

★ JUNE 2010

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ELECTRIC CARS • WHAT'S IN STORE

SNAKEBITE ALERT! • SORRY, NO MORE ANTIDOTE PAGE 26

Popular Mechanics

Science Technology Automotive Home Outdoors

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2010

June



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Flat Out

We drive two iconic American muscle cars from Michigan to Utah and redline them on the Bonneville Salt Flats to find the fastest.

Plus: Behind the scenes at Speed Week, Bonneville's salty salute to amateur racing.

BY EZRA DYER

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The Man in the Black Flying Suit

BASE jumper Jeb Corliss has thrown himself from buildings, into sinkholes and in front of fierce predators. Now, he wants to become the first man to jump from an aircraft and land without a parachute. It sounds suicidal, but that's what makes Corliss feel most alive.

BY JAMES VLAHOS

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The Electric Plug-In Acid Test

The largest rollout of electric vehicles ever will hit the U.S. later this year, which could mark the start of profound changes in the way we drive. For a glimpse of the future, we consulted experts, then tagged along on a day in the life of an EV owner in 2020.

BY ERIK SOFGE

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It's a Beautiful Day for a Flamethrower

William Gurstelle ditched his job to tinker full-time. Now, the Minnesota inventor launches fiery projectiles and high-velocity vegetables in the name of scientific instruction. Whoosh, boom, splat!

BY HARRY
SAWYERS

Inventor William Gurstelle fires up his handmade potato launcher in his Minneapolis, Minn., home. Photographed for POPULAR MECHANICS by Chris Buck.

ON THE
COVER

Jeb Corliss is secretive about the wingsuit that will enable him to leap from a helicopter and land without a parachute. So PM asked designers and other experts for some informed speculation about what the next-gen version might look like. Here's the result, as conceptualized by Pixar Animation Studios' technical director Nathan Fariss.



Popular Mechanics

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Research for her book *Deadliest Sea* took PM contributing editor Kalee Thompson (right) to Coast Guard stations in Alaska and the Pacific Northwest.

Story of an Epic Rescue

It was 2:46 am on March 23, 2008, when a mayday call came into the U.S. Coast Guard station in Kodiak, Alaska. The *Alaska Ranger*, a 184-foot fishing trawler, was taking on water in the frigid Bering Sea, with 47 souls on board. So began the biggest and most daring open-water rescue operation in the Coast Guard's history.

By the time the first Coast Guard helicopter arrived, the *Ranger* was gone. Fewer than half of the crew had made it into life rafts; the rest were floating in 35-degree water, protected only by neoprene survival suits, each one marked by a strobe. From the cockpit, all the pilots could see was a long string of flashing lights, as if marking some ragged, undulating runway stretching across the dark waves.

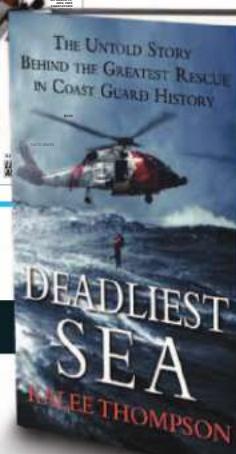
When we heard the news about the *Ranger* sinking, we asked POPULAR MECHANICS contributing editor Kalee Thompson, a veteran outdoor journalist who began her career at the National Geographic Society, to tackle this breaking story. Over the next few weeks, she interviewed survivors and rescuers, attended investigative hearings and produced the first definitive account of the sinking, "Ranger Down," the cover story of our July 2008 issue.

This month, Thompson's *Deadliest Sea* hits bookstores. Thompson's research took her to the remote Alaskan fishing port of Dutch Harbor, across the Bering Sea aboard the Coast Guard Cutter *Munro* and into the air with Coast Guard helicopter pilots. And what a tale she brought home. Like *Into Thin Air* and *The Perfect Storm*, *Deadliest*

Sea is a gripping story of death and survival in one of the world's most dangerous places. It is also a portrait of heroism. Thompson reaches deep into the culture of the Coast Guard, helping us to understand the bravery of rescue swimmers eager to drop into frigid waters protected by little more than a drysuit, the skills of pilots and flight mechanics hoisting survivors up from surging waves and the dedication of sailors who spend years at sea training for the moment when they will be called upon to save a life. We need more stories like this. I can't think of a better writer than Kalee Thompson to tell this one.

JIM MEEIGS
Editor-in-Chief

The massive rescue operation to save the crew of the *Alaska Ranger* was the subject of a 2008 PM cover story. Now, author Thompson chronicles the event in more detail in her new book, *Deadliest Sea*.



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WHAT THEY'RE DOING



X SHAWN CARLSON

Carlson, the executive director and founder of LabRats, is working to launch the science education program in several cities over the next few months, beginning in Chicago. Carlson, who stepped down from his position at the SciTech Hands On Museum to build LabRats nationally, designed the teen-based scouting groups to build character and boost science education.



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PM LETTERS

How I Survived

There is one thing missing from the survival stories that you published in the April 2010 issue—the desire to live. You may think that is in all peoples' thoughts, but it is not.

I am a survivor of the sinking of the USS Indianapolis. I was on watch just after midnight when the ship was hit [by torpedoes fired from the Japanese submarine I-58]. At first I thought it was a boiler exploding because I saw flames shooting up through the stack. We lost communications, and in a few minutes we began to list starboard. I slipped and fell, and when I got up the ship was leaning. My watch station was about 60 feet up and I saw water a few feet from me. I prepared to jump.

Training taught me to swim away so I would not get caught in any suction. I swam as far as I could on one breath, and when I looked again, I saw a propeller coming down on me, still turning. I became a motivated swimmer, and the next time I looked the ship was gone. Here I was, alone, in the middle of the ocean without a

life jacket, in the pitch-black darkness. I thought I would wake up in my bunk, dry, having had a bad dream.

I swam about an hour and finally found two sailors with a preserver. I hung on to it until morning when I spotted a loose life jacket. Some time that afternoon, we saw a small group of sailors with four big life floaters built for about 10 people each. I could not get aboard because there was no room but I tied myself to the group. I know how delirious the others got. I decided I would use as little energy as I could and only worry seriously when I could see no others' faces.

The group had a keg of water but it was impossible to drink out of it. It was heavy and, when lifted, one would go underwater. Some sailors were attacked by sharks. Some, in their delirious states, would swim away, and others said they were going



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Donald Blum



"below" to the drinking fountain. Some said they had been to the ice cream stand on the ship.

During the fourth day, a plane spotted us and wagged its wings. We waited well past midnight for a ship to pick us up. No one missed us, although Navy ships used to run on tight schedules and we were expected for gunnery practice almost three days earlier. This was the worst screw-up the Navy ever had. Out of the original crew of 1199, only 316 survived.

How is it I did and so many did not? I firmly believe it was because I didn't think I had anywhere to go—others believed heaven was waiting for them. To survive, I kept thinking I should keep on treading water and waiting. I hope this brings to your attention the will to live as the most important ingredient in a rescue.

DONALD BLUM

what
do you
think?

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X JUNE

Military Moves



FUTURE OF THE MILITARY The Air Force, Army, Navy, Marines and Coast Guard continuously redefine themselves to fit with the times by investing in new technologies, implementing new strategies and fighting wars in new ways. PM brings you the latest on the weapons, tactics and policies that will shape tomorrow's military.

ROBOT ARMIES Robots—in the form of unmanned aerial vehicles, autonomous tanks and pack-carrying “mules”—are emerging out of research labs and onto the battlefield. We report on how they work, what they do and what's next.

MISSILE DEFENSE As more nations tout their space tech, intercontinental ballistic missiles remain a theoretical threat to the United States. Read about next-generation lasers, missile-detection systems and interceptors that are being developed and tested.

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2010 Toyota RAV4 4x2

MPG: 28 – EPA est hwy

Hwy Driving Range: 445 miles

Five-Star Crash Safety Rating: no*

Powertrain Warranty: 5 years/60,000 miles**

A Consumers Digest Best Buy: no

Automatic Crash Response: not available

Link to Emergency Services: not available

*Government star ratings are part of the National Highway Traffic Safety Administration's (NHTSA's) New Car Assessment Program (www.safercar.gov). **Whichever comes first. See dealer for limited warranty details. Visit onstar.com for details and system limitations.



2010 Chevy Equinox FWD

MPG: 32 – EPA est hwy

Hwy Driving Range: 600 miles

Five-Star Crash Safety Rating: yes*

Powertrain Warranty: 5 years/100,000 miles**

A Consumers Digest Best Buy: yes

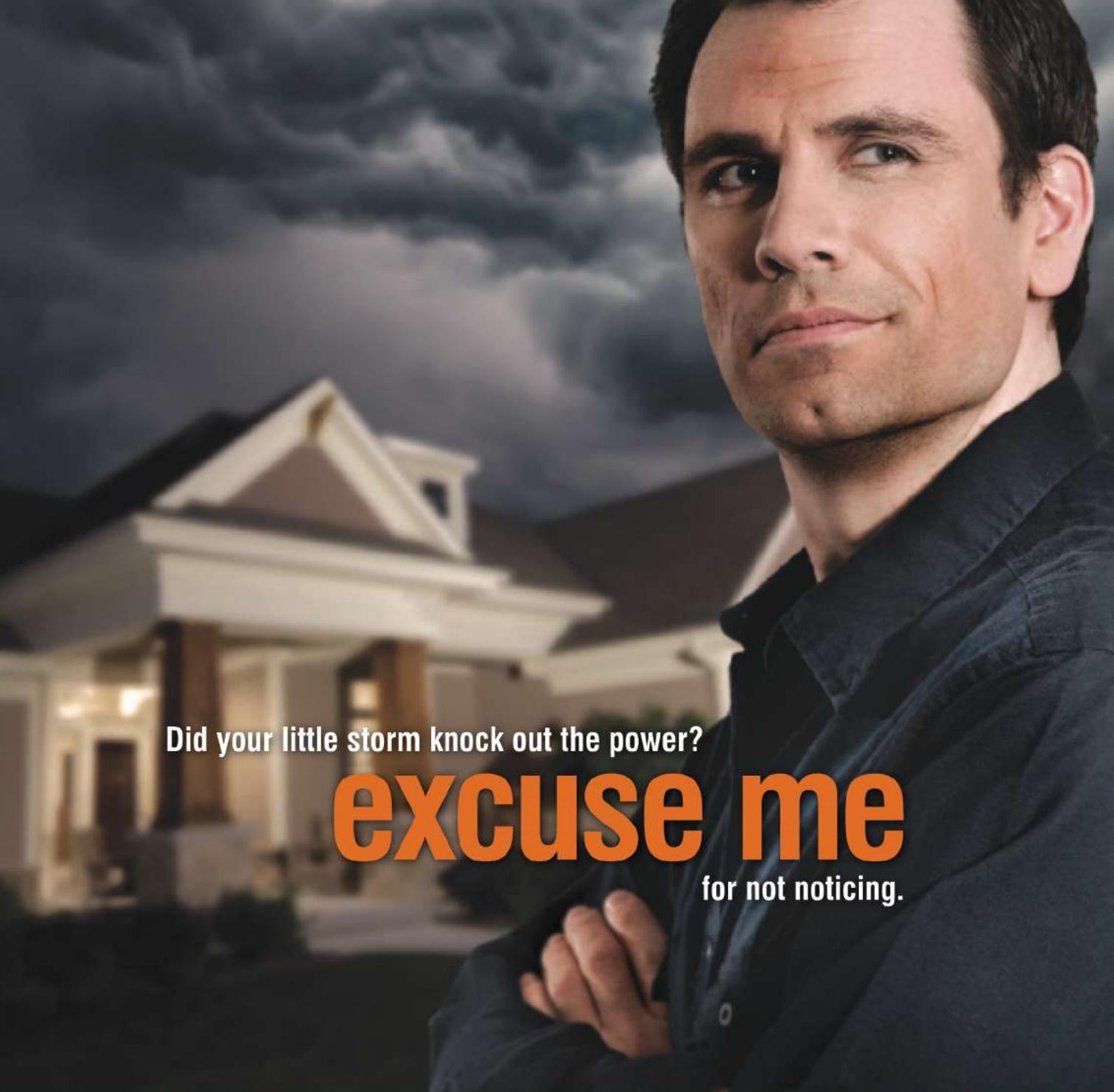
Automatic Crash Response: OnStar®/1 year standard†

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Tech Watch

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advantage**

STICKY ON DEMAND
 + Researchers at Cornell University have developed a way to produce instant adhesion that can be activated with a switch. The technique relies on surface tension produced by water droplets as they're forced through microscopic holes. The charge from a 9-volt battery pumps water through the team's device, creating a bond; reversing the voltage pulls droplets back through the holes and into a reservoir, releasing the surface. A 1000-hole prototype supports about 70 paperclips; a square-inch device with millions of small holes could support 15 pounds.

Gunslinger Math

In the unlikely event that you find yourself in a Wild West shootout, should you draw first or wait and react to your opponent pulling his pistol? Researchers at the University of Birmingham in England put this quandary to the test in a "laboratory gunfight" that involved pressing buttons rather than squeezing triggers. The scientists found that the second person to draw moves faster—but the average advantage of 21 milliseconds is too slim to make much difference in a gunfight. They speculate that two different types of brain processes may govern action and reaction, a theory supported by the fact that some Parkinson's patients find it easier to catch a ball than to pick one up off a table. — ALEX HUTCHINSON



Hushed Helicopters

+ European aerospace company Eurocopter is ready to sell redesigned helicopter blades that nearly silence the noise of the main rotors and dampen vibrations that wear out mechanical parts. The double-swept shape of Blue Edge rotors diminishes the interference created when the tip of a whirling blade hits the vortex created by the blade preceding it. A trio of piezoelectric flaps on the trailing edge of each rotor blade move 15 to 40 times per second, automatically compensating for blade-vortex interaction. Civilian and military operators could use helicopters and unmanned aircraft more broadly if the craft didn't announce their presence to neighbors or enemies.

IONIC TIMEPIECE

+ A single aluminum ion, vibrating a quadrillion times a second, is the basis for a new "quantum logic" clock developed by the National Institute of Standards and Technology. A prototype of the clock remains accurate to within a second every 3.7 billion years—significantly better than the current U.S. civilian time standard, a cesium fountain clock accurate to within a second every 100 million years. The General Conference on Weights and Measures, based in France, may consider the design for a new international time standard. Such precise clocks are used to synchronize telecommunications networks and deep-space communications and to assist satellite navigation and positioning. They could also lead to new types of space-based gravity sensors, used to locate underground natural resources.



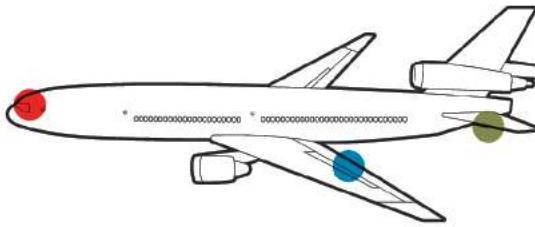
AVIAN ESP

+ Many birds have nerve branches filled with iron in their upper beak, enabling them to navigate using the "feel" of Earth's magnetic fields. German researchers confirmed that these specialized dendrites, first detected in homing pigeons, also exist in birds such as robins, warblers and even chickens, which don't migrate. This suggests the extra sense appeared early in avian evolution.

What's Wrong With the MD-11?

PM EXAMINES AN AIRPLANE THAT SOME PILOTS SAY INVITES DISASTER. BY DAVID NOLAND

→ A FedEx McDonnell Douglas freighter, landing through gusty winds at Tokyo's Narita International Airport on March 23, 2009, bounces during touchdown. As the airplane impacts the runway a second time, it banks sharply, snapping the port wing on the ground and rupturing a fuel tank. In flames, the MD-11 rolls over onto its back, then slides out of view of the airport surveillance camera filming the tragedy. Both pilots are killed. The accident, still under investigation, appears to be a carbon copy of two previous MD-11 crashes—a FedEx freighter at Newark International Airport, N.J., in 1997 and a China Airlines passenger jet at Hong Kong International Airport in 1999. "I've never heard of a landing flip-over with any other type of airliner," says John DeLisi, deputy director of aviation safety at the National Transportation Safety Board (NTSB). "The MD-11 has done it three times." Only 11 of 200 built still carry commercial passengers, for KLM and World Airways.



POSSIBLE CULPRITS:

The blueprints In the late 1980s, engineers at McDonnell Douglas updated the 1960s DC-10 and reduced the size of the plane's horizontal stabilizer by about 12 feet, which cut weight and drag. Depending on an airplane's center of gravity, the smaller the horizontal stabilizer, the less longitudinal stability the plane has. The MD-11 entered service with a system that automatically moves elevators on the stabilizers to compensate for unwanted pitching. However, the plane still has a reputation for unexpected motion. "In windy conditions, the MD-11 can be a bear to land," says Ken Adams, an air-safety investigator and former Delta MD-11

The controls The NTSB determined that the MD-11's controls are more sensitive than other airplanes', especially at low speeds and altitudes. Also, pilots have reported that the airplane's autopilot was not disconnecting when they input manual controls, as happens in other airplanes. The safety board asked that the software be changed, and Boeing (which bought McDonnell Douglas in 1997) did so in 2000. But the poor reviews continued. "The 11 is more than a handful to fly," says a FedEx pilot who flies MD-10s and 11s. "And the landing speed is 20 or 30 mph higher [than the MD-10's], so things happen faster."

The pilots Investigative reports about the MD-11 crashes in Hong Kong and Newark cite the cause as pilot error. While studying the Newark crash, the NTSB found that the energy transmitted to the right main landing gear during the second touchdown was 3.2 times greater than the MD-11's maximum certified tolerance. Boeing flight operations staff say that it would take a similar, atypically hard impact to cause the damage that occurred at Narita, and that the MD-11's landing-gear design is not at fault. The NTSB has urged airlines to train pilots to better handle the airplane if it moves erratically.

Verdict Sensitive controls make the MD-11 tough to handle, which contributes to pilot error that can destroy airplanes during hard landings.

◀ An eerily familiar hard landing in Japan killed two MD-11 pilots in 2009.



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Tiny Tubes, Big Energy

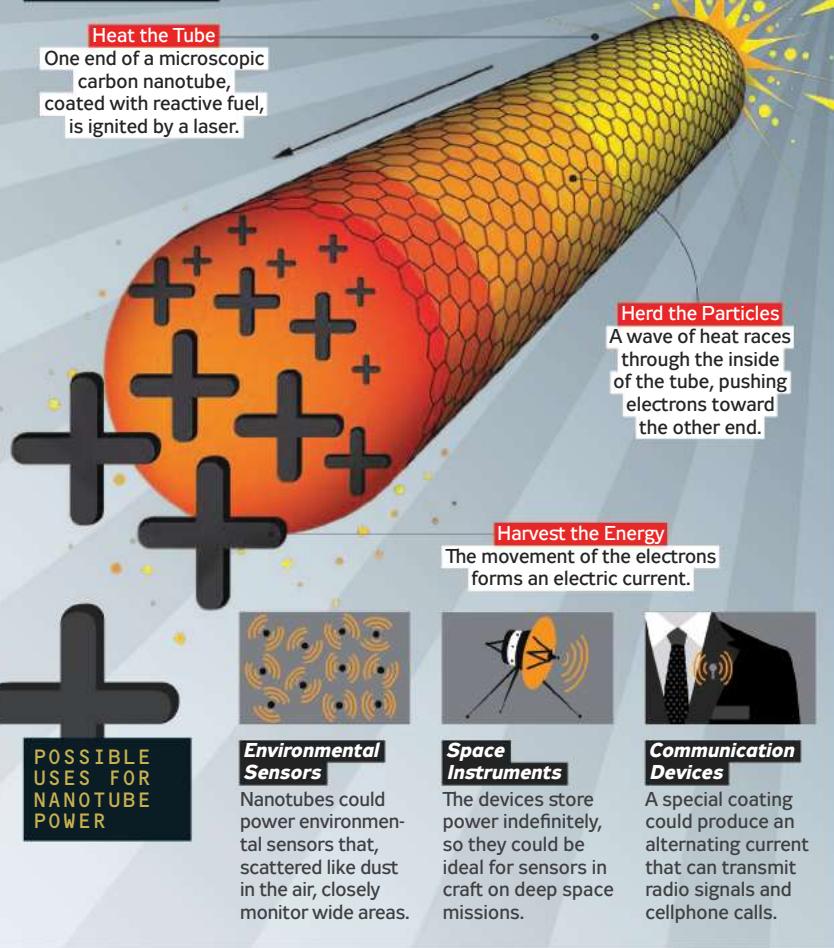
A BLAZING COATING ENABLES MICROSCOPIC CARBON NANOTUBES TO GENERATE ELECTRICITY. BY ALEX HUTCHINSON

→ Engineers at MIT have devised what they call a new way of producing electricity. By coating a microscopic carbon nanotube with a layer of fuel and igniting one end with a spark or laser, they're able to send a wave of heat shooting through the nanotube's interior. This thermal wave pushes electrons in its path, generating a significant electric current. Prototypes already have energy density 100 times greater than lithium-ion batteries, and they can be stored indefinitely without leaking charge. The researchers are now investigating optimal fuels and, to make the system reusable, will have to invent a way to automatically apply a fresh layer of fuel after the first burns away.

HOW IT WORKS

Heat the Tube

One end of a microscopic carbon nanotube, coated with reactive fuel, is ignited by a laser.



POSSIBLE USES FOR NANOTUBE POWER

Environmental Sensors

Nanotubes could power environmental sensors that, scattered like dust in the air, closely monitor wide areas.

Space Instruments

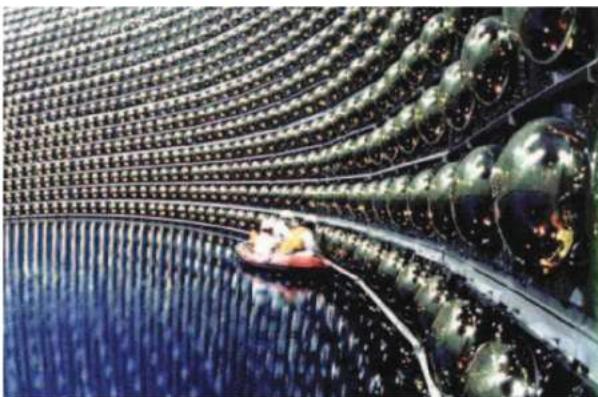
The devices store power indefinitely, so they could be ideal for sensors in craft on deep space missions.

Communication Devices

A special coating could produce an alternating current that can transmit radio signals and cellphone calls.

Superbeam Success

→ Why wait for elusive cosmic particles to arrive from space when you can order them on demand? A multinational team of researchers in Japan became the first to detect a man-made neutrino particle, after shooting it underground from a particle accelerator to the massive Super-Kamiokande detector 185 miles away. The detector is housed in a 12 million gallon tank of water surrounded by 11,000 light sensors, at the bottom of an abandoned mine 3300 feet underground. The neutrinos impact water molecules and the sensors record the pattern of light radiated by the collisions. Tests with the controlled beam of neutrinos could prove that the particles change as they travel, and strengthen the growing consensus among particle physicists that neutrinos have mass—a conclusion that would influence the ongoing debate over the balance between matter and antimatter in the universe. —A.H.



Workers inspect light sensors that detect the watery impact of rare cosmic particles.

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Walls That Take the Temperature

→ A new type of energy-saving drywall promises to keep houses cooler in the day and warmer at night. National Gypsum's ThermalCORE drywall is embedded with microscopic spheres of paraffin wax that melt when the indoor temperature exceeds 73 F and solidify when it cools below that. This phase change allows the walls of homes and other structures to absorb excess heat during the day and release it during the evening. Moderating the interior temperature subtly lowers energy use, especially helpful during peak hours. Engineers from the German company BASF are conducting tests in California to determine the potential savings of using the drywall in U.S. homes. —AH.

Making the World Cup Go 'Round

WHEN IT COMES TO ELITE SOCCER GAMES, EQUIPMENT DESIGNERS CRAFT BALLS WITH THE CARE GIVEN TO SPORTS CARS. *BY JEREMY REPANICH*

Every four years, the German company Adidas unveils what they hope is the perfect soccer ball, to be used in the FIFA World Cup. For the 2010 tournament, which begins in June in South Africa, designers used a wind tunnel to create a highly calibrated soccer ball of optimal roundness and stable flight. But how much is the game influenced by player skill versus ball design? "If you have good technique, then I think you can hit any ball well," says former U.S. national team member Alexi Lalas. "But the advances in technology have made it easier to use that technique consistently."



EVOLUTIONARY KICK

Notable World Cup Ball Improvements:



MEXICO, 1970

The first ball to use 32 panels to preserve its spherical shape.



MEXICO, 1986

Synthetics replace leather, preventing weight gain caused by water absorption.



UNITED STATES, 1994

A layer of cushioning polyethylene improves ball velocity.



KOREA/JAPAN, 2002

Layers of foam and fabric prevent the dissipation of energy. Players call the ball erratic; Adidas argues they're kicking it too hard.

IT MUST TAKE SOME REALLY SMART PEOPLE TO PUT THIS MAGAZINE TOGETHER. THIS IS SOME HIGHLY TECHNICAL SUBJECT MATTER.

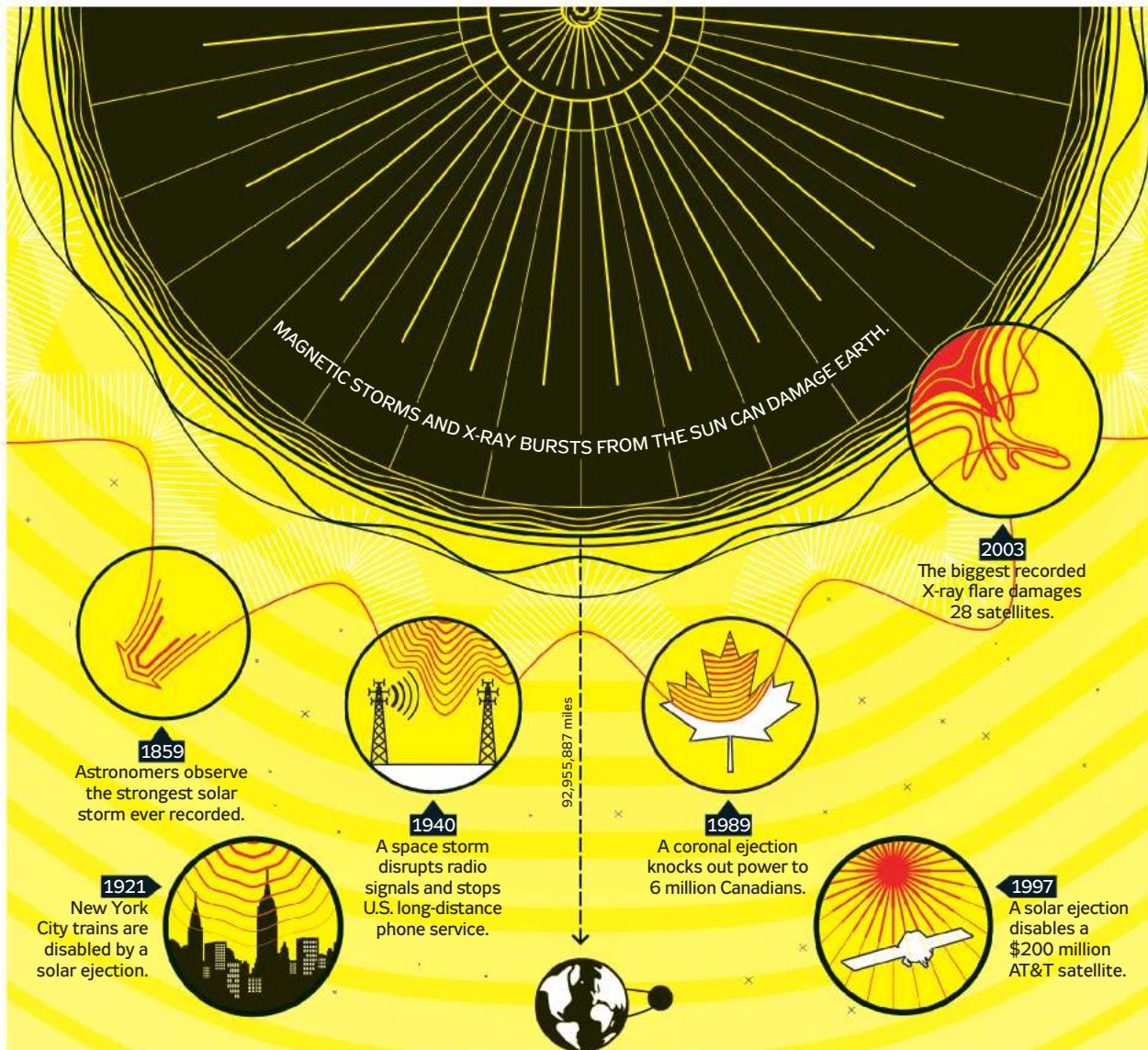
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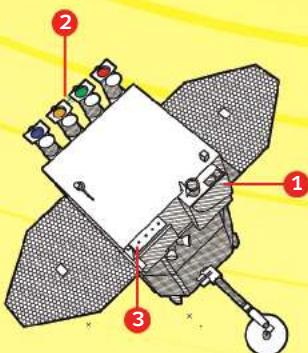


It's Hard To Stop A Trane.

Potential energy use comparing an 8-SEER system to a 20-SEER high-efficiency system. Actual energy savings will vary. © 2010 Trane. All rights reserved.



Stormy With a Chance of X-rays The sun gives the Earth life, but it also poses a planetary threat. X-ray bursts and magnetically driven explosions of solar material can wreak havoc by knocking out satellites, causing power failures and emitting radiation surges that require airline flights to be rerouted. To keep an eye on our local star, this year NASA launched the Solar Dynamics Observatory (SDO) satellite. "Imagine a weather system where instead of the water cycle, with rain and snow, it has magnetic fields," SDO project scientist Dean Pesnell says. The five-year, \$850 million mission continually beams data to Earth at 150 megabits per second. The information will be used as a warning system and to better predict damages. —ERIN SCOTTBERG

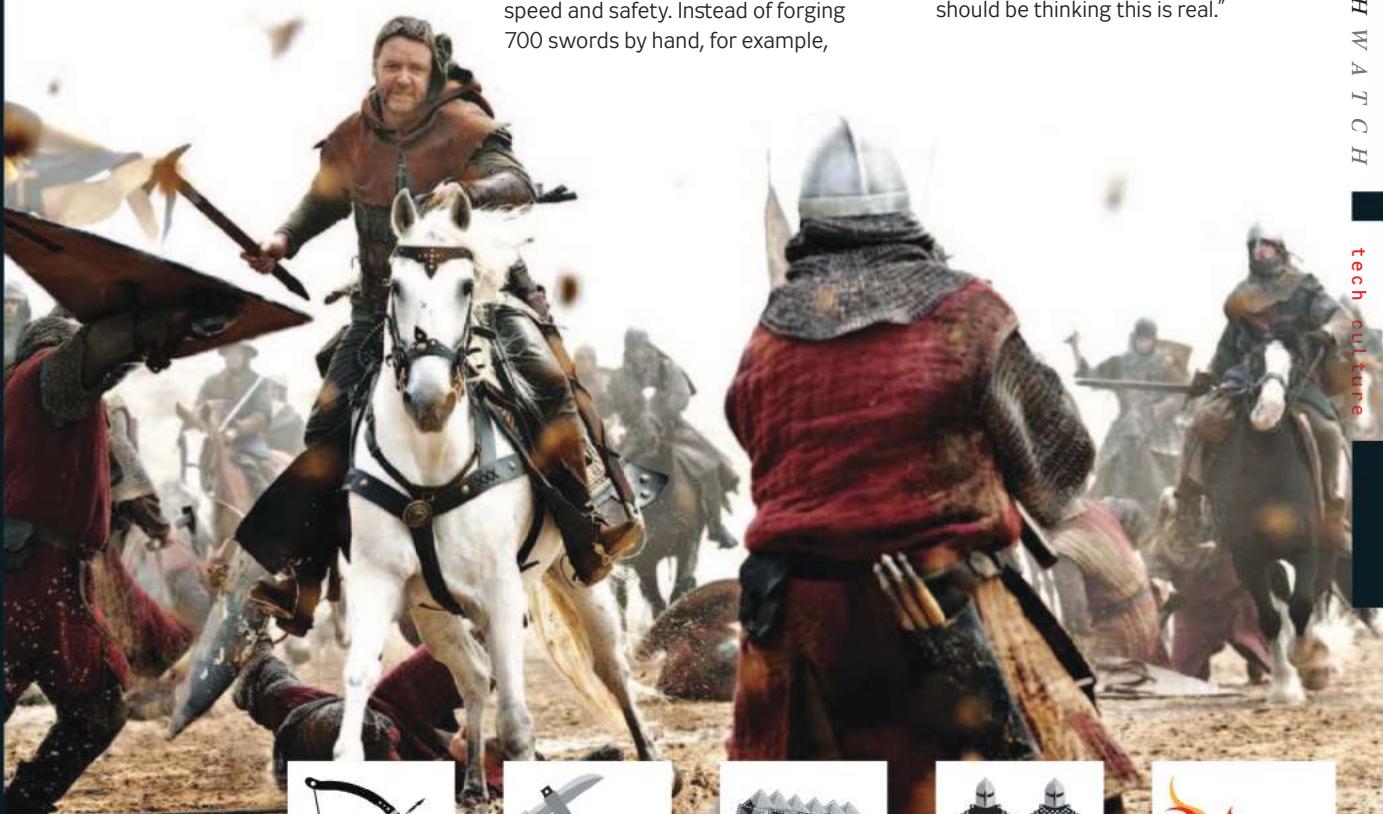


SOLAR DYNAMICS OBSERVATORY SENSORS

- | | |
|--|--|
| 1. Helioseismic and Magnetic Imager (HMI) | → Currents of plasma and other material beneath the surface create magnetic fields that generate solar emissions. HMI uses seismic data to map the strength of these fields and forecast eruptions. |
| 2. Atmospheric Imaging Assembly (AIA) | → AIA takes images of the sun's atmosphere and filters them at 10 different wavelengths. These images are combined with data from terrestrial and space instruments to document changes inside the sun before, during and after spouts of solar material. |
| 3. Extreme Ultraviolet Variability Experiment (EVE) | → EVE measures changes in the sun's output of extreme ultraviolet radiation, which influences the amount of protective ozone enveloping the Earth. Ultraviolet surges can also shatter molecules in the atmosphere, forming ions that disturb radio signals. |

Equipping Robin's Army

ARTISTS RE-CREATE 13TH-CENTURY WEAPONS TO ENVISION THE BATTLE FOR SHERWOOD FOREST.
BY ERIN MCCARTHY



ROBIN HOOD'S WEAPONS:
FROM HISTORY
TO HOLLYWOOD



BOW AND ARROW

History: Bow makers tensioned a branch with a slave string, then shaved the wood until each half had the same curve; the weapon was secured with a hemp bowstring.

Hollywood: All 250 bows, plus thousands of arrows, were handmade. "Most of the arrows have rubber tips," Atherton says, "because when you ask 150 guys to shoot at a castle, they turn into kids."



WAR PICK

History: The pointed end of this iron weapon pierced chain mail, while the hammer bashed an enemy's helmeted skull.

Hollywood: The weapon of choice for Robin, as played by Russell Crowe, is made of rubber with an interior steel armature to keep it stiff. "You have to make something that is strong, but not strong enough to kill anyone when it makes contact," Atherton says.



BATTERING RAM

History: This ancient weapon's design ranged from simple (a denuded tree) to complex (a tree slung from a wheeled support and swung into a door using pulleys).

Hollywood: Artists took a mold of a real pine tree to create the film's fiberglass ram, which had a lightweight aluminum core. The weapon weighed 3.5 tons—half that of the real thing.

armors received components that were 90 percent finished, then altered them to look as if they'd been handmade. Most were also constructed of bamboo and painted to resemble steel. "If we did our job well, you should be thinking, 'God, I'm there,'" master armorer Simon Atherton says. "You should be thinking this is real."



ARMOR

History: Each soldier wore a long-sleeved tunic and a pair of stockings, both made of chain mail.

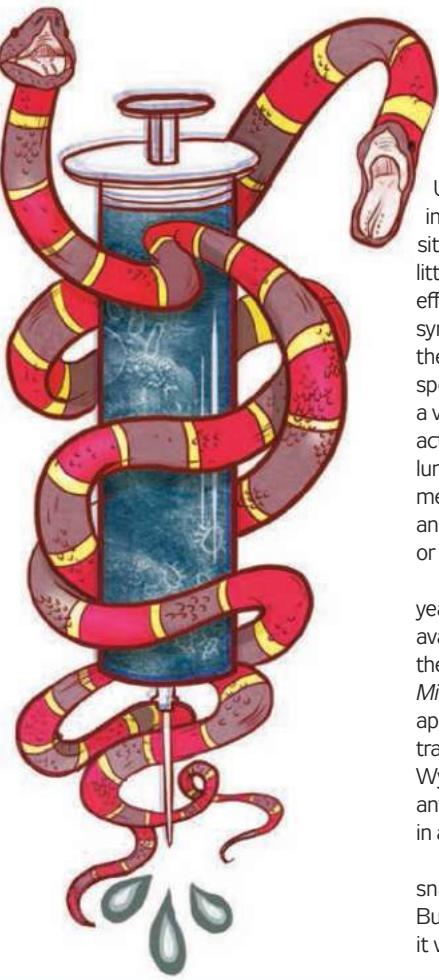
Hollywood: Crowe and other leads wore prefabricated plastic chain mail, while extras wore suits of aluminum; every actor needed multiple fittings for the suits, which costume designers altered with pliers. Helmets were made of auto rubber painted to look like metal.



FIRE GRENADE

History: Before a battering ram assault, soldiers weakened a castle gate with this precursor to napalm—a mixture of naphtha and turpentine oil delivered in pig bladders or goatskin.

Hollywood: Special-effects artists mixed glycerin and dye with gasoline to make the flaming grenades, which created 35-foot-high fireballs.



The Venom Crisis

THE CURE FOR CORAL SNAKE BITE IS ABOUT TO DISAPPEAR. WHY AN UNPROFITABLE ANTIVENOM MAY END UP COSTING LIVES. BY GLENN DERENE

As venomous snakes go, the coral snake is a clumsy biter. Unlike pit vipers such as rattlesnakes and cottonmouths, which have gruesomely efficient fangs that articulate forward during a strike and inject venom like hypodermic needles, the brightly colored coral snake has small, rear-facing fangs that guide venom into a wound. This process doesn't always work well—experts estimate that 25 percent of coral snake envenomations are dry bites—which is perhaps why the coral is so unaggressive. The snake is found throughout Florida, as well as in parts of Alabama, South Carolina, Louisiana, Texas and Arizona, but there are generally

only about 100 or so bites each year.

What the coral lacks in belligerence, it makes up for in neurotoxicity. Unlike bites from pit vipers, which cause immense pain and swelling at the wound site, coral snake victims usually report little pain after being bitten. But the effects begin to show within hours, with symptoms such as tingling sensations in the extremities, dysarthria (slurred speech) and ptosis (droopy eyelids). Then a victim's lungs shut down. "The venom acts as a neuromuscular blockade to the lungs," University of Florida professor of medicine Craig Kitchens says. "Without antivenom, you need artificial respiration or you die."

Unfortunately, after Oct. 31 of this year, there may be no commercially available antivenom (antivenin) left. That's the expiration date on existing vials of *Micruurus fulvius*, the only antivenom approved by the Food and Drug Administration for coral snake bites. Produced by Wyeth, now owned by Pfizer, the antivenom was approved for sale in 1967, in a time of less stringent regulation.

Wyeth kept up production of coral snake antivenom for almost 40 years. But given the rarity of coral snake bites, it was hardly a profit center, and the

company shut down the factory that made the antivenom in 2003. Wyeth worked with the FDA to produce a five-year supply of the medicine to provide a stopgap while other options were pursued.

After that period, the FDA extended the expiration date on existing stock from 2008 to 2009, and then again from 2009 to 2010. But as of press time, no new manufacturer has stepped forward.

Antivenom shortages are a surprisingly common occurrence. The entire state of Arizona ran out of antivenom for scorpion stings after Marilyn Bloom, an envenomation specialist at Arizona State University, retired in 1999. Bloom had been single-handedly making all the scorpion antivenom for state hospitals. Recently, Merck & Co, the only FDA-licensed producer of black widow antivenom, has cut back distribution because of a production shortage of the drug. In a 2007 report, the World Health Organization listed worldwide

envenomations as a "neglected public health issue."

New scorpion and black widow antivenoms are currently in the pipeline, thanks to efforts by several poison-control associations to speed foreign drugs into the market through FDA research programs. There is also a coral snake antivenom produced by Mexican drug manufacturer Instituto Bioclon that researchers believe could be even more effective and safe than the outgoing Wyeth product. But that drug, Coralmyn, is not currently licensed for sale by the FDA. The tests required for licensing would cost millions of dollars, and for such a rare treatment (there are 15 times as many scorpion stings per year as coral snake bites), it could take decades for Bioclon to make its money back.

Envenomation experts express exasperation and disbelief at the situation. "It's ridiculous that we're losing a technology that we already have," says Joe Pittman, a snakebite treatment specialist at the Florida Poison Information Center in Tampa. "It's even more ludicrous that we have a product that's available, and we have to jump through so many hoops to get it approved." In July 2009, an FDA advisory board determined that Coralmyn qualified for an accelerated approval process, but there is still no one with the estimated \$3 million to \$5 million to pay for the required studies.

"Nobody in this situation is being a bad actor," says Eric Lavonas of the Rocky Mountain Poison and Drug Center. "We just don't have a system set up to deal with it." With no adequate replacement for coral snake antivenom, hospitals are likely to appeal to local zoos, many of which maintain small stocks for their staff. But zoos are under no obligation to provide the medicine.

If and when shortages do occur, many hospitals will have no other option but to intubate coral snake bite victims on ventilators for weeks until the effects of the toxin wear off—potentially costing hundreds of thousands of dollars per bite. "It's probably going to end up costing us far more not to deal with this than to deal with it," Lavonas says, "both in human suffering, and in dollars and cents."

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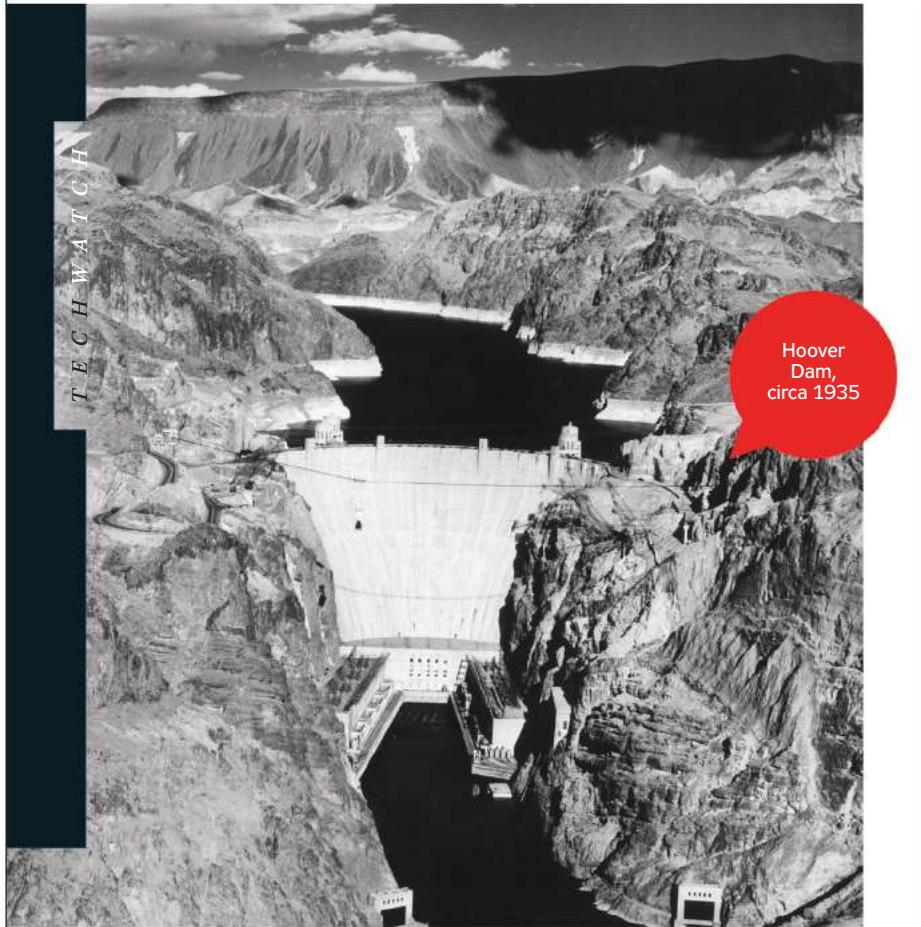


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Abe Lincoln was the first wired president. At the outbreak of the Civil War, there was no telegraph line to the White House. Within a year, Lincoln was sending telegrams directly to his field commanders.

SAFETY ELEVATOR

Episode 7, City

The concept of the elevator goes back to Archimedes, but it wasn't until 1852 that Elisha Otis introduced the safety elevator, which used locking rollers to stop the cab if it descended too quickly. Otis's invention made high-rise cities possible.

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Episode 9, Bust

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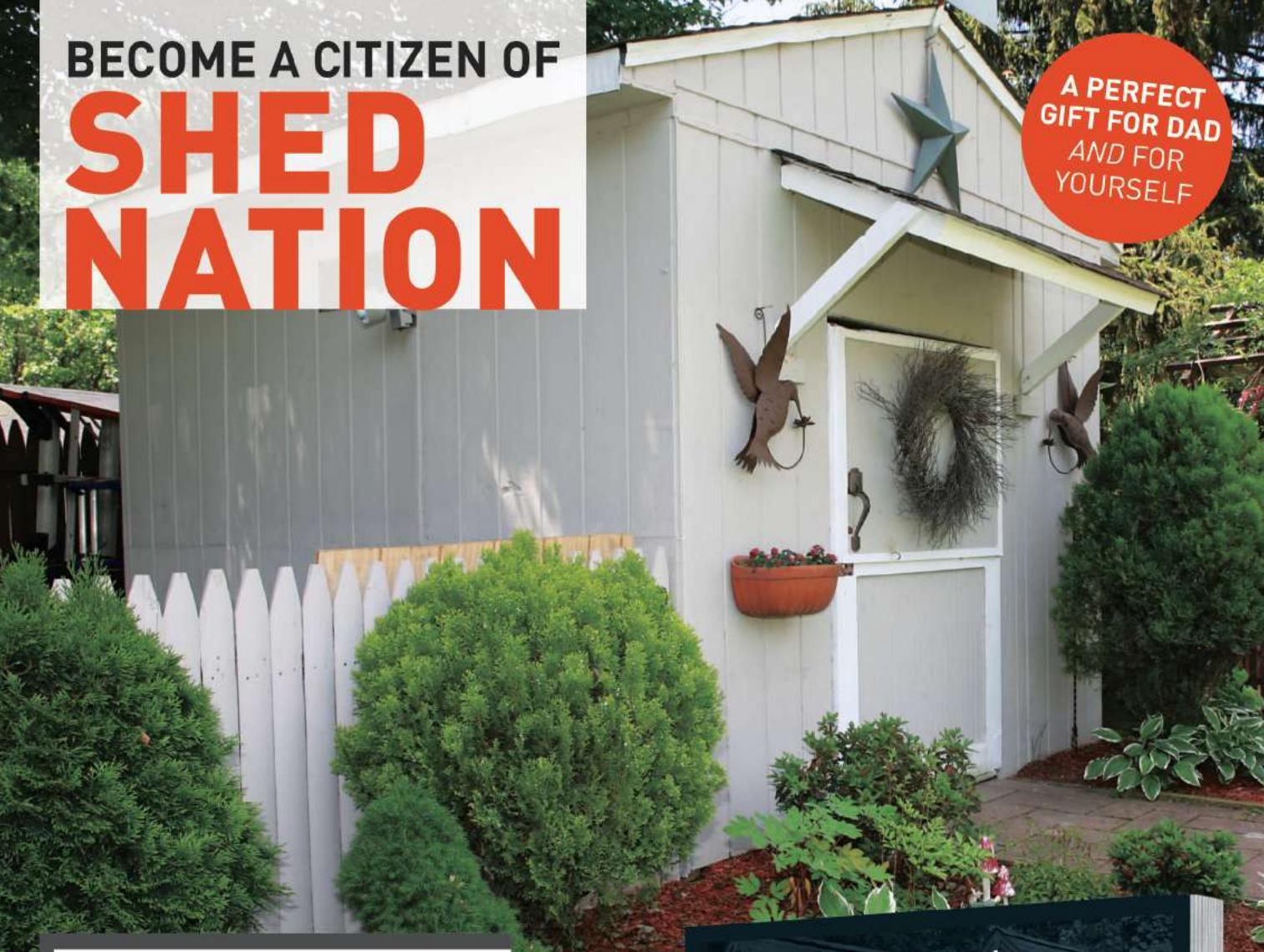


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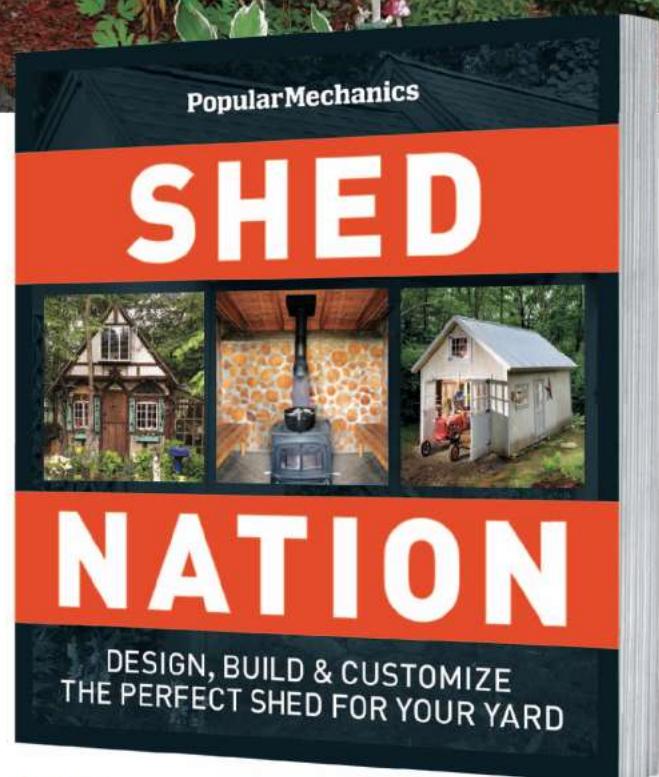
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→ No offense to the millions of Roomba robotic vacuums dutifully picking up after their slovenly human overlords, but cleaning bots are the dumbest of all domestic servants. For all their advanced sensors and algorithms, they still bounce seemingly

randomly around a room, banging into furniture in an exercise in state-of-the-art inefficiency. The **Evolution Robotics Mint (\$250)** hopes to live up to our dreams for automated butlers. To aid in indoor navigation, a wireless beacon (placed anywhere in

the room) casts an infrared spotlight on the ceiling, which the bot uses as a reference point as it maps out a tidy grid across the floor. And the bot is whisper quiet: It swaps out a Roomba's whirling vacuum for simple wet or dry Swiffer pads.

—ERIK SOFGE





Mowing the Middle Ground

→ The **Husqvarna WeedEater One (\$700)** is a riding mower with a compact footprint—you can bring it home from the store in the back of an SUV.

The single-blade mower, powered by a low-emissions Briggs & Stratton engine, tames those fields of green large enough to strain one's patience with a push mower, yet too small to justify the expense of a multiblade, sit-down monster.



Video Star

→ Digital SLR cameras are the kings of quality in the photo world. Their big sensors, interchangeable lenses and flexible settings create still images that no

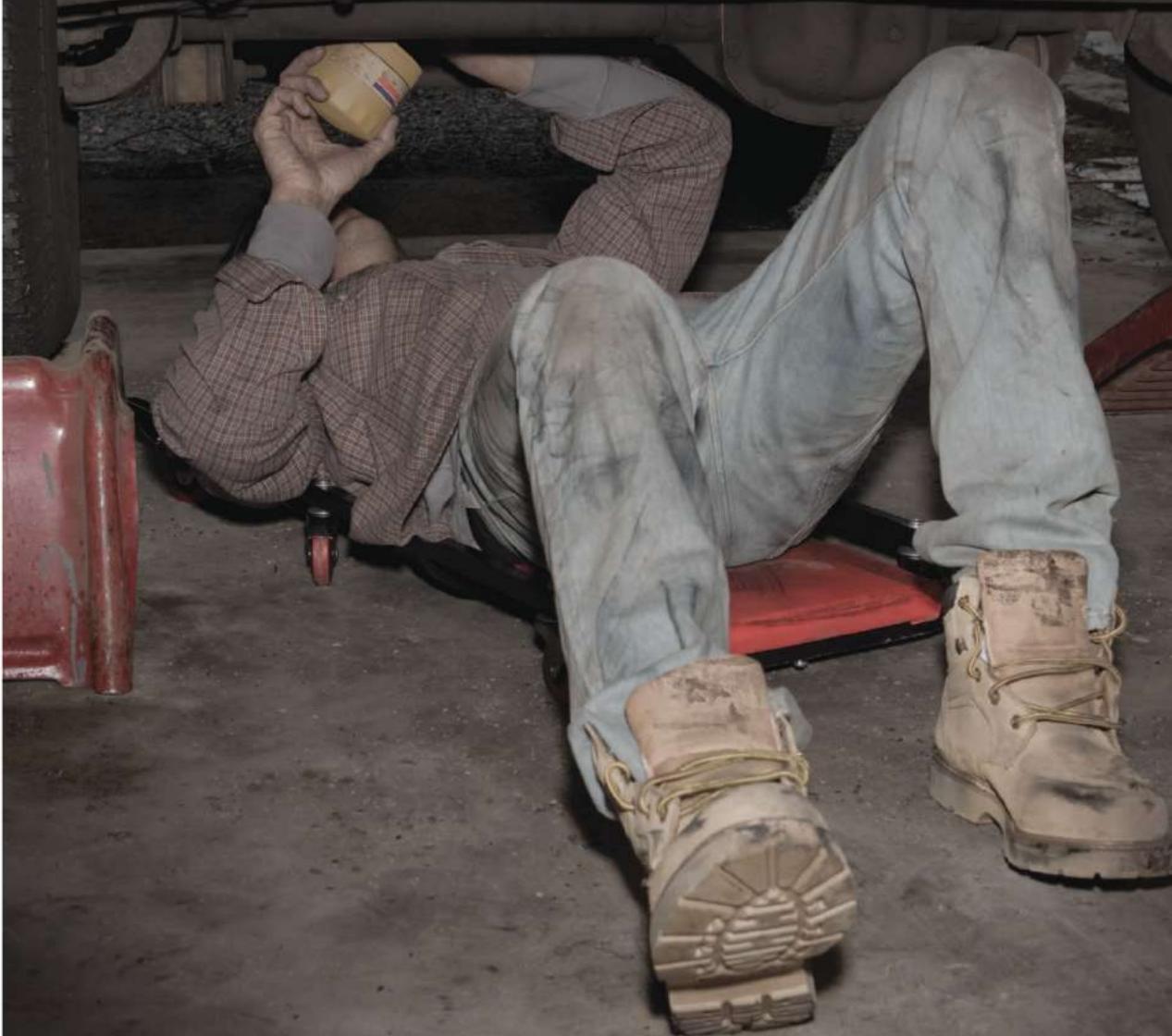
pocket point-and-shoot can match, but when it comes to shooting video, SLR cameras never seem to reach their potential. The 18-megapixel **Canon EOS Rebel T2i (\$900 for body and lens kit)**, however, is one of the first SLRs that shoot movies in 1080p hi-def and allow users to fiddle with exposure settings. Now photographers can put as much care into video as they do still shots.

TV, Set Free

→ Television streaming to mobile devices has had a tricky technological history. Services offered by cellular providers tend to be expensive and serve up a limited supply of choppy video feeds. The **Valups Wi-Fi Mobile DTV Receiver (\$100)** provides a brilliantly simple alternative: The

battery-powered device uses an antenna to pick up free, over-the-air digital TV channels, then rebroadcasts them to your laptop or phone over a dedicated Wi-Fi network—no cords, no subscription fees.





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Compact Cycle

→ Creating the perfect folding bike has proved a persistent engineering challenge (patents date back to the 1800s). The problems: Most folding mechanisms add a lot of weight, are difficult to use and take a long time to fold and unfold. The eight-speed Giant Clip (\$1025) doesn't quite perfect the concept (at 25 pounds, the rig is a bit on the heavy side), but it's pretty close. The folding process takes about 20 seconds and, once folded, the whole thing sits upright on the kickstand, making it easy to park or stash. Yes, it's pricey, but for commuters who place a premium on portability, it rocks.

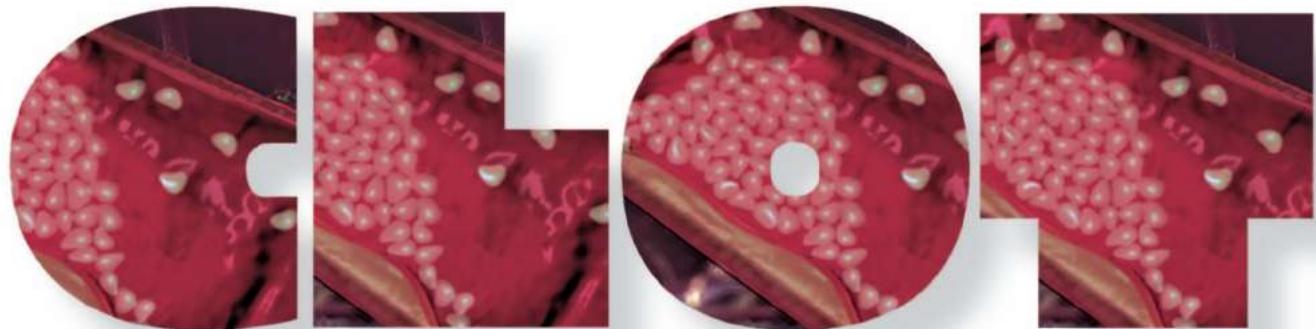
Media Monolith

→ The guts of the *Sony NX800 Series HDTVs (starting at \$2300 for 46-inch model)* cover all the bleeding-edge bases: blur-free 240-Hz, LED backlighting, built-in Wi-Fi. But honestly, we're more impressed by the way this thing looks when parked in its optional metallic base dock: like a single slab of black marble. TV has never looked so good.



Tiny Pliers

→ Serrated, concave jaws allow the 6.5-inch *Channellock 412 Pliers (\$13)* to perfectly grip ½-inch pipe, ¾-inch PVC tubing, bolts, pins and other small, round stock—with a stature slight enough to fit into tight spaces.



You can help protect against the formation of clots and reduce your risk of a future heart attack or stroke.

This is important information if you've been hospitalized with heart-related chest pain or had a heart attack. That's because these conditions, known as Acute Coronary Syndrome—or ACS—are usually caused when blood platelets stick together and form clots that block blood flow to your heart. And if you've already had a clot, you're at an increased risk for a future heart attack or stroke.

PLAVIX, taken with other heart medicines, helps provide greater protection against heart attack or stroke than other heart medicines alone.

That's because prescription PLAVIX works differently than your cholesterol and blood pressure medications, focusing on your blood platelets to help keep them from sticking together and forming clots.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.



Important Safety Information: People with stomach ulcers or other conditions that cause bleeding should not use PLAVIX. Taking PLAVIX alone or with some other medicines, including aspirin, may increase bleeding risk, so tell your doctor when planning surgery. Certain genetic factors and some medicines, such as Prilosec, may affect how PLAVIX works. Tell your doctor all the medicines you take, including aspirin, especially if you've had a stroke. If fever, unexplained weakness or confusion develops, tell your doctor promptly. These may be signs of TTP, a rare but potentially life-threatening condition, reported sometimes less than 2 weeks after starting PLAVIX. Other rare but serious side effects may occur.

See important product information on the following page.

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Rx Only

WHO IS PLAVIX FOR?

PLAVIX® (clopidogrel bisulfate) is a prescription-only medicine that helps keep blood platelets from sticking together and forming clots.

PLAVIX is for patients who have:

- had a recent heart attack.
- had a recent stroke.
- poor circulation in their legs (Peripheral Artery Disease).

PLAVIX in combination with aspirin is for patients hospitalized with:

- heart-related chest pain (unstable angina).
- heart attack.

Doctors may refer to these conditions as ACS (Acute Coronary Syndrome).

Clots can become dangerous when they form inside your arteries. These clots form when blood platelets stick together, forming a blockage within your arteries, restricting blood flow to your heart or brain, causing a heart attack or stroke.

WHO SHOULD NOT TAKE PLAVIX?

You should NOT take PLAVIX if you:

- are allergic to clopidogrel (the active ingredient in PLAVIX).
- have a stomach ulcer.
- have another condition that causes bleeding.
- are pregnant or may become pregnant.
- are breast feeding.
- have certain genetic factors.

WHAT SHOULD I TELL MY DOCTOR BEFORE TAKING PLAVIX?

Before taking PLAVIX, tell your doctor if you're pregnant or are breast feeding, if you are taking any other drugs or if you have any of the following:

- gastrointestinal ulcer
- stomach ulcer(s)
- liver problems
- kidney problems
- a history of bleeding conditions

WHAT IMPORTANT INFORMATION SHOULD I KNOW ABOUT PLAVIX?

Genetics: People with a specific genetic makeup may get less protection against heart attack or stroke with PLAVIX.

Drug interactions: Some medicines, such as Prilosec, may affect how PLAVIX works. Tell your doctor all the medications you are taking, including prescription or over-the-counter medications. You should tell your doctor about any other medications you are taking, including prescription or over-the-counter Prilosec (omeprazole). Taking Prilosec with PLAVIX may reduce the effect of PLAVIX. Antacids and most H₂ blockers, except Tagamet (cimetidine), are not known to interfere with how PLAVIX works.

TTP: A very serious blood condition called TTP (Thrombotic Thrombocytopenic Purpura) has been rarely reported in people taking PLAVIX. TTP is a potentially life-threatening condition that involves low blood platelet and red blood cell levels, and requires urgent referral to a specialist for prompt treatment once a diagnosis is suspected. Warning signs of TTP may include fever, unexplained confusion or weakness (due to a low blood count, what doctors call anemia). To make an accurate diagnosis, your doctor will need to order blood tests. TTP has been reported rarely, sometimes in less than 2 weeks after starting therapy.

Gastrointestinal Bleeding: There is a potential risk of gastrointestinal (stomach and intestine) bleeding when taking PLAVIX. PLAVIX should be used with caution in patients who have lesions that may bleed (such as ulcers), along with patients who take drugs that cause such lesions.

Bleeding: You may bleed more easily and it may take you longer than usual to stop bleeding when you take PLAVIX alone or in combination with aspirin. Report any unusual bleeding to your doctor.

Geriatrics: When taking aspirin with PLAVIX the risk of serious bleeding increases with age in patients 65 and over.

Stroke Patients: If you have had a recent TIA (also known as a mini-stroke) or stroke taking aspirin with PLAVIX has not been shown to be more effective than taking PLAVIX alone, but taking aspirin with PLAVIX has been shown to increase the risk of bleeding compared to taking PLAVIX alone.

Surgery: Inform doctors and dentists well in advance of any surgery that you are taking PLAVIX so they can help you decide whether or not to discontinue your PLAVIX treatment prior to surgery.

WHAT SHOULD I KNOW ABOUT TAKING OTHER MEDICINES WITH PLAVIX?

You should only take aspirin with PLAVIX when directed to do so by your doctor. Certain other medicines should not be taken with PLAVIX. Be sure to tell your doctor about all of your current medications (prescription or over-the-counter), especially if you are taking the following:

- aspirin
- nonsteroidal anti-inflammatory drugs (NSAIDs)
- warfarin
- heparin
- heartburn or stomach ulcer medicines, like Prilosec

Be sure to tell your doctor if you are taking PLAVIX before starting any new medication.

WHAT ARE THE COMMON SIDE EFFECTS OF PLAVIX?

The most common side effects of PLAVIX include gastrointestinal events (bleeding, abdominal pain, indigestion, diarrhea, and nausea) and rash. This is not a complete list of side effects associated with PLAVIX. Ask your doctor or pharmacist for a complete list.

HOW SHOULD I TAKE PLAVIX?

Only take PLAVIX exactly as prescribed by your doctor. Do not change your dose or stop taking PLAVIX without talking to your doctor first.

PLAVIX should be taken around the same time every day, and it can be taken with or without food. If you miss a day, do not double up on your medication. Just continue your usual dose. If you have any questions about taking your medications, please consult your doctor.

OVERDOSAGE

As with any prescription medicine, it is possible to overdose on PLAVIX. If you think you may have overdosed, immediately call your doctor or Poison Control Center, or go to the nearest emergency room.

FOR MORE INFORMATION

For more information on PLAVIX, call 1-800-633-1610 or visit www.PLAVIX.com. Neither of these resources, nor the information contained here, can take the place of talking to your doctor. Only your doctor knows the specifics of your condition and how PLAVIX fits into your overall therapy. It is therefore important to maintain an ongoing dialogue with your doctor concerning your condition and your treatment.

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Truly Unique



Time travel at the speed of a 1935 Speedster?

The 1930s brought unprecedented innovation in machine-age technology and materials. Industrial designers from the auto industry translated the principles of aerodynamics and streamlining into everyday objects like radios and toasters. It was also a decade when an unequaled variety of watch cases and movements came into being. In lieu of hands to tell time, one such complication, called a jumping mechanism, utilized numerals on a disc viewed through a window. With its striking resemblance to the dashboard gauges and radio dials of the decade, the jump hour watch was indeed "in tune" with the times!

The Stauer 1930s Dashtronic deftly blends the modern functionality of a 21-jewel automatic movement and 3-ATM water resistance with the distinctive, retro look of a jumping display (not



True to Machine Art esthetics, the sleek brushed stainless steel case is clear on the back, allowing a peek at the inner workings.

an actual jumping complication). The stainless steel 1 1/2" case is complemented with a black alligator-embossed leather band. The band is 9 1/2" long and will fit a 7-8 1/2" diameter wrist.

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for a full refund of the purchase price. If you have an appreciation for classic design with precision accuracy, the 1930s Dashtronic Watch is built for you. This watch is a limited edition, so please act quickly. Our last two limited edition watches are totally sold out!

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2010

TOOLS of SUMMER

Upgrade your home and workshop with PM's summer gift guide for dads, grads—and other guys too.

BY SETH PORGES & HARRY SAWYERS



TIP

PACK THE CHARCOAL AS TIGHTLY AS YOU CAN ON ONE SIDE OF THE GRILL. THIS MINIMIZES AIRFLOW, WHICH KEEPS THE COALS BURNING LONGER AND PROVIDES GRATE SPACE FOR BOTH DIRECT AND INDIRECT HEAT.

Weber One-Touch Platinum Grill (\$300) → How to improve on a classic? Add a second side table that brings the total work space on this charcoal kettle grill to more than 300 square inches.

Ryobi TEK4 Professional Infrared Thermometer (\$70) → This point-and-shoot infrared thermometer instantly measures grill and oven temperatures up to 590 F.



Sony Cyber-shot TX5 Camera (\$350) → If you want to document your creation as it comes to life in a dust-filled workshop, ruggedized cameras are must-haves, but their durability usually comes at the expense of portability. This 10-megapixel, 4x zooming shooter is dustproof, drop-proof (up to 5 feet) and waterproof—but still measures less than $\frac{3}{4}$ inch thick.

Rockwell Jawhorse with Plywood Jaw Attachment (\$200 for Jawhorse, \$60 for attachment) → The Jawhorse, popular as a stable, vise-equipped work surface, has a hard time gripping big panels for work with a paintbrush or a circular saw. New jaws designed to wrangle 4 x 8-foot sheets can manage drywall, MDF, OSB, particleboard and, yes, plywood. Hold the work steady and stop making crooked cuts.



TIP DON'T HAVE A WATERPROOF CAMERA? WHEN DIVING WITH AN UNDERWATER CAMERA HOUSING, STASH A PACKET OF SILICA GEL WITH YOUR SHOOTER—it'll SUCK UP STRAY MOISTURE AND LENS-FOGGING CONDENSATION.



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But he cleans up
after himself.**



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Sonos ZonePlayer S5 (\$400) → The Sonos wireless sound system beams songs around your house, but a typical setup costs more than a grand. This five-driver speaker, which wirelessly pulls and plays computer-stashed songs, is the cheapest and easiest way to use the system. And for existing Sonos users, the S5 lets you seamlessly extend the system to extra rooms.



Stanley FatMax AntiVibe Carpenter's Hatchet (\$28) → This carpenter-friendly combo has a wood-splitting hatchet on one side and a hammer on the other.



Ridgid JobMax Tool Set (starts at \$200) → Like a five-headed power-tool hydra, this 12-volt system's single handle can accept interchangeable attachments. Switch between a socket wrench, a right-angle drill, an impact driver, an oscillating tool and an automatic hammer.

Sportcraft Soft Tip Sky Darts (\$20) → Because of their tendency to get lodged in more than just the ground, lawn darts have been banned since 1988. This tamer version of the classic (if occasionally dangerous) toy uses a blunt weighted tip that ensures the darts stay upright once they hit the grass.



**Lee Valley
Wenzloff
Crosscut Panel
Saw (\$225)**

→ No, this saw isn't cheap, but its classic design, hand-sharpened spring-steel blade, bubinga wood handle and taper-ground precision make it the perfect pegboard centerpiece.

TIP FOR A PERFECT CROSSCUT, LOOK AT THE SAW: IF THE VISIBLE REFLECTION SHOWS A STRAIGHT CONTINUATION OF THE CORNER YOU'RE ABOUT TO CUT, IT IS SQUARE. IF THE REFLECTION VEERS OFF TO EITHER SIDE, ADJUST ACCORDINGLY.

Cooper Lighting Might D Light Worklight (\$50)

→ Because this battery-powered worklight's 80 super-bright LEDs are split between two sandwiching panels, users can illuminate work surfaces from two angles, reducing shadows and glare. And the LEDs' low operating temperature makes the rig safe to use in close quarters.

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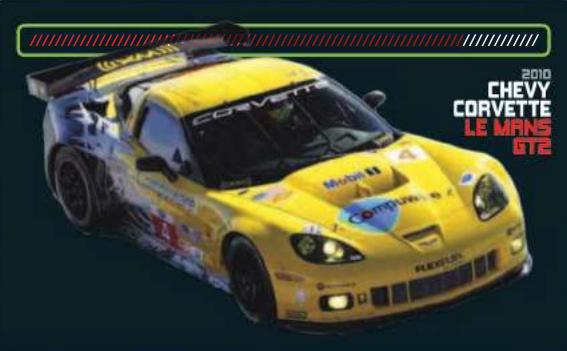
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New Cars



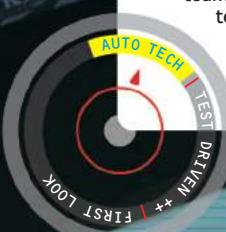
CHEVY'S NEW Z06 CARBON STREET CAR COMBINES THE HOWLING Z06 505-HP V8 WITH THE ZR1 CHASSIS.



Dogfight

The 78th running of the 24 Hours of Le Mans, which starts on June 12, will be the Corvette racing squad's toughest challenge to date. After years of dominating the lightly contested GT1 class, the Vette team moves into the fiercely fought GT2 category, where it will battle factory teams from Ferrari, Porsche and BMW. To prepare, there's an all-new racer based on the Z06 production car. Although most parts have been modified or changed—for instance, custom-made single-lug wheel nuts will speed pit stops—the aluminum frame remains, and 85 percent of the body geometry carries over. The racer's 5.5-liter V8 uses the production block and 16 pushrod-activated valves. There's even air conditioning, although the race car uses the Volt's electric compressor to save fuel. The team is tight-lipped on details—no sense tipping off the other teams—but it did reveal that the engine makes 485 hp.

Plus it returns 4.1 mpg burning E85, an astonishing figure considering the car nears 200 mph around the 8.5-mile circuit. —LARRY WEBSTER





1

2010

Mitsubishi Outlander GT

↑

Hard-Charging Sport Ute

"Sporty SUV" is a bit of an oxymoron, but Mitsubishi's Outlander GT defies expectations. This model employs Mitsu's S-AWC system, which distributes torque between the front tires and the rear axle. The system affects not just traction but also handling. A rotary knob switches between tarmac and snow settings. On New Hampshire roads the GT cuts a precise line, feeling surprisingly frisky for a seven-passenger wagon. Squeeze the gas while exiting a corner and it overdrives the outside wheel, increasing the turn rate like a kayaker paddling harder on one side. Other sporty bits include shifter paddles that manually operate the six-speed automatic gearbox, and a new, eye-catching schnoz. With a 230-hp 3.0-liter V6, acceleration is brisk. Even better, the GT has a lock setting that holds 4WD for the muddy bits. All this—and a rare fold-down tailgate—costs \$29,250. —L.W.

↑

EASY, BREEZY, BEAUTIFUL

It's a cool, sunny morning on the Spanish island of Majorca. The Benz E550 Cabriolet's burbling tailpipes are rather loud—a hint at what's in store. Ameri-

cans can order either this thunderous 5.5-liter V8 (391 lb-ft and 382 hp) or a 3.5-liter V6. Either one complements this elegant droptop. The AirCap—an electronically actuated lip atop the windshield—lifts,

reducing cabin turbulence, and the AirScarf headrest vents blow warm air on my neck. Only rain could force me to raise the roof.

—JAMES TATE



3

Big Cat Fever

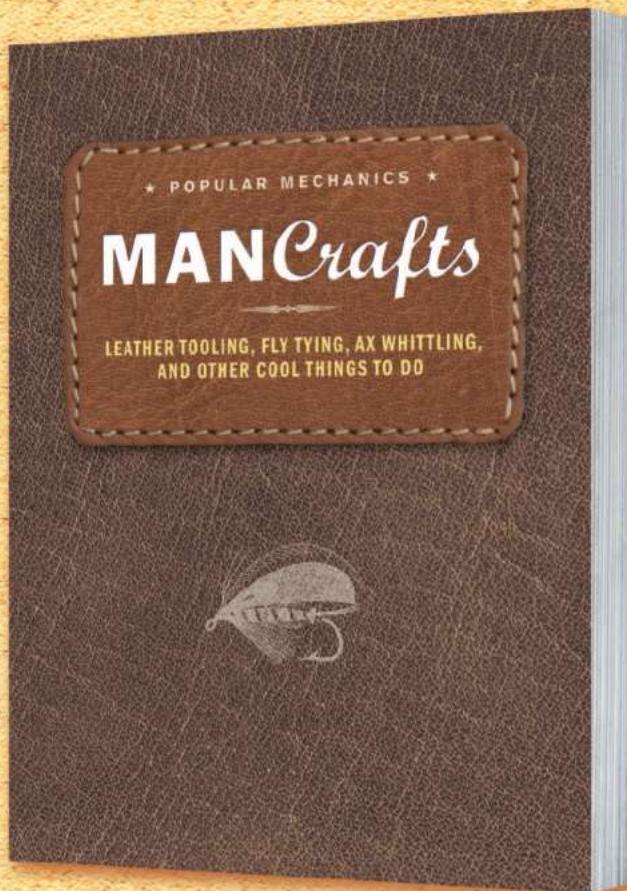
The new XJ's roofline forms an elegant coupe-like profile with a long rear window. Some bits—the six-speed gearbox and independent suspension—are borrowed from the XF, while the aluminum structure and engine—a 5.0-liter V8 with 385 hp (\$72,500) or supercharged to either 470 hp or 510—are carried over. The quickest model hustles to 60 mph in 4.7 seconds with an agile mien. It's a private world well worth entering. —ANDREW ENGLISH

↓
++ PM TEST DRIVEN
COMPARISON

MITSUBISHI OUTLANDER GT + MERCEDES-BENZ E-CLASS CABRIOLET + JAGUAR XJ +
FORD MUSTANG: V6 VS GT 5.0 +
VW TOUAREG HYBRID + MV AGUSTA BRUTALE 1090RR + FORD F-SERIES SUPER DUTY +
FERRARI 599 GTB HYBRID CONCEPT

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Comparison

Mustang Sallies

IN THE FACE OF INCREASED COMPETITION, FORD REVITALIZES THE ORIGINAL PONYCAR WITH TWO ALL-NEW ENGINES: A FAST-YET-FRUGAL V6 AND A GNARLY, SNARLING, NOSTALGICALLY NAMED V8. *BY GREGORY ANDERSON*



++ vs

Mustang V6

\$22,995
305 hp/280 lb-ft, 3.7-liter V6, 6M
5.52
13.34
13.91 @ 102.05 mph
27.44
19/29

Mustang GT 5.0

\$30,495
412 hp/390 lb-ft, 5.0-liter V8, 6M
4.91
10.70
13.03 @ 109.91 mph
29.13
17/26

the SPECS

"I'm most proud of our V6," says Dave Pericak, Mustang's chief engineer. "It's the first car ever to get over 300 horsepower and over 30 miles per gallon," he brags, although that's only with the optional six-speed automatic. Still, the V6 is impressive—305 hp, 280 lb-ft and up to 31 mpg highway—thanks in part to variable valve timing. Not too shabby for a \$22,995 base model. Step up to the GT, and the big news is the new aluminum 5.0-liter V8. This flexible engine—it redlines at 7000 rpm—bumps power from last year's 315 to a very respectable 412. The manual gearboxes now sport a sixth ratio, and Pericak claims the new six-speed automatic matches the straight-line performance of the manual. The chassis on both cars benefited from a thorough makeover, including electrically assisted power steering. Interior goodies include a navigation system and backup camera.

the DRIVE

Equipped with the wonderfully precise short-throw manual shifter, the V8 scoots from 0 to 60 mph in 4.9 seconds, and the V6 does it in 5.5. Both easily run the quarter-mile in the 13-second range. That's respectably quick, but the V8 feels considerably faster thanks to a plastic tube that routes the V8's husky wail directly to the cabin. It's a gratifying sensation when the V8 reaches its peak of 390 lb-ft of torque at 4250 rpm.

Drop into sixth gear at 60 mph, however, and the GT lopes along quietly at 1800 rpm, as wind noise and whispers easily drown out the exhaust. Happily, engine noise is just a downshift away.

Standard V6 models are on the soft side, but the optional Performance Package stiffens the suspension. So equipped, the V6 matches the GT's precise handling and firmly damped ride.

BOTTOM LINE

Both cars are impressively well-rounded daily drivers with swanky, attractive interiors and gobs of performance at a decent price. The V6 model is no longer a secretary's special, although it's hard to take it seriously after driving the thumping V8. If you want decent mileage, buy a Focus. Life begins at 5.0.



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PM TEST DRIVEN

COMPARISON

FIRST LOOK

MITSUBISHI OUTLANDER GT +

FORD MUSTANGS: V6 VS GT 5.0 +

VW TOUAREG HYBRID +

MV AGUSTA BRUTALE 1090RR +

FERRARI 599 GTB HYBRID CONCEPT

MERCDES-BENZ E-CLASS CABRIOLET +

JAGUAR XJ +

1020RR +

FORD F-SERIES SUPER DUTY +

SNUS

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**WE all
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THE SAME
THEN SOME OF US GET
MORE INTERESTING**

**WARNING: This product can cause
gum disease and tooth loss.**

Electrifying SUV

VW's first production hybrid powertrain debuts in the new Touareg with an electric motor sandwiched between the engine and the transmission. A clutch decouples the supercharged 3.0-liter 333-hp V6 and the 46-hp electric motor. So with the 1.7-kilowatt-hour NiMH battery pack, this SUV can motor electrically for about a mile at up to 30 mph. VW says fuel economy increases by 25 percent and might touch 30 on the EPA highway cycle. The two power sources coordinate seamlessly—there's barely a shudder when the engine kicks in. It performs too—sprints to 60 mph take about 6.5 seconds—and tows 7700 pounds, just like a pickup truck. The only downside: a base price that's likely to be in the 50s. —MIKE ALLEN



**2011
VW Touareg
Hybrid**

MIKE ALLEN
PM Automotive Editor



**2010
MV
Agusta Brutale
1090RR**

STREET FIGHTER

The MV Agusta Brutale 1090RR is every bit a stylish, charismatic charmer. But unlike other exclusive bikes, this one operates without annoying idiosyncrasies. Crack open the throttle and the fuel-injected, 144-hp four-cylinder pulls like a Saturn rocket—even at 20 mph in sixth gear. The shifter smoothly notches gear changes, and a slipper mechanism in the clutch reduces wheel chatter. This bike turns a 90-minute NYC commute into a blow-out-the-cobwebs adventure.

Listening to the wailing engine note bouncing off the Lincoln Tunnel borders on a religious experience. The attention to detail further sets this bike apart, with flawless welds and excellent ergonomics. The former alone make the estimated \$18,000 price seem reasonable.

—M.A.



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P M N E W C A R S

Diesel Does It

Fuel economy was Ford's top concern when designing the 2011 Ford F-Series Super Duty's new Power Stroke diesel, which gets 390 hp, 735 lb-ft of torque—and 24.5 mpg, according to the onboard computer. (Ford engineers claim between 23.5 and 26 mpg in testing.) Despite its bigger size, a new 6.2-liter V8 (385 hp and 405 lb-ft of torque) combines with a new six-speed automatic to get 15 percent better fuel economy than the old 5.4-liter engine. The diesel Super Duty can tow up to 24,400 pounds with a fifth-wheel trailer that connects to the bed above the rear axle—the first factory-installed fifth-wheel and gooseneck substructure attached directly to a frame. Moreover, the truck now has Hill Descent control, which allows you to set a speed and let the computer handle steep grades with minimal stress. Rolling downhill with a 10,000-pound trailer and letting the system do its work feels like a trust fall, but on a 3-mile descent, I become a believer. The base XL is \$28,020, while the King Ranch version costs more than 60 grand. —DAVID KILEY

first look



Ferrari
599 GTB Hybrid
Concept

FERRARI GOES HYBRID

Even Ferrari must lower fuel use. And so we have this 620-hp, 206-mph prototype sports car with a hybrid system that boosts in-town fuel mileage by nearly 50 percent. Ferrari's solution is clever: The 100-hp electric motor bolts to the rear of the dual-clutch seven-speed

transmission, and the li-ion battery pack hides under the floor. The system adds 176 pounds, but it's capable of low-speed EV propulsion. A crankshaft clutch keeps the auxiliary systems functioning when the engine is off. All Ferraris will soon have this system. —BARRY WINFIELD

- FIRST LOOK** **1** 2011 Ford F-Series Super Duty
- TEST DRIVEN** **2** **2** Ferrari 599 GTB Hybrid Concept
- COMPARISON** **3** Mitsubishi Outlander GT +
- VS** Ford Mustang: V6 vs. GT 5.0 +
- VS** VW Touareg Hybrid +
- VS** MV Agusta Brutale 1000RR +
- VS** Ford F-Series Super Duty +
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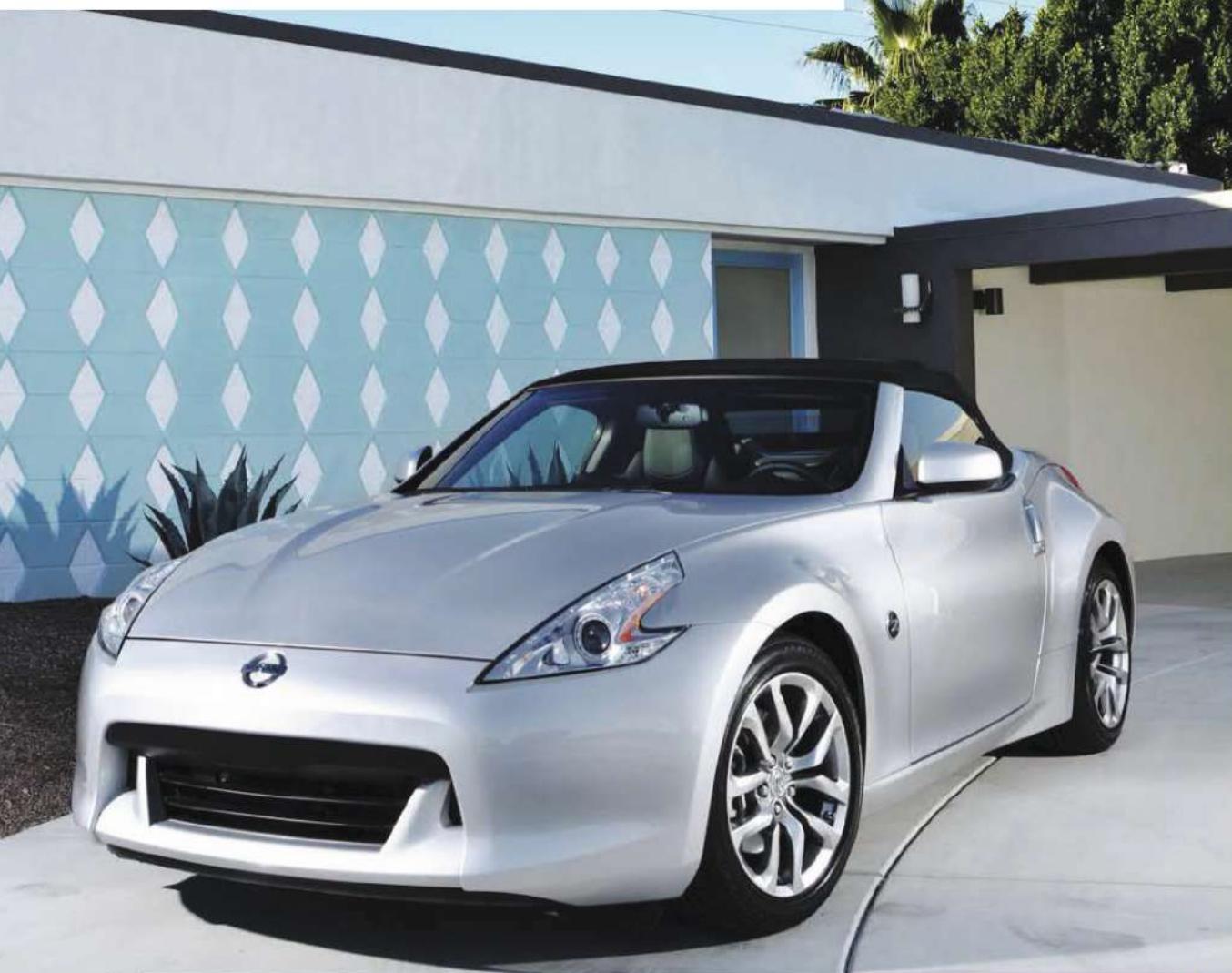
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Long-Term Test Cars

NISSAN'S NEW ROADSTER ENERGIZES THE FLEET,
AND THE DODGE RAM MAKES AN UNPOPULAR EXIT.



+ Nissan 370Z Roadster

FIRST REPORT

With three practical rides in the fleet, we decided to inject a little levity into the lineup by welcoming Nissan's carefree new 370Z Roadster. Packing a silky 332-hp V6, a quick-acting power top and moves that encourage spirited driving, it's the perfect sum-

mer fling. Since we frequently fight L.A. and N.Y. traffic, we ordered the seamless seven-speed automatic. With glorious paddle shifters that flank the steering wheel, we haven't missed the manual yet. Our Roadster is equipped with nearly Infiniti-level

luxury including heated and cooled seats, a brilliant hard-drive-based navigation system with a 7-inch screen, and a fat leather steering wheel. The Z's interior quality has really impressed us. There's not only a generous pad for the driver's knee and a

VITAL STATISTICS Base price \$42,540 : As-tested price \$44,505 : Extra-cost options Navigation system with 9.3 GB hard drive, USB port, Bluetooth streaming audio, floor mats : Drivetrain 3.7-liter V6, 7A, RWD : Engine performance 332 hp, 270 lb-ft of torque : EPA fuel economy 18 city/25 highway

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comfortable elbow perch on the door, but the top of the dash is soft-touch; the sides of the center stack are nicely trimmed with stitched leather. Okay, so we know it's comfy. How's she run? Power down the top, snick the shifter into manual mode, and hit the tarmac. The sweet snarl of Nissan's V6 is deliciously good when that top is down—and the thrust is enough to stay within a hood-length of much more expensive roadsters, like a certain black Porsche Boxster that likes to prowl Malibu's Encinal Canyon on Saturday mornings. We'll catch you next weekend, bro.

—BEN STEWART



The 370Z's dash-mounted gauges are easy to read quickly—thanks to those little awnings—and hark back to the original 1970 Datsun 240Z.



Honda Insight EX Navi

SECOND report

If the goal of a hybrid car is economical driving, shouldn't a hybrid be, you know, cheap? That's the logic behind Honda's Insight, which clearly targets the Toyota Prius buyer, but at a price about \$2000 lower. Now we can say that the Insight largely delivers on its promise, easily hitting—and often beating—its EPA figures over almost 7000 reliable miles. But there are compromises needed to build a hybrid at this price: The Insight lacks the Prius's high-tech flash; it looks and feels more like a low-cost compact. Even with the 13-hp electric boost, the little 1.3-liter strains to generate much oomph. And we miss the geeky fun of nursing top mileage out of a more sophisticated hybrid system. Unlike the Prius, the Insight's pure-electric mode rarely engages, so you don't get the thrill of silently gliding past gas stations. Still, the Insight shows just how practical an everyday hybrid can be. —JIM MEIGS

DRIVERS

NOTEBOOK

- A pothole-induced blown tire and bent rim cost an unconscionable \$603 to replace at the dealer.
- Mileage data is

available, but the dash lacks visual punch when compared to Ford's Fusion and Toyota's Prius.

DATA SO FAR

As tested :	Average—40.1 mpg
\$23,800	Worst—33.8 mpg
Previous reports :	Best—47.1 mpg
See 03/10	Maintenance/
Miles driven : 6939	repair : \$603
Miles since last report : 2031	
Fuel economy :	

Average—40.1 mpg
Worst—33.8 mpg
Best—47.1 mpg
Maintenance/
repair : \$603

Audi A4 Avant 2.0T Quattro

THIRD report

The Audi A4 Avant's combination of good looks, strong performance and ample interior space makes it a perfect getaway companion. On an impromptu weekend drive from New York City to Annapolis, Md., the vehicle's smooth ride and quiet interior initially had us second-guessing its power. But, with the slightest press to the pedal, the responsive 211-hp turbo engine commanded lanes effortlessly, tackling both city stop-and-go traffic and interstates. Back home, this ride leads a double life. After working the daily grind as our go-to commuter car most of the week, the Avant's rear seats flip down flat with one instinctively easy motion, instantly increasing the cargo space of the vehicle to 50.5 cubic feet. This feature is why we love wagons,



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and the extra space comes in handy when hauling tools and equipment for Saturday Mechanic shoots. We look forward to keeping this wagon in our fleet for a few more months to come.

—ALLIE HAAKE

DRIVERS

NOTEBOOK

- The Multi Media Interface (MMI) makes for easy toggling between entertainment, HVAC and navigational controls.
 - The fluky tire-pressure warnings have not reoccurred, and the A4 has performed spotlessly.
- DATA SO FAR**
- As tested : \$43,050
Previous reports : See 11/09, 03/10
Miles driven : 18,306
Miles since last report : 8010
Fuel economy : Average—25.4 mpg
Worst—20.3 mpg
Best—31.5 mpg
Maintenance/repair : \$297

The Ram has had little time to rest.

Whether flat-towing an ice-racer to Michigan's Chippewa Lake or ferrying the kids to school, it's been an unflappable and tireless workhorse. It spent much of its time this past winter cutting through snow, and in those conditions we found that rotating the 4WD switch from "auto" to "lock" provided the most sure-footed traction. The all-season Goodyears are a little greasy when braking on wet snow, but they've provided enough stick to pull out several snowbound cars. Plus they're on track to last at least another 20,000 miles. Sure, this rig is pricey, but we're constantly amazed when we drive similarly priced luxury cars that don't have heated steering wheels or backup cameras. While maneuvering this beast in parking lots and garages is tiresome, we'll miss the vast interior room and cargo-hauling skills. —LARRY WEBSTER

DRIVERS

NOTEBOOK

- The Uconnect system has a USB port on the dash, but it's only for uploading media files. Controlling an Apple device requires an \$87 iPod interface.
- A recall fixed the Ram's only flaw: The flimsy tailgate trim that quickly fell off was replaced with a new, better-anchored piece.

END DATA

As tested : \$52,520
Previous reports : See 08/09, 11/09, 03/10
Miles driven : 14,463
Miles since last report : 2924
Fuel economy : Average—12.7 mpg
Worst—11.4 mpg
Best—15.4 mpg
Maintenance/repair since last report : \$68
Overall : \$406



PHOTOGRAPH BY MATTY BROWN

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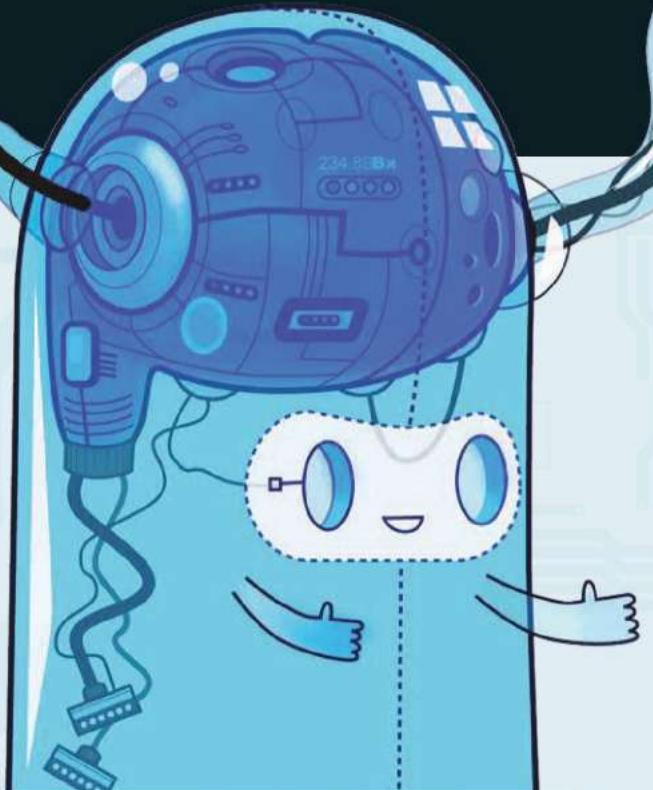


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VIRTUAL SMARTS

> BY DOUGLAS FOX
> ILLUSTRATION BY POKE D STUDIO

S

WHAT'S THE BEST WAY TO
MAKE A MACHINE'S BRAIN
SMARTER? DESIGN IT
MORE LIKE THE REAL THING.

Step into an acre-size room at Lawrence Livermore National Laboratory (LLNL) in California, and you come face to face with a giant. In the far corner, across an ocean of empty floor tiles, sits Dawn, a Blue Gene/P supercomputer—one of the fastest machines in the world. Its 147,456 processors fill 10 rows of slanted computer racks, woven together by miles of cable. Dawn's gentle name belies a voracious appetite. It devours a million watts of electricity (equal to 1000 U.S. households) through cords as thick as a bouncer's wrists, racking up an annual power bill of \$1 million. The roar of refrigeration fans fills the air: Below our feet, 6675 tons of air-conditioning hardware labor to dissipate Dawn's body heat, blowing 2.7 million cubic feet of chilled air through the room every minute.

For a few days in 2009 Dawn brought its number-crunching muscle to bear on the largest brain simulation to date—a cell-by-cell model of the human visual cortex: 1.6 billion virtual neurons connected by 9 trillion synapses. This mathematical simulation of a cerebral cortex as large as a cat's blew away the previous record—55 million neurons, the size of a rat's—achieved by the same team two years before.

"This is a Hubble Telescope of the mind, a linear accelerator of the brain," says Dharmendra Modha, the project's lead researcher and a computer scientist from IBM's

Almaden Research Center in San Jose, Calif. The simulation, assembled using neuroscience data from rats, cats, monkeys and humans, will provide a tool for testing theories about how the brain works, and the insights gained could pave the way to designing robots and computers that are truly intelligent.

In his office at Almaden, Modha flashes an image on his computer. "This is an MRI of my brain," he says. Red and blue threads show the twisting routes of thousands of nerve-axon bundles that connect different parts of his cerebral cortex.

The cortex, the wrinkly outer layer of the brain, performs most of the higher functions that make humans human, from recognizing faces and speech to choreographing the dozens of muscle contractions involved

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in a perfect tennis serve. It does this using a universal neural circuit called a microcolumn, repeated over and over. Modha hopes the simulation will help scientists understand how the cortical microcolumn performs such a wide range of tasks.

But deciphering the microcolumn can also help build better computers. By reverse engineering the cortical structure, Modha says, researchers could give machines the ability to interpret biological senses such as sight, hearing and touch. And artificial machine brains could process, intelligently, senses that don't currently exist in the natural world, such as radar and laser rangefinding. Modha envisions some day peppering the planet with sensors—transforming it into a virtual organism with the capacity to understand its own patterns of weather, climate and ocean currents.

The simulation currently lacks the neural patterning that develops as real brains mature—complexity that comes from stumbling around in a body, in which every action has consequences. As Anil Seth, a neuroscientist at the University of Sussex in England, puts it: "The brain wires itself."

Seth and his colleagues demonstrated this principle, called embodied learning, while at the Neurosciences Institute in San Diego, using a brain simulation called Darwin X. They embodied Darwin's 90,000 virtual neurons (roughly the brain of a pond snail) in a wheeled robot. As Darwin wandered around, its virtual neurons rewired their connections to produce the equivalent of hippocampal place cells, which help mammals navigate. Scientists don't know how to program such cells; with embodied learning they emerge on their own.

Paul Maglio, a cognitive scientist at Almaden, has similar plans for Modha's cortical simulation. He's building a virtual world for it to inhabit using

software from the video shootout game *Unreal Tournament* and topographic maps, aerial photos and rover-level imagery from Mars. As the simulation moves around this virtual landscape in a rudimentary rover, programmed to avoid hazards that lead to injury, it will gradually learn the basics of eye-wheel coordination—just like a baby learning to walk.



Super-Supercomputer

The National Nuclear Security Administration (NNSA), within the Department of Energy, installed Dawn at Lawrence Livermore's Terascale Simulation Facility in 2009. After Modha's team ran its brain simulation, the supercomputer was transitioned to NNSA work, conducting massive simulations to ensure the readiness of the nation's nuclear weapons arsenal. Modha's neurons are far simpler than real ones, and yet for all its computing power, Dawn ran the 1.6 billion neurons at only one six-hundred-forty-third the speed of a living brain. A second simulation, with 900 million neurons, ran a little faster—but still at one eighty-third the speed.

These massive simulations are merely steps toward Modha's ultimate goal: simulating the entire human cortex, about 25 billion neurons, at full speed. To do that, he'll need 1000 times more computing power. At the rate that supercomputers have expanded over the past 20 years, that super-supercomputer could exist by 2019. "This is not just possible," Modha says, "it's inevitable."

But it won't be easy. "Business as

usual won't get us there," says Michael McCoy, head of advanced simulation and computing at LLNL. Development of supercomputers in recent decades has ridden the wave of Moore's law: Transistors have shrunk and the computing power of processor chips has doubled every 18 months. But that ride is coming to an end. Transistors are now packed so densely on chips that the heat they generate can no longer be dissipated. To reduce heat, Dawn uses larger 180-nanometer transistors that were developed 10 years ago—rather than the 45-nanometer transistors used in desktop computers today. And for the same reason, Dawn runs these transistors at a sluggish 850 megahertz—one-third the speed of today's desktop computers.

The supercomputer that Modha needs to simulate a whole cortex would also consume prohibitive amounts of power. "If you scale up current technology, this system might require between 100 megawatts and a gigawatt of power," says Horst Simon, a project collaborator at nearby Lawrence Berkeley National Laboratory. One gigawatt (1 billion watts) is the amount of power that the mad scientist Emmett "Doc" Brown needed to operate his DeLorean time machine in the 1985 movie *Back to the Future*. Simon puts it more bluntly: "It would be a nuclear power plant," he says. The electricity alone would cost \$1 billion per year.

The human brain, by comparison, functions on just 20 watts. Although supercomputer simulations are power hungry, Modha hopes the insights they provide will eventually pave the way to more elegant technology. With DARPA funding, he's working with a far-flung team at five universities and four IBM labs to create a new computer chip that can mimic the cortex using far less power than a computer. "I'll have it ready for you within the next decade," he says. **PM**

**"I used to think it was
just a phase, until I had 'the talk'
with my doctor."**

Your Doctor Talks to Men About ED Every Day

Actually, erectile dysfunction (ED) is more than just a phase. It's a common medical condition affecting millions of men just like you. But your doctor can help.



Keys to Opening Up to Your Doctor

The hardest part about having 'the talk' is getting those first few words out. Here are some ideas to help you break the ice when your doctor asks how everything's going:

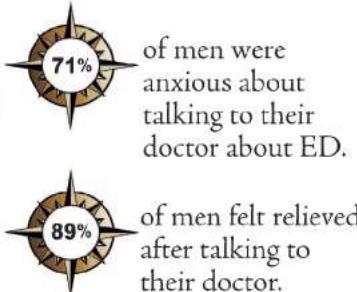
The Direct Approach:
"I have trouble sometimes in bed. Could it be ED?"

The Indirect Approach:
"Is it true age affects sexual performance?"

The Silent Approach:
Just hand this ad to your doctor, he'll take it from there.

Running the Numbers

Did you know half of all guys over 40 have some form of ED? Here are some numbers to keep in mind from a recent survey of men with ED:



Tell Me More

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Important Safety Information

We know that no medicine is for everyone. Don't take VIAGRA if you take nitrates, often prescribed for chest pain, as this may cause a sudden unsafe drop in blood pressure.

Talk with your doctor first. Make sure your heart is healthy enough to have sex. If you have chest pain, nausea, or other discomforts during sex, seek medical help right away.

In the rare event of an erection lasting more than four hours, seek immediate medical help to avoid long-term injury.

In rare instances, men who take PDE5 inhibitors (oral erectile dysfunction medicines, including VIAGRA) reported a sudden decrease or loss of vision, or sudden decrease or loss of hearing. It is not possible to determine whether these events are related directly to these medicines or to other factors. If you experience any of these symptoms, stop taking PDE5 inhibitors, including VIAGRA, and call a doctor right away.

The most common side effects of VIAGRA are headache, facial flushing, and upset stomach. Less common are bluish or blurred vision, or being sensitive to light. These may occur for a brief time.

VIAGRA does not protect against sexually transmitted diseases including HIV.

Please see Important Facts for VIAGRA on the following page or visit viagra.com for full prescribing information.

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IMPORTANT SAFETY INFORMATION ABOUT VIAGRA

Never take VIAGRA if you take any medicines with nitrates. This includes nitroglycerin. Your blood pressure could drop quickly. It could fall to an unsafe or life-threatening level.

ABOUT ERECTILE DYSFUNCTION (ED)

Erectile dysfunction means a man cannot get or keep an erection. Health problems, injury, or side effects of drugs may cause ED. The cause may not be known.

ABOUT VIAGRA

VIAGRA is used to treat ED in men. When you want to have sex, VIAGRA can help you get and keep an erection when you are sexually excited. You cannot get an erection just by taking the pill. Only your doctor can prescribe VIAGRA.

VIAGRA does not cure ED.

VIAGRA does not protect you or your partner from STDs (sexually transmitted diseases) or HIV. You will need to use a condom.

VIAGRA is not a hormone or an aphrodisiac.

WHO IS VIAGRA FOR?

Who should take VIAGRA?

Men who have ED and whose heart is healthy enough for sex.

Who should NOT take VIAGRA?

- If you ever take medicines with nitrates:
 - Medicines that treat chest pain (angina), such as nitroglycerin or isosorbide mononitrate or dinitrate
- If you use some street drugs, such as "poppers" (amyl nitrate or nitrite)
- If you are allergic to anything in the VIAGRA tablet

BEFORE YOU START VIAGRA

Tell your doctor if you have or ever had:

- Heart attack, abnormal heartbeats, or stroke
- Heart problems, such as heart failure, chest pain, or aortic valve narrowing
- Low or high blood pressure
- Severe vision loss
- An eye condition called retinitis pigmentosa
- Kidney or liver problems
- Blood problems, such as sickle cell anemia or leukemia
- A deformed penis, Peyronie's disease, or an erection that lasted more than 4 hours
- Stomach ulcers or any kind of bleeding problems

Tell your doctor about all your medicines. Include over-the-counter medicines, vitamins, and herbal products. Tell your doctor if you take or use:

- Medicines called alpha-blockers to treat high blood pressure or prostate problems. Your blood pressure could suddenly get too low. You could get dizzy or faint. Your doctor may start you on a lower dose of VIAGRA.
- Medicines called protease inhibitors for HIV. Your doctor may prescribe a 25 mg dose. Your doctor may limit VIAGRA to 25 mg in a 48-hour period.
- Other methods to cause erections. These include pills, injections, implants, or pumps.
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POSSIBLE SIDE EFFECTS OF VIAGRA

Side effects are mostly mild to moderate. They usually go away after a few hours. Some of these are more likely to happen with higher doses.

The most common side effects are:

- Headache
- Feeling flushed
- Upset stomach

Less common side effects are:

- Trouble telling blue and green apart or seeing a blue tinge on things
- Eyes being more sensitive to light
- Blurred vision

Rarely, a small number of men taking VIAGRA have reported these serious events:

- Having an erection that lasts more than 4 hours. If the erection is not treated right away, long-term loss of potency could occur.
- Sudden decrease or loss of sight in one or both eyes. We do not know if these events are caused by VIAGRA and medicines like it or caused by other factors. They may be caused by conditions like high blood pressure or diabetes. If you have sudden vision changes, stop using VIAGRA and all medicines like it. Call your doctor right away.
- Sudden decrease or loss of hearing. We do not know if these events are caused by VIAGRA and medicines like it or caused by other factors. If you have sudden hearing changes, stop using VIAGRA and all medicines like it. Call your doctor right away.
- Heart attack, stroke, irregular heartbeats, and death. We do not know whether these events are caused by VIAGRA or caused by other factors. Most of these happened in men who already had heart problems.

If you have any of these problems, stop VIAGRA. Call your doctor right away.

HOW TO TAKE VIAGRA

Do:

- Take VIAGRA only the way your doctor tells you. VIAGRA comes in 25 mg, 50 mg, and 100 mg tablets. Your doctor will tell you how much to take.
- If you are over 65 or have serious liver or kidney problems, your doctor may start you at the lowest dose (25 mg).
- Take VIAGRA about 1 hour before you want to have sex. VIAGRA starts to work in about 30 minutes when you are sexually excited. VIAGRA lasts up to 4 hours.

Don't:

- Do not take VIAGRA more than once a day.
- Do not take more VIAGRA than your doctor tells you. If you think you need more VIAGRA, talk with your doctor.
- Do not start or stop any other medicines before checking with your doctor.

NEED MORE INFORMATION?

- This is only a summary of important information. Ask your doctor or pharmacist for complete product information OR
- Go to www.viagra.com or call (888) 4-VIAGRA (484-2472).

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PLACE TO FIND
OUT THE REAL
TOP SPEED OF
TWO ICONIC
MUSCLE CARS.

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Flat Out

BY EZRA DYER PHOTOGRAPHS BY NATHANIEL WELCH

it's a question to gall anyone who loves fast cars:

What's the point in driving a high-powered machine when a Prius can easily surpass the highest speed limit in the land? The annoying thing is, the maudlin pragmatists who look at a Porsche 911 GT2 and say, "Well, that guy's just going to get a lot of speeding tickets" are mostly right. In terms of performance, our cars have outgrown our roads.

You can go to a dragstrip and get a good run through the lower gears; you can go to a road course to exploit the limits of

Two overpowered muscle cars face an arrow-straight course that stretches beyond the horizon. Guess which one was the fastest.

a car's chassis and brakes. But top speed is a different matter. Even a four-cylinder Mazdaspeed3 breaks 150 mph. Cue the chorus of downer realists: So where are you gonna do that?

Bonneville, that's where.

the bonneville salt flats, home of every land-speed record worth having, is a destination that all gearheads need to visit at least once. I've never been there. But as luck would have it, PM auto editor Larry Webster has wrangled a permit for the salt on a rare day when nobody else has it booked. All I need is a car.

Or better yet, two cars. I arrive in Ann Arbor, Mich., to meet the screaming-red weapons with which I'll assault the salt. For this mission, we selected two of America's feistier machines, the Chevrolet Camaro SS and the Ford Mustang Shelby GT500. With 426 hp under the hood of the Camaro and a full 540 horses propelling the Stang, these are definitely two cars that should put on a good show on the salt.

There's only one problem: The Mustang and the Camaro have 155-mph electronic speed limiters. And running into a 155-mph speed limiter on the Bonneville Salt Flats would be like going to an all-you-can-eat buffet and leaving only pleasantly full. If we're going to drive 1700 miles to go flat-out in Utah, we want to fully answer the question, what'll she do?

Hence, a few days earlier, Webster brought the cars to Lingenfelter Performance Engineering in Decatur, Ind. Lingenfelter, in addition to its more involved performance packages, sells portable engine-computer reprogrammers. Plug them into the Mustang and Camaro OBD (onboard diagnostics) ports, and a few seconds later the cars forget they ever had a speed limiter.

Suitably modified, we depart Ann Arbor. I've recruited my friend Murph, who is happy to drive muscle cars to the Salt Flats. I'm behind the wheel of the Mustang, Murph's in the Camaro. We've got multiple bags of beef jerky, walkie-talkies and three days to get to Bonneville.

It's quickly evident that getting to Bonneville while resisting Bonneville-esque velocities will test our restraint. Our path takes us through Iowa, Nebraska and Wyoming, states that offer a lot of room to run. We're barely out of Michigan when a Subaru STI comes charging up on the GT500's

bumper. While there are scenarios where an STI will trump a GT500—a wet autocross track, a winter rally stage—I can say that straight-line third-gear acceleration is not one of them. Subaru dispatched, I slow to the speed limit and hope that nobody with a badge witnessed my little moment of weakness. Save it for the Salt Flats.

Early in the trip, we trade cars, and I soon bond with the Camaro, while Murph is happy to stick with the Mustang. You don't learn much about cars like this on the highway, but we do agree that the Camaro is more comfortable, thanks to its softer suspension. On one choppy section of highway, Murph radios, "These expansion joints are giving me a nice kidney massage." In the Camaro, I'm comfortably numb.

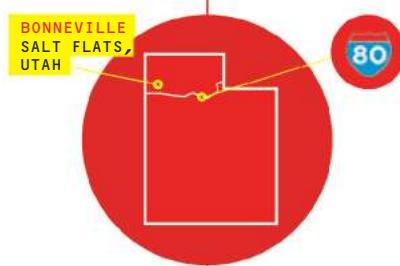
As we make our way west, we meet curious bystanders wherever we stop. Everyone wants to know where we're going with these two red muscle cars. A guy named Andrew, on tour with a band called the Fall of Troy, gives us CDs. An entrepreneurial trucker hands us bottles of American Shine car-wash concentrate. And a gentleman in Wyoming gives me a little



keepsake—a \$140 speeding ticket.

This happens on the third day, when I pull off an exit for a rest stop soon after leaving our hotel in Laramie. As I wait for Murph at the bottom of the exit, a state trooper drives down the ramp and turns on his lights. He approaches the window, tells me I was doing 90 mph in a 75-mph zone and asks for my license. "Don't worry," he says, "I'll get you out of here in a minute." I sit in the car and ponder how I was speeding and stopping at the same time.

The trooper doesn't ask why a Mustang GT500 and a Camaro SS from Michigan are convoying through his fair state. All he cares about is writing the ticket as fast as possible and getting back up to his position, where 5 minutes later he pulls over a fresh victim. On one hand, I'm angry that I didn't see him. On the other, maybe this is cosmic penance for the 30,000



Left: The Mustang and Camaro sport blocky-looking bodywork, but going full-throttle on the Salt Flats proves they're aerodynamically stable, even at 170 mph and beyond. Below: A Wyoming state trooper writes an ironic ticket—for speeding on the way to the Bonneville Salt Flats.

miles I have spent behind the wheel of a Camaro without one speeding ticket. I was overdue. Also, I could say that my ticket amounts to one dollar for each mile per hour I was traveling shortly before he bagged me. (In Wyoming? Possibly.) So it's kind of a bargain when you look at it that way. And hey—a speeding ticket en route to a place with no speed limit? Thank you for the delicious irony, Wyoming Highway Patrol.

As we make our way into Utah, a new problem is brewing. We're not planning to hit the salt until tomorrow, but

Mother Nature has other ideas. When we pull over for a break, Murph is frowning at his iPhone. "The forecast is calling for rain tomorrow," he says. "Maybe even snow."

This is unacceptable news. I'm not driving 1700 miles to find out that Wall-Eyed World is closed. So we have two options: Gamble that the forecast is wrong, or try to get there before dark and hope that nobody else is using the salt. I'm a pretty terrible gambler, so we decide to make a push for the flats.

the salt comes into view. Or, more accurately, swallows up the highway. While the land-speed area is north of the interstate, the sprawling bright emptiness of the salt is everywhere. Just before the Nevada state line, we exit I-80 and take a desiccated two-lane toward the edge of the salt. Somewhere out there are the faded pair of parallel stripes that demarcate the race course.

It seems unbelievable that this place exists in modern America. I expected a gatehouse, a fence, someone to come out and frown at the cars and tell us that our tires' valve stems are out of compliance and that we'd need to come



back with proper paperwork.

But there is no gate, no fence, no tech inspection. We have the permit, filed through the Bureau of Land Management, but there's nobody here to see it. In fact, the only other humans in this alien landscape are a distant fashion model and a photographer. The model is wearing a wedding gown. I pick up the walkie-talkie and caution Murph, "Once we get past 170, we're gonna have to keep our distance from the bride." Personally, I like to maintain at least a mile of separation from matrimonial fashion shoots during instrumented top-speed testing.

We're in a race against the encroaching rain clouds and the fading daylight, so we head directly to the course. The race groove reaches out over the horizon, smoother than the surrounding salt, as if the countless passes by land-bound rockets have ironed its creases. I still feel like we're about to do something wrong, so we set up our base camp deep out on the salt. Nobody driving past on the highway will happen to see us, because we're hiding—behind the curvature of the Earth.

With the Mustang parked, I plug in our GPS-based VBOX data logger, put on my helmet and race suit and head out in the Camaro to get a feel for the course. The salt offers more traction than I had expected. I stop and drop the clutch, and the Camaro lays black stripes before hooking up and getting on its way. Bend the car into a wide turn, and the tires squeal. I've heard the salt be compared to a wet road, but I'd say it's more like worn asphalt when the oil is weathered away—granular but grippy, the world's loneliest parking lot.

Heading down toward the far end of the course, I push the Camaro to about 140 mph and find it completely stable. I make a U-turn and decide to give it the business. If it's okay at 140, I reason, it'll be okay at 170, or whatever velocity I attain once I push into the

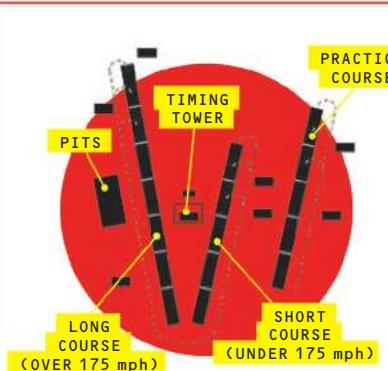
CONTINUED ON PAGE 76

OPEN HERE

speed week field guide



Long before the first Speed Week competition—held in 1949—hot rodders used the Bonneville Salt Flats to put it all on the line and see just how fast they could go. Now the annual event is a speed-merchant pilgrimage with over 500 competitors ranging from backyard tinkerers to sponsored professional efforts. Car and motorcycle racers vie for record top speeds in hundreds of classes based on engine size, type of fuel and vehicle layout. This year, the pedal-to-the-metal-fest kicks off on Aug. 14. Get there early since many drivers simply leave after they've broken a record—or their car. Don't forget the sunblock. Here's a small sample of the machinery.



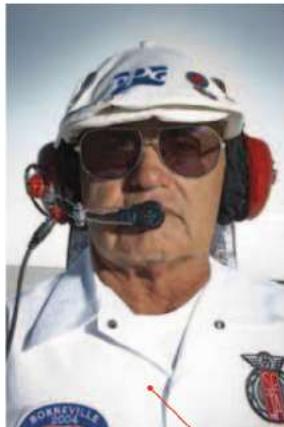
If salt conditions permit, the Southern California Timing Association sets up three separate courses. The long course is for cars and motorcycles that can go faster than 175 mph. It shares a starting area with the 5-mile short course, so that's a good place to hang around and spectate. Plus an announcer calls out the speeds as the cars fly down the track. The third course, another 5-miler, is usually reserved for practice runs and slower, small-displacement motorcycles and interesting vintage iron. Don't miss the tech area near the pits. That's where inspectors pore over the cars, allowing unfettered views beneath a car's bodywork.

1. Wedged in like a Mercury astronaut—driver comfort clearly matters little—Tim Cunha wraps a 170-mph run in a streamliner powered by a 500-cc snowmobile engine.

2. Electrically driven vehicles like Kent Riches's motorcycle are getting more common. With 1054 li-ion batteries and a 200-hp motor, Riches ran 176.434 mph.

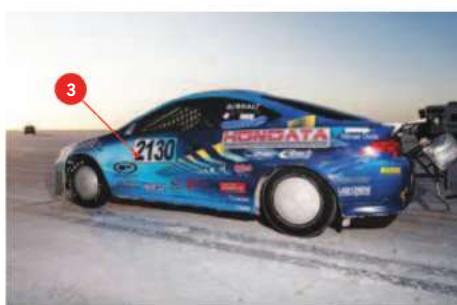
3. Doug Macmillan drove his 2005 Acura RSX to 219.049 mph, retaining a coveted spot in the 200-mph club and a red hat. The 2.0-liter Acura engine belts out over 600 hp, thanks to two Rotrex blowers and an ice-cooled intercooler.

4. Retired firemen Gene and Alan Barbee compete yearly and push their 810-hp replica land missile to over 200 mph. The car is a '29 Ford knockoff. In Bonneville-speak, it's known as a roadster, which is anything that resembles a classic hot rod.

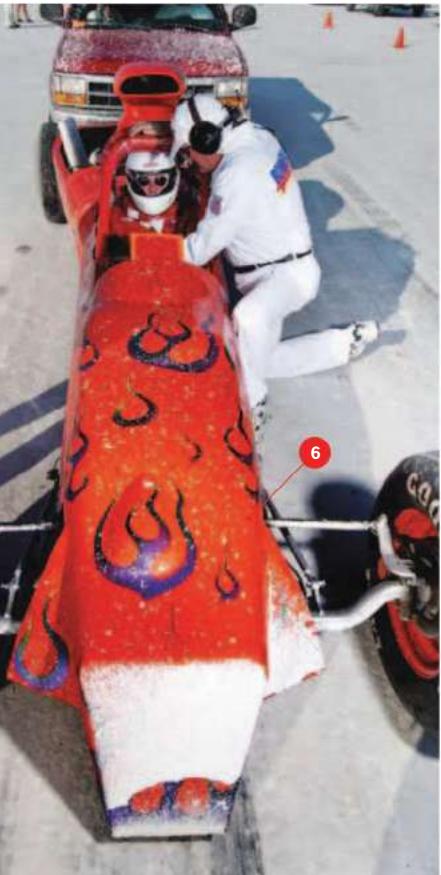


5. Starter Buddy James is one of over 100 volunteers and the sole Japanese speaker. He's pressed into service when a Japan-based team arrives.

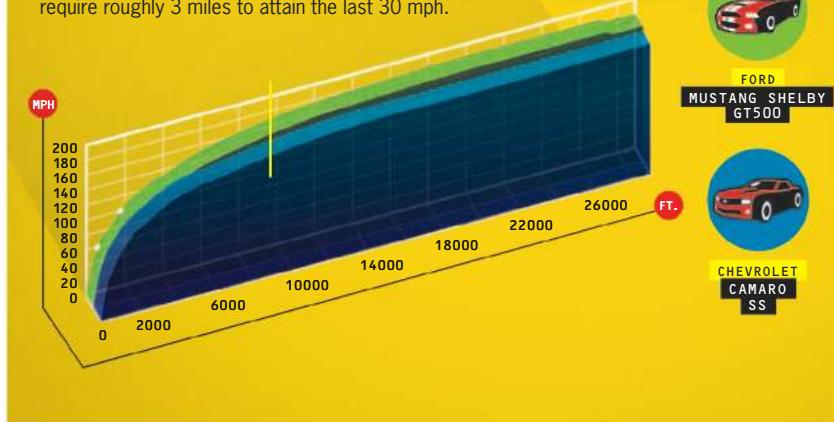
6. Speed Week car classification is so complicated that veteran car builder and driver Larry Rouch couldn't immediately remember his car's category. For the record, it's a "rear-engined roadster."



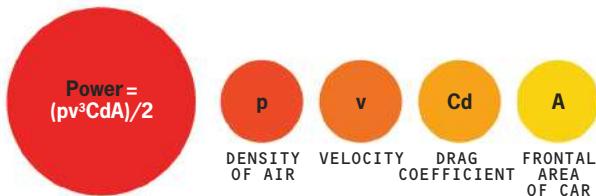
↓ science of speed



→ This speed-versus-distance graph of the Mustang and the Camaro on the salt illustrates why a place like Bonneville is needed to reach terminal velocity. The cars require roughly 3 miles to attain the last 30 mph.

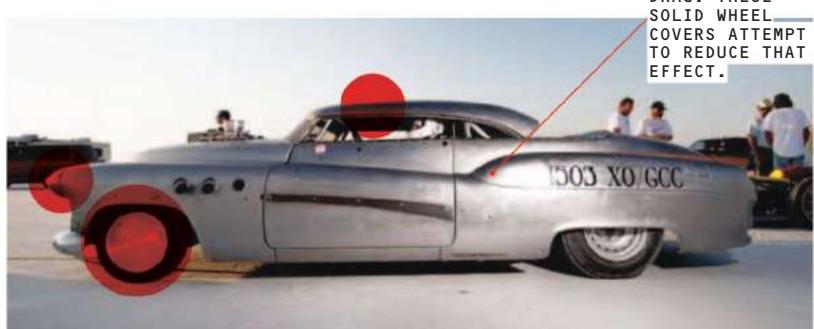


All land-speed racers fight one main adversary: aerodynamic drag. The devil thing about drag is that the power necessary to overcome it increases exponentially based on vehicle speed. So a car that requires only 10 hp to go 50 mph needs 80 hp to reach 100. Bonneville competitors—either by design or intuition—work both sides of the formula that calculates the power required to overcome aerodynamic drag.



Given a car's power and aerodynamic data, this equation can be manipulated to spit out a pretty good approximation of top speed. More horsepower equals greater terminal velocity, of course, but reducing the car's frontal area and drag coefficient (C_d) are just as critical. Since frontal area is simply the product of the car's width and height (minus about 15 percent for the area under the car), it's fairly straightforward to reduce that figure. But accurately measuring C_d requires a tool most racers lack—a wind tunnel. So competitors rely on the eye method—if it looks aerodynamic, it probably is—with varying degrees of success and hope that their body modifications don't induce high-speed instability. Land-speed racing is an engineering challenge, which is, naturally, half the fun. —*LARRY WEBSTER*

JEFF BROCK'S 1952 BUICK SUPER RIVIERA SET A RECORD AT 130.838 MPH, THANKS TO SEVERAL AERODYNAMIC MODIFICATIONS.
→ LOWERING THE ROOF REDUCES THE FRONTAL AREA.
→ STREAMLINING THE FRONT OF THE CAR HELPS LOWER THE DRAG COEFFICIENT. THE NOSE OF THIS BUICK WAS NARROWED BY 6 INCHES. THOSE HEADLIGHT BUCKETS MAY OR MAY NOT WORK, BUT THEY LOOK COOL.
→ THE WHEELS THROW OFF COLUMNS OF SPINNING AIR THAT UPSET THE AIRFLOW TRAVELING DOWN THE CAR'S SIDE AND INCREASE DRAG. THESE SOLID WHEEL COVERS ATTEMPT TO REDUCE THAT EFFECT.



ILLUSTRATIONS BY GABRIEL SILVEIRA

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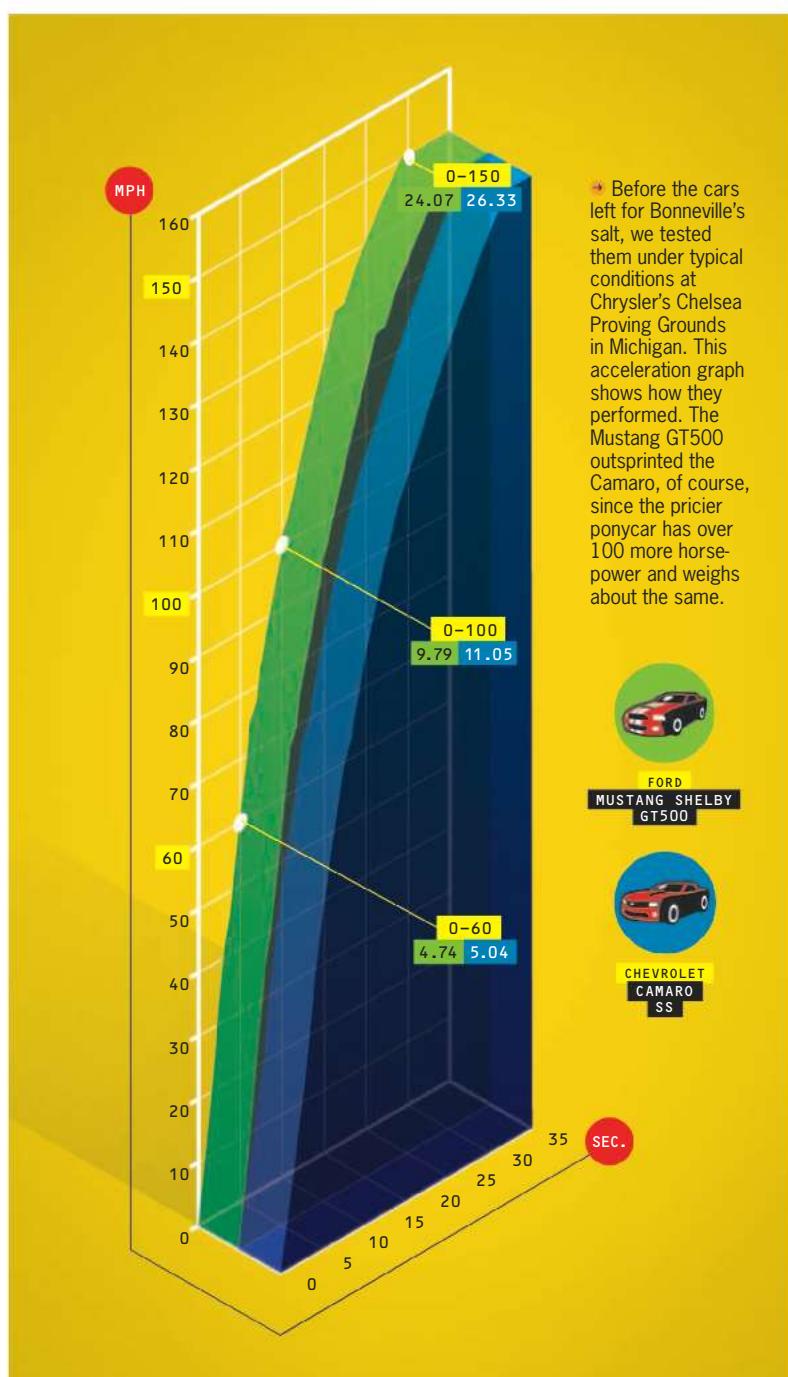
performance zone unlocked by the Lingenfelter boys.

There's just one problem. As I try to upshift from fourth gear to fifth—up and to the right—the shifter balks. I coast along at 140 mph, trying to slot the shifter into gear, but it's having none of this. Have I discovered a Camaro performance foible, transmission synchros that get grouchy at autobahn speeds? Actually, no. After I slow down and carefully guide the shifter into fifth gear, I realize that the problem isn't the Camaro. It's me.

I'm so jacked up on adrenaline, and so afraid to mistakenly hit third gear, that I was muscling the shifter past the gate for fifth gear. And the next gear over from fifth is not seventh. It's reverse. Happily, I can report that the Chevy Camaro SS will not let you shift into reverse at 140 mph.

Once I calm my nerves, I turn around for another pass and get a clean shift into fifth, the top-speed gear (the sixth gear on both the Camaro and the Mustang is there purely for highway fuel economy). The Camaro easily hits 170 mph, but from there the last few miles per hour creep up in tiny increments. I'm pressing so hard on the gas that my right leg is quivering. But when the VBOX reads 174.4 mph, that's all she's got. The car is completely benign—no wandering, no scary front-end lift. The blunt Camaro is docile even when I squeeze hard on the brakes. I concede that Chevy's muscle car isn't perfect, but it's mildly amazing that when I say, "The Brembos easily hauled it down from 174 mph," I could be talking about either a \$300,000 Ferrari or a \$32,000 Camaro.

With the Camaro in the books, it's time to turn to that unholy handful of supercharged Mustang. I head back toward our base, and as Murph comes into view, I slow down so that I'm not barreling up on him like a maniac. But it seems like it's taking forever to get there. I glance at the speedometer and discover that I'm still



doing 130 mph. This place definitely alters your perception of speed.

Back in Decatur, the Lingenfelter dynamometer revealed that this particular Mustang put down 489 hp at the rear wheels, so every bit of its advertised muscle is accounted for. I leave the stability control engaged, and

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small bumps in the salt trigger subtle traction-control interventions up to about 100 mph. Fortunately, once you break into the really high speeds, the Mustang is just as glued down as the Camaro.

The GT500 is unique in that its speedometer is actually calibrated to a number commensurate with the car's abilities. A stock GT500 is limited to 155 mph, so it makes sense that the car's speedometer reads only to 160. Given that every hot-rod hatchback now has a speedometer that reads to Mach 10, the delimited Mustang offers a rare opportunity: the chance to pin the needle. Which it does, with extreme prejudice. At 160 mph, this thing still has a long way to go. In fact, at the 15,000-foot mark, where the Camaro was touching 170 mph, the Mustang is already at 180. And still pulling.

While the Camaro ran into a wall of aero drag at 174.4 mph, the GT500 bumps up against its redline, supercharger screaming, at 184.7 mph. The late Ford GT, with sleeker bodywork but only 10 more horsepower, is good for 200 mph, so it seems logical that the Mustang has a few more miles per hour to unlock. Given longer gearing, I'll bet this thing could hit 190. Still, I'm impressed: If you had this car on the autobahn, you could pull up behind a Porsche 911 (top speed: 180 mph) and flash your headlights in the international signal for "get out of my way, slower car." That's a rapid Ford.

with nightfall creeping

over the mountains, I sneak in a few more runs. It's not every day that you're alone on the Bonneville Salt Flats with nearly 1000 hp at your disposal, and I intend

**Happily, I can report
that the Chevy Camaro SS
will not let you shift
into reverse at 140 mph.**

to make the most of it.

I don't better my initial speeds, but my continued Salt Flats research does produce additional valuable information. For example, did you know that the Camaro SS lets you set the cruise control at 159 mph? It's true. Although, when I set the cruise at 159 mph, the VBOX says I'm actually doing 165 mph. Besides that discrepancy, I find that the car lurches in an unsettling manner when you cancel the cruise control. Typical rough-around-the-edges Camaro, I suppose, stepping on its own feet every time you want to cancel the cruise control at 165 mph.

The fact that a Camaro is even capable of such a thing is properly amazing. And the Mustang, while expensive relative to the Chevy, is a bargain compared to the six-figure purebreds it can outrun. It seems unfeasible, on the face of it: You can take two attainable American muscle cars, drive them 1700 miles, run more than 170 mph on the Bonneville Salt Flats, then get back on the highway and drive to Los Angeles in reasonable comfort and without any mechanical complaint. The Camaro even managed 22 mpg on the highway. The Mustang? Well, you can lead a horse to a gas pump, but you can't make it drink less than a gallon every 19 miles.

Our modern automotive lives are defined by their restrictions, the lure of speed always tempered by the reality of traffic jams and insurance premiums and points on our licenses. Even our muscle cars have speed limiters. That's why the Bonneville Salt Flats are so glorious. Because no matter how beat-down you get by the entrenched web of radar guns and speed bumps, you can still get a fast car and go to Bonneville. You can put on a helmet. And you can crack a V8 throttle wide open and hold it there, reveling in the continued existence of a place where the only limits are horsepower and the horizon. **PM**



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Jeb Corliss
(33, 6'3", frequent flier)

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Jeb Corliss has jumped from the world's tallest buildings, leaped into its deepest sinkholes and gone for a swim with its fiercest predators. But that was just a warmup. Sometime soon, Corliss hopes to put on a wingsuit similar to the one above, launch from a helicopter, glide through the air and land — without a parachute.

THE MAN IN THE BLACK

FLY

BY
JAMES
VLAHOS

photograph by Michael Muller

Up in the sky: a black dot, like a speck of pepper on a white tablecloth, hurtling through the air. I was plummeting at more than 100 mph myself, the jet roar of wind blasting by, but the speck was closing in on me like a missile. I yanked the ripcord of my parachute and then watched as the object became a human body with wings. The body had a man's face, and as he streaked by, not even 10 yards away, I could practically see the tonsils inside his screaming mouth: *Yeeeeaaaaahhh!* The tawny grasslands of southern California rushed upward to pancake him. Then, and only seconds before impact, did his canopy blossom above him.

On the ground, dozens of parachutists were milling about the hangars of the Perris

FLYING SUIT

POPULARMECHANICS.COM
JUNE 2010
PAGE 81

Valley Skydiving Center. The birdman, renowned BASE jumper Jeb Corliss, was easy to spot: Tall, with a shaved head, he was dressed like a flying squirrel. A heartfelt “Dude!” was all I could initially manage. My tandem jump partner, Jim Wallace—a world-record-holding sky diver himself—was only slightly more composed. “I can’t believe how much control you had,” he said. Corliss just shrugged. “I told you I was going to fly close,” he said.

Among BASE jumpers—people who leap from buildings, antennas, spans and earth—Corliss is both the reigning superhero and the leading villain. Superhero because he has logged more than 1000 jumps on five continents, launching from the Matterhorn and the Golden Gate Bridge and dropping 2000 feet into a sinkhole cave in China. And villain because Corliss, the former host of the television show *Stunt Junkies*, unfailingly attracts attention—most notoriously in 2006 when he was arrested for trying to leap from the Empire State Building. In a sport whose practitioners prefer to keep a low profile because the safety of what they do is always under fire, attracting the media spotlight is an unpardonable sin.

Corliss says attention is unavoidable for someone whose “whole purpose in this world is to do what people think can’t be done.” More accurately: things that people think shouldn’t be done because they are absurd and dangerous. “The average person looks at sky divers like they’re crazy,” Corliss says. “The average sky diver looks at BASE jumpers like they’re crazy. And the average BASE jumper looks at me like I’m crazy.”

Which brings us to the morning flyby, and Corliss’s vision for his most audacious feat ever. The flying squirrel get-up was a wingsuit, a wearable plane whose wings are nylon panels fanning out below the arms and between the legs. The pilot, rather than simply plummeting, can steer and achieve a glide ratio of up to 3 feet forward for every

1 foot down. Wingsuits are used by a tiny but growing cadre of pilots worldwide; to land, they always deploy a parachute.

Corliss’s immodest proposal: Skip the parachute. Cut the umbilical and achieve one of mankind’s most ancient and enticing dreams—unpowered human flight, no external contraption required.

He calls it the Wingsuit Landing Project. Fly, land and live to tell the tale. Doing so will require a vertically inclined landing strip—picture how Olympic ski jumpers touch down on mountainsides—and to build it, he has consulted with an engineering firm that does work for NASA. The budget is \$3 million, which Corliss hopes to raise from corporations willing to sponsor the feat. Or the fiasco. “I’m going to be landing at 100 mph on my face,” Corliss says. It’s truly terrifying, but that’s just how he likes it. “Some people are gifted singers, dancers, whatever. My gift is fear.”



Jeb Corliss (pictured here flying near Mount Fuji in Japan) is planning to land, sans parachute, on a specially designed ramp—at 100 mph. “The average person looks at sky divers like they’re crazy,” Corliss says. “The average sky diver looks at BASE jumpers like they’re crazy. And the average BASE jumper looks at me like I’m crazy.”

A

month before our near midair collision, the door to a two-story townhouse just a few blocks from the ocean in Venice Beach, Calif., opened to reveal a figure clad in head-to-toe black. Corliss led me into a darkened living room and seated me on one of two black couches. Plates decorated with skulls sat on a nearby counter. In the corner stood a tall crystal statue of Icarus, the flying legend who fatally plummeted. Inspiration? Warning?

Corliss has been a fear junkie virtually since birth. Gigi Corliss, Jeb's mother, says that when her son was "still wearing a diaper and sucking his thumb" he used to point up at the high dive at a local pool. She let a swim instructor take Jeb up to the top on the theory that the toddler would become scared, want to come down and stop begging to go up. Instead, Gigi says, Jeb "wiggled out of his arms, squealed, 'Wee, wee, wee!' all the way down, doggy-paddled back to the side of the pool and said, 'Again.'"

Aquatic frolics notwithstanding, Corliss was a miserable child. His parents were art dealers, and the family spent much of each year scouring countries such as India and Afghanistan for works to buy. When they weren't overseas, they lived in New Mexico, where Corliss attended six different elementary schools. Always the new kid, ostracized and bullied, he discovered that to harness fear—your own, that of others—was to gain power. He brought tarantulas, scorpions and rattlesnakes home as pets. He started battling the bullies so savagely that some of them wound up in the hospital. His depression worsened.

BASE jumping would seem an unlikely savior, but it gave Corliss purpose and happiness. He discovered the

Epic Air

TESTING THE LIMITS OF FLIGHT IS AN AGE-OLD HUMAN URGE. HERE ARE FIVE FEARLESS PILOTS WITH SUPERLATIVE ACHIEVEMENTS IN AIR ADVENTURE. BY JEREMY REPANICH

**1 × Longest
Powered Paraglide**

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Dangling from a parachute with a 202-cc engine and a carbon-fiber propeller on his back, Ben Jordan glided more than 6000 miles across Canada at 25 to 30 mph, stopping every few hours to refuel. On his 114-day journey from the Pacific Coast to Newfoundland, he traveled over vast expanses of uninhabited land that most paragliders wouldn't attempt to cross. "There's a reason no one has ever done this," he says. "You don't want to fly this thing 60 kilometers from civilization."



**2 × Highest Building
BASE Jump**

Jan. 6, 2010

Though Omar Alhegelan has sky-dived more than 16,000 times and BASE-jumped from places like Malaysia's Petronas Towers, fear still courses through him before every jump—and Burj Khalifa, the world's tallest building, was no exception. As he stood on the precipice, 2200 feet above the ground, "I felt a little shake in my knees," he says. "But I welcome that fear." To those watching, Alhegelan's fear was unapparent: He gracefully backflipped off the tower, plummeted for 10 seconds and deployed his chute, gently floating to the ground.

2.



**3 × First Jet Pack
Crossing of the English Channel**

Sept. 26, 2008

People have traversed the channel by boat, plane, Channel and backstroke, but Yves Rossy chose a less obvious method: jet pack. Rossy jumped from a plane over the coast of France and unfolded an 8-foot-long carbon-fiber wing strapped to his back; four jets on the wing thrust him to England, where he used a parachute to land.



**4 × Highest
Sky Dive**

Aug. 16, 1960

On the edge of Earth's atmosphere, in a helium balloon and a pressure suit, Joe Kittinger readied himself. "I said a

little prayer," he says. "Then I jumped." He plummeted at 614 mph, five times the speed of a sky diver. He set records for the highest sky dive (102,800 feet) and the longest free fall (4 minutes 36 seconds).

**5 × Longest
Hang Glide**

June 19, 2002

To fly his hang glider 438 miles over Texas, Mike Barber needed skill, endurance—and good weather. "Thermal paragliders are solar-powered," he says. "The sun heats the ground, which creates thermals." Barber used the warm pockets of air so effectively that once he was able to stay aloft for 11 hours without stopping.



sport in his early 20s, and when he had logged only six relatively easy leaps, Corliss got the idea to try an advanced one from a 300-foot antenna.

BASE jumping is perilous because the margin of error is slim. Open the chute a half-second too late—*splat*, you're dead. Open it with your body off-angle, and you might career into the object you've just jumped from—*splat*. When Corliss told his BASE mentors about the antenna, they told him he wasn't ready. His mom begged him not to try. His friends said they didn't want to watch him commit suicide. So Corliss climbed to the top of the antenna by himself. At night. Standing there in the moonlight he even told himself, "I am not going to do this." And then he jumped.

The chute opened horrifyingly late. He smacked the ground, hard. But he realized he was still alive. "I'm lying on the ground, my entire body is shaking, every hair is standing on end," Corliss recalls. "I can feel the air touching my skin, hear insects crawling in the grass." Bruised but otherwise unhurt, Corliss felt born again and had the template for his career: Confront fear, ignore all doubters, and do exactly what you want to do.

As you might expect, this uncompromising approach has resulted in both triumph and disaster. Typical Corliss tale: Not long after the antenna escapade, Corliss and a French BASE jumper named François were eating dinner in Italy and got the idea to jump off Angel Falls. They paid the check, drove to Paris and boarded a plane to Venezuela. Less than 36 hours later they were squeezed into a Cessna on a flight-seeing trip over the famous cascade. Corliss reached forward into the cockpit and waved

\$100 in front of the pilot, whose eyes grew large. Corliss opened the plane door, shouted "See ya!" and he and François jumped out.

They had sneaked their BASE rigs aboard. After landing near the falls, they repacked their chutes and successfully took the plunge off the top of the 3200-foot cataract. Then they spent the next two days blundering through the rain forest. They had no food. It rained torrentially, and the pair took shelter in caves with gooey, multicolored insects until they reached civilization.

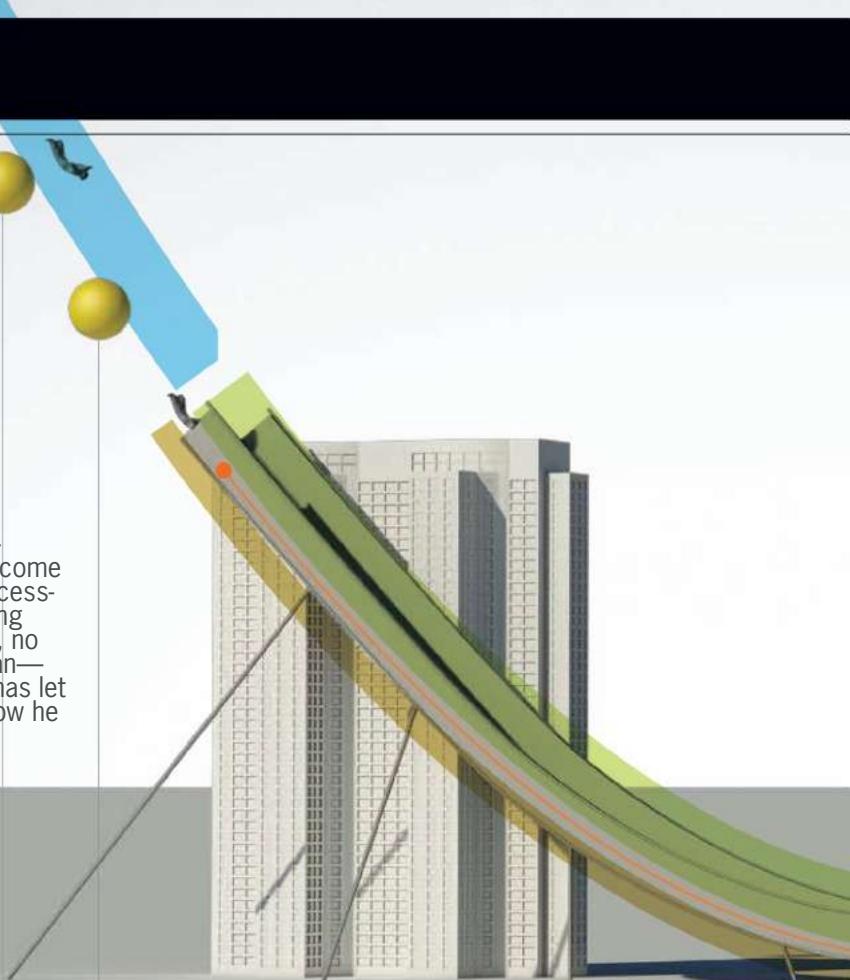
You would think that kind of misadventure would cause Corliss to rethink his career choice. But he never has. "BASE jumping for me was kind of like an exorcism," he says. "It was horrifying, but I had to go through it to come out on the other side a happy person."

This begins to make sense if you dis-

How It Works

the ULTIMATE FACE-PLANT

Anyone can fly like a bird and land without a parachute—once. But Jeb Corliss has no desire to become a human pancake. "A wingsuit landing is only successful if you can do it 10 times out of 10 without being injured," Corliss says. "I'm talking no broken toes, no broken anything." Corliss is guarded about his plan—he doesn't want rivals to steal his ideas—but he has let some details slip. Here's an educated guess at how he might pull off the stunt.



Not to scale

card the conventional wisdom that all practitioners of extreme sports must have sensation-seeking personality disorders—that they’re addicted to the flood of pleasure-inducing hormones and neurochemicals released by death-cheating stunts. Corliss claims that the terror before a jump and the elation afterward were appealing only early in his career and are now his least favorite part. He doesn’t like intoxication, abhors drugs and alcohol. “I’m very control-based,” Corliss says. “And with those things you lose control and become a slave.”

Corliss, it seems, is less of an adrenaline junkie than he is a control freak. Precision is the essence of his work. To succeed he must be obsessive about every minute detail—chute packing, weather conditions, body position—and Corliss relishes meticulous planning. Perhaps, and this is just armchair psy-

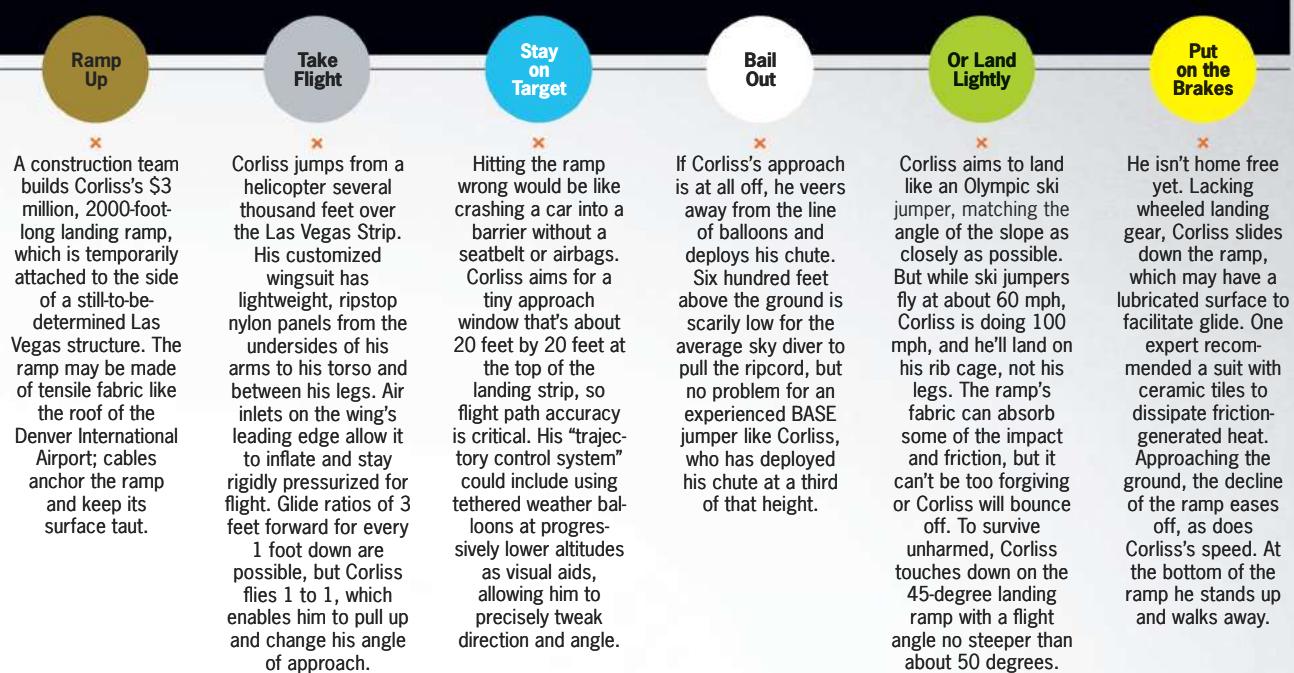
chology, it is a coping mechanism from his chaotic childhood. Say what you want about the sanity of Corliss’s pursuits, they do offer the ultimate form of control—that over one’s own life or death. Or at least the illusion.



recision flying is the key to the Wingsuit Landing Project. Mont Hubbard, a professor of mechanical and aeronautical engineering at the University of California–Davis, confirms that if Corliss’s flight angle matches that of the landing slope, and friction is kept to a minimum, the impact force on touchdown will be almost nil. If he is 6 degrees off—hitting the 45-degree ramp at 51 degrees—the force on his body would be the same as if he were dropped from 3 feet in the air onto flat ground. So far so good. But the math quickly starts to work against Corliss, and misalignments of 11, 16 and 23 degrees result in equivalent fall heights of roughly 13, 30 and 50 feet.

People have survived far worse, plummeting chuteless from planes in emergencies and living to tell the tale. In 2007 window washer Alcides Moreno plunged

CONTINUED ON PAGE 160



THE ELECTRIC PLUG-IN ACID TEST

WITH THE LEAF, THE VOLT AND OTHER PLUG-IN CARS ENTERING THE MARKET, POTENTIAL BUYERS WONDER: HOW WILL RECHARGING STATIONS WORK? WHERE WILL THEY BE? AND WHAT WILL A "FILL-UP" COST? TO ANSWER THOSE QUESTIONS, WE SPENT A DAY WITH A HYPOTHETICAL EV DRIVER OF THE FUTURE.

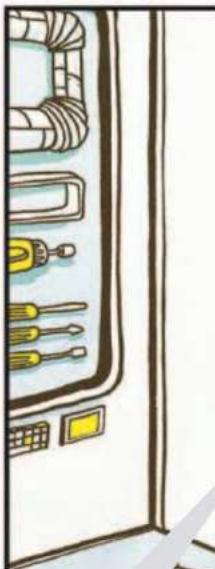
SANTA MONICA, CALIFORNIA, 12 AM, AUGUST 4, 2020

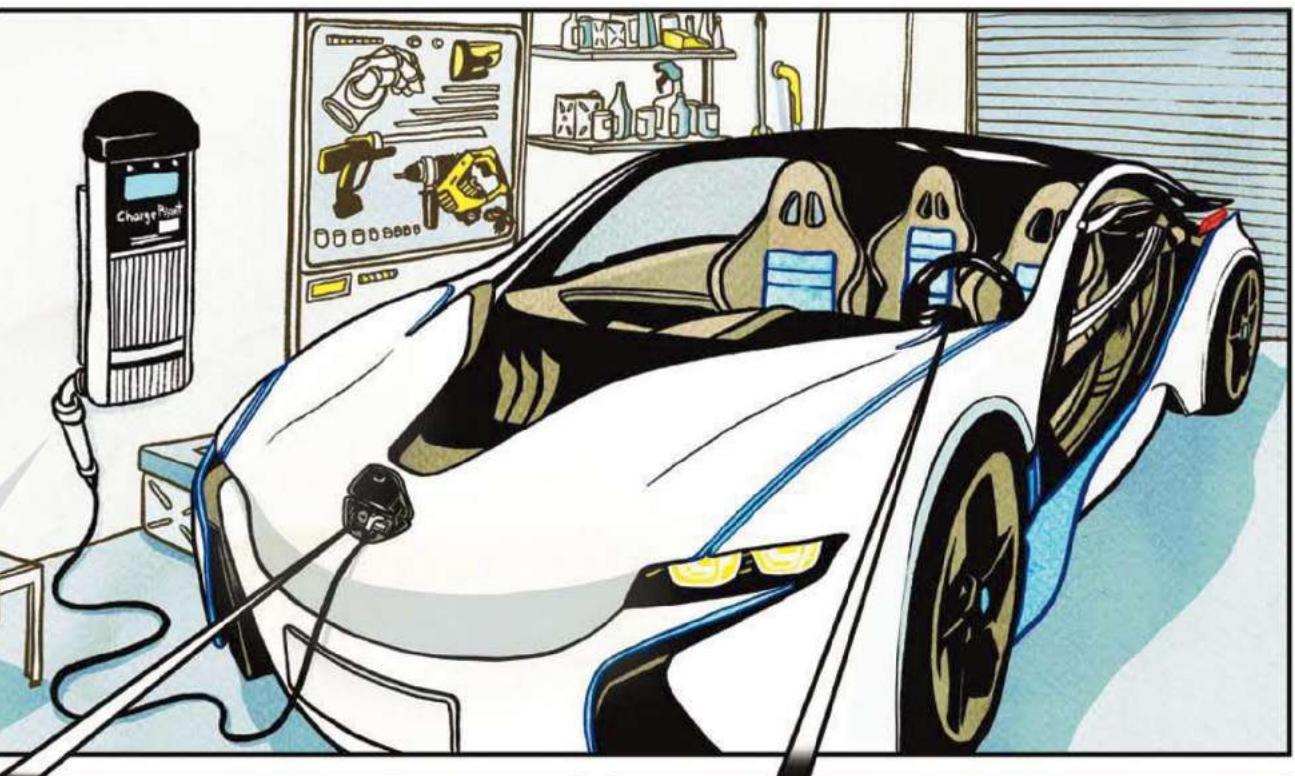
At midnight, your car wakes up. The hefty, 15-pound charging cable tethering the front of the vehicle to a 220-volt outlet in your garage goes live, pulling 5 kilowatts of power from the grid. In just 5 hours, it will nearly double your home's average daily electrical consumption. Across California, hundreds of thousands of plug-in hybrids and pure electric vehicles are doing the same, sipping electricity from a power network at rest. Some of those vehicles have different charging regimens, communicating more with the local utility, or even allowing that utility to actively control when and how to recharge their batteries. But yours follows a simple pricing scheme, automatically charging during what is typically the cheapest time of the day, between midnight and 5 am. That's when the utilities have power to spare, when the office buildings in downtown Los Angeles have gone dark and sweltering. In the daily rhythm of the grid, this is off-peak.

Tonight, though, the off-peak grid is unusually busy. Air conditioners across Southern California are battling a week-long heat wave, with temperatures exceeding 100 F during the day and barely easing up at night. So far, it's the worst heat wave to hit the region since 2006. The forecast

HOME CHARGING

By 2020, electric vehicles (EVs) will practically refuel themselves—provided you have a garage, a smart power meter and a home charger. With utilities offering discounts for off-peak charging, when power is cheap and plentiful, most EVs will be set to automatically recharge at night. Some models will even kick on the a/c or heat at a designated time, preconditioning the car for your commute.





for today shows no signs of a break: Angelenos can expect afternoon highs of 103 F. Aug. 4 is shaping up to be one of the first real tests of the so-called smart grid, an effort to create a nimbler, more efficient, less vulnerable electrical grid. It will also test the nearly 500,000 electrified vehicles in the state.

The push to make plug-in vehicles a key part of America's automotive mix began in earnest back in 2010, when the Chevy Volt and Nissan Leaf were poised to hum into dealerships. That same year, strict new mileage standards forced carmakers to begin developing petroleum-free methods to power portions of their fleets. But vehicles were only one part of the equation—what would happen, exactly, when people plugged them in? What would it cost to recharge on the road? And would an aging, weather-vulnerable electrical grid be able to safely charge thousands, even millions, of the most power-hungry consumer products in history?

In the summer of 2020, the answers to many of these questions are becoming clear (PM interviewed over two dozen engineers, analysts and other experts to create this hypothetical scenario): By this time the U.S. electrified vehicle fleet has reached 2 million. It's a number that's seen as either a minor triumph or a total disaster—higher than some analysts had estimated, but short of the 14 million that companies like Nissan had predicted, accounting for less than 1 percent of the national fleet (a smaller market share than even diesel).

Half are plug-in hybrid electric vehicles (PHEVs), with lithium-ion battery packs that provide 40 or 50 miles of electric range, and liquid-fuel engines that kick in for longer trips. These are most popular in suburbs, rural communities and colder states. The other million or so vehicles are called simply EVs, or electric vehicles. With larger battery packs that can run for 100 miles or more between charges and no backup gas engine, they tend to be used by residents of cities and warmer climates. Collectively, these various types of electrified vehicles are called grid-enabled vehicles, or GEVs, because unlike early gas-electric hybrids, the grid—not just the brakes or the motor—provides their batteries with a full charge. Thanks in part to zero-emissions vehicle mandates dating back decades, California has attracted the bulk of this new market, meeting analysts' predictions of a 25 percent share.

CALIFORNIA IS ALSO WHERE MOST GEV-RELATED STARTUPS

have flourished or failed, populating neighborhoods, shopping malls and the occasional highway rest stop with charging stations. These come in three varieties. Level 1, or 110-volt chargers, can take 12 hours or longer to refill a vehicle's battery and are mainly found in the garages of PHEV owners and in some public parking lots. Level 2, or 220-volt chargers, are the most common. They can replenish a drained battery in 4 to 5 hours or top off a partially depleted EV parked at a Target,

Best Buy, or a growing number of workplace lots. And then there are Level 3 chargers, known as fast chargers, 440-volt stations that can get some batteries back to 80 percent in 15 to 20 minutes, but they generally are in remote locations and their surcharge rivals gas prices.

Not that you pay much attention to gas prices anymore. There's a 2014-model-year internal-combustion sedan parked next to your EV, but that's for driving up to San Francisco, out to Vegas, or for the occasional camping trip. Instead, you keep your eye on electricity rates, which have climbed as utilities scramble to meet demand that's growing by 1 percent every year, despite more energy-efficient appliances and unpopular restrictions on the size of flat-screen TVs. Still, by triggering your Level 2 charger to run at night and grabbing one of the free charging spots at work, running your EV costs about a dollar per day. The cost of installing that charger—about \$1000, with the utility covering half—was recovered in the first year. The switch from hydrocarbons to electrons has been, for you, a bargain.

AT 7:45 AM, YOUR CAR'S AIR CONDITIONING COMES ON.

Instead of drawing power from the battery during driving, which would reduce your effective range, the EV sips electricity from the grid to precondition the cabin. An hour later, when you plug your phone into the center console, a touchscreen display lists your favorite radio stations and your estimated time of arrival—adjusting for traffic and weather conditions—at the office. In an EV, where built-in devices like satellite radios and CD changers only add cost and range-reducing weight, offloading as

FAST CHARGING

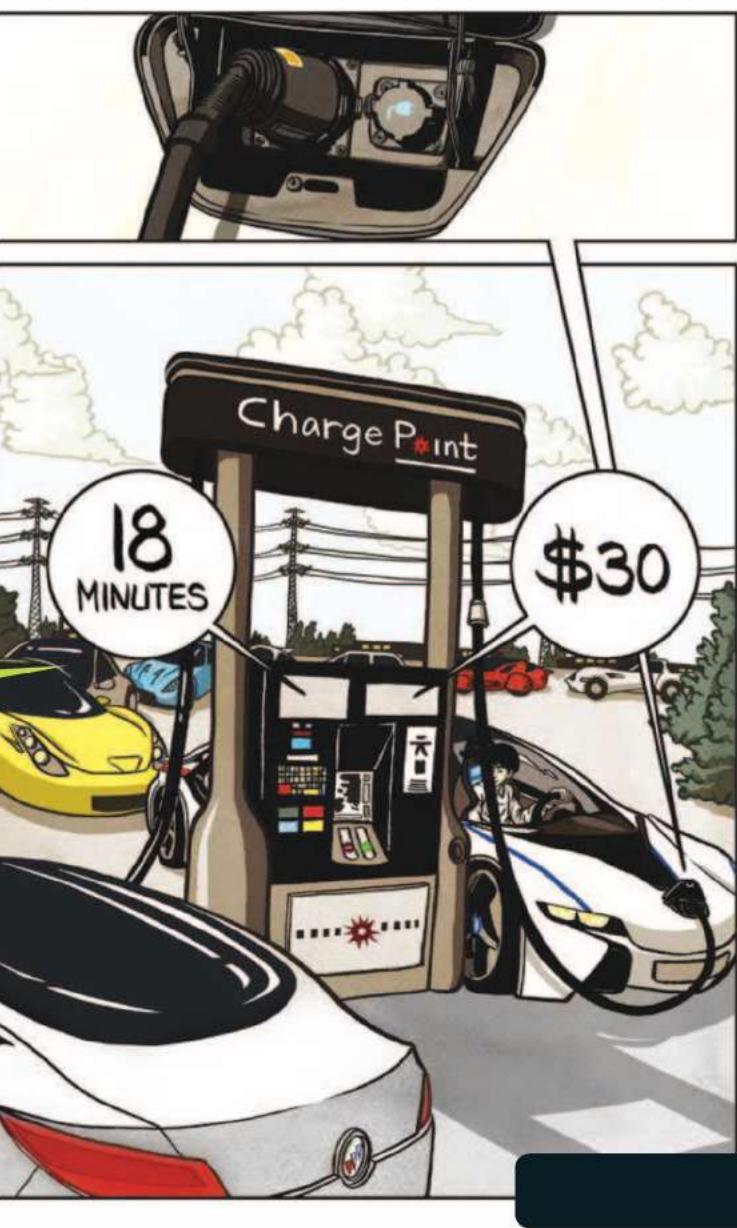
While Level 1 and 2 chargers—the kind found at home or in workplace and mall parking lots—can take hours to fully charge an EV, Level 3 chargers promise to be exponentially quicker. That said, they still require you to cool your heels for 15 to 20 minutes. And aside from being slower than gas pumps, fast chargers will likely be expensive and located in remote spots, where commercial-scale power is already in place.

many amenities as possible onto the driver's handheld device is a smarter, more efficient design decision. "Instead of a bunch of old geezers like me wondering what the kids like, we'll just leave the architecture open, and let them run everything through their iPhone," says Bill Reinert, national manager of Toyota's Advanced Technology Group.

There are some gadgets still hard-wired into the car, such as a GPS system that displays public chargers and maps out routes that maximize your battery range. Today, you opt for the quickest path to work, and instead of sweating out the last miles as the sun starts to bake your preconditioned cabin, you crank the a/c. There are five Level 2 charging spots at work, and only seven employees with GEVs. You're bound to beat them there. Sure enough, when your car glides into the parking lot emitting a high-pitched whine—one of countless downloadable car tones, required by law to reduce the risk of collisions with pedestrians—all of the chargers are free. You pull the spare Level 2 charging cable out of the trunk, plug in and check the station's LCD display. Battery: Sixty-two percent. Time to

charge: N/A. That's not normal. Neither is the alert window, apologizing for the inconvenience, explaining that your company's chargers have been temporarily disabled to assist the local utility's load management.

This, it hits you, is how the smart grid begins to fail—not with a bang or a brownout, but a million polite refusals.



THE DEALERSHIP IS 20 MILES AWAY. IT'S JUST PAST NOON NOW. UNLESS YOUR COMPANY'S CHARGERS ARE ONLINE WHEN YOU GET BACK, MAKING IT HOME COULD BE A WHITE-KNUCKLE RIDE.

ON A NATIONAL SCALE, THE

grid barely registers a couple of million electric vehicles.

The Department of Energy

predicts a 0.1 percent increase in overall electricity demand per million plug-ins. Other experts see no more than a 1 percent bump by 2020. Even if 2 million EVs were all plugged into Level 2 chargers, that might constitute roughly the same demand as 2 million new homes suddenly appearing on the grid. Spread out across the country, that's a negligible increase.

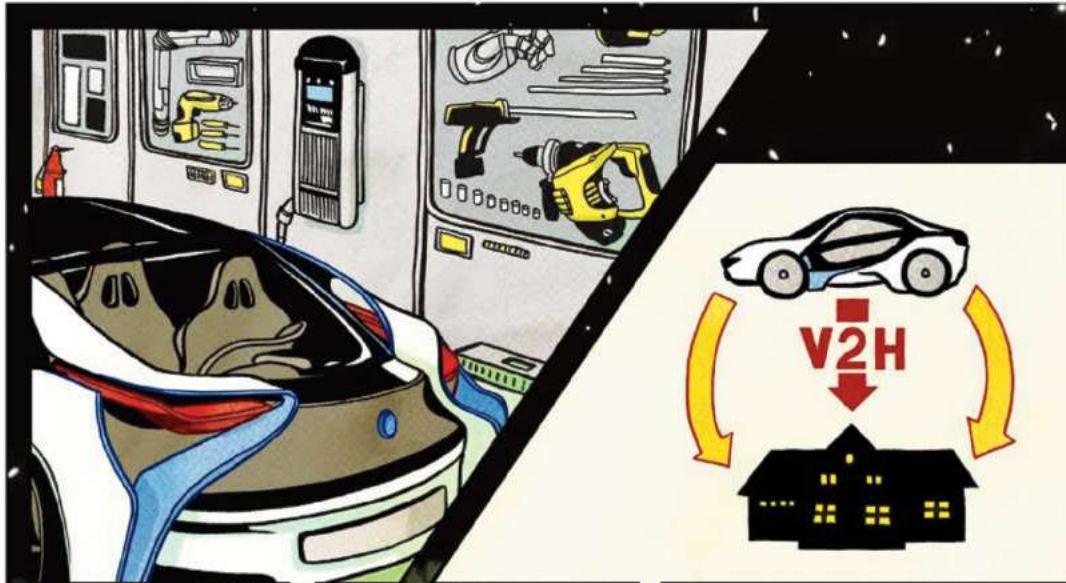
Unfortunately, the grid lives and dies on a local level—there is no central operator that juggles the peaks and valleys of supply and demand around the United States. That's why the heat storm (a longer, more severe version of a heat wave) that hit California in 2006 led to major power failures. By 2020, national electrical demand will be even higher, rising by around 14 percent. For years, utilities have struck deals with customers to help shave peak loads. Southern California Edison, for example, gives customers a credit in exchange for allowing the utility to wirelessly shut down their air conditioner's compressor. Whether it's referred to as load control or stop-charging, the ability of utilities to pull the plug on GEVs is seen as a natural extension of this practice. The digital, two-way communication associated with the smart grid would make it easier, but it isn't necessary—researchers at the Electric Power Research Institute are currently testing load control with Ford and GM vehicles using wireless signals, as well as GM's OnStar system.

IN 2020, NOT EVERY GEV DRIVER IS GOING TO BE TALKED

into giving utilities final charging approval. PHEV owners might be more willing—they can always run on gas, if necessary. Commercial customers might also be game, since the charging spots they've paid for are essentially perks.

Which leaves you in a bind. Today, along with being the hottest day of the year, is your annual scheduled dealer maintenance visit. The dealership is 20 miles away. It's just past noon now. Unless your company's chargers are online when you get back, making it home could be a white-knuckle ride. There are no fumes to run on in an EV, and no fuel light to ignore.

EV dealer maintenance is both less of a hassle than if you drove an internal-combustion vehicle and more of a necessity. Electrification eliminates many wear-and-tear issues, or at least mitigates them. According to Nancy Gioia, director of global electrification at Ford, a San Francisco cab company using Ford Escape Hybrids went from changing brake pads every 10,000 miles to every 50,000 miles (regenerative braking absorbs most



of the car's kinetic energy before the pads engage). Oil changes disappear in EVs, and even in plug-in hybrids oil-filter changes could be reduced by a factor of five or 10.

But as mechanical failures become less of an issue, babysitting the expensive, complex and potentially explosive battery pack requires a new approach to maintenance. GEVs will regularly assess and wirelessly transmit battery-health updates to dealers or mechanics, in the same way that modern jet aircraft can send maintenance alerts to ground crews while in midair. Nissan is currently setting up its own global data center to manage this information, and GM expects to use its OnStar telematics system to do the same.

That's why you're on your way to the dealer—to check on the battery's health and, more importantly, to take advantage of an invitation to try a firmware update, which should optimize the EV's battery pack, expanding your range by 5 percent. Missing this visit could mean waiting months for the software's full release. There are thousands of apps for GEVs, most of them changing the way vehicles handle data. But tweaking the algorithms and code at the heart of the car's performance takes an authorized mechanic.

In fact, the EV revolution eventually could deal the final blow for automotive DIY. "For the do-it-yourself mechanics, without having a tie-in to the infrastructure or the systems that allow you to talk to the car, it's going to get more difficult to diagnose and address the electrified vehicle's needs," Ford's Gioia says. Those dead set on modding their GEVs will have to contend with the usual voided warranties, plus new risks associated with high-voltage equipment and battery cells that can detonate when overheated. But the true gearheads aren't exactly dinosaurs—with more than 280 million nonelectric cars in the country in 2020, there's still plenty of axle grease and hydraulic fluid to go around.

You barely have time to pick out a magazine in the dealership's waiting room before the tests are finished. Back on the road, you notice the battery gauge has taken a sudden nose-dive to 40 percent. The tests they ran at the dealership sucked out what little safety margin you might have had. If the work chargers are still cut off, there are only a couple of options for getting home: Either stop at the mall and kill a few hours while the car sits in a complimentary charging spot, or get to a fast charger.

BY THE END OF 2010, THE DEPARTMENT OF ENERGY WILL have installed 50 Level 3 fast chargers, each running at 50 kilowatts, in the San Diego area. Theoretically, the presence of fast chargers can reduce the so-called range anxiety that keeps EV drivers from pushing the limits of their battery range. In an

ongoing study that began in 2007, the installation of a handful of Level 3 chargers in Japan encouraged participants to drive their EVs as much as 80 percent more often, and 30 percent farther from their homes. In fact, almost none of the subjects actually used the fast chargers—the high-voltage, high-priced equipment is as much a psychological tool as it is a piece of electric transportation infrastructure.

But as Mark Duvall, the Electric Power Research Institute's director of electric transportation, points out, it's hard to come up with a worse investment than a \$50,000 charger that no one uses. (Public Level 2 chargers run \$5000 to \$10,000.) One key reason drivers might be avoiding fast chargers: Twenty minutes is still way too long to wait. To get charging times down to 5 minutes—more than the average gas station fill-up, but not by much—means installing chargers capable of 250- to 600-kw output. On paper, the numbers add up just fine: More kilowatts mean faster recharge rates. Even sticking with the math, though, ultrafast charging becomes an unwieldy and even frightening prospect. "For 5-minute charging, you've got to go to 600 kw," says Don Hillebrand, director of the Center for Transportation Research at Argonne National Laboratory. "That's how much power you put in a city block." With that sort of industrial-strength output, capacitors could take 20 minutes to recover between charges, provided the utilities would even allow such stations access to the grid.

PROPONENTS OF FAST CHARGING SEE DISTRIBUTED STORAGE

as the key to making the technology feasible. "You can populate L.A. with 250-kw chargers and have 250-kwh storage units right there with them," says Kristen Helsel, vice president of EV solutions at AeroVironment. "As you take power from the grid, you can put it back in." These stationary batteries could be charged by solar power or off-peak grid electricity, or by something more innovative, such as hydrogen fuel cell generators.

Whether or not anyone would commit to that level of capital investment, the physics still gets in the way. "Batteries don't like getting hot," Hillebrand says. Even if a new generation of batteries could survive years of fast charging, a hardware failure during a Level 3 charge could be fatal for nearby humans. "People don't think about the phenomenal amount of heat generated when you move that much energy that fast," Hillebrand says. "When you look at dealing with potential arcs and thermal events, I don't see it as even remotely possible by 2020. And our guys are the ones who write the standards for these chargers."

The fast charger you pull up to is the more common 50-kw variety. It's located in a desolate spot in Sun Valley, a drive-through kiosk in the parking lot of an industrial metal supplier. Even at 50 kw, handling a steady

CONTINUED
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It's a
***Beautiful Day for
a Flamethrower***

OR A CATAPULT OR A SPUD GUN—ANY DAY WORKS FOR BILL GURSTELLE, MAD SCIENTIST OF MINNEAPOLIS.

By HARRY SAWYERS

Photographs by CHRIS BUCK

ON A WARM LATE-SUMMER EVENING, a crowd gathers in the parking lot of the Susan B. Anthony Middle School in Minneapolis, Minn., to watch a man in a navy blue jumpsuit as he prepares to fire his catapult. He pivots the 800-pound machine by its fir and oak beams, aiming it at a grassy slope about 80 yards away. Passing dog walkers pause, kids lean bikes on kickstands, and a security guard strolls over from the school to get a closer look.

"We'll be doing some flinging before long," says the man in the jumpsuit, William Gurstelle, the catapult's builder.

On one side of the machine's central fulcrum hangs a counterweight filled with 400 pounds of rocks and lead shot. On the other side of the pivot is an elegantly tapered 5-foot-long throwing arm pointing skyward. Gurstelle grabs the tip of the arm and pulls it down nearly 180 degrees until it's almost perpendicular to the

Why fire a flamethrower on the front walk at six in the morning? "To master a grandly exciting, arcane and perhaps even diabolical technology," the machine's builder, William Gurstelle, says.



X

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"My grandfather liked to build things, but he wasn't that handy. He was a 'bigger hammer' type of guy. We'd hit a snag working on a soapbox derby car, and he'd say, 'We just need a bigger hammer.'"

asphalt, then latches it to the catapult's base. The 400-pound weight rises in opposition, poised like a boot ready to kick. Gurstelle gathers the ammunition: baseballs impaled by eyebolts, a box of gym socks and a bottle of lighter fluid. He drops a ball into a sock, hooks it to a sling at the throwing arm's tip, soaks the stuffed sock in accelerant and sets it all on fire.

Gurstelle steps back as the flames flicker and tightens his grip on a 6-foot rope tied to the latch pinning the throwing arm. He counts to three and yanks the line. The latch springs, the weight drops, the catapult creaks, and the throwing arm rises like a basketball player making a hook shot. The ball slings upward so fast that the flames seem to disengage. But the stocking stays ablaze, a low-level comet in a sizzling line drive. It hits the grassy hill with a thunk, ricocheting embers of sock elastic, and rolls down to the parking lot. "Is that a tray-boo-chit?" a bystander asks. "Correct," Gurstelle says, "except that it's treb-yoo-SHAY."

Gurstelle seizes any opportunity to educate his audience. He explains how to build a model of this particular trebuchet in his third book, *The Art of the Catapult*, with copious details on its role in the siege of Scotland's Stirling Castle in 1304, where it was known as Ludgar the War Wolf. Gurstelle's sixth book, 2009's *Absinthe and Flamethrowers*, balances smoke-bomb recipes with studies suggesting that a reasonable amount of risk-taking can make you a happier person. "I find a certain nobility in living a little more dangerously than the average guy," Gurstelle says.

Gurstelle got his first taste of danger during downhill slaloms on soapbox derby racers that he and his grandfather built using broken chairs and scrap lumber from the family's house in St. Paul. Gurstelle says his grandfather was a "bigger hammer" type of guy—construction snafus can all be solved, the thinking goes, by pounding the project with a bigger hammer. Lessons in precision came from Gurstelle's phar-

macist father, who stocked Gurstelle's basement chemistry sets with vats of hydrochloric acid and metallic zinc. Gurstelle soon began modifying equipment, bending glassware into alembics and pot stills. Before long, he was cooking up his own gunpowder.

DESPITE GURSTELLE'S PROWESS, HIS WORK

rankled his teachers. "I was always told I had great potential but wasn't living up to it," he says. He struggled to find his niche, even after earning a degree in mechanical engineering from the University of Wisconsin. Working as a manufacturing engineer, he was bored welding tiny electrodes to other tiny electrodes. He left for a job designing industrial ovens and furnaces. "Grinding, punching, shearing, making ovens big enough to dip a Toyota into. It's what all American industry should be like," he says. But he lost interest in continuously redesigning the same oven. So after a misguided detour into an MBA program—"I thought I'd be this captain of industry," he says—Gurstelle wound up with a gig as a billing analyst for Northwestern Bell. "Who could be happy doing that?" he asks.

Tinkering after hours during those dreary years, Gurstelle compiled test notes and performance data on the devices he built in his spare time—potato cannons fueled by hair spray, bratwurst missiles launched on bursts of compressed air or ghostly floating orbs made of plastic dry-cleaner bags and Sterno cans. The plans for 13 projects eventually became the manuscript for *Backyard Ballistics*, his first book. After its publication in 2001, Gurstelle quit the telecommunications industry. "And I never looked back," he says.

He found satisfaction as a full-time



writer publishing plans for his projects. "Having control over the physical environment lets me parse it out and see what's inside it," Gurstelle says. After demonstrating his creations, he encourages his fans to go forth and tinker. "Not to be too highfalutin about it, but I think there's something good and noble in getting people interested in finding out what they can do," he says.

Sometimes Gurstelle hears about the results. A *Backyard Ballistics* reader once wrote to tell him that she still has the first spud gun she built, a family collaboration executed per Gurstelle's instructions. "It is one of the strongest memories I have of my dad and me together before he passed away. Thank you," she wrote.

THE DAY AFTER THE CATAPULT LAUNCH,
the scent of peeled potatoes permeates
Gurstelle's shop. Inside the concrete-walled room on an alley behind his home, a mesh sack of russets shares space on the workbench with PVC

scraps, tees, purple primer and a Stanley SharpTooth crosscut handsaw. Labeled bins along each wall hold grinding wheels, copper tubing, rope, clothespins, casters, measuring cups and muffin pans. "A clean workbench is a happy workbench," Gurstelle says, sweeping the plastic plumbing pieces into their respective containers. Gurstelle leaves a dog-eared copy of the *Mechanical Engineering Reference Manual* lying open on the table, turned to a page of uniform acceleration formulas. Next to it, a stack of graph paper covered with scrawled equations and computations contains the lab notes on a supersize spud gun.

Gurstelle wants to see those notes in a science-class lesson plan on particle kinetics. "The potato only goes in two directions—up and down—but you can tell a lot of stuff from that," he says. "Acceleration, muzzle velocity, altitude of apogee—I like to know these things." He has received one letter in support of his vision, from a California high school



senior who used *Backyard Ballistics* to co-teach an elective course. "I want you to know that the students in the class are both having fun and effectively learning science," he wrote. "Thanks for making such great experiments available to all the amateur scientists of the world!"

Out in the alley, Gurstelle sets up his latest cannon—82 inches of PVC pipe emblazoned with stickers that read, "Noisy Plumber." The gun is mounted vertically on a plywood stand, steadied on the concrete by 10-pound barbell plates. At the coupling where the gun's barrel meets its combustion chamber, purple stains of PVC primer show beneath the hardened ooze of excess cement. A threaded end cap, skewered by a flint-and-steel lantern sparker, seals the chamber. This allows Gurstelle to ignite the cannon without touching a flame to the fuel—unscented Aqua Net.

Gurstelle approaches the gun with a potato and a broomstick. He twists the spud, forcing it into the barrel, and then uses the broomstick to tamp it down. With deft motions, Gurstelle unscrews the end cap, spritzes a cloud of hair spray into the combustion chamber, pops the lid on and spins the igniter.

Listening to the potato launch, it becomes clear how Gurstelle settled on the title of his fifth book, *Whoosh Boom Splat*. He watches the russet shrink to a pinprick against the blue sky while a stopwatch measures seconds aloft. A seeming eternity after the whoosh and boom, a neighbor's concrete patio gets the splat. Vibrations from the impact cause Gurstelle's deaf dog to bark wildly nearby. The engineer rushes to his notebook, plugging in variables to document the results of this 8.8-second flight: muzzle velocity, 96 mph; apogee, 315 feet. "I said 4.4 seconds, right?" Gurstelle asks. He double-checks the numbers. Problem solved. The Noisy Plumber is

ready to debut in public education. All Gurstelle needs now is an audience. **PM**



- ✖ 1. A diagram for a four-barrel pneumatic gun, which Gurstelle will likely use to fire rolled-up T-shirts into crowds at college football games, shares workbench space with potato-cannon fodder.
- ✖ 2. With socks and lighter fluid ready nearby, Gurstelle prepares his trebuchet for a fling in the parking lot of a Minneapolis middle school.



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A close-up photograph of the front left side of a black Chevrolet Camaro. The focus is on the shiny, multi-spoke silver alloy wheel and the dark, ribbed tire. To the right, the car's bodywork features a distinctive black and white checkered racing stripe pattern. The background is blurred, showing a brick wall and some foliage.

PM

TOP
SHOP

PROJECT CAMARO

Part II, Chronicling the true story of a small New Jersey restoration shop faced with a huge challenge!



Last month, we told you about the Popular Mechanics Top Shop Project Camaro. We started with the hottest new muscle car of 2010 and set out to create something truly unique. Something that's clearly a Camaro, but also clearly something much, much more. We wanted to boost the performance, maximize visual drama and install a level of technology unprecedented in new car showrooms.

SEE THE TOP SHOP COME TO LIFE ON YOUR SMART PHONE!

Good news for readers: This story delivers fresh new supplemental video content via 2D barcodes. To experience it, follow these three simple steps:

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LOOK AT THE INTERIOR OF OUR
INCREDIBLE CAMARO!**

TOP SHOP



SCANLIFE

Tip: Position your phone so that you can see the barcode in the screen so that it fills about half the screen.

To do this, we reached out to custom car builders nationwide and ended up with a small, family-owned shop in New Jersey that specializes in restoring old sports cars and modifying new ones. Why'd we choose Netcong Auto Restorations instead of one of the 24 other finalists? Because they're different. Phil and Dana Brazer, the former high school sweethearts who own the place, left lucrative careers in corporate America, risking everything they own, including their children's college funds, to pursue their lifelong dream: working together and working with cars. But when they left their corner offices, they didn't leave what they'd learned in them behind; they applied the systems, practices and attitudes that make big American business such a success story to their small car restoration—and now modification—business.

That's not to say that Netcong lacks experience with cars. The Brazers drew from a lifetime's experience collecting rare cars when embarking on their new enterprise, and, more importantly, hired employees that Phil likes to describe as "child prodigies" despite their grey hair and collective 119 years of professional experience spread across just three men. His reasoning? They started doing what they do as young as eight years old. If they'd been piano players, they'd be selling out Carnegie Hall. Combine that kind of expertise with Phil and Dana's professional management and communication skills, and you have a recipe for a truly unique auto shop. At least that's what we were thinking when we chose them.

Did our gamble pay off? Judge for yourself. Dana drew the original sketches that have now been transformed into one very wild Camaro. Starting at the front, an extra pair of Chevy's stock headlights have been grafted into



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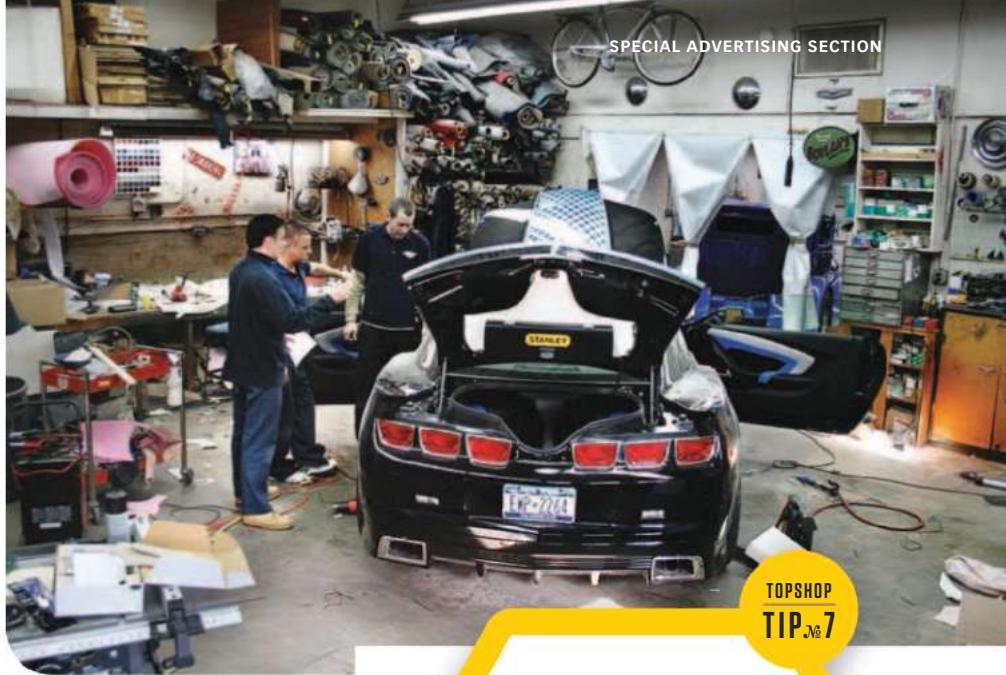
Solo Classic subwoofers deliver the bottom end in Ryan Sheckler's 2008 Ferrari F430 | www.kicker.com

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ABOVE:
CHANGING THE OIL WITH
MOBIL 1

RIGHT:
CREATIVE AUTO
INTERIORS TEAM AT WORK



TOPSHOP
TIP #7

DON'T TRY TO REMOVE
THE CAMARO'S STOCK RADIO,
DOING SO WILL DISABLE FUNCTIONS
LIKE THE HEATING VENTILATION / AIR
CONDITIONING CONTROLS, ON STAR AND
EVEN THE HEADLIGHTS WHICH ARE ALL ROUTED
THROUGH THE SILVER BOX BEHIND THE HEAD UNIT.
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the custom grille, accentuating the width of the front end. That grille's deeper now, while the Camaro's stock nose-mounted intake has been made drastically larger, and the hood has been brought forward to house it. That intake feeds the Paxton NOVI 1200SL supercharger, which adds 6.5 to 7.5 PSI of additional air pressure, increasing power by 45 percent. Starting with a 426 HP, 6.2-liter,

Corvette-sourced V8, we now have around 600 HP and 600 lb-ft of torque to play with. Keeping the intake air cool, and therefore more oxygen-rich, is a huge intercooler that you can see through the menacing grille. The intercooler is so big that it blocks off much of the radiator, but that hasn't reduced the cooling capacity. The other function of the new hood scoop is to block off the radiator housing, channeling the cool air flowing through the grille, up and over the intercooler and through the radiator.

Power is sent to the rear wheels through an MTI quick shifter and put to the ground by high-performance Cooper RS3 tires mounted to 20x9.5-inch BBS alloy wheels. The Camaro's fake brake vents have been opened up and now feed cool air to the stock rear brakes. The front and rear brakes have been upgraded with Leviathan 15-inch rotors, while the front brakes utilize custom blue 6-piston Brembo calipers courtesy of SLP Performance Parts. The stock calipers in the rear share the same custom blue Dupli-Color paint.

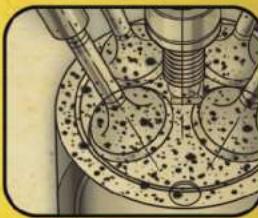
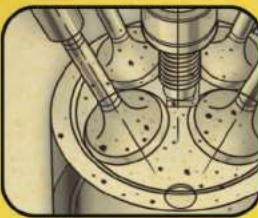
The extra power should give us a top speed far in excess of the stock vehicle's 155 MPH limit, but we'll be able to triple highway speed limits safely thanks to a functional rear spoiler that adds about 200 pounds of downforce at just 100 MPH. The guys at Netcong hand-fabricated it from steel, integrating it so well that you can't tell it wasn't originally part of the car. The spoiler, along with the two extra front headlights and rear taillights (Corvette California



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HAL

Painter and Mechanic

"Dupli-Color sent us some really awesome paint. It took us four days to paint the Camaro but the result is nice and vibrant."

The Brazers met Hal after seeking down the creator of a truly extraordinary Corvette paint job that Hal describes as "average." Now, Hal says, "we're like family."

SCAN HERE FOR AN EXCLUSIVE LOOK AT THE DETAIL WORK DONE TO THE CAR'S EXTERIOR.



Special-style), is responsible for creating a shape that's clearly Camaro, yet deviously altered into something altogether more menacing and purposeful.

That allegiance to the classic Camaro theme and the ability to twist it in a new direction are what define Netcong's approach to this Top Shop project. The blue in the paint job, for instance, is a '60s Corvette color (Marina Blue: 3-parts Dupli-Color base Silver to 2-parts Dupli-Color Deep Blue) that's been chosen to highlight the car's aggressive new lines. It looks futuristic, yet also somehow at home on the Camaro's retro body, probably because the two originated in the period of Chevy muscle cars.

Hal, the car's painter, describes his handiwork as, "something vibrant and crazy." For the checkered flag, silver was chosen over white to give the car a more mechanical vibe. In total, the paint alone took four days of hard work, but that wasn't as long as it could have been thanks to the Dupli-Color Paint Shop system, which comes pre-reduced in its cans, for easy mixing. Hal achieved the right color balance for the Marina Blue on his first try, mixing a

blue pigment with a Silver base. First to be sprayed on were two to three coats of Paint Shop Gray Primer to give the paint a nice smooth surface to bond to, then three coats of color were applied. Five layers add depth to the paint work while adding protection. Next was a five-coat layer of Dupli-Color clear coat which adds depth to the finish and protects the color from fading or scratching. The final step was wet sanding and buffing to achieve a perfect shine.

The exterior paint scheme is carried over to the interior, where



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SPECIAL ADVERTISING SECTION

TOPSHOP

TIP #8

AN OBD II SCANTOOL MIGHT BE COMPATIBLE WITH THE CAR YOU'RE WORKING ON NOW, BUT WHAT ABOUT IN THE FUTURE? IF YOU ONLY WANT TO BUY THE TOOL ONCE, YOU NEED TO MAKE SURE IT CAN BE UPGRADED WITH NEW CODES FOR NEW VEHICLES. MANY SCAN TOOL MANUFACTURERS WILL CHARGE YOU \$500 OR MORE PER UPGRADE, BUT THE ACTRON AUTOSCANNER PLUS CAN BE UPGRADED THROUGH ACTRON'S WEBSITE FOR FREE.

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the checkered flag is referenced by the black and white houndstooth accents on the doors, dash, headliner and seats. That pattern was also used on the original '67 Camaro, the vehicle this new one is styled after. See how cohesive the entire visual theme of the car is? It remains true to the original throughout so, despite how wild everything looks, it also just seems to fit the car. When cars are painted in a factory, they're cured at very high temperatures before any of the trim or rubber pieces are added. Since removing every piece of the interior and every seal from a car's body would be nearly impossible after the car is completed, it's impossible to cure a car to the same degree if you decide to paint it yourself. As a result, some of the curing takes place during the first 90 days after the paint is applied. You should wait at least that long before you wax an aftermarket paint job like ours. We're planning to display the Project Camaro at the Pocono 500 NASCAR race, the Route 66 Car Show in San Bernadino, CA, and the SEMA show in Vegas throughout the rest of the year. It's going to get covered in grime during shipping and with oils from people's fingers and noses at the shows themselves. To keep it in tip-top shape once that initial 90-day period is over, we're keeping a bag of Mothers polishes, waxes and cleaners in the car to take care of it wherever we go.

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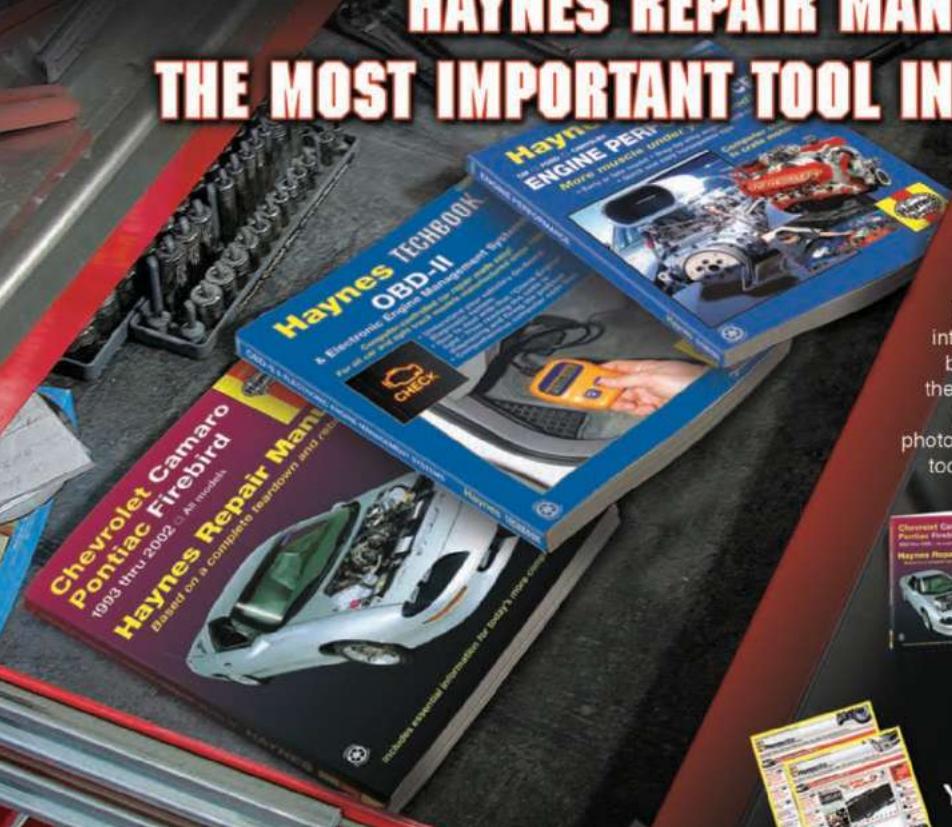
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Compatible with all 1996 and newer OBD II-compliant vehicles — which is just about everything — the AutoScanner Plus is not only capable of reading, displaying and erasing error codes, but interpreting them in plain English too. You can use the AutoScanner Plus for everything from figuring out why the "check engine" light won't go out to checking emissions ahead of an inspection. It's future-proof too; you can download compatibility data for new vehicle's right off the Internet. Buy one and enter the world of modern automotive repair.

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Mothers All Wheel and Tire cleaner will make keeping the BBS wheels and Cooper tires looking like new. It can dissolve all kinds of grime, grease and brake dust without harming the rubber or the wheels' finish. After doing that, we'll protect the dark chrome wheels with Mothers Chrome Polish; it won't just give us a shine, it will also keep pesky fingerprints from leaving a mark. When we first apply the wax, and in subsequent touch-ups, it'll be with a Mothers PowerBall 4 Paint drill attachment. It makes large surfaces a breeze, and it can deal with all the Camaro's sharp curves too. However while we're out on the road, we'll do quick touch-ups using Mothers California Gold Showtime Instant Detailer. It comes in a spray bottle, making last minute touch-ups or full-body cleanings a breeze. Not only does it clean, it'll enhance the Camaro's vibrant colors and add clarity and depth to give us a true mirror finish, perfect for showing off.

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Netcong contracted out the interior work to Creative Auto Interiors in Butler, N.J., which does a lot of work not only for Netcong, but for many of New York's luxury car dealers too. If they can make a modern BMW or Mercedes better than new, then working on this Camaro should have been a cinch—and it was, at least until it came time to integrate the custom electronics so they'd fit seamlessly into the interior. Re-profiling the seats for more lateral support and reupholstering just about everything in black leather, blue microsuede and houndstooth cloth was easy compared to installing the active FLIR night vision system, the hidden Netbook computer and the rear seat-mounted printer. Sit in the Camaro, and your attention is immediately drawn to the luxurious quality and vibrant colors of the new materials. But you have to look closely to see the new technology.

Flip down the sun visors and you'll find dual LCD screens. All three screens (one in the rear of the center console) can view any of the four available inputs: FLIR night vision, rear camera view, PS3 (gaming/DVD/Blu-ray) or an auxiliary input. The car is also equipped with a Sprint Samsung Moment linked to a blue connect unit for hands-free communications. An Escort 9500 CI radar and laser detector and a G-Meter were also added.

One area where the stock Camaro's interior is lacking is in the gauge department. Making things safer and more convenient are custom Sunpro gauges that not only allow us to pick and choose their placement and functions, but also provide much clearer—and therefore more useful—readouts. That's important in a car generating 174 HP more than stock; with every component under 45 percent more stress, clear gauge readouts can provide an early indication of trouble, potentially saving you from shelling out big money for repairs or, worse, being stranded by the side of the road.

While not in motion, both the Camaro's driver and front seat passenger will be able to take advantage of the onboard Netbook to pretend they're in the office working and not out exploring mountain roads that are abandoned on weekdays. It's mounted on a gimbal that not only fully retracts inside the glove box when not in use, but slides into position to serve either front seat. No need to hold the computer in your lap, it's designed to be used while attached to its mount. The computer is connected to the Internet via a 3G cellular data network, while cables provide a connection to onboard power and the printer. That full-color printer is mounted in the bolster between the two rear seats, spitting its paper out onto the right seat.

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Connected to the onboard performance meter, the netbook will allow you to compare 1/4 mile times, braking and handling forces, then print out and share your results for bragging rights.

We'll be keeping the interior spotless with Blue Magic cleaners. Products like the Blue Magic Leather & Vinyl Cleaner and the Carpet Stain & Spot Cleaner are safe to use on all the new materials in the Project Camaro. The interior's not all business though. Two sets of Kicker component speakers are mounted in the doors and within the rear deck. The tricked-out custom trunk houses four Kicker 10-inch subs and three amps (Two power the four subs while one fuels the component speakers).

Also back there is one surprise we weren't expecting: a trunk-lid mounted Stanley tool box made just for this Camaro and filled with tools that have been anodized black and printed with "PM Top Shop Camaro." Not only does this surprise kit contain every size ratchet bit and wrench we'd need to work on the car, but also a high-quality, liquid-filled air gauge, a flashlight and

even our very own pair of Stanley work gloves to match the car. It's all almost too nice to use, but if we had to, we'd feel safe in the knowledge that every tool we'd need is easy to access, high-quality and doesn't even take up any room in the trunk, thanks to the innovative mounting solution.

Looking at the interior during the day reveals an incredible level of attention to detail, striking colors and advanced electronics, all seamlessly working together. But, to really appreciate the Camaro's cabin, you have to see it at night. Blue LED

RODGER PISANI

Owner,
Creative Auto Interiors

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BUTLER, NJ 07405
973-838-5152
www.creativeautointeriors.com

"The stock Camaro interior is very basic. We've made it flashy without making it tacky."

Rodger's been with Creative Auto Interiors since it was founded in 1978, buying the company from his former boss seven years later when he was just 25.

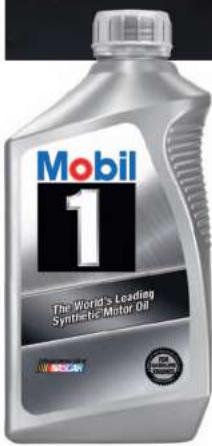




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accent lighting is secreted throughout the interior, invisible during the day but casting a high-tech glow at night, making things easy to find without impacting the driver's night vision.

Of course, this 600 HP Camaro's not just for looking at, it's for driving fast, and that's what brings us to Texas during a torrential, three-day-long downpour. We're at the The Cooper Tires Tire and Vehicle Test Center (TVTC), a giant automotive playground located in the usually reliable weather of south Texas. Equipped with a two-mile oval track, a 1.3-mile handling circuit (think road course), a 14-acre wet skid pad and a huge selection of off-road trails and obstacles, the TVTC has been specifically designed as the ideal place to evaluate and develop tires.

While often ignored by casual drivers, tires are probably the most important component of any vehicle. They're the only part on the entire car that actually touches the road, so every function has to work through the four black hoops. You can throw thousands and thousands of dollars at an engine to make it more powerful, but without an appropriate set of tires, it'll spin the wheels instead of accelerate. You can fit lower, stiffer suspension, but without equivalent tires, the extra handling ability will be lost for want of grip.

The TVTC is where and how Cooper develops all of its tires. In fact, the facility offers such an exhaustive degree of testing that other tire manufacturers regularly rent time there to develop their own products. Every single aspect of vehicle performance can be evaluated here, aside from outright top speed and winter driving, which is done in northern Michigan. That makes the TVTC the perfect place for us to put the Project Camaro through its paces.

There are two problems with that plan. One, it's raining, hard. Two, by drastically increasing the performance level of this Camaro, we've also narrowed the range of conditions in which it's easy to drive. It's faster, but now it's got so much power that it can easily spin. It corners harder, but now you'll be traveling

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faster if things go wrong. Luckily, the TVTC comes with its own resident race car driver, Ali Aljibouri, who's raced everything from open-wheeled formula cars to D1 drifters. Ali's agreed to evaluate the Project Camaro back-to-back with a stock Camaro SS, which will reveal where and how we've made improvements.

First up is the wet skid pad. A huge asphalt square, the entire pad is constructed on a perfect one degree slope. Equipped with a sprinkler system at the top and sides and recycling drains at the bottom, this allows the water to flow across the pad at a known rate, creating a uniform one-tenth of an inch of water across the entire pad. Not only does this allow Ali to evaluate the rate at which a tire can clear water through its grooves, but tight corners, continuous circles and slaloms created with cones allow him to measure the outright grip possible in these conditions, and on-the-limit handling characteristics like the balance between understeer and oversteer, and how easily the car transitions between slide and grip.

The stock Camaro is already a fast, capable car, but with the stability and traction control systems switched off, the front end will understeer before wildly snapping into oversteer. The transition is so harsh that spinning is a possibility, even when you're anticipating the snap and are ready to counter-steer to catch it. Despite the added power, the Project Camaro is far friendlier.

TOPSHOP TIP #9

IF YOU SPILL COFFEE ON INTERIOR FABRIC, DILUTE THE STAIN IMMEDIATELY WITH COLD WATER, THEN BLOT WITH A TOWEL TO ABSORB THE LIQUID. IF THERE'S STILL DISCOLORATION, SOAK THE AREA IN GLASS CLEANER. THIS WILL DISSOLVE THE STAIN AND ANY COATING ON THE THREADS OF THE FABRIC, BUT WILL LEAVE THE MATERIAL MORE SUSCEPTIBLE TO FUTURE STAINS, SO RE-APPLY A CLEANER LIKE BLUE MAGIC HEAVY FOAM UPHOLSTERY CLEANER, WHICH WILL RE-SEAL THE FABRIC WHEN IT DRIES.

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FROM THE SKID PAD AT THE
COOPER TIRE TEST TRACK

TOP SHOP



SCANLIFE

PROJECT CAMARO
CUSTOMIZED SS

STOCK CAMARO



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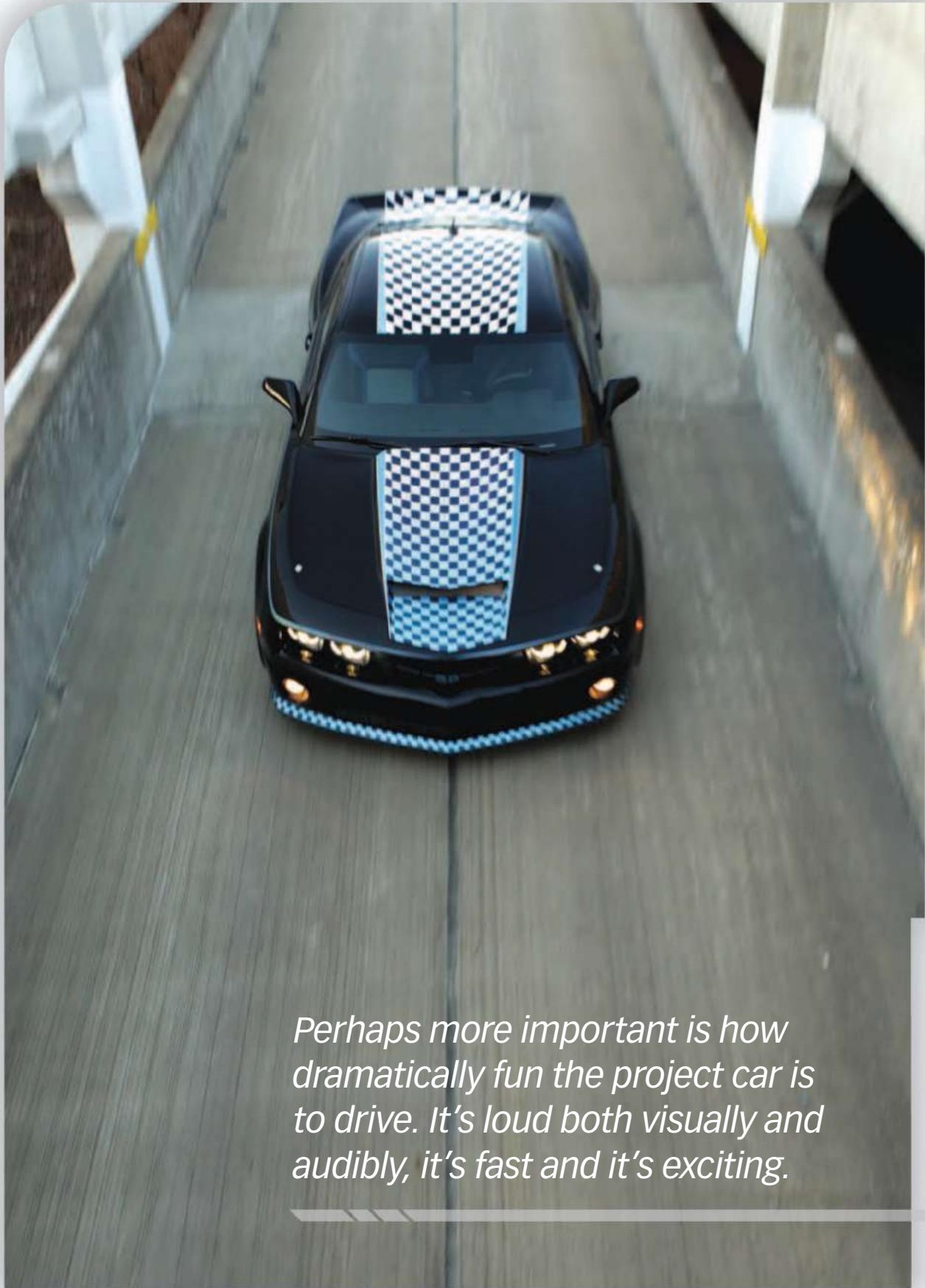
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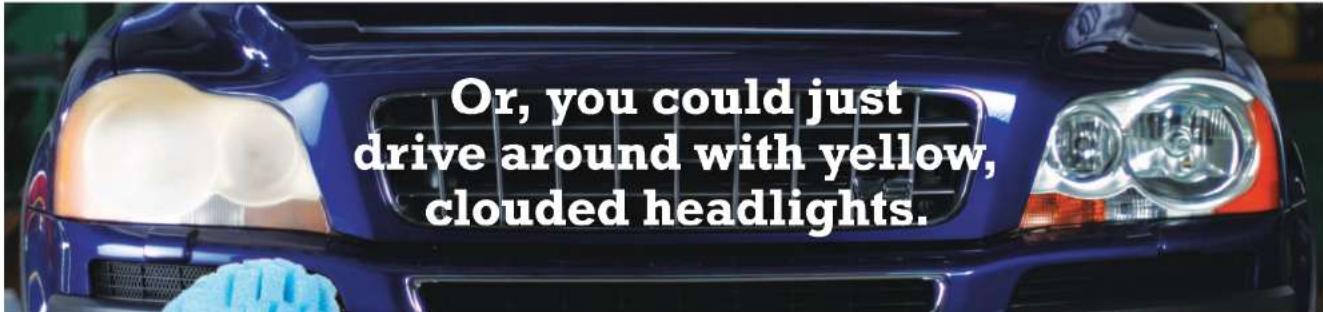
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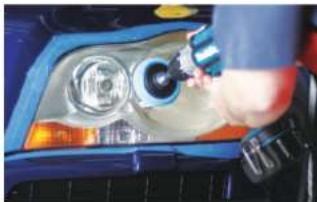
Perhaps more important is how dramatically fun the project car is to drive. It's loud both visually and audibly, it's fast and it's exciting.



Or, you could just
drive around with yellow,
clouded headlights.

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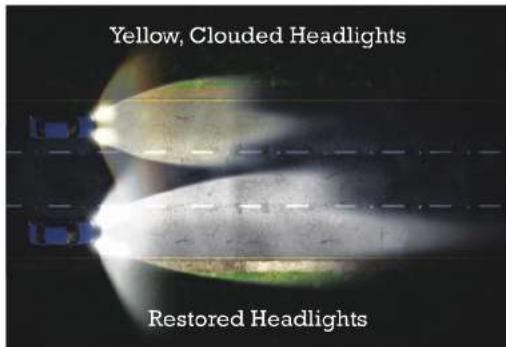
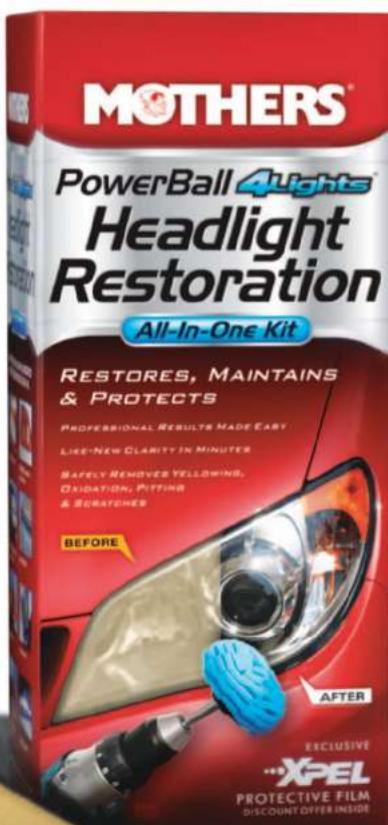


Sunlight, heat, cold, rain, smog, and harsh chemicals can accelerate the effects of oxidation, dulling and degrading headlights.

STEP 1: Prep. Works with any cordless drill.
Apply a nickel-sized amount of PowerPlastic® Polish.

STEP 2: Polish. With Mothers® PowerBall 4Lights,™ headlight restoration is safe and easy.

STEP 3: Shine. Buff clean with microfiber towel. Enjoy the crystal-clear results.



Not only is this an unsightly problem, but lower light output also reduces your ability to see at night, creating a serious safety concern.

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MOBIL 1

Mobil 1 5W-30 is specially tailored to work in GM's LS-series of V8s. The fully synthetic oil provides superior wear protection to mineral oil counterparts while keeping all the parts it lubricates exceptionally clean. Not only can Mobil 1 increase horsepower through reducing frictional losses inside an engine, but that results in increased fuel economy and engine life too. It works across a huge temperature range too, pouring smoothly all the way from -53°F to 400°F.

www.mobil1.com

Understeer is now resisted at noticeably higher speeds under identical conditions, while hitting the throttle mid-corner results in a soft, easy transition into oversteer that's eminently controllable. Throughout the whole process, our Project Camaro telegraphs what it's doing to the driver. Clear communication between the car and the driver is almost more important than outright ability, and it's rare to find in any muscle car, much less one with this degree of power.

What's the reason for the improvement? Adjustable sway bars on the project car allow us to slack off the front end's tendency to resist body roll, increasing grip. The tires are now far more capable, and the adjustable Bilstein shocks work to keep them in better contact with the ground more of the time. You've probably guessed it by now, but we're not just at Cooper's test facility because they have a great track; we're also using their products. Where the stock Camaro leaves the showroom equipped with performance tires, our project car is wearing Cooper Zeon RS3s.

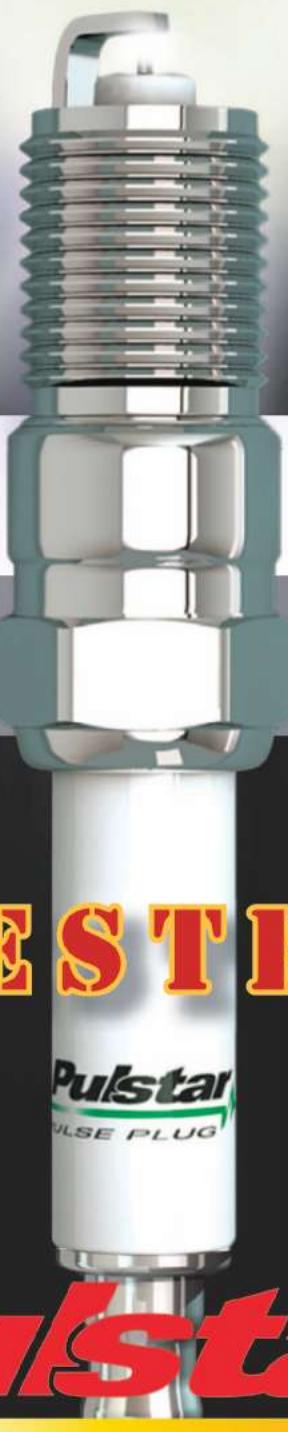
We wanted to see how big a performance difference the tires alone were responsible for, so we fitted them to the standard Camaro. A few laps around the wet skid pad later, the vehicle entered "Oil Starvation Mode" and limited the car to 8 MPH. The RS3s were able to pull so many extra Gs on the wet surface that the LS3 V8's oil pump was unable to keep up. Now, that's a tire.

Cooper didn't just stop with wet and dry performance when it developed the RS3. Ali estimates that the standard Pirellis wouldn't have lasted a full day of performance testing onboard the 600 HP Camaro. The RS3s endured three days of high speeds, heavy braking and driving sideways and hardly showed signs of wear.

TOPSHOP TIP #10

WEATHER AND OTHER HARSH ELEMENTS CAN RUIN YOUR PAINT IF YOU LET IT SIT, BUT CLEANING THE WHOLE CAR IS A PAIN AND JUST WIPING IT AWAY COULD RESULT IN SEVERE SCRATCHING. INSTEAD, SOAK A PAPER TOWEL IN UNDILUTED MOTHER'S CAR WASH AND LET IT ABSORB FOR A FEW MINUTES. THEN, SIMPLY HOSE IT OFF. THE SPECIALLY-FORMULATED CLEANER WILL BREAK DOWN THE STAINS AND PULL IT OUT OF THE PAINT, PREVENTING DISCOLORATION AND SCRATCHES.

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THE CREW AT WORK AND THE FINISHED INTERIOR



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One area where the tires were unable to help was in the wet braking tests. Despite six-piston Brembos and increased grip from the tires, the project and stock vehicles turned in near identical figures. The reason? The Camaro's ABS was calibrated to work with the limited capability of the standard equipment, and we didn't think to alter it ahead of testing. Braking to the maximum possible degree on slippery pavement left the ABS computer unable to keep up, releasing the brakes unnecessarily to compensate for nonexistent skidding. Because of the weather, we were unable to test dry braking, but the seat of our pants test revealed not only stronger overall brakes, but better pedal feel too.

Like all other production vehicles the Camaro has been designed not only to appeal to enthusiasts, but also casual drivers. People that just want to look good in their new muscle car don't want to sacrifice a luxurious, quiet ride. Those necessary compromises leave the opportunity to reap dramatic improvements to an already capable platform. The RS3s amp up steering feel and quicken the steering response; the adjustable MTI coil-overs and Bilstein shocks give us the choice of stiff handling or a smooth ride, but deliver plenty of feel in either mode; the whine of the supercharger, the scream of the cone filter with forced intake and the growl of the GM Performance cat-back exhaust with 2.5-inch tips add much needed aural drama to accompany the much-improved power. Unexpectedly, the added power across the rev-range by the belt-drive Paxton supercharger improves drivability too. Where the standard Camaro tends to bog at low speed with unpredictable clutch uptake, the added power in the project car makes pulling away smoothly a breeze.

The added power also means we need to take special care of the engine internals. They can take the added power but are under that much extra strain, increasing the likelihood of premature wear. Mobil1 offers a synthetic oil specially tailored to the Camaro's LS3 V8 that can provide unrivaled lubrication even at extremely high or low temperatures. Using it means we can push the engine to its newly maximized limits, confident in the knowledge we're not causing long-term harm.

Super-aggressive driving, like what we're doing on the test track, also puts added stress on any vehicle's fuel system. The Camaro's fuel-injection works extremely well at delivering both power and fuel economy, and to keep it that

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way, we're running Gumout All-in-One fuel system cleaner through by adding it to the gas we're using on the track. Doing so will ensure there's no water getting through with the gas, keep our valves free from power-robbing carbon deposits and keep the injectors flowing optimally. It also helps lubricate the valve surfaces and combustion chamber, which the Mobil 1 oil can't reach.

Of course, it'll pull away with conviction too. While we recorded a slightly faster 1/4 mile time for the project car in the rain versus what we've previously recorded for the stock Camaro in ideal conditions, the terminal speed for the project car was noticeably higher, indicating that once it got over the wheelspin in first, second and third gears, it really started to take off. In the same vein, while the 9.97-second 0-100 MPH time we recorded with the project car in the wet isn't terribly impressive for a 600 HP car, it still beats the number we previously recorded with the standard car in the dry by nearly a second, indicating our little project will simply run away from its sibling in comparable circumstances.

Perhaps more important is how dramatically fun the project car is to drive. It's loud both visually and audibly, it's fast and it's exciting. Just like the body, the performance feels like a Camaro, just the Camaro of your dreams rather than the Camaro of a built-to-a-price reality. In short, this car is exactly what we wanted to build.

With a feeling of "mission accomplished," Phil, Dana, Hal, Mick and the Top Shop team at Netcong Auto Restorations can now leave the time-consuming, deadline-maddening world of magazine restoration projects, and return to the "normalcy" of regular, every-day clients. A world where each day delivers new cars, new challenges, and a barrage of interesting personalities. Our guess is there's no place they'd rather be. ●

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Think this Camaro is ready for the big time? Evaluate the job PM's 2010 Top Shop did at pmtopshop.com. Post a comment and let us know what you think! Anyone that rates the job will automatically be entered to win a \$500 gift certificate from Rockauto.com and a Kicker 10-inch sub with a 500-watt amp.

While you're there, check out some really cool bonus coverage of the project, including video and extensive photos of the car.

No purchase necessary to enter or win. The PM Top Shop Sweepstakes. Sponsored by Hearst Communications, Inc. Begins May 1, 2010 at 12:01 AM EST and ends July 31, 2010 at 11:59 PM EST. Open to legal residents of the 50 United States and D.C. who have reached the age of majority in their state of residence at time of entry. Void where prohibited. Sweepstakes is subject to complete official rules available at www.pmtopshop.com



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Floor shown: Rialto Porcelain Tile in Noce #57954. Grout shown: Laticrete, Antique White Sanded Grout #50029.

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Hard Drivers

WE SINK ONE SCREW AFTER ANOTHER TO FIND THE BEST IMPACT DRIVER. *BY ROY BERENDSOHN*

→ **There's no telling** nowadays what people build. Decks, docks, tree-houses, pressure-treated retaining walls, sheds, fences and firewood racks are projects our readers have asked about recently. This work calls for lots of fasteners, especially lag screws. Only one tool combines rota-

tional speed and blows per minute in a way that makes it excel at driving these big screws: the impact driver. It's faster and more consistent than a drill driver and transfers less reaction torque to you. We gathered nine li-ion impact drivers, and a thousand screws later, here's what we found.

INSIDE

X

STRIPPING PAINT + SAFER DECKS + FLAG ETIQUETTE

PM
DIY HOME
///
IMPACT
DRIVERS



BOSCH
 26618-01

PRICE: \$395
RPM/BPM: 2800/3200
AMP-HOURS: 2.6
LAG SCREWS: 128

Likes: The Bosch is a capable driver equipped with three speed/impact settings. It seems the most likely to survive a drop off a ladder owing to its thoroughly protected rubber nose and handle.

Dislikes: The driver is larger and heavier than comparable products. Its speed/impact selector switch is hard to budge.

CRAFTSMAN
 79568

PRICE: \$220
RPM/BPM: 2500/3200
AMP-HOURS: 2.6
LAG SCREWS: 108

Likes: This is a straightforward tool with a helpful charge-indicator light on the face of the battery.

Dislikes: The 20-volt battery is too large relative to the driving power it provides.

DEWALT
 DC827KL

PRICE: \$330
RPM/BPM: 2400/2700
AMP-HOURS: 2.2
LAG SCREWS: 100

Likes: Compact and rugged, the DeWalt has a battery post that inserts into the handle, giving it a characteristic that some severe-use builders will value: It has the least amount of wiggle. It also has few exposed body fasteners, making it sleek and easy-handling.

Dislikes: No complaints noted.

HITACHI
 WH18DL

PRICE: \$309
RPM/BPM: 2600/3200
AMP-HOURS: 3.0
LAG SCREWS: 76

Likes: A simple sliding switch on the handle increases or decreases torque. We also think its pivoting handle-mounted worklight is a great idea.

Dislikes: The tool needs to catch up with other 18-volt competitors in lag-driving performance.

MAKITA
 BTD144

PRICE: \$350
RPM/BPM: 2600/3400
AMP-HOURS: 3.0
LAG SCREWS: 128

Likes: The Makita combines small size, light weight and powerful driving performance. Its three speed settings and responsive trigger permit better force adjustment, so you can apply more power to lags and less to Phillips-head screws—preventing strip-out.

Dislikes: Its charger is over-engineered and its graphics mysterious.



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PM
DIY HOME
///
**IMPACT
DRIVERS**



**MILWAUKEE
2650-22**

PRICE: \$319
RPM/BPM: 2200/3200
AMP-HOURS: 2.8
LAG SCREWS: 138

Likes: A lag-driving powerhouse. It drove the most lag screws and was among the fastest drivers in our multifastener time trials. It's ruggedly built, with a heavy nosepiece and plentiful rubber overmold protection, especially under the battery.

Dislikes: Nothing noted.

**PORTER-CABLE
PC18ID**

PRICE: \$190
RPM/BPM: 2900/2800
AMP-HOURS: 2.6
LAG SCREWS: 96

Likes: Neither a bell nor a whistle to be found on it. That austerity could explain why this tool offers such a reasonable amount of driving capacity for the money.

Dislikes: Clunky battery engagement.

**RIDGID FUEGO
R86030**

PRICE: \$170
RPM/BPM: 2400/3100
AMP-HOURS: 1.5
LAG SCREWS: 52

Likes: Part of the compact Fuego line, this driver is perfect for all but the largest jobs and turns in a respectable 35 screws per amp-hour.

Dislikes: You can't turn on its worklight separate from the motor.

**ROCKWELL
RK2800K2**

PRICE: \$220
RPM/BPM: 2400/3000
AMP-HOURS: 1.3
LAG SCREWS: 57

Likes: You won't lose this neon-green tool in the leaves, making it ideal for building cabins, ziplines and camping platforms.

Dislikes: Its art-deco motor housing is uncomfortable.

OTHER OPTIONS:
14.4-volt tools and impact wrenches

All the tools tested are more than enough for homeowners. So much so, we think 14.4-volt models are worth exploring. One example is the Panasonic EY7541, an impact wrench with a square nose like a socket wrench's. It uses an adapter collet to accept 1/4-inch hex-shank bits. It may be expensive (\$345), but it's a superb, industrial-quality power tool.

ALL LAG SCREWS USED WERE 1/4" x 3"



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Homeowners Clinic

by Roy Berendsohn

Q+A

To Strip or Not

Q The exterior wood trim on our 20-year-old house has hardened drips and blobs of paint everywhere. We're wondering whether we should strip the paint or simply replace the trim. Since the trim is not historically valuable, I don't think it's worth saving.

A Both stripping and removal are pretty radical solutions. I'd wet-sand big blobs of paint using water-resistant sandpaper on a hand-sanding block and a plastic spray bottle. Keep misting the surfaces down as you work, and use a garden hose to rinse pigment off nearby siding. You don't want pigment-tinted runoff to dry in place and stain the siding. For large areas, use a random-orbit sander and stearate-coated (paint-stripping) sandpaper. Empty the sander's dust bag frequently and consider hooking the sander to a shop vacuum to keep airborne debris to a minimum.



■ WORK BETTER

Stripping-Safety Toolkit

Paint stripping is already hard and dirty work; don't make it worse by not protecting yourself.

Eyes

→ Old paint is brittle, and chips can fly off a scraper, so wear safety glasses. Make that goggles if you're working overhead or using paint stripper that can splash.

Hands

→ Wear work gloves for handling scrapers and sandpaper. When working with paint stripper, you'll need chemical-

resistant gloves—don't use the dishwashing variety.

Lungs

→ A dust mask or respirator should have an R95 rating; a better mask will have a P100, especially necessary if there's lead in the removed paint. Wear a cartridge respirator rated for organic vapors when using paint stripper.

For areas that are truly in bad shape, stripping might save you some time over sanding. Remember to protect adjacent siding using painter's tape (the blue, green and purple types) sold at paint stores and home centers. Don't use tan-colored masking tape; that stuff

is only good for household (nonpainting) applications. Spread dropcloths on pavements or over shrubbery to protect them from falling globs of goo. Stripper will take you just so far, though. You'll have to scrape softened paint off curved surfaces and out of corners, so get

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PM DIY HOME // HOMEOWNERS CLINIC Q+A

yourself a selection of flat and contoured scrapers.

Many amateur painters overlook the following: A stripped surface usually needs to be neutralized and rinsed after the stripping is done; otherwise, the residual chemicals can discolor the paint and interfere with its bond. The manufacturer of the stripping chemicals will recommend a specific neutralizer, which could range from a mild acidic solution to a quick wipe with a clean cloth moistened with paint thinner. Finally, check with the town about how to dispose of the gunk that you strip off the trim. With a house that age, it's unlikely it contains lead, but you may need to dispose of stripped paint as hazardous waste.

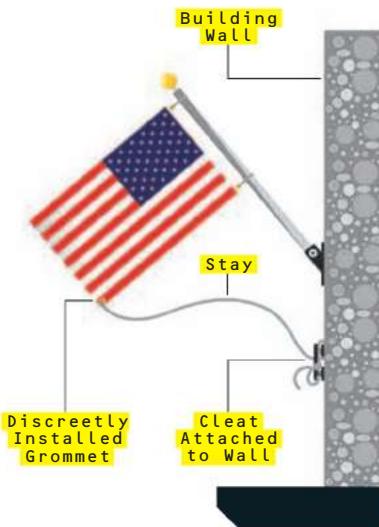
Untangling Old Glory

I fly my American flag a lot during the summer, using a pole mounted on my front porch. The wind whips it around, and I frequently return to find that it's a tangled mess. I was thinking of installing a freestanding flag pole to prevent this. Can a flag flying from a pole also get tangled? Just because I've never seen it happen doesn't mean it can't.

It's gratifying to hear about your respectful care of our nation's symbol. Compared to the method you're using now, a vertical flag pole is tangle-free, though putting down a footing for the pole and caring for the pole and its hardware can be a lot of work.

There are other solutions, some of them quite simple, such as displaying the flag vertically. Suspended in this position, the canton (the blue rectangle with stars; also called the union) is stationed to the observer's left when viewed from the street. For more on flag etiquette, see U.S. Code, Title 4, Chapter 1, "The Flag."

If you'd rather continue displaying the flag as you are, there are retrofit sleeves that slip over the pole and allow the flag to wave back and forth or even spin around the pole given



enough wind; there are also free-spinning and tangle-free poles that provide the same protection. Here in New York City, some of the flags that flutter gracefully from office buildings have a diagonal stay that is secured to a grommet at the lower corner of the flag. The rope is tied off to a cleat mounted on the wall of the building. That also seems to help greatly.

Raising a Stink

In the past couple of months, whenever I do a load of laundry, I get a strong sewer smell in the back of the house. The smell arises when the washing machine drains after the wash cycle. There are toilets, sinks and showers in the area where the smell is coming from, but their traps are full of water. I'm stumped.

Sometimes the answer to this is simple and sometimes it's not. First, get up on the roof and check that the vent stacks are clear. Falling leaves and nest-building birds can clog a house's drain vents. If needed, clear them with a piece of wire or a shop vacuum. These roof vents supply makeup air to the house's plumbing system. Without that makeup air, draining water (whether it's from the washing machine, a sink or a shower) will create a vacuum that's strong enough to siphon water out of one or more



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plumbing traps. A dry trap will let sewer gas into the house.

Next, check around the washing machine itself for signs of leakage in its drain. Finally, if everything appears in order, you'll have to call a plumber with a sewer camera and drain-clearing

equipment. Years ago I was living in a house that connected to a municipal sewer, and I had a problem similar to what you describe. The problem turned out to be that the municipal sewer was clogged and was backing into the sewer lateral—the line that connects the

house to the sewer below the street. The washer pumped out and filled the lateral, and although it did drain eventually, it also left some pretty nasty stuff behind. This stuff got stirred up when the washer pumped out the next load. The problem was most pronounced when the washer discharged. A drain-cleaning company ran an auger through the line from the basement cleanout into the street. That solved it.

Good Decks Gone Bad

→ THERE ARE ABOUT 40 MILLION WOOD DECKS IN THE UNITED STATES, MANY OF THEM 20 OR MORE YEARS OLD, ACCORDING TO THE NORTH AMERICAN DECK AND RAILING ASSOCIATION. WHILE THESE STRUCTURES DON'T COLLAPSE EVERY DAY, WHEN THEY DO, PEOPLE CAN BE INJURED OR KILLED. CARY, ILL., RESIDENT MARISA COSTELLO WAS ALMOST KILLED A YEAR AGO WHEN HER DECK GAVE WAY (RIGHT). A SIMPLE INSPECTION AND SOME CORRECTIVE CARPENTRY CAN PREVENT MOST OF THESE DISASTERS.



ADDING SAFETY Any deck has to conform to the local building code. A call to the municipal building department is in order. The same office may have copies of specific construction details that you should employ if you repair or completely

rebuild a deck. Also download the following PDF from the American Forest and Paper Association: "Design for Code Acceptance, Prescriptive Residential Deck Construction Guide, Based on the 2009 International Residential Code."

INSPECT YOUR DECK FOR THE FOLLOWING CONSTRUCTION DETAILS:

1	2	3	4	5	6
<p>A deck should be attached through its ledger to the rim joist using ½-inch-diameter lag screws with washers under the screw heads. You can also use nuts, bolts and washers. The deck should never be nailed to the house. All hardware should be stainless steel or hot-dipped galvanized.</p>	<p>The joint between the deck and the house should be protected with flashing to prevent water intrusion. Water from rain or melted snow that gets between the deck and the house is liable to rot the deck ledger or the house's rim joist. Even a rust-proof fastener will not grip if it fastens into rotted lumber. The deck will be at risk of collapse.</p>	<p>Stairs should not be nailed to the deck but attached with specific hangers designed to make a connection from the stair's stringer to the deck joist. Before the current building code, many stairs were firmly and safely attached with lag screws or bolts. Let common sense be your guide and install screws or bolts accordingly.</p>	<p>Handrail assemblies should not be nailed to the side of the deck. Posts should be supported with hardware such as that manufactured by Simpson Strong-Tie. Post and railing assemblies should be rigid. Rebuild or reinstall handrail assemblies that wobble.</p>	<p>Deck joists should be attached with hot-dipped galvanized joist hangers and joist-hanger nails, not roofing or common nails. Metal joist hangers designed for interior use won't hold up when used on a deck built of pressure-treated lumber.</p>	<p>If the deck is supported on a beam (and most are), the beam should be connected to its posts with an appropriate hot-dipped galvanized bracket. If toenails are driven through the beam into the end of the post, the connection is inadequate; install a bracket. — ROY BERENDSOHN</p>

Pressure-Washed Concrete

Our home in the Southwest has nicely done concrete patios and walks that look like they're 30 years old or more. We pressure-washed the surfaces and that did make them cleaner, but their color is uneven.

Pressure-washing concrete can be tricky for the reason that you describe. You can get it clean and evenly washed without the striping sometimes associated with pressure washing, and even after all that it still may not be as evenly colored as you would like. I'd suggest that you clean it with an acidic concrete/masonry cleaner, such as H&C Etching Solution. Afterward, apply a masonry stain to even out the color discrepancies.

Removing Metal Lath and Plaster

I'm doing some remodeling in my mother's house and need to remove some metal lath and plaster. I've already removed some. Tearing down these walls is enough to make a grown man cry. How can it be done efficiently?

Having tangled with that material, I've asked myself that question many times since. If I had to do it over again, I'd mark out the stud locations and saw between them using a heavy-duty circular saw and an industrial-duty diamond blade such as those made by Diteq Corp. New vacuum-brazed technology permits manufacturers to make extremely capable hybrid blades. In the past, there were blades that could cut plaster or masonry materials but not metal. New blades will cut anything in one pass. They're not cheap, of course. Expect to pay at least \$90 a blade, and you could go through one per room. I'd saw the vertical leg of each rectangle and then the bottom. Drop the piece

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.

free by sawing out the short side of the rectangle up top.

Obviously, this is brutally hard and dusty work. A house built using that plaster system will certainly have lead paint on the walls. I wouldn't even think of doing this without a dust-collection system that's up to the job. Again, Diteq and others have hoses and saw shrouds to keep the dust under control. You'll also need to wear a dust mask.

If you don't want to use a circular saw, I'd cut each rectangle with an angle grinder and an appropriate wheel

using a dust shroud and shop vacuum, as with a circular saw.

That leaves the lath and plaster on stud faces, along the top and bottom plates, and on window headers.

I'd smash the plaster off these with a hammer and go at the lath with everything from a ripping hammer to a crowbar or even a square-nose shovel. Show the stuff no mercy. Use end-nipper pliers to clip off nail stubs. Keep a reciprocating saw and some diamond grit or metal-cutting blades handy to deal with stubborn pieces of lath.

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S-HOOKS

1.→ S-hooks along the gate rails hang pots, pans, colanders and baskets. Spread out the hooks to avoid cookware clang.

WIRE ROPES

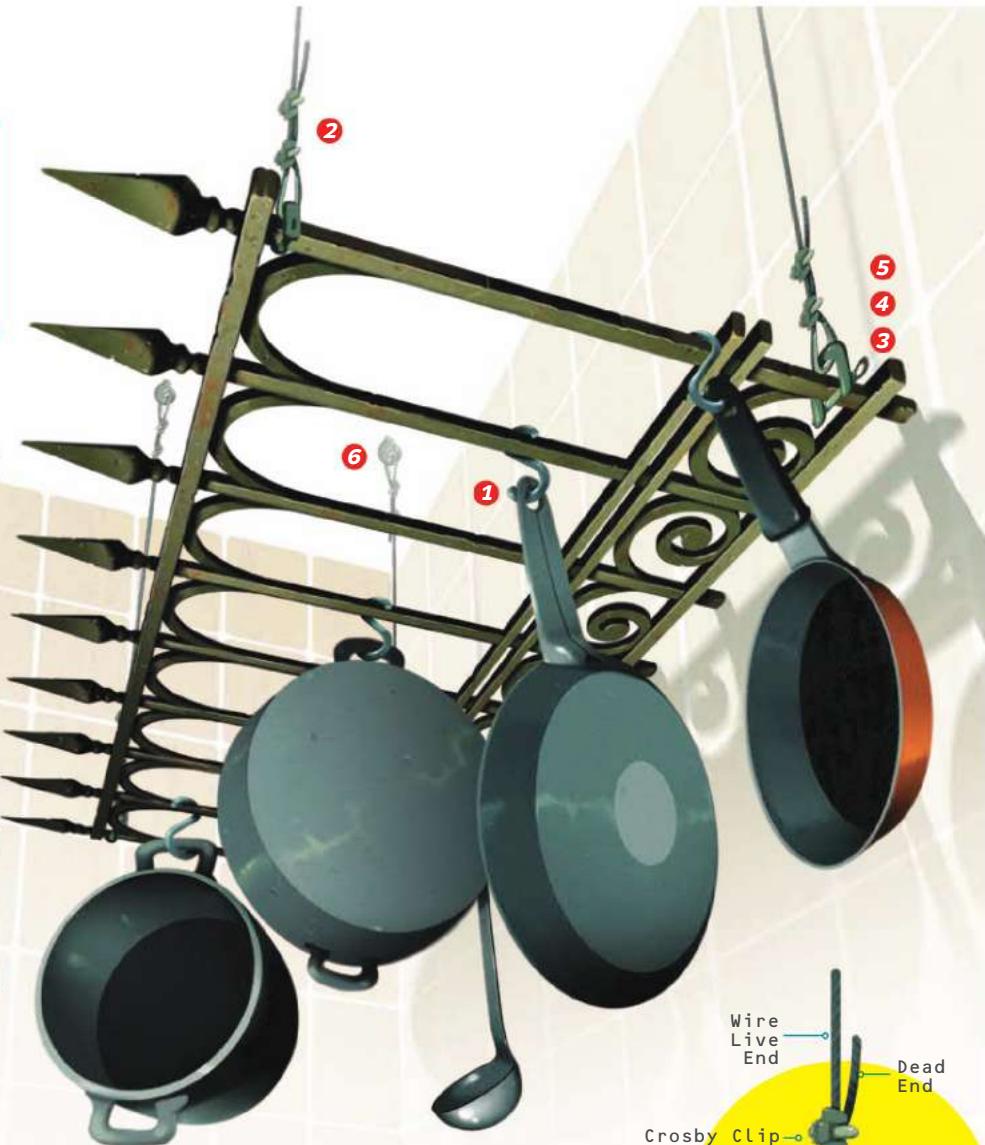
2.→ Wire ropes at the corners suspend the rack from the ceiling. Four type-305 stainless-steel ropes with a $\frac{3}{32}$ -inch diameter, a 7 x 7 strand core and a 700-pound breaking strength—that's plenty for Granny's cast iron.

D-SHACKLES

3.→ Wire ropes fasten to the gate using horseshoe-shaped anchor shackles or forged D-shackles. A $\frac{7}{16}$ -inch-thick pin slips into the D-shackle's $\frac{5}{8} \times 1\frac{1}{4}$ -inch opening.

THIMBLES

4.→ The wire rope loops through the D-shackle via a thimble, a curved, grooved track that prevents the wire rope from kinking in its U-turn.



WIRE-ROPE CLIPS

5.→ Threaded through the thimble, the wire rope fastens to itself using single-saddle Crosby forged wire-rope clips. Make sure that the clip's nut side (or saddle) fastens to the load-bearing (live) leg of the wire rope. As the *Rigging Handbook* says, "Don't saddle a dead horse."

LAG EYEBOLTS

6.→ Lag eyebolts with at least 2 inches of wood-screw threads anchor the wire ropes to the ceiling joists. Fasten the ropes using Crosby clips and thimbles slipped through each eyebolt. When all four corners are fastened, loosen and tighten the saddle nuts to adjust ropes one at a time until the rack is level.



+ MORE TO DO IN JUNE



Batten Down → Atlantic hurricane season begins June 1—a fine excuse to invest in functional exterior shutters.

Summerize the Ride → Rotate car tires and reset their pressure for higher temperatures. Don't forget the spare. If you changed over to winter-weight oil, replace it.

Set a Goal → FIFA's World Cup begins June 11. Rig a backyard goal from PVC and polyethylene netting. Train your kid to be the next Kaká.

Evict Ants → Carpenter Ant Awareness Week is June 20–26. Wood shavings on a window sill indicate infestation.

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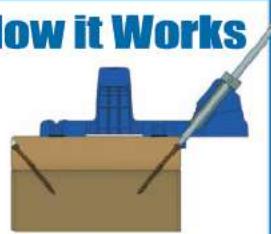


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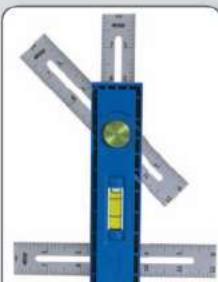
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Uncovering Battery Drains

THERE ARE PLENTY OF ENERGY-ROBBING DEVICES ON YOUR CAR THAT ARE SUPPOSED TO GO TO SLEEP WHEN IT'S PARKED. HERE'S HOW TO GIVE THEM A TRANQUILIZER. *BY MIKE ALLEN*

➲ **Your car won't start.** The battery is so dead that the dome light barely makes enough illumination to help you find the key slot, not that turning the key generates anything more than a muted click underhood.

Usually, a dead battery wouldn't be that big of a deal, right? Except your car is parked in an airport parking lot, it's raining, and your cellphone is dead. It's going to be a long, wet walk back to a pay phone to call AAA for a jump.

All is fine—until the next morning when it's déjà vu. A quick boost from your battery charger gets your engine running, and a charging-system

INSIDE ➤ COOLANT LEAKS + CURRENT CONSUMPTION + SPARE TIRES

voltage test confirms that your alternator is charging. Further poking around doesn't uncover an obvious electrical issue. After charging the battery overnight, the car starts fine. But when left overnight without the charger, the car refuses to start. Conclusion: Something's draining the battery. You've got parasitic battery drain.

Basics

→ **Most vehicles** draw some battery current when the key is off, thanks to the clock and the internal memory of engine computers, body-control modules and radio presets. Altogether, they draw a very small amount of current. Fifty millamps would be a safe upper limit for this, although many vehicles will draw less. If you're not sure, look up the correct rating in the service manual.

To measure the car-off current draw, you'll need a multimeter capable of reading current, preferably one with a 10- or 20-amp capacity, but a 200 milliamp lower scale. You can find these for as little as 20 bucks.

Start with a fully charged battery. Either make sure the doors are closed or wedge the door switch shut. Turning off the dome light isn't good enough—on many cars, an open door will activate several circuits. (One example: Open the driver's door on some vehicles and the fuel-pump relay briefly activates, to prime the fuel injection for faster starting. After the initial surge, that circuit will continue to draw over 100 millamps.) Unplug any power-draining cables from the lighter socket, such as a cellphone charger or GPS. Even if the device itself is unplugged from the charger, the plug may still consume a few millamps of current. Got an ear-bleedin' stereo amp in the trunk? Pull the fuse, because it may be in standby mode rather than completely shut down.

One caution: If your radio or antitheft system requires you to input a code after the power is interrupted, better hunt it down now. It's likely that you'll need it. Don't let the dealer entice you to bring the car in and pay him to input it. The code should have been included

START
1A

1B

1C

2



with the owner's manual when you purchased the car.

Start hunting by putting your ammeter in series with the battery's ground circuit. (It's safer to meter the ground because if you use the positive side, it's easy to short the jumpers to ground, which makes sparks and burns up wires. Short the ground to ground and nothing happens.)

Disconnect the battery's ground cable and wire the ammeter in series between the battery terminal and the

1. Start with a fully charged battery. Be sure the radio and lights are shut off. Unplug your cellphone charger, GPS or laptop. Close the door or hold the dome-light button down with a wedge. Remove the key from the ignition. Now use a jumper to bridge the battery's negative post to the clamp to preserve any memory and to keep from activating the antitheft code if your radio uses one.

2. Now you can put your ammeter in series with the post and clamp. When you remove your first jumper, the meter will read the current draw from the battery. Here, 61 millamps is just a little too much for comfort.

cable. Start with the meter on the highest range, probably 10 or 20 amps. Warning! Doing something silly, like trying to start the car or turn on the headlights—anything that draws more than the meter's rated capacity—can blow the meter's fuse. Once you have determined that the current drain you're reading is safe, gradually reduce the meter's scale to the appropriate low range, probably 2 amps or 200 mA. You are now reading the parasitic drain on the battery. Some vehicles will show as

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little as 10 mA residual drain. Others, probably high-end cars with lots of high-end gadgets, will draw more. An important note: Some devices, like alarms and automatic-dimming lights, will draw substantial amounts up to 20 minutes after they're deactivated. So if the reading is high, wait a few minutes to see if it changes.

You've determined you have excessive current draw from the battery. Now you have to figure out where. If it's not obvious, like the trunk light not going off, you have to get methodical. You can throw caution to the wind and start pulling fuses one at a time, until you see the excess drain drop off. Just be careful to get them back into the right socket.

Once you've determined the high-draw circuit, there still may be a half-dozen loads, each individually innocuous but collectively sucking the lifeblood out of your battery.

To zero in on that circuit or circuits, first reconnect the battery ground, taking care to maintain continuity through the jumpers until the clamp is making good contact. Then remove the offending fuse and use the leads of the multimeter to jumper the fuse terminals. I've got a set of dummy fuses—all three



3. Got a light in the glovebox? Maybe it's not turning off. Pop open the door and see if the bulb is hot, but don't burn your fingers. Perhaps the trunk light stays lit. You might need to get into the trunk and have someone you trust close you in to see if it's going out. Or just touch the bulb to see if it's hot. (The first way

is more fun.)
4. Once we narrowed the parasitic drain down to a single circuit, we used this test cable, which plugs in to the fuse box (grahamtool.com) to patch our ammeter in to the circuit. Disconnect, remove or turn off all the loads on the circuit one at a time until you identify the culprit.



PROXIMITY KEYS

Lots of new cars are available with proximity keys. They're a great convenience—all you need to do is walk up to your locked car with the key in your pocket or purse. As you approach the door, the locks pop open automatically. Plunk yourself in the seat and, with the key still in your pocket, thumb the starter button and drive away.

Guess how these things work. There's a radio receiver that continuously listens for the key's frequency. When the receiver hears a signal at its assigned frequency, it

wakes up to see if the key is the one that matches the car. That draws more current for a minute or two, until the receiver abandons the possibility that it's about to unlock the door for master. This might be an issue if you leave the car parked for many weeks without starting it. Imagine the confusion of a car parked near the elevator door in a busy parking structure. Every proximity key that walks past makes it sit up and beg, draining your battery for a few minutes. Soon, dead battery.

This issue is even more profound in the case of hybrids like the Toyota Prius. The key receiver operates on 12 volts, as do most of the accessories. More importantly, the 12-volt battery operates the main computer that controls

everything else, like the door locks. The Prius starter, however, operates off the 280-volt traction battery—but the main computer has to be powered up for anything to happen. Since it doesn't have to start the engine, the 12-volt battery of the Prius is very small, 38 ampere-hours. So while a 64-ampere-hour battery in a normal car can last for weeks of a proximity receiver checking for the right key, the Prius battery can run too low within a few days. Bottom line: Turn off the proximity-key function, from the Prius's electronic dashboard, whenever you're parking it longer than overnight. It might be possible to do this on other vehicles as well. Check the owner's manual.



sizes of blade-style and the old-fashioned glass ones—with attached leads that make this part simple. Next, with the help of the schematic diagram, disconnect each device on the circuit—one at a time—and check the meter. When the milliamp reading drops precipitously, you've found the problem. It could be anything, but in my experience, the following are the most common.

Alarms

→ **Aftermarket alarms** are notorious for sucking even healthy, fully charged batteries dry within a few days. If you have any non-factory alarms, it's the first thing you should check. Be aware that there may be more than one connection to the car's electrical system, and some aftermarket installers may use, ahem, non-industry standard splicing techniques. So you may have to simply follow the alarm wires to see where they go. More expensive alarms tend to be less problematic, but maybe that's because more expensive alarms are installed by better, higher-paid technicians.

Stereos

→ **OEM stereos** are usually not problematic. Aftermarket stereos, the kind with giant, finned boxes and their own finger-thick wires directly wired to the battery, can be. With a power lead bypassing the car's electrical system, they go into standby mode, waiting for the main radio head unit to tell them to wake up. In standby, they'll draw only a milliamp or three. If they fail to go into standby, or if the DIP switches on the amp are set incorrectly, they can draw as much as several hundred millamps, even though they're not producing any actual noise. Or music.

PM

Car Clinic

by Mike Allen

Q+A

Stubborn German

Q I'm trying to change the oil in the gearbox of my old VW Beetle. I can't get the drain plug to turn. Any ideas?

A A lot of German cars use that same 17-mm Allen-hex drain plug, and they can require some persuading. This plug is steel. It's screwed into an aluminum-magnesium-alloy transmission case with tapered pipe threads. After a few years of marinating in road salt and mud, electrolysis can weld the two dissimilar metals together. I've actually broken ratchets fitted with 17-mm hex sockets, so the first tool I usually reach for is my 17-mm Allen key. Slip a 2-foot piece of pipe over that, and you can get most stuck plugs to move. If a big cheater bar isn't enough, try heating the plug with a propane torch until it smokes. This will make the plug expand, faster than the highly conductive trans case. The asymmetrical dimensional change will crush the corrosion in the threads, releasing some pressure. Allow to cool, then use a cheater or a big dead-blow hammer to *tighten* the plug. Tighten until you can just perceive motion. Then you can (usually) unscrew it readily. I suggest using a dollop of anaerobic Teflon-based pipe-thread

→ **Loosening up ossified transmission drain plugs** can require the application of plenty of torque and, occasionally, some heat to get things moving. Try alternating tightening the plug with loosening it.

sealer (the same stuff you'd use on steel water pipe) when you reinstall the plug to prevent this happening again. The Teflon will lubricate the threads, and the anaerobic gel will preclude water, salt and oxygen from entering the interface between the steel and aluminum alloy.

Tire Dilemma

My car needs four new tires but my budget will allow me to buy only two at this moment. I'll need to use the two best tires left over. Where should I install the new tires?

Don't forget about the spare; using it may mean that you have to buy only three. Save the best of the old tires for the spare.

Regardless, the proper place to install two new tires only is on the rear of the car. That's because the tires with the least tread will tend to have less grip on rainy days, and you'd rather have more grip at the rear while going around a corner to prevent the car from spinning out. It's usually better to understeer off the outside of a corner headfirst than to lose control and hit





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something sideways or backwards. In fact, most tire shops won't install new tires anywhere else except at the rear for just this reason.

More Tire Stuff

I have a quick question about the spare tire in my car. I want to remove it because of weight concerns and fuel mileage. It would also open up more room for storage. I keep a pump in the car, along with a can of Fix-A-Flat in case I need it. Is this more common nowadays, or am I being silly by taking it out of the car?

No surprise, many new cars don't come with a spare as standard equipment, for exactly the reasons you've mentioned. And I've done the same thing when I needed to take a lot of luggage or camping gear in my two-seater Porsche 914. A 12-volt pump will reinflate a flat tire, or at least delay a slowly leaking one long enough to reach civilization. I



■ TOOL OF THE MONTH

Where
There's Smoke

A blown head gasket is a terrible thing. Generally, the resultant leak is bad enough that the extra pressure from the exhaust gases venting into the cooling system blows the radiator cap seal. This will vent coolant in proportion to the throttle setting. I've seen a bright green geyser 6 feet tall spouting from a radiator neck as the throttle was blipped. Not all leaks are as profound. Subtler leaks don't cause overheating, and can simply be manifested as a misfire on startup as the coolant drains into the cylinder and wets the plug. The plug soon dries off,

and the car runs normally—although short an ounce or two of coolant. Or maybe there are no symptoms except a steadily dropping coolant level—yet no external evidence of leaks. One way to sniff out this last kind of leak (literally) is to use the probe of an exhaust-gas analyzer in the filler neck and sniff for exhaust gas in the cooling system. What? You don't have a \$2500 exhaust gas analyzer? Try the Combustion Leak Detector kit from grahamtool.com. Just suck some fumes from the radiator through the cool blue fluid. If it changes to green, you've got exhaust in the coolant.

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usually carry the tiny Slime Power Sport Tire inflator and a worm plug kit, even on my motorcycle. A can of flat-fixer aerosol will work, but may not have enough volume of propellant inside to inflate a big truck tire or a 20-inch rim on your blinged-out ride. Consider the aerosol can a very short-term solution—the can I have here on my desk says not to leave it in the tire overnight. It says right on the can that it won't damage the tire-pressure monitoring-system sender, but my experience says otherwise.

Neither of these fixes will help if you have a major tire failure, like a thumb-size hole in the sidewall. Carry a cellphone.

Danger!

Having been a privileged subscriber for many years and a fan for many decades, I've got to say I love the tidbits of wisdom from PM's "Test Your DIY IQ" (March 2010).

Would you help me with No. 17?

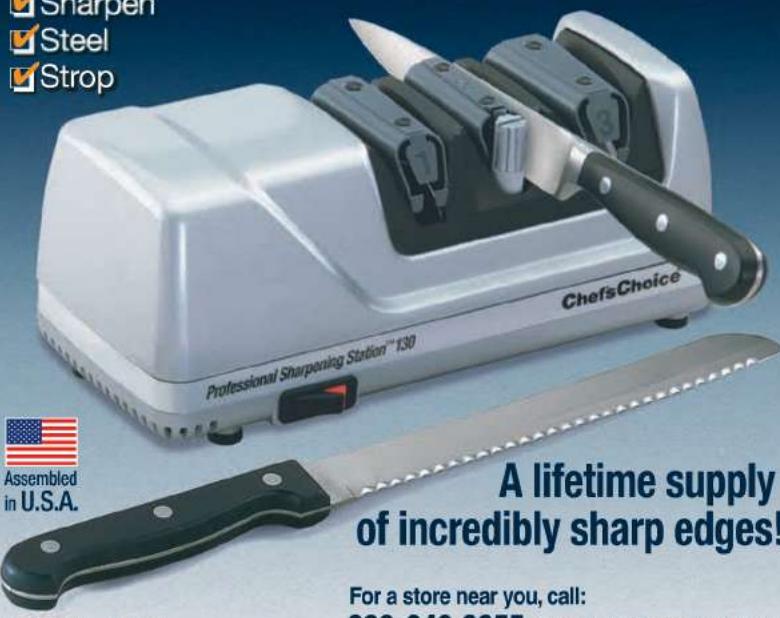
Why is attaching the booster cable's black negative connector to the negative terminal on the dead battery not as good as (and simpler than) attaching it to the dead car's engine block? And what would happen if you used the boosting car's engine block to ground the good battery's negative ground?

For those of you who didn't read last month's Letters column I will repeat this, because it's important. Electrically, there's no real difference as to where the connection is made. It's purely a safety issue. I once watched my crew chief working on my race car do just that; he attached the black jumper from the dead battery to the booster battery's ground terminal. A small spark ensued, which is normal when the last connection is made. The entire top of the battery blew up with a noise like a pistol shot, spraying him and everything nearby with razor-sharp shards of plastic and sulfuric acid. Hydrogen venting from the battery had been ignited by the spark.

Fortunately, he was wearing safety glasses. I dragged him into the driveway and hosed him down

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with the garden hose before he blistered any skin. His coveralls were covered with holes, and I had to repaint the front half of the car, both eaten by sprayed battery acid. Oh yeah, the nearly new battery was junk.

Lesson? Make that final connection, with its attendant spark, nowhere near the hydrogen gas normally being vented whenever a battery is being charged. It doesn't happen very often, but it's easy to prevent.

Slap Me Silly

What can be done about piston-slap noise? I have a 2001 GMC Sierra with the well-known clicking. The noise, which is very apparent at startup, started shortly after purchase and got worse as the vehicle aged. (Mine now has 135 K miles). The noise is a result of an engineering tolerance error, but GM sent me a letter saying the noise was "normal." I'm sure it

was normal because half of the trucks made in 2001 with the 5.2-liter engine have this issue. Anyway, what can be done to protect the engine for the next 100 K miles? The noise is caused by the piston skirts literally slapping the cylinder walls because the clearance between the skirts and the cylinders is excessive. The only sure cure is to dismantle the engine, rebore the cylinders accurately and reassemble with new pistons that properly fit the bores.

Historically, piston slap has been common in a lot of GM engines. On the other hand, your engine has been trouble-free for 135,000 miles, and apparently is running well and not consuming oil, or that would have been part of your complaint. My suggestion is to turn the stereo up and drive it, probably for a lot more miles. Economically, a complete engine rebuild doesn't make sense when the truck is still running well.

Hoarder

I keep a 5-gallon plastic fuel can of diesel in my garage to take with me on trips in my diesel pickup truck. The fuel is modern-grade diesel from a gas station (not a biodiesel). To date I have not needed to use it. The fuel is now about 2 years old. It sits on my cement garage floor and during the winter the temperature is normally between the high 20s and the low 30s. On occasion the temperature gets down to 10 to 12 F. Is the fuel okay to use, and is there anything I should be adding to it? Does the freezing temperature affect diesel fuel? How often should it be replaced, if at all?

I wouldn't trust that 2-year-old diesel in my truck, and you shouldn't either. Find out how to dispose of it safely by calling your local department of public works or fire department.

Gasoline and diesel fuel slowly degrade in storage. Gasoline oxidizes and turns to varnish, while the more volatile fractions disappear. They either evaporate off or actually migrate through the plastic. The varnish plugs up the fuel system, and the remaining heavier fractions make the engine hard to start.

Diesel also oxidizes, but has other issues as well. Small amounts of moisture, inevitable even in a well-sealed container, will allow mold or bacteria to grow. This will turn your emergency supply of diesel into a foul-smelling, gelatinous glop guaranteed to plug your filter and jam up your injectors. There are diesel additives that will slow this down, but why take chances? A better practice would be to fill your diesel can before a trip and use it up on or soon after your return. Store the container empty and fill it just before you leave.

Missed the Gate

I have a 2004 Ford Thunderbird with coil-on-plug ignition. I've had several coils go bad and I would like to know if there is a way for a DIYer to diagnose which cylinder is misfiring.

I have three ways:

→ Start with the engine cold. Idle it for 1 minute. The misfiring plugs will be much cooler. Usually you can just feel the exhaust manifold. Or use a spray bottle filled with plain tap water—idle

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the engine a little longer, until a quick spray on the exhaust manifold turns to steam, except near the misfiring cylinder, where it will stay wet. If the exhaust manifold is not readily visible under all those parts, try one of the following.

→ If the Check Engine light is on, you can scan a trouble code that will tell you which cylinder is misfiring. The code will be P030x, where x equals the number of the misfiring cylinder. Or if it's P0300, it's a random misfire that can't be attributed to any particular cylinder. Needless to say, you'll need to buy or borrow a scan tool or at least a code reader to do this. Of course, this won't tell you if the coil is the problem or not, only that one or more cylinders are misfiring for some reason.

→ If you swap the coils from one cylinder to another, the misfire should follow along if the coil is the problem. Do I need to mention to move only the coils, leaving the appropriate wires to each cylinder where they belong?

Flattie

I have a '41 flat-head Ford V8 with the dual-point distributor. I don't really want to convert it to a 12-volt, but I think I would like to convert it to electronic ignition. Do you have any idea who might make what I need, and do you recommend doing this? It's even been suggested to me that I rebuild the original distributor using one set of points.

Generally, dual-point distributors were used because a single set of contact points wouldn't carry enough current to feed an ignition coil without burning up regularly. Could be that if your '41 sees service only when you're trotting it out to show it, you might get away with it. A 6-volt coil will draw twice as much current as a 12-volt coil to supply the same energy to the spark plugs. Plan on setting the dwell and timing frequently as

Got a car problem?

Ask Mike about it. Send your questions to pmautoclinic@hearst.com 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.

the points erode away.

A better solution would be to convert to 12 volts or even to a hybrid 12-volt/6-volt system, but if your intent is to keep the car as original as possible for car shows, maybe not.

Your idea of using some sort of electronic ignition is confounded by the fact that the car is wired for positive ground, not the negative ground universally used for automotive applications today. (Ford finally changed over to negative ground in 1958.) I did some looking

around and found an outfit called Pertronics that makes a 6-volt positive-ground electronic-ignition module for flat-heads, but it's not clear whether it would fit into your '41-vintage distributor. There may be others. Furthermore, your distributor may not be the correct one for your engine, as I find is often the case with older, restored cars. Consult with Pertronics or whomever you want to source your ignition module from to be sure it will work with the distributor you actually have.

PM



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Tech

Home Theater PCs

NEW SOFTWARE AND CHEAPER HARDWARE MAKE A COMPELLING CASE FOR THE PC AS ENTERTAINMENT DEVICE. BUT SHOULD YOU BUY ONE OR BUILD YOUR OWN?

BY GLENN DERENE AND ANTHONY VERDUCCI

→ The computer industry has been trying to sneak its way into the home theater since 2002. That's when Microsoft first introduced Windows Media Center, a version of the company's media player with a "10-foot" user interface—large type and simplified menus that could be read and operated easily from couch distance. Apple



Small, inexpensive computers plug directly into an HDTV, bringing offline and online content to the big screen.

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followed in 2005 with Front Row, a Jobsian take on the 10-foot UI that was also used in the Apple TV. The computer-as-entertainment-device idea was compelling to technophiles (after all, people were already migrating massive amounts of music to their PCs), but it was a hard idea for most people to swallow back then. Dedicating a powerful, \$1000-plus computer solely to TV duty was fine for the super-enthusiast, but computers at the time had few options for video (don't I already have a DVD player?), plus cable boxes and DVRs were becoming more computer-like anyway, so the computer as video recorder was an awkward fit.

What a difference a few years can make. The price of a new computer has plunged so that a few hundred dollars is all that's required to get up and running. Also, there has been an explosion of

video content available online, and a full-fledged computer is the easiest way to get it to your HDTV.

But what do you really get for the money if you go out and buy a media PC? Besides, even if you want such a machine, how hard could it be to just build one yourself—getting more performance for the same investment? We've been wondering about this recently, so we tried it both ways, creating our own media-ready computer, and then slapping down some plastic to acquire one ready-made.

Comparing Costs

➊ **The innovation that** has enabled dirt-cheap PCs is the dirt-cheap processor. With the ascendancy of the netbook in the past few years, chipmakers have rolled out hyper-efficient, low-cost pro-

cessors such as Intel's Atom series that are good for everyday Web browsing and other common computing tasks. Those bargain CPUs aren't so good at rendering video, however, which is why many low-cost computers now add an Nvidia Ion graphics processor, which can output 1080p video. That Atom-Ion combo has begun to show up in "net-top" computers as well, which are small, relatively cheap boxes that plug into a TV through an HDMI interface. These are home theater PCs in a cute, new and far more affordable package.

How affordable? Well, at press time, the entry-level Acer AspireRevo 1600 was selling for as little as \$200. But it's not really a bargain—the 1600 is a poor excuse for a computer, with only 1 GB of RAM, a single-core CPU and Windows XP as its operating system. We wanted cheap, but not that cheap, so we opted for the AspireRevo 3610, which sells for as little as \$330. The 3610 doubles the RAM to 2 GB, has a dual-core Atom processor, integrated Wi-Fi, a wireless mouse and keyboard and runs Windows 7 Home Premium. Additionally, its slim white frame is peppered with ports—eSATA, a four-in-one card reader, six USBs, headphone and microphone jacks, an optical audio output and, of course, HDMI—for maximum connectivity.

Could we do better by building our own machine? We started by matching the Acer's main components. We found a \$180 Zotac motherboard with the same Atom 330 chip and Ion GPU found in the off-the-shelf computer. Add in a Seagate 160 GB drive (\$38), 2 GB of discount Rendition RAM (\$40), an Athene-tach ITX form-factor case with integrated power supply (\$30) and a copy of Windows Home Premium (\$110), and we had essentially the same computer as the Acer AspireRevo 3610, only bigger, uglier and \$68 more expensive.

Okay, that didn't seem worth it at all, so we tried again with the intention of making a truly better home theater computer. This time, we kept the Zotac board, put it in a far nicer SilverStone Sugo SG05-B mini-ITX case, beefed up the hard drive to a 7200-rpm 500 GB Western Digital Caviar Blue, doubled the memory with 4 GB of G.Skill RAM, and then blew the budget all to hell with a Panasonic slot-load Blu-ray drive.

BUILD

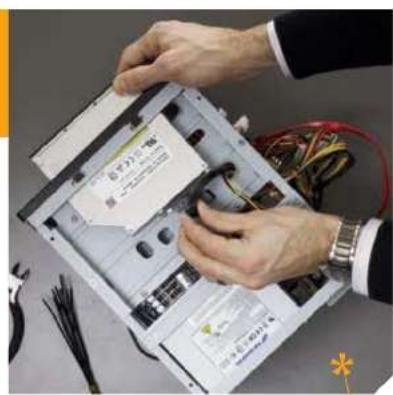
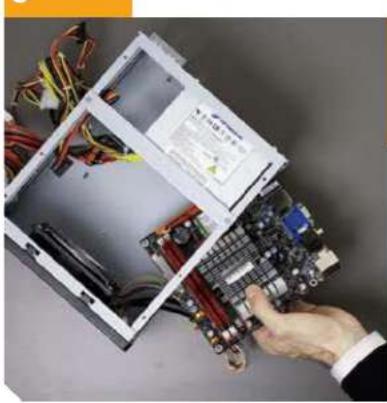
The 10-Minute PC Project



1. For a home theater PC, start with a small motherboard with an HDMI output. Many mini-ITX-format boards come with the processors pre-installed, which cuts down prep work. Just snap in memory modules and the board is ready for the case.

2. If your case comes with an internal power supply (as opposed to an external power brick), make sure it has a fan for extra cooling. Screw your motherboard into the case before locking down other components.

3. DIY cases allow you to be flexible about what components you use. We built in a slot-load Blu-ray player and a 500 GB hard drive.



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Home Theater PC Without the PC

Total price: \$742—more than double the AspireRevo 3610's.

At least it didn't cost much in terms of human effort. Building these small mini-ITX rigs is a far simpler affair than their larger ATX counterparts. Since the CPU, heat sink and GPU are all pre-mounted to the motherboard, most of the hard work is done for you. Everything can be assembled with a single screwdriver within 10 minutes. The longest stretch of the project was the half-hour we spent staring at the screen watching Windows install.

Performance Showdown

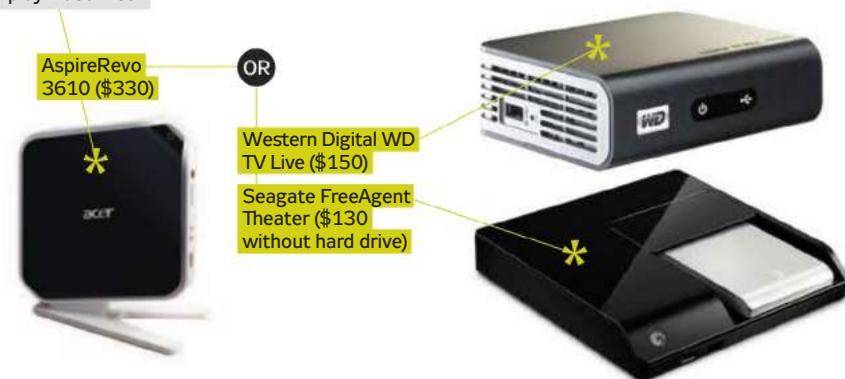
So did our extra horsepower make a difference? It certainly made the operating system work faster. The zippy drive and extra RAM in our home-built rig gave Windows speedier boot times and made basic performance snappier and more responsive, but none of our improvements could help with tasks that strain the Atom processor. Installing software, for example, was a slow and creaky proposition.

But, to step back for a moment, who cares about computing performance? The point of these machines is to play and stream HD video on a big, glorious TV screen. And both computers did a marvelous job playing movie files, including challenging 15 GB, high-bitrate .mkv files, which essentially are Blu-ray-quality compressed video. However, both machines also choked and sputtered occasionally when streaming HD video from hulu.com. Apparently the Flash-based online site presents another insurmountable strain to the Atom CPU, and the GPU can't seem to pick up the slack.

Our rig certainly beats the Acer when it comes to playing Blu-ray discs, since the AspireRevo comes with no disc drive at all. But just as we started tapping our feet to a little victory dance, we found that newegg.com sells an Asus external Blu-ray drive for \$150, which would bring that functionality to the AspireRevo and still cost \$262 less than our creation. Nuts!

It's worth noting, however, that Blu-

Not interested in having a PC in your living room but still want to play video files on your TV? Try these pint-size players instead. The Western Digital WD TV Live and Seagate FreeAgent Theater are far friendlier to the wallet than even the cheapest computers and can stream video content either over a network or directly off a USB-connected hard drive. The software and most video codecs are built in, and these devices plug directly into your HDTV or home theater via HDMI. In our tests, both devices played every format we could throw at them, displaying stutter-free, high-quality HD video. The onscreen menus—browsable via remote control—are a bit clunky, but serviceable. While not a replacement for a computer (they have limited access to Web content), these are a cheap and easy alternative if you just want to play video files.



ray players aren't just a plug-and-play proposition for any home theater rig. For the time being, Blu-ray discs don't play natively in Windows (although it is rumored that this might change). So you'll need software such as Corel's WinDVD or CyberLink PowerDVD 10. Expect to pay at least \$50.

There's also another potential video hang-up to prepare for. The codecs (plug-in software used by video playback programs such as Quicktime and Windows Media Player to decode media files) required to play many video formats aren't natively built into Windows. You can download them one by one, or you can save yourself a lot of searching by downloading the free K-Lite Codec Pack from download.com.

Was It Worth It?

We're tinkerers, but we have to admit it's pretty hard to make the case for building your own home theater PC. Our build has space for extra drives and a separate graphics card if we wanted to do gaming, but that would certainly strain the low-powered CPU. Plus, anyone looking for storage capacity beyond the AspireRevo's 160 GB drive can always plug in an external drive.

When it comes to the core function-

ality of an entertainment PC, both computers did an equally admirable job of playing stutter-free video, streaming Netflix movies and pumping out music through our home theater system.

Whatever route you take, we strongly suggest a few modifications: First, don't rely upon a mouse and keyboard (even if they're wireless) to control your television PC. Spring for a Media Center remote control. You can get a cheap one for under \$25, or you can buy the Star Trek-style Lenovo Multimedia Keyboard and Remote übercontroller for \$60. These remotes are completely plug-and-play and require no software. And they make the Media Center's 10-foot UI a far more browsable experience.

Which brings us to one final suggestion. Don't use Windows Media Center at all. Instead, install either XBMC or Boxee. Both software suites, which are free to download, search your local drive and network for media, then display it in an easy-to-search way. Boxee, which is built on the XBMC framework, also reaches out to video and audio "channels" on the Web. XBMC in its native format is more flexible and customizable, but Boxee gets major points for ease of use. Both are light-years better than the Windows-native media UI. **PM**

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Digital Clinic

by Seth Porges

Q+A

The Truth Behind the “Unlocked” iPad

Q Apple is promoting the idea that the iPad’s 3G data access is “unlocked.” Does that mean I can just pop my cellphone’s SIM card into it and surf away without paying for another data plan?

A Probably not. Yes, the iPad is technically “unlocked”—meaning it can use any compatible SIM (or Subscriber Identity Module) card to get online, instead of one tied to a particular carrier. But actually inserting your phone’s SIM card into the device? Well, that’s likely to be a bit like cramming a jigsaw piece into the wrong hole.

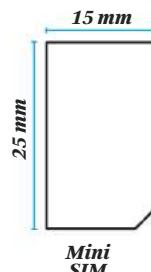
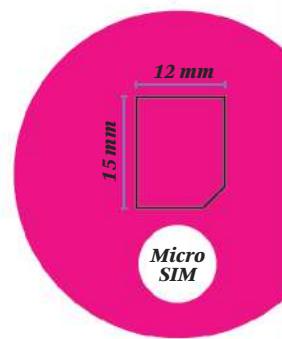
The problem: Unlike virtually every phone sold in the United States, the iPad uses a new type of SIM card called a micro SIM. This card, which is about half the size of the ubiquitous mini SIM that powers most GSM phones, was engineered to allow phone manufacturers to build smaller devices and has been used in a number of phones in other parts of the world.

It’s a surprising choice for the iPad—that device is so large that the few millimeters of space saved by the smaller

slot probably doesn’t make a big difference and, in the U.S., micro-SIM-compatible phones are virtually nonexistent. But the format was likely appealing to Apple and AT&T for one key reason: Its obscurity makes it impossible for most people to pop in their own SIM card. In effect, the “unlocked” iPad is more locked to AT&T’s network than any phone on the market—while a typical locked phone can be unlocked by a tech-savvy hacker, no amount of hacking is going to make a large card fit into a tiny slot.

However, the fact that phone manufacturers currently choose not to use micro SIM cards doesn’t mean they won’t in the future. And the iPad could be just the kind of high-profile device needed to spur other manufacturers to adopt the smaller format. Keep an eye out for companies to begin selling pre-

Competing SIM Formats



Because the Apple iPad uses the smaller micro SIM format, most people can't insert their phone's SIM card.

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Unsending E-Mail

I have a problem: I am prone to accidentally hitting the "send" button on my e-mail a bit prematurely. This has gotten me into a pickle or two. Any tips on preventing the same kind of trouble in the future?

I encourage people to exercise common sense (and sobriety) when they are surfing the Web and sending out e-mails. That being said, we've all accidentally sent an unfinished e-mail, or one with the wrong name in the "To" line, more than once.

Thankfully, Google now gives Gmail users the option of "unsending" misfired messages (sorry non-Gmail users, you'll still need to be extra careful). To give yourself this extremely useful option, click on Settings at the top left of your inbox, and then the Labs tab. This brings

you into the menu for Google Labs, which is basically a clearinghouse for Google's weird, wacky and experimental features. Scroll down to the Undo Send feature and click Enable. Now, whenever you send an e-mail, Gmail will wait a few seconds before actually sending it out into the ether—a grace period during which you will have the option of hitting an Undo button that

will pop up on your screen. If you "Undo" the e-mail, it will bring it back onto your screen, allowing you to edit it if you choose to try again.

At-Home Hotspot

I recently purchased a MiFi mobile hotspot, and I love it. Is there any reason I can't cut my cable Internet service and just use this?

Wireless mobile hotspots are so fantastic, they almost seem like magic—battery-powered, credit-card-size devices that pull 3G cellular signals from the

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air and transform them into Wi-Fi feeds that any computer can use to get online. Awesome? Definitely. But a replacement for your home Internet service? Not quite.

The problem: Not only is the 3G data feed used by mobile hotspots not nearly as fast as a typical home broadband setup, but these devices are patently ill-equipped for use as the backbone of a modern networked home. These days, all sorts of devices plug in to a home router—game consoles, Internet-enabled TVs, network-attached storage drives—and you quite simply cannot jack these devices into a tiny wireless mobile hotspot. Now, many of these networked devices can use a mobile hotspot's Wi-Fi feed, but you can expect the result to be frustratingly slow and intermittent. For now, I'd keep the cable.

MacBerry Sync

I have a BlackBerry. The included software doesn't allow it to sync with my Mac. Is there any other way around this?

For years, BlackBerry users wishing to sync their mobile device with a Mac had to rely on third-party software—a disappointing snub, especially since these programs tend to cost money. This oversight was finally fixed last October, when BlackBerry-maker RIM released a Mac version of its official BlackBerry Desktop Manager. The new program lets users sync a Mac-full of tasks, contacts, appointments and notes, and makes it very easy to transfer media files to a phone (a useful option, considering the very nice displays built into new BlackBerry models). The software can be found at blackberry.com/mac and, like its Windows counterpart, it is free. **PM**

Got a technology problem?

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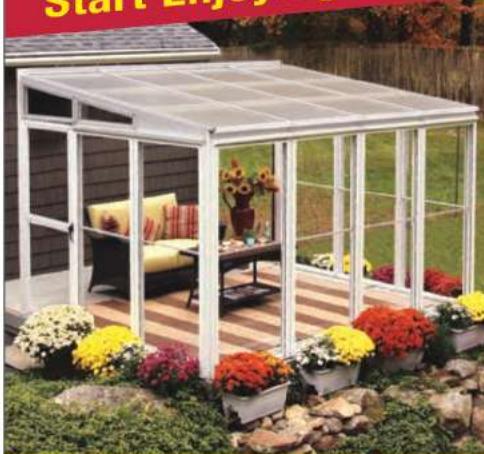
While we cannot answer questions individually, problems of general interest will be discussed in the column.



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Flying Suit
(CONTINUED FROM PAGE 85)

from the roof of a Manhattan skyscraper and lived. But Dr. Christopher Kepler notes in his grimly entrancing paper "Orthopaedic Injuries Associated With Fall From Floor Forty-Seven" that cases like the window washer's are very much the exception. Falls from even four or five stories (about 40 to 50 feet) are fatal half the time, and survival rates drop rapidly when you plunge from anything higher than that.

Considering the risk of injury upon landing—to say nothing about what would happen if Corliss went into a 100-mph tumble on the landing strip—the experts assessing Corliss's plans are skeptical. "Theoretically, if he got everything just right and his flight path was perfect and there was no wind, he could do it, but the probability is low," says Albert I. King, chairman of the biomedical engineering department at Wayne State University, which studies human survivability in car crashes. "I say, don't do it." Former Hollywood stuntman turned aerospace technologist Roy Haggard has consulted with Corliss on the landing ramp's design, and even he has concerns. Corliss plans to use a sequence of weather-type balloons to provide visual cues to the top of the landing ramp (see page 84), but Haggard questions whether the balloons would be stable enough to provide precision guidance. "That's like trying to shoot a sniper rifle using balloons for sights," he says.

To be fair, most of Corliss's BASE jumping exploits—double backflip through the center of the Eiffel Tower, anyone?—would never have been greenlit by the risk-assessment crowd. The real Achilles' heel of the Wingsuit Landing Project, arguably, is not safety but cost. Haggard says the landing ramp could be easily engineered and built; the problem is that it would cost at least \$3 million, quite possibly a prohibitive amount to raise even from reality-television producers eager to broadcast the spectacle.

The most obvious alternative would be to simply build a landing strip on a suitably steep mountainside—or skip the strip altogether and

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land on snow. Corliss, however, says it would be difficult to ensure that the landing surface would be uniformly smooth as needed for safety; worse, he would have no option to bail out and deploy the chute if his approach was off. Only a ramp would give him complete control.

But other would-be record breakers have cooked up different methods that might enable them to land without a chute. A wingsuit manufacturer in South Africa is developing a design that would allow a chuteless pilot to land on his feet, no landing strip required. Jii-Wings' Integrated Glide And Landing System (IGALS) calls for a larger than normal wingsuit, capable of a 4:1 glide ratio that the pilot can drop below just before landing, a position that allows him to execute an aeronautical maneuver known as a flare, lifting upward and shedding speed dramatically just before reaching the ground. "I think for one to say one has landed a wingsuit without a parachute, it should be the design of the suit, and not the environment in which one lands, that enables the landing," designer Maria von Egidy says.

The IGALS approach, though, has not yet been tested with people jumping from planes. Even if it proves viable, Corliss sees it as a variation on something that has already been done, namely, landing in a hang glider. Being original (or "forcing evolution," as he describes it) is vital to Corliss. "What makes human beings so special is that we don't evolve through morphing our bodies, we evolve through our minds," Corliss says. "We create technologies that allow us to do things like breathe underwater, fly in the sky and land on the ground."

A couple of days after my first visit, I stopped by Corliss's house again, just as he was returning from the first

meeting with his parole officer. At the time of the attempted leap from the Empire State Building, BASE jumping wasn't illegal in New York City, so the only charge prosecutors could get to stick was a conviction for misdemeanor reckless endangerment—for struggling with the security guards who tried to stop him. He was sentenced in January 2009 to three years' probation and 100 hours of community service (which he has finished).

Fear and physical agony never clipped the birdman's wings, but the legal system just might. Since BASE jumping is strongly discouraged in the U.S., international travel is essential. But the probation officer told Corliss he would need to get a letter from the judge okaying any travel.

Corliss was upbeat, though. He was sure the judge would give him the green light to continue earning his livelihood through projects like the wingsuit landing or a television program about swimming with predators. "I've been diving with sharks for 16 years," Corliss says. "Name a big, nasty species that everyone's petrified of, and I've played with them. I've tickled them. I've hugged them."

Corliss's speech is as over-the-top as his stunts; taking his statements at face value can be difficult. He must have read the skepticism on my face because he fiddled with his iPhone for a minute and then shoved it at me. "Here, look, this is me petting a 12-foot great white shark."

The picture on the screen showed exactly what he said it did.

I sighed and said the only thing one could. "Dude, you're nuts."

He smiled enigmatically. "Am I?" The day before had been his birthday; for him, more than almost anyone else, reaching it was a noteworthy achievement. He was 33. **PM**

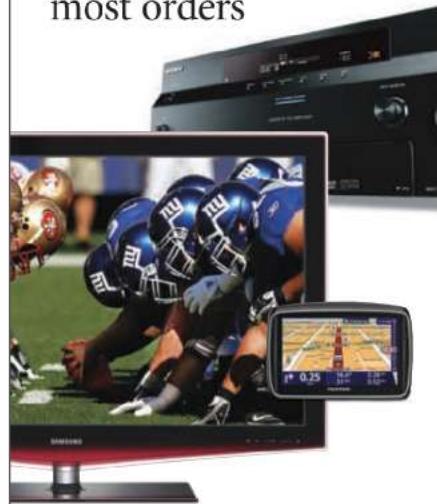
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EV Future

(CONTINUED FROM PAGE 91)

stream of demand at this wattage requires industrial-capacity transformers and is more profitable for businesses already paying commercial electricity rates. As you wait for the two cars ahead of you to juice up, you see an attendant brave the 100-plus-degree heat to tape a paper sign over the kiosk's price-per-kwh display. Fast charging already runs 10 times what you pay off-peak at home. As of right now, legal or not, the price of

an emergency charge just tripled to \$30.

A public-minded Samaritan might realize the grid is already reaching its breaking point, head back to work and ask for a ride home or to the nearest Zipcar. Naturally, you drive to the fast charger and, in 20 minutes, suck almost as much electricity into your car as the average house consumes in a day.

ELECTRIC VEHICLES AREN'T GOING

to bring down grids around the country simply because of increased demand. A more realistic threat lies in the

uneven distribution of GEV ownership. Just as hybrids like the Toyota Prius tend to show up more commonly in certain types of neighborhoods, experts expect a clustering effect for plug-in vehicles. Tease apart these demographic pockets and you might find a concentration of liberal, environmentally conscious types, or simply cost-conscious drivers who live 30 to 40 miles from the nearest city. In some areas, such as Austin, Texas; Chicago; and along the West Coast, it's likely that multiple GEVs will soon be pulling into garages on the same street.

Even if you assume that Level 3 fast chargers will be rare, and that the owners of public chargers will allow utilities to remotely disable or delay charging with load-control signals, the majority of Level 2 chargers will remain in the hands of individual GEV owners. Some will likely agree to load control, and most will charge during the cheapest, off-peak hours. But some home chargers will come on at exactly the wrong time, in all the wrong, highly clustered places.

At 6 pm, you make it home, and become part of the problem. There are reports of transformers going down in L.A. If the power goes out overnight, you could be on an even longer fast-charger line tomorrow, assuming it hasn't been actively shut down. So you disable the off-peak charging mode and start tanking up immediately. And since the default rate of charge is the maximum, your home charger is suddenly draining 19 kw of electricity, almost four times your normal draw.

Within 15 minutes, two other drivers on your street are doing the same. In the typical neighborhood, each transformer supplies power to five to 10 houses. And typically, this circuit's GEVs draw 3 to 6 kw apiece. Tonight, it's not the capacity of the transformer that matters, anyway. "Transformers are designed to run up to 50 percent above capacity for short periods," says Philip Gott, director for automotive consulting at IHS Global Insight, a Massachusetts-based forecasting firm. "As long as you allow a transformer to cool down at night, it can run like that for 20, 30 years." But Gott notes that too many GEVs charging at night would

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mean those transformers won't get their off-peak cooldown. Add a heat storm, with temperatures dropping only slightly overnight, and the stage is set for a scattered but significant infrastructure meltdown.

SOMETIMES AROUND 7 PM, THE HOUSE goes dark. Your mobile phone flashes on—it's an alert from the garage charger that the vehicle's battery has stopped charging at 81 percent. Across Southern California, in neighborhoods where GEVs are popular, and in some urban areas where not a single vehicle is plugged into the grid, another handful of transformers has blown. There are plenty of GEV owners whose lights are still on, customers who agreed to load-control intervention by their utility. And in Burbank, there's a pilot program of pure EVs that are actually serving as distributed backup batteries, pushing power back into the house and out into the local grid. This is called vehicle-to-grid charging, or V2G, and in 2020, it's still a decade or more from widespread adoption.

SOME HOME CHARGERS WILL COME ON AT EXACTLY THE WRONG TIME, IN ALL THE WRONG, HIGHLY CLUSTERED PLACES.

What's far more common in 2020 is V2H charging, or vehicle-to-home. Instead of wheeling a carbon-monoxide-belching generator out into the backyard for emergency power, GEV owners can simply draw electricity from the vehicle's battery. Provided the home is wired for backup power, and depending on the size of the home and the capacity of the battery, V2H charging could be a seamless backup system for the entire house, or a direct power source, via plenty of extension cords, for specific air conditioners, refrigerators and other appliances.

Your home is fully V2H-ready, and with your partially charged EV plugged into the house, the lights, the fridge and the a/c are all back on. The news is reporting blackouts across the state. In the days and weeks to come, some analysts will claim that electric cars played a part, however small. Residential chargers and fast-charging stations that

didn't sign up for load control will be singled out. The utilities will push even harder to get customers in line, adjusting electricity rates to further penalize peak charging and reward off-peak.

The smart grid will be seen as a success and a failure, depending on whom you ask. On a national level, there's no single solution to be gleaned, just as there's no single problem that led to California's blackouts—GEV adoption will be different in every state, and each grid will handle electric vehicles differently. The only clear lesson is that the transition from liquid fuel to battery cells has not been as smooth or as painless as promised.

For tonight, as midnight approaches, and the power rolls on and off across California, your home is running just fine. The car's battery will be wiped out by morning, but no matter. That's what the six-year-old gas guzzler sitting next to it is for.

PM

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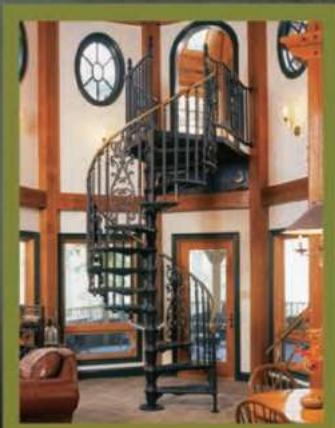
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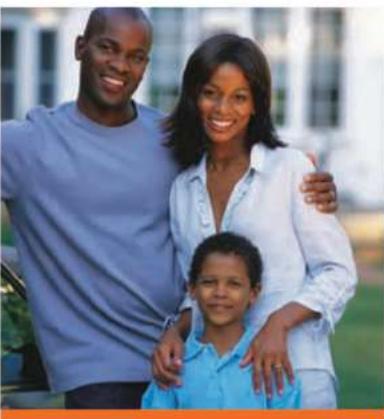
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X When Craig Swopeston wants his athletes to perform, he reaches for a bucket of herring. As a trainer with the Navy Marine Mammal Program, Swopeston prepares sea lions for military missions. They practice capturing enemy divers with snap-on shackles and locating unarmed mines, dropped by pilots during training missions, so they can be recovered. "The sea lions can dive several hundred feet and recover a target in minutes," he says. "That could take a dive team a week." In 2003 he spent three months on patrol at Mina Salman pier in Bahrain. "We were the defense against enemy swimmers—think of sea lions as underwater guard dogs." —EMILY MASAMITSU

1. TRAINING BOAT

Swopeston navigates the waters off San Diego in a 33-foot-long Northwind Marine boat. The craft carries up to four sea lions and holding cages, buckets of fish and practice targets. Away from base, the team uses inflatable Zodiacs.

2. TARGET

A 7-foot aluminum cylinder simulates live targets that sea lions—including Joe, left—tag on recovery missions. It's outfitted with a dual-frequency transponder that emits a 9-kilohertz audio ping detectable by the animal, and a 37-kHz ping, which Swopeston tracks himself. "We set the target from 200 to 1000 feet deep and exercise the animal a number of times on it."

3. GRABBER

Sea lions mark the target by attaching a stainless-steel hook (with neoprene bite plate) to a wire loop on the target's end.

4. GPS UNIT

Navy trainers use military-exclusive Defense Advanced GPS Receivers to set targets at precise points.

5. HARNESS

Swopeston tracks his animals' location with three devices attached to the harness: a 45-kHz pinger, an RF tag and a satellite tag. "The sea lions rarely stray from the boat, but we can actively track them via satellite if they get lost or disoriented," he says.



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