

FIXING THE U.S. BORDER FENCE

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Popular Mechanics

PM TEST:
**BIG HONKIN'
CHAIN SAWS**

HOME OUTDOORS AUTOMOTIVE SCIENCE TECHNOLOGY

SPACE DIVE

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New Tricks—**
HOW TO GUARD YOUR PC

The Right Tires for Your Car

diy

Defog
Headlights

Hang a
Hammock

Upgrade
Switch
Plates



Felix Baumgartner plans to ascend to the stratosphere in a capsule tethered to a helium balloon—then jump out.

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2010

Aug.

PM FEATURES

VOL. 187 NO. 8

54 The Highest Dive

The record for the longest free-fall—102,800 feet from a high-altitude balloon—has stood for 50 years. This summer, two men race to soar even higher and make supersonic jumps from the edge of space.

BY JENNIFER BOGO

66 The Good Guys

Despite the rocky economy, Americans are participating in community service more than ever. PM salutes four neighborhood heroes who are making a difference, from leading outdoors trips for at-risk kids to building homes for disabled vets.

BY DAVIN COBURN

62 Mending Fences

Most people agree that a well-regulated border is essential for national security—but after two decades of construction, the southern boundary's 650 miles of physical barriers are often breached. Why is it so hard to build a good fence?

BY DAN KOEPEL

70 Steam Punks

Steam cars fell out of vogue in the early 20th century. But that didn't stop a modern British racing team from constructing one such vehicle using a hodgepodge of parts in a bid to claim the dubious title of "World's Fastest Steam-Powered Car."

BY JEFF WISE



In a vertical wind tunnel at California's Perris Valley Indoor Skydiving facility, Felix Baumgartner trains for his 22.7-mile-high leap.

ON THE COVER

Our cover image of Felix Baumgartner's high-dive capsule is a composite based on a variety of photographs and computer-generated models. It was created by Jeremy Hunt of Screaming Death Monkey VFX.



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WHAT THEY'RE DOING



DANIEL H. WILSON

Robotist Daniel Wilson is simultaneously expanding his techno-imaginative reach to fiction and the movies. Film rights for his first novel, *Robopocalypse*, have been purchased by DreamWorks while the story is still being written. The book is scheduled to come out next summer, but no release date has been set for the movie. Meanwhile, Wilson's latest book, *Bro Jitsu*, a combat guide, was released in April.



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OF PREDICTIONS FOR THE FUTURE.

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PM LETTERS

Electric Surge

I thoroughly enjoyed "The Electric Plug-In Acid Test," Erik Sofge's look at the challenges of rolling out electric vehicles. I'm hoping we can convince people that pure EVs can be a viable way to reduce fossil fuel consumption and pollution. And I'll be interested to see if engineers solve the problem of charging stations tied to the grid, which will place high demands on our fragile system. Thanks for the thought-provoking story.

TIM FARRELL
FORT MADISON, IA

Surviving Snakebites

I recently read "The Venom Crisis," about the looming expiration of the current stock of antivenom for coral snakebites. As a survivor of a coral snakebite who almost died from lack of available antivenom, I think it's absolutely ludicrous that we'll soon run out of a ready supply. My bite landed me in the emergency room and intensive care for two days, plus a week or two of recovery. After I was

bitten, I was contacted by snakebite experts in San Antonio, who informed me that snakebites are becoming more frequent. It's quite irrational to stop producing such an important medicine.

LINDSEY KANG
HOUSTON, TX

Freedom of the Road

Nice job to Ezra Dyer for his story "Flat Out," about racing culture and record setting on the Bonneville Salt Flats. I laughed as I read it. Nothing gets the adrenaline pumping like reading an article that

resurrects feelings of the '60s, when people found every opportunity to burn rubber and take cars to the limit. I am even thinking of going to Bonneville this summer. Keep up the good work.

SCOTT SUTHERLAND
NEWBERG, OR

I very much enjoyed "Flat Out." The writing was snappy and informative and filled with good-natured humor. Best part: Dyer's positive attitude on his speeding ticket.

CHARLES BLEDSOE
WALLED LAKE, MI

CORRECTION: In June's "Uncovering Battery Drains," the caption for the initial multimeter reading should have read 610 mA.



ISSUE

06/10



Readers responded to our stories about the antivenom shortage, Bonneville racing and plug-in hybrid electric vehicles.



KIDS DO GREAT THINGS!

How will humans travel in the years to come? POPULAR MECHANICS and Old Navy invited children to answer that question by drawing a PM cover showcasing the theme "The Future of Transportation." Congratulations to Arnon E. of Davis, Calif., who created the winning cover! Arnon received a \$500 shopping spree, and Old Navy made a donation to FIRST Robotics, a program that promotes the fun of science education through robotics engineering and competition.

what do you think?



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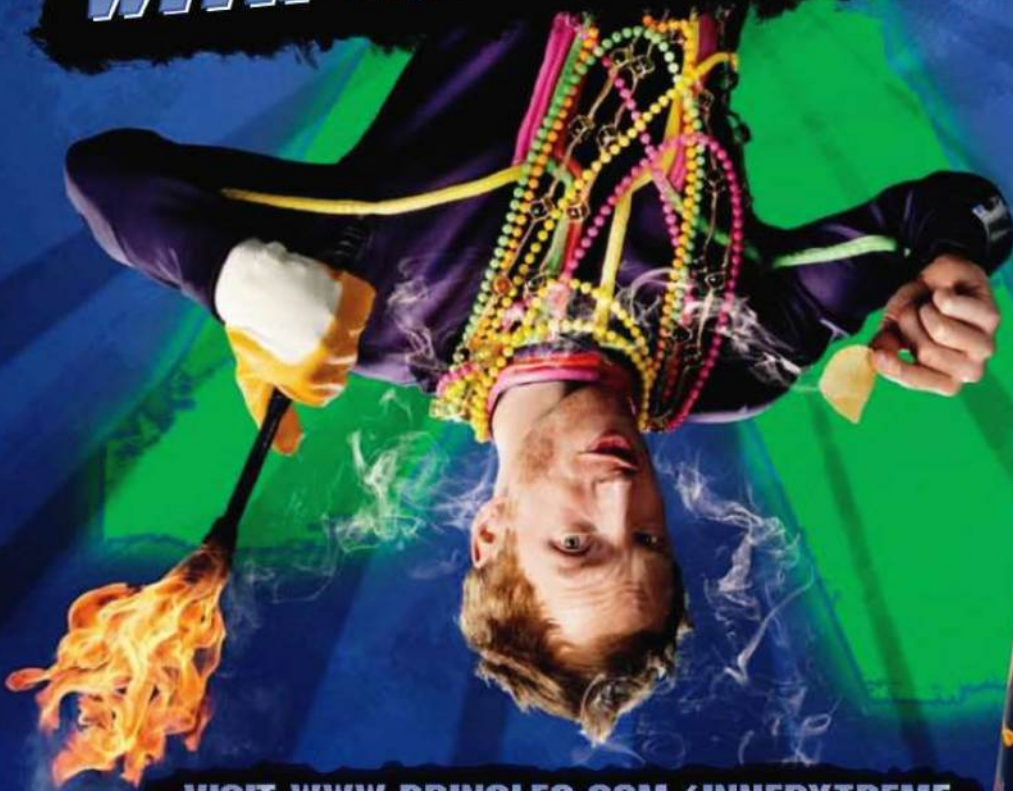
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Big Fixes



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BETTER FUEL In the wake of the largest oil spill in U.S. history, scientists are upping their efforts to find oil alternatives. We report on fuel-making microbes, biodiesel-bearing algae and other future fuels. popularmechanics.com/science/energy

SMARTER GADGETS We envision a future where the phone is a holographic computer, an interactive projector and a key to your house. Our experts shed light on tech advances such as green lasers and smarter memory that will cement this vision. popularmechanics.com/technology/gadgets

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IN THE JUNE 2010 ISSUE OF POPULAR MECHANICS' TOPSHOP SECTION, TIP NO. 10 BY MOTHERS SUGGESTED TO SOAK A PAPER TOWEL IN UNDILUTED MOTHERS CAR WASH AND LET IT ABSORB FOR A FEW MINUTES. THE TIP SHOULD HAVE SUGGESTED:

NO TIME TO WASH? SO LONG AS YOUR CAR ISN'T TOO DIRTY, YOU CAN USE MOTHERS SHOWTIME INSTANT DETAILER OR SPRAY WAX. THESE PRODUCTS WILL SAVE TIME AND WATER. THE TRICK IS TO EXAMINE HOW MUCH DUST IS ON THE CAR AND WHAT SORT. IF THERE'S A LIGHT LAYER OF DUST, FINGERPRINTS OR EVEN SMUDGES, YOU CAN MAKE QUICK WORK OF THEM. ANY MORE THAN A LIGHT LAYER WILL REQUIRE WASHING WITH MOTHERS CAR WASH AND WATER.

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Joel Wasserman,
KILZ primer user and
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*Compared against prior generation V8 engine. **The available Around View™ Monitor is a parking aid and cannot completely eliminate blind spots or warn of moving objects. Always check your surroundings before moving the vehicle. Always wear your seat belt, and please don't drink and drive. ©2010 INFINITI.



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After rigorous testing, researchers in England and Australia have crowned a species of dung beetle the world's strongest insect. Male *Onthophagus taurus* beetles are capable of pulling up to 1141 times their own weight—a feat equivalent to a 154-pound person pulling six full double-decker buses.

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BASE:
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UNDERCARRIAGE

PILOT LOAD:
280-PLUS LB



Two-Stroke Jet Pack

New Zealand-based Martin Aircraft Company announced a \$12 million joint venture to build a factory for producing a new kind of jet pack. Only, the pack doesn't have a jet engine at all. The craft uses a 200-hp engine running on ordinary gasoline to power two ducted fans. Riders can cruise for 31.5 miles at the FAA-mandated maximum speed of 63 mph, controlling pitch and roll with one hand and yaw and throttle with the other. The company is charging around \$100,000 for the first units. Owners won't need a pilot's license, but they will have to pass a mandated training program. — ALEX HUTCHINSON

GAME-CHANGING TECH



28 Days Later

“One million iPads in 28 days—that’s less than half of the 74 days it took to achieve this milestone with iPhone.”

— Steve Jobs, Apple's CEO

QUICK HITS

Onion Power

Gills Onions produces up to 300,000 pounds of peels a day. Rather than waste them, the California company is now using the refuse to run its processing facility.



Engineers installed machinery at the plant to grind and press the peels into 30,000 gallons of onion juice, which is fed into an anaerobic digester to produce methane that powers two 300-kw fuel cells. The system also presses the solid remains into 20 tons of onion cake that the company sells as cattle feed. Gills Onions

expects the \$9.5 million project, which earned this year's top award from the American Council of Engineering Companies, to pay for itself within six years.

Touchy Electronics

As portable electronics shrink, our fingers become too large to press tiny buttons and our



eyes too weak to read small screens. A computer science Ph.D. at Carnegie Mellon University has come up with a novel solution: use the human body as a proxy. To work, the device

projects a screen and keypad onto the skin. Piezoelectric vibration sensors detect taps and finger flicks and translate them into commands. A prototype of the “Skinput” system straps to the upper arm, but the researchers expect future versions to shrink to the size of a wristwatch. — A.H.

Bruce Lund's Biggest Hits

1984 »
 1986 »
 1994 »
 2006 »
 2009 »
 2010 »

INVENTORS
 AT WORK

Toyman Turns Weaponeer



Lund & Co. Invention, an independent toy-maker that invents products for manufacturers, founded in Chicago.



Milton Bradley buys Lund's board game **Fireball Island**, now a cult classic among gamers.



Hasbro debuts **Baby Alive Sip 'n Slurp**, a doll that can eat food and wet her diaper.



T.M.X. Elmo, a special edition of the popular giggling toy, sells more on launch day than any toy in history.



Vivid Imaginations hires Lund to create **Honey, My Baby Pony**, one of the year's top sellers.



Lund (left) introduces the hydrogen-powered **Variable Velocity Weapon System** for police and military use.

Bruce Lund, CEO of Lund & Co. Invention, built his company's reputation developing hit toys like Honey, My Baby Pony and T.M.X. Elmo. But his latest product is hardly a plaything: a weapon for the military nicknamed the Big Hurt.

Lund's path to weaponeer began in 2001 when, recalling a seventh-grade science demonstration, he built a toy rocket that used hydrogen gas as the propellant. Six years later, when the Pentagon issued a request for new technologies to power nonlethal weapons, Lund applied the same concept to the Variable Velocity Weapon System (VVWS). Whereas current nonlethal military weapons are refilled from heavy and expensive compressed-air tanks, the VVWS utilizes the high concentration of hydrogen in cans of MAPP gas sold at hardware stores. "You might view the VVWS as a repurposed nail gun," Lund says.

The problem with existing nonlethal weapons that fire rubber bullets, beanbags and other rounds is velocity: Anything effective at 50 yards may be lethal at 5 yards, and a projectile safe at 5 yards won't stop anyone 50 yards away. Lund's weapon varies muzzle velocity based on distance. A soldier uses a laser scope to determine target range, and the weapon automatically provides the appropriate amount of hydrogen gas.

The inventor's next challenge will be to make a more robust prototype and find a commercial partner for production. But whatever the future of the VVWS, Lund doubts weaponearing will lure him away from his true vocation. "Nothing is more fun than making toys," he says. — DAVID HAMBLING

CRISIS IN THE GULF

Robots Rise to Track Sinking Oil



After an explosion gutted the Deepwater Horizon drilling platform this spring, energy firm BP deployed remote-operated vehicles (ROVs)—underwater robots that are tethered to the surface by power and control cables—to track the oil pouring into the Gulf of Mexico. But joystick-controlled ROVs need too much tending to track an ever-growing subsurface oil slick. To get more persistent coverage, the government recruited advanced civilian robots: **Slocum Gliders, 6-foot-long, 110-pound autonomous underwater vehicles (AUVs) that can operate for up to a month without human intervention.** Researchers at Rutgers University in New Jersey are providing at least one robot and UV light sensors that detect the fluorescence of compounds present in submerged oil. The scientists also integrated the sensors on robotic subsurface gliders donated by other organizations. If the AUVs prove themselves during this emergency, they could inspire the oil industry to fund research into underwater robots that can independently undertake long missions. — ERIK SOFGE



I'D NEVER LET A MICRON OF DIRT COME BETWEEN US.

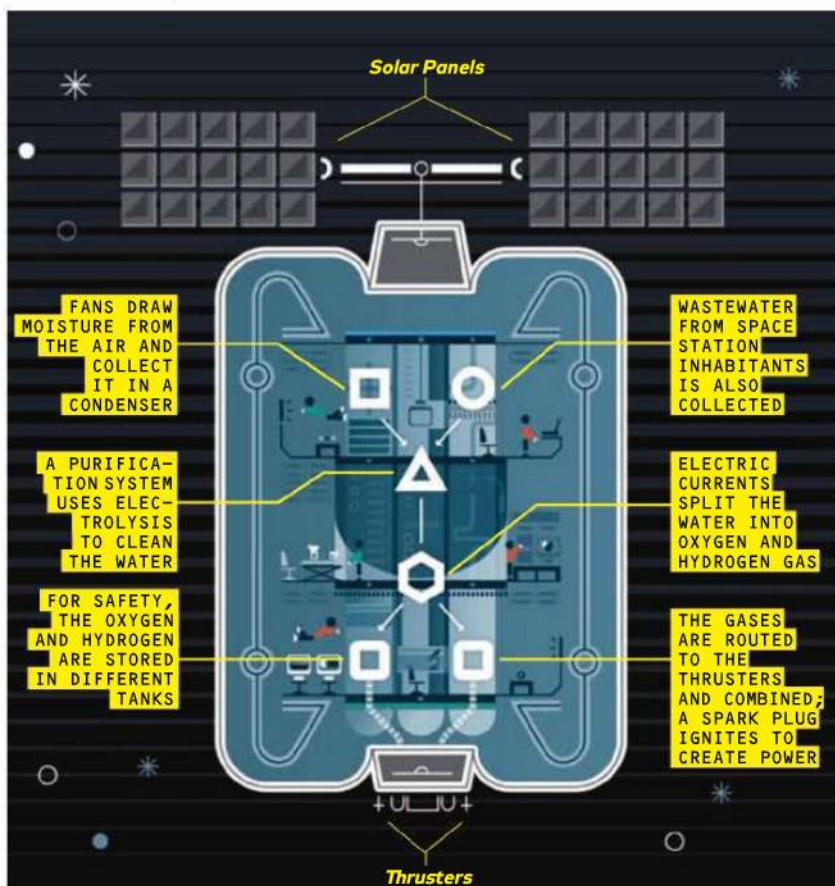
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PIONEERING SPACE



From Flush to Thrust

To maximize efficiency, everything inside a space station should be reused, including the sweat, urine and wastewater of its inhabitants. Las Vegas-based Bigelow Aerospace—which is currently building inflatable, orbital habitats to rent to customers—will be recycling these fluids to power the station's thrusters. The system, designed by Orion Propulsion (now owned by Dynetics), collects and purifies the wastewater before using an electric current to break it into hydrogen and oxygen. The thrusters ignite the gases to provide force that keeps the station stable and correctly positioned in orbit.

The space station operators have good reason for replacing propellants such as hydrazine or nitrogen tetroxide with water collected from a life-support system: money. "The price per pound to get anything up there is so high, we're trying to maximize what they've already got," says Tim Pickens, Orion's founder and the thruster's designer. These hydrogen-and-oxygen engines also produce double the specific impulse that hydrazine thrusters do, and don't rely on toxic fuels.

Bigelow already launched two prototypes into orbit, but won't light a vacancy sign until private space companies create the craft that will deliver customers. The company expects tourists and microgravity researchers to be the first to sign up for visits. — JOE PAPPALARDO



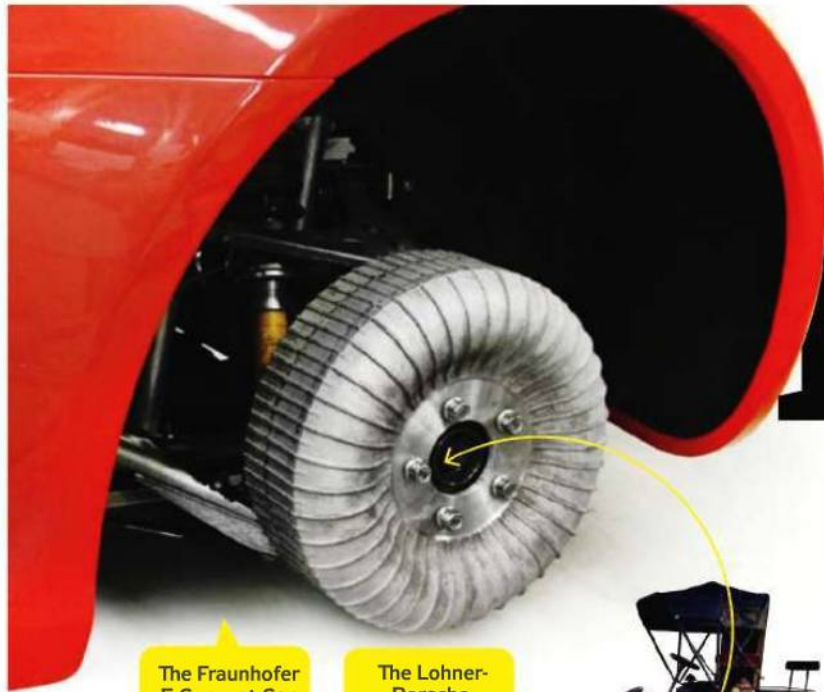
UNRAVELING
THE PAST

4% Caveman

Genetic analysis proves that early humans interbred with Neanderthals, according to researchers at the Max Planck Institute for Evolutionary Anthropology in Germany. Using DNA fragments from ancient bones, the team sequenced 60 percent of the Neanderthal genome and found that humans in Asia and Europe share between 1 and 4 percent of their DNA with the ancient hominid. The researchers also identified genetic differences related to cognitive functions and bone development that may have helped modern man flourish, whereas Neanderthals died out 30,000 years ago.

What's Old Is New

Researchers at Germany's Fraunhofer Institute recently unveiled their vision of the electric car—but the technology would have been familiar to Ferdinand Porsche, the icon of German automotive engineering. The Fraunhofer E-Concept Car uses wheel-hub motors (left) that were a prominent feature of the Lohner-Porsche, invented in 1900. The power and control electronics are integrated into the hub motor, freeing up space under the hood and eliminating the need for a transmission. The researchers say the high-power density of the new motors, along with a carefully configured chassis, helps the car avoid the handling problems that have plagued previous wheel-mounted designs. — ALEX HUTCHINSON



The Fraunhofer E-Concept Car, introduced in Germany in 2010.

The Lohner-Porsche, unveiled at the 1900 World Fair in Paris.



SCIENCE OF WARFARE

Bolt-Action Bruiser

For snipers, every war is different. Recognizing the conditions these specialized troops face in Afghanistan, the Pentagon is upgrading its inventory of 22-year-old Remington bolt-action rifles. "The engagements in Afghanistan are at a lot farther distance than in Iraq," says Milo Afong, author of *Hunters: U.S. Snipers in the War on Terror*. Plus, he says, they take place at higher altitudes and in less populated areas. To compensate, the M24's barrel has been modified to shoot larger .300 Winchester Magnum rounds instead of 7.62-mm NATO ammunition, extending the rifle's effective range from 850 yards to about 1300 yards. The Army invested \$5.6 million in the weapons, which will be delivered to troops this fall. — ROXANA TIRON

M24 In 1988 the Army adopted this bolt-action rifle, shown here without modifications, for use by its snipers.

Chassis The M24 customized for use in Afghanistan will have a rail chassis that provides space for more accessories, including night-vision gear, which will clip to the rail in front of the scope.

Ergonomic Stock The M24's new stock features an adjustable butt plate so that snipers wearing body armor can use it easily. A collapsible stock will make it more compact.

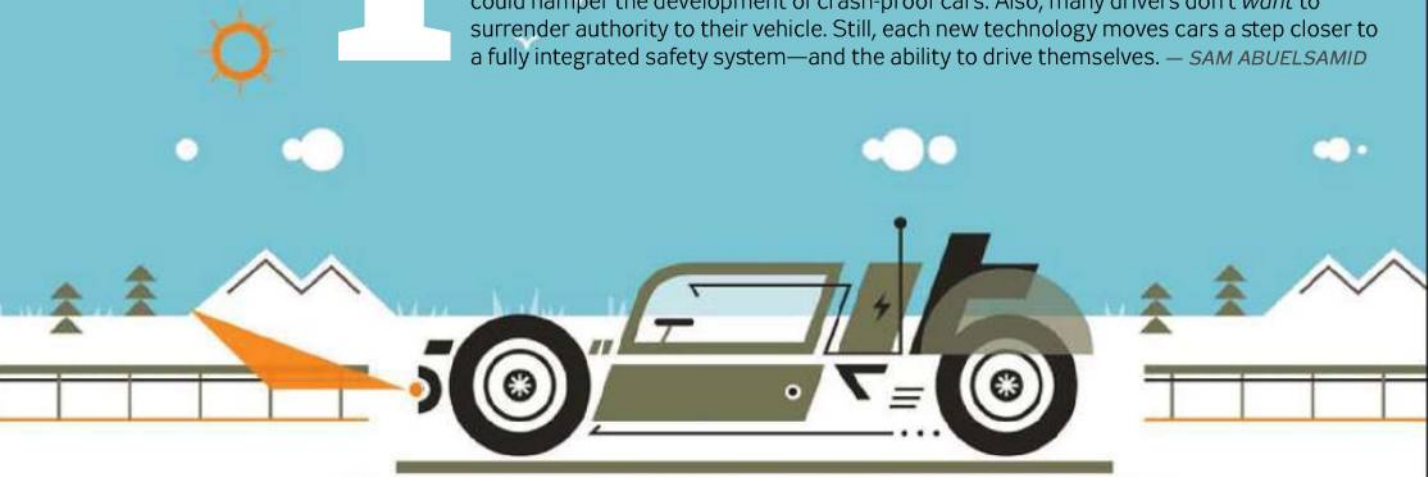
Signature Suppressor The military will, for the first time, fit the M24 with a suppressor, which reduces the rifle's noise and distorts the telltale sound (called the signature) that enemies use to identify a shooter. The mod will allow snipers to stay in their hiding positions longer after they fire.

Optic Scope The rifle will be modified with a variable power scope that can reach as high as 25x magnification. Snipers can also utilize a rangefinder so that they no longer have to perform distance calculations.



Cars Don't Crash, People Do

Is it possible to build a car that can't be involved in an accident? Engineers are certainly trying—by taking control away from drivers and ceding it to the vehicles. The building blocks of autonomous cars already exist in today's models: Antilock braking systems have been able to override driver input since the '70s. "From the researcher perspective, we think that the sensor equipment is available. But we have other problems," says Burkhard Huhnke, director of the Volkswagen's Electronics Research Laboratory in Palo Alto, Calif. For instance, liability issues and manufacturers' reluctance to share proprietary information could hamper the development of crash-proof cars. Also, many drivers don't want to surrender authority to their vehicle. Still, each new technology moves cars a step closer to a fully integrated safety system—and the ability to drive themselves. — SAM ABUELSAMID



1 HOW TO STEER

As manufacturers convert more vehicles to electric power, they will likely adopt drive-by-wire systems: Turning the wheel will not directly move any gears or steering arms. Instead, the motion sends a digital signal to actuators in each wheel to perform the turn. Steering control systems can also automatically tweak the relative angles of each wheel separately, maximizing handling performance.



2 WHERE TO NAVIGATE

Truly autonomous cars will be able to communicate with each other and with road infrastructure. With such a network in place, vehicles could slow or stop to avoid impending hazards or instruct navigation systems to find alternate routes. The Japanese government is deploying infrared transmitters and wireless beacons at intersections that warn of red-light runners and stop-sign violators by measuring vehicles' speeds and locations.



3 WHEN TO STOP

Adaptive cruise-control systems can use radar to detect the distance to other vehicles, bring the car to a complete stop and automatically resume acceleration when traffic picks up. The manufacturer's next step is automatic collision avoidance: Researchers at Audi and Volvo are linking radar signals with ultrasonic, laser and optical sensors that enable a vehicle to identify approaching pedestrians or vehicles and stop before the driver sees the danger.



4 HOW TO HANDLE

Satellite navigation will become more precise and could provide a vehicle with information on its dynamic parameters. For example, a car with GPS antennas mounted on its front and back could determine the slip angle between the tires and the road by comparing the subtle difference between the way the car is pointing and the direction the vehicle is heading. With such data, a car could drive itself with more panache than its owner.

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The Connect Kit is compatible with most iPod models and iPhone. In the event of audio interference, set iPhone to airplane mode. *Bose payment plan available on orders of \$299-\$1500 paid by major credit card. Separate financing offers may be available for select products. See website for details. Down payment is 1/12 the product price plus applicable tax and shipping charges, charged when your order is shipped. Then, your credit card will be billed for 11 equal monthly installments beginning approximately one month from the date your order is shipped, with 0% APR and no interest charges from Bose. Credit card rules and interest may apply. U.S. residents only. Limit one active financing program per customer. ©2010 Bose Corporation. Patent rights issued and/or pending. The distinctive design of the Wave® music system is a registered trademark of Bose Corporation. Financing and free shipping offers not to be combined with other offers or applied to previous purchases. Prices and/or offers subject to change without notice. Risk free refers to 30-day trial only and does not include return shipping. Delivery is subject to product availability. iPod and iPhone are trademarks of Apple Inc. All other marks are property of Bose Corporation. Quotes reprinted with permission: Thomas Jackson, *Forbes FYI*, Winter'04.

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Spin Machine



Arthur (Joseph Gordon-Levitt) picks a fight in a revolving corridor in *Inception*.

would make actors appear as though they were walking on walls and otherwise defying the laws of physics.

The most complicated of Nolan's trippy sequences involved a fight inside a 120-foot-long by 30-foot-wide revolving corridor. The room was constructed of wood and backed by steel tubing; Corbould's team placed seven steel I-beam rings with roller wheels every 16 feet along the length of the corridor. The wheels were connected to two 55-hp electric motors, which were synchronized by a computer. Filmmakers only had to press a button to make the rig move; the corridor could complete one revolution every 10 seconds and rotate both clockwise and counter-clockwise. Tracks for cameras were built into the room to shoot the scene. "We'd program the camera to be at a certain spot at a certain point of the revolution when the actors were in a certain position," Corbould says.

The actors trained for two weeks to prepare for the sequence. "It's one thing to have a fight; it's another thing to have a fight in a rotating room," Corbould says. "The first time you get in, it's disorienting." But the actors—Joseph Gordon-Levitt in particular—rose to the occasion. "He threw himself into making it work," Corbould says. "You need somebody who can pull the most out of a rig like this. And he did." —ERIN MCCARTHY

M

ost of the action in Christopher Nolan's *Inception*, out July 16, takes place within the human mind—specifically, when people are dreaming. Using a machine called the PASIV Device, agents can invade a target's dream and steal, or even plant, ideas. To make these mind games a physical reality, a team led by special-effects supervisor Chris Corbould had to build unique rigs that



« ACTOR JOSEPH GORDON-LEVITT TALKS TRAINING AND FILMING IN *INCEPTION*'S VARIOUS REVOLVING RIGS.

What training did you do for the sequence?

It was two weeks full-time, divided between basic physical training, combat, wire work and revolving corridor. On one

hand it was incredibly challenging. On the other hand it felt like playing in my backyard as a kid.

How did you keep your bearings?

The corridor rotates in a constant

rhythm, and you have to stay on beat. You have to know when the floor becomes the wall and the wall becomes the ceiling. I would count and repeat melodies—usually

Bach—in my head to keep me on time.

Were any parts more difficult than others?

There are two rotating sets. The narrow corridor was more physically demanding,

because you had to jump from floor to wall more often. But the larger room had less tolerance for error, because if you got behind the rotation, you could be looking at a 25-foot drop.

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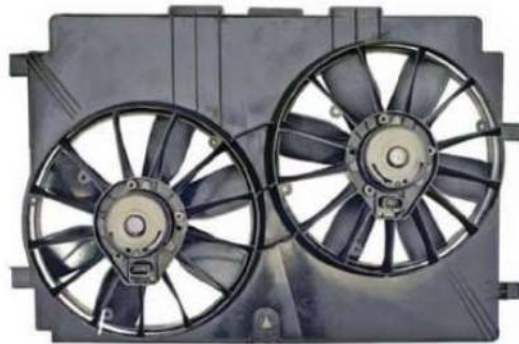
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Upgrade

Bulk Smash

→ Demolition tools can be imposing, beautiful agents of destruction, but they normally sit idle: The average homeowner rarely finds the opportunity to knock down entire walls. Demo multitools, in contrast, are good for a whole lot more than smashing drywall. The **Razor-Back Pulverizer (\$40)** has a pair of nail pullers that can dislodge fasteners with either a squeeze to the head or bite to the shank, two pry bars to pull apart framing from distinct angles and a silver-dollar-size hammer head designed for pulverizing hard concrete. And the rubber handle is a vibration-dampening miracle. —SETH PORGES



Lighted Level

→ From closet corners to dark basements, levels are frequently called into service in dimly lit conditions. The **Swanson 24-inch Lightning Level (\$45)** is easy to use in low light—tiny LEDs illuminate its three vials.



Liquid Force

→ When it comes to water-based warfare, a weapon requires both speed and power. The **Nerf Super Soaker Shot Blast (\$20)** pumps like a shotgun, quickly blasting a soaking's worth of H₂O up to 25 feet.



Maintenance Multitool

→ Maintaining outdoor power equipment typically requires an entire toolbox. The **MTD Gadget (\$15)** is an 11-in-1 multitool with four wrenches and four screwdrivers to switch out spark plugs, replace air filters and snug up parts rattled loose from vibration. Also included: a gauge to gap spark plugs, a clamp to hold a file when sharpening chain-saw blades, and a bottle opener to refuel the operator.

Small Body

→ Over the past few years, camera manufacturers have been hard at work cramming the best parts of bulky digital SLRs—their massive image sensors and interchangeable lenses—into tinier and tinier bodies. At just about 1 inch thick (sans lens), the **Sony Alpha NEX-5 (\$650)** is currently the smallest camera on the market capable of handling interchangeable lenses. Under the hood, the 14.2-megapixel sensor can also capture 1080p HD video and is so adept at shooting in low light that it doesn't even have a built-in flash (though it comes with a snap-on one). Still, the camera's most innovative feature may be its ability to easily shoot 3D photos. When you swipe the camera back and forth, it stitches dozens of shots together into a single 3D image that can be viewed on a 3D HDTV.





**“Talk about a
wake-up call.
I had a heart attack
at 57.”**

~John E.
Lafayette, CA
Heart attack: 8/16/2007



**“I should have been doing more for my high cholesterol.
I learned the hard way. Now I trust my heart to Lipitor.”
Talk to your doctor about your risk and about Lipitor.**

- When diet and exercise are not enough, adding Lipitor may help. Lipitor is FDA-approved to reduce the risk of heart attack and stroke in patients who have heart disease or risk factors for heart disease, including family history of early heart disease, high blood pressure, low good cholesterol, age and smoking.
- Lipitor has been extensively studied with over 18 years of research. And Lipitor is backed by over 400 ongoing or completed clinical studies.

IMPORTANT SAFETY INFORMATION:

LIPITOR is not for everyone. It is not for those with liver problems. And it is not for women who are nursing, pregnant or may become pregnant.

If you take LIPITOR, tell your doctor if you feel any new muscle pain or weakness. This could be a sign of rare but serious muscle side effects. Tell your doctor about all medications you take. This may help avoid serious drug interactions. Your doctor should do blood tests to check your liver function before and during treatment and may adjust your dose.

Common side effects are diarrhea, upset stomach, muscle and joint pain, and changes in some blood tests.

INDICATION:

LIPITOR is a prescription medicine that is used along with a low-fat diet. It lowers the LDL (“bad” cholesterol) and triglycerides in your blood. It can raise your HDL (“good” cholesterol) as well. LIPITOR can lower the risk for heart attack, stroke, certain types of heart surgery, and chest pain in patients who have heart disease or risk factors for heart disease such as age, smoking, high blood pressure, low HDL, or family history of early heart disease.

LIPITOR can lower the risk for heart attack or stroke in patients with diabetes and risk factors such as diabetic eye or kidney problems, smoking, or high blood pressure.

Please see additional important information on next page.



Have a heart to heart with your doctor about your risk. And about Lipitor.

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IMPORTANT FACTS



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(LIP-ih-tore)

LOWERING YOUR HIGH CHOLESTEROL

High cholesterol is more than just a number, it's a risk factor that should not be ignored. If your doctor said you have high cholesterol, you may be at an increased risk for heart attack and stroke. But the good news is, you can take steps to lower your cholesterol.

With the help of your doctor and a cholesterol-lowering medicine like LIPITOR, along with diet and exercise, you could be on your way to lowering your cholesterol.

Ready to start eating right and exercising more? Talk to your doctor and visit the American Heart Association at www.americanheart.org.

WHO IS LIPITOR FOR?

Who can take LIPITOR:

- People who cannot lower their cholesterol enough with diet and exercise
- Adults and children over 10

Who should NOT take LIPITOR:

- Women who are pregnant, may be pregnant, or may become pregnant. LIPITOR may harm your unborn baby. If you become pregnant, stop LIPITOR and call your doctor right away.
- Women who are breast-feeding. LIPITOR can pass into your breast milk and may harm your baby.
- People with liver problems
- People allergic to anything in LIPITOR

BEFORE YOU START LIPITOR

Tell your doctor:

- About all medications you take, including prescriptions, over-the-counter medications, vitamins, and herbal supplements
- If you have muscle aches or weakness
- If you drink more than 2 alcoholic drinks a day
- If you have diabetes or kidney problems
- If you have a thyroid problem

ABOUT LIPITOR

LIPITOR is a prescription medicine. Along with diet and exercise, it lowers "bad" cholesterol in your blood. It can also raise "good" cholesterol (HDL-C).

LIPITOR can lower the risk of heart attack, stroke, certain types of heart surgery, and chest pain in patients who have heart disease or risk factors for heart disease such as:

- age, smoking, high blood pressure, low HDL-C, family history of early heart disease

LIPITOR can lower the risk of heart attack or stroke in patients with diabetes and risk factors such as diabetic eye or kidney problems, smoking, or high blood pressure.

POSSIBLE SIDE EFFECTS OF LIPITOR

Serious side effects in a small number of people:

- **Muscle problems** that can lead to kidney problems, including kidney failure. Your chance for muscle problems is higher if you take certain other medicines with LIPITOR.
- **Liver problems.** Your doctor may do blood tests to check your liver before you start LIPITOR and while you are taking it.

Call your doctor right away if you have:

- Unexplained muscle weakness or pain, especially if you have a fever or feel very tired
- Allergic reactions including swelling of the face, lips, tongue, and/or throat that may cause difficulty in breathing or swallowing which may require treatment right away
- Nausea, vomiting, or stomach pain
- Brown or dark-colored urine
- Feeling more tired than usual
- Your skin and the whites of your eyes turn yellow
- Allergic skin reactions

Common side effects of LIPITOR are:

- Diarrhea
- Muscle and joint pain
- Upset stomach
- Changes in some blood tests

HOW TO TAKE LIPITOR

Do:

- Take LIPITOR as prescribed by your doctor.
- Try to eat heart-healthy foods while you take LIPITOR.
- Take LIPITOR at any time of day, with or without food.
- If you miss a dose, take it as soon as you remember. But if it has been more than 12 hours since your missed dose, wait. Take the next dose at your regular time.

Don't:

- Do not change or stop your dose before talking to your doctor.
- Do not start new medicines before talking to your doctor.
- Do not give your LIPITOR to other people. It may harm them even if your problems are the same.
- Do not break the tablet.

NEED MORE INFORMATION?

- Ask your doctor or health care provider.
- Talk to your pharmacist.
- Go to www.lipitor.com or call 1-888-LIPITOR.

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Dual-Screen Tablet

→ At first glance, the clamshell **Toshiba Libretto W100 (\$1100)** looks like a pint-size netbook. But open it up, and it reveals itself to be a keyboardless dual-screen tablet. The clever design offers a nice change from the typical slate, and we appreciate the built-in webcam (a feature missing from the first-gen iPad). But it's disappointing that the machine runs Windows 7—a resource-intensive operating system better suited for a mouse-enabled computer than for a tiny touchscreen tablet.



A Smarter Grid

→ The **Honeywell Prestige Thermostat (starts at \$250)** programs HVAC settings around utilities' peak pricing plans—its touchscreen display asking questions (When do you wake up? Come home? Go to bed?) to determine what time and how high to crank the a/c. That's all good. But while the unit lets you program peak times, it never asks for actual prices. We'd like to see thermostats that can track prices, tell users what they're spending and catalog year-to-year consumption trends within the home. Until those models appear, the Prestige is a smart step toward a smarter grid.

Spin Control

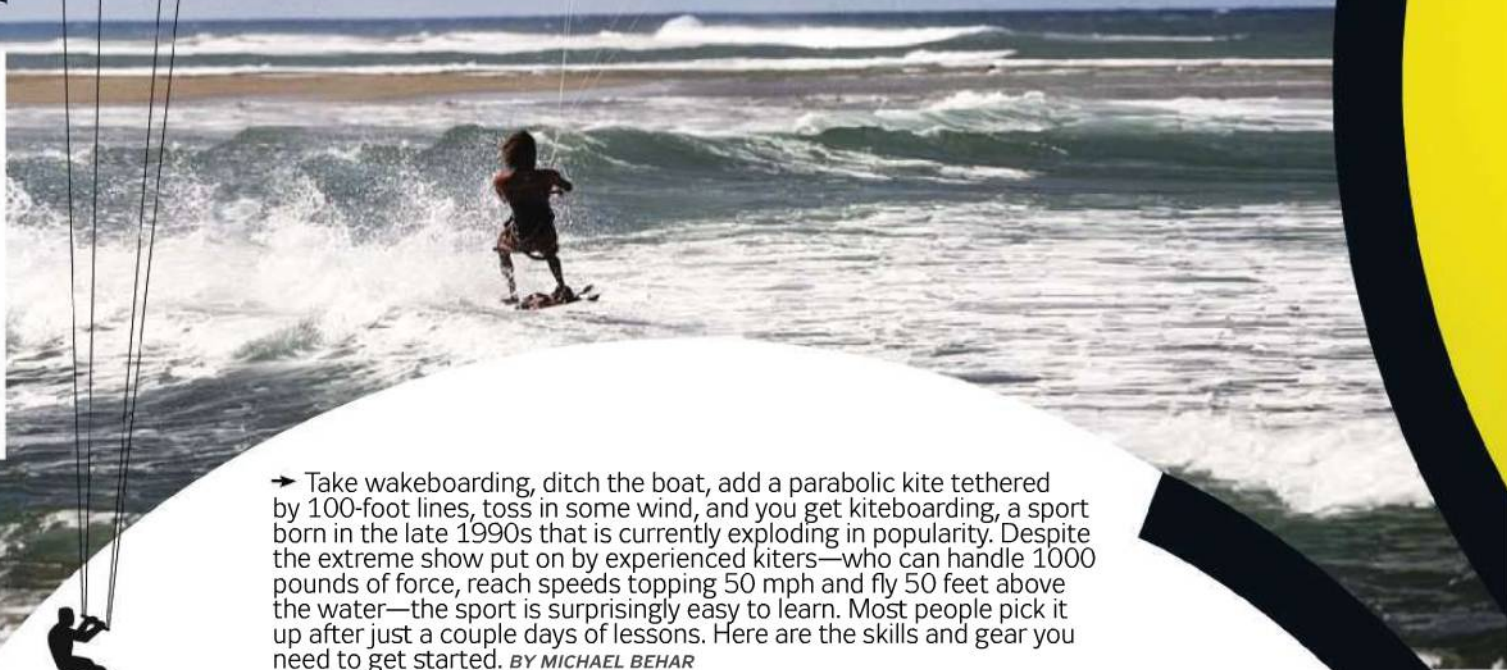
→ The age of ubiquitous touchscreens has now entered the laundry room. So what exactly do the LCDs on the **Whirlpool Vantage washer and dryer (\$2000 each)** allow you to do that a regular old dial doesn't? Choose among lots and lots of special cycles—33 to be exact, including ones tailor-made for everything from shower curtains to stuffed animals to shoes. And while there are plenty of guys who don't even know what perma-press means, we could easily see this machine giving birth to a whole new breed of laundry geeks—especially since it has a USB port that allows users to create and upload their own custom cycles.



Getting Started

KITEBOARDING

P M U P G R A D E



→ Take wakeboarding, ditch the boat, add a parabolic kite tethered by 100-foot lines, toss in some wind, and you get kiteboarding, a sport born in the late 1990s that is currently exploding in popularity. Despite the extreme show put on by experienced kilters—who can handle 1000 pounds of force, reach speeds topping 50 mph and fly 50 feet above the water—the sport is surprisingly easy to learn. Most people pick it up after just a couple days of lessons. Here are the skills and gear you need to get started. *BY MICHAEL BEHAR*



LEARNING PROGRESSION

1 Land Lesson

"Ninety percent of kiteboarding is kite control," Markus Schale, owner of Kiteboarding School of Maui, says. Beach-based lessons allow beginners to practice with special training kites that have short, easy-to-control lines. The key is to keep an eye on the 180-degree arc in the sky that the kite flies in, called the "wind window."

2 Body Dragging

Before strapping on a board, you'll practice controlling the kite as it drags your body—face-first—through the water. Fly the kite close to the water while keeping your head down and legs together. This turns your torso into a rudder, dragging you upwind—an essential skill if you hope to retrieve a lost board. (Kilters don't use leashes; the slingshot effect can be skull-cracking.)

3 Water Start

Start out your run with the board pointed about 45 degrees downwind toward the kite—there will be less resistance than with a sideways board and it'll be easier to get up. While keeping the kite hovering at the neutral noon position, carefully slip your feet into the board's foot straps. Aim the board slightly downwind, and then dive the kite hard while driving your weight

through your hips, legs and feet. Once you're standing upright, dive the kite again to accelerate and get your board planing. Now lean back at a 45-degree angle and, depending on which direction you're riding, park the kite at either the 11 o'clock or 2 o'clock position. "Keep your body in a straight line," Laurel Eastman, a former pro kiter, says. "Push your hips forward and shoulders to the sea."

4 Riding Upwind

Riding upwind returns you to the beach at the same spot you entered the water. To do this, fly the kite low and maintain even power. While edging against the kite, lean back, then swivel your hips and upper body in the direction you want to tack. Push down on your back foot to keep your edge from slipping downwind. "Always look over your shoulder, facing where you want to end up," Schale says.

the gear



1 Kite: Cabrinha Crossbow IDS (starting at \$1650)

Kite sizes, measured in square meters, get progressively smaller for increasingly stronger winds. For a basic quiver, a 9-meter and 12-meter kite will cover most conditions. Don't go for top of the line. "Your first kite is the one that will suffer the most," Schale says, so buying used is okay. "Just make sure it's not older than two years—equipment has changed a lot recently—and if possible, buy from a school, because they are more professional in how they maintain equipment."

2 Helmet: Mystic Razor (\$75)

Accidents (or "kitemares") happen, and helmets are a must-have. Only use helmets designed for watersports—ones made for other activities can get heavy when wet and sometimes have oversize sun visors that can turn a harmless face-plant into severe whiplash. This helmet's detachable ear covers make it ideal for warm and cold conditions.

3 Board: North X-Ride (\$700)

"Until you really learn to drive the kite, a larger board makes it easier to get on a plane and ride," Eastman says. A length of at least 140 centimeters and a waist width of 40 centimeters are ideal.

4 Harness: Liquid Force Luxury 2.0 (\$150)

The harness takes the load from your arms and transfers it to your body, which becomes a counterbalance. Fit is key—look for one that's comfortable and wraps snugly around your waist with no gaps. A poor-fitting harness will chafe your hips raw. The quilted liner on this harness could literally save your skin.

the skills

Fig. 1 STEERING THE KITE

To steer the kite, push forward with one hand while pulling back with the other—like your hands are exchanging punches. "The kites have a flexible structure, so when you're steering, you're actually twisting the entire membrane of the kite," says engineer and inventor Saul Griffith, who has designed kites for a number of companies. To dive the kite to the left, pull in with your left hand and push forward with your right. To steer right, do the opposite.



Fig. 2 DIVING THE KITE

To stand still, keep the kite flying in the noon position. To pull yourself forward, dive the kite toward the water before pulling it back up to the sky. "The kite acts like a wing, and diving it makes it move faster, which gives you exponentially more force," Griffith says. "And when the kite skims close to the water, it is perpendicular to the wind, and catching more air." Fly the kite back up to the sky and dive it again to continually generate more speed.



Beginning kilters will need to find a school to take lessons and rent equipment.

- EAST COAST** REAL Kiteboarding, Cape Hatteras, N.C.; realkiteboarding.com
- GREAT LAKES** Broneah Kiteboarding, Traverse City, Mich.; broneah.com
- GULF COAST** South Padre Island Kiteboarding, South Padre Island, Texas; southpadreiskiteboarding.com
- WEST COAST** Wind Over Water Kiteboarding, Burlingame, Calif.; wowkite.com

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CONQUER A STEEP DECLINE ON A MOUNTAIN BIKE

Looking down a steep decline is enough to make anyone uneasy, and stress can cause body odor, which is never good when biking with a group. With the right basic skills, even the novice mountain biker can make it down a hill with confidence. First, use **Gillette Odor Shield Anti-Perspirant Deodorant & Body Wash** so you don't need to worry about the odor. Then when approaching the hill, lean back away from the handlebars, putting your weight on the back tire. The steeper the hill, the further you should slide back on the seat. Be sure to keep your feet level on the pedals and don't forget to relax; let the bike absorb most of the shock from the bumpy trail. Once you have conquered this task, you'll be ready for the next one.

Using Gillette Odor Shield Anti-Perspirant & Body Wash will give you confidence that you know you'll smell great. And did we mention that your friends will be thankful that you did?

Learn more about Gillette's products with Odor Shield technology at www.gillette.com.



PAINT A HIGH VAULTED CEILING

With the help of a friend or two, start by preparing the room: cover any ceiling fans, furniture and windowsills. Dust the surface of the vaulted ceiling. Determine if an extension ladder will sufficiently reach the highest points. Otherwise, you may need to set up scaffolding. Start by cutting in the line where the ceiling and wall meet using a brush or mini-roller. Use a roller to paint the sloped walls of the ceiling. Use an extension ladder or pole to reach high parts of the ceiling. The job can give you a workout, but you'll be able to perform under pressure if you protect yourself from odor with **Gillette's Odor Shield Anti-Perspirant and Body Wash**.

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TARGETS
SHIELD ZEROES IN
ON ODOR



NEUTRALIZES
ODOR COUNTERACTED
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Accessible Alternative

→ The **Archos 7 Home Tablet (\$200)** is no iPad. Its screen is smaller (7 inches versus the iPad's 9.7 inches) and has a lower resolution (800 x 480 versus 1024 x 768), plus its processor is slower (600 MHz versus 1 GHz). But the Archos does have one very important competitive advantage—its price. For less than half the cost of the cheapest iPad, you get a full-color movie-watching, music-playing, Web-surfing and reading device that runs tons of apps (more than 3000 are currently compatible) via the increasingly popular Google Android operating system.



Blade Roller

→ Sure, if the only thing you care about when shopping for a folding knife is sheer utility, the price tag on the **Spyderco Phoenix (\$310)** is a bit... ridiculous. But once we got our hands on this thing, we couldn't stop playing with its innovative locking mechanism—the springs are controlled by pushing down on a free-floating ball bearing. And while the manufacturer claims this design can handle extra abuse, to us it just feels and looks great.

Small Saw

→ The **Craftsman Nextec Circular Saw (\$170 for kit that includes drill driver, worklight and sander)** may have a relatively puny 3 $\frac{3}{8}$ -inch blade powered by a 12-volt, 1.3-amp-hour lithium-ion battery, but our tests proved it more than able to crosscut 1x stock and rip $\frac{3}{4}$ -inch sheet goods with relative ease. And while the saw occasionally bogged down on us as 1 x 4 lumber pinched its wee blade, a little persistence at 2400 rpm pushed the 20 carbide-tip teeth through. At 3.8 pounds—less than half the weight of a standard 7 $\frac{1}{4}$ -inch-blade circ saw—it makes handling small jobs a breeze.





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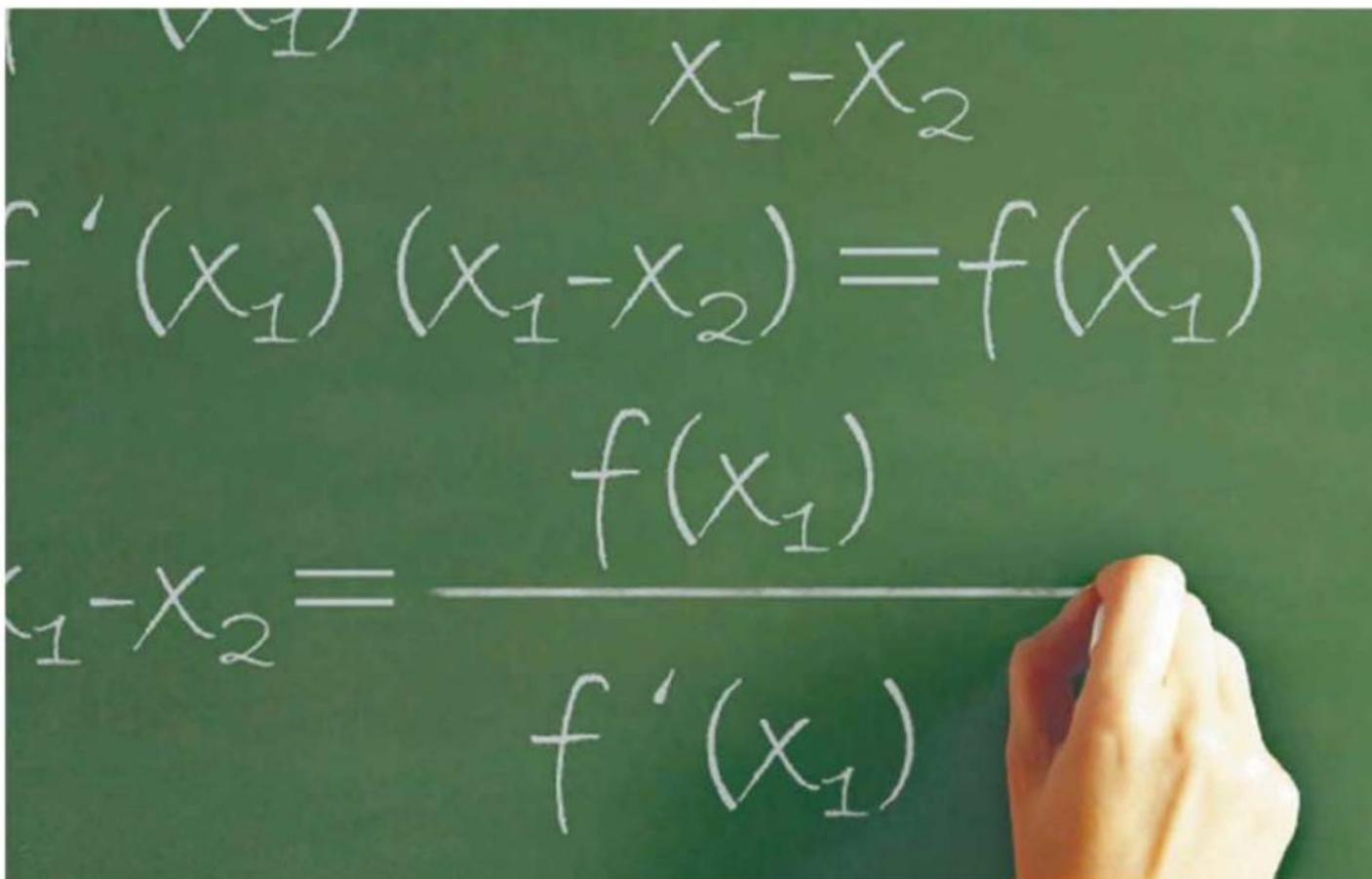


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One Tough Animal.



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2011
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\$26,995

Buick Rising

The resurgent Buick aims to take on midsize sporty sedans with the Euro-flavored Regal. Based on the Opel Insignia, the revamped Regal eschews the usual optional V6 for a stout turbocharged Four (220 hp, 258 lb-ft) and a base 2.4-liter engine with 182 hp. Presently both motors couple to a six-speed automatic, but a manual will be available later. Liberal use of high-strength steel gives the structure a solid feel, and the interior layout is tastefully tidy. In the mountains outside San Diego, we discovered that the base engine pulls willingly and the gearbox shifts seamlessly. The turbo model makes good use of the wide torque band, but even with the optional adaptive shocks the Regal doesn't quite provide the same cornering reassurance you'll find in a VW Passat or an Acura TSX. It's close, though, and this is the best midsize Buick has ever produced. — *BARRY WINFIELD*

++ PM TEST DRIVEN



↑↑
2011
Bentley
Mulsanne



↑↑
2011
Infiniti QX56

↑
Beyond Bling
The Nissan Patrol, a large Japanese-built SUV not sold in the U.S., competes with Toyota's Land Cruiser in global markets. According to Ben Poore, vice president of Nissan's Infiniti division, the body-on-frame Patrol was an ideal foundation for the 2011 Infiniti QX56 (\$57,650 for 2WD; \$60,750, 4WD), because these days utilitarian qualities sell luxury SUVs—looks alone won't cut it. "The bling buyer is gone," Poore says. Complementing the robust chassis, the M56-derived 5.6-liter V8 delivers 400 hp (and 413 lb-ft of torque at 4000 rpm) through a seven-speed automatic transmission that features a rev-matching manual downshift mode, a snow mode and a tow mode with a capacity of up to 8500 pounds—all while achieving 16 mpg in overall fuel economy. — KEVIN WILSON

↑
POSH SPICE
You'd think that Bentley's customers would be largely immune to economic downturns, and apparently you'd be right. The new flagship Bentley, the 2011 Mulsanne (\$285,000) is not lacking for orders; next year's allotment of 300 to 400 cars is

already sold out. Beneath the hand-rubbed paint and aluminum body is a 6.75-liter engine—a redesigned, twin-turbocharged, 505-hp V8 that produces 752 lb-ft of peak torque at 1750 rpm. Paired to an eight-speed transmission, it hustles the 5699-pound brute to

60 mph in 5.1 seconds and to a top speed of 184 mph. At highway speeds, the powerplant operates quietly, thanks in part to variable displacement, which shuts down four cylinders while cruising. Because fat cats like to save a few bucks at the pump too.
— BASEM WASEF



↑↑
2010
Ford SVT
Raptor 6.2

↑ **This Raptor Really Flies**
Externally, nothing distinguishes the base 2010 Ford SVT Raptor with a 5.4-liter Triton V8 (\$38,995) from the one with the new 6.2-liter engine (a \$3000 option). The difference only becomes evident when you floor the throttle. The SOHC 16-valve 6.2-liter, which develops 411 hp and 434 lb-ft, shaves a second from the base truck's 8-second zero-to-60 time, yet Ford claims a tiny fuel-economy penalty. SVT engineers retuned the spring and damper rates but maintained suspension travel (11.2 inches front, 12.1 inches rear), which helps the 35-inch BFGoodrich All-Terrain tires overcome any obstacle. During our test drive in Romeo, Mich., the Raptor cruised the highway like an old-school Cadillac, but off-road is where it excels, and we thoroughly enjoyed getting all four wheels airborne. Raptors, after all, are birds of prey. — REX ROY

→	PH TEST DRIVEN	BUICK REGAL +	INFINITI QX56	+ BENTLEY MULSANNE	+ FORD SVT RAPTOR 6.2	+
	COMPARISON	LOTUS EVORA	VS PORSCHE CAYMAN S	*		
	PH TEST DRIVEN	JEEP GRAND CHEROKEE	+ JEEP GRAND WAGONEER	+		
	CHINESE CARS	BYD E6				

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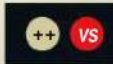
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Comparison

Ultimate Driving Machines

IN A DUEL OF TWO CANYON CARVERS, WHICH ONE CUTS THE BEST ARC?
BY LARRY WEBSTER



2010 Lotus Evora

2010 Porsche Cayman S

\$74,675
276-hp V6/6M

BASE PRICE
POWERTRAIN

\$61,150
320-hp flat Six/7-speed auto-man

ACCELERATION (SEC)

5.32
12.93
13.58 @ 102.47 mph
104.29

(0-60 MPH)
(0-100 MPH)
QUARTER-MILE
BRAKING (60-0)

4.82
11.11
13.00 @ 109.05 mph
108.21

FUEL ECONOMY

22.69

(OBSERVED)

22.90

the SPECS

With midmounted six-cylinder engines and curb weights of roughly 3100 pounds, these back-road burners share a common mission and layout but diverge quickly. The Cayman's steel unibody chassis employs struts all around and carries Porsche's 320-hp 3.4-liter flat Six and a seven-speed dual-clutch automated gearbox. The Evora sports a three-part frame: The center tub is made from bolted and bonded aluminum extrusions; sheet-metal structures—aluminum in front, steel in the rear—carry the control-arm suspension. For motivation, Lotus uses the same 3.5-liter Toyota V6 that's in the Camry. With Lotus-designed intake, exhaust and engine computer, this smooth motor pumps out 276 hp at 6400 rpm and, like the Cayman, inhales with a deliciously deep song. A six-speed manual with optional close ratios routes the power to the rear wheels. Only the Evora has a kid-size rear bench, but the Porsche offers adjustable suspension and heated seats.

the DRIVE

Lockwood Valley Road traverses a ridge in the Los Padres National Forest, about 2 hours northeast of L.A. On this lumpy mountain road, the Evora's non-adjustable chassis displayed an uncanny competence. The wheels freely followed the tarmac's contour, and the steering transmitted minute surface details. We aggressively and confidently dived into the exposed corners. And the seat, which has only two adjustments, was superbly supportive, proof that simple can be good. The Cayman, a long-praised driver's car, easily kept up—in part thanks to its 11 percent better power-to-weight ratio and quick-shifting gearbox—but comparatively, it bounded over imperfections. In short, the Lotus made us feel like pros. Back in L.A., both cars are supple, but the Evora has a couple of nagging flaws—poor rear visibility and a wide sill that impedes climbing aboard.

BOTTOM LINE

Either car will deeply satisfy sports car aficionados. In the daily grind, the Porsche is simply easier to live with. But the Lotus is no bare-bones racer, and it has achieved a new level of handling competence. **The Lotus wins.**

PM TEST DRIVEN BUICK REGAL + INFINITI QX56 + BENTLEY MULSANNE + FORD SVT RAPTOR 6.2 +
 ++ COMPARISON LOTUS EVORA VS PORSCHE CAYMAN S +
 PM TEST DRIVEN JEEP GRAND CHEROKEE + JEEP GRAND WAGONEER +
 CHINESE CARS BYD E6

2011
Jeep Grand
Cherokee

1989
Jeep Grand
Wagoneer

A Fantastic Start

Chrysler's been quiet since it took a taxpayer bailout last year and merged with Fiat—the company's third dance partner since 2005 (after Daimler and Cerberus). The 2011 Jeep Grand Cherokee (base price: \$33,775) is the post-bailout company's first new model, so more than usual is riding on its all-independent suspension. But the boardroom drama has not adversely affected the grandest Jeep. While crawling along Moab, Utah's off-road trails and cruising the town's pavement, the Cherokee proved to be equal part rock crawler and luxury car. Some parts are shared with the Mercedes-Benz M-Class (a legacy of the Daimler days), but the engines—a new 290-hp V6 and the returning 360-hp Hemi V8—are Pentastar creations. There's one transmission—a five-speed auto—and three AWD systems.

The axles are now 5.3 inches farther apart, yielding a roomier rear seat and 17 percent more cargo room. The cabin feels upscale, with soft-touch panels and optional, beautifully lacquered real wood. Nearly every conceivable feature can be ordered.

The available air springs jack up the body and increase ground clearance to 10.7 inches, so unlike other luxury SUVs, the Jeep doesn't merely play off-roader—it's the real thing. And, after riding over a nail, we learned that it has a now rare full-size spare, a must-have for dirt duty. What's astounding is that after tackling the aptly named Hell's Revenge trail, the unscathed Grand carried us back to the hotel with Germanic refinement. The chassis feels simultaneously robust and plush, making it a fine choice for urban pothole pounding. And it's very quiet. We handed back the keys thinking that if this new Jeep is a harbinger of cars to come, America's Chrysler investment might yet yield high dividends. —BEN STEWART

++ SELEC-TERRAIN

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THE ORIGINAL GRAND

Jeep's reputation as the workingman's Land Rover began nearly five decades ago with the 1963 Grand Wagoneer. Until 1991, the GW's last year, it cemented Jeep's credibility as a luxury 4WD manufacturer. Few know that better than Matt Liddane, the current Grand Cherokee's vehicle line executive and the owner of the 1989 Wagoneer pictured here.

With 90,000 miles on the clock, Liddane's rig feels remarkably tight. For sure, the solid rear axles—suspended by leaf springs—ricochet off larger bumps, but overall it's quite plush and the interior is luxurious. Various engines powered the GW over the years, but by the late '80s a 5.9-liter V8 and three-speed automatic rode inside the frame rails. It's pokey—and noisy—by today's standards, a far cry from the Cherokee's refinement.

The GW's a charismatic piece, however. The dash is low and shallow, so you feel high up and have a clear view through the nearly vertical windshield to the standing-proud hood emblem. The windowsill is the perfect height for a resting forearm, and the vent windows feel decidedly old-school. These traits and the classic style are one reason an example like Liddane's fetches about \$15,000, and the best Wagoneers cost about as much as a new one did—roughly \$25,000. —B.S.

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People's Republic of Carmakers

Chinese automobile manufacturers are already making their first inroads into the U.S. car scene—from the inside. *BY DAVID KILEY*

BYD Auto—subsidiary of a Chinese rechargeable battery company best known for its most distinguished investor, Warren Buffett—aspires to become the world's biggest carmaker by 2025. Last year, BYD sold 449,000 vehicles in China. This December, the company says, it will establish a beachhead in the United States by selling its e6 electric car in California.

China's entry into the U.S. market is causing concern in Detroit, but many analysts say it could take time before China enjoys the type of success that U.S. car companies already do there.

Before succeeding in foreign markets, there are hurdles Chinese carmakers must first overcome. Analysts point to a lack of experience meeting quality standards in the U.S., a deficit in engineering prowess and intense competition from established brands.

The Chinese have been criticized for knocking off Western designs, but while some of their cars may look familiar, they have yet to copy quality engineering. The China Association for Quality says that dissatisfied customers are on the rise. Complaints within six months of purchase rose 60 percent in Q1 of 2010, and safety concerns and defects were up compared with the same period in 2009.

For now, at least, the Chinese might be better off concentrating on their home turf. Brilliance Automotive is withdrawing from Europe after a poor reception and reports of deficient quality.

Last year, more than 13 million new vehicles were sold in China, eclipsing the entire American market. Through the first quarter of 2010, the industry was on track to sell more than 16 million cars and trucks, or 25 percent more than the best estimates for the United States.

That's why GM has renewed its focus on China. The company hopes to sell more than 2 million vehicles there in 2010, and 3 million annually by 2015.

Geely Automobile recently finalized a deal to buy Sweden's Volvo from Ford, but Geely's growth at home is one reason it has tempered export aspirations. Despite buying Volvo, the company plans to keep the brands and operations separate. "Selling to developed markets is a few years down the road," says Frank Zhao, Geely's VP of technology. However, Zhao says, Geely will learn much about those markets from its Swedish brand.

"That's the sensible approach," says Rebecca Lindland, director of automotive research at IHS Global Insight. "Companies like Mitsubishi, Suzuki and others have been in the U.S. a lot longer and found acceptance very hard to crack."

Chinese brands may be years away from making a major impact in the U.S., but their presence is already being felt. GM's Shanghai design center heavily influenced the 2010 Buick LaCrosse's interior. Jim Federico, vehicle line engineer for Buick, maintains that while the Chinese will be challenged to integrate all the systems in a complete car, they're learning fast. "They've taught our people a lot about creating a whole environment for the driver and passengers, not just designing individual elements," Federico says.

The irony is that Buick, once a symbol of American luxury, may soon be the best example of Chinese know-how in the auto industry. Or, we should say, *ni hao*.

PM TEST DRIVEN
 ++ CHINESE CARS

BYD E6

BUICK REGAL + INFINITI QX56 + BENTLEY MULSANNE +

FORD SVT RAPTOR 6.2 +

COMPARISON

LOTUS EVORA VS PORSCHE CAYMAN S +



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+ BMW X5 xDrive35d

FIRST report

With the Volkswagen Jetta TDI recently leaving our long-term fleet (see March '10) after spoiling us with fantastically frugal mileage figures of up to 40 mpg, we were eager to test out another diesel's fuel economy. BMW revised the X5 for 2011, which seemed the perfect excuse to

sample its torquey diesel engine. The 3.0-liter sequential twin-turbo inline six-cylinder engine uses a particulate filter and AdBlue—a urea solution injected into the exhaust gas that converts nitrous oxide into inert nitrogen and water vapor—to achieve emission levels that pass muster in

all 50 states. We've already driven it through six of those, plus the District of Columbia. By way of breaking in the X5 xDrive35d, we hopped a flight to BMW's factory in Spartanburg, S.C., and returned to our New York offices in style—and in just over 11 hours, averaging 60 mph and

VITAL STATISTICS Base price \$51,300 : As-tested price \$61,025 : Extra-cost options Cold-weather package, premium package, navigation, Park Distance Control, satellite radio, iPod adapter : Drivetrain 3.0-liter diesel inline Six, 6A : Engine performance 265 hp/425 lb-ft : EPA fuel economy 19 city/26 highway



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PM LONG-TERM
TEST CARS

26.7 mpg, impressive for a large, feature-laden five-passenger wagon (seven with the optional third row). First impressions are all positive. The diesel makes a distinctive grumble at city speeds, but once underway, any noises are easily drowned out by tunes emanating from the sat radio. In an era of minivans with 260-plus-hp V6 engines, a 265-hp SUV may not seem all that remarkable, but 425 lb-ft of torque at 1750 rpm provides a 0-to-60-mph time of under 7 seconds. Best of all, the big Bimmer's odometer currently shows 1020 miles, and we've only refueled it once.

—G.E. ANDERSON



The X5's nav system uses GPS and a separate radio tuner to display Real Time Traffic Information (RTTI) and find the roads less traveled.



+ Nissan 370Z Roadster

SECOND report

The top has been up more than down over the past six months—the realities of the '09 to '10 El Nino season in Southern California. But the storms are gone. And we've found great pleasure in leisurely early morning top-down drives up the Pacific Coast Highway, sipping a warm cup of coffee as the cool breezes caress our cheeks. Who needs aromatherapy, yoga or meditation? Drives like that instantly melt away stress. But our experience with the Z so far has not been entirely Zen-like. There's a mischievous gremlin living in the nav system causing delayed reactions to our commands. For example, keying letters or numbers into the device produces slowed responses. Want to select a previously traveled route? That'll be a minute or two, sir. It's frustrating. So we'll have the dealer check it out next time we're in. Aside from our slightly dense nav system, the 332-hp sports car has been bullet-proof—and a blast to use as a daily driver. And with summer around the corner, we're very happy we opted for those ventilated seats. —BEN STEWART

DRIVERS
NOTEBOOK

- The Z Roadster is plush enough for road trips, but the trunk holds only a couple of modest-size duffle bags.

- The roof's clamshell cover noisily clanks open and closed during the top-up and top-down process—seems a little low-rent for a nearly

\$45,000 sports car.
DATA SO FAR
As tested :
\$44,505
Previous reports :
See 06/10
Miles driven : 5717
Miles since last

report : 2389
Fuel economy :
Average—18.2 mpg
Worst—13.5 mpg
Best—23.9 mpg
Maintenance/
repair : \$0

+ Honda Insight EX Navi



THIRD report

The Insight continues to grow on us as a practical, no-frills car that delivers high mileage—PM drivers topped EPA figures on a number of trips. When it comes to hybrid performance, though, the Insight just isn't as much fun as the Toyota Prius. It doesn't have its techier competitor's acceleration or true electric-only mode. But the Insight also costs \$3000 less than the Prius and gets comparable mileage. Automobiles, like life, are all about compromises. The Insight handles well darting around town and cruising interstates, with a functional interior that remains comfortable even on long hauls. Its drag-reducing aerodynamic design looks sleekly sophisticated, but it includes a 2-inch-wide bar across the hatchback, which most PM drivers say obstructs

PHOTOGRAPHS BY NOAH SHELDON (BMW DETAIL), DAN CHAWKIN (NISSAN), DOUG ADESKO (HONDA)



Our Audi wagon departs for an unnamed Audi exec who personally asked for this car. It's easy to see why. The A4 Avant was the hottest vehicle around here and was typically booked two months in advance. It traveled more than 25,000 miles in a year. Logbook entries from appreciative drivers mentioned the car's long legs on extended freeway trips (it ventured as far as Miami and Boston), as well as its capacious interior storage and oh-so-comfortable seats. Another bonus: This wagon is every bit as stylish as the sedan. Several staffers also remarked on Audi's audio/nav menu interface. The rotating dial on the center console falls readily to hand and, unlike the systems on other high-end German cars, this one can be discerned without reading the owner's manual. With cars like the Avant, wagons may one day again be a family's first choice. — MIKE ALLEN



rear views. One glass-half-full colleague, however, noted that at night it also blocks headlight glare. — DAVID DUNBAR

DRIVERS NOTEBOOK

- The brakes are a touch twitchy, with more than the usual hybrid lurch during the regenerative-to-hydraulic transition.
- A persistent leak in one of the low-rolling-resistance tires prompted a service call.

DATA SO FAR

As tested : \$23,800
 Previous reports : See 03/10, 06/10
 Miles driven : 12,460
 Miles since last report : 5521
 Fuel economy : Average—43.4 mpg
 Worst—37.7 mpg
 Best—54.6 mpg
 Maintenance/repair : \$155.71

for passengers, and found the transition simple and easy to perform.

END DATA

As tested : \$43,050
 Previous reports : See 11/09, 03/10, 06/10
 Miles driven : 25,680
 Miles since last report : 7374
 Fuel economy : Average—18.8 mpg
 Worst—13.1 mpg
 Best—22.2 mpg
 Maintenance/repair since last report : \$0
 Overall : \$297

DRIVERS NOTEBOOK

- We wish the liftgate opened just a few inches farther, but the bruises on our forehead went away in a week or so.
- We wound up using the rear-seat area for dunnage a lot more often than

THE CADAVER IN THE SPACE CAPSULE

> BY MARY ROACH
> ILLUSTRATION BY HEADCASE DESIGN



C

Crash simulation is a world comprised largely of metal and men. The simulator at Ohio's Transportation Research Center resides in a clanging, hangar-size room with few places to sit, and none of them upholstered. The room holds little beyond the crash sled, on a track down the middle, and a few engineers in safety goggles, forever walking back and forth with coffee mugs. Other than the reds and oranges of warning lights and hazard signs, color is hard to find.

The cadaver seems almost a homey touch. Subject F wears blue Fruit of the Loom underpants and no shirt, as though he were lounging around in his own apartment. He looks deeply relaxed. As dead men do. Are. He slumps slightly, and his hands rest on his thighs. Were F alive, he would not be so relaxed. In a few hours, a piston as fat as a redwood will shoot a slug of pressurized air at the seat in which he'll be strapped. Both the force of the impact and the position of the seat can be adjusted to create whatever crash scenario a researcher requires. Today it's NASA's new Orion capsule, dropping from space onto

THE ULTIMATE
CRASH TEST
PROTECTS FUTURE
ASTRONAUTS FROM
HARD LANDINGS.

the sea. F gets to play astronaut.

In a space capsule, every landing is something of a crash landing. Unlike a plane or the space shuttle that Orion and its booster rocket were designed to replace, a capsule has no wings or landing gear. It doesn't fly back from space; it falls. (If President Obama's termination of the Constellation program comes to pass, Orion's entire purpose may be falling back to Earth, as an escape pod for the International Space Station.) The capsule has thrusters that can correct its course or slow it down enough to drop it from orbit,



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**BIOMECHANICS ///
CADAVER CRASH TEST**

but not the kind that can be fired to soften a landing. As a capsule re-enters the Earth's atmosphere, its broad, flat bottom plows into the thickening air; the drag slows it down to the point where parachutes can open without tearing. The capsule drifts down to the sea, and if all goes well, the touchdown will feel like a mild fender-bender—2 to 3 g's, 7 at most.

Touching down on water rather than earth makes for a gentler landing. The tradeoff is that oceans are unpredictable. What if a cresting wave slams into the capsule as it's coming down? Now the occupants need restraints that protect them not only against the forces of being dropped straight down, but also against a sideways or upside-down impact.

To be sure Orion's crew are unhurt no matter what sort of wild card the seas present, crash-test dummies and, lately, cadavers have been taking rides in an Orion seat mockup here at the research center. Crash-test dummies can provide only limited information; their rigid bodies are best suited to measuring head-on or side impacts, which is why car manufacturers find them so useful. In order to find out how a landing impacts soft tissue or bone, researchers need to use actual bodies donated to science. The simulations are a collaboration involving the center, NASA and Ohio State University's (OSU) Injury Biomechanics Research Laboratory.

Dead people make NASA uncomfortable. They don't use the word *cadaver* in their documents and publications, preferring instead the new euphemism *postmortem human subject*. Corpses in spaceships take them to places they'd rather not visit: *Chal-*

lenger, Columbia, the Apollo 1 fire. But the students appear at ease. Earlier this morning, two of them stood beside F, talking and laughing as they untangled the long, fine wires that trail from strain gauges mounted on F's bones. Rather than seeming gruesome, the scene had a comfortable feel, like a family stringing lights on a Christmas tree. To them, the cadaver seemed to inhabit an in-between category of existence: less than a person, but more than a piece of tissue. F was still a "he," but not someone you need to worry about hurting.

Now F sits on a tall metal chair beside the piston track. OSU graduate student Yun-Seok Kang stands at his back, using an Allen wrench to mount a wristwatch-size block of instrumentation on an exposed vertebra. Along with the strain gauges, these instruments will measure the forces of the impact. Kang's gloved fingers are glossy with fat. The fat—because it's slippery and because there's a fair amount of it—makes Kang's task difficult. He has been working on this mount for more than half an hour.

The dead are infinitely patient.

Safeguarding a human for a multi-axis crash is not all that different from packing a vase for shipping . . . you need to stabilize it all around.

A useful model for the kind of impact NASA must plan for—multi-axis and unpredictable—is the race-car crash. In April 2009, Nascar's Carl Edwards, traveling at close to 200 mph, slammed another car, launching his own high into the air, where it spun

like a flipped quarter before slamming down into a wall. Whereupon Edwards casually got out and jogged away from the wreckage. How is this possible? To quote from *Stapp Car Crash Journal*, "a very supportive and tight-fitting cockpit seating package." Note the word choice: package. Safeguarding a human for a multi-axis crash is not all that different from packing a vase for shipping. Since you don't know which side the UPS guy is going to drop it on, you need to stabi-

→ An anthropomorphic test dummy at Wright-Patterson Air Force Base sits in a crash sled that's modeled after an Orion capsule seat.

→→ Nascar crashes, like this one involving Carl Edwards on April 26, 2009, provide a useful model for a hard Orion landing.



lize it all around. Race-car drivers are strapped tightly into custom-fitted seats with a lap belt, two shoulder belts and a crotch strap. A HANS (Head and Neck Support) device keeps the head from snapping forward, and vertical bolsters along the sides of the seat keep the head and spine from whipping left or right.

Early on, NASA had dismissed race-car seats as models for Orion. For one thing, race-car drivers are sitting up, not reclining. Bad idea for astronauts who've been in space for a while. Lying down is not only safer, it keeps astronauts from fainting. Veins in the leg muscles normally constrict when we stand, to help keep blood from pooling in our feet. After weeks without gravity, this feature stops working. But there is a problem with lying on your back in a spacesuit in a very safe seat: "We threw a racing seat on its back, put a guy in it and said, 'Can you get out?'" recalls NASA crew survivability expert Dustin Gohmert. "It was like putting a turtle on its back."

Worried that Nascar-style shoulder bolsters might dangerously extend the time it takes an astronaut to get out of the Orion capsule, Gohmert and his colleagues ran some simulations with head bolsters only. For these they used crash-test dummies—or "mannequins," as Gohmert calls them, causing me to picture them taking their hits in department store outfits. It was a bad business. Gohmert described the slow-motion video



footage to me. “The head stayed stationary and the body kept moving. We were actually concerned about the mannequin being okay.” As a compromise scenario, the shoulder bolsters are still there but have been scaled down.

A further complication for the astronaut: He’s got vacuum cleaner parts attached to his suit—hoses, nozzles, couplings, switches. To be sure the hard parts of a suit don’t injure the soft parts of an astronaut in a rough landing, F will be wearing a suit simulator: a set of rings duct-taped in place around his neck, shoulders and thighs. The rings are facsimiles of the mobility bearings, or joints, of a spacesuit. (Tomorrow’s cadaver, presently thawing, will be wearing a vest with “umbilicals”—life-support hoses and couplings—mounted on it.) One specific concern today is whether, on a sideways touchdown, a mobility bearing might collide with the seat’s shoulder bolster and be driven into the astronaut’s arm with enough force to break a bone.

The present challenge is to get F into the seat on the sled. Think of wrestling a comatose drunk into a taxicab. Two students have F’s hips, and another has his hands beneath F’s back. F is lying with his bent legs raised, like a man whose dinner chair has tipped over. John Bolte, who runs OSU’s Injury Biomechanics Research Laboratory and is overseeing today’s

tests, cues the push. “One, two, three!” The piston is off to F’s right; he’ll be impacted along his lateral axis—the most dangerous kind of hit.

When an unsecured head whips from side to side, the brain gets slammed back and forth against the sides of the skull. The brain is a smushable thing; it alternately compresses and stretches out as this happens. In a lateral impact, the stretching pulls on the long neurons, called axons, that connect the brain’s two lobes. The axons swell, and if they swell too much, you may go into a coma and die.

A similar thing happens to the heart. A heart, when it’s full of blood, can weigh a good three-quarters of a pound. In a side impact, there’s more room for it to whip back and forth on the aorta. If the aorta stretches far enough and the heart is heavy with blood, the two may part ways. “Aortal severation,” as Gohmert puts it.

F is finally ready. We’ve moved upstairs to watch the action from the control room. A bank of lights comes on with a dramatic *phumph*. The actual impact itself is anticlimactic. Because it is air that’s doing the impacting, sled tests are unexpectedly quiet, crashes without a crash. And they are fast, too fast for the eye to register much of anything. The video is shot at ultrafast speed so that it can be played back in extremely slow motion.

We all lean in to see the screen. F’s arm bends up underneath the shoul-

der bolster, the space where the rib bolster had been removed. The arm appears to have an auxiliary joint, bending where arms shouldn’t. “That can’t be good,” someone says.

F endured a peak impact of 12 to 15 g’s—right on the cusp of injury. The extent of an accident victim’s injuries will depend not only on how many g’s of force there were but on how long it takes the vehicle to come to rest. If a car stops short the instant it hits a wall, say, the driver may endure a split-second peak load of 100 g’s. If the car has a collapsing hood (a common safety feature these days), the energy of those same 100 g’s is released more gradually, reducing the peak force to maybe 10 g’s—highly survivable.

The students slide F onto a stretcher and load him into a van. At the OSU Medical Center he’ll be scanned and X-rayed. The images, and an autopsy later, will reveal any injuries caused by the force of the impact and, in turn, contribute to the body of knowledge that will prevent future astronauts from ending up in F’s seat. The whole procedure will unfold exactly as it would with a live patient, right down to a 45-minute wait and a problem with the billing. **PM**

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PHOTO PHOBIA

> BY GLENN HARLAN REYNOLDS
> ILLUSTRATION BY RUI RICARDO

TOO MANY OFFICIALS THINK TAKING PHOTOS IS A CRIME. HERE'S WHY THEY'RE WRONG.



Today, most people walk around with a camera of some sort in their possession. Point-and-shoots, DSLRs and tiny video cams—not to mention cellphones—have become ubiquitous. And yet it seems that in many public locations, security officials are touchier than ever about letting people actually use those cameras. Our guardians of public safety often have the idea that shooting pictures in public places might be a

precursor to some sort of terrorism. It's an understandable concern, but misguided. I believe there is a good case to be made that having lots of cameras in the hands of citizens makes us more, rather than less, safe.

Here's how bad it has gotten: Not long ago, an Amtrak representative did an interview with local TV station Fox 5 in Washington, D.C.'s Union Station to explain that you don't need a permit to take pictures there—only to be approached by a security guard who ordered them to stop filming without a permit.

Legally, it's pretty much always okay to take photos in a public place as long as you're not physically interfering with traffic or police operations. As Bert Krages, an attorney who specializes in photography-related legal problems and wrote *Legal Handbook for Photographers*, says, "The general rule is that if something is in a public place, you're entitled to photograph it." What's more, though national-security laws are often invoked when quashing photographers, Krages explains that "the Patriot Act does not restrict photography; neither does the Homeland Security Act." But this doesn't stop people from interfering with photographers, even in settings that don't seem much like national-security zones.

Tennessee law student Morgan Manning has compiled a list of inci-

dents in which individuals were wrongly stopped. Cases like that of Seattle photographer Bogdan Mohora, who was arrested for taking pictures of police arresting a man and had his camera confiscated. Or NASA employee Walter Miller, who was stopped for photographing an art exhibit near the Indianapolis City-County Building and told that “homeland security” forbade photos of the facility. More recently, a CBS news crew was turned back from shooting the oil-fouled gulf coastline by two U.S. Coast Guard officers who said they were enforcing “BP’s rules.”

Unfortunately, Manning notes, although such hassling is generally illegal, it’s hard for the average citizen to get redress in court—how do you calculate the value of deleted snapshots or photos never taken in the first place?

As the examples above demonstrate, it’s a problem that stems as much from cluelessness at the bottom of the chain of command as from heavy-handedness at the top. The officers who crack down on photographers no doubt believe they are protecting public safety. But evidence that photography might be useful to terrorists is slim. According to security expert Bruce Schneier, head of security technology for British Telecom, terrorists don’t typically photograph targets in advance. “Look at the 9/11 attacks, the Moscow and London subway bombings, the Fort Hood shooting—no photos,” he says. “I’m not seeing a whole lot of plots that hinge on photography.” On his blog, Schneier advises: “If you’re harassed, it’s almost certainly a law enforcement official, public or private, acting way beyond his authority.”

Not surprisingly, police tend to be particularly sensitive about being photographed themselves. And many of the cases cited by Manning involve officers discouraging citizens from filming them while they go about their duties. Though one can understand their skittishness, the fact is, our ability to document the actions of public officials is an important freedom, one that can serve as a check against abuses.

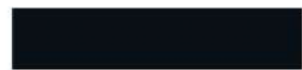
Police and prosecutors in Maryland have been taking a particularly hard line. In one case, motorcycle rider Anthony Graber left his helmet cam on while he was pulled over by a state trooper. A grand jury indicted him on several violations of the state’s wiretapping laws. If convicted on all charges, Graber could face up to 16 years in prison. In alleging that the GoPro video camera on Graber’s helmet constituted a “surreptitious” wiretapping device, prosecutors are making the claim that a person recording his own arrest is violating the police officer’s right to privacy.

This is the sort of thing you might be tempted simply to toss in the crazy file. But, in fact, this is one of the comparatively few issues that could merit a new federal civil rights law. Under the 14th Amendment to the Constitution, Congress is empowered to pass

police officer approaches you and tells you to stop? First, be polite. Security people have tough jobs and probably mean well. Ask them what legal authority they have to make you stop. (If you’re in a public place, like a street, a park, etc., they have none; if you’re in a private place, such as a shopping mall, they may have a basis for banning pictures.) Krages advises those hassled by security guards to threaten to call law enforcement. If it’s an actual police officer who’s telling you to stop shooting, ask to speak to a superior. And remember—you never have a legal duty to delete pictures you’ve taken.

More importantly, we need better education among security guards and law enforcement. In Britain, the country’s police chiefs’ association is attempting to educate officers about the rights of photographers. So far,

The officers who crack down on photographers no doubt believe they are protecting public safety. But evidence that photography might be useful to terrorists is slim.



laws protecting civil rights against infringement by state and local officials, and that seems to be what’s happening here. A clear federal law would limit cases, like Maryland’s, in which local officials use their power to harass those who might keep an eye on them. Passing such a law would make us all safer.

Even in potential terrorism cases, the presence of lots of ordinary folks carrying cameras actually enhances public security. In the hours after the failed Times Square car-bomb attempt, officials searching for clues didn’t just look at their own security-camera footage, they also sought out home movies shot by tourists.

So what should you do if you’re taking photos and a security guard or

nothing like that has happened in the U.S., but it should. Trying to block photography in public places is not only heavy-handed and wrong but, thanks to technology, basically useless. With the proliferation of cameras in just about every device we carry, digital photography has become too ubiquitous to stop. Let’s have a truce in the war on photography and set our sights on the real bad guys. Who, it seems, don’t carry cameras anyway. **PM**

POPULAR MECHANICS contributing editor Glenn Harlan Reynolds, author of *An Army of Davids* (Nelson Current, 2006), teaches law at the University of Tennessee and blogs at Instapundit.

BY JENNIFER BOGO

PHOTOGRAPHS BY CRAIG CAMERON OLSEN

THE HIGHEST DIVE

BREAKING THE RECORD FOR THE LONGEST, FASTEST FREE-FALL MEANS JUMPING INTO A NEAR VACUUM AND HURLING TOWARD EARTH AT THE SPEED OF SOUND. THIS YEAR, TWO MEN ARE RACING TO DO JUST THAT— BUT THE HARDEST PART MAY BE GETTING OFF THE GROUND.






"CAN A MAN FALL OUT OF THE SKY AND LIVE TO TELL ABOUT IT? WILL HE FREEZE TO DEATH ON THE WAY TO EARTH? OR WILL AERODYNAMIC HEATING LITERALLY COOK HIM?"

POPULAR MECHANICS,
MARCH 1956

Felix Baumgartner practices skydiving in a fully pressurized spacesuit inside a vertical wind tunnel in Perris, Calif.



A spacesuit is not Felix Baumgartner's typical attire. He's used to moving freely, his arms and legs swimming easily through the air, his thin flightsuit rippling against his skin in the sky over Taipei, or Rio de Janeiro, or Warsaw; he usually feels wind rushing across the square cut of his jaw. Late on a Friday night in February, he moves across the small room stiffly, one appendage at a time, like the Stay Puft Marshmallow Man, or a boy in a very, very thick snowsuit. ¶ A blue light flashes and a buzzer sounds. Inside the vertical wind tunnel, air whooshes up at Baumgartner at 130 mph, lifting his body in the puffy white pressure suit parallel to the ground. He oscillates for a moment, porpoising noticeably. "His chest pack is catching a little bit of air," observes Dan Murray, Baumgartner's flight surgeon, watching from outside the plexiglass window.

Then, Baumgartner's form begins to stabilize, hovering concave atop the column of wind. "There we go, he's got it," Murray says. "He figured it out."

A professional skydiver and BASE jumper from Austria, the 41-year-old Baumgartner has already set many world records: highest BASE jump from a building, lowest BASE jump, first person to BASE jump from the 1125-foot Millau Viaduct in France. He's even jumped from an airplane 32,808 feet over Dover, England, in order to free-fall 22 miles across the English Channel wearing a carbon-fiber wing. The spacesuit is necessary for his most audacious record yet, the one that would answer questions about human endurance that have lingered (including in the pages of *POPULAR MECHANICS*) for the last half-century: the highest and fastest free-fall in history—a leap from the upper stratosphere.

The existing record of 102,800 feet,

established by U.S. Air Force test pilot Joe Kittinger, has remained untouched for 50 years. By the end of this year, Baumgartner—backed by energy drink company Red Bull and advised by Kittinger himself—plans to surpass that, rising to a height of 120,000 feet in a pressurized capsule dangling beneath a high-altitude balloon. When he steps out, he'll hurtle toward earth at supersonic speed, breaking the sound barrier with only his spacesuit as the vehicle.

At least, that's the theory. In practice, it has never been done, which is why Baumgartner is training so rigorously now. Today's test is to determine whether he can actually skydive in a pressure suit inflated to 3.5 psi. Bustling around him in the facility in Perris, Calif., are members of the Red Bull Stratos team, chosen for their extensive experience in fields like aerospace, medicine, fabrication, electronics and skydiving.

But Kittinger's record will be difficult to break. "The parachutes have gotten better, the pressure suits have gotten better, the life-support systems have gotten better, the communications have gotten better," Kittinger says, "but the danger and the hazard of being at that altitude has not changed one bit. It's extremely hostile."

Others have tried, and died, over the last five decades. And this year, Baumgartner's not the only person mounting an effort: Michel Fournier, a parachutist and former colonel of the French army, also has his sights set on the stratosphere. This will be his fourth attempt to pilot a balloon to 130,000 feet, and if his skydive is successful, it will be the culmination of a 22-year dream. As Red Bull Stratos methodically moves through a scientific test-flight program—building, testing and simulating each scenario, including the countless things that can go wrong—Fournier has enlisted French and North American crews to join him at a launch site in Western Canada. Determined to beat Baumgartner into the sky and the history books, he's skipping straight to the big jump.



WHEN EXCELSIOR III LIFTED OFF from the desert floor of New Mexico on Aug. 16, 1960, it was only Joe Kittinger's 33rd parachute jump. He wore a partial-pressure suit like those designed for high-altitude pilots; the Project Mercury astronauts hadn't yet flown. As he ascended at 1200 feet per minute in an open gondola, passing through temperatures minus 100 F, the air bladders in his suit inflated to compensate for the reduced atmospheric pressure—all except for those in his right glove. Calculating that he could execute the mission without the use of that hand, which began to swell painfully, he declined to inform ground control.

When he reached peak altitude, Kittinger floated for 11 minutes toward his target, looking out over a "deep, dark indescribable blue" with wispy white clouds that were luminous from the sun. With his hand twice its normal size, and burdened by 160 pounds of equipment, he completed the 46 items on his checklist, pushed a button to start the cameras

THE CAPSULE



1 CAMERA SYSTEMS

Three pressurized housings on aluminum arms will contain a total of three HD, three ultra-high-resolution video and two digital still cameras. Four more cameras record outside and three inside. "We basically built a flying television studio," says Jay Nemeth of FlightLine Films.

2 OUTER FAIRING

The *Gemini* shape of the capsule is "really a very elegant way of putting a lot of insulation around a lot of the systems," says chief engineer Bill Dodson. R-24 equivalent foam, covered by a fiberglass shell and fireproof paint, helps guard against temperatures as low as minus 100 F.

3 LIQUID OXYGEN

Redundant liquid-oxygen tanks with independent lines provide 10 hours of O_2 for the 3-hour flight, plus pressurize Baumgartner's suit at altitude. N_2 , flowing from an oversize liquid-nitrogen tank will keep the cabin's oxygen level to below 30 percent, minimizing fire risk.

4 PRESSURE SPHERE

A pressure sphere, molded from fiberglass and epoxy, sits in a chrome-moly steel load frame "like an egg in a bubble-wrap container," says project director Art Thompson. It will be pressurized to 8 psi—equal to 16,000 feet—but is designed to withstand 50. "It's definitely overbuilt."

and said a quick prayer. Then he stepped over the threshold. "I rolled over onto my back and could see the capsule and the balloon roaring into space at a fantastic rate," he says. "And then I realized the balloon was standing still and it was me going down." Accelerating at 32 feet per second squared, he eventually reached 614 mph—just shy of the speed of sound.

Kittinger was already familiar with the dangers. During an earlier jump from 76,400 feet, a timer on his multistage parachute activated early and a pilot chute deployed only 2.5 seconds after he left the gondola. It pulled out a drogue, but with too little air density to billow out, it wound around Kittinger's neck. He went into a flat spin; blood surged to his brain, and he passed out. At 18,000 feet the main canopy, sensing the change in barometric pressure, automatically deployed, but it tangled in the drogue as Kittinger continued to tumble toward the ground. At 11,000 feet the reserve chute deployed, and at 6000 feet, finally freed of the main canopy, it fully unfurled.

But in August, the redesigned gear worked perfectly, and Kittinger spent the 4 minutes and 36 seconds of his free-fall assessing it thoroughly: "I was a test pilot, and my job was to gather information," he says. "I never had an opportunity to just relax and contemplate what was going on." The drogue chute Kittinger used to stabilize his fall and the automatic-opener device on his reserve parachute are now standard gear among high-altitude pilots and parachutists. His partial-pressure suit evolved into the suits used by shuttle astronauts.

"To me, the big difference between Project Excelsior and everything that's come after is that Project Excelsior had a clear, justifiable and urgent mission," says Craig Ryan, co-author of *Come Up and Get Me*, an autobiography of Kittinger published this June. "It was to prove the viability of emergency escape from super-high-altitude vehicles. This was necessary work, because for the first time we were sending pilots and astronauts to extraordinary heights, and we didn't really know how to get them back if anything went wrong."

History has shown there are many ways to die at high altitudes. Pyotr Dolgov, a parachutist for a Soviet ballooning program, leaped from the *Volga* at 93,970

THE DESCENT

120,000 FT

Felix Baumgartner exits capsule and executes a small hop from the threshold, falling feet down.

100,000 FT / 35-37 SEC

Accelerating at 32 feet per second squared, he reaches 690 mph, Mach 1, breaking the sound barrier. Baumgartner plans to rotate into delta position, arms and legs outstretched behind him, increasing his speed to as high as 740 mph.

60,000 FT / 1 MIN 35 SEC

Falling into denser air, Baumgartner slows to subsonic speeds and passes through the coldest part of the atmosphere, from minus 70 F to minus 100 F.

35,000 FT / 2 MIN 45 SEC

His pressure suit completely deflates, and Baumgartner may choose to assume standard skydiving position.

5000 FT / 5 MIN 35 SEC

Baumgartner deploys 270-square-foot main parachute and descends for roughly 10 more minutes.

MICHEL FOURNIER'S GOAL

130,000 FT

120,000 FT

110,000 FT

JOE KITTINGER'S RECORD

100,000 FT

90,000 FT

80,000 FT

70,000 FT

60,000 FT

50,000 FT

40,000 FT

30,000 FT

20,000 FT

10,000 FT

0 FT

feet in 1962. His faceplate cracked and his spacesuit depressurized; he died almost immediately from hypoxia—oxygen rushing to leave his body for the vacuum of space. In May 1966, a gondola carrying American skydiver Nick Piantanida rose to 57,600 feet before he either accidentally or purposely opened his own faceplate. His team brought him back down, but he slipped into a coma and died months later. Since then, not a single super-high-altitude manned balloon flight has left the ground.

If Baumgartner or Fournier succeeds, the technology and techniques they demonstrate would be of interest to NASA, the military's suborbital space-flight program and, most of all, the burgeoning industry of private space. A handful of companies are now racing to develop technology that would take civilians into low Earth orbit. "But none of them are really thinking beyond what's called shirt-sleeve technology, where they're going to put somebody in a regular jumpsuit in a space capsule and they're going to fly," says Art Thompson, Red Bull Stratos's technical project director. "We're looking at the next step. What happens if you need to get out?"



THE NACELLE BELONGING TO 66-year-old Michel Fournier looks like a relic of a bygone space program. Covered by quilted silver insulation, it's roughly the shape of a hot-water heater and not that much bigger. Inside, there is just enough room for a single seat and some electronic controls; stickers along the top read "Who Dares Wins" in both English and French. In fact, Fournier himself is an artifact of such a program: a skydiving project by the French Defense Ministry to test equipment for the first European space shuttle. The project was canceled in the late 1980s and the shuttle shortly after, but Fournier never gave up the ambition behind it.

In mid-May, the nacelle sits inside a small metal hangar on the far end of a tiny airfield in North Battleford, Saskatchewan. Fournier's countrymen work behind long pressed-wood tables covered with power tools, parts and a battered gray space helmet; a cardboard box containing food and a bottle of Mer-

FOURNIER'S AMERICAN SUPPORT TEAM FRETS ABOUT HIS PLAN TO MAKE ANOTHER ATTEMPT. "I DON'T WANT TO SEND THE MAN UP JUST TO DIE," SAYS ONE MEMBER.

Early on May 16, 2010, French parachutist Michel Fournier prepared to enter his capsule for what he hoped would be a record-breaking skydive.



lot sits nearby. The North American half of the team can be found in the back of the hangar, where they are busy installing a helium vent valve in the thin plastic balloon spilling out of a large crate.

Fournier's past attempts have been plagued by balloon problems. Weather ended his first try at the record, in 2002, after wind ripped away the inflation tube. When his team tried to launch again the following year, the balloon itself ruptured. In 2008, everyone cheered as the gossamer-thin craft floated up into the sky, but then gasped as they realized the capsule hadn't. A mechanism linking the two had fired prematurely, leaving Fournier on the ground.

Author Craig Ryan was there for the first attempt and observes the team did

not function as a well-oiled machine. "These projects need more than a daredevil," he says. "Daredevils are a dime a dozen." Such endeavors need money, technology and a crew with expertise—which everyone seems optimistic Fournier has finally assembled. This year, the balloon's Nevada-based manufacturer handpicked balloon pilots from around the U.S. to handle the launch. "Hell, yeah, we're going to get 'er done," draws Jim Roybal, a lanky pilot from Fort Worth, Texas. "We came up here to get this guy to where he wants to go, and that's what we're gonna do."

A fourth crucial requirement, Ryan says, is strong leadership. But at the operation's unofficial headquarters, a small motor lodge a few miles from the

airfield, Fournier's team has segregated by native language. The French gather in motel rooms and the small, sunny lobby. The American pilots and a group of Canadian ham radio enthusiasts, charged with tracking the balloon and capsule, stake out a picnic table and grill in the corner of the parking lot.



AT 1:30 AM ON THE DAY OF THE launch, the balloon pilots begin to stir. Mark Conner, the team meteorologist and a staff scientist at an environmental consulting firm in Omaha, leans against the motel's peach-colored siding, coffee mug in hand. He explains that the ideal launch conditions are very light winds in the lowest layers of the atmosphere, which typically require getting the balloon off the ground at dawn. The current wind speed is 6 mph—right at the upper limit. "All week long, no day would have worked," says Phil Bryant, a structural engineer who owns a balloon repair station in Houston. "This morning, it's just meant to be. It'll calm down."

The team drives to the airfield, and soon headlights pierce the darkness as a forklift lumbers down the runway, ferrying the large plywood crate with the roughly 8-million-cubic-foot balloon packed neatly inside. In the distance, Fournier's capsule sits illuminated in a cone of light. At 4 am, the sky lightens to a deep purple, then a smoky blue. The Canadian flag whipping over the main terminal slows to a lazy wave and finally hangs limp from its pole. By 5:30, the small crowd of local observers peering through binoculars along a chain-link fence can see the balloon stretched out for 400 feet along the runway. Fournier, in a bright yellow spacesuit, sits pre-breathing pure oxygen in the open door of the capsule.

No one moves to fill the balloon for another 2 hours. Word ripples out that a problem with Fournier's suit was responsible for the delay. Finally, the helium truck rumbles to life, and the balloon begins to float up off the runway, slim and transparent like a man-o'-war. Then, the steady hum of the truck stops, and the press agent's cellphone rings. "Oh, *shi-i-it*," she says into it. "Oh, shit, oh, shit, oh, shit." Fournier's reserve para-



THE SUIT



1 CONFORMAL HELMET

Like those worn by Air Force U-2 pilots, Baumgartner's helmet is conformal: It moves as the wearer's head moves, unlike the larger, nonconformal helmets of NASA astronauts.

2 ARTICULATED JOINTS

"The arms articulate around the shoulders so he can fall in one of two positions," says life-support engineer Mike Todd. And whereas NASA and Air Force suits inflate to a sitting position, the hips of Baumgartner's suit have been straightened.

3 REARVIEW MIRRORS

A mirror on the back of each glove allows Baumgartner to see what his parachute is doing above him during the jump.

4 CHEST PACK

A chest pack contains telemetry that will record and transmit data to crew on the ground. An inertial measurement unit will report altitude and spin, and a GPS unit will track Baumgartner's position. A123 lithium-ion batteries supply localized power.

5 CAMERA POCKETS

Two HD video cameras mounted on the thighs, one aimed up and the other down, will film the skydive. "That was a huge challenge for us," says Dan McCarter of the David Clark Company. "We didn't want to do anything that would affect the form, fit or function of the suit."

chute popped open in the capsule during a pressurization test, she says. The attempt has to be terminated for the day.

Only, rescheduling the launch is not that simple. Stratospheric balloons are made of a sheer, low-density polyethylene plastic as thin as a dry-cleaning bag. They're one-time use. The pilots vent the gas and carefully spool the balloon back into its crate, but it may have stretched.

Back at the lodge, the balloon's manufacturer, Mark Caviezel, joins the North American support team at the picnic table. He leans back in his chair, stirring a glass of Jack Daniels with his finger. "Mr. Fournier wants to fly on Tuesday," he announces. "Let me say that again: *Mr. Fournier wants to fly on Tuesday.*" The team waits expectantly; a few people shake their heads. "He's got issues with his balloon. He's got issues with his spacesuit. He's got issues with his chute," Caviezel says. He's asked how much of the balloon actually filled with helium. "About 60 to 70 feet," he replies. "One option we didn't discuss is to cut and reterminate the balloon. You'd probably lose a million cubic feet. You can still get record-breaking altitude. You can still have supersonic free-fall." Would Caviezel be willing to do that? "Among the core crew," he says, "the sentiment is not only no, but hell no. My professional meteorologist is telling me I have five days of nonflyable weather and [the French] tell me Tuesday is looking good." Conner confirms: "I don't think Tuesday's looking any better than tomorrow and tomorrow's shit." "Can you put that in laymen's terms?" someone asks.

They discuss it further: the weather, their protocol as pilots, their concerns about the rest of the team's preparation. They note that they have to get back to their jobs—some have taken vacation days to volunteer. Finally, they talk about how much they like Fournier.

"I don't want to send the man up just to die," Roybal says.

"I agree," Caviezel says. "He's a nice guy."

The next morning, the pilots fly home, and the Canadian hams drive back to Edmonton. Fournier walks from his room to the lobby, where his countrymen are once again congregating. The day before, as a distant figure in a yellow spacesuit being ushered off the tarmac,

he looked small—and he still does. But Fournier's demeanor is chipper, as though everything is going according to plan. When asked whether he'll try again, he smiles broadly and says, in French, "Oh, yes, we'll wait five days for the weather!" His equipment disappears from the hangar a few days later, but he'll be back, he tells the people of North Battleford. Hold the hangar for August.



THE CAPSULE BUILT FOR FELIX

Baumgartner at Sage Cheshire Aerospace, a private shop in Lancaster, Calif., looks not so much like the relic of an early space program as a shiny scale model of one manufactured for a museum. Its sleek, silvery shell is bell-shaped, like the *Gemini*. A half-inch-thick round acrylic door, 4 feet in diameter, swivels cleanly to one side on internal rails.

Beneath the fiberglass shell, it's outfitted like a spacecraft. "When you get above 120,000 feet, you're at around 0.2 percent atmosphere," says Art Thompson, who's also Sage Cheshire's co-founder. "So there's very little difference between being at 120,000 feet and being on the moon." A pressure sphere molded from fiberglass and epoxy and surrounded by a load-bearing cage of chrome-moly steel contains the craft's instrumentation, including manual controls for a redundant life-support system.

Whereas Kittinger ascended in an open gondola, Baumgartner's capsule will be pressurized to 8 psi so that he can ride safely up with his suit uninflated (and back down, in the event that the suit becomes compromised). But once Baumgartner opens the door, the inside of the craft will be exposed to the stratosphere—as will all the systems it holds.

"One of the unique things about this aircraft is that it goes up under a balloon and comes down under a parachute, and it goes up under pressure and comes back down under a vacuum condition," says Michael McDowell, the capsule's electrical and test engineer. "So this is very unlike any standard aircraft in that we're going to see cold, we're going to see vacuum, and then at the end of our trip, we don't land on wheels."

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Mending Fences

by Dan Koepfel

After 20 years and billions of dollars, securing the southern border remains a seemingly insurmountable challenge. Why is it so hard to build a fence that works?

Map by AxisMaps

The Secure Fence Act (2006) instructed the Department of Homeland Security (DHS) to protect some 700 miles of the 1952-mile U.S.-Mexico border. A patchwork of physical barriers includes more than a dozen types of fencing, from three-strand barbed wire to 18-foot-high steel walls, strung along roughly 650 miles. Virtual fences—camera- and radar-equipped towers networked with ground-motion sensors and other devices—were meant to guard some areas, but the DHS suspended work after testing several pilot projects. Here are some of the ways the U.S. attempts to regulate its southern frontier.



FIRST FENCE

It was started in 1990—a 14-mile-long, 10-foot-high barrier of welded steel that extended east from the Pacific shoreline south of San Diego.

THE LONG WALL

The 123-mile-long vehicle fencing along the southern boundary of Arizona's Organ Pipe Cactus National Monument forms one of the longest continuous physical barriers on the U.S. border.

As lines in the sand go, this steel structure is designed

to be the toughest on earth to cross. The 15-foot-high fence extends west of Nogales into the Arizona desert, undulating and curving as it follows the border with Mexico. South of the fence, hillside houses rise beyond a hundred-yard-wide no man's land. Some houses contain migrant laborers who will try—perhaps even tonight—to cross this line. A pickup truck makes its way up a gravel cut that zigzags across a hillside on the Mexican side. “He’s watching us,” says Border Patrol agent Mario Escalante. “He’s trying to gather intelligence—and so are we.”

This kind of fence—one of about a

dozen different barrier types found along the southern border—has a name that sounds like something the Army would give its brawniest tank: the anti-ram. From a distance, it looks like an array of dark-colored vertical blinds. On closer inspection, the slats reveal themselves to be steel pipes 4 inches in diameter filled with concrete poured around interior skeletons of rebar. The fence is modular, built in segmented panels 8 feet wide and sunk 6 feet into the ground.

One manufacturer claims it would take two men, each with a power saw, nearly 40 minutes to cut a 2-foot-wide hole in its anti-ram fencing, and they'd

LANDING MAT

Named for portable touchdown pads used by helicopters operating in Vietnam, landing mats form panels 12 feet long, 20 inches wide and ¼ inch thick that are welded to steel pipes buried 8 feet deep. A mile of fencing requires 3080 panels.



UNMANNED AERIAL SYSTEMS

Six Predator B drones based at Libby Army Airfield in Sierra Vista, Ariz., provide border surveillance. According to U.S. Customs and Border Protection, unmanned aircraft have flown 3000 hours since 2004 and contributed directly to 4766 arrests and the seizure of 22,823 pounds of marijuana.

NORMANDY FENCING

Named for the X-shaped barricades on Normandy beaches during D-Day, this fence type is designed to impede only vehicles.



VEHICLE FENCING

Half of the 650 miles of barriers along the border are designed to stop vehicles only. The rest, like the fencing in Presidio, Texas, is to halt foot traffic.

ANTI-RAM FENCING

It extends 15 feet aboveground and 6 feet deep to deter tunnelers. Expensive but difficult to defeat, this type of fencing can stop a 10,000-pound vehicle traveling at 40 mph.

BOLLARD FENCING

Typically 6 feet high and embedded 5 feet deep in a concrete base, this is built at small enough intervals so that it's impassable to vehicles but not to wildlife—or humans on foot.

need to carry additional fuel and extra blades to do it. And if the fence's name invokes images of an impenetrable barrier to powerful machines, it should—some anti-ram fences are designed to withstand a 40-mph impact by a 10,000-pound vehicle. Such defensive measures don't come cheap: The average cost of vehicle fencing is \$1 million per mile.

For more than 20 years, politicians from both parties have held the same basic position on the nation's frontiers. "First, the United States must secure its borders," President George W. Bush said on May 15, 2006. "This is a basic responsibility of a sovereign

nation." President Obama noted on April 29, 2010: "It is the federal government's responsibility to enforce the law and secure our borders. . . ."

Few political leaders have disagreed with these sweeping sentiments. And polls show that about 60 percent of Americans are in favor of a barrier that they believe will curb illegal immigration, drug smuggling and terrorists.

Since 1990, the U.S. has barricaded about 650 miles of the nearly 2000-mile border with everything from rudimentary barbed wire to fencing made of Army surplus helicopter landing mats to three-sided steel barriers that look like bulked-up versions of the tritons that littered the

World War II beaches of Normandy. More recent designs include concrete and steel bollards—vehicle-stopping posts similar to the kind found at entrances to government buildings, office towers and shopping malls. Some of the most expensive barriers—remotely operated surveillance systems—have been deployed in several field tests but with disappointing results.

Despite all the time, effort and money spent on both physical and virtual fences, about 175,000 migrants, mostly coming for work, made it past existing barriers in 2008. After decades of effort, bipartisan consensus and billions of dollars, America's southern border seems

STEEL/WIRE MESH

Installed in varying heights and designs, these fences are relatively economical to build but easily compromised by cutting and tunneling.



PICKET FENCING

It's designed primarily to soften the symbolic and visual impact of a barrier on both sides of the border. The Secure Fence Act calls for 130 miles of this 18-foot-high metal pedestrian fencing to be built in Texas, mostly near urban areas and international bridges.



SEGMENTED PROTECTION

The proposed fencing for 21 locations in the lower Rio Grande Valley will range in length from 1 to 13 miles.

as permeable as ever. And the frustrated American public wants to know: What's so hard about building a fence?

At the headquarters of the Border Patrol's Tucson sector, in a room filled with video monitors, agents play for me a recording made two weeks ago, in early January. The incident began with a hit from a motion sensor buried 50 miles south in the Sonoran Desert.

An agent using a joystick controller swiveled a camera on a surveillance tower near the sensor to scope out the hit. The video recording, even in night-vision silhouette, shows telling detail, including more than a dozen people wearing what appear to be small backpacks, which means they probably contain personal possessions, not drugs. Back at headquarters, the agent trained lasers on the group, "painting" its location for approaching Border Patrol agents. The migrants scattered. Some got away; most were caught.

What I see is a rare success. Over the years, the federal government has tried several times to use virtual fencing between stretches of physical fencing in remote areas. The first two projects, begun in 1998—the Integrated Surveillance Intelligence System (ISIS) and America's Shield Initiative (ASI)—cost more than \$429 million without working effectively. "It's a severe environment to expect cameras to operate reliably [in]," says Rich Stana, director for Homeland Security and Justice Issues at the Government Accountability Office.

Nevertheless, after 9/11 and the founding of the Department of Homeland Security, demand heightened for surveillance systems. When the Boeing Company won the contract for the Bush administration's 2005 Secure Border Initiative, initial projections claimed that by the end of 2009, the entire frontier would be secured by what was called SBInet, which included both virtual and physical barriers.

Seventeen towers were built in Arizona, but they swayed in the wind, making it impossible for cameras to get a steady fix. Radios used to transmit images were prone to latency. Lags of up to 4 minutes between detection and reception made apprehensions almost impossible. False positives—cattle or pronghorn antelopes, for example, setting off motion sensors—ranged up

After spending \$1.6 billion on two test projects in Arizona, the Department of Homeland Security in March postponed further work on a virtual fence. Like this test facility near Playas, N.M., it would rely on networked ground sensors and camera- and radar-equipped towers to monitor cross-border movements.



to 90 percent. The mapping software used to dispatch agents was based on a product more commonly found in urban police departments and keyed to street addresses; it couldn't zero in on the desert and mountains that make up the Tucson sector's Connecticut-size jurisdiction.

By last year, instead of San Diego-to-Texas coverage, the initial test hadn't expanded beyond the 17 towers. Congress's Government Accountability Office issued a report saying that the \$1.1 billion program had actually reduced border security. "We thought if we bought commercially available cameras and radars and put them on towers and connected them together with some kind of software package, it really wouldn't be that difficult," says Mark Borkowski, the Border Patrol's top official overseeing SBInet. "Well, it was difficult—and it needed to be treated as difficult."

Beginning in 2009, the government gave virtual fencing yet another try, using \$100 million provided under the American Recovery and Reinvestment Act. The first tower went online in January 2010 in what is possibly the single busiest border migratory zone on the planet: Arizona's rugged Altar Valley. At

the Tohono O'odham Indian Reservation, mountains of garbage include thousands of discarded bicycles that migrants have pedaled to the border. "We don't know what to do with them," says Gary Olson, the tribe's solid-waste coordinator. "There's no place to put them, and nobody wants them." At the Buenos Aires National Wildlife Refuge, it is almost impossible to find the facility's trails amid hundreds of footpaths created by north-bound traffic.

On the wish list for the newly christened Tucson-1 project were nine sensor towers, eight communications towers and 200 ground detectors linked by high-speed microwave to reduce latency. But when I visit, there is only a single tower surrounded by razor wire just a few hundred yards from the entrance to the refuge. A decommissioned tower from the previous attempt at virtual fencing stands about a half-mile away, and the differences are clear. No guy wires are needed to anchor the new structure, which is outfitted with a pair of gyro-steadied cameras and a laser pointer/sighter. Propane-fueled generators and solar panels power the installation; version one relied on a

single, failure-prone, liquid-fuel system.

Agents in Tucson headquarters played me a second video recording they said was made from this tower. Remotely controlled cameras tracked a white pickup that had slipped across the border. The Tucson operators maintained sight of the speeding vehicle, positioning agents ahead of it. The drivers were apprehended without injury.

It was clear that the Border Patrol agents believed in the technology. But in March, just two months after my visit, Homeland Security Secretary Janet Napolitano put the project on hold for "assessment." In fact, the program appears to have been canceled; \$50 million of SBInet funds are being used to hire additional Border Patrol agents and to equip law enforcement with more mundane tech like improved night-vision equipment and vehicle scanners designed to detect drugs. In addition, President Obama has ordered 1200 U.S. National Guard troops to join the 344 members of the guard already stationed on the southern border.

On a bright, sweaty afternoon, just a few feet from the primary crossing gate that allows legitimate vehicle and foot traffic between Nogales, Ariz., and Nogales, Mexico, Border Patrol field supervisor Kevin Hecht orders a group of men with jackhammers to position themselves at the center of a closed-off street. They're digging to uncover—and then fill—a newly discovered tunnel that leads directly beneath the border wall.

Though tunnels are becoming more common along the entire border, this area remains the frontier's hotbed. The reason is geography. Nogales, Mexico, shares a drainage system with Nogales, Ariz. A network of storm drains—some decades old—keeps water moving but also allows Mexican smugglers to enter the tunnels, then break through the walls and build side routes into the northerly sister city.

Hecht leads me to another section of tunnel at the edge of a landing-mat fence made of corrugated steel panels welded to steel posts. A hole about the size of a small washing machine is visible. "You're welcome to climb in," he says.

I drop down into the darkness and peer along what looks like a miniature mine shaft supported by wooden beams

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HOMETOWN HERO AWARDS

THE **GOOD GUYS**

BY DAVIN COBURN

PHOTOGRAPH BY BRIAN FINKE

For more than 100 years, POPULAR MECHANICS has celebrated the technological breakthroughs that have shaped the future. But we also know that changing the world is a local endeavor. Despite a tumultuous economy, 63 million Americans donated time, skills and patience volunteering to help their communities. Here, we salute four of them with our inaugural Hometown Heroes Awards and crown one of them Hero of the Year.





HAZZARD'S SKATING ANGEL

JESSE CLAYTON: CREATING NEW PLAY SPACE
IN A ROUGH PATCH OF PHILADELPHIA.

NORTHEAST OF PHILADELPHIA'S CITY CENTER, where the neighborhood of Kensington folds into Fishtown, there's Hazzard Street. For years, the name seemed appropriate. After the city and then the kids abandoned a local park—known as Pop's Playground, for a local who picked up the trash—the drug dealers moved in.

Two years ago, the New Kensington Community Development Corporation (NKCDC) offered local skateboarders the opportunity to turn Pop's into a skate park—if they did it on their own. Jesse Clayton, a local skateboarder, mason and carpenter, heard about the project and jumped at the chance to

design his own park. Using Google SketchUp, he laid out a 60 x 110-foot space with a variety of ramps and rails. "I pulled inspiration from average urban architecture," Clayton, 28, says. "All the things skaters normally skate on but then get kicked out of because it's public property." He organized a group of tradesmen who raised money by throwing beef-and-beer fundraisers and auctioning off hand-painted skateboards. Donations also poured in from the Tony Hawk Foundation and Franklin's Paine Skatepark Fund, a local skating advocacy group. After raising a little over \$23,000 on materials, volunteers spent 2500 hours building the park over nine months. They poured 65 yards of concrete and hauled nearly 4000 blocks. "It's tough to ask people to work for free," Clayton says. "But a half-dozen showed up every day." Pop's Skate Space opened last July.

A year later, it's turned into more than a skate park. "Summer camps use the space, and in the evenings it hosts summer movie nights," Tom Potts, an NKCDC organizer, says. "It's a community center." Clayton, meanwhile, is helping rebuild a nearby park in Whitehall. "The impact of these parks is so far-reaching," he says. "When a project can bring the community together, it feels like a real success story."



Jesse Clayton rides the rails at Pop's, a Philadelphia skate park he designed and built with the help of volunteers.

Fixing by feel, blind mechanic Larry Woody tends to cars—and high school students.

FROM GANGLAND TO WOODLANDS



BILL VANDERBERG:
STREET GANGS ARE
NO MATCH FOR THIS
OUTDOOR LEADER.

AGAINST A BACKDROP OF barbed wire, concrete and bitter gang violence, Bill Vanderberg, the 57-year-old dean of students at Crenshaw High School in South Central L.A., launched an Eco Club to lead kids on trips into the nearby mountains. For these mostly poor students, performing tasks like basic trail maintenance, erosion control and building stone steps across streams has opened minds and changed fates. Last year, Vanderberg organized a trip to Yosemite and invited students from rival Dorsey High. Crenshaw High is Crips territory; Dorsey is solidly Bloods. But at a snowed-in cabin during a spring blizzard, the kids bonded and renamed the club the Dorshaw Eco Club. The Sierra Club estimates Vanderberg has introduced over 1000 students to nature. "This project got students outdoors, but it also connected them with each other," Vanderberg says. "Along the way, we created a whole new group of conservationists."



Through backcountry hikes and trail maintenance work, Vanderberg gets students who rarely venture from their tough neighborhoods outdoors.



TEACHING BY EXAMPLE

LARRY WOODY: BLINDNESS DOESN'T STOP HIM FROM MENTORING KIDS.

EIGHT YEARS AGO, LARRY WOODY WAS HEADING TOWARD EUGENE, ORE., when the driver of an oncoming tractor-trailer lost control of his rig. Woody's Toyota Celica was no match; the accident broke his back and shattered bones in his face. Seven hours of surgery closed the wounds and set the bones—but doctors weren't able to restore his sight. Suddenly, the everyday activities the then 42-year-old had taken for granted weren't so routine anymore.

Woody had spent decades fixing, racing and restoring cars—and being sightless was no reason to stop tinkering. "So much of it is done by feel anyway," he says. "I just use my hands to see what I'm doing now." He opened his own place, D&D Automotive, in Cottage Grove, Ore., a quiet town with a population of less than 10,000. A town that needs mentors like Woody.

Down the road from Woody's shop, Cottage Grove High School instituted a School to Work program that matches students with local community mentors. One of the school's first calls was to Woody. "Not every student is meant to spend years in college," he says. "If I can do something to help while they're in high school, it offers them direction and a little bit of experience."

And a little bit of inspiration. Woody's first apprentice was a 17-year-old named Otto Shima—who was deaf. "He's just another student, and I'm just another guy trying to help him," Woody says. Last year, a girl named Scarlett Fulton spent three months at the shop learning the trade, and soon a new student will arrive. "It's a small town, so everyone heard about the accident," says Denise Beauchamp, who oversees the program. "Being paired with Larry is empowering for these students, because often they're struggling in their own ways."

FIGHTING—AND BUILDING—FOR WOUNDED WARRIORS

JOHN GONSALVES: BUILDING NEW HOMES FOR VETERANS DISABLED IN IRAQ AND AFGHANISTAN.

LIKE MANY OF THE SOLDIERS HE NOW helps, John Gonsalves doesn't back away from a challenge. The 44-year-old former construction supervisor knew that Iraq and Afghanistan veterans who came home wheelchair-bound would need major overhauls of their old houses—or entirely new ones with adapted living quarters. And, knowing that many of these men could never afford the modifications, Gonsalves looked to volunteer. "I assumed somebody was building homes for them, but nobody was," he says. So in 2004, he quit his job and launched Homes For Our Troops. The organization builds homes—free of charge—for veterans considered to be 100 percent disabled. Many

of the supplies are donated, the land is often purchased at a discount, and community-wide build brigades—like the 400 volunteers who came to the outskirts of San Antonio at the end of April—take the houses from concrete foundations to watertight shells in three days. "We're so excited, we frequently visit the site to watch it coming together," says Army Sgt. Nathan Hunt, who lost his legs to an IED in Baghdad. This summer Hunt will move in to one of the homes with his family. "We try to thank the volunteers for everything, but they all want to thank us." The veterans pay it forward by volunteering for other builds and launching their own charities. Teams have finished 63 homes in 24 states—at a cost of roughly \$350,000 each—and another 45 are under development. "Luckily, there aren't 35,000 servicemen who need these homes," Gonsalves says. "There are about 1000 who need our help. That's not an unattainable goal." With that kind of drive, Gonsalves takes home our first annual Hometown Hero of the Year Award and a \$1000 stuffed toolbox—donated by Stanley—that we hope helps him reach his admirable target. **PM**

Veteran Neil Frustaglio (left) and John Gonsalves in front of a typical volunteer-built home.



**PM'S
HOMETOWN
HERO OF
THE YEAR**

If someone you know deserves recognition for community service, please fill out the nomination form at our website, www.popularmechanics.com.

STEAM PUNKS



Driver Don Wales inside Inspiration, a steam-powered car that hit 159 mph—and broke a century-old land speed record.

A TEAM REVIVES LONG-ABANDONED TECHNOLOGY IN AN ATTEMPT TO BREAK A RECORD—AND PROVE A POINT.

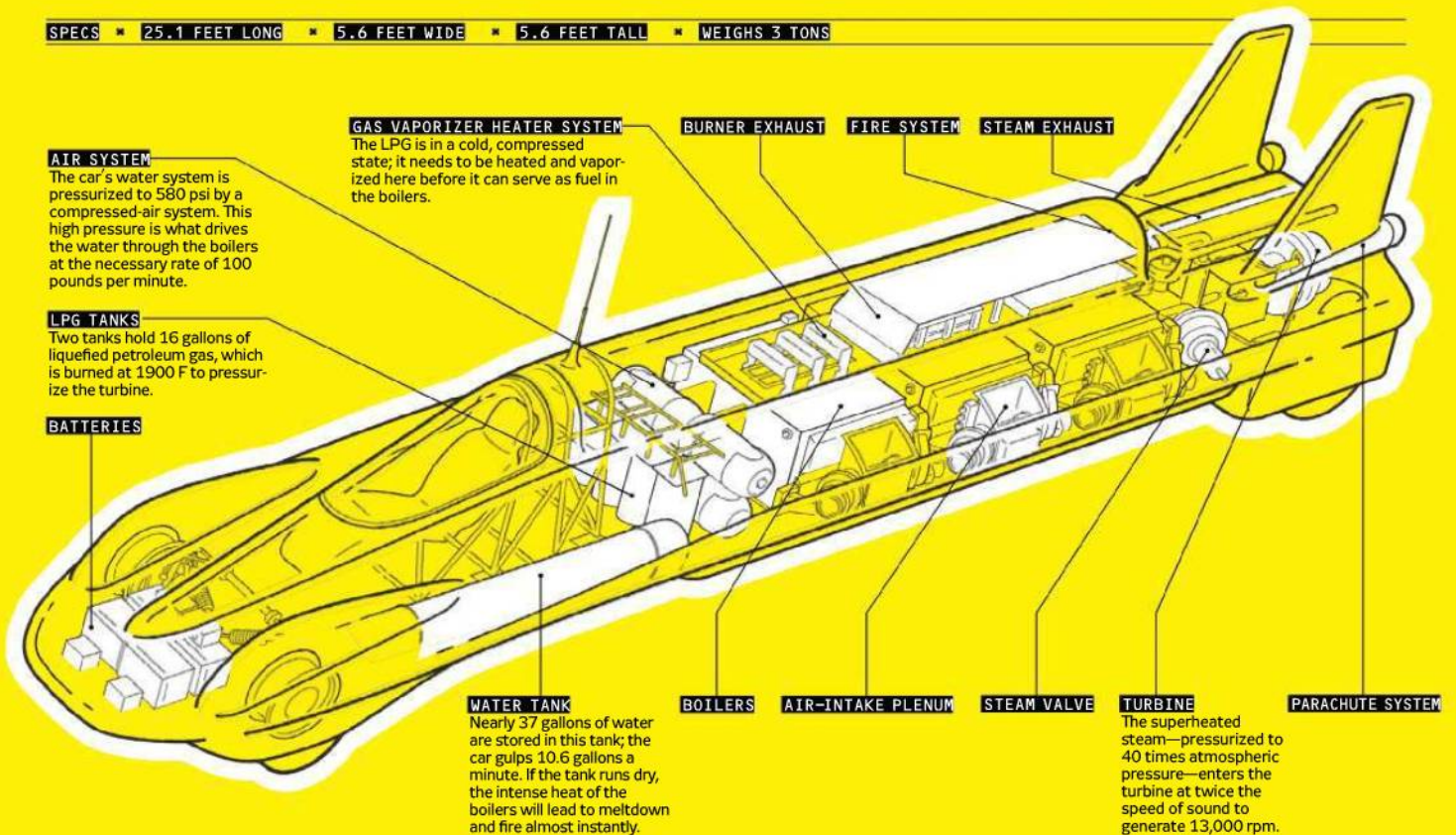


BY JEFF WISE

ILLUSTRATION BY MERCÉ IGLESIAS

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SPECS ■ 25.1 FEET LONG ■ 5.6 FEET WIDE ■ 5.6 FEET TALL ■ WEIGHS 3 TONS



THE SUN HAS JUST RISEN, AND

already the heat is shimmering over the dry lakebed. Craggy brown mountains loom over the towers and hangars of Edwards Air Force Base, the country's main military flight-testing center. A plywood trailer sits on the heat-cracked mud, thick black wires running from it in a giant V toward a quartet of sensors in the distance. Every few minutes, the desert's early-morning stillness is torn by a gut-thumping rumble as fighter jets take off on afterburners.

A walkie-talkie crackles. "Turnaround team to control: burners lighting."

Matt Candy, a balding 40-year-old Brit in dark glasses, clicks his handset. "Control to turnaround team, confirmed burners lighting. Clear to run."

"Turnaround team to control, car is away."

Through binoculars, the desert floor to the north is a vast mirror, the mirage reflecting distant peaks. After a long minute, a ball of dust appears, low in the sky. It grows longer, stretching out into a brown smudge. A green nub appears at its front, then lengthens as the vehicle emerges above the shimmering surface to reveal a long, low race car with a double fin in the back.

The vehicle, named Inspiration, was brought to the lakebed two months earlier by the British Steam Car Challenge, a group that has spent more than a decade designing and building what it hopes will be the fastest steam-powered vehicle in history. Weighing 6600 pounds and capable of generating

between a pair of orange flags like a landborne torpedo. At last its sound can be heard, a whispery, high-pitched drone like an airliner passing far overhead. Just as the car races through the end of the timed mile, a sonic boom rolls over the lakebed.

The thunderclap did not come from Inspiration. As the onlookers congregate around the timing trailer, the average speed through the traps pops up on a laptop screen: 104.202 mph. It's a modest velocity by any measure, and certainly well below the mark that the team has been hoping to beat. Something must have gone wrong. Again.

"That's our car for you," Candy says. "Reliably unreliable."

THE TITLE OF "WORLD'S FASTEST

Steam-Powered Car" might seem an arcane achievement, along the lines of "most powerful mechanical computer" or "tallest wooden skyscraper." And indeed, nothing rides on the Brits' success or failure other than the pleasure of playing around with an obsolete technology and seeing if you can make it work. But there was a time when steam cars were cutting-edge. A century ago, steam was everywhere. It powered locomotives and ships and heated homes. In 1906 the fastest automobile of any kind was a Stanley Steamer, which driver Fred Marriott took to the then-astonishing velocity of 127.659 mph.

But the age of the internal combustion engine was at hand, and soon steam was virtually a byword for obsolescence. Marriott's record for fastest steam car stood forlornly until the 1980s, when a hobbyist named Jim Crank pieced together a steam-powered vehicle from spare parts and a driver named Bob Barber took the contraption to 145.607 mph at the Bonneville Salt Flats in 1985. That record, however, was not an official result because the world authority on land speed records, the Paris-based Fédération Internationale de l'Automobile (FIA), wasn't present.

Meanwhile, a small but passionate underground was forming around the

idea that steam power still had a vital role to play. One such enthusiast was Dr. Neil Richardson of the University of Southampton in England. In 1997 he was advising a group of engineering students on their thesis project and suggested they design a vehicle that could break Marriott's long-standing record. Richardson brought their design to the attention of Lord Montagu, scion of Britain's foremost motoring family. Montagu had just the person in mind to take the project forward: his nephew, Charles Burnett III. Burnett had been running a company that converts automobiles to run on propane and, in his spare time, setting speed records in offshore powerboats. Burnett took on the project and hired a series of designers to bring the idea to life.

A decade later, he has arrived on the sweltering sands of the California desert to make his mark on steam history.

AS THE TEMPERATURE CLIMBS

into the triple digits, the pit crew swarms around the car, sitting in the shade of a canvas canopy at the team's encampment at the end of a taxiway. Mechanics remove rows of panels from the body and plunge into the internal workings. They quickly diagnose the problem: A large valve is stuck open, allowing steam to escape. Swapping it out for a new valve will be an all-day affair, a grueling undertaking in the August heat. Unfortunately, it's all too typical of how the team has spent the past two months. Each day, they take advantage of the cool early-morning hours to run the car over the lakebed. The rest of the day they fix whatever turns out to be broken.

As the mechanics tackle the wayward valve, Candy walks me around the car. Near the front sit twin liquid petroleum gas (LPG) tanks, which feed into a heating unit that converts the fuel into a gas. This flows into burners in 12 suitcase-size boilers. The resulting flames reach 1900 F. Demineralized water flowing through coils of tubing in the boilers is heated to 750 degrees, becoming high-pressure, superheated dry steam. The steam emerges into a collection system that funnels the output through a turbine that connects directly to the rear wheels.

**"THAT'S OUR CAR FOR YOU,"
PROJECT MANAGER MATT
CANDY SAYS. "RELIABLY
UNRELIABLE."**

3 megawatts of heat in its boilers—equivalent to 1500 electric teakettles—the sleekly sculpted car represents the apex of modern mobile steam technology. The big question: Can it beat a record set more than a century ago?

Drawing closer to the observers on the lakebed, the steam car shoots

All told, the system runs through 16 gallons of LPG on every 3-minute run. Because it's a total-loss system—the steam, instead of being recirculated, is vented out of the turbine into the atmosphere—the car goes through nearly 30 gallons of water as well. If the car ever runs out of water during a run, the boilers will melt and the whole car will likely blow up.

“The first rule of Steam Car Club,” Candy says, “is ‘Always have water.’”

The need to keep steam cars filled with both fuel and water is one of the reasons they gradually fell from favor. That, and the fact that it takes time to heat up the water and make steam. “Something feels wrong with your car if it won't go within seconds of turning the key,” says Charles Mendler, an engine designer at Envera LLC who is not affiliated with the project.

Those factors aren't relevant for the record bid, but the Inspiration's complexity is: Its parts have been scrounged from all sorts of unusual sources, including teakettles and power stations. “It's an eclectic mix,” Candy admits, “and as a result there are a lot of failure modes.”

That the project has come this far is a testament to the remarkable array of talent that has gathered on its behalf. The system designer, Jeremy Bliss, performed the same role on Thrust SSC, the car that set the absolute world land speed record of 763 mph in 1997. Mike Horne, the bodywork specialist, is also working on Bloodhound SSC, a new land speed record attempt that's aiming to hit 1000 mph. The test driver, Don Wales, is the grandson of land speed titan Malcolm Campbell, and holds the U.K. electric car record. “In the U.K., we're a small country, and everyone knows what everyone else is doing,” Wales says. “It's very incestuous and friendly.”

Nearby, inside an air-conditioned trailer, Burnett relaxes on a plushly padded leather sofa. While it's true that he descended from the peerage and summers in a castle in England,



Burnett comes across as anything but a stuffy toff. Raised partly in Florida, the 54-year-old speaks with an American accent and rocks a pair of batik shorts and a Hawaiian shirt whose garishness perfectly matches his lobster-pink sunburn. Of Marriott's elusive record, he says, “It's clear we can break it. It's just the tweaks and the twiddles that you can get in anything that's built from scratch.”

Day after day, unsuccessful record attempts segue to long, hot days probing and patching the huge car's innards. There are valves to replace, faulty sensors to troubleshoot. Until, finally, the day arrives when nothing goes wrong.

In the predawn darkness of Aug. 25, the team assembles at the encampment, trailers the car to the starting line and makes another attempt. This time, the machine works flawlessly. Burnett hits 136 mph on the outbound run and 151 on the return, for an officially sanctioned average of 139.843 mph. Though still shy of Bob Barber's run, it's enough to earn Inspiration official FIA recognition as the world's fastest steam car. The next morning, every newsstand in Britain is bedecked with triumphant headlines: “British steam-powered car boils 100-year-old record!”

Later that day, Don Wales takes the driver's seat and manages to do his boss one better, hitting a top speed of 159 and an average speed of 148.308 mph. Out of deference to the boss, the team will record Burnett's time for the mile—the prestige event—and log



X The car blows past a T-38 on the runway at California's Edwards Air Force Base.

X The British steam car faced a number of issues before its record-setting run; here, mechanics troubleshoot one of its 12 boilers.

Wales's time for the kilometer.

For an hour, the team celebrates in the encampment. Then it's time to pack up and get off the lakebed. The steam car goes back into its shipping container for the long return journey to the U.K., where it will tour until it's placed in Lord Montagu's Beaulieu, Hampshire-based National Motor Museum. “We've done what we set out to do,” Candy says. “It will never run again.”

Out on the course, FIA-authorized chief timing official James Rice rolls up the sensor wires and stows his gear in the trailer. In his 14 years as a land speed record timer, he's recorded tens of thousands of runs, both at big meets and at one-offs where a single goes for a record. Of these world records, he says, the Inspiration holds a special distinction. “This,” he says, “was the slowest one I've ever done.”

PM

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diy

Home

An appropriately named editor if there ever was one: PM's Harry Sawyers takes a test cut in a hardwood limb.

Wood Chopper's Ball

WE TEST FIVE CHAIN SAWS IN A BATTLE FOR WOOD-SLICING SUPREMACY. BY ROY BERENDSOHN

➔ **Testing chain saws** was a tough job this year. Not because of messy oil, loud engines or spraying wood chips—we love all that stuff. The trouble was, these heavy-duty saws were just too good. It took huge amounts of cutting to tease out the distinctions,

and we called in some pros for help. Luckily, last winter prepared lots of test material for us at a farm owned by contributing editor Fred Mackerodt in New York state. Storms snapped off nearly tree-size limbs, while deep in the woods whole trees had crashed

down hillsides and snarled in gigantic heaps of brush. We felled, bucked or cleared sugar maple, red cedar, hickory, ash, pine, spruce, white birch and red oak. The test was tough, as tough as the saws themselves, but it was fair. Here's what we found.

INSIDE

×

A/C TRAPS + LEAD-SAFE REMODELING + JACKING CONCRETE SLABS



●●●●●
ECHO
CS-600P

ENGINE SIZE: 59.8 CC
HP: 4
BAR LENGTH: 20 INCHES
WEIGHT: 17.4 POUNDS*
FUEL: 19.1 OUNCES
AIR-FILTER ACCESS: TOOL-FREE
DECOMPRESSION VALVE: YES
PURGE BULB: NO
DECIBELS (A-SCALE): 113
PRICE: \$560

Echo is known for simple, intuitive outdoor power equipment, and that reputation will be enhanced by this saw. It's got an on/off toggle switch, a clearly visible decompression valve and a large knob on its air-cleaner cover. "They just build good, honest equipment," one of our testers said. That's the Echo in a nutshell. It also has the best action on its chain-brake lever—crisp, with no slop. Finally, and perhaps most important, its engine operates with a broad torque curve, and that power comes shining through in the tough cuts.

Dislikes: Nothing noted.



●●●●●
HUSQVARNA
455 Rancher

ENGINE SIZE: 55.5 CC
HP: 3.5
BAR LENGTH: 20 INCHES
WEIGHT: 17.4 POUNDS*
FUEL: 14 OUNCES
AIR-FILTER ACCESS: PHILLIPS-HEAD SCREWS
DECOMPRESSION VALVE: YES
PURGE BULB: YES
DECIBELS (A-SCALE): 111
PRICE: \$400

From comments about our tests posted on the Web, we know that every time we pit a Husqvarna saw against a Stihl, we're entering a divisive political battle. The fact is, both companies make great saws. The Rancher has excellent throttle response and power thanks to well-designed airflow through the engine. Husqvarna calls its design X-Torq. It uses ducts that channel clean air to evacuate exhaust gases while ushering in a separate air-fuel mixture. We can't say whether this also makes it easier to start, but the saw came out of the box fully assembled and it started on the second pull.

Dislikes: A woodcutter needs tool-free access to the filter—not small black screws. Luckily, the screws are captive, so they won't fall out, and Husqvarna says it's looking into alternatives. We didn't experience problems with the chain-brake lever, but it feels like it could be sturdier—added robustness is called for.



●●●●●
JONSERED
CS2159 C

ENGINE SIZE: 56.5 CC
HP: 4.4
BAR LENGTH: 20 INCHES (PRO BAR OPTION)
WEIGHT: 17.6 POUNDS*
FUEL: 22.8 OUNCES
AIR-FILTER ACCESS: CLIPS, SCREWDRIVER
DECOMPRESSION VALVE: YES
PURGE BULB: NO
DECIBELS (A-SCALE): 114
PRICE: \$580

For this test, it seemed appropriate to call in some pros to get their opinions: Jeff Paulsen and Jeff Conklin of Timber Care Tree Service in Campbell Hall, N.Y. "It's got some guts," Paulsen said after using the Jonsered to saw up a maple limb. That's no coincidence. This saw has the highest horsepower of any of the saws tested. Combine that hard-charging power with good balance and a slim body, and you've got a saw that couples solid felling power with ease of use for limbing.

Dislikes: The clip-on air-filter cover is normally easy to remove and gives good access to the top of the engine, but we're still not big fans of the design. We found it hard to remove when our hands were cold or wet.

*WITH BAR AND FUEL

Big Saws, Big Decisions

If all you do is take care of a few winter-downed tree limbs, you don't need saws as big as these.

A saw in the 30-cc to 45-cc range that weighs 10 to 14 pounds is a better choice since it's less tiring to use.

The bigger machines are designed for people who produce at least five cords a year for heating or who deal with large trees as part of property maintenance, farming, ranching or construction. And if that's your work, we'd suggest you visit a dealer and try a saw on for size and handling. These are expensive products, and a little professional advice goes a long way to ensure you get it right. Buy something that suits you; you'll be a safer and more productive woodcutter for it.

SAFETY GEAR

The rain, snow, wind and early spring heat of this test made the need for good safety gear all the more obvious.

CHAPS: This was our first test wearing them. When bucking my way along a huge maple on a steep hill, I was glad I had them. Yes, they make you sweat, but a leg gash deep in the woods can be fatal.

WRAPAROUND SAFETY GLASSES: Two pairs are optimal. After getting plastered in the face by sticky pine chips one afternoon, I turned to a clean pair. Next time I cut softwoods, I'm also bringing some glass cleaner.

GLOVES: I typically don't wear them. Still, they're useful when handling jagged stuff and putting on chain.

BOOTS: I'm done using my regular work boots. My next pair will have a really deep tread and steel toes for kicking my way through the logging slash.

BUG SPRAY: One doctor's visit later, to dig out a large, deeply embedded tick, and I'll never head into the woods again without a thorough application of DEET-containing bug spray. — *R.B.*



SOLO
656

ENGINE SIZE: 56 CC
HP: 4.1
BAR LENGTH: 18 INCHES
WEIGHT: 16.2 POUNDS*
FUEL: 20 OUNCES
AIR-FILTER ACCESS: CLIPS, SCREWDRIVER
DECOMPRESSION VALVE: YES
PURGE BULB: YES
DECIBELS (A-SCALE): 114
PRICE: \$709

Our Solo was the only saw with an 18-inch bar. While that limited its cut slightly, it magnified its impressive power-to-weight ratio. The slim body, light weight and power make it perfect for limbing and other jobs that require awkward sawing positions, such as clearing tangled knots of small-diameter downed trees. We turned to the Solo when we cut away the nasty mash of red cedars that had fallen across our logging trails.

Dislikes: Given how capable and well-engineered the Solo is, we found it odd that its throttle linkage is exposed in the gap between the front of the handle and the saw body. We didn't experience dirt or twigs hanging it up, but this linkage should be shielded, as on all the other saws.



STIHL
MS 290 Farm Boss

ENGINE SIZE: 56.5 CC
HP: 3.8
BAR LENGTH: 20 INCHES
WEIGHT: 17.4 POUNDS*
FUEL: 18.9 OUNCES
AIR-FILTER ACCESS: TOOL-FREE
DECOMPRESSION VALVE: NO
PURGE BULB: NO
DECIBELS (A-SCALE): 111
PRICE: \$370

The Farm Boss is Stihl's No. 1 selling saw, and you can see why. It's thoroughly engineered. Its manufacturer makes its own bar and chain, engine and most of the other components on the saw. Many saws today have an airflow pattern that takes out the worst of the debris before it gets anywhere near the air filter, but the Stihl is exemplary. It's amazing how clean its air filter stays. It seems that the company lavished attention on every square inch of the saw, from the crisply activated chain brake to the plastic retainer straps on the oil and gas caps to the caps themselves, which lock with a half-turn.

Dislikes: Nothing noted.

Homeowners Clinic

by Roy Berendsohn

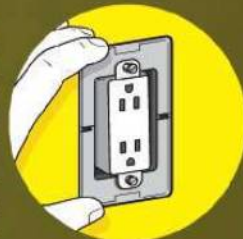
Q+A

SMALL JOBS

Screwless Covers

Step 1

→ Cut power, then move the outlet receptacle forward. Snap the two halves of the subplate together under the mounting strap.



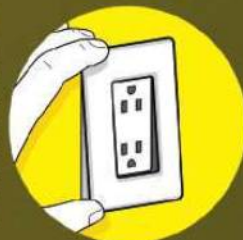
Step 2

→ Tighten the receptacle's screws until its mounting strap clicks into the tabs on the subplate.



Step 3

→ Position the screwless cover plate correctly over the receptacle and lock it down by pressing it onto the subplate.



Taking Cover

Q I want to install new cover plates on my outlets and switches and use the types that don't have screws—I think they look nicer. Do these work with standard outlets and electrical boxes? Are they easy to install?

A Yes, these screwless covers should work with a standard duplex receptacle or a rocker light switch that has a rectangular face. No, these plates will not work with duplex outlets that have a round face or with a toggle light switch.

I was interested enough in your question to take it for a test run, so I went to

a home center, bought several different types of screwless covers and tested them on various outlet receptacles. Some of the outlets were made by the same manufacturer as the covers, and other outlets were made by a different manufacturer. The covers worked in both cases. That doesn't qualify as a universal test, though. Buy some covers and try them out before buying enough to do your entire house or several rooms.

These cover plates mount to a subplate that is installed under the mounting strap of the outlet or switch. To do that, you'll need to cut power to the device, remove its cover plate, loosen

STUDIO D: ILLUSTRATIONS BY MERCÉ IGLESÍAS

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*Based on pricing for comparable equipment from ADT and Broadview as of 4/14/2010.

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SECURITY

the device's mounting screws and then lift the receptacle or switch up about a half-inch. Then you push the subplate (which comes as two halves) below the strap and screw the device back down. The device should snap firmly down onto the subplate as you drive the mounting screws home. Finally, position the screwless cover plate over the base correctly—an arrow on its back tells you which end is up. Then snap the cover onto the base. You should be aware that the cover snaps very firmly onto the base. With the covers I tested, you need to insert a small screwdriver into a slot on the bottom of the receptacle to pop it off the base. If you install these covers on receptacles that have a ground pin facing up, then the small slot will be visible after the cover is installed.

A couple of things can go wrong. First, the subplate needs flat drywall or plaster to rest on. A lump or a bulge will prevent the plate from mounting correctly. Second, I can see where the design of the subplate may not permit it to be used on plastic old-work electrical boxes (these are boxes installed after the house is built into which wire is fished and devices are installed). The face of this box is positioned slightly above the wall surface, unlike that of a standard electrical box with a face, which sits flush to the drywall. The raised face of the old-work box may interfere with the subplate.

Water Heater Cuts Out

I have a direct-vent natural-gas-fired water heater that goes out frequently, requiring me to relight the pilot light. The appliance is six years old. What causes this and how can I stop it from happening?

Of course, a bad or loose thermocouple could be the culprit here. This device generates electrical current from the pilot flame; in turn this energizes the solenoid valve, keeping it open and allowing gas to flow to the burner when called for by the thermostat. But things aren't as simple as they once were in diagnosing why the pilot has gone out on a gas-fired water heater. The culprit

could be a lack of airflow to the heater brought about by a dust buildup or by a badly done installation that has compromised the airflow to the appliance.

"Just as people maintain and clean their furnaces, boilers and air conditioners, they now need to do the same for their gas-fired water heaters," says Mark Petrarca, an industrial engineer and senior vice president at water-heater manufacturer AO Smith. This is especially true if the water heater is located in a dusty or dirty environment such as a garage or attic. New safety standards that went into effect in 2003 have mandated that gas-fired water heaters be Flammable Vapor Ignition Resistant (or FVIR). If gasoline vapors, for example, enter into the heater's combustion area, they will be safely burned off without causing a flashback that would ignite combustible fumes outside the heater, resulting in an explosion. To prevent combustible-vapor explosion, some of these water heaters have air screens and flame-arrestor plates that need to be cleaned per the manufacturer's instructions. A lack of combustion airflow, particles in the combustion chamber or even condensation can shut down the pilot. This can give a homeowner or a technician a false sense that the appliance's thermocouple is bad.

Cracked Stoop

Winter took its toll on my front concrete stoop. I've noticed a small crack at one corner where the steel handrail is mounted. What's the fix?

It may be winter-related damage, but it's more likely caused by year-round wear and tear. A common problem with steel handrails mounted into masonry is that the steel rusts (and it can rust quickly if you use rock salt). The expanding rust creates enough force to crack the concrete. The same thing can happen with a steel screw driven into a mortar joint in a brick wall or chimney.

If it's just a hairline crack, consider coating the stoop with a masonry stain mixed with nonskid abrasive particles.

Continued on page 84

HOW YOUR HOUSE WORKS

→ Induction Cooktop

Cooking With Joule

HOW INDUCTION COOKTOPS USE ELECTROMAGNETS, CONDUCTORS, RESISTANCE AND HIGH-FREQUENCY CURRENTS TO FRY EGGS AT WARP SPEED.

BY HARRY SAWYERS

→ "Use Channel 7. It always cooks on 7," chef Sean Rembold of Brooklyn restaurant Marlow & Sons says. Nearby, a cook whips up the signature Brick Chicken on one of five single-burner induction cooktops. The "channels" refer to the 20 heat settings on his machines. They have plenty of firepower for his restaurant, and more than enough for the 2 percent of U.S. homes with induction in the kitchen. "It's a fun way to cook," Rembold says. "Perfect for a geeky man's kitchen. I'm not a recipe cook, but this makes you more precise." The results are consistent. The pan-fried bird never gets a singed skin, a risk when frying in warped pans over flames. Instead, it is crusty perfection: salt, pepper, crunch. The secret? Magnets. Let us explain.



INSIDE

→ MAGNETIC FIELDS → ELECTRONS
→ HYSTERESIS → IRON SKILLETTS →
JAMES PRESCOTT JOULE

FAR RIGHT: GE PROFILE 30-INCH INDUCTION COOKTOP, MODEL PHB9255PSS (\$2799)

ELEMENTS OF INDUCTION

Aluminum Plates

Aluminum stampings beneath the burners shield sensitive electronics from electromagnetic fields and from heat generated by cooking.

Ferrites

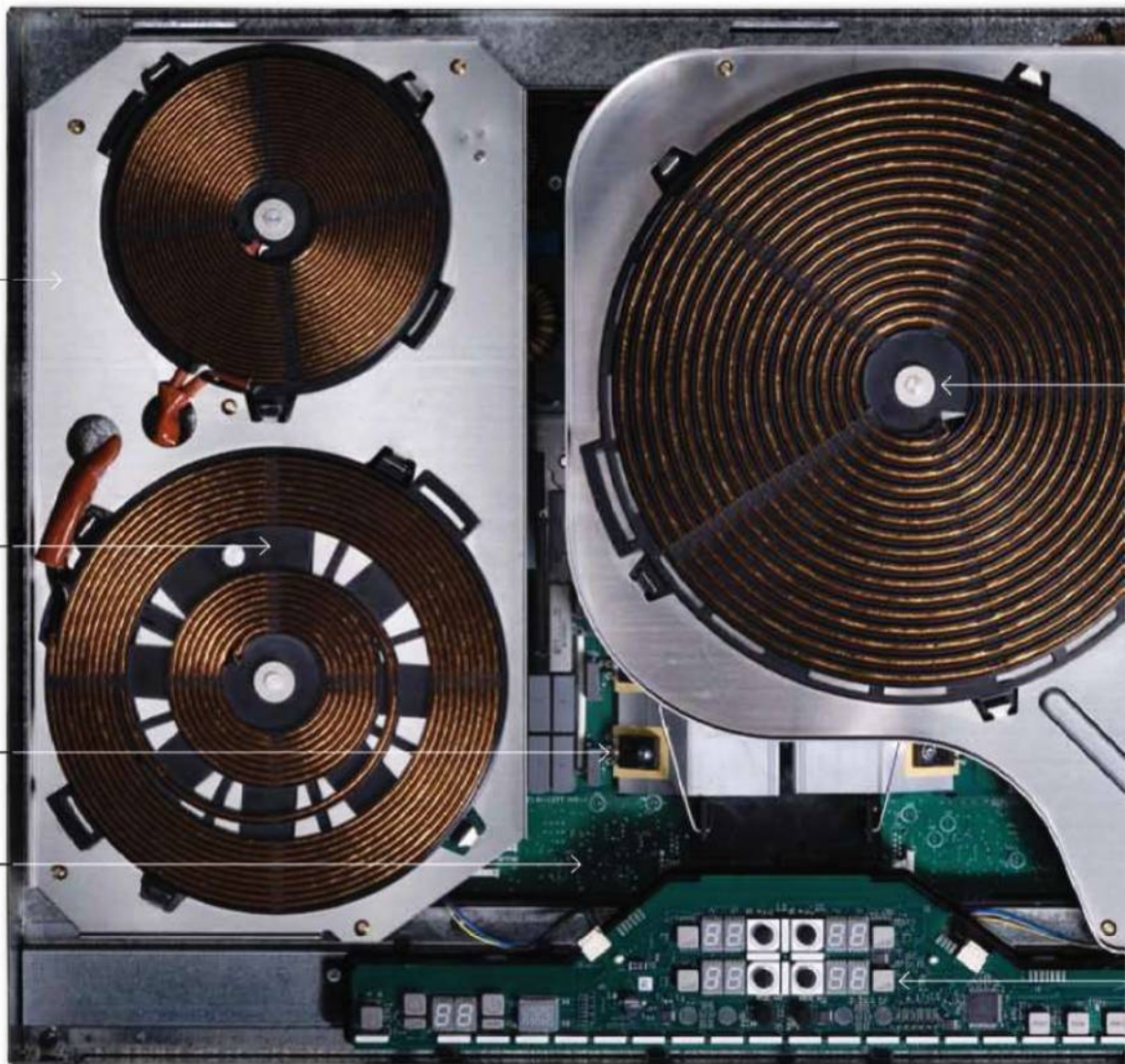
Ferrites beneath the copper coils repel the magnetic field, concentrating the field on the cookware above.

Insulated Gate Bipolar Transistor

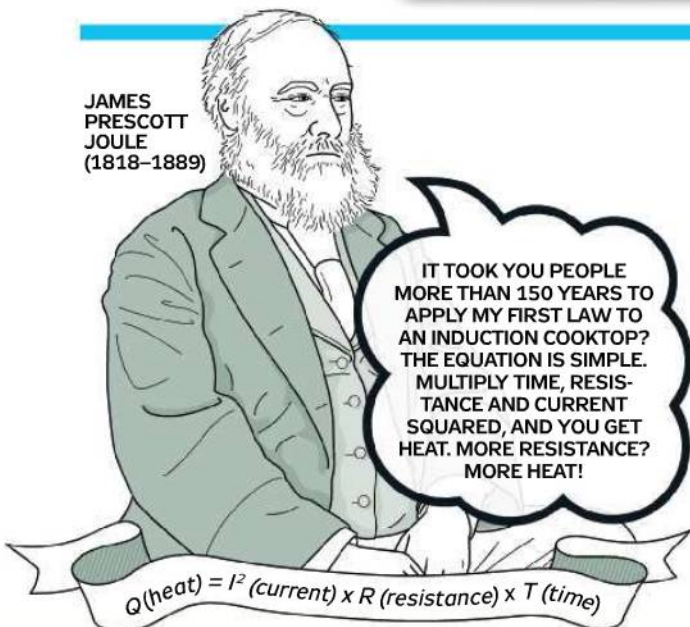
The IGBT chops up the electric current's wavelengths, rapidly turning the power on and off. The process pushes the pan's electron domains in and out of alignment, generating heat through intermolecular friction.

Central Processing Unit

The computer sends current to each inductor coil, which produces a magnetic field. Sensors detect and maintain the temperature of the pan. Chef Rembold calls it "cooking by numbers," with distinct settings generating consistent results for creamy grits or perfect pancakes.



JAMES
PRESCOTT
JOULE
(1818–1889)



IT TOOK YOU PEOPLE MORE THAN 150 YEARS TO APPLY MY FIRST LAW TO AN INDUCTION COOKTOP? THE EQUATION IS SIMPLE. MULTIPLY TIME, RESISTANCE AND CURRENT SQUARED, AND YOU GET HEAT. MORE RESISTANCE? MORE HEAT!

$$Q(\text{heat}) = I^2 (\text{current}) \times R (\text{resistance}) \times T (\text{time})$$

➔ Induction cooktops generate heat in the cookware itself.

The processes described at right are a more efficient alternative to heating by a flame or a resistive electric coil. Ninety percent of the heat made by induction reaches the food—on an electric range, 65 to 70 percent goes to the food; for gas, it's only 40 to 55 percent.

1 Electric current A magnetic field is generated by a 240-volt, 20-to-30-amp, 20-to-75-kHz-frequency electric current from a 40- or 50-amp breaker through a copper coil.

2 Magnetic field The magnetic field acts as a bridge, linking the electric current in the copper coils with eddy currents induced in ferromagnetic cookware.

3 Eddy currents Magnets pull otherwise randomly distributed electrons in a consistent direction. The magnetic field sets the pan's electrons into organized motions known as eddy currents. The currents generate heat in the pan walls.

4 Joule effect Resistance to electron flow is higher in the cookware than in copper. Increasing the resistance raises the heat, as James Prescott Joule demonstrated in 1841. The skillet, to a physicist, is merely an impedance.

5 Hysteresis The intermolecular friction and heat made by the IGBT result from a process called hysteresis. Both hysteresis and eddy currents generate heat in the cookware. Attempts to determine which process plays the more important role have been known to cause screaming arguments between induction-cooktop engineers.

COOKTOP MYTHS



IT AFFECTS PACEMAKERS

➔ Studies suggest that induction poses little risk to pacemakers, though most manufacturers still recommend that patients with pacemakers consult a cardiologist.



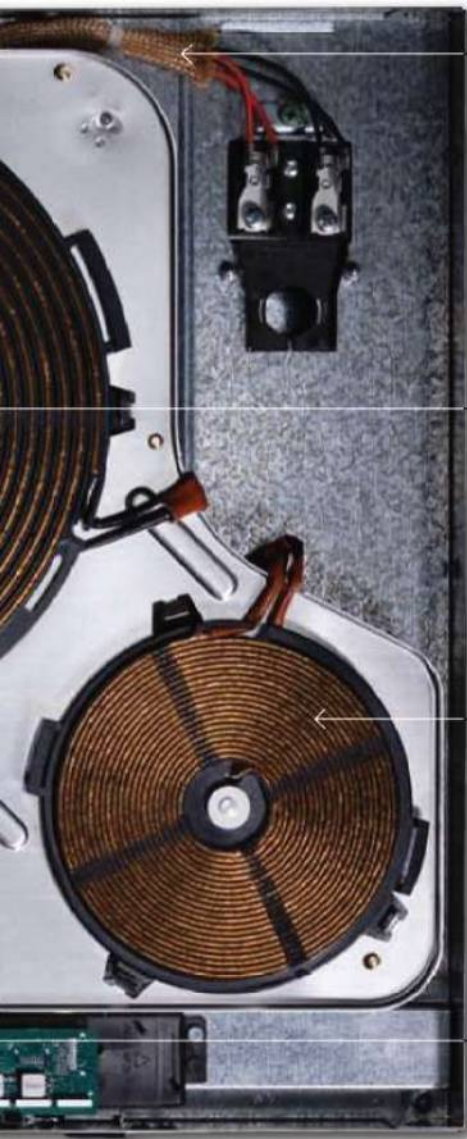
IT NEEDS ODD PANS

➔ Put a magnet on your cookware. If it sticks, it's ferromagnetic—iron or some types of steel—and it'll work.



IT HEATS UP SPOONS

➔ Stray utensils in the cooktop's magnetic field won't get hot. A flat pot bottom must make contact before current flows.



Wiring to CPU & Burners

Copper conductors, bundled to distribute load evenly, carry current from the breaker panel to the CPU. Internal wires carry current to each copper inductor at a frequency of 20 to 75 kHz (the wave peaks 75,000 times a second). Electrical currents produce a magnetic field equal to their own frequency. But you already knew that.

Cookware Sensors

Sensors in each coil/inductor detect the temperature of the cookware on top. This safety feature ensures that the current deactivates if the cooktop overheats.

Inductors (Burners)

These copper coils' magnetic fields induce heat-producing currents in the cookware. The "burner," in essence, is the pot itself—it's the heat source, and the only nonfood item truly getting hot. This keeps the kitchen cool, makes efficient use of electricity and creates consistent heat within the cookware.

Control Panel

A digital display shows heat settings on a numerical scale, say, 1 to 20, or as a temperature in degrees. At the lower end of the scale, the cook has considerable control—Level 4 is not quite twice as hot as Level 2. Chef Rembold prefers knobs (rare) over touchscreens, which can be hard to operate with wet fingers. This Bosch NIT8065UC addresses the problem with easily manipulated steel buttons.

WHEN TO TAKE THE PLUNGE

TO UPGRADE AN ELECTRIC RANGE → Induction is an ideal upgrade from a dated electric range. Installers connect a 6- or 8-gauge wire to a 40-amp circuit breaker, which existing electric ranges may already have. Induction is more efficient, but the switch makes little difference on the electric bill. Up-front costs are another story—a 30-inch electric range/oven combo goes for about \$500, an induction cooktop (with no oven) can top \$2000.

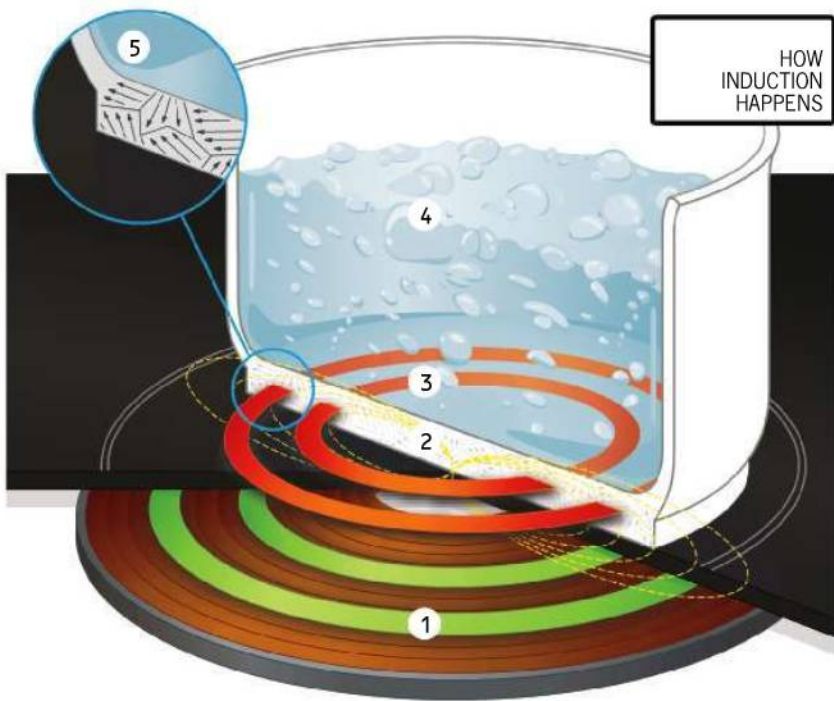
TO SAVE TIME → A 2000-watt electric stove uses 320 watt-hours to boil 2 liters of water in 9 minutes 50 seconds. The same job takes a gas range 8 minutes 18 seconds and requires 3100 watt-hours (converted from Btu). A 2800-watt induction unit boils 2 liters in 4 minutes 46 seconds, using 225 watt-hours.



TO STAY SAFE → The cooktop cools from boiling to 60 degrees C in about one-quarter the time it takes a comparable electric top to cool, reducing burn risks. Children can't accidentally ignite or contact open flames. Since switching from gas, chef Rembold says, "I've retained much more of my arm hair."

TO GET PRECISE POWER → Induction has more oomph than the most powerful residential gas burners in the U.S. Those consume up to 18,000 Btu an hour. At 7185 Btu per kilowatt, that converts to 2.5-kw induction—a fraction of a 3.6-kw induction element. Induction pairs this firepower with precise, instant adjustment, even at low temperatures.

TO KEEP THE KITCHEN CLEAN → Any seamless surface is easier to clean than the nooks and crannies of gas cooktops. Unlike typical electric tops, induction heat won't bake food spills onto the cooktop. Steady, even heat keeps the cookware cleaner—unlike with gas, grits won't burn and stick to the bottom of a pot.



ILLUSTRATIONS BY MERCÉ IGLESÍAS

Continued from page 80

Also, use a butyl rubber caulk to seal around the perimeter of the handrail's base, where it enters the concrete. These measures will reduce the water infiltration that contributes to the corrosion problem. If the crack is severe and the corner is loose, bite the bullet and remove the piece of concrete. Grind away rust on the railing base with a Dremel rotary tool, apply a coat of zinc-rich primer to the freshly ground steel, and then rebuild the cracked corner with an epoxy-concrete repair material.

Keeping the Peace and the Energy

In my neighborhood, outdoor power equipment runs from dawn until dusk. At night, just when things have settled down, my pool pump kicks in to take advantage of off-peak utility rates. There goes the peace and quiet. What can I do to quiet that pump? It may be old, but it's a real workhorse.

You can try to reduce just the noise, or you can strive for a double-header and reduce noise and energy use. In the first case, build a lumber baffle and hood that will muffle the pump's noise. (Note: This will also increase the heat at which the pump operates.) For a more complete solution, replace the pump with a smaller,



THE DIY LIFE

The Meaning of Yardwork

It was a perfect day. The sky was blue, the air cool, and I set out to do some work. There were storm-damaged limbs to cut up; a large cracked limb had to come off a spruce; a smaller tree had to be felled. The lawn needed mowing and edging, and it was time to attend to some small repairs that I had put off.

The chain saw started with one pull, but it quit when I cut with it.

While I fumed over that and fussed,

my neighbor Kevin stopped by. He was raised in the house one over from mine and now lives a little farther down the street. We chatted. His company had weathered the winter doldrums, and he was in line for a promotion. Turning back to the work, I pulled out an older chain saw. It started easily and ran like a thief. I cut up the fallen limbs.

Next, I took out the extension ladder, but its pulley was stuck, and its rope had shrunk so severely that I could pluck it like a guitar string. Ten or 15 minutes of fiddling with the jammed ladder and I cut its pulley rope, kicked the stuck fly section loose and raised it up the tree. I took off the limb with a bow saw and cut it up with the chain saw, but then I had to re-rope and lubricate the ladder. While I was doing that, my neighbor Doug stopped by. We chatted. His house had come through the winter storms in good shape, and his son was engaged and had just bought his first house. I turned back to the work, now bundling brush. Kevin's mother and father stopped by. That would be Irene and Tex. We chatted. "Come in for some coffee when you're ready," Irene said. Turning back to the work, I grabbed the mower and started it with one yank, but it left a ragged cut thanks to a dull blade. I was examining the blade when neighbor Bill and his wife, Linda, stopped by. We chatted. They thanked me for a small donation of furniture and other stuff for their volunteer group. I turned back to the work, but before I knew it, the Saturday was done. As I pondered how quickly the day had left, a stranger stopped. He lives a few blocks away, and though he's been in the neighborhood for years, we had never met. So, we chatted.

Much work went undone or uncompleted, yet I'd rather than a day free of pleasant, neighborly interruptions. Knowing all is well with my neighbors made the day perfect. — R.B.

KNOW YOUR STUFF

Lead-Safe Remodeling: Are the New Regulations Worth It?

As of April 22, 2010, federal law requires that all U.S. contractors be certified to work with lead-based paint in homes, child-care facilities and schools built before 1978. Details of the new RRP (Renovation, Repair and Painting) rule appear in a brochure, "Renovate Right," which contractors must give homeowners before work begins. The law requires certified renovators to be on-site to ensure that employees follow specific practices to prevent lead contamination. These include posting warning signs, taping up heavy plastic to contain the work area, minimizing dust by wet sanding, then cleaning with a HEPA vacuum and a wet mop. Certification takes 8 hours of training by an EPA- or state-accredited provider and costs from \$200 to \$400 per trainee. Not every employee of a remodeling firm needs to be certified, but the firm itself pays a \$300 fee to obtain EPA certification. Contractors failing to comply could get hit with a civil penalty of up to \$37,500 per incident, per day. — GREG COOK

CONTRACTOR'S PERSPECTIVE → "Even though it costs money, I actually think it's a good idea," electrical contractor and master plumber Pat Porzio says. "But of the 40 people in our training class, I was one of few who thought that." Porzio estimates the law will add \$500 to \$1500 in labor costs, depending on the job's size. The EPA estimates that the cost for containment, cleaning and verification will range up to \$170 per job.

REGULATOR'S PERSPECTIVE → "Lead poisoning is completely preventable," says Steve Owens, assistant administrator for the EPA's Office of Chemical Safety and Pollution Prevention. Exposure can damage young brains and nervous systems, leading to learning disabilities. Children can be exposed directly, or a pregnant mother can pass toxins to a fetus. "The EPA issued RRP," Owens says, "because a disturbing number of America's children are still being poisoned by lead-based paint."

energy-efficient model, one designed to operate as quietly as possible.

Energy savings and noise reduction are closely related, and replacement makes the most economic sense for old pumps and for regions with long swimming seasons. A pump operating at 1800 watts will cost roughly 13 to 34 cents per hour to run, and that will add up if the pool is in use for a number of months. Don't get a bigger pump than you need, and install it with a mechanically efficient piping layout. Then, by trial and error, establish how to operate the unit as little as possible to maintain water quality while cutting noise and electricity use. Those are recommendations laid down in a landmark engineering study produced decades ago by Florida Atlantic University (1984, to be exact). The study, which is seeing a rebirth of interest, is widely quoted by energy analysts as a common-sense, mechanically valid approach to energy efficiency in swimming pool operation. It also translates into a quieter pool.

Are there other, less drastic ways to make your pool work more quietly? Sure. Reducing right-angle bends in pipes near the pump, ensuring that the filter and skimmers are clean, and supporting the pump on rubber dampers can all help, even if only slightly.

Clean Trap, Happy Trap My air conditioner's air handler is located in the attic, mounted above

a pan with a drainpipe that leads to the outside. It's not unusual for the condensate pipe to become plugged and for the condensation to build up and overflow out of the pan. How can I prevent this?

It's not unusual. Mold will grow inside the condensate line, especially in the trap. Also, bugs can crawl into it during the off-season and build nests, and dust from inside the attic can fall into the pan and contribute to the slime that forms in the drain line.

You can do a couple of things to combat the problem. First, flush the trap on the condensate line with a dilute solution of water and bleach at the beginning of each season. Follow the flush with clear water to ensure that the bleach solution doesn't rust out the condensate pan that the evaporator sits in. You can also replace the standard plastic trap with a product called the EZ Trap. It's made out of clear plastic and has an entry port for maintenance. The unit's design makes it easy for a homeowner to spot and clear blockages. **PM**

Got a home-maintenance or repair problem? Ask Roy about it.

Send your questions to pmhomeclinic@hearst.com or to Homeowners Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.



CONSUMER ADVOCATE'S PERSPECTIVE → Rebecca Morley is executive director of the National Center for Healthy Housing, a nonprofit organization that supports the RRP rule. Compliance with the law will protect 1.4 million children under the age of six and 5.4 million adults from lead dust exposure, she says, citing an EPA statement. "To me," Morley says, "the most poignant thing about lead poisoning is that you don't see symptoms in a child until later in life and that the damage is permanent and irreversible."

HOMEOWNER'S PERSPECTIVE → Elizabeth Babbin of Bethlehem, Pa., lives in a stone colonial house built in 1930, so lead paint is a given. Before the new rule

took effect, she investigated lead risks to her 4-year-old son. "I can't imagine anyone who wouldn't be for regulation," she says. "I'm surprised there haven't been stronger rules before this." Asked if she would pay as much as \$1500 extra to comply with RRP standards on a big remodeling job, she says, "Are you kidding? A child's IQ can drop I don't know how many points. You can't put a price on that."

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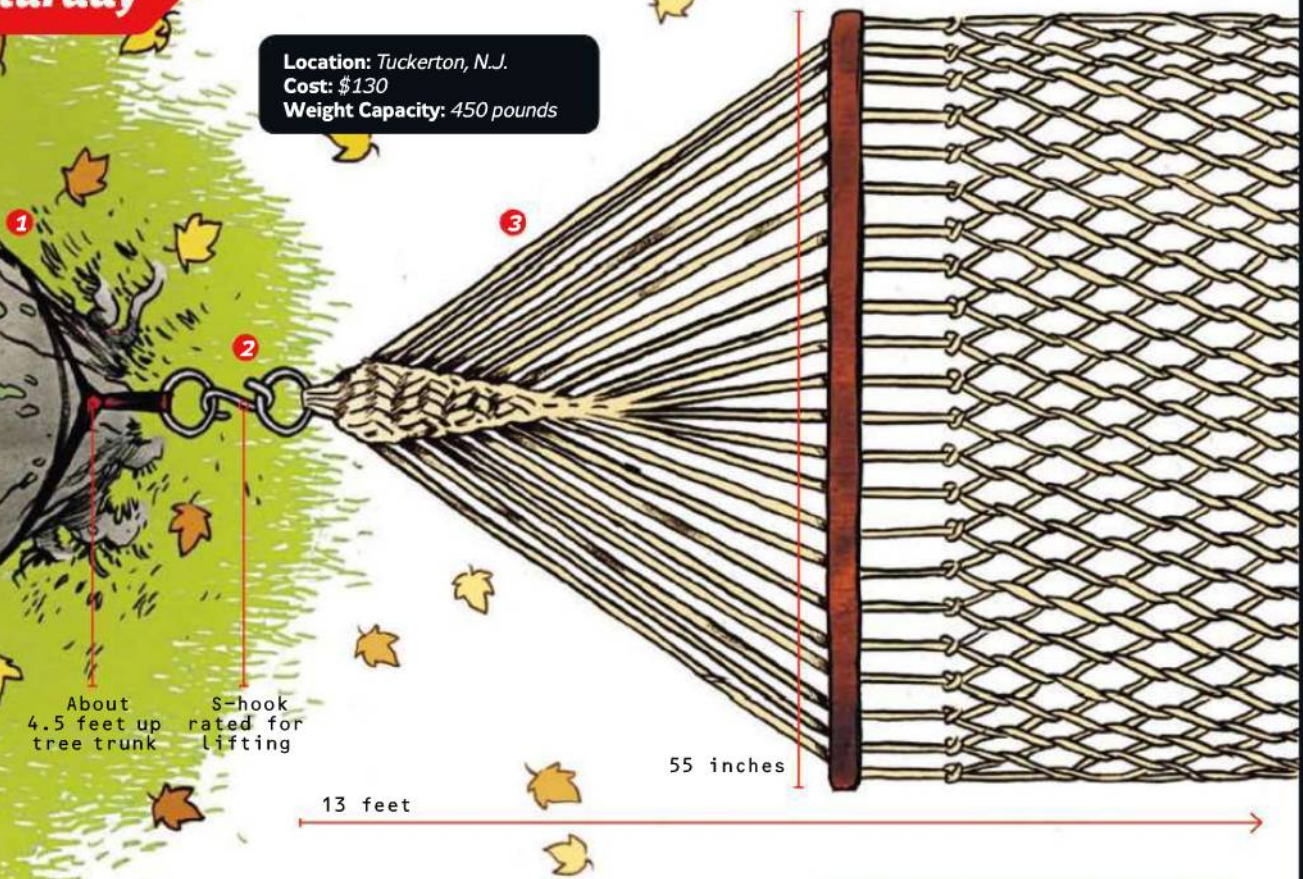


+ ONE-DAY PROJECT

Hang a Hammock

KEVIN LINTNER OF HAMMOCK-COMPANY.COM HAS COUNSELED CUSTOMERS HANGING HAMMOCKS IN "EVERYTHING FROM PINE TREES TO PALM TREES," HE SAYS. FOLLOW HIS ADVICE TO GET HORIZONTAL IN A HURRY.

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TREES

1 → A trunk-to-trunk distance of 13 to 16 feet is ideal. Distances of 16 to 25 feet can be spanned with straps. If the span is too small, a two-poled mounting stand is a must. "Traditionally people want trees," Lintner says, "but the stand at least ensures a proper fit."

HARDWARE

2 → A popular fastening option is a pair of removable tree straps, which have a loop of fabric at one end and a metal ring at the

other. Wrap the fabric around the tree, pass the ring end through the loop, and align the strap ring with the ring on the hammock end. Connect the two rings with an S-hook rated for lifting. Adjust the straps for the proper height, then mark their location on the trees for easy setup.

Another popular (and cheaper) method is to drive a coarse-threaded forged 4-inch eyebolt into the tree trunk. Drill a 1/8- or 3/16-inch pilot hole, and use a carabiner rated for lifting to connect the hammock. Make sure the tree doesn't engulf the bolt.

HAMMOCK

3 → Lintner recommends a hammock with a 55-inch spreader bar for an optimal combination of comfort, stability and roominess. Styles without bars, known as Mayan or Brazilian types, create a cocoon effect that's awkward when sharing the hammock with a plate of barbecue. Solid, cushioned hammocks have padding, but they don't breathe well. For hot weather, choose a type woven with DuraCord, which resists mildew and UV fading. Avoid cotton, nylon and unvarnished spreader bars.

+ MORE TO DO IN AUGUST



Just Brew It → On International Beer Day, Aug. 5, find a beer brewer's supply shop at homebrewersassociation.org. Test-toast the first batch six weeks later.
Head for the Black Hills → Sturgis, S.D., hosts the 70th Motorcycle Rally on Aug. 9-15. Expect public nudity.

Start a Car Company → On Aug. 15, 1899, Henry Ford quit his job at Edison Illuminating Company. His next gig? You guessed it.
Stay Lit → Run the generator biweekly to keep it limber for August, when heat and storms cause an average of a dozen large-scale blackouts each year.

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Beyond Round and Black

THINKING OF UPGRADING YOUR TIRES? WE HIT THE TEST TRACK TO HELP RANK THE PROS AND CONS OF THE MAJOR TIRE TYPES.

BY MIKE ALLEN

➔ **Tires are a major investment**, and one that drivers need to make decisions about each time a set wears out. Choosing a replacement tire can be like picking an air filter because there are so many choices, and tire dealers sometimes sound an awful lot like used-car salesmen. The simplest solution is to buy the same tires your car came with, and that's a good option—after all, the engineers designed the suspension to

INSIDE



TIRES + SOGGY HEADLIGHTS + HYBRID-CAR MYTHS

Test Procedures

Testing tires is a tricky business because there are so many variables. We measured braking, lateral grip and an autocross-type lap time in both wet and dry conditions. To minimize the effect of changing weather conditions and, ahem, driver error, we ran each test several times over the course of one day. For the braking tests, we drove a half-dozen max-effort full-ABS stops and averaged the results. Then we did a half-dozen pairs of timed laps around the handling track, discarding any laps with missed gates or clipped pylons. Once we had a half-dozen good sets, we discarded the

best and worst laps and averaged the rest. Skidpad g's were calculated from times through a constant-radius section of the handling course, with similar refinement of the raw data. The next morning, we drove a 6-mile street loop on all five sets of tires. The loop had plenty of pavement variation, from smooth asphalt to coarse concrete, potholes and patched and tar-stripped

concrete freeway blocks. This evaluation was completely subjective. Bottom line: The raw lap times and skidpad lateral g's tell only part of the story. Far more important is the subjective feel of a tire, as well as other tangibles like noise, road harshness and, of course, price.



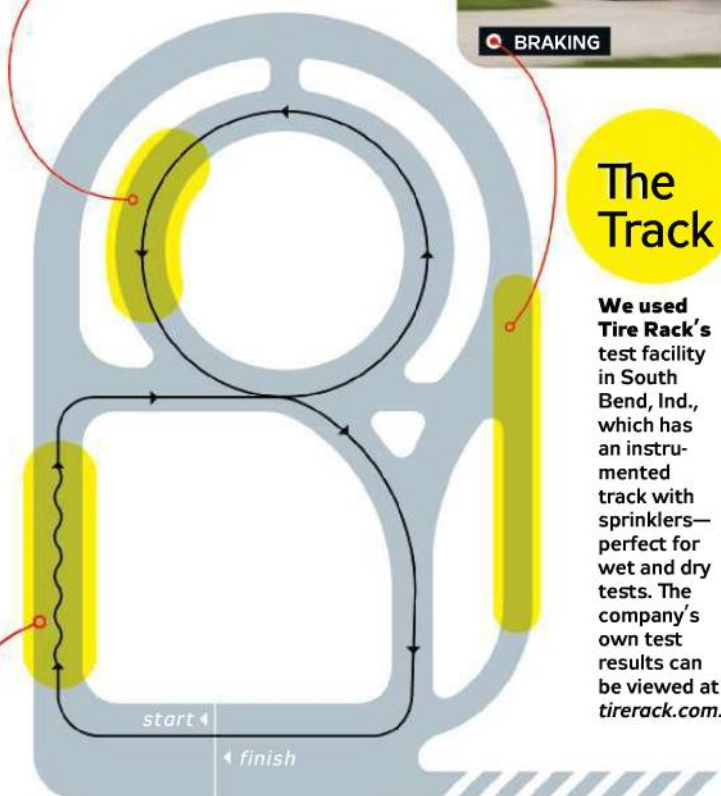
SLALOM



SKIDPAD



BRAKING



The Track

We used **Tire Rack's** test facility in South Bend, Ind., which has an instrumented track with sprinklers—perfect for wet and dry tests. The company's own test results can be viewed at tirerack.com.

match the OEM rubber. But what if you want, say, more cornering grip or would like to save a few bucks? What do you get if you upgrade to larger diameter wheels? Now what? To illustrate the possibilities, we tested different types of tires—high-performance, low-rolling-resistance and the cheapest set we could find—against a baseline all-season. We also sampled a high-performance tire on 18-inch wheels, 2 inches larger than our test car's original units. Since

tires massively contribute to how a car feels behind the wheel, we supplemented our instrumented tests with subjective analysis of all of the tires' behavior both on the track and on a variety of road surfaces.

All-Season

→ **Michelin MXM4 205/55R-16** The MXM4 is new this year and thus has the latest technology. That's likely why it posted the best lateral dry grip, a

result we didn't expect. In other tests, the tire was competent—typical for this genre. And don't believe the "all-season" name—they're okay in light snow, but you'll need snow tires for serious powder. On the plus side, these tires rode quietly and offered the smoothest ride of the group. With good overall grip and predictable handling at the edge of the handling envelope—wet or dry—this class of tire would be the right choice for most people most of the time.

TEST RESULTS



BMW 328i

We chose a 328i Sedan for several reasons. Its rear-drive layout let us explore the under-oversteer characteristics of the tires, which would not have been possible in a FWD vehicle. And its suspension strikes a near-perfect ride-and-handling balance, so our results apply to most mainstream cars. It's quiet enough to evaluate road noise. And most important, Tire Rack had an ample supply of BMW rims on hand.



**MICHELIN
MXM4**

On the dry- and wet-handling course, the all-season MXM4s gave just a touch of understeer. Lifting the throttle midturn made the back end gently come around. Even lurid slip angles were easy to correct, getting the car back into shape for the next pair of hapless orange pylons. It also communicated surface conditions to the driver without telegraphing imperfections.



**MICHELIN
PILOT SPORT**

This tire reacted quickly, with a wide handling sweet spot that required less throttle and fewer steering inputs to go where intended. All of which was fun, but the numbers don't lie—the Pilot Sport was only marginally faster than the baseline all-season in spite of the wheel factor. On the road, they were remarkably quiet, devoid of tar-strip slap or sizzle, and had excellent on-center feel.



**PLUS 2 MICHELIN
PILOT SPORT**

Although more neutral on the skidpad, they were harder to drive, requiring a lot of dithering of the throttle. Predictably, the ride was harsher and noisier on the stiffer, low-profile sidewalls and 2-inch-wider rims. Those stiff sidewalls also contributed to great road feel. Wet grip was surprisingly good, but deeper water combined with a wider footprint would undoubtedly lower the threshold of hydroplaning over narrower tires.



**BRIDGESTONE
ECOPIA**

The braking and handling numbers of the Ecopia are nothing to write home about, but the tire doesn't feel particularly gripless. On-center feel was typical of the tires on most hybrids, which invariably feel a little nervous in freeway traffic, partly from the slippery aerodynamics at the price of lateral stability. A well-balanced tire with the balance tipped toward economy, but the wrong tire for a sporty BMW.



**REPUBLIC
ENTERPRISE**

Surprisingly, the raw numbers on this low-buck tire weren't horrible—about on par with the low-rolling-resistance Ecopia. Subjectively, however, on-center feel obviously was not a design criterion. The first impression I had was that the lug nuts were loose: It was nearly impossible to keep the car in the center of the lane. While quiet over small tar strips, the ride was punishingly harsh over potholes.

Price (\$)	178.00	131.00	196.00	124.00	55.00
Dry braking, 50–0 mph (ft)	90.6	89.9	91.5	97.2	92.7
Wet braking, 50–0 mph (ft)	91.9	90.0	90.8	103.5	100.8
Dry skidpad (g's)	0.881	0.812	0.803	0.736	0.762
Wet skidpad (g's)	0.838	0.841	0.877	0.758	0.735
Dry lap time (sec)	30.84	30.61	30.28	31.68	31.64
Wet lap time (sec)	31.69	31.32	31.91	33.54	34.58

High-Performance

→ **Michelin Pilot Sport AS+ 205/55R16** Stepping up the performance ladder a notch or two lands at a tire like the Pilot Sport AS Plus. It's meant for drivers of high-end sports cars who want extra precision and grip, but not at the expense of bad-weather traction or reasonable wear. On the small test course, the tire outperformed the all-season in nearly every category and simply felt sharper. So it was more

fun to drive. There are even higher-performing street tires—like the Pilot Sport PS2—but they're more expensive and wear out sooner, especially if you frequently explore the outer limits of the tire's performance envelope.

Plus-Two

→ **Michelin Pilot Sport AS+ 225/45R18** A common upgrade on today's cars is to boost the diameter of the rim a couple of inches, add about

half of that to the tread width and then reduce the sidewall profile enough to make the overall diameter the same. That's called a plus-two fitment. In theory, you get more grip from the extra rubber, as well as that all-important aura of style. In reality, sometimes this works. A lower profile, wider tire realizes all its benefits only in conjunction with upgraded suspension that can keep the extra rubber flat on the road. And that's exactly what we found on

our plus-two Pilot Sports. It posted good numbers, but in aggregate it didn't outperform its smaller sibling. If we had tuned the suspension on the Bimmer to keep the tires more square to the pavement, no doubt the raw cornering numbers would have been better. Bottom line: Be sure your suspension and driving skills are up to cashing the checks that upsize tires and wheels can write.

Fuel-Saving

→ **Bridgestone Ecopia 205/55R16**

The Ecopia EP100 advertises lower rolling resistance, which increases fuel economy slightly. The compromise is reduced grip through the entire testing regime. These low-rolling-resistance tires are intended to stretch a gallon of gas as much as 5 percent, saving you money. It's achieved by using different construction internally and a new class of rubber compounds with less internal

friction. We didn't have the opportunity to test for fuel economy, but Tire Rack has done so in the past, and it documented a 4 percent improvement on a Prius, over and above the Prius's already low-rolling-resistance OEM tires. This all comes at the price of something, and that's grip—these tires needed about a half-car length more distance to stop, potentially the difference between spilling your coffee and rear-ending the guy in front.

Low-Cost Alternatives

→ **Republic Enterprise 205/55R16**

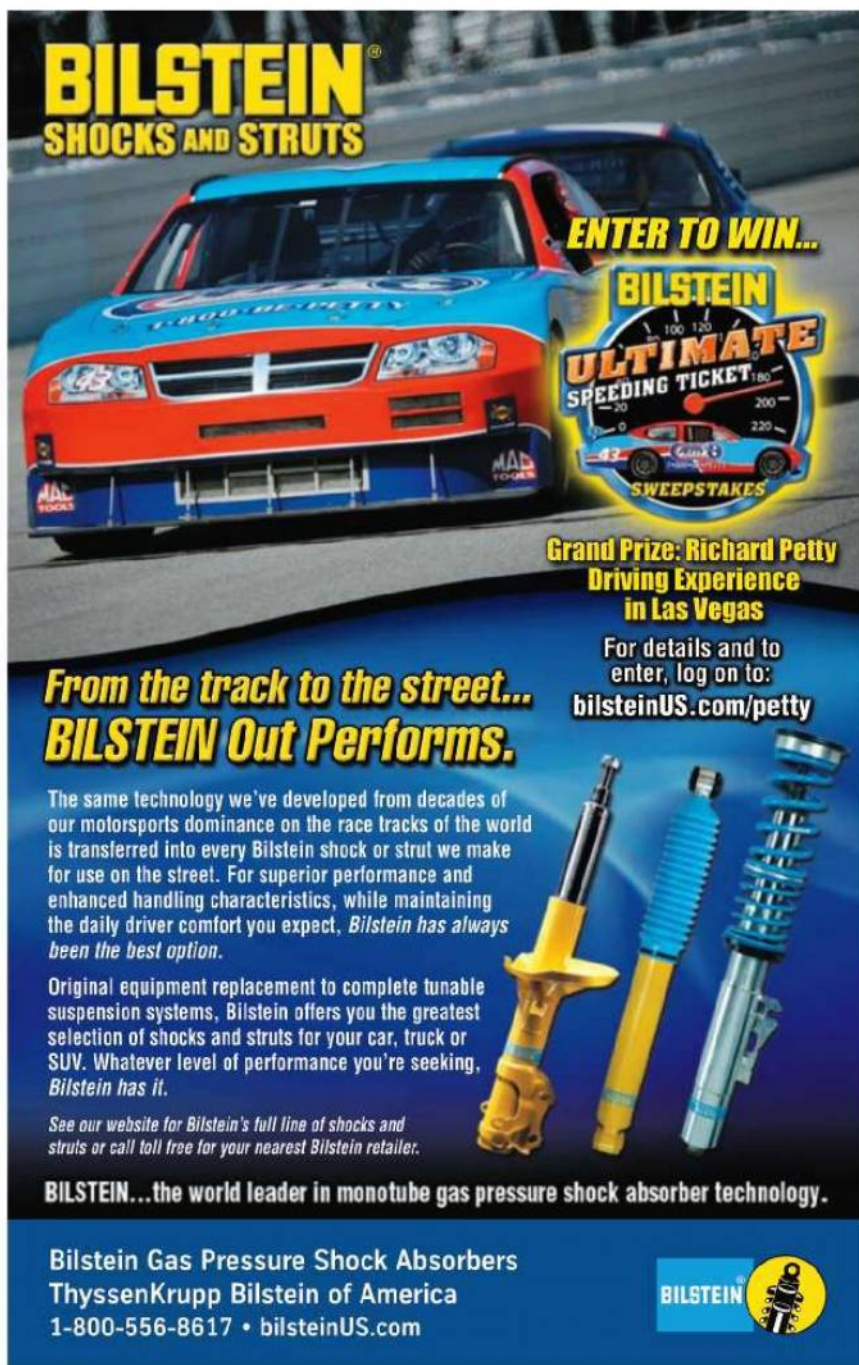
We walked into a tire store and demanded the cheapest tire they could get in our size. In all fairness, the counterman tried to up-sell us to a Kumho tire that was only about \$25 more expensive. For that hundred bucks extra, we should have listened. Bottom line: We'd rather buy used tires, if we were that desperate. Sure, the numbers weren't terrible, but the lack of precision could make a sketchy evasive maneuver difficult for drivers of average skill.

What's Best?

We're not picking any winners here. The point is that different tires have different performance envelopes and are more suited to different vehicles, climates and driving styles. Most people with normal cars will be best off with a tire of the same category as the original-equipment tire.

You can improve tire performance by going to a high-performance tire, of course, but based on our results, going to a larger wheel and tire could be pointless unless you upgrade the suspension at the same time. Also, the single low-rolling-resistance tire we tested had demonstrably less grip on dry pavement. That translates to a very small decrease in stopping power and raw cornering, but still better than most tires of even a decade ago. You may find the promise of reducing fuel consumption by one tankful out of 20 compelling enough to warrant mounting up a set.

Shopping strictly on price? There's a similar compromise in performance, but not horrible if you only look at numbers. Subjectively, you're shooting craps. **PM**



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■ NOW YOU KNOW

How They Make Tires

A few years back, I had an opportunity to go to a Goodyear tire manufacturing facility and spend the day building tires, and it was very illuminating.

To start: Natural and gum rubbers, oils, carbon black and other arcane additives they won't discuss are added to a giant mixing machine. Rubber flows out of the bottom of the machine like giant sheets of crepe paper. On another machine the size of my backyard, steel wire is woven into sheets on a rubber ribbon and cut into chunks on a guillotine 10 feet long. Farther along inside the mile-long factory, the wire-bead reinforcements, inner liner, sidewall and tread fabric, steel and tread rubber are all hand-assembled on another machine. The rubber, only slightly less gummy than warm chewing gum, sticks to itself readily. The all-important splice in the tread plies is made by eyeball, and a sloppy job leaves the tire with a vibration that can't be balanced out. From the assembly machine, the green tire is conveyed to a mold, where 350 F, 350-psi steam forces the tire into the tread of the mold, expanding it to its final size and vulcanizing the raw rubber at the same time.



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Car Clinic

by Mike Allen

Q+A

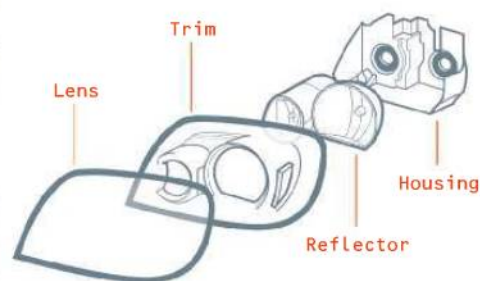


UNACCEPTABLE
LEVELS OF
CONDENSATION

CONDENSATION IS NORMAL

At least in small doses. Car manufacturers say that condensation may cover 50 percent of the surface of the lens before it's considered a problem. The heat from the bulbs should dry out the vented interior of the housing in an hour or two.

ACCEPTABLE
LEVELS OF
CONDENSATION



Foggy, Foggy Nights

Q My headlights are always collecting water inside. The dealer says he can replace them, but they're very expensive, and he wouldn't guarantee that the new headlights wouldn't collect water also. I took out the headlamp assemblies and coated all of the seams between the clear lens and the back with bathtub caulk, and gooped up the rubber dingus that goes over the headlight wires with a lot more caulk, but it didn't help a bit.

A Let's examine why there is water inside the lamp assemblies in the first place. As the outside temperature goes down and your nice warm headlamps cool off (either from being in the sun or just from being turned on), cooler, moister outside air trickles into the

housings. The housings are vented top and bottom to allow for pressure differences, or they would quickly crack and fail. When the clear plastic lens is even a little bit cooler than the air inside the housing, droplets of moisture will condense on the inside of the lens. That's

normal. When the outside temperatures come back up in the morning, the moisture will evaporate.

Some vehicles don't vent as well as others. Some drivers keep their cars parked in shady, damp areas or in cool, damp underground parking structures. And the moisture collects not as tiny droplets of mist but as what looks more like raindrops, and can even run down the glass and pool inside the housing.

Check to see if there's a Technical Service Bulletin for your make and model of vehicle. If so, there may be a retrofit housing or an upgrade to the venting system. If not, you're on your own. The first thing to try, if all you have is droplets, is to leave your headlights

on while driving for a couple of hours, forcing the moisture off. If you have a spoonful or more splashing around, you may need to remove the housing and dry it out. Pour off the excess water, then add a few ounces of rubbing alcohol to the housing, sloshing it around and pouring it out. Repeat. Let the housing dry for a couple of hours in the sun or inside a nice warm house, preferably in some air that's moving. Check that any vents aren't plugged with spider eggs or mud. Install the housing and try to park facing south.

Overheated

Our 1999 Ford Taurus, which resides under a cover, almost always has a dead battery after it sits for a month. I have had to replace it three times in the past seven years. I tried one of those solar panels plugged into the cigarette lighter by having a clear plastic window installed in the cover. The plastic housing on the charger actually melted when the heat outside got to 118 F and shorted, further draining the battery. Who knows what the temperature got to inside the car? Sure, I can disconnect and reconnect the battery, but for what that takes I can jump-start it with a portable jump-start battery device easier. Any advice to keep the battery from dying? The car's parked in a lot across the street from the house, so running an extension cord to a trickle charger isn't an option.

Melted the solar charger? Man, I bet you could bake cookies in there on a sunny day.

Letting any battery discharge that deeply will damage it immediately, which explains your high failure rate. And the heat will make the battery self-discharge even faster than normal.

My best suggestion: Get a battery disconnect switch, wired into the ground cable. This won't prevent normal self-discharging, but it will eliminate any parasitic drains (like the radio presets and computer memory) that are killing the battery between uses. Then whenever you need the car, all you have to do is open the hood, turn the switch on, and start it up and drive away with clean hands. A decent battery should have enough juice left after

a month to light the fires. In case the idle period is a little longer, keep an auxiliary starter box in the house on a charger. You can probably get enough charge into the nearly dead battery by plugging one of these gadgets into the cigarette lighter, also leaving you with clean hands.

A second suggestion would be to hard-mount the solar charger on the front license-plate bracket and leave it uncovered by your car cover. Park the car pointing southwest toward the afternoon sun to catch the most rays.

Summer Cold

My 180,000-mile 1999 Pontiac is doing something I can't easily

explain. While I'm driving along, the temperature gauge will suddenly plummet, from about 177 degrees all the way to minus 7. And I think the engine is trying to keep up with the misinformation, because the fuel economy is suffering. I don't think it's the thermostat. Could it be the temperature-sending unit? I drive about 700 miles a week.

It's a bad temp sender or a bad connection somewhere between the sender and the computer.

One week later...

On your advice, I put in a new coolant-temperature sender. Now the temp gauge reads minus 40 all the time and my car really runs

IT'S NOT EASY BEING GREEN

Coolant Confusion, 2010



No, these aren't Cosmo-politans; they're three different—and incompatible—coolants, specified by different car manufacturers.

Conventional **green-colored** antifreeze/coolant has been quietly dropped by virtually all car manufacturers, domestic and import, in the past decade or so. Different formulas of coolant, dyed a rainbow of colors, have replaced shelves full of green coolant at auto parts stores and car-dealership service departments. All carmakers say it: Pour in anything except the approved factory-fill-type coolant and you'll compromise the factory's chosen type of corrosion protection. Sure, all

automotive coolants are 93 to 95 percent ethylene glycol, but they have different protective, anticorrosion additives. And vehicles are now manufactured with pump seals, gaskets, O-rings and polymer parts that are engineered with a specified additive formula in mind. So, any replacement coolant formula has to be pretty much the same as the original. The color is only just that: dye to help mechanics visually spot a different fluid. Put in a different technology coolant and you might face corrosion, leaks,

water-pump failures and overheating.

As an example, consider any recent Ford product with the 3.5-liter V6. The radiator may contain a yellow, deep-green or (next year) orange antifreeze and a label warning not to add anything but the original formula. They're all different long-life formulas. That orange coolant is called an OAT (organic acid technology), and it's a clone of the Dex-Cool General Motors has been using since 1996—it contains one or two organic acids, but no

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poorly. Next suggestion?

It's running poorly because the engine is injecting fuel as if the coolant temperature—and consequently the cylinder heads—were over 100 degrees lower than it really is. The mixture is being enriched enough to run at well below zero, way too rich for normal temps.

From the shop manual: "The Engine Coolant Temperature sensor is a thermistor, a resistor which changes value based on temperature, mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at -40°C [-40°F], while

high temperature causes low resistance [70 ohms at 130°C/266°F]."

Your minus 40 reading says to me that, like I said in my first reply, the circuit is open, as in showing an infinite or very high resistance, so: Look for a connector with a pushed-back pin, a broken wire or corrosion or anything that keeps the circuit from being completed.

Hybrid Fallacy

I have an idea for a story in your magazine. I was thinking you guys could buy a Prius and pull the batteries and anything at all related

silicates or phosphate inorganic inhibitors. The Ford yellow and deep green are "hybrid" OATs that also contain silicates (in yellow) or phosphates (in deep green). Thankfully, in Ford's case, the confusion should be short-lived. Ford is moving to one worldwide antifreeze—Dex-Cool OAT orange, like GM. As Ford implements the change, it will redesign water pumps and avoid gasket materials that OATs could affect (primarily silicone rubber and Nylon 66 gasket carriers). Also, air trapped in the system above the level of OAT coolant will degrade the additives' anticorrosion properties, so ensuring a full coolant fill and adding sensors to warn if the level drops are particularly important with cast-iron engines. Aluminum-block diesels also need to be designed to reduce pitting of the steel cylinder liner, as OATs offer only fair protection against it. Ford isn't even planning to try

to convert its aluminum 4.6 and 5.4 modular V8s, because those engines will eventually be replaced with one designed for OATs.

And that's just Ford. European and Pacific Rim cars also might specify the use of a coolant of a very specific formula, phosphate-free or some alternative formula not necessarily compatible with any other additive package—often difficult to find anywhere except at the dealer, who gets top dollar.

Fortunately for the Saturday Mechanic, there are aftermarket alternatives that mimic the formulas of coolants from the car dealer. Zerex G-05 and Havoline Custom Made are the same as Ford and Mercedes yellow and Chrysler orange. All antifreezes labeled Dex-Cool are okay for GM, Ford products with orange coolant and VW/Audi with pink through 2009. Prestone's yellow coolant is a substitute for Texaco's orange Dex-Cool,

without the label.

Ford deep green (originally a Mazda formula) and all recent Asian cars use a similar phosphate-containing hybrid OAT, with dye colors that are the primary difference (typically deep green, blue-green or, in the case of Toyota, pink). There's one aftermarket choice for those cars: **pink Zerex Asian Long Life.**

Don't even think you can drain your cooling system and fill with a different antifreeze. There's always residual fluid in the block—as much as 40 percent of the total coolant capacity—and mixing formulas is not a good option for the reasons stated above.

Bottom line: Don't mix. Don't substitute. Look askance at one-size-fits-all replacements, which are usually based on Dex-Cool or a variant and are known to cause problems in some vehicles not engineered from the get-go to use them. — PAUL WEISSLER

to the hybrid portion of the car. Obviously this adds up to a lot of weight—dead weight on the interstate where many people do most of their driving. No doubt this car would then get much better highway mileage. If they built it that way, it would be *much* cheaper and have a much smaller “carbon footprint” due to much less energy being used to build it. As the car is now, it often has to recharge the battery pack on the highway, hurting its real mileage, not to mention the burden of all that dead weight.

Your logic is faulty. Here's why:

1. Overall weight has virtually no effect on steady-state cruising economy. Fuel consumption at expressway speeds on level ground is determined largely by aerodynamic drag and other parasitic drags such as the tire's rolling resistance.

2. The onboard battery pack is charged, for the most part, when the vehicle slows down, capturing the energy that otherwise would be dissipated as heat in the brakes. It normally doesn't get charged during steady-state driving or acceleration. (One exception: On some hybrids, notably Toyotas, the battery will be charged to load the engine when the engine is otherwise running to warm up or provide cabin heat. This avoids wasting the fuel needed to keep the engine running when the car isn't moving. Clever.)

3. Aerodynamic drag goes up with the square of speed, but the power needed to overcome drag goes up with the cube of speed. It takes *eight times* as much power—or fuel—to go a constant 60 mph as it does to go 30 mph.

That's why the Prius, the Insight and other hybrids can actually achieve better miles per gallon during moderate-speed urban stop-and-go driving than on long, high-speed freeway trips. **PM**

Got a car problem?

Ask **Mike** about it. Send your questions to pmautoclinic@hearst.com or over Twitter at twitter.com/PopMechAuto or to Car Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.



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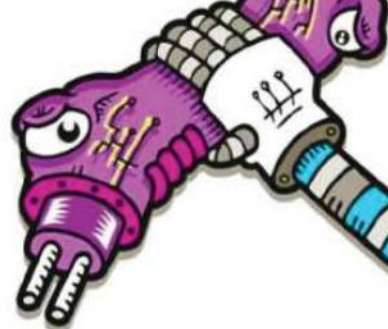
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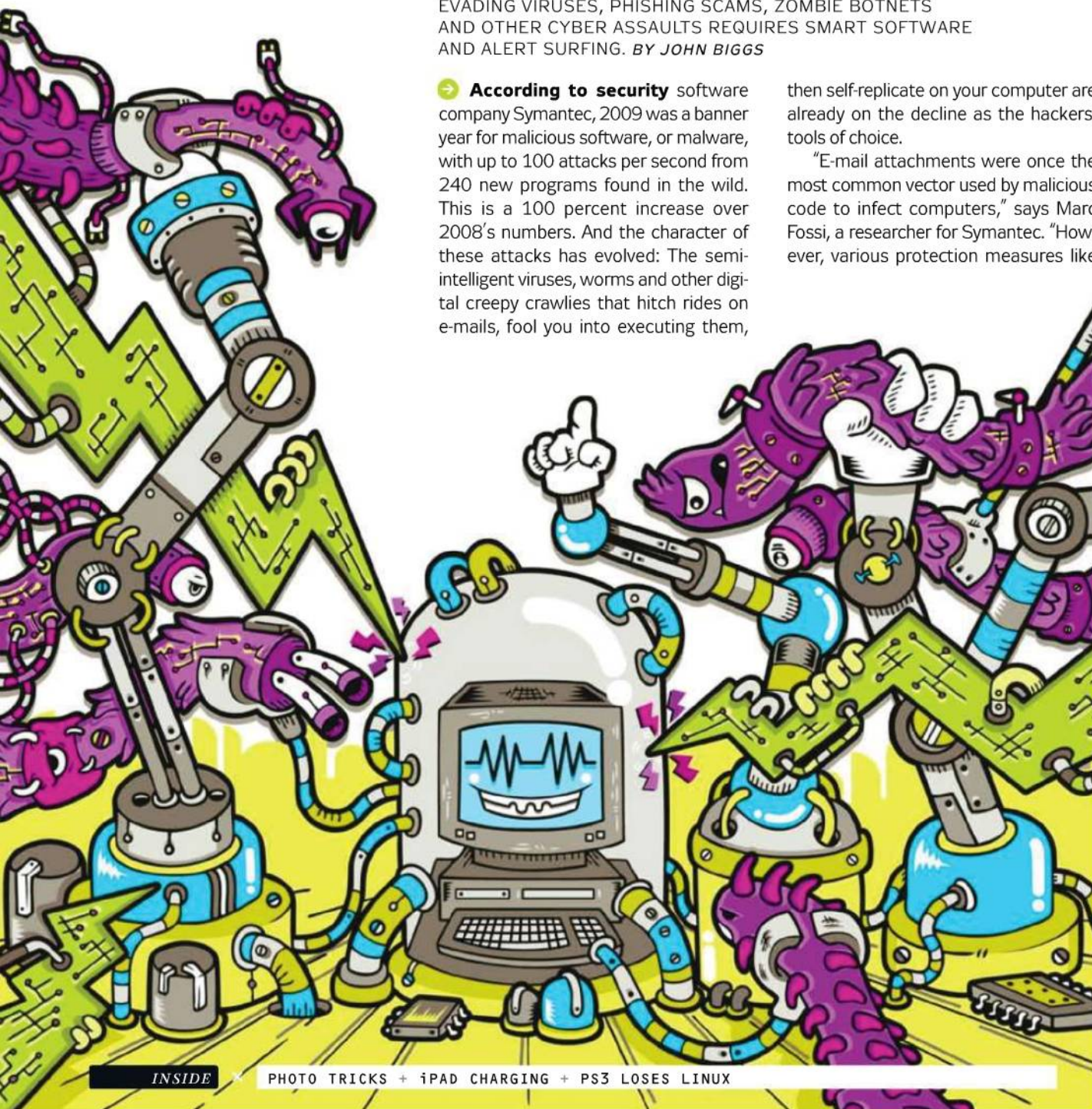
Stop Hack Attacks

EVADING VIRUSES, PHISHING SCAMS, ZOMBIE BOTNETS AND OTHER CYBER ASSAULTS REQUIRES SMART SOFTWARE AND ALERT SURFING. BY JOHN BIGGS

→ **According to security** software company Symantec, 2009 was a banner year for malicious software, or malware, with up to 100 attacks per second from 240 new programs found in the wild. This is a 100 percent increase over 2008's numbers. And the character of these attacks has evolved: The semi-intelligent viruses, worms and other digital creepy crawlies that hitch rides on e-mails, fool you into executing them,

then self-replicate on your computer are already on the decline as the hackers' tools of choice.

"E-mail attachments were once the most common vector used by malicious code to infect computers," says Marc Fossi, a researcher for Symantec. "However, various protection measures like



INSIDE

PHOTO TRICKS + IPAD CHARGING + PS3 LOSES LINUX

e-mail attachment blocking, along with user education about these threats, have limited their effectiveness.”

There’s a lesson and a warning to be gleaned from this: Good software and smart users can foil malware threats, but hackers adapt quickly, and last year’s threat can morph without warning into a totally new and insidious techno-tactic. According to Fossi, Web-based attacks are on the rise, and we’re now more vulnerable when we click on bogus links than when we open poisoned e-mail attachments. Malware writers have even created code capable of combing through contacts on social networks, delivering their pernicious payloads in messages purportedly from our most trusted friends. (Just this past May, a Facebook message with a link to a “Distracting Beach Babes” video began making the rounds, infecting the PC of anyone who clicked on the video link.)

And the latest malware attackers are more ambitious than their predecessors. No longer content to simply replicate themselves and spread, modern malware programs can install themselves secretly on your PC and attempt a complete takeover of your system. The hackers who design these attacks can take thousands (in rare cases, millions) of computers hostage and remotely command them to do pretty much anything. Compromised “zombie” computers are organized into massive multimachine armies known as botnets, then rented to the highest bidder like hacker vacation condos. These networks, with names like Rustock and Mega-D, can be used by bot herders to send out spam, attempt to infect other computers and even request files off remote computers. The botnet associated with the ever-morphing Conficker worm has even set up a decentralized peer-to-peer communications network, making it almost impossible for researchers to track.

The damage to a zombie computer can sometimes be minor (systems slow-downs and random glitches) and potentially unnoticeable—after all, the point of much of this software is to fly under the radar. But, since much of modern malware is designed to allow remote users complete access to your system, such hacks can also be used to steal

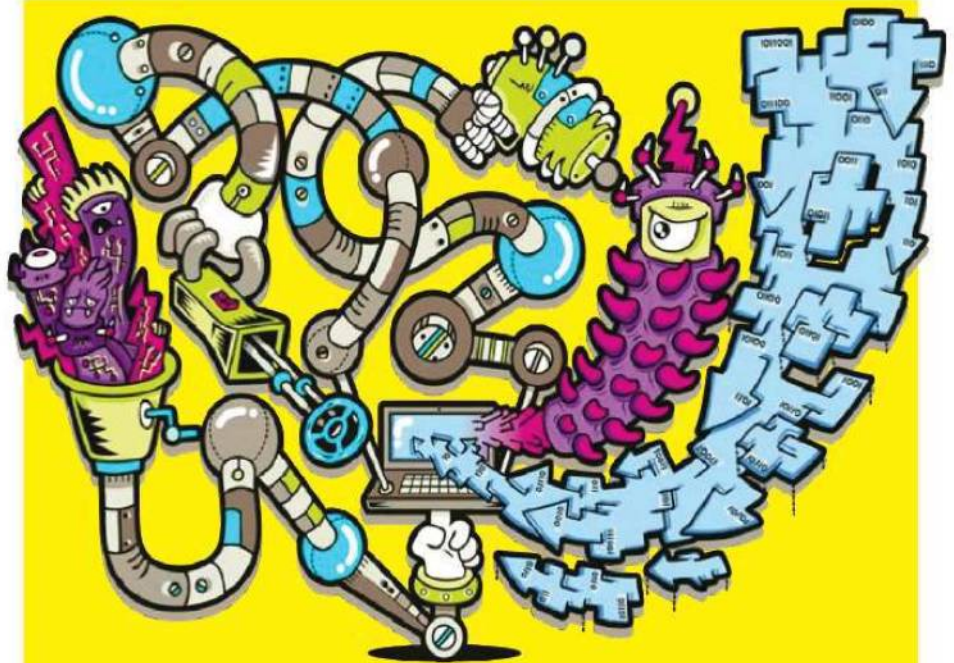
valuable personal information.

Hackers prey on folks who are trying to check their bank balances or visit their favorite e-commerce sites. By grabbing a password or two, most hackers can quickly and easily worm their way through the rest of your accounts.

Breaking and Entering

➔ **The first step** toward prevention is to understand the two-headed beast

that is modern hacking. These days, cyber criminals are as interested in access to your online accounts as they are in access to your home computer. Most users’ personal data networks exist both on their PCs and in the cloud (the term for Web-based services that include online e-mail, banking, document creation and social networks where more and more of our info resides). And many attacks take advan-



Help! I Think I’m Infected. What Now?

FOLLOW THESE STEPS, IN ORDER, TO REPAIR A SYSTEM INFECTED WITH MALWARE.

STEP 1 UPDATE

First, check for operating system security updates and patches. Most modern OSs offer automatic update support, but confirm you have the latest version manually. Then update your security software. Check your firewall and router for updates as well, and, if necessary, reset the security settings to ensure your Wi-Fi is locked down using WPA security.

STEP 2 ERADICATE

Run a full scan with your security software and delete any suspicious files it finds. Then make sure it is set up for scheduled scans. Some malware can open ports on your PC, allowing updated versions to pop in even after the real threat has been eradicated.

STEP 3 MONITOR

To make sure the demons are gone, run a program like Zone Alarm (PC) or Little Snitch (Mac) to monitor incoming and outgoing data. At first, things will pop up that aren’t threats; over time these programs learn your usage patterns. When you see a program or process displaying unusual activity, check the Web to see if it’s known malware.

STEP 4 REINSTALL

If you’ve got a bug that resists all attempts to remove it, you’ll need to reinstall your system from scratch. Back up all your personal files on a large USB hard disk, then reinstall your operating system. Move your old files back in and reinstall all your applications as well.

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PM DIY TECH /// STOP HACK ATTACKS

tage of security lapses and behavioral slipups in both arenas.

The easiest and most common method for bad guys to get your data is currently the phishing attack, wherein hackers create a Web page that looks trustworthy but is actually a collection point for passwords and credit card information. Many scams involve e-mails about fake charges to your credit cards or online payment accounts. The subject line may be something like "Your charge of \$521 has been completed," and the e-mail includes a link to what appears to be a bank or online service. The link will direct you to a log-in Web page that resembles your bank's, but has a slightly different URL. By attempting a log-in, you inadvertently give your account number and password to a hacker.

But these poisoned sites could just as easily install a permanent bit of malicious code on your computer and harvest information when you go to legitimate websites. And if that doesn't instill a sense of digital paranoia in you, consider this: A recent study by a Cisco researcher checked the effectiveness of antivirus products and found that many popular programs achieved a detection rate of less than 19 percent for brand-new threats.

Malware designed to exploit newly discovered software vulnerabilities is known as a zero-day attack. To identify malware, security programs rely upon something called an MD5 hash, a fingerprint taken of the virus on the day security software programmers discover it in the wild. Hackers using zero-day attacks take advantage of the short window of time between the malware release and the moment the hash is prepared and uploaded to your security software. That's why the Cisco study found that after one week the security software identified 63 percent of the same threats.

This is not to discount the value of good security software. Symantec, McAfee and Kaspersky Lab all offer a variety of products for both Windows and Mac OSs, ranging from \$40 to \$80. These programs may not catch every-

thing, but they are an important line of defense against the malware onslaught and will monitor your computer's behavior for anything suspicious. Free antivirus programs such as Avast and AVG Free (both for Windows) and iAntiVirus (for Mac) will also cover most basic virus protection and browser safety issues.

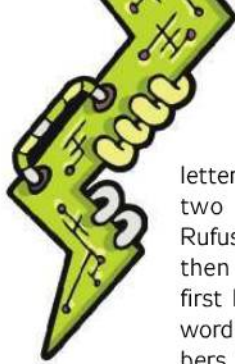
Habitual Security

➔ **But no software** can replace good security habits, most of which derive from simple common sense.

One of the most important—and most neglected—security practices is good password selection and protection. The modern computer user can end up with dozens of accounts with various services, all of which require a user name and password, and it can be a lot to remember. But easy-to-guess passwords can open up a security hole that can end up being a huge headache for you, your family and even your employer.

Consider the case of the social networking site Twitter, which recently found itself the victim of a hack attack that exposed many of its private e-mails and business documents. By guessing the password of a hapless office assistant at the company, hackers were able to move through the assistant's Google account and grab shared documents with ease. It didn't help that the assistant used the same password for many of her website log-ins, allowing the hackers to traverse from service to service without worrying about hacking each one.

Experts agree that the only way to keep hackers from leapfrogging from account to account is to maintain different complex passwords for each one. At the very least, maintain a few passwords with multiple levels of security. One level for low-security accounts like YouTube and Netflix, another higher level of security for social networks, and another still for banking and online shopping sites. That way, someone may be able to stream movies from your Netflix queue, but at least they can't easily empty your bank account. Choosing effective passwords can be done with mnemonic devices. Pick a phrase that means something to you and includes numbers and capital



letters (e.g., "I have two dogs named Rufus and Natalie"), then combine the first letters of each word with the numbers to construct a password ("lh2dnRaN").

Even with the best passwords and software, it's essential to pay close attention to your hardware, software and accounts. If you notice that e-mails you may not have read are now marked as read, or unknown files suddenly appear on your computer, or that your hard drive is "churning" without much going on, there's a chance someone has gotten to your machine.

Review your bank and credit card information regularly. Because most attacks are almost invisible, if someone gets your passwords and runs up a huge bill, it could be months before your bank unravels and repairs the error. Interestingly, credit card transactions are usually easier to reverse than debit card transactions, which should give you pause before typing in a card that is directly connected to your bank account.

Pay attention to URLs when browsing, especially when following a link that may seem suspicious. If your browser displays anything other than the website you intended to visit, close the session right away. Remember that mobile browsers on phones and tablets may not be as secure as desktop-based Web browsers simply because they may not show the URL you're visiting or alert you to security problems with the domain you've typed. In any case, it's always best to accurately type in a URL address to a known site yourself than to follow a link.

Finally, keep all your software—not just your operating system—up-to-date with the latest security patches and upgrades. Sure, it's a lot of management, but think of security maintenance on your computer as the high-tech equivalent of checking the fluids and tire pressure on your vehicle. Just as you don't want to explain to your mechanic that your engine seized because you never checked the oil, you don't want to explain to your credit card company a \$10,000 charge at *sportsbook.com* because you didn't have time to update with the latest patches for Internet Explorer. **PM**

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Digital Clinic

by Seth Porges

Q+A



Photographically Faking It

Q I've recently seen a number of photos online that seem to take expansive shots of cities and vehicles and make them look like tiny scale models. How do I do this?

A It seems like every year or so, a different niche photographic technique crosses over from the photorati to the point-and-shoot mainstream. This year I'd put my money on fake miniaturization—a trick that makes full-size cityscapes and vehicles look like closeups of dioramas or Fisher-Price models. In recent months, groups on Flickr and other photo-sharing sites have brought attention to the technique's amateur auteurs.

So how are these photos made? It usually comes down to depth of field—that's the term photographers use to

describe how much or how little of a photo appears sharp and in focus. When a photo of a large scene is taken from far away—such as one shot from the top of a hill or building—almost the entire photo will naturally be in focus. But with closeup shots of smaller objects, such as scale models, it is very difficult to keep more than a small sliver of the frame in focus. By exploiting this expectation, and selectively blurring the foreground or background, a photographer can trick your eyes and brain into thinking a large scene is really a closeup shot of a scale model. The end

How to Take Fake Miniature Photos

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OPTION 4: USE A CAMERA WITH A BUILT-IN MINIATURE MODE.

tech

term

→ LIGHT PEAK

Current USB connections are too slow to move large movie files between devices quickly. Light Peak is the code name for a new Intel-developed tech that uses fiberoptic cables to transfer data between devices at a claimed speed of 10 gigabits per second (that's enough to send a Blu-ray movie in 30 seconds). In the future, the tech, which Intel says could be available as soon as this fall, could be scaled up to speeds of 100 Gbps.

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result is, in a nutshell, very cool.

There are a few ways of taking these shots yourself. The first—and best—is to load an SLR camera with a specialized lens called a tilt-shift lens. These lenses allow photographers to physically tilt the axis of the glass in front of the camera's image sensor (the movement is controlled using knobs on the side of the lens barrel), giving them a huge amount of control over what part of the image is in focus. This makes it easy to focus in on an object—such as a car or train—while leaving the background or foreground blurry.

If you don't want to buy an expensive tilt-shift lens (they typically cost well over \$1000), you can simulate the effect with photo-editing software such as Adobe Photoshop (try using the Lens Blur filter to blur the background). The process can also be automated using mobile apps (such as the \$1 TiltShift Generator for the iPhone) or websites (such as *tiltshiftmaker.com*) that allow

you to upload a photo and select which part you want to keep in focus.

The recent surge in interest in fake miniaturization has also spurred camera manufacturers to build the ability directly into some newer cameras. Three new models in Canon's PowerShot line of compact cameras (the SD1400, SD3500 IS and SX210 IS, which range in price from \$250 to \$350) have a Miniature Mode that automates the process, and the Nikon D3000 digital SLR (\$550) has a Miniature Effect function that lets users specify which part of a just-shot picture they want to keep in focus, directly from the camera's LCD screen.

Conference Call

I heard that Apple's new iPhone 4 includes video calling. Does this feature work only for calls between two iPhone 4s, or can I use it to make calls to other video-conferencing programs?

Sure, Apple may have a well-deserved reputation for being in love with proprietary formats and closed standards, but the new iPhone 4's video chat is anything but. To make video calls, the phone uses a feature called FaceTime. When the iPhone 4 launched in late June, FaceTime could only be used to make calls between two iPhone 4s. But because FaceTime is an open standard, hardware manufacturers and software developers should be able to produce devices and programs that can communicate with the new phone's front-facing camera. In other words, we could soon be using our iPhone 4s to make calls through Skype, iChat, Google Talk and all sorts of other video-conferencing applications that allow us to speak with our iPhone-less friends. We'd also be shocked if the next iPad doesn't feature a front-facing camera that communicates with FaceTime.

Still, there's one major usefulness-dampening downside to FaceTime: It can currently only be used over Wi-Fi. And while this is understandable considering how beaten down AT&T's much-maligned 3G network is these

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The iPhone 4's front-facing camera is designed for video calling.

days, it is nonetheless disappointing—especially when one considers that the new Sprint Evo 4G phone can make video calls over both Sprint's 3G and 4G WiMax data networks.

Hard Charger

My iPad won't charge when it's plugged into my computer. Why?

Compared with an AC plug's eight-lane highway of power, a computer-connected USB cord is a single-lane access road, able to provide enough power to keep a phone running but not nearly enough for power-hungry laptops. This leaves the iPad—a device that sits somewhere between a phone and a laptop—in a sort of gray area, even though it uses the same iconic Apple 30-pin connection jack and white USB cord as an iPhone or iPod.

The result: While the iPad can charge over USB, it needs more power than a lot of older computers were designed to dish out. In fact, when it comes to charging an iPad, the various methods can be broken down into what is basically a three-tiered hierarchy. The single fastest way to charge an

iPad is to plug it into a wall using the included 10-watt, 2.1-amp charger, or a similarly specced third-party charger, such as the Griffin PowerBlock iPad charger. Not quite as fast, but still serviceable: plugging it into a computer with a high-power USB port that abides by the USB Battery Charging v1.1 specification (this includes a mix of newer Mac machines, but virtually no currently available PCs), or an iPhone's bundled 5-watt, 1.1-amp charger. The final, last-ditch method: plugging the iPad into a PC or older Mac. This will cause it to pull a trickle charge over the course of many hours. However, this technique provides such a slow draw of power that it works only when the iPad is in sleep mode—when the tablet is in use, its large 9.7-inch screen actually uses more power than the USB cord is taking in, which is likely why your iPad screen gives no indication that it is actively charging.

Linux No Longer

I heard that Sony has recently disabled the ability for PlayStation 3 users to install Linux on their console. If I already have Linux on my system, will I lose my ability to access it?

That's right: Sony recently issued a PS3 firmware update that strips users of the ability to load the console with the Linux operating system. Of course, we've heard this story before: Hackers find a way to install an unauthorized operating system or piece of software on a device, so the manufacturer designs a firmware update that nullifies the hackers' work.

But what makes this case so unusual is that Sony originally supported the PS3's Linux compatibility and built it into the system. It wasn't hackers or pirates who were cracking into the system but

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normal users who were following Sony's license agreements to the letter. The stated reason for the change is unspecified "security risks," although cynical gamers are more likely to believe Sony is using that as an excuse to exercise more control over how customers use its game system.

And for a certain segment of techies, the ability to run Linux (which is absent on both Microsoft's Xbox 360 and the Nintendo Wii console) was likely a key reason for their purchasing a PS3 in the first place. So what if you already have Linux on your machine? A Sony spokeswoman confirmed that upgrading the firmware will cause users to lose access to the operating system and any files that are parked in it. Which is unfortunate—for Linux users, it could feel like Sony is playing a game of chicken with them. You can choose not to upgrade your console to the latest firmware, but you'll also lose access to core features, such as the ability to sign in to the PlayStation Network or to play newer games or Blu-ray discs that are designed to work only with the latest firmware. And if you've spent a lot of time and resources turning your PS3 into a working computer, loaded with documents and media, you'd better back it up onto some sort of external drive before you upgrade your firmware. Otherwise, your data will be gone for good.

Still, there's one potential upside for customers on the horizon: Sony's actions have prompted several disgruntled gamers to file class-action lawsuits,

alleging the company had disabled features they had previously paid for. So even if PS3 owners have to choose between Linux and online gaming, there's still the possibility that they could at least get a check in the mail for a few dollars for their trouble.

Google Math

I know Google has a lot of hidden features built into its search engine. What's your single favorite?

You're right: Google engineers are famous for subtly inserting Easter eggs and features that range from the useless (who can forget the period in June when a playable version of Pac-Man populated the Google home page?) to the brilliant (type "weather" followed by the name of a city to get an instant forecast). But the one I find myself using the most would undoubtedly be the built-in calculator. To get Google to do your math for you, simply type the arithmetic into the search bar and hit enter. The answer will pop out on the next page. To find a list of dozens of these built-in search tools (believe me, some will surprise you), surf to google.com/intl/en/help/features.html.

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Mending Fences

(CONTINUED FROM PAGE 65)

extending toward the jackhammer site. Hecht points to a building across the street. "The tunnel was going to come out there," he says. After recent rains, the street caved in, and the passage was discovered.

Tunneling schemes have become more audacious and sophisticated in recent years. In Nogales, a passage that began on the Mexican side in a phony human-rights office led into the basement of a clothing store on the U.S. side. Those using the tunnel emerged in the retail outlet, where they blended in with the shoppers, then exited to the street. (The Border Patrol calls the speed with which a crosser mixes into the general population the melt factor.) In December 2009 officials discovered an unfinished burrow in a Tijuana warehouse. It stretched 900 feet into the U.S. and was equipped with an elevator, electricity, lighting and plumbing.

The problem with tunnels is that there's no effective technology to detect them. Sinking fences deeper helps, but that doesn't work with pre-existing passages, like those of the Nogales drainage system. To find existing tunnels, the patrol has to rely on human-gathered information. Agents of smaller stature—often females, according to Hecht—who can fit in tight spaces are encouraged to volunteer for special training. Once certified as CATS (confined-area technicians), they put on headlamps and crawl into the dark passages.

The tunnels of Nogales allow for some electronic surveillance. Several passages have recently been equipped with night-vision cameras. Those areas are also rigged with pepper-spray nozzles, which border guards can activate by remote control to thwart attempted breaches.

I emerge from the Nogales tunnel and dust myself off, leaning against the rusting landing-mat fencing. West of here, within my line of sight, it yields to miles of newer anti-ram fencing. In the other direction, the fence becomes almost decorative, painted to look less imposing, friendlier. There's even a window in it. And through it I can see people, watching, searching for a weakness, a way in.

PM

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The Highest Dive

(CONTINUED FROM PAGE 61)

Also unlike with a standard aircraft, more than half of the 100 switches on the instrument panels control camera systems: On the capsule alone, nine high-definition, three digital still and three ultra-high-res video cameras will film the attempt for the benefit of ground control and to provide live footage for a television and Web audience. A separate lithium-ion battery system powers the camera equipment so as not to interfere with critical functions of the capsule; communications are transmitted through independent radio-telemetry systems as well.

The capsule with its payload—both human and electronic—weighs about 2500 pounds; Fournier's is about 1100; Kittinger's gondola was 920. "This is weight-critical in that any extra pound of payload decreases the altitude that it can reach under the balloon," says Bill Dodson, the capsule's chief engineer. To rise to the record-breaking 120,000 feet, Baumgartner's balloon will have to be 30 million cubic square feet in capacity—more than three times the size of Fournier's and 10 times Kittinger's. It will climb at about 1000 feet per minute until it reaches altitude, where it will swell to approximately 400 feet in diameter as Baumgartner prepares to step out.



THE TOES OF BAUMGARTNER'S thick white boots creep to the edge of the narrow step. He leans out ever so slightly, his gloved hands grasping the gray handrails at each side. His dark faceplate glints briefly in the sun. Then, a bunny hop. Both feet leave the platform at the same time, knees gently bent, and he hurtles toward the earth. Suddenly, he jerks back upward, whipping violently around with a loud *thwap* as his bungee cord slaps his helmet, then briefly wraps around a leg of his pressure suit. He twists in the air and bounces again and again until the line hangs still, and a yellow Champion crane slowly lowers him to the ground.

He lifts his faceplate and sinks into a folding chair as his team crowds around him. "It looked like you leaned forward," Dan Murray says. "That's *not* the way you

want to go." Baumgartner nods, his face intense with concentration.

He is now nearly three years into the project's development and training and less than six months from the final jump. Everyone is aware of Fournier's attempt the week before. "You can never rush a scientific test program to meet somebody else's jump schedule," Thompson says. "If you do, you're making a major mistake. If Fournier jumps, Fournier jumps. If we get there first, we get there first. But we need to be sensible."

And so, at a fairground a few miles from Sage Cheshire, Baumgartner is practicing taking that all-important first step. "I want to have all the confidence in the world," he says, "because at the end of the day we still have one big unknown, and that's what happens to the human body when you reach the speed of sound." If he begins to tumble at 120,000 feet, he can go into a deadly uncontrolled spin. At that altitude, there's not enough air density for him to correct himself or for a drogue chute to be effective.

But after the first 18 to 20 seconds, a drogue chute can help. Luke Aikins, Baumgartner's aerial strategist, has designed a drogue unlike any other: It's independent of the main and reserve chutes and will deploy automatically if he experiences 3.5 g's for 6 seconds—about 96 revolutions per minute. The plan, though, is not to use a drogue at all. The team wants to prove that a person could do a high-altitude re-entry, passing from subsonic through transonic to supersonic flight and back again, while controlling his body positioning.

In order to do that, Baumgartner needs a pressure suit with some flexibility. His is a hybrid of those worn by U-2 pilots and astronauts, with an important distinction: It is designed to inflate to the standing position and has articulated joints in the hips and shoulders. Still, it is a little like being inside a football. "By the time I step off it's already been 5 hours in that suit," Baumgartner says. "You're completely worn out in that moment. But this is the moment when everything starts. It's not over yet. You need to get back to earth, safely."

Ideally, he will rotate into a delta position as he's falling, head slightly down and arms and legs outstretched behind him like a diving osprey. At

around 100,000 feet, he'll reach Mach 1. "Nobody's ever accelerated through the sound barrier and decelerated back through it, and monitoring him during that is going to give us a lot of information," says Jon Clark, the project's medical director and the space medicine adviser to the National Space Biomedical Research Institute. "Can it be done?"



BAUMGARTNER STANDS IN THE door of the basket as the crane slowly lifts him back into the air. From 200 feet below, his white suit is just a smudge against the faded red paint of the steel lattice. The cord hangs beneath him in a long graceful loop, swaying in the wind.

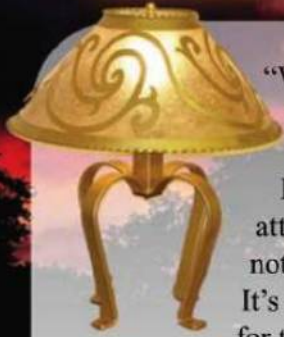
In the corner of the parking lot, Joe Kittinger and Einar Enevoldson, the team's high-altitude research consultant, sit in folding chairs, gazing up at him under the brims of their hats. Enevoldson has flown more than 300 kinds of aircraft and set eight world records, five of which still stand. The men, a little rounder and thinner, respectively, now, and freckled with age spots, wear the signs of their long distinguished careers—but they're still every bit test pilots. "Joe and I, our goal wasn't to set records—we were just doing our daily jobs," Enevoldson says. "You have to go about this in a businesslike way."

Asked if he'd given his first step this much consideration, Kittinger promptly replies: "I gave it a year and a half of thought. I did it in my mind 1000 times, and in a pressure chamber 30 times. I didn't want to go headfirst, so I thought I'd just do a short hop, and it worked out perfect. That's what Felix will do too."

Baumgartner moves forward to the edge of the basket. He stands, a bit straighter now, pauses, and then gives a short hop. He falls in slow-motion, a tiny white figure, like a toy parachutist dropping from the sky. "Beautiful," Enevoldson says. "I think he was too much feet forward," Kittinger replies. "He's got to get rotated around." Baumgartner bounces a few times, cleanly, and then is lowered to the ground. He wants to go back up. In a few months, he'll have one shot at that first step, one chance to break the record. But today, he can try it again and again.

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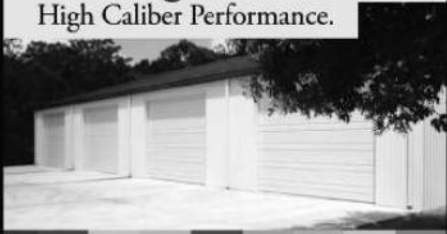
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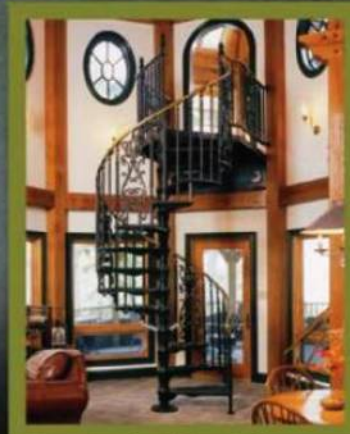
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× Navy Lt. C.J. Simonsen used to land jets on ships in the dark, which is why he sees his role as a No. 7 pilot for the Navy Flight Demonstration Squadron—the Blue Angels—as a relatively stress-free job. After Simonsen graduated from the Naval Academy in 2002, he spent three and a half years training to fly the F/A-18F Super Hornet. Piloting the aircraft, he claims, beats any carnival ride. "Multiply the best roller coaster you can imagine by 100," he says, adding that compared with combat training, "flying as a Blue Angel is just pure exhilaration." — G.E. ANDERSON

F/A-18 HORNET Other than the distinctive DuPont paint job, the biggest differences between a Blue Angels jet and its Navy fleet counterpart are weight and drag. Although the craft gains a smoke oil tank for shows, it loses a nose cannon, external fuel tanks, bombs, rails and missiles. A 1:1 thrust-to-weight ratio lets the Hornet accelerate quickly to its max speed of Mach 1.8 (1400 mph). A pressurized

spring on the stick helps pilots maintain arm stability while flying inverted and performing other aerobatic maneuvers such as the Diamond 360.

TEAMWORK "The guys that do the wrench turning and make sure our jets are safe are the best maintainers in the Navy and Marine Corps," Simonsen says. "I'd say that my No. 1 tool is my No. 7 crew chief, Travis [Simpson]. He always

knows what I'm doing, and I always know what he's doing. We have the utmost trust in each other."

SUITING UP Fleet squadron pilots wear G-suits, which pressurize to keep blood from pooling in the lower body during high acceleration. Blue Angels can't do that. "We rest our forearms on our legs and use our knees as a fulcrum," Simonsen says. The inflating

suit could interfere with hand movement—dangerous in tight formations. Instead, Blue Angels use the hic maneuver: bracing the legs and flexing lower body muscles to constrict the vascular system, then exhaling forcefully, causing the diaphragm to elevate blood into the upper torso. Blue Angels also eschew oxygen masks during demonstrations because they typically don't fly above 15,000 feet.

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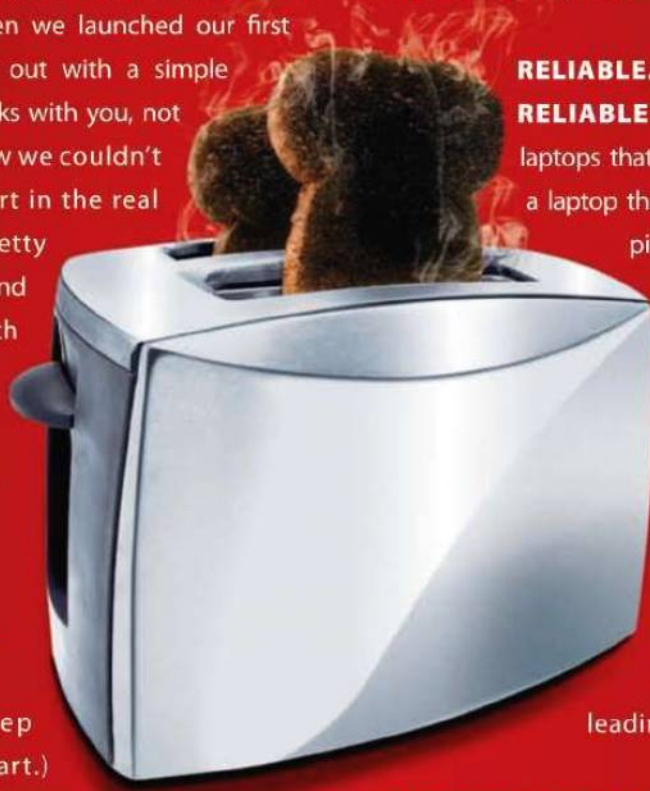
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