

APRIL 1991 \$1.95

Popular Mechanics

INSIDE AMERICA'S WAR MACHINE

65 GREAT WAYS TO IMPROVE YOUR HOME

Frontline Report On Our Fighting Forces And Their Newest Weapons Systems



OWNERS RATE FORD'S F-150 PICKUP

LOU PINIELLA ON HITTING A HOME RUN





efficient powerplant that uses resources wisely. (18 EPA est. city MPG, 25 EPA est. hwy. MPG.) You also have the most advanced engine in its class.

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We made this Crown Victoria sleeker on the outside, yet roomier and quieter on the inside. We gave it more trunk room than any other car in its class. Which means we put more room in the same space.

New Ford Crown Victoria. Other cars just don't measure up.

Ford. The best-built American cars... ten years running.

This is based on an average of consumer-reported problems in a series of surveys of all Ford and competitive '81-'90 models designed and built in North America. At Ford, "Quality is Job 1."

New Crown Victoria

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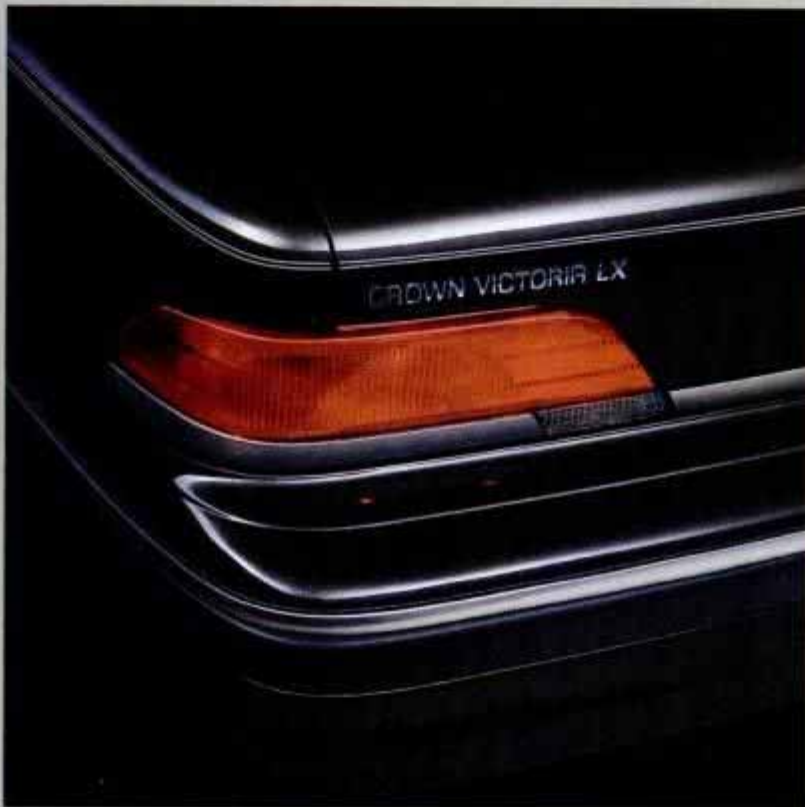
**Introducing the new
Ford Crown Victoria.**

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More powerful.

More fuel efficient.

Better handling.



This One
8DPU-4ZF-W53J

WHAT 43 NEW PATENTS GOT US

We didn't start out to build an engine that would win one of the most prestigious engineering awards around. We started out to build the world's finest outboard engine for you.

But we're proud to be a winner of Popular Mechanics' 1991 Design & Engineering Awards. These awards are given annually by the editors of the magazine to a select group



of outboard engine. Five years and \$25 million in development, it's the new Spitfire Series™ outboards from Evinrude. New 150- and 175-hp engines that are lighter, quieter and smaller than anything in their class. With quicker acceleration and higher top-end speed than anything in their class.

And between the engine cover and the prop, so much new technology — much of

of products that represent the very best in worldwide engineering excellence — “the best of the best” say the editors.

We're even prouder to bring you the world's most advanced

it modular — that it took 43 new patents to cover it all.

The all new Spitfire Series outboards from Evinrude.

...AND WHAT THEY GET YOU.

We get the award... you get the world's most advanced outboard engine.

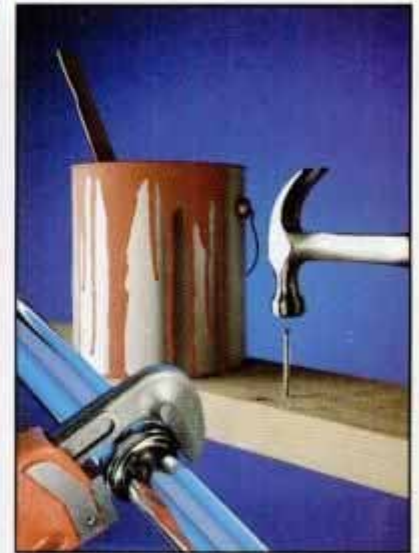
The All New Evinrude Spitfire Series
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OMC OUTBOARD MARINE CORPORATION
World Headquarters • Waukegan, Illinois



Popular[®] Mechanics

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NO. 4



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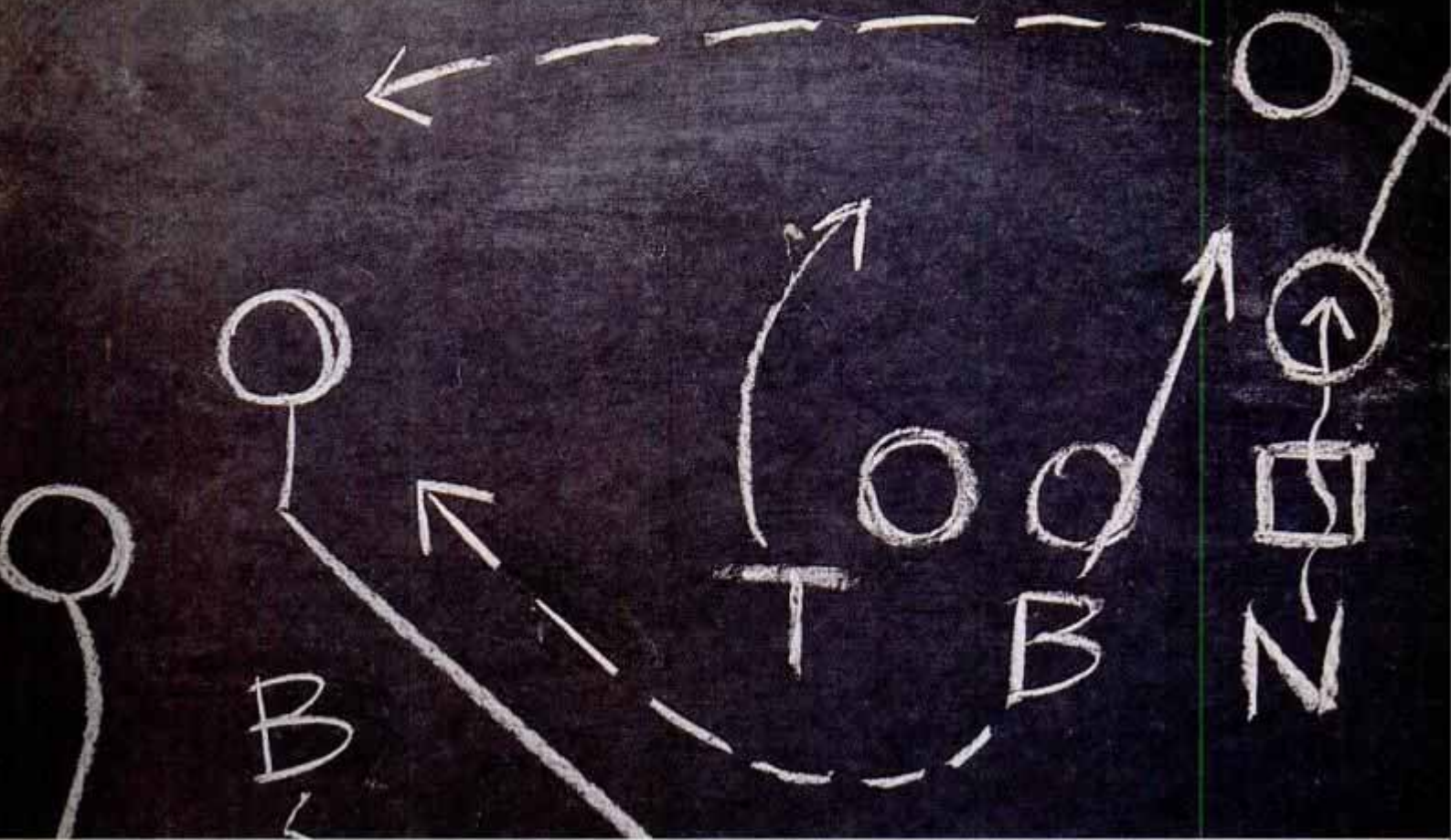
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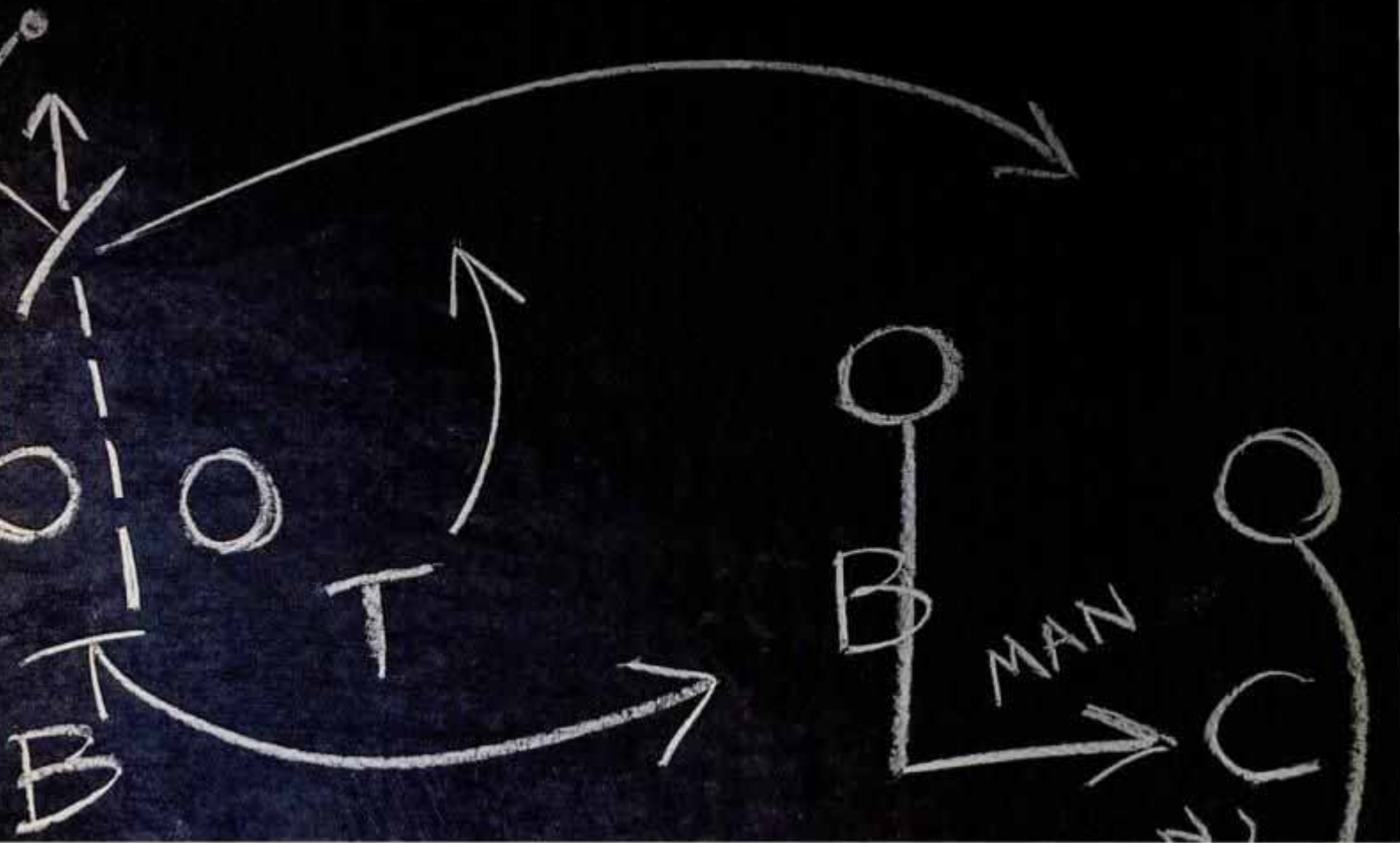


The answers to your insurance



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EDITOR'S NOTES

● When Science/Technology Editor Abe Dane arrived in Riyadh, Saudi Arabia, and was then transported by the Army to a remote Patriot missile battery somewhere in the Saudi desert, little did any of us know that he was about to spend 72 hours with the first heroes of Operation Desert Storm. The Patriot antimissile missile batteries and the crews that operate them proved their mettle in the early days of the war. Never before fired in actual combat, the Patriots were more than a match for the Soviet-built Scud missiles fired into Saudi Arabia and Israel by the Butcher of Baghdad, Saddam Hussein. Dane's assignment was to live with the crew of one Patriot missile battery and report what it's really like out there. His article, "Report From Charlie Battery," on page 23, does just that. If you were like me, you spent the early days of the war glued to the TV set listening to the CNN crews and Peter Jennings on ABC. And if you were like me, you were slightly bewildered by the incredible array of weapons being deployed against Iraq. It seemed at times that there were scores of different aircraft, missiles, guns, ships and tanks in the Persian Gulf—all aimed at Saddam Hussein. And there were. Upon his return from Saudi Arabia, Dane and contributor Greg Pope compiled a directory of major U.S. weapons systems currently operational in the Persian Gulf. I hope it helps you sort through the nightly newscasts. Or better yet, let's hope it's over by the time you read this. . . .



Capt. Kevin Groome, commander of Charlie Battery, confers with private Dane.



Sweet Lou easily handled Vizard's best pitch.

Back on the home front, life goes on as normally as possible. If you're going ahead with any home improvement projects, you'll want to check out our Improve Your Home Guide starting on page 73. Our editors have compiled a list of 65 great tips to help you with any home project. . . . From time to time we've examined the science behind sports, and, this time, Electronics Editor Frank Vizard worked with Lou Piniella to produce "Mechanics Of A Home Run," on page 40. Piniella, currently manager of the World Champion Cincinnati Reds, was not particularly known for the long ball when he was an active player with the Orioles, Indians, Royals and Yankees. But he was a strong .300 hitter—dangerous in the clutch—and a batting instructor, and he knows the mechanics of hitting one out of the park. In case you're asking what electronics has to do with hitting a baseball, nothing. But Vizard is the biggest fan on the staff. Till next time.


Joe Oldham

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Number 9 in a series:

The off-the-shelf oil for million-dollar cars.



With millions in investment and winnings at stake, the motor oil that lubricates the tormented components of racing engines had better do its job. That's exactly what Havoline Superior Grade Motor Oil did. It performed in more than 100,000 grueling racing miles in CART, NASCAR, and IMSA last season — without an oil-related problem. But winners never stop trying to improve.

Introducing the complete motor oil — New Havoline Formula³




Say hello to new Havoline Formula³ Motor Oil from Texaco. A combination of additives enables Formula³ to offer complete protection.

Havoline Formula³ resists heat. Oil in any engine, on the street or track, acts as a coolant as well as a lubricant. Formula³ fights viscosity and thermal breakdown.

Havoline Formula³ reduces friction when starting your engine. As an enthusiast, you know that initial start-up can cause engine wear. Formula³ stays around rings and cylinder walls when it's needed most.

Havoline Formula³ helps keep your engine clean and free of deposits. Deposits not only cause wear, but they can do other mischief. For instance, deposits under piston crowns can make them run hotter. Formula³ helps resist such deposits.



-  Overall heat is reduced by oil functioning as an improved coolant.
-  Startup is helped by lubrication at cylinder walls and piston rings.
-  Deposits are inhibited, including under piston crown.

For race cars and your car too.

Look for new Havoline Formula³ in the engines of Mario, Michael, and Jeff Andretti this year in CART racing, and also in Davey Allison's NASCAR engine. While you're at it, look for other Texaco products in the same venues. Because we're competing for your business, we continually improve the quality of our products by competing on racetracks. Racing teaches us valuable lessons in fuel management and the cleansing of critical components in the air-fuel mixture path. This never ending search for knowledge is what led us to products as advanced as System³ gasolines.

And look for Havoline Formula³ at many fine retailers as well as the place you find System³ — the sign of the star. Because good things come in threes.



**TEXACO SYSTEM³ AND
HAVOLINE FORMULA³**

T E C H N O L O G Y I N M O T I O N

LETTERS

Attire-ing Subject



Joe Oldham's editorial comments in the February issue concerning the annual boating section demonstrate an insensitivity to the problems of sexism, feminism and male chauvinism. His comment that "in deference to the women (emphasis mine), we also have men (emphasis his) in bathing suits" implies that only women were concerned about POPULAR MECHANICS' handling of last year's boating issue. This is inaccurate. The letters to the editor last year complaining about the boating issue included many letters from men. Oldham's insensitive replies to the letters disturbed me. Most men are much more sensitive and concerned about treating women fairly and equally than Oldham. So this year, Oldham and Boating Editor Joe Skorupa have once again decided to show only men driving the boats and to show the women in revealing bathing suits. And Oldham decided to draw attention to the issue in his column. The issue is not whether people in boats wear bathing suits or whether people in boats wear revealing bathing suits. The issue is the manner in which POPULAR MECHANICS treats women and men. It is time to

Letters are subject to editing for length, style and format.

show women and men driving the boats, wearing bathing suits and other boating attire. And it is time for Oldham and Skorupa to be replaced by individuals sensitive to the issues raised by this controversy. PM has a macho tone that needs to be changed. Please look at the photographs in the previous 12 months of boating sections. Then read the associated letters and Oldham's replies. PM is showing an insensitivity to fair treatment of women and an insensitivity to its readers.

TOM GREINER
AMES, IA

Yes, you have done it again. Now, pray tell me, where I can find the one wearing the red bikini top? If you can't remember where, then just publish a big picture of her on next issue's front cover. Who needs *Sports Illustrated*?

K. BURT
DEER PARK, TX

Sticks And Stones

Shame on you for your response to James D. Bushnell's letter regarding Detroit's failure to produce fuel-efficient automobiles. There is no name signed to the response. But judging from what was said, you now have the former U.S. president on your payroll. It was his espousing of the idea that Americans are God's chosen people, and therefore entitled to wantonly waste natural resources. This has placed us in a position of an insurmountable federal deficit, in a war over oil and far down in the standing of nations.

WESLEY R. DICKENSON
SOUTHOLD, NY

All replies to letters are written by that guy, Ed. —Ed.

I was appalled at the ungracious tone of the reply to James Bushnell's letter.

GEORGE E. LOCK
TOMS RIVER, NJ

Garsh! What a snappy comeback to reader Bushnell. Your response did make one point clear. America is about choice. A magazine can even choose to belittle readers who are concerned about the abuse of our planet. I eagerly anticipate your cheeky response. Of course, if you want to hit the panic button and not print this letter, that's up to you.

DON STUART
ST. JOSEPH, MI

Whoever wrote the answer to Bushnell sounds like a hot-headed Rambo who probably throws beer cans out of his hot rod's window, dumps his used motor oil in the nearest ditch and has been known to fire his AK-47 in anger.

TOM HUNTER
HUBERT, NC

I would never use a foreign-made weapon. —Ed.

This is perhaps the dumbest editorial reply to a reader's well-justified questions that I have ever read. "America is about choice" may be true, but those choices end at the

end of my nose. Three-hundred horsepower engines violate me and many other Americans. They deplete energy resources merely to gas the macho, who-gives-a-s---attitude your reply so perfectly exemplifies. They are dangerous and unnecessary.

REGINALD A. BOWES
FRANKLIN, TN

So are those who tolerate only their own opinions. —Ed.

Stealth Failure?

An award for the F-117A Stealth Fighter? It's unproved, a failure in Panama and hyper-expensive. Is it really worthy of an award?

LEONARDE E. OPDYCKE
POUGHKEEPSIE, NY

By now, reports from the Persian Gulf have reached Poughkeepsie. —Ed.

On Track

Thank you for putting me on a new track. "Restoring The Great Steam Trains" (page 117, May 1989) put me into a different version of woodworking. I used all wood and glue with no metal parts—no nails or screws. I made a train over 5 ft. long with pine and some redwood. The 7-ft. track's rails are made out of red cedar.

ED ST. PIERRE
JEWETT CITY, CT



Reader Ed St. Pierre and his great wooden steam train.

Number 10 in a series:

Every ounce of performance helps.

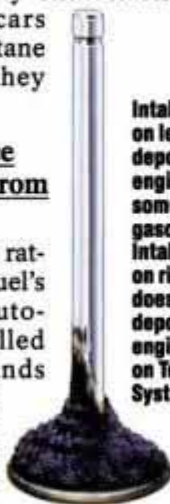


When the checkered flag is in sight, $\frac{3}{4}$ -horsepower can be as good as 100. As an enthusiast, you know that. You probably also know how, at Texaco, we study the tiniest details in our racing program to develop the highest quality products for you. For example, the new Havoline Formula³ Motor Oil that provides complete lubrication to Davey Allison's NASCAR engine is the same you can buy at Texaco stations or in stores. Texaco System³ gasoline is the same that Robert Yates, Davey's engine builder, uses on the test stand.

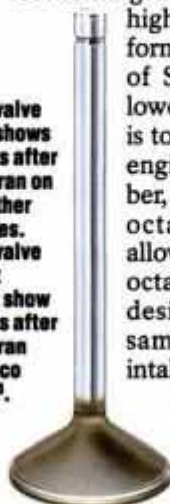
Yet, on the subject of small but important differences in gasoline, here's something many enthusiasts don't know: Some cars don't need all the octane some people think they need.

Higher performance doesn't always come from higher octane.

Octane is basically a rating that measures a fuel's tendency to resist auto-ignition, which is called "knocking" but sounds more like pinging. Then why octane's mystique? Like most folklore, it was rooted in



Intake valve on left shows deposits after engine ran on some other gasolines. Intake valve on right doesn't show deposits after engine ran on Texaco System³.



fact. After a year or so of owning a car, people often notice that it's not so peppy. Maybe the engine pings as it lugs up a hill. If so, higher octane can cure it.

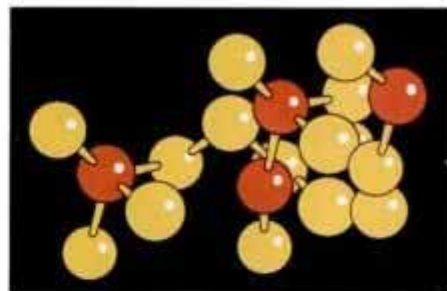
But it may be the right cure for the wrong disease. The real problem may be the gasoline itself. It can leave deposits behind. Over time, those deposits accumulate in combustion chambers and choke off performance.

The octane requirement increase story.

At Texaco, we call this phenomenon octane requirement increase. And our research chemists and engineers did something about it. The secret is a highly proprietary additive formula in all octane grades of System³ gasolines, from lowest to highest. The effect is to neutralize deposits in an engine's combustion chamber, which can control a car's octane appetite. System³ allows you to keep using the octane grade your car was designed for, while at the same time providing your intake system with the highest level of cleanliness. The ability of System³ to clean dirty intake valves and fuel injec-

tors can even help improve performance in older cars.

In fact—for different but very important reasons—System³ is used *only* for cleansing by our CART Indy car teams. After a day at the track, the engines of Mario, Michael, and Jeff Andretti are run on System³ to flush out corrosive methanol residues.

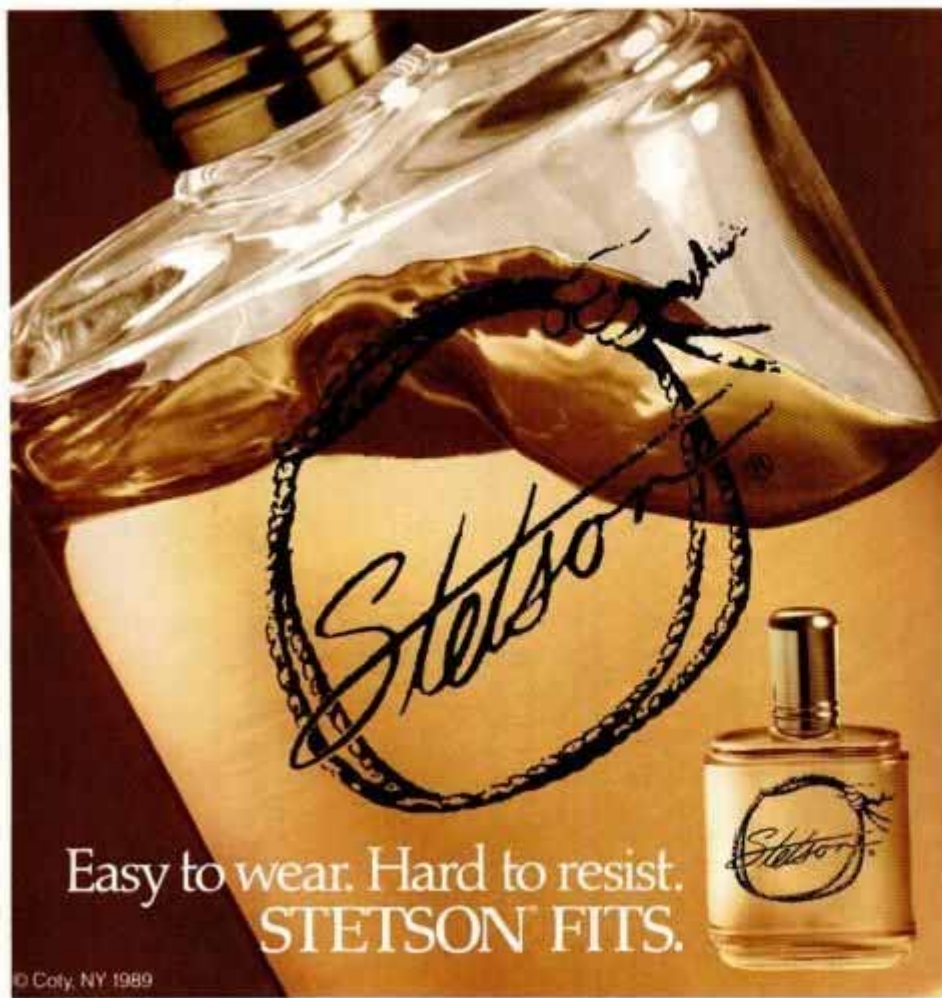


All this helps our racing teams compete. And it helps us compete for your business. So try a few tanks of System³. As someone who appreciates the details of automotive technology, it's likely that the extra ounce of performance will be detected by that most sensitive of instruments—your right foot.



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BMW Roundel, December 1989

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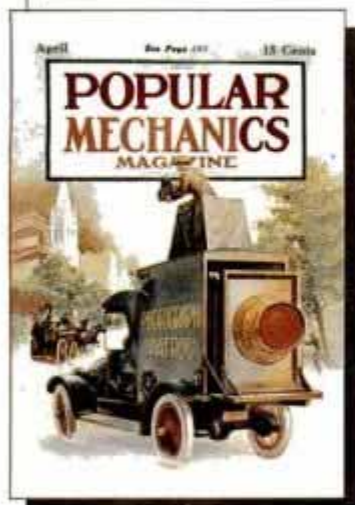
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TIME MACHINE

75 YEARS AGO: APRIL 1916



News Flash

During the heyday of tabloid competition, scoop-hungry publishers pulled out all the stops to shave minutes from production time. One Philadelphia daily sent out a mobile photographer's platform that doubled as a darkroom. The shutterbug popped out of a hood on the truck's roof to shoot the scene. He then dropped back into the light-proof truck to develop the film, racing the clock to have his plates ready by the time the truck pulled up at the printing plant.

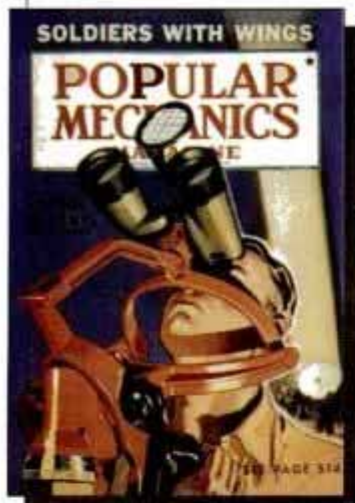
Ironsides

Artillery salvos on the western front were building in a steady crescendo as the Germans launched an offensive on Verdun. Not only were troops shellshocked, but the trenches themselves were collapsing. So to shore up both field positions and infantry morale, both sides built steel-plated miniforts. The Germans fitted theirs with revolving machine-gun turrets and would use them with horrible efficiency in the coming Battle of the Somme. And it was during that 4-

month bloodbath that the British would introduce a mobile version of the steel redoubt: the tank.



50 YEARS AGO: APRIL 1941



Light Brigade

As war clouds gathered, the nation mobilized its scientific resources. Premiere among industrial labs of its day was General Electric's Schenectady, New York, facility. GE's anti-aircraft searchlights probed 6 miles into the sky, and their ultraviolet lamps illuminated fluorescent signs on blacked-out streets. But the lab was also marshaling hundreds of scientists on a top-secret mission: harnessing the magnetron to jam German and Japanese radar.

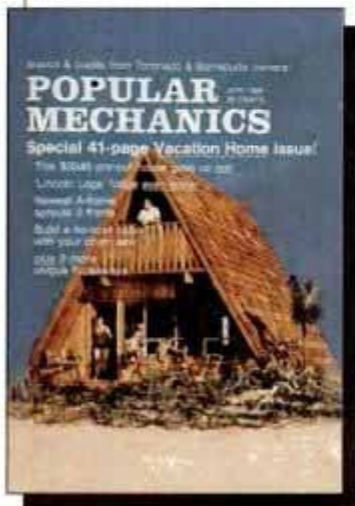
Mosquito Fleet

Meanwhile, we also began making sure our military resources were up to snuff. Tugboat skippers gaped as

the Navy's new motor torpedo boat dashed across New York Harbor at 50 knots, leaving only a thin wake. High-riding PT boats could tiptoe over submerged mines as they pestered bigger enemy ships in swarms, stinging them with torpedoes and gunfire, or blinding them with smoke to mask other craft. Over 700 PTs would see action in WWII.



25 YEARS AGO: APRIL 1966



Take The A-Frame

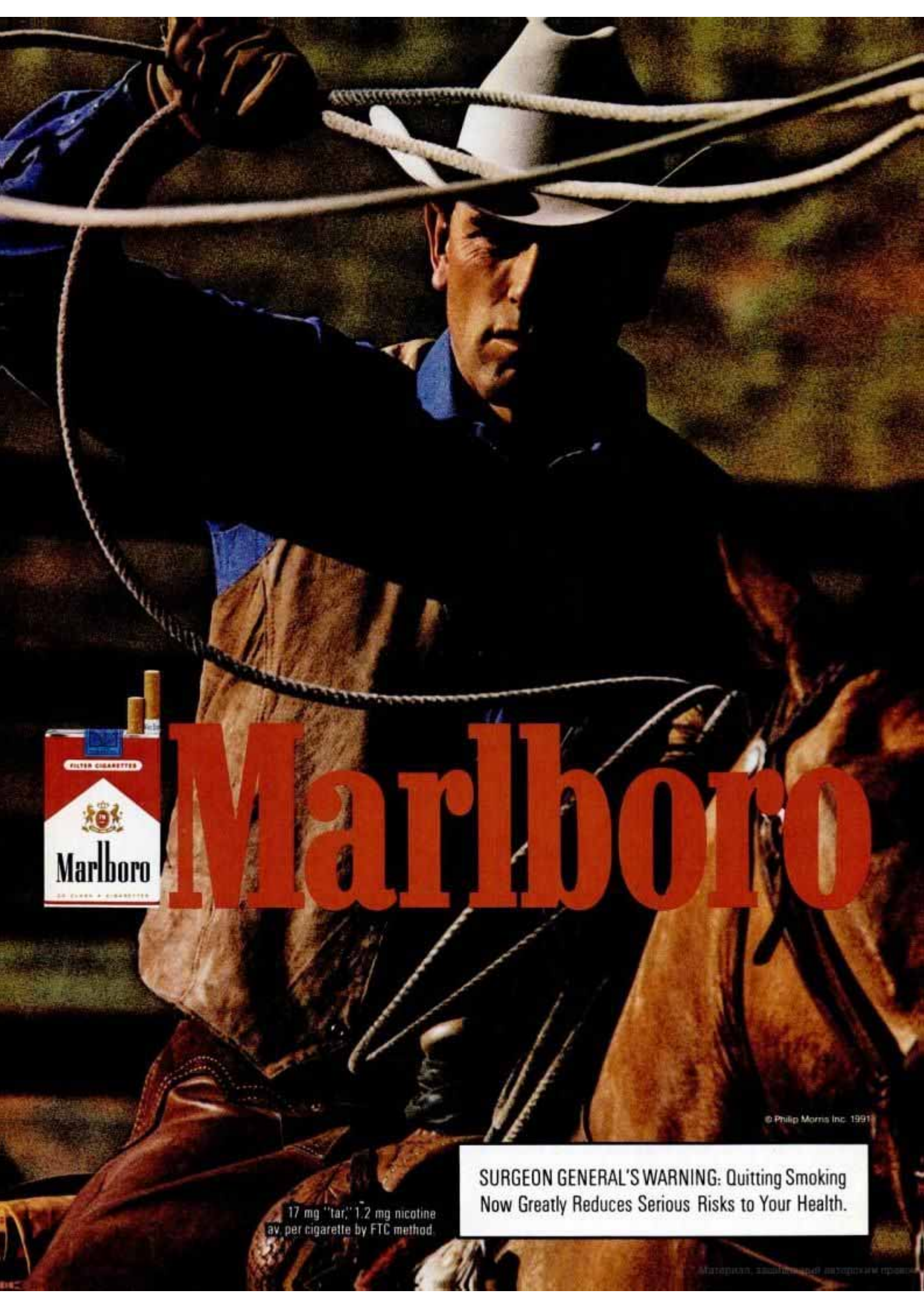
From ski slopes to seashores, a now-familiar structure—the A-frame vacation house—was sprouting everywhere. Manufacturers hawked build-your-own kits, claiming they required less than 60 man-hours to assemble. We took the challenge with a tongue-and-groove precut kit finished in red-cedar shingle. Chaperoning the lumber from British Columbia to the Bahamas proved the trickiest part of the project. Once in Freeport, the house went up in 38 hours.

Take A Byte Out Of Crime

Computers, even the bulky, whirring devices of the '60s, were revolutionizing law enforcement. N.Y. police loaded stolen-car license plate numbers into a UNIVAC, and put an operator next to the machine to respond to radio calls. Detroit detectives computerized everything from a felon's pet phrases to his fa-

vorite brand of beer. Speed of data entry was the bottleneck back then. Lawmen awaited the long-promised optical scanner that would whisk fingerprints into the memory bank in a flash. **PM**





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▼ FOR ROADSIDE PROBLEMS

A compact carrying case with snap lock comes complete with the most-wanted emergency aids. First, an up-to-date battery charger that plugs into another car's cigarette lighter. There's a powerful 12-V spotlight with lighter plug and red reflector, plus two 15-minute safety flares (approved in 50 states) — a 24" sq. distress flag. A tank-to-tank gas siphon pump, a 6-qt. bag for carrying water, a roll of plastic tape for emergency repair of hoses and wiring, a coil of wire and 4 elastic trunk tie-downs complete the kit. **\$21.98** (\$4.00) #A1826X.



▼ NIGHT TRACKER™

Light up your night! Night Tracker™, the cordless, rechargeable hand-held spotlight packs a 500,000 candlepower beam to give you a light whenever, wherever you need it. The beam is 10 times brighter than your automobile headlights and will carry over 1 mile. Operates on rechargeable batteries or recharge it from 110 volt AC outlet or from any 12 volt car or boat outlet. Perfect for home, travel, boating and camping. Made in the USA and comes with a 90 day warranty. Now featured with amber and red lens attachments. **\$79.98** (\$6.25) #A1975.



▼ INFRARED IMPROVEMENT



Home infrared heat treatments are an increasingly popular form of natural pain relief. Now the means of applying that heat have been significantly improved. Heating surface has been tripled, the larger contour head comfortably angled for reaching neck and back. Replaceable interior infrared bulb is now 10w, giving 45% more heat. Reaches deeper than heating pads or hot water bottles. The new infraflux has two heat settings: High and Low (plus off) which allows you to experiment and choose most comfortable setting. It comes with its own zippered vinyl bag for neat storage or packing for travel. UL-listed. **\$39.98** (\$4.25) #A1906.

▼ DIVER'S WATCH

The Diver's Watch, priced under \$50, is rated waterproof to 5 atmospheres (over 150'). The movable bezel, case and band are all "black chrome" plated in a rugged matte finish. Two sunken faces provide fully independent digital and analog timekeeping, so you can set one face to home time and one to travel time. Date, day and month display; alarm; 1/100 second chronograph with lap timer; choice of hourly chime, 12 or 24-hour format. Precision Japanese movement. 1-yr. warranty. **\$39.98** (\$5.00) #A1490.



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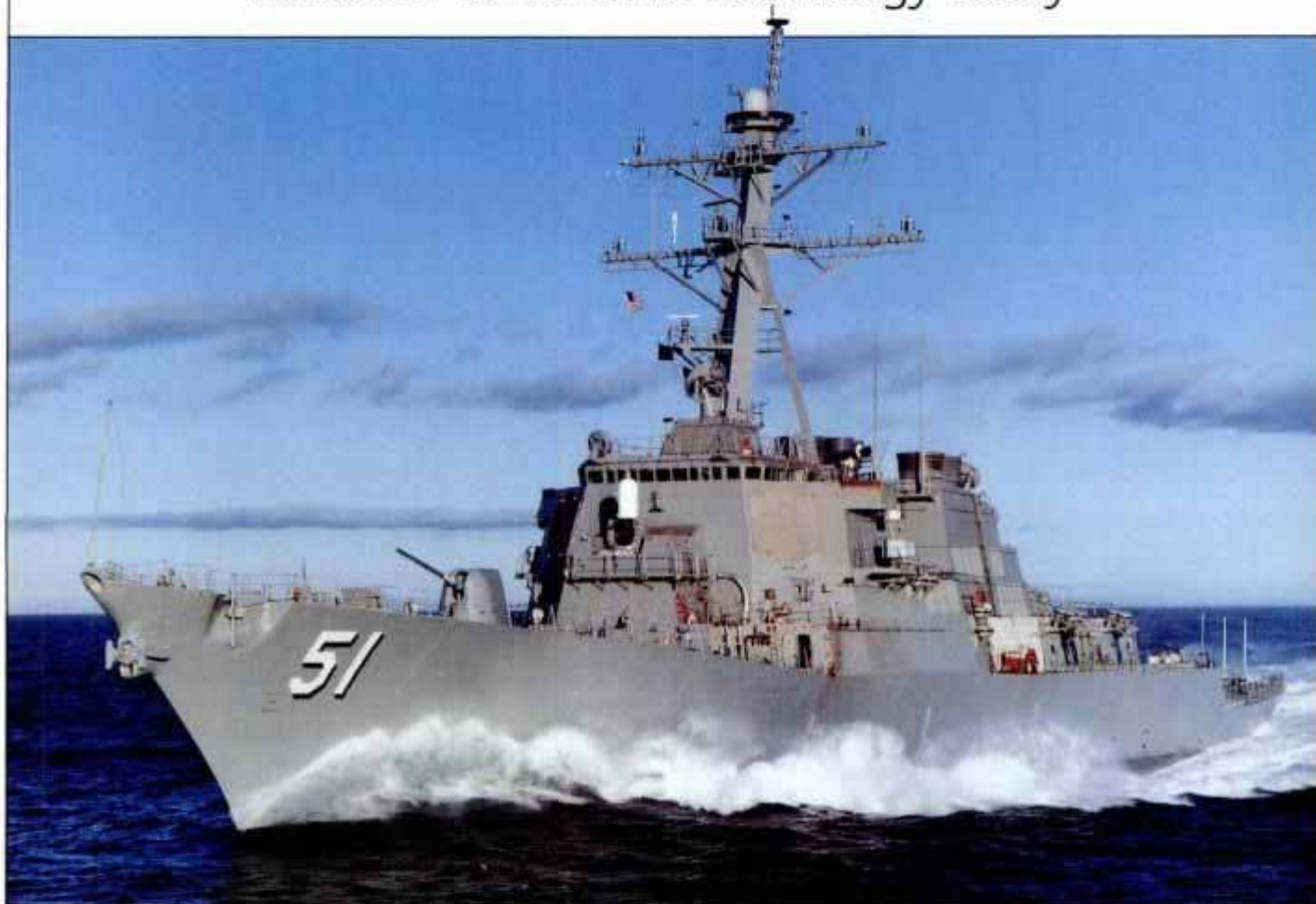
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TECH UPDATE

News Of Tomorrow's Technology Today



BATH IRON WORKS PHOTO

Navy's New Destroyer Takes To The Seas

BATH, ME—First in a brand-new class of AEGIS destroyers, the *Arleigh Burke* may be the toughest ship in the Navy—and she's ready to prove her mettle.

Survivability is the watchword on the *Burke*. Unlike the destroyers now fighting in the Persian Gulf, she carries an all-steel superstructure. And she's the first vessel in the Navy with built-in nuclear, biological and chemical protective systems. The ship rides low in the water, her Kevlar-armored combat information center buried deep in her hull, and her clean lines shaving her radar profile to a minimum.

Bolted to a single forward deckhouse, four SPY-1D ra-

dar antennas allow the AEGIS fire-control system to guide missiles up to 20 targets at once. Weaponry can include Tomahawk cruise, ASROC antisub or Standard surface-to-air missiles, all nestled in 90 vertical-launch cells. Six torpedo tubes, eight Harpoon antiship missiles, two Phalanx close-in guns and a five-inch round out her firepower.

Four 100,000-hp gas turbines propel the *Arleigh Burke* to more than 30 knots. In ocean trials this winter, her unusually broad 66-ft. beam kept her rock-steady

Editor: Abe Dane
Assistant Editor: Greg Pope
Contributors: Mike Dillon,
Peter Hoffmann, Paul Ruben

in rough seas.

The Navy plans to add 28 more AEGIS destroyers by the turn of the century.

Arleigh Burke, Navy's new 505-ft. AEGIS destroyer, churns through the North Atlantic during sea trials.

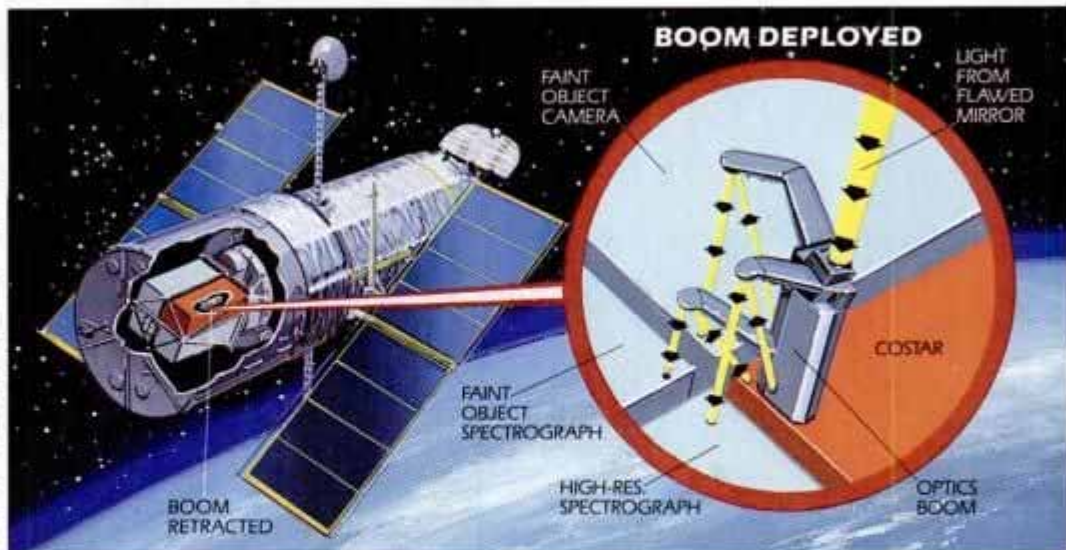
Highlights This Month

- **It's Done With Mirrors**—The plan to fix Hubble, plus latest Earth-bound telescope tech.
- **Sea To Sky**—The Navy tests some big water rockets.
- **Fighter de France**—Red-hot Rafale gets ready to rumble.
- **Two Wings And A Tail**—You pilot the newest wingsail yacht like a powerboat.
- **Cool Uniform**—Future GI gear has built-in air conditioning.
- **Ozone Drones**—Highest fliers ever will probe stratosphere.

Help For Hubble

GREENBELT, MD—In 1993, Shuttle astronauts will set off on the longest-duration spacewalk yet, in an effort to fix flaws in the Hubble Space Telescope.

One repair method now under consideration uses mirrors on a retractable boom to replace one of the four instruments now lying along the telescope's optical axis. Called CoSTAR (Corrective Space Telescope Axial Replacement), the device could fit into a phone-booth-sized box that now houses the high-speed photometer. Light from Hubble's distorted primary mirror would bounce off two corrective mirrors before entering each



CoSTAR's mirrors will correct light destined for three key on-axis instruments.

of the three remaining instruments.

Meanwhile, the spacewalkers must also put in an

upgraded version of the off-axis Wide-Field/Planetary Camera, with its own corrective lens. They may also re-

place Hubble's jittery solar panels, which have blurred the telescope's most sensitive readings.

Polished To Perfection

TUCSON, AZ—Hubble's optical flaw shows what happens if a big mirror is rubbed the wrong way. Now, a unique University of Arizona facility can put the right finish on future megamirrors.

In an 8-story steel tower, engineers have mounted a laser interferometer, which measures the profile of a newly cast mirror. In order

New polisher works over 5-ft. Air Force mirror created at Arizona's spin-casting lab.

to minimize vibrations during use, the 320-ton tower rests on 32 air cushions.

If interferometry finds any rough spots, the mirror heads downstairs, to the world's first polishing machine big enough to handle 26-ft.-dia. surfaces. Its polishing foot is a new device called a stressed lap: a 60-in.-wide aluminum plate with actuators that bend its face to polish mirrors with strongly curved contours.

First Light For King Keck

MAUNA KEA, HI—Although only half-built, the world's biggest optical telescope has imaged a distant galaxy using nine of its even-

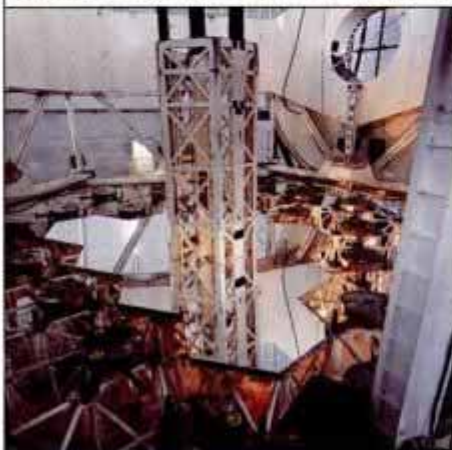
tual 36 mirror segments.

Inside the Keck Observatory, the gigantic mirror will rest on complex machinery. Springs and flex discs keep

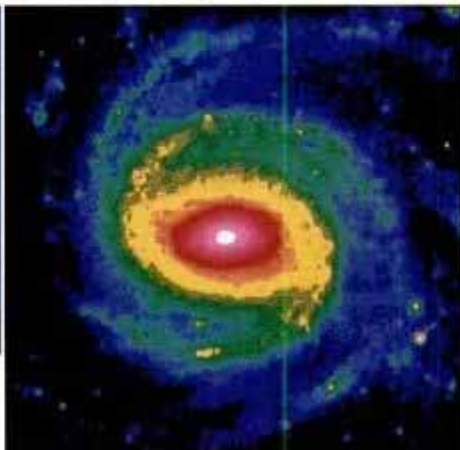
each segment stressfree as the telescope angles toward different parts of the sky. Meanwhile, hydraulic actuators align the segments into a single 32-ft. reflector.

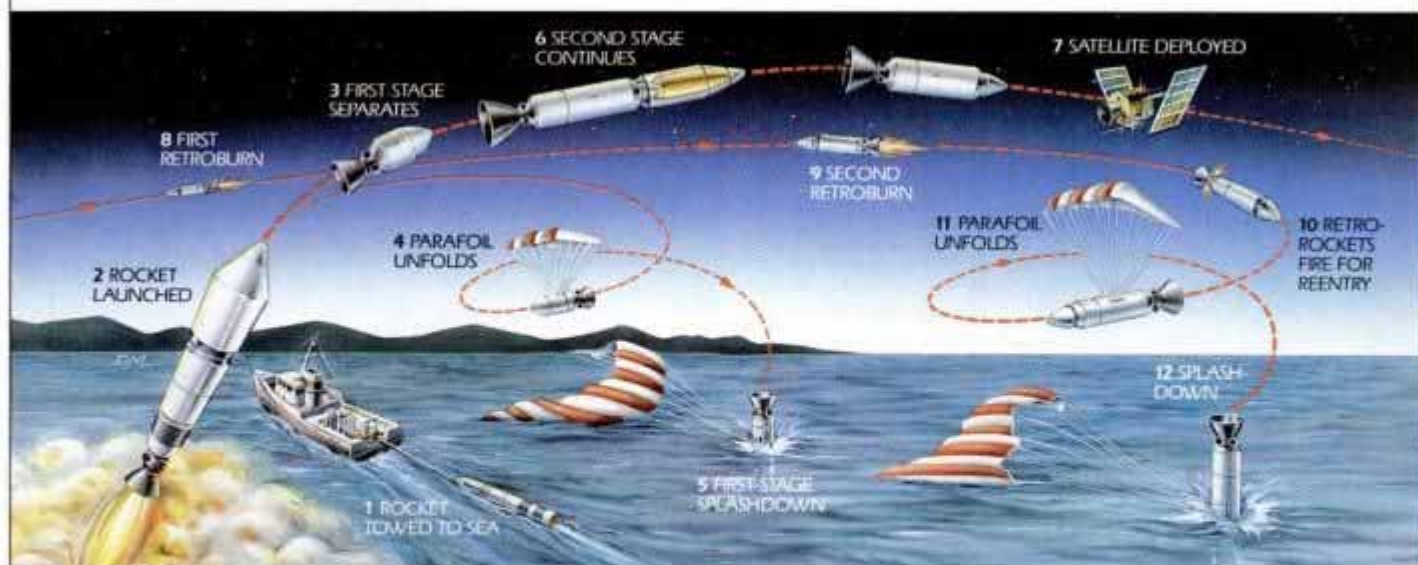
Astronomers say Keck will

complement a repaired Hubble Space Telescope by reading the chemical signatures of objects that Hubble finds. The observatory should be fully operational by the end of this year.



Keck Observatory (above) will feature segmented mirror (under construction, left). Nine segments already imaged spiral galaxy (right).





PM ILLUSTRATION BY DON MANNING

Davy Jones' Rocket

WASHINGTON, D.C.—Eager to loft payloads into orbit without waiting in line for land-based launch pads, the Navy is exploring a Sea Launch and Recovery (SEALAR) system.

Under the Naval Research

Lab concept, a buoyant, waterproof rocket would roll off the stern of a ship, right itself by flooding ballast tanks and fire its first-stage engine.

Once the first stage jettisons, the second stage deploys an expanded nozzle for

extra thrust at high altitudes. After unloading its payload, the booster executes retroburns to head back to Earth.

Parafoil wings are one likely way to guide expended stages in for soft landings on water. Otherwise, stages will have to be built to toler-

Two-stage SEALAR rocket roars into space from anywhere at sea, returns, and is then refurbished for reuse.

ate repeated high-velocity plunges into salt water.

Naval engineers plan to begin test launches this spring, aiming to field a family of ocean-to-orbit vehicles.

France's Future Fighter Debuts

ISTRES, FRANCE—The first of five preproduction versions of the Rafale fighter will begin flight tests this spring. Built by Dassault-Breguet of Mirage fame, the all-purpose combat jet is roughly the size of an F-16, yet harnesses the double-engine horsepower of an F-18.

The preproduction Rafale is a bit smaller than the technology demonstrator that has flown since 1986, but its

canards are bigger. Propulsion comes from twin Snecma M88-2 engines, equivalent in thrust to the GE F404s that powered the demo. Weapons will include a 30mm gun and eight medium- and close-range air-to-air missiles.

Production Rafales will begin fighting for the French air force in 1996. A somewhat heavier naval version will enter service at the same time and will fly from France's



AVIATION WEEK PHOTO

first nuclear carrier—the *Charles de Gaulle*, due to steam out in 1998.

Mach-2 Rafale shows off curvy forward fuselage shaped to optimize flow into air inlets.

Instant Radioisotopes

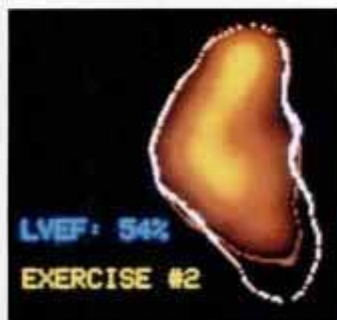
OAK RIDGE, TN—A short-lived radioisotope that is able

to decay quickly without subjecting the body to long radi-

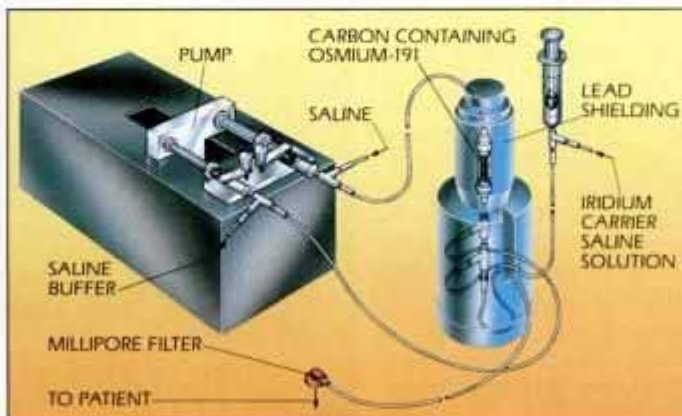
ation doses would be ideal to inject into the bloodstream for cardiovascular imaging. Until now, however, there's

been no way to make such a substance and use it before it loses effectiveness.

Oak Ridge National Laboratories, working with Belgian researchers, has overcome the problem. ORNL's ion-exchange column contains long-lived osmium-191, which decays into short-lived iridium-191. Saline flushes out the iridium without dislodging the dangerous osmium. Once in the bloodstream, it radiates for a few seconds to trigger gamma-ray-sensitive imagers. The device is undergoing FDA review.



Osmium stays in carbon (right), while iridium enters bloodstream for heart imaging (above).



OAK RIDGE PHOTO: PM ILLUSTRATION BY MARINO FERRO

Wind Beneath Its Wings

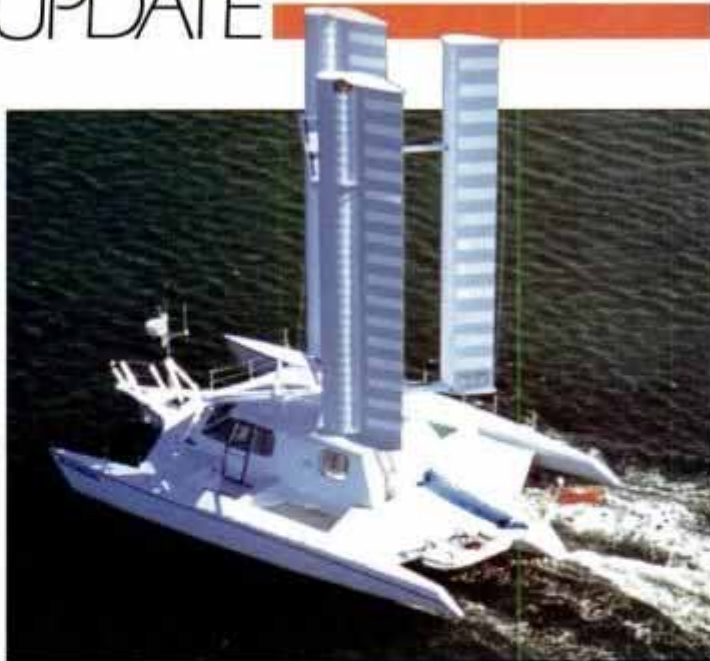
PLYMOUTH, ENGLAND—Wingsail technology continues to evolve at a brisk clip. Walker Wingsail Systems has brought out a yacht that makes sailing as easy as powerboating. The 54-ft. *Blue Nova* uses twin wings and a tail turning freely on a ring bearing to reach speeds up to 21 knots.

Data from wind and direction instruments feed into an onboard computer, which responds to helm inputs by triggering electric actuators on the wings. The computer allows automatic tacking and

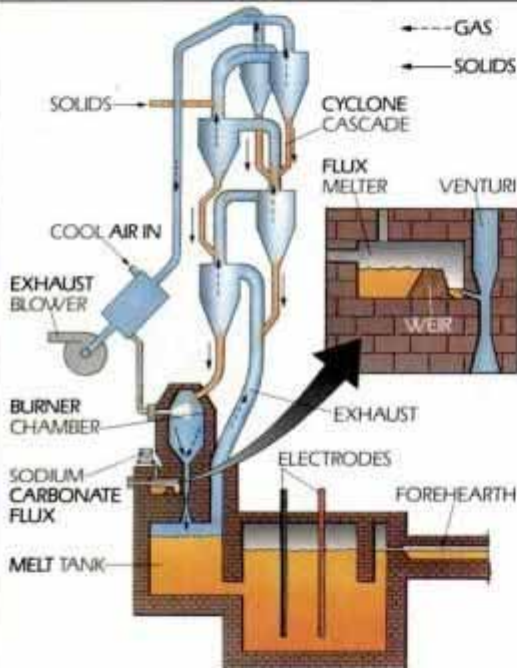
jibing, and feathers and deploys flaps on the wings to vary thrust.

For maneuvering in confined waters, the computer can lock up the flaps and move only the tail, for faster response and reduced thrust. Wind generators and solar cells power the actuators. The tri-hull has hit top speed in force-five beam winds, and the wings have withstood 108-knot hurricanes.

Three aerodynamic surfaces—two wings and a tail—propel trimaran *Blue Nova* under computer control.



WALKER WINGSAIL PHOTO



Glass Breakthrough

RICHLAND, WA—Researchers at Pacific Northwest Laboratories have developed a cheaper, more energy-efficient approach to glass-making, a craft that hasn't changed radically for 2000 years.

The key is a new glass-melting

system called Pyroflux. Instead of dumping solids (silica, limestone and other additives) straight into a melt tank, the Pyroflux process warms up these ingredients by trickling them through a cyclone cascade. The solids absorb heat from exhaust gases rising from the melt tank. They then pass through a narrow-throated venturi tube, where they mix

with the essential additive known as flux (molten sodium carbonate).

Because this mixture is preheated, it dissolves in half the time normally needed. Pyroflux, its developers claim, burns 30% to 50% less fuel and costs 30% to 50% less than the conventional method. Nitrous oxide pollution is also reduced.

The lab is now licensing out the process to make glass bottles and other products.



Battelle's new Pyroflux melter preheats ingredients to make glass more quickly and cleanly.

Air-Conditioned Battlegear

NATICK, MA—Amid growing concerns about the effectiveness of infantry wearing today's protective gear on a nuclear, biological or chemical battlefield, the Army has undertaken the design of a combat suit known as SIPE (Soldier Integrated Protective Ensemble).

SIPE reduces soldier heat stress with forced air cooling from a backpack power unit, and tiny air conditioners will cool future versions. Both systems produce an overpressure within the suit to keep out chemical agents.

The soldier will sight his

rifle via a thermal imager linked to a head-up helmet display. The helmet's visor will protect against lasers, while the bodysuit will resist chemical, flame and directed-energy assaults. SIPE will also incorporate improved ballistic protection, a communications headset and a microcomputer.

Army researchers hope to begin full-scale development in 1993 and start fielding SIPEs in the late 1990s.


SIPE-clad soldier can shoot from the hip, thanks to a head-up display linked to the gun's thermal sight.



PM ILLUSTRATIONS BY PAT RUGGERO

(More Tech Update on page 20)

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The New 1991 Plymouth Voyager.

*Lap belt on center rear seat. †Protects engine, powertrain and against outbody rust through. See limited warranty at dealer. Restrictions apply. Buckle up for safety! © Plymouth/Chrysler Motors, 1990



PM ILLUSTRATION BY ED VAUGHNSKY

Drones Of The Stratosphere

ALEXANDRIA, VA—Twenty miles above sea level lies a region that has been restricted to high-altitude balloons and rockets—until now. This year, researchers plan to loft what could become the highest-flying

plane ever: a remotely piloted craft named *Perseus*.

Its nose filled with chemical sensors, *Perseus* will fly 1-hour missions to measure ozone depletion, greenhouse-effect gas buildup and other climate phenomena.

A catapult will launch the aircraft. Then a 15-ft., 2-blade propeller will begin to turn slowly. At cruise altitude, *Perseus* will fly at only 220 mph, its 59-ft. wingspan getting as much lift as possible out of the scanty air. The small closed-cycle engine will burn methane in oxygen.

Strato-drones *Perseus* (right) and *Theseus* (left) gain lift from geometry based on human-powered aircraft.

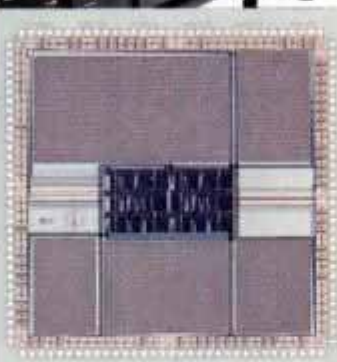
Engineers at Aurora Flight Sciences Corp., which developed *Perseus*, plan a future version called *Theseus* that will run on fuel cells for 2-day missions.



Super-Duper Computer

PASADENA, CA—The fastest supercomputer ever built will begin crunching numbers this month at the California Institute of Technology.

Touchstone Delta—cofunded by Intel Corp. and the Defense Advanced Research Projects Agency—will harness 528 of Intel's million-transistor i860 processor chips. Packed into a highly parallel architecture,



Touchstone Delta features Caltech-designed routing chip (above) that interconnects powerhouse i860 processors.

these will yield a peak speed of 32 billion operations per second—twice as fast as anything else on the planet.


The next step, says Intel: a version with 2048 processors that will do more than 150 billion operations per second.

Coin-Op Dogfight Simulator

TOKYO, JAPAN—Combining videogame and thrill-ride technology as never before, Sega Enterprises is testing a prototype arcade flight simulator.

Instead of the complex hydraulic movement gear used in military and commercial simulators, the Sega game uses a relatively simple electric stepper-motor system to spin a cockpit 360° around two axes.


Joystick movements feed into a computer that controls both the action of the cockpit and the dogfight-game presentation on the video screen. Strapped into the cockpit with a safety bar and 4-point harness, the player can climb, dive and roll.

Sega plans to introduce the machine in the U.S. to large video arcades later this year, and is also building an 8-passenger simulator. 



DC stepper motors activate high-fidelity 360° motions that send the Sega R360 simulator hurtling through penny arcades.

PAUL RUBEN PHOTO

When you consider all the advantages of the 1991 Plymouth  **Plymouth Acclaim** Acclaim, we don't think you'll give the Honda Accord a second look. For one thing, Acclaim has available seating for 6. Accord only seats 5. Acclaim offers greater power than the Accord, with available V-6. And our powertrain warranty is longer, too—7 years or 70,000 miles.* Safety? We feature standard driver's-side air bags and available 4-wheel ABS braking; Accord doesn't. The Acclaim also costs over \$1,500 less than Accord.† Call 1-800-PLYMOUTH for purchasing or leasing information. Test drive the Acclaim and you won't have second thoughts about owning one.

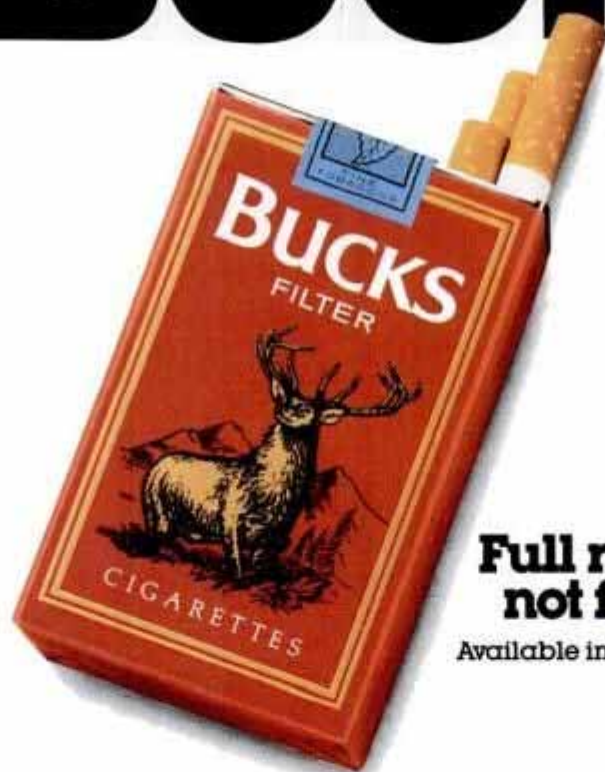
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Plymouth Acclaim

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Kings Lights: 11 mg "tar," 0.7 mg nicotine—Kings: 14 mg
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REPORT FROM CHARLIE BATTERY

Three days in Saudi Arabia with a U.S. Army Patriot missile battery reveals a vital human element behind the spectacular success of this modern black-box weapon system.

BY ABE DANE, Science/Technology Editor; PM Photos by Skip Gandy

● At midnight, the reddish glow of a fire-belching industrial plant somewhere in central Saudi Arabia makes the desert look like hell. A new year is upon us, and war is two weeks away.

Sgt. 1st Class Maconia Satterfield strides ankle deep through the talcum-powder sand, making his rounds—going from ready tent to command post, to fire control bunker, to missile launcher, to engagement control station—keeping spirits up among the men and women of Charlie Battery. If they do their job, he says, 1991 is the year they'll be going home.

They are here in this forbidding land to man the Patriot anti-aircraft missile, the most advanced weapon of its kind and the only thing that can stop the blistering ballistic course of Saddam Hussein's terror weapon—the Soviet-made Scud-B rocket. These members of the Army's 11th Air Defense Artillery Brigade call themselves "Guardians of the Flame."

Plucked from their home base in Fort Bliss, Texas, they came halfway around the world aboard the Military Airlift Command's lumbering C-5 and C-141 transport jets. On landing, their 10-ton high-mobility trucks moved out and converged on a strategic piece of desert, which military re-



CHARLIE BATTERY

porting restrictions prevent us from naming.

Army and Air Force engineers threw up a berm and uncoiled concertina wire around the emplacement's perimeter, while the 85 men and women of the battery set up and tested their equipment. Within three days, their phased-array radar and five missile launchers staked out a 120° segment of sky extending more than 50 miles. They could have done it within hours, but they planned to stay awhile, so they arranged the site with care and dug in deep.

Charlie Battery had been on guard in the desert for three months when *POPULAR MECHANICS* arrived. Our report covers 30 hours spent with the men, women and machines of this self-sufficient, highly mobile community of war.

Welcome at gunpoint

Spotting the trail of dust kicked up by our Army-modified Blazer, Pvt. 2 Sandra Morrow walks down through a slit trench from the heavily sandbagged entry control bunker and waits by the gate, M-16 in hand. Another guard stays back, watching from beside one of the bunker's heavy machine guns. After checking our ID and phoning in to the sergeant of the guard, Morrow pulls aside a coil of concertina wire and waves us through. The whole procedure seems to say: "This is for real."

The encampment spread before us is a cluster of shapeless humps formed by equipment veiled in camouflage netting. Here and there an antenna mast juts toward the sky, and sandbagged "Scud bunkers" pockmark the powdery sand. Pervading everything is the tremendous din of turbine and diesel generators, an ever-present reminder of the voracious energy appetite of the Patriot's electronics.

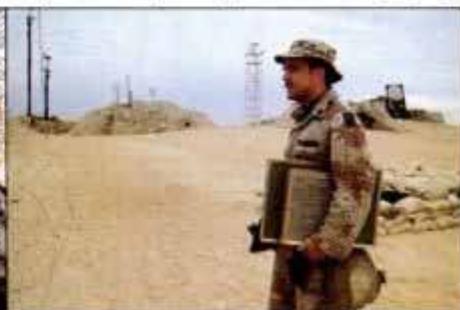
At the center of the site, on the highest piece of ground, stands the battery's radar, its panel of radiating elements cocked slightly upward and slued toward Iraq. Arrayed in an arc roughly a hundred yards in front of it are the five launchers, each holding four boxlike missile canisters angled toward the sky.

The main part of the encampment lies behind the radar, safely outside the irradiated no man's land created by the half-million-watt pulses of energy with which it probes the sky. Here, in addition to a control room and other equipment needed to operate the missiles, are the tents and trailers where the soldiers on site eat, sleep and do most of their work.

Four overriding concerns shape the efforts of these men and women: First, protecting key facilities in the area against Scuds and other threats from



Air war is fought in the ECS (above) by TCA at left and TCO at right. Green lights at top center show launchers okay to fire, and white numbers to right give missile count. At change of shifts, Sgt. Stonestreet briefs ECS crew (below left) and replaces air filters (right).



above. Second, keeping their own perimeter secure against ground attack or terrorist incursions. Third, keeping the complex Patriot system in good repair and ready to fire. Fourth, keeping their fleet of 30 trucks ready to roll, so they can relocate at a moment's notice. The normal 24-hour shifts sometimes stretch to 36 hours, during which personnel are lucky to grab a couple of hours of sleep.

Blazing skies

The first warning of incoming missiles would be received in the Engagement Control Station (ECS). Encased in a titanium-walled, chemical weapons resistant shelter mounted on the back of a truck, this electronics-crammed room is the nerve center of the battery. Two radar scopes, manned by a tactical control officer (TCO) and his tactical control assistant (TCA), show everything in the sky. A third ECS crewman maintains communications links with the rest of the battery and with battalion-level commanders.

Although not necessarily the highest ranking on site, those in the ECS van take charge of the battery in the event of an attack. "They execute and control the whole battle," says Capt. Kevin Groome, commander of Charlie Battery. When the battery goes to battle stations, a condition they call

"Blazing Skies," the TCO gives a quick mission brief to key battery personnel assembled behind the van. He then seals the door, pulls on his Kevlar helmet, flak vest and MOPP-4 chemical warfare suit, and goes back to his scope to fight the air battle.

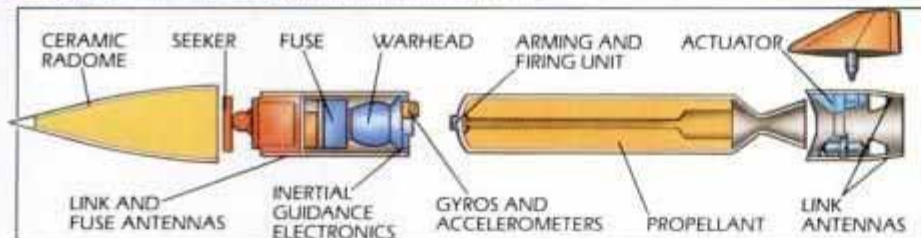
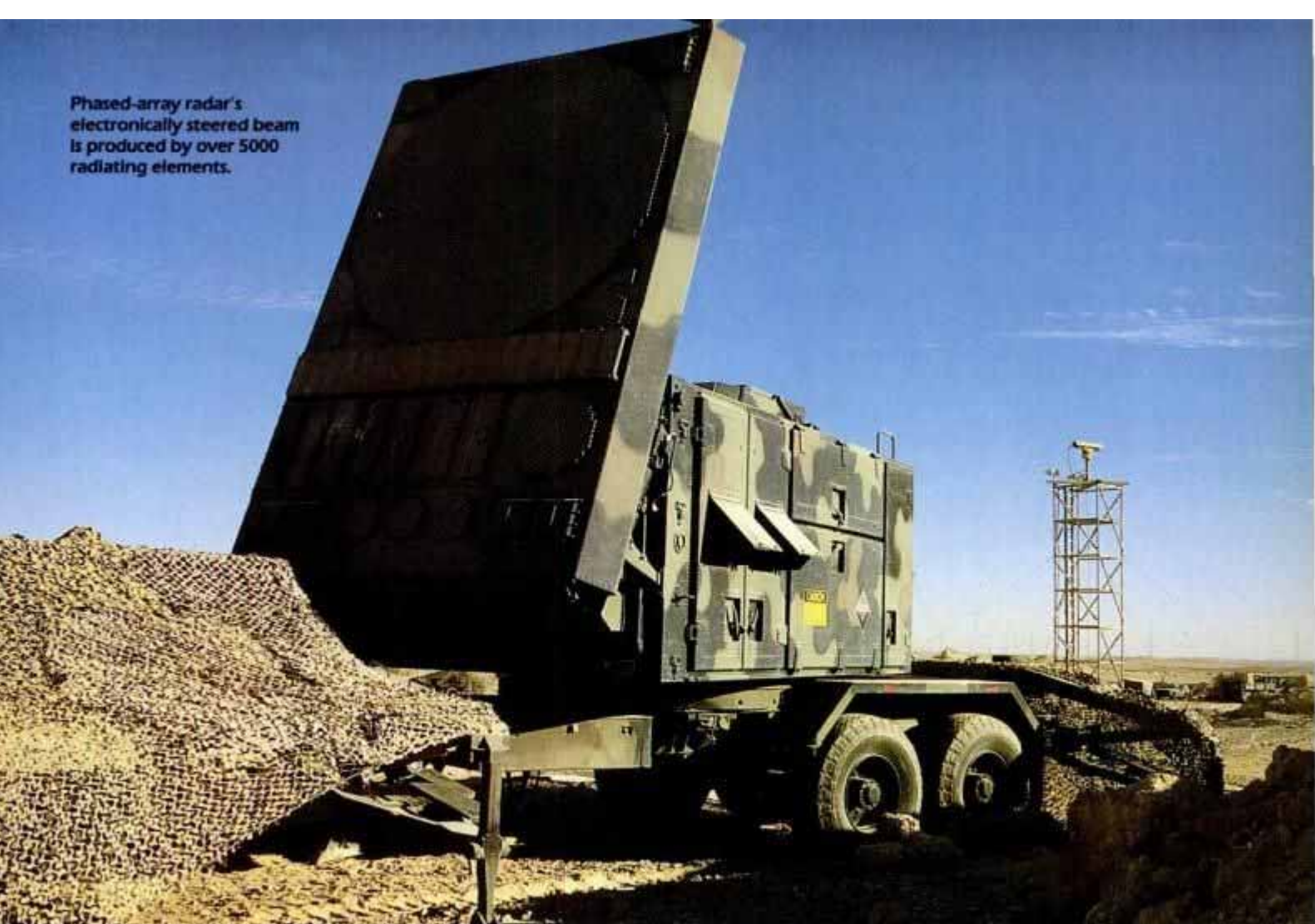
Friend or foe

"My main function in the van is to ensure friendly protect," says 2nd Lt. Kevin Gale, one of the battery's TCOs. That means he bears the weighty responsibility of making sure the battery attacks the right targets. Some of the most sophisticated electronics in the Patriot system are dedicated to helping him with that task.

The bulk of the work is done by a strip of Identification Friend or Foe (IFF) transmitters running along the lower part of the radar's antenna array. These interrogate aircraft transponders, triggering them to send back a return signal. Transponders set according to secret codes distributed daily to U.S. forces appear on the ECS screen as a flashing circle around a T, standing for true friend. Allied warplanes appear as empty circles, and each civilian aircraft is a circled S, which stands for special unknown.

If, as is likely in wartime, aircraft cannot be counted on to broadcast

Phased-array radar's electronically steered beam is produced by over 5000 radiating elements.



To kill a Scud: Patriot missile's seeker detects radar return bouncing from target, computes bearing to it, then transmits data to ECS via radar array. ECS calculates best intercept course, and transmits it back to the missile. Although complex, such Track Via Missile guidance systems are highly accurate and difficult to jam.

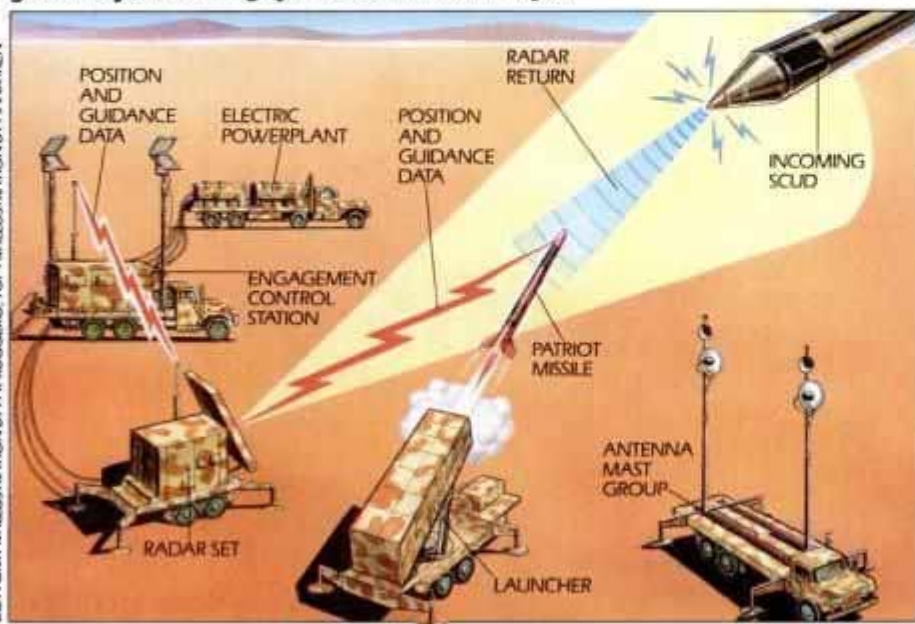
their intentions, more sophisticated measures come into play. Safe passage corridors programmed into the system's computer, and known to allied aviators, aid in sorting out the enemy. Additional information may be entered at any time, if friendly aircraft are expected to deviate from these flight lanes. The computer also analyzes tracks to see if their behavior conforms to hostile flight profiles.

Scud attack

The most hostile of all flight profiles is that of the Scud, one of a class of weapons Patriot operators refer to as TBMs, or Tactical Ballistic Missiles. "A TBM flies only one way—up and down, so it's very, very easy to decide," says Groome.

Spec. John Davis showed me just how a Scud attack would look by running a training simulation programmed into the ECS computer. As one of the battery's TCAs, he is responsible for carrying out the TCO's orders to fire at specific targets. "I'm the shooter for the battery," he says.

The Scud appears as a triangle moving in from the top of the screen with disconcerting speed. Davis works a joystick to maneuver a cursor, and within moments it zips over the track. Smacking a button marked HOOK on his keyboard locks the cursor



BOTTOM PMI ILLUSTRATION BY PAT RUGGERO; TOP PMI ILLUSTRATION BY HANIK IZEN

CHARLIE BATTERY



Launcher hot-crew member runs to turn torque tube handles, the last step before missiles can be fired.



Motor pool mechanics are responsible for keeping 10-ton HEMTTs ready to roll (above). In all, 30 trucks of various types are attached to the battery, as well as 14 diesel generators. Sgt. Gamboa (below right) oversees their maintenance.



on. He sets the system to ripple fire mode, and before the time to last launch indicator counts down below 50 seconds, he punches the caged ENGAGE button. A Patriot is away.

The missile appears as a football-shaped symbol floating toward the Scud at Mach 3. Twenty seconds later, the second Patriot in the ripple fires automatically. The first finds its mark, however, and a tic-tac-toe sign flashes over the downed Scud.

Hot crew

Outside the air-conditioned confines of the ECS, war is a less cerebral exercise. No amount of button pushing will have any effect unless someone has gone down range and activated at least one of the launchers. This task is handled by the launcher hot crew, a roving band of three personnel who remain in constant contact with the ECS via a backpack radio.

Although the battery normally keeps enough launchers running to counter a surprise attack, the hot crew must scramble to get all remaining launchers operational the minute an alert is sounded. Bouncing down to each in a pickup truck, they leap out and perform a complex sequence of steps, shouting back and forth to keep their actions coordinated. They check the system, fire up its diesel generator, power up its electronics, synchro-

Origins Of The Scud Threat

● In an adaptation typical of the process by which Iraq has scrounged and patched together much of its war machine, the SS-1 tactical ballistic missile, or Scud-B, has gone from a means of delivering nuclear warheads in support of Russian troops on European battlefields to a means of sowing near

random terror among civilians.

The Scud is a liquid-fueled, 14,000-pound rocket, launched either from 8-wheeled mobile launcher/erectors or from static sites. The accuracy of its primitive inertial guidance system is believed to be within 1 mile—acceptable for the delivery of nuclear ordnance, but of little military use when equipped with a high-explosive warhead. Launched at civilian targets, however, it can wreak havoc, killing hundreds and keeping entire cities captive to fear.

As originally sold to the Iraqis in the late 1980s, the Scud had a maximum range of about 180 miles. But during its 8-year war with Iran, Iraq devoted considerable effort to increasing this. Their aim was to strike at the Iranian capital city of Tehran.

With the help of German, Brazilian and Egyptian technicians, Iraq produced two Scud variants—the al-Hussein and al-Abbas, shown at left. With a larger fuel tank and warhead size reduced from

2000 to about 500 pounds, the al-Hussein can reach approximately 360 miles. The later al-Abbas is said to be capable of traveling 540 miles, bringing the entire Persian Gulf and Israel into range.

All variants of the Scud-B are still hindered by the late 1950s design of the original. In addition to poor accuracy, they are believed to require a full hour and 45 minutes to fuel before firing. However, by clever use of cloud cover, many of Iraq's mobile launchers have so far remained elusive, leaving the Patriot as the only way of preventing heavy civilian casualties.

—A.D.



DEPARTMENT OF DEFENSE PHOTO



PM ILLUSTRATION BY PAT RUGGERIO

CHARLIE BATTERY



nize its clock with that in the ECS, enter codes that prevent communications with the ECS from being jammed, and turn torque tube handles on each canister to release the missiles for firing. Drills I watched took less than 5 minutes. When all launchers are running, the hot crew can head for the Scud bunkers.

Another group that swings into action at the outset of an alert are the Stinger missile teams. Departing the site in a truck prepacked with their equipment, these three crews fan out to locations 1.5 km away. With their shoulder-launched, infrared-guided missiles, they guard against hostile aircraft that might sneak under or around the battery's radar. They also form a last-ditch air defense cordon should the Patriot system for any reason cease to function.

Keeping Charlie up

Preventing just such a failure is the responsibility of Chief Warrant Officer Terrance Driscoll, the battery's top missile system repairman. Not surprisingly, most of his attention is devoted to the ECS and the radar, the two most sophisticated pieces of Patriot equipment. "We run a computer diagnostics on the radar and the ECS every day," he says. The result is a printout about 50 pages long.

If there are problems, the computer lists parts that may need to be replaced, starting with the most likely culprit. From there, it's usually a matter of replacing parts until the problem goes away. "We're basically chassis changers," Driscoll says.

Unless, of course, something goes wrong with the system in the midst of an air battle. Then Driscoll's maintainers go to a set of procedures known as BDAR, or Battle Damage Assessment and Repair. A special toolkit in the maintenance trailer is broken out for these quick and dirty repairs. "It's the 'MacGyver' kind of

Spec. Nikki Akin (right) and Sgt. Thomas Rotter pull guard duty outside the entry control bunker, one of three machine-gun-armed emplacements that guard the base.

stuff," he says. "We do some things that might cause it to smoke, but it'll get you through a battle."

Driscoll still admits some nostalgia for the now-retired Nike-Hercules strategic anti-aircraft missile, which he spent most of his Army years maintaining. Because of its simplicity, he says, "Herc was a lot easier to work on." But the Patriot system has earned his respect. "I was convinced it wouldn't work over here in this desert, but it is. It's working very well."

With a system as complex as the Patriot, downtime is nonetheless a fact of life. To allow for this, Charlie Battery works closely with the neighboring batteries in its battalion. "When we're at a lower state of readiness doing maintenance, another battery will be at a higher state to cover us," Groome says.

The batteries of the battalion are knit together via UHF digital data links emanating from their Antenna Mast Group trailers. These tie them in to an Information Coordination Central (ICC) van located at battalion headquarters. Based on hardware similar to the ECS, the ICC's scopes

(Please turn to page 126)



AMERICA'S ARSENAL

A guide to our major weapons systems that put the thunder into Operation Desert Storm.

● The outbreak of war in the Persian Gulf has brought together nearly 50 years of American military technology—from World War II-vintage battleships, through Vietnam-era Wild Weasel and Corsair aircraft, to today's state-of-the-art Stealth fighters and Tomahawk

cruise missiles. Now arrayed against Iraq is an armada of more than 1300 airplanes, 1500 helicopters, 3700 armored vehicles, 3000 artillery pieces and 115 naval vessels. This reference guide will help you identify what you're seeing on the evening news.

FIXED-WING AIRCRAFT



F-14A Tomcat
Carrier-based fighter
Max. speed: Mach 2.3
Max. range: 2000 mi.

Armaments: 20mm gun; usually eight AIM-7 Sparrow or AIM-9 Sidewinder air-to-air missiles



F-15C Eagle
Air-superiority fighter
Max. speed: Mach 2.5
Max. range: 3570 mi. (with

conformal fuel tanks)
Armaments: 20mm gun; various air-to-air and air-to-ground weapons



F-16C Fighting Falcon
Multirole fighter
Max. speed: Mach 2.1
Max. range: 2415 mi.

Armaments: 20mm gun; various air-to-air and air-to-ground weapons



F/A-18A Hornet
Strike fighter
Max. speed: Mach 1.8
Max. range: 2303 mi.

Armaments: 20mm gun; various air-to-air and air-to-ground weapons



F-4G Wild Weasel
Air-defense suppression fighter
Max. speed: Mach 2

Max. range: 1978 mi.
Armaments: Various, including AGM-88 HARM antiradar missiles



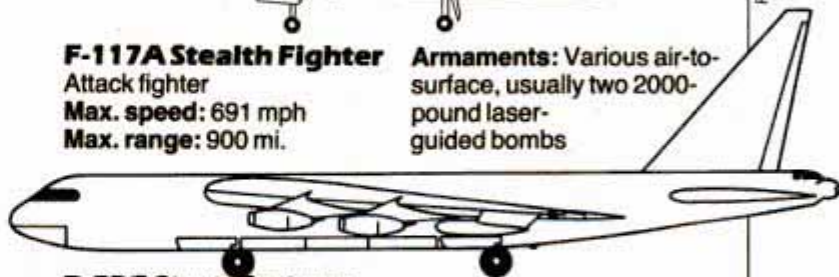
F-117A Stealth Fighter
Attack fighter
Max. speed: 691 mph
Max. range: 900 mi.

Armaments: Various air-to-surface, usually two 2000-pound laser-guided bombs



F-111F "Aardvark"
Long-range strike bomber
Max. speed: Mach 2.5
Max. range: 2925 mi.

Armaments: 20mm gun; up to 25,000 pounds of bombs on external pylons



B-52G Stratofortress
Strategic bomber
Max. speed: 595 mph
Max. range: 7500 mi.

Armaments: Up to 50,000 pounds of bombs; twin 0.5-in. tail guns



AV-8B Harrier II
VTOL attack fighter
Max. speed: 661 mph
Max. range: 2418 mi.

Armaments: 25mm gun; various air-to-air and air-to-ground weapons



A-6E Intruder
Carrier-based heavy attack bomber
Max. speed: 806 mph

Max. range: 2740 mi.
Armaments: Mostly air-to-surface weapons, often 28 500-pound bombs

PM F-4G AND F-111F ILLUSTRATIONS BY RON CARBONI

PM F-117A AND B-52G ILLUSTRATIONS BY RON CARBONI

AMERICA'S ARSENAL

FIXED-WING AIRCRAFT



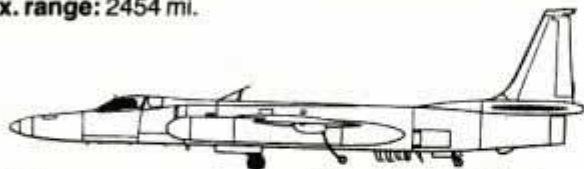
A-10A Thunderbolt II
Close air-support aircraft
Max. speed: 439 mph
Max. range: 2454 mi.

Armaments: 30mm Avenger antitank cannon; other air-to-surface weapons



A-7E Corsair II
Carrier-based medium attack bomber
Max. speed: 698 mph
Max. range: 2870 mi.

Armaments: 20mm gun; various air-to-air and air-to-surface weapons



TR-1A
High-altitude reconnaissance aircraft
Max. speed: 430 mph

Max. range: 3000 mi.
Armaments: None, but carries a variety of electronic sensors at 70,000-90,000 ft.



OV-10A Bronco
Low-altitude reconnaissance aircraft
Max. speed: 281 mph

Max. range: 1437 mi.
Armaments: Four 7.62mm machine guns; other air-to-air and air-to-ground weapons

PM A-10A, A-7E AND OV-10A ILLUSTRATIONS BY RON CARBONI

MISSILES AND ARTILLERY

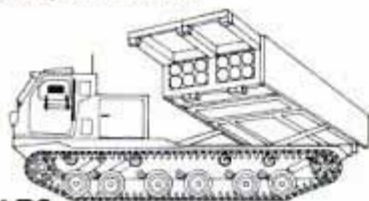


M109A1
155mm self-propelled howitzer
Max. speed: 35 mph

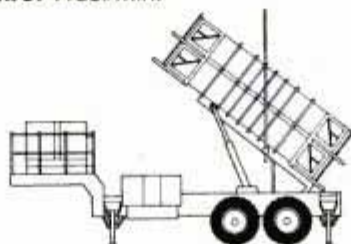
Max. range: 220 mi.
Max. projectile range: 14 mi.
Max. rate of fire: 4 rds./min.



M198
155mm towed howitzer
Weight: 15,600 pounds
Max. projectile range: 11.2 mi. (standard); 18.4 mi. (rocket-assisted)
Max. rate of fire: 4 rds./min.



MLRS
Multiple-launch rocket system
Projectiles per launcher: 12
Max. projectile range: 19 mi. (M77 submunition warhead); 24 mi. (AT-2 antitank mine warhead)
Rocket size: 13 ft. x 9 in.



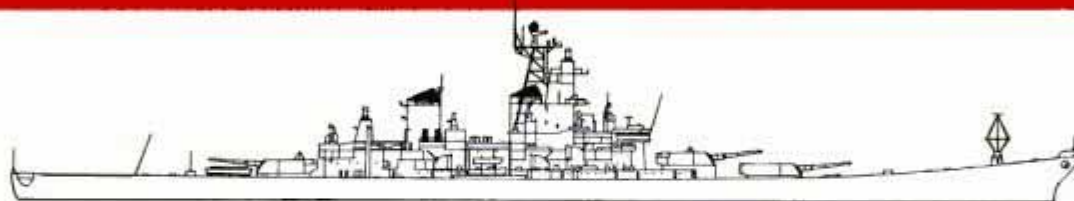
MIM-104 Patriot
Air-defense missile system
Missiles per launcher: 4
Max. missile range: 50-plus mi.
Max. missile speed: Mach 3
Missile size: 17 ft. x 16 in.



BGM-109 Tomahawk
Sea-launched cruise missile
Size: 21 ft. x 20 in.
Speed: Mach 0.7
Range: 1555 mi.
Circular error probable: 60 ft.

PM ILLUSTRATIONS BY RON CARBONI

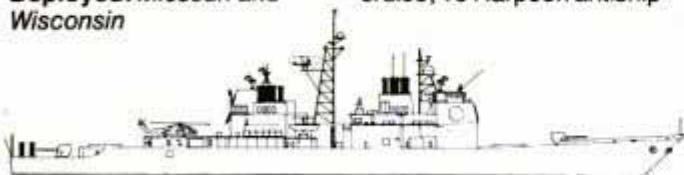
SHIPS



Iowa-Class Battleship
Deployed: *Missouri* and *Wisconsin*

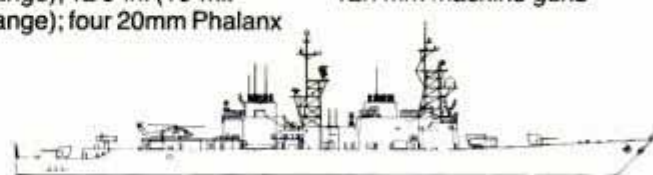
Missiles: 32 Tomahawk cruise; 16 Harpoon antiship

Guns: Nine 16-in. (23-mi. range); 12 5-in. (10-mi. range); four 20mm Phalanx (3000 rds./min.); four 12.7mm machine guns



AEGIS Guided Missile Cruiser
Deployed: At least 10
Missiles: 26 Tomahawk cruise; eight Harpoon antiship; 122 Standard surface-to-air; 20 ASROC antisub

Guns: Two 5-in. (14-mi. range); two 20mm Phalanx; four 12.7mm machine guns



Spruance-Class Destroyer
Deployed: At least eight
Missiles: 45-60 Tomahawk cruise; eight Harpoon antiship; 24 Sea Sparrow surface-to-air; 24 ASROC antisub

Guns: Two 5-in. (14-mi. range); two 20mm Phalanx; four 12.7mm machine guns

ROTARY-WING AIRCRAFT



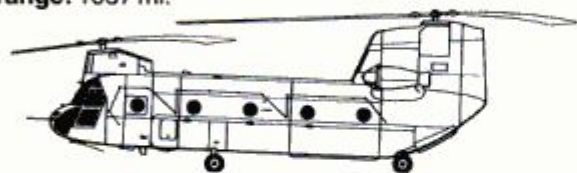
AH-64A Apache
Antiarmor attack helicopter
Max. speed: 227 mph
Max. range: 1057 mi.

Armaments: 30mm Chain Gun; Hellfire antitank missiles



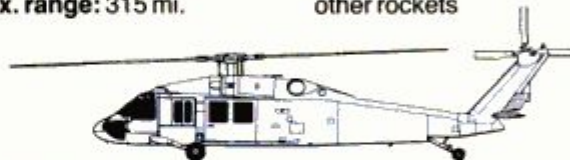
AH-1S HueyCobra
Attack helicopter
Max. speed: 195 mph
Max. range: 315 mi.

Armaments: 20mm gun; TOW antitank missiles; other rockets



CH-47D Chinook
Transport helicopter
Max. speed: 188 mph

Max. range: 1279 mi.
Armaments: None, but can take 12-ton cargo load



UH-60A Black Hawk
Assault helicopter
Max. speed: 184 mph
Max. range: 1380 mi.

Armaments: Hellfire missiles; 7.62mm machine gun

ARMORED VEHICLES



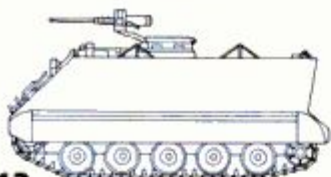
M1A1 Abrams
Main battle tank
Max. speed: 45 mph
Max. range: 288 mi.
Armaments: 120mm main gun; 12.7mm anti-aircraft gun



M60A1
Main battle tank
Max. speed: 30 mph
Max. range: 310 mi.
Armaments: 105mm main gun; 7.62mm machine gun



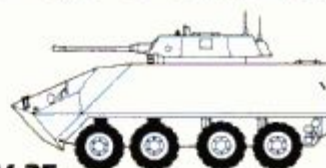
M2A1 Bradley
Infantry fighting vehicle
Max. speed: 42 mph
Max. range: 300 mi.
Armaments: 25mm Chain Gun; 7.62mm machine gun; TOW antitank missiles



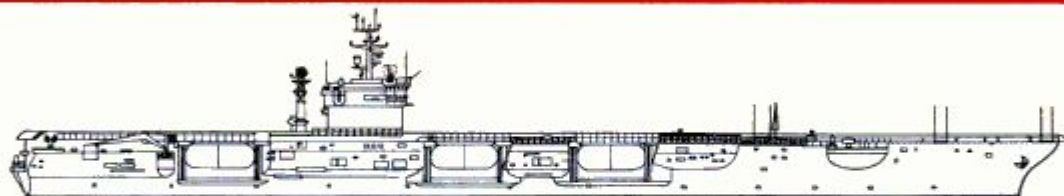
M113
Armored personnel carrier
Max. speed: 41 mph
Max. range: 369 mi.
Armaments: 12.7mm machine gun; various weapons systems



LVTP-7
Amphibious assault vehicle
Max. speed: 40 mph (land); 8 mph (water)
Max. range: 300 mi. (land); 55 mi. (water)
Armaments: .50-caliber machine gun



LAV-25
Light armored vehicle
Max. speed: 41 mph
Max. range: 415 mi.
Armaments: 25mm Chain Gun; 7.62mm machine gun; TOW missiles



Aircraft Carrier

Deployed: *Theodore Roosevelt, America, Ranger, Saratoga and Midway*

Typical attack airwing: 20 F-14; 20 F/A-18; 20 A-6E



Guided Missile Frigate

Deployed: At least 10 antiship; 36 Standard surface-to-air

Guns: One 3-in. (10-mi. range); one 20mm Phalanx; four 12.7mm machine guns



Amphibious Assault Ship

Deployed: At least eight one Marine battalion landing team
Typical complement: Four AV-8B Harriers; 16 CH-53D Sea Stallion helicopters;

TRUCK OF THE DECADE



1980 1981 1982

1983

1984

1985

1986

1987

1988

TOYOTA REMINDS YOU TO
TREAD LIGHTLY!
ON PUBLIC AND PRIVATE LAND

*R.L. Polk Registrations, 1980-1990.
© 1991 Toyota Motor Sales, U.S.A., Inc.



1989

1990

#1-SELLING COMPACT 4X4 TRUCK 1980-1990.*

In 1979 Toyota put an all-new generation 4x4 out on the street. It could haul and tow with the best of 'em. Its rugged stance told of its Land Cruiser lineage. It took what the young guys were dishing out. The word got around. By the end of the 1980 model year Toyota was the number one selling compact four-by. Over the years we put on more than a few pounds of payload and towing. A V6 was added. Our looks just naturally improved with age. As for toughness, well, the word on the street is we can still take what the young guys are dishing out.

But will we still be on top at the dawn of the next decade? Probably, but finding a bigger mountain could be a challenge.

"I love what you do for me."

 **TOYOTA**

AUTOMOBILES

SUNCHASERS

If you're in the market for a convertible this spring, start your shopping here.

BY TONY SWAN, Automotive Editor

● It's spring again. The convertibles have come out of hiding. Your best friend just zoomed by in something red and topless, with someone who looked a lot like Madonna draped all over him. And you told yourself, this year I *will* have a ragtop.

But what's available? And for how much?

Relax. Anticipating your spring fever, here's a sampler of just about every convertible sold in America. Check these pages before you shop. As for the Madonna lookalike, well, that part's up to you.



ALFA ROMEO SPIDER

BASE PRICE: \$20,950

The basic design of the Alfa Romeo Spider has been around since 1966, and still looks good. Updates for '91 include a new front bumper and rear-end treatment (the ugly rubber spoiler is gone), plus an optional automatic

transmission. Two models—Spider and Spider Veloce (\$22,950)—are available, both powered by a 120-hp dohc alloy Four. The Veloce adds alloy wheels, fatter tires and leather seats. Veloce buyers can also add a removable hardtop.



ASTON MARTIN VOLANTE

BASE PRICE: \$225,000*

If you want prestige and performance to go with your fresh air, we can't think of any ragtop to rival this one. Aston Martin's Volante version of the Virage coupe packs 330 hp in its 32-valve 5.3-liter V8—enough to

hustle this big (4224-pound), stylish 2-seater to 100 mph in 16 seconds, with a top speed of 150-plus. Best of all for a luxury tourer like this, the handling matches the speed. Put this one at the top of your wish list for the day you win the lottery.



BENTLEY CONTINENTAL

BASE PRICE: \$225,900

Yearning for Rolls-Royce elegance, but worrying about what the neighbors will think? Here's one solution. The Bentley Continental is a Rolls-Royce Corniche, minus the Flying Lady hood ornament, which

saves you a thousand bucks, enough for a nice picnic at your next polo match. Inside, it's the same sumptuous, handcrafted symphony of burled walnut and Connolly leather, with the familiar 412-cu.-in. V8 under the hood.

* Estimated



PONTIAC FIREBIRD TRANS AM

BASE PRICE: \$22,980

While there have been topless Pontiac Firebirds on the road prior to now, this is the first time you'll be able to buy one through Pontiac dealers with a full factory warranty. Tops (black or tan) are manually operated. The

convertible will be offered either in Trans Am or standard Firebird (\$19,159) trim levels. Engine options on the convertible will include a 140-hp V6, 170-hp TBI 5.0-liter V8 and 205-hp port-injected 5.0-liter V8 (standard on Trans Am).

PW PHOTO BY RICH COX



BMW 325i

BASE PRICE: \$35,700

This Bimmer begins life as a coupe, but even in convertible trim as taut and responsive as most sports cars, and bolted together better than most. BMW's 165-hp 2.5-liter sohc straight-Six provides lively

performance to go with excellent handling. If you want BMW panache and handling, but 35 grand is a stretch, a 318i ragtop will be available this year, starting at \$28,500. This one's propelled by a 134-hp dohc 16-valve Four.



BUICK REATTA

BASE PRICE: \$35,700

Buick pointedly refrains from calling the Reatta a sports car, but its performance is far from ho-hum, thanks to GM's torquey 3800 V6. Add competent handling, standard antilock braking and improved steering, and

you've got a 2-seater that can hold its own in some pretty sporty company. As you'd expect, there are lots of creature comforts, and the ragtop Reatta measures up as one of the roomiest 2-seaters on the market, with lots of lockable storage.

SUNCHASERS



CADILLAC ALLANTÉ

BASE PRICE: \$52,250

Conceived as a direct competitor for the Mercedes SL series, the Pininfarina-designed Allanté now finds itself with a substantial price advantage over the new roadsters from Benz. Performance from the

aluminum 4.5-liter V8 is stirring—0-60 mph in about 8 seconds—and handling is also a strong suit. The soft-top, though still manually operated, is improved for '91, as is build quality—something that plagued early models.



CHEVROLET CAMARO Z28

BASE PRICE: \$21,284

Though the basic design dates back a decade, Chevy's Camaro still looks hot, particularly so in topless trim. If the Z28 price tag seems a bit high for your budget, check out the RS version, which starts at

\$15,914. Like Firebird, there are three engine options: 140-hp V6, 170-hp TBI V8 and the Z28's standard 205-hp port-injected V8. All the engines can be mated to either 4-speed automatic or 5-speed manual transmissions.



CHEVROLET CORVETTE

BASE PRICE: \$39,300

Aside from the addition of small gill-like vents behind the front wheel wells, the Corvette convertible is basically unchanged for 1991—which means that it's still one of the sexiest roadsters on the road.

Chevy's chassis engineers have done a good job of maintaining the Vette's superb handling in the topless version, and the 245-hp 5.7-liter port-injected L98 V8 continues to make this one of the fastest ragtops sold in America.



CHRYSLER LEBARON GTC

BASE PRICE: \$18,100

According to Chrysler, this is not only the best-selling convertible in America, it's the best-selling convertible on the planet. The GTC includes a 141-hp 3.0-liter V6 as part of the package, which is new for '91. If you

want more speed, you can order the 152-hp 2.5 Turbo, and there are three transmission options: 3- and 4-speed auto, 5-speed manual. The basic ragtop (\$15,705) has a 100-hp normally aspirated version of the same powerplant.



CHRYSLER TC BY MASERATI

BASE PRICE: \$37,000

Here's one that could very well become a collector's item. Built in Milan, this joint Chrysler-Maserati design is a limited edition of 7300 cars total, and '91 will be its last year on the market. The TC is roomy, leather-lined and

comes with two tops: one foldable (manually), one a detachable hardtop. The 3.1-liter V6 (the only engine offered) is on the tepid side (141 hp) but, working with Chrysler's 4-speed automatic, it's quiet and ultrasmooth.



DODGE SHADOW

BASE PRICE: \$12,995

Like so many cars, the trim little Shadow actually gets better looking with its top removed. New for '91, the ragtop Shadow is available with two engine options—a 100-hp sohc 2.5-liter Four or 152-hp turbo version of the

same engine—mated to either a 5-speed manual or 3-speed automatic. The turbo version is gratifyingly quick. The top is manually operated, assisted by gas struts, and the rear quarter windows roll down automatically.



FERRARI MONDIAL

BASE PRICE: \$105,650

Thanks to the activities of speculators, *anything* wearing a Ferrari badge has become collectible, which shows in the price of the Mondial—the only true convertible in the Ferrari lineup. Power is plentiful,

thanks to a 296-hp 3.4-liter dohc 32-valve alloy V8. Handling is precise, if a trifle heavy, and braking (ABS standard) is superb. Besides the basic appeal of Ferrari panache, here's one car that will actually increase in value as time goes by.



FORD MUSTANG GT

BASE PRICE: \$19,864

When we say the Mustang convertible is an old favorite, we're not kidding. The current rear-drive platform traces its heritage all the way back to the Ford Fairmont, although the chassis engineers work hard

to keep it current. The basic Mustang ragtop, powered by Ford's 88-hp 2.3-liter sohc Four, is a good buy at \$16,222. If you want the muscle of Ford's 225-hp 5.0-liter V8, but want to save some dough, check the LX, which lists for \$16,652.



Geo METRO

BASE PRICE: \$9740

They just don't get much cuter than this. Built in Japan by Suzuki, the little (89.2-in. wheelbase, 146.1-in. overall) Geo Metro seats two, and has a parcel shelf in the rear. Power (55 hp at 5700 rpm) comes from a

tough little 1.0-liter sohc 3-cylinder engine, along with a 50 mpg EPA highway cycle fuel economy rating. Performance can be called adequate with the standard 5-speed, but it's downright sluggish with the optional 3-speed automatic.



JAGUAR XJ-S

BASE PRICE: \$59,900

The things that make the standard XJ-S coupe so appealing—262-hp 5.3-liter sohc V12 engine, leather interior, walnut trim—are positively seductive here. The ragtop version is unquestionably better

looking than the somewhat dated lines of its hardtop sibling, and, like most convertibles, should hold its value better too. ABS is standard, and while the XJ-S can't really be called a sports car, it's silky smooth and sneaky fast.



LOTUS ELAN SE

BASE PRICE: \$39,340

The name's familiar, but this nifty newcomer has a couple departures from traditional Lotus gospel—it's front-drive, powered by a 1.6-liter dohc 16-valve Four from Isuzu. Power-to-weight—162 hp, 2350 pounds

—is textbook Lotus, though, as is the handling. The new Elan's price obviously takes it beyond the realm of toys. But for the driver who wants a serious sports roadster that he won't see in every parking lot, this one's worth a hard look.



MAZDA MX-5 MIATA

BASE PRICE: \$14,700

This is arguably the best-loved sports car sold in America, and for good reason. The Miata updates the joys of the old British roadsters with a modern 1.6-liter dohc twin-cam Four, contemporary suspension

and a top that actually keeps heat in and weather out. The folding top is wonderfully simple to use, and an optional hardtop is available. Nimble, peppy and well-made, we rate the Miata as the best sports car buy on the market today.

PHOTO BY JOHN LAWAN

SUNCHASERS



MAZDA RX-7

BASE PRICE: \$28,150

Somewhat shrouded by the acclaim surrounding its smaller sibling, the RX-7 continues to be one of the most pleasant and polished ragtops on the road. Distinctions in handling between coupe and

convertible are all but indistinguishable, and the general level of fit and finish is very high indeed. And even though it lacks low-end torque, the 160-hp rotary engine—an RX-7 exclusive—is a very smooth traveling companion.



MERCEDES-BENZ 300/500SL

BASE PRICE: \$78,500/\$89,500

These are the world's most sophisticated roadsters, bar none, and likely to be worth more at trade-in time than they are new. Progress is leisurely with the 228-hp dohc 24-valve Six, but the 322-hp dohc 32-valve V8 is

equal to the car's substantial 4150-pound mass. Tech highlights include a rollover bar that automatically deploys when peril impends and an automatic power top that qualifies as entertainment.



MERCURY CAPRI XR2

BASE PRICE: \$15,920

This is Ford's answer to the Mazda Miata, and if it's not quite as compelling, it is a little more versatile. Seating is 2+2, and there are two engine options: the base (\$12,580) 1.6-liter sohc Four (100 hp) and an optional 16-

valve intercooled turbo version of the same engine rated at 132 hp. We'd characterize the front-wheel-drive Mercury Capri's handling as sporty, and its ride quality as good. A removable hardtop is offered as an option.



OLDSMOBILE CUTLASS SUPREME

BASE PRICE: \$20,995

To keep conversion costs in hand, Olds had to retain a targa-style bar amidships in the Cutlass Supreme convertible. That's where the door handle hardware hides. Whatever you may think of this arrangement from

an aesthetic point of view, the yield is a smooth and roomy 5-seat ragtop that's long on comfort. Go-power from the 140-hp 3.1-liter sohc V6 is so-so, but thoroughly civilized. Leather upholstery and ABS braking are optional.

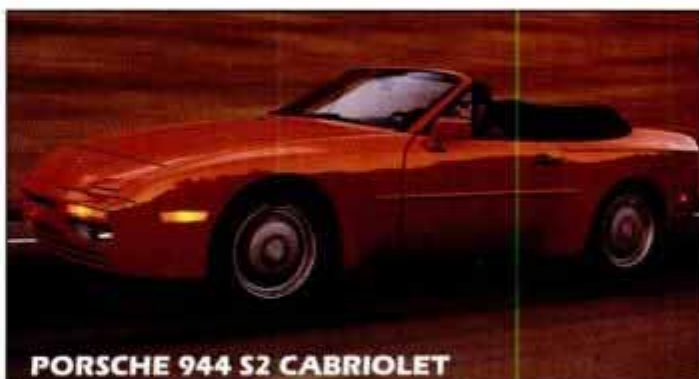


PONTIAC SUNBIRD

BASE PRICE: \$14,414

Pontiac has done a good thing for the little 4-seat front-drive Sunbird. The old 2.0-liter turbo Four option has been replaced by GM's 3.1-liter V6. This means less horsepower (140 versus 165), but it's a smoother and

much more manageable setup. The base engine continues to be a 96-hp 2.0-liter sohc Four, and the Sunbird's top goes up and down at the touch of a button. A sports suspension package is offered as an option.



PORSCHE 944 S2 CABRIOLET

BASE PRICE: \$50,350

Porsche is better than most at compensating for the loss of structural rigidity that goes with convertibility, and the 944 S2 is rolling proof. It's tight, and gives little if anything away to the S2 coupe in handling. There's

plenty of power (208 hp) from the dohc 16-valve Four, and the braking system (ABS standard) is nothing short of exemplary. Beyond the leather upholstery option, there's little to add to the 944's substantial list of standard equipment.



PORSCHE CARRERA 2 CABRIOLET

BASE PRICE: \$69,300

If there's a more successful convertible conversion on the market than this one, we don't know about it. The 911 ragtop is as rigid as something made from bridge girders, and the recent redesign makes this the

best-handling 911 yet. With 247 hp on tap in the immortal Porsche sohc flat-Six, it's fast by any definition, and it's also available in 4wd Carrera 4 (\$80,600) trim. Best of all, it's hard to lose money on any 911-series Porsche.



ROLLS-ROYCE CORNICHE III

BASE PRICE: \$226,700

This is autodom's way of saying you make too much money. Sumptuously handcrafted inside and out, the Rolls pampers you all the way—from its electronically controlled suspension to its lambswool

and leather interior. True, the price equals a nice house, but we wouldn't mind living in this one, and we're still glad that Rolls sticks to its lofty standards. Before you buy, though, you better make sure you're square with the IRS.



SAAB 900 TURBO

BASE PRICE: \$33,295

A show car that reached production by popular demand, the Saab 900 convertible continues to deliver the kind of performance, durability, individuality and comfort that have distinguished this

family for so long. Power (160 hp) comes from Saab's smooth dohc 16-valve turbo Four, mated to a 5-speed manual (recommended) or 3-speed automatic. ABS is standard equipment, and the well-made top is power-operated.



TOYOTA CELICA GT

BASE PRICE: \$18,953

This is the third generation of Toyota Celica convertibles, with the conversion handled capably once again by ASC. The top-chopping and structural reinforcement is performed on the Celica GT coupe, with

Toyota's 130-hp 2.2-liter dohc 16-valve Four delivering power to the front wheels. The premium sound system should be audible even at maximum speed with everything open, and the top stores tidily behind the rear seats.



VOLKSWAGEN CABRIOLET

BASE PRICE: \$16,540

Besides being a pretty good buy to begin with, the VW Cabrio is a real champ at holding its value. Like every VW convertible dating back to the Bug, the 4-seat Cabriolet is produced by Karmann, and is top quality

inside and out. Power (94 hp) comes from VW's solid 1.8-liter sohc Four, and handling is the equal of many so-called sports cars. The same goes for braking. A welcome plus for '91 is the availability (optional) of a new power-operated top.

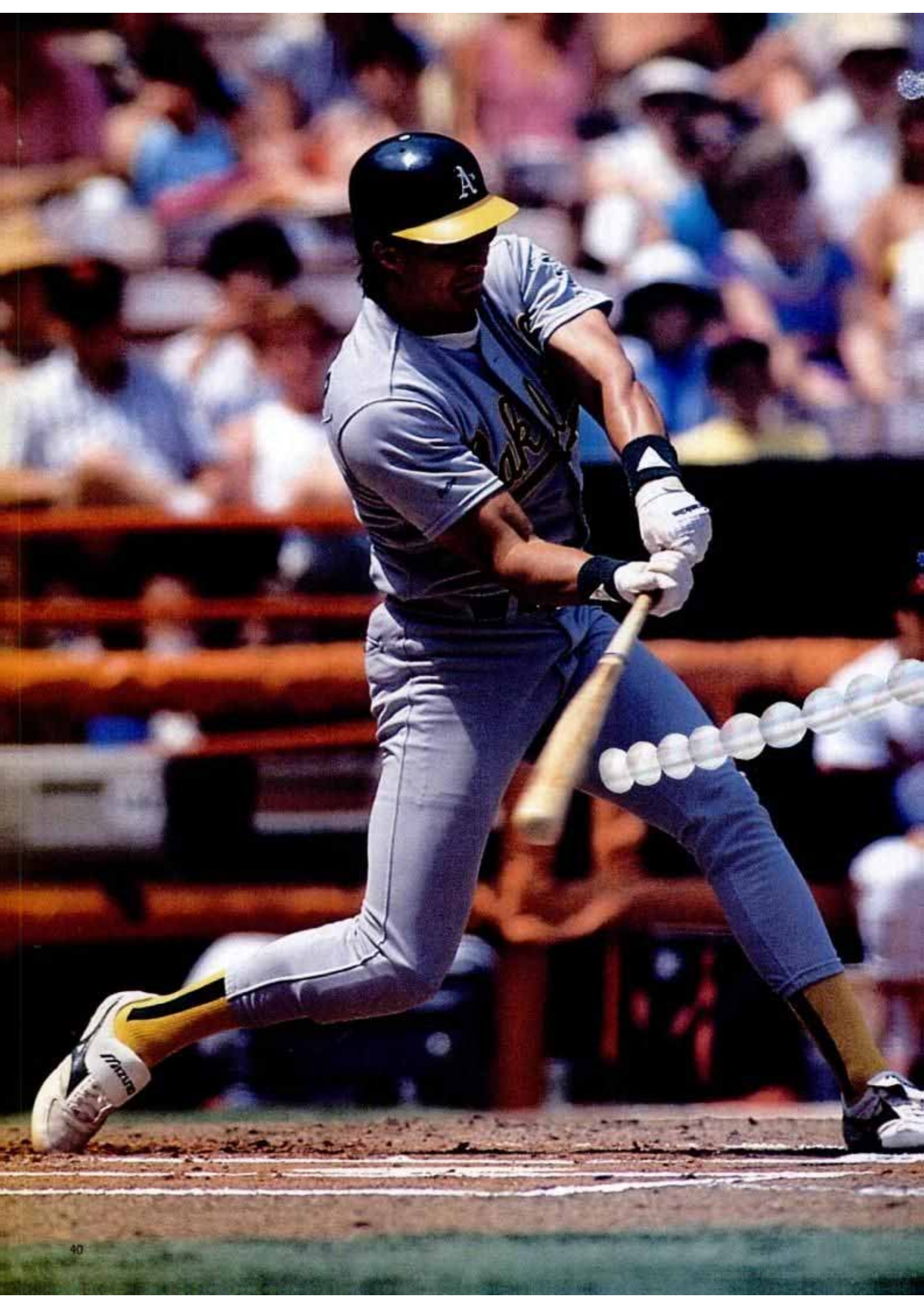


YUGO CABRIO

BASE PRICE: \$8025

We have to admit that the Yugo Cabrio gets high marks on the cuteness scale, and it's also cheap—the cheapest convertible automobile on the market. There's not much in the way of muscle.

The 1.3-liter sohc Four makes only 61 hp, but it only has to haul 2000 pounds of car. Niceties include a fair-sized trunk, zip-top storage pouches built into the seatbacks and, remarkably, a power convertible top as standard equipment. **PM**



THE MECHANICS OF A HOME RUN

A lot of science is happening every time Jose Canseco blasts a homer—even if he doesn't know it.

BY LOU PINIELLA

● The home run can win a ball game for you with one swing of the bat. No question. It's the most exciting hit in baseball.

By extension, the guys who can smash a baseball 400 ft. or more over a fence are among the most exciting players in the game. Everybody wants to see a Jose Canseco or a Cecil Fielder swat a baseball out of the park.

How far can a baseball be hit? The oldtimers talk about Mickey Mantle hitting one 565 ft. I've seen some audacious shots but never one in the 500-ft. category. The longest shot I saw in 1990 was 450 ft., and I'd say 450 to 475 ft. is about as far as a human being can hit a baseball without help from the elements.

Among today's hitters, Canseco of the Oakland A's hits the long ball the most consistently. When he is healthy, it's almost worth the price of admission to watch him in batting practice. He propels them. Other big home-run hitters include Fielder of the Detroit Tigers, Darryl Strawberry of the Los Angeles Dodgers, Ryne Sandberg of the Chicago Cubs, Kevin Mitchell of the San Francisco Giants and even our own Eric Davis. Dave Justice with the Atlanta Braves is an up-and-coming home-run hitter.

Schools of thought

There are basically two schools of thought when it comes to hitting a baseball. One school of thought was developed by Ted Williams, the legendary Boston Red Sox slugger. The

Lou Piniella is manager of the 1990 World Champion Cincinnati Reds.

Jose Canseco of the Oakland A's is one of the best home-run hitters today.

Williams school emphasizes a rotation of the hips to generate power.

The second school of thought is best articulated by Charley Lau, a former coach with the Kansas City Royals, New

York Yankees and others. The Lau school puts a premium on making contact with the ball. Lau asks you to keep your head down and shift your weight from back to front as you swing.

While Ted Williams was my idol as a child, I'm philosophically more in the Charley Lau school. If you throw your hips as Williams recommends, your hands are going to drag and your swing is going to be a little longer. Your navel is going to lead, and your hands are going to catch up a little late.

With the Williams approach, it is much easier to hit the low ball. On the low pitch you have more time to catch up to the ball. The higher a pitch is in the strike zone, the harder it is to catch up to it. Your swing has to be shorter and more compact.

The problem is that as the ball moves up the strike zone, it will hop a little more and have 2 to 3 miles per hour more velocity.

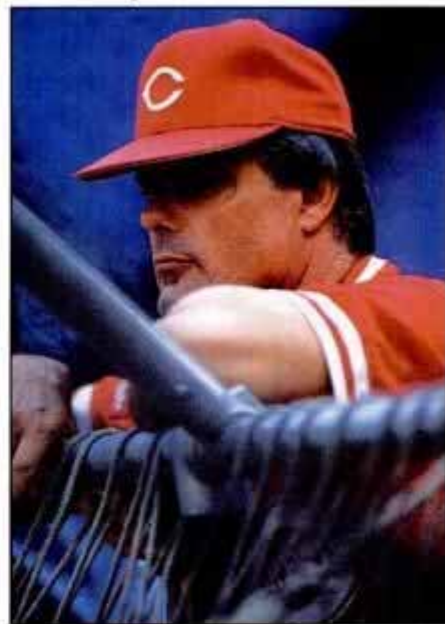
The hitting method I'm going to describe is fundamentally derived from the Lau school, but with a variation designed to deliver more power. Does it work? Chris Sabo on our team upped his home-run production from eight to 25 using this approach.

The stance

What you want in your stance is balance. Balance allows you to do a lot of things. It allows you to get a good weight shift. It allows you to go out after a breaking ball. It allows you to wait on an off-speed pitch.

The way George Brett of the Kansas City Royals stands in the batter's

box is nice to see. The good hitter will lean forward across the plate and then shift his weight back. One way to set your balance in this manner is to reach across the plate with your bat. I used to do this every at-bat. It was a great balancing trick for me. Brett does this also. He leans out, touches the other side of the plate, and he's ready to hit a baseball. He knows exactly how much extension he needs to the outside of the plate.



In terms of positioning the feet, the home-run hitter cannot have a very closed stance—meaning one in which the front leg is closer to the plate than the back leg. Most of the guys hitting the ball out of the park have a slightly open or square stance. This means that the front leg is a degree or two off a straight line that can be drawn from the back leg of the batter to the pitcher. Even if they start out slightly closed, they'll all wind up slightly open when they're done.

Home-run hitters don't have very

THE MECHANICS OF A HOME RUN

THE POWER SWING



Home-run hitters use a front-knee cock to get their weight back. The front-knee cock acts like a trigger and also gets the batter's hands back. As the ball enters the hitting zone, the hands lead the body through the swing. The bottom hand provides the extension needed to cover the

SWEET LOU'S HOT SPOTS



wide stances. Most stances are about shoulder width—a position that allows them to stride and make good use of the weight transfer in their lower bodies when they swing.

Once you're in the batter's box, don't lock into a stance. There should be a little movement in the feet. Like a tennis player awaiting a serve, your feet should not be stationary. If a tennis player can return a fast-moving ball off movement, that tells me you

can get set to swing off movement quicker than you can from a stationary position.

The trigger

All home-run hitters have one thing in common—the front-knee cock. It's really their trigger to get everything going. When the knee cocks, you're shifting weight to the back leg and getting ready to drive off it. In base-



Some pitches are more likely to be hit for home runs than others. Baseball people always tell pitchers to "keep it low." The truth is most home runs come on down-and-in fast balls and breaking balls that let hitters fully extend. More home runs are hit when the ball is in the red zone. The orange zone is No. 2 and the yellow zone is No. 3. It becomes progressively more difficult to hit a home run when the ball is in the green, blue and purple zones. The blue zone jumps to the No. 1 spot for hanging breaking balls.

In The Lab

● The batting technique described by Lou Piniella is basically designed to generate more bat velocity—we call it bat speed. Anything you can do to generate more bat speed should drive the ball a greater distance.

Dr. Peter Brancazio of the Brooklyn College physics department ran some tests in his lab regarding baseball bats themselves. Brancazio says that the newer bats—those with an inch-deep scoop of wood removed from the top—are theoretically the best to use if you want to hit a ball a long distance. That's because the mass, or weight, is removed farther away from the bat's pivot point at the handle. The net result is that you get around quicker on the pitch.

Dr. Robert Watts, a mechanical engineer at Tulane University, calculates that a hitter using a 32-ounce bat generates a bat speed of about 70 mph. If someone had the nerve to use a 26-ounce bat, the bat speed would rise to 72 mph. The extra velocity would drive the ball an extra 15 to 20 ft., Watts says.

This is in the lab, of course. Out on the field, it's a different story and lab findings may not apply. —F.V.

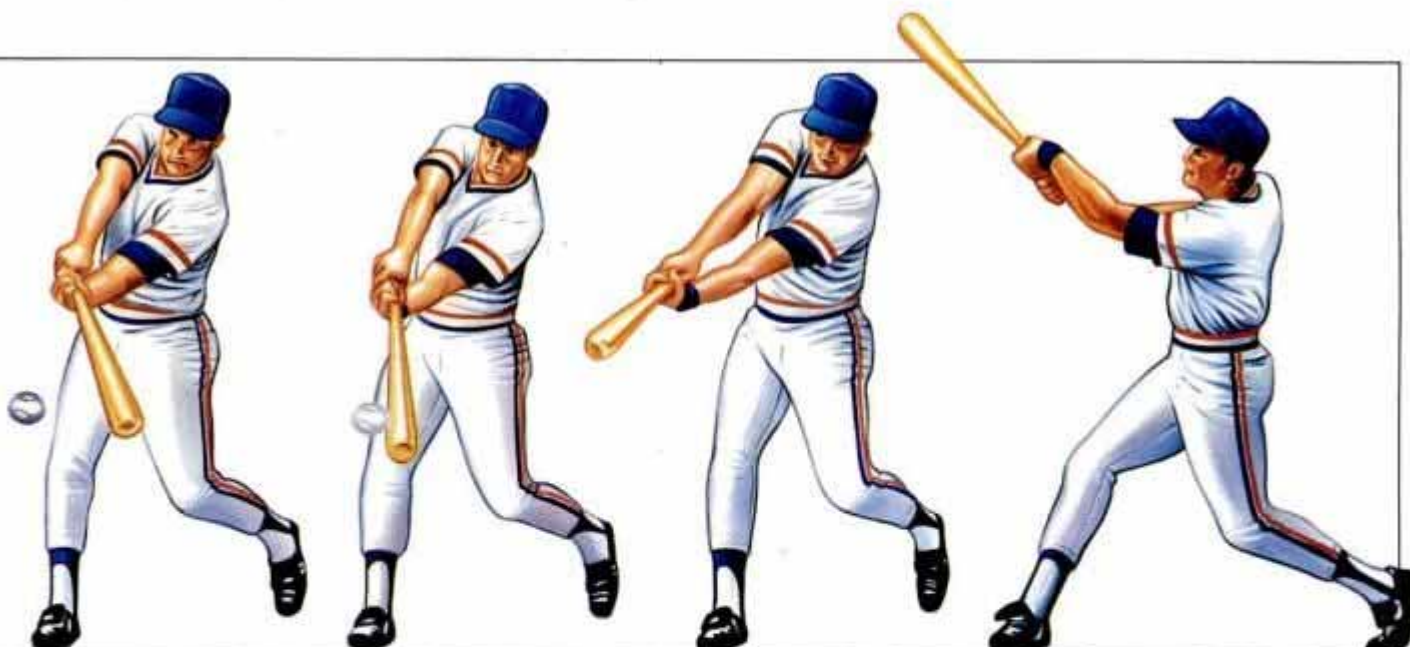


plate and supplies power. The top hand guides the bat. After contact is made, the hands grip the bat in the follow-through. This produces a total weight shift that helps generate the power needed to hit the ball out of the park.

ball, you have to go back before you can go forward. As the knee is cocked, you get a small turn at the hip and at the shoulder. This turning motion helps the hitter get his hands back.

At this point, the great home-run hitters do something you can't teach. Amazingly, most of your home-run hitters don't have classic swings. Most of them have hitches—a little up/down motion with the bat at the start of their swing that's just innate. The hitch is almost like cocking a pistol before the trigger is pulled. Canseco's got a hitch. So does Fielder and Strawberry. If they weren't successful, they'd be trying to get it out of their swings. You don't need a hitch to hit your fair share of home runs—Sabo doesn't have one. Nevertheless, a lot of the big home-run hitters have that hitch.

Hitch or no hitch, at this point there should be a straight line coming up from your back foot through your hip to the top of your back shoulder. This is a power position.

Your shoulders should be fairly horizontal at the start of the swing, but as you make contact, the front shoulder is going to be a little higher than your back shoulder. This is because there's no such thing as a level swing. Everyone swings slightly up. Home-run hitters swing slightly more up than other hitters. The higher you finish, the more power you get—not to mention lift.

A loose bat

The bat should be held in a relaxed, loose grip. Somebody should be able to pull it right out of your hands. The bottom hand should grip the bat a little more tightly than the top. The bottom hand is the lead hand because this hand gives you the extension.

All your home-run hitters get bottom-hand extension. That's what gives them power. Everyone thinks the top hand gives you power, but the bottom hand provides most of it. The top hand steers the bat. If the top hand dominates the swing, the bat will be in and out of the hitting area very quickly. With bottom-hand extension, you stay in the hitting area much longer.

Now here's where I disagree with



Cecil Fielder of the Detroit Tigers hit 51 homers last year. Note the follow-through.

Lau and his disciples. They suggest bottom-hand extension, but with top-hand release of the bat upon contact. I don't agree with that because you lose power. You're not getting the back side of your body to drive through the ball.

If you look at your home-run hitters, there isn't one that lets the top hand go off the bat. The bottom hand gets the hitter to the ball. The top hand gets the hitter through the ball.

By holding onto the bat with both hands into the follow-through, you get a total weight shift that delivers more power into the swing.

You only let go of the bat when you've driven all the way through the ball—when it's no longer physically possible to hold onto the bat because the bottom hand has extended well beyond the top hand's ability to hang on. At that point, your back foot is slightly off the ground or has pivoted so only the toe is touching the dirt.

With the Lau method, you get a pretty good lateral weight shift, but not a total weight shift. Without a total weight shift, you can't generate the power to drive the ball out of the park as consistently. With Lau, the front foot may skate forward a little and the top hand leaves the bat upon contact. There is no trigger or top-hand follow-through to generate a total weight shift for power hitting. Likewise, I disagree with the Williams method of throwing the hips at the ball. I believe in throwing the hands at the ball and letting the hips follow the hands.

Technique helps a lot, of course, but a lot of what comprises a home-run hitter occurs naturally. There's the hitch for one thing. Home-run hitters also go to the ball quicker. They don't take a long time deciding on whether or not to swing.

For the most part, home-run hitters use a bat that is 2 to 3 ounces heavier than most, with a thin tapered handle and lots of barrel at the end. It takes a man to swing it. Home-run hitters want a club to slug the ball. When they connect properly, the ball is as likely to go out of the park as it is anywhere else.

PM

Electronics Editor Frank Vizard assisted in the preparation of this article.

Chevy S-10 Pickup. More Truck Per Buck.



Chevy S-10 Tahoe. More power than Ford Ranger XLT—for less than ten grand.

Chevy S-10 Tahoe has real V6 appeal. And this idea alone can drive you wild: You can get this 1991 Chevy S-10 Tahoe, with uplevel trim and V6 power, for less than \$10,000* You can't get this kind of power in a Ford Ranger XLT for less than ten Gs.

You also get more torque, a bigger pickup box and a larger standard fuel tank. Plus Rally Wheels, Two-Tone paint, sliding rear window, AM/FM stereo with cassette and more for less than ten grand. No wonder more truck owners switched to Chevy last year than to any other truck.†



*M.S.R.P. including dealer prep, tax, license, destination charge and other optional equipment additional.
†Based on 1989 light-duty truck registration data. **Includes cargo, passengers and equipment.
Chevrolet, the Chevrolet emblem and S-10 are registered trademarks and Chevy is a trademark of the GM Corp. © 1991 GM Corp. All Rights Reserved.
Let's get it together. Buckle up.

Chevy S-10 EL. Better gas mileage than the leading import. At a nice, low price.

Chevy S-10 EL is one of the lowest-priced pickups you can find. You get rear-wheel anti-lock brakes, tinted glass, halogen headlamps and a 1529-lb. payload.** Its powertrain includes a 2.5-liter electronically fuel-injected engine hooked to a 5-speed manual gear box.

Yet Chevy S-10 gets better fuel economy than the leading imported compact pickup. Think about that the next time you buy gas.

| | |
|---------------------|-------------|
| EPA EST. MPG | |
| CITY | HWY. |
| 23 | 27 |

More People Are Winning With *The Heartbeat*  of America. TODAY'S TRUCK IS CHEVROLET.™

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COMPARISON TEST

WALLEYE

Location: Green Bay. Boats: High-powered walleye fishing machines. Purpose: A 5-way shootout.

BY JOHN WOOLDRIDGE; PM Photos by Skip Gandy



WARRIORS

● Even a bad day fishing is better than a good day doing most anything else, especially if you're pulling in big walleyes. The appeal of this sweet-tasting member of the perch family has exploded in the past few years. Gone are the days when tournaments were low-entry-fee affairs filled with tiller-steered aluminum runabouts. Today, wall-

eye tournament payouts approach \$100,000, and as the stakes climb, powerful, sport-specific boats are beginning to dominate.

PM lined up five of these walleye warriors for three days of testing on Green Bay's northern rim in Michigan's Upper Peninsula. The 18-footers were equipped with Mariner Magnum II 150-horse outboards, Mariner 9.9-horse kickers and bow-mounted electric trolling motors.

We ran the boats through a battery of tests with the radar gun,

stopwatch and measuring tape. We ran and fished in conditions that ranged from dead calm to a 3-ft. chop. Special note was taken of backtrolling characteristics, which veterans claim is the make-or-break feature of a true walleye boat. Here's what we found.

Crestliner V180 Viking Pro Am

When it comes to aluminum boats, Crestliner is an innovator. These welded, rivetless rigs are so meticu-

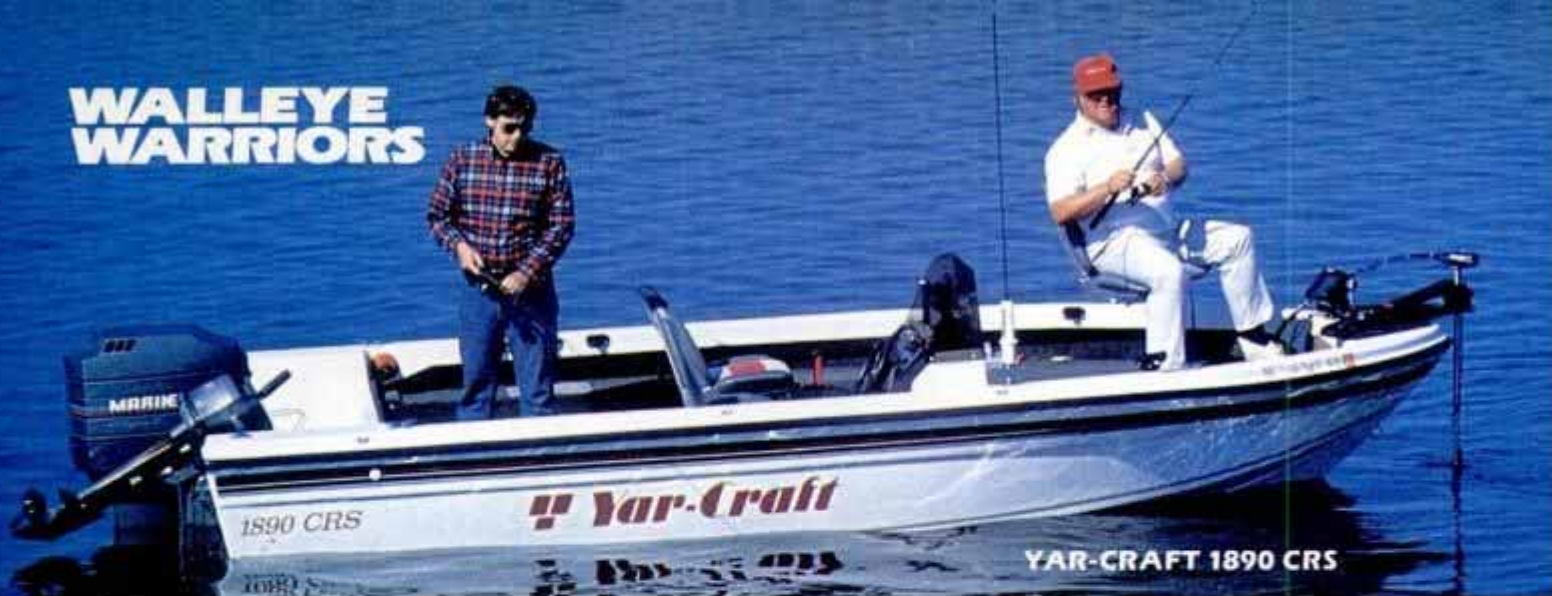


lously built that most people mistake them for fiberglass boats at first glance. The V180 Viking Pro Am is Crestliner's new top-of-the-line tournament walleye boat, and the builder is proud of the pains it took to bring it to market. It should be. The Viking Pro Am is our overall comparison test champ.

With top scores in fishability, fit and finish, and livewell/baitwell storage space, the Viking Pro Am scored ahead of other boats that were a shade faster—a point that many speed-obsessed builders often forget. While it didn't smoke the competition, the Crestliner is far from slow. It finished within a hair's breadth of the leaders in hole shot and on the performance course.

Deployment of walleye weapons from left to right: Crestliner V180 Viking Pro Am, Skeeter S-150-HP, Lund Tournament Pro-V 1800, Champion Fishhunter and Yar-Craft 1890 CRS. A just-reeled-in, trophy-size walleye (inset, opposite page) tests the capacity of the Skeeter livewell.

WALLEYE WARRIORS



YAR-CRAFT 1890 CRS

It was a close third in top end.

Top marks in fishability were based on a functional layout, outstanding backtrolling characteristics, huge aerated wells and the second largest deck area.

Fit and finish, as mentioned, is remarkable. Of special note are the baked-acrylic enamel paint and insulated hatch lids that fit into drained sleeves.

It may surprise some boaters that an aluminum boat could compete with fiberglass rigs in a comparison test, but few companies build them like Crestliner. Fewer still have a champ in the line like the Viking Pro Am.

Yar-Craft 1890 CRS

A Yar-Craft 1781 TPS won the last PM walleye-boat shootout two years ago, and the new 1890 CRS nearly walked away with the current crown. The new 1890 CRS finished with top rankings in fishability, fit and finish, and usable deck area. It was near the top in all other categories.

There are too many excellent features to list, but two we especially liked are the double-flared bow and a Marincor plug-in battery charger.

While Yar-Craft's performance numbers were middle of the pack, the 1890 CRS was the clear fiberglass-hulled winner in the fleet.

Lund Tournament Pro-V 1800

While the Pro-V 1800 missed a second-place ranking by the slimmest of margins, its overall high marks clearly place it in the upper echelon of our comparison test.

The smooth-handling Lund smoked the fleet on the performance course—it was the only boat to make it through the hard turns at full throttle—and in hole shot. Stowage and fishability were also among the Pro-V 1800's strong suits.

Top features of the Pro-V 1800 include two built-in, multidrawer tackle boxes, an aft electronics compart-

TEST PARAMETERS

Top-end, acceleration and performance course (two hard turns and a 180° turn) data are averages of three runs with two riders and matched fuel loads. Fishability rankings are result of analysis of bow thruster and backtrolling control on a crosswinded course. Other fishability factors include ease of operation and practicality of layout. Bold numbers on each line in the chart indicate ranking.



| MAKE/MODEL | 1. CRESTLINER V180 VIKING PRO AM | 2. YAR-CRAFT 1890 CRS |
|-------------------------------|--|--|
| LOA/Beam/Weight/Fuel Capacity | 18' / 83" / 1729 lb. / 40 gal. | 18' 3" / 90" / 1684 lb. / 36 gal. |
| Top End | 3. 47.5 mph, fast enough for walleye, rock solid | 5. 46.5 mph, not far from the other V-bottoms |
| Acceleration 0-35 mph | 2. 5.64 sec., spirited performer | 3. 5.93 sec., quick to plane |
| Performance Course | 2. 25.64 sec., nimble and responsive | 3. 25.97 sec., lively cornering |
| Fishability | 1. (tied) great backtrolling and fishing features | 1. (tied) superb backtroller and layout |
| Livewell/Baitwell Space | 1. 6.8 cu. ft., big, functional spaces for big fish | 3. 5.5 cu. ft., balanced approach to enclosed space |
| Stowage | 5. 17.0 cu. ft., larger livewells a tradeoff | 3. 20.8 cu. ft., enormous rod locker |
| Deck Area | 2. 70.9 sq. ft., expansive, everything in its place | 1. 77.7 sq. ft., four can fish from this one |
| Fit and Finish | 1. (tied) beautifully detailed, a fiberglass lookalike | 1. (tied) exceptional workmanship |
| Price | \$18,850 | \$18,995 |
| Address | Crestliner, 609 13th Ave. N.E., Little Falls, MN 56345; (612) 632-6686 | Yar-Craft, 1213 20th Ave., Menominee, MI 49858; (906) 863-4497 |

MARINER 150 MAGNUM II

Test boats were equipped with 60", V6 150-hp Mariner Magnum II outboards. Oil injection, low-copper aluminum-alloy castings, loop charging, high-capacity 40-amp alternator/voltage regulator, and trim and tilt are standard. Price is about \$9800. Kicker motors were Mariner 9.9s.

Removable windshield. Padded tilt steering wheel. Generous legroom. Side pocket for stashing items.



Helm seat fixed in place to accommodate large cooler in base. Legroom is adequate. Throttle mounted slightly high.





LUND TOURNAMENT PRO-V 1800

ment and five pedestal-seat bases.

An abundance of visible pop rivets and fasteners place the Pro-V 1800 squarely in the utilitarian-but-functional ranking in fit and finish. But its price tag, lowest in the fleet, makes this highly rated boat a value leader.

Champion Fishhunter

The Fishhunter, with its bass-boat heritage, turned in a sizzling 58-mph top end (ranked second). It was also a champ in two other categories: stowage space (ranked first) and livewell/baitwell space (ranked second).

Among many outstanding features are an onboard battery charger, hy-

draulic stowage hatch lifts and an aft electronics box.

On the performance course, however, the Fishhunter's hull fell off its planing pad and lost prop bite in hard turns. Since it was dialed in for maximum top-end speed, hole shots suffered. While backtrolling, the modified-flat-V bottom required constant course corrections in a crosswind, and operating the kicker motor was hindered by a tall splashwell wall.

Skeeter S-150-HP

The Skeeter S-150-HP is another boat with a hull that reflects bass-boat breeding—quick on top end, but slow-

er out of the hole and on the performance course.

Like the Champion, its relatively flat-bottomed hull required considerable effort to maintain control while backtrolling in a crosswind. It, too, was equipped with a high splashwell wall that interfered with kicker motor operation.

Like all Skeeter boats, fit and finish was superb and craftsmanlike. The Skeeter S-150-HP we tested was an early prototype, and with minor tweaking, it will ultimately be a worthy successor to Skeeter's top-rated 135 System Series tournament wall-eye boat. **PM**



3. LUND TOURNAMENT PRO-V 1800

17'10"/96"/1579 lb./27 gal.

4. 47.0 mph, fast enough for a big-water boat

1. 5.47 sec., head-snapping hole shot

1. 24.61 sec., turns on a dime at full throttle

2. level attitude makes it a good backtroller

4. 5.4 cu. ft., sufficient aerated wells

2. 21.9 cu. ft., excellent use of space

3. 66.8 sq. ft., roomy for two or three

4. lean, many visible rivets and fasteners

\$17,737

Lund Boats, P.O. Box 248, New York Mills, MN; (218) 385-2235

4. CHAMPION FISHHUNTER

17'6"/84"/1774 lb./26 gal.

2. 58.0 mph, fast, thrilling ride

4. 7.77 sec., bow stays up a bit too long

5. 29.15 sec., excessive prop blowout in turns

3. adequate backtroller, good fishing features

2. 6.2 cu. ft., surprisingly large aerated wells

1. 23.53 cu. ft., giant storage compartments

4. 62.9 sq. ft., big fishing decks, deep freeboards

3. fine fiberglass work, carpet strips detract

\$18,500

Champion Boats, P.O. Box 763, Mountain Home, AR 72653; (501) 425-8188

5. SKEETER S-150-HP

17'10"/84"/1569 lb./30 gal.

1. 59.0 mph, king of straightahead speed

5. 9.06 sec., prop took awhile to bite

4. 28.38 sec., requires wide turns

4. bow-high profile gets blown around backtrolling

5. 5.3 cu. ft., aerated wells set to be enlarged

4. 17.5 cu. ft., future models will have more

5. 49.8 sq. ft., sufficient for tournament duo

2. high standards evident

\$18,200

Skeeter Products, 1 Skeeter Rd., Kilgore, TX 75662; (214) 984-0541

Well-placed throttle. Console lacks optional windscreen. Livewell controls and other gauges are conveniently located.



Large console. Comfortable wheel and throttle position. In-dash sounder. Helm seat doesn't slide, but good legroom.



Small but functional console for instruments. Legroom is tight. Fixed helm seat with ice chest in base. Tall windshield.



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innovations like its "Concept 2+2"[™] induction system, which allows the engine to operate on just two of its

And for the ultimate in handling ease, we even offer our optional Quicksilver[®] power steering kit.

In fact, virtually every part on this solid, precision-crafted machine is a tribute to inspired engineering.

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the water hunting for wall-hangers than anywhere else?

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And what we are obsessed with is building superior, highly responsive outboards for fishermen like you.

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For faster planing and superior holding in turns, it has a computer-designed cavitation plate.

There's an integral power trim system, for better tuck, trim and tilt.

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And see why our outboards were made for fishermen like you.



ENGINEERING UNLEASHED.



FORD F-150

America's best seller keeps 'em coming back for more.

BY MICHAEL LAMM, Contributing Editor; PM Photos by Ron Hussey

● As a single-line vehicle, Ford's F-150 not only outsells all other pickups on the road—it outsells absolutely *everything* on the road: cars, trucks, vans, you name it.

According to Ford, the F-150 has been America's best-selling single vehicle line for seven years, from 1983 through 1990. Ford sells more F-150 pickups than Escorts, and this full-size pickup outsells Taurus and Tempo combined.

People who drive pickups seem to be more brand-loyal than car buyers. That's why 39.1% of our Owners Report respondents gave past experience as their primary reason for choosing the F-150. They'd owned at least one—some as many as five—Ford pickups previously, and saw no reason to change.

Ford's two main competitors among half-ton pickups are the Chevy-GMC C/K-1500 series and Dodge's W/D-150. As a class, the three look pretty similar in terms of specifications, engines, transmissions, drive systems and options. But careful shoppers find major differences between the Big Three.

The Dodge W/D-150 half-tonner is

seen as the most traditional in style and purpose. It's the farm truck, in contrast to Chevy's more citified pickup. The Chevrolet-GMC family was restyled and reengineered for 1989. It's more carlike than the Ford and Dodge in its interior appointments and ride, and the GM trucks are per-



ceived as more white collar than blue.

The F-150 holds a broad stretch of middle ground between these two. It's both white *and* blue collar. You use it for work, but still feel comfortable driving it to the golf course on weekends. It's truly the archetypal American full-sized pickup.

Price and value ranked second in our survey group's reasons for choosing the F-150. Ford currently offers the least expensive base pickup in this very competitive field. The F-150's

basic manufacturer's suggested retail price beats the Dodge by \$221 and the Chevy by a substantial \$1056.

Of course, hardly anyone buys a base pickup these days, and similarly equipped versions and trim levels tend to cost about the same from all three manufacturers. They all offer regular and extended cabs and beds, as well as a variety of engines and drivetrains.

In our survey, the most popular F-150 combination was the 5.0-liter V8 with 4-speed electronic overdrive automatic (E40D) and dashbutton lockout in 2-wheel drive with an 8-ft. bed, regular cab and the upmarket XLT Lariat trim package. This brought the average price paid by our respondents to \$14,793, or about \$4000 more than the base price.

Almost all buyers in our survey ordered comfort and convenience options like air conditioning, cruise control, power windows and power door locks. In addition, 16% specified the optional camper package, and 36.7% got the trailer-towing package. Both include suspension upgrades and special outside mirrors, to which

FORD F-150



Straightforward analog instrumentation is attractive, contemporary and easy to read.



Bench seat drew complaints from some owners for marginal comfort.



F-150 owners liked V8 power, but fuel economy was their No. 1 complaint.

the trailer package adds auxiliary cooling, heavy-duty battery and a specific wiring harness.

As always, we paid close attention to owners' opinions on workmanship and quality. How good a job does the

factory do to make quality Job One? Are Ford vehicles as troublefree as those from Japan? Or do dealers have

SUMMARY OF 1990 FORD F-150 PICKUP OWNERS REPORTS*

| | | | | | | | |
|---|-----------------|--|-------|--------------------------------------|-------|--|-------|
| Total miles driven: | 1,094,360 | 6$\frac{1}{2}$-ft. Trim level: | 34.2 | Performance | 19.2 | Average | 29.5 |
| Purchase Price: | | XL T Lariat | 85.2% | Power | 14.6 | Poor | 15.9 |
| Average | \$14,793 | Custom | 11.4 | Specific dislikes: | | Mechanical trouble? | |
| Range | \$9999-\$20,500 | XL | 3.4 | Low mpg | 28.5% | No | 74.0% |
| Avg. mpg by engine, city/hwy: | | Body style: | | Paint quality | 8.1 | Yes | 26.0 |
| 4.9-liter inline Six | 14.6/18.0 | Regular cab | 75.3% | OEM tires | 8.1 | What type of trouble? | |
| 5.0-liter V8 | 13.4/16.7 | SuperCab | 24.7 | Uncomfortable seating | 6.5 | No consensus | |
| 5.8-liter V8 | 12.9/15.7 | Major options chosen: | | No complaints | 6.5 | Did you repair it yourself? | |
| Avg. mpg by trans, city/hwy: | | Cruise control | 95.9% | Suggested changes: | | No | 92.1% |
| 5-speed manual | 14.6/17.8 | Air conditioning | 95.3 | Better mpg | 24.4% | Yes | 7.9 |
| 4-speed automatic | 13.5/16.9 | Power windows/locks | 80.6 | No changes | 21.3 | Dealer repairs satisfactory? | |
| Avg. mpg, 2x4 and 4x4, city/hwy: | | Handling suspension | 65.1 | Better seating | 10.2 | Yes | 60.6% |
| 2x4 | 14.3/17.7 | Limited-slip | 48.8 | Better paint quality | 8.7 | No | 39.4 |
| 4x4 | 13.0/16.1 | Trailer-towing package | 36.7 | More power | 4.7 | Dealer service opinion: | |
| Engine choice: | | Camper package | 16.0 | Workmanship opinion: | | Excellent | 34.8% |
| 5.0-liter V8 | 48.3% | Why did you choose the F-150? | | Excellent | 36.4% | Good | 42.4 |
| 4.9-liter inline Six | 38.3 | Past experience | 39.1% | Good | 60.7 | Average | 13.0 |
| 5.8-liter V8 | 13.4 | Price/value | 21.8 | Average | 1.4 | Poor | 9.8 |
| Transmission choice: | | Styling | 18.8 | Comfort opinion, front seats: | | Would you buy a different Ford product next time? | |
| 4-speed E40D automatic | 65.3% | Ford reputation | 11.3 | Excellent | 57.7% | Maybe | 44.5% |
| 5-speed manual | 27.9 | Dealer service | 6.0 | Good | 34.2 | Yes | 28.5 |
| 4-speed manual | 4.8 | Specific likes: | | Average | 6.7 | No | 27.0 |
| Drive system: | | Ride quality | 42.3% | Poor | 1.3 | Would you buy an F-150 again? | |
| 2wd | 64.6% | Styling | 40.0 | Rear seat comfort (SuperCab): | | Yes | 73.3% |
| 4wd | 35.4 | Interior/comfort | 32.3 | Excellent | 15.9% | Maybe | 20.0 |
| Bed length: | | Handling | 28.5 | Good | 38.6 | No | 6.7 |
| 8-ft. | 65.8% | | | | | | |

* Percentages might not equal 100 % due to rounding up or insufficient data.

to make up for factory lapses. And if that necessity arises, how successful is the dealer at pleasing a customer who returns with a problem?

Minor complaints

A little over a quarter of our F-150 owners told us they had minor mechanical and paint complaints. The key word here is minor. No single complaint showed up often enough to be statistically significant, but some general concerns centered on easily scratched paint (especially with 2-tones), juddery shifts into and out of Fourth with the automatic transmission, false flasher signals from the rear antilock brake system, and cruise controls that didn't work.

Unfortunately, dealers succeeded with first-time repairs only 60.6% of the time—not a terrific record.

But the most significant complaint had nothing to do with quality or reliability. It was fuel economy—28.5% of our survey group wanted more miles per gallon. The volume of individual complaints depended to some extent on engine/transmission/drive selections. Our tabulations indicate that the 5.8-liter V8 gets about 2 mpg less than the 4.9-liter Six. The popular E40D automatic knocks off another mile per gallon, and so does 4wd.

Amiable attributes

The qualities F-150 owners liked best about their pickups were ride, styling, comfort, handling, performance and power, in that order. The majority felt that Ford's Twin I-Beam front suspension (Twin Traction Beam with the 4x4) gives a ride much like a passenger car. Owners were nearly unanimous in their praise of cab comfort, both standard cab and SuperCab.

Performance from all three available engines—the 150-hp Six and 185- and 210-hp V8s—seemed to come up to owners' expectations. Only 4.7% of those surveyed said they'd like more power, and that tiny sample simply wished they'd chosen one of the V8s instead of the Six. It's the old story of economy versus power.

To sum up, the versatility offered by Ford's F-150 range of pickups, from their very complete option list to the way they handle both work and play, pleases the majority of owners. They're basically happy with their trucks' value, performance, quality, comfort and all-around usefulness.

The bottom line: 73.3% of our survey group said they'd buy the F-150 if they had it to do over again, and another 20% said maybe. Add this to the 39.1% who based their purchase on past experience, and it's easy to see why this truck remains a perennial best seller.

PM



F-150's styling looks subdued compared to current GMC and Chevrolet pickups, but is clean and contemporary. Owners rated styling second behind ride quality among best-liked attributes. Workmanship was rated either Excellent or Good by 96.4% of survey group.

EDITORS REPORT

Fundamentally Ford

● Ford has been building pickup trucks since 1925, and F-Series pickups since 1953. That's plenty of time to figure out how to do it right, and in our judgment, Ford is doing just that.

Our experiences with Ford's full-size pickups have always been positive, and the current edition is no exception. To refresh our memories, we spent a few days with an F-150 in XLT Lariat trim. And like every F-Series pickup we've ever driven, this one creates an impression of all-around solidity. It may lack the flash of GM's current Chevy and GMC pickups, but it's well-made, well-finished and solidly in touch with its fundamental purpose. Ford hasn't lost sight of the fact that a truck should be, first and foremost, a truck.

Considering this basic attribute, we rate the F-150's ride quality as very good. However, we wouldn't go as far as some of the owners who think their trucks ride like sedans. The F-150 is smooth on city streets, but doesn't damp out pavement irregularities as well as a passenger car. This is a function of spring and shock absorber damping rates chosen to accommodate heavy loads. When the truck is empty, irregular surfaces tend to show up as sharp jolts.

Similarly, we don't agree with owners who regard the handling as car-

like. Like other full-size pickups, the F-150 tends to respond ponderously. This is not a vehicle designed for lightning lane changes or hard cornering. It's intended to haul loads competently, with minimum drama, and does this job well. But nimble just isn't part of the F-150 equation. Buyers thinking in terms of a sport truck would do well to look at the midsize pickups, or Chevy's 454 SS.

Power, delivered by one of Ford's excellent V8 truck engines, seems to be plentiful, and the automatic transmission in our tester performed smoothly, with none of the hiccups that bothered some of the owners. Fuel economy during several days in the L.A. area paralleled the owners' at just over 15 mpg.

Inside, the F-150 is attractively finished. We like the straightforward analog instrumentation, in contrast to the glitzier layouts we've seen. We have to agree with owners who complain about seating comfort, though. Our F-150's bench seat isn't something we'd care to experience for more than an hour at a time, a classic failing of all pickup trucks.

Basically, we think Ford's heritage of truck leadership shows to good advantage in the F-150. Inside and out, it's solid goods—short on flash, long on value.

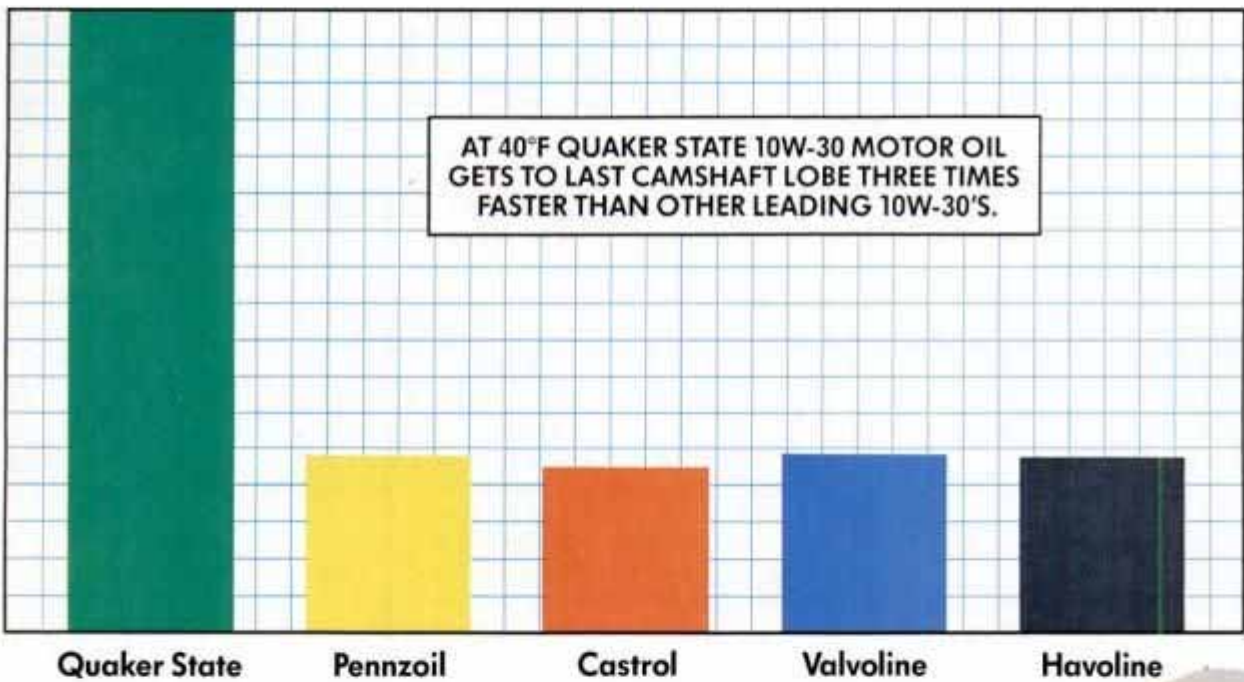
—Tony Swan

WARNING:

SOME PARTS OF YOUR CAR'S COLD ENGINE MIGHT NOT BE GETTING LUBRICATION FOR A FULL MINUTE AFTER STARTING.

FACT:

QUAKER STATE 10W-30 GETS LUBRICATION TO ALL ENGINE PARTS FASTER THAN OTHER LEADING 10W-30'S DURING COLD STARTS.



Independent lab tests confirm whether it's 35° below zero or 50° above, Quaker State 10W-30 gets to all your engine parts faster than other leading 10W-30 brands. In fact, at 40°F, Quaker State 10W-30 motor oil speeds protection to your entire engine three times faster.



So don't let cold starts make it tough on your engine. Get Quaker State.

QUAKER STATE IS ONE TOUGH MOTOR OIL.

DON'T POLLUTE. PLEASE DISPOSE OF USED MOTOR OIL AND PACKAGING PROPERLY.



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CAR CARE

MAINTENANCE BASICS

MAXIMIZE TIRE LIFE

BY DON CHAIKIN

● Though we're normally preoccupied with horsepower, when it comes to going, changing directions and stopping, nothing is as critical to your car's performance as its tires.

Considering their importance, tires require remarkably minor maintenance. Yet few elements of routine automotive maintenance are more neglected. Underinflation is the No. 1 cause of tire failure, as well as shortened tire life.

If you develop the habit of checking your tires' inflation at least twice a month, your tires will live longer.

All it takes is a little air—a specific amount of it. This isn't a matter of simply inflating the tire until there's no sag in the sidewall. With today's lower-profile radial tires, your eyeball isn't an effective gauge. Check inflation with your own quality tire-pressure gauge.

There are two key reasons for this:

- The gauges on service station air pumps are often inaccurate.
- To get a true reading, you must check pressure *before* you've driven the car. Tires heat up as you drive, raising their pressure. Pencil and dial-type gauges cost less than \$5.

Other tire maintenance basics:

- Check your owner's manual for recommended pressures. These pressures represent the best compromise of ride, handling, fuel economy and load-carrying capacity. You can add more to increase fuel economy or carry heavier loads. However, never exceed the maximum pressure embossed on the sidewall.
- Each time you check pressures, carefully check valves and stems to see that none are bent or cracked.
- Screw the valve cap down tight, to keep air in and dirt out.
- Inspect sidewalls for scuffs, cracks and bulges, and check tread for nails, glass, cuts and other damage. Also check the wheels for dents, cracks or missing balance



Proper cold inflation pressure is critical to tire performance and lengthening the tire's life.



It's just exactly $\frac{1}{16}$ in. from the top of Lincoln's head to the edge of a penny.

weights.

Properly inflated tires on properly balanced wheels will wear evenly. Tread that's worn more on the outer edges indicates chronic underinflation. Predominant center wear indicates chronic overinflation.

Tread that's scalloped or feathered indicates a problem—anything from worn shocks to wheel alignment.

● To help even-out treadwear and tire life, rotate tires according to the diagram shown in your owner's manual. Since the front tires of a front-wheel-drive car carry most of the weight and do most of the work, they wear much faster than the rears.

● To keep ahead of treadwear, periodically check tread depth.

● Your tires have reached the end of their service life when the tread is down to $\frac{1}{16}$ in. Tires with built-in tread indicators will show bald bands, running across the tread. When they do, they're ready to be scrapped. **PM**

PM ILLUSTRATION BY DON MANNES

PM ILLUSTRATIONS BY ARON CARBONI

After dragging it the least they could do was

Dodge Dakota V-8. Petersen's

They punished it. They tortured it. They tried it on the rocks. And even mixed it with mud. But no matter what they did to it, the new mid-size Dodge Dakota V-8 came back for more. And walked off with *Petersen's 4-Wheel "4x4 of the Year"* award. The power behind its winning ways is a

potent new available 5.2 liter V-8. With 170 hp, it's got the muscle to take this 4x4 to some of America's most wondrous places.



Dakota's available new V-8 packs the power a '4x4 of the Year' needs.

A four day four-wheel drive torture test.

The road to victory took Dakota over 575 miles of

every kind of surface *4-Wheel* could find. In every case, Dakota's new V-8 pulled it through. In fact, the editors said Dakota's "major muscle made it a runaway." They gave high marks to its easy shift-on-the-fly capabilities. Its outstanding acceleration and traction. The way its responsive suspension handled everything from asphalt to gravel comfortably. And summed up by calling the new Dakota V-8 "the best all-around new 4x4 of the '91 model year."

Dakota shows the world what a winning 4x4 is made of.

It should come as no surprise that Dakota's bold new styling also came in for some well-deserved critical approval.



Dodge Dakota 4x4 V-8

through the mud, name it "4x4 of the Year."

4-Wheel "4x4 of the Year."

The editors called it "sexy and styled like a sports car." They also gave top marks for its generous standard cargo capacity. And with up to 2,000 lbs of



The new Dakota 4x4 Club Cab lets you enjoy off-roading more by letting you take more off-road.

available cargo and 6,500 lbs of available towing capacity, Dakota can offer you even more of a good thing. Yet its one-of-a-kind mid-size helps it maneuver all of these good things into tight places. Anywhere you find them.

Now the "4x4 of the Year" has its own exclusive Club.

Introducing the new Dakota 4x4 Club Cab. Now when you go off-road, you'll be able to take more with you. Whether it's people or all those other things you just need to keep secure inside.

Welcome home to Dodge.

The new Dodge Dakota V-8. It's 4-Wheel magazine's 1991 "4x4 of the Year." And with its unbeatable 7/70 powertrain warranty protection, chances are a new Dakota V-8 could be your 4x4 of the year for many years to come.* Making the Dakota V-8 4x4 one award-winning reason to come home to Dodge this year.

*See this limited warranty and its restrictions at your dealer.

BUY OR LEASE AT YOUR DODGE DEALER.
Buckle up for safety.

Dodge reminds you to "Tread Lightly!"
when you go off-road.



Welcome Home, America.
Advantage: Dodge.



HOW IT WORKS

VARIABLE VALVE TIMING

BY DON CHAIKIN

● Since the dawn of internal combustion, carmakers have been wrestling with a basic problem: An engine designed for high-speed power feels anemic at lower speeds, and one designed to run smoothly and effortlessly around town starts gasping when you want it to really go fast.

At the root of this dilemma is how the engine breathes—how it takes in fresh air and fuel, and expels the exhaust. The timing of the opening and closing of the valves for low-speed tractability is at odds with the timing needed for high-speed power.

But technology marches on. A growing number of carmakers have devised ways to actually change valve timing while the engine is running, much the same way engine ignition timing changes. Altering valve timing, though, is just a wee bit more complicated.

Fresh fill

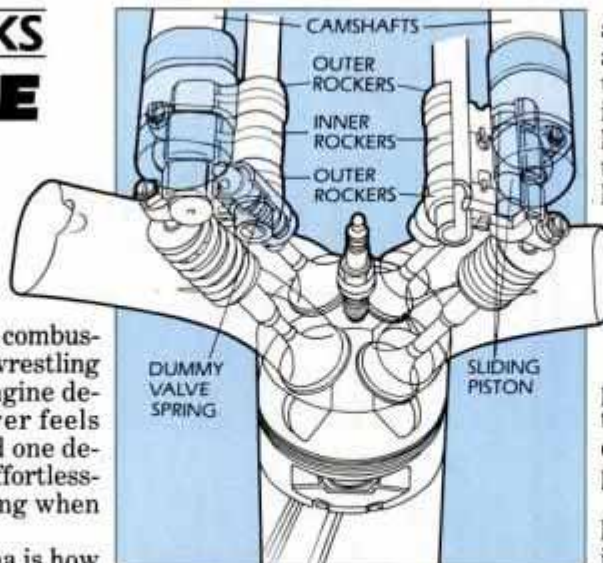
Engines run on air and fuel. The more air that goes in, gets mixed with fuel and burned, the more power the engine produces. To get in as much air as possible, the intake valves on high-performance engines open early and close late in the intake cycle.

This means the intake valve is partially open while the exhaust valve is also open—good for getting fresh air in and stale air out. The interval when both are open is called overlap.

Modest-performance car engines run at moderate to slow engine speeds, and don't consume huge volumes of air. At low speeds, too much overlap hurts performance—and emissions—since some of the fresh air/fuel mix gets sucked out with the exhaust. These engines have intake valves that close sooner than their more potent brethren.

Two camshafts in one

To help get air in and out of the combustion chambers, more and more carmakers have developed engines with four valves per cylinder, with separate camshafts for intake and exhaust. Multiple camshafts have been around for 80 years. But this combina-



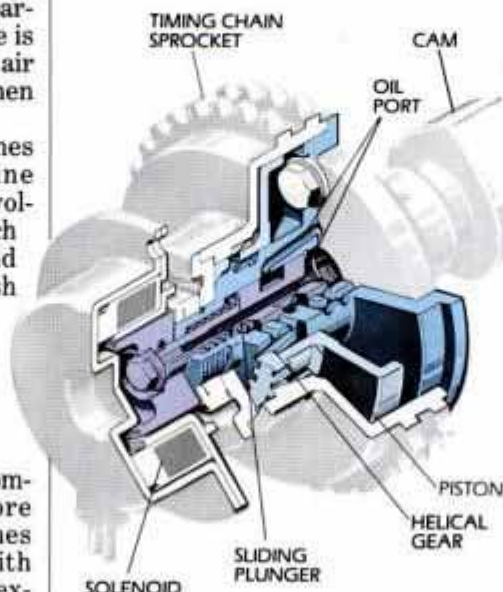
Acura NSX uses split rockers, locked together by pressure-driven sliding pistons.

tion of multiple camshafts, computer-controlled ignition timing and fuel injection has made it possible for the camshaft timing to be controlled, too.

The intake cams on the Alfa Romeo Spider Veloce, Infiniti Q45, Mercedes-Benz 300SL/500SL and Nissan 300ZX all operate similarly to change the timing of the valve opening and closing, upon computer command.

Two-stage timing

This system works by slightly rotating the camshaft (about 10°) in relation to its own drive gear. The drive gear, or sprocket, is mated to the engine crankshaft via a toothed belt or chain, the same as with other engines. However, the camshaft sprocket has



Other systems use helical gears in camshaft sprocket to skew intake timing as far as 10°.

a drive gear mounted inside its hub, and the camshaft is solidly connected to this inner separate drive gear. This inner gear is spring-loaded and has helical splines, kind of like very coarse threads on a bolt. The drive sprocket has mating splines inside, like the threads of a nut.

When the engine computer decides that engine speed and load conditions are right, it sends a signal to a control valve at the other end of the camshaft. This valve directs oil pressure through the hollow camshaft to the gear in the drive sprocket. The oil pressure overcomes the spring pressure, forcing the hub to move.

As it moves, the gear follows the helical splines, twisting the camshaft in relation to the outer drive sprocket, changing the relationship of the camshaft to the crankshaft to alter valve timing.

This process takes about a second, and is almost imperceptible. There is no in-between, by the way, and the valve timing isn't truly variable—it merely has two settings.

Acura NSX system

Honda's system on the Acura NSX operates in a totally different way. Each cylinder in the NSX has two intake and two exhaust valves, but there are three camshaft lobes for each pair of valves. The outer lobes, designed for smooth idle and mid-range torque, operate rocker arms that open and close the valves. Under most driving conditions, the center lobe operates a rocker arm that goes up and down on a dummy spring. This lobe is designed to open the valves wider and keep them open longer.

The three rocker arms each have a hole, perpendicular to the valve. The outer two rockers each have a small piston in them. On command of the engine computer, a control valve sends oil to the rocker arms, forcing the pistons to slide inward, locking the outer rockers to the center rocker. This forces the locked rockers to follow the center camshaft lobe, changing both the valve timing and lift. The locking rocker is on both intake and exhaust camshafts. When the engine computer decides that the engine speed and load conditions warrant, it directs the valve to release the oil pressure to the rocker pistons, which slide back under pressure. Like the other systems, there are only two valve-timing settings, and the driver really doesn't know it's all happening—except when he stomps his right foot.

PM

PM ILLUSTRATION BY IRON CARBON

SATURDAY MECHANIC

FIXING LEAKY FUEL INJECTORS

BY PAUL STENQUIST

● Burble, spurt, rumble. Burble, spurt, rumble. At idle, your engine shakes and stumbles, at speed it lacks power and smoothness, and your gas mileage is sinking slowly into the Persian Gulf.

You've completed all the standard diagnostic routines as outlined in previous Saturday Mechanic features. You've got good spark and compression on the cylinders that are misfiring. Could it be the fuel injectors?

Or maybe you've been chasing down a hard-starting problem. The engine cranks fine and has plenty of spark, but won't start after a hot soak. Could it be the fuel injectors?

A fuel injector is a simple device. Basically, it's a valve that is opened and closed by a solenoid. Fuel injectors usually fail in one of four ways:

- They become partially clogged with

fuel/air deposits and deliver a lean, uneven mixture.

- They fail to fire due to an electrical failure.
- The solenoid quits, and the injector fails to fire even though it's getting voltage.
- The injectors drip after the engine is turned off and cause a flooded no-start condition.

In the following sections, we'll look at each of these situations and explain what you can do to get your buggy back in shape. We'll talk about two basic kinds of injection systems—multipoint systems with one injector for each cylinder, and throttle body injection (TBI) systems with one or two injectors mounted in a central throttle body.

Stumble or misfire

An uneven and sometimes intermittent stumble or miss is frequently the result of dirty, partially clogged fuel

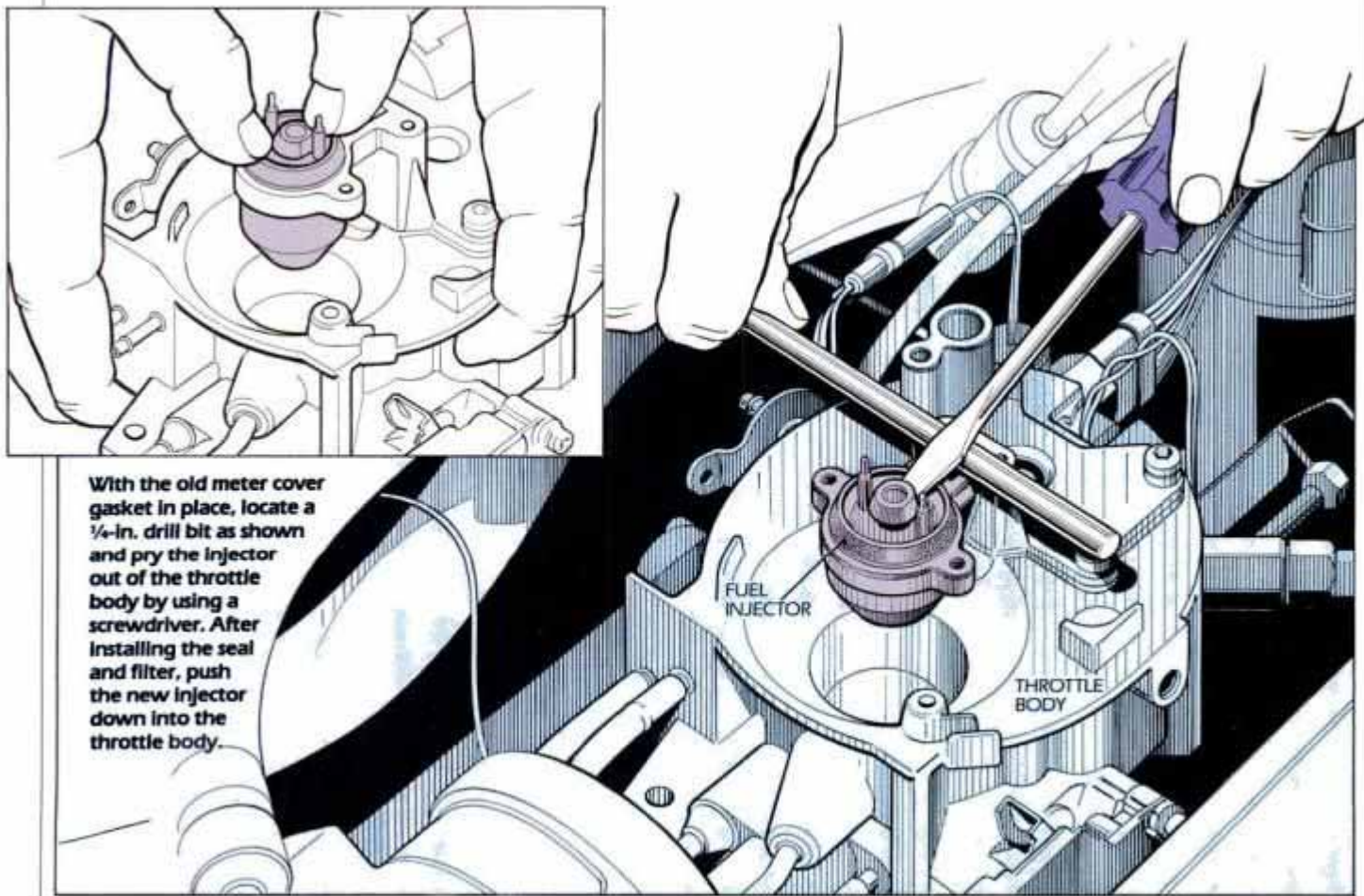
injectors. However, it can also be caused by a variety of other conditions, including lack of compression in one or more cylinders, lack of ignition spark in one or more cylinders, or fuel starvation. Before you begin chasing down a fuel injector problem, remove and examine all the spark plugs and check the engine compression.

Because a lean misfire may cause one of the plugs to appear wet or discolored, you can't assume you have a spark problem on the basis of spark plug condition alone—so test each spark plug cable for voltage with a spark tester. Spark testers are available (ask for the ST 125 tester) from most auto parts stores.

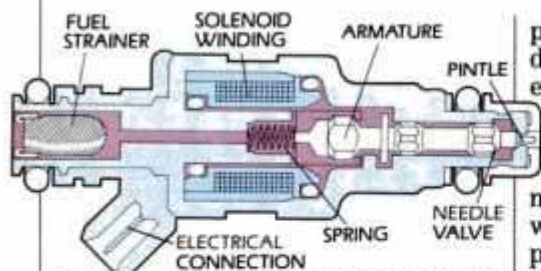
Attach plug wires one at a time to one end of the tester. Attach the other end of the tester, by means of its clamp, to ground. Start the engine and watch the tester to see if you get spark. If you don't, the wire or the distributor cap is defective.

If spark is good and the compression gauge reading of each cylinder is within 25% of the others, you can start looking for a fuel mixture problem.

But before you turn your attention to the injectors, make sure that a vacuum leak isn't the cause of the lean



PM ILLUSTRATIONS BY FRED WOLFF



Solenoid pulls up plunger to spray fuel from pintle, which closes under spring pressure.

condition. To check vacuum hose connections, find the vacuum hose diagram for your car. It's probably in the engine compartment, frequently on the Vehicle Emissions Control Information Label. Make sure all hoses are connected as shown on the diagram. Make sure they fit tightly on their respective pipes. If not, replace them, or, if they're larger hoses like those used for power brakes and are in good condition, secure them with hose clamps. Visually check every hose for kinks or splitting.

Once you're sure all the vacuum hoses are in good shape and properly connected, grab your needle-nose pliers and, with the engine running at idle, squeeze each hose closed near the point where it connects to its vacuum source. If the idle smooths out when you squeeze off the hose, either the hose is leaking or the component it's connected to is defective.

Check the intake manifold gaskets by spraying nonflammable solvent on them while the engine is running. If the idle smooths out, the gaskets are leaking, and you'll have to remove the manifold to replace them. While the intake manifold is off, check it for cracks or warpage.

On cars with multipoint fuel injection and a mass airflow sensor, check the air-inlet ducting for leaks in bellows connectors and other mating surfaces that are downstream of the airflow meter.

On carbureted cars, or cars with throttle-body injection, check the bolts that hold the carb or throttle body onto the intake manifold. These frequently come loose and can cause a rough or erratic idle. Check the carb base or throttle-body gasket by spraying nonflammable solvent as you did for the intake manifold.

Everything okay? Now let's have a look at those injectors.

Multipoint injectors

Using a stethoscope or a piece of hose, listen to each injector while the engine is running. If you use a piece of hose, make sure it doesn't touch a

plug wire. Black hose is a good conductor and can deliver a shock to your ear—no fun.

You should be able to hear the injector open and close rapidly. The sound of a good injector is crisp and metallic. One that is partially clogged with deposits on the seat or pintle will produce a dull, muffled sound. Compare the sound of each injector to that of the other injectors.

If your stethoscope diagnosis found one injector that opened and closed with a muffled sound, the injector is probably dirty and could be the cause of a misfire or stumble.

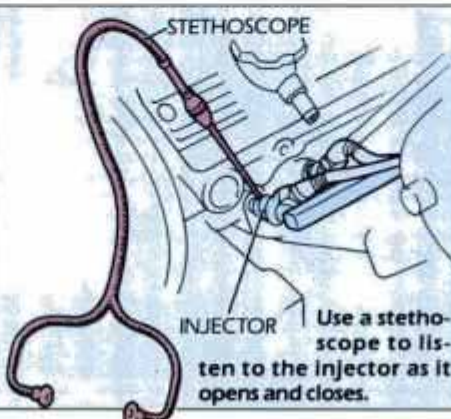
You may find that one injector makes no noise at all. If so, turn off the engine, unplug the injector electrical harness connector and attach a 6-volt test light to the harness connector. You might want to purchase a test light (noid light) sold specifically for checking fuel injectors. This tool will plug right into the harness connector.

Crank the engine. The light should flash on and off. If it does, the injector is bad or the plug is severely corroded. Clean the connector and reattach it. If the injector still won't fire, it's defective and must be replaced.

If the light doesn't flash—indicating no power to the injector—there's a problem in the wiring or in the engine computer system. On many applications, the injector wiring harness is grounded. Make sure the ground connection is good.

If the wiring checks out okay, perform a computer system diagnostic routine. You should find instructions for this in your service manual.

On most cars, the computer system can be diagnosed without special equipment. While the routines are usually elaborate, they're not necessarily difficult if you can follow a tree diagram. If you don't have specific instructions or the right equipment for your car, don't diagnose the computer system. Get professional help.

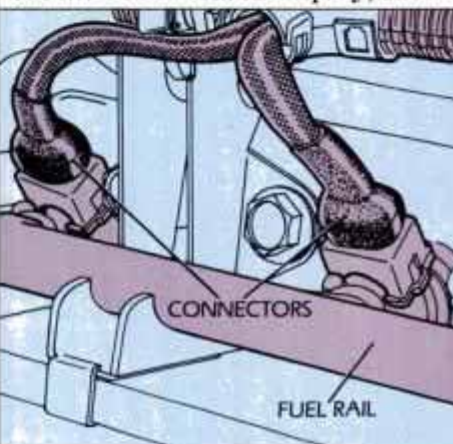


TBI diagnosis

On carbureted or throttle-body-injected cars, it's not likely that one cylinder is totally fuel-starved—unless there's an internal engine problem. However, the engine can idle roughly due to intermittent lean misfire on all or some cylinders. And, if a TBI injector doesn't deliver any fuel, you'll have a no-start problem to deal with.

When the engine is cranking, the TBI injector should spray fuel. If it doesn't, attach that 6-volt test light to the connector to see if it's being supplied with electricity. If not, a check of the wiring and possibly the computer system is called for.

If the power supply checks out okay but the TBI unit doesn't spray, check



Check the fuel injector electrical connectors for a good fit and clean contacts.

fuel pressure. To check pressure, attach a high-pressure gauge to the fuel supply Schrader valve, or other connection point as indicated in your service manual. Then turn off the ignition for about 30 seconds and turn it on again. Note the reading on the gauge immediately after the ignition is turned back on.

If fuel pressure is good, the injector is bad. If fuel pressure is below specs for your car, or if there is no pressure, you have a problem in the fuel supply system—possibly the pump or the fuel pressure regulator.

At medium throttle, the TBI spray should be cone-shaped and consistent. If it is even slightly irregular, driveability problems can occur. Sometimes a cleanup can restore good performance. Sometimes replacement of the injector is necessary.

Fuel injection cleanup

Sometimes dirty injectors can be cleaned adequately by adding injector cleaner to the fuel tank. Follow the directions on the can.

(Please turn to page 62)

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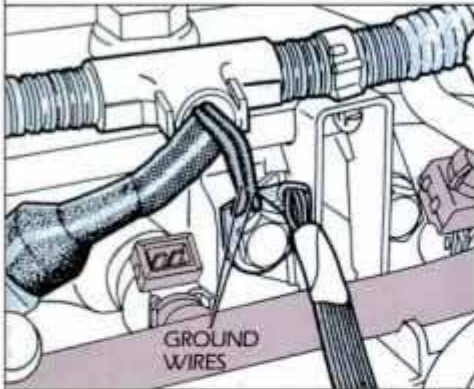
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CAR CARE



Some injector system harnesses, like this Chrysler unit, are connected to ground.

The best way to clean a fuel injection system is by removing the injectors from the engine and having a professional clean them on a specialized flow-tester/cleaner. Some repair shops are equipped with on-car injection cleaning systems that can do a good job, but don't allow for visual spray-pattern checks. There are also some simple injection cleaning systems inexpensive enough that the driveway mechanic might consider purchasing.

Injector designs have improved to the point where they're now much more resistant to clogging. On older cars where injector clogging is a recurring problem, replacement of the injectors with new aftermarket or OE units might be the best alternative.

Dripping fuel injectors

A fuel injector that sticks open can flood the engine and foul one or more plugs. Given enough time, the fuel evaporates and the engine starts easily, but for the first hour or so after shutoff, starting can be tough.

On port-injected engines (one injector per cylinder), a sticking injector can sometimes be located by checking for fouled or wet plugs half an hour after shutoff.

The absence of wet plugs doesn't necessarily rule out dripping injectors. A visual check of the injectors is the best way to test. On TBI systems, the injectors are easy to observe, and you can simply warm the engine, shut it off, remove the air cleaner and watch the injectors to see if there's a drip. On some port-injected systems, you can lift the injectors and fuel rails out of the ports to watch for drips.

A check of system pressure is also useful in tracking down leaking injectors. If pressure drops continuously after shutoff, a leaking injector could be the cause. But other problems—like a faulty fuel pump check valve, a

leaking pump connection or a bad pressure regulator—can cause pressure loss as well.

Port injector R and R

If you find that electrical current to an injector is okay, but the injector still doesn't fire, it should be replaced with a new unit. Or you may decide to remove your injectors for professional cleaning or replacement with the later-model aftermarket types that are less prone to clogging.

In either case, the removal and replacement job can vary from being relatively easy to quite complex. We'll provide some examples here. For instructions specific to your model, use this guide in combination with your service manual.

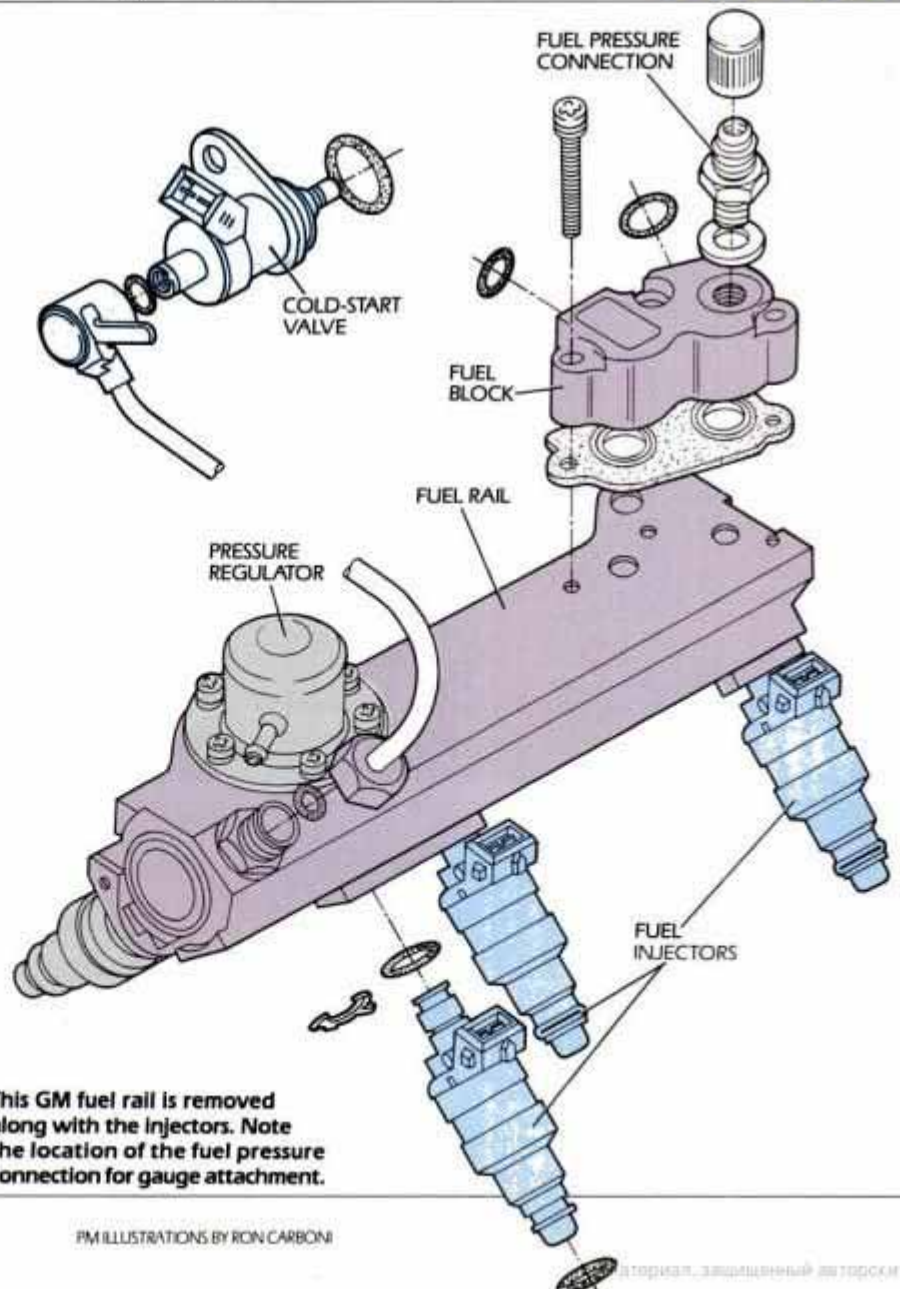
Prior to working on a fuel injection system, disconnect the battery's negative cable. (In fact, we recommend disconnecting the negative cable when-

ever you work on your car. It's good insurance against accidental shorts or spark-induced ignition of gasoline fumes.) On Chrysler systems, you'll have to disconnect the cable after you've relieved fuel pressure.

Before you can remove an injector from most fuel injection systems, you have to relieve the fuel system pressure. In most cases, this can be done with a fuel pressure gauge and bleed-off hose. The gauge is attached to a valve on the fuel rail, frequently a Schrader valve, and system pressure is released. Wrap a rag around the connector while attaching the gauge to prevent fuel spillage.

Chrysler has specific instructions for relief of fuel pressure in its multi-point systems. Loosen the gas cap and remove the wiring harness connector from one fuel injector. Then ground one injector terminal with a jumper,

(Please turn to page 64)



This GM fuel rail is removed along with the injectors. Note the location of the fuel pressure connection for gauge attachment.



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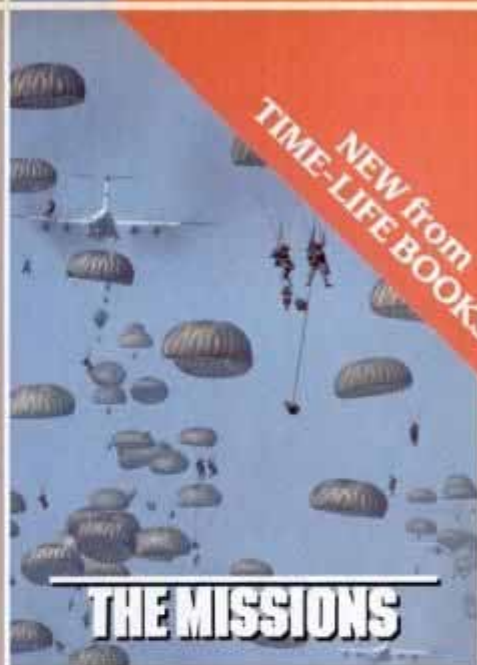
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CAR CARE

and connect another jumper between the second terminal and the battery's positive post. Leave the wires in place for 10 seconds.

On many cars, the removal of the fuel injectors is quite simple. The rail and injector assembly can be removed from the engine as a unit once the fuel lines and electrical connectors have been disengaged.

On some cars, you'll have to remove quite a few other components before you can get to the fuel rail. On some Toyotas, for example, you'll have to remove the distributor and air-intake chamber before the fuel rail.

In most cases, the injectors are retained in the fuel rail by lock rings. On GM cars, this lock ring is disengaged by turning it clockwise and locked by turning it counterclockwise. On some applications, no snap rings are used

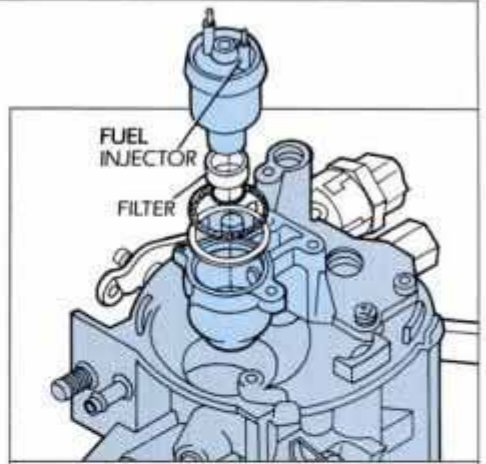
and the injectors are retained only by their seals. On these, it's important not to drop any injectors when you lift the fuel rail off the intake manifold.

All injection system O-rings and seals should be replaced when the unit is serviced. You must use O-rings intended for this purpose. Some O-rings are made of materials that are not tolerant of gasoline.

TBI R and R

The TBI R and R is relatively easy because there's not much stuff in the way. The procedure varies somewhat from car to car. We'll cover the most common application here—the GM TBI. Before beginning any injector R and R, make sure you relieve fuel system pressure as described earlier.

After removing the air cleaner and the electrical connector, unbolt the



The GM TBI unit commonly used includes a single injector. Some V8 TBIs have two.

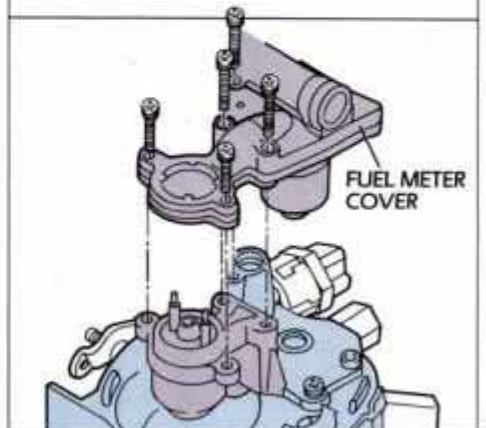
fuel meter cover. Do not remove the four screws that secure the pressure regulator to the bottom of the fuel meter cover. There's a giant spring lurking in there.

Leave the fuel meter gasket on the throttle body so you won't damage the casting, and lift the injector from the throttle body using a screwdriver and 1/4-in. drill bit as shown. Remove the O-ring and washer from the fuel meter body injector cavity and the small O-ring from the nozzle end of the injector. Rotate the injector fuel filter until you can remove it from the base of the injector.

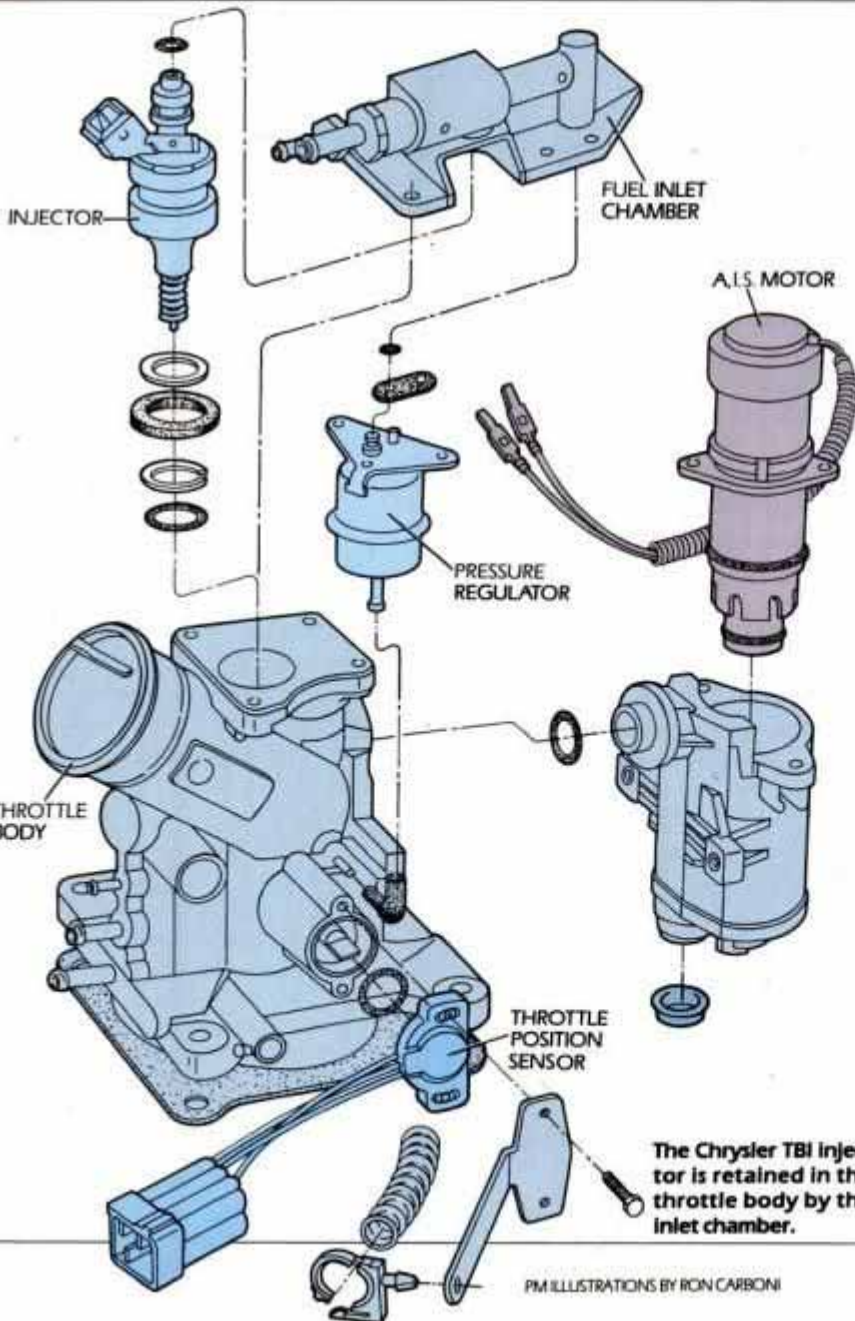
Lube a new small O-ring, and push it on the nozzle end of the injector until it is flush against the fuel filter. Install the steel washer in the fuel meter body. Lube a new large O-ring, and install it on top of the washer. The O-ring should be flush with the top of the fuel meter body casting.

Install the injector in the cavity, aligning the raised lug on the injector base with the notch in the fuel meter body cavity.

Install the fuel meter cover using a new gasket. Apply anaerobic threadlocking compound to the fuel meter screws. Reinstall the injector's electrical connector and air cleaner. **PM**



Loosen five screws to remove the fuel meter cover from the GM throttle body.



PM ILLUSTRATIONS BY RON CARBONI

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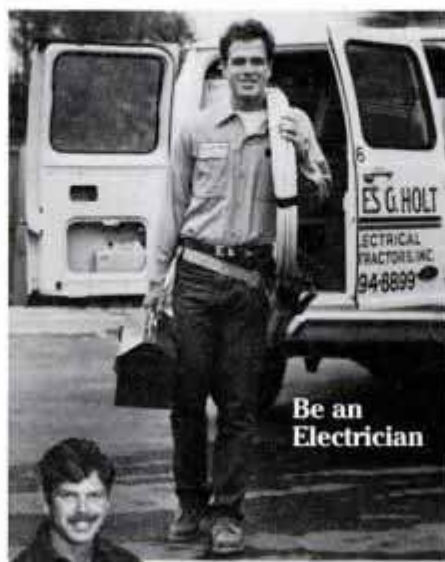
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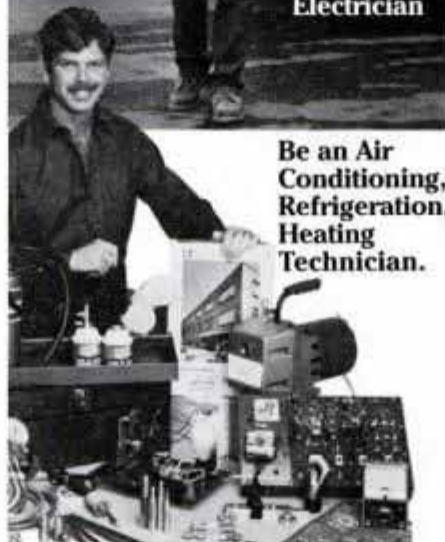
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CAR CLINIC

BY MIKE ALLEN,
Assistant Automotive Editor

Lord Of The Rings

I rebuilt the engine on a 1.6-liter Escort that I bought cheap because it had serious mechanical problems—there was oil all over, and it only ran on two cylinders. Water was coming out of the exhaust, as well.

The rebuild went normally, except that I didn't hone the cylinder walls before installing the new pistons. There was little or no cylinder bore wear, but I did file the ring end gap on the new rings to the correct spec, as the new rings were a little big—I'm sure to compensate for what would normally be a worn cylinder.

Now the engine drinks oil, and two cylinders oil-foul the plugs within 100 miles. I kept hoping the rings would seat better, but after 1000 miles, there's no improvement. At high speeds, there's so much blowby that the valve cover leaks oil all over.

What I don't understand is the compression is good—140 psi on all cylinders—and doesn't improve if I spray oil into the spark plug holes.

PHIL HALL
HARRISON, MI

I've got bad news for you, Phil. You're going to have to take the engine apart again.

Piston rings, and oil rings in particular, depend on proper cylinder wall finish in order to seat properly. If you simply install new rings into a glazed cylinder bore, they'll never seat.

You might get acceptable compression readings from the top ring, but you'll never have any oil control. The second and oil rings don't have combustion chamber pressure behind them to force them into the cylinder wall—and they need the rough surface of the freshly honed cast iron to wear in properly.

You can either pull the engine or just drop the pan and yank the head, but the pistons have to come out. You might get by with a flex-hone, the kind that looks like a big bottle brush (shown above), but my preference is to get the block to a machine shop where the machinist can use a Sunnen CK-10 honing machine.

As you can see from the top inset cross section, cylinder bore wear tends to concentrate in the upper inch or so. Proper honing will true up this



wear and leave the proper crosshatch pattern. The machinist will know, but you'll want about a 240-grit pattern. More serious wear will require boring to a standard oversize and new pistons. You'll need to properly measure the cylinder to determine the amount of wear before doing anything else. If there was as little bore wear as you say, your machinist might be able to do this without making the cylinder oversized.

Be sure to use plenty of hot, sudsy water to clean the abrasives from the cylinder wall after you complete the honing.

And yes, you'll need to buy new rings as well. The ones you've tried to make seat won't cut it for a second try.

Cruisin'

A few weeks ago, I overloaded my 1988 Accord with about 900 pounds of people and luggage. I know that this

was too much because for the whole 60-mile trip, every time the car hit even a medium-sized bump, the cruise control kicked off. I assume that some safety feature in the cruise control mechanism was indicating that an accident was about to occur.

Now the cruise control doesn't work at all. I've checked the fuses, but they're fine. Is this related to the overload?

MARK SYKES
CHEVY CHASE, MD

The cruise control uses the brake light switch as a signal to turn itself off when the brake pedal is depressed. And your Honda was bottoming out on the bumps hard enough to make the brake pedal jiggle down sufficiently to depress the switch. This will happen to almost any car if the bump, load and speed are just right.

(Please turn to page 70)

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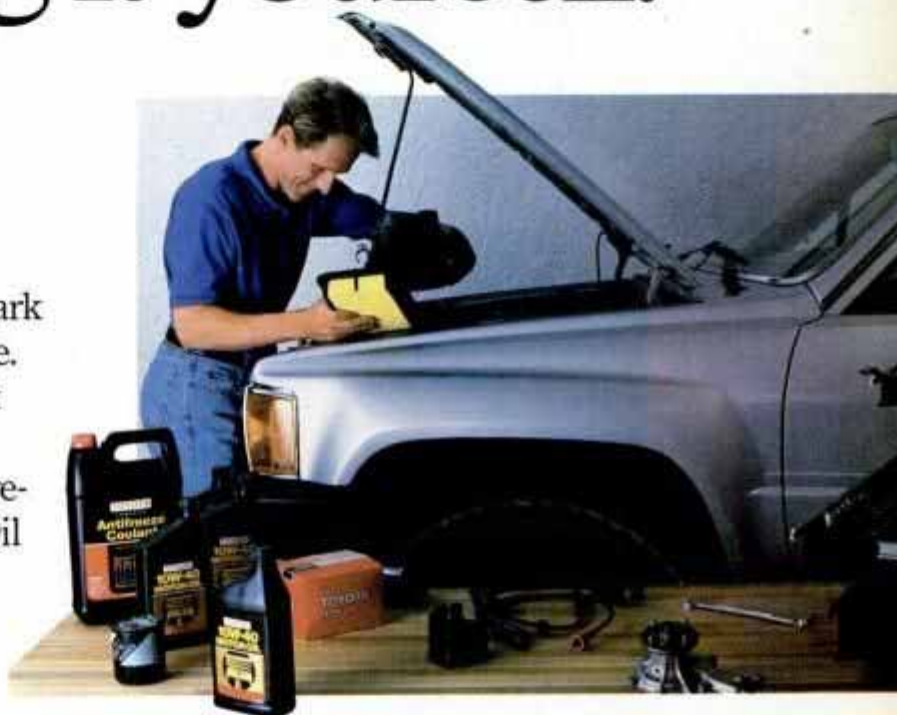
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As to why the cruise doesn't work now—I don't know, but it's not related to your relatively short, slightly overloaded trip.

Reluctant Bug

My 1974 VW Bug has 250,000 miles on it—I did have the engine rebuilt several years ago. There's an intermittent cranking problem, which started out as a hot start problem. After a trip of several hours, I would have to push-start it. Now the problem seems to happen anytime.

The engine simply won't crank, but there's no consistency to it. Something is drawing current because the dashboard lights dim as the switch is thrown.

Needless to say, the problem never acts up when it's at the shop. The battery is new, and the connections at the starter, battery and ground have been checked.

PAUL PRIGGE
VANCOUVER, WA

First off, Paul, congratulations on keeping your Beetle on the road for a quarter-million.

Start by replacing the ground strap from the transmission nose-piece to the frame. This is often neglected, especially by non-Volkswagen specialists, because it's buried well underneath the car. Be sure the alloy nose-piece casting hasn't corroded out from underneath the nut—you may need to use a different stud nearby. Use Never-Seez or some other antiseize compound to promote electrical conductivity and retard corrosion.

If that doesn't fix the problem, replace the starter. I'd suggest looking at the ignition switch next, but if the dash lights dim, it means that the starter solenoid is getting juice, but not making contact.

Don't replace just the solenoid. I've found that Bosch starters seem to last just about as long as the solenoids, so replacing just one is generally a false economy.

Old 6-volt VWs often had similar problems caused by corroded wiring, but in that case, the dash lights wouldn't be dimming.

Avenue Of Broken Dreams

I recently purchased a 1989 Buick LeSabre, and about a month later, it developed a crack in the left side of the windshield. About a week later, another crack developed on the right side, mirroring the first. The dealer

As The Worm Turns

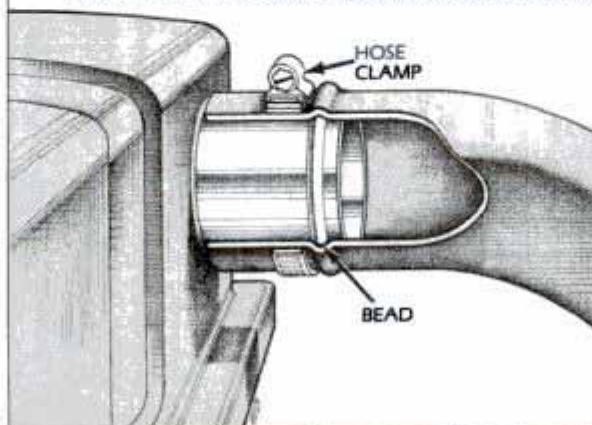
● There are few devices on a modern automobile as ubiquitous and as easy to comprehend as the ordinary stainless-steel worm-drive hose clamp. Or as reliable or longlasting.

But give a moment's thought to the dynamics of what keeps a hose from leaking or blowing itself off the fitting it's attached to. Pressure inside the hose causes it to swell slightly, especially when the rubber is softened by hot coolant or oil. The increase in diameter would let the hose slide right off if it weren't for the clamping action of the clamp, helped quite often by the raised bead on the fitting.

If, however, the clamp is installed too far from the bead, crud and sediment can

build up in the cavity that's formed between the clamp and the bead, potentially shortening the life of the hose and making the hose more difficult to remove. There's even the potential for corrosion of the fitting's surface.

Install the hose clamp adjacent to the bead, leaving just enough room for the hose to lie comfortably without being pinched, but without room for anything else.



and a glass specialty shop both agree that the car had not been in an accident. The glass shop also said they'd seen a lot of similarly broken glass in Buicks.

I'm going to get the glass replaced anyway, but is this a known problem? What can I do to assure that it doesn't happen again?

KENNETH POLING
NEW HAVEN, IN

I'm suspicious of any vehicle with unexplained windshield cracks. It's often a symptom of a vehicle that's been tugged and twisted on a frame rail.

But since you say that two independent sources find no evidence of body damage, I'd guess that either the windshield was defective, or there's something about the geometry of the windshield channel that is causing the problem.

Be sure you tell the glass shop to carefully check for this before installing the new glass, as they'll have to warranty the new glass against spontaneous breakage. A few medium licks with a body hammer might be necessary to trim up the window channel. **FM**

DO YOU HAVE A CAR PROBLEM?

Just ask Mike about it. Mail your question to Car Clinic, Popular Mechanics, 224 W. 57th St., New York, NY 10019. While letters, faxes or phone calls cannot be answered individually, problems of general interest will be discussed in the column.



SERVICE TIPS

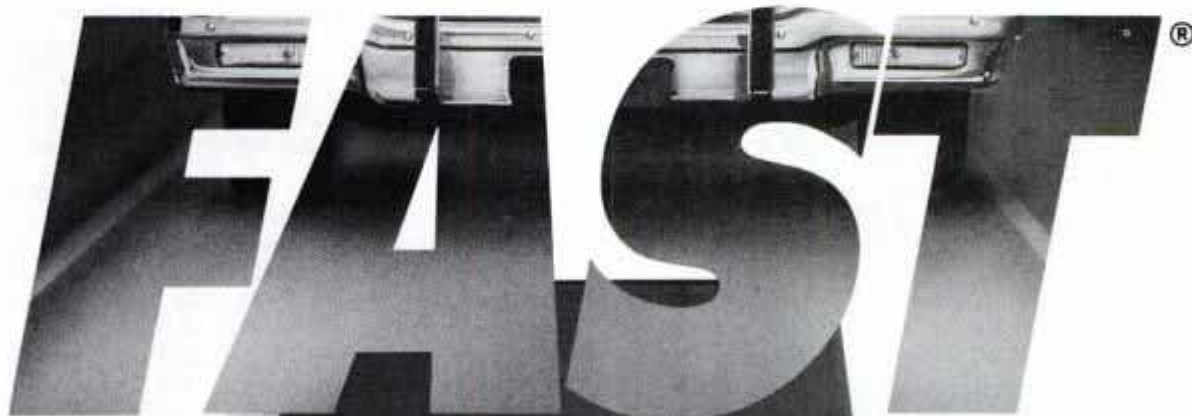
● Toyota TSB 006-06-30-89 talks about the need for thoroughly flushing the radiator oil cooler to remove contamination after a transmission failure. It's a Toyota TSB, but it applies equally well to any car that's had an automatic transmission failure.

Basically, it involves removing the cooler lines and flushing with compressed air and automatic transmission fluid. Don't forget to clean or replace the torque converter, too.

● If your '86 to '89 Acura Legend has wind noise from the front door area, check TSB 89-017. There's a lengthy procedure for disassembling the door's interior, adding weatherstripping and tightening up clearances in the window channel.

● Saab TSB 11/89-11/90 suggests that the best method for refinishing brake rotors is to use an on-car brake lathe, to avoid machining-in out-of-true conditions caused by poor centering of the rotor on bench lathes. It's also a good discussion of proper brake service, covering proper measurement and criteria for resurfacing or replacing brake discs.

● Some Pontiac Trans Sport, Chevy Lumina APVs and Oldsmobile Silhouette minivans are subject to recall 90-C-01, calling for replacement of hardware attaching the rear seats to the floor.



ACTUAL SIZE

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The more you drive, the more you need this high-performance detector with our FAST system. It covers all three police radar bands. It has a GaAs diode front end and dual-superheterodyne design for extra-long range. And its exclusive, full time FAST circuit dramatically reduces false alerts caused by other radar detectors, without sacrificing sensitivity.

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CAR CARE

NEW PRODUCTS

IMPROVE YOUR CAR

Warm 'n' Dry

One of life's lesser pleasures is feeling a steady cold draft on the side of your neck as you drive. Even a small tear or worn spot in your car's weatherstripping can let the outside into the passenger compartment. Reseal your car with new weatherstripping. Seal-Rite offers universal rubber weatherstripping that securely and simply clips onto door flanges. The stripping comes in three section widths, in 8-ft. lengths. Seal-Rite also offers foam-rubber strips, in 10-ft. lengths and five different diameters, for sealing trunk lids and rear hatches. Prices vary depending on type and size. From Automotive Insulation, Inc., 150 E. 7th St., Paterson, NJ 07524; (201) 684-5000 or (800) 526-5265.



Spray Safe

Okay, so there's a hole in the ozone layer that's big enough for the USS *Missouri*, but what can you do about it? For one thing, you can use spray products that have no fluorocarbons in them. Next time you paint, try Nature Safe. These paints not only have no CFCs, they're non-toxic, nonflammable, water-based acrylic enamels. Nature Safe can be used safely indoors and cleans up with soap and water. A 12-ounce can is \$8.69. From Plasti-Kote Co., Inc., 1000 Lake Rd., P.O. Box 708, Medina, OH 44258; (216) 725-4511.



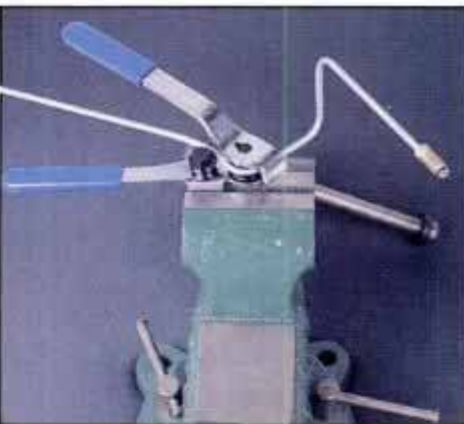
Visual Aids

If you know your engine compartment as well as you know the back of your hand, you might not need help in finding the dipstick, reservoir or battery ground terminal, even in the dark. But if you *can* use a little guidance, consider these Vehicle ID Tags. They're relatively large, easy to find and read, made of bright-yellow plas-

tic. The tags attach to engine maintenance items simply and reliably with locking plastic straps. They're sold in a package of eight—battery positive and negative, oil dipstick, oil fill cap, power steering, transmission dipstick, coolant fill cap and washer fluid reservoir—for \$3. From V. Price Co., P.O. Box 3, Brazil, IN 47834; (812) 448-8561.

Clip-Ons

Instead of racking your brain trying to devise a simple way to keep your sunglasses within easy reach while driving—or fumbling around under the seat for them in rush-hour traffic—rack the glasses instead. This simple plastic clip-on rack from Z-Best Products fits snugly to the back of most rearview mirrors. The protruding fingers from the top of the rack are designed to securely hold glasses over the mirror. The arms of the glasses hang down in front of the mirror and pose no real obstruction to your view, either fore or aft. The clip-on racks are available in a variety of colors, ranging across the spectrum from black to neon yellow, for \$3.50. From Z-Best Products Co., P.O. Box 6833, Auburn, CA 95604; (916) 268-0144.



Easy Bender

There's no problem bending metal tubing to fit between and around obstructions, unless, of course, you want the liquid to flow through the tubing and not leak through cracks at bends. You can accurately bend and shape metal tubing— $3/16$ in. and $1/4$ in.—without kinking or marring it with an inexpensive, handheld Rolling Tubing Bender from Eastwood. The tool rolls the tubing as it's being bent and can create tight 180°, 1-in.-dia. curves. There's also a tab on one handle for clamping it in a vise if needed. Cost is \$24.95, plus shipping, from The Eastwood Co., 580 Lancaster Ave., P.O. Box 296-PM, Malvern, PA 19355; (800) 345-1178.

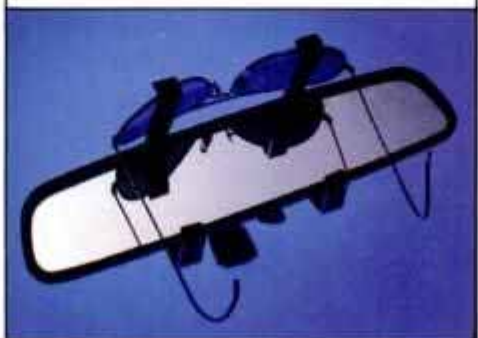
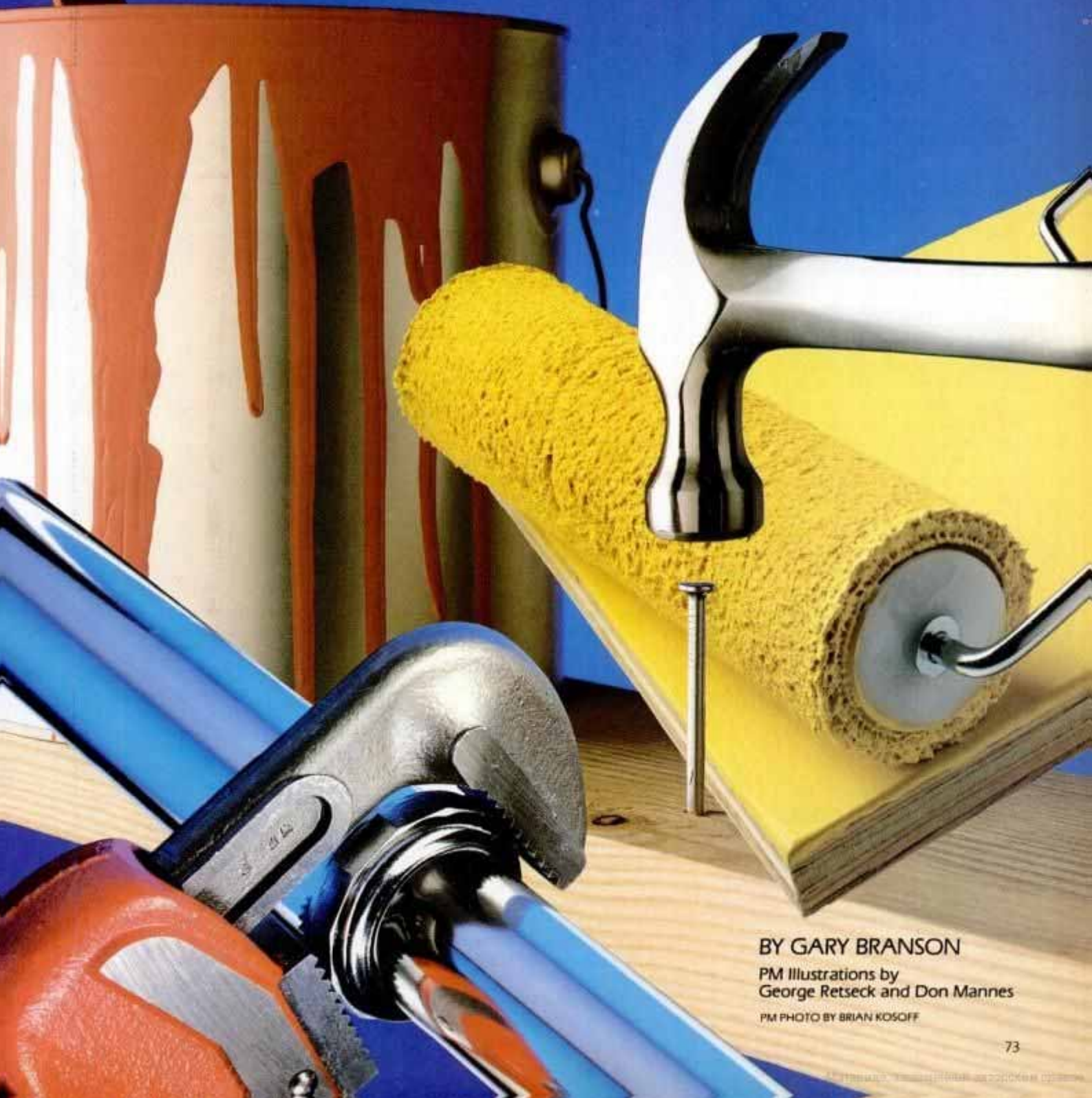


PHOTO BY BILL ASHE

SPECIAL SECTION

65 GREAT WAYS TO IMPROVE YOUR HOME

Here are a wealth of clever home improvement tips—for the novice and expert alike—to help make your home a better place for you and your family to live:

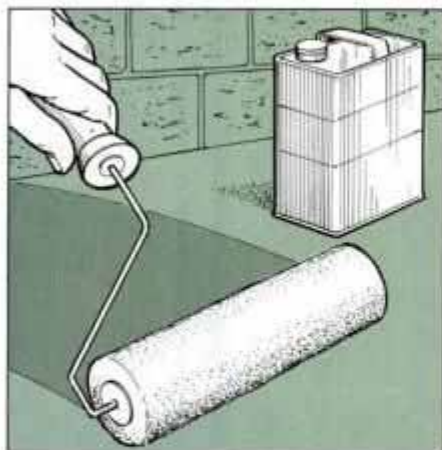


BY GARY BRANSON

PM Illustrations by
George Retseck and Don Mannes

PM PHOTO BY BRIAN KOSOFF

1 Sealing Concrete



Unsealed concrete floors are dusty and stain easily. To seal them, first clean the surface, then apply the sealer using a paint roller.

Most homeowners are aware that exterior concrete slabs, such as driveways and patios, require a coat of sealer to protect the concrete from freezing rain, oil stains and rust. However, even interior concrete slabs should be sealed annually to stop concrete dusting, resist stains from spills and make cleaning easier. As an added bonus, you'll find your home is cleaner because concrete dust won't be tracked through the house.

Concrete sealer is also recommended for garage floors. Dripping road chemicals in winter can ruin concrete, and auto liquids such as oil and transmission fluid can cause stains that are nearly impossible to remove.

To seal your floor, begin by cleaning it with a concrete driveway cleaner, available from auto parts stores. Or, wash the floor with TSP (trisodium phosphate) in a strong solution. When the floor is dry, apply one or two coats of concrete sealer. If you have no experience with these products, ask your local hardware store salesperson to recommend one. A paint roller, fitted with an extension handle, provides quick and easy sealer application.

2 Painting A Wood Fence

Wood fences—such as the privacy fence shown here—often have offset boards that defy ordinary painting methods. If the board fence is also made of rough-sawn lumber, such as cedar or pine, the paint tool of choice should be a sprayer.

The handheld cup sprayer shown is a reasonable tool if the fence is not too large. But a gun cup system can be a

nuisance if you have a lot of fence to cover and gallons of paint or stain to apply. Refilling its quart-sized reservoir gets tiring very fast. Instead, consider renting an airless sprayer with a suction tube that can be used with any size container.

Keep in mind that airborne paint particles can become windblown and cause spatter problems for your neighbors. The repercussions can be legally and financially depressing. To control paint overspray, heed the following list of tips:

- Do not spray paint on windy days. Wind can carry paint droplets far



The easiest way to paint a fence is with a spray painter. To control overspray, drape a plastic sheet over opposite side of fence.

from the work area. Wait for calm weather to paint.

- Check the opposite side of the fence and be sure that there is no car, lawn equipment or other object near the fence. Ask your neighbor to move everything of value from the area.

- Buy plastic sheeting and staple it so it drapes over the opposite side of the fence. When you paint the backside of the fence, remove the sheeting and cover your own side of the fence so that airborne paint is stopped before it can travel or become windblown.

- Finally, don't overthin your paint or stain.

3 Moss Problems On Wood Roofs

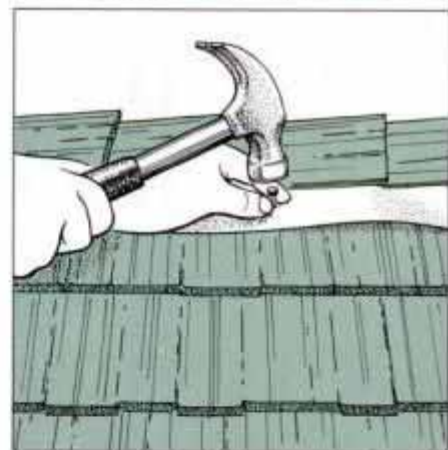
Moss and mildew love a moist climate, so moss or mildew growing on your wood roof indicates that your roof is not draining well after a rain. Sources of roof moisture can be a lack of sunlight to dry the roof deck (usually caused by trees or adjoining buildings that shade your roof) or the result of leaves, twigs or other debris that collect on the roof and hold moisture. Additionally, the spaces between shakes or shingles are meant to aid water

runoff. Leaves and other debris that block these paths also block good drainage and prevent proper runoff.

The first step to a dry, moss-free wood roof is to cut away any branches that overhang the roof and block out sunlight. Exceptionally thick limb growth on trees should be remedied by a professional tree trimmer who can selectively thin the branches so that sunlight can filter down to the roof deck. This thinning of treetops can also open the space to better ventilation, and proper ventilation or airflow across the roof aids the drying process.

The next step is to inspect the roof for debris that may be trapped in valleys, behind chimneys or in the cracks between the shakes or shingles. Vegetable debris, such as leaves, acts like a sponge on the roof surface, soaking and holding moisture in the cracks or gaps between shingles. This can be alleviated by trimming back tree limbs, but it may be necessary to power-wash the roof once or twice a year to keep it clean and free of debris.

A product commonly used in the far

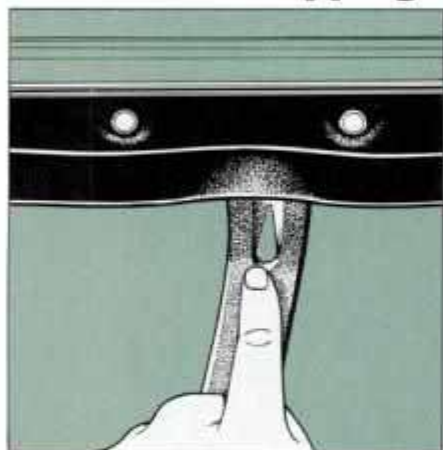


Adding a strip of zinc near the ridge of a wood roof inhibits the growth of moss. Install the strip with galvanized nails.

West is a strip of metal that is 97% pure zinc. The zinc strip is nailed at the edge of the ridge or below the level of anything that blocks water flow, such as vents or chimneys. As rainwater washes down the roof, it picks up zinc from the strip, and the zinc inhibits future moss growth.

One such product is named Z-STOP and manufactured by WESPAC, P.O. Box 46337, Seattle, WA 98146. To use Z-STOP, first power-wash or brush away the existing moss. (For severe cases, you can buy a herbicide from your local garden center that will kill moss.) Then use roofing nails with neoprene washers to nail the Z-STOP in place along ridges, gables or skylights.

4 Garage Door Weatherstripping



If your garage door weatherstripping is broken or torn, it should be replaced. Remove the old one by prying it off with a flat bar.



Cut the new weatherstripping to length, and then nail it to the bottom edge of the door using galvanized roofing nails.

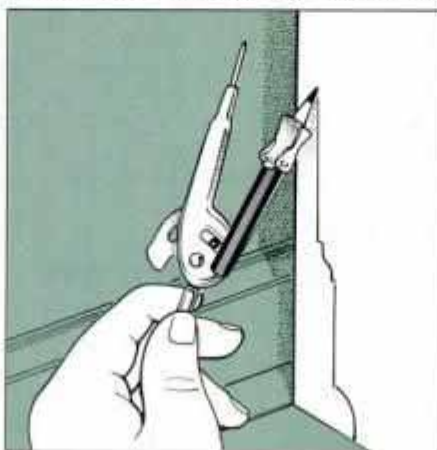
The weatherstripping at the bottom of your garage door provides a seal against water, cold air, dust and insects. If this strip becomes torn or worn, it's easy to replace it because the strip is only attached with galvanized roofing nails. Just pry off the old strip and nail on a new one. Check with your door manufacturer for instructions on steel or fiberglass doors.

5 Scribing Parts To Fit

When doing home carpentry, you may face difficult fitting jobs. The method for establishing cutlines to fit uneven surfaces is called scribing. Shown in the illustration is how to scribe the back edge of a cabinet to fit against a baseboard molding. Other jobs where scribing can be used are fitting a mantel against a stone or brick fireplace, fitting a wood beam against an uneven ceiling, or fitting paneling or counter-

tops against wavy plaster walls.

To scribe an edge to fit against any uneven surface, temporarily hold the material to be fitted into place. Measure the distance—in several places—between the uneven surface and the edge that will be cut, and note the maximum distance. Spread the compass legs to match or slightly exceed this maximum distance. Then position the metal point on one leg against



Use a drawing compass to scribe a cutline that matches an uneven surface. Move slowly and keep the point and pencil even.

the uneven surface that must be matched, and place the pencil leg on the material to be marked.

Now slide the compass along the uneven material so its shape is recorded on the material to be cut. Remove any temporary clamps or nails, and use a band saw or sabre saw to cut along the uneven scribe line. After cutting along the scribe line, you should have a perfect fit where the material abuts the uneven wall or other surface.

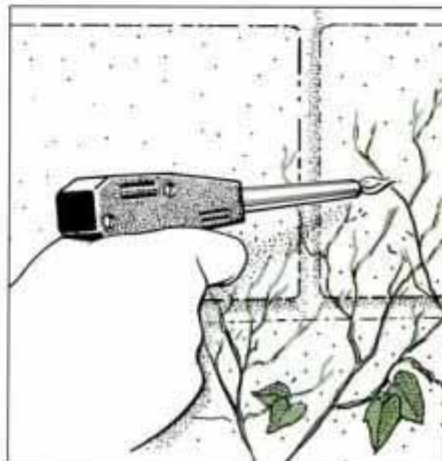
6 Removing Troublesome Ivy

In grandpa's day, sentimentalists wrote songs about the joys of living in a vine-covered cottage. Anyone who ever had to paint one of those cottages knows that ivy is something less than a real joy: You can't paint around it, and it's very difficult to remove. Ivy is held in place by tiny-but-tough hair-like tendrils. These tendrils invade every available crack and cranny, where they are almost impossible to pry out, especially on masonry walls. In addition, water can penetrate into the tiny cracks that have been formed by these tendrils causing damage during each freeze-and-thaw cycle.

To remove the ivy from masonry surfaces, start by cutting apart the vines and pulling them from the wall. Be sure to wear gloves to keep from



Use pruning shears to cut the bulk of the ivy from the wall. Then follow up with a simple paint scraper or stiff wire brush.



Burn off stubborn tendrils with a propane torch and brush away any residue. Keep a hose handy when working with the flame.

injuring your hands. (You can use a scraper to remove the tendrils that cling to smooth siding.) Then use a propane torch to burn off the tips of the tendrils and get rid of all vegetation. Remember to keep a hose and spray nozzle handy, and spray down any surface that was hit with the flame. Take special care if you decide to burn off the tendrils from wood siding. Spray the siding as soon as the ivy is removed, and then keep watch for several hours to be sure there is no possibility of starting a house fire.

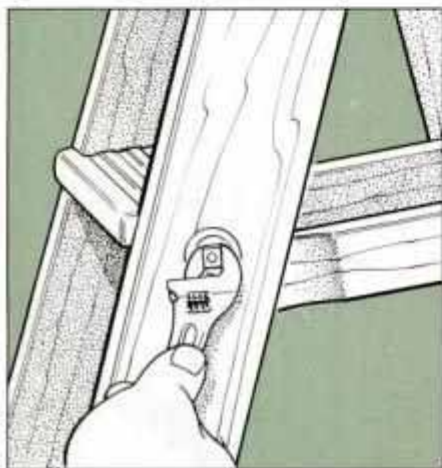
7 Ladder Safety

Many home repair chores require the use of a ladder, so we should learn to handle ladders safely. According to the U.S. Consumer Products Safety Commission, 97,000 people were treated at hospitals for injuries resulting from ladder use in 1989. These injuries could be avoided by choosing and using a ladder in the proper way.

First, read and heed the labels on



Read and heed all label warnings printed on any stepladder, particularly the caution against using the tray shelf as a step.



Periodically check the step brace nuts to make sure they are tight. If not, securely tighten each with an adjustable wrench.

ladders. Ladders are rated for their intended use and the load they will bear. Keep in mind that the load or *duty* rating of a ladder refers to the *total* weight it can carry, not to the worker's weight alone. This limit should include the weight of the heaviest person in your household plus the weight of any tools and materials carried up the ladder.

Ladders are rated by type. Type I can hold 250 pounds, Type II holds 225 pounds, and Type III will hold 200 pounds. If you are over 200 pounds, buy a Type I or even the Type IA, which will support 300 pounds. This will allow a safety margin if you ever climb a ladder with a bundle of roof shingles.

After reading the ladder's label for weight limits, check any warnings printed on the ladder. The top of a stepladder is not a step, nor is the tool tray that is commonly attached to fold out at the back of the ladder. In addition to observing warnings, you should be aware that ladders are most stable when your weight is kept cen-

tered between the ladder legs. Leaning or reaching can cause the ladder to topple. If you can't reach far enough, climb down and move the ladder.

Ladders are commonly made of wood, fiberglass or aluminum. Aluminum extension ladders have become popular because they are lightweight and easy to move. But one common accident occurs when aluminum ladders hit overhead power lines, or when homeowners use electric tools while working on the ladders. The metal conducts electricity, making it a potential hazard. So, watch where you move your ladder, avoid hitting power lines and buy cordless tools to help prevent electrical shock.

8 Painting Chain-Link Fences

Chain-link fencing has a durable galvanized coating that keeps it trouble-free for years. Eventually, though, even this galvanizing will fail, and the fence will require painting.

Wire fencing can be difficult to paint. Brushing on paint is usually slow and tedious, while spraying the open fencing permits too much wasted paint from overspray. The best solution is to use a long-nap paint roller. The long nap reaches into the weave



To paint the wire panels on a typical chain-link fence, use a long-nap paint roller. The long nap reaches into the tight bends.

of the wire and covers hard-to-reach corners. And, it's a good idea to enlist your neighbor to paint his side of the fence while you paint yours. This way, you will see each others' misses and can touch up the paint as you go.

Before starting, use a rotary wire brush, chucked into a drill, to clean away loose rust or dirt. You can also use an ordinary wire brush, to clean the surface. When everything is properly prepared, wipe down the fence with a sponge that's been soaked in mineral spirits. When the fence is

dry, apply the paint. Aluminum paint is a common choice for restoring chain link, or you can use any color paint. Just be sure to use paint designed for covering metal, not woods.

9 Bathroom Moisture

A common homeowner complaint is moisture buildup, often with mildew, in the bathroom. The procedures to eliminate the problem include finding and reducing the source of the moisture, making sure that proper ventilation is present in your bathroom and changing personal bathing habits in order to minimize moisture.

The first step is to find out where the moisture is coming from. Check your plumbing to be sure there are no leaks in the pipes under floors or in walls. If you find leaks, high humidity can be the least of your problems: Damaged wall tile, loose floor covering or rotted floor joists are all possibilities. Repair all plumbing leaks.

If you see water seeping around the base of the toilet, it means that the wax ring needs replacing. The wax ring seals the joint between the toilet and the waste drainpipe.

Moisture may be due to sweating of the toilet tank which is caused by cold water that cools the tank and, in turn, causes the humidity in the room to condense on the tank and run onto the floor or wall. To stop condensation, buy a terry-cloth tank cover to absorb the moisture. Better still, have a plumber install a mixing valve that warms the water coming into the toilet tank.

If excess moisture is due to steam from bathing, shaving and other activities, install an exhaust fan to remove the moist air from the room. Or, keep the bathroom door open so the humidity can circulate outside and mix with drier air in other rooms. You can also wipe down the shower or tile with your bath towel when you have finished drying yourself. And, don't leave wet towels in the bath. If necessary, use a small bath fan to circulate the moist air and reduce moisture levels and mildew growth.

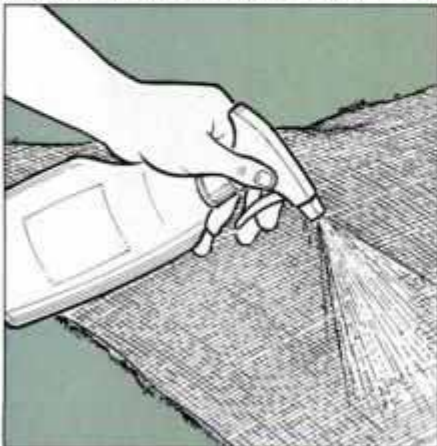
10 Installing Carpet

Much of today's carpeting is made of manmade fiber that's held together by a latex or foam backing. When it's new, carpet is very stiff and difficult to handle. But a few easy installation tips will help you add flexibility to the carpet so it will easily fit into odd

shapes and around stair steps.

If at all possible, lay the carpet flat, unrolled, to let it relax and lose any wrinkles that resulted from rolling. If you have a large paved area, such as a driveway or patio, unroll the carpet outdoors, so the sun can warm and soften the backing. This will make the carpet more flexible.

If you are working in cold or wet weather, unroll the carpet in a basement or garage and leave it open for a



To make stiff new carpet more flexible, dampen the backing with a plant sprayer, or warm it with a heat gun or hair dryer.

day or two. If you still have trouble fitting the carpet around any obstacles, apply moisture to the backing, using a common plant mister. This moisture will soften the latex backing. If the carpet is still stiff, augment the moisture treatment with heat. Use a hair dryer or heat gun to warm the backing. It will become as flexible as ordinary fabric, so you can shape it easily.

When the carpet is ready to lay, use double-faced carpet tape (it has adhesive on both sides) to hold the carpet in place. If you've let the carpet relax and lose its wrinkles, you can often install the foam-backed carpet without even using a stretcher. Of course, you can always rent carpet tools such as stretchers and hot-melt seam tools at carpet or rental outlets.

11 Trash Bag Composting

Composting grass clippings need not be a smelly business, nor take months to complete. If you have small amounts of grass, just place them in plastic lawn bags. Add 1 cup of high-nitrogen fertilizer to each bag, sprinkle water on top and seal it with a twist-tie. Roll the bag over to mix the water, fertilizer and grass clippings. Then, place the bag or bags in a storage shed or garage. Try to roll them

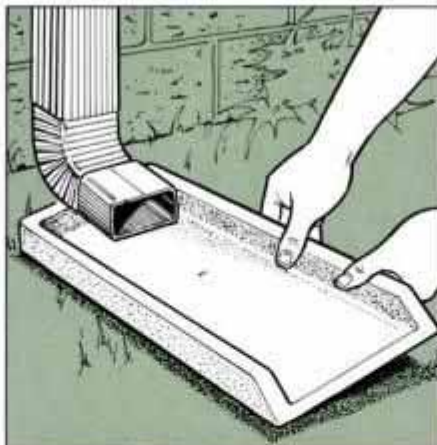


For quick composting of your grass clippings, place clippings in trash bag, add fertilizer and water, then seal and turn frequently.

over once, or more frequently if you like. Within a couple of months, you will have rich compost that you can spread on your garden, use to nourish new trees or mix with perlite to make potting soil.

12 Maintaining Rain Gutters

Rain gutters that become clogged or drop water in the wrong location can cause soil erosion and basement water problems. Tour the exterior of your house to check how your roof gutter system is working, and whether water is directed away from the foundation, driveway, patio and other things that could be undercut by erosion.



Use splashblocks under downspouts to direct water away from house. This reduces the chance of water entering your basement.

Water that pours along a blacktop or concrete driveway, for example, can erode the soil, wash away and undercut the gravel base from underneath, and leave the top unsupported so that the weight of an automobile could break it.

Check your rain gutters at least twice a year, in the spring and in the

fall, to make sure that they are clean and securely attached to the house. Check downspouts to be sure they have not been loosened by roof ice or snow loads. Next, check the ground pipes to be sure water that reaches the ground is carried away from the house's foundation. Of course, splashblocks, placed under the ground pipes or downspouts, help direct water away from the house.

If water coming from ground pipes or downspouts is causing a problem, you may have to redirect the pipes so that the water flows out in a better direction. Sometimes this means moving the downspout to a different location and changing the pitch of the rain gutters. But more frequently, all that's required is rerouting or lengthening your ground pipes. Generally speaking, a ground pipe should carry water at least 8 ft. away from the house's foundation.

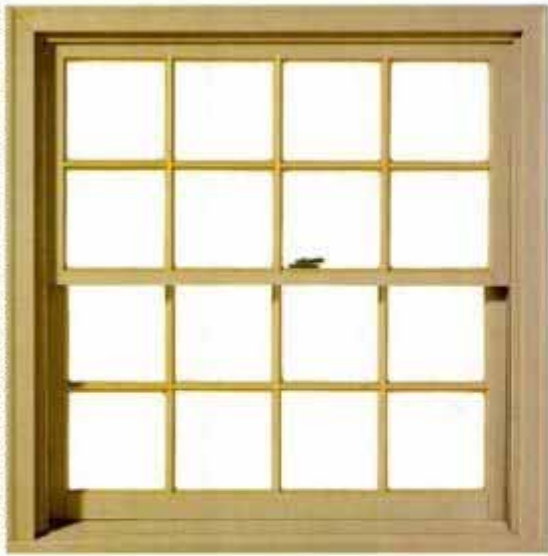
13 Quieting Floor Noises



To stop the noise from pipes rubbing together, separate the pipes and reset them using hanger brackets driven into the joists.

Many times, what we call floor squeaks are only noises and have nothing to do with squeaking floors. Plumbing pipes, bridging and heating ducts can pop and crackle, and even squeak, when we walk or roll something across the floor.

The easiest way to find the source of any noise is to have someone walk across the floor while you listen carefully below. Noises that seem to come from heating duct locations can be traced down and eliminated by loosening brackets that connect the ducts to the underside of floor joists. Sometimes a piece of rubber material, such as weatherstripping, can be wedged between the air duct and the joists to provide a sort of shock absorber between the two.



1. Clean the areas that you are going to paint. If the wood is especially dirty, hand scrub it with trisodium phosphate.



2. Remove mold from around windows with a wire or other stiff-bristle brush and a mixture of bleach and water (½ cup bleach to 1 gallon of water).

3.

Grit your teeth and do what must be done: scrape off all the loose and flaking paint.



5.

Replace any loose or cracked window putty, then prime the wood exposed in the process. Take care to feather the edges of the new putty into the old.



7.

With a razor blade, scrape excess paint off the window panes (happens to the best of us).



9.

Choose your weapon. A 2½-inch angled brush is ideal for painting windows. Remember: the wrong brush can actually make the job harder. We assume you wouldn't want that.



8.

Caulk around windows as necessary to seal out moisture. Latex caulk is paintable, while some silicone caulk is not, so be sure to read the product's instructions carefully.



4.

Sand over the old paint to make sure the new paint will adhere, then pick up the sanding dust with a damp cloth. Make sure the wood has dried thoroughly before you prime.



6.

Mask window panes with tape. Be sure to leave a gap between the tape and the window frame, so the paint will seal against the glass.

How to paint windows.

If you've spent too many Saturdays suffering through the routine on the left, you'll appreciate the paint on the right: Rust-Oleum Wood Saver® Trim Paint.

Made especially for your windows and other house trim, Rust-Oleum Wood

Saver contains Teflon®, so it gives your trim twice the moisture resistance of premium house paint.

Water tends to simply bead up and evaporate, instead of "pooling" and then seeping into the wood.



How to paint windows less often.

The result? House trim that's been covered with Rust-Oleum Wood Saver is less prone to cracking and peeling.

In other words, you will clean, scrape, sand, tape and paint less often. And years from now, when the neighbors

want to know why your windows still look so good, you can tell them your secret.

You just used the right paint.

 **RUST-OLEUM
WOOD SAVER®**

The name that means protection.

You should also check pipe locations where V-shaped pipe hangers support water or gas pipes. Joists that flex when they're walked on can rub against pipes and create a noise. Adjust the pipe hangers to relieve the rubbing.

Pipes can also make noises when they expand from hot water, contract



To dampen a variety of pipe noises, install foam insulation over the pipes. The insulation will also reduce condensation.

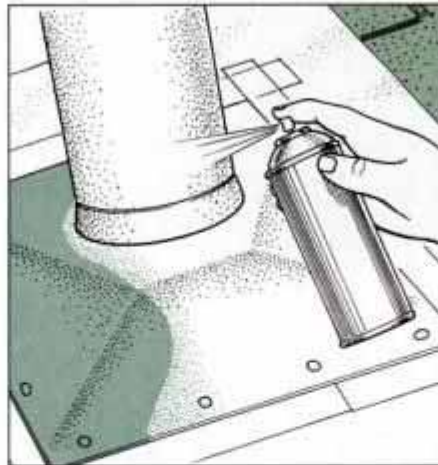
from cold water, or vibrate or hammer from high pressure. Foam pipe insulation can be used to cushion the pipe and muffle expansion or pressure noises. The insulation will also help prevent condensation from forming on the pipes which can cause water puddles on basement floors.

14 Painting Roof Vents

Today's new houses usually have pre-painted aluminum vents and flanges, but on older houses, the choice was often galvanized steel. Galvanized metal does resist rusting. But, it's best to give it a coat of paint periodically to prevent rust that will, in time, perma-



If metal vents or flanges need painting, first brush off the old flaking paint and then mask the surrounding roof with paper and tape.



Spray a metal primer on the surface first. Then let it dry and spray on one or two top coats. Keep the coats thin to prevent runs.

nently stain your roof shingles.

The first step is to clean it with mineral spirits. Then apply a coat of metal primer, followed by a top coat of metal paint. The paint not only will protect the metal from rust and corrosion, it will also help vents, valleys and flashing to blend in with the roof shingle colors. Note that we recommend that you use *metal paint* only for painting metal components. House paint is much too thick for use on metal. And, a too-thick paint film will blister and peel—a condition that's all too common on gutters and downspouts painted with house paint.

If the fixture has already been painted, but is peeling, use sandpaper or a wire brush to remove loose paint. If rust is present, apply a coat of rusty-metal primer first.

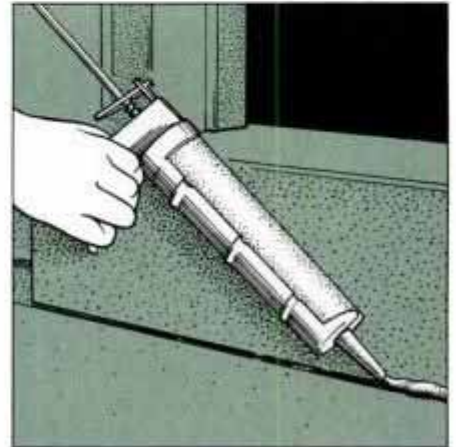
15 Patching Masonry Cracks

In the past, one of the most difficult and frustrating home repairs was trying to patch cracks in masonry products like concrete and stucco. Most cracks are due to expansion and contraction of the masonry when temperatures change. So, the movement that caused the crack almost invariably caused the patch to fail. In addition, masonry products are not adhesive, so they don't stick well to the old surface. Because of this, the old advice was to begin by chiseling out an inverted V in any crack. This was supposed to create a mechanical bond between the old and new materials because the patch material would be locked in place by the joint configuration. The failure rate of such patches proves the system was lacking.

Today, patch materials, usually with an acrylic latex base, are available in caulk tubes. These repair

caulks are adhesive, so they will stick to almost any clean surface. This allows you to successfully patch concrete slabs, steps, retaining walls and stucco. Patching cracks in brick joints, however, is a bit more of a problem, because the patching products may not match the color of the existing mortar joint.

Before using any of these products, a few precautions are in order. First, ask the dealer if the product color will match concrete or mortar colors.



Caulks are available for many masonry repairs. Make sure the one you choose matches the color of the material you're working on.

Some of the products are white and make an unsightly patch. Next, try to line up enough crack repairs to use up all the patching in the tube or tubes you buy. The product is hard to store once it is opened. Finally, keep in mind that it's almost impossible to make a permanent repair in masonry because of the expansion and contraction factors we mentioned earlier. As seasons change, the cracks will open up again. Just think of an annual foray with caulk as routine maintenance.

16 Painting Paneling

If you've inherited a roomful of dark wood paneling, or have simply grown tired of the finish, you can paint over it to lighten the room or change the color. As with most materials, paint success depends primarily on proper preparation.

The first step is to scuff sand the gloss finish to give the paint a better surface to grab. Use a power sander or sanding block and 120-grit sandpaper. Then, fill any nailholes or other blemishes with a high-quality wood filler. Once the filler is dry, sand the patches smooth.

When you are done sanding, remove the dust and then apply an alkyd primer to the surface and let it dry.

(More Improve Your Home tips on page 82)

Plan Your Home in Three-Dimensions



Design floor plans and build a three-dimensional scale model of your own home, addition or remodeling project. The removable roof, Floor Plan Grid and furniture symbols help you organize your plans and interior design. Also ideal for deck and landscape design.



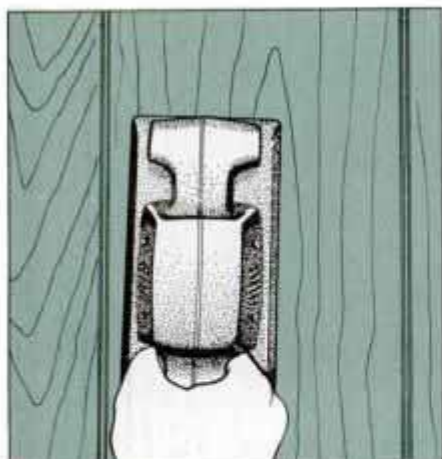
When you compare the models of two designs, you'll see which one is better for you—before you build. The 3-D Home Kit is fun and easy to use. Ideal for professionals, homeowners and students!

The hardest part of planning a new home, addition or improvement project is visualizing how the final results will actually look and work. Building a three-dimensional model of your project *before* construction begins can be a great help. The **3-D Home Kit** provides complete materials to design floor plans and build a detailed 1/4-inch scale model of *your own* home—up to 6,200 square feet. You can use your model to improve your design, save time and avoid costly mistakes. The kit is fun and easy to use. Model building materials include siding, roofing, windows, doors, skylights, interior walls, brick, stone, decking, stairs, kitchen cabinets and appliances, landscaping, and even scale people, a dog and a cat. The kit also includes complete model building instructions, Floor Plan Grid, furniture and bath symbols, Scale Ruler & Roof Slope Calculator, and notes from a professional designer on how to plan and evaluate your design. The Floor Plan Grid and furniture symbols can help you organize your plans and interior design. Whether you are designing your own home, working with a professional, or just fantasizing, the **3-D Home Kit** provides the most important tools you need.

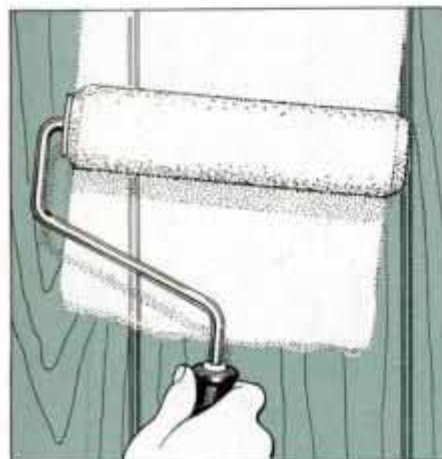
HOW TO ORDER: Send a check or money order (no cash please) for \$29.95 (\$25.95 + \$4.00 for shipping, handling and insurance) for each 3-D Home Kit to **H.M. SPECIALTIES**, Dept. PMTD 041; P.O. Box 1764; Sandusky, OH 44870.

(Sorry we cannot accept Canadian, foreign or C.O.D. orders.) Please allow 30 days for delivery. We ship by U.P.S. wherever possible. Orders outside the continental U.S. will take 6 weeks via insured Parcel Post.





To paint paneling, first sand the entire surface using 120-grit paper. An orbital finishing sander will make the job go much faster.



With sanding done and dust removed, apply an alkyd primer with a low-nap roller. Oil base or latex paint can be used for top coat.

You can finish coat with the paint of your choice, either latex or alkyd. But for the best results, use a low-nap paint roller to apply the paint to the paneling.

17 Sticking Windows

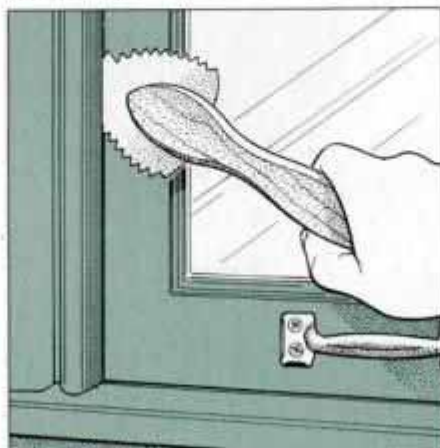
There are few things more frustrating than a window that will not open. Unfortunately, most of us pay no attention to our windows until they start to stick. But, a little periodic maintenance is all it takes to keep them running smoothly.

First of all, clean the window channels with a hand vacuum or a tapered nozzle on your floor vacuum. Next, apply a lubricant to the channels. Keep in mind that some vinyl channels in modern windows should not be lubricated, but older windows with metal channels require lubrication to keep windows moving smoothly.

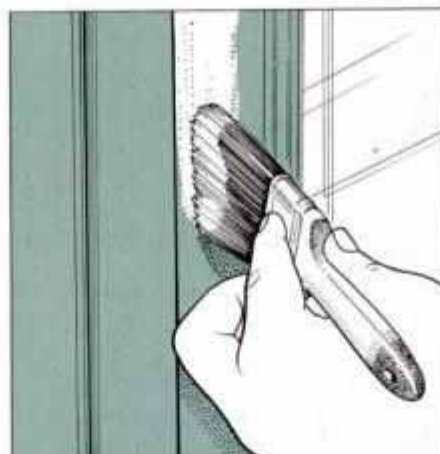
In truth, most balky windows are caused by sloppy paint jobs. A too-full

brush will let paint drip and run between the sash and stop, painting the window shut. When painting, remember to use the minimum paint and to move the window up and down several times during the drying process.

If all this advice is too late, and the window is already stuck or sticking, do not try to force the sash. You may



To free a window that's painted shut, slide a paint cutting tool between the sash and stop. Then pull the tool around the sash.

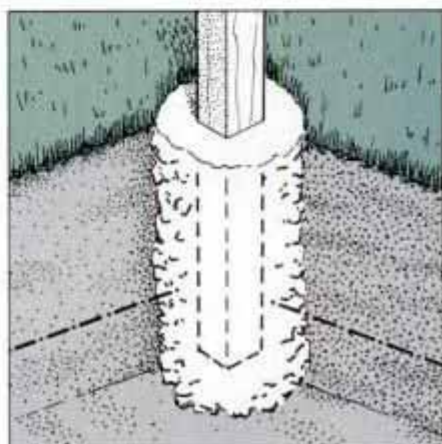


When repainting the window, use the minimum amount of paint, and move the sash up and down frequently while the paint dries.

damage the window, break the glass or injure yourself. Instead, pick up a serrated tool, usually called a *window zipper*, at your local hardware store. The tool has a blade shaped like an arrowhead, so it will fit into almost any crack. And, the edge of the blade is notched or serrated like a bread cutting knife. This notched edge will cut through just about any paint in the cracks. But for stubborn cases, you may have to pry loose or unscrew the stop strips that hold the window in the sash. When you have removed the stop, sand or scrape the edges of both stops and sash to remove excess paint. Then repaint both edges and let them dry before you reinstall the stops and sash.

18 Frost Line Requirements

A common question shared by many homeowners concerns the proper depth to dig post holes and foundations for outdoor projects. The most frequent response is to dig the hole down to the *frost line*, the depth to which the soil freezes in your locale. (The reason for the advice to dig to the frost line is that frozen ground heaves or expands, and will raise any structure whose base is not below the depth where the ground freezes.) Generally speaking, this advice is good, but one problem with it is that the frost line varies geographically.



The frost line (dotted line) is the depth that freezing temperatures will reach in any area. Footings should be below the frost line.

In my own Minnesota, for example, the frost line is 48 in. deep, whereas in the far West or deep South, there is no frost line because these areas have no prolonged freezing weather. To find the right depth for holes or foundation trenches in your area, call your local building department or inspector.

Keeping regional differences in mind, here are a few general guidelines: Most free-standing structures with wooden floors should have posts or foundations that extend to the frost line. A gazebo, for example, should have footings at the frost line, so the frost will not heave it unevenly and leave the building out of plumb. The posts that rest on the footings and that support the gazebo can extend down to the frost line, with concrete or tamped gravel packed in the holes around the posts. Or, you can form and pour concrete piers that reach to the frost line, and set the posts or joists atop the concrete piers—above the surface of the ground—anchored there by metal concrete-to-wood connectors.

A shed or garage that rests on a concrete slab floor, on the other hand,

(More Improve Your Home tips on page 85)

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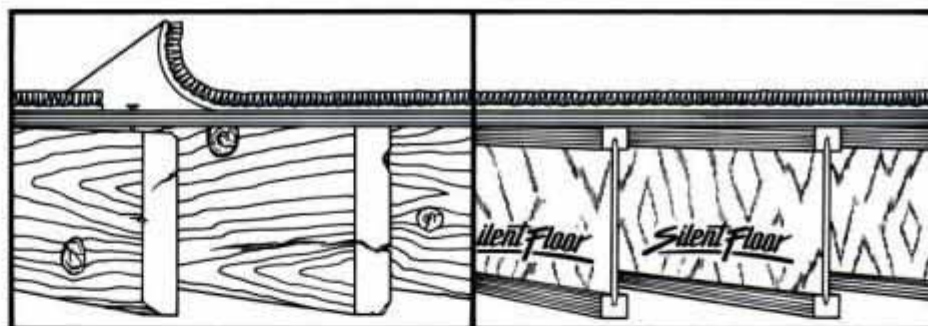
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need not have frost footings below the frost line. The slab can be poured at grade, after the vegetation is removed and rock or gravel are spread to provide drainage under the slab. This type of construction is called a *floating slab*, and it is commonly used, even in Minnesota. The recommended procedure for floating concrete slabs is to dig a slight trench, perhaps 2 ft. wide and 12 to 18 in. deep, so that the concrete pour is thicker at the perimeter of the slab. This will help prevent the slab from cracking on the edges where the weight of the framed building will rest.

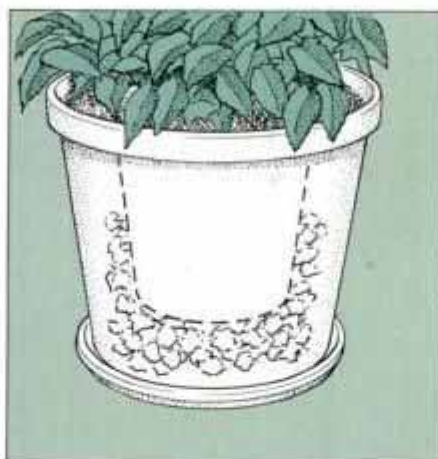
If a deck is attached to the side of the house on a ledger board, the outboard posts—those that hold up the far end of the deck—need not necessarily be dug to frost depth. The house side of the deck will not heave or raise in any event, because it is attached to the house itself. However, if the deck edge is more than 3 ft. above ground level, you should sink the posts deeper to resist the increased wind load.

Note that metal connectors can be used to anchor wood to concrete piers for most structures. If the post holes you require are for fence posts, you should never use metal connectors above the ground. Rather, the fence posts should be set into the ground to anchor the fence against high-wind pressures from the sides. The rule for fence posts is to set the post in the ground to a depth equal to one-third of the post height above ground. For example, a fence that will be 6 ft. tall should have 2 ft. of post in the ground. Keep in mind that the new fast-set, no-mix concrete products are excellent for anchoring fence posts.

In closing, remember to check with your local building department and any contractors you may know to determine the common building practices in your area. And, when in doubt, realize that it's always better to go too deep than too shallow.

19 Windblown Potted Plants

Potted plants such as hibiscus or small evergreens can add color and beauty to your deck or patio area. But sometimes these plants are top heavy, with a large leaf area above a small pot. Because of this, such plants are frequently damaged because their top-heavy form causes them to tip over in high winds. Your garden dealer may not advise repotting because some plants will thrive better in smaller pots. And if you try to tie the plant to a



To keep a small plant from being blown over by the wind, place it in a larger pot and fill underneath and around it with gravel.

deck post or rail to stabilize it, the binding may damage the plant or spoil its appearance. How can you leave your potted plants out when strong winds threaten?

The secret is to buy a second, larger pot. Shown is a hibiscus that has been potted in a 10-in. pot. We purchased a 20-in. pot and a bag of decorative garden rock that people usually place around the base of shrubs or in flower gardens. First, pour a layer of rock in the bottom of the large pot, then place the small pot in the larger pot. Pour the rest of the garden rock around the edges of the small pot until the rock is level with the plant base. The wider pot base plus the added weight makes the plant very stable in high winds.

20 Wallcovering Tips

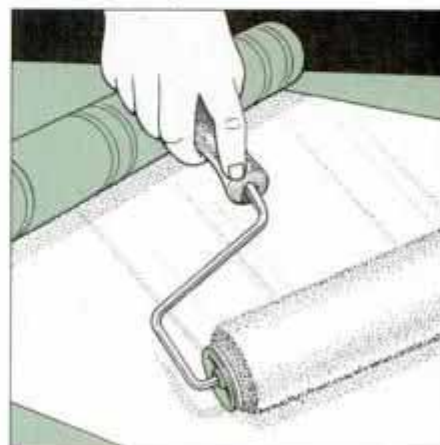
Most of the wallcovering installed today is not *paper*, it's vinyl. And, most of the wallcovering is now prepaste, not plain, to save the homeowner the task of mixing and applying adhesive. In early days, there were some failures with the prepasted coverings, and, although manufacturers have made great strides in adhesive technology, you can still hear complaints about coverings that didn't stay put.

There are several ways to ensure that prepasted wallcoverings do stay put, have closed seams, and do not blister or loosen from the wall. The first step is to prime the wall with an alkyd primer, which seals the wall so moisture cannot soak from the adhesive into the drywall or plaster.

Another tip is to control the temperature and the humidity in the space where you will be working. Close the windows, shut the doors and turn off the thermostats on heating equipment to keep the room cool

and draftfree. If the day is very hot and dry, place throw rugs under the cracks at the bottom of the doors and run a humidifier in the room to raise the humidity and to slow the drying time. This will prevent premature drying of the adhesive and will increase your *open time*—the time you have to fit and smooth the wallcovering before the adhesive sets.

If you still mistrust the prepasted coverings, buy an adhesive intended



If you're worried about prepasted wallpaper sticking to the wall, coat its backside with a water and paste solution before hanging.

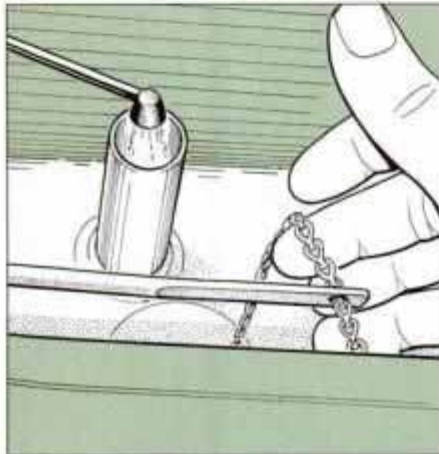
for use with vinyl coverings. Add 1 quart of vinyl adhesive to 1 gallon of warm water. Lay the wallcovering strips on a table and, instead of dipping the strips in a water tray, use a paint roller with a medium nap to apply the mix to the covering. The water will activate the glue on the back of the covering, and adding the quart of adhesive to the solution will provide added assurance that the coverings will stay put. Don't neglect, however, to inspect the seams after the covering has hung awhile. Any shrinkage can be adjusted if you do it while the piece is still wet.

21 Flush Lever Replacement

Whether your toilet flush lever breaks, or you just want to change it to match other hardware, lever replacement is a simple, 10-minute chore. Begin by removing the top of the toilet tank and unhooking the chain or strap that connects the lever to the tank flapper below. Inside you will find a retaining nut on the back side of the lever. Hold the lever on the outside of the tank with one hand, then, using adjustable pliers, remove the retaining nut from inside the tank. Do not inadvertently tighten the nut—or drop tools on the tank—because the tank could crack.



To replace a toilet flush lever, first remove the tank cover and find the retaining nut. Remove the nut with adjustable pliers.



Slide the new lever into the tank hole and tighten it in place with its retaining nut. Then hook the flapper chain on the lever.

To install a new flush lever, insert the arm of the lever through the hole in the toilet tank. Install and tighten the retaining nut, then connect the flapper strap or chain to the lever. Flush to test.

22 Painting Cleanup

Try as you may, paint brushes or rollers often don't come clean with washing, and the result is stiff brush bristles or a roller that's rock hard. It's difficult to get paint tools completely clean with soap and water alone, even though latex paint is a water-based product.

To thoroughly clean brushes and rollers, buy a cleaning tool that has teeth on one side and a curved edge on the other side. The curved side fits around a paint roller and helps force the paint from the nap. The toothed edge is used to comb the brush bristles after cleaning to keep them straight.

As a general rule, you should re-

move as much paint as possible before you wash the brush or roller. Then flush the paint from the tool, applying a high volume of water. When the tool appears to be clean, squeeze it in your hand. If you still see paint residue oozing out, apply a solvent such as mineral spirits or brush cleaner to the brush or roller. Mineral spirits or brush



To clean a paint brush, first soak it in solvent. Then hold it in the end clamp of a spinner tool and spin it until the solvent is gone.



The same tool works for rollers. Just soak the roller in solvent, then slide the roller onto the tool and spin it completely dry.

cleaner will help bring out any paint residue, even latex.

Also, if you do any amount of painting yourself, invest in a spinner tool. The spinner has a spiral shaft like a child's top, and spins at high speed as you work the handle quickly up and down. The tool's round shaft can hold a roller, and a clamp device on the end can hold a brush handle for cleaning. Slip the roller or brush onto the spinner, and position the end of the tool in a 5-gallon plastic paint pail. Spin the tool as rapidly as possible. The centrifugal action will force the water and/or solvent from the paint brush bristles or the roller nap, and your painting tools will dry soft and be ready for the next project.

23 Patching Blacktop

Blacktop (asphalt) driveways require more maintenance than concrete ones because the asphalt tends to lose oils from exposure to the direct sunlight, causing it to dry out and crack. As tiny cracks develop and fill with fall rains, the water freezes and expands in the cracks, breaking up the blacktop. Depending on the climate where you live, blacktop may need patching and sealing on an annual basis.

Not so many years ago, there were no patch products available for do-it-yourselfers. The homeowner could visit the asphalt plant and carry



To fill cracks in asphalt, first remove any debris, then partially fill with fine sand to reduce the amount of patching needed.



Load the patching compound into a caulking gun, then fill the crack. Use a putty knife, dipped in solvent, to smooth the patch.

home hot asphalt in galvanized garbage cans to do one's own patching, or one could hire pros to do it. Now, cold patch products for large areas are widely available, as well as crack patching compounds and sealers in 5-gallon pails.

The first step in blacktop repair is to clean the surface with a driveway

(More Improve Your Home tips on page 88)



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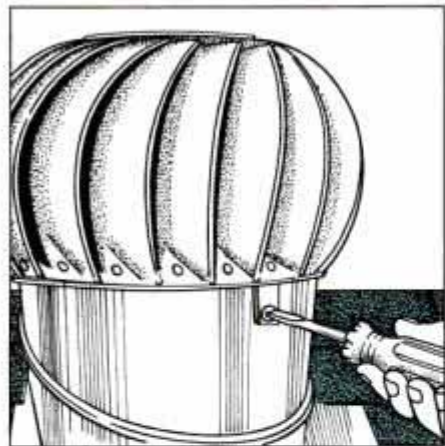
cleaner. This will remove any dirt and oil from the surface. Let the slab dry, then patch any cracks using the caulk tube patchers. A good tip to remember is that you can save on patching expenses if you partially fill deep cracks with sand before applying the patcher.

Even though cold patching products are called *cold*, in contrast to the hot asphalt mix the pros use, it's a good idea to let all asphalt repair products stand in the sun for several hours, so they will thin out and become easier to spread and smooth on the driveway.

When all cracks and holes have been filled, use a squeegee and broom to spread the sealer. Spread the sealer at the recommended rate of coverage. Heavy-duty sealers are available at higher cost, but in harsh northern climates, this heavier product doesn't seem to reduce the number of coats or the amount of maintenance needed.

24 Ventilation Checkup

Good ventilation is necessary to prevent winter ice dams on your roof and other moisture problems in any season. Though you may have had your ventilation and insulation updated for energy savings, it's a good idea to check the attic and roof each spring to make sure everything is working.

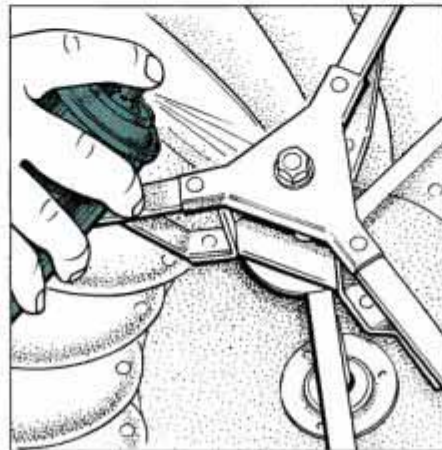


Inspect rooftop ventilators once a year to make sure they're still securely attached to the roof. Check inside by removing turbine.

The best ventilation is continuous soffit ventilation for the length of the house combined with full continuous ridge venting. This setup creates a natural chimney effect that pulls cool air in at the soffits, moves it across the insulation blanket where it picks up moisture and heat, and then exhausts it out at the ridge vent.

Climb into the attic to check the insulation. High winds can blow fiber-

glass about, even though wind velocity is reduced by the soffit vents. Check also to make sure that no insulation is blocking the airflow where the roof truss or rafter crosses over the top plate of the outside wall. Clear away any obstructions so the air can flow freely between the soffit and ridge vents. Also check the underside of the roof deck for water stains, which may indicate a roof leak or the buildup of frost and moisture in the attic during winter. Any sign of mois-



Wiggle the turbine shaft to check for bearing wear. Then lubricate the bearings using a spray lubricant. Reattach the turbine.

ture in the attic indicates either a roof leak or insufficient roof ventilation.

Next, go on the roof and check any rooftop ventilators. If you have a turbine vent, check the turbine for wear by wiggling it from side to side. Any excess play on the shaft indicates bearing wear and early failure of the turbine. To make the turbine last longer, remove it from its base and lubricate its bearings using an aerosol penetrant and lubricant, such as WD-40. Reassemble the turbine and check for smooth operation.

25 Removing Old Flooring

A couple of common repair issues are how to remove old tile and adhesives from walls or floors, and how to remove sponge carpet pad when it's time to recarpet. Your first option is a rental machine that has a horizontal cutting knife to cut loose the old floor covering. But if your problem is vinyl tile or linoleum over a wood floor, you often can leave the old floor covering in place. Simply cover it with a layer of $\frac{3}{16}$ -in.-thick lauan plywood. Then install your new flooring over this new plywood. This is much easier than tearing up the old floor covering and fighting to remove the old adhesive. Laying plywood over the old



A simple wallpaper scraper with a razor blade does a great job removing old adhesive. Always push the tool away from you.

floor is especially recommended if the old floor covering contains asbestos.

If you must remove the old adhesive or rubber carpet backing, use a scraper with a razor edge. You can also soften these adhesives for removal by using a commercial adhesive remover available at floor tile dealers. These products soften adhesives used on plastic and ceramic tile, cove base or any all-purpose latex adhesive, including that used with foam-backed carpet. They're also great for simply removing adhesives from the surface of wall tiles or flooring. Let the remover set a few minutes and scrape away the adhesive with a putty knife or paint scraper. Some of these products do contain methylene chloride, so be sure to supply adequate ventilation to the area.

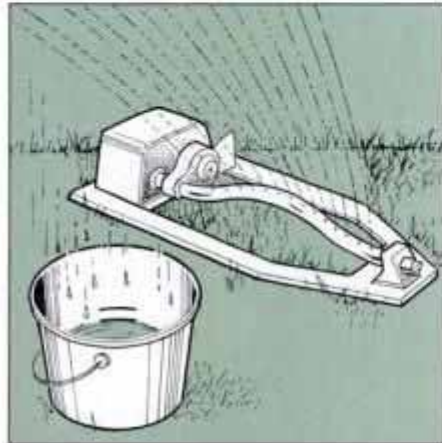
26 Drought-Free Lawn

Perhaps you live in an area where watering the lawn is often prohibited, or rising water bills make you think twice about the expense of watering. Here are some steps you can take that will help you keep the lawn green and healthy, but let you use less water.

The first step for conserving water is to mulch everything. Buy or rent a shredder to turn lawn waste into mulch. Spread a layer at least 4 to 6 in. thick around trees, shrubs, and in flower or vegetable gardens. Mulch helps hold moisture, reduces moisture loss from evaporation in hot weather and discourages weed growth. Making and using mulch can also reduce the amount of lawn waste you generate, important in these days of overloaded landfills.

The average lawn needs about 1 in. of water per week to keep grass green and healthy. This includes whatever rainfall you've had during the period.

Keep track of the rainfall in your area for two weeks, then water your lawn enough to bring the total up to 2 in. If you have an underground sprinkler system, of course, it will have a meter that will let you gauge exactly how much water you want to apply to your lawn. If you use a hose and sprinklers, you can paint marks inside plastic pails or coffee cans at 1- and 2-in. levels. Set these around the lawn and check when you have the right water depth in the containers. Then shut off



To check how much water your lawn is getting from your sprinkler, place a couple of open pails around the yard to act as gauges.

the hose to avoid wasting water.

Another thing you can do to reduce lawn water usage in hot weather is to set your mower blade height at 2 in. Taller grass will reduce evaporation from the soil by shading it more. On very hot days, sprinkle the lawn lightly at sundown. This practice, called *syringing*, cools the lawn and helps the grass survive on less water.

27 Heeding Label Warnings

If you ask paint dealers what is the best advice they can give consumers, they will always reply: "Tell them to read the labels." Most of us think we know how to apply the paint or use the chemical in the container, so we neglect the instruction side of the label. But do you understand what terms such as "flammable," "use with adequate ventilation" and "keep away from heat and flame" really mean? Knowing how to work with chemicals can save your health or your life.

Paints or other chemicals that can be fire hazards are listed as combustible (least flammable), flammable or extremely flammable. Remember that the fumes of flammable chemicals are also flammable. In fact, fumes such as gasoline are a greater threat for fire or explosion than liquid gaso-

line. Avoid using any flammable product near any appliance that has a pilot light. Remember, too, that fumes are heavier than air and settle toward the floor, where low pilot lights can ignite them. The best rule is to use flammable chemicals outdoors.

What does the phrase "use with adequate ventilation" really mean? Many people think that if they open a window, ventilation needs are met. In fact, the warning means that ventilation should be such that fume disper-

sal is equal to what you would have if working out of doors. The fumes from some of these chemicals can damage you or your home. Paint removers especially have been a risk. So never use them indoors without shutting off the furnace and opening windows and doors. You can augment air movement with a fan set in a door or window to pull outside air in.

Finally, the warning "keep away from heat and flame" means just that: The chemical and its fumes are flam-

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mable, and represent a hazard of fire or explosion. This warning, of course, implies a ban on smoking or any other activity that requires an open flame.

28 Stucco Renewal

In warmer areas of the United States where temperatures never drop below freezing, masonry paints are sometimes used to renew stucco that has grown dingy with time. But in northern states, moisture migration through walls that have no vapor bar-



For small repairs, first clean the surface, then mix the stucco according to the label directions. Apply it with a sponge or a roller.

riers will often cause widespread paint failures, such as peeling and mildew. Stucco is in fact a masonry finish, and as such, any finish coat applied over it should be a nonsealing masonry product.

If you have stucco that is aged, first try power-washing it. Grime and mildew that can collect on the stucco make it look dull and dirty. Washing will often bring back the new stucco look. Use a garden sprayer or a power washer to apply a masonry cleaning product to the stucco. First, wash with clear water to wet the stucco and begin soaking dirt loose. Then apply a cleaner. You can use a 50/50 mix of water and ordinary chlorine bleach, or ask your hardware store to recommend a cleaner for masonry. Be sure to rinse the entire surface thoroughly with clean water.

The first choice for renewing stucco should be a cement-base stucco coating. These are available in dry form and must be mixed with water. Most manufacturers offer several color choices. Thoro, for example, offers a color chart of 10 stucco colors. Mix the stucco according to directions on the bag, and apply over the old stucco using a rental hopper-type sprayer or a sponge, brush or roller.



For larger stucco repairs, you can rent a hopper-type spray gun. These tools have different orifices for a variety of masonry finishes.

If you choose to use paint on stucco, tell your paint dealer of your intentions, and ask for advice on which paint product is best and for proper application techniques. Also, ask for the address of any houses that have been painted with the product, and visit them, if possible, to see how the product has performed.

29 Painting Over Wall Stains

If your budding artist has used your wall for a canvas, your first impulse may be to try to paint over the stain. But many stains cannot be covered with paint alone: Rust, grease or oil, crayon wax and magic marker ink may be activated by the solvent (water or oil) in the paint, and bleed back through the new paint. This is true re-



Before painting over stains, make every effort to remove them. Try different removers until you find one that works on your stain.

ardless of how many coats of paint you apply. You must either seal over the stain or remove it from the wall before painting.

Many decorating texts will advise you to just seal the stain in. The prob-

lem with this approach is that if you apply a good sealer—such as shellac—over the stain, the new paint will be shinier over the patch than it is over the rest of the wall. Depending on where they're located, these shiny patches can be unsightly.

The best approach is to try to remove the stain. Check with your local paint dealer for products with trade names such as *Lift Off*. These cleaners contain solvents that will remove spattered latex paints, grease, crayons or other stains. To use them, pour some cleaner on a clean cloth, wet the stain and let the cleaner work for a couple of minutes. If you just try to scrub the stain away, you may re-



If the stain comes off, then just prime and paint normally. But if the stain remains, coat it with shellac first, then paint over it.

move the wall paint with the stain. Wiping gently will minimize damage to the finish.

If the stain comes off the paint, spot prime the stain area and then repaint the wall. If it proves difficult to remove, you can seal in almost any stain with a shellac sealer. Shellac is fast-drying so it does not activate the stain material, and is especially effective over rust and grease. It is also useful for sealing over smoke and oil stains, which are common after a house fire.

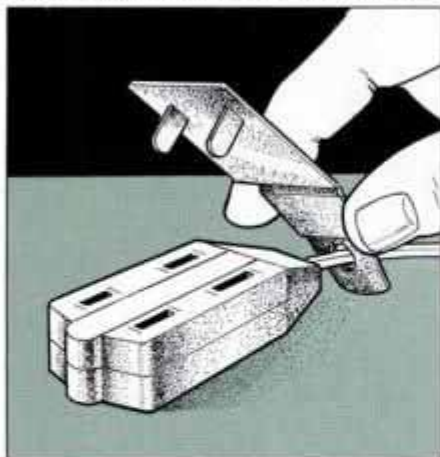
To avoid the shiny spots due to higher sheen over the shellac sealer, seal the entire wall with shellac, not just the stain.

30 Childproof Your Home

Burns, falls, electrical shock and drowning are all hazards for children. Here are some tips to follow so your child won't become a statistic.

• Did you know that, according to the Consumer Products Safety Commission (CPSC), 125 infants have drowned, since 1985, in 5-gallon pails left unattended by their parents? It's

true. An infant can climb headfirst into such a pail. Keep children away



If you use extension cords around young children, be sure to use cords that have protective covers for the unused outlets.



Even the apparently harmless 5-gallon pail is a risk for young children. They could drink poisonous contents, or climb in and drown.

when you are using any large open container for washing cars, windows or other chores.

- Buy extension cords that have protective plug covers. These covers should be in place whenever any slots are not being used. Open slots in that socket can provide the opportunity for infants to stick metal or other objects into the holes. Also buy inexpensive outlet covers that plug into unused outlet openings. And, don't let appliance cords hang from countertops. Use twist wires to fold and tie the cords so an inquisitive child cannot grab the cord and pull down a hot appliance.

- Turn handles of cooking pots inward so children cannot grab pot handles and dump boiling contents.

- Turn down your water heater thermostat so a child cannot be scalded accidentally in the bathtub. Adults may know to mix in cold water if the faucet runs too hot. But children may turn the hot faucet on while they are in the

tub, with disastrous effects.

- Check all container labels and place dangerous chemicals or anything with a poison label in a locked cabinet. And, don't leave caustic cleaning products under the sink cabinet to be discovered by a young child.

31 Three-Prong Installation

Homes of the '50s or older may have 2-slot electrical receptacles, which

means that the entire electrical system was grounded through the cable that connected the outlets. The cable, a flexible steel tube called *greenfield*, tied the entire system together, rather than using a third wire as today's Romex cable does.

These old outlets are safe, but often inconvenient. You must use a grounding adapter plug to connect any tool or appliance that has a 3-prong grounding plug. A better idea is to simply replace old 2-slot receptacles with 3-slot



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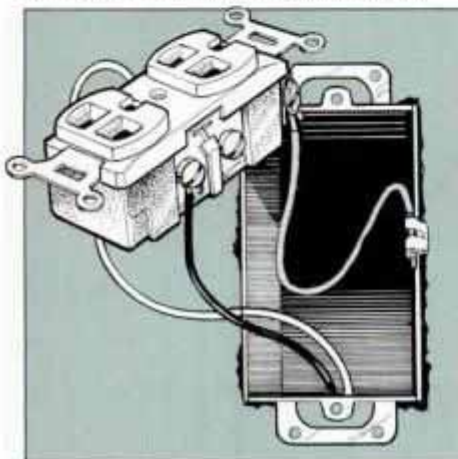
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Adapters should not be kept on electrical cords, as shown. They should be attached to the outlet with the covering plate screw.



Wire a 3-pronged receptacle just like a 2-pronged one. But add a grounding pigtail and clip from the receptacle to the box.

models, especially in frequently used outlets.

The first step is to turn off the electrical current to the circuit at your fuse box or breaker panel and use a neon tester to be sure no current is present. Remove the outlet cover, then pull the old receptacle out of the box and loosen the wire screws on both sides.

When you have disconnected the old receptacle, attach the wires to the new receptacle in the same way. Then attach a pigtail ground wire (available at hardware stores and electrical supply houses) to the green screw at the bottom of the new receptacle. The pigtail has a spring clip that must be pushed over the edge of the metal outlet box. Replace the retaining screws that hold the receptacle to the box, add the cover and turn on the power.

32 Correct Bulb Sizes

On lamps or ceiling light fixtures, you may see a warning to use 60-watt

bulbs only, or some similar restriction. The reason for this warning is the chance of heat buildup and fire if you use a hotter, oversized bulb in the fixture. Recessed and flush-mounted light fixtures are especially at risk from heat buildup and fire because there is no air circulation around the fixture to cool the bulb.

For example, the flush-mounted fixture shown in this drawing has a cover that traps the heat from the bulb. Additionally, the bulb itself lies flat against the metal base, which in turn is attached directly to ceiling tile. The heat buildup in such a fixture can



Ceiling light fixtures that provide little clearance around the bulb will easily overheat if improper high-wattage bulbs are used.

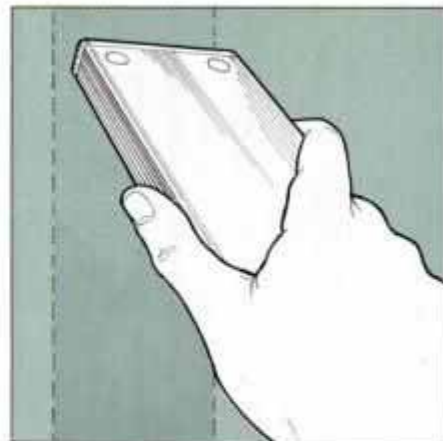
lead to a fire even if the bulb you are using is only 15 watts higher than the recommended size. If you need more light, either add another fixture or replace the existing one with something that can use a more powerful bulb.

33 Finding Studs

To hang heavy objects on the wall, you must locate the wall studs. Draperies, large pictures and mirrors must be hung on anchors fastened to the wood framing, not simply driven into wallboard or plaster. With a little detective work, you can easily locate wall studs or other framing members.

If you have wallboard on your walls, finding the studs is easy. Turn off all lights in the room and remove the shade from a lamp, or use a bare bulb in a trouble light. Hold the bare bulb close to the wall, just far enough away so the heat from the bulb will not scorch the wall. With this strong sidelight, you should be able to see the slight indentations over the nail- or screwheads. Each row of these fasteners marks a stud location.

Another way to locate the studs is to check the baseboard along the bot-



Electronic stud finders are a great way to locate framing members hidden in a wall or ceiling. They measure density differences.

tom of the wall. The nails used to attach baseboards are usually driven into the wall studs. Once you locate these nails, measure the distance from them to the nearest wall. Then measure the same distance near the top of the wall. A straight line between the two will represent the length of the hidden stud.

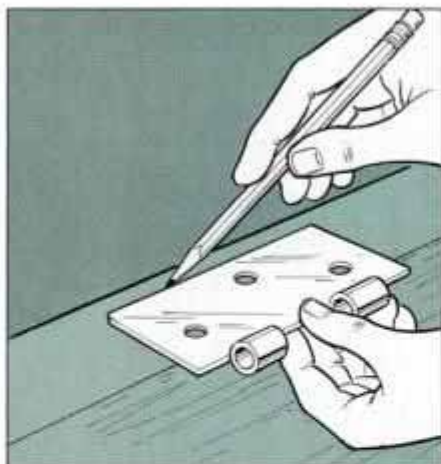
Also, stud locaters—which are available in two basic types—work well. One has a magnetized arrow inside a clear window in the locator. To use it, just move the tool laterally across the wall. The magnetic arrow will move when the locator goes over a nail in the wall. The nail, of course, indicates the location of a wood stud.

Electronic stud locaters work best. To use them, all you have to do is move the tool over a known stud location and note how it reads. The locator reveals the difference in density between the plaster or wallboard and the wood stud.

34 Adding Door Hinges

Because they are made of solid wood (or metal) and are heavy, exterior entry doors are usually hung on three hinges. Interior doors, on the other hand, are lightweight and usually have only two hinges. The 2-hinge system is sufficient for most interior doors, but if you decide to add weight to the door, you may have to install an extra hinge to help support the added weight. Over-door clothes hangers and door-mounted mirrors are additions that can greatly increase the weight on the door. And, you must either reinforce the door with an extra hinge, or face the possibility that the door will sag under the weight.

To add an extra door hinge, first remove any added weight. Then use a screwdriver and hammer to drive up



To add a third hinge to any door, just buy one that matches the size and shape of the existing hinges and trace it on the door.

the hinge pins and remove them. With the door removed, lay it across a pair of sawhorses or, preferably, stand the door on edge with the hinge side up. To help hold the door upright, push one end of it into a corner of the room.

Next, using a hinge that matches the existing ones, mark the hinge out-



Using a sharp chisel, cut a mortise within the lines to accept one hinge leaf. The depth of the mortise should match the leaf thickness.

line on the door edge, midway between the other two hinges. When you have marked its outline, use a chisel or a router to cut a mortise (recess) for the hinge. You must also mark and cut a hinge mortise on the door frame. Once these cuts have been made, screw the door side of the hinge to the door, and the frame side of the hinge to the door frame. Reinstall the door. The added hinge support will now hold any reasonable weight you place upon it.

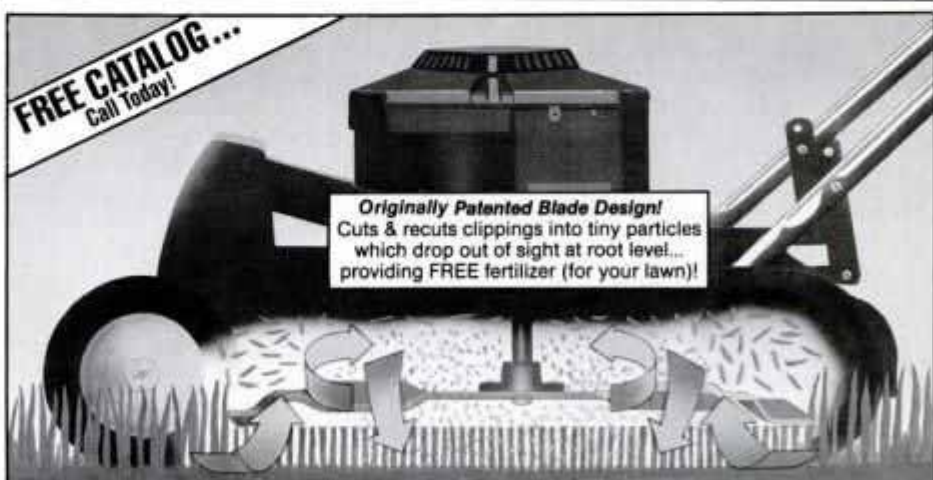
35 Installing A Fan Control

When you start shopping for a ceiling fan, you may find that a variable-speed feature costs a lot more than

single-speed models. Keep in mind that you can make any ceiling fan variable speed by installing an adjustable fan control.

The fan control shown here is a rheostat type, with a switch handle that slides up and down. Similar controls are available as light dimmer switches. But these switches are not intended to control fan motors and are not equal to the task. Fan control switches should have at least a 5-amp capacity.

To install the fan control (we are assuming the fan is connected to a ceiling light box), shut off the electric power to the circuit, then remove the old switch from the box. Straighten out the ends of the electrical wires in the box. Then join the pigtail wires from the back of the fan control to the ends of the box wires. Join the white wires together and the black wires together using the proper-sized Wire-Nuts. Replace the switch cover, turn on the power and test the control to



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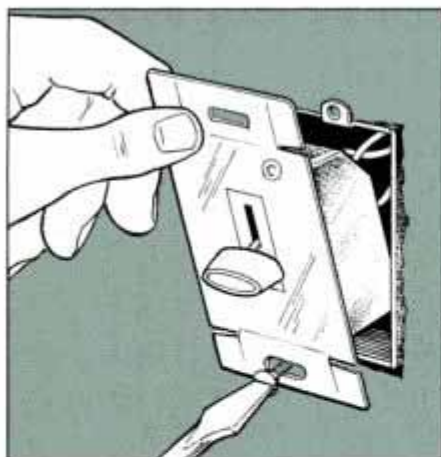
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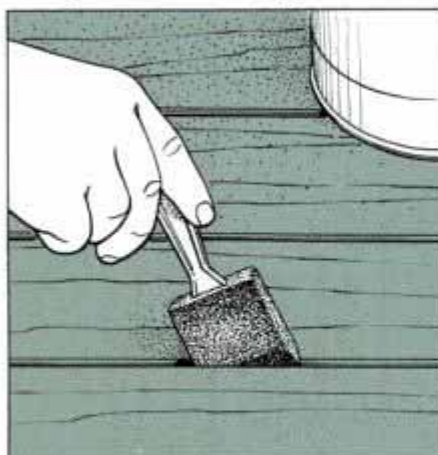
To make a single-speed ceiling fan into a variable-speed model, just replace your wall switch with a variable-speed fan control. make sure that your fan is working properly.

36 Renewing A Deck Surface

Every deck surface takes a beating because it catches the full brunt of both blistering sunlight and rain or snow. Inspect your deck each spring because regular maintenance will help it survive longer and look better.

The first step is to check between deck boards for leaves, twigs and other debris that might hold moisture. The deck must drain quickly after a rain. Standing water or constant wetting will destroy any wood species.

Next, go over the deck with a hammer and a nailset, driving in any nails that may have popped above the surface. This step will keep your deck strong and smooth. (Popped nails be-



When refinishing a deck, apply the new coating to the wide areas with a roller. But use a small sponge brush to cover the edges.

come loose, rust, then fail.) If necessary, re nail any loose areas with galvanized or aluminum nails to avoid future rust.

If the deck boards are split or

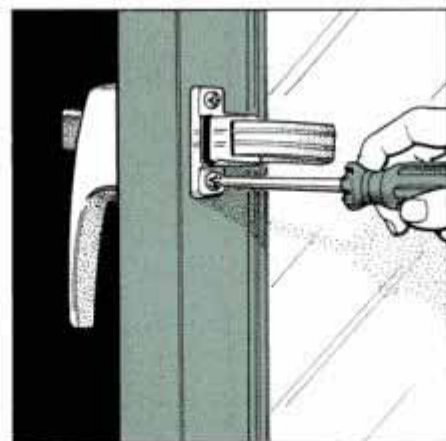
splintered, sand them smooth or replace them. Then apply a coat of your favorite deck finish. If you're undecided about what to use, look for a stain and sealer product that will wear well, has ultraviolet blockers to block out the Sun's rays, contains a mildewicide and is warranted to last two years or more between coats.

Use a paint roller with a long-nap fleece cover that will reach into all the cracks and crannies for full coverage. A helpful aid to save your back is to buy an extension handle for the roller, so you can place the roller pan on the deck and work while standing.

One hard-to-reach area is the drain spaces between deck boards. Buy a couple of disposable sponge brushes for staining the edges in the cracks between the boards. The sponges can reach down into the cracks to ensure full stain protection of the wood.

37 Storm-Door Handles

If you break the door handle on your aluminum storm door, don't consider replacing the door. These days, you can buy replacements for anything—including storm-door handles. The only thing you will need to know is the spacing between the retaining screws that hold the interior and exterior



To get the proper replacement handle for your storm door, remove the old handle and take it to the store to get a perfect match.

parts of the lock together. Remove the old lock handle and measure the distance between these screws, or take the old lock and handle assembly with you when you go shopping for a replacement.

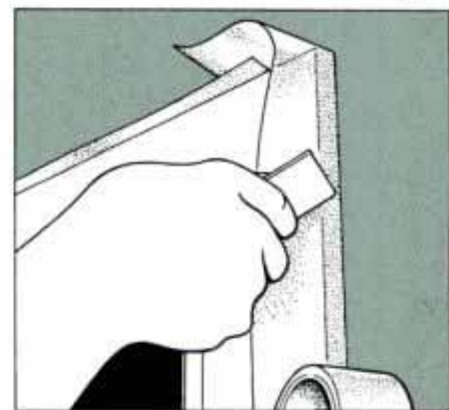
The replacement lock kit will contain the new lock and handle, plus retaining screws and extra shims for moving out the old strike plate, if necessary. Replacement couldn't be easier. Just remove the screws from the old lock unit, position the new unit

and secure with the new screws. You may have to loosen the two screws on the strike plate and add the shims in order to make sure the storm door latches securely.

38 Run-Free Masking Tape

Have you ever masked an area such as wood trim only to find, upon removing the masking tape, that paint had seeped under the edge of the tape and onto the trim you were trying to protect? Here are a couple of tips to prevent loose edges on masking tape and ensure clean paint lines:

- When masking wood trim, wipe over the surface where you'll apply the tape with fine 0000 steel wool. This will remove any bumps caused by lint or dust that got stuck in the fresh paint on the last coat. Then, run your hand over the area to be masked to be sure it's smooth, and wipe the trim with a clean cloth or tack rag to



To keep paint from running under masking tape, rub the surface with steel wool, then press the tape in place with a putty knife.

remove any dust that was caused by the steel wool.

- When the trim is clean and smooth, position the masking tape and press it in place. Now use the tip of a putty knife to run along the edge of the tape, to ensure a complete seal.

- Finally, be sure to remove the masking tape as soon as the paint is dry enough so it won't run (usually within 1 hour). This way, you can inspect your job for any runs and deal with them while they're still easy to clean. Just wrap a clean rag around the tip of the putty knife, dip the tip into water or another appropriate solvent, and wipe away the paint runs.

39 Buying Wallboard

Most consumers are aware that wallboard can be bought in almost any

length—from 8 ft. to 12 ft. long. But you will also see wallboard for sale in several different thicknesses, with 3/8-in.-thick wallboard being the thinnest and cheapest. Before picking up your bargain, you should understand the advantages and limitations of each panel thickness.

Wallboard that is only 3/8 in. thick does not meet code requirements for use as a primary wall. It has little fire resistance, sound resistance or impact strength. These thin panels cannot be used for ceilings because they are not thick enough to support the weight of ceiling insulation without sagging between the ceiling joists. Use 3/8-in.-thick wallboard as a new finish surface over deteriorated plaster, as a backer board underneath wood paneling or in double thicknesses to match older, 1/2-in.-thick plaster when you are remodeling.

The standard of the industry is 1/2-in.-thick wallboard. This can be used on walls or ceilings, with framing spaced up to 24 in. on center. Keep in mind, however, that thicker and heavier insulation blankets in the attic can place extra weight on ceilings.

Therefore, 5/8-in.-thick panels are preferred on ceilings, especially where trusses are spaced 24 in. on center.

Special applications also require 5/8-in.-thick wallboard. The thicker wall panels have better soundproofing qualities because they have extra mass and weight. These thicker panels also have extra fireproofing qualities. They have a fire rating of 60 minutes, compared to a 45-minute fire rating for 1/2-in.-thick wallboard.

40 Winter Plant Storage

Many people have several hundred dollars worth of yard and deck plants. Not only are these plants expensive, but they require several seasons to reach good size and full growth. If you live in the North, you cannot leave such plants outside in the winter. But you can store them in your basement under fluorescent lights from mid-October to the end of April.

Many plants will sit on makeshift shelves constructed from scrap lumber and concrete blocks. Hanging plants can be hooked over nails driven

in the floor joists above.

Shop lights are often on sale for \$10 each, or less, and the fluorescent



To save deck and yard plants from year to year, store them in the basement during the winter with shop lights turned on overhead.

bulbs cost about \$1 each. Even the cost for electricity to operate them is only pennies per month. But, the rewards of saving the plants are many, including having a crop of healthy, bushy plants that flowers on your deck each spring.

GET A LOCK AND, IF YOU'RE LUCKY, PLENTY OF STUFF TO LOCK UP.

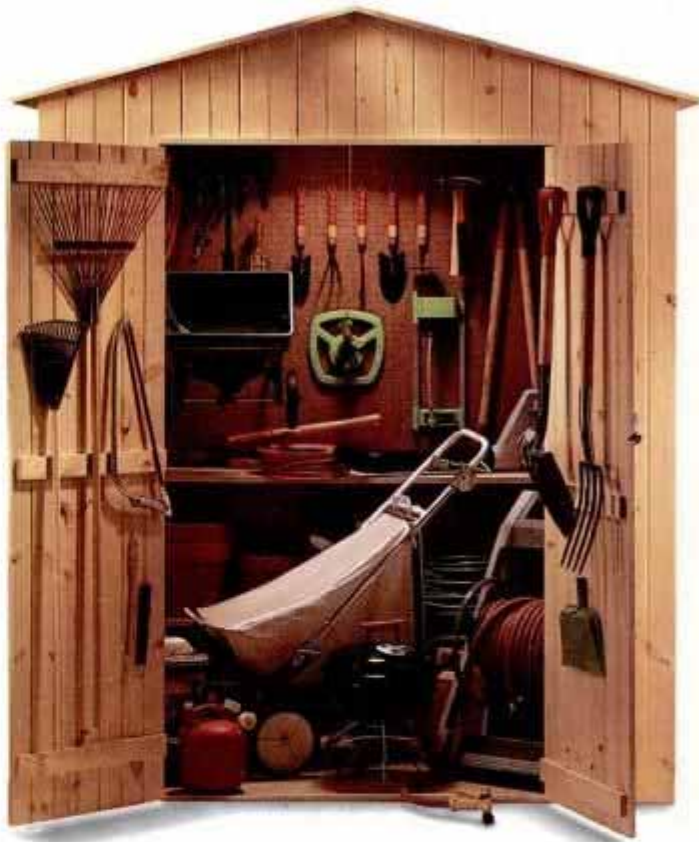


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41 Stopping Air Leaks

One vital key to reducing home utility bills is to block air leaks with insulation, weatherstripping and caulk. Whether the air is *conditioned* for winter heating or summer cooling, it is essential that we do not let this air escape to the outside. Contractors and energy inspectors tell us that two of the most commonly overlooked cracks in the house are where the sill meets the basement wall and under exterior doors where the door meets the threshold.

The crack between sill and basement wall is the longest continuous crack in the house because it includes the total circumference of the first



To reduce air infiltration, caulk between the sill and foundation, and install batt insulation between the joists above the sill.



Inspect all door sweeps for fit. If they are loose, tighten them. But if worn, replace them with new layered vinyl versions.

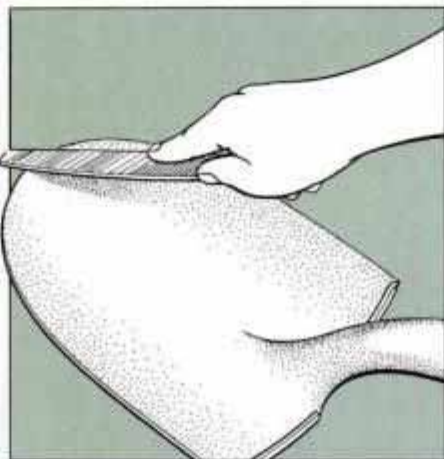
floor. Check the crack to see how large it is. If this crack is very large, you can fill it with plumber's oakum or twisted strands of fiberglass insulation, followed with caulk until the crack is filled completely. Once the crack is filled, cut fiberglass insula-

tion batts to fit in the space where floor joists and sill meet.

Advances in door weatherstripping include door sweeps, made of vinyl, that often have multiple, overlapping layers to ensure a seal between the bottom of the door and the threshold. Inspect the door sweep on all exterior doors, and install the best sweep you can find at replacement time.

42 Sharpening Garden Tools

Farmers know about the value of sharp tools for the garden, but many city folks will bring a garden hoe or shovel home and go right to work with them, never thinking to sharpen them first. The work goes much easier with sharp tools, especially when summer



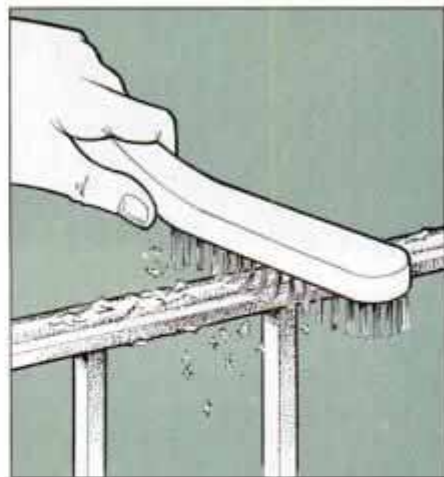
Garden tools, like hoes and shovels, work much better when they're sharp. To sharpen them, use a handheld file or grinding stone.

sun makes soil dry and hard. Keep a file or grinder handy in your toolshed, and sharpen your tools frequently. Hand shears, garden hoes, shovels, spades and mower blades are just a few of the tools that need to be sharpened before they're put into service, and then kept sharp as you use them.

Another trick farmers know is to fill a 5-gallon pail with fine sand, then pour a quart or two of waste oil from the lawnmower into the sand. When you finish using the tool, work the tool blade up and down in the oil-soaked sand. This will remove dirt from the blade and leave an oil coating that will prevent rust on tool blades. Finally, sand the wood handles lightly to smooth raised grain, to make the handle blisterfree and to extend its life.

43 Painting Wrought Iron

Wrought-iron railings and trim can add a design plus to any house. But



To prepare wrought iron for painting, brush off any rust or flaking paint. Then wipe the surface with mineral spirits.

they can be time-consuming to paint because the intricate shapes and patterns make preparation and coating difficult. One way to make the preparation easier is to use a rotary wire brush chucked into an electric drill. This can clean rust and dirt from wrought iron much quicker than a handheld wire brush.

And, when it's time to paint, try a variety of flexible painting tools, including the rollers that are specially designed to clamp over ironwork and roll both sides at the same time. While these hand tools do have their advantages, probably the best job is achieved using aerosol paint.

The flat-black finish that is representative of true wrought iron is available in aerosol cans. And, the spray can be readily directed for full



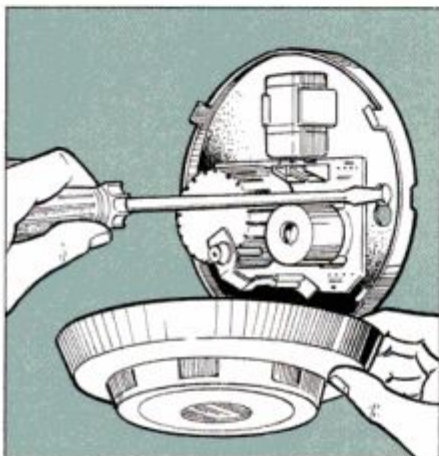
Use a special roller, like the one shown, or an aerosol spray can to paint the ironwork. A flat-black finish is the traditional look.

coverage of intricate shapes. Before using it, however, you should apply masking tape and paper to any surrounding surfaces. And, only spray paint on calm days to avoid wind-blown paint damage.

44 Installing Smoke Alarms

If you haven't provided your home with fire-protection alarms, by all means do so. When strategically placed, these alarms can provide the few seconds of advance warning needed for your family to escape injury or death from fire or smoke. Keep in mind that most house fires occur at night when your family is sleeping and most in need of a warning.

You should install smoke alarms on every floor of the house. Fires most often occur in kitchens, furnace or appliance rooms, and attached garages. Install an alarm at the top of each staircase, near heating equipment in the basement and in the hall outside bedrooms.



Smoke alarms are so easy to install that there's no reason for not having several in every house. You only need a screwdriver.

The alarms are not expensive, and battery-powered versions are easily installed. The only tool you'll need is a screwdriver. New alarms will not only sound if smoke is detected, but a light will also go on to help the family find its way to safety. Such alarms cost around \$18, even less on sale. Test your alarms frequently to make sure the batteries are fully charged.

45 Painting Window Sashes

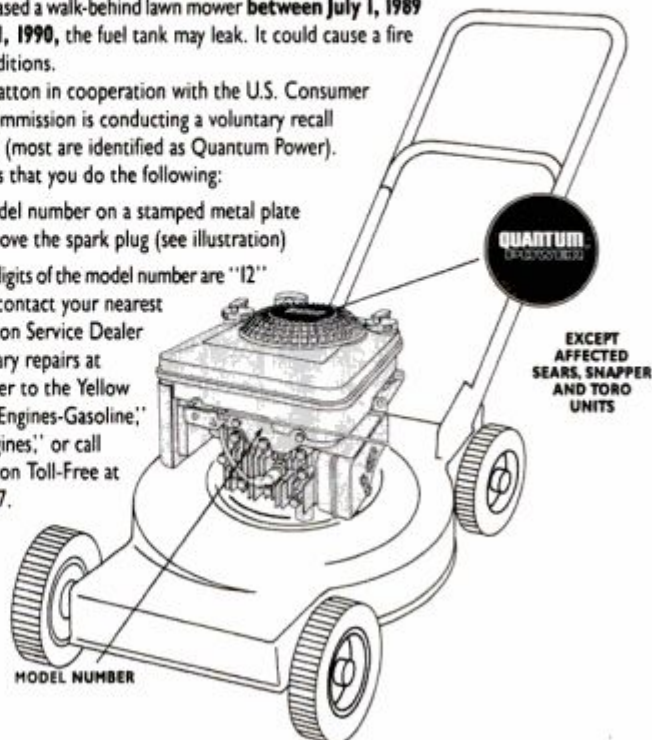
When you paint windows you should let the paint overlap slightly onto the glass, to ensure that you have a moisture seal between the window sash and the glass. If you try to mask window glass to protect it from paint, you will find that the masking tape may cover the slim crack between the glass and sash, and the open crack will fill with moisture when the window sweats (on the inside) or when it rains (on the outside). When water or mois-

URGENT SAFETY NOTICE FOR LAWN MOWER OWNERS.

If you purchased a walk-behind lawn mower **between July 1, 1989 and November 1, 1990**, the fuel tank may leak. It could cause a fire under certain conditions.

Briggs & Stratton in cooperation with the U.S. Consumer Product Safety Commission is conducting a voluntary recall of these fuel tanks (most are identified as Quantum Power). The Company asks that you do the following:

- Check the model number on a stamped metal plate located just above the spark plug (see illustration)
- If the first two digits of the model number are "12" (e.g. 121702), contact your nearest Briggs & Stratton Service Dealer for any necessary repairs at no charge. Refer to the Yellow Pages under "Engines-Gasoline," "Gasoline-Engines," or call Briggs & Stratton Toll-Free at 1-800-328-4457.



Do not store your mower near a device which uses an open flame such as a water heater.

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ture penetrates into the sash, the window will begin to rot. So don't mask glass.

Instead, buy a quality paint brush designed for painting the line between glass and sash. A good brush will have thick bristles that hold together when wet with paint, instead of spreading apart and covering adjoining glass with paint. Most pros prefer a tapered sash brush or a 1½-in.-wide trim brush for cutting around window glass.

If you have never used a professional-quality brush, you will be amazed at the difference it can make. Poor-quality brushes will lose bristles as you paint, leave brush marks from the cheap, coarse bristles, and spread as you brush, making it almost impossible to paint a straight line.

Another secret is to *wipe* the paint

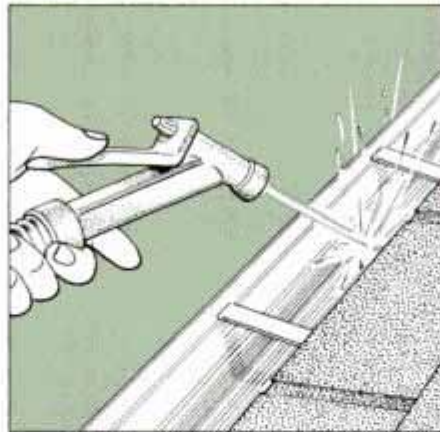


To ensure a straight paint line on glass, wrap the end of a putty knife with a clean rag and pull the knife across the surface of the glass.

line when you are done. Wrap a piece of clean cloth over the tip of a paint scraper or putty knife and wipe away excess paint from the glass. Periodically, move the cloth so the part covering the tool blade is clean. And keep from dragging the remainder of the cloth over surrounding painted surfaces. When done properly, this technique should yield a straight and clean paint line.

46 Cleaning Rain Gutters

If there are lots of deciduous trees near your house, you'll need to clean your rain gutters at least twice a year—after the seeds blow in spring and after leaves drop in fall. Gutters that are clogged with leaves or debris can cause water backup that runs under shingles or overflows the gutter rim, and washes down to stain the siding or windows below. Keep your gutters clean so the system delivers roof



If your house is surrounded by trees, wash out all your gutters at least twice a year to remove debris like leaves, seeds and twigs.

water to downspouts, then away from the house foundation to ensure a dry basement.

Cleaning gutters is not a hard job, assuming the gutters are within easy ladder reach of the ground. If gutters are two stories or more above ground, you might consider hiring a roofer for this sometimes dangerous task.

While you're climbing to clean rain gutters, conduct your spring roof inspection. Check for windblown shingles, beginning rust on valleys or vents, and check flashing where fireplace chimneys or walls intersect the roofline.

Use a power washer or garden hose and spray nozzle to flush debris from the gutters. Check the debris as you flush it away. One early indication of roof failure is to find a lot of granules from the asphalt shingles washed into rain gutters.

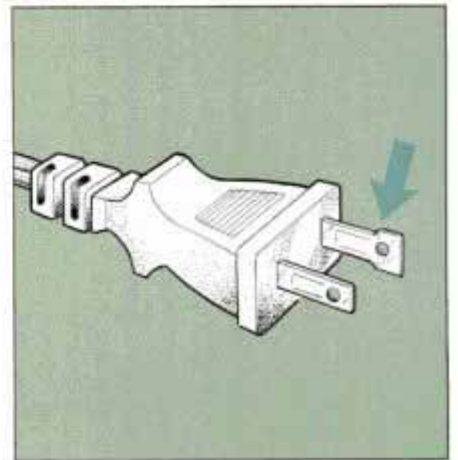
As you flush the debris from the gutters, check the water flow. Are there low spots in the gutters where water can pool? If so, raise the gutter at this point and rehang it so it empties properly. Also, watch the water flow from the downspout at ground level. If the water flows swiftly away from the foundation, you'll have a dry basement. If the water flows toward the house or gathers in puddles near the basement, you may have basement moisture problems in the making. Correct the ground pipe direction so water flows away from the house.

47 Preserving Polarity

Perhaps you have read instructions for doing electrical repairs that warned you to connect the white (neutral) wire to the silver terminal, and the black (hot) wire to the brass terminal. This color-coding technique ensures that you will not cross wires

and create a dangerous short. In addition, only black (hot) wires should be switched in your house. Of course, you could turn off the light if you switched the white (neutral) wire, but the light socket would still be hot. And, you would run the risk of getting shocked if you directly handled the light socket, even though the light switch was off.

To ensure this continuity or polarity, lamps and small appliance cords have a wide blade on one side of a cord plug, and a narrow blade on the other side. The wide blade only fits into the wide slot in a polarized outlet. Because of this, you cannot turn the plug over and make the neutral wire the

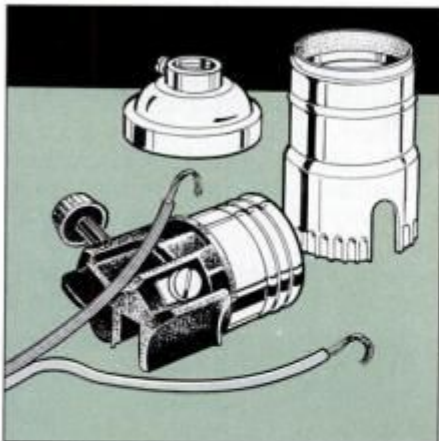


The wide blade on an electrical plug (arrow) maintains circuit polarity. Because of it, the plug can only be inserted one way.

switched wire. Even the simplest and least expensive lamps are wired so that the switched wire is the black or hot wire, and therefore no electric current is flowing into the socket when the switch is turned off.

When you replace the cordset on a lamp, be sure to check the wire you are using. One side of the replacement wire should have a ribbed finish, while the other side will be smooth. If both sides are smooth, don't use the wire. Always wire the lamp with the ribbed side connected to the wide-blade side of any plug, and the smooth wire connected to the narrow-blade side of the plug. When you attach the wire to the new (or old) lamp socket, be sure the ribbed wire is connected to the silver screw, and the smooth wire is connected to the brass screw. By doing this, the black (hot) wire will always be the switch wire.

Here's one more tip for rewiring a lamp. If you want a custom-looking job, instead of buying a separate wire and plug, buy a 6-ft.-long extension cord that already has a molded plug attached. Cut off the outlet end of the cord and strip off the insulation to at-

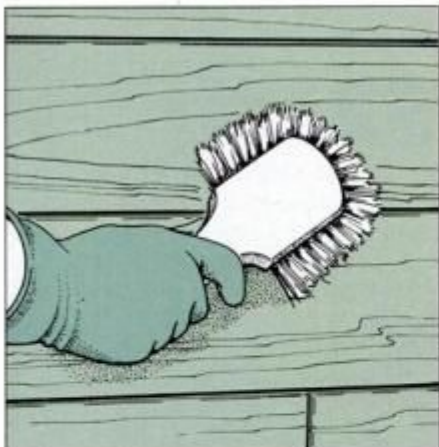


Light-duty wire insulation is smooth on one side, ribbed on the other. To maintain polarity, attach ribbed wire to silver screw.

attach the wires to the lamp socket. This is a good idea because the extension cord is cheaper than buying the wire and plug separately, and you have a much nicer, molded plug.

48 Cleaning Retaining Walls

New products abound for cleaning wood decks. But keep in mind that these cleaners will also work to clean other wood structures, such as fences and timber retaining walls. Check the label of the cleaner before you buy it. Some of these cleaners are so versatile they can even be used to clean your fiberglass boat or to remove oxi-



To clean any exterior wood, apply deck cleaner and let it soak until the surface is sudsy. Then thoroughly rinse it and let dry.

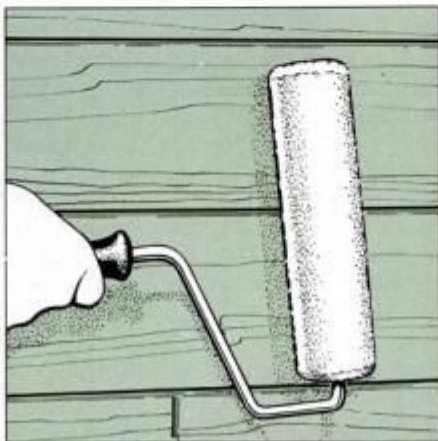
dized paint from aluminum siding and other surfaces.

To use these cleaners, first mix with water according to the label directions. Most cleaners are concentrated and can be mixed 1 gallon of cleaner to 4 or more gallons of clean water. Be sure to wear rubber gloves and eye protection when mixing or applying any chemicals.

Use a garden hose or a pressure

washer to wet down the wood, then apply the wood cleaner using a stiff scrub brush. Make sure that you brush the entire surface with the cleaning solution. Then let the cleaner set for a few minutes, and rescrub any stubborn areas if necessary. When the cleaner is working, a foam will appear on the wood.

When the cleaner has lifted the dirt, flush the wall with water. Then let the timber wall dry, and check to be sure you have removed all grime



Once the surface is dry, apply wood sealer using a roller or spray gun. Reseal whenever water drops stop forming on the surface.

and any mildew. If necessary, repeat the cleaning, and when the timbers are dry, apply a wood sealer.

Some sealers are the consistency of water and can be sprayed on using a garden sprayer. Others require a roller with a long nap. Be sure you cover all the rough wood surface and apply enough sealer to soak thoroughly into the wood. To maintain the wall in the future, periodically rinse it with clean water. When water appears to soak into the wood and no longer forms beads on the wall surface, it's time to clean again and apply a fresh coat of sealer.

49 Cleaning Fiberglass Tubs

A common problem in newer homes is how to clean tubs, shower enclosures or laundry sinks made of fiberglass. Molded fiberglass products were an instant hit with homeowners because of their joint-free construction and lack of periodic maintenance. But owners soon found that soap or mineral films clung to fiberglass and were difficult to remove.

If you have a fiberglass product that is dull and/or stained, avoid using

Ratcheting screwdriver.

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abrasive cleansers or cleaning pads. They can scratch fiberglass finishes, making them very difficult to repair. Instead, use a quality fiberglass cleaner, usually available at supermarkets and hardware stores.

Once clean, you can make the fiberglass easier to reclean and more stain resistant with an application of automotive-type paste wax. Bear in mind, however, that the floors of a shower or bathtub may become slippery if waxed. Consider using wax only on surfaces you do not walk or stand on.

If mineral buildup is very heavy, you should do something about your water quality. Water treatment experts can install filters in water lines to remove the staining minerals. Installing a water softener can also re-



Never use abrasive cleaners on any fiberglass fixture because they will scratch the surface. Instead, use fiberglass cleaners.

duce staining, especially if soap scum is the problem, because soft water will leave less soap residue.

Finally, when you've dried yourself after a bath or shower, take time to wipe down the shower or tub with your bath towel.

50 Avoiding Nail Pops

Nail pops can occur any time that wood is nailed (or screwed) to wood or any other material. They are most common, and perhaps most objectionable, when they occur on interior wallboard, especially on ceilings that have bright light fixtures. But nail pops are also a visible nuisance on exterior siding. And, when they occur on decks, they are not only unattractive, they also present a hazard to bare skin.

What causes nail pops? It was once thought that nails simply become loose and move. But for years it's

been known—from tests conducted by the gypsum industry—that nail pops are the result of wood shrinkage. The nailhead does not loosen and pop out. Instead, the wood shrinks away from whatever is nailed to it, and the nailhead stays in place. To avoid nail pops, keep in mind that wet lumber shrinks a great deal more than dry lumber. So let lumber dry out before you begin to nail or screw it together. This is especially important when you are building with pressure-treated lumber, which usually has a high moisture content.

Also keep in mind that the amount of movement on the fastener head will be directly proportional to the length of the nail, which means the distance the nail penetrates the wood. If the nail penetrates half the thickness or width of the framing, for example, the degree of pop at the head will be equal to the shrinkage in half that framing member. That is why the industry developed shorter screws to replace nails in wallboard. The screw has the same holding power as the nail, but much less penetration.

Another industry development that has helped reduce nail pops is today's wide range of construction adhesives. When you use these adhesives, you reduce the number of nails or screws needed: Less nails equal less pops.

51 Chalked Paint

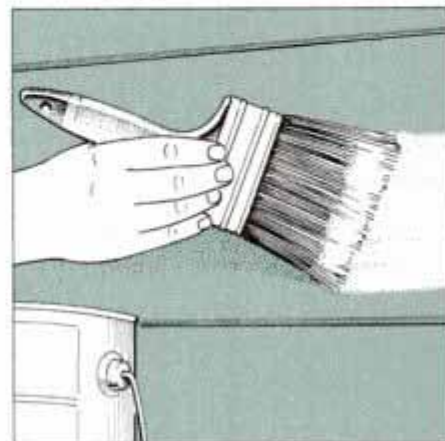
A common homeowner query is: What kind of paint should I use over chalked paint? Most often the advice is to use oil paint on a chalked surface, but the answer should be: Don't paint over chalked paint—clean it. In the past, chalking was very difficult to remove from house siding or trim, but many of the new deck-cleaning products will remove it.

To clean your siding, first wash off any visible dirt or grime, and then mix up some cleaner. Be sure to wear long pants, a long-sleeved shirt, eye protection and rubber gloves when working with this or any harmful chemicals. Keep in mind that the deck cleaner is concentrated, so you should mix it according to label directions, usually about 4 or 5 parts water to 1 part cleaner. You may have to use a scrub brush to remove the chalked paint, and a pressure washer is great for power-flushing the surface after you've loosened the chalked particles.

If the chalked paint is still a problem, you can stabilize it using a product called Emulsa-Bond (made by

Flood Co., Minneapolis, Minnesota). This product was designed to act as a binder to lock down the fine chalked particles. Once you've coated the chalked surface with Emulsa-Bond—according to the manufacturer's directions—you can topcoat it with any latex or oil product you want.

Remember, the advice to use only oil or alkyd paints on chalked surfaces

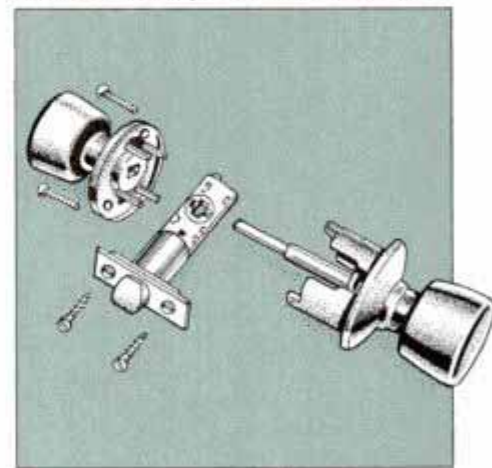


To stabilize chalked paint, first wash the surface with deck cleaner, then apply a primer, and follow with latex or oil paint.

ignores the advances in paint technology. Modern acrylic latex products work very well on chalked surfaces and will hold up well. Two excellent examples are Benjamin Moore's Exterior Latex and Olympic's Overcoat paint, both of which are usually available at your local paint dealers.

52 Sticking Locks

Most houses have only two or three exterior door locks, and removing, cleaning and lubricating each takes only a few minutes. All the tools and materials required are the right



To repair a sticking lockset, first remove it and thoroughly clean all the parts. Then spray them with lubricant and reinstall.

(More Improve Your Home tips on page 103)

screwdriver—slot tip for older locks, Phillips-head tip for newer locks—and an aerosol lubricant/penetrant such as WD-40.

There are four screws holding a door lock in place. Two retaining screws hold the interior and exterior parts of the lock together, and two more screws hold the faceplate of the latchbolt to the door.

Remove all four screws and pull the handles apart, then slip the latchbolt out of its hole. Spray the moving parts of lock assembly liberally, flushing out all dirt and old lubricant. Products such as WD-40 combine penetrant and lubricant properties, so they can be used both to clean and to lubricate at the same time. Do not use grease for a lubricant. It becomes stiff in cold weather and will make the lock difficult to operate. Grease also will hold any dirt or grit that gets into the lock. Sticking locks on interior doors can be fixed in much the same way.

A final tip: Periodically clean your keys to remove dirt and lint from the grooves because the lint picked up from your pockets can plug locks. Once clean, be sure to spray your keys with WD-40 and let them dry. The lubricant will help keep the keys clean and fit easily in the locks.

53 Painting A Textured Ceiling

For better or worse, the spray-textured ceiling became the most popular ceiling finish about 30 years ago, and in some areas, it's still going strong. Its great advantage is that it reduces the time it takes to finish a ceiling properly. It also can hide defects.

The early texture materials were odd blends of taping compounds—perlite or vermiculite and whiteners—all mixed with water. The resulting textured finish was a superporous material that absorbed paint unevenly. It was this porosity and unequal paint absorption that made textured ceilings difficult to paint when they became soiled.

All spray-textured finishes are, even today, mill mixes. This means they are a combination of powdered ingredients mixed with water. Painting such finishes is almost like painting a sponge because of their heavy and unequal paint absorption. The result is that if you apply ordinary latex or oil paint, you will see roller marks or lap marks where the paint lies unevenly on the finish. To overcome this, you must apply a good sealer. Use an alkyd (oil) sealer, and apply it with a long-nap roller. The long nap

reaches into the valleys in the textured pattern and ensures complete coverage.

Before you start the actual painting of your ceiling, the easiest way to proceed is to cover the entire floor with a canvas cloth or tarp. These are available at your local paint store. Also, buy a roller with an extension handle to apply the sealer and paint. Working with the pan on the floor and a 4-ft. extension handle on the roller is a great way to prevent back strain, and it reduces the uneasiness that many people feel when on step ladders.

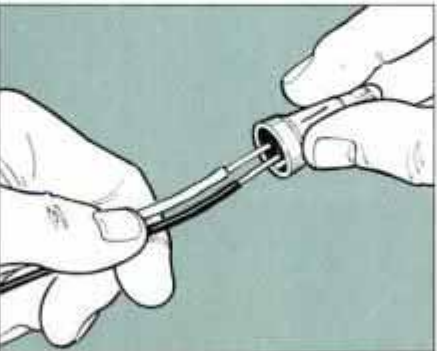
Apply a generous coat of sealer, checking the ceiling from several angles. Sighting from various angles will help you detect any missed spots in your sealer or paint coats.



Textured surfaces, like ceilings, generally absorb paint unevenly. To prevent this, roll on an alkyd primer before painting.

54 Wiring Connections

If you've tried connecting two electrical wires together with Wire-Nuts, you may have had trouble getting the Wire-Nuts to hold. The trouble may be that you first twisted the wires to-



When joining wires, do not twist them around each other. Leave them straight and simply turn the Wire-Nut onto the ends.

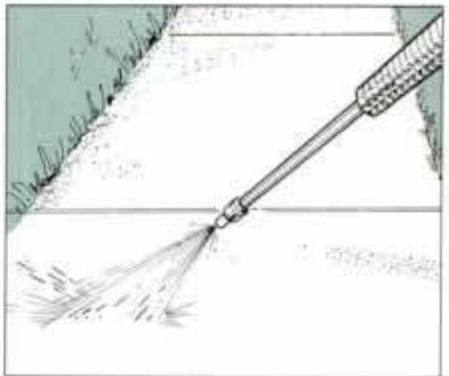
gether. When the nut would not tighten, you may have tried holding it in place with electrician's tape, and ended with a messy and bulky connection.

To join two wires together, strip the insulation back about ¼ in. from the wire ends. Hold the two wires alongside—and parallel to—each other. Slip the Wire-Nut over the ends of the wires and tighten it. Then, tug on each wire to test the connection. Do not add electrician's tape: The Wire-Nut will stay firmly in place.

55 Keeping It Clean

In these days of increased concern over environmental pollution from chemicals, the power washer has become an even more welcome tool for home maintenance. There are few dirty surfaces that will not come clean if subjected to a water stream of 800 pounds or more of pressure. These tools are common rental items, often by the half-day, and a half-day may be adequate for doing all your exterior spring cleaning.

If the surface to be cleaned is very dirty, or covered with mildew, you can first soak it with a spray of diluted chlorine bleach. Mix the bleach 50/50 with clean water, then apply the bleach with the washer unit or a pump-type garden sprayer. If the



For stubborn stains on driveways, garage floors and sidewalks, presoak the surface with driveway cleaner, then pressure wash.



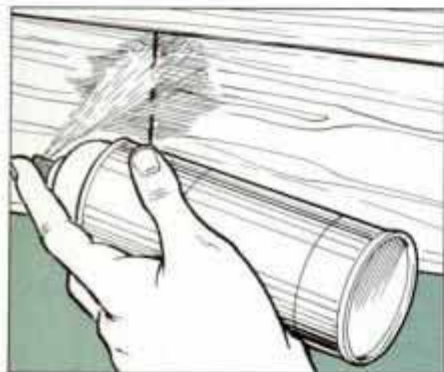
Instead of a costly and time-consuming painting job, sometimes all your house needs is a thorough cleaning with a power washer.

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surface isn't all that dirty, you may need only to apply a fine mist to pre-soak and loosen the dirt. Let the water or bleach-and-water solution set on the surface for a while, until it loosens the grime. Then, turn the sprayer unit up to full pressure, and blast away dirt and mildew. It is best to pressure wash on a hot day because the surface will dry quickly and permit you to inspect it to make sure it's clean. If not, keep washing. Use the washer on house siding, eaves, soffits, porch ceilings, driveways, sidewalks, retaining walls and decks.

56 Combating Carpenter Ants

Anyone who thinks pressure-treated lumber will resist attack from insects like carpenter ants never met the ants that inhabit our retaining wall. These ants grew fat and happy from feeding on the ground-side timbers. Each sea-



Carpenter ants attack any wood structure, including retaining walls. As soon as you see them, spray the area with pesticide.



Once all the ants have died, immediately sprinkle diazinon around the perimeter of the wall. This will help stop reinfestation.

son they deposited finely chewed sawdust along the joints in our retaining wall. No amount of ant poison would deter them. We even suspected that several pesticides acted like ant vitamins instead—so large and vigorous did the ants become.

In desperation, we sprayed some Ortho Hornet & Wasp spray between

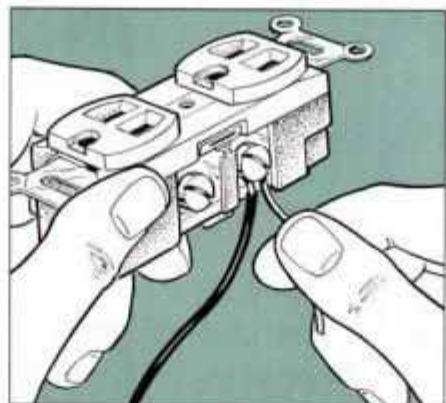
the timbers of the retaining wall. The immediate result was no more ants. They completely abandoned our wall.

57 Wiring Outlets

Have you ever removed an electrical outlet and noted the clean attachment of the wire to the outlet screw? Electricians have a secret for making those neat connections on new work.

First, leave the wires long in outlet boxes you are wiring—don't cut them so short you have no wire to work with. When you are ready to attach the receptacle or outlet, cut the wires about 8 in. long and use a wire stripper to remove the insulation about 2 in. from the end. Don't use a knife to strip the insulation. A knife may nick the wires and cause them to break when they are flexed.

Now wrap the wire around the proper receptacle screw (white wire to silver screw, black wire to brass screw) in a clockwise direction. Tighten the screw. Now grasp the end of the wire and bend it back and forth un-



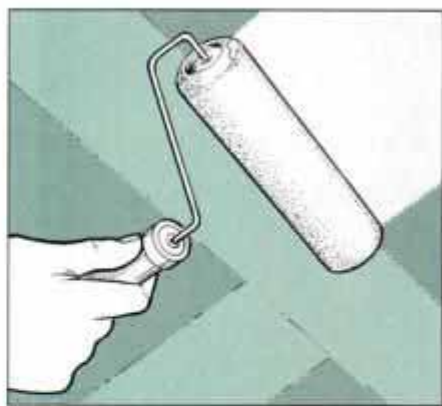
To make wire connections like a pro, wrap the stripped wire end around the screw, tighten the screw and break off the wire.

til it breaks off. You now have a professional-looking connection between the wires and the receptacle.

58 Priming New Wallboard

Painting newly finished wallboard can present a challenge for the amateur because you are actually painting two materials: the paper covering on the wallboard and the compound that was used to cover nail- or screwheads, seams and corners. The paper face has a slightly rough surface, while the taping compound is glass-smooth. These two surfaces also present unequal absorption rates, and will soak up paint or primer unequally.

Because of these problems, wall-



Use latex primers on newly finished dry-wall. Oil primers can't conceal the texture difference between the joints and surface.

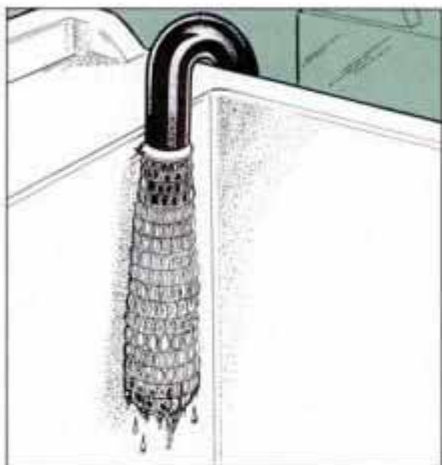
board manufacturers always advise that you use a latex or water-based primer as a first coat on new wallboard. Oil primers dry slowly, soak into the paper face of the panels and cause the paper nap to raise. And, they often cause very smooth spots where there is compound—over seams or fasteners—and very rough areas where the nap of the paper has been raised. Thus, all wallboard manufacturers recommend a heavy-bodied latex paint as a first coat over new wallboard.

One major manufacturer, United States Gypsum, makes a special base-coat for new wallboard, appropriately called First Coat. It is available premixed, or you can buy the primer in powder form and mix it with water. It is cheaper than ordinary primer, and will provide the coverage of primers and sealers—without the disadvantages of either. First Coat will seal the surface and contains enough fillers to act as a primer, so it equalizes the absorption rate.

The Gypsum Association advises professionals to shear coat the entire surface of the wall and ceiling with compound, so no bare paper is left. In effect, one just plasters the entire surface with taping compound, so there is no difference in texture or absorption. However, troweling a complete room can be a messy job if you are not skilled with a trowel, so we advise using First Coat as a wallboard undercoater. Once the surface differences have been eliminated with First Coat, you can then recoat with any type of paint finish.

59 Preventing Drain Clogs

Knowing how to unclog blocked drains is very useful, but preventing the drains from becoming plugged in the first place is the better idea. Most



One way to minimize drain debris is to install a filter, made of stocking material, on the end of your washer's drain hose.

drain blockage occurs because of materials that never should have reached the drain. Homeowners often cause themselves embarrassment and expense by pouring leftover patch materials and paint down drains, where the materials solidify and cause clogs. Let these materials harden, then dispose of them in the trash.

Another good idea is to install a filter on your washing machine drain hose, to trap fibers and lint before

they can go into the drain. One of the best filters is the foot from a pair of discarded pantyhose. Its finer weave will catch smaller particles than stock filters will. And, keep in mind that the primary causes of bathtub drain clogs are soap particles and human hair, so it's a good idea to discard soap bars before they disintegrate into clog-size particles.

Finally, when operating your kitchen disposer, be sure to run plenty of water down the drain while the disposer is on. And continue to run the water for a minute or two after the disposer is off. This ensures that all the ground garbage has reached your main drainpipe, not just your smaller sink wasteline.

60 Central Air Maintenance

Modern central air conditioners require little attention from the homeowner. The most common maintenance step is to replace the filter in your furnace monthly during peak air-conditioning season. This will ensure a free flow of clean, cool air. But the air-conditioning equipment will also benefit from extra attention.

Check the top of your compressor

for screw locations. By removing a few retaining screws, you should be able to easily lift off the top. When you have access to the fan motor, check your owner's manual for lubrication



To maintain an air conditioner, remove the cover, then wash away any dirt from the coils using a garden hose and nozzle.

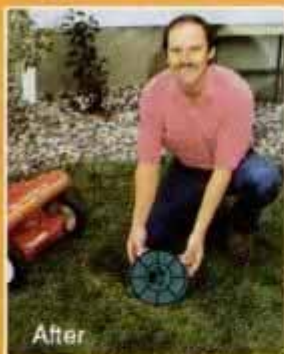
and cleaning needs. It should reveal the lubrication ports on the motor that need oil. Use an oiler with a flexible tube to place a few drops of 30W motor oil in each oil port. Usually these ports are at one or both ends of the motor shaft. Be sure to replace any plastic caps that cover the ports to prevent dirt or water entry.

Use a garden hose with a spray nozzle to clean the finned tubing inside the housing. The fins help dissipate

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ice and lets standing water filter down into the ground. The solid drain cover will then drop down and seal out grass clippings and dirt.

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|------------------------------|--------------|------------|
| 5 Foot Main Sections | 5' L x 4" H | \$ 8.48 ea |
| Inside Corner | 14" L x 4" H | \$10.40 ea |
| Outside Corner | 14" L x 4" H | \$10.40 ea |
| Butt-joint Connectors | | \$.85 ea |
| Dead End Caps | | \$ 1.35 ea |
| BeaverSeal Adhesive, 2QT Pak | | \$32.50 ea |

2 QTS = APRX 20 feet
All Canada Orders Plus Freight.

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\$150.01 - \$300.00
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\$300.01 - \$500.00
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IMPROVE YOUR HOME

heat from the copper piping. Because outside air is drawn in over these pipes or coils, they can become coated with dust. (You may be amazed at the amount of grime you will rinse out of those coils.) Remember, the unit has to work harder to remove heat if the coils are layered with dirt. Flush out all the dirt before you replace the cabinet top and screws.

Finally, a compressor that sits in direct sunlight will work harder to dissi-

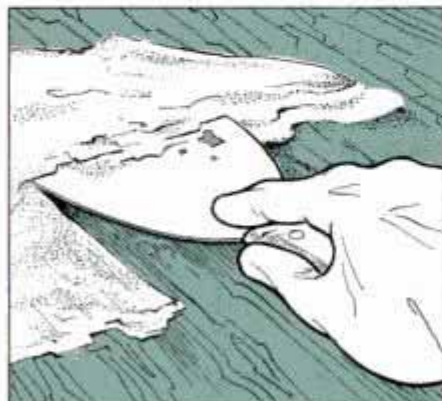


Consult your owner's manual to determine proper lubrication points for the fan motor. Then add oil as required and replace cover.

pate heat. If your yard compressor is in direct sunlight, especially if on the west side so it receives the sun's hottest afternoon rays, consider building a shade screen around the compressor. One option is a lattice-and-ivy screen that will not only protect the compressor, but look great, too.

61 Removing Paint

Paint buildup from repeated coatings can cause cracking or alligating. Older plywood surfaces such as the panels on garage doors are especially susceptible to such cracking of paint. Any additional painting will only make matters worse. You must re-



New, nontoxic paint strippers are easy to use and have long open times. You can work for hours before the stripper dries out.

move all the old paint and start over to eliminate the problem.

To strip the old garage door shown, we used 3M's Safest Stripper—the first of the growing number of water-based paint removers. These strippers have a gel consistency, so they won't run and drip when applied to vertical surfaces. And, generally speaking, they don't have high evaporative rates, which means they can be left on the surface for hours without requiring a reapplication. Of course, the best part of these new strippers is that they aren't toxic. The fumes are safe and barely detectable, and contact with the skin poses no problem.

62 Hazardous Wastes

Homeowners are constantly being bombarded with warnings of hazardous wastes. What are the guidelines for determining which household materials are hazardous?

Most states now classify as hazardous any waste product that meets these criteria:

- Any ignitable liquid or gas, or any solid that could easily ignite at ordinary temperatures or pressures.
- Any waste that contributes oxygen or other reactive gas to a fire.
- Any material that is highly caustic or acidic.
- Any material or chemical that reacts violently or produces dangerous fumes when in contact with water.
- Any material that may give off toxic chemicals when dissolved in a landfill or other acidic environment.
- Any chemical that is toxic to animals or persons when inhaled, drunk, eaten or in contact with the skin.

A list of household wastes that may be potentially hazardous if improperly used or handled include: most wood preservatives, pesticides, herbicides, fertilizers, paints, varnishes, paint thinners and cleaning solvents.

To reduce common yard and garden products in the waste stream: 1. Strictly observe the application instructions on any container; 2. Use all of the product before discarding the container; 3. Shop for products which are environmentally safe.

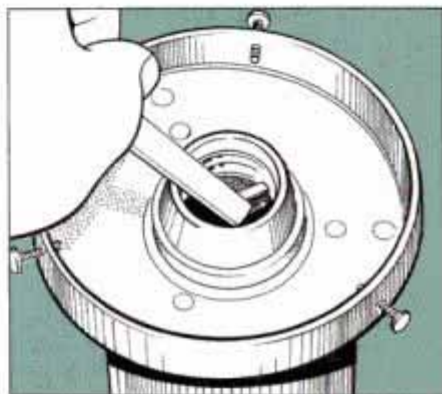
Many paint solvents and thinners are made unnecessary by the new water-based paints and finishes that are available today. For example, modern chemical combinations have made acrylic latex paints nonfading and easy to apply. The acrylic latexes are so tough they are now used as a wear surface on concrete floors.

63 Yard Light Maintenance

A yard light can keep silent watch in your yard, revealing intruders, welcoming guests and even preventing tripping or falling injuries. So, to keep these lights in good repair and working properly, give them about a half-hour of attention each year.

The first step is to repaint the light post. This is a simple procedure of lightly sanding the post and applying the fresh paint. If you mask any outlets or the electronic eye on the post, you can quickly paint, using a sponge brush or aerosol can.

While you have the light globe removed, and with the current turned off, clean the light socket to remove any corrosion. With the light exposed to all kinds of weather, moisture often



To maintain yard lights, first shut off power and remove globe and bulb. Clean away erosion in the socket with an emery board.



After the socket is clean, blow away any dirt. Then spray auto ignition sealer into the socket and replace the bulb and globe.

reaches the socket and causes some corrosion. To clean the contacts, use an emery board, the sort that smooths fingernails. The boards are abrasive enough to clean the socket, but are not so hard as to cause damage.

Once the socket is clean, blow away any bits of corrosion, then give the socket a protective shot of silicone ignition sealer. This helps seal the sock-

et against corrosion and moisture, and it lubricates the socket so the light bulb is easy to install and to remove when it needs to be replaced.

64 Furnace Maintenance

If your home has a forced-air furnace, the blower unit does some pretty heavy work moving all the heated air. And, if the furnace incorporates central air conditioning, your blower unit may run at high speed almost all year long. Because of this, read your owner's manual and apply lubrication to the blower motor as indicated. (Some furnace blower units are sealed and permanently lubricated, so check the manual to see which kind you have.)

On our forced-air furnace, the blower motor is secured by two sheetmetal screws. We removed these retaining screws and pulled the blower unit forward to reach the oil ports on the motor shaft. Then we applied a couple of drops of 30-weight oil to each oil port. It's a good idea to do this oiling at least twice a year. But if your owner's manual suggests more frequent service, follow the recommendation.

Both furnace servicemen and interior decorators will tell you that most



Consult your owner's manual for the oil port locations on the furnace. Then remove the blower cover and apply oil to the ports.

people neglect the furnace filter. The filter is an inexpensive but important component of good furnace operation. The filter removes dust and dirt from the air as it enters the main return duct at the bottom of the furnace. All the air is filtered to preclean it before it enters the furnace, which helps keep the furnace clean. Neglected filters will lose their effectiveness, letting dirt pass through. Under these conditions, the blower unit on your furnace becomes little more than a dirt-circulating machine.

65 Cleaning Siding

Aluminum siding carries the happy guarantee that it won't need painting. This is true, up to a point, because factory-applied aluminum finishes do last a long while, up to 20 years in many cases. Of course, no finish lasts indefinitely. Air pollution and acid rain increasingly are causing premature paint failure. A common sight is siding with a finish that has oxidized, leaving the paint film intact, but dull.

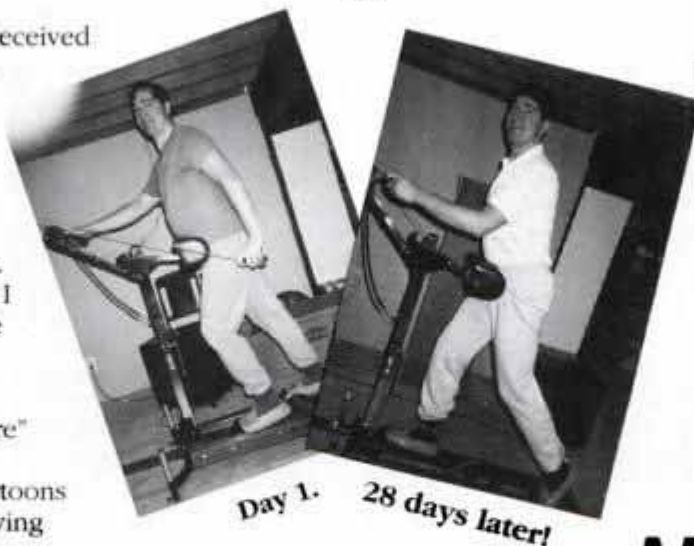
To clean oxidized paint from metal siding, use one of the products made to clean outdoor decks. Check the product label to see if it's recommended for cleaning prefinished metal siding. If so, just mix the concentrated cleaner with water, at the ratio recommended on the label, and prewet the siding with a spray nozzle or pressure sprayer. Then use an automotive-type sponge to apply the cleaner and to rinse away dirt or oxidized paint. It's best to use two pails and two sponges for this chore: one pail filled with cleaner, the other pail filled with clean water. It's easier to wash away the fine paint particles while the siding is still wet. The more water pressure you can use, the better. **PM**

Living proof. NordicTrack takes weight off and keeps it off.

About two months ago I received my NordicTrack Pro model.

I had my wife take a photo of me the day I received the unit and another after 28 days. At that time I re-packed the machine in its box to return. My wife, who kept insisting I had lost weight and become trimmer, had the film developed immediately.

I have enclosed the "before" and "after" pictures. I was stunned. I have seen the cartoons in your advertisements showing stomachs shrinking but I always dismissed them as fantasy! However, I submit my photos as a testimonial of how great the machine works. Needless to say, I unpacked the NordicTrack and have continued to use it about three times a week. Congratulations on a terrific machine!



Yours sincerely,

Stephen M. Chinnery
Boothwyn, PA

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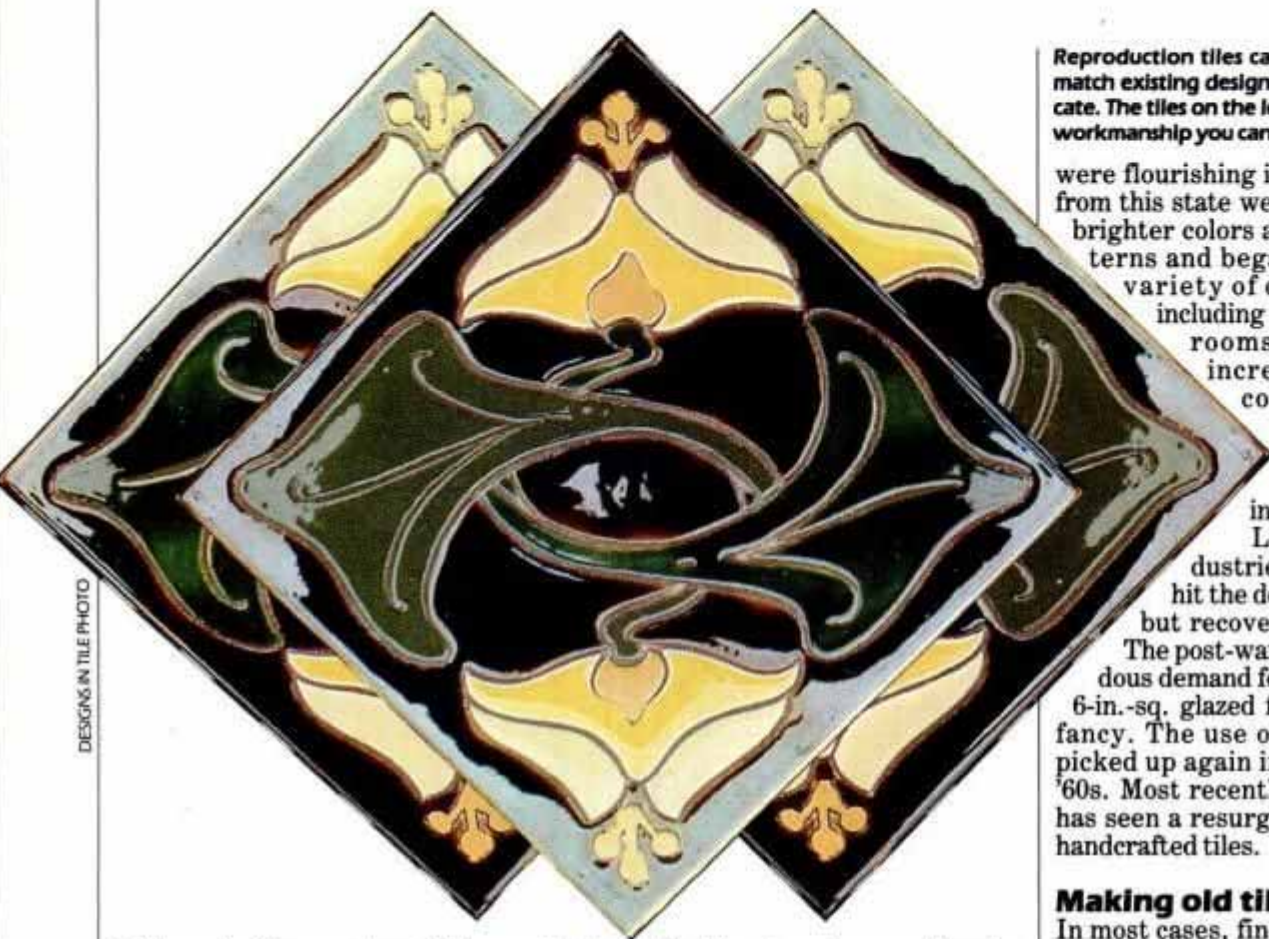
EXT. 275D1

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OLD HOUSE RESTORATION

CERAMIC TILE

BY BOB VILA, Contributing Editor



DESIGNS IN TILE PHOTO

Reproduction tiles can be custom-made to match existing designs no matter how intricate. The tiles on the left show the quality of workmanship you can expect.

were flourishing in California. Tiles from this state were known for their brighter colors and geometric patterns and began to be used in a variety of different places, including kitchens and bathrooms. There was an increase in the use of contrasting colors (for trimwork and other decorative accents) in a single installation.

Like many other industries, tile production hit the doldrums in the '30s, but recovered after the war. The post-war era saw a tremendous demand for plain 4¼-in.- and 6-in.-sq. glazed field tiles—nothing fancy. The use of decorative tiles picked up again in the late '50s and '60s. Most recently, the last decade has seen a resurgence of interest in handcrafted tiles.

Making old tiles anew

In most cases, finding replacements for old tiles isn't as easy as a trip to the local home center or tile store. The difficulty in finding matches for old handpainted, -printed or -carved tiles is obvious. Differences in the way tiles were made years ago make most of today's mass-produced tiles inappropriate replacements for even plain field tiles.

Color variations were common in the glaze of many old tiles. Two glaze variations that were typical of tiles produced 50 years ago are picture framing and crazing or crackle glazing. Picture framing occurs when the glaze puddles around the edges of the tile, outlining or framing it. The latter situation appears when the glaze doesn't actually fit the body of the tile but shrinks at different rates, causing cracks to occur in its face. Today, the pair would be considered color flaws.

Fortunately, both can be reproduced by some of the custom tile studios catering to this type of work today. (Please see supplier Source List at the end of this story.) The first

● Ceramic tiles are a beautiful accent in many old homes. Whether decorative or plain, the richness of this material commonly lends an air of grace and charm to old entranceway floors, baths and fireplaces.

Like everything else in this world, some of these tiles may become damaged over time and need replacement. What's an old-house owner to do when he or she needs a few pieces of an original tile?

Fortunately, there are some custom tile studios ready and willing to make handmade replacements for old, missing or damaged tiles. As you can imagine, there's a lot involved in this process, and it can be expensive. But for those who insist on keeping as much of the original materials in their old houses as possible, it may be the only way to go.

American tile making began around the middle of the 19th century

in the Northeast and was well under way by 1880. Production spread all over the East in areas where there was an abundance of clay deposits. This included Ohio, Indiana, Pennsylvania, New Jersey, parts of New York and Massachusetts.

In addition to floor tiles, many of these early ceramics were considered decorative and were used for fireplaces and hearths. The latter were often made on screw presses and decorated with florals or portraits designed along classical lines. Called art tiles, they commonly had a glossy glaze. These types of tiles were popular through the 1880s and 1890s.

Around the turn of the century, Arts & Crafts tiles became popular. These differed from the earlier Victorian art tiles in that they were largely handcrafted with matte glazes. More historical in nature, the designs on some Arts & Crafts tiles sometimes told a story.

By the 1920s, ceramic tiles were produced all over the country and

"Home Again With Bob Vila" is the title of our contributing editor's new TV show.

step in this process is sending a good sample piece of the tile you're trying to replace to one of these studios. It's best to try to remove an entire undamaged piece. But, a good size piece along with a quality photo will work.

I mentioned earlier that this process can be costly. You'll understand why when you see what's involved. The major expense is usually for the research and development of the glaze and clay body. Much trial and error is involved here, and the experts depend on their past experiences to guide them. Choosing a glaze color is not like choosing a paint color: What you see is not what you get. The unfired state of a glaze is nothing like its fired state. Finding the right match of glaze and clay body is a slow process. Expect to pay between \$150 to \$300 for this work, unless the shop you choose has already developed a matching glaze for a past job and has this information in its files.

Once the color match is developed, the next step is creating the template or mold. Depending on how intricate or carved the tile is, you can pay anywhere from \$100 on up for this work. It depends on the shop and what type of work is involved. Matching hand-painted tiles runs from \$25 to \$100 each. Of course, pricing is not a static figure. Each situation is unique.

Yesterday's tiles today

Sometimes it pays to go the above route and replace a few old house tiles, especially if they're quite fancy. And sometimes it doesn't. You may decide it's cheaper to just retile the entire area, whether it's a fireplace, foyer or bath, rather than pay to match a few original tiles. If that's the case, it pays to check out some of the reproduction tiles available today. Designs In Tile, for example, puts out a \$3 color brochure that shows examples of some of their historic designs, including Victorian Transfer, Gothic Revival, Art Nouveau, Art Deco and Arts & Crafts styles.

A note of caution here: If you decide to replace old tile, please remove the original pieces carefully and save them. Decorative tiles are a valuable part of our historic record and, as such, should be preserved.

Some custom tile studios recondition old, damaged tiles. Original tiles can often be repaired and reglazed, solving some of the common problems associated with age, like cracks, chips and abrasions. Tile size, too, can sometimes be changed, allowing the original ceramic pieces to be manipulated in different patterns or layouts.

I'm sure many of you will also be happy to note that American Olean Tile Co. (1000 Cannon Ave., P.O. Box

271, Lansdale, PA 19446) still manufactures their popular 1-in. and 2-in. hexagons and squares in a variety of different colors. So, for those of you longing to restore an original ceramic mosaic tiled bathroom floor (or even to add this period charm to a new house), take heart. It's easier than you think.

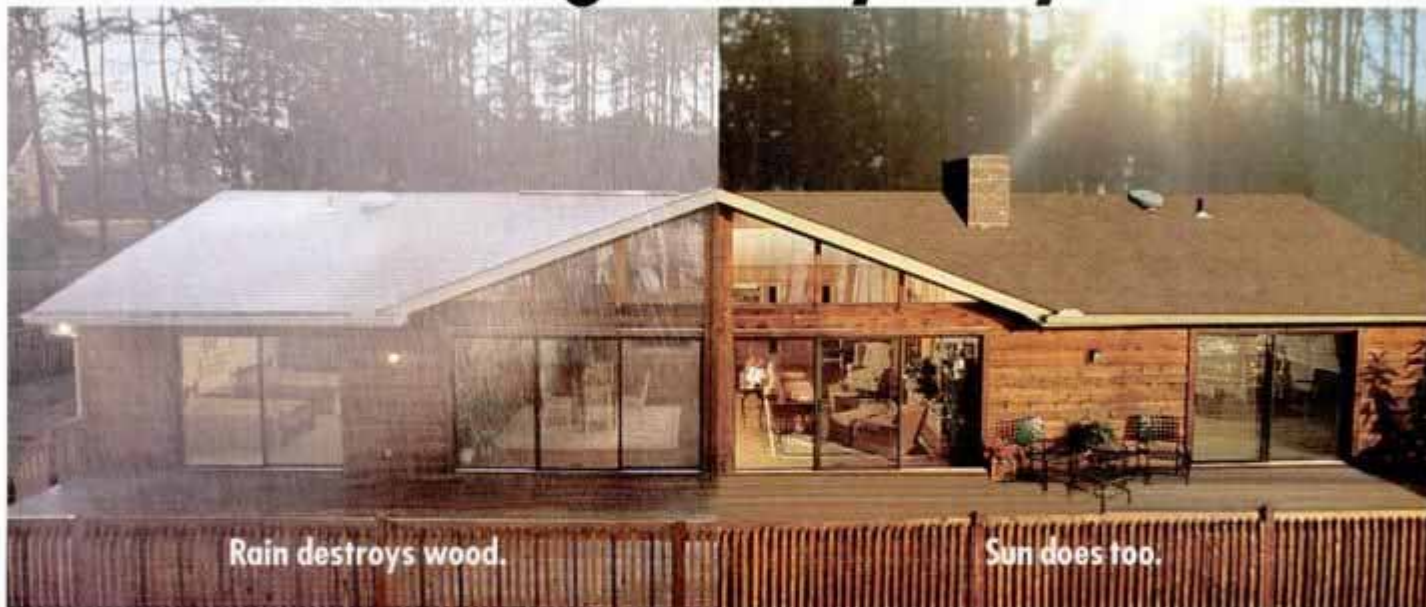
Finally, there's one last service I'd like to mention to those interested in tile history. The Tile Heritage Foundation (P.O. Box 1850, Healdsburg, CA 95448) is a nonprofit, member-supported organization for research and preservation. As such, it has a network of tile identifiers across the country that is able to establish where a tile came from and what type of tile it is. If you want to learn more about this part of your old house, all they need from you is a good quality photograph of the tile and a stamped, self-addressed return envelope. **FM**

SOURCE LIST

The following is a list of some custom tile studios:

- Designs In Tile, P.O. Box 358, Dept. 1, Mount Shasta, CA 96067
- L'Esperance Tile Works, 237 Sheridan Ave., Albany, NY 12210
- K. J. Patterson Ceramics, 5052 Calmview Ave., Baldwin Park, CA 91706
- Restoration Tile, 3511 Interlake N., Seattle, WA 98103
- Terra Designs, 241 E. Blackwell St., Dover, NJ 07801

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There's an all too common notion that owning a 4-wheel drive vehicle means sacrificing a smooth ride and a comfortable interior environment. But the 4-wheel drive Ford Aerostar is changing that notion—combining improved traction with ride and handling so exceptional, you may not even realize you're driving a 4-wheel drive vehicle.

Advanced electronic 4-wheel drive and anti-lock brakes.

To help you stay calm (even when the weather doesn't), we gave this Aerostar the most advanced 4-wheel drive available in a minivan: a full-time system that electronically senses road conditions and accordingly adjusts the power given to each set of wheels. In addition, we included standard rear anti-lock brakes, designed to inhibit rear-wheel lockup and help you make straight stops.

Smooth handling. Comfortable ride.

But since a minivan should be as comfort-



able as it is comfortable, we also gave Aerostar smooth ride and handling, along with a well-appointed, roomy interior. In fact, Aerostar has greater rear cargo capacity than Caravan or Voyager.*



Standard 4.0L V-6 power.

As for Aerostar's 4.0L V-6 engine, it, too, is capable of handling practically anything—like towing up to a 4500-pound

trailer.** It's just one more reason Aerostar is ideal for families on the go. And for families who refuse to let Mother Nature rule the roost.

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*With rear seats removed.
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Buckle up—together we can save lives.

DETROIT SPY REPORT

BY JIM DUNNE, Detroit Editor



Ford Peps Up Its SHO

● As is true of the rest of the popular Taurus lineup, Ford product planners feel no need for major changes in its hot-rod SHO (Super High Output) sedan edition. When the '92 Taurus SHO is introduced this fall, only minor facelifting will distinguish the car from its predecessors.

Ford will use smaller headlights at the front and more soft covering materials fore and aft. As the photo indicates, the new SHO's taillights will be set slightly higher.

Though the changes are subtle, they do seem to add up to a slightly more aggressive appearance.

The '92 SHO will be mechanically unchanged, with power delivered by Yamaha's excellent 220-hp dohc 24-valve V6.

Lack of mechanical change may not be very good news to Ford dealers, who have been hampered by the company's inability to provide an automatic transmission option for the SHO version of the Taurus. The automatic transmission that's used in the

standard Taurus won't handle the SHO engine's output.

1992 Sable

Snapped near Ford's North American headquarters in Dearborn, Michigan, this 1992 Mercury Sable prototype appears to be a preproduction edition.

Like the '92 Taurus, it takes a sharp eye to see the differences between new and old. Smaller headlights, a fuller bumper fascia, a redesigned trunk and full-width taillights with new texture are the major features of the Sable facelift.

While the general body shape and major sheetmetal panels are unchanged from the current model, the facelift does seem well conceived to freshen the appearance of the 6-year-old design.

Impact Static

General Motors confirmed early this year that it really does intend to build its electric-powered car—the Impact.

But GM still refuses to say exactly when the car will go into production.

It only promises that Impact will be in showrooms no later than 1998.

That date is important. It's the year California will require that a small percentage of cars have zero emissions. Zero emissions can only come from electric or solar power.

Look for Impact to use the old-fashioned lead-acid battery as its power source. This means that Impact will have the typical problem that hampers most electric car projects—limited range—although its performance is spectacular.

Meanwhile, GM is working on a hybrid vehicle that uses both batteries and a small gasoline-powered engine. The car's drive system, however, is all electric. The engine is hooked up to a large alternator that recharges the batteries while the car is running, extending the vehicle's operating range to acceptable distances.

GM is saying that this concept is also likely to be in production before the turn of the century.

GM's Straight-Six

There is a big push inside GM to build a new inline 6-cylinder engine for compact and subcompact cars. Yes, the proposal seems contrary to the swing to V-type engines.

But a straight-Six does have a number of appealing advantages. It's smoother—less shake and vibration. It needs only one exhaust manifold, while the V-type uses two, cutting manufacturing costs.

Insiders report that the length of the proposed GM Six is less than 20 in.—short enough to fit sideways in a typical front-drive car. It's also much narrower than V-type engines, lending itself to compact designs. **PM**



Facelifted Sable for '92 retains distinctive front light bar.



Sable's new rear end is distinguished by new lights and bumper.

Car owners!

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What about additives that claim to be a one-time treatment that will last the life of an engine? Well, I've been following the scientific literature on lubrication for a very long time. As far as I know, there isn't a shred of scientific evidence for such a claim. So don't believe it!



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Several months ago, a nice man I'd never seen before walked into my office, big smile on his face, sat down and said, "Would you believe 340,000 miles on a Tufoil engine?" He went on to rave about how well his engine has been running all these years. I couldn't get a word in edgewise.

Recently, a truck driver called in with over 1,000,000 miles on a diesel using Tufoil - WOW!

A customer from Vermont added 10% Tufoil to his sticky mechanical transmission, called in and said he couldn't believe it... "Shifting is like slicing butter now!" he said.

SAAB owners are writing letters praising Tufoil in their "NINES" magazine. They report spectacular improvements in their engines and transmissions!

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PUMPING FIBERGLASS

BY JOE SKORUPA, Boating/Outdoors Editor



● "They should have called it fiber-steel instead of fiberglass," complained the boat salesman. It was a number of years ago, and he was trying to sell fiberglass rigs to fishermen loyal to aluminum. Today, few people question the strength of fiberglass. In fact, the shoe is on the other foot. With the boat market in a slump, some salesmen now complain, "I wish the damn things would wear out."

But durability isn't the only criterion for sound hull construction. Rigidity is equally important. This is especially true at speed, which gets higher each year and loads more and more stress on hulls.

While it's difficult to make a typical fiberglass hull wear out, it's fairly easy to make one twist or flex. This isn't a problem for nonracing hulls, but it does result in measurable loss of performance and increased stress on joined and bonded parts.

One common solution is to build a stringer system, a grid of support beams made of wood or fiberglass.

Another solution is to build a cored or composite hull.

Body builders

I met Ab Crosby about a year ago. He's a tall, broad-shouldered, full-bodied man who's president of Hydrodyne Boats. Ab told me of a demonstration he sometimes does at boat shows. He climbs a ladder above one of his enclosed-bow ski boats and jumps onto the forward deck. He lands flatfooted and brings all of his 200-plus pounds to bear on the fiberglass.

After the boat survives the pounding, he challenges the crowd, "Now go over to the other displays and ask if you can repeat this test on other boats." Ab knows that few of his competitors will permit it. On most boats, a man of his size would crash right through the deck.

Ab's dad, the original Ab Crosby, is a legend in the pleasure-boat industry. The family's trade name, Hydrodyne, is a line of fiberglass runabouts

and ski boats that dates back to 1949. For 40 years, each of the boats built by the Crosby family has been equipped with a cored hull.

In its heyday, Hydrodyne was one of the country's largest fiberglass boat builders, and its products were known for their durability. Five of the seven original astronauts bought Hydrodynes, among them Cooper and Grissom who later asked Ab Sr. to build a raceboat. This caught the attention of the White House. A Hydrodyne was delivered to Jacqueline Kennedy one day before her husband was assassinated.

Composite, or cored, construction isn't new. It wasn't even new in Ab Sr.'s day. Aircraft builders used it in World War II to build DeHavilland and Mosquito bombers, which were constructed of *balsa*—an extremely lightweight wood from a tropical tree—sandwiched between thin skins of birch plywood. These aircraft were the inspiration for Ab Sr.'s revolu-

(Please turn to page 116)

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tionary Hydrodynes, which pioneered balsa-cored construction in pleasure and racing boats. Hydrodyne still uses balsa—imported and processed by New Jersey-based Baltet—as its core material.

In addition to balsa, synthetic foams are also used as a core material in composite construction. These foams are typically cut from large sheets and are available with names such as Airex, Divinycell, Nomex, Klegecell and many others.

Adding muscle

It's fairly easy to understand why cored hulls are many times stronger than typical fiberglass hulls. The basic hull layup technique is to start with a female mold. The first layer is wax, which enables the hull component to be removed easily. Then comes the outermost skin, which is called *gelcoat*. This laminate is a colored, nonreinforced resin.

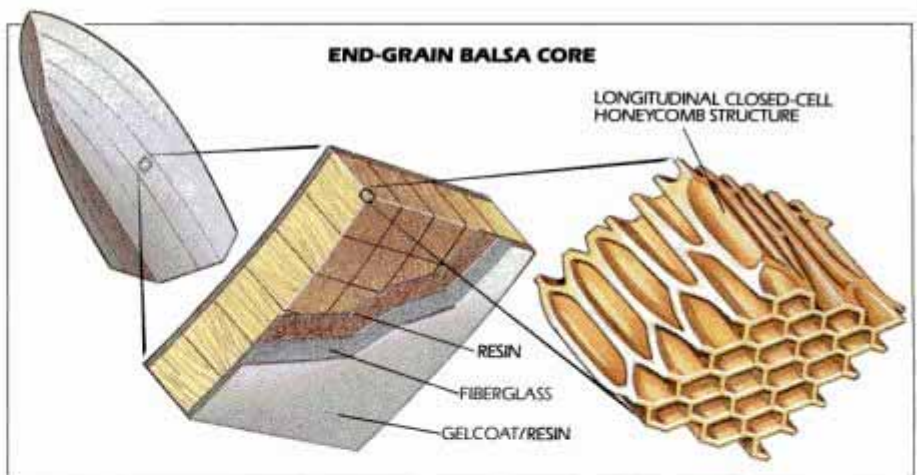
The next laminate is called *fiberglass mat*, a nondirectional blanket of short fibers. The purpose of this layer is to prevent a checkerboard pattern from emerging onto the smooth exterior of the hull. This flaw is called *bleed through* or *print through*, and it derives from the coarser layers of fiberglass laminate that follow.

The fundamental strength and rigidity of the hull comes from the middle laminates—long strands of fiberglass and resin. Woven fiberglass, called *roving*, is a coarse cloth made by passing relatively thick strands over and under each other. In essence, this is a *biaxial* weave with the strands oriented at 90° to each other.

Knitted fiberglass fabric is finer than roving. It's also stronger and more expensive. Knits are produced in a variety of weaves. A *triaxial knit* has strands oriented in three directions. A *biaxial knit* skips seven or eight strands before ducking over and under. A *unidirectional* fabric, often used on stringers, runs strands in a single direction.

The portion between the outer skins of a typical boat hull today is composed of alternate layers of fiberglass fabric, resin and mat. Since this layup gives the hull strength, why not simply add more layers to make the hull stronger? While this is possible, there are some drawbacks.

I've seen studies that indicate hull stiffness increases roughly with the cube of the thickness. In other words, if you double the thickness, you get eight times the strength. But doubling the thickness of fiberglass laminates is a very expensive proposition. Also, when compared to balsa- and foam-cored hulls of the same thick-



When used as a core material, ultralight balsa is composed of long cells cut across the grain.

ness, a hull stiffened by increasing fiberglass laminates would be extremely heavy.

More strength, less weight

The photo on the opening page of this story shows an 18-ft. Boston Whaler Outrage taking on a 44,000-pound John Deere bulldozer. As you can see, the Whaler is winning the battle.

All Boston Whaler boats are built with composite construction. On the sides, the foam core is 2 to 3 in. thick. On the bottom, core thickness widens to as much as 3 to 4 in. This overbuilding—it's not often your boat will have to take on a 44,000-pound bulldozer—enables Whaler to eliminate a dedicated stringer grid, which is an absolute requirement on noncored-hull boats. It also enables Whaler the opportunity to offer a 10-year transferable hull warranty, which is extremely rare in the marine business.

Composite construction provides boats with many advantages, including improved insulation against noise and cold. But there's no such thing as a free lunch. The price of a cored-hull boat is higher than a typical noncored hull for two reasons: 1. The additional cost of the core material; and 2. The additional cost of improving quality control during the layup process.

Cored-hull boats need especially careful layup techniques to avoid the problems of *delamination*, when the layers become separated, and *shear*, when the core material splits apart through stress.

Since the hull is subject to extreme stress, any failure of the bond between the core and the skins will destroy the integrity of the hull. This failure is called *delamination* and is not limited to composite construction. A noncored hull can also delaminate.

Water intrusion, induced by holes made for through-hull fittings, is a primary source of delamination. For this reason, cored hulls must be constructed without any voids in the lam-

inate. If the skins and core are riddled with voids, water will travel throughout the hull and induce delamination.

To some boaters and builders, balsa cores are especially worrisome. Since balsa is a natural wood, some people fear that water will eventually enter the hull, migrate throughout the core, induce rot, produce delamination and destroy structural integrity.

More than 30 years ago, this unfounded prejudice was laid to rest in landmark studies done by the Society of Plastics Engineers and the U.S. Navy Bureau of Ships. Both studies showed that balsa, which is primarily offered in the United States by Baltet, resists rot and water migration.

Before it's shipped from Ecuador to Baltet's plant in New Jersey, balsa is kiln-dried and glued into large, parallel-grained blocks. After this, it's sliced into end-grained panels. From these panels, Baltet produces a variety of products. But the point to note is that kiln drying destroys rot-inducing spores, and end-grain-cut panels prevent water migration. Studies show that water only fills the cells it comes in contact with and cannot migrate across the grain.

While the cost of a cored hull may be higher than a boat built of typical fiberglass construction, the benefits are greater, too. The extra care required in composite construction translates into better overall quality. Warranties are longer. Boats are more durable and efficient.

In the future, the trend is clear that more boats will be cored. For those curious about a current boat's construction, try a simple kick-the-hull test. Find a long uncurved hull section and pound it with your fist or foot. If it gives and rings with a hollow sound, it's not cored. If it's as rigid as steel, it is. If you're really daring, you might climb a ladder and give the boat the Ab Crosby Jr. test. But be careful, in an uncored boat you'll probably crash right through the deck.

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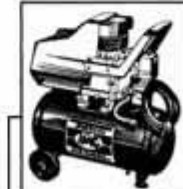
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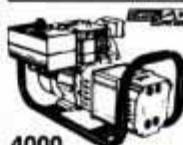


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X-PLANE STALKS IRAQIS

BY ABE DANE, Science/Technology Editor



GRUMMAN PHOTO

● At the request of Operation Desert Storm commander, Gen. H. Norman Schwarzkopf, the Air Force has dispatched the only two existing prototypes for its Joint Surveillance and Target Attack Radar System (Joint STARS) to serve in the Persian Gulf. It is the first time the Air Force has ever rushed a major weapons system into combat so early in its development.

AMERICA AT WAR

Built by Grumman Corp. as part of an Air Force/Army initiative to exploit rapidly advancing computer and radar technologies, Joint STARS gives battlefield commanders instant access to detailed information on the forces massed against them. Housed in a used Boeing 707 commercial jet, the system scans the ground with a 26-ft.-long phased-array radar antenna slung under the fuselage. Flying in an elongated racetrack pattern over the friendly side of the battlefield, the plane can peer deep behind enemy lines. Its extremely sensitive multi-mode radar, aided by tremendous computer processing power, can spot low-flying aircraft, tanks and trucks over 100 miles away, providing ample warning of impending enemy action.

The ability to recognize such small targets, whether moving or standing still and regardless of weather, is the aircraft's greatest technological feat. The system can select what it displays with great specificity, filtering out

the clutter of radar returns that bounce off the ground.

This is done by alternating the radar between two modes. In Doppler mode, the Joint STARS array works on the same principle as police speed radars to highlight targets that move relative to the ground. In synthetic aperture mode, it works like the radar aboard the Venus-mapping *Magellan* spacecraft to show the shapes of stationary objects in great detail. The tremendous flow of data that results is combined and prepared for display by multiple processors arranged in a parallel architecture. Writing the 1.7-million lines of software code that control this high-speed system was one of the greatest challenges of the program, according to Air Force officials.

After processing, radar data is fed via secure digital data links to mobile ground stations carried aboard 5-ton trucks and high-mobility multi-purpose wheeled vehicles. There, it may be used in targeting preemptive strikes with rockets or

artillery fire just minutes after targets are spotted. Alternatively, airstrikes can be guided directly from the aircraft. After the battle, Joint STARS data may be used to assess the damage to enemy forces.

Stellar performance

Although there is little question that such capabilities would be extremely useful to air and land commanders, the decision to field Joint STARS so early in its development was not without controversy. At first, the Central Command declined offers to send the aircraft, saying they already had more than adequate reconnaissance capabilities with current-generation



GRUMMAN PHOTO

Joint STARS operator views map of Florida during tests.

satellites and planes. Furthermore, deployment would have interrupted the complex and expensive development process that the Joint STARS aircraft were in the midst of.

Minds began to change after Joint STARS had its first real demonstration as part of an exercise of NATO forces held in Europe last September and October. In "Operation Deep Strike," U.S. Army VII Corps commanders used the aircraft to spot an approaching armored column and dispatch helicopter gunships to counter-attack. Fifty-one "kills" were credited to the strike.

Later, top NATO commanders, including Gen. John R. Galvin, Supreme Allied Commander, Europe, flew aboard the craft and watched as it produced photograph-like images of distant bridges and airfields. The radar was even able to pick out fragments of a wrecked C-5 over 60 miles away.

In all, the demonstration was termed spectacular, and Gen. Galvin is reported to have said he felt as if he had been "blindfolded for 20 years."

Special delivery

By January, the two fledgling aircraft were in the Middle East, along with more than 50 Grumman technicians needed to keep the unfinished systems operational. Able to stay aloft for up to 20 hours at a time with in-flight refueling, the aircraft are providing constant frontline surveillance. On long missions, 34 crewmen take turns at the aircraft's 17 operations and control consoles.

Reports on the aircrafts' missions so far are limited, but they are known to have served as a key element in the hunt for the elusive mobile Scud missile launchers, which up to now have been Iraq's primary means of retaliation. Under a new search-and-destroy scheme, Joint STARS works from tips sent by satellite sensors that detect the missiles' fiery exhaust. Focusing its radar on the area of each launch, the radar plane pinpoints mobile launchers as they flee, and sends in airstrikes to knock them out.

As the war progresses, likely jobs for Joint STARS include warning of enemy force buildups, providing data on terrain and enemy fortifications, finding safe landing zones for helicopters, and targeting the new Army Tactical Missile System (ATACMS) fired from tracked MLRS vehicles (see "America's Arsenal," page 29).

When the plane returns to the United States, full-scale development will continue. Before the deployment, the Air Force expected to begin Joint STARS production in 1993, eventually acquiring 20 of the aircraft. **PM**



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SMALL-SCALE INGENUITY

BY FRANK VIZARD, Electronics Editor



● Bose is introducing smaller versions of its Acoustimass 3-piece speaker systems. Dubbed the Series II, these two models are even tinier than their predecessors.

Referred to as stealth speakers by PM in our November 1990 issue (page 51), a 3-piece system employs a bass module and a pair of satellite speakers. Of these elements, only the two satellite speakers are in view.

Out of sight is the bass module which reproduces the lower frequencies in the musical spectrum. Since low bass notes are omnidirectional, the bass module can be placed anywhere—such as behind a sofa or under a table. To get big sound, you no longer need big speaker boxes taking up space in your living room.

While the number of speaker companies offering small, 3-piece systems has grown tremendously, the new Bose entries are probably the smallest yet. In the Acoustimass 3 Series II system, each satellite speaker is roughly the size of a regulation softball and weighs only 18 ounces. The speaker inside the cabinet is 2½ in. in diameter. Each one is magnetically shielded so it can be placed near a TV without affecting picture quality.

The bass module is about the size of a large shoebox and weighs only 14 pounds. The system is compatible with amplifiers and receivers rated from 10 to 100 watts per channel. List price is \$469.

The satellite speakers for the Acoustimass 5 Series II are 20% smaller than its predecessors. Just imagine two stacked apples. With the Acoustimass 5, the “apples” rotate on a central axis so that the sound can be more widely dispersed.

The bass module uses a new internal design. Two 5¼ in. speakers fire into three internal chambers. This design results in better dynamic range, smaller size and lower distortion, says Bose. The bass module measures 7½ × 14 × 19 in. in size. The system can handle up to 200 watts per channel of amplifier power. List price is \$799.

Keen-eyed readers of November's “Stealth Speakers” article noticed the puzzle-solving contest relating to the lead photograph. The response was overwhelming. With this issue, though, we're cutting off entries. Winners will receive a PM T-shirt.

Poor Man's Laptop

The Laser PC4 does not compare to more powerful laptop computers, but nor does it cost hundreds or thousands of dollars. In fact, the list price is only \$250. What the PC4 does give you is a fair amount of computer power that's portable.

The PC4 weighs only 2 pounds and is about the size of a notebook. Internally, there's only 32K of computer memory. This memory can be used in a variety of ways. You can enter data through a personal file, word processor, spreadsheet or expense account program. Other programs include a telephone directory, appointment book, alarm clock, calculator and an 80,000-word spelling checker.

The PC4 would be nothing more than a fancy electronic toy if it weren't for its ability to download data onto a personal computer. The PC4 comes with a 2-diskette PC Tools software program that sets up the communications link. The PC4 connects directly to a printer as well.

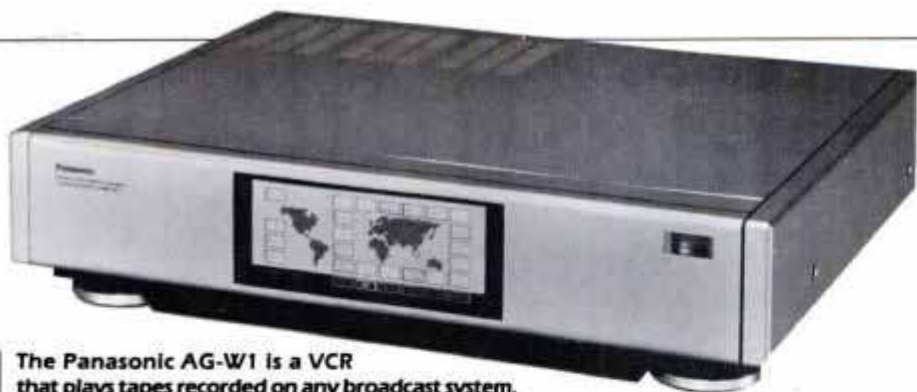
Now let's suppose you find yourself far from the desktop computer at the office or at home. You have some notes or a short paper to write. If you do the work on the PC4, all you have to do is download the material later. It is relatively easy since the PC4 features a QWERTY-style keyboard like your personal computer. And for the traveler, the PC4 can be an alarm clock and appointment book. Or it can keep your expense account up-to-date. Data can also be downloaded to the PC4 from a personal computer.

The PC4 can be criticized for having only a 4-line by 40-character screen, although it seems adequate over the short term. Telephone modem capability is to be available on a future PC4/XL version. There's also a Macintosh version listing for \$280.

You may also critique the PC4 as



The Laser PC4 features a QWERTY-style keyboard.



The Panasonic AG-W1 is a VCR that plays tapes recorded on any broadcast system.

being short on memory. However, the machine is upgradable to 128K of memory. External cartridges are also available that are dedicated to specific tasks relating to law and medicine. There's also a dictionary and thesaurus cartridge available. The PC4 runs on four AA batteries or can be plugged into a wall outlet.

The Laser PC4 doesn't have the muscle of a legitimate laptop computer, but it's handier and easier to work with than an electronic organizer. Many of the most commonly used functions of a laptop can be handled by the PC4. Think of the PC4 as sort of a shuttlecraft for a bigger computer. This review, by the way, was written using the PC4 and downloaded onto a desktop computer at a later time.

Global VCR

If you go shopping for a videocassette recorder in the electronics district in Tokyo, you can find VCRs that play tapes recorded in the NTSC standard used in the United States and in the PAL and SECAM standards used elsewhere in the world.

In the United States, VCR sensibilities seem to be less globally oriented. VCRs that play back tapes recorded from foreign broadcasting systems are not widely available. Companies like Instant Replay of Coconut Grove, Florida, and Ten-Lab of Los Angeles, California, are among the few U.S. companies supplying this gear.

Panasonic, though, is now offering

a multiformat VCR for sale in the United States. Called the AG-W1, this machine uses digital technology to provide complete compatibility between broadcasting systems.

Broadcasting does vary depending upon the part of the world the recorded tape originates in. In our NTSC system the number of scanning lines in the luminance signal is 525, the field frequency is 60 Hertz, and 30 frames are transmitted per second. The PAL and SECAM have 625 scanning lines, a field frequency of 50 Hz, and 25 frames per second are transmitted. The AG-W1 detects the broadcasting system used to record a tape and sets the correct tape speed and video head rotation speed automatically. To record a tape for playback in another country, just press the right "country" button on the front panel.

The AG-W1 carries a list of \$2250. While the price is admittedly higher than your average VCR, keep in mind that the AG-W1 can be used with any television or monitor. With other multiformat VCRs, you often need a separate PAL, SECAM or NTSC monitor for playback. The price differential, therefore, is not as dramatic as it may first appear.

Radio Waves

You can float on water and still listen to your personal stereo this summer, thanks to a new air mattress called Radio Waves.

Developed by inventor Mark Nesbit and marketed by ERO Industries of Morton Grove, Illinois, Radio Waves looks like a big radio. The personal tape player is put in a sealable bag and connected to a pair of 2½ in. speakers mounted in the air mattress. An FM radio is built into the raft as well. Radio Waves should be a hit with musical sunbathers. List price is \$40. **PM**



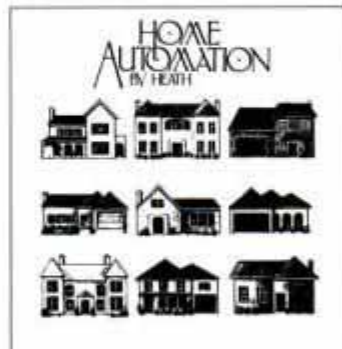
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COMPUTERS

EYE OF THE STORM

BY PETER GEIGER AND GINGER HALTER



USAF PHOTO

● A marine patrol crawls slowly up the south side of a sand dune in Eastern Saudi Arabia and peers north toward the Kuwaiti border. Clearly visible in the bright desert sun is a fortified Iraqi position, complete with

AMERICA AT WAR

gun emplacements, trenches, barbed wire, tank traps and some signs of land mines. One Marine reaches into his pack and retrieves a small computer, then a device that looks like an oversize remote control for a TV or CD player. The device sports a keyboard, a tiny LCD screen and a swiveling, rectangular appendage on its left side. The Marine points the appendage skyward and presses the ON/OFF key on the device. The screen reports, "Ready, press survey." The Marine hits the survey key. The screen responds with, "Computing 3D search for sats. 02 06 09 11"; then, "Computing pos." After a pause, the screen reports, "Pos. 28deg.71.3551N, 045deg.13.9912E, +00103 alt."

Thus begins what might have been part of the initial ground action in Operation Desert Storm. While the armed forces have steadfastly declined to detail how computer technology operates in battle, it is possible to piece together the details from pre-war military technical papers, military supplier proposals and other sources, all unclassified. The amazing picture that emerges is one of reliance

on technology that is strikingly similar to its civilian counterparts.

The Marine on patrol stores his position in a Magellan geopositioning satellite (GPS) receiver, identifying it as "RIDGE 47," along with a specific map reference or datum—world geodetic survey 84, for example—for later interservice coordination. He hauls out a 2-ft. cable and plugs one end into the right side of his GPS receiver, nearly identical to those used by recreational boaters. Magellan is located in Monrovia, California. GPS receivers are also made by Trimble Navigation Ltd. of Sunnyvale, California, for use in Desert Storm.

The other end of the cable goes into the top of the computer, a portable similar to a conventional laptop. The differences: The military GPS is accurate to 50 ft., while the civilian version only to 300 ft. The battlefield computer is "hardened" to withstand dust and moisture, temperature extremes, G-force shock and attempts to breach security by reading its magnetic or radio-frequency emissions.

The Marine turns a switch on the top right end of the computer. Its LCD screen comes to life and prompts him for what kind of report he wishes to make. He hits one of 10 function keys to the left of the screen. The display becomes a forward observation form, complete with blanks to fill in.

As other patrol members calculate the range and bearing from the dune

to the Iraqi position, the computer operator enters numbers for the estimated enemy manpower and weapons. He enters the range and bearing to the Iraqi position, then presses the AUX key on the GPS receiver, followed by the 1, 0 and ENTER keys. The latitude, longitude and altitude information on the GPS screen transfers to the computer screen.

Marine Staff Sgt. Eric G. Motier wrote to Magellan from Saudi Arabia: "Though we have only had [your] unit for a short time, we quickly figured out all of the unit's functions which, we might add, are nothing less than incredible. . . . We have devised a system which . . . enables us to generate firing data in a more timely manner. . . . It is our belief that accuracy will be significantly enhanced."

The Marine on forward patrol unplugs the cable from the GPS receiver and attaches it to his pack radio, switches the radio to data transmission and presses another function key on the computer. The patrol's observations are encoded by the computer and transmitted in the 420- to 450-megahertz band by the radio as high-speed, hybrid pseudo-noise phase modulated, frequency-hopping signals, a technology called spread-spectrum that is reportedly impossible either to intercept or to jam. Received on a combat net radio at battalion headquarters miles to the south, the signal is unscrambled, then decoded and posted as new data on a computer local area network (LAN).

Lt. Col. Larry L. Sims, head of technical services for the Marine Corps Central Design and Programming Activity in Quantico, Virginia, told *Government Computer News* that Desert Storm is the first time the Marines have used LANs in "an operational commitment." Sims estimated some 200 networks link more than 1000 microcomputers in the Saudi Arabian desert.

Tim Greer, retired Marine captain who helped design the system, told *POPULAR MECHANICS* that the Marines "have to be very mobile and their equipment must have quick setup." Greer is now national sales development director for Banyan Systems, Inc., of Westboro, Massachusetts,

maker of the Vines network operating software used by the Marines. One attribute of Vines is its ability to recognize a computer device or user upon hookup anywhere in the Marine Corps worldwide data network.

At headquarters

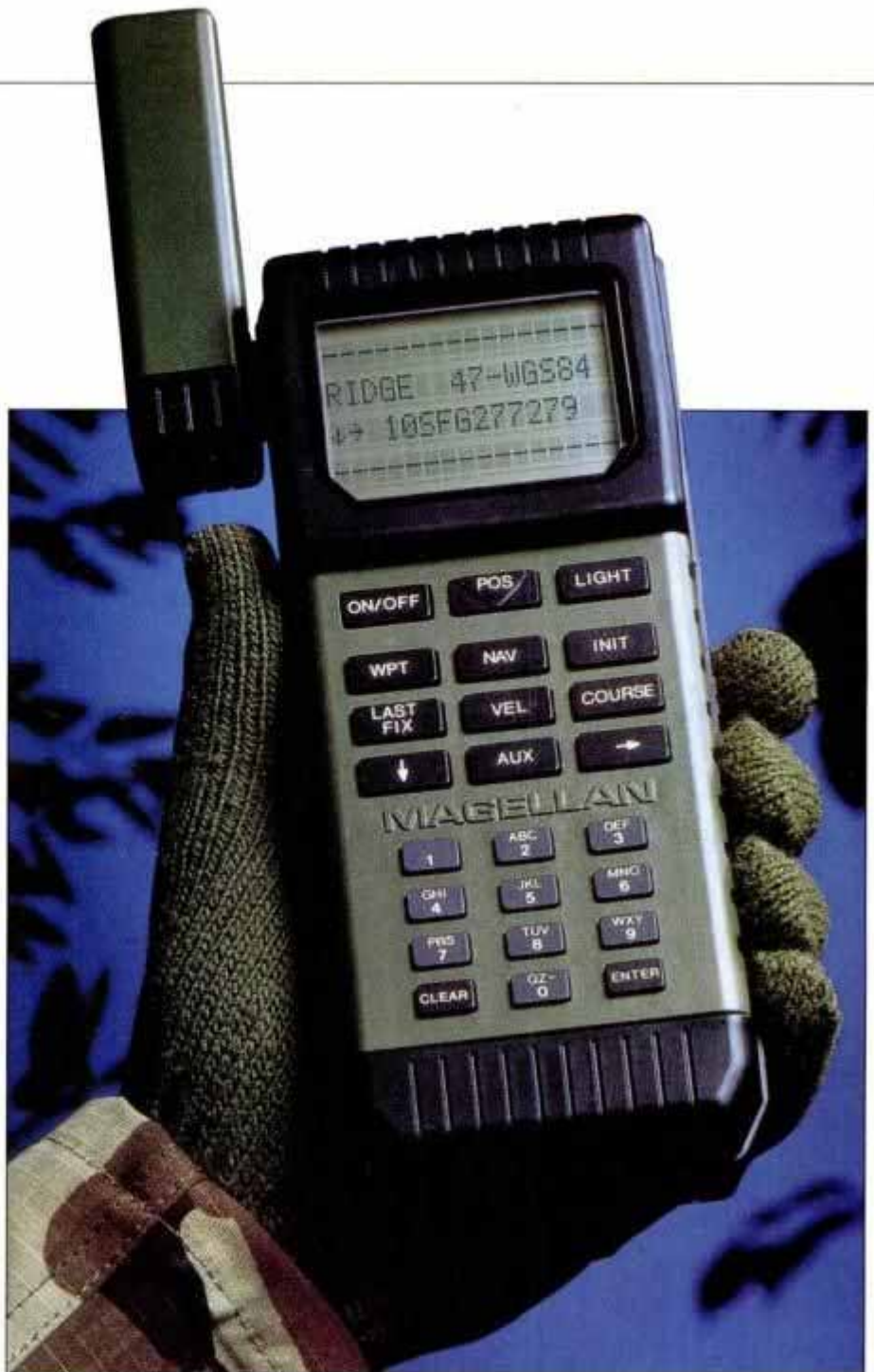
Data from the frontline observers is called up by a Desert Storm headquarters desktop computer. Software skews the geoposition data by the range and bearing from the dune to yield the exact Iraqi position. The battalion desktop computers are Hewlett-Packard machines, hardened and repackaged as transportables by Miltope Corp. of Melville, Long Island, a supplier of classified computer products little known outside military circles.

A battalion commander brings his laptop computer into the HQ tent, plugs into the LAN using an off-the-shelf adapter and reviews the observers' data. He decides to relay the Iraqi position to the Air Force and Army, to the Desert Storm Coalition's Coordination, Communication and Integration Center in Riyadh, and to his division headquarters. He issues a command from his laptop, sending the information by high-frequency radio to his division, to Tactical Army Command and Control System (TACCS) LANs and to the Forward Area Air Defense Command, Control and Intelligence system.

The newest version of the Army's TACCS runs on readily available Unisys commercial workstation computers with Intel 80386 central processing chips. With some of its planes equipped to receive Joint Tactical Information Distribution System Data, the Marine observers' information can be relayed directly to pilots to call in an airstrike. The entire process can be accomplished in mere seconds, when necessary.

Saving lives

Not only has PC technology helped fight the war, it also is helping save lives on the frontline. The Army field hospitals are managed with Unisys PCs running the Theater Army Medical Management Information System. TAMMIS accounts for medical



This device pinpoints a soldier's exact location using satellites in space.

supplies and identifies casualties.

Furthermore, forward observation platoons such as one at the Kuwaiti border may be the most at risk in the event of chemical attack. Micromedex, Inc., of Denver, Colorado, a subsidiary of Mead Data Central of Dayton, Ohio, has donated copies of its CD-ROM clinical information and toxicology databases to all military branches. The CD-ROMs are the same used with small computers in U.S. hospitals, another example of familiar technology in Desert Storm.

In the field, CD-ROMs can be used to diffuse land mines or obtain specifications for specific types of weaponry soldiers may face. One CD-ROM can store more than a half-billion bits of data. An entire Jane's weapons cata-

log as well as thousands of maps can be stored on a single disk. CD-ROM disks are the same size as those used to play music on home CD players.

Just how many computers are being used in Desert Storm? The exact number may be classified, but published reports do show how extensively the armed services rely on computers. One company, Compuadd Corp. of Austin, Texas, delivered 1300 desktop computers and laser printers, 350 laptops and 10 fully configured LANs to Desert Storm just prior to January 15. The laptops were equipped with 40-megabyte hard disks which can store the equivalent of 20,000 pages of typewritten text. The war with Iraq is one that is heavily dependent on computers. **PM**

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It is Not A Pyramid Game!

I wouldn't insult your intelligence.

Remember, It is Perfectly Legal!

No, it has nothing to do with working for someone else. It is Your Business and all the money you make is yours to keep. It is NOT a Pyramid Scheme or any of those "envelope-stuffing businesses" you read so much about. It is a legitimate Business that can produce up to \$25,000 a MONTH if you apply the program I've developed and, most important, it does Not require a College Education or any Specialized Business Knowledge to get started.

Start The Program Part-Time!

I realize you are skeptical at this point and

you have a perfect right to be. I know in the past, you have probably been exposed to money-making plans, but when you tried to put them into operation you found out you were EITHER working for someone else or you would have to invest several thousand dollars to start them.

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Easily Started From Your Own Home.

Let me explain how well it works:

I put my "money-making program" into operation four times last year and deposited \$180,000.00 in my checking account. (My Certified Public Account, in Vienna, Virginia has my financial statements in his office to prove it.) Last month, to prove to you again how well it works, I deposited \$1,900 in crisp \$100 dollar bills in my checking account, NOT over several weeks or days, but the whole **One Thousand Nine Hundred Dollars in ONE Day.** (The President of my bank has my checking account records in his office to prove it.)

Testimonials

I would be more than happy to provide you with Hundreds of testimonials, if I had them. But, I don't.

I would be lying to you if I told you I did.

Up to this point, only a handful of people in America have put my program into operation. Here is what a few friends and family members have to say about it.

\$4,000 in Two Weeks!

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R.S., Great Falls, Virginia

You Weren't Kidding

"When you told me about your program I thought it was just one of those Get Rich Quick Schemes. I Was Wrong! Please accept my apologies. It has changed my life. Today, I have money in the bank for a change and I have just finished remodeling my home to the tune of several thousand dollars which I would have never been able to do without your program."

M.H., Sterling, Virginia

I'm Impressed!

"Let me level with you. I sent you my check for \$20 in desperation. I thought what can I lose, since you wouldn't cash my check for thirty days anyway. I was right. Your plan was delivered to me today and I am impressed. It is truly worth the twenty bucks and I can't wait to get started."

Mr. R.C.S., New York, N.Y.

I Won't Sell It To Everyone!

I am not going to sit here and tell you that my confidential money making ideas are offered to anyone who sends in \$20.

They are NOT! I won't sell it to anyone residing outside of the United States of America. I am tired of seeing New American Ideas being copied by other coun-



tries and then put into operation on such a mass scale that no one can make a dime. I put too much time into developing this one to see that happen. In fact, while I am on the subject, I would appreciate it if you keep it a Secret from your friends, neighbors and fellow office workers. It is just too valuable to pass around for free.

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THE IRON SHOP
MANUFACTURERS

CHARLIE BATTERY (Continued from page 28)

display information from all the radars in the battalion. ICC crew members can thus tell the batteries how to work in concert with each other and with other air defense assets, such as fighter planes.

Mobile village

In the ever-shifting context of war, the ability to move is as critical as the ability to fight. Charlie Battery keeps this in mind. "We could get an order, be off site, and on to another site in a matter of hours," Groome says.

While earlier armies may have marched on their stomachs, this unit is immobile without its fleet of trucks. In a tent bearing the sign "Motor Pool, No Coneheads Allowed," the jovial Sgt. 1st Class Rosa Gamboa copes with the daily challenges of keeping heavy equipment running in the abrasive sands of Saudi Arabia. Coneheads are what she and her mechanics jokingly call the missile specialists, because of an alleged similarity between their heads and the empty radomes of the Patriots. "Sometimes they're very irrational," she chuckles.

Highest on her list of concerns are the HEMTTs, or Heavy Expanded Mobility Tactical Trucks. These 10-ton, 8-wheel-drive prime movers pull

the battery's radar and launcher trailers. "We have to maintain them in a high state of readiness, because if the vehicle goes down, the whole system goes down," Gamboa says. The sand keeps her mechanics working steadily. Air filters and oil are expended at a prodigious rate, and rear main seals regularly spring leaks.

An Arabian night

The day wears on, then darkness falls over the desert with tropical suddenness, bringing a chill to the air. Soldiers drift by the mess trailer in ones and twos to pick up a meal of spaghetti, chicken patties, corn, gravy and mashed potatoes, dished out of heated marmite containers. Those not eating at their posts head over to the ready tent, where they sit at a folding table and on cots.

They are too tired to talk. By 8 pm, those few not needed to run or guard the battery are asleep, their boots still on and their camouflaged parkas zipped against the cold. A guttering diesel burner in the middle of the tent gives off more smoke than heat.

A little before midnight, Sgt. Satterfield bursts through the flap. Beaming widely, he seems to be the kind of sergeant who enjoys waking

people up. "You better get on up, damn it," he bellows. "It's New Year's. Take one of these damn beers and suck on it for a while." The beers are nonalcoholic, but with Saudi Arabia's strict Islamic laws, they're the best available. Then he speaks more gently. "Don't get homesick. Come on now. Got to sit on up now, you only got a few more minutes."

This is a hell of a way to spend New Year's Eve—waiting for a war to start in a cold and barren desert 10,000 miles from home. Sand is a part of everything, saturating the clothes, stinging the eyes and caking up on teeth. But through a combination of cussedness, cohesion and hope, these people bear up well. All I spoke to shared one idea: Let's do our job, so we can get the hell home.

We left Charlie Battery on January 1. As we go to press, the war with Iraq is just three weeks old, and no one can say what the next weeks and months will bring. But the Patriot, an untested weapon charged with the unprecedented task of shooting down ballistic missiles in midflight, has already acquitted itself splendidly—and so have the men and women who call themselves Guardians of the Flame.

PM

NEW CARS



Ford Revitalizes Big Car Lineup

● Ford may have lagged behind Chevrolet with the redesign of the Crown Victoria and Mercury Grand Marquis, but judging by the cars that finally emerged, Dearborn is back on top in the full-size sedan business.

With new shapes, a new engine, larger interiors and thoroughly revised suspension systems, Ford's old boats have become totally modern.

The new body designs reflect considerable effort to make both models more aerodynamic while simultaneously enhancing interior space. A steeper windshield rake, flush-mounted glass, low-protrusion door handles and low-drag mirrors all contribute to a more contemporary look.

Interiors are larger, cleaner in design and far more comfortable. The

instrument panels are smartly designed. The greenhouses have been enlarged, improving driver sightlines as well as ease of entry/exit. A driver's airbag is now standard, a passenger-side system optional.

The ladder-style chassis and body-on-frame construction are familiar, but the road manners of these new cars is another story. Smooth and surefooted, their handling is precise and far more responsive than the roll and wallow of their predecessors.

New front spindles, with 5.5° of caster and a new direct-link front antiroll bar, which now mounts the front spindle directly to the bar itself, provide excellent control of body roll and much better steering response.

Both front and rear suspension systems received revised spring and shock absorber rates, and a rear antiroll bar is now standard.

The hardware list reads like the order sheet for a Mustang: 4-wheel disc brakes with an ABS option, speed-sensitive variable-assist power steering, a 20-gallon fuel tank, and an instrument cluster with oil pressure, voltmeter and water temp gauges.

Underhood appearance is highlighted by map-routed wiring with highly detailed wire saddles and coolant hose layout.

For all this sophistication, though, it's Ford's all-new 4.6-liter sohc 190-hp (210-hp with the optional dual exhaust system) V8 that really pushes the new cars to the front of their class. Smooth, quiet, powerful and fuel efficient, the new engine mates to Ford's 4-speed automatic, which adds the final pinch of refinement.

Comparing previous models with the new provides a sharp contrast in design then versus design now. The older models, though still serving well, were '60s-think vehicles.

The 1992 Ford Crown Victoria and Mercury Grand Marquis are no longer aimed at the retirement end of the market. They're intended for the buyer who's ready to step up from a Ford Taurus or Mercury Sable.

It's rare for a manufacturer to redesign its buyers, as well as its cars. It's rarer still for a manufacturer to do it this well.

—Rick Titus

(Please turn to page 128)



New Crown Vic (top) and Grand Marquis (above) offer conservative but contemporary look.



BMW Launches New 3-Series

BMW kicked off 1991 by introducing a pair of entries: the 318i and 318is, new model numbers in a smooth redesign of the entire 3-series lineup. As BMW entry-level cars, they're priced aggressively against several models from Japan that have invaded traditional BMW territory.

The starting point is a completely new dohc 16-valve 1.8-liter Four, which shares much of its technology with the new 5-series 2.5-liter straight-Six and the V12 in the 750iL and 850i.

The new powerplant pumps out a healthy 134 hp, and a willingness to rev right up to the red numbers on the

New BMW 3-series styling echoes the lines of the recently introduced 5-series cars—smoother, more aggressive and more aerodynamically efficient. New instrument panel has familiar BMW aircraft cockpit look. New 318i and 318is models will be offered only with 5-speed manual transmissions, underscoring emphasis on high-performance image.

tach. This kind of performance is bound to bring a smile to Bimmerphiles who cut their teeth on 2002s and Bavarias.

Emphasizing BMW's commitment to market these models as performance cars is the absence of an automatic transmission in the 318 order book. (Think about it—even a Porsche 911 or Mazda Miata can be had with an automatic nowadays.)

To provide competition in the showroom as well as on the street, BMW has priced the base 4-door 318i at just under 20 grand, which is intended to

lure buyers who've been straying into Acura, Infiniti and Lexus showrooms. That makes it the least-expensive BMW in years. And it's no loss-leader stripper, either—every BMW comes with antilock brakes, good sound systems, driver's-side airbags, a/c and central locking.

The 2-door 318is comes standard with alloy wheels, front and rear spoilers, and torso-grabbing front seats to announce its sporting intentions. Considerable driving experience in these models confirms first-glance impressions—0-60 times are well under 10 seconds, and the transmission, brakes and suspension are more than up to the demands of an afternoon of carving up country roads.

Although the 5-series cars get the aforementioned 24-valve Six, the various iterations of the 325 still retain the older 2.5-liter sohc engine, rated at 168 hp. Available in both 2- and 4-door versions, the 6-cylinder cars are available with either Getrag 5-speeds or ZF 4-speed automatics.

Also propelled by the straight-Six is the 4wd 325ix. At a cost of \$5500 over 2wd, the ix provides all-weather traction and a BMW logo ski rack as standard equipment. Also standard is a viscous-couple limited-slip for the center and rear differentials.

And when summer rolls around, there's the popular 325i convertible, one of BMW's most persistent strong sellers.

For seriously serious enthusiasts, there's the M3, virtually handbuilt by the Motorsports department, and largely unchanged for '91. Its 192-hp 2.3-liter 16-valve engine has little in common with the new 1.8, and neither does its near-\$36,000 price tag.

—Mike Allen

(Please turn to page 130)

Infiniti G20 Engine Tech

● Engineers are managing to extract more and more power and efficiency from smaller-displacement engines—without resorting to the additional complexities that go with turbocharging. One example can be found in the cylinder head of the new Infiniti G20 16-valve inline 2.0-liter Four.

The 4-valve concept is hardly new, but manufacturers are coming up with new ways to operate the valves, and Nissan's G20 engine embodies an interesting example of this technology.

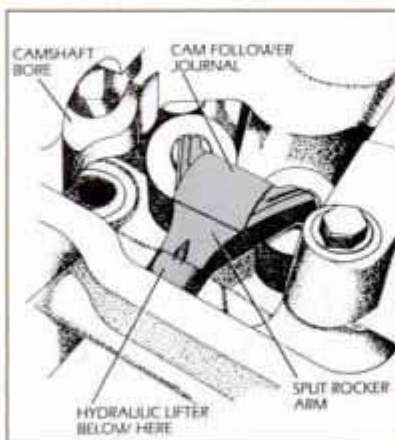
Even with overhead cams, there still has to be room in the cylinder head casting for amenities like hydraulic lifters and intake ports. In the G20, Nissan engineers use a single cam lobe pressing on a single split rocker, one end of which fulcrums off a

stationary hydraulic adjuster/lifter.

By using a single lifter for two valves, there's room for the intake ports to go to either side of the lifter's cavity in the cylinder head.

This raises a question: Why not just put the rocker and adjuster on the other side? Two reasons: First, the spark plug has to go somewhere. Second, simply raising the whole valvetrain would make the engine taller—too tall for packaging under today's lower hoodlines.

The end result is a straighter shot to the intake valve from the manifold. The benefits are improved airflow and more power without aggressive cam timing or increased displacement, both of which are employed at the cost of poorer mileage and emissions. —M.A.



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NEW CARS (Continued from page 128)



Saab's New 2.3-16

● Responding to the challenge of V6 and V8 engines in the luxury car field, Saab has renewed its 4-cylinder engines.

The new dohc 16-valve 2.3-liter engine represents an extensive reengineering of the old 2.0-liter. The stroke has been stretched from 78mm to 90mm, and counterrotating balance shafts damp vibrations.

Saab's Direct Ignition system, with a coil for each plug, is used on both the normally aspirated and turbo versions, yielding 150 hp in the former (up from 130), 200 hp in the turbo (up from 160).

Honda Accord Wagon

If the question is how to expand sales of the best-selling car in America, this looks like a pretty good answer.

Honda startled the American automotive establishment in 1989 when the Accord topped U.S. sales charts and underscored that achievement by selling even more Accords last year.

To Honda's product planners, it seemed clear that an Accord station wagon could only enhance this success story. And here it is.

Designed in America and assembled exclusively at Honda's plant in Marysville, Ohio—a first for Honda—the Accord wagon seems, in concept, to be aimed squarely at Toyota's successful Camry wagon.

Like the Accord sedans, Honda's wagon is a little bigger than the Camry—107.1-in. wheelbase, 186.0 in. overall length, 67.9 in. wide, 55.1 in. high, versus 102.4/183.1/67.4/54.5 for the Toyota. As is true of all Hondas, bigger exterior dimensions mean more space inside the vehicle.

The Accord wagon will come in two flavors: LX and EX. Typical of Honda, both offer impressive lists of standard equipment, including air



Accord wagon shares sedan platform. Honda also plans export sales.

conditioning, cruise control, power door locks, power windows, power mirrors and AM/FM/cassette sound systems.

A principal point of difference between the two models lies under the hood. The LX is powered by a 125-hp 2.2-liter sohc 16-valve Four, while the EX version of the same engine makes 140 hp. There's no penalty for the extra power. EPA ratings are identical for both engines—22 mpg city, 27 highway with a 5-speed, 20/26 automatic.

Consistent with the rest of the Accord family, the wagon is quiet and mannerly on the road. The high level of standard equipment is reflected in the pricing, which starts at \$17,300 for an LX with 5-speed manual transmission and tops out at \$19,800 for an EX with 4-speed automatic.

—Tony Swan

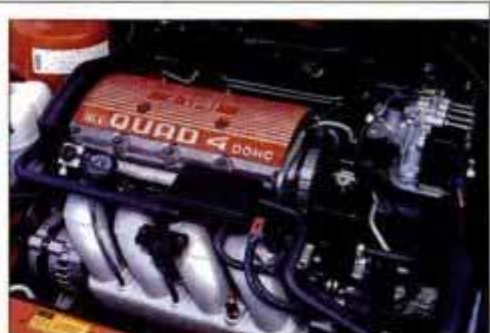


PHOTO BY RICK VOGELIN

With 190 hp and only 2518 pounds of car, the W41 option on the Olds Cutlass Calais creates plentiful launch power. Injection system tweaks account for most of the gain, 10 hp more than the standard high-output Quad 4.

Quad 4 Q-Ship

Oldsmobile was GM's development division for the 2.3-liter dohc 16-valve Quad 4 engine, so it's appropriate that Olds is the source of Quad 4 performance enhancements.

The latest of these is at the core of the new limited-edition W41 option in the Calais 442 coupe. By massaging the multiport fuel injection system, Olds has mined another 10 hp out of the high-output version of the Quad 4—190 hp versus 180. The torque rating remains the same at 160 ft.-lb.

To help make the most of the extra muscle, the W41 package also includes a close-ratio fifth gear (it's 5-speed only) and a 3.94:1 final drive, in contrast to the stock 442 3.61:1. There's also more contact patch, with 215/60R tires on 14-in. alloy wheels.

What all this adds up to is straight-ahead performance that's nothing short of startling. In a test session at Firebird Raceway in Phoenix, the W41 Calais hit 60 mph in less than 7 seconds, and hustled through the quarter-mile in 14.7 seconds at 94.7 mph—quick by anybody's clock.

For all its point A to point B verve, the W41 Calais loses some of its charm when it's time to turn the corner and head for point C. Even with Oldsmobile's stiffer FE3 suspension package, there's a lot of body roll in hard cornering, which translates as relentless understeer and wheelspin on the inside front wheel.

A limited-slip differential and stiffer rear antiroll bar would help correct these tendencies, and both are available through Oldsmobile's new Rock-et Parts division.

Still, understeer or no understeer, the W41 option puts the Calais 442 on an equal footing with some pretty pricey performance cars. The package, which includes the various 442 goodies, costs \$2595. Added to the price of a basic Calais coupe, it works out to \$14,090.

You just don't get much more bang for your buck. —Tony Swan

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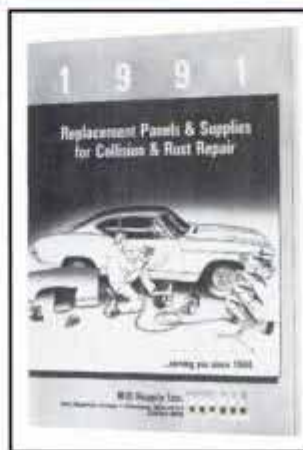


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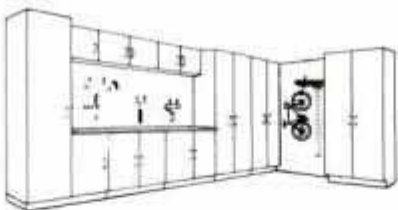
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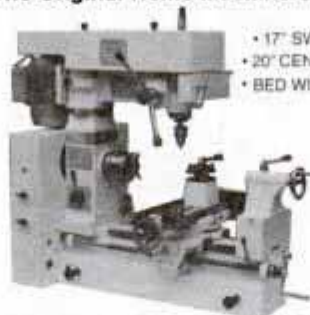
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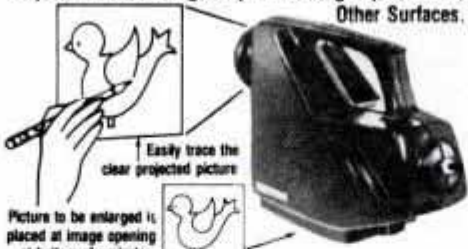
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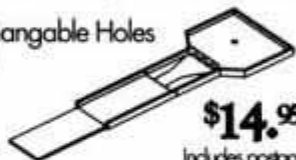
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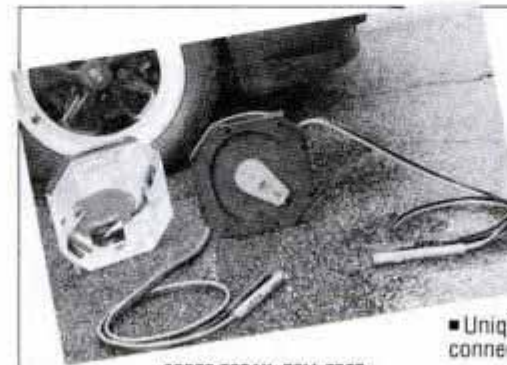
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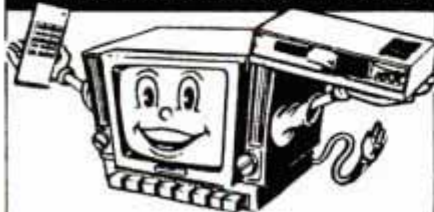
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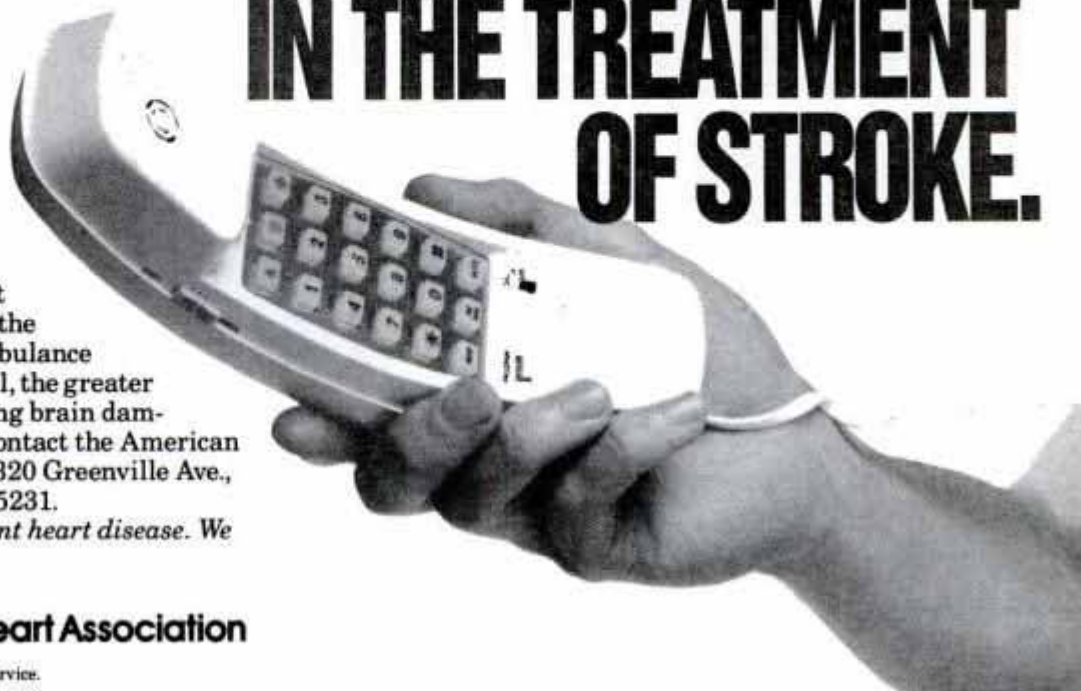
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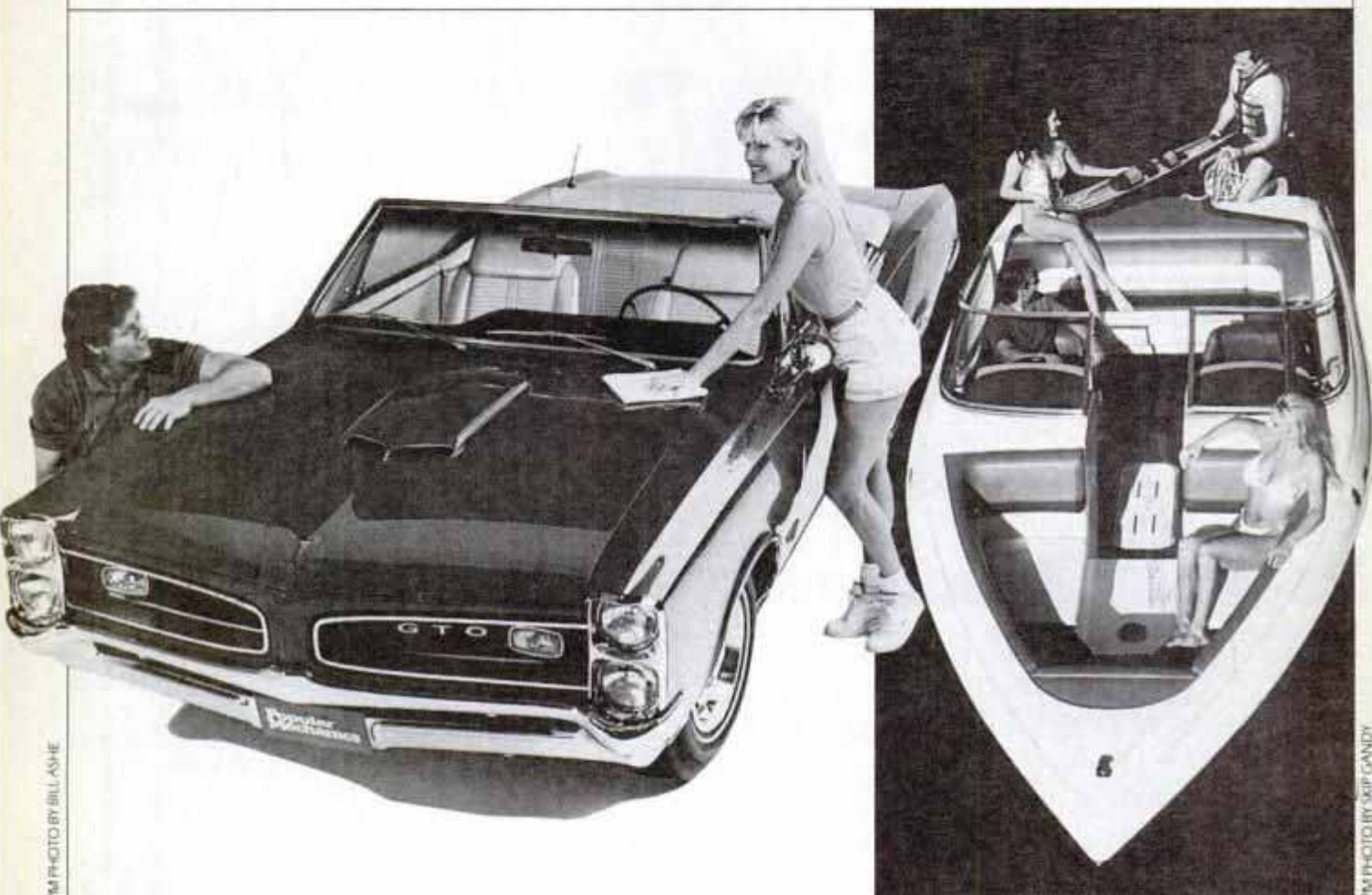


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A sophisticated computer-controlled braking system, designed to help prevent wheel lock-up under braking... keeping you in control. And it's available on LE. But there's more built into Pontiac Bonneville* than just sheer stopping power.

For instance, its powerful 3.8 liter "3800" V6 engine has sequential-port fuel injection to maximize output at 165 hp and 210 lbs.-ft. of torque.

All this power can be fully appreciated from the friendly confines of an acoustically insulated interior complete with air conditioning and seating for six passengers. There's even an available AM/FM stereo cassette with a 6-speaker sound system.

The Bonneville LE sedan. Performance, excitement and an uncompromising commitment to quality are what this agile American sedan is all about. And news like this is bound to travel fast.

PONTIAC *We Build Excitement* 

 Call Toll-Free 1-800-762-4900 For More Product Information.

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| | |
|--------------|---------|
| EPA Est. MPG | |
| 19 City | 28 Hwy. |



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Lights.
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