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AMERICA'S

SECRET SPACE PLANE

ALSO IN THIS ISSUE

BUILDING A BACKYARD PULSE JET

12 DIRTY JOBS—
DONE RIGHT

MOVE OVER NASA—
THE AIR FORCE
HAS A NEW RIDE



SMARTPHONE
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GUIDE

diy

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The Pentagon plans to secure space with a fleet of aircraft like the one at right, shown during re-entry.



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60 Return of the Space Plane

The Air Force has spent decades on the concept: an unmanned space plane that can be used to spy, reposition satellites, possibly even bomb targets, then return to base. A successful launch this spring could turn that vision into a reality.

BY SHARON WEINBERGER

66 Freedom Machine

When Chris Neal was born with a crippling deformity, doctors said he would never walk. But today, thanks to dogged determination, the 22-year-old hunts, skis—and wins dirt-track races.

BY JENNIFER BOGO

70 Down & Dirty

It takes more than a mop and broom to clean up the toughest household jobs. You need the right tools and the PM plan. Fire up the sewer auger—we're going in.

BY JIM GORMAN

74 Welcome to the Brooklyn Academy of Mechanical Arts and Ballistic Sciences

This scruffy collective of DIY enthusiasts transforms urban salvage into jet-powered contraptions and fire-spewing machines. Join PM on a tour of the ultimate outpost of mechanical mischief.

BY SETH PORGES

Popular Mechanics

2010

May

PM FEATURES

VOLUME 187 NO. 5

WHERE THE RUBBER MEETS THE ROCK

80



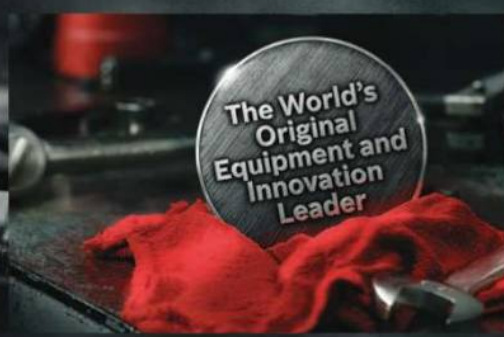
PM takes to the iconic trails of Moab, Utah, for full-throttle tests of the fiercest mountain bikes, ATVs, off-road motorcycles and trail-ready pickups. BY LARRY WEBSTER



Automotive editor Larry Webster (left) and co-pilot Chris Brown suit up to field-test ATVs on the Fins and Things Trail near Moab, Utah ("Where the Rubber Meets the Rock," page 80).

ON THE COVER

Referencing commercial and experimental aircraft specifications and details from the Air Force's X-37B Orbital Test Vehicle program, Pixar Animation Studios technical director Nathan Fariss modeled this depiction of the classified space plane exclusively for POPULAR MECHANICS.

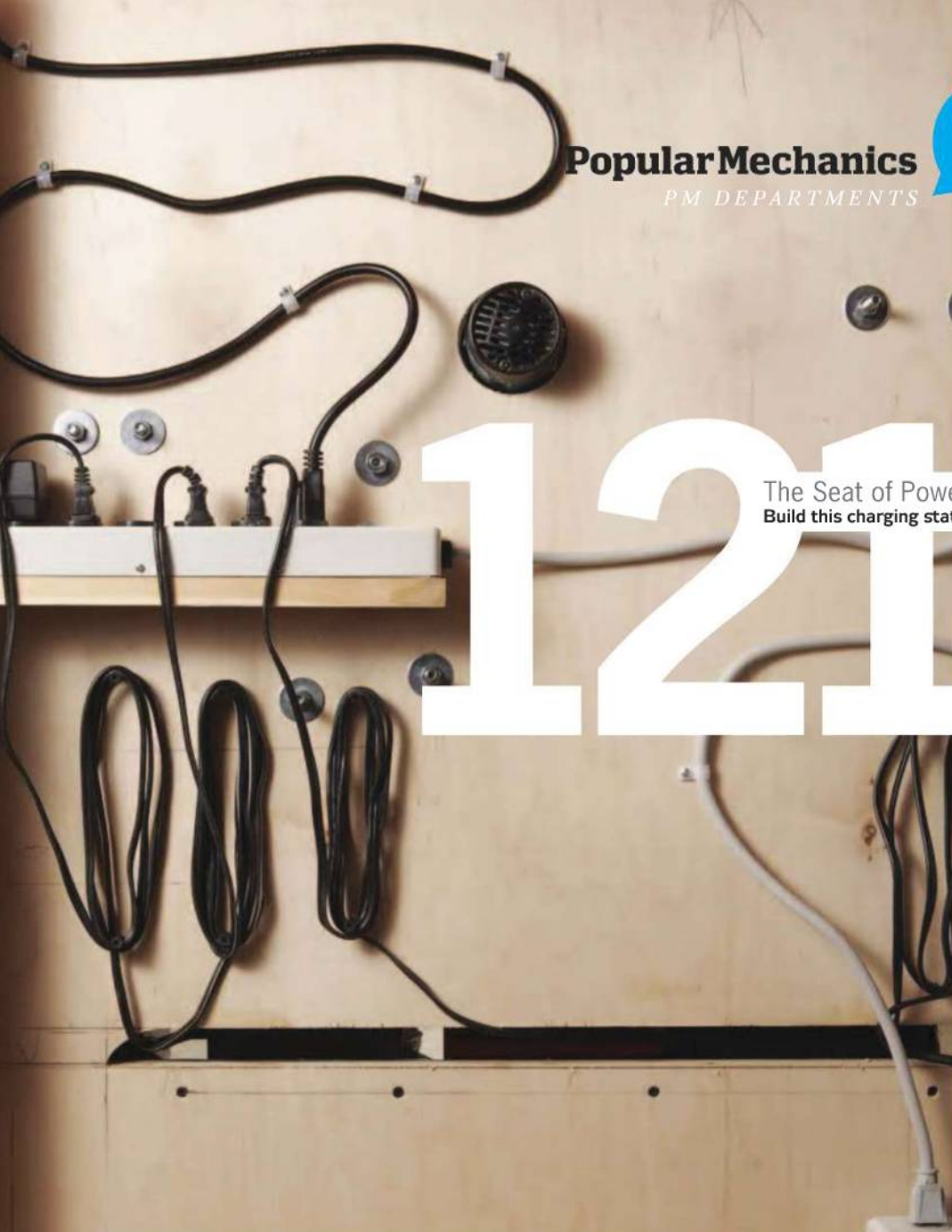


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The Seat of Power

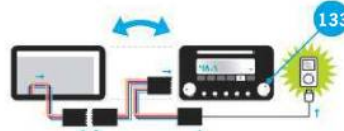
Build this charging station for easy access to cordless tools.

124 PM Saturday

How to construct a heavy-duty tire swing in just one afternoon.

126 Homeowners Clinic

These seven easy steps will help winter-weary plants spring into summer. **Plus:** How to fish cable through an exterior wall.



× AUTO

133 Saturday Mechanic

Install an iPod-compatible stereo system in a flash.

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Getting to the bottom of Toyota's troubles. **Plus:** How to degrease dirty hands.

× TECH

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How to transfer files, software and settings to your new computer.

148 Digital Clinic

Four ways to watch 3D content at home. **Plus:** Using Google Voice on the iPhone.

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Rockwell's H3 rotary hammer puts full-size power in a small package. **Plus:** We bully gas cans in our Abusive Lab Test.

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Even on a diet, Audi's fuel-efficient aluminum A8 is fast. **Plus:** We fire up the sleek V12 Aston Martin Rapide.

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Jay feels confident that, after almost four decades of playing it safe, the American auto industry is gearing up to surprise us again.

52 Putting the Fun Back in Flying

Today, air travel equals intrusive security checks and temper-fraying delays. Glenn Harlan Reynolds says he'd rather hail a fast and efficient air taxi instead.



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*Fig. 1
Red Fox*



Fig. 2 Black-Tailed Jackrabbit



*Fig. 3
American Bison*



*Fig. 4
Porcupine*



Fig. 5 Bighorn Sheep



Fig. 6 Black Bear



Fig. 7 Bobcat

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PM EDITOR'S NOTES

Ghosts in the Machine

For anyone interested in the state of basic mechanical and scientific knowledge in our society, the recent Congressional hearings regarding Toyota's sudden-unintended-acceleration issue were discouraging. If Toyota, or any other company, has been lax about safety, it should be held accountable and required to fix the problem. But the Toyota hearings—and most of the press reports surrounding the controversy—have been stunning for their lack of seriousness. Our congressmen and women listened raptly to dramatic but unverifiable anecdotes from drivers. They speechified and lectured. But they showed little interest in actually understanding the problem. We do know that, in certain cases, misplaced floor mats in some Toyotas have jammed throttles in an open position, and that in other, totally unrelated cases, gas pedals have been slow to return to idle after being pressed. (In both cases, a firm, steady application of the brake will stop the car.) But those humdrum explanations weren't nefarious enough for our representatives. Instead, we heard wild speculation that electronic gremlins might be taking over the cars' drive-by-wire throttle systems, causing vehicles to take off like the '58 Plymouth in the movie *Christine*.

Did Congress talk to any independent experts—i.e., engineers not affiliated with trial lawyers pursuing Toyota—about these malfunctions? Did they put the Toyota data in perspective by analyzing the thousands of unintended-acceleration complaints that *all* carmakers receive? Did they even try to understand how gas pedals work? Sadly, none of the above. It was easier to imagine spooky, malevolent forces lurking inside our cars. *BusinessWeek's* Ed Wallace had it right when he said that Congress should have held its hearings in Salem, Mass.

On page 138, PM senior automotive editor Mike Allen looks into the speculation that electronic glitches are to blame for unintended acceleration. His solid primer on how drive-by-wire systems really work—and how very unlikely it is that they would behave as Congress imagines—is a must-read for those concerned about this issue.

JIM MEIGS
Editor-in-Chief

PM's **Mike Allen** has been working on cars ever since he started fixing his mother's '65 Mustang. That kind of hands-on expertise is invaluable when tackling issues like the Toyota controversy.

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WHAT THEY'RE DOING



AMY B. SMITH

MIT instructor and 2008 Breakthrough Leadership Award winner Amy Smith will host the International Development Design Summit in Colorado this summer to come up with strategies to disseminate new technology in developing nations. Smith is working to design a creativity curriculum for first-year students at MIT that increases hands-on learning and reduces the use of textbooks in engineering classes.

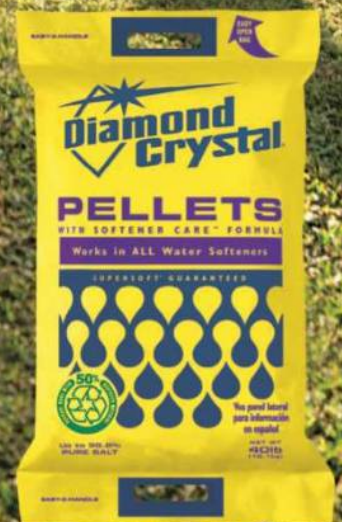


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DIY Pop Quiz

I read the "Test Your DIY IQ" quiz in the March issue with interest. For anyone who wants to upgrade his building knowledge, here's a great idea: Volunteer with Habitat for Humanity. For the past year, I have been spending time building two houses with the organization. What a great way to learn everything from framing to roofing to kitchen layout skills. It's all free, and everyone wins big-time.

BEAU SCHLESS
SUDBURY, MA

Having been a privileged subscriber for many years and a fan for many decades, I have to say I love the little tidbits of wisdom from "Test Your DIY IQ." But could you explain No. 17, about what to do if your truck is dead in the driveway? 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 car's engine block? And what would happen if you used the boosting car's engine block to ground the boosting



ISSUE

03 / 10



Readers responded to our quiz on DIY skills and stories about the *Edward J. Moran* tugboat and thwarting Somali pirates.

battery's black negative connector? What DIY wisdom am I missing here?

DANIEL BEARD
HOUSTON, TX

EDITOR'S NOTE: *Batteries being rapidly discharged or charged produce an explosive mix of hydrogen and oxygen gases. Making that final jumper cable connection to any part of a car will create a spark. Connecting to the block will keep the spark away from the hydrogen. I once saw a mechanic ignore that advice and blow the entire top surface of a battery off, spraying everything within 6 feet—including his face—with battery acid.*

Making the final connection to the dead car precludes the possibility of getting the cables, clothing or fingers into a spinning fan or belt, although you really should do this with the donor car shut off.

Mike Allen, PM senior automotive editor

Pirate Repellent

Two stories in your March issue caught my attention: one about a floating rope designed to foil the propellers on Somali pirate boats, and the other about the firefighting capability of the *Edward J. Moran* tugboat. In looking for nonlethal ways to defend commercial shipping vessels against pirates, could the same type of pump-and-nozzle system used on the *EJM* be used on commercial vessels as defense? It would seem that the powerful streams of water might be able to repel boarders and even keep small boats at bay. It may not be feasible, but I thought it might be an interesting test.

MATT KASINDORF
NEW YORK, NY

CORRECTION: *In the March issue, "Over the Horizon" misidentified an image of a C-130 as a KC-135 and an image of Global Hawks as Predators.*

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THE ROAD LESS TRAVELED Looking for the best highways, roads and dirt trails in America? Get advice from PM's off-road-savvy auto editors. They have traveled the best highways and byways in the country and have maps, advice and lists of must-see stops. Whether you're looking to head into blues country along the Mississippi, drive motorcycles in Michigan or just get lost in Baja, we have the guide for you.

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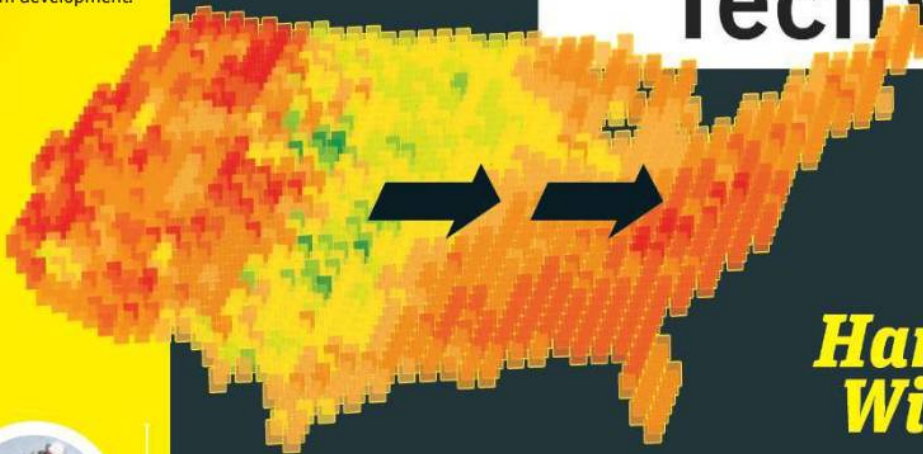
TechWatch

Where the Wind Is

The U.S. Department of Energy considers areas with annual average wind speeds of at least 14 mph at a 260-foot height suitable for wind farm development.

WIND SPEEDS

- Less than 9 mph
- 9 mph
- 11 mph
- 13 mph
- 16 mph
- 18 mph
- 20 mph
- 22-plus mph



The Hardware of Wind Power

New networks of transmission lines will be needed to connect zones of good wind in the Midwest with areas of high demand, such as the East Coast.

The wind might be free, but it will cost plenty of money to deliver the electricity it generates. According to a recent report by the U.S. Department of Energy, supplying an extra 225,000 megawatts—20 percent of the power needed to keep the lights on in 35 states—will require a \$90 billion investment in transformers, substations and tens of thousands of miles of extra-high-voltage transmission lines for moving electricity to places where the wind doesn't blow as steadily. The study examined the Eastern Interconnection, one of three independent power grids in the continental United States, and did not include offshore turbines.



DESIGN NAILS SOLAR SHINGLES

✦ The complex installation of solar panels can be off-putting to many homeowners. To open the market to more people, Dow Chemical created thin-film photovoltaic solar panels that are the size and shape of ordinary asphalt shingles. Installation is easy: They can be nailed into the roof like conventional shingles. Plus, the solar shingles are healthier for homes than solar panels because they don't use elaborate racking systems that penetrate a roof. Sales of the Powerhouse Solar Shingles are expected to begin late this year.

ALIEN ICEBERGS OF DIAMONDS

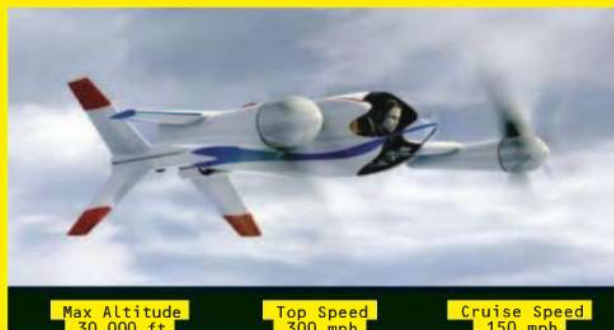
✦ Just how tough are diamonds? In a coordinated effort to determine exactly how diamonds react in extreme environments, two teams of physicists blasted samples of the gem with powerful lasers—the Janus laser at Lawrence Livermore National Laboratory and the Omega laser at the University of Rochester. The lasers created shock waves of pressure 40 million times the Earth's atmospheric pressure, melting the diamonds. The researchers then tweaked the lasers to gradually decrease the temperature and pressure to see

when solid diamond would re-form. At 11 million times the pressure on Earth, pieces of diamonds began to appear on

the surface of the liquefied carbon. The dual experiments lend credibility to a theory that gas

giants like Uranus and Neptune have oceans of liquid carbon that are dotted with floating icebergs of

diamonds. The data could also encourage more extreme industrial uses for diamonds. — A.H.



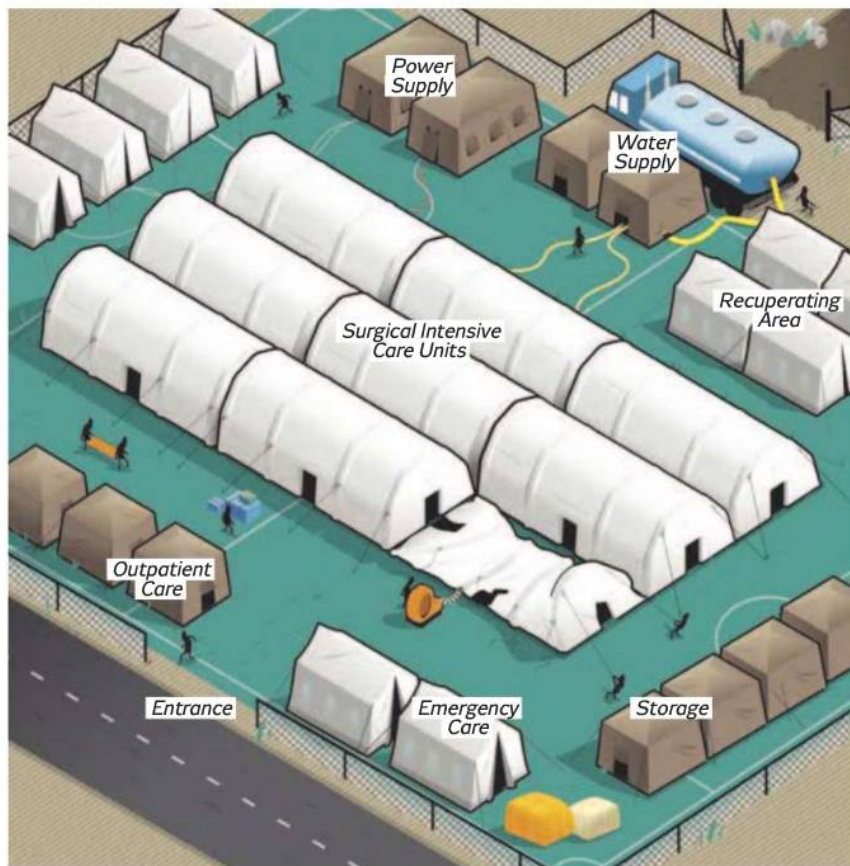
WHAT IS NASA PUFFIN?

✦ Aerospace engineers from NASA's Langley Research Center have designed a ... well, a cross between an ultralight electric airplane, a military V-22

Osprey and a jetpack. The conceptual "Puffin" aircraft would use lithium-phosphate batteries to power two 7.5-foot propellers, which would point upwards to take off vertically but tilt forward to fly horizontally. Researchers hope to operate a 1:3 scale model of the personal air vehicle this year. The craft's avian namesake shares an awkward appearance and a tendency to fly alone. — ALEX HUTCHINSON

Hospital In a Hurry

+ When a disaster destroys a city's medical facilities, victims rely on field hospitals to provide care. In undeveloped nations, poor infrastructure makes transporting the tons of necessary equipment especially challenging. The staff at the nonprofit organization Doctors Without Borders, or Médecins Sans Frontières (MSF), set up a nine-tent hospital in earthquake-stricken Haiti three days after the group had arrived, but the facilities can stay operational indefinitely. — AMBER ANGELLE



Location

A 100-bed MSF facility requires about 64,000 square feet, preferably on flat ground. Since the hospital should be accessible by roads and have a controlled entrance, sports fields make ideal sites. In Haiti, MSF supplies are flown to the Dominican Republic and then trucked 230 miles to Port-au-Prince.

Power

Two generators, a 30-kilovolt and a 60-kilovolt, supply electricity for X-ray machines, air conditioners, blood-bank refrigerators and autoclaves that sterilize surgical tools.

Tents

MSF tents have no rigid parts. Staff first inflate the support spars, then hoist them before filling the walls with air. The tents may be reinflated if the air pressure inside decreases when the outside temperature drops. "There are entrances at the front, middle and back so they can be set up in any configuration," says Laurent Dedieu, MSF's logistics coordinator. "This offers a lot of leeway."

Water

Trucks bring water from a nearby water tower, dock or airfield. The MSF hospital can get by on a daily ration of 26 gallons per bed; 100 to 150 gallons is the usual.

Staff

About 30 medical personnel work in 8- or 12-hour shifts. During a 24-hour period, 80 to 100 doctors and nurses can see hundreds of patients.

Smooth Operator



To capture shots of moving animals, filmmakers use a rig that ignores rough terrain.

→ It can be difficult for documentary nature filmmakers to shoot Hollywood-style scenes that move seamlessly with wildlife on the hoof. Documentarians for the Discovery Channel's series *Life* have created a stabilizing system called the Yogi Cam that allows filmmakers to record animals but ignore the rough, frame-shaking terrain below. Ted Oakes, an executive producer, created the rig by putting a gyrostabilized HD camera on the end of a jib arm and counterbalancing it with weights. The gyrostabilized camera compensates for frequent vibrations, while the weight of the jib counters the jarring movements of the vehicle. This enables film crews to drive alongside animals running at full speed. "Before this, you placed a cameraman with a tripod in position and filmed a static, nonmoving shot as animals passed," Oakes says. Now, cameramen can create long tracking shots that capture the intimate aspects of animal behavior and immerse the viewer in a scene. — ERIN MCCARTHY

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The U.S. Department of Energy is funding research into the following breakthrough technologies:

Cellulosic Biofuels From Genetically Modified Plants

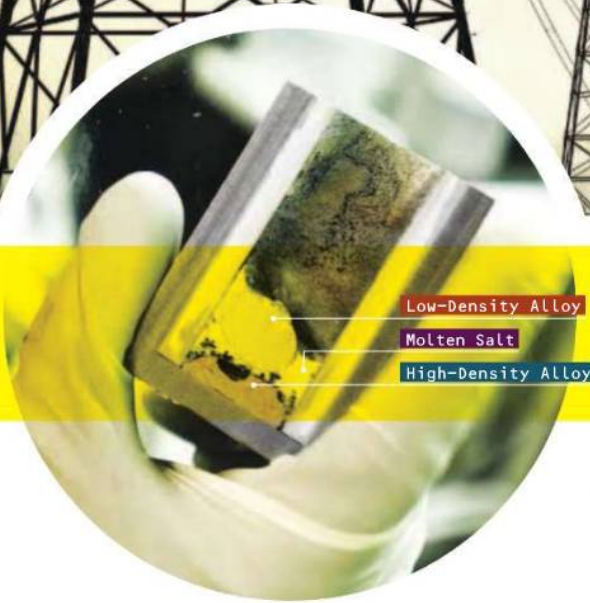
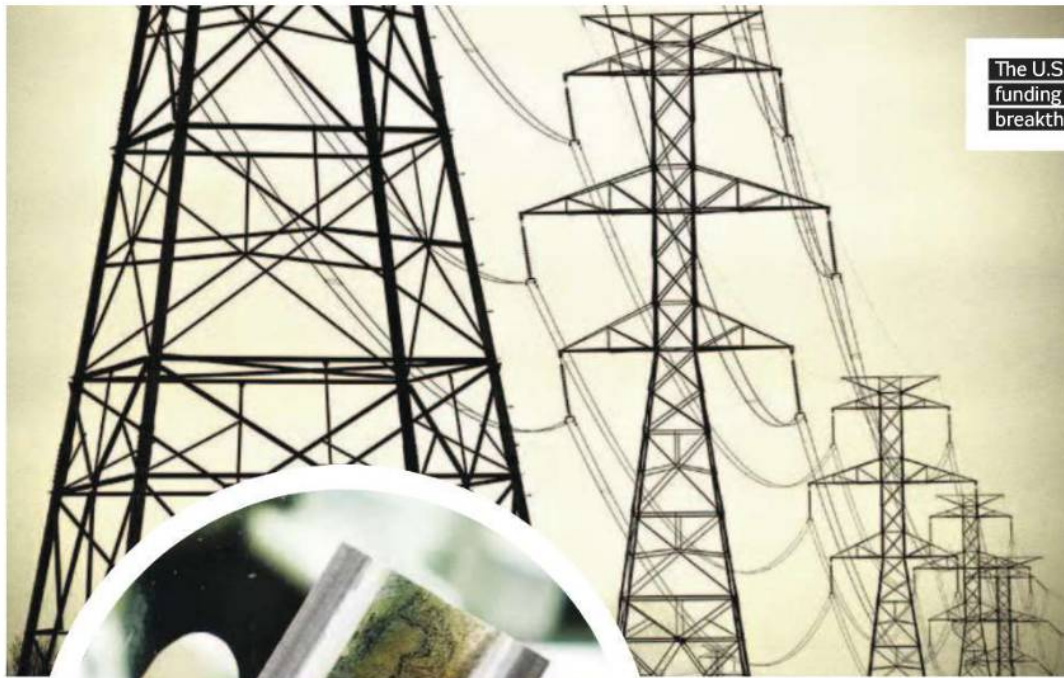
→ Conventional biofuels, like corn-based ethanol, divert food crops to generate energy. Massachusetts startup Agrivida is genetically engineering fuel crops to contain cellulose-processing enzymes, potentially making cellulosic biofuels commercially viable for the first time. Federal funding: \$4.5 million.

Bacteria That Produce Biofuels

→ Researchers from the University of Minnesota are using two species of bacteria to make it easier and cheaper to turn plants into fuel: one to photosynthesize sugar from sunlight and carbon dioxide, and another to convert it into biofuel. Federal funding: \$2.2 million.

A More Perfect Metal-Air Battery

→ Fluidic Energy, founded by Arizona State University materials scientist Cody Friesen, is creating a portable metal-air battery that uses ionic liquids (low-temperature liquid salt) instead of water-based electrolytes. The design could pack 11 times the energy density of today's best lithium-ion batteries without the limited voltage and evaporation problems typical of metal-air designs. Federal funding: \$5.1 million.



Low-Density Alloy

Molten Salt

High-Density Alloy

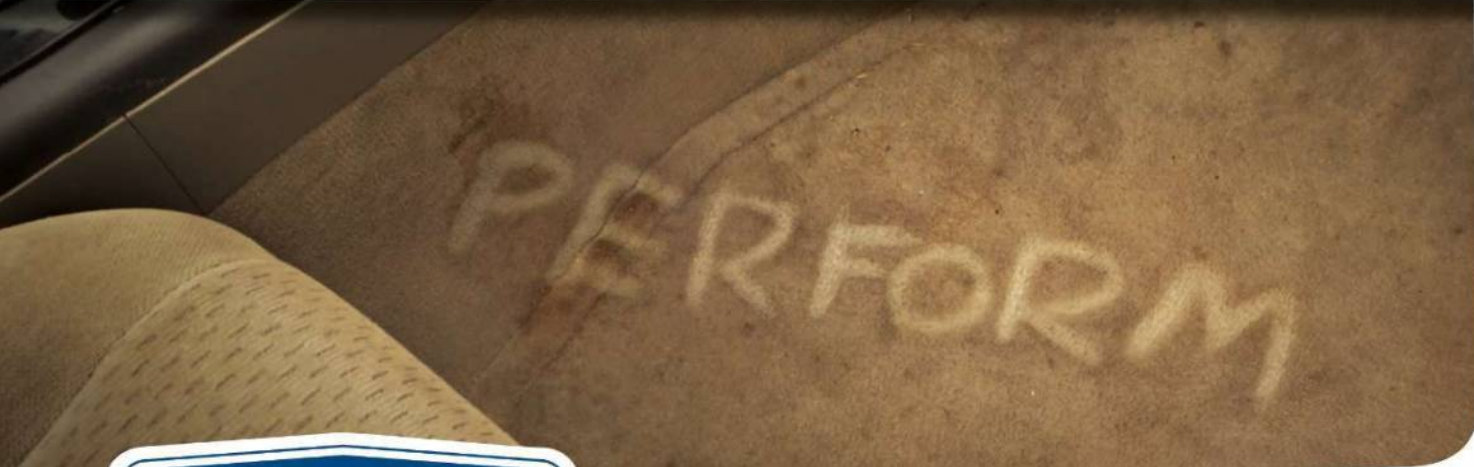
← Scientists at MIT slice super-cooled liquid-metal batteries in half to study the way the molten material inside behaves. The battery at left has charged and discharged many times, but the three layers remain intact.

A Real Energy Drink

RESEARCHERS CREATE AN ALL-LIQUID-METAL BATTERY THAT COULD ALLOW ALTERNATIVE POWER SCHEMES TO FLOURISH. BY MICHAEL BELFIORE

→ **Plans to add** renewable power sources to the electric grid have a common problem: weak, expensive and small batteries that can't guarantee there will be juice when the wind isn't blowing or the sun isn't shining. Donald Sadoway, professor of materials chemistry at Massachusetts Institute of Technology, thinks the solution lies in novel batteries that use liquid metals. The battery designed by Sadoway and his team works on the same principle as any other: Two electrodes exchange electrons through an electrolyte to complete a circuit. But by using liquid metals for electrodes and molten salt as an electrolyte, their battery can absorb

electrical currents that are 10 times higher than present-day high-end batteries. Only the different densities of the liquids keep them separated inside the battery, which means it would be a poor choice for most mobile applications—but smart for a fixed location, such as an electrical installation. Sadoway's team first made shot-glass-size prototypes to experiment with costly ingredients such as pure magnesium and pure antimony, but is now seeking the right mix of alloys for optimal performance and cheap manufacture. The Department of Energy's idea factory, the Advanced Research Projects Agency-Energy (ARPA-E), is putting \$6.9 million behind Sadoway's project. His award is one of the biggest of the agency's first round of funding, released in late 2009. The batteries need external heaters to keep their innards molten at operating temperature. "One of the goals of the ARPA-E-funded project is to determine the smallest size of cell that would not need booster heaters," Sadoway says.



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Be Car Care Aware



Big Future for Little Fliers

+ Don't let the size of micro air vehicles, or MAVs, fool you. Although some measure less than a foot across, these remote-control reconnaissance planes have proven to be deft, powerful tools for soldiers and police operating in the narrow airspace of cities and towns. But diminutive aircraft can't carry much fuel or many batteries, and their use is often limited by short flight times. With civilian and military officials clamoring for more advanced urban MAVs, defense firms are developing models that can undertake longer surveillance missions. Future MAVs will also be able to set down on rooftops or ledges, which consumes less power than hovering and maintains a more stable viewing platform for cameras. — DAVID HAMBLING

CYBERQUAD
LENGTH: 21" / MAX WEIGHT: 6.6 LB



XQ-138
LENGTH: 28" / MAX WEIGHT: 6.2 LB



DEVIL RAY
LENGTH: 24" / MAX WEIGHT: 2.5 LB



1 2
4 3

STANFORD DRONE
LENGTH: 39" / MAX WEIGHT: 0.8 LB



1 Hover and Stare

The electric CyberQuad, built by the Australian company Cyber Technology, uses four ducted fans that allow it to fly and hover. Like a helicopter, it can set down on any flat surface. Shrouds around the rotors give operators confidence to fly the craft in areas where an exposed blade might catch—a feature that came in handy during the recent inspection of a damaged oil rig in the Timor Sea.

2 Stand Up and Fly

The XQ-138, designed by University of Kansas aerospace engineering associate professor Ron Barrett, takes off and lands on its tail, courtesy of a spinning rotor. The entire airframe of the XQ-138 rotates 90 degrees for 150-mph forward flight. Actuators counter gusts of wind to keep the craft stable.

3 Stick Around

At Stanford University's Biomimetics and Dexterous Manipulation Lab, professor Mark Cutkosky is developing a drone that can land on walls using sticky feet. The plane executes a deliberate stall as it approaches a wall and turns its underbelly to face the vertical surface. Flexible legs absorb the shock of impact. Tiny claws on the feet give the aircraft a tenacious grip, allowing it to crawl around and reorient before taking off again.

4 Perch for Power

Engineers at Defense Research Associates designed a specialized perching craft for the Air Force. The Devil Ray can cruise at 42 mph, but its upside-down, turned-in winglets give it stability at slow speeds. The MAV's precise control is needed to snag power lines with a custom-made latch. Perched like a raven, the Devil Ray then tops off its energy with an induction-based recharger.

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**Three
Missions Enter,
One Leaves**



NASA has whittled its next robotic space mission to a trio of candidates. The mission can cost no more than \$650 million and must be ready to launch by the end of 2018. Each proposal received \$3.3 million this year for a 12-month mission-concept study that NASA will use in 2011 to select a winner.

**Mission No. 1
VENUS**



A probe measures chemicals in the planet's atmosphere before landing on the surface, where its scraping tool analyzes the makeup of the Venusian rocks.

**Mission No. 2
ASTEROID**

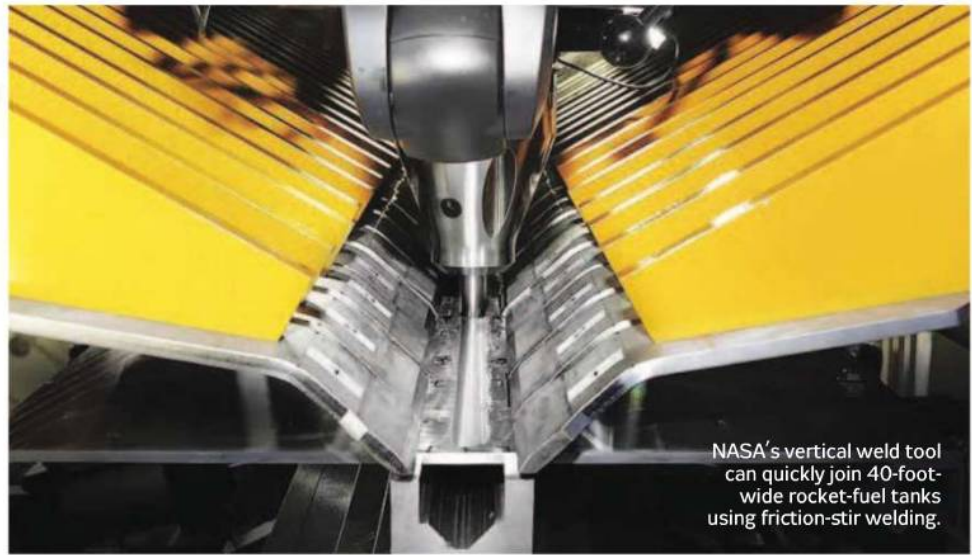


A robot lander collects about 2 ounces of material from an asteroid and returns it to Earth. The samples will be tested for the presence of molecules needed to produce life.

**Mission No. 3
MOON**



A lander descends into a basin near the moon's south pole and returns with 2 pounds of material from the lunar mantle.



NASA's vertical weld tool can quickly join 40-foot-wide rocket-fuel tanks using friction-stir welding.

Merging Metal

INDUSTRIAL ENGINEERS GO BEYOND ARC WELDING TO FUSE MASSIVE SHEETS OF ALLOYS. BY HARRY SAWYERS

→ **Joining the giant** aluminum alloy plates used on large ships and spacecraft usually requires teams of workers with handheld arc welders. But having to rely on human labor can cause costly delays, and manufacturing companies are eager to develop new methods. One of the most promising is friction-stir welding, which uses a

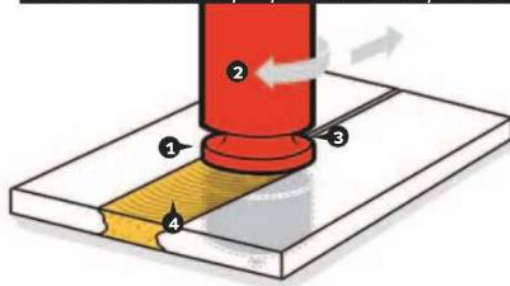
spinning rod to generate enough heat to soften the aluminum and to push the alloy's molecules together with 15,000 pounds of pressure. A friction-stir welding machine moving at 8 inches a minute can join inch-thick alloy plates in a single pass, while traditional arc-welding would require over a dozen welds to complete the same seam.

But the technology does have a downside: The machines need extra hardware to absorb the intense pressure, known as Z-force. Bulky and expensive, the hardware limits the length of the welds and often relegates friction-stir welding to big-dollar government programs in need of precise joins, such as the Navy's Littoral Combat Ship and NASA's Ares I-X test rocket, which lifted off in late 2009.

A new tool called a bobbin may help make the method mainstream by simultaneously joining the plates and absorbing pressure. Next-generation friction-stir welding devices could weld steel, combine heterogeneous metals and make welds of indefinite length by perching bobbins on dollies that move along lengthy seams.

HOW IT WORKS:

Friction-stir welding joins metal with heat and high pressure. A new tool called a bobbin could make the technique quicker and more practical.



1. The bobbin's shoulders, working like a vise, stabilize 1-inch-thick aluminum alloy plates.

2. The rotating head, spinning at 275 rpm, generates friction heat that softens the metal along the path of the weld.

3. The pressure that merges the metal is absorbed by the bobbin instead of by separate machinery.

4. The rotation of the tool leaves concentric circles on both sides of the joint.

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SEA-DOO



→ **Why are humans** the only species capable of having a verbal conversation? New research indicates the answer may involve more than the presence of specialized vocal cords. Neurobiologist Genevieve Konopka and her lab group at the University of California—Los Angeles examined a gene called FOXP2, which is linked to human language. But FOXP2 is also found in other animals, and the human version of the gene produces proteins that differ from the chimp's in only two out of 715 locations. To determine the influence of these two mutations, Konopka's team first grew human brain cells in cultures, then injected some samples with human FOXP2 and others with chimp FOXP2. The human FOXP2 led to the expression of a set of different genes than the chimp FOXP2—proving that the two mutations have functional consequences. "This was completely unexpected," Konopka says. The discovery yields the first evidence that human-specific FOXP2 mutations have influence over speech. Interestingly, the mutations are believed to have occurred around the same time that human language first appeared. But activating a set of language genes isn't enough to create a talking chimp—the way genes influence the brain is too complex. For example, genes "turn on" at different times throughout human development to coordinate the formation of parts of the brain involved with language. "The next step is to look at the individual functions of this set of genes," Konopka says. "They may offer insight about why we're the only species that has the ability to speak, and may even show us how to help people with language abnormalities."

nanochannels to unravel the double-stranded DNA. An electrical charge in the chip moves the strands along the channels, and an ultra-high-resolution camera allows scientists to view DNA within minutes. The company will release a test version this year.

Nanopore Sequencer

→ The four types of nucleotide bases in DNA are denoted by letters: A, C, G and T. Last year, IBM received a three-year grant from the National Human Genome Research Institute to develop a sequencer that can analyze DNA one base at a time. The device consists of a silicon microchip with a 3-nanometer-wide hole, called a nanopore, through which a strand of DNA passes. The trick has been slowing the DNA enough to make each base unit readable by a sensor. IBM plans to ratchet the DNA by manipulating an electrical field inside the nanopore.

Nanofluidic Chip

→ Current technology forces researchers to chop up DNA into millions of pieces to prevent the strands from coiling, which makes them difficult to read. Also, putting the DNA back together can result in missing or duplicate pieces. A new chip from BioNanomatrix in Philadelphia uses branching

Next-Generation Gene Sequencers

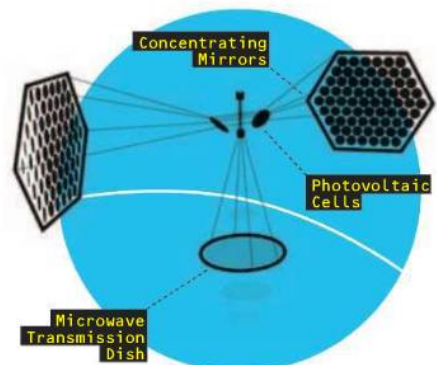
Two tools now in development could help doctors read DNA more quickly and cheaply, ushering in an era of personalized medicine.

Why Apes Can't Talk

HUMANITY'S ABILITY TO COMMUNICATE THROUGH VOCAL LANGUAGE HAS A GENETIC COMPONENT THAT CHIMPS LACK. BY AMBER ANGELLE



Solar-Based Power Play → California is forging ahead with a plan to beam power from space-based solar panels as early as 2016. In a deal approved by state regulators, start-up Solaren will provide 1700 gigawatt-hours of power per year for 15 years to Pacific Gas and Electric, using satellites to convert the sun's rays into radio-frequency beams that can be transmitted to receiving stations on Earth. The biggest hurdle: the high cost of launching the components into geosynchronous orbit, which starts at about \$20,000 a pound. (The utility and Solaren have not released the financial details of the deal.) Other entrepreneurs are pursuing similar systems, including a group of Japanese companies that last summer announced a \$21 billion plan to test hardware in space in 2020 and sell power by 2030. — A.H.



ILLUSTRATIONS BY LOULOU & TUMMIE (APE), BRADLEY R. HUGHES (SOLAR)

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Upgrade

Hammer Time

→ While rotary hammers are great for drilling through hard materials like concrete and brick, they are too big and unwieldy to be totally practical for most homeowners. The **Rockwell 12-Volt Li-Ion H3 (\$180)** shrinks the rotary hammer down from a reciprocating saw-size tool to a machine no bigger than a power drill. Its weight: just 3

pounds (some rotary hammers weigh almost 20). But despite the tool's Lilliputian build, it still packs a punch—its hammer mechanism delivers up to 4800 blows per minute, and our tests found it amply able to bore pilot holes in solid concrete block before socking down screws.

— SETH PORGES

Point and Shoot

→ Radar guns are typically bulky, megaphone-size affairs. The 4.5-ounce **Pocket Radar Gun (\$250)** is the size of a Flip camera, yet still allows users to measure the speed of a moving object to within 1 mph at speeds of up to 375 mph—meaning it can be used by everybody from Little League coaches to car-racing enthusiasts.



Couch Conferencing

→ In our sci-fi fantasies, videoconferencing takes place on massive space-age screens—not the miniature computer monitors typically used for Skype and iChat. So Skype's announcement that it's bringing its VoIP videophone service to select TVs from Panasonic and LG? Welcome news for those looking for full-screen video chats from the comfort of their couch. **Skype TV (price not set)** launches later this year, and will require a purpose-built webcam that straps to the top of the TV.

pm
EDITOR'S
CHOICE



Kinetic Energy

→ The **YoGen Universal Mobile Device Charger (\$40)** isn't the first pull-string gadget charger we've seen (we covered a prototype for a similar product back in 2008)—but it is the first you can buy. Its promise: The ability to transform your muscular strength into endless power for any gadget, just by pulling a string. Of course, the reality is a bit more tame (and exhausting): The second your hand lets up, so does the charge. But for an emergency 1-minute call, it could be a lifesaver.

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beautiful on the inside? It's one of the many ideas
that make Delta® more than just a faucet.



Field Guide

SMARTPHONE OPERATING SYSTEMS

→ Sure, a smartphone's specs matter—you definitely want one with a fast processor, bright screen and decent camera. But all that horse-power is wasted if the phone is difficult to use. That's why, when it comes to user experience, nothing is more important than a phone's operating system. A good OS is intuitive enough to be figured out in seconds, easy to navigate and can run a mountain of apps. Here's what you need to know about five top smartphone platforms. *BY SETH PORGES*



→ **Android** × **BlackBerry OS** × **iPhone OS** × **Palm webOS** × **Windows Phone**

YOU'VE SEEN IT ON:

Motorola Droid, Google Nexus One, HTC Hero	All BlackBerry phones	Apple iPhone 3G, Apple iPhone 3GS	Palm Pre, Palm Pixi	Samsung Omnia II, HTC Imagio
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WHAT WE LOVE ABOUT IT:

The Google-developed Android OS has a plethora of apps (free auto navigation!) that are absent on the iPhone. Android is available on many different phones, and on all major carriers.	Its unrivaled business acumen extends from solid e-mail and messaging services to its appearance on phones with famously thumb-friendly keyboards.	Unparalleled usability and as intuitive as they come. The Apple App Store defined the field and still has the most (and the best) apps—particularly when it comes to games.	Extremely fast and easy to use, with topnotch multitasking. Phone-wide "universal search" makes it very easy to find files and contacts across programs.	The platform is powerful and filled with features—as long as you can navigate its archaic interface. A ray of light: The upcoming Windows Phone 7 (due in late 2010) should improve the experience.
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DRAWBACKS:

Its app store is still a distant second to the iPhone's—particularly when it comes to games. The multitude of Android phones means some of them could have issues supporting some apps.	The OS feels a bit dated next to the flashier competition. Its app store can't compete with the iPhone's.	The platform is notoriously closed—Apple restricts what sort of apps developers can create for it. Minor differences aside, there is really only one phone to choose from. No multitasking.	Its app selection is very thin, as is the roster of webOS phones. Palm's uncertain financial future means there's a real risk that webOS will be a short-lived platform.	Notoriously sluggish and the most difficult OS to use. Finding simple functions on the frustrating interface can involve digging through multiple menus.
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BOTTOM LINE:

If you're reluctant to buy into Apple's ecosystem or AT&T's over-stretched network, Android is a strong alternative.	A great choice for the business class and heavy e-mailers, but it falls a bit short in the fun department.	The gold standard when it comes to usability and app selection. But if you want to play, you have to play by Apple's rules.	In terms of sheer usability, webOS rocks. But without many apps, there's little that allows it to shine in a crowded field.	Our advice: Wait for Windows Phone 7—a promising update that should act as a much-needed reboot for the OS.
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EVERY MONTH THE LATEST
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Lab Test5-GALLON
GAS CANS

→ Pouring from a 5-gallon gas can without spilling is no easy task. To see how leak-prone and durable different models are, we put three cans (two bargain, one pricier) through a battery of tests designed to simulate common calamities. *BY SETH PORGES*

→ **the tests****POUR TEST**

To gauge how the design of the can provokes spills, we took turns pouring gas into various vehicles and containers.

SCEPTER: The cumbersome dispenser was difficult to use. We eventually ditched it.

BLITZ: A "Store/Pour" switch effectively sealed the can when not in use. Trigger-controlled pouring was easy and accurate.

TUFF JUG: While the nozzle is designed to fit into some vehicles, making it do so required holding 5 gallons of heavy gasoline upside down. Pouring into noncompatible containers was very messy.

WINNER: Blitz

KNOCK-OVER TEST

Simulating the effect of a bumpy ride in the back of a pickup, we repeatedly kicked the cans over to see if they leaked.

SCEPTER: Our boots had little problem knocking over the full can, but it survived the upsets without losing fluid.

BLITZ: Like the Scepter, the Blitz was easy to kick over but handled the falls without incident.

TUFF JUG: Although a high center of gravity made the Tuff Jug tip-prone when standing up, it was nearly impossible to knock over when placed on its alternate horizontal surface.

WINNER: Tuff Jug

DROP TEST

To assess durability, we dropped full cans onto concrete from progressively higher heights—top down—until they split.

SCEPTER: Our toughest can survived until it fell from 5 feet, which caused the seam on the plastic handle to split and its contents to spill.

BLITZ: At 4 feet, the plastic dispenser snapped into several pieces and its seal broke, allowing liquid to seep out.

TUFF JUG: After a fall from 3 feet, the nozzle completely broke off the tank and the fluid began to gush.

WINNER: Scepter



For safety reasons, our tests involved filling the cans with a mixture of water and antifreeze (designed to create a more gasoline-like surface tension).

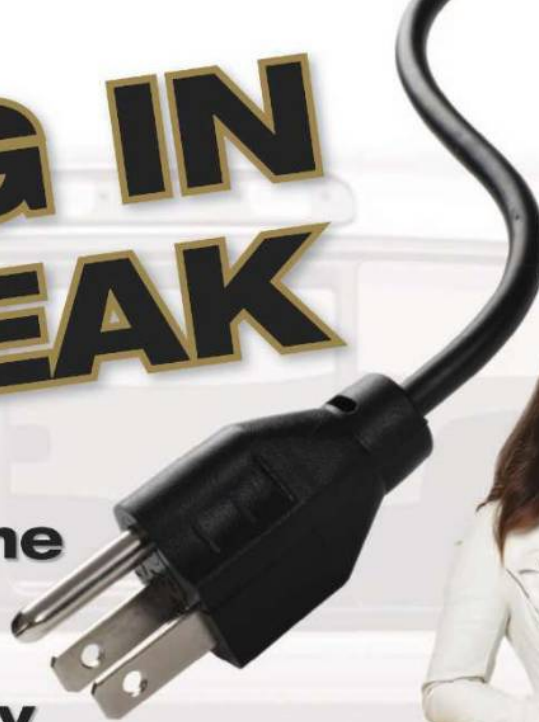
→ **the cans** 1. Scepter Eco (\$11) | 2. Blitz Enviro-Flo Plus (\$13) | 3. Tuff Jug Gasoline (\$43)

BOTTOM LINE

Although it was bested slightly in the drop test, the Blitz's accurate and easy-to-use nozzle makes it the best overall choice. The takeaway: For gas cans, a high price is no marker of quality.

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¹Available with a package or as optional equipment. ²Comparison based on 2010 EPA city/hwy mpg estimates for Compact Crossovers with V6 engine. EPA estimates for 2011 Kia Sorento are 20 mpg/city and 26 mpg/hwy with V6, 2WD. Actual mileage may vary. ³MSRP for Sorento M/T model is \$19,995 at participating dealers. MSRP for EX V6 with Limited Package (w/Navigation System) shown is \$32,095. Prices exclude \$795 freight, and tax, title, license, registration, other options and retailer charges. Actual prices set by retailer. Model shown with optional features.



KIA MOTORS

The Power to Surprise[®]

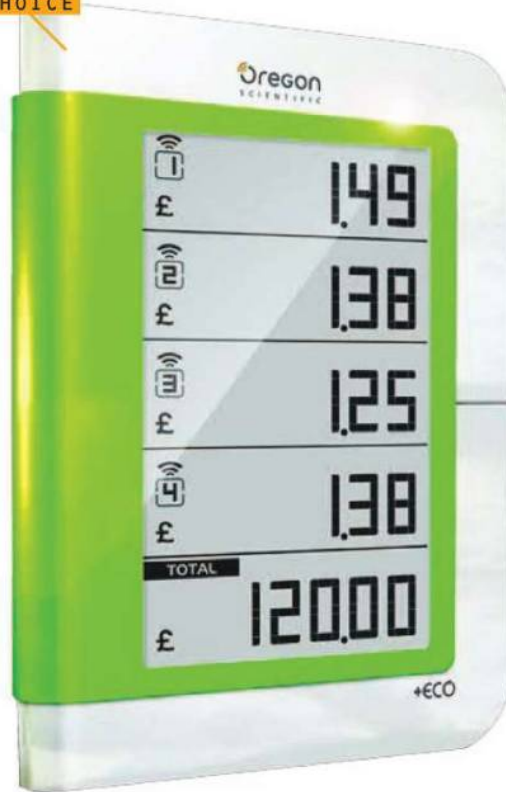
Compact Crossovers with V6 engine. EPA estimates for 2011 Kia Sorento are 20 mpg/city and 26 mpg/hwy with V6, 2WD. Limited Package (w/Navigation System) shown is \$32,095. Prices exclude \$795 freight, and tax, title, license, registration,

Power Patrol

→ When it comes to home energy use, simply knowing how much you're consuming is half the battle. That's why we love appliance power monitors—by displaying exactly how much electricity each device consumes, they make it easy to cut back. But none we've seen is as seamless—and, dare we say, sexy—as the Oregon Scientific Wireless Appliance Manager (\$60), which comes out this summer. Real-time energy cost and power consumption is remotely gathered by sensor plugs at up to four sockets and wirelessly beamed to a single display. Surveying your electrical domain has never been easier.



pm
EDITOR'S
CHOICE



Tiny Telescope

→ The laws of physics dictate that a deep zoom requires a long lens, which is why ultra-compact cameras rarely have more than a 3x optical zoom. The Nikon Coolpix S8000 camera (\$300) seems to defy logic—it stuffs a 10x optical zoom into a camera that's less than an inch thick. When not in use, the extra-deep telescoping lens hides in the body like a Russian nesting doll.

Big Touch

→ The Nintendo DS portable gaming platform has been nothing if not a cultural phenomenon—in six years, the company has sold well over 100 million of them. But while Nintendo has released sporadic updates of the system over the years—a more pocket-friendly version, one with a camera and access to an online store—current versions of the DS have changed little from the original. That trend continues with the latest iteration, the Nintendo DSi XL (\$190). The key



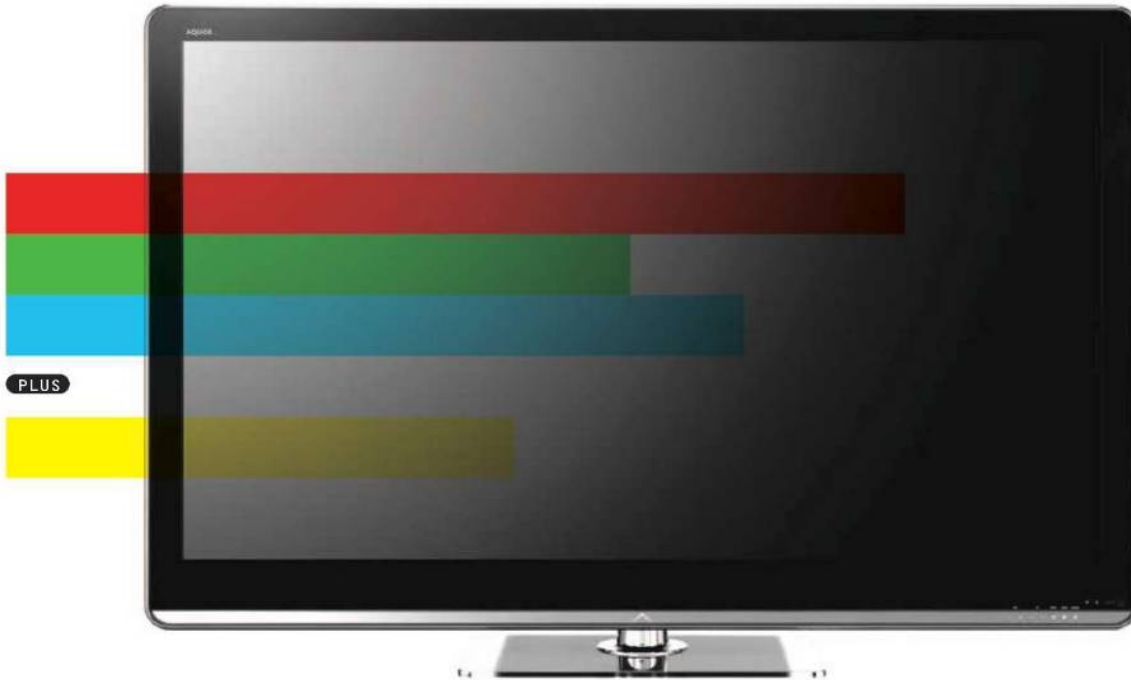
difference: The screens are much, much bigger (it now has a pair of 4.2-inches). Does this make it easier to precisely navigate a stylus over the touchscreen? Absolutely. But it's hard to see it as a game-changing system that will have people tossing out their old hardware.



Laser Equator

→ Laser measuring devices have long allowed homeowners and builders to measure distances quickly, without unfurling an awkward tape. Where the compact *Prexiso X2* (\$100) trumps the competition: It can also compute area, height and volume. For example, to measure height, users first detect the distance to the base of an object. Then, holding it in the same place, pivot the pointer up to measure the distance to the top of the object. From there, height is just a simple trigonometry calculation away—and the device does that for you.





The Rise of RGBY

➔ In order to render millions of different colors, TV monitors typically rely on pixels that can display a combina-

tion of three basic colors: red, green and blue (a so-called RGB matrix). Taking a page from four-color printing

presses, the *Sharp QuadPixel LE line of LED-backlit LCD TVs (starts at \$1800 for a 40-inch model)* adds

in a fourth, yellow pixel—increasing the quantity of viewable shades to trillions. Plus, Sharp claims the extra pixel

produces increased color accuracy and better overall picture. RGB, meet your younger brother, RGBY.

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Brett Favre

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—George Thomas
Towson Watch Company



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Weight Watcher

The skeleton of the new Audi A8 is the third all-aluminum version since 1994. Audi employed aluminum, rather than steel, to save weight and fuel. But the material is less than half as strong and harder to draw into complex shapes,

so maximizing the benefits can be a tricky process. The A8's frame now uses one single stamping rather than seven welded pieces, a refinement that adds stiffness but not pounds. Audi has made more than half a million aluminum-intensive cars. Expect to see more carmakers

follow. For 2011, the all-wheel-drive A8 grew in every dimension, and added features like night vision and a 19-speaker stereo. Yet it gained no weight. The direct-injected DOHC V8 makes slightly more power (372 hp) than the previous A8 and is joined to a new eight-speed automatic transmission.

This slick combo silently ferries the sedan to 60 in less than 6 seconds, and returns 15 percent better fuel economy (estimated 18/26). Adjustable shocks deliver a creamy ride and surprisingly crisp driving dynamics. Inside is a benchmark interior, flush with adjustable



→ **INSIDE:**

++ **PM TEST DRIVEN**

AUDI A8 + BMW 5 SERIES +

HYUNDAI SONATA +

ASTON MARTIN RAPIDE + BMW S1000RR

TECH WATCH

2011 FORD MUSTANG ENGINES

FIRST LOOK

CHEVY SILVERADO HD + PORSCHE 911 GT3 R HYBRID



LED lighting, optional massaging seats, high-quality materials and more class than the Four Seasons. The show-stopping nav system uses Google satellite images that are fantastically rich, while a console-mounted touchpad—you write the address with your finger—means no more scrolling for letters.

—LARRY WEBSTER



Bavarian Business Suit

For the new 5 Series, BMW stretched the wheelbase by 3 inches and increased the length by 1.5. Yet, it looks more compact, effectively hiding the roomier back seat. Three gas engines—two straight Sixes and one V8—offer from 240 up to 400 hp, but, sadly, there's no U.S. diesel just yet. The six-speed manual returns with a new eight-speed auto that should bump highway fuel economy close to 30. "Variable" is the key word with the chassis, since the car's onboard computers can adjust the shocks, steering ratio and antiroll-bar stiffness to find the handling sweet spot. In our test drive near Lisbon, Portugal, the nose turned in with alacrity and the shocks brilliantly handled both curves and potholes. —ANDREW ENGLISH

1.

2011
BMW
5 Series



Bland No More

Hyundai's mission to energize everyday cars continues with the new Sonata. It combines a high-quality interior, upscale sheet metal and good fuel economy. While it's grown slightly to fit a larger rear seat and a 16.4-cubic-foot trunk, the structure is stiffer and lighter. A slippery 0.28 drag coefficient, 198-hp 2.4-liter four-banger and six-speed transmissions combine for 35 highway mpg. No V6 is offered, but a hybrid and a turbo model with over 250 hp debut next fall. On the sinewy roads of SoCal's Palomar Mountain, the Sonata displayed an Accord-like compromise of compliance and agility. It's quiet too, and well-equipped, with a base price of \$19,195.

—BEN STEWART

2.

2011
Hyundai
Sonata



→ PM TEST DRIVEN
++
TECH WATCH
FIRST LOOK
AUDI A8 + BMW 5 SERIES + HYUNDAI SONATA +
ASTON MARTIN RAPIDE + BMW STOURER
2011 FORD MUSTANG ENGINES
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2010
Aston Martin
Rapide



Four-Door Sports Car

Sliding the glass-capped key fob into the dash fires up the Aston Martin Rapide's gently growling V12, and clicking the leather-wrapped magnesium paddle shifter readies the 48-valve 470-hp powerplant for effortless forward motion. There's a sense of opulence to this new sedan that's almost worth the \$199,950 price. For this sleek vehicle, Aston stretched the DB9 platform 11.4 inches and inserted a pair of rear seats decked out in sublime luxury. It's a little tight back there for six-footers, but there's no sense fretting over a few missing cubic feet. In the mountains of

eastern Spain, the Rapide handled winding roads with crisp turn-in and strong grip that had seemed unlikely considering its plus-size body. Impressively, this four-door's ride was also supple—thanks to computer-controlled shocks—and the traction control gently halted easily achieved wheelspin. Double-paned glass offers a well-insulated bubble of peace even when you're flogging the car near the 184-mph top speed. An exhaust valve opens at high rpm to fully release the V12's bark. With six-piston front and four-piston rear calipers, stopping is as effortless as going. Awash in mahogany and aluminum trim, the interior feels quite royal. Don't, however, expect miserly fuel use—figure 13/20 mpg.

—BASEM WASEF

2.



2010
BMW
S1000RR

German Road Rocket

To attract younger buyers, BMW is heading into the sportbike category. Architecturally, the S1000RR is very similar to the Asian race replicas. A four-cylinder engine runs across the bow, a chain transfers power, and an aluminum twin-spar frame forms the backbone. But BMW has added rider aids uncommon to the genre. A lean-angle sensor detects cornering maneuvers and automatically restricts engine power. Antilock brakes take the worry out of high-speed braking. There's even an ignition cutout for full-throttle upshifts. It's potentially more rideable than any comparable machine for most of us, and as fast as anything out there in the hands of experienced riders. If the new superbike benchmark is accessible performance, then BMW got there first.

—BARRY WINFIELD

The 16-valve 1000-cc inline engine belts out 193 hp and revs to 14,200 rpm. That's heady stuff for a \$13,800 bike. The current horsepower king, the Suzuki Hayabusa, has similar power, but it needs a third more displacement to produce it.



→ ++ PM TEST DRIVEN
TECH WATCH
FIRST LOOK
AUDI A8 + BMW 5 SERIES + HYUNDAI SONATA +
ASTON MARTIN RAPIDE + BMW S1000RR
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CHEVY SILVERADO HD + PORSCHE 911 GT3 R HYBRID



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 TECH WATCH 2011 FORD MUSTANG ENGINES
 FIRST LOOK CHEVY SILVERADO HD + PORSCHE 911 GT3 R HYBRID

1. 2011 FORD MUSTANG GT 5.0



2. 2011 FORD MUSTANG SHELBY GT500

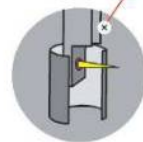
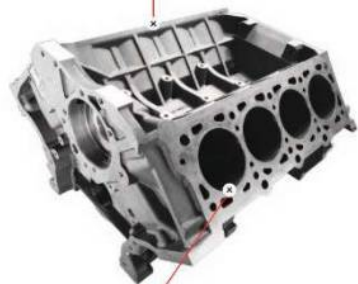


Long Live the V8

FORD'S BEEN AGGRESSIVELY SWAPPING MANY V8S FOR SMALLER TURBO ENGINES. EVIDENTLY, THE MUSTANG GROUP DIDN'T GET THE MEMO. THIS YEAR THE PONYCAR ENJOYS TWO NEW AND LUSTY V8S.

1. The first 5.0 Mustang debuted over 30 years ago, with a V8 that actually displaced 4.948 liters. So while Ford used unconventional rounding back then, the ruse is no longer needed—the new aluminum V8 displaces 4.951 liters. Nitpicking aside, the new 5.0 has race-spec parts, like four-bolt main-bearing caps and oil-cooled pistons. Unlike the original pushrod motor, double overhead cams operate four valves per cylinder. The cams are offset to the exhaust side to make room for massive, nearly straight intake ports. Gorgeous stainless-steel headers handle the exhaust. **"The heart of this engine is in the breathing,"** says Mike Harrison, Ford's V8 programs manager. **And boy does it breathe.** The peak 412 hp crests at the motor's 7000 rpm redline. Torque is stout at 390 lb-ft. Plus, this new mill is backed with a six-speed manual gearbox, and Ford promises better fuel economy.

2. **With 540 hp, one could argue that the supercharged GT500 didn't need more. However, a Slim-Fast plan was definitely in order, especially to trim the porky front end.** So Ford swapped the iron engine block for an aluminum one and dropped 102 pounds. The company also patented a cost-effective plasma-transferred wire-arc spray bore (PTWA) process that coats the cylinder walls with a tough form of iron oxide. This reduces friction and makes typical, heavy iron liners unnecessary. The bore, the stroke and the belt-driven blower are unchanged, but there's a bigger intercooler for consistent power output. A larger exhaust system reduces back pressure and increases max power to 550. These changes increased fuel economy enough (15/23) that the gas-guzzler tax no longer applies. Plus, Ford hinted that more power is in the tank, just in case Chevy releases the long-rumored Camaro Z28. — L.W.



The cylinder probe (left) coats the cylinders with iron oxide, making liners redundant. High-voltage electricity arcs from a consumable steel wire to ground like a MIG welder. Compressed air sprays the plasma onto the cylinder walls, forming a tough 150-micron-thick coating.



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P M N E W C A R S

Revised Workhorse

Underneath the little-changed Silverado HD sheet metal is an all-new truck, starting with a new frame. Make that 11 all-new frames, to accommodate variations of cab and cargo-box length and 4x4 and RWD drivetrains.

A 6.0-liter V8 is the lone gas engine, now with variable valve timing and a six-speed automatic. To meet tougher exhaust emissions, the revised 6.6-liter Duramax diesel has been revamped with urea-injected exhaust treatment. A new engine-

braking system debuts, and the diesel can now run on 20 percent biodiesel. Expect more than 400 hp and torque that could nudge 700 lb-ft. Tow ratings are naturally stout, topping out at 20,000 pounds. — KEVIN A. WILSON



2011 Chevy Silverado HD



Porsche 911 GT3 R Hybrid

Hybrid Racer

Now that Formula One has abandoned last year's hybrid experiment for cost reasons, Porsche has picked up the baton with a gas-electric hybrid 911 race car. It will race this month in the 24 Hours of Nürburgring, a grueling event that uses the notoriously fast and challenging 15.8-mile track configuration. The powertrain consists of two 80-hp electric motors driving the front wheels. To store and then release the car's kinetic energy, Porsche uses a flywheel generator. The flywheel was originally developed for the Williams F-1 team, but was never raced. To equalize weight distribution, the flywheel unit is mounted next to the driver, where the

passenger seat normally resides. Under braking the axle motors generate electricity that spins the flywheel rotor up to 40,000 rpm. The stored energy then provides supplemental power bursts of up to 8 seconds. Combined with the rear-mounted 480-hp flat Six engine, this racer has over 600 hp of potential thrust and four-wheel drive. Porsche says the system will also increase fuel economy, which could save time spent in the pits. The extra weight—Porsche isn't saying how much—however, will likely cause increased tire wear. In a first for Porsche, the company says the focus is not on winning—it views the car as a "racing lab." — L.W.

PM TEST DRIVEN	AUDI A8 + BMW 5 SERIES + HYUNDAI SONATA + ASTON MARTIN RAPIDE + BMW S1000RR
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FIRST LOOK	CHEVY SILVERADO HD + PORSCHE 911 GT3 R HYBRID



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GREAT AMERICAN CARS

> BY JAY LENO
> PHOTOGRAPHS BY JOHN LAMM



1937
CORD 812



1966
CHEVY
CORVAIR

AFTER DECADES OF DORMANCY, AMERICAN ENGINEERING, DESIGN AND TECHNOLOGY ARE POISED FOR A COMEBACK.



1966
OLDSMOBILE
TORONADO

W



e lost our way with American cars, and I'm not sure where. I do know that the U.S. led the world in automotive technology for many decades. People rave about the French 1937 Citroën Traction Avant. But it was a four-cylinder that could barely do 70 mph. My 1937 Cord 812, with its supercharged V8, cruises at 75. Its preselector gearbox has a fourth-gear overdrive. I drive my 812 just like I drive any modern car.

I would argue that, at one point, the 1949 Cadillac was the most advanced car in the world. At a time when Rolls-Royce had an F-head six-cylinder with a stick shift, the Cadillac had an OHV V8 with a four-speed Hydra-matic, air conditioning and power windows—options people could only dream about on European cars. My '67 Chrysler Imperial

has a 350-hp 440-cid V8, front and rear air conditioners, electric seats and power windows, for less money than a '67 six-cylinder Mercedes-Benz 250 SE with manual windows and few options.

Looking back, I think that where we really started to lose it was with the Chevrolet Corvair. Introduced in 1959 by Chevy general manager Ed Cole, the rear-engine Corvair was built to mimic the best of Europe: Porsche, VW and Tatra. They even called it the "American Porsche." It had an air-cooled turbocharged 180-hp flat Six and a four-speed stick. Was it as good as a Porsche? No. But at half the price, it was a real bargain.

When consumer advocate Ralph Nader went after the Corvair with *Unsafe at Any Speed*, he also went after all American cars. The Corvair was just one chapter. But in a classic case

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**JAY LENO'S GARAGE///
AMERICAN CARS**

of the denial being worse than the crime, General Motors was so incensed about this upstart young lawyer that they hired investigators to follow him and tried to entrap him with prostitutes. After a Senate subcommittee looked into it, the whole thing blew up. GM chairman James M. Roche had to apologize to Nader, and all that bad publicity caused the Corvair's demise.

When the National Highway Traffic Safety Administration did a study in 1971, the Corvair was deemed as safe as its contemporaries, particularly 1965 and later models, which had four-link rear suspension instead of spooky swing axles. The damage, however, had been done. From then on, the Big Three played it safe. It was, don't try to make anything different—put the engine in the front and a live axle at the back. And that's pretty much where it stayed.

There were a few exceptions, like the '66 Olds Toronado, the first American full-size front-wheel-drive car since the Cord. It was a 385-hp sport coupe with sensational styling. The drilled wheels of the Toronado mimicked the hubcaps on the Cord. There was nothing like the Toro except for the Cadillac Eldorado, but the innovative versions only lasted a few years, and then Detroit built a lot of boring, safe, unexciting models.

But that's changing. I've driven the

new Chevy Volt. It's different from the Prius in that it's a fully electric car with an electric generator powered by a 1.4-liter gas engine. But unlike the Nissan Leaf, the Mini E and some of the other electrics, this is a car you could drive from L.A. to San Francisco, with the gas engine kicking in when needed. I think that's a real breakthrough. And I applaud GM for taking a risk with such new technology.

It's fun to see engineers running car companies again, rather than accountants. GM has real engineers in place now, like Mark Reuss, its new U.S. president, and Tom Stephens, who's in charge of GM's global product operations. These gearheads are now calling the shots. That'll help the turnaround.

And there are already imitators, like the upscale Fisker, which essentially uses a Volt-style powertrain but in a fancy body style. That sort of technology will be the way to go. In the 1900s, people believed electricity was the best way to power an automobile. It was quiet; there was no pollution compared to horses dumping manure; you could park one indoors without suffocating anybody. You just couldn't go very far.

The other thing that killed the electric car the first time around—and most people don't know this—is that women loved them. You could just get in it; there was no hand-cranking. You simply stepped on the pedal and away you went. Clara Ford, Henry Ford's wife, wouldn't drive a Model T. She drove a Baker Electric. So, EVs had fancy interiors with cut-glass flower vases. And, like today, you can't sell a man a woman's car.

Hybrids have a similar image: "You

got a speeding ticket in a Prius—what's funnier than that?" That was the big joke when those cars first came out. But the Tesla Roadster, which can hit 125 mph, helps to dispel that.

The last days of old technology will always beat the first days of new technology. At the Isle of Man TT races, where they've raced motorcycles for over 100 years, they now have electric bike races. Instead of doing 128-mph laps, the e-bikes lap at 85 mph. Of course, some of them drain the batteries in one lap, but they're getting there.

Vintage Hemi 'Cudas and GTOs that get, like, 9 mpg will become the motorized toys of the new millennium. You'll have fun with them on weekends. But during the week, you'll drive your little electric whatever-it-is to and from wherever you work or shop.

In Hollywood, I knew things had changed when I went to the Academy Awards and everybody started pulling up in Toyota Priuses and other hybrids. Nobody wanted to arrive in a big Rolls-Royce or a Maybach anymore.

We'll always have luxury cars, but that big Lexus LS 600h hybrid seems redundant to me. There's really no need for that car other than to clear people's consciences. We Americans want everyone to know about the good work we're doing anonymously. So you show up in a huge limo, but *ohhh, seeeeee*, it's a hybrid. And "hybrid" will come to be like the word "turbo." You go to Costco, pick up a men's hair dryer, and it's a turbo model. Hybrid will become just another word that people use to describe whatever: "Oh, it's a new TV hybrid." It lets you combine anything. When I was a kid, a hybrid meant an Iso or a Monteverdi with European styling and suspension and Borrani wire wheels along with a big American V8 powerplant.

With hybrids and other new technology, the automobile has changed more from 1986 until now than it did from 1900 to 1986. It's funny when kids come over to my garage and I take out a box of Weber carburetor needles and they go, "What's *thaaat*?" Then they take out a laptop and plug it in, and they're actually tuning the fuel-injection system and ignition. Then it's my turn to say, "What the heck is *thaaat*?"

I guess that's progress.

PM



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PUTTING THE FUN BACK IN FLYING

> BY GLENN HARLAN REYNOLDS
> ILLUSTRATION BY SUPERTOTTO



AIR TRAVEL STINKS.
BUT NEXT-GEN AIR
TAXIS COULD HELP
REMAKE THE SKIES.

When I was a kid, I traveled a lot, and I loved to fly. Nowadays, I travel less, and I also enjoy flying less. I don't think it's me. I think it's that flying has gotten a lot worse—and slower.

That's not the fault of the airplanes. Today's jets fly at about the same speed as the ones 30 or 40 years ago. The problem is what happens on the ground, and the way the travel is routed. A few years ago I had business in Washington, D.C. By the time my flight arrived—after a series of delays—the trip from Knoxville, Tenn., where I live, had taken me 9 hours. Driving to D.C. takes about 8 hours, meaning that my effective travel speed was worse than a car's, even though I was traveling hundreds of miles an hour while I was airborne. This, alas, is a common problem.

In order to cut costs, airlines over the past couple of decades have been putting as many passengers as possible on as few airplanes as possible. This has produced the hub-and-spoke system that we all know

and, usually, don't love. There are a few nonstop flights from Knoxville to Washington, New York, etc., but to go most places I have to fly through a hub—Atlanta, or Cincinnati, or Memphis, or Charlotte. At the hub, I join lots of other travelers on a larger plane that takes me to another hub, where I then have to board a small plane to fly to my final destination. I travel hundreds of miles out of my way and run the risk of delays at multiple airports. That's no fun for me, and it doesn't look like the airline employees are having much fun either.

But maybe there's a better way. What if, instead of flying from Knoxville to Washington by way of Atlanta (two legs, 605 miles), I could just hop on a plane in Knoxville and fly direct





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THINKING AHEAD /// THE RISE OF AIR TAXIS

to Washington (one leg, 373 miles)? And what if—while I'm dreaming—I actually had some control over the schedule? What if booking a flight was more like booking a cab?

Well, I could do that right now if I had the money—jet cards, fractional ownership and charters let me whistle up a jet anytime I want one, so long as I'm willing to shell out something in the neighborhood of \$3000 to \$5000 an hour. Plenty of people do just that, and they seem to like it. I've been told by more than one very wealthy person that access to private jets is one of the few areas where being really rich is drastically better than just being comfortably well off.

But what about the rest of us? You don't have to be rich to afford a taxi, so why not an air taxi? The whole big-airplane, hub-and-spoke model seems so 20th century. In the 21st century, isn't there some way to use technology to do things on a smaller, more responsive scale? I imagine going to a website, entering a destination and a range of times, and having a plane swoop in to pick me up, perhaps at one of the country's many smaller airports, thus sparing me parking hassles and long security lines.

To make that work you'd need a reservation system to match up travelers flying the same route and to plan the most efficient series of trips for each airplane—various carriers might even compete to handle each trip. This is a simple software problem, really, compared to eBay's. (There's a trucking website called uShip that kind of works that way for freight already.) On the hardware side, you'd need an airplane that is small, efficient and fast—like a taxicab, instead of a bus. Now, this isn't a brand-new idea. Roughly a dozen U.S. operators

run what could be called air-taxi services. Mostly they focus on regional flights and own only a few planes. Several more ambitious services, including DayJet, which launched in 2007 with 28 Eclipse 500 VLJs (or "very light jets"), and SATSair, with a fleet of 26 Cirrus SR22s, went under in the economic downturn, while some new operators are still making a go of it.

One thing that could help is new



THE HONDAJET IS SMALLER THAN MOST PRIVATE JETS, BUT ITS SLICK INTERIOR (WHICH REMINDED ME OF AN UPSCALE AUDI) FEELS BIGGER THAN IT IS.

airplane technology, and Honda is working on just that. When I visited the HondaJet plant in Greensboro, N.C., and talked with Honda Aircraft CEO Michimasa Fujino, I discovered that the inspiration for the new HondaJet advanced light jet came from his experience in his first job in America; he worked in Mississippi, and his frequent travels required him to change planes at Atlanta even though that was well out of his way. (In the South, we say that when you die, whether you're going to hell or heaven, you'll have to go through Atlanta first.) Fujino envisioned an airplane that could not only shuttle private-jet folks more efficiently, but also work as an air taxi.

I got to look at a prototype—and even to take off and land in one, surprisingly without crashing it, in a simulator—and it seems to me that they're on to something. The HondaJet is smaller than most private jets, but its slick interior (which reminded me of an upscale Audi) feels bigger than it is. The five passenger seats and lavatory make it seem like a larger jet in miniature, and its 420-knot cruising speed means that you get where you're going before you have time to wish the plane were bigger. The high-efficiency engines being developed with General Electric sit above the wing, which means that the wing can be placed lower



for more cabin space, and they're directly above the landing gear, reducing wing stress on landing. The fuselage is lightweight composite, and the entire plane is designed to make frequent flights easy and inexpensive. Fully loaded, Fujino says, the cost and fuel consumption per seat should be about the same as for a first-class commercial ticket.

Honda isn't the only manufacturer with a jet more or less in this class. Embraer and Cessna have entries too, as did the now-defunct Eclipse (which is being resurrected as Eclipse Aerospace). But Honda says that its plane will be the best suited to an air-taxi role. I hope that it helps produce the kind of market I've described. Air travel stinks. In the 21st century, it's time for something better. **PM**



ON THE WEB > For more coverage on HondaJet, see popularmechanics.com/technology/aviation/.

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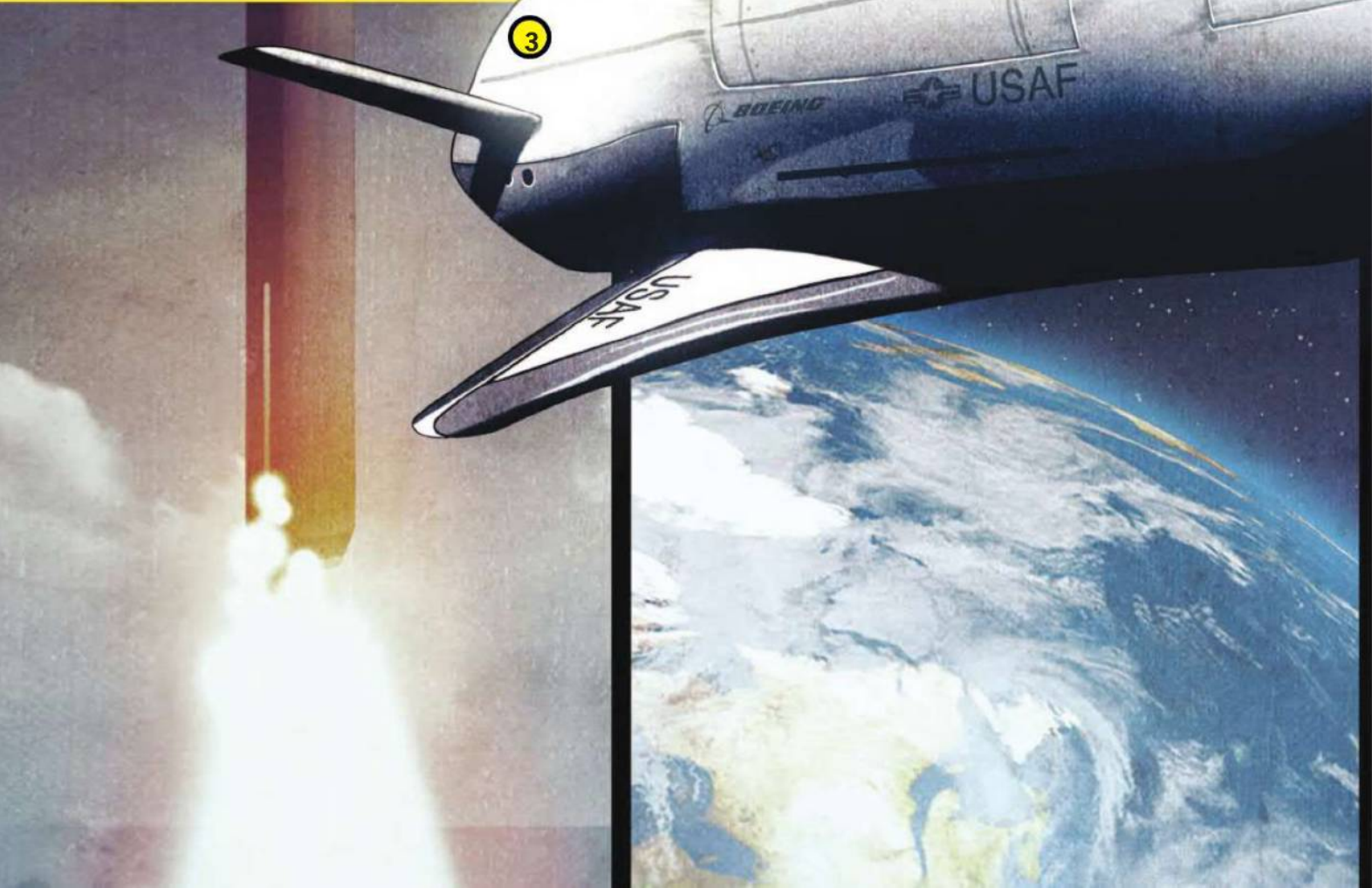
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4

Return of the SpacePlane

HONEST, THIS TIME IT'S FOR REAL.

By Sharon Weinberger

WHEN THE ENGINES OF A 19-STORY ATLAS V IGNITE IN APRIL at Cape Canaveral Air Force Station in Florida, the liftoff will look like any other for the workhorse launch vehicle. After about 4 minutes, the engines will cut off and the rocket's first stage will fall away, freeing the second stage to boost the upper section of the rocket into low Earth orbit.

Away from prying eyes, the mission will cease to be ordinary. A few seconds after the second stage fires, the fairing, a protective shroud that surrounds the cargo at the rocket's tip, will split in half, revealing the classified payload: a 29-foot-long delta-wing spacecraft called the X-37B Orbital Test Vehicle. It might look like a miniature version of the space shuttle, but this spacecraft is unmanned, and instead of NASA, the U.S. Air Force is operating it. The moment the X-37B emerges from the shroud will mark the fulfillment of a dream the Department of Defense has been pursuing for nearly 50 years: the orbital flight of a military vehicle that combines an airplane's agility with a spacecraft's capacity to travel in orbit at 5 miles per second.

At the end of its maiden trip, which could last days or even weeks, the X-37B will glide to Earth under robotic control without the benefit of engines. Instead, it will rely on flight-control surfaces in the tail to steer it through a fiery re-entry, during which the nose and leading edges of the wings must resist 3000-degree-Fahrenheit temperatures. The flight will end in secrecy with a 230-mph touchdown on an isolated runway at an Air Force base in California, most likely Vandenberg. If all goes well, the X-37B will be the first unmanned space plane to complete an orbital mission.

Though based in many ways on the shuttle—the only operational orbital space plane in the world—the X-37B showcases plenty of innovation. The shuttle uses hydraulic lines to power the control surfaces on its wings and tail, but the X-37B takes advantage of small, powerful electromechanical

5

The April flight of the first military space plane, the X-37B, begins atop an Atlas V ①. In space, the craft emerges from a protective shroud ② to orbit a classified number of times ③. After a 3000-degree-Fahrenheit re-entry ④, the X-37B glides to the runway of a California air base ⑤.

illustrations by Andres Rivera

actuators instead, eliminating the weight of fluid and hoses. In lieu of the ceramic tiles used on the shuttle, the X-37B's leading edges and nose cap are made of an easily shaped composite material that NASA developed when the space agency ran the experimental craft's development, before the military took charge of it in 2004.

The stubby 15-foot wingspan also echoes the shuttle's design, but unlike the larger craft, which has one tall vertical stabilizer, the X-37B has a V-tail with two rudders, a combination of a rudder and an elevator. David Hamilton, the director of the Air Force Rapid Capabilities Office, explains that the shorter V-tails are easier to package in a fairing, something that's not a concern for the shuttle. Those V-tails also help guide the X-37B through its 40-degree, nose-high re-entry, while a speed brake along the upper centerline helps it slow down as it prepares to land. Since the X-37B is unmanned, it does not need hardware to maintain a pressurized compartment for a crew and does not have to carry supplies for an extended manned mission.

The X-37B's simplicity and small size are part of what makes it appealing to the military. "There was always this issue with the space shuttle that you were sending up this enormous truck no matter what you were launching into space," says Mark Lewis, the former chief scientist for the Air Force. "There are times you want the Mack truck and times you want the Volkswagen Beetle. Unfortunately, with the shuttle, you were forced to fly the Mack truck."

The Air Force won't say what the X-37B will do during its first trip to orbit because the program has sunk into the "black" world of classified programs. Until a couple of years ago, the spacecraft was regarded as just another experimental prototype. Today, Air Force officials are skittish to mention even the smallest details. Asked in a recent PM interview what he could say about the X-37B, Werner J.A. Dahm, the Air Force's chief scientist, replied, "Nothing very useful," before quickly changing the subject.

Most of what the Air Force will now publicly acknowledge about the vehicle is contained in an opaquely worded two-page fact sheet: Built by Boeing's secretive Phantom Works division and managed by the Air Force's Rapid Capabilities Office, the X-37B Orbital Test Vehicle "will demonstrate a reliable, reusable, unmanned space test platform for the United States Air Force." Because the program did not start as classified, many of its design details can be gleaned from documents drafted before the program went dark.

The Pentagon's X-37B program stands out at a time when there is a dearth of radical, groundbreaking government-sponsored aircraft and air transportation concepts. "We retired the SR-71," says Vincent Sabathier, a senior associate and space policy specialist at the Center for Strategic and International Studies, based in Washington, D.C., referring to the legendary Blackbird supersonic spyplane. "We will retire the space shuttle.

This is something that is still exciting."

Despite decades of work and billions of dollars, the X-37B is the Pentagon's only surviving space plane program after post-Cold War budget cuts. "I think what we had in the last decade was an interruption, or intermission, in space plane development," says Rebecca Grant, a former Air Force official and now the president of the Washington, D.C.-based IRIS Independent Research. "Hopefully now [with the X-37B launch] we're looking at the next act."

Reusable launch

vehicles (RLVs) and space planes have suffered from the promises of scientists and politicians who overestimated their utility and underestimated their complexity. The X-20 Dyna-Soar, a flat-bottom glider that used rockets to take off but made powerless landings, was touted as

an unstoppable hypersonic space bomber but was canceled in 1963. Designers billed the quixotic single-stage-to-orbit X-30 as a new Orient Express, leading President Ronald Reagan to say in a 1986 speech that it would be able to "take off from Dulles Airport and accelerate [to] up to 25 times the speed of sound, attaining low Earth orbit or flying to Tokyo within 2 hours." But as the complexities of reusable spacecraft became clearer, the government started cutting space planes from the budget.

NASA took over the development of RLVs from the Pentagon in the 1990s, but critics soon assailed the agency for pursuing endless testbeds rather than operational spacecraft. One of the most ambitious space planes of the era was the X-33, a 69-foot-high craft that did not need a heavy rocket to reach orbit. A test craft was nearly complete in 1999 when engineers discovered cracks in the overweight vehicle's fuel tank. NASA officials canceled the program in 2001, and like nearly all previous space planes, it never flew. "The X-33 required at least one miracle," Lewis says.

In a 2001 congressional hearing, Henry Cooper, the former head of the Strategic Defense Initiative Organization, blamed both NASA and the Air Force for killing space planes: "The Air Force has not been a serious advocate for military space programs—otherwise it would not have supported transferring the reusable launch mission to NASA, an organization that has shown little responsiveness to supporting innovative military space programs."

But civilian space planes did not perform as expected, either. The space shuttle failed to reach its primary goals of making transportation to space cheaper and more efficient. The prospects for a new generation of reusable space planes went from bad to catastrophic when, on Feb. 1, 2003, the space shuttle *Columbia* broke up during re-entry. NASA's shuttle program, which

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was originally supposed to carry the X-37 orbital test vehicle, faced an early retirement, and the agency lost interest in RLVs and space planes.

The X-37B, though more modest than its predecessors, seemed to be on a familiar path to extinction. NASA started work on the X-37 in 1999, and soon after, agency officials developed a plan to build an approach and landing test vehicle and an orbital test vehicle. But in 2004 NASA dropped them both. The Defense Department then adopted the X-37 and placed it under the auspices of its research arm, the Defense Advanced Research Projects Agency.

DARPA contracted Burt Rutan's Scaled Composites to conduct drop tests of the X-37 off its White Knight carrier aircraft over California. (The jet-powered White Knight gained fame as the mother ship that launched *SpaceShipOne*, the suborbital craft that won the Ansari X Prize in 2004.)

In 2006, the X-37 again changed hands, this time going

from DARPA to the Air Force, and a cloak of secrecy fell over the program. The new plan focused on building a single orbital test vehicle, rebranded as the X-37B. "I can't say a lot about it," says Lewis, the former Air Force chief scientist. "I had to actually start asking questions about what this thing is, because it was being kept so secret."

The presumption that the space plane's mission is important because it's classified might be a smokescreen, says John Pike, the director of GlobalSecurity.org. "Maybe it's a bad idea," he says. There are reasons for a military program to go "black" that don't have to do with national security.

Secrecy also protects the X-37B and its funding. With tight budgets and skeptics alert for failure, "you put it in the black and you operate it without telling people," Sabathier says. The Air Force declines to disclose how much it's spending on the X-37B, and, because of the classified status, the figure is not otherwise available.

What's in a Space Plane

How do we know anything about the classified X-37B? Luckily, the program existed for five years within NASA before becoming a secret Air Force project. Here's what we know is under the hood:

A. Reaction Controllers

Small nitrogen tetroxide/hydrazine thrusters around the nose and tail enable the X-37B to climb, descend and turn in space.

B. Cargo Bay

A solar array unfolds from this storage hold to power the space plane's electronics.

C. Flaperons:

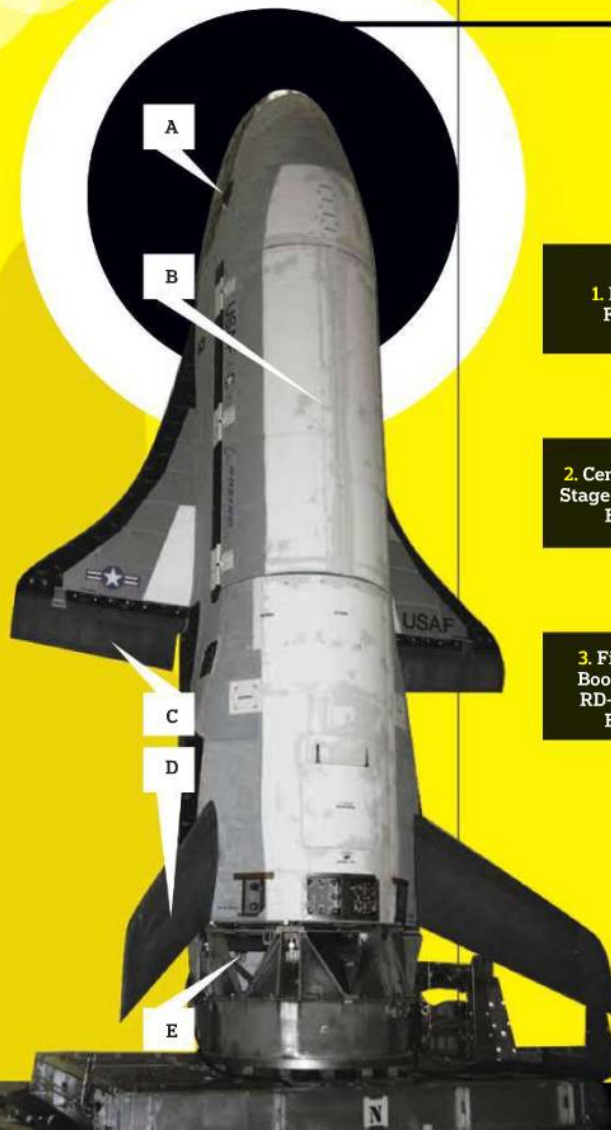
These control roll and bank as the space plane glides in for a landing. When lowered, they enable the aircraft to slow without stalling.

D. Ruddervator:

Both parts of the V-tail act in concert to simultaneously control the horizontal and vertical movement of the space plane as it glides through the atmosphere.

E. Main Engine

A hydrogen-peroxide and jet-fuel engine propels the craft in orbit.



An Atlas V rocket (left) will launch the X-37B into orbit. The Air Force released this photo of the secret space plane (far left) at media request in late 2009.

Space Plane History

NASA and the Pentagon have been investigating space plane technology for decades, but the space shuttle is the only one in actual operation. The efforts left a legacy of unique aircraft that generated the data used by aerospace engineers to create the X-37B. Advocates hope the current Air Force program will pave the way for future concepts.



1960s

X-20 Dyna-Soar

Agency: USAF
Type: Manned; experimental prototype
Purpose: It was to be the first spacecraft to launch into space on a rocket and glide to land.
Legacy: The program was canceled in 1963 before a plane was completed, but the research led to the space shuttle's delta wings.

1970s

X-24A/B

Agency: NASA, USAF
Type: Manned; test airplane
Purpose: In dozens of test flights, two versions of the X-24 proved space planes can maneuver while gliding to Earth.
Legacy: Flight tests validated that a space plane can land without using engines. An X-24A is on display at Wright-Patterson Air Force Base in Ohio.

1970s

Space Shuttle

Agency: NASA
Type: Operational space plane
Purpose: To be a reusable platform to deliver and repair space hardware.
Legacy: History's most accomplished space plane never met its goal of reducing launch costs; the fleet will retire in 2011.



1980s

X-30

Agency: USAF/NASA/DARPA
Type: Manned; part of the National Aerospace Plane program
Purpose: This sleek craft was designed to use a scramjet to reach orbit with no extra rocket stages.
Legacy: Military planners' demands that the craft carry people complicated the design; the program was canceled in the early 1990s before an aircraft was built. Data from the program were used to research scramjets later in the decade.



One very public event may have

secured the future of military space planes. On Jan. 11, 2007, China destroyed one of its obsolete weather satellites with a missile ("Battlefield Space," July 2007). Though China's test was hardly a complete surprise to the military or intelligence communities, the incident became a dramatic reminder of the vulnerability of critical satellites.

In an emergency—like a rapidly unfolding crisis or an attack on a vital U.S. satellite—a space plane could become a reconnaissance platform by scanning the Earth below or by observing other objects in orbit. The ability to launch orbital surveillance platforms quickly—what the Pentagon calls "operationally responsive space"—has been a longtime goal of the Defense Department.

"The weird thing to me is that they are being so coy about the types of missions they want space planes to do," says Theresa Hitchens, a space policy expert and director of the United Nations Institute for Disarmament Research. "The first thing that comes to mind is a pop-up reconnaissance vehicle for a place where you don't have satellite reconnaissance or can't

move a satellite fast enough."

It can take the Air Force months to prepare a military satellite and days to move one into a new position, compared to about an hour or two to position a space plane kept on alert. Also, any nation with intelligence about U.S. satellite paths can predict when the satellites are overhead, so a space plane offers an element of surprise.

In current conflicts, military commanders have a hard time sharing orbital images because satellites controlled by the National Reconnaissance Office are often tasked to stare at another target. "All the strategic applications are still very appealing if the technology can come together," Grant says.

But if getting satellites into space cheaply is the main goal, then a reusable spacecraft like the X-37B is by no means the best option. Peter Wegner, the director of the Pentagon's Operationally Responsive Space Office, says he's watching advances in RLVs, but his focus instead remains fixed on finding ways to slash the price of expendable rockets. "I think we can hit the [launch] timelines with the expendable vehicles and still cut the cost dramatically," Wegner says.

1990s

DC-X Clipper

Agency: NASA/DOD
Type: Unmanned; test aircraft

Purpose: Engineers used the Clipper to advance single-stage-to-orbit aircraft. Two variants of the Clipper flew 12 times in the mid-1990s, setting time-to-altitude and engine-reusability records.

Legacy: In 1996 pressure failure in the landing gear caused the plane to tip over and explode on the launchpad during a flight test.



2000s

X-37B

Agency: USAF
Type: Unmanned; orbital test vehicle

Purpose: The Pentagon wants to validate the craft's orbital operation and its ability to make autonomous, robotically controlled landings.
Legacy: The X-37B's first flight is scheduled for April 2010.



The Future

Spacebus

Designer: Bristol Spaceplanes (U.K.)

Type: Manned; space transport
Purpose: Launching space planes from high-altitude aircraft could reduce the prep time and cost of deployment. Free from the mother ship, a space plane would use its own rockets to gain orbit.

Space Bomber

Potential Agency: USAF

Type: Unmanned; global strike
Purpose: An orbital bomber could destroy ground targets with vehicles (mounted on the wings, above) that drop through the atmosphere and release bombs or kinetic munitions.



The most daring job of a space plane, and the one least discussed, is the role of a bomber. The craft could fly over targets within an hour of launch to release cone-shaped re-entry vehicles that would both protect and guide weapons through the atmosphere. A craft the size of the X-37B could carry 1000- or 2000-pound re-entry vehicles armed with precision munitions like bunker-busting penetrators or small-diameter bombs, or simply use the explosive impact of kinetic rods cratering at hypersonic speeds to destroy targets.

However, widespread concerns about stationing weapons in space, possibly starting an orbital arms race with China, could make this option unappealing. In 2001 Boeing pitched a space bomber system to the Pentagon, but there is no evidence that the X-37B is being used to create such a weapon system.

Others in the U.S. government are also expressing interest in the space plane concept. The Pentagon recently completed a document outlining the requirements and development path for a space plane that could insert small teams of Marines anywhere in the world in 2 hours. In February NASA awarded \$20 million in research funds to a private space company called

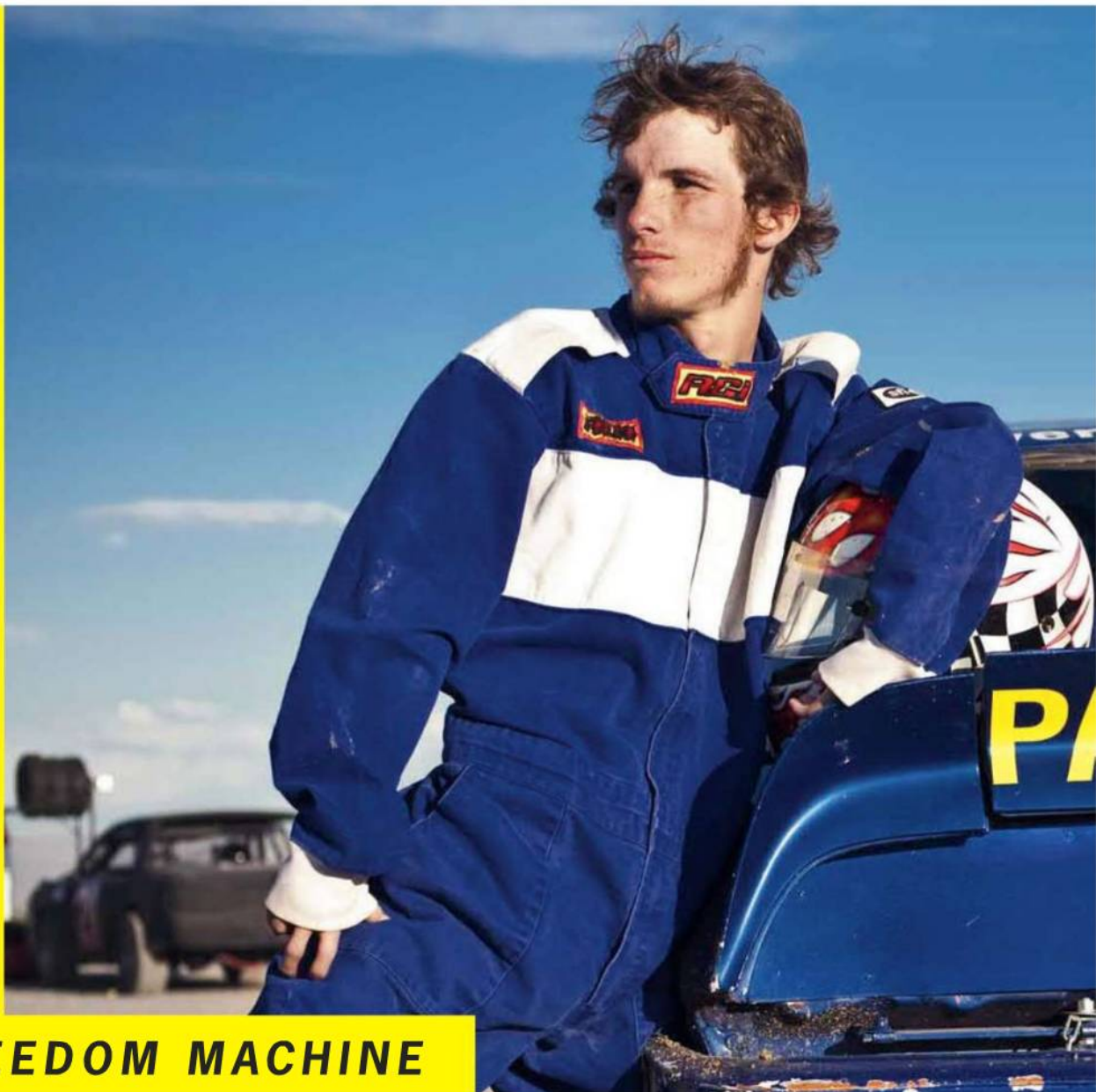
Sierra Nevada Corp. to build a passenger space plane called Dream Chaser. The craft would launch on a rocket, ferry up to seven people to the International Space Station (or private space hotels) and then land like the space shuttle. The Air Force's X-37B has the clear lead on these conceptual contenders—Hamilton says the X-37B team is currently preparing for a second launch sometime in 2011.

What may differentiate the X-37B from its predecessors—and what confounds the critics trying to make sense of it—is precisely that its goals don't sound overly futuristic. "I'm more concerned about the programs that are touting themselves about all they will achieve," says Richard Hallion, a former Air Force chief historian and one-time special adviser to the Pentagon on space programs. "The ones that are quiet, the ones that maintain a more modest public posture, we often find have the potential for true greatness."

The X-37B might lack a flashy name, a made-for-the-movies mission and public hoopla, but this space plane's low profile might be just the thing that helps it beat the long odds and become a success.

PM

■ Chris Neal races a 1976 Pontiac Firebird with hand controls—and wins. On the track, it's not about how well he moves his body, but how fast he drives his car.



FREEDOM MACHINE

→ ON SATURDAY MORNING IN FALLON, NEVADA, the casinos that





populate the town's main drag offer eggs over easy and slot machines, depending on one's preference. But by late afternoon, the draw shifts to a dusty knob of earth just east of town, and the intersections fill with a steady procession of Dodge Rams and Ford F-150s hauling trailers. They're all wending their way to a quarter-mile banked dirt track called Rattlesnake Raceway, where the spray of mud and the thrill of competition far eclipse the \$100 purse.

The 22-year-old champion of the 2007 and 2008 Gen X class—which consists mainly of four-cylinder stock sedans—drives fast, both on and off the track. **“I love racing. I love competitions. I love speed,”** Chris Neal says. “Anything over 100 mph is

by JENNIFER BOGO → photographs by DANIEL BEDELL



very good.” He also talks fast and walks fast, which at first glance seems unlikely. Chris stands in a permanent plié, his knees deeply bent and turned out, his feet pointing backward. When he moves, it’s like a sand crab, sideways, his legs scissoring past each other. He throws the rest of his body after them.

At his dad’s auto repair shop, 4 miles from the raceway, Chris leans through the window of a ’76 Pontiac Firebird to point out the hand controls. Attached to the steering column is a lever, connected to the foot pedals, that he pushes down to accelerate and forward to brake. Because he has very little dexterity in his fingers, he uses the back of his left hand to manipulate the lever and steers with his right hand at 12 o’clock.

Maneuvering around a Lincoln Town Car and GMC pickup, Chris heads out the back door. He’s wearing a royal blue fireproof suit, half-zipped with the arms tied around his waist, and a black-and-white T-shirt that

says, “I didn’t come here to lose.” Glued to his right hip is a nine-month-old chocolate Lab named Sadie, who wears a pink rhinestone Harley-Davidson collar and a serious expression. She watches him intently. “She’s as loyal as all get-out,” Chris says. “I don’t fall as much as I used to, but when I do, if I say ‘brace,’ she’ll jump in front of me so I’ll fall on her. I’m always dropping my phones and stuff like that because I don’t have a strong grip. She can pick stuff up for me.”

Behind the shop is a battered yellow quad that Chris rides around the desert—he uses a metal bar welded onto the shifter to push it into first. He also snow skis with a sit-ski and hunts elk and mule deer, propping up a .243 rifle and pulling the trigger with his thumb. When it comes to the limits imposed by his disability, Chris follows one maxim: “If someone says I can’t do it, you might as well count on me trying.”

→ **That Chris can walk at all,** let alone drive, ski and hunt, is an impressive accomplishment. He was born with arthrogryposis, a congenital disorder that affects one in 3000 children and results in curved joints and contracted muscles. Chris’s particular condition, distal arthrogryposis, severely affects his hands and feet. When he was born, his legs were folded up like a pretzel, his dad Larry says. Doctors warned he’d never walk; as a baby, he didn’t crawl. “He rolled everywhere he wanted to go,” Larry says. “He could go from one room to another 90 mph.” As a toddler he chased other kids around on his knees, which developed thick calluses.

Chris was sent to Shriners Hospitals for Children in Northern California, where doctors pinned an Ilizarov frame to his leg bones when he was four. It enveloped Chris like an Erector Set, and his mom Jana adjusted it a little every day until his legs unfolded. When surgeons removed the frame, he was sent to Sonny Alcairo, an orthotist at Shriners, to be fitted for braces that would stretch from the tops of his legs to his toes.



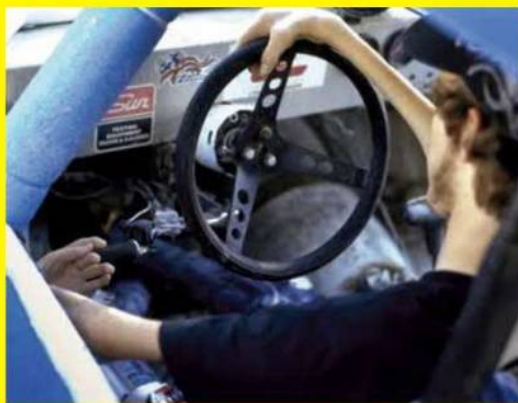
WHEN IT COMES TO THE LIMITS IMPOSED BY HIS DISABILITY, CHRIS NEAL FOLLOWS ONE MAXIM: “IF SOMEONE SAYS I CAN’T DO IT, YOU MIGHT AS WELL COUNT ON ME TRYING.”

“He’s one of the kids I loved working with because he was a challenge each time you made a brace for him,” Alcairo says. As Chris got older, his hips and leg bones continued to rotate out. “When they get to that point, [most kids] actually just give up on walking,” Alcairo says. Not Chris: “We call him the miracle kid. I’ve never seen anyone as determined as he is.”

Chris grew up around cars, first in a playpen in the middle of his dad’s Texaco station, then in the pit at drag races, where both of his parents competed. But when, at age 16, he announced he wanted to race cars himself, his parents were skeptical. “I thought, how’s he going to do it?” Jana says. “At the time, most everybody, when they raced, had standard transmissions.” It turned out that racing an automatic was more common than she thought. But Larry still resisted. “The thing that scared me was that if he caught on fire, he couldn’t get out of the car,” Larry says. “I was just worried to death that he would get burned up.”

Larry installed a grenade pin to Chris’s hand controls instead of a bolt, so they would quickly detach from the steering column to get out of his way. Then Chris practiced unlatching his safety belts and hauling himself through the open window. “I can get everything undone and out in 35 or 40 seconds,” Chris says. “That’s not real fast,” Larry says, “but fast enough.” So in 2007, Chris began racing at Rattlesnake as a rookie—and raced well. “I don’t know how he does it,” Larry says. “He’s unreal. The first two years they’d start him at the back of the pack, and within one lap he was in the lead and would just walk away from them.”

Still anxious about a fire, Larry practically lived at the track. Then, when it happened, he was over in the pit helping Jana, who was also racing in the Gen X class. On the wall in the office of Larry’s shop is a color photo of Chris’s car at the time, a yellow ’00 Mitsubishi Galant, just after T-boning the Honda Prelude of a friend who’d spun out—flames are



■ Chris Neal races his blue '76 Pontiac Firebird, No. 12, using hand

controls, which connect to the brake and accelerator. At Neal's Garage,

his dad digs into the engine, while Chris, his mom and his cousin look on.



leaping from the hood. The other driver is halfway out his window, frozen in the motion of going to pull Chris from the burning vehicle. After raising himself up to the window, Chris escaped unharmed. He also won the points championship that year. His trophy, which sits on a shelf near the photo, is a good foot taller than Jana's—she tied for third place.

→ **For the 2009 season,** Chris moved up two classes to Hobby Stock, which meant a V8 engine and rear-wheel drive, and more experienced competitors. "Gen X was getting ... not easy, but boring," Chris says. But the Firebird proved trickier to steer with hand controls, and he'd spin out coming into the corners. That tendency, combined with the cars flying around the track at 100 mph, made him a little bit "chicken-y," Chris says. "I didn't want to spin out in front of the whole pack and have everybody plow into me."

By September, he still hadn't won any races, but he felt like his car was finally set up properly. There was just one lingering problem. When steering, it typically takes two-and-a-half

turns of the wheel to move the tires from full right lock to full left. Chris's right arm is stronger than his left, but it doesn't have enough muscle to do that easily. Hours before the evening race, the last one of the regular season, Larry and Jana installed a steering quickener—a reverse-mounted reduction gearbox that changes the ratio of the turns between the steering wheel and the steering box. Now it takes Chris only half a turn to move the tires from lock to lock.

At the raceway, Jana hoists Chris up and through the open window of his car, *Dukes of Hazzard* style. He settles into the stripped-out interior, ankles crossed, and locks the hand controls in place. Then he flips a switch to turn on the engine and shifts it into gear with his wrist. Jana climbs a small hill to watch the qualifying heat through a chain-link fence, since she's the pit crew. "One thing about Chris: He's good at the start," she says. "As soon as they drop the flag, he's gone. A lot of guys are sleeping."

Chris's blue Firebird, No. 12, launches into the race, but the track has just been watered down. One car spins out and Chris slides a little on the corner. He finishes third out of five. After the heat, Chris and his parents debate whether his car is tight or loose—whether the front or rear wheels slide first—then adjust his tire pressure. He gets back in the car and queues up in the middle of the pack for the feature race.

When the green flag is dropped, Chris takes off again, his Firebird standing out against a blur of Monte Carlos, Novas and Camaros. On successive laps, Chris passes three cars, then creeps up on another. "It looks like it's handling good for him," Jana says. Chris passes two more cars and a cheer goes up—he appears to be just three cars from the lead.

Then, as Chris is coming around the corner, hugging close to the inside, a white Monte Carlo nudges his left rear fender. Chris veers through the mud in the center of the oval track and out the other side, ending up near the back of the pack. With just a few laps to go, that's where he finishes.

After the race, the Monte Carlo's driver walks up to the pit and begins to apologize—to a 25-year-old photographer, who is wearing jeans and a T-shirt. Chris is leaning against his car, and he's wearing the blue fireproof suit. "Hey," Chris says, waving. "I'm the driver." The guy starts his apology over, to Chris now, but when he leaves, Chris looks frustrated. "I'm wearing the race suit, but I'm short and crippled," he says. "They always come up and apologize to someone else."

It's a rare moment of deflation, and it doesn't last long. "Now it's just getting used to the quick steer," he says. "I was just kind of squirrely out of the corner, so it wasn't bad. It didn't hurt me in the race." Eventually, Chris wants to move to North or South Carolina, where there are a lot more dirt tracks and big-money races. His parents think he can do it. "As far as I'm concerned, there's people who can race and people who can't," Jana says. "I think my son is one of those people it just comes natural to." For tonight, his race is over. Chris scissor-walks up the hill to watch the next class. **PM**

Down & Dirty

12 SMART SOLUTIONS TO THE HOME'S MESSIEST PROBLEMS. DOUBLE-KNOT YOUR WORKBOOTS—WE'RE GOING IN.



1. Damp Crawlspace Dry-Out

Cobwebbed and claustrophobic, crawlspaces are awful places to work—yet they may hold the key to improving your home's indoor environment. Many dirt-floored crawlspaces lack a vapor barrier (polyethylene sheeting at least 6 mils thick), allowing moisture to seep into the insulation and wood overhead. Hello, mold and mildew. The fix: Unroll the sheet inside the crawlspace and cut it to fit, leaving an extra 6 inches at

each wall. Scoot this material up the walls and lock it in place with construction adhesive. If you have multiple sheets, overlap them by 6 inches and tape the seams. Prevent the plastic from shifting on the ground by topping it with sandbags, bricks or smooth stones.

2. Lawnmower Muck Work

The instructions inside Briggs & Stratton's lawnmower tuneup kit recommend replacing or cleaning the air filter every 25 hours or once a

season—and you won't want to do it more often. If it's a foam filter, squeeze residual oil into a newspaper or rag. Seal the rag in a non-flammable container before tossing it out, to prevent a trash-can fire. Give pleated paper filters a blast of compressed air and knock off the buildup. That's not the only messy part of mower maintenance. The machine's second dirtiest spot is the underside of the deck. Scrape off the compacted, moldy grass with a putty knife and a wire brush. In the fall, mow over dry leaves—they'll scour the living daylight out of the deck. Before storing a self-propelled mower away for the winter, remove its drive-belt cover and pull out any junk that has worked its way inside.

3. Plaster and Lath Pullout

When plaster comes down, the dust flies. To cut cleanup time, seal the room's doors with 2-mil plastic sheeting and cover the floor with Masonite sheets (shiny side up). Set a window fan to blow outward (for lead paint, add a HEPA reverse-flow filter to the fan and a respirator to your face). Al Smith, a general contractor in South River, N.J., says, "Don't use a sledgehammer. Instead, poke through the plaster with the head of a crowbar, twist, then pull down."

by Jim Gorman

ILLUSTRATIONS BY MATEUSZ KOLEK

4. Range-Hood Degreasing

Grease in a kitchen exhaust hood has to go—it's a fire hazard, says Curt McDonald, a ServiceMaster cleaning pro in Fairbanks, Alaska. Remove the grease filters and fan blades, then spray greasy surfaces with a 15 percent solution of d-limonene citrus cleaner. Keep a plastic sheet beneath the hood to catch drips. Soak filters and blades in a hot d-limonene bath while the cleaner breaks down buildup in the hood. Wipe it out, then scrape remote spots with a putty knife wrapped in cloth.

6. Insulation Mess Management

This is one of those rare jobs that's both dirty and fun—prepare to be pulped.

Installing blow-in cellulose insulation in an attic on a warm day will leave you covered in paper particles, looking like a Chia Pet. Protect yourself from the flying fibers by wearing a respirator mask, goggles, gloves, long pants tucked into socks, and a long-sleeve shirt with cuffs cinched tight by rubber bands. A hard hat prevents protruding roofing nails from doing real damage. If you set up the hopper indoors, a box fan in the window will blow dust outside.



7. Sewer Rx

If every sink and toilet is backing up—not just one—your main sewer line may be clogged. Use a heavy-duty sewer auger in the sewer cleanout in the basement. Start with the smallest blade, says Nebraska-based master plumber Merle Henkenius. “Go into the clog, pull back and see what’s on the head,” he says. If it’s tangled in roots, use the biggest blade to scour the pipe, then flush the line with a root killer. Visible dirt indicates a collapsed sewer pipe. Measure the cable length to the clog and call a plumber.

5. Flooded Carpet Fix

A wet carpet can turn into a mildewed mess overnight. But work fast and you just might save that rug, says Danny Brown, owner of a Servpro home cleaning firm in McDonough, Ga. “If the subfloor is concrete slab, pull the carpet back and just rip out and dispose of the padding,” Brown says. Use pliers to pinch one corner of the carpet and pull it away from the tack strips to reveal the pad. Remove the pad, roll the carpet back down and hit it with a wet/dry vacuum. If the carpet has become delaminated, toss it out too. Rent large fans to move air around the room for several days, placing a machine every 12 to 16 linear feet, Brown says. Simultaneously run the air conditioner and a dehumidifier to help remove moisture from the air.

8. Squirrel Eviction

Don't let a nest of squirrels squat in the attic. First things first: Trap the squirrels and bar them from returning. That means using metal plate covers for vents and fans and galvanized hardware cloth to seal up damaged soffits, fascia boards or roofing where the critters gain entry. Eric Arnold, a wildlife control specialist in Medina, Ohio, advises wearing a half-face respirator (rated for asbestos removal) to guard against leptospirosis and other disease. Disinfect the area by spraying with a 10 percent bleach solution followed by a pesticide application to kill off ticks and fleas. Replace any urine-soaked drywall. For colossal messes, check your insurance policy—it might cover the cleanup.



9. Popcorn Ceiling Makeover

Getting rid of a 1970s-era popcorn ceiling is a tough and grubby job, but it's every bit as satisfying as ridding your closet of leisure suits. First, take a sample of the ceiling material and send it to be analyzed for asbestos. If it comes back positive, call in a remediation firm. If not, get to work—clear the room of furniture, and protect flooring by covering it with thick plastic sheeting taped to the baseboards. Wear a dust mask and goggles. With a heavy-napped paint roller soaked in water, wet a small area of the ceiling and scrape away the moistened popcorn with a 4- to 8-inch drywall taping knife. Repeat. The absorbent popcorn weakens when wet, but be careful—too much moisture can damage the underlying gypsum board. Once the entire ceiling is cleared and dry, smooth it with medium-grit sandpaper. Patch gouges with drywall compound, and apply a stain-killing primer before painting.



10. Rotten Refrigerator Rescue

When storms knock out power, the useful life span of a refrigerator goes from years to mere days. Empty out the refrigerator ASAP and you can rescue it, even if the contents are smelling ripe. Wipe down inside surfaces with an ammonia-based detergent. When power returns, run the refrigerator for several days with an opened 5-pound bag of natural charcoal briquettes in the freezer. "Charcoal will filter and deodorize even spoiled fish or meat smells," Brown says.

11. Toilet Seal Transplant

A commode leaking at the bottom may have a broken wax-ring seal between the toilet and the floor's toilet flange. Replacing the ring is simple—for those with a strong stomach. Here's how to do it: Turn off the water valve feeding the toilet. Flush and hold down the handle. Pour a bucket of cold water into the bowl to eliminate all but a small amount of water, which you can then sponge up. Separate the toilet tank from the base, and unscrew the nuts holding the toilet to the floor. Gently lift the toilet up and off the bolts and place it on its side on a large plastic garbage bag. Here's where the ick factor runs high. Scrape off the remains of the old wax ring and any, ahem, residual material from the base of

the toilet and flange. Press a new ring over the hole in the base of the toilet and reverse your earlier steps. Place plastic straws on each of the new bolts to help guide the toilet base home. Definitely wear gloves—a tough nitrile pair will resist punctures and splashes.

12. Cat Urine Treatment

Cat urine on linoleum or tile flooring is rank but treatable. On hardwood flooring, it's fatal. The uric acid crystals in cat pee bond tightly to any surface, causing a stubborn odor. Get the stench under control by blotting the affected wood with a rag or mop soaked in 3 percent hydrogen peroxide solution. Black stains caused by persistent peeing won't come out, even with heavy sanding, says Jim Schwab of Carter Wood Floors in Long Beach, Calif. "Refinish the floor with a dark color to cover a big pee stain, or swap in a couple of spare floorboards," he advises. Use short lengths from inconspicuous parts of the room, or, better yet, leftover planks piled up in the basement. **PM**



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Welcome to the Brooklyn Academy of Mechanical Arts ...

In an obscure corner of Brooklyn, a loose coalition of renegade builders spends weekends welding together carnival rides, rocket-powered motorcycles and flaming street-fair attractions. They occupy the vanguard of an offbeat movement of DIY mayhem.



and

Ballistic

Above: Madagascar member Gaylen Hamilton uses a leaf blower to ignite a valveless pulse jet while Chris Hackett feeds it propane. Opening Elizabeth Townsend West Lis Chere KIM! Rivka Karasik Mia Ihara Tom Kirsch Back row, left to right: Sarah E. McMillan Drew Feuer

Sciences

For the mechanical pranksters of New York's Madagascar Institute, there's nothing that can't be improved by adding a fire-spewing pulse jet.

*By Seth Porges
Photographs by Eric Ogden*

C

Chris Hackett's face and broad hands are marked by scars, the evidence of a dozen years of explosions and scrapes. Some are thin, flat lines, while others are deeply grooved or as thick as calluses and discolored. Hackett is

showing me around the workshop of the Madagascar Institute, where he collected many of those scars. The shop occupies the ground floor of a decaying townhouse in Brooklyn, just a few yards from New York City's famously fetid Gowanus Canal. There's a MIG welding kit, a half-built wooden boat and an assortment of aging band saws, bench grinders and drill presses. The room's walls are peppered with hand-written warning signs and posters promoting past projects ("Madagascar Institute Presents: Death Blender"). U-shaped stainless-steel pulse jets are scattered across the floor, stacked against the walls and stuffed onto shelves.

Hackett has a clump of graying dreadlocks that sways across his broad back as he steps out the back door into a cluttered, overgrown yard that looks like a prop dump from *The Road Warrior*. I spot a trio of rusty barrels that Hackett identifies as a gasifier for transforming garbage into methane fuel. There's a jet-powered bike that was once featured on the TV show *Monster Garage* and dozens of rusty wheels, oil drums and strips of sheet metal. "Welcome to the tetanus farm," he says.

The Madagascar Institute arts combine ("arts collectives are for hippies," one member tells me) has perfected the pastime of turning salvaged parts into mechanical mischief machines. Its 20 or so members are dot-com veterans, graphic designers and writers who spend their unpaid hours building fire-spewing carnival rides, rocket-powered vehicles and just about anything you can imagine strapping a pulse jet to. These engines serve as a sort of mechanical mascot for the group. They are cheap, loud and capable of spewing flames on command. "A pulse jet is instant awesome," Hackett says. "Take a fat kid on roller skates. Boring. Fat kid on roller skates and you slap a pulse jet on him? Awesome."

Hackett founded Madagascar in 1998 with two friends, Ryan O'Connor (who is still with the group) and Eric Singer (now executive director of the League of Electronic Musical Urban Robots, or LEMUR, an organization that, yes, creates robotic musical instruments). They were inspired by the work of Mark Pauline, whose Bay Area group Survival Research Labs started constructing large-scale, fire-

spewing, performance-oriented machines in the late 1970s. Hackett was a 25-year-old programmer and technical writer at the Internet startup Reviews.com, O'Connor was in law school and Singer had just earned a computer science degree. "The idea was to stop doing stuff virtually, and learn to do it with our hands," Hackett says.

At first, the group worked in an extra bedroom in Hackett's Manhattan apartment. They didn't have the mechanical skills to build anything complicated, so they compensated by using lots of fire. One of the first projects was something called Flaming Simon. "It was just like the electronic game Simon, except instead of colored lights you stood in the middle surrounded by flamethrowers and had to follow the blasts," Singer says.

Today, a typical large-scale Madagascar work involves much more mechanical complexity, with multiple teams working in parallel. But planning is minimal. "I'm a believer in 'build it, then measure it,'" Hackett says.

I first stumbled across the group at Gadgetoff, an annual New York-area gathering of inventors, technologists and scientists that feels like a cross between Burning Man and a TED conference. Lunch was served outdoors on the massive green lawn of a former estate on Staten Island, and the space was strewn with gonzo vehicles, trebuchets and robots. What drew me was a swing ride surrounded by propane tanks and a dozen men and women with matching white lab coats. The ride consisted of a rusting column of steel with a pair of long arms supporting gently rocking, abstract leather-and-metal horses, each outfitted with a pulse jet. It looked like a rusty, creaky affront to common sense, a machine imagined by Ray Bradbury and unwisely brought to life by Tim Burton. A handwritten sign staked into the ground read, "Caution: This May Kill You."

"We've tested this ride before, just never with a person on it," Madagascar member Hans-Christoph Steiner told me. I volunteered, and climbed aboard one of the horses while Steiner mounted the other. Hackett stood in the center manning a pair of propane tanks. Two women held the horses steady while a man inserted a leaf blower into the U-shaped steel pulse jets. (To ignite, the combustion chambers require an infusion of air.) When the jets lit up, the noise was instantly deafening—it sounded like a 747.

The horses began to move. First, slowly. Then, terrifyingly fast. The jets glowed orange with heat, and streams of fire shot out. Within seconds, the centrifugal force brought us horizontal, and I felt my face flatten against my skull, before the ride mercifully came to an end. Minutes later, the fire department showed up and shut the thing down.

Not every Madagascar project features machinery.

Perhaps even more than builders, the members are highly theatrical pranksters. They have held no-permit Broadway-style dance routines on the steps of the New York Public Library, recreations of historic naval battles using paddle boats in a pond in Brooklyn's Prospect Park and impromptu soccer matches in the middle of a Manhattan street with the ball set aflame. The group's one-off creations pop up at events of all sorts: Brooklyn warehouse



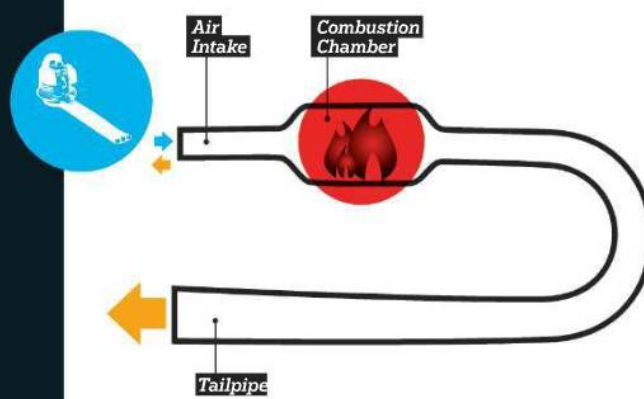
BIKE: LAUREN SILBERMAN; EVENT: TOD SEELIE; DIAGRAM BY GABRIEL SILVEIRA

How It Works:

VALVELESS PULSE JET

High-pressure air (pumped in through an air compressor or leaf blower) enters through the air-intake pipe and mixes with fuel. The vapor is ignited by a spark to create an explosion in the combustion chamber. This explosive force is directed out both ends of the U-shaped jet, propelling it forward.

As the air-fuel mixture exits the jet, it creates a vacuum in the combustion chamber, sucking in more air. The lingering heat creates another explosion—and the cycle continues as long as fuel is available.



parties, street fairs, large European music festivals. “One of our most popular events is something called Madagascar Presents: Work, where we go to an event and literally just show people working with tools,” Hackett says. “And if we have girls working, it’s standing room only. People could watch that all day.”

Mishaps can occur when you build loosely planned machines designed solely to move fast or shoot fire. “We’ve given each other stitches, but, fortunately, I’ve taken most of the injuries myself,” Hackett says. He reels off a greatest-hits list of personal injuries in a rehearsed and almost gleeful recitation, showing off his scars. Highlights include the car shock that sprang up and “tore my nose off” and the starter pistol that exploded in his hand—a woman standing nearby was hospitalized, Hackett says, and the explosion “blew my face off.”

Madagascar’s finances are equally insecure. Members contribute dues, some events will pay a small fee and public classes offered by the group bring in a bit of cash. (They teach welding, electrochemical etching, robotics, absinthe-making and how to build a DIY generator.) Hackett owns the building and lives on

the top floor, but says he can barely keep the electricity on. His personal income derives from a smorgasbord of odd jobs, from metal-fabrication work to serving as a bouncer at parties. Many of Madagascar’s tools and equipment are donations or antiques found at estate sales.

All the hardship would seem to cement these mechanical pranksters as cultural pioneers, at the vanguard of an emerging movement of renegade DIYers. Yes, their skills and ideals—self-reliance, craftsmanship, handiwork—are timeless, but there are eras in which hands-on building skills are particularly in vogue, and this is one of them. LEMUR in Pittsburgh, Robochrist Industries in New Mexico, eatART in Vancouver and dozens of other machine-heavy arts groups share a similar aesthetic. And, thanks to a decade-long diaspora of ex-Madagascar builders, many of these groups feature former members in their ranks. The steampunk image and sense of humor emanating from Hackett’s collaborators (not to mention their almost-even gender breakdown) makes them particularly appealing evangelists for the new generation of offbeat builders.

Top left: A pulse-jet-augmented motorcycle built by the Madagascar Institute. Left: The author takes the maiden flight of a fiery swing ride. Below: Madagascar members weld together a valveless pulse jet.



A few weeks after my spin on the

swing ride, I drop by the Madagascar workshop and see the pulse jets once mounted on the horses scattered about. The machine has become an organ donor, its salvaged components already being built into instruments of future mayhem. In one corner of the workshop, Lis Chere, a gardener at the Brooklyn Botanic Garden, is busy laying coats of fire-engine-red paint on a wood boat she has built. “We’re going to go sailing on the Gowanus,” she says. “It’s a really great date.” Across the room, Melissa White, an artist, is cannibalizing a children’s toy piano to build an electric xylophone.

“Let’s say you want to make a death-dealing machine or a recreation of the Hindenburg disaster,” Hackett says. “You have your crazy idea, and everything you need to make it a reality is here—skills, tools, people to work with. The only thing stopping your idea from becoming a reality is your own lazy ass.”

Hackett looks out over his workshop. In front of him: a half-dozen men and women who gave up their Saturday afternoon to work on transforming concepts—idiosyncratic, frivolous ones—into metal machines. The whining, buzzing and rumbling of power tools collide in the air as if they are in competition to do the most harm to our hearing. Hackett folds his arms, sighs with contentment and smiles. **PM**

WHERE THE RUBBER MEETS THE ROCK

✕ by **LARRY WEBSTER**
photographs by
CHRISTOPHER WRAY-MCCANN

**ENJOYING MOAB'S
MAGNIFICENT
BACKCOUNTRY
DOESN'T REQUIRE
MOTORCYCLES,
ATVS, PICKUPS OR
MOUNTAIN BIKES.
BUT WE'VE GOT
ALL FOUR.**

PM
OFF-ROAD SPECIAL



MOUNTAIN
BIKES

ATVS

MOTOR-
CYCLES

TRUCKS



• A rider races sundown on the Porcupine Rim Trail, one of Moab's signature routes. **•** Opposite: Ripping up a slickrock ridge on the Fins and Things Trail tests machines—and nerves.



→→ **SLICKROCK ISN'T SLICK.
CRANKING UP AN IMPOSSIBLY
STEEP STONE RISE ON OUR
MOUNTAIN BIKES IS LIKE
RIDING ON 80-GRIT SANDPAPER.**

But to the early Mormon traders who first came to Moab, Utah, some 150 years ago, riding not knobby-tired bikes but iron-shod horses, the exposed sandstone was like ice. Someone called the surface slickrock, and the name stuck.

Who could have guessed that Moab's signature feature would be the town's salvation? Certainly not the uranium miners, whose glory days ended three decades ago, along with the boomtown's fortunes. And probably not John Ford, the director who filmed several westerns among the area's dramatic stone features. If anyone deserves credit for Moab's current status as an adventure-sport hub, it's probably former mayor Harold Jacobs. In 1967, he had the idea to start the Easter Jeep Safari, utilizing the seemingly countless acres of empty slickrock backcountry. Word spread, and today, the Moab region abounds in outdoor possibilities not only for Jeepers, but for bikers, rafters, rock climbers, BASE jumpers and more, making the town a life-list destination for adrenaline junkies.

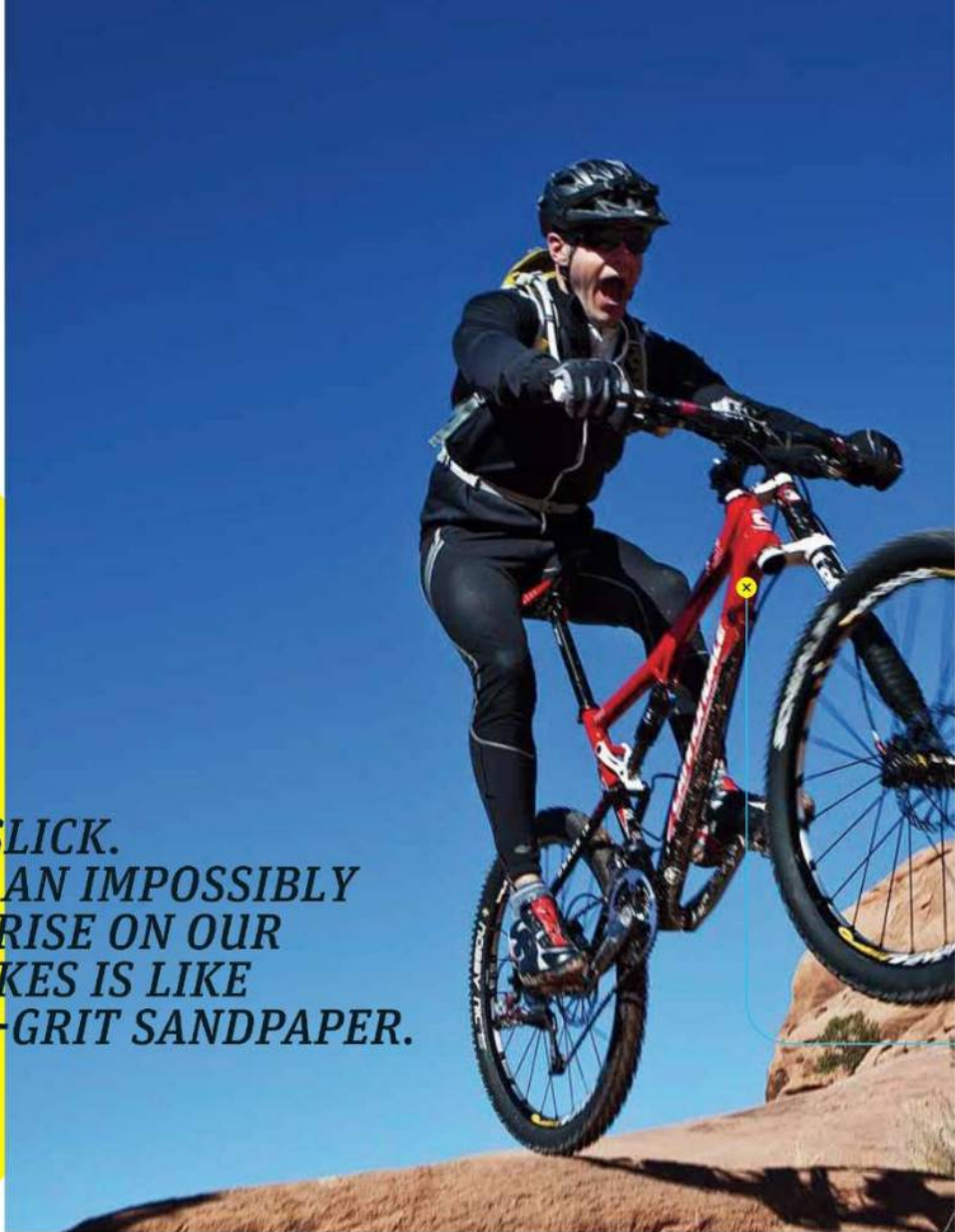
The geography sets the stage. The Colorado River glides by the northern border. Desolate, rocky BLM land stretches for miles east and west. Canyonlands and Arches national parks lie to the southwest and north, respectively. An adventure-sport infrastructure of tour companies, guides and shops caters to all skill levels. But the best way to enjoy Moab is to arrive prepared. And we're prepared as few have ever been.

Yesterday, my friend and neighbor Chris Brown and I rolled down Moab's scruffy main street outfitted for an off-road fantasy camp. We packed not only two mountain bikes but also pairs of motorcycles, ATVs and jacked-up pickup trucks, ideal

machines with which to experience Moab. Our mission is to ride four of Moab's iconic trails with four different machines in just four days.

Iconic and world-famous describes the Slickrock Trail, a mountain-bike route that winds through a maze of precipitous sandstone ridges and sweeping gullies. Naturally, that's where we head. Pedaling the Cannondale with Chris following on the GT, I climb the rock like a squirrel up a tree. Suddenly, there's a loud pop, and I turn just in time to see Chris fall over and slide down the hill.

He's unhurt, but he has somehow managed to break the GT's brand-new chain. I guess he had his Wheaties this



MOUNTAIN
BIKE



• *Catching air on the Slickrock Trail. Notice the body positioning—move your body rearward in flight to land squarely on both wheels. A strong pedal stroke and a tug of the handlebars at liftoff also helps.*



morning. To fix the chain, we don't have to access our own tools because the Cannondale's unique one-sided fork leaves room in the head tube for a shockingly complete factory-supplied toolkit that includes a chain break.

and catching air off the ledges. These two bikes have over 5 inches of suspension travel, front and rear, so they spare us the pounding. Not too long ago, bikes built for this kind of downhill punishment came with a huge weight penalty. But neither of these bikes is a porker, especially the featherweight carbon-fiber Cannondale.

If there's a downside to full-suspension bikes, it's their tendency to bounce in time to pedal strokes, sucking precious energy. While both bikes do a fair job mini-

THE
RIDES

**CANNONDALE
RZ ONE FORTY
CARBON 2**

While this \$5299 MTB is used-car pricey, it works brilliantly. Carbon-fiber frame tubes keep the weight to just 26.1 pounds, so this long-travel, mogul-capable ride feels as flickable as a BMX. The unique, single-side fork uses four needle-bearing sets to reduce friction and increase stiffness. One downside: Removing the front wheel requires an Allen wrench.

GT SENSOR 1.0

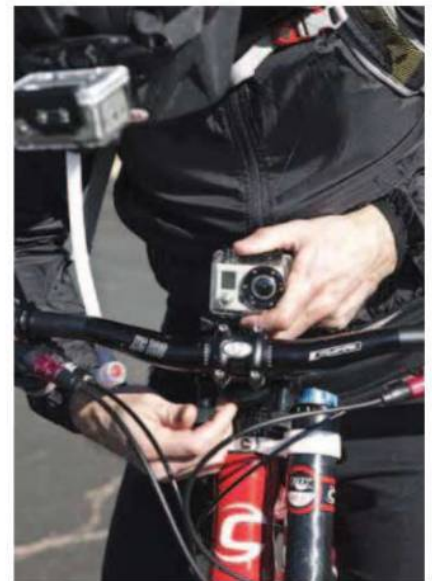
Be it suspension geometry or shock tuning—we're not sure which—the \$3000 GT climbed almost as sure-footedly as a rigid bike, yet still cushioned Moab's endless steps. The kinked top tube leaves extra inseam space. It feels heavier than its 29.4-pound weight suggests, but is capable on any terrain.

GETTING
STARTED

Mountain biking is both entertaining exercise and extremely accessible—all you need is a helmet and a bike. Ride often and you'll appreciate the quality of bikes that generally run \$1000 and up. Places like Moab do not require expert skills—guides cater to all riders.

THE
GEAR

Cycling shoes aren't necessary, but they are more efficient since they anchor a rider's feet to the pedals. The Lake Cycling MX330 MTB shoes (\$200) have the Boa lacing system that effortlessly cinches with a heel-mounted knob. The Osprey Talon 11 (\$89) waterpack has a drink-valve-securing magnet and a large screw-on filling port.



• *To film our exploits, we used GoPro's new \$300 HD Hero. This lightweight unit shoots HD video and stills and records to an SD card. Optional mounts allow multiple recording angles. The rechargeable lithium-ion battery lasted almost an hour during our outings. Although the user interface isn't intuitive and the sound quality is poor, the Hero takes great videos—check them out at popularmechanics.com.*

Less than 10 minutes later, we are back in action and cresting the hill.

The crux of the Slickrock Trail comes next: gliding down the backside



THE RIDES

SUZUKI KINGQUAD 750AXI LIMITED

The Suzuki's 722-cc single-cylinder engine uses rubber mounts and balance shafts to reduce vibration. With a locking center differential, a low-range gearbox and independent suspension, there are few places this \$9099 machine can't go.

YAMAHA GRIZZLY 700 FI

Despite its smaller 686-cc engine, the Yamaha doesn't feel less powerful than the Suzuki, because it's about 50 pounds lighter. This \$9899 quad, however, is more nimble and extremely sure-footed. Crawling over rocks never required locking the center diff. Both ATVs have digital fuel gauges—a nice touch.



• *The Suzuki survived this operator-induced tip-over (left) with barely a scratch and, thanks to its fuel-injection system, immediately refired. While stopped on the trail (above), we discuss the finer points of navigating the tricky terrain.*



mizing that effect, the GT's multilinked rear suspension seems especially stable.

We've got 27 gear ratios on call to minimize our effort, but after a couple of hours scampering up and down the hills, our hydration packs are spent, and we're sweating like Swedes in a sauna. Salvation is an expansive overlook that's as awe-inspiring as the Grand Canyon but free from busloads of tourists.

We've got a long, gradual descent ahead. Since we both have Y chromosomes, we wind up racing as we rocket down, dicing back and forth and launching off the natural rock steps. A few involuntary whoops are probably yelled, but thankfully no one's around to hear grown men howling like children.

FOUR-WHEELED MOUNTAIN GOATS

→→ *If Slickrock offers the iconic mountain-bike experience*, the nearby Fins and Things Trail seems almost custom-made for ATVs. The trail starts gently enough, but less than a mile in, I'm faced with a 15-foot-tall mound of solid rock. Tire-track evidence suggests that the trail climbs the mound's steep face, but from my vantage point it looks unscalable. Thankfully, we've got high tech on our side. Both the Suzuki KingQuad 750 and the Yamaha Grizzly 700 FI pack independent

suspensions, CVT gearboxes, fuel injection, four-wheel drive, crawler gears and even power steering.

I gear the Suzuki down to low range, engage 4WD with the button and nudge the front tires to the sandstone. It's time to attempt the ascent. I gingerly press the gas, and, to my great relief, the big quad effortlessly climbs. Chris follows without drama.

We skip the high-fives because after traversing the top of the rock, the trail descends an even steeper, perfectly smooth pitch that ends abruptly at the sand floor. I set off the edge and pray that the crawler gear and engine braking will do their job. And what about the brakes? True, there are powerful

GETTING STARTED

With comfortable riding positions and automatic transmissions, ATVs are easy to operate. Mastering them safely is another matter. Helmets, goggles, boots and gloves are the bare-minimum safety gear. And keep kids off the big machines. Training is always a good idea. Check out atvsafety.org.

THE GEAR

To communicate on the trail, we installed the Cardo Systems Scala Rider Q2 communication gear (\$155) in our helmets. This hardware allows clear, natural conversation. Garmin's \$500 Oregon 550 handheld GPS not only tracks a route, it also takes pictures and tags the location.

• *Treading lightly on the Fins and Things Trail. Staying on established trails is vital to preserving the backcountry environment. Off-trail riding destroys delicate desert soils, leading to erosion and vegetation die-off.*



THE RIDES

HONDA CRF250X

Docile for beginners, but quick enough to entertain experienced riders, the \$7149 CRF250X could be the best all-around dirt bike. The 26-hp four-stroke engine uses an offset single overhead cam to save weight and space. The controls work with silky smoothness. We found only one flaw: The seat-to-foot-peg relationship is cramped for tall riders.

KAWASAKI KLX450R

A lightly civilized race bike with an explosively powerful but easy-to-stall 40-hp engine. Fits taller riders well and has well-modulated controls. As in the Honda, electric start and electronic ignition ease cold starting. The \$7499 KLX can be ridden by novices, but is best suited to experienced hard chargers.



GETTING STARTED

As we found, eventually you're going to fall, so plan on spending at least another \$1000 for a complete set of safety gear. A riding school will dramatically shorten the learning process. Find a training program near you at dirtbike.school.com.

THE GEAR

After safety, the next consideration is comfort. Alpinestars Tech 10 boots (\$580) are like fleece-lined slippers compared to others we've tried. We also liked Arai's VX Pro 3 helmet (\$485). It's light and has a large eyeport and a removable, washable liner.

disc binders on call, but I worry a panic grab might send me sailing over the handlebars. Better to let Mr. KingQuad deftly handle the tricky bits. Now I know why this popular trail earned a "Most Difficult" rating.

We motor onto the first fin, a tall, thin rock formation, like the dorsal fin on a supersize sailfish. Straddling the route markings is critical: The ridge is 50 feet high and barely wide enough for the ATVs. Our balloon tires—inflated to just 5 psi—grip the slick-rock like an octopus on a clam. We're finally comfortable enough that we relax a bit and take in the stunning vistas that the ATVs have carried us to. The snowcapped La Sal Mountains majestically peak at over 2 miles above sea level to the southeast. To the north, there's a heaving field of slickrock stretching as far as we can see.

A few miles later, we're in a sand wash with a series of banked turns. Now on the Yamaha, I switch out of four-wheel drive to see if this big brute has some moves. With techniques I learned from riding a three-wheeler as a kid, I turn, weight the inside peg and goose the gas. The rear end gracefully drifts out, proving that these workhorses can play too.

I caution Chris, who doesn't have the benefit of my misspent youth, not to copy my moves. But back in the dirt parking lot, he tries the fishtail maneuver and is promptly pitched—harmlessly—off the side.

That's my signal to call it a day. After all, at the Red Cliffs Lodge, our home base, there's a fire burning, and it's kick-back time.

TWO-WHEELED TERRORS

→ *I blame the muffler.* Outwardly, the Kawasaki KLX450R's rear pipe looks conventional enough, but inside there's trickery. A series of baffles quiets this beast to the point where you forget that it has enough power to separate shoulders. And so I crack open the throttle at the worst possible moment, oblivious to the horses cocked and ready to flee the paddock.





• *Traction on loose dirt is always an issue, especially when exiting a turn. Sitting on the rear of the saddle increases weight transfer and gives the rear tire a fighting chance of harnessing the Kawasaki's grunt.*

• *Mud at Moab is extremely rare—usually riders are faced with choking dust. Either way, goggles are essential. In extreme conditions, use clear tear-off goggle skins to maintain visibility.*





THE RIDES

FORD F-150 SVT RAPTOR

It absorbs jumps like a motocross bike, rock-crawls like a Jeep and plies highways in comfort. While the exhaust sounds righteously throaty, the \$38,995 320-hp Raptor could use more power. That will be fixed this year with an optional 411-hp 6.2-liter V8. Either way, we want one.

DODGE RAM 2500 POWER WAGON

With charismatic toughness, the \$45,780 Power Wagon comes loaded with off-road gear. Solid front and rear axles have electronically locking differentials. With the flip of a switch, the front antiroll bar can be coupled to allow full articulation. And if you get stuck, there's a 12,000-pound winch to haul you out.

GETTING STARTED

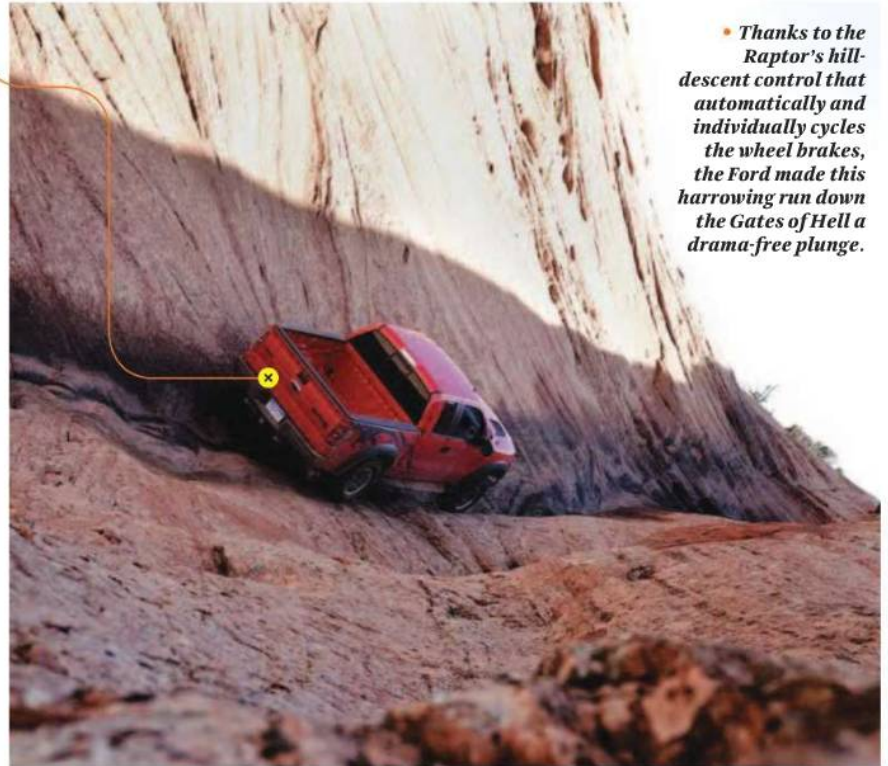
As with all off-roading, it's imperative to use areas designated for motorized vehicles. Once at a suitable location, travel straight up and down hills to avoid sliding down

sideways or, worse, a tip-over. Lower your tire pressure to increase traction. And since the steering wheel can kick back violently, don't wrap your thumbs around the wheel.

THE GEAR

Warn's Winch Kit (\$213) includes tow straps, hooks and even gloves. It's a must-have. Oakley's Jawbone glasses (\$205) adapt to any lighting with hinged lower frames that

make for painless lens changing. Sierra Designs' Fresco jacket (\$149) is thinner and lighter than a sweatshirt, but the effective PrimaLoft insulation retains heat like a parka.



• Thanks to the Raptor's hill-descent control that automatically and individually cycles the wheel brakes, the Ford made this harrowing run down the Gates of Hell a drama-free plunge.

We're on the Onion Creek Trail, a seemingly harmless and loamy dirt road that snakes along another of the area's numerous canyons. A half-hour ago, we started near the point where the flowing creek empties into the Colorado River and headed uphill. I believed I had a good handle on the green machine. Its punchy 450-cc four-stroke effortlessly lifted the front wheel over the multiple water crossings. On the switchbacks, I even sliced the turns with the throttle pinned open and the rear tire spitting loam and sliding wide, dirt-track style. The Kawie was making me look good.

But now, not so much. The road here is steep and in a deep, narrow and

shaded part of the canyon. Despite the warning signs of visible breath and the lack of sunlight, I don't anticipate that the surface has turned from loose, moist dirt to frozen hardpack. And probably because I'm too engrossed in the bike's talents, I also fail to notice that the side of the trail butts a 50-foot cliff off the creek bed.

With my blissful ignorance, I lean into the left bend—which naturally lacks a catch fence—and enthusiastically twist the throttle.

Bad move: The surface is Antarctica-frozen. The rear end rockets out and down I go. Now I'm sliding to the rapidly approaching edge. Man, I hope I signed that life-insurance form. My fate lies in two 6-inch-tall rocks that arrest my slide less than a foot from the edge.

As Chris helps me to get upright, he says, "And to think I thought this trail was a cakewalk." And herein lies a Moab central truth: No matter how innocuous the situation seems, disaster is never far off.

We switch bikes. What the Honda CRF250X lacks in power compared to the bigger-engined Kawasaki, it compensates for with puppy-dog friendliness. It's roughly 25 pounds lighter and so lithe and agile you could mistake it for a motorized mountain bike.

After 10 miles, we're above the canyon on the flat, wide floor of Fisher Valley. The

road forks, and we stop to consider our options—climb the Cottonwood or Thompson canyons or simply head back to town.

Chris, gnawing a PowerBar, says, “After what happened back there, you want to go farther from civilization?” I look over at him and say, “I heard they found gold in Cottonwood.”

FEAR OF HEIGHTS

→→ Trucks don't do backflips, I think as the Dodge's nose bounces off the rock step and heads skyward. A minute ago, everything was cool as I inched up a stone hill so steep I'd need a rope and belay to climb it on foot. This rock face in Moab is known as the Gates of Hell, and more than one rock crawler has gone ass over backwards attempting this very ascent.

Trying to creep over the step, I foolishly goosed the gas—the Hemi V8 enthusiastically responded. And just like that, I'm doing a wheelie in a 3-ton truck. The Dodge teeters on the rear wheels, hanging there, as the hand of gravity decides my fate.

→ And so we introduce today's festivities: A crash course in mainlining adrenaline while moving at a walking pace. The fun—or terror, depending on where you sit—began long before that rock step as we inched the Dodge Power Wagon and the Ford Raptor onto the first fin of the Hell's Gate Trail.

High up in the truck cabs, where visibility is limited, climbing these rocks is even more unsettling than on the ATVs. Whenever the front end climbs a bump on the already steep hill, only the hood and blue sky are visible. You then envision that you've drifted from the trail route and are about to drive off the side to disaster. On the ATVs we believed we could jump to safety. Here, we're locked in, certain victims of our own mistakes.

Keeping us and these pricey trucks intact falls on Dan Mick, an experienced rock crawler we hired. He guides us over obstacles and rock formations that at first glance appear to be impassable to our unprotected stock trucks. But under his careful eye, both trucks tackle obstacles we didn't think possible.

After an hour of inching and jostling on the slickrock, we arrive at the overlook that marks the Gates of Hell. This optional diversion travels down a horrifyingly steep, lumpy rock gorge, makes a hairpin turn at the bottom, and then comes up an equally intimidating ascent.

After a dicey descent taken mostly on three wheels, I nose the Dodge onto



• On the Hell's Revenge Trail, the Power Wagon's 148.9-inch wheelbase leaves it vulnerable to steps like this one. Cresting at a slight angle reduces the chance of scraping the undercarriage. Running boards, which ours didn't have, are handy skids. With a good spotter, however, they're not needed. We survived this day—and all four—with only a few bumps and bruises.

the hill. With steady throttle pressure—you're like a drifting canoe, Mick instructs—I inch upward to the last rock step.

And now I'm nearly vertical, wondering which way this is going to go. Whether it's karma or just plain luck, the front end falls back onto the rock, and I scramble the final few feet to the summit, panting heavily. Chris effortlessly makes it up. “You're a natural,” Mick tells him. Quite a humbling moment for me, the supposed professional of the two. But that's the beauty of Moab: No matter your skill level, you will find challenges that make you feel like a beginner, and thrills that will last a lifetime. **PM**



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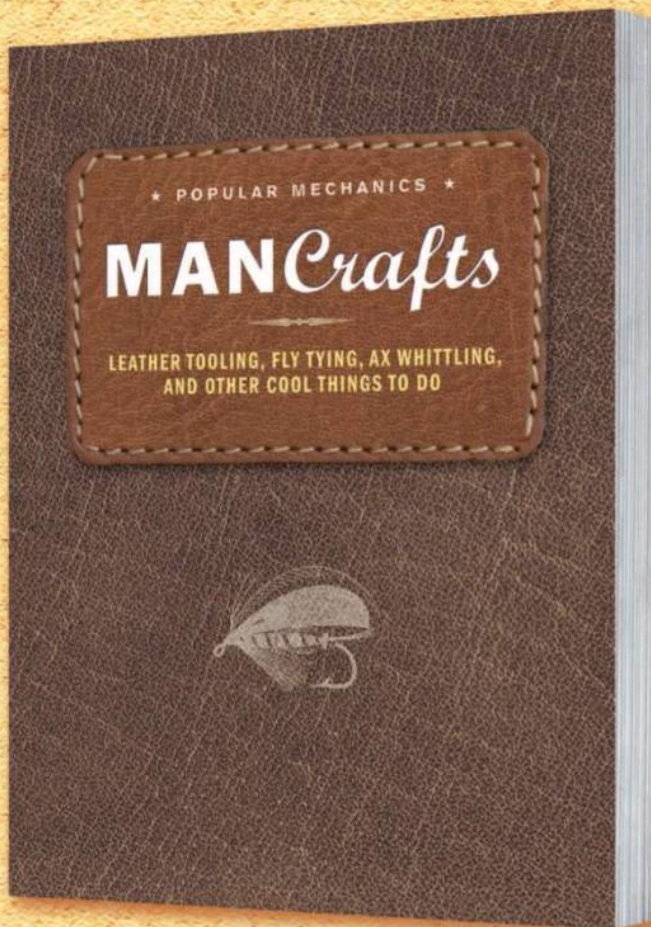


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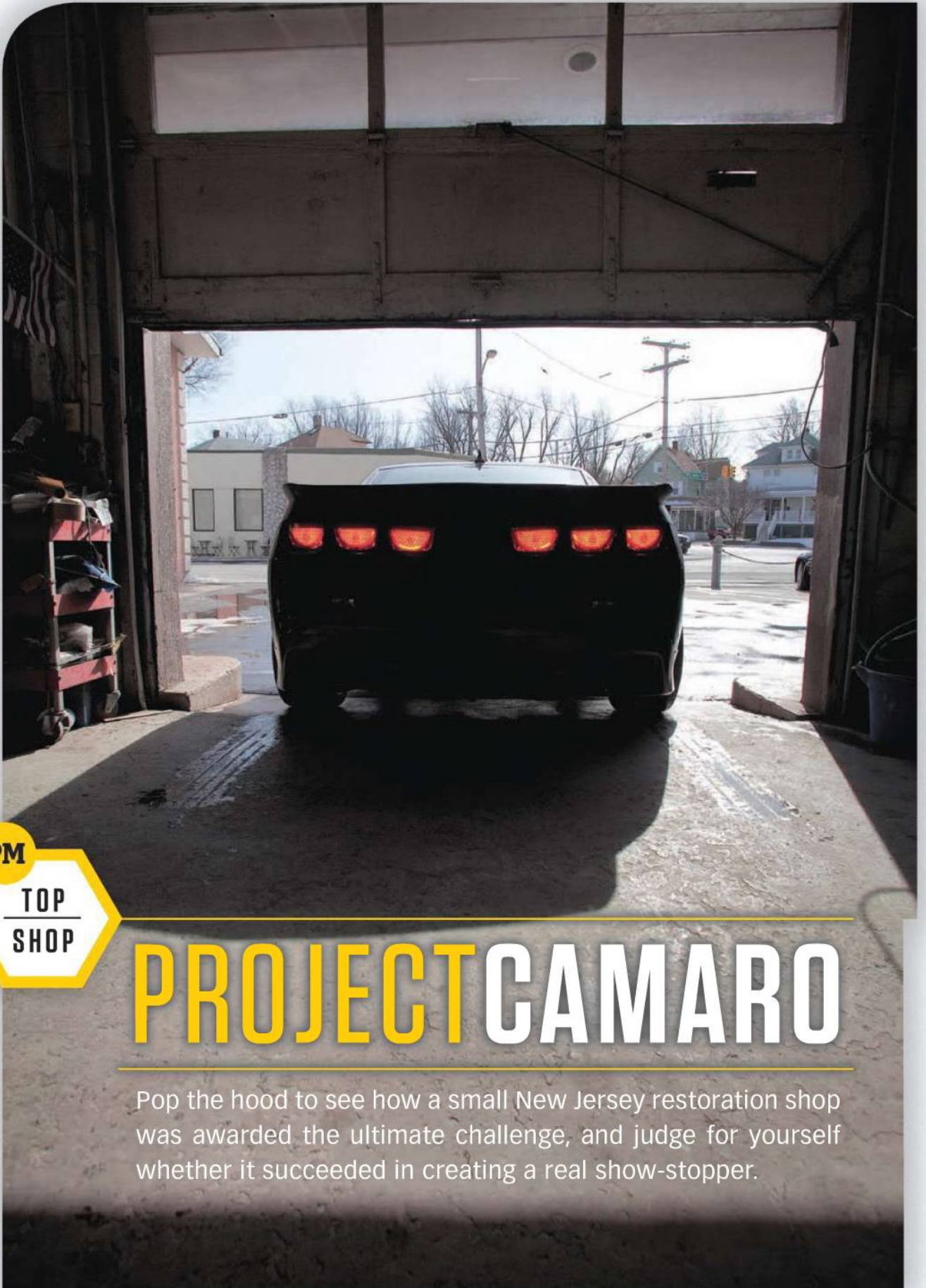
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PM

TOP
SHOP

PROJECT CAMARO

Pop the hood to see how a small New Jersey restoration shop was awarded the ultimate challenge, and judge for yourself whether it succeeded in creating a real show-stopper.

Almost anyone in the auto restoration business will tell you: as personally rewarding as the field can be, not a day goes by without potential problems. Crazy client demands, mechanical issues, parts that just don't fit perfectly—there always seems to be something. This should make everyone truly appreciate the challenge covered in this story. In addition to the standard pitfalls, the shop selected to take on this job had to contend with even more pressure: deadlines that simply wouldn't budge, photographers and film crews showing up with limited notice, and time-consuming requests from our team. Not for the faint of heart—but, let's start from the beginning...

After conducting a nationwide search for a custom shop capable of turning a stock 2010 Chevy Camaro 1SS into something seriously special inside and out, the possibilities were narrowed down to 25 shops. Those shops then responded to a request for proposal with their own creative ideas and images. Some were weird, some were wacky, but it was the Netcong Auto Restorations sketches that stood out, proposing a car that used retro design cues to make the already wild-looking Camaro even more futuristic. Barely a year old, Netcong Auto Restorations is located in a northern New Jersey town of the same name. It employs just three people and is owned by a couple with no prior experience working with cars.

Their designs look like a Camaro on steroids, which is perfect for this already-ripped muscle car. Underneath, they'd complement the looks with substantially more power and stiffer suspension, while inside, the look would be classic but the technology would surpass that of any current production car. We dug it, so we dropped off a brand-new Camaro and told them to get started.

"What we're trying to do is enhance the design of the Camaro, to hold true to Chevrolet. You'll do a double take on it and go 'Whoa, that

wasn't the Camaro I saw in the showroom,'" says Mick, the 61-year-old project manager who gave up a career doing light shows for the likes of Pink Floyd in order to get his hands dirty building cars. "What we want to do is make it look different without going into the absurd. We want to make it go fast, and we want to make it stop."

The Camaro Mick's talking about is a brand-new 2010 ISS, the one with the 6.2-liter, 426 HP V8 out of a Corvette. Enhancing this car can't be easy; it already accelerates harder than a Porsche 911 and looks like a concept car.



THE CHEVY CAMARO 2010 1SS BOUGHT AND DRIVEN FROM GEARHART CHEVROLET IN DENVILLE, NJ



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PHIL & DANA BRAZER**Owners**

"How many people do you know that are high school sweethearts that can work 24 hours a day with each other? We put everything we had in this, our kids' college funds, everything."

Phil and Dana skipped out on successful careers in corporate America to follow their dream: restoring and customizing cars. How are they doing so far?

There's a reason for the latter, after Tom Peters' 2006 Camaro concept proved a hit with muscle car fans and modern car enthusiasts alike, Chevy decided to produce it as-is, with minimal sacrifice made at the altar of road legality.

As it sits now, with roughed-in bodywork, no interior and no grille, this Camaro strikes a very distinctive pose. The exposed intercooler sits low to the ground and, paired with the pointed ram-air intake, evokes power. The quad halo headlights exaggerate the width of the front end and the downward V of the front bodywork. From the front, this car looks menacing. Move around to the sides, and the GM Performance Parts side skirts drop the body even closer to the ground. The functional intakes in front of the rear wheels channel cool air to the brakes and broaden the already-wide shoulders. The faired-in rear spoiler cradles the glass house while adding over two hundred pounds of down force at 100 MPH. It took a lot of work just to get it to this point, but there's a long way to go before this is going to be a show car.

Why a Camaro? It's the most exciting performance car to come out for the 2010 model year, but despite independent suspension on all four corners and killer straight-line performance figures, somehow the excitement gets lost in translation between spec sheet and driving experience. But, looking this good

already, fitted with one of the most easily tuned V8s around and priced at just shy of \$31k in base V8 spec, it could be the ideal platform for a practical four-seat coupe that's faster than just about any other car out there.

So what is the broader Netcong approach? "We're applying lessons learned from 17 years spent in corporate America to a small auto restoration and customizing business," explains Phil, the less-attractive half of the Brazer couple that owns the shop. "Dana's applying a six sigma approach to managing a team of three gurus. No one will ever use that word, but that's what we have here."

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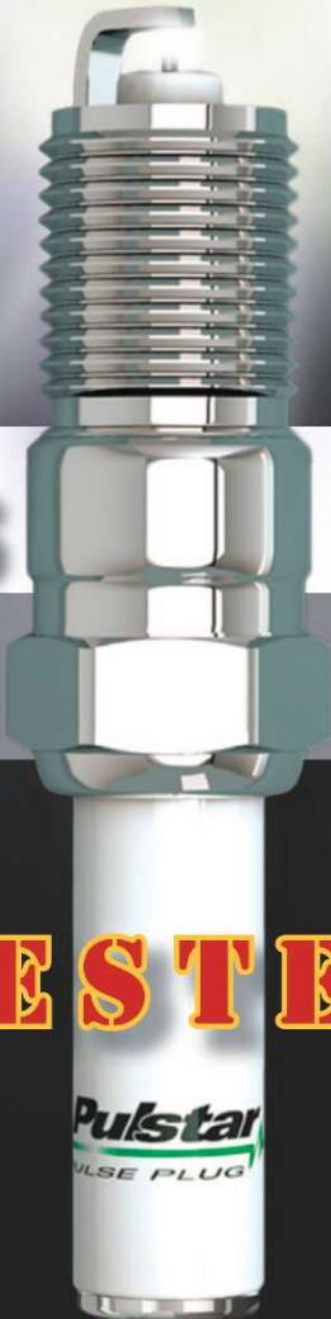
Phil and Dana are incredibly proud of their three mechanics. In their business, their human assets are their capital, which is why it makes sense to get the most out of them with effective management. "We have a matrix that shows all the duties that they all perform," explains Phil. "They rate each other and we do a job role assessment. That's how we make sure the most-talented, the most skilled person at a specific task performs that duty.

A lot of places just put one person on a car from start to finish and say 'whether you stink at this part or whether you're good at it, it doesn't matter.' That's why we can outperform our competition." Netcong's getting more out of more-talented employees than their rivals.

It's this professional approach that made Netcong such an attractive shop to work with. But, while it was the professionalism that drew us to them, it was the creativity that sealed the deal.

Where the stock Camaro looks like a modern interpretation of the 1967 original, Netcong's sketches at once look like something that's more historically accurate yet even wilder, sort of like a really slick period show car, maybe something George Barris could have dreamed up.

The quarter vents were originally an element planned for the stock Camaro's design, but the cost of producing them was simply too much for a muscle car that starts in the low \$30k range. Instead, on the standard car, they're represented by three grooves running diagonally across the flanks just behind the doors. By adding the vents back in, the original design is emphasized while introducing a further retro element. "My uncle had a Javelin, a '71 AMX car, and we flared out the quarters like that about 15 years ago," says Wizz. "Nothing I haven't done before."



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INSTALLING THE VORTECH SUPER-CHARGER



But this car isn't just supposed to stop people in their tracks visually, it's also got to blow them away with its performance. Making the visual modifications functional is where things get tricky. "The air [from the quarter vents] has to go somewhere," explains Mick. He took his designs and helped make them contribute to the Camaro's performance. "I don't want it just to disappear under the wheels' skirts, the air's going to funnel around and into the back of the wheel to cool the brakes."

Cooling the brakes is necessary because this Camaro is going to be fast. We originally envisioned boosting a V6-engined car to V8 performance levels with an emphasis on handling in order to give it an edge. But that 3.6-liter engine is brand new and there simply aren't parts available for it yet. The Camaro's LS3 is a version of the standard small-block Chevy LS architecture, so a lot of basic tuning knowledge exists. At least that's the thinking that led to the decision to slap a supercharger on it. The reality was far more complicated.

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One of the easiest ways to get more power out of an engine is with a supercharger. Powered by the drive belt, they squeeze more air into the engine allowing more fuel to be added which increases the power of each explosion powering each cylinder. Vortech has a long history of creating supercharger systems for muscle cars, so we chose their V-3 Si Self Lubricating Supercharger system for its proven performance, reliability and ease of installation. The charger in this car is one of the first ones produced for the 2010 Camaro SS. Installation also turned out to be more complicated than expected, with the pulleys requiring a visit to a local car dealer to get the right wrench. Once this problem was resolved, the system went on smoothly.

**TOPSHOP
TIP No. 2**

IGNORE THE OLD WIVES TALE THAT SAYS YOU CAN'T USE SYNTHETIC OIL DURING AN ENGINE'S BREAK IN PERIOD. MODERN PRODUCTION TECHNIQUES HAVE ELIMINATED THE NEED TO BREAK-IN MOST ENGINES, AND MOBIL 1 SYNTHETIC IS ACTUALLY USED IN MANY NEW CARS, STRAIGHT FROM THE FACTORY, INCLUDING EVERY SINGLE PORSCHE AND ASTON MARTIN.

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The V-3 Supercharger adds 6.5-7.5 PSI of pressure, resulting in around a 45-percent boost to horsepower. On the Camaro, that means we've now got about 600 HP at the crank. Considering that improvement, adding the blower was well worth the hassle.

To make the most of that performance, Netcong also added a stainless steel GM Performance Parts cat-back exhaust that remains road-legal while adding a nice rumble to the engine note through 4.5-inch tips. Pulstar™ Pulse Plugs also help things along by pulsing the ignition at two nanosecond



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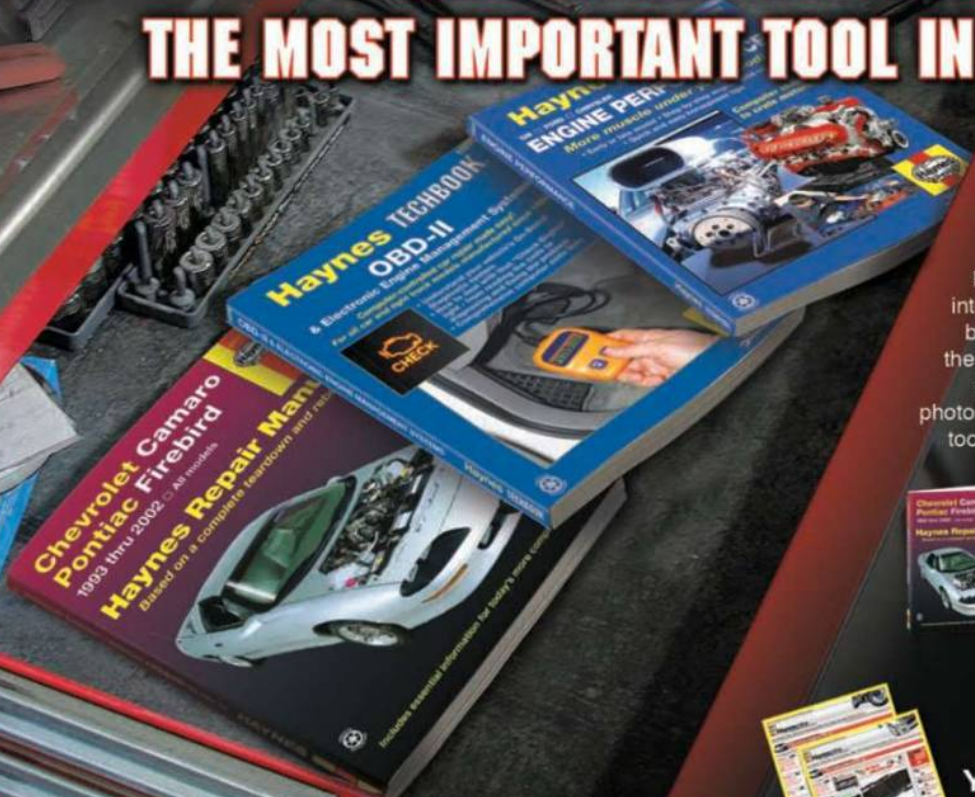
After all this work, the last thing we want to do is scratch the Camaro or have something dropped on it. Covercraft car covers use a body-hugging spandex knit that's lined on the inside in 100% cotton terry loop that's been sheared to make it extra-soft. The best part? The form-fitting cover make it look like your car's wearing slinky underwear.

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intervals that boost the power of the spark 20,000 times greater than any other spark plug. That ignites more of the fuel/air mixture, making the most of the extra gas we're pumping into the engine thanks to the supercharger. Pulstar estimates we're seeing a 12- percent improvement to power and torque from this more efficient combustion alone.

The engine's running Mobil 1 synthetic oil to minimize power loss from friction and maximize the longevity of the internal parts under extreme conditions.

"This thing takes off from 2,000 RPM, and a stock takes off from 4,700. Big difference," says Wizz, who's completed some initial engine tuning work on the road before running the car on the dyno to finalize the maps. You can hear the difference too, with the supercharger's blow-off valves spitting out a whistle every time you lift off the throttle, and the exhaust roars as the Camaro pulls away.

As a result, the intake required some serious modifications to the front of the car. The stock Camaro breathes through a small slit in the nose

mounted in the plastic in front of the hood, rather than the hood itself. Netcong knew it'd need to improve on this if the car was to stand half a chance of flowing enough air to feed the supercharger. Rather than simply opening up the existing hole, which only feeds the engine bay in general, they elected to develop an entirely new inlet integrated into the hood and box it off to force high-pressure air in front of the car into the intake. All this ended up requiring much more work than the clean execution would have you think.



MICK
Project Manager

"I apprenticed as an auto body tech, and then I was a painter in England on British Motor Corporation."

That's before Mick got into doing light shows for rock bands like Pink Floyd, The Nice, Yes, and Nektar, who Mick toured with for 6 years. That experience paid off when he went back to working on cars, giving Mick an unrivaled eye for color and outrageous design.

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TOPSHOP
TIP No. 3

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"You've seen how tight everything under the hood is," explains Wizz. "We dropped the rad support two inches, the radiator down, the intercooler is down as low as it'll go, we had to more or less reconfigure everything that was made for it. In the front of the car, we moved the wiring harnesses back two inches. There's nothing under that hood that's stock. The hardest part was fabricating the hood, cause it's aluminum. We had to extend the hood forward by seven inches to accommodate the new engine, cutting a slot for it out of the front bumper."

"The intake was squared up about three weeks ago," says Mick, who intervened to find a solution that would look more at home in the Camaro's pointed nose. "Now it matches the front of the car."

Dropping the radiator support and running the hood into the bumper also eliminates the standard latch, necessitating an alternative solution. Two posts on the leading edges of the hood now secure it, race car style.

Adding the intercooler, which cools the air flowing from the supercharger to the engine to maximize the density of oxygen, allows the engine to make more power, but it's a big metal box that sits in front of the radiator. Fearing that this could lead to cooling problems when pushing the engine hard, Wizz and Mick devised a ram-air intake for the engine that also seals off the radiator and intercooler from the rest of the engine bay. Not only does this minimize radiant heat from the engine, but it also traps air being forced into the radiator while the car is moving, causing cool air to circulate within the front of the car rather than disappearing through the engine bay.

Like all of the other modifications made by Netcong, the front end looks good, but functions better.

Framing all of this is a custom set of quad halo headlights. To create them, Netcong took two sets of the stock Camaro lights and welded them together. The custom grille this necessitated wasn't the hardest part of the job.

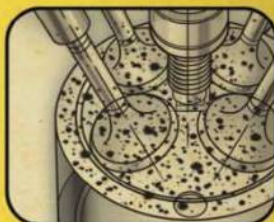
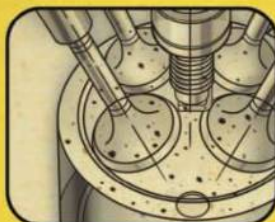
"We couldn't even figure out if the lights were working, because we



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couldn't get power to the lights because the radio wasn't in the car. Newer cars are all run by the main computer, sub computers and with this one, the radio," explains Mick. "Unbeknownst to us, the radio was like the brains of the whole system. We had to take the radio out to do the dash; once you take the radio out, nothing works, absolutely nothing. You couldn't even turn the car on; we were pushing it around all the time. Once that radio was back in, everything worked, I guess we did something right."

Aft of the engine, there's an MTI Racing quick shifter that makes rowing through the Camaro's six speeds much easier. Important when you're blasting back roads or ripping down the drag strip. The stock car runs a 1/4 mile in as little as 13.0 seconds, with 174 more HP, ours should be much faster. Believe it or not, that quick shifter is all the rest of the power train needs to cope with the added power; the clutch and differential are built strong enough to accommodate most tuning.

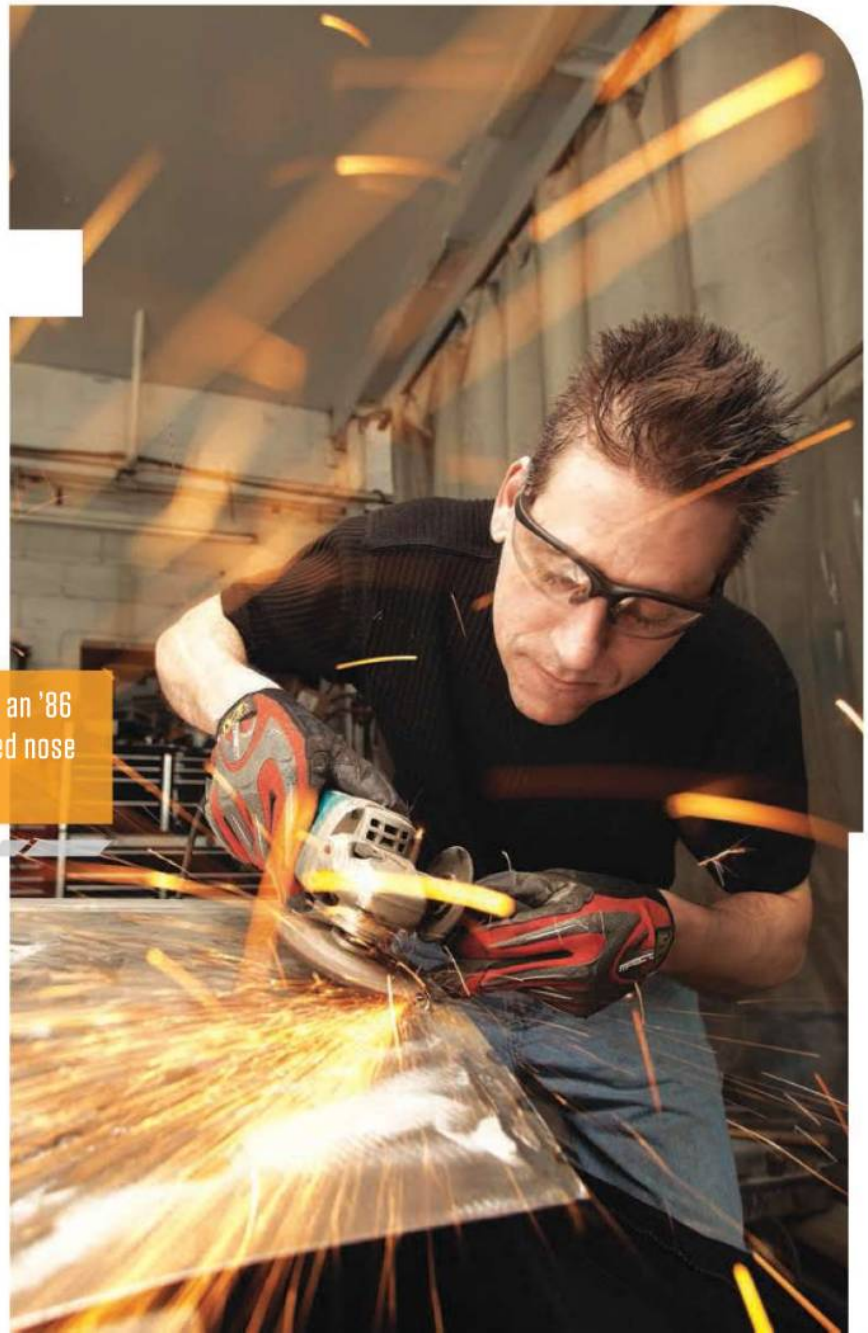
Four things that can't handle the extra power are the tires. The stock tires are a great compromise between grip, ride comfort, noise and longevity, but they wouldn't last 8 hours on the back wheels of this Camaro with its newfound power. Luckily, Cooper Tires has just designed a new tire, the RS3, that will drastically improve grip in both wet and dry conditions.

Originally developed for high-power custom Mustangs from Roush, the RS3 is the highest performance tire offered by Cooper Tires and is specifically designed to make the most out of cars with huge horsepower figures. As the only parts of the car that actually touch the road, the tires are responsible for safety,

WIZZ Technician

"They call me Wizz 'cause I fix cars. I just came here one day to pick up my toolbox, and unfortunately they hired me."

Wizz doesn't talk much, but he drives an '86 GM pickup with gullwing doors, a tilted nose and 500 HP, which speaks volumes.





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performance, refinement and feel. It doesn't matter what else you have on the car, if you don't have the right tires, the other upgrades won't be able to live up to their potential. The race-inspired RS3s are designed for extreme levels of grip combined with heightened vehicle control. They achieve that thanks to a specially designed silica rubber compound and an asymmetrical tread pattern that clears water aggressively through large central grooves yet features large, uninterrupted block of rubber on the outside edges for maximum traction. Designed for the race track, the RS3s will also boost on-road performance to the maximum possible degree.

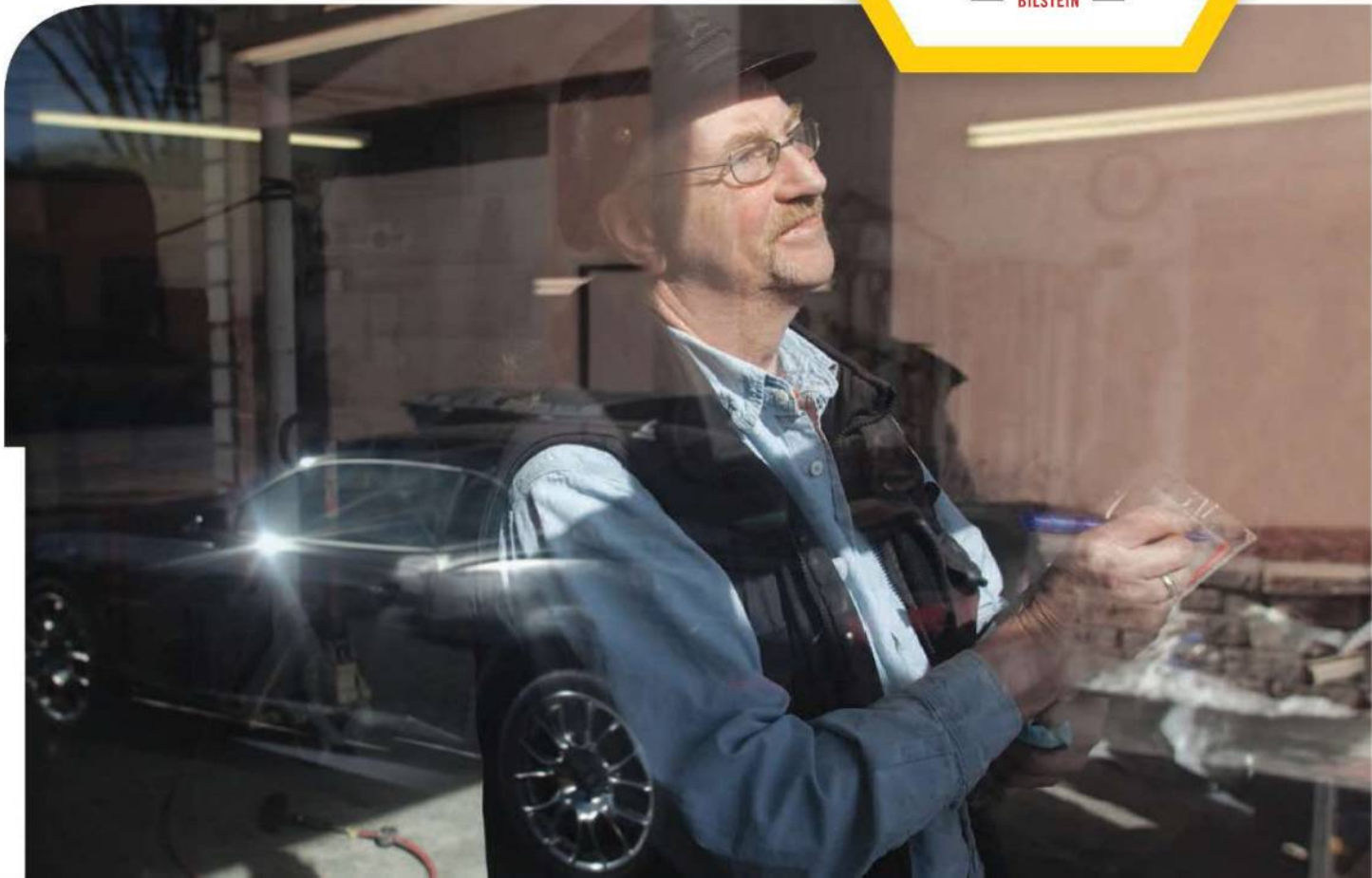
Those tires sit on 20" x 9.5" BBS Alloys and are connected to the car by custom MTI Racing coil-overs running Bilstein shocks. Combined with SLP Performance adjustable sway bars, the Camaro's handling should now essentially be programmable to individual conditions. A few turns of the wrench can have it tied down tight for the track, while doing the reverse could slack off the adjustable Bilstein dampers to absorb bumps on the road. At the same time, the anti-roll bars can be adjusted to tweak handling characteristics like under-and-oversteer.

The higher speeds all this extra performance is going to bring means we're going to need stronger brakes too. Everyone whistles when they talk about the setup on this car. While the rear calipers remain stock, the front and rear have been replaced with 15" Brembo cross-drilled rotors, and the fronts get positively enormous 6-piston Brembo calipers courtesy of SLP Performance.

TOPSHOP
TIP #4

MOST NEW CARS ARE SET UP TO SAFELY UNDERSTEER RATHER THAN ENTHUSIASTICALLY OVERSTEER. EXPERIENCED DRIVERS MAY WANT TO CHANGE THAT TO IMPROVE RACETRACK PERFORMANCE. RATHER THAN CHANGE SUSPENSION SETTINGS OR TIRE PRESSURES, TRY ADJUSTING THE FRONT SWAY BAR TO BE LESS STIFF. IF YOUR SWAY BARS AREN'T ADJUSTABLE, FIT A THINNER AFTERMARKET ITEM.

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People in stock cars are going to be seeing a lot of this Camaro's taillights, which is probably the reason Netcong decided to make them special.

"We wanted to hold true to Chevrolet," says Phil. "We're modifying and fabricating pieces on the car so that it can keep the Chevy flavor. In the '60s they used to come out with a Corvette called the California Special, and they'd add a taillight to a mid-year Corvette, and so we added a triple taillight."

All of this sounds suspiciously knowledgeable for someone without a lifetime of restoration experience. "After 9/11 something clicked and my whole life came into perspective, and I said 'I can't see myself doing the corporate thing and working for all these other people for the next 20 years.' So I woke up at 3:30 one morning and I said to Dana, 'Listen, I don't think I can do this anymore. Why don't we just downsize and go to work together?' And she says, 'Why don't you go back to bed, forget the whole thing. We're not downsizing.'"

To make a long story short, Phil persisted, and the couple eventually left the corporate scene and purchased Netcong Auto Restorations, their dream business.

"We closed on the business in September 2008, right before the stock market crashed," says Phil.

"We put everything we had in this, our kids' college funds, everything. Seriously. It's scary," Dana chimes in.

TOPSHOP
TIP #5

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MICK WORKING ON THE
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But Phil and Dana are confident their dream business is going to work out. Why? The three mechanics. "They're really child prodigies," says Phil of Mick, 61, Wizz, 40, and Hal, who's in his 50s. "It's a word that no one's willing to use. It's only reserved for musicians and painters, but these guys are not just technicians and mechanics, they grew up with cars. Hal started at 14, Mick at 15; Wizz was 8 when he started working on cars with his uncle. "People that have the talent to start at a young age and that have the kinds of skills and the work ethic to do this kind of work, I believe they are child prodigies."

You can see the talent Phil's talking about in the work on the Camaro so far. All the fabrication work is metal. The custom hood is all-aluminum. It weighs the same amount as the stock hood, despite the addition of that 7-inch lip and the internal bracing to support it. The rear spoiler is steel.

"The rear spoiler is still not my idea of exactly what I had envisioned, but it's very close to it, and by the time you see it done, it will be," says Mick, still not

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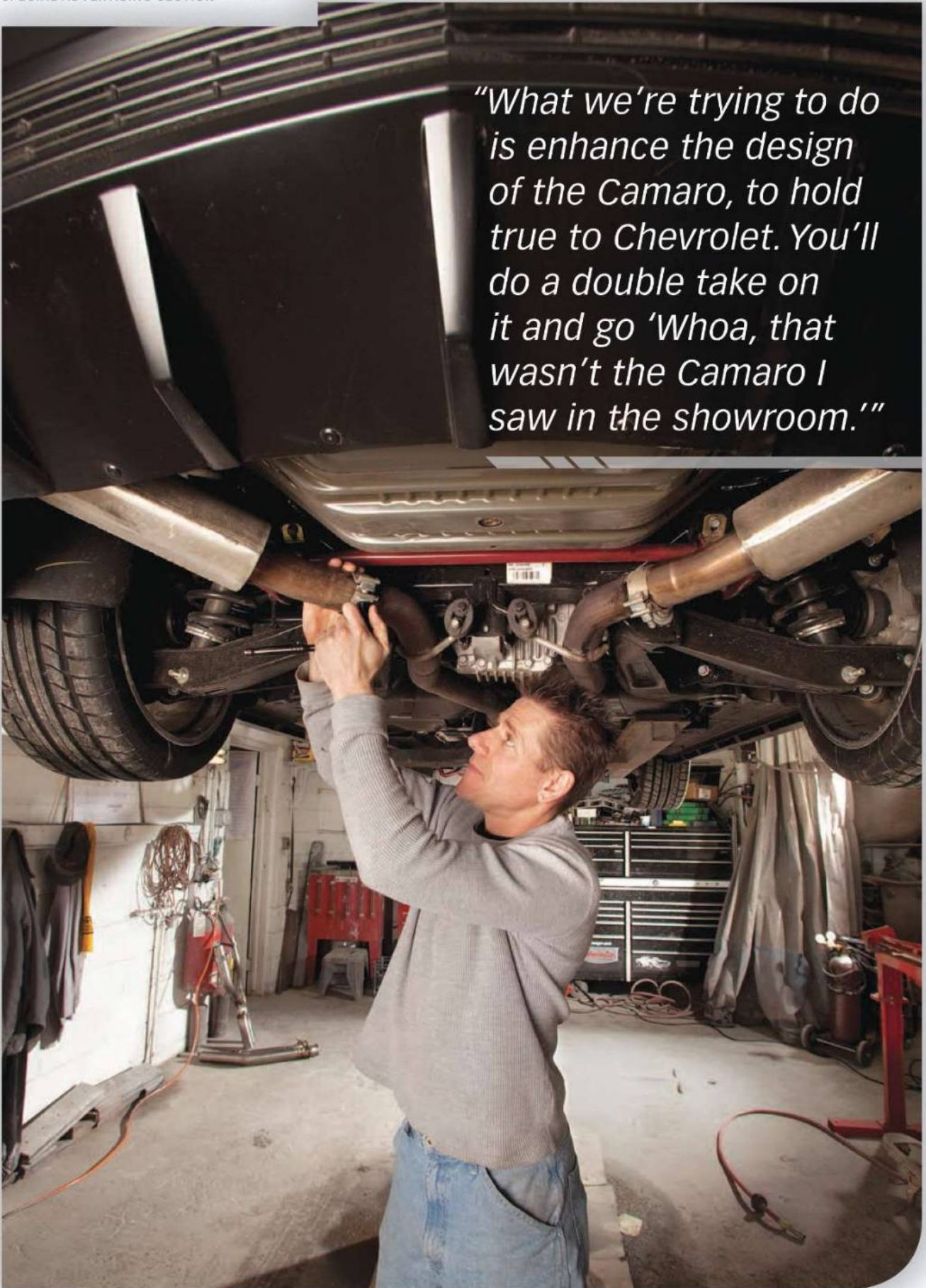
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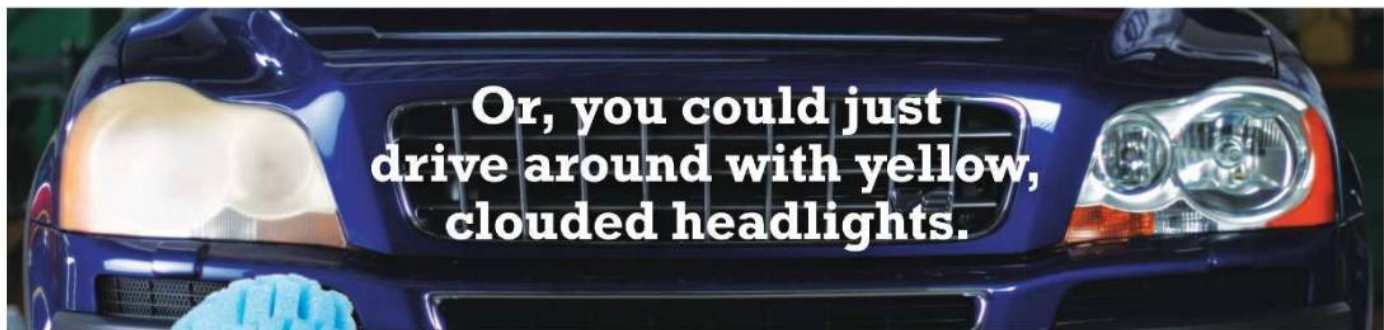


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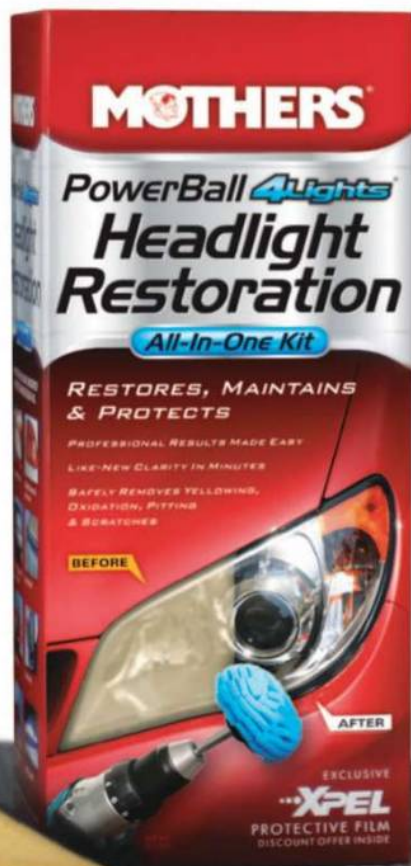
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happy with his work. “It needs to flow, it needs to follow the lines of the original car without being upset and not too many sharp lines. It needs to have a definition, but it also needs to blend.”

That’s just one of many things on the “still to do list” to finish the car on time, two weeks from the date the latest photos you see here were taken.

One of the biggest jobs remaining is the paint. It’s going to be black with a blue-outlined checkered flag running around the sides. This is where Mick’s expertise in lighting comes into play. “Hal lays the paint on the cars, but that’s only part of the painting process,” says Mick. “The prep, the masking, mixing of the colors, the right balance of hardener to product, that usually comes down to me, and I give it to Hal and he sprays it. Hal can lay it out better, but the painting process, that’s my area back there, that’s my workbench.”

“I got into light shows after I saw Jefferson Airplane,” Mick says of his unusual background. “For five tons of equipment and 23 guys running around, I said, ‘I can do a better show than that in my basement.’ I politely told this to the promoter and he said, ‘Well, bring your stuff down and let’s see what you can do,’ and I blew him away. I got invited to do a big festival in Holland, and I said, ‘That’s it, that’s my ticket.’ Got two other guys to help me, painted up the van and took off to Holland. I was 18.”

Luckily, Mick’s talent with lights translated to painting cars. “Even just lighting in a shop and positioning the cars so that you can see the colors the way they’re supposed to be, but really, I have a good eye for color and I can tell what’s in a color, the pigments, just from looking at it. A crucial skill when it comes to restoring older cars which may use an uncataloged shade.”

Of course, Mick’s time in rock and roll didn’t just result in an eye for trippy colors. “I like being outrageous. But my outrageous is going to be way more outrageous than any outrageous you can think of. Problem is, it’s usually too expensive.”

So what’s this Camaro going to look like after the paint’s been done? “It’s a race car. It’s fast, the blue, I think, is going to give it a retro touch, the same as the

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TOPSHOP
TIP #6

A "CHECK ENGINE" LIGHT DOESN'T MEAN YOU SHOULD PULL OVER AND STOP DRIVING, IT JUST INDICATES THAT THERE'S A PROBLEM WITH YOUR VEHICLE'S RUNNING CONDITION. BUT THAT DOESN'T MEAN YOU SHOULD JUST IGNORE IT. YOU WILL FAIL YOUR EMISSIONS TEST IF THE LIGHT IS ON. SAVE MONEY AND DETERMINE THE CAUSE OF PROBLEM YOURSELF USING A TROUBLE CODE READER AND A HAYNES OBD-II TECHBOOK. IT COULD BE AS SIMPLE AS AN IMPROPERLY SEATED GAS CAP.

BROUGHT TO YOU BY
HAYNES MANUALS

quad lights and the triple rears. The slight retro tipping of the hat follows through with the color scheme too, it's actually a '60s Corvette color," explains Mick.

The theme of retro looks combined with a level of performance that's only just available in 2010 will be continued inside the car too. Right now, it's a raw shell, but over the next couple of weeks, the exterior's blue and checkers will be brought inside, contrasting with a level of in-car technology that's not even attainable on exotic cars. Heading that list will be a forward-looking FLIR thermal-imaging night vision camera system capable of zooming in on far-off objects or, closer up, checking to see who drank the last cup of coffee. The extra on-road safety that it will provide will be complemented by a custom Escort Passport 9500CI radar and laser detection system. Since its drivers will be arriving at their destinations ahead of time, they're going to be equipped with a host of in-car productivity items too, namely a netbook computer, onboard wireless high-speed Internet, a gaming system and even a color printer in the back seat.

In addition to finishing the bodywork, applying paint and tricking out the interior, we're also going to find out exactly what this 600 HP Camaro is capable of at the Cooper Tires *Tire & Vehicle Test Center* in Pearsall, Texas. Equipped with a high-speed oval, a wet skid pad and a 1.3-mile road course, as well as facilities like a special area designed to evaluate wet braking distances, it should be the ideal place to figure out just how much faster our project Camaro is over a stock version. We're guessing the answer to that question is: much. ●



HAYNES MANUALS

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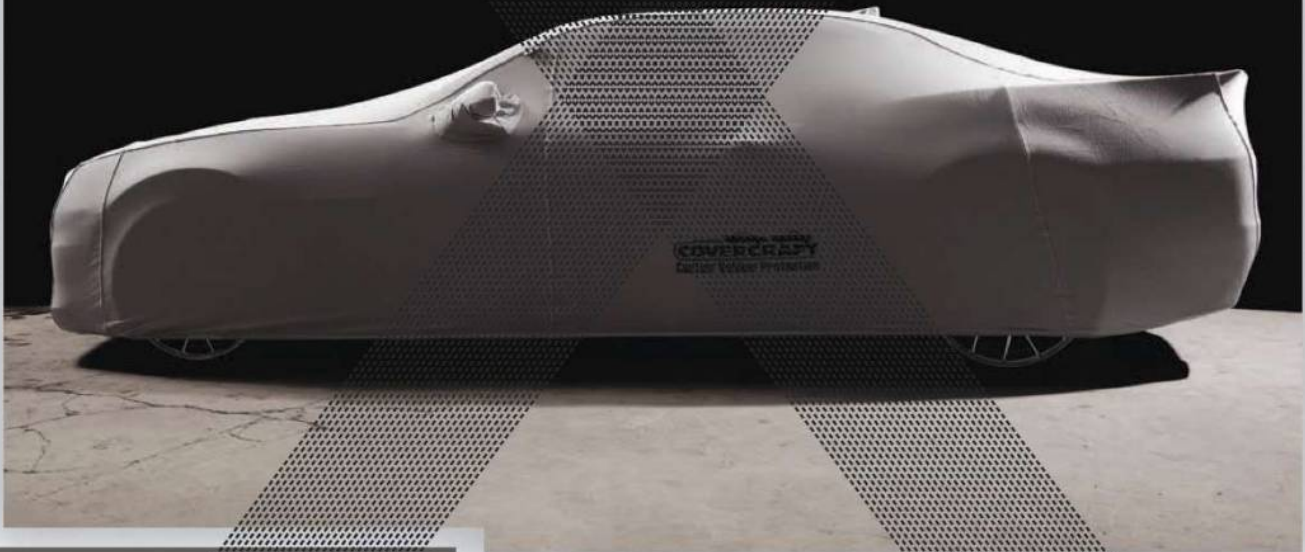
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Want to see what's next for Project Camaro?
Next month, witness the complete transformation
of the Camaro as Netcong's team puts the
finishing touches on the car.

Also watch the Camaro perform at Cooper Tires
Tire & Vehicle Test Center.



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✓Yes



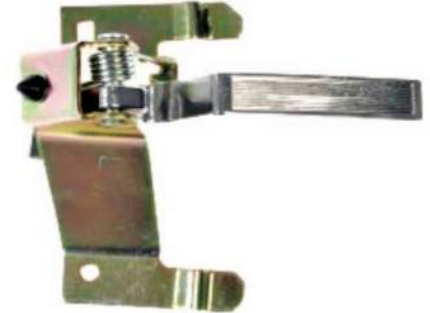
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Home

The Seat of Power

BUILD A CHARGING STATION FOR YOUR CORDLESS TOOLS. BY JOSEPH TRUINI

➔ **If you're like me**, your cordless-tool collection has grown a lot in the past few years. From a single drill driver bought 20 years ago—and replaced several times since—my battery-powered arsenal has expanded to more than a dozen tools and includes everything from screwdrivers and saws to

hand vacuums and worklights. This array of equipment is great, but the mess it made of my workshop was not. It seemed like every horizontal surface was covered with a tangle of cases, tools, chargers, batteries and wires. I needed a means to keep my tools organized and their chargers accessible.

The solution was to build a cordless-tool station. It permits several batteries to be charged at once and keeps the most frequently used tools ready. The station is built out of 1 x 4 and 1 x 6 lumber and birch plywood, but it's not without some pretty cool features. An armored 4-foot-long fluorescent

INSIDE

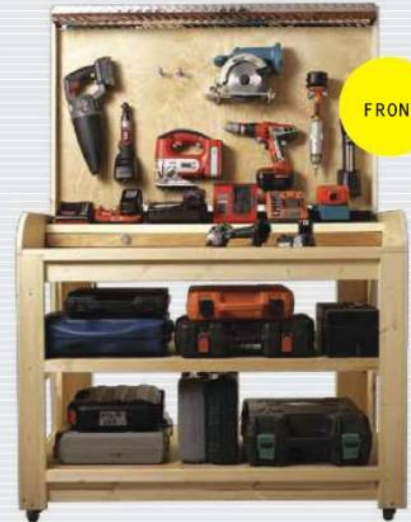
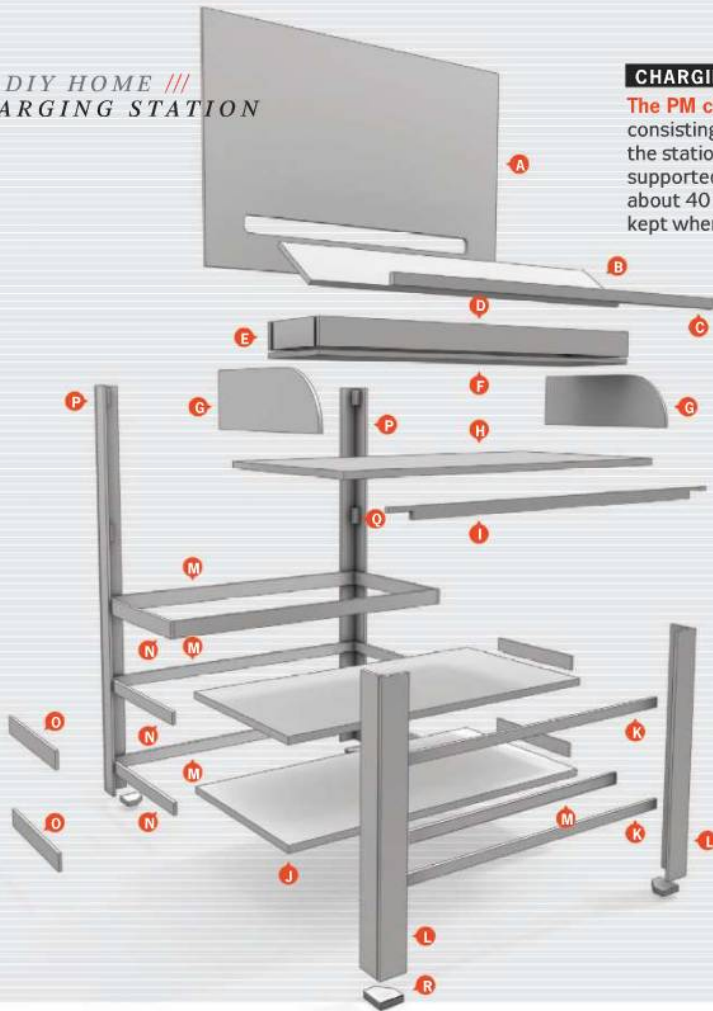
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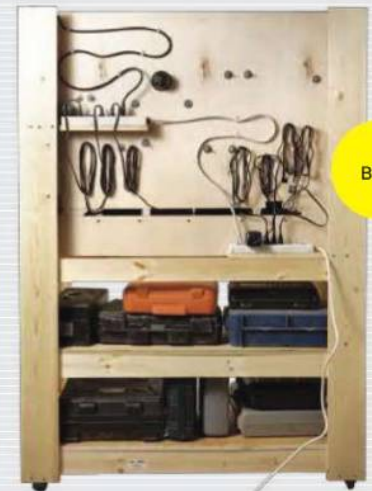
PM DIY HOME ///
CHARGING STATION

CHARGING AHEAD

The PM charging station is a simple exercise in basic carpentry, consisting of 1x pine and plywood. Its backboard is recessed so that the station can be rolled neatly against the wall. Power strips are supported on wood blocks on the back, and the design conceals about 40 feet of electrical cords. The best part is that everything is kept where you can see it, ready for use or maintenance.



FRONT



BACK

PART	QUANTITY	SIZE & DESCRIPTION	PART	QUANTITY	SIZE & DESCRIPTION
A	1	3/4" x 36 5/8" x 48" (backboard)	J	2	3/4" x 26 1/2" x 48" (shelf)
B	1	3/4" x 9 1/2" x 48" (charger shelf)	K	2	1" x 2" x 42 1/2" (shelf edging)
C	1	1/4" x 1 1/4" x 48" (front strip)	L	4	1" x 4" x 33" (front leg)
D	2	3/4" x 1 3/4" x 47 3/4" (drawer front)	M	5	1" x 4" x 46 1/2" (stretcher)
E	3	3/4" x 1 3/4" x 8" (drawer side, center)	N	6	1" x 4" x 26 1/2" (stretcher)
F	1	1/4" x 9 1/2" x 47 3/4" (drawer bottom)	O	4	1" x 2" x 17 5/8" (edging)
G	2	1" x 6" x 21 3/4" (side splash)	P	4	1" x 6" x 69 1/2" (rear legs)
H	1	3/4" x 23 1/4" x 48" (bench top)	Q	4	3/4" x 1 1/4" x 6" (blocks)
I	1	1" x 2" x 48" (front edging)	R	4	1" x 2 1/2" x 3 1/2" (caster blocks)

Miscellaneous: casters, worklight, power strips, ribbed shelf liner, nuts and bolts to serve as drawer pulls

worklight, a slanted charger shelf, swiveling casters and an accessory drawer make it fun and convenient.

Construction Sequence

➔ I started by crosscutting four 1 x 4s—two for each front leg—and four 1 x 6s—two for each rear leg. I then glued and nailed together each leg, forming a right-angle assembly. At the bottom of each leg, I attached a small wood block for mounting the casters.

Next, I joined the left rear leg to the left front leg with three stretchers. Each stretcher is fastened with glue and 1 1/4-inch drywall screws. The right-hand legs are joined the same way.

When these assemblies were completed, I crosscut five stretchers to connect the two leg assemblies. I also cut the plywood shelves. After gluing and screwing the three rear stretchers to the left-leg assembly, I used a pneumatic finish nailer to attach the shelves

to the left-leg stretcher assembly. If you lack a finish nailer, use screws. With the shelves installed, I glued and screwed the right-leg assembly.

To complete the basic frame of this project, I attached the final two stretchers across the front, connecting the left front leg to the right front leg. Note that there's no middle stretcher between the two front legs. It's not needed structurally, and by not installing it, you improve access to the bottom shelf.



ON THE WEB > For step-by-step plans go to popularmechanics.com/home/how-to/.

BUILDING THE BASE

1. Legs First

Glue and nail the legs together, then glue and screw the caster block to the bottom of each leg.



2. Add Stretchers

The legs are joined with stretchers glued and screwed into place.



3. Tilt in the Back

The back is tilted up and nailed in place. We used blocks on the rear leg to position it, but it could just as easily have been screwed or nailed in place without them.



4. Nail in Trim

A narrow pine trim strip is nailed against the side and front of each shelf. Note that when the bench top is trimmed, the trim is notched around the front legs.



CHARGERS AND TOOLS

5. Nonslip Shelf

Cover the charger shelf with nonslip ribbed shelf liner.

6. Mark Motors

Cordless circular saws have large sideways facing motors that make

mounting them a challenge. Mark the motor's position.

7. Clearance

Use a 3-inch holesaw to cut the motor clearance hole or use a jigsaw to cut the opening.

Next, I ripped and crosscut the backboard from $\frac{3}{4}$ -inch birch plywood. Then, I used a jigsaw to cut a 1 x 32-inch-long slot through it. The slot is $6\frac{1}{8}$ inches up from the bottom edge of the backboard, and is used for passing the battery-charger power cords through to the power strips. The backboard is installed between the rear legs, recessed 2 inches from the front and secured with 2-inch nails.

With the backboard installed, I

ripped and crosscut the bench top, then laid it over the upper stretchers and secured it with glue and 2-inch nails. I made the shelf and its front lip from scrap birch plywood. I simply screwed the shelf through the side of the rear legs and the backboard. Then I installed the side splashes. After these were installed, I drove screws through them into the shelf.

To mount the cordless tools, I just installed long carriage bolts with a nut

and washer on both the front and back of the backboard. Remember to leave extra space on the backboard for mounting tools, such as the flashlight, that have an integral (nonremovable) battery. These tools are mounted with their chargers.

Now that the bench is finished, my basement is a lot neater. My cordless tools are charged and stored in one place where I can easily see them. They'll be ready to work when I am. **PM**

PM
Saturday

+ ONE-DAY PROJECT

Tire Swing

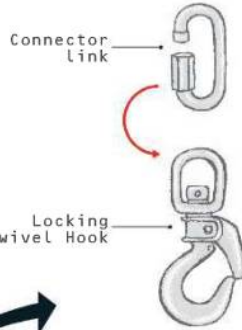
DAVID LABENS'S 15-INCH MOTORCYCLE TIRE "JUST HAPPENED TO FALL OFF AT THE RIGHT TIME" FOR HIM TO RIG THIS SWING FOR HIS TWIN DAUGHTERS.

TREE BRANCH

Level, stout and about 10 feet up. Ideally in an isolated oak or maple. Knots or branches can help hold the chain in position.

HANGING CHAIN

Fasten links into a fitted loop around the branch with a connector link. The CPSC's Public Playground Safety Handbook No. 325 dictates a 30-inch clearance distance between the tree trunk and the swing at the height of its arc. Slip tubing over the parts of the chain in contact with the branch to minimize abrasion.

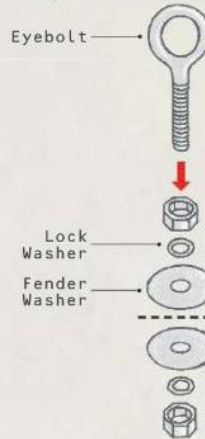


CHAIN CONNECTORS

The hanging chain attaches to the tire chains with a connector link and a locking swivel hook. Use steel hardware grade 5 or higher in hardness, designed for "lifting" work. Check periodically to make sure the connections stay secure and free of corrosion—keep a keen eye on the connector links to ensure their threads stay fully engaged.

CHAIN-TO-TIRE HARDWARE

Drill three equidistant holes in the sidewall's flattest point. Thread eyebolts through nuts, lock washers and fender washers above and below the sidewall. Connector links fasten the eyebolts to the chains.



TIRE CHAINS

Three hardened-steel chains, 3 to 5 feet long and at least $\frac{3}{8}$ -inch in link diameter. Sheathe the chains in tubing for a comfortable grip.

TIRE PREP

Drainage holes prevent water accumulation—and mosquitoes. An annual insecticide application stops stinging insects from building nests inside. Avoid steel-belted radial tires. Spread some mulch beneath the tire in case of falls.

Location: Pecan Tree, San Antonio, Texas **Cost:** \$60
Weight Capacity: 400 Pounds

+ MORE TO DO IN MAY



Blast Dirt → Rent a pressure washer and put it to work with a 45-degree nozzle and Zinsser Jomax cleaner—a classic stain buster. **Play Outside** → Break out the horseshoes, croquet and badminton for National Backyard Games Week, May 17–24. **Prep the Grill** → Rust on the grill grates? You're cleaning it too much. This Memorial Day, don't scrape away the protective layer of charred residue until moments before searing the next round of steaks. **Lose Weight, Save Gas** → Winter's over—time to lose the bag of rock salt and the chains in the trunk, and the aerodynamically disastrous ski rack on the roof.



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Happy Shrubs

Q About half the plants we put in the ground last year don't look very healthy. Many of them appear dead or severely winter damaged. Some came with a warranty. Others didn't. Looks like I'm out some cash and have to replant. Advice is welcome.

A It was a tough winter, but the good news is that correct care can help shrubs, trees and flowers bounce back and thrive in the growing season ahead. So don't be so fast to yank a shrub or young tree that doesn't seem to be shaping up. People have a powerful urge to plant in the spring and to put the winter behind them, especially if it was harsh. Many a plant that still had life in it has been tossed on the compost heap, where it has miraculously recovered from oblivion. Since in most parts of the country you can plant trees and shrubs well into the fall, give the plant a full season to recover. If the plant fails to put on green leaves or is dried out, brittle and obviously dead, then consider replacing it. But first, try a little judicious pruning to remove winter-damaged material. Also, get some local advice. Your best sources for this are the nursery from which you purchased the stock and a regional agricultural extension office. These folks know local growing conditions

better than anybody.

There are two other steps to take to aid in recovery. Apply fertilizer to help the plant heal damage and put on root growth. And prevent deer damage. Deer may have an entire forest at their disposal, but these mowers on hooves will



The \$10 Hole

→ When replacing winter-damaged plants or adding to your landscape, follow the advice of Connecticut landscape contractor Frank Gardner (really, that's his name). His motto: "Put a \$5 plant in a \$10 hole." In other words, your extra labor will be repaid with vigorous trees and shrubs.

1. Make the diameter of the hole two to three times that of the plant's root ball.
2. Dig the hole just deep enough that the plant rests on undisturbed soil and its root flare (the point at which the stem flares out to meet the roots) won't be covered.
3. Cut away all wrapping twine, wire or cord holding the planting container to the root ball.
4. Sever roots that have wound themselves around the root ball.
5. Place the plant gently in the hole so the root ball does not break away or crack open.
6. Backfill the hole to about halfway and moisten the backfilled material, then finish backfilling. Water again so the plant is resting in consistently moist soil.
7. Use mulch to suppress weed growth and hold in moisture, but do not mulch over the root flare.



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prefer your plants' tender growth. Take it from me: Few things will inflame anti-deer anger more than rescuing a plant only to see its new growth gnawed off. There are lots of foul-smelling spray-applied deer repellents available; I don't need to list them. They work, but if the shrubs are small, you can just as simply block access to the plant with wire mesh. Green plastic mesh also works and is less visible. The more quickly you can get a plant to turn around and thrive this spring and summer, the more likely it can withstand next winter's wrath.

SHOP WISDOM
Dry Compressed Air

I'm getting water vapor in my compressed-air system on humid days. I have three filter/dryers in the air line, and I'm considering a refrigerated air dryer. Will this work?

→ First, look at compressed-air basics to solve the problem.

"One of the most common mistakes that people make is to place the filter/dryer too close to the compressor," according to Gary Burke in the technical service department of DeVilbiss, a maker of compressed-air equipment in Glendale Heights, Ill. The first filter/dryer shouldn't be closer than 25 feet from the compressor. This allows the air to cool and the vapor to condense.

Burke recommends that the main air line should slope back to the compressor to allow

condensation to drain and the filter/dryers should be regularly serviced. He also warns to be on the lookout for oil in the air stream. If the compressor is pumping oil into the system, it will quickly overload the filter media. The moisture will bypass the filter/dryer and move downstream to the air tool. A good tutorial on air-system basics is the "ABCs of Spray Finishing" PDF at the DeVilbiss website.

There's more to a refrigerated dryer than meets the eye. "There are refrigerated dryers that can handle high-temperature air directly from the compressor, but most can't," says Ernie Hughes, service manager for Taylor Air Center in Whitehall, Pa. They need an after-cooler on the compressor, he says, to reduce air temperature from 200 F to a range of 120 to 140 F.

Gone Fishing

I need to fish some RG6 cable through an exterior wall. Is there any problem with fishing cable through a wall with insulation?

Not at all. Phone company and cable TV technicians do it all the time, as do electricians. Having said that, there's obviously a risk that you can get the cable hung up in the insulation, but you can avoid hang-ups (as well as minimize damage to the insulation and its vapor barrier) by using a few simple tricks.

First, start with the hole you're cutting in the drywall. To avoid making a mess out of the insulation, I mark out the box or bracket location and gently cut through the drywall with a hole saw chucked in a cordless drill. With a light touch, it's amazing how well this works. You can cut out a clean little disc of drywall and leave the insulation and even the vapor barrier virtually unscathed. Depending on whether you're cutting in for a box or a mounting bracket, you can gently saw away remaining drywall and remove insulation as needed or simply push the insulation to one side.

What you do next depends on how far you have to fish the cable. For a truly short run, the cheapest and best fishing tool is a piece of wire coat hanger. It works beautifully. Pre-bend the hanger to the desired shape and gently slip it between the drywall and the insulation. For fishing longer runs of cables, you can use any number of tools and materials.

My brother-in-law Mike, a data-communications technician in Texas, has nearly 40 years' experience doing this work. The guy's an artist; he can fish a long run of cable in the time it takes me to get my tools ready. He bores a hole, slips a thin and flexible pine slat into it and uses the slat like an oversize tongue depressor. He gently pushes back the insulation, and once he has a cavity established, he drops a heavy fishing weight tied to a piece of string into the wall. The weight is usually enough to take the line down to where he meets up with the cable he's going to pull.

There are still other tricks. Some electricians use a tool called a fishing stick, a slim fiberglass pole that can work its way through insulated cavities more effectively than a steel fish tape.

Barking Up the Wrong Idea

I'm going to put down new pressure-treated planks on my deck this spring. Does it matter which side of the board faces up?

This is known as the bark-side-up or bark-side-down argument. Deck boards are usually flat-sawn. One wide face of the board corresponds to the bark side of the log while the opposite face corresponds to the log's interior. Typically, such a board will dry out and cup across its width. Theoretically, the upward face of the cup (the concave face) will be toward the bark side of the log. Placing the deck plank bark side down means that the cup would face downward. This would look nicer and aid in shedding moisture. It would also prevent tripping hazards.

Now the reality. A piece of lumber may behave just the opposite of what is described above, owing to its moisture content, internal stresses and the kind of conditions it sees once it's installed. Many times, all the deck planks will cup upward so they hold water, regardless

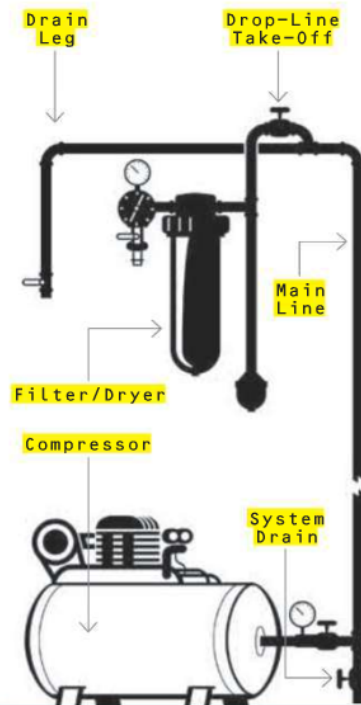


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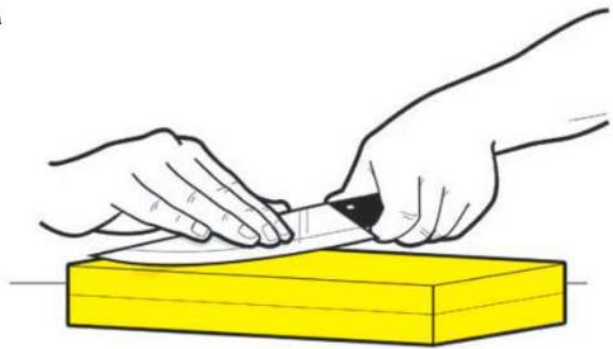
"I'm surprised people are still asking about it," says Paul Fisetto, a professor at the University of Massachusetts-Amherst, who has written widely on building materials and construction technology. "I thought it was settled long ago."

Consider, he says, that if the deck is built close to the ground, its bottom face will experience higher relative humidity compared to the top during much of the year. This will cause the planks to cup opposite the direction you would normally expect.

"Pick the best-looking surface," Fisetto says, "and install that faceup." Case closed.

Sharp Idea

I tried to sharpen my wife's new kitchen knives and I'm not having much luck. The old ones were easy. Is it me or the knives?



VARY THE EDGE

People often try to put a very fine edge on kitchen knives, almost as if they were sharpening a woodworking tool. Experiment with the edge angle. Sometimes a less acute edge makes a knife cut better and hold its edge longer.

Some kitchen knives refuse to take a sharp edge because their stainless steel is relatively poor quality or the steel is good but its heat treatment was incorrect. After their factory-ground edge has been dulled, they're almost useless. Also, some very expensive knives are made from alloys, such as chrome vanadium, that are more difficult to sharpen compared to older carbon steels. Once you learn to sharpen these, though, they will take a good edge and hold it well.

Try a couple of things. First, if you're using sharpening stones, try putting a slightly different angle on the edge. Experiment and see if a finer or a more blunt angle makes a difference. Most people start out trying to put as fine an edge on a knife as they can, so it's counterintuitive that a broader angle might actually improve cutting performance. It's not whether the knife will

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slice through a sheet of paper or shave hair off your forearm or a sliver off your thumbnail. Kitchen knives are used to cut meat and vegetables, and sometimes you just have to try different edge angles until you get something that works better.

Now might also be the time to switch your sharpening gear, especially if you're currently using dirty old sharpening stones. Try a small manual or motorized knife sharpener. I've had excellent results with EdgeCraft sharpeners over the years. When I don't use those, I use a set of water stones from Norton Abrasives. These will put an edge on nearly anything, and since they use water (not oil) as the cutting lubricant, they eliminate the risk of leaving behind petroleum oil residue on your kitchen cutlery.

Mission Possible

My California mission-style house has a problem with its stucco. I applied a masonry paint to it a few years ago and it looked great for a couple of years, but now the paint is bubbling off and there's this sandy stuff under the bubbles. The house is 25 years old.

I'm willing to bet there's a moisture problem somewhere. The telltale sign is the sandy stuff that you're finding beneath the paint blisters. Here's the failure mechanism: Water is getting through a crack in the stucco or is coming in from a roof leak, a flashing leak at a sidewall or chimney, a plumbing leak, a worn-out window or from some exterior change (such as a badly installed garden-hose rack). Water that gets into a wall will find its way out, either through the outside surface or the inside. In this case, the water is evaporating and the vapor is what's lifting the paint. After the moisture evaporates, it leaves behind the salts it

leached out of the masonry. That's the sandy substance you're finding below the blisters. The process itself and the powdery residue are both known as efflorescence.

To solve the problem, I'd start snooping around. Inspecting the attic can help pinpoint leaks through the roof or flashing (such as where a chimney meets a house). Inspecting for damp areas around windows and doors can help you find leaks there. Even hairline cracks through the stucco need to be carefully inspected. Musty odors from areas

along walls, inside a bathroom vanity, under the kitchen sink or in a basement or crawlspace may well indicate a plumbing leak.

There's one other aspect to my theory—a cause that's water-related but is not a leak. The same sort of paint blistering and failure can occur where a sprinkler strikes the side wall of a house. Repeated wetting of the surface from a sprinkler will be obvious. The blisters will be low on the wall and grouped in the area where the sprinkler strikes. Redirect the sprinkler head. **PM**

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

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



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Bad to the Bone

ADDING AN IPOD OR MP3-PLAYER CONNECTION
TO YOUR EXISTING CAR STEREO IS SURPRISINGLY EASY.

BY MIKE ALLEN

➔ **Broadcast radio stinks.** And that's a bummer if your commute is like mine. As I navigate two states, I pass plenty of hissing, buzzing power lines and a couple of Faraday-cage tunnels while listening to the same

commercials over and over again. The interference, constant dropouts and yet more ads for hair-restoration products and male enhancement are enough to make you want to stick your fingers in your ears and hum. Unfortunately, my family car is old enough that the optional iPod dock wasn't an option. Man does not live

INSIDE



ROCK OUT + CLEAN HANDS + STUCK SCREWS

solely on a steady diet of NPR, hip-hop and treacly pop music chosen by programmers at commercial radio stations. Thankfully, there's another option.

Have It Your Way

➔ **You can always** go to the local car-stereo joint for a new, iPod-ready car stereo, or (gasp) the car dealer and have your relatively new car retrofitted. Bring lots of money, though. Here's how it worked out for our donor 2008 Volkswagen, for which a dealer-installed iPod/MP3 dock is available, sanctioned by VW (and consequently included in the factory warranty). The dock, when installed by a dealership technician before you take delivery of the vehicle, runs \$199, or at least that's what this dealership was asking.

Like most things associated with buying a new car, it's negotiable. Drive the car off the lot and return a few weeks or years later and the price—for the exact components installed by the same technician—magically jumps to \$300. The factory warranty may or may not apply. A car-stereo shop would probably charge in the same vicinity as the dealer, around \$300, including labor.

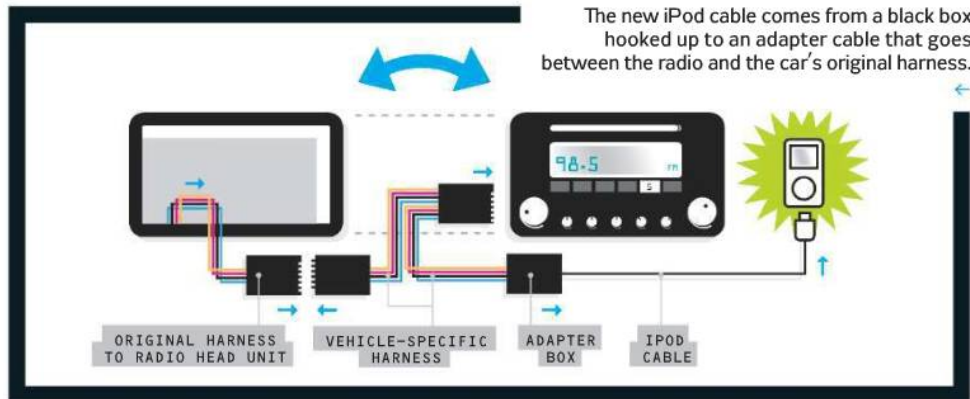
We knew our car was upgradable but had no interest in spending dealer prices. (And besides: We're Saturday Mechanics.) It turns out that there are many sources for player-connecting hardware. The Internet is your friend, so research what you need and what you can get thoroughly before whipping out the Visa. A good place for advice about your car is the enthusiast websites specific to your brand and model.

The cost of our parts from *pac-audio.com*: 20 bucks for the vehicle-specific wiring harness, and an additional \$170 for the iPod/MP3/line-level input adapter. This black box gives you full transparency on the iPod—you can see

Then we unscrewed a couple of Torx fasteners and pulled the radio straight out of the dash. Pull the multiprong connector free from the radio back. Sister the aftermarket harness in between the OEM connector and the radio.

the track information on the radio display and can control virtually all of the iPod functions from the dash- or steering-wheel-mounted radio controls. It also charges the iPod. This means you can leave the iPod buried in the glovebox or console more or less permanently but still have access to it for out-of-car excursions or for loading more songs. You can also plug in another non-iPod music source and play it through the radio by using the adapter's 3.5-mm line-level input. That includes HD radio adapters, satellite radio receivers or some non-iPod audio such as a generic MP3 player or even a DVD player or video game.

The new iPod cable comes from a black box hooked up to an adapter cable that goes between the radio and the car's original harness.

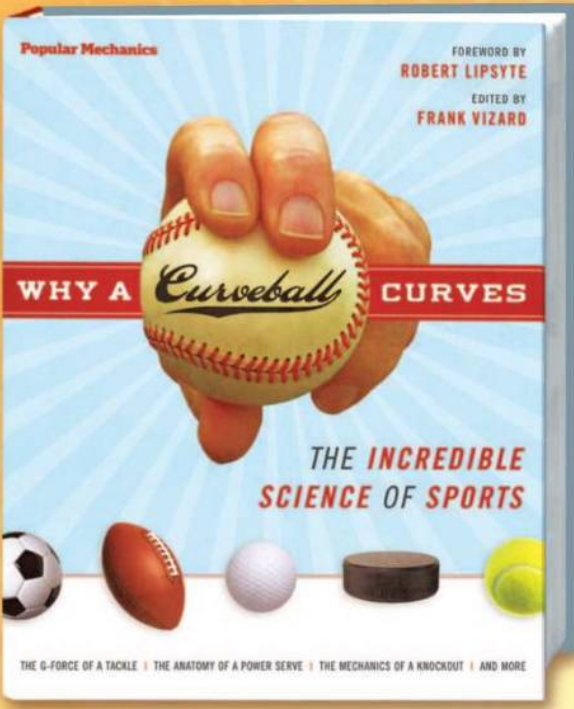


We started by removing some trim on top of the dash panel and then the trim ring around the radio.



Or Maybe Not

➔ **Not all car stereo systems** are upgradable. Older vehicles, ones that were manufactured before satellite radio, navigation systems and MP3 players, may very well not be set up for any auxiliary inputs at all. Your only option for many of these vehicles is to replace the entire stereo with an upgrade unit that has all the appropriate plugs on the back. How about one of those FM modulators? Nah, the audio quality is too poor for serious audiophiles, and there are too many



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wires in a cockpit already strung with cellphones and on-dash GPS.

Things to Watch For

→ **Dismantling automotive** instrument panels is not a task for impatient, hamfisted or uninvolved individuals. There's the chance your dash panel may sustain damage if you try to pry up something not meant to be pried up. No problem, you say: The service manual you cleverly purchased years ago will unlock all the secrets, allowing you to dismantle and remantle the trim in minutes.

Wrong. Most service manuals have little information on trim removal, which is just another obstacle for a real Saturday Mechanic to overcome. We did our due diligence and discovered that YouTube is a huge resource, with several videos detailing how to dig into the VW we were modifying. Similar videos are posted for most vehicles.

Another caveat: Be sure you have the reset code for your stereo. Many head-end units require that an antitheft code be entered into the radio anytime the power to it is interrupted. The code should have been supplied to you when you bought the car or when any aftermarket radio was installed. If you don't have this code, you'll need to get it from the dealer, who will probably try to get you to pay the minimum shop charge to have a mechanic enter it for you. Good-bye, \$50. Keep the card with the code on it somewhere besides the glovebox. Thieves interested in boosting radios have learned to rifle this first. If they don't find the code, they won't bother with the radio. We suggest keeping a copy at home, not in the car.

The Easy Way Out

→ **We needed to** dismantle a lot of trim on this VW to pull the radio loose

far enough to get to the cabling. You may be able to access these delicate underpinnings without such invasive surgery. If you're lucky and your car has no center console, a deep dive underneath the dash may uncover sufficient access. Alternatively, removing the glovebox door and/or the glovebox itself may give you access. Many glovebox doors are removed without any tools. Simply pinch the sides together and swing the door farther than normal. Then unhook it from the hinge. Surprise, the shop manual usually doesn't bother to detail how to do this.

The specifics of where to route wires on any given car are highly variable. But there are a few constants.

→ Don't route wires or cables over sharp edges of sheet metal or even plastic panels. Eventually, the insulation will wear, shorting out the wiring. A handful of grommets, cable ties and some kinky cable protectors costs only a few bucks.

→ Leave a couple of inches of slack near every hard point. Cars vibrate, and eventually a tightly pulled cable will break invisibly inside the insulation.

→ Keep wires away from any air conditioning/heating bellcranks or actuators; see above for why. Inadvertently cable-tying a cable to the HVAC pieces will cause erratic climate control and eventually make the cable fail.

→ The safest place to route cables is right next to existing cables, which should be obvious if you think about it.

→ You'll find No. 1 and No. 2 Phillips, assorted sizes of Torx fasteners, Allen heads and even the odd hex screw securing parts of the interior and dashboard. Trying to get by using the wrong style or size of tool is asking for big scratches on your fragile vinyl or leather interior. Don't ask how we know this.

→ Keep track of which fastener goes where. I use a piece of corrugated cardboard and screw the bolts into it in positions corresponding to the fastener. Sometimes it helps to draw a little diagram to keep them all straight. One common danger is installing a bolt or screw that is longer than the original and shorting out hidden wiring.

When you button everything up and verify that it's all working peachy, use some protectant and polish your fingerprints off the dashboard. **PM**



A pigtail of wires will lead from this harness to the iPod adapter itself.



The adapter box can be mounted anywhere underdash and out of the way. We velcroed it inside the console, under a piece of trim we could access readily. We drilled a small hole into the bin under the armrest and snaked the cable forward, under the trim, to the adapter box. Last step was to adjust the DIP switches (small red panel) to match the brand and model of radio in the car.



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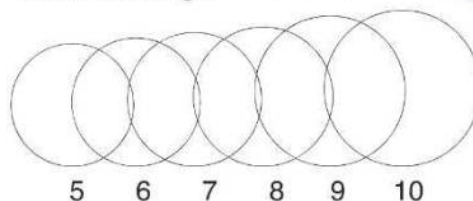
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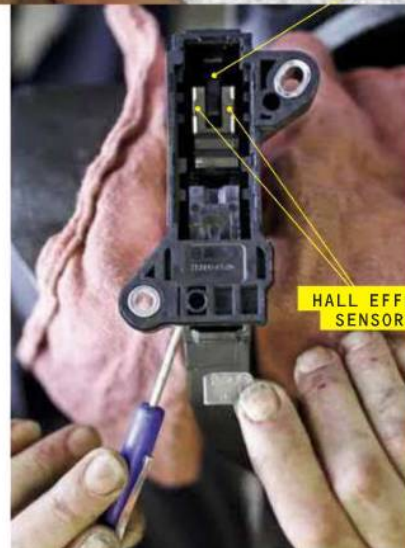
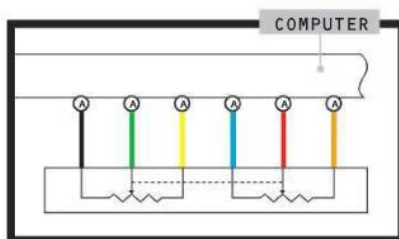
MAGNET

Toyota's Woes

Q What's the real problem behind Toyotas' unintended acceleration? Is it simply a sticky pedal, or is the trouble more fundamental? Is it electromagnetic interference that's causing the runaways, not the floor mats and sticky pedals that Toyota is blaming to cover up the problem?

A Toyota has recalled millions of cars and trucks—4.2 million—to replace floor mats that might impede throttle-pedal travel, and 2.4 million to install a shim behind the electronic pedal assembly. All of the affected pedal assemblies were made by Canadian supplier CTS. Toyota's boffins have documented a problem that can make a few of these pedals slow to return, and maybe even stick down. Problem solved.

But the media and Congress—and personal-injury lawyers—smell the blood in the water. Not to diminish the injuries and a few deaths attributable to these very real mechanical problems, but they're statistically only a very small blip, which may explain why Toyota took so long to identify the issue, especially when it has symptoms similar to the similarly documented floor mat recall. Plus, sudden unintended acceleration



HALL EFFECT SENSORS

(SUA) is notoriously difficult to diagnose because, more often than not, the problem can't be repeated in front of a mechanic. Let's not forget the Audi SUA episode back in the '80s: The National Highway Traffic Safety Administration eventually concluded that there was no mechanical problem. The culprit, as hard as this is to admit, was most likely driver error. To put the issue into context, in the last decade, there were

about 24,000 customer complaints about SUA, involving almost every major automaker. The NHTSA investigated fewer than 50.

The issue now is whether there's a more insidious problem unrelated to the two recalls already extant. Specifically, whether there's some design flaw in the concept of electronic throttle control. Some are questioning whether electromagnetic interference from



← This Toyota brake pedal assembly has been shown to become sticky, an issue that resulted in some 2.5 million cars being recalled for repairs. But some instances of sudden unintended acceleration are being blamed on a more abstract problem, the potential for electromagnetic interference (EMI) to interfere in the signals between the pedal-position sender and the computer, causing the throttle to open unexpectedly.

devices like cellphones could be contributing to the acceleration problems.

It used to be that there was a steel cable that ran from the pedal itself through the firewall and attached to the throttle blades that admitted air to the intake manifold. A sticking throttle could be the result of friction anywhere—in the pedal pivot, between the cable itself and its nylon-lined sheath, or in the carburetor or fuel-injection throttle blades. (Does anybody remember carburetors?) Modern cars, which make up the majority on the market today, use a throttle-pedal assembly that is connected to the engine only electronically. Signals are carried over wires to the engine computer, which in turn sends commands to the stepper motor that operates the throttle blades.

Sounds like there are plenty of places for gremlins to seize control of the works, right? And that's where pundits who don't really understand the architecture of throttle-by-wire systems go wrong. It's all in the engineering.

Let's start at the bottom of it all—your foot, which moves the pedal fore and aft in relation to the firewall. Inside

the pedal assembly is a spring to make it return as you lift off, a device to add a little friction that dampens the movement (your foot would tire in short order if there wasn't some damping) and a transducer of some sort that turns the movement of the pedal into an electrical signal. That transducer is a simple device, invented in 1879 by Edwin Hall (not 1979; 1879). It consists of only a single slab of conductor with a few wires attached to its edge, one on each end and one in the middle. With a voltage applied to the end wires, it acts as a voltage divider. Placing a magnet near the sensor moves the magnetic lines of flux, which literally pushes the electrons away from the electrodes and changes the voltage at the center wire. The magnet, in the Toyota case, is on the pedal arm. As the pedal moves, it alters the voltage at the semiconductor, and that's how the engine computer knows the position of the pedal. The benefit of Hall-effect sensors is that there's no mechanical connection to corrode and no internal resistance, and other electronics, such as amplifiers, aren't needed. You could make one on your kitchen table with a refrigerator magnet and some doorbell wire.

There are two discrete Hall-effect sensors in the Toyota/CTS pedal, which is common industry practice. Just to make sure the sensors aren't confused, they run on totally separate circuits back to the ECM, three wires each. They don't even share an electrical ground. Like many onboard automobile sensors, they are also completely isolated from the vehicle ground. To reduce the potential for interference or mistakes, they operate at different voltages. The first sensor, known as ACCEL POS #1, has a nominal voltage range from 0.5 volts to 1.1 volts at idle and 2.5 volts to 4.5 volts at wide-open throttle (WOT). The second sensor, ACCEL POS #2, delivers from 1.2 volts to 2.0 volts at idle and 3.4 volts to 5.0 volts at WOT. Why such a wide range of permissible voltages? The engine computer (ECM) recalibrates the sensor regularly, every time you start the car, and the ECM goes through its power-on self-test.

Both accelerator-pedal-position Hall-effect sensors have to agree fairly

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closely, or the ECM will go into its limp-home mode, which turns on the Check Engine light and sets a trouble code.

There's more. If Toyota's engine-management scheme is anything like that of most other car companies, firmware inside the ECM also monitors the airflow into the engine, the throttle blade position and engine rpm, and calculates backwards to what the throttle pedal position should be. Any discrepancy, and a trouble code is set, the Check Engine light on the dash goes on, and you're dialing the service manager to make an appointment.

Bottom line: The system is not only redundant, it's double-redundant. The signal lines from the pedal to the ECM are isolated. The voltages used in the system are DC voltages—any RF voltages introduced into the system by, say, that microwave oven you have in the passenger seat, would be AC voltages, which the ECM's conditioned inputs would simply ignore. Neither your cell-phone nor Johnny's PlayStation have the power to induce much confusion into the system.

Throttle-by-wire systems are very difficult to confuse—they're designed to be robust, and any conceivable failure is engineered to command not an open throttle but an error message.

So what to make of the unintended-acceleration cases popping up by the dozens? Not the ones explainable by problem sticky pedals, but the ones documented by people who claim their vehicle ran away on its own, with no input, and resisted all attempts to stop it. Some can probably be explained as an attempt to get rid of a car consumers no longer desire. Some are probably the result of Audi 5000 Syndrome, where drivers simply lost track of their feet and depressed the gas instead of the brake. It's happened to me: Luckily I recognized my mistake and corrected before it went bang. Others may not have the presence of mind.

But the possibility that a vehicle could go from idling at a traffic light to terrific, uncalled-for and uncontrollable acceleration because the guy next to

you at a traffic light answered his cell-phone? Or some ghost in the machine or a hacker caused a software glitch that made your car run away and the brakes suddenly simultaneously fail? Not in the least bit likely. Toyota deserves a better deal than the media and Congress are giving it.

Don't Cross This Guy

When I changed the oil and filter on my 1997 Crown Victoria, I had more than the usual devil of a time extricating the old filter from the tangle of the steering linkage. Inserting a new filter was also grueling—finally, when I began to screw the filter on, the first

two or three turns went normally, but then the thing bound up as if I had cross-threaded it. I leaked 9 quarts of oil onto the garage floor, one at a time, as I started the engine and watched the oil trickle out. I kept tightening the filter with a wrench until it finally sealed. How do I tackle the next oil change without risking complete failure, a tow to get the car to a repair shop and a major repair expense?

Good news: Ford's service manual says it's less than an hour's labor to replace the entire oil filter adapter bolted to the side of the engine block. Bad news: The part is \$126 (ouch), but (good news) it may be that only the 22-mm threaded portion of the adapter is damaged. Bad news: Good luck finding the 22-mm pipe nipple that screws into the adapter without buying the whole thing. But: Are

TOOL TECHNIQUES

Impact Drivers Demystified



Stuck fasteners are a mechanic's worst nightmare. Nothing's more infuriating than spending an entire afternoon trying to remove a single Phillips head.

Immovable hex bolts are tough enough—but Phillips-head screws are way too easy to strip. Most of the effort goes into trying to keep the screwdriver seated in the head. Tapping the screwdriver handle will help seat the bit, but it will still cam out if you twist hard enough. And there's a chance the blows could break the handle in your hands.

The best way is to use a handheld impact driver. This tool has internal cams that spin the bit

when you whack the handle with a hammer. Start by engaging the driver's bit to the screw. Firmly tap the end a few times to seat the bit. Then slowly rotate the handle in the direction you want to move the screw—in this case counter-clockwise—until it stops. Now carefully hold the handle and strike it hard. The device rotates the screw while the hammer blow keeps the bit seated. The impact also loosens up any crud cementing the fastener. Alternate loosening with tightening, and eventually almost any Phillips screw will budge.

Unfortunately, this will only work on 6-mm or smaller fasteners.

we sure the thing is actually cross-threaded? My first insight to share is that the filter you installed may actually have 7/8-inch threads, not the 22-mm threads called for. Both dimensions are common on oil filters. For instance, the same engine installed in a Mitsubishi product has 22-mm threads, but uses 7/8-inch threads when installed in a Chrysler vehicle, even though the engines came down the same assembly line. Your filter may have been misboxed or improperly cross-referenced. The two different thread pitches are close enough that the filter would spin on for two or three turns before binding up. And if so, it just may spin off without damaging the male threads on the adapter. Bad news: It probably won't. The other possibility, and a pretty good one, is that the old filter's sealing O-ring stuck to the adapter on the car when you changed the filter, instead of spinning off with the old filter. When you installed the new filter, the new O-ring stacked up on top of the old one, and I happen to know that this feels a lot like a cross-threaded filter (don't ask). Usually, no amount of extra torque will make these not leak, but I suppose if you tighten it enough ...

Regardless, eventually you've gotta unscrew the old filter. I'd have a replacement filter adapter, the appropriate gaskets and a new filter and oil available. You may be able to keep the filter adapter on hand and return it if you don't need it. Oh yeah, the filter adapter has a coolant line to it, so be prepared to drain the coolant out of the system and top off if you remove it.

Three Bags Full

A couple of days ago we were driving about 30 mph when a pickup ran a stop sign and hit my car on the driver-side front corner. My car was totaled, but neither the front nor side

curtain airbags deployed. I had my seatbelt on and was not injured other than a cut on my head where I hit the side, and my chest is very sore from the shoulder belt, but isn't this what airbags are for? I realize airbags have their own hazards, but I was very surprised they did not deploy.

You are correct; an airbag inflates violently enough that you really don't want them to do so unless there's real benefit. Aside from the extremely loud noise (which can damage your hearing), there's the potential for the airbag itself to injure occupants, particularly ones who aren't sitting straight up and alert like a crash-test dummy. Not to mention that if they deploy during an accident, they'll already be deflated if there's a secondary collision, with a second vehicle or a stationary object. Oblique impacts, like yours, don't transfer energy to the vehicle's airbag sensors (or to you and your passengers) as profoundly as perpendicular or frontal impacts. Much of the energy turns into angular momentum and makes the car spin, instead of straight-line deceleration.

Because you say you weren't seriously injured, I'd say your airbag system was operating as designed. Count your blessings.

Dirty Boy

What's the best, cheapest way for a car mechanic to degrease his hands? My son's hands are so deeply imbedded with grease. He is an automotive technician and works in this stuff every day. Can you advise?

The first line of defense is gloves, obviously. There's a secondary consideration: The lubricants and solvents used on cars and trucks may contain traces of benzene or other toxins. Inhaling this stuff is sometimes unavoidable, but absorbing it through your skin usually is. I use urethane gloves, which last a lot longer than latex-based ones.

One trick: Use one of those lanolin-based hand cleaners like GoJo first thing in the morning, before starting in the shop. That way, nice, clean lanolin soaks into your pores, preventing your skin from soaking up stuff like that black molysulfide grease they use for CV joints.

PM

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.



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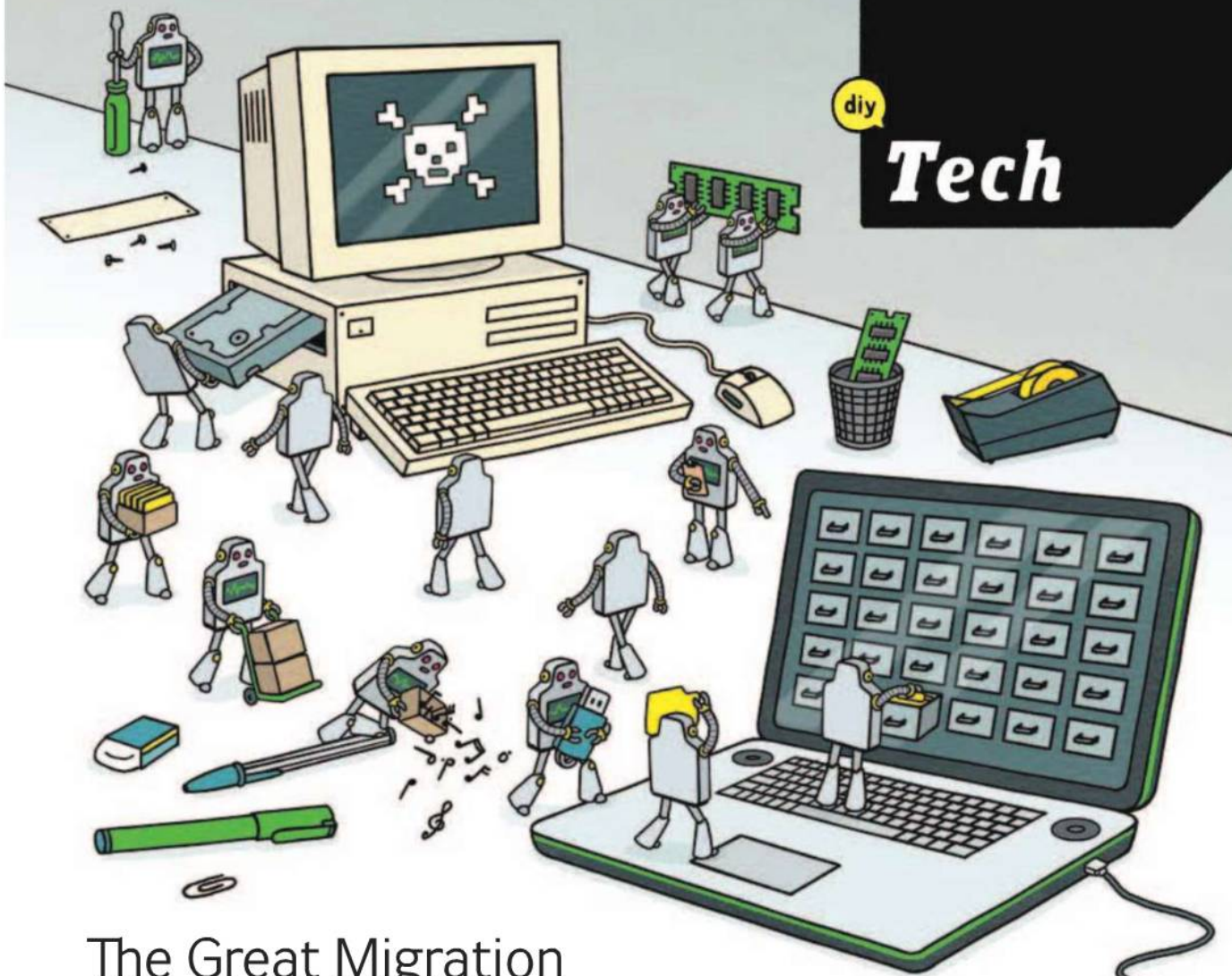


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Tech



The Great Migration

MOVING FROM AN OLD COMPUTER TO A NEW ONE TAKES ORGANIZATION, PATIENCE AND A GOOD STRATEGY. HERE'S HOW TO DO IT RIGHT. BY ANTHONY VERDUCCI

➔ **Windows Vista was**, if anything, an excellent excuse to hold on to an old computer. Microsoft's last-generation operating system was so widely ridiculed that a whole generation of PCs running the previous OS, Windows XP, was kept in service long after the hardware had become creaky and outmoded. That has largely changed with Windows 7—a system that, although not a complete reinven-

tion of Vista, is a vast improvement in terms of performance, reliability and usability. In fact, the past year has brought us new operating systems from both Apple and Microsoft. Apple's new version of OS X, Snow Leopard, along with a host of updated desktops and laptops, has introduced plenty of innovation to the Mac platform, as well.

So now is a natural time to think of

INSIDE

✕ 3D TVS + GOOGLE CALLS + XBOX BLACKOUTS

upgrading to a new computer. But if it's been four years or more since the last time you migrated from one computer to another, you'll find that the logistics of moving have become far more complicated. The days of throwing all of your files on a floppy disc or even burning them to a CD are over.

Computers are now often our main repository of music, photos and even movies—which have both sentimental and real monetary value that may exceed that of the computer itself. That means that one's personal files may amount to a multi-gigabyte transfer that requires both capacity and organization. Plus, the longer you've waited since your last computer upgrade, the higher the chances that software

you've grown accustomed to may not transfer at all.

Whatever your situation, make sure to allot a decent amount of time to the process (it can eat up a full weekend). Our own POPULAR MECHANICS assistant editor Erin McCarthy recently switched from a three-year-old Dell laptop running Windows XP to a new Intel-based MacBook running OS X Snow Leopard. She's impressed by the performance of her new laptop. "It's so much faster than my old computer," she says. But she was also humbled by the work involved in the data transfer from her old PC. "The amount of time it took to get everything the way I like it was ridiculous," she recalls. "But I wasn't going to let the machine win."

Step 1: Get Organized

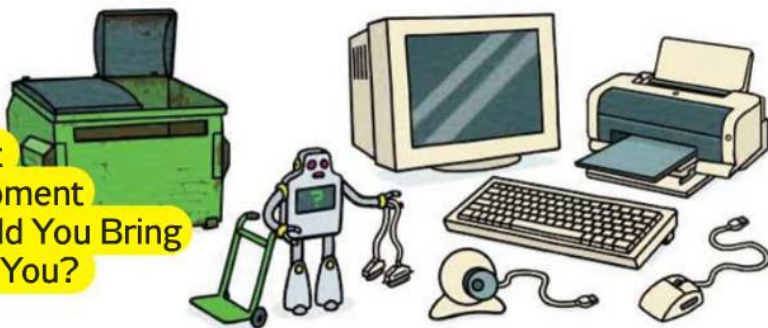
➔ **Think of moving** to a new computer like moving to a new house. First figure out how much stuff you're taking with you (2 GB? 10 GB? 100 GB?). Then box it up logically (photos, music, documents, videos). Finally, determine what type of moving equipment (DVDs, memory keys, external hard drives) you'll need. A network attached storage (NAS) drive can make the process easier, as it can serve as a waypoint between your old PC and your new one.

You may have kept your files well organized (or not), but even if you think you know where most of the files on your old computer are, use the search tool built into your OS (in Windows XP, it's called Search Companion; in the Mac OS, it's referred to as Spotlight) and look for files by type and/or extension: photos (.jpg, .jpeg, .bmp, .raw, .gif); documents (.doc, .docx, .txt, .rtf, .pages); music (.mp3, .wav, .aac, .m4p, .m4u); and movies (.avi, .mov, .mp4, .wmv). Many of the files you find will be sample files that came with the OS or other programs, but you may also discover a hidden repository of forgotten gems.

Speaking of things you might forget, don't overlook the browser bookmarks, iTunes playlists, passwords, software preferences and printer and network settings that made your personal computer personal to you. Some of these can be easily exported. (Firefox, for example, allows you to make a transferable bookmark backup file.) For other things, such as program settings, it may be necessary to take an old-fashioned paper and pencil and browse through the various menus in each program's preferences section, taking notes on how you set it up.

If you'd rather save time and pay to migrate the simple way, then it's worth considering solutions such as Belkin's Easy Transfer Cable (\$40), which uses software to find and move all media files, documents and settings over a special USB cable. Macs make the moving process a bit easier with OS X's built-in Migration Assistant, which moves most of the data and settings from an old to a new Mac via FireWire. For converts moving from a PC to a Mac platform, Apple offers data-migration services at the company's in-store

What Equipment Should You Bring With You?



→ SCREEN

KEEP IT: Even if your new computer comes with a screen, an extra LCD can create a dual-monitor setup.
DITCH IT: An older CRT monitor is probably not worth the trouble.

→ CABLES

KEEP IT: Any USB, SATA, DVI and even power cables can be handy as spare parts.
DITCH IT: Really old wires, such as serial cables and parallel printer cables, are now officially outdated. Throw 'em out.

→ PRINTER

KEEP IT: Inkjet tech hasn't advanced much in the past few years, so if your printer's not too old (i.e., if it has a USB connection), it's fine.
DITCH IT: On the other hand, printers are cheap. If yours is acting creaky and is almost out of ink (ink's the expensive stuff), it might be time for an upgrade.

→ MOUSE AND KEYBOARD

KEEP IT: If your new computer is a laptop, it's always good to have a

full-size keyboard and mouse around for desktop duty.
DITCH IT: Older mice and keyboards use an antiquated PS/2 connection standard. If they're not wireless or USB, toss 'em.

→ WEBCAM

KEEP IT: If you've recently bought a USB webcam, it should work on your new PC.
DITCH IT: Many new computers have webcams built in, so you might want to post your old one on eBay.

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Genius Bars as part of its \$99 One to One service. If you'd rather not leave your personal files in the hands of Apple's geniuses, try Move2Mac (\$40) software by Detto Technologies, which automatically transfers files over a network or via external drive. For those migrating from Mac to PC, there really aren't a lot of third-party solutions—which maybe tells you something.

Step 2: Sort Out Software

➔ **Software presents** a different challenge. Any software that you have purchased or downloaded for your old computer will have to be reinstalled on your new machine. Some software will need to be deactivated from your old computer before you install it on your new one. (Some programs, such as iTunes, must be deactivated from within the software; others, such as Microsoft Office, automatically deactivate when uninstalled.) Software that you paid for will probably require its activation code on reinstall, so hopefully you kept that—if you didn't, look around the program's About This Product menu, and the activation code may be there.

Keep this in mind as you switch: Many programs don't work across platforms (PC to Mac or vice versa), and it's more than likely that if you are jumping at least two generations of operating system (XP to Win 7 or OS X Tiger to Snow Leopard), the software you used on your old machine will either not work on your new one or will be so out of date it's worth considering an upgrade.

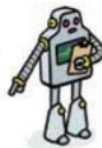
Another thing: Many new operating systems can be installed as 64-bit versions (older PC and Mac OSs were 32-bit), which allows computers to operate faster by processing larger chunks of data. Both Win 7 and OS X allow older 32-bit software to operate in a compatibility mode, but that can be a pretty glitchy proposition—and it doesn't mean that older 32-bit drivers for peripherals such as printers, scanners, etc., will continue to work.

Adding to the confusion, when you purchased your old machine, it most likely came bundled with OEM (original

equipment manufacturer) software. Computer builders have special deals to distribute software such as Microsoft Office and Roxio with new computers, but the licenses on such software don't necessarily allow you to reinstall it on a new computer when you upgrade. So as a general rule, if you never got an individual serial number for your pro-

PC Postmortem

DON'T JUST THROW AWAY YOUR OLD COMPUTER. **DISPOSE OF IT SECURELY AND RESPONSIBLY.**



➔ SCRUB YOUR HARD DRIVE

If the hard drive from your old machine isn't useful in your new one, make sure to get your personal data off before sending it to the great beyond. Formatting doesn't actually erase data; it simply reallocates space on the drive—so opt for a more secure data wipe with a true hard-drive eraser such as Active@ KillDisk (\$30).

➔ CONSIDER DONATING

Your computer may be too slow for your needs, but if it is less than five years old, it may still be useful to someone. Many local organiza-

tions refurbish old machines for schools and charities. Find one near you at techsoup.org/mar.

➔ OR AT LEAST RECYCLE

Even if your machine is too old to be useful to anyone, it still shouldn't go to the dump. Many computers—particularly older ones—contain lead, mercury and other environmental pollutants. Check the website of the manufacturer of your computer. Many PC makers will recycle your old computer for free. Likewise, many technology stores, such as Best Buy and Staples, will recycle your old electronics.

gram, it's probably not coming with you to your new computer.

After culling out all the programs that are either unlicensed or outdated, you might suddenly find yourself surprisingly softwareless. For some essential programs, the only reasonable option is to upgrade to the latest and greatest version. Subscription-based software, such as antivirus programs, can usually be installed on a new computer and activated from the same account. There is also a surprisingly sophisticated pool of free software worth considering, if only as a stopgap between purchases. For instance, OpenOffice and Google Docs offer no-cost alternatives to Microsoft Office and can save files in formats compatible with Word, Excel and PowerPoint. Plus, light photo editing can be handled by Google's Picasa software, while high-level photo manipulation can be done with the open-source GIMP software.



Step 3: Salvage Hardware

➔ **Once you've managed** to move all of your data and salvageable software from your older computer to your new one, it's worth giving the old machine a once-over to see what hardware you might be able to use with your new setup. It's a good bet that your RAM, power supply, graphics card and motherboard are obsolete—although you can try to sell them on eBay—but you might have a use for the optical drive and hard drive as alternates on your new machine. The optical drive can be useful in disc-to-disc copying, and the hard drive can be easily set up for external storage in an enclosure. (Make sure to purchase the correct enclosure for your hard drive. Older drives use IDE connectors; newer ones use SATA.) Even some wires and internal connectors can be useful as spare parts for your new computer.

One final note: If it hadn't already occurred to you, now's a good time to do a little housecleaning, sorting out the files, bookmarks and settings that you'd rather be rid of, and adding organization where it might have been lacking—it will seriously improve your experience on your new computer. **PM**

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Digital Clinic

by Seth Porges

Getting 3D TV

Q I've been hearing a lot about these new 3D HDTVs that are on the way. What sort of 3D content will there be for them to play?

A To take advantage of the new breed of 3D HDTVs hitting stores this summer, customers will have to make sure they possess a checklist of items. A 3D-ready TV? Check. Battery-powered shutter glasses? Check. Actual 3D content to watch on the new set? Uh, well, for most people I've spoken to, this is where it gets confusing. But it doesn't need to be—there are several different ways of bringing the third dimension to a 3D HDTV.

The best-quality 3D will come from the new 3D Blu-ray format that is being launched this summer. For A-list theatrical digital 3D movies—films like *Avatar*, *Coraline* and *Monsters vs. Aliens*—these discs are the way to go. The tricky part here is figuring out if your Blu-ray player can play these 3D discs. As of press time, only a handful of existing Blu-ray players (including the PlayStation 3) can handle 3D, and most of them will



require a firmware upgrade that is coming this summer. Don't have one of these players? You'll need to buy a new one to play 3D movies.

There's also a handful of new 3D cable and satellite stations in the works. DirecTV has announced plans to launch one for its subscribers sometime in the

coming year, and the Discovery Channel is teaming up with Sony and Imax for another. But the most important offering could be the one coming from ESPN, which has announced its intention to broadcast the 2010 World Cup live in 3D (although it's still unclear which cable and satellite providers will

tech

term



IPS
SCREEN

View an LCD screen straight on, and it'll look great. But look at the screen from an angle, and once-bright colors are likely to lose their luster. One tech for tackling this problem: IPS (it stands for "in-plane switching") LCD screens—a Hitachi-developed technology that has been around since 1996 but is gaining newfound prominence, thanks to its inclusion in the Apple iPad. These screens work by aligning their liquid crystals with the panel plane, instead of perpendicular to it. The result is a wider viewing angle with little to no color shifting.

actually carry these broadcasts). Hi-def sports broadcasts played no small part in the widespread adoption of HDTV, and the sports world could very well have a similar tipping-point effect on the spread of at-home 3D. This presents at least one potential problem—social gatherings for games might be hampered by the need for a large number of 3D glasses. And because universal standards on these glasses are still a work in progress, bringing your own set to a friend's house could be an exercise in futility.

One drawback to these live 3D broadcasts is that, unlike 3D Blu-rays, they aren't likely to be high-definition—at least not at first. That's because 3D stations require an enormous amount of bandwidth from the cable companies, and adding hi-def to the mix would just make the problem worse—particularly since these stations aren't likely to have very many viewers at first.

The third way of watching 3D TV: A few new HDTVs from companies such as Toshiba and Samsung will have the ability to transform 2D content into 3D live as it plays. However, because creating effective 3D shots is a skill that can't quite be automated (at least not yet), I expect this method to be less impressive than watching made-in-3D movies.

The fourth (and, for now, final) method of watching 3D is through a PC connected to your 3D HDTV. Computer software from companies such as DDD currently allows users to transform 2D DVDs into 3D, but these rarely look good. Some 3D video games, however, look spectacular, so we wouldn't be surprised if this avenue turns out to be of greatest interest to gamers.

Google Voice Work-Around

I heard that Apple blocked Google from releasing a Google Voice app for the iPhone. Is there any way to use Google Voice on my iPhone?

Last year, Apple made headlines for refusing to allow a Google Voice iPhone app into its App Store. For

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many observers, this was simply one small fracas in what is shaping up to be a clash between tech titans Apple and Google. But for iPhone users who depend on Google Voice's ability to selectively forward calls from a single number to multiple phones, it was positively annoying. The main problem: While Google Voice can still forward calls to an iPhone without a special app, not having one prevents your Google Voice number from automatically showing up on a recipient's caller ID. This can be problematic if your contacts only have your Google Voice number. (I can't tell you how many times friends of mine have let my calls go to voicemail simply because they didn't recognize my non-Google Voice phone number). Thankfully, Google just gave iPhone users a work-around. There is now a Web-based Google Voice app that users can use to access their Google contacts, make calls and send text messages. And the best part is that calls made through the app cause one's Google Voice number to show up on a caller ID. To access the Web app, use your iPhone's browser to go to google.com/voice.

Got a technology problem?

Ask **Seth** about it.

Send your questions to pmdigitalclinic@hearst.com or over Twitter at twitter.com/sethporges. While we cannot answer questions individually, problems of general interest will be discussed in the column.



Wrong Resolution

I have a 1080i TV and accidentally adjusted the resolution setting on my Xbox 360 to show the games in 1080p. When I did this, my screen went black. Without the ability to see what is going on, I can't adjust the resolution setting back to the proper setting. Is there any way to fix this?

If you set a TV-connected device, such as the Xbox 360, to play at a resolution that your display can't handle, it should go black for a second before automatically switching down to a compatible setting. Emphasis on "should." Sometimes, the device simply doesn't realize that it isn't working right. And without the ability to see what's on your TV, it's nearly impossible to fix the problem by digging into your settings menu.

Fortunately, Microsoft built its systems with a shortcut that allows users to reset the resolution without having to see the screen. To do this, remove any discs from the console and turn it off. Then restart the system and, as it starts up again, hold down the controller's right trigger button (the one on the top of the controller, labeled RT) and the Y button for about 15 seconds.

In the event that this doesn't work (I once came across a particularly problematic machine that seemed immune to this fix), call up Microsoft's tech-support line, and have the agent walk you through a "blind" setting change. They'll tell you exactly what buttons to press, and in what order, to sift through the menus and change the display resolution.

PM

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1. MICROSCOPE

Stenger analyzes a paint sample using Raman spectroscopy: A laser excites electrons in the material, which emit light at wavelengths that are shifted longer or shorter than the laser's, depending on the kinds of chemical bonds that are present. Stenger measures this shift to deduce what molecules are present—and thus, what pigments Rothko used.

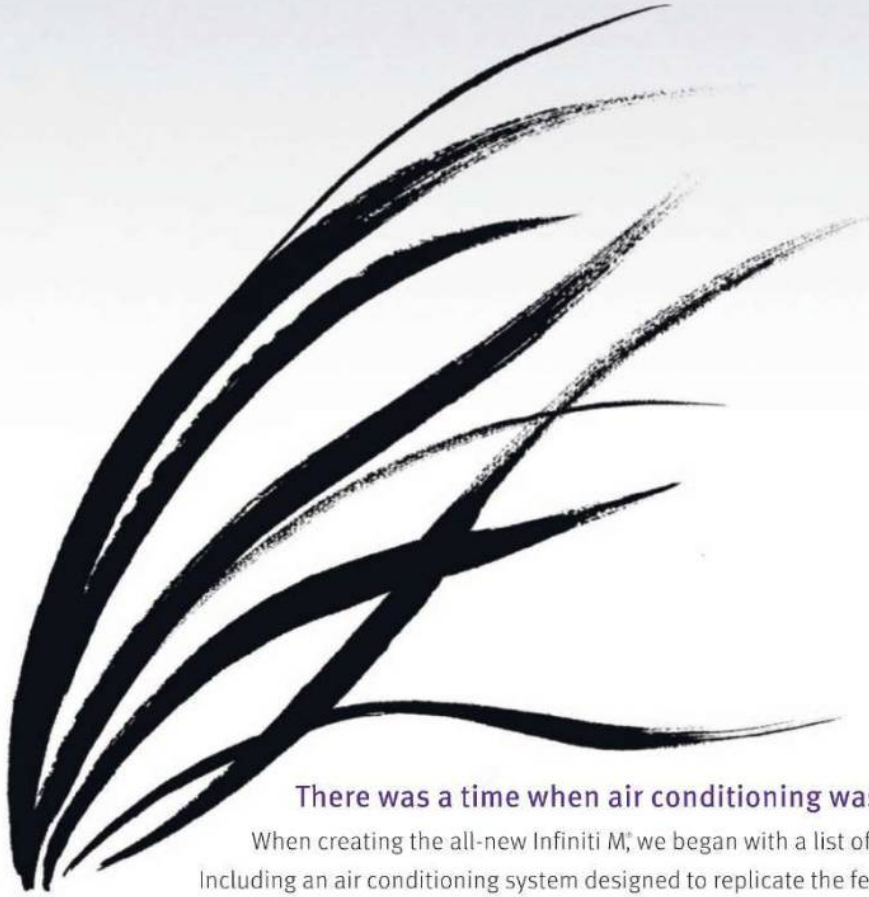
2. X-RAY SPECTROMETER

Stenger also examines the murals with a handheld X-ray fluorescent spectrometer. It identifies pigments with a specific elemental signature, but doesn't show what form they're in. "It would identify barium and sulfur," Stenger says, "but to confirm the presence of the compound barium sulfate, one would use Raman spectroscopy."

3. CAMERA

Because repainting the murals is a big no-no, Stenger wants to restore the color through light projection. After snapping a picture of the paintings, he'll use custom software to calculate the missing colors—so the Rothkos could go back on display with projectors overlaying those colors onto the canvases, making the works look like they did in 1962.

X When physicist Jens Stenger joined the Harvard Art Museum in 2004, the staff was consumed by a mystery—why was a set of murals, painted in the 1960s by artist Mark Rothko, changing color? Stenger's team determined that Rothko's homemade pigments and adhesives had chemically reacted with one another over the decades. Now, he's trying to restore the murals so future generations can enjoy them. In the past, some art restorers did more harm than good—even painting over an original artist's work—so Stenger will revitalize the murals with digital projection. "We want to exhibit the paintings again," he says. "We'll bring back the colors with a trick."
— ANDREW MOSEMAN



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1 – Based on third-party wet braking test results versus the Goodyear® Assurance® ComforTred® product line in wet testing. 2 – Based on third-party wear test results versus Goodyear® Assurance® products. 3 – Comparisons based upon fuel efficiency testing between MICHELIN® HydroEdge® tires, Goodyear® Assurance® TripleTred™ tires, Goodyear® Assurance® ComforTred® tires, and Bridgestone® Turanza® EL400 tires. Fuel savings are estimates based on comparative rolling resistance. Actual on-road savings may vary. Based on comparisons against the leading competitors in the standard S/T-rated all-season category. Copyright ©2010 Michelin North America, Inc. All rights reserved.