.77	57.9	11.7
Rossion Q1	1-10	$108,151	V-6tt	450	390	2675	3.2	7.8	11.6@121.6	185	130	217	1.06	73.0	18.0[4]
Saleen S7 Twin Turbo	9-06[10]	$602,442	V-8tt	750	700	2900[4]	3.3	6.0	10.6@139.8	250	119	210	1.03	69.9	13.0[4]
Shelby GT500 Super Snake	12-07	$70,670	V-8s	605	590	3915	4.4	9.1	12.5@119.9	150[6]	118	204	0.93	68.4	15.6
Smart ForTwo passion coupe	3-08	**$15,625**	I-3	**70**	**68**	**1825**	**13.3**	na	**19.2@70.5**	**90**[5]	130	230	**0.72**	**57.6**	32.0[4]
Spyker C8 Spyder	3-07	$296,785	V-8	400	354	2985	4.4	10.3	12.7@112.0	160	120	204	0.92	67.1	18.0
Subaru Impreza WRX	11-08[2]	$28,660	F-4t	265	244	3230	5.1	13.5	13.8@101.0	140[6]	124	221	0.87	67.0	22.2
Impreza WRX STI Limited	3-11[2,10]	$39,870	I-4t	305	290	3455	4.9	13.3	13.4@100.6	155	119	211	0.91	70.9	16.0[4]
Legacy 2.5GT Limited	5-10[10]	$34,146	F-4t	265	258	3500	5.8	15.2	14.3@97.2	150[6]	116	222	0.84	67.2	19.0
Legacy 3.6R Limited[1]	12-09[10]	$32,383	F-6	256	247	3555	6.5	16.7	14.9@95.6	149[6]	129	232	0.81	63.8	19.2
Tesla Roadster	2-09	$118,400	Elec	248	276	2750	4.0	11.1	12.7@105.3	121	119	210	0.92	68.6	132/chg[4]
Roadster Sport	5-10[10]	$159,145	Elec	288	295	2790	3.7	10.9	12.6@104.9	125[5]	123	210	0.96	70.3	160/chg[4]
Volkswagen CC 3.6L 4Motion[1]	7-09[2]	$42,630	V-6	280	265	3855	6.1	15.5	14.5@97.0	130[5]	127	225	0.91	66.5	19.2
Golf TDI	4-10[10]	$27,090	I-4td	140	236	3120	8.8	24.5	16.6@83.9	125[5]	132	233	0.84	64.4	38.9
Golf GTI 3-dr	8-10[10]	$31,900	I-4t	200	207	3370	6.1	15.8	14.6@96.9	130[5]	**143**	247	0.86	66.2	25.0[4]
Golf GTI 5-dr	8-10[10]	$24,789	I-4t	200	207	3285	6.6	16.1	14.9@96.2	130[5]	136	237	0.88	67.1	25.0[4]
R32	12-07[10]	$35,430	V-6	250	236	3720	6.0	16.3	14.6@95.0	130[5]	134	237	0.85	65.9	18.2
Volvo C30 Version 2.0	11-07[2]	$27,700	I-5t	227	236	3200	6.5	16.3	14.9@95.8	149[6]	122	218	0.85	66.3	22.8
S60 T6 AWD[1]	2-11	$46,200	I-6t	300	325	3950	5.5	13.9	14.1@100.6	130[5]	118	210	0.87	69.5	20.2
S80 V8 AWD[1]	6-07	$56,025	V-8	311	325	4080	5.6	14.3	14.2@99.4	155[5]	123	210	0.85	64.6	16.3
V70[1]	5-08[10]	$34,410	I-6	235	236	3530	7.3	18.6	15.6@92.3	130[5]	131	230	0.82	63.0	21.5[4]

R&T Classics

The following cars are chosen from thousands in our Road Test archives. Some may have relevance to stories in this issue; others are here purely to pique your curiosity.

MAKE & MODEL	ISSUE	PRICE AS TESTED[3]	ENGINE TYPE	HORSEPOWER, SAE	TORQUE, LB-FT	CURB WEIGHT, LB	0–60 MPH, SEC	0–100 MPH, SEC	1/4 MILE, SEC @ MPH	TOP SPEED, MPH[4]	BRAKING 60–0 MPH, FT	BRAKING 80–0 MPH, FT	SKIDPAD, G	SLALOM, MPH	OUR FUEL MILEAGE, MPG
BMW 530i	6-04[2]	$54,120	I-6	225	214	3660	7.2	19.2	15.5@90.8	150[5]	131	231	0.83	60.7	21.1
Dodge Charger[1]	2-67[CL]	$5289	V-8	425	490	4160	6.4	16.4	14.2@96.2	134	143[4]	255[4]	na	na	10.1
Dodge Charger R/T[1]	1-06	$33,645	V-8	340	390	4150	5.9	14.4	14.3@99.8	126[5]	132	240	0.77	61.4	18.0[5]
Ferrari 612 Scaglietti[1]	9-05	$269,829	V-12	532	434	4260	4.6	10.2	12.8@115.4	199	115	202	0.91	66.0	9.4
Infiniti G20	10-90	$19,700	I-4	140	132	3000	10.0	na	17.6@78.5	130	150	268	0.80	61.5	24.0

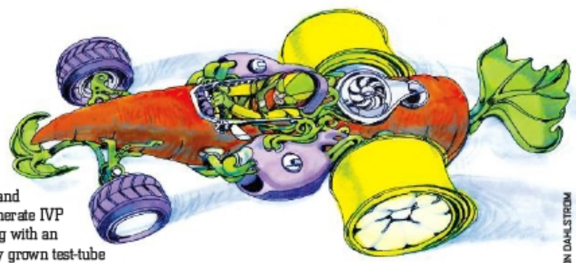
ROAD TEST ARCHIVE—DOWNLOAD OVER 250 DATA PANELS AND THE CURRENT ROAD TEST SUMMARY: roadandtrack.com/data

P.S.

Formula 1 announces new greener engines for 2013

The Swiss manufacturer Red Cow's rumored "GREEN STEP RACER" has been spotted running tests in Europe and South America, pushing the green envelope with an exclusive onboard methane fuel refinery, dairy and cheese shop.

The newly formed Taiwan Racing Group unveiled their Prototype Green F1 Racer, the TAI-COB 1. This car features a mono-cob chassis, and is powered by a corn oil and butter mixture contained in bright yellow energy pods attached along the body. On-site observers reported strange popping sounds under acceleration.



The long-rumored International Vegetable and Pharmaceutical Conglomerate IVP is jumping into F1 racing with an experimental organically grown test-tube V-8, powered by a potent mix of vegetable stew and pond scum. From its carrot nose to its banana peel racing slicks, each of these Green Racers will be bioengineered to take full advantage of the specific characteristics of all the circuits.

TEXT & ILLOS BY JON DAHLSTROM

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ROAD & TRACK (ISSN 0035-7189), (USPS 570-670), April 2011, Volume 62, Number 8, is published monthly by Hachette Filipacchi Media U.S. Inc., 1271 Avenue of the Americas, New York, NY 10020. Periodicals postage paid at New York, NY 10001 and at additional mailing offices. Authorized periodicals postage by the Post Office Department, Ottawa, Canada, and for payment in cash.
POSTMASTER: Send address changes to Road & Track, P.O. Box 422524, Palm Coast, FL 32142-8768; U.S. and Canada: (800) 876-8316, Foreign: (386) 597-4375; Email: roadandtrack@emailcustomerservice.com. If the postal services alert us that your magazine is undeliverable, we have no further obligation unless we receive a corrected address within one year.

CANADIAN IDENTIFICATION STATEMENT: Publications Mail Agreement No. 40052054. Canadian Registration Number 126018209RT0001. Return undeliverable Canadian addresses to: P.O. Box 503, RPO West Beaver Creek, Richmond Hill, ON L4B 4R6, Canada. Email: roadandtrack@emailcustomerservice.com