

Popular Mechanics

MARCH 1995

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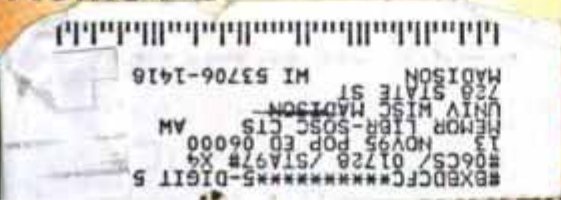


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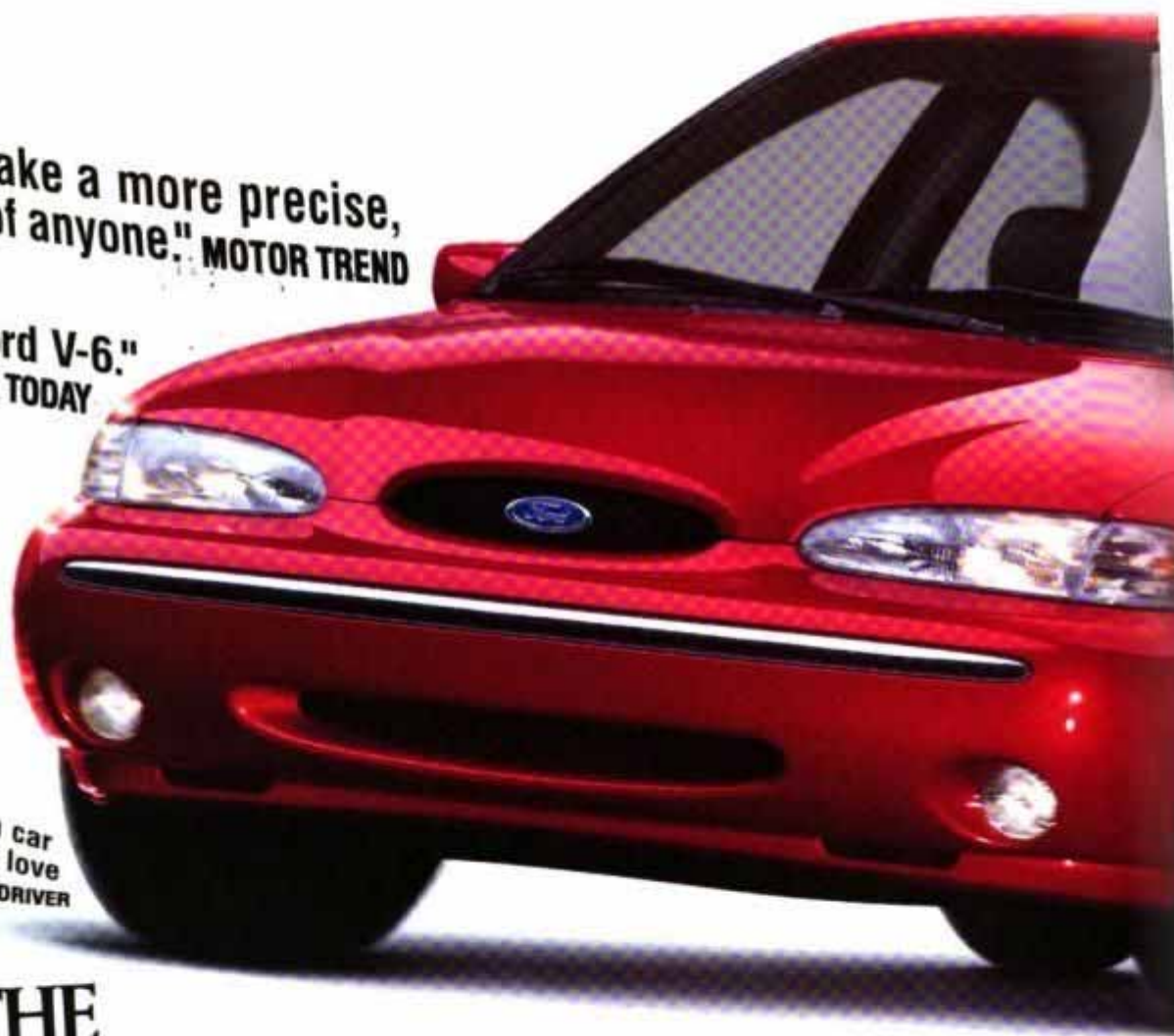
"The Duratec is ... a compact, torquey, wake-up-and-smell-the-coffee powerplant." ROAD & TRACK

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"The Contour will make a more precise, better driver out of anyone." MOTOR TREND

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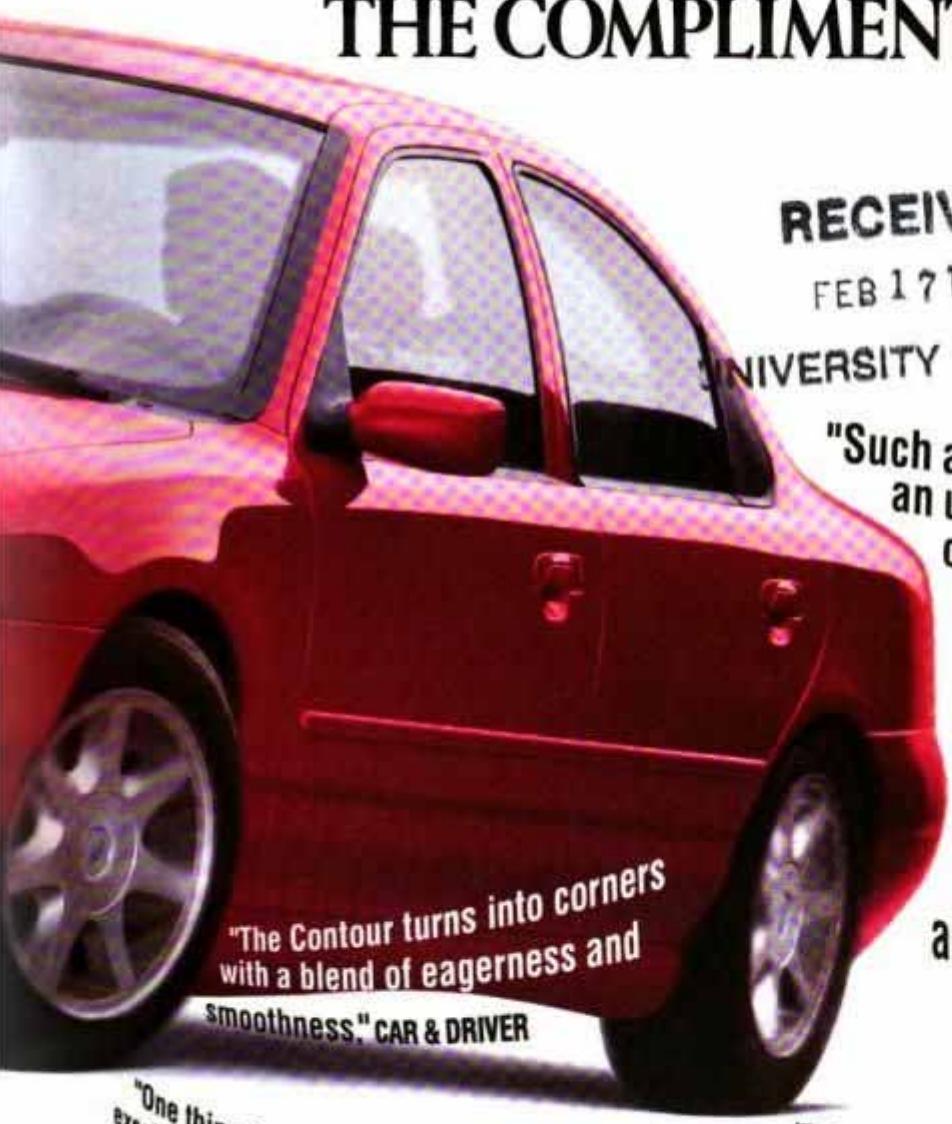
"Ford Contour SE - A stunningly satisfying sedan." CAR & DRIVER

"The engine is one of the most sophisticated you can buy." USA TODAY

"1995 Ford Contour SE - A giant step forward." ROAD & TRACK

"Ford designers strove to include many of those important little touches..." POPULAR MECHANICS

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EDITOR'S NOTES

● It's as old a rivalry as exists anywhere. It ranks right up there with the New York Yankees versus the Boston Red Sox and the Chicago Bears versus the Green Bay Packers. This particular battle has been waged for years on the roads and race circuits of America and the world. Louis Chevrolet versus Henry Ford. C/K 1500 pickup versus F-150 pickup. Lumina versus Taurus. Caprice versus Crown Vic. Cavalier versus Escort. And now for '95, with both automakers fielding totally new entries, the war has reached the sport/utility ranks. Chevrolet invented the compact sport/utility vehicle with the first S-10 Blazer. Ford perfected the genre with the first Explorer. It is Chevrolet Blazer

versus Ford Explorer, and the war continues on page 66. ... In answer to those of you who have been critical of our electronic communications capabilities, and have been questioning whether we really are a leading-edge, high-tech magazine, yes we are. And yes, we are on the Internet. On page 15 of this issue, you'll find complete details on how to contact us via the Internet. Next

month, we'll tell you all about our very cool site on the World Wide Web. ... Come on, let's have a beer. What does that have to do with POPULAR MECHANICS? Not a thing except for the fact that members of the PM staff have been known to quaff down a few beers from time to time. And when it comes to quaffing, it's generally conceded that our Electronics Department editors have the championship locked, absolute, hands-down. So when we wanted a couple of experts to look into the science behind the burgeoning popularity of home brewing, I bypassed our Science Department and went right to the experts, Frank Vizard and Steve



Beer expert Vizard samples his brew.

Booth in Electronics. Their investigative report begins on page 79, and, while home brewing is a lot of fun, the stuff that comes out can vary wildly from not bad to outright swill. As for myself, I think I'll stick to Miller Genuine Draft. ... Think of the possibilities. You never have to go into your office again. Not your physical office, anyway. Instead, you sit at home in front of your computer and enter your virtual office. No wasted time commuting. No wasted time dealing with office minutiae. You sit down and you're instantly at work—instantly productive, conducting meetings, having conferences, writing reports, doing “paper” work. You're in your virtual office. Well, that's the theory. We all know people who can't be productive no matter what the environment. The concept of a virtual office does have appeal, though, when we're sitting in traffic trying to get through the Lincoln Tunnel into Manhattan each morning. On the other hand, the camaraderie of the office is also virtual when you eliminate the physical workplace. Hey, no more water cooler. It's sad, in a way, but this may be the work world of the future for some of us. It's already today's world at such business enterprises as the Chiat/Day advertising agency in Venice, California. You can read more about the future of the workplace beginning on page 62. Meanwhile, I have to go interface with another human being here at the real POPULAR MECHANICS offices. Till next time.


Joe Oldham

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LETTERS

Working On The Railroad



The new wonder engines being produced by General Electric, General Motors and now Morrison Knudsen are designed with fuel economy and low exhaust emissions in mind rather than good train handling and ease of operation. Give me the World War II U-boat-like controls and the good throttle response of old locomotives over the space-age plastic cabs and sluggish performance of the new computerized locomotives any time.

D.E. JONES
SULPHUR SPRINGS, TX

Where did the idea of the "desktop" engineer's control stand come from? Obviously from an "engineer" who sits at a desk all day long and has no idea of how uncomfortable it is sitting behind this thing for hours on end. Even with the new chairs that have lumbar support, it is still a very uncomfortable position to have to be in. You should come on a real trip, 12 hours long, traveling through all the sidings. Ask the boys in the railroads how popular the "desktop" controls really are.

BILL HRYCHUK
SASKATOON,
SASKATCHEWAN

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

As a retired locomotive engineer, I take exception to one word used throughout your story: A railroad engineer does not *drive* a locomotive, he *runs* it.

PAUL R. ALBERT
BALTIMORE, MD

I must admit that today's diesel-electric locomotives sound a heck of a lot better, thanks to the thundering horses under the hood. But, steam still sounds best.

JOHN BATESON
GLENFORD, OH

High Tech?

You're supposed to be a high-tech magazine. So why aren't you guys online?

JEFF NACHBAR
OCEAN TOWNSHIP, NJ

We are now. You can reach us via the Internet at:

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This address is available via major online services such as CompuServe, America Online, Prodigy and other Internet service providers. —Ed.*

Made In America, Part II

I was elated to read the two patriotic letters on "Made In America?" in last month's column. Then I was infuriated to read the Neanderthal editor's response. Sure they hire Americans, but they should be working for American companies.

A.M. HANSEN
BISMARCK, ND

The fact that you pointy-headed editor types fail to understand is this: For every job created by the likes of Honda and Toyota in their auto plants located in the United States, there is one less job at a GM, Ford or Chrysler plant. Why don't you get off your

cushy swivel chairs and visit Flint or Lansing, Michigan. Then you can see where the jobs went that are sending profits home to Japan.

ALMON S. BARTHOLOMEW
NEW SMYRNA BEACH, FL

We the people (10,000-plus) who work at Honda of America would like to thank the editor for setting the record straight.

Honda Accords are tooled, designed and manufactured in America with 80% American-sourced parts—the same as Ford Taurus.

TIM SIEGEL
FORT LORAMIE, OH

There certainly are valid arguments on both sides of the question as to whether the Honda Accord is "as American as apple pie." As you pointed out, few items are 100% American nowadays, particularly items as complex as an

automobile. Additionally, there is no reason we should consider an insistence on "100% American" as desirable. Fair and equal trade between Japan and the United States should result in mixed products in both markets and benefit both nations in the long



run. However, there is no reason for people to lower themselves to personal insults simply because another has a different opinion as to what constitutes an "American" car.

DAVID H. EILERS
GURNEE, IL

Your response reflects an unconscionable arrogance. Neanderthals? You, sir, are a doo-doo head.

LONNIE W. WILLIAMS
MOUNTLAKE TERRACE, WA
(Please turn to page 12)

Reader Project Of The Month

I really enjoyed building the rocking chair featured in the Home & Shop Journal of your September 1993 issue. I've built a lot of furniture, but this was my first chair. It was a great project to work on. However, I ran into two problems that others attempting to build this chair should be aware of. The first problem involved the backrest. I built my chair out of solid birch, and was unable to find 12/4 birch. I had to glue two pieces together. The second problem was with the 7/8-in.-dia. holes in the rockers. That diameter is too large for the 3/4-in.-dia. posts.

DON GABEL
CHINO HILLS, CA



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I do not care to subscribe to a publication that resorts to calling its subscribers names just because they may hold a different point of view than its staff. I'm not sure of your upbringing but I was raised with the thought that name-calling is childish.

PAUL M. WISEMAN
LEESVILLE, LA

I am not going to cancel my subscription because of your glib remark. I'm just going to be a Neanderthal about it and burn every issue until my subscription expires in August.

LAWRENCE "NEANDERTHAL" HOOKER
KENMORE, NY

This is actually a letter of praise, rather than criticism. Your response delighted me. Are there really people who actually think that most of what they consume in the United States fits the strict criteria suggested? I'm not in manufacturing or sales or any field that gives me a view of the global business and economy we now live in. I'm simply an average Joe who decided to go through life with my eyes open, unlike the short-sighted readers responding in those letters. Thank you for not taking those half-thought-out arguments without a proper response. You make your readers proud of you, and proud to call themselves Americans.

BRIAN T. THOMPSON
ELIZABETHTOWN, PA

Thank God the Neanderthals are still being heard from because if the overabundant, current crop of chuckle-headed liberal-minded media weenies would have prevailed 50 years ago, this still-great nation could now be pledging its allegiance to the meatball on the Rising Sun and your license to call them such would be nonexistent.

KEITH GILMORE
STARKVILLE, MS

A patriot, you most certainly are not. Case in point: In your February '95 is-

sue, you report on four new cars—the Hyundai Accent, Toyota T100, Mercedes-Benz C36 and Mitsubishi Montero. My, my! What nice American names. Four out of four are *foreign*. How's that for balanced reporting?

EVERARD G. SCOTT
MARGATE, FL

What new American cars came out that month that we missed? —Ed.

These gentlemen made very valid points about profits flowing to foreign manufacturers. Every responsible purchaser should know and consider the impact of their purchase decisions on the U.S. balance of payments. You

would be working for one of the Big Three if Japan had not flooded our auto dealers with cheap cars. Japan was selling cars for less than it cost to manufacture them just to get a hold on our market.

ROBERT E. SMITH
ARLINGTON, TX

You may have sold out to foreign companies, but there are still many of us who haven't.

GREG
(PM BULLETIN BOARD)

I can't believe your response. You think exactly the way the Japanese have brainwashed Americans into thinking—that their cars are as American as any other. I don't mind

as much if I have to buy a product that has 30% of its parts made in another country if that country has a fair trade policy with the U.S.

G. BANDZUCH
WASHINGTON, PA

Okay, okay, I admit using poor judgment with the Neanderthal comment. I apologize to any reader who was offended by my remark. But hey, people, if you want to keep reliving WWII, that's your decision. As for me and a lot of others here in America, we prefer to deal with the reality of the present-day situation. You can't change the past. So let's restate the facts, as they are. There are no longer any 100%

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it the national bird.

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may consider yourself a patriot, but your failure to acknowledge this point and help educate the American public is irresponsible journalism.

ZANE M. PHILLIPS
HUNTSVILLE, AL

It's a damn shame some of you kids did not spend some of your life in the Pacific fighting. There isn't anything American about Japan—and that means Japanese cars built here by American people. By the way, do they own PM?

DON BARRETT
CASPER, WY

Those thousands of American workers now employed by the Japanese

American cars. All three American car manufacturers own chunks of Japanese car companies. At least some of the content of every American car is Japanese. Many tens of thousands of Americans earn a living for themselves and their families working for Japanese companies. And let's not forget the American labor that goes into the assembly of a Japanese automobile when we're talking about "content." The new labeling law conveniently ignores labor. Today, many Americans prefer Japanese cars, and wasn't freedom of choice one of the reasons World War II was fought? Them's the facts, folks. Live with it. —Ed.

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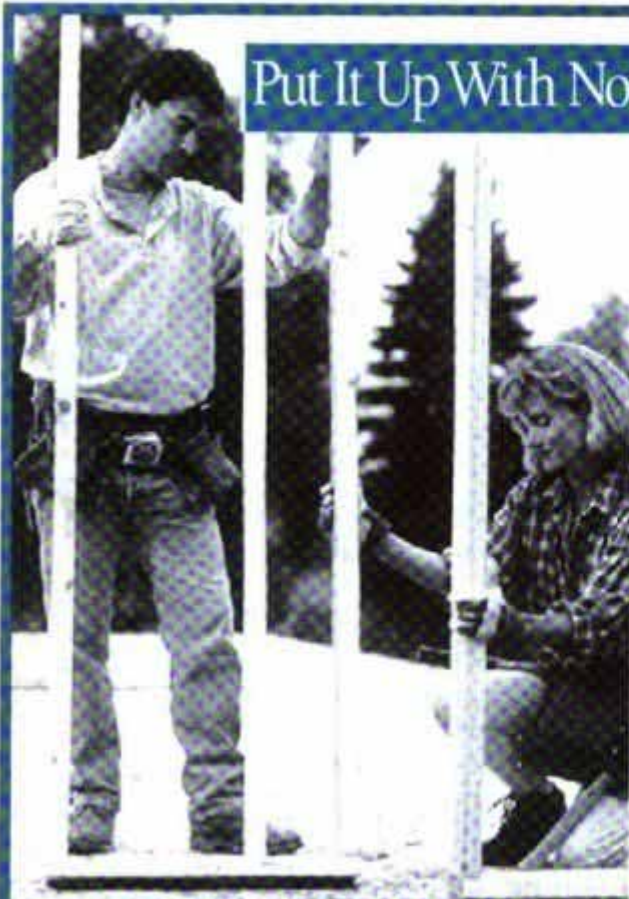
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Your written letters are always welcome. If we think your letter would be interesting to other readers, we might even print it in our Letters column (unless you request that it not be printed). Our editors are listed by department on the masthead printed in the front of the magazine next to Editor's Notes. Our address is: Popular Mechanics, 224 W. 57th St., New York, NY 10019.

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You can call the PM computer any time, 24 hours a day, every day. The number is (212) 582-8369. Once you're online, you can leave messages for specific editors, or direct inquiries and comments to a specific department. The department bulletin board also allows you to share your thoughts with other readers who call in.

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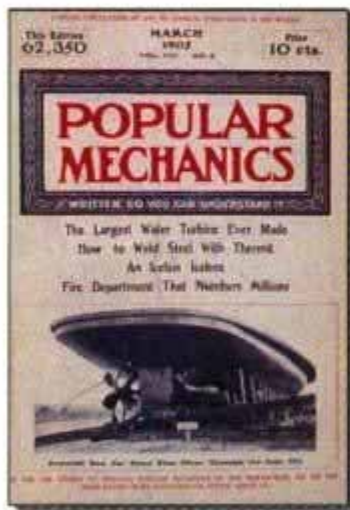
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TIME MACHINE

90 YEARS AGO: MARCH 1905



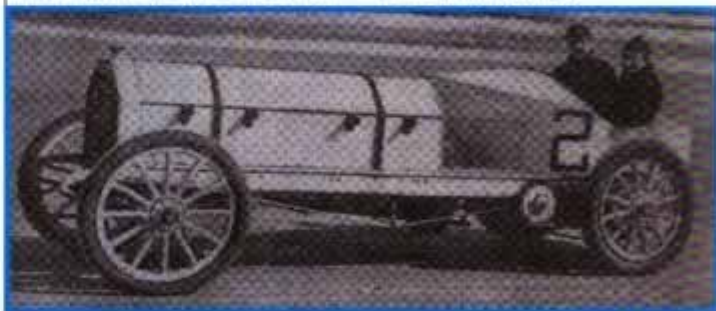
Ferry Queen

Between Detroit and Ontario sliced a perilous gap—the Detroit River, cursed in cold months with strong currents and a stubborn crust of ice. To shuttle railroad cars into Canada, the Michigan Central piled them onto a new ferry, built to tame the river. The 308-ft. *Detroit Of Detroit* churned through the ice with two propellers spun by mammoth steam engines. Even the Motor City's worst winters wouldn't freeze this juggernaut.

Beach Buggy

Daytona was the setting for a new automotive speed record—a breathtaking 105 miles per hour. The *Flying Dutchman II*, a stretch Mercedes powered by two

60-hp engines, raced across the sand with H.L. Bowdin at the wheel. Race fans had much to cheer that day. The *Teakettle*, a freakish 20-hp steam car, whistled by nearly as quickly.



60 YEARS AGO: MARCH 1935

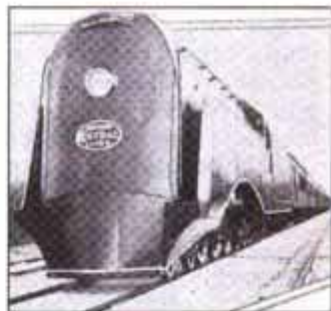


Past Present

In 1910, the *New York World* had published prophecies from such luminaries as Thomas Edison and Hudson Maxim. Did their predictions pan out 25 years later? Edison's vision of airmail—deemed “wild and irresponsible” by his contemporaries—proved on target, although his wireless power transmission fizzled. Maxim, meanwhile, had anticipated cities with rooftop airports.

Aero Dynamos

Steam locomotives would not surrender to diesel-electrics without a fight. Streamlining remained an option, as seen in the New York Central's 90-ft. Mercury locomotive. Meanwhile, the Germans were putting sleek bullet noses on their locomotives.



30 YEARS AGO: MARCH 1965



Water Strider

As hydroplanes regularly stormed across lakes in pursuit of water speed records, we reckoned the 3-point design would suit a \$25 garage-corner project for PM readers. Just over 8 ft. long, the Saucy Shingle could fit inside a station wagon, or its 74-pound hull could ride atop a compact car. The one-man plywood skimmer was blueprinted to tiptoe across a lake at 33 mph.

Green Days

The pleasure of a luxurious green lawn without the pain of weeding and mowing? Back in the '60s, the answer lay in artificial turf, much to the dismay of gardening purists. You could even buy matching green gravel—concrete aggregate treated with dye. In Florida and

Arizona, retirement-home communities seized on this trend, but local tennis courts were also turning to turf. The balls bounced truer, and sure footing enabled fast, sharp turns. **PM**



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NRI's breakthrough training gives you everything you need to build your own computer-controlled music studio, master MIDI technology, then start a new career or business of your own.

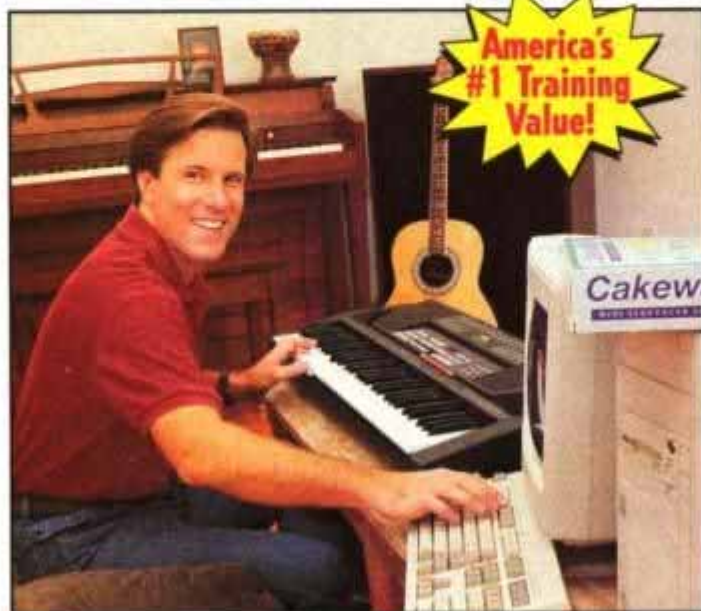
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- High-end Kawai X50-D General MIDI synthesizer with touch-sensitive keyboard, digital effects with reverb and chorus built-in, one finger ad-lib, mixing, and more
- Sound Blaster-compatible sound card with built-in MIDI interface and speakers



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See other side for highlights of how NRI's hands-on training can put you in control of today's electronic music technology

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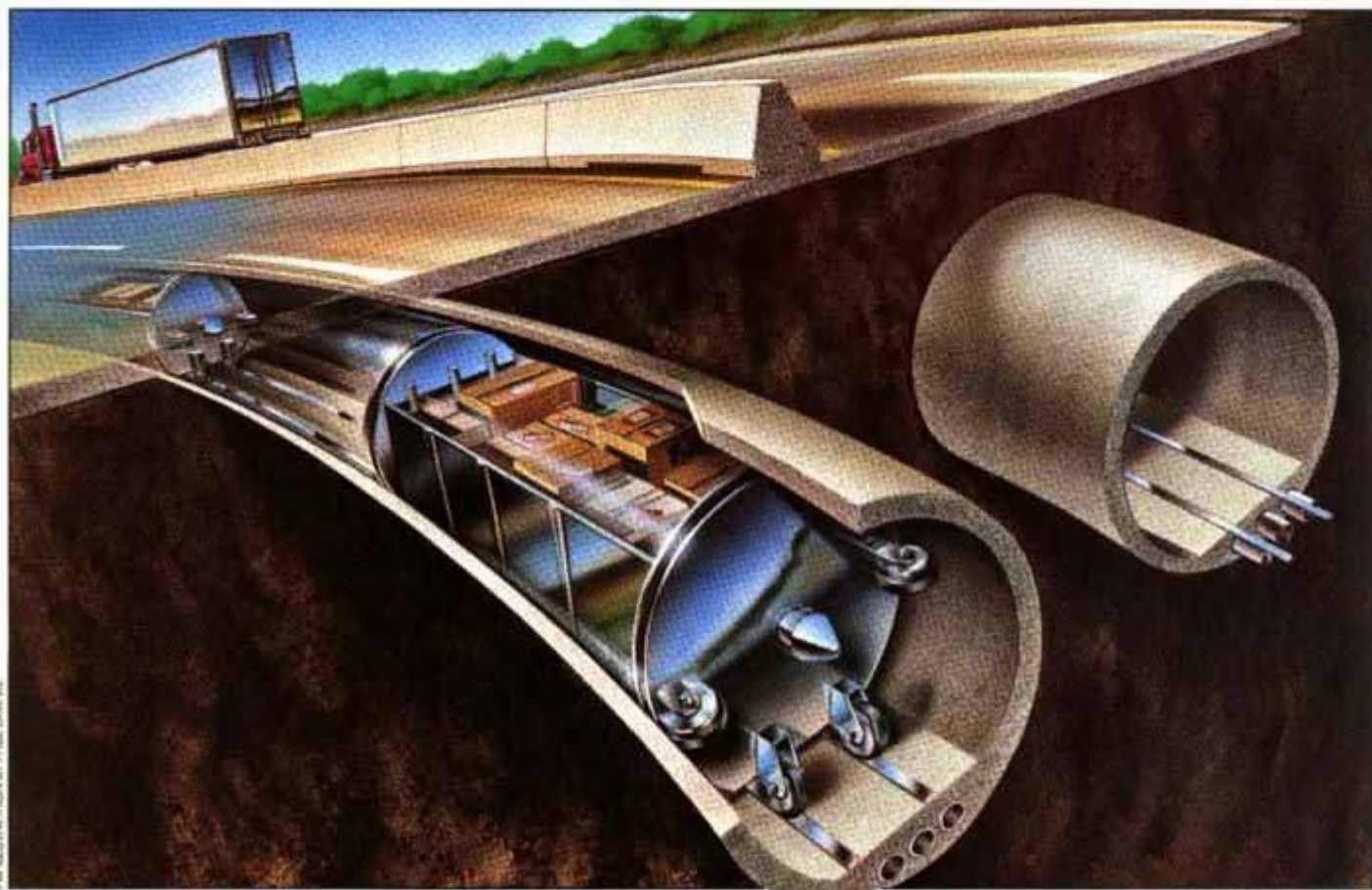
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TECH UPDATE

News Of Tomorrow's Technology Today



Underground Freight Could Shoot The Tube

CAMBRIDGE, MA—Unmanned freight trains that roll through subterranean viaducts? The idea dates back to the origin of the subway system. After all, pneumatic mail tunnels once snaked beneath city streets. And even today, in Japan and Russia, short pipelines shuttle raw materials between industrial facilities. But so far, widespread use of the freight tube has been little more than a pipe dream.

Now, Department of Transportation research engineers are taking a fresh look at tubular cargo. What prompts the renewed interest is the realization that road construction cannot keep up with projected increases in traffic, which threaten to paralyze metropolitan areas after the turn of the century. Tube freight systems, even if restricted to local networks, could thin out congestion by hauling trucks off the roads. Isolated from road traffic, the underground passages promise unrivaled safety.

A contemporary version of the pneumatic pipeline would feature 6-ft.-dia. capsules propelled by linear induction motors. Called Subtrans, and proposed by Ampower of North Bergen, New Jersey, this electric system would operate at 60 mph under computer control. The capsules wouldn't chain together like railroad cars. Instead, a slim clearance between each vehicle's end plates and the tube's wall would create an air buffer between moving capsules. A shipper could thus fill a carriage and dispatch it individually, without delay.

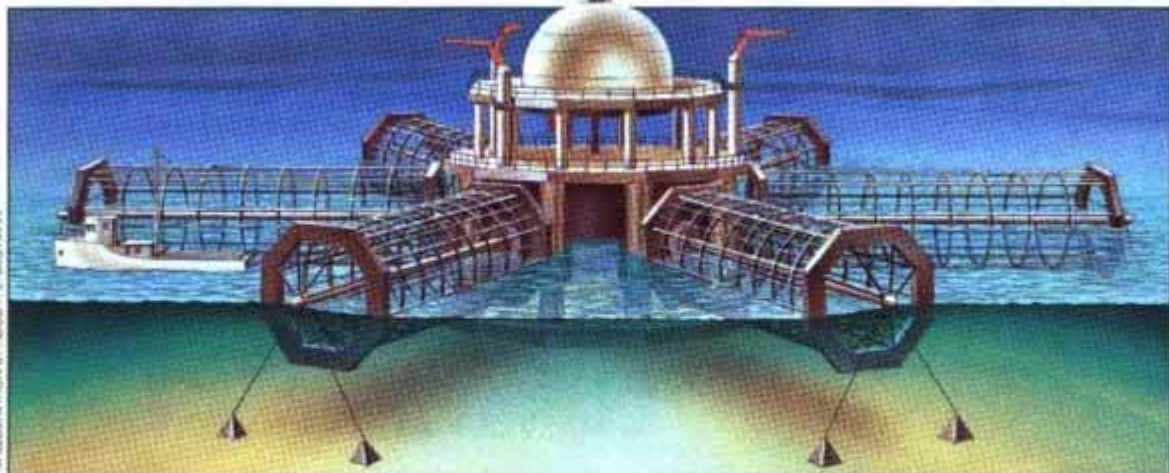
Driven by linear motors, tube freight capsules could whistle along right-of-ways beneath Interstate highways.

Although Subtrans has not progressed beyond the drawing board, researchers are trying to get a fix on the capital cost of a modern tube system. Tunneling, after all, is expensive. One pivotal question: Should the capsules be big enough to handle intermodal containers? While that would swell the size—and price tag—of the tunnels, it would also make a freight tube compatible with truck, rail and sea shipping.

Highlights This Month

- **Rancho Di Mare**—Huge offshore fish-farming systems.
- **Fire Walker**—Tracked vehicle to beat blazes to death.
- **Driving Machine**—Robot gets behind the wheel.
- **Straight Up**—Ride offers 4-g payoff in Las Vegas.
- **Night Sights**—Infrared scopes for footsoldiers' rifles.
- **French Flattop**—Europe's nuclear-powered carrier.
- **Dream Reaper**—Revolutionary high-speed harvester.

Editor/Writer: Gregory T. Pope
Reporters: Philip Chen, Mike Filion, Scott Gourley,
Paul Ruben, Rick Schrader, Herb Shuldiner



Sea Trek offshore platform would raise a million Gulf fish in 150 to 365 days.

Farming System, six 160-ft. barrel cages protrude from a concrete-legged platform. Computer-controlled feeding pipes deliver nourishment to growing fish, while an oxygen-diffusion system keeps the water healthful. At har-

Offshore Farms To Reap Ocean's Bounty

GULF BREEZE, FL—Human demand for seafood could jump 70% by 2025, but don't tell that to the fish. Their numbers are barely keeping pace with the high-volume trawling techniques now practiced. Maricul-

ture, or fish farming, may prove a viable—and necessary—alternative.

To that end, Sea Pride Industries is proposing a huge offshore facility designed to raise more than a million fish per year. On the Sea Trek Ocean

vest time, water-vacuum pipes transfer the fish to waiting boats.

Equipped with a ballast system, each cage can be raised and lowered to maintain an ideal water depth—or duck beneath threatening weather.

Lasers On Stun



LOS ALAMOS, NM—Laser weaponry raises concern among humanitarians, and for good reason: Not only can the beams knock out electronic optics, they can also cause permanent blindness. But Los Alamos National Laboratories is developing a low-powered laser rifle geared to dazzle, not damage vision.

The prototype weapon emits a continuous-wave visible-light beam that has the same effect on an aggressor as a car's high beams or a flash grenade. The light would also cripple sensors such as television cameras or image-intensifying night-vision optics, while an infrared version could knock out a missile's heatseeker.

Dazzle laser could keep fighter pilot from finding targets, but wouldn't fry his retinas.

The light would also cripple sensors such as television cameras or image-intensifying night-vision optics, while an infrared version could knock out a missile's heatseeker.

Robotic Biotechnology

MELBOURN, ENGLAND—Tomorrow's miracle drugs are as likely to emerge from small biotechnology laboratories as they are from great pharmaceutical factories. But harvesting biotech products from genetically engineered cells remains a labor-intensive process.

Automation is on its way, however. One example: Cellmate, a robotic cell-culture system developed by the Technology Partnership Ltd. Intricate, tedious tasks—normally the lot of a lab technician—take place inside Cellmate's sterile environment. That minimizes the odds of contamination. The computer-controlled system can also handle 10 times the workload of a human.



Cellmate brings large-scale manufacturing techniques to biotechnology.

C-17 Goes Operational

CHARLESTON AFB, SC—With little fanfare, the Air Force now has an operational squadron of C-17 Globemasters in the new 437th Airlift Wing.

The short-takeoff transport jet, of which 14 now exist, has already flown an oversized mobile command post to Saudi Arabia and delivered other equipment into Panama. Early production models have had their wings strengthened. Four C-17s also carry defensive avionics, featuring missile sensors and flare dispensers.

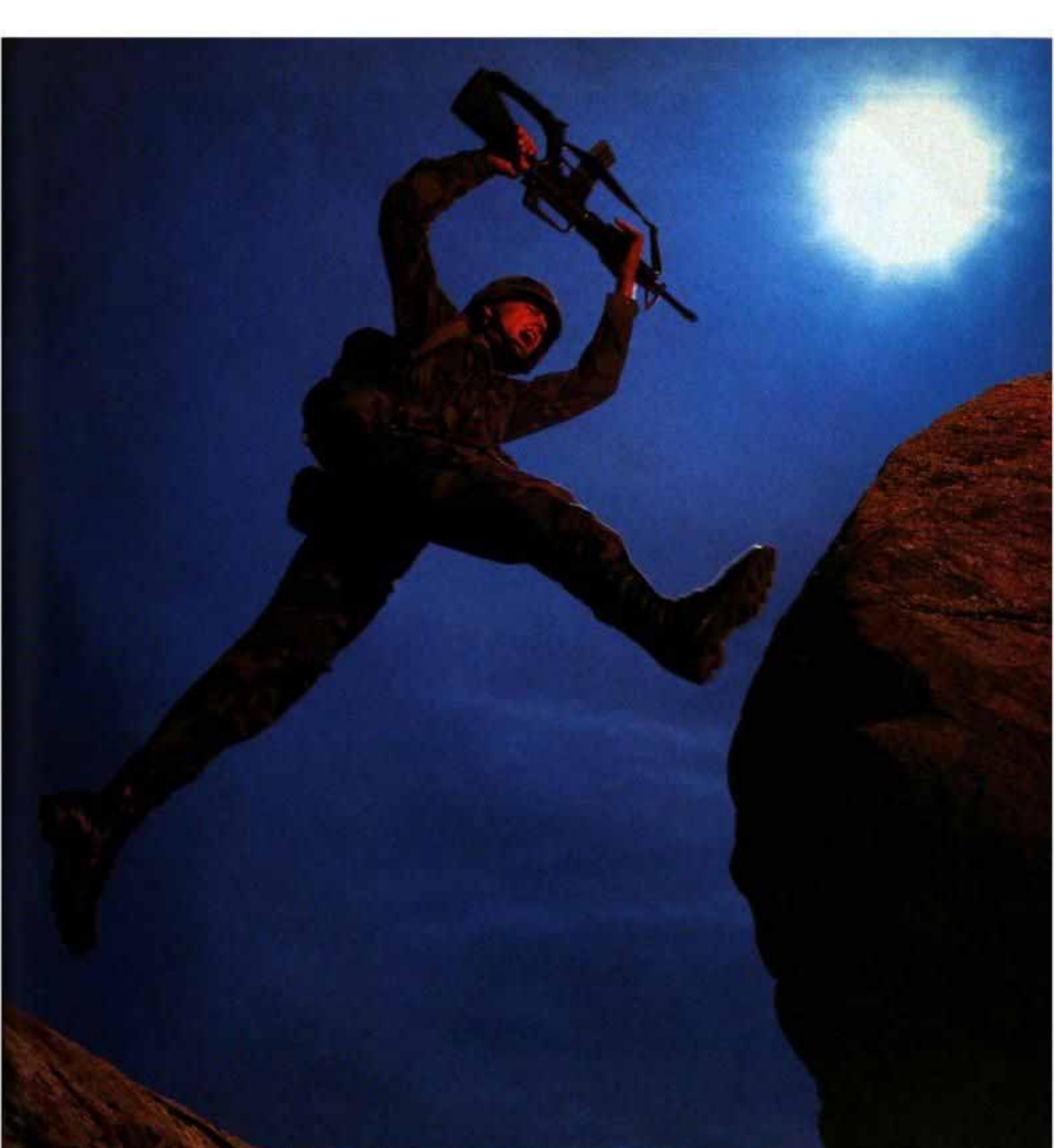


C-17 launches flares designed to camouflage plane from heatseeking missiles.

During the last year of flight testing, the C-17 has set 20 payload-to-altitude records and landed 80 tons of cargo on a short runway, coming to a halt in less than 2100 ft.—roughly

the ground roll of a Cessna 172.

Program officials expect a decision this November on whether more than 40 C-17s will be allowed to join the Air Mobility Command.

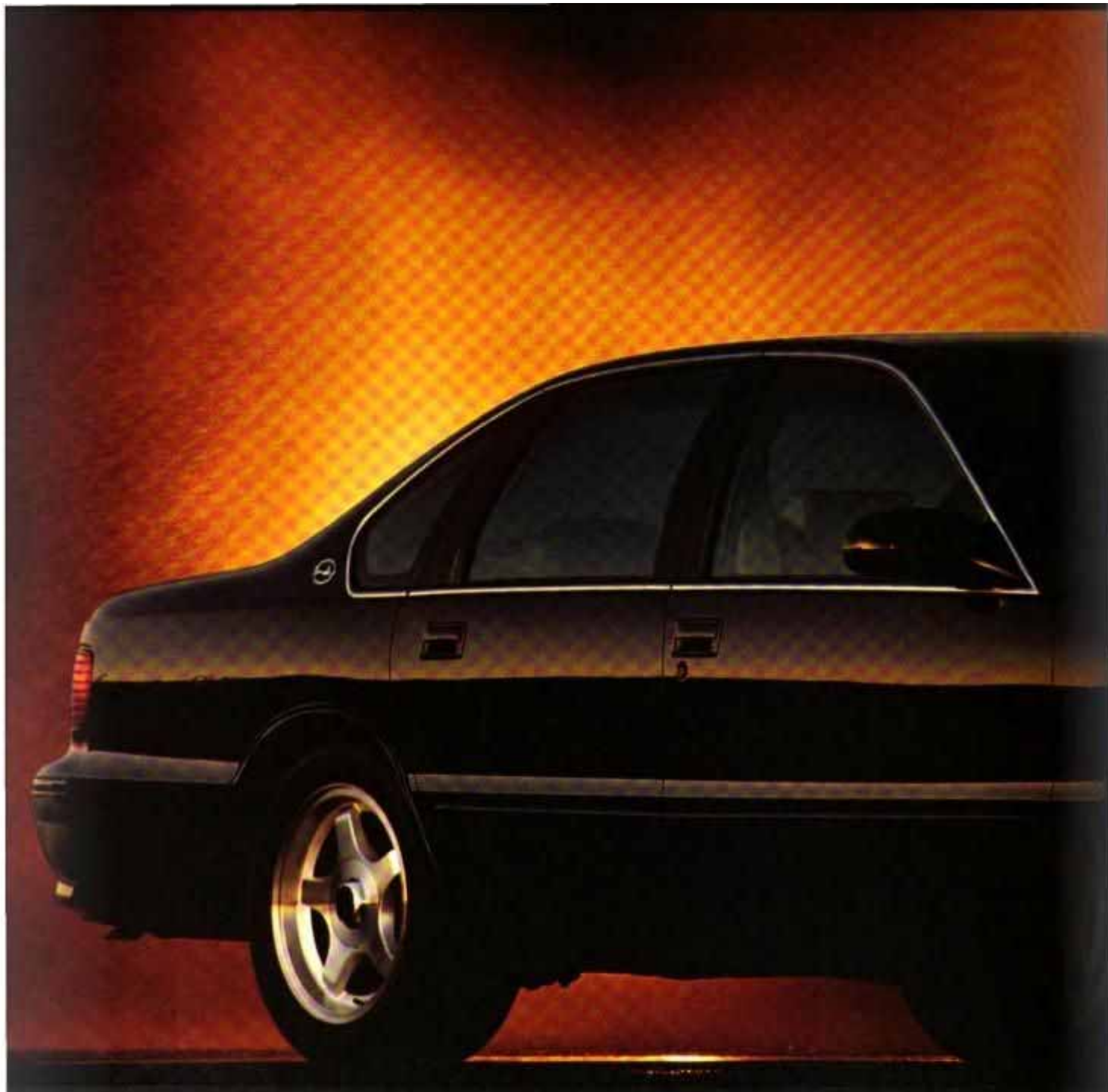


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Firecat To Thrash Infernos

SAN DIEGO, CA—Water. Foam. Fire-retardant mud. A wildfire can quickly exhaust these measures. But another way to kill a fire is to disrupt the combustion process mechanically. A new company called FAV Inc. is proposing a vehicle to do just that.

Dubbed Firecat, the machine is a highly modified excavator equipped with a unique fire-destroying mechanism. At the end of the excavator boom stretches a 20-ft. T-bar. Along the bar lie the fire-destroying mechanisms: flailing chains, blades or brooms, depending on blaze conditions. These devices pulverize burning material and cast it back into the hot side of the



Firecat shreds burning debris, halting spread of flames by disrupting combustion.

fire line, creating a firebreak as the Firecat advances.

Although the vehicle's cabin will lie several dozen feet from the flames, it's nevertheless armored with fireproofing material borrowed from the nuclear-power industry. The operator

will watch a radar display that provides a 3D view of the surrounding terrain, while an infrared camera peers through a periscope to spy hot spots.

FAV has field-tested the slashing mechanisms and is negotiating with equipment suppliers.

PH. ILLUSTRATION BY ED VAUGHAN

Tracks With A Light Touch

IDAHO FALLS, ID—What makes a new transit system so expensive? The tracks must be robust enough to handle heavy vehicles, and that adds millions of dollars per mile to the price tag, even for so-called light rail systems.

By contrast, the Idaho National Engineering Laboratory (INEL) is championing "very light rail" in its CyberTran system. CyberTran's solution is simple: run more cars with fewer passengers per car—and eliminate the locomotive. Traveling individually under computer control, each vehicle

would weigh only 10,000 pounds and zip from station to station on its own power. Two 75-kilowatt electric motors, drinking juice from a third rail, would whisk the car around. Between six and 32 passengers would ride inside.

Two CyberTran prototypes have undergone tests at 55 mph, while computer simulations suggest that a fast intercity version could sustain 160-mph speeds. The guideway could fit within a highway's 8-ft. median strip.



INEL Engineers figure the track to support CyberTran cars would cost \$2 million per mile, not the \$10 million to \$30 million per mile that European and Japanese elevated-train systems require.

CyberTran vehicles would carry fewer passengers and hence exert lighter loads on elevated track.

Robot In The Driver's Seat



TC-6000 imitates driving patterns of humans more adroitly than automated test cars.

ADDISON, IL—Put this lightweight robot behind the wheel, and it will test drive your car for you.

Called the TC-6000, the machine is made by Ono Sokki Co. Engineers there recorded driving patterns of various humans from truckers to hot rodders, then loaded them into the robot's memory. The TC-6000 duplicates driving motions through two sets of actuators, one for the gearshift and one for the pedals.

Particularly useful for long-duration emissions tests, the robot can meet exacting and repetitive performance requirements that would wear out drivers. It typically drives on a dynamometer in a test cell, however, not on a test track.

Although several Japanese carmakers have bought TC-6000s, so far none of the robots have ventured to Detroit.

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assemble the wheels, one spoke at a time. And, when your model is completed, you'll proudly display a museum quality replica you've built yourself!

Parts screw together with tiny nuts and bolts supplied in the kit. Body panels are pre-colored, precision molded plastic, so no painting is necessary. Your finished model is loaded with operational features. The engine is complete with working pistons and crankshaft. Doors open and close, crank operated windows go up and down, and the handbrake really works. You can even turn on the headlights!

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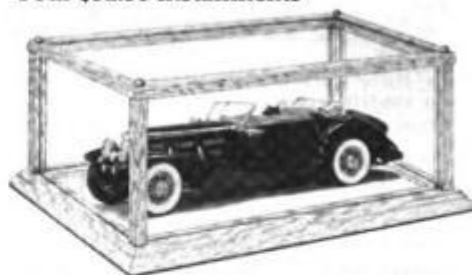
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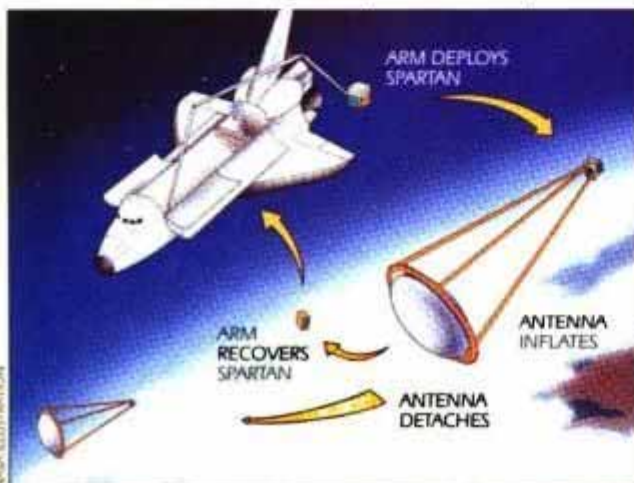
Special offer is valid through July 31, 1995.

Blow-Up Space Dish

PASADENA, CA—NASA is breathing some fresh air into an old idea: inflatable antennas in space. Next year, in fact, the shuttle will toss one overboard.

The experiment will begin when the shuttle's arm releases a mini-satellite known as a Spartan. Inside, tucked into only 72 cu. ft., lies the antenna. Once the Spartan drifts to a safe distance, nitrogen will whoosh into three 92-ft. struts and a 50-ft.-dia. ring, support structures for the antenna itself. Then the 46-ft.-dia. antenna, made of aluminized Mylar, will inflate.

Shuttle and antenna will complete an orbit together, as cameras record how well its parabolic shape holds up under different solar heating loads. Finally, the antenna will detach and burn up in the atmosphere.



Inflatable experiment will demonstrate technology for cheap, lightweight, easy-to-store space antennas.

Blast Off Over Vegas

LAS VEGAS, NV—Zero to 70 in 3 seconds. Sound sensational? Now imagine it going straight up.

That's exactly what Space Shot, an unprecedented new amusement ride, delivers. To top it off, the ride will begin 909 ft. in the air, at the summit of Las Vegas's Stratosphere Tower.

With a blast of compressed air, 16 riders will rocket skyward, shooting up a 180-ft. tower as they experience four times their normal body weight. At 140 ft., they become weightless and then actually feel negative gravity as they are pushed down by their shoulder restraints. They pogo-stick to an air-cushioned stop within 27 seconds.

S&S Sports Power, based in Logan, Utah, promises to



Space Shot, shown above as 8-place prototype, will crown Stratosphere Tower in Las Vegas (left).



build larger-capacity and taller versions of Space Shot, which is scheduled to open this November. Engineers at the company have designed the ride to loom as high as 320 ft.

Twin-Engine Sky Walker

MANASSAS, VA—Aurora Flight Sciences is now poised to begin work on Theseus, a twin-engine follow-on to its Perseus unmanned stratospheric aircraft (see Tech Update, page 16, March '93).

Theseus will feature much of Perseus's technology: the same airfoil design, engine core, ground station, software and so on. The 119-ft.-wingspan drone will be able to lift three of the payloads sized for Perseus, however. It will also soar on an advanced supercharged powerplant. If all goes according to plan, the first Theseus will fly in June 1996.



All has not gone to plan with the three Perseus drones. Just before this past Thanksgiving, one crashed after a gyro conked out. And mechanical problems have kept the Perseus from venturing above 50,000 ft. Both Perseus and Theseus are blue-printed for 80,000-ft.-plus altitudes.

Theseus will carry three Perseus-class payloads 16 miles above Earth.

Infrared Rifle Sight

EL SEGUNDO, CA—Soldiers have long relied on image-intensifying optics for night-vision rifle sights, but now they may switch to infrared. Hughes has developed a thermal weapon sight that's light enough to clip to the barrel of an M16. Unlike currently fielded night-vision sights, the unit isn't blinded by bright lights and can see through smoke and rain.

The AN/PAS-13 uses a mercury-cadmium-telluride detector chip, which must stay refrigerated to be effective (see "Night Hawks," page 78, Nov. '94). But a thermoelectric cooler the size of a quarter reduces the sight's weight to 4.2 pounds. It can run for 12 hours on a single battery charge. To save power, the unit activates automatically only when the soldier peers into the eyepiece.

Now undergoing tests at Fort Greeley, Kentucky, and in Panama, the sight awaits a production decision.



Cooled thermoelectrically, AN/PAS-13 thermal weapon sight brings infrared vision to the footsoldier.

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Bill Smith

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- TV/Satellite Dish Service and Repair, Dept. 31050
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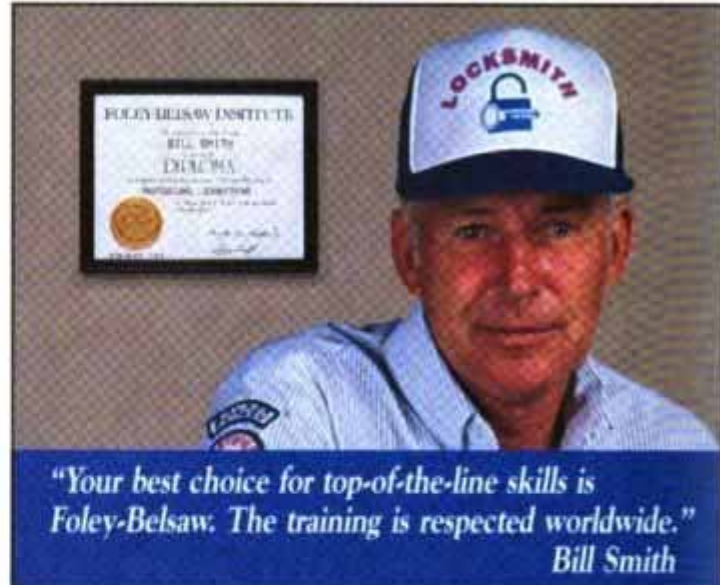
1 Locksmithing - As crime rates rise and millions of Americans seek more protection, locksmiths are now enjoying more business and higher profits than ever before. Your professional locksmith training includes a burglar and fire alarm course to complete your education as a highly paid security specialist.

2 Small Engine Service & Repair - Today, there are over 65 million small engines in America, with **1,000,000 more purchased each month**. And most owners don't have the skills to perform even simple repair jobs on them. This course could be your golden career opportunity. With the skills you gain, you can earn as much as \$49.94 for a simple tune-up that takes about an hour of your time.

3 Professional Saw and Tool Sharpening - Imagine earning \$18-\$30 an hour — and 90 cents out of every dollar you earn is cash profit! All the work space you need is a corner of your garage and you're in charge. Foley-Belsaw provides everything you need to master the craft, including your own professional Sharp-All machine.

4 VCR Cleaning, Maintenance & Repair - Right now, more than 77 million VCRs are in use and a thousand more are purchased every month. VCR repair is clearly a great career choice for the 1990s! And you need no prior experience for success. David K. Knowton, New York, tells us, "I thought you

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"Your best choice for top-of-the-line skills is Foley-Belsaw. The training is respected worldwide."
Bill Smith

had to be a 'wiz' in electronics to succeed in VCR repair. Now I know nothing is further from the truth."

5 Computer Repair, Maintenance, Upgrade - Most businesses are "on-line." And so are a growing number of homes — personal computers are practically household appliances! The need for skilled computer installation, maintenance, upgrades and repair is tremendous. Foley-Belsaw offers the training you need to cash in on this growth.

6 TV/Satellite Dish Service and Repair - You see them popping up in yards all over town. The market for satellite dishes will continue to grow to satisfy the demand for variety in entertainment. Get the skills you'll need to profit.

7 Professional Gunsmithing - Skilled gunsmiths - when you can find one - charge up to \$50 per hour for simple repairs. That's money you can put in your pocket with the training you'll get from Foley-Belsaw.

8 Professional Woodworking - You'll start your course with the simplest of projects, but soon will be crafting mortise and tenon joints, creating heirloom-quality pieces worth thousands of net-profit dollars. The course is also ideal for the do-it-yourselfer. As J. B. of Shawnee Mission, Kansas, writes, "I saved well over \$2,000 in kitchen remodeling and \$1,000 on a deck."

9 Upholstery - Furniture prices have increased yet quality has noticeably decreased. So many individuals and businesses now turn to skilled upholsterers to restyle furniture instead of discarding it. With the Foley-Belsaw course, you'll become an upholstery professional, using your knowledge for a full-time business, part-time career, or a satisfying, money-saving hobby.

10 Computer Programming - It's a fact: Computers are more widespread than ever before. And programmers with the right skills command top dollar for their work. Learn the languages most in demand — Q Basic, C, C+ and C++ — and watch your income soar.



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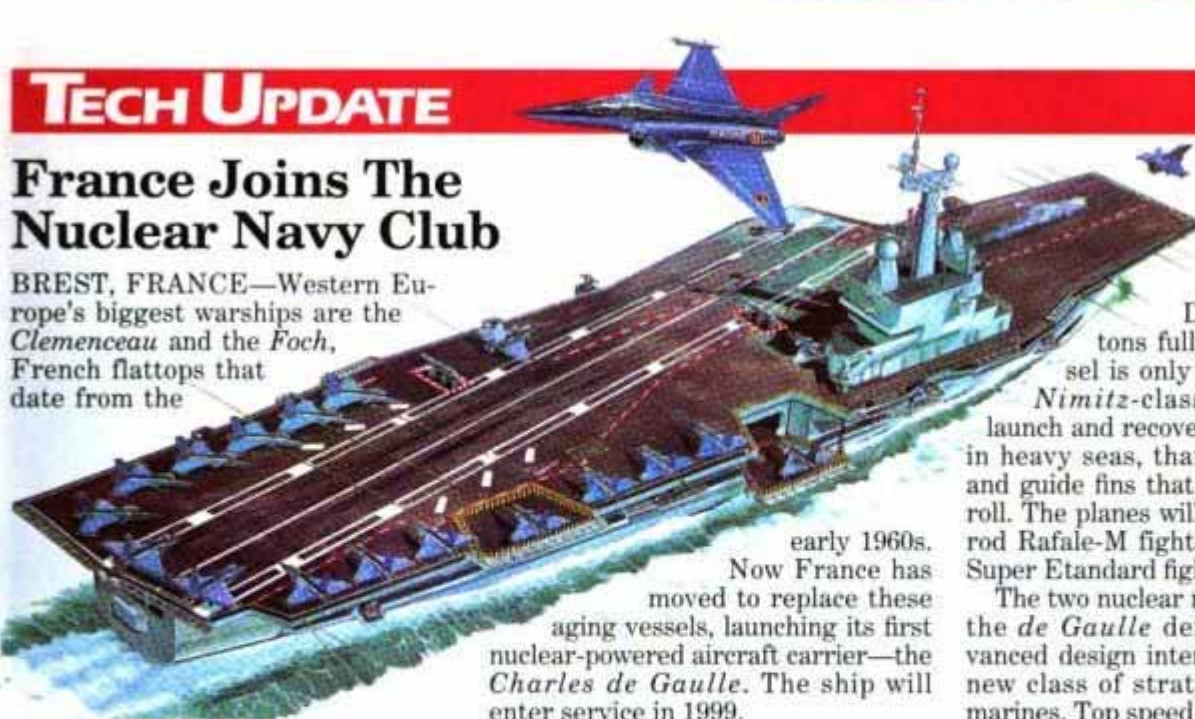
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France Joins The Nuclear Navy Club

BREST, FRANCE—Western Europe's biggest warships are the *Clemenceau* and the *Foch*, French flattops that date from the



Charles de Gaulle will project power with naval versions of the Rafale.

Displacing 39,600 tons fully loaded, the vessel is only half the size of a *Nimitz*-class carrier. It will launch and recover up to 40 aircraft in heavy seas, thanks to stabilizers and guide fins that control pitch and roll. The planes will include both hot-rod Rafale-M fighters and upgraded Super Etandard fighter-bombers.

early 1960s. Now France has moved to replace these aging vessels, launching its first nuclear-powered aircraft carrier—the *Charles de Gaulle*. The ship will enter service in 1999.

The two nuclear reactors that drive the *de Gaulle* derive from an advanced design intended for France's new class of strategic-missile submarines. Top speed is 27 knots.

Rescue Me With GPS Beacon

LONDON, ENGLAND—Signature Industries has located yet another use for the Global Positioning System (GPS)—a rescue beacon that tells search teams exactly where to look. Although covert military units carry similar devices, this is the first intended for the rest of us.

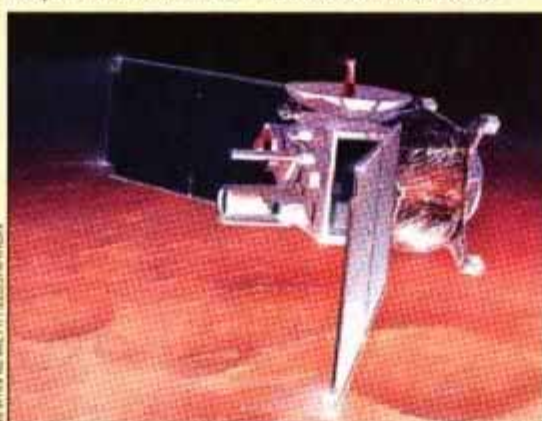
The size of a transistor radio, the device broadcasts a data stream that includes position information and a user-identification code. The transmitter operates over a range of at least 50 miles and can work with a variety of rescue homing systems. Waterproof, the beacon can bundle into a life jacket, survival pack or inflatable raft.



GPS rescue beacon transmits latitude, longitude and 6-digit identification code.

Return To The Red Planet

PASADENA, CA—Yes, the failure of *Mars Observer* (see Tech Update, page 18, May '94) threw America's space program for a loop. But the Martian mission still beckons.



Mars Global Surveyor will carry out most of the mission of the ill-fated *Mars Observer*.

NASA will try again with *Mars Global Surveyor*, a \$200-million spacecraft due for launch in November 1996.

Designed by Martin Marietta, *Surveyor* will sport the same instruments as *Observer*, including the most sophisticated camera ever flown on a civilian spacecraft. The big difference will be a cheaper ride to Mars. The new spacecraft will go up on a Delta rocket, not an expensive Titan III.

Because the less powerful Delta wasn't designed for planetary missions, timing will be critical. Its launch window for the *Surveyor* shot will last just one second. Fortunately, Deltas have proven virtually foolproof. Very few have experienced delays beyond a second.

Surveyor will use aerobraking to lock into a circular orbit around Mars, kicking off the survey in January 1998.

In Search Of A Crashproof Car

OAK RIDGE, TN—An intelligent cruise-control system could take over steering and braking at the last second to dodge a collision. That's the goal of a collaboration between Oak Ridge National Laboratories and Scientific Atlanta. Their Data-Acquisition System for Crash-Avoidance Research (DASCAR) will begin tests this year.

DASCAR will record the behavior of drivers and vehicles under varying conditions—weather, traffic and even the effects of drugs and alcohol. Cars will carry four thumb-size video cameras, a suite of accelerometers and a computer. These will determine a car's lateral position in its lane and distances from other cars. Meanwhile, drivers will wear heart-rate and brain-wave monitors. Recorders

will also note such activity as tuning the radio or flicking on windshield wipers.

DASCAR-equipped cars will first ply a test track in East Liberty, Ohio, before hitting the open road.



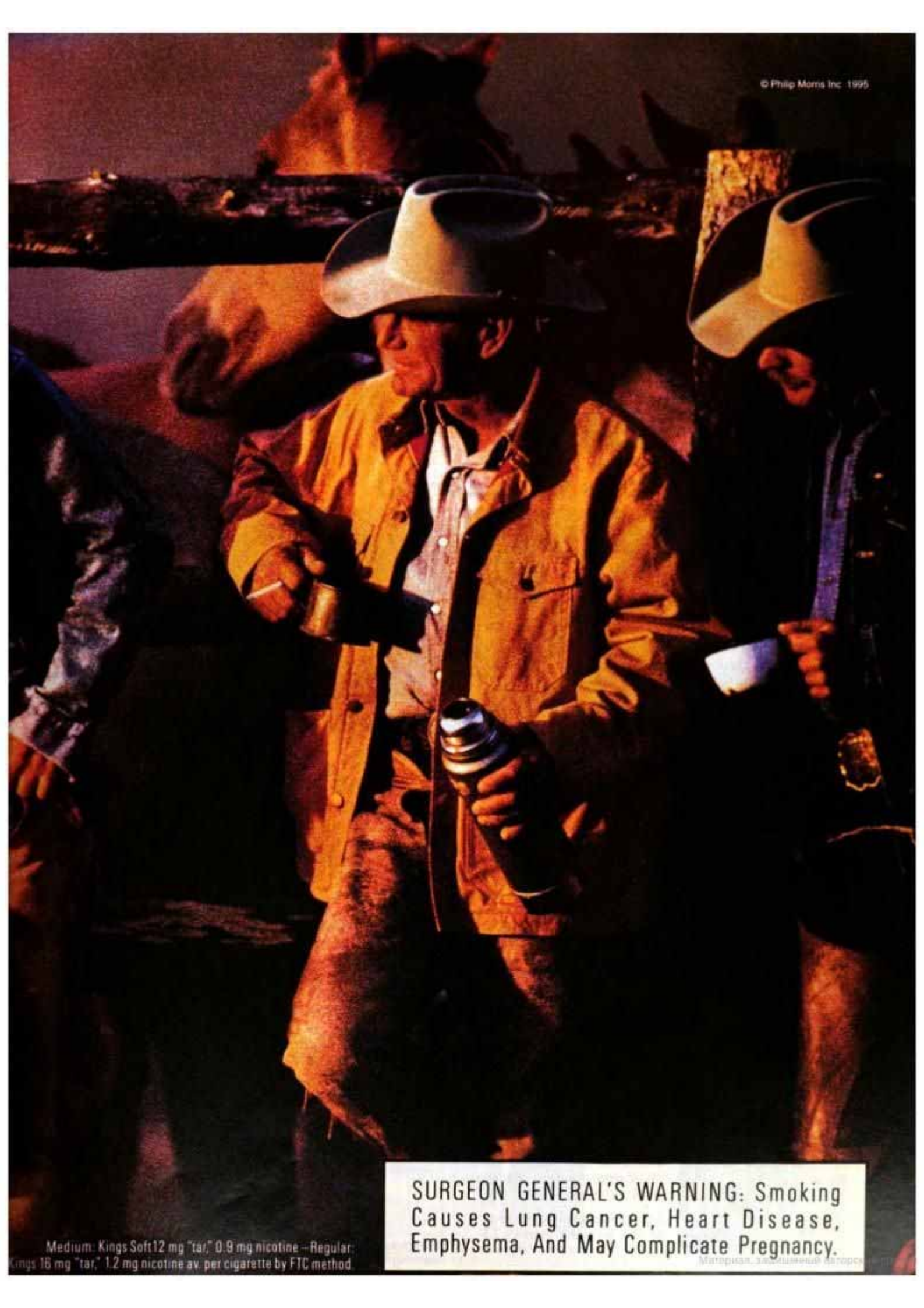
DASCAR will try to prove that a car's position and distance from other cars can be recorded, for future crash-avoidance systems.



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Материята, защитавашава на хората

Harvesting The Future

WINFIELD, KS—Combine harvesters haven't reaped a cornucopia of new technology lately. But two Kansas cousins may change all that with the Bi-Rotor, a prototype harvester built last year with the help of Gordon-Piatt Manufacturing.

The machine has half the moving parts of a conventional thresher. But its key feature is its unique high-speed threshing chamber, where grain and chaff are separated.

Typical combines use a rasp-studded rotor that threshes harvested wheat or corn against a curved grate, called a concave. In the Bi-Rotor, the concave wraps around the rotor. Both spin, at different speeds. Because the cylindrical



Bi-Rotor's compact thresher means the grain tank can be twice as big as normal.

concave provides a 360° separating surface, the threshing area can be half the size of that in a conventional thresher.

This, in turn, provides room for a double-size grain tank able to carry 400 bushels.

American Tankers Work Abroad

NEWPORT NEWS, VA—American shipyards hadn't sold a vessel to a foreign owner for 37 years until last October, when Newport News Shipbuilding rang up an overseas sale. It wasn't a warship, however, but a pair of oil tankers destined for the Greek shipowner Eletson Corp.

The *Despotico* and *Agathonissos* are the first in the shipyard's



Double Eagle tanker carries up to 56,000 cu. meters of oil.

new line of Double Eagle tankers. To swaddle the cargo and prolong the ship's life span, each of the 600-ft. vessels features a double hull made of mild steel, rather than high-tensile steel. Another safety feature is the centerline bulkhead that contributes to stability in rough waters.

Unusually, the ships were built in sections, inside, on dry ground, at Newport News's Module Outfitting Facility.

Hole To Nowhere



WINDISCHESCHENBACH, GERMANY—The Germans' ambitious plunge into our planet's crust (see "Journey To The Center Of The Earth," page 27, May '91) has come to a screeching halt. Geologists had hoped to bore a 6.25-mile hole in the ground. But last October, from a depth of 5.6 miles, they had to pull up their hydraulically steered drill for good.

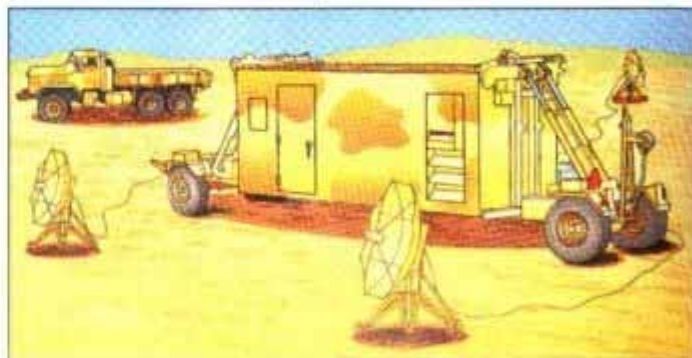
That far beneath the surface, rock no longer cracks under pressure—it flows. The liquid rock simply filled up the bottom of the hole every time drillers yanked up their hardware to replace a worn drill bit. Researchers thought they would hit this ductile zone lower down, where temperatures are even higher.

Drill rig marks 5.6-mile hole in Bavaria, second to Russia's 7.5-mile shaft in the Kola Peninsula.

Instant Scud Warning

COLORADO SPRINGS, CO—When Iraq's Scud missiles rained down during Desert Storm, area commanders had little time to react. That's because alerts from the Defense Support Program early-warning satellites went through stateside computers before reaching forces in the Persian Gulf. The relay ate up several precious minutes.

The Joint Tactical Air-to-Ground Station (JTAGS) will shave that time to seconds. Developed by Aerojet, the unit will downlink data directly through stereo satellite dishes. Inside, computers will predict missile-impact zones and times of flight. JTAGS will track incoming missiles and cue defenses such as Patriot batteries. Prototypes of the new ground station are now in place in the Persian Gulf.



Army/Navy JTAGS mobile unit will take data directly from early-warning satellites without intermediary relays.

Army's New Bunker-Buster



MESA, AZ—During Desert Storm, the Army found itself lacking a handheld rocket launcher designed to breach fortifications. Soldiers were forced to borrow the Shoulder-launched Multipurpose Assault Weapon (SMAW) from the Marine Corps.

Now the 82nd Airborne Division will have its own bunker-defeat munition. Instead of lugging the reusable SMAW's 28-pound weight, paratroopers will carry a one-shot throwaway weighing only



16 pounds. The disposable launcher comes from Talley Defense Systems.

The weapon retains the high-explosive dual-purpose rocket of the



Bunker-defeat munition combines discriminating fuse with throwaway launcher.

SMAW. On its warhead, a "smart" fuse senses the resistance of the target. The munition can either detonate early if it detects hard walls or go off later after penetrating soft sandbags or earthen fortifications.

Walls Trap The Sun

GOLDEN, CO—Sunlight beating down on metal has given researchers an idea for an efficient new way to heat a building. Conservational Engineering of Downsview, Ontario, and the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) are collaborating on the technology.



Fan draws air traveling through tiny perforations in cladding as metal captures heat from sunlight.

The transpired solar collector consists of dark metal cladding mounted several inches from a south-facing wall or roof. A fan pulls fresh air through perforations in the metal as it bakes in the sun. The heated air then flows into the building's ventilation system. Since it lacks glazing, the system loses no energy to reflections.

In The Wake Of A Giant

HAMPTON, VA—Jumbo jets leave turbulent trails. Swirling pockets of air called wake vortices spiral off the wingtips of airliners. Air traffic controllers maintain healthy distances between planes to avoid sending them through these maelstroms.

Now the Federal Aviation Administration and NASA's Langley Re-



NASA PHOTO

search Center are examining how atmospheric conditions dissipate wake vortices. At Memphis International Airport, NASA has been flying a sensor-studded OV-10A to map the facility's local climate, while laser beams probe wake vortices from arriving and departing planes. Combined with wind-tunnel tests, the data may help shorten separations between planes and thus boost airport capacity. **TU**

Smoke highlights artificially generated wake vortex in Langley's wind tunnel.

Weather Eye In The Sky

SUITLAND, MD—It's clear sailing for America's newest weather satellite, GOES-8 (see "Finer Forecasts," page 70, Oct. '94). The spacecraft has passed in-orbit tests and was scheduled to assume its permanent position 22,300 miles above the eastern United States last January.

Next in line is GOES-9, set for launch this spring. This weather bird will perch over the Pacific Ocean.

The National Oceanic and Atmospheric Administration, which operates the satellites, may consider adding an unprecedented third GOES to the system. The satellite would go up in 1996 and hover above the central United States to watch midcontinent storms.



GOES-9, shown undergoing pre-shipment checkout, will cover the western United States and Pacific Ocean.

T
HERE ONCE WAS A GUY



NAMED CLYDE,

WHO WAS SEARCHING FOR A COOL,

ONE DAY HIS HOPES SOARED,

WHEN HE DROVE THE RANGER FROM FORD.



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AUTOMOBILES

Asia Spy Report

BY SCOTT OLDHAM, West Coast Editor



Honda Sport/Utility

● The Japanese market for small sport/utility vehicles has exploded. Or as a Honda source recently told us, "Small sport/utes have gone nuts in Japan." The SUV boom is fueled by the recent release of Toyota's RAV4—a Suzuki Sidekick-size runabout that Toyota can't build fast enough to keep up with demand. Toyota is now building 8000 RAV4s a month. In response, Honda is developing its own vehicle. Although this test mule is based on a 1988-89 Civic station wagon, the production model will not look like an 8-year-old Civic. A major restyling is in the works, but this vehicle does indicate the size of the soon-to-be-marketed truck. The new front end



Hyundai's newly styled '96 Elantra sedan (above) and coupe (right) will arrive this fall.

swing-away-mount spare tire. You can expect that this vehicle will ultimately replace the Isuzu-built Passport at Honda dealerships.



New Infiniti G20 in early development.

and higher hood indicate a larger engine, possibly a 2.2-liter Four from the Accord. The tires are also jumbo size and the wheel openings have been opened up substantially to allow for needed wheel travel. The rear of the test car shows twin exhaust pipes, a high-mounted rear spoiler and a large

Infiniti G20

Nissan is preparing a replacement for the current Nissan Primera, which is sold in the United States as the Infiniti G20. Release in Japan is set for 1995, but the new model will go to Europe and come to the United States in 1996. The front-wheel-drive mid-class sedan will be powered by a more powerful 4-cylinder engine than today's dohc 140-hp 2.0-liter, and it will gain an all-new look by its release date. This early prototype shows a radically raked windshield, an aggressive rear spoiler and front airdam, and a Q45-like grille and headlights. The Primera, which was introduced in

1990, has aged much more quickly than its Q45 bigger brother.

1996 Hyundai

All-new styling is planned for the 1996 Hyundai Elantra sedan and coupe. These heavily disguised prototypes show a slick coupe with styling based roughly on the HCD-2 show car of a few years ago and a sleek sedan with large air intakes in the front spoiler and no conventional grille, à la Saturn. The coupe replaces the Scoupe in the Hyundai lineup and will be powered by a 2.0-liter version of the Hyundai Alpha 4-cylinder engine. The sedan will also be powered by Hyundai-designed-and-built engines. The choices will be a 90-hp 1.8-liter or a 150-hp 2.3-liter. Both are dohc Fours. The coupe will debut as a 1997 model, almost a year after the sedan is released at the Frankfurt Auto Show this fall. The sedan, not unlike the J30, Altima and Contour, is very rounded. All surfaces are curved and flush—even the door handles. Rear-seat headroom seems to be in abundance in this narrow but tall sedan.



PHOTOS: HYUNDAI BY JIM DUNN

Mazda 626

Mazda's 626 will be getting a new nose, as shown on this test car undergoing hot-weather testing in Death Valley, California. The new grille, styled like that of the Mazda Millenia, is flanked by large, round headlights and round turn-signal lights, partially disguised by the car's bra. The rest of this sedan is unchanged. **PM**



Mazda will add a Millenia-like nose to its smaller 626.

Officially authorized by Ford Motor Company.

1931 Ford Model A



Shown slightly larger than actual size of 6 1/2" in length.

Meticulously handcrafted in die-cast metal—features working rumble seat!

In 1927, Henry Ford introduced the beautiful Model A to replace the legendary Model T motorcar—the beloved "Tin Lizzie." When the American public saw "The New Ford," it was love at first sight. The Roadster's racy styling—and its jazzy genuine leather rumble seat—represented high-fashion motoring at its finest. Now, you can acquire an amazingly detailed replica of this classic American convertible.

A Danbury Mint exclusive.

This replica is faithfully reproduced in 1:24 scale from 165 parts. All the major components are die-cast metal. Each replica is individually polished by hand to a showroom finish. The 1931 Ford Model A Deluxe Roadster is available exclusively from the Danbury Mint at just \$94.50, payable in three monthly installments of \$31.50. Your satisfaction is guaranteed. To order, send no money now. Return your Reservation Application today!



Rumble seat opens smoothly.

Engine boasts a superb level of detail.



Dash features readable gauges.

Hood opens on both sides.



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BOATING

Big Three In PWC

BY JOE SKORUPA, Boating/Outdoors Editor

● Ah, the good old days of PWCs. Remember them? All the way back to the late 1980s, the "stone age," before the current class of sit-down Wave-Runners, Sea-Doos and Wet Jets was firmly established.

Sit-down PWCs were primitive then with design possibilities wide open. So much so that POPULAR MECHANICS' first comparison test included outboard-powered units, pickle-fork hot rods and tall, narrow motorcycles of the water.

Even Kawasaki—the Jet Ski pioneer and industry leader—showed up for the shootout with a funky, modified stand-up unit that was fitted with removable pontoons.

Needless to say, the offbeat models didn't score well in the PM comparison test and have since gone out of business. All except for Kawasaki. Within a short time, Kawasaki debuted its first true sit-down PWC, and Jet Skis have been a major player in this category ever since.

But there's something else that should be remembered about the stone age of sit-down PWCs, especially in light of current developments. For the first couple of PM shootouts, the participating competitors abided by an unwritten industry rule to keep top-end speeds below 40 mph. Even as engines were increasing in size, builders toed the line by detuning the motors to reduce speeds.

Why did they do this? Lawyers probably had something to do with it. Kawasaki and Yamaha, the two big guns at the time, also make ATVs. I'm sure they probably felt stung by the



PHOTO BY AMST/REUTE

controversy that led to the eventual ban on 3-wheel ATCs (all-terrain cycles), a hot issue that back then was still fresh in people's minds. It didn't take a genius to make an analogy between ATVs and PWCs.

But one builder didn't agree with the analogy (nor did it make ATVs), and decided to play by a different set of rules. That builder was Sea-Doo, and it quickly became clear that its water bikes were intentionally designed to shatter the 40-mph barrier, first by a little and then by a lot. This gave Sea-Doo a marketing edge, and the company used it to gobble up huge chunks of market share at the expense of the 40-mph builders.

Ultimately, these builders were forced to follow Sea-Doo's lead, and each year water bikes became faster and faster. For a while, Sea-Doo was still clearly in the forefront of the speed wars, and the others were playing catch-up. But not anymore.

This year, the gloves are off and the days of self-imposed speed barriers are over. No more limits. No more engine detuning. In fact, no more 2-cylinder motors. From this point on, high-performance PWCs will

be powered by fire-breathing triples—big 3-cylinder motors with roughly 900cc displacements, 100 hp and throttles with wide-open settings labeled, "Now entering warp speed."

Interestingly, Sea-Doo doesn't have a big three in its line this year.



Water-jacketed exhaust reduces noise.

And equally interesting, Kawasaki does (as do Yamaha, Polaris and Arctic Cat). Kawasaki's entry in the new era of high-performance PWCs is the Jet Ski 900 ZXi (top photo). I got a chance to ride the new screamer recently at a rollout in Acapulco, Mexico, where the weather was unseasonably warm for early November, and the water boiled every time I squeezed the throttle.

Maybe it's just me, but there's a certain stomach-tensing, hair-standing-on-the-back-of-your-neck kind of thrill found in blasting along as fast as technology can propel you while sit-



The 900 ZXi's triple has machined combustion chambers.

The 900 ZXi's smaller sibling, the 750 ZXi.



ting only 18 in. from the water. The stock 900 ZXi peaks at 55 mph, and I'm tempted to say that the sensation felt scary fast, but the truth is I never felt out of control. Still, I wouldn't recommend this water bike for beginners, and I can foresee the day when helmets may be required safety gear.

To get the 900 ZXi to deliver speeds in the mid-50s, Kawasaki equipped it with an 891cc 3-cylinder powerplant that produces 100 hp at 6750 rpm. To ensure free breathing at the top end of the powerband, the motor is fitted with three Keihin CDK 38mm carburetors that are fed by a pair of fuel pumps. Other features include a one-piece cylinder head with machined combustion chambers, a smooth-operating 120° crank and an electric trim for the jet pump—all of which make the 900 Kawasaki's biggest and fastest performance package.

In addition to performance features, Kawasaki's flagship model comes with waterproof digital CD ignition, superlube oil injection, a magnetic ignition key to prevent unauthorized use and a water-jacketed exhaust with a rear-mounted outlet flap to lower noise levels.

Coping with speeds in the mid-50s compelled Kawasaki to rethink its basic hull design. To add strength, an inner liner was bonded to the hull, and polyurethane foam was injected between the layers for reinforcement. Also, it has a fairly sharp deep-V bottom (22.5° dead rise), which reduces hull flex at speed and enables the craft to knife through chop.

Dimensionally, the 900 ZXi's hull is 8 in. longer (at 108 in.) and 1.5 in. wider (at 42.1 in.) than Kawasaki's previous high-performance model, the Super Sport Xi. This was done to add stability and to increase speed. Those familiar with naval architecture know that long, narrow hulls are inherently faster than short, wide ones.

A new feature that works well on the 900 ZXi is a series of antispray

strips or ridges that run horizontally across the nose of the bow. Drops of spray hitting the face at 55 mph can sting like needles. The antispray strips work like above-surface strakes or chines and throw off water that normally surfs up the smooth contours of the bow. Kawasaki has hit on something here, and I wouldn't be surprised to see the feature extended throughout its line.

After spending three hard-riding days on the water in a virtually private bay just south of Acapulco, I can say that I came away suitably impressed with the new 900 ZXi and its smaller sibling, the new 750 ZXi, which is equipped with a different 743cc 85-hp 2-cylinder engine but the same hull and features.

On the slalom course, the 900 ZXi ran like a Formula One race car—carving corners and accelerating through the straightaways. But, so did the 750 ZXi. Where the two differed was in straight-line, wide-open-throttle (WOT) running.

While the 750 ZXi was a couple of mph slower at top end (52 mph), its running attitude was smoother. The 900 ZXi displayed a tendency to porpoise (bounce up and down at the bow) at WOT. Fortunately, fiddling with the trim setting and moving forward in the seat helped smooth out the misbehavior. However, Kawasaki's second-best PWC, the 750 ZXi, rode sweet at all speeds and still broke the 50-mph barrier, which makes it second to none in my book.

During the rollout in Acapulco, I literally rode every one of Kawasaki's stand-up and sit-down PWCs—12 models in all (by far the broadest line in the market). It took a considerable amount of time to do it, but I felt I had to make the effort. You see, the Mexican customs official laughed when I said I was visiting sunny Acapulco on business, so I put in full days (and full nights) trying to prove him wrong. Hey, somebody had to. **FM**



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Detroit Spy Report

BY JIM DUNNE, Detroit Editor



1996 GMC Rally

• The full-size van from GMC is beginning to look a lot like its smaller sibling, the Safari. Trust us, though, this is the big van. You really see the resemblance between the new Rally and the Safari—size aside—when checking out the going-away view. Overall, the major changes in the rear styling of the Rally center around the high pillar-mounted taillights, which GM first used on its plastic-body front-wheel-drive minivans (Lumina APV, Pontiac Trans Sport and Olds Silhouette), integrated bumper shape and larger windows. The Rally also borrows heavily from the look of the smaller Safari around its doors and side glass. Viewed head-on, however, the stubby nose of the Rally shows that it uses some of the styling cues of the full-size Sierra pickup truck, par-



Ford revamped the best-selling F-Series.

ticularly the grille and the headlights. To go with the new sheetmetal, look for new interiors with dual airbags on the Rally passenger van model.

Ford F-Series

Ford will have engine changes in its new line of full-size pickups next year. Base engine in the new F-150 is a 4.2-liter V6 that turns out an industry-leading 200 hp. The first of the engine options is a 215-hp 4.6-liter V8, similar to the engines in the Ford Crown Vic and Lincoln Town Car. For heavy hauling, the new F-150 gets an optional 5.4-liter V8 that produces 225 hp and 331 ft.-lb. of torque. This 1996 model F-150 is a smaller size than the big workhorses, the F-250 and F-350. Those larger models will remain unchanged in appearance through the 1997 model year. One of the other features Ford plans to introduce on the 1996 model is a small swing-out third door. The door offers easy access to the compartment behind the front seats, which houses a split rear seat. The rear seats can accommodate

two passengers or cargo, or one passenger and some cargo. The rear seats will be equipped with shoulder belts and headrests.

4-Door Bronco Power

Ford plans a new engine lineup for the soon-to-be-here 4-door Bronco. The engine is based on those available in Ford's new light-duty F-Series pickup truck, code-named PN96 (see above). The standard engine is the 4.2-liter 200-hp V6. With a rating of 22.5 mpg, this engine will be sold on its fuel-economy merits. Next up is the 4.6-liter 215-hp V8, which offers fuel economy of about 21 mpg. For maximum performance or towing, the 225-hp 5.4-liter V8 will still be expected to deliver more than 19 mpg.

Switchable Airbag

Various automakers are looking into the feasibility of having an ON/OFF switch control the front-passenger's airbag on certain vehicles. The purpose of the switch is to let the driver disarm the passenger's-side airbag under certain conditions. Safety folks figure that airbags can be dangerous to babies and other small passengers. The force of an inflating bag can hurl them rearward with harmful results. This is especially true in pickups,



'96 Lumina minivan gets always-on lights.

where it might be possible to power those passengers out the rear window in an accident.

'96 Lumina Minivan

Talk about your minor facelifts. This 1996 Lumina gets new headlights and a new bar for its grille opening. This is the last year for the plastic van, so the fact that the changes are minor is not surprising. Daytime running lights may be the major reason for the small differences.



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ELECTRONICS

More Space TV

BY FRANK VIZARD, Electronics Editor

● Given the success of RCA's Digital Satellite System (DSS), which lets you receive television signals directly from an orbiting satellite using an 18-in. dish antenna, it only stands to reason that more satellite TV systems are on the way.

Sony, for instance, is scheduled to offer a system that's similar to RCA's later this year. Meanwhile, an existing system called Primestar says it will utilize a new satellite to upgrade its service early next year. Its dish is comparable in size to the DSS dish.

Like DSS, Primestar is a digital system that beams a picture of excellent quality directly to people's homes. The dish size, however, is 36 in. or bigger, depending upon your location. Primestar uses a relatively low-powered satellite operating at 45 watts. The DSS satellite uses 120 watts. More power means a smaller

dish can be used for reception.

Primestar does have a few features that may make it an interesting alternative for some people. Unlike DSS, you don't have to plunk down \$700 for the hardware. The cost of the Primestar dish and



receiver is built into your monthly fee, much the way cable TV companies make you pay for their set-top converters.

Another interesting feature is the ability to connect Primestar to your



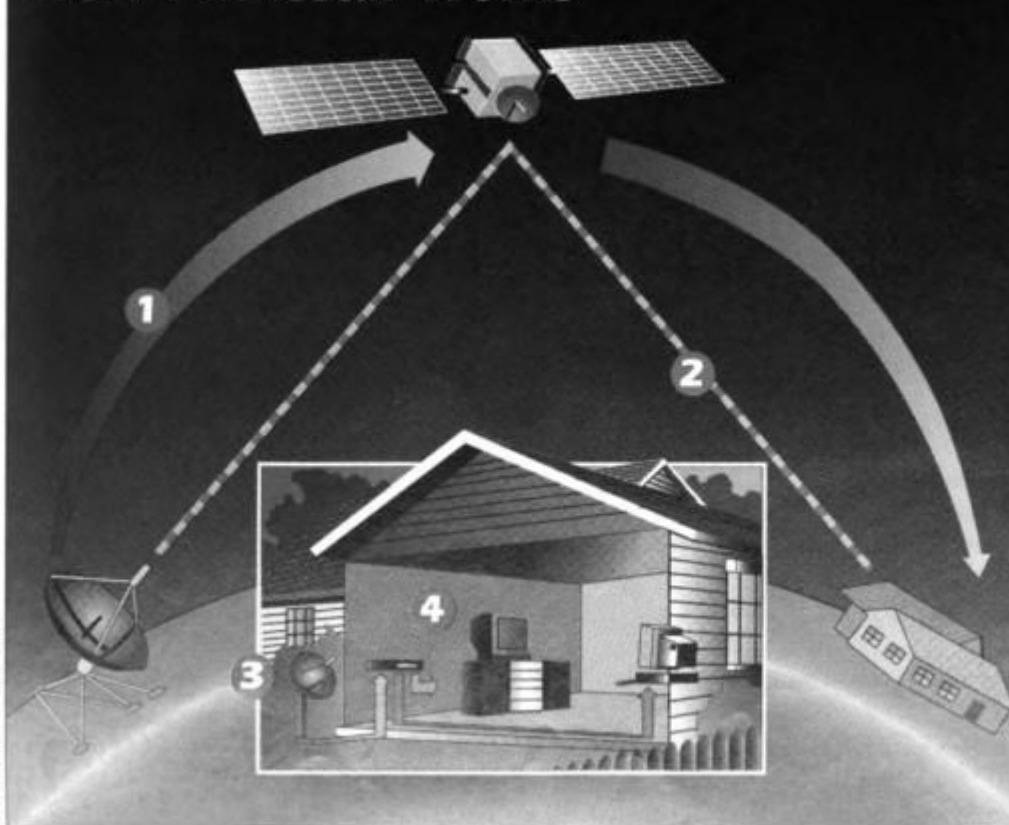
Primestar's smallest dish size is 36 in.

computer. Through Primestar, you can connect to an education service called Ingenious and a news and information service called X•Press. The software costs \$105, and the monthly subscription fee is \$6. Basic Primestar service costs about \$1 per day.

Primestar's computer connection is made through a serial data port on the receiver. Interestingly, the DSS receiver also has a serial data port, although plans for its use haven't been revealed. You can probably expect some news from RCA shortly, however—perhaps a space link to the Internet?

Once Primestar gets its new satellite up in space, it expects to offer 200 channels, up from its current 67-channel offering. DSS also will be adding to its 175-channel base. Ah, another numbers race. **FM**

How Primestar Works



① Digital TV signals are transmitted from Primestar headquarters to a satellite in a stationary orbit over the United States.

② Primestar's signals are then sent to a small, unique Primestar satellite dish outside of the customer's home.

③ The signal received by the small dish is then sent through a special cable to a state-of-the-art Primestar receiver inside the customer's home.

④ From the receiver, signals are sent to the customer's television, VCR, stereo and/or personal computer.

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By Dane Spotts



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SCIENCE

Mind Control

BY GREGORY T. POPE, Science/Technology Editor

● Remember when Clint Eastwood spirited a futuristic fighter jet out of the Soviet Union in the 1982 movie "Firefox"? The plane's secret was that the pilot controlled it merely by thought, firing its missiles through the sheer force of will.

As it turns out, the U.S. Air Force takes this mind-over-matter business quite seriously. At Armstrong Laboratory, located on the grounds of Wright-Patterson AFB, Ohio, experimenters have devised hardware that allows a person's brain waves to control a flight simulator. While it's a far cry from "Firefox," the system may one day relieve overtaxed fighter pilots. Modified, the technology could also help bring independence to the handicapped and even restore voluntary movement to paralyzed limbs.

"We're excited about this phenomenon, but we're also trying to demystify it," says research psychologist Grant McMillan, who is spearheading the effort. "We want to take it out of the realm of psychic phenomena and paranormal behavior."

Although the military has tinkered with brain-actuated controls since the 1960s, the current activity stems from a separate

line of research at Armstrong Laboratory. Psychologists there have long sought to identify bodily measurements that can reveal the workload level of an Air Force pilot. Heart rate is one such gauge. Another, research has shown, is a brain wave, a distinct pattern of cerebral electricity known as a visual evoked response. A flickering light can trigger this steady brain wave. As the light flashes on and off, its rhythm synchronizes the firing of nerve cells in the section of the brain that processes sight. The result: an electrical signal from the mind that echoes the frequency of the flicker.

Investigators have discovered that the strength of this brain wave varies with pilot workload. To their surprise, they also found that many of their experimental subjects were subconsciously intensifying or suppressing the electrical signal. This phenomenon planted an idea in researchers' minds: Why not harness the brain wave? Because an external stimulus—rather than a subject's internal whim—touches off the the electrical activity, the brain wave is well suited for controlled experimentation.

Accordingly, McMillan and a team of psychologists and engineers have built a prototype system into a simplified flight simulator, in which the subject sits. Two

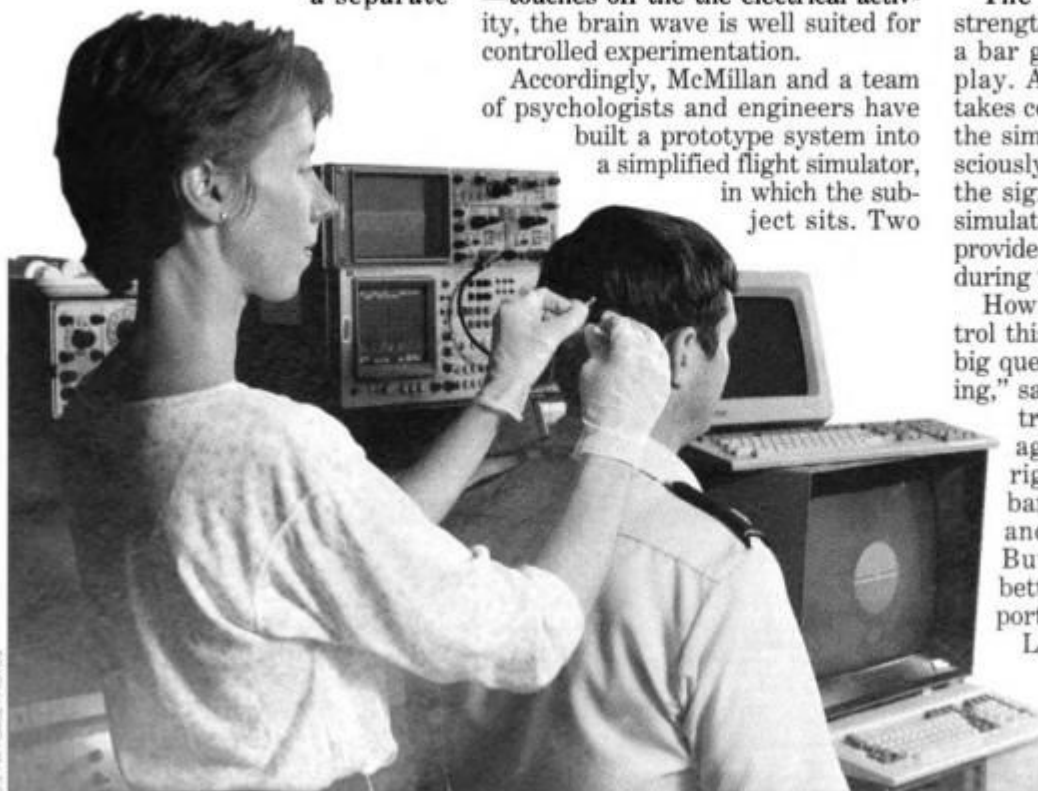


fluorescent lights, flickering 13 times a second, evoke a brain wave at a frequency of 13 Hz. An electroencephalograph (EEG), in the form of small electrodes on the subject's scalp, picks up this signal and relays it through a bank of analog filters and amplifiers. This circuitry isolates the 13-Hz signal from the rest of the brain's electrical chaos.

The subject can monitor the strength of his or her EEG signal via a bar graph on the simulator's display. At the same time, the signal takes command of the roll controls on the simulator's motion base. By consciously strengthening or weakening the signal, the subject can bank the simulator right or left. The bar graph provides the visual feedback necessary during training sessions.

How do subjects deliberately control this brain wave? That remains a big question mark. "What we're finding," says McMillan, "is that early in training, people use mental imagery to help—turning left or right, or pushing the feedback bar in one direction, or tensing and relaxing. That's fatiguing. But as your performance gets better, that imagery gets less important. It becomes automatic."

Later this year, McMillan plans to splice the technology into a more advanced flight simulator known as a virtual cockpit. There, subjects will use brain waves to



change radio frequencies, adjust radar or bring up display screens.

Realistically, notes McMillan, these secondary tasks—rather than life-or-death joystick movements—are the types of pilot chores that may best accommodate brain-actuated control, particularly under stressful conditions such as high acceleration. In addition, avionics designers are unlikely to incorporate a flickering light into a cockpit. Other stimuli can evoke similar responses, or future research may show that an external stimulus is ultimately unnecessary.

The Air Force researchers, as well as other investigators in the United States and overseas, are already looking to broaden uses for the technology. Last year the Armstrong Laboratory group hooked up its hardware to electrical neuromuscular stimulators, used to exercise paralyzed muscles. Three able-bodied volunteers wore the stimulators on their quadriceps muscles and varied the strength of a 13-Hz visual evoked response to extend a knee, without consciously flexing. The experiment's success suggests that brain-actuated control might allow paraplegics to regain some natural movement.

Outside military circles, in fact, researchers are targeting rehabilitation as the most promising application for brain-actuated control. To that end, at the New York State Department of Health's Wadsworth Laboratories, neurologist Jonathan Wolpaw is tapping into a different kind of brain wave. He's interested in a wave generated by the sensorimotor cortex, a strip of brain that runs ear to ear like a headband. The signal isn't stimulated by an external trigger, but rather arises via voluntary thought processes relating to physical movement.

Wolpaw has had his experimental subjects—some physically disabled—learn to control the strength of this wave and thereby shift a cursor around on a computer screen. Most can do it, although, like McMillan's subjects, they can't really explain how. But their success points to the possibility of a brain-actuated device that a handicapped individual would use to control lamp switches, operate a television and perform similar functions.

At the Technical University of Graz, Austria, engineer Gert Pfurtscheller is tracking down the brain-wave patterns that occur when the mind prepares to execute specific motions. His neural-network computer is analyzing EEG readings from subjects and learning to recognize the electrical activity that heralds a toe movement, a finger movement and so on. These brain-wave patterns show up even in paralyzed persons. So it's conceivable

that the research could lead to a system by which a paraplegic could think about walking and allow his mind to control electrical stimulators implanted next to leg muscles.

Meanwhile, McMillan and company continue to refine their system. Digital signal-processing chips have caught up with their analog circuitry. This technology will quicken the capture of the brain-wave signal. At the same time, the researchers plan to set up an EEG that covers the entire head while a subject practices the biofeedback technique. Psychologists suspect the elusive mechanism that

provides control over the 13-Hz wave lies in the frontal lobes of the brain.

The mystery that surrounds this mechanism may ultimately prove moot. "We're beginning to believe," says McMillan, "that EEG-based control is really no different from other kinds of learned-skill behavior, such as hitting a golf ball or driving a car. When you think about skilled behaviors, they all involve getting feedback. Well, with signal-processing technology, we can now make available to people a feedback they've never had before. They can now observe the electrical activity of the brain." **PM**

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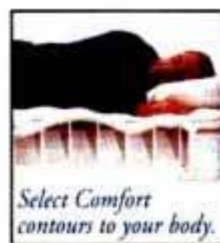


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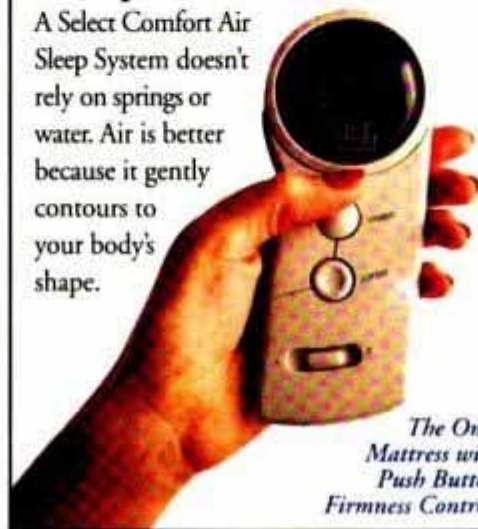
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Ferrari F512 M

● At the Paris Motor Show, Ferrari unwrapped its replacement for the 3-year-old F512 TR. The \$195,000 F512 M (for Modified) is 88 pounds lighter, thanks to engine modifications and new fixed headlamps (the first since the Daytona). The new forged-aluminum pistons mounted on titanium connecting rods and a lighter crankshaft also help bump up the power of the 5.0-liter horizontally opposed 12-cylinder engine by 20 horses to 440 hp. The round taillamps and foglamps, and the oval grille, add a resemblance to the new F355. Twin ducts in the hood and blender-blade wheels add attitude. —*Scott Oldham*



Ferrari F130 can go 220 mph, and costs \$2000 for each mph.

Ferrari F130

F130 is the internal code name for this 220-mph supercar that should replace the McLaren F1 as the fastest sports car in the world when it debuts at the Geneva Auto Show in March. The successor to the F40, the F130 borrows heavily from Ferrari's 333 SP race car. The 2000-pound midengine rear-drive car has a carbon-fiber chassis and a 550-hp normally aspirated 4.7-liter V12 with five valves per cylinder, redlining at nearly 10,000 rpm. An educated guess pegs the car going from 0 to 62

mph (100 kph) in 3.5 seconds with the 6-speed manual. Ferrari is also working on a semiautomatic. You'll have to part with about \$450,000 to put one in your garage. —*S.O.*

Nissan 200SX

Time will tell whether 40,000 Generation Xers (Nissan's sales target) will purchase copies of this all-new 1995 200SX. A recent drive, however, on California's curving Ortega Highway told us that this nimble little sport coupe is a blast to drive. Three models are available: the 200SX, the sporty 200SX SE and the 200SX SE-R for the performance buyer. Both the 200SX and the SE have a dohc 115-hp 1.6-liter 4-cylinder engine, while the SE-R gets a torquey dohc 140-hp 2.0-liter Four. All three use



Volvo's rear-drive 960 is fun and mobile in the snow.

Nissan's new rear Multilink Beam suspension, also found on the Maxima, and either a 4-speed automatic or 5-speed manual. Antilock brakes are an option only on the SE or SE-R. In keeping with the practical '90s, Nissan's designers utilized what they call "rational packaging," which gives this car a long 99.8-in. wheelbase, and a back seat that holds two 6-ft. junior executives and their cappuccinos. —*S.O.*

Volvo 960

In the universe of carmakers, Volvo is not really very big. In fact, Volvo sells about as many cars in the U.S. as Ford sells Probes or Pontiac sells Bon-



Nissan's 200SX: an affordable sport coupe.

neville. The gist of it is that Volvo just doesn't have the resources to ballyhoo the arrival of a new car the way Chevrolet or Toyota might. That's why, when the new Volvo 960 arrived last fall, not very many people noticed. So Volvo is kind of reintroducing the 960, even though it has been on sale for months. To help get a better picture of the 960's capabilities, the Swedish carmaker showcased the car among the reindeer of northern Finland, in Lapland. And you know what? The 960 is really a fine automobile. Both the sedan and wagon versions boast a new strut front and multilink rear suspension, a new nose, and a leather and wood interior. Both also share the torquey (199 ft.-lb. at 4100 rpm) dohc 2.9-liter inline Six and 4-speed automatic. The automatic features Volvo's "winter mode" for Third-gear startups. This, along with the locking rear differential, helps keep the rear-drive car moving, snow or not. Prices range from \$29,900 to about \$32,500. —*Don Chaikin*



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The *Vornado EVH* (Electronic Vortex Heat) is the discriminating buyer's space heater of choice. It automatically responds to your every need with — **Constant Comfort Control** — continuously delivering the precise amount of heat you require. Simply set the desired temperature on the calibrated, easy-access, temperature-control panel and *EVH* goes to work raising the room temperature to the exact setting. Once the temperature is reached, *EVH* "throttles back" both fan speed and heat output to maintain it efficiently and effectively. *No annoying hot blasts or cold spots typical of other heaters.* Just set it and forget it! The *EVH* features a non-glowing heating element, maximum 120° exit air temperature and a cool-touch cabinet making it completely safe — even around kids and pets. It has two energy-saving power settings plus essential over-heat and tip-over protection. *No other heater warms the air more evenly or more safely.* Its compact size, flat back and angled air inlets allow you to tuck it close to a wall or under a desk and out of the way. Lighted power switch. Mfr.'s 1-year warranty **\$109.95** (\$11.95) #3800.

Great taste and good health!

The *Original Burton Maxi Stove Top Grill* is a kitchen must. Inspired by the Korean Bulgogi, it follows an ancient grilling technique that lets you grill foods smokelessly indoors. You can now grill your favorite foods, everything from fish to fowl to fruit. The water reservoir below the domed, non-stick grill collects unwanted drippings while keeping



everything moist and packed with nature's original seasonings. But the big news is what it does for flavor. How? First, it eliminates the need for added fat. Then, its high heat quickly sears in your food's natural juices and flavors, preventing them from drying out. Cooking times are cut dramatically. This is the ultimate in healthful, low-fat cooking and the food tastes great. It's fast, easy, incredibly versatile to cook on and a breeze to clean up. Which is why *Burton* is the hottest name in cooking today. Constructed of the finest materials, this grill is unbelievably durable. Also included is the *Grill It In!* cookbook, with dozens of delicious recipes created expressly for the *Burton Stove Top Grill*, a \$10.95 value that's yours free. **\$59.95** (\$6.95) #4030.

Don't be fooled by its size — This is one powerful vacuum!



You'll be amazed with the performance of this machine. At how effortlessly the *Oreck Power Broom* picks up anything and everything in its path. Dust, crumbs, broken glass, bugs — you name it. *In fact, it's got more power than any other electric broom you can buy.* The *Power Broom* features a two-speed motor for customized cleaning control, a large capacity dust cup with a washable, reusable filter and an extra-long 25-foot cord to make easy work of even the largest spaces. With a self-adjusting floor tool that quickly and easily glides

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"The Magellan Ultimate Guarantee"™ If you're not completely satisfied with your purchase, simply return it for a full refund.

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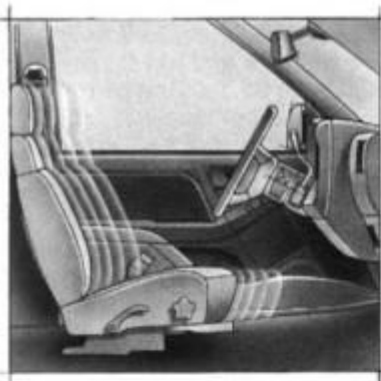


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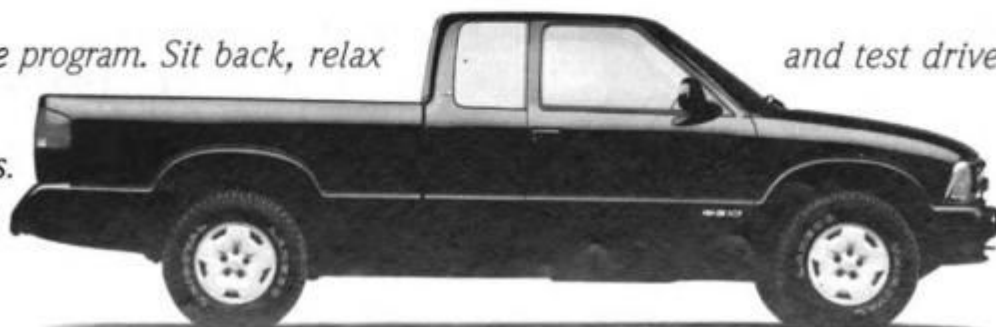
Chevy S-Series. Hang on to your popcorn. Now you can watch your favorite action and adventure show without getting a cramp in your leg or a crick in your neck. The roomy new Chevy S-Series is here. Designed from the inside out, the S-Series Extended-Cab

gives you an extra notch of seat travel for more leg room than almost any full-size extended-cab pickup made. How's that for good measure? And the S-Series is exceptionally quiet. Foam plugs, triple-sealed doors and a great deal of sound insulation keep outside noise outside.

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TRUCKS WITH BRAINS

The big rigs are rolling better than ever thanks to truckloads of new technology.



BY ANDY TURNBULL

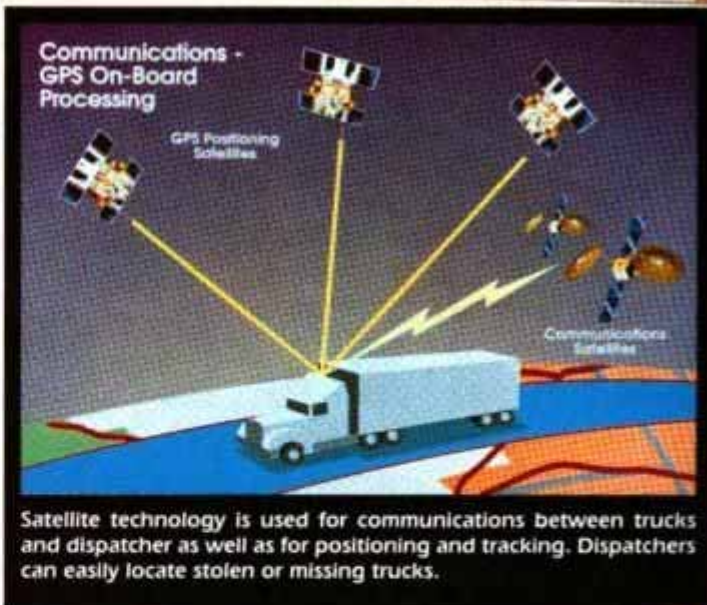
• Loaded trucks are a favored prey of thieves. But now technology is coming to the aid of truckers. More than 65,000 big trucks carry automatic locating systems that report the trucks' locations to their dispatchers. When a locator-equipped truck is stolen, the truck's exact whereabouts can be reported to the police in the very same phone call. In finest Hollywood fashion, some robbers have been visited by the gendarmes while gleefully unloading their

pilfered cargo in the security of a locked warehouse. Satellite-based truck-locating systems were developed and proliferated initially to help trucking companies keep track of shipments. The adaptation of the truck-tracking technology to a theft-recovery system is a natural, but far from its only other use. Rockwell International is working with the Iowa Department of Transportation on a program to make Rockwell's Pro2000 digital satellite radio—which

TRUCKS WITH BRAINS



Modern sleeper is a home and office away from home, with TV, VCR, phone and fax.



Satellite technology is used for communications between trucks and dispatcher as well as for positioning and tracking. Dispatchers can easily locate stolen or missing trucks.

LED MARKER LIGHTS

The truck of the future may have totally enclosed wheels and racecar-like ground effects.



AERODYNAMIC SKIRTS

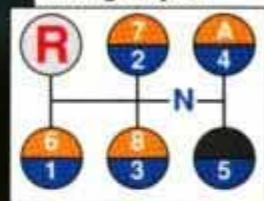
ANTILOCK BRAKES



Ultraviolet headlights reveal more than standard ones.



Modern transmissions can operate in semi-automatic modes, easing the job.



includes a Global Positioning System—log the miles interstate truckers run in each state for fuel-tax reports. On-board computers can also track a driver's hours of service and make an electronic log that's easier to keep and harder to fake. Some trucks have on-board scales to weigh the load, antilock brakes and traction control, and even radar to warn the driver of traffic hazards.

Eaton Corp.'s VORAD system mounts Doppler radar sensors on the front and sides of a truck. The system sounds a buzzer and blinks lights to warn the driver if he gets too close to the vehicle ahead or if he signals a

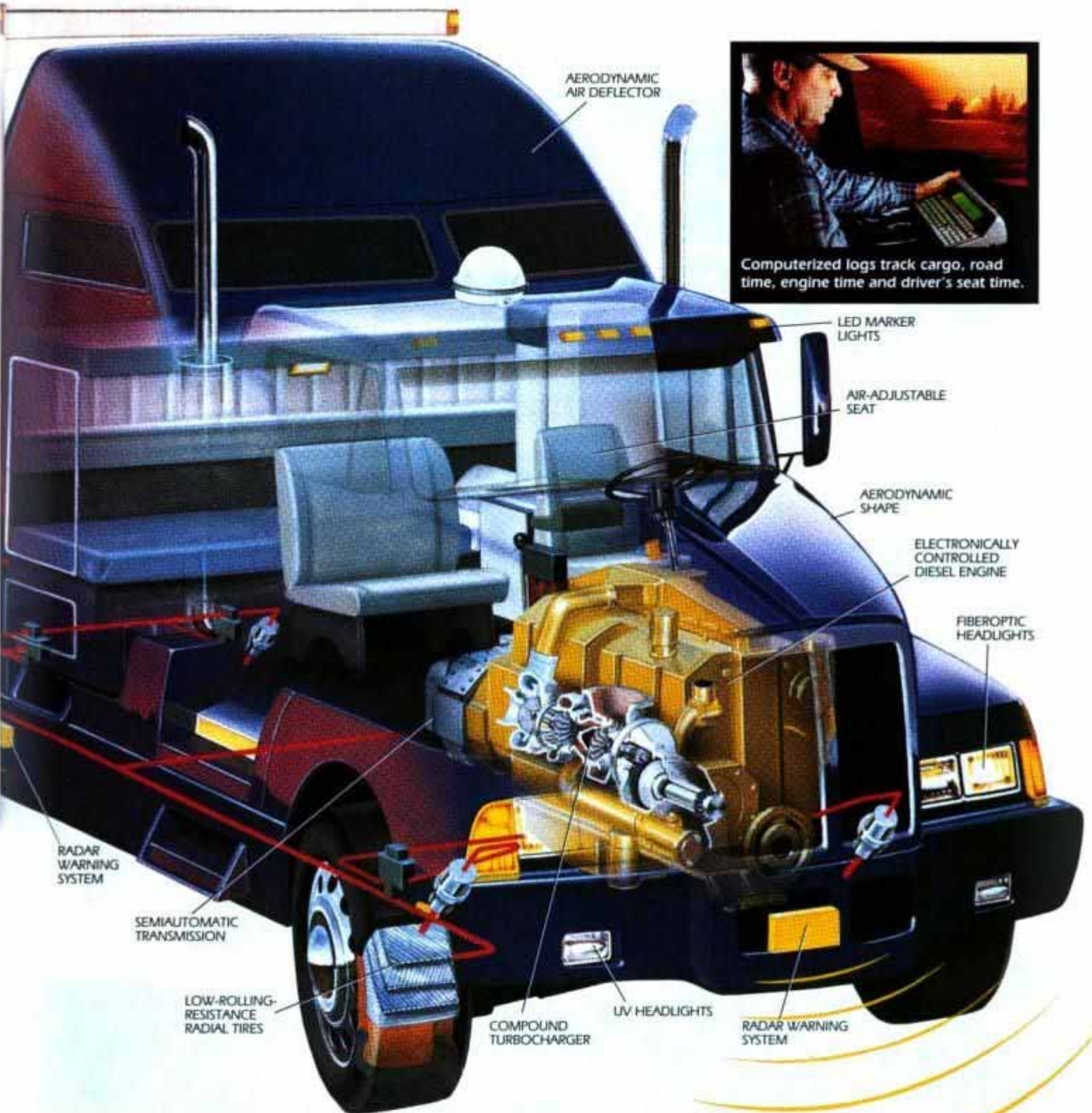
turn when there's a vehicle beside him. The system tracks truck speed and adjusts the warning distance—up to 350 ft. ahead—to suit forward speed. It also logs vehicle data that could help reconstruct an accident, and can include a "smart" cruise control that can adjust itself to keep pace with other traffic.

Hino trucks in Japan already offer an "intervehicular distance alarm" that uses an infrared beam to warn drivers of slow traffic ahead, and Mercedes-Benz has an experimental truck with fully automatic control. Watching through television cameras, the EXT-92 truck's computer can follow a normal

highway and brake for slower traffic, pedestrians or other obstructions.

Modern big rigs are still powered by big diesels. The typical engine displaces anywhere from 10 to 14 liters and boasts electronic controls for its injection, four valves per cylinder and compound turbocharging. Like the modern car engine, the big diesels boast self-diagnosis capabilities and reduced exhaust emissions. Oh, the typical diesel also develops about 350 hp and more than 1300 ft.-lb. of torque—both at speeds below 1500 rpm.

Thanks to that bodacious band of mountain-moving torque, truckers don't need to shift gears nearly as



AERODYNAMIC AIR DEFLECTOR

Computerized logs track cargo, road time, engine time and driver's seat time.

LED MARKER LIGHTS

AIR-ADJUSTABLE SEAT

AERODYNAMIC SHAPE

ELECTRONICALLY CONTROLLED DIESEL ENGINE

FIBEROPTIC HEADLIGHTS

RADAR WARNING SYSTEM

SEMI-AUTOMATIC TRANSMISSION

LOW-ROLLING-RESISTANCE RADIAL TIRES

COMPOUND TURBOCHARGER

UV HEADLIGHTS

RADAR WARNING SYSTEM

often as they used to. Today's 18-speed transmissions have only one shift lever, and most trucks today have only a 9- or 10-speed gearbox. And, of course, that gearbox can be an automatic. Spicer's "AutoMate-2" has eight manual and two automatic gears. Eaton's new AutoSelect is a semiautomatic 10-speed. It's offered only on Kenworth and Peterbilt trucks as of this writing but will soon be available on other lines. Even truck lights are going high-tech with light-emitting-diode lights that draw less current, are less affected by vibration and last much longer than standard lights. LED brake

lights illuminate about 200 milliseconds faster than incandescent lights. Truck-Lite Corp., of Falconer, New York, will use 5mm fiberoptic cables to carry light from a single gas-discharge lamp to a dozen or more outlets to replace conventional clearance, stop, turn and backup lights. A General Electric headlight system will use a single gas-discharge lamp and 12mm optic fibers to produce about twice as much light as standard halogen headlights. And Sweden's Scania truck company is working on ultraviolet headlights for better vision with less dazzle. Filters will stop the UV-B and UV-C

rays, which can damage eyes, but pass visible light and enough UV-A rays to make some types of paint and many common materials fluorescent. Naturally, modern trucks also offer nice upholstery, air conditioning, stereo systems and compact-disc players. Most big trucks have cellular phones and CB radios. And most long-haul trucks have sleepers. The 3-ft. box that used to ride behind the cab of highway trucks is now an 8-ft. integral or integrated sleeper that may have double bunks, or a sofa and daybed. Most have closets, TVs and VCRs, and some have microwave ovens and refrigerators.

COVER STORY

TITANS OF TRANSPORT

A new generation of oversize cargo planes—container ships with wings—promises to fast-forward the freight business.

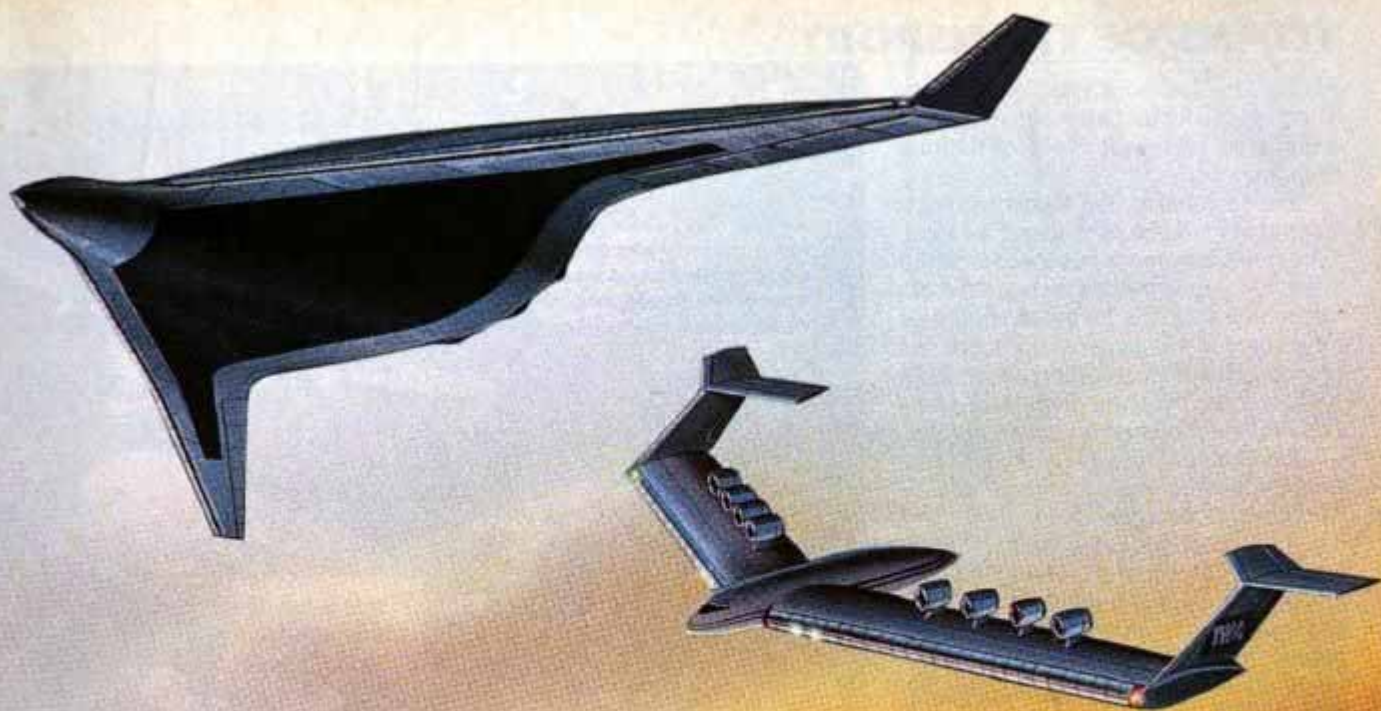
BY GREGORY T. POPE, Science/Technology Editor; PM Illustration by Craig Attebery



● March 19, 2015. Welcome to America's newest port. The thriving complex was once an abandoned military base. Today it pulses to the rhythm of import and export. Here, tractor-trailers stream off a freeway spur that feeds the port's material-handling zone. There, great robotic gantries hoist containers from the trucks and swing them into their next mode of transportation. Elsewhere, the big rigs themselves wheel right into gaping cargo holds, while others, brightly splashed with Asian and Cyrillic markings, rumble out.

The activity recalls the bustle of Amsterdam or New Orleans. But the ocean lies a thousand miles away. This port sprawls in the nation's heartland—it's an airport dedicated to freight. Those cargo holds yawn not from ships but from monster planes that touch down, discharge containers, load up, check out, refuel and roar off again to destinations abroad.

Could such a vision—the freight business lifted from the seas to the skies—come to pass? Transportation researchers are preparing for that possibility. After



Clockwise from top: McDonnell Douglas blended wing-body, Lockheed spanloader, Airbus Super Transporter, Lockheed Very Large Airplane and Molniya 1000 Heracles.



all, a similar revolution began 40 years ago, when the jet airliner lured long-distance travelers from the passenger ship. What the Boeing 707 did for trans-Atlantic passage, many argue, a new breed of all-cargo megajet could do for international trade—spur the growth of a huge new market drawn by speed and convenience.

Economics will determine how quickly and thoroughly this dream becomes reality. But America's aeronautics experts aren't waiting passively in the wings. At NASA's Langley Research Center, engi-

neers are beginning to hammer out technology requirements. Meanwhile, at NASA's behest, manufacturers are already sketching aircraft that would overshadow today's flying beast of burden, the Boeing 747-400F. And at the Massachusetts Institute of Technology, research is under way on the infrastructure—terminals, runways, cargo-handling gear—needed to usher in a new age of air freight.

At the center of all this brainstorming is the group of NASA-Langley aeronautical engineers led by

TITANS OF TRANSPORT

Shelby J. Morris. Right now, admits Morris, thinking about future air freighters prompts more questions than answers.

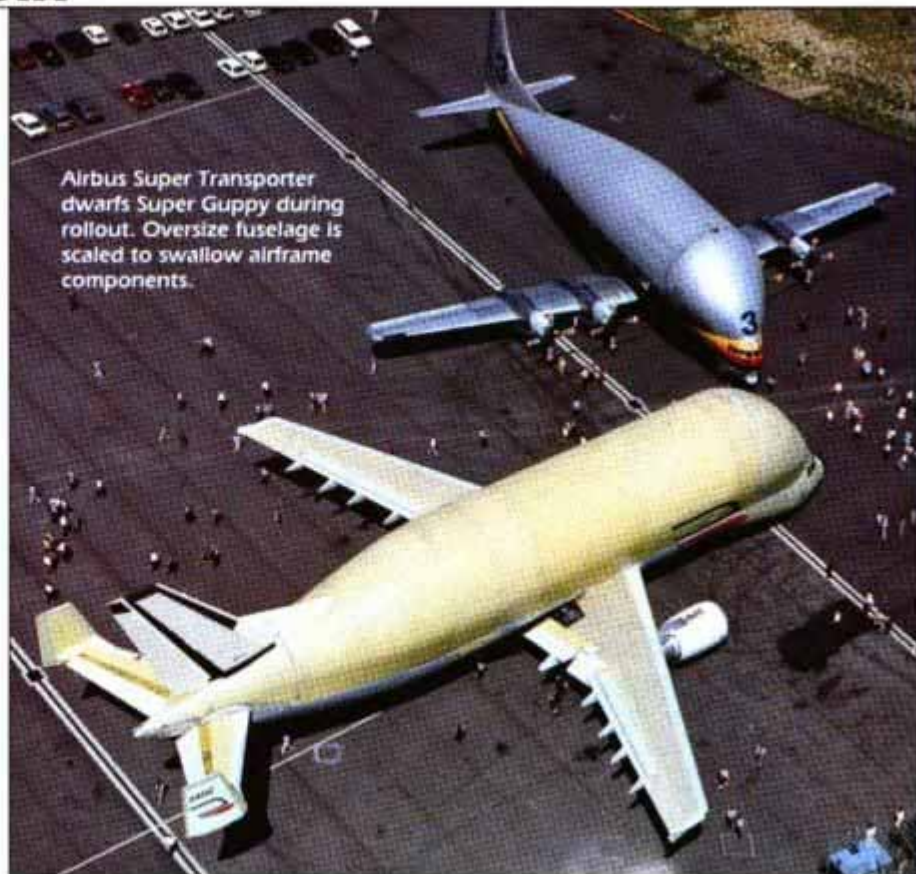
"We're looking, in a preliminary way, at very large airplanes," he says. "We think largeness has a virtue up to a certain point, but we're not sure exactly how large is large enough and how large is too large. And we're exploring the technologies associated with these airplanes, including radically different airframe shapes."

The blended wing-body (BWB) certainly qualifies as such. Conceived by McDonnell Douglas Aerospace (see Tech Update, page 16, April '94), its batlike silhouette emerged from a challenge, issued by NASA, to look beyond the winged-cylinder configuration that has typified transport aircraft since the 707.

The BWB began as a design for an 800-passenger, 7000-mile airliner. "But it turns out it works very well as a cargo airplane," says McDonnell Douglas's Bob Liebeck. "It has a large cabin that's very versatile in its layout. If you didn't need the cargo pressurized, you could build it very light." Liebeck envisions a cargo variant laid out like the passenger version: two decks stacked inboard with single decks out toward the wings.

In designing the aircraft, Liebeck and company assumed the technology of 2015—an all-composite structure, either three or four big ducted-fan engines, "fly-by-light" fiberoptic controls and the relaxed static stability seen today in the B-2 bomber. According to a McDonnell Douglas analysis, the BWB would outperform an equivalent conventional aircraft—such as a double-decker Boeing 747—that featured the same technology.

Even more radical is the spanloader, a concept that surfaced in the late 1970s when NASA last sponsored a major study of future cargo planes.



Airbus Super Transporter dwarfs Super Guppy during rollout. Oversize fuselage is scaled to swallow airframe components.

In this configuration, cargo takes up space inside the aircraft's gigantic wings. Spanloader anatomy minimizes the distance between aerodynamic lift forces and the payload to be lifted, thus reducing structural reinforcement and hence the airplane's weight. Lockheed Aeronautical Systems Co. has recently considered a spanloader sized to carry 600,000 pounds over 3000 miles.

Lockheed is also toying with a more traditional silhouette in a vehicle known simply as the Very Large Airplane. Something like a mammoth C-5 Galaxy, the aircraft could play three roles at once: cargo, passenger and military airlift. "If one thinks about multiple uses early enough in the de-

sign process," says Lockheed's Tony Hays, "there may be a way to satisfy all these requirements without significant compromise." This approach veers from the conventional route taken by Boeing, McDonnell Douglas and Airbus—each of which has plans for a superjumbo of at least 600 seats, an airliner that might later be pressed into freighter service.

Payload payoff

One thread common to the tailoring of these planes is their accommodation of intermodal cargo containers. Those are the standardized 8 x 8 x 20-ft. or 8 x 8 x 40-ft. steel boxes hauled by ship, train and truck alike. The Boeing 747-400F can swallow only 14 alu-



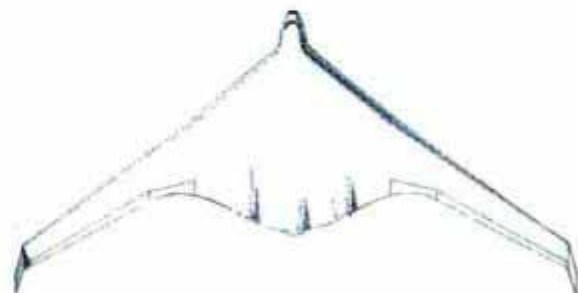
BOEING 747-400F

WINGSPAN: 213 FT.
LENGTH: 231 FT.
MAXIMUM PAYLOAD: 280,000 LB.



LOCKHEED VERY LARGE AIRPLANE

WINGSPAN: 281 FT.
LENGTH: 262 FT.
MAXIMUM PAYLOAD: 410,000 LB.



MCDONNELL DOUGLAS BLENDED WING-BODY

WINGSPAN: 280 FT.
LENGTH: 172 FT.
MAXIMUM PAYLOAD: 300,000 LB.



Unusual silhouettes mark blended wing-body, shown above in original 4-engine configuration, and spanloader, shown below loading through wing.

minimum versions of the 20-ft.-long containers, while a typical container ship can take on 4000. For the air-cargo market to support development of giant freighters, researchers believe, the planes must be optimized to handle intermodal containers.

Outsized consignments defy containerization, however. To get such shipments airborne calls for a special-purpose sky freighter. One, in fact, made its maiden flight last September. The Airbus Super Transporter (AST)—an A300 modified with a whaleback fuselage—offers a record 50,000 cu. ft. of main-deck cargo volume, more than either the Lockheed C-5 or the Antonov An-225. Airbus has planned a fleet of four ASTs, replacing the 40-year-old Super Guppies, to whisk aircraft-fuselage sections between assembly facilities in Europe.

Russia's Molniya Scientific and Industrial Enterprise also targets bulky payloads with its proposed Heracles heavy lifter. Three wings, two fuselages and six engines would create the world's strongest airplane—able to lift 992,060 pounds and roar skyward weighing nearly 1000 tons. A removable payload canister would nestle between the fuselages.



LOCKHEED ILLUSTRATION

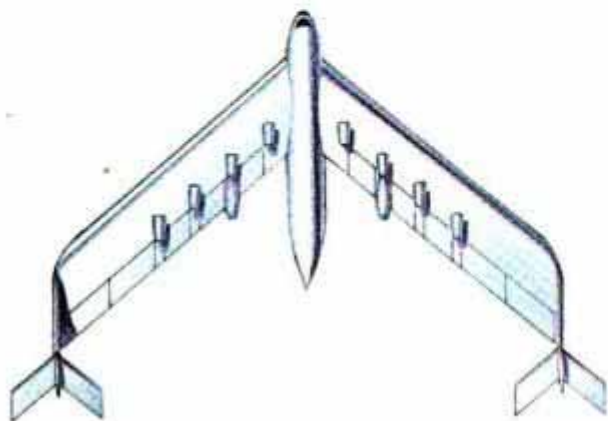
Landing trouble

The sheer size of all these proposed aircraft raises questions. "It's going to be tough to get these very large airplanes into existing airports," says Robert Simpson, director of MIT's Flight Transportation Laboratory. "It's going to mean moving taxiways and tearing down buildings and folding wings. And the strength of the runways becomes a problem."

Simpson has aired a novel solution—landing amphibious freighters on pier-lined lakes. While this idea intrigues the NASA-Langley group, they point out complications from corrosion—and the fixed geography of lakes. Location of an air-freight port is critical to the concept. "The system wants

to go midcontinent to midcontinent," notes Simpson, "trying to save time and money by avoiding the train."

Time and money will ultimately dictate the success of the sky-freight revolution. Boeing predicts air cargo growing at a rate of 6.5% a year, which triples the tonnage by the year 2013. Already air transport attracts shippers for whom the added cost is outweighed by their cargoes' short-lived market value. These include garments, electronics and other items with fickle customers and fast-changing models. For these businesses, time is money, and time flies. So as industry's pace continues to gather speed, look for the titans of transport to deliver the goods. **FM**



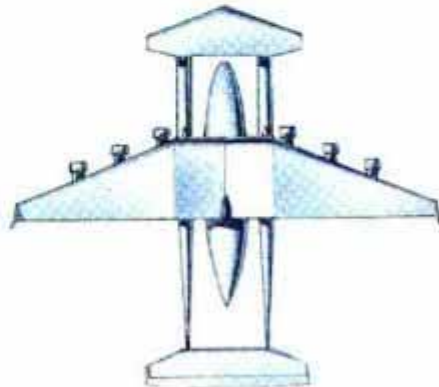
LOCKHEED SPANLOADER

WINGSPAN: 331 FT.
LENGTH: 256 FT.
MAXIMUM PAYLOAD: 600,000 LB.



AIRBUS SUPER TRANSPORTER A300-600ST

WINGSPAN: 147 FT.
LENGTH: 184 FT.
MAXIMUM PAYLOAD: 100,309 LB.



MOLNIYA 1000 HERACLES

WINGSPAN: 295 FT.
LENGTH: 240 FT.
MAXIMUM PAYLOAD: 992,060 LB.

ILLUSTRATIONS BY ADOLPHE BRITMAN

COMPARISON TEST

FAB FOUR

Just how good is the new breed of 4-stroke outboards?
We wring out the big new 50s in a head-to-head shootout.

BY CHARLES PLUEDDEMAN; PM Photos by Skip Gandy



● As you've probably heard by now, the EPA wants to turn your lake into a smoke-free environment. New regulations designed to clean up exhaust emissions of marine engines are slated to begin with 1998-model outboards, sterndrives and inboards. Although the rules will phase in over a 9-year schedule, that doesn't stop builders from beating the deadlines.

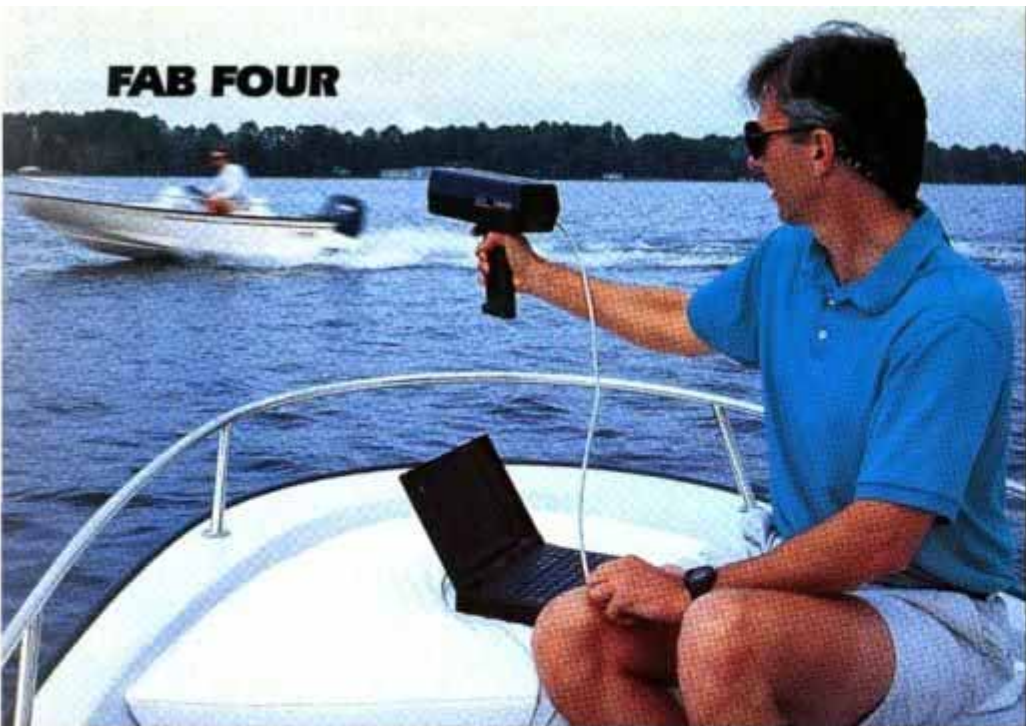
In fact, the first examples of the green machines (achieving 80% reduction in hydrocarbon emissions) are already available. These are clean-burning 4-stroke outboards in the 50-hp class made by Mercury Marine, Yamaha and Honda. Beyond reducing emissions, the builders claim the new engines offer substantially better fuel economy with little or no loss of performance. Hmm. Really? Sounds like something POPULAR MECHANICS should put to the test.

To make the test as fair as possible, we assembled a fleet of identical boats and asked each 4-stroke builder to rig and prop the engines. In addition, we brought along a 2-stroke outboard (rigged and propped by OMC) for our cross-technology comparison.

The test boat on which we mounted the 50-horsepower engines is the new Boston Whaler 13 Dauntless center-console skiff. The 13 Dauntless is 13 ft. 9 in. long, 6 ft. wide, and rated for up to 50 hp. Whaler lists the boat at 625 pounds, and delivered the test rigs with a variance of no more than 20 pounds either way. The 13 Dauntless features Whaler's foam-filled, un-sinkable construction with a V-bottom hull. Equipped with a swim step, rod holders, bow and seat cushions, a cooler seat and stainless-steel bowrail, the 13 Dauntless lists for \$5405 without power or trailer.



FAB FOUR



Computer-linked radar gun (left) and fuel-flow meter (above) collect data for charts on opposite page. Below, the Boston Whaler 13 Dauntless test boat at speed.

While the 2-stroke Johnson 50 will eventually be replaced by a direct-injection model featuring OMC's trail-blazing LEAP (low-emission advanced propulsion) technology, the test motor is actually new for '95 and represents the very best in current 2-stroke design. Keep in mind that this motor will be a legitimate option for boaters well into the next century even under the EPA plan.

Honda BF50

While other builders are converts to 4-stroke outboard technology, Honda has been using it since 1974. But Honda has taken a conservative approach in the marine market (unlike its car division) and didn't have a model to compete with the big new Merc and Yamaha 50s. Not wanting to let the 50-horse class go uncontested, Honda boosted its former 45-horse motor up 5 hp for '95. As a result, this engine's 3-cylinder 808cc powerhead is the smallest in our test, but on the upside, at 203 pounds it is also the lightest.

Interestingly, the Honda powerhead is offset 3 in. forward of the driveshaft. This places the engine's center of balance over the transom bracket and noticeably reduces vibration, making the Honda BF50 the smoothest-running motor in the test.

The Honda BF50 was also the fuel-economy champ, achieving 13 mpg at 5000 rpm and 31.3 mph. (We were able to calculate mpg by recording radar-gun readings during gallons-per-hour runs.) That's 80% better economy than the 2-stroke at the same speed. The Honda also burned the least fuel at wide-open throttle, 10.3 mpg at 6250 rpm and 40 mph. From trolling speed to full throttle, the Honda operated with smooth precision, except for its raspy trim pump, which was the loudest of the group.

With power trim and tilt, and re-



mote control, the Honda BF50 has a suggested retail price of \$6395 (price includes a tachometer, trim gauge, 6.6-gallon fuel tank, aluminum prop and a 24-month warranty).

Mercury 50

The first 4-stroke outboard from Mercury Marine was developed as a cooperative project with Yamaha in a venture designed to save both companies engineering and manufacturing costs. Mercury manufactures and assembles the short block in Wisconsin, while Yamaha builds the cylinder head and valvetrain in Japan. Each then swaps the components it builds and completes final assembly in its own plant using a fuel system, ignition, starter and charging system supplied by Yamaha. As a result, the finished powerheads are almost identical, but the rest of the motor is unique to each builder.

At 215 pounds, the Merc 50's 4-cylinder 2-valve 935cc powerhead is more complex, expensive and a little heavier than the Honda triple.

At idle and throughout the powerband, the motor was smooth and

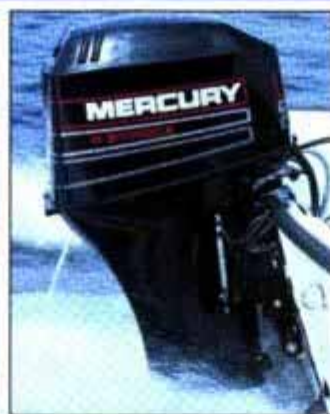
quiet, but it passed a little more vibration to the boat than the Honda. Its 8.6-second average 0-25 mph acceleration time was about the same as the smaller Honda, but on a heavier boat its displacement advantage should be more apparent.

The Merc 50 posted the fastest top speed in the test with a run of 41.2 mph. Its best fuel economy was 11.5 mpg at 4000 rpm and 24.2 mph, which was third to the other 4-strokes but dramatically better than the 2-stroke.

Mercury 50 features include a new transom bracket with integral power trim, a third water inlet under the antivibration plate and a built-in garden-hose flush fitting. It holds 3 quarts of oil, almost a quart more than the Yamaha or Honda, and the dipstick tube accepts a threaded Mercury oil-drain pump. The suggested retail price of \$6534 includes a 6-gallon fuel tank but no instruments, control or prop. The same motor is also offered as a Mariner model.

Yamaha F-50

While it shares the 4-cylinder 935cc powerhead with development partner



HONDA BF50

Type/Cylinders	4-stroke/3
Displacement/Wt.	808cc/203 lb.
Bore x Stroke	2.8" x 2.8"
Gear Ratio	2.08:1
0-25 mph	8.4 sec.
Top Speed	40.0 mph
Noise @ Idle/WOT	65 dBA/96 dBA
Best Cruise	
Range	13.0 mpg @ 5000 rpm
Price	\$6395

MERCURY 50

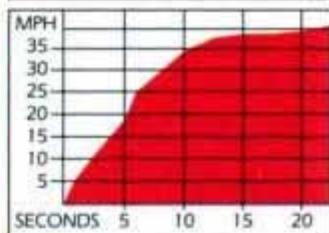
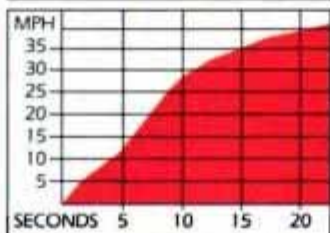
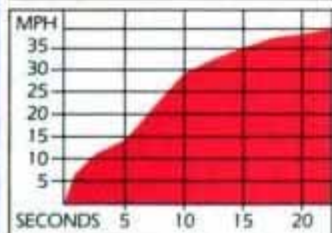
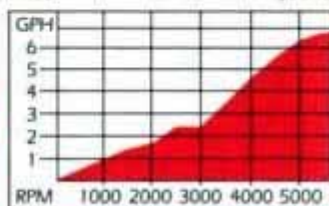
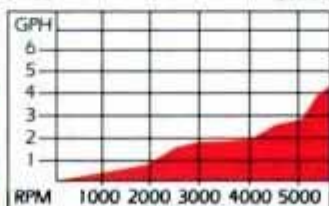
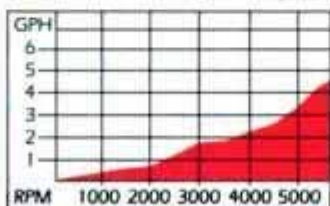
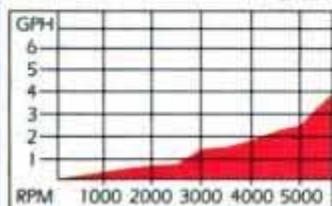
Type/Cylinders	4-stroke/4
Displacement/Wt.	935cc/215 lb.
Bore x Stroke	2.48" x 2.95"
Gear Ratio	2.0:1
0-25 mph	8.6 sec.
Top Speed	41.2 mph
Noise @ Idle/WOT	68 dBA/94 dBA
Best Cruise	
Range	11.5 mpg @ 4000 rpm
Price	\$6534

YAMAHA F-50

Type/Cylinders	4-stroke/4
Displacement/Wt.	935cc/212 lb.
Bore x Stroke	2.48" x 2.95"
Gear Ratio	1.84:1
0-25 mph	8.4 sec.
Top Speed	38.4 mph
Noise @ Idle/WOT	71 dBA/96 dBA
Best Cruise	
Range	11.8 mpg @ 4500 rpm
Price	\$6950

JOHNSON 50

Type/Cylinders	2-stroke/3
Displacement/Wt.	920cc/250 lb.
Bore x Stroke	3.19" x 2.34"
Gear Ratio	2.4:1
0-25 mph	6.5 sec.
Top Speed	40.3 mph
Noise @ Idle/WOT	73 dBA/96 dBA
Best Cruise	
Range	7.1 mpg @ 3500 rpm
Price	\$5846



Mercury, Yamaha puts its own stamp on the new F-50. Yamaha utilizes a smaller 2.2-quart oil sump, which saves weight but forces the oil to work harder. The smaller sump also makes room for a maze-type muffler that reduces exhaust noise before it exits the idle relief on the back of the pan. The system works—at trolling speeds the Yamaha F-50 was much quieter than other motors in the test.

The Yamaha delivered about the same fuel economy and acceleration as the Mercury, but was 3 mph slower at top speed. This was partially due to Yamaha's choice of a lower mounting position on the transom and a lower-performance propeller. Boaters who raise the motor on the transom and seek out a high-performance prop will probably gain several mph.

Notable features on the Yamaha F-50 include a transom bracket that incorporates an ultraquiet dual-piston trim pump, a new gear case with lower water pickups that allow the motor to operate at a higher angle in shallow water and a slightly higher gear ratio than the Mercury.

The Yamaha F-50 has a suggested

retail price of \$6950, about \$400 more than the Mercury, but that price includes a tachometer, a trim gauge, control box and fuel tank—plus two years of warranty coverage.

Johnson 50

As expected, the Johnson 50 displayed both the advantages and disadvantages of current 2-stroke technology. One surprise, though, was in weight: The Johnson 50 (also available as an Evinrude) is a 920cc triple that tips the scales at a surprisingly hefty 250 pounds, which is 35 pounds more than the heaviest 4-stroke.

The Johnson 50 matched the performance of the fastest 4-stroke by topping out at 40.3 mph, just a tick slower than the Mercury 50. However, where the Johnson really shines is in bottom-end power, where it is able to turn a 20-in.-pitch prop and plane the Whaler at 3000 rpm (the 4-strokes needed 3500 rpm to plane off). It raced from 0 to 25 mph in just 6.5 seconds, 2 seconds faster than the 4-strokes. A low gear ratio (2.4:1) and the ability to make its peak horsepower at lower rpm also gave the Johnson

a much snappier throttle response.

Not surprisingly, the 2-stroke couldn't come close to matching the fuel economy of the 4-strokes, and it smokes noticeably at idle, especially after a cold start. However, with a suggested price of \$5846, the Johnson 50 costs \$1100 to \$550 less than the new 4-strokes, although that price does not include a control box, instruments or prop. It does include the very quiet FasTrak midsection and trim pump, a 12-amp alternator, a fast-idle ignition advance for quicker starts and a rev-limiter for engine protection.

So, does the outboard have a 4-stroke future? These new motors are proof that a 4-stroke can compete with current 2-stroke technology, at least in this power category, and offer significantly better economy. OMC, however, is not convinced, and is investing heavily in direct-injection 2-stroke technology for motors over 15 hp. OMC believes its innovative motors will deliver the same economy and low emissions as a 4-stroke with better performance, especially on the important low end of the powerband. Sounds like the basis of a future test. **FM**

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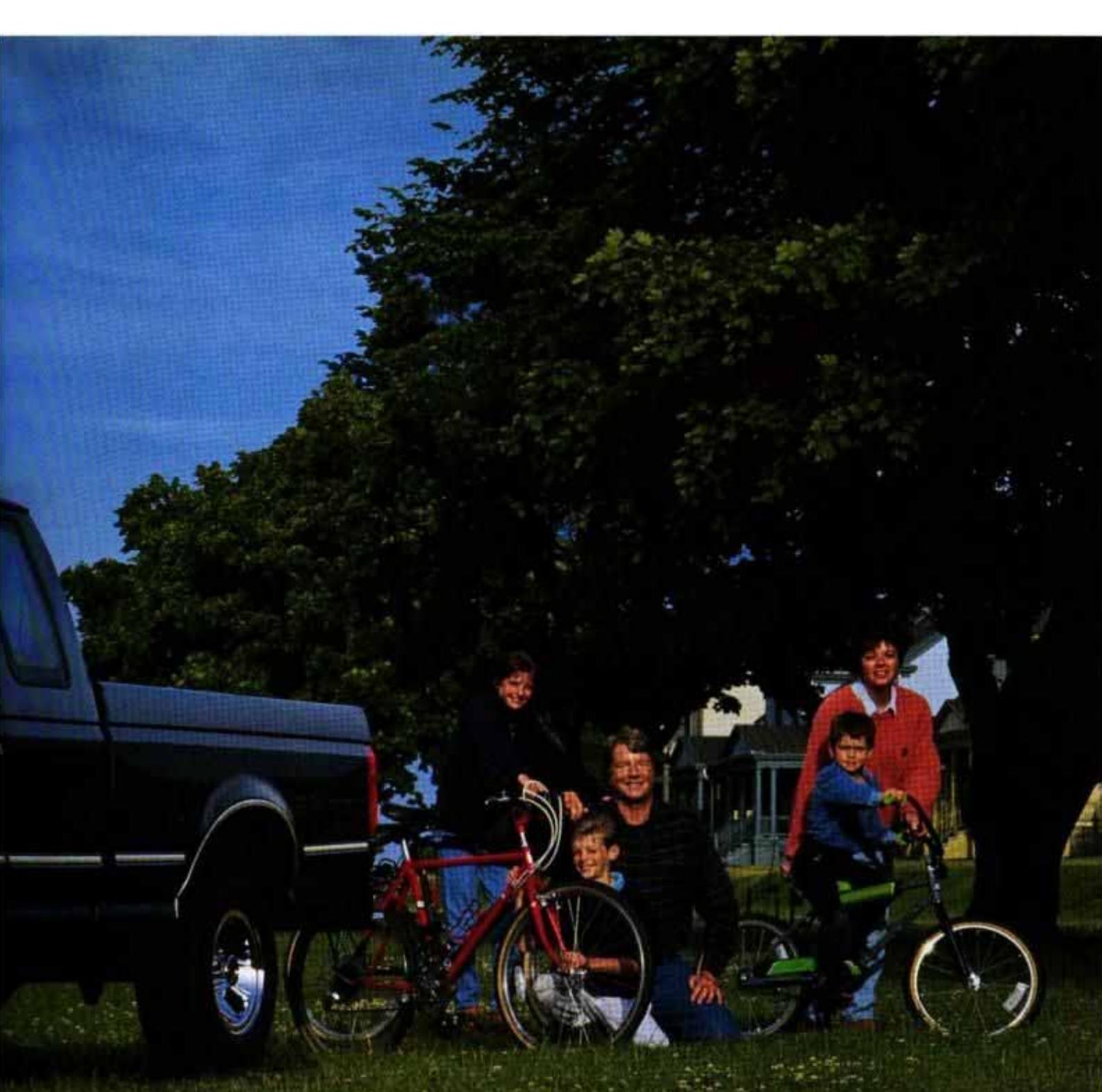
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7.5 DL V-8 EPA est. 15 city/20 hwy. mpg. **Airbag on models under 8500 lbs. GVWR. Always wear your safety belt. †Based on 1977-1993 CY manufacturer's reported

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THE VIRTUAL OFFICE

With telecommuting becoming more common, cyberspace becomes the next workspace.

BY GEORGE MANNES; PM Photo by Michel Tcherevkoff

• If you were to ask Rocky Mortensen why he used to go into the office every day, he would have a quick answer for you. "Because that's the way it was done," says the salesman who works for Pacific Bell. "That was basically the expectation—that you showed up at 8 o'clock and stayed 'til 5, or later."

But that's not the way it's done anymore. Instead of driving half an hour to get to his office on time, he walks over to the desk in a corner of his bedroom and phones his office for his voice mail. Instead of reporting to his office before each sales call to pull information out of a company database, he can just open up his notebook computer to get the information he needs—whether he's at home, a satellite office or anywhere else there's a phone jack. And after selling a customer on a new service, he doesn't have to go back to the office, print out an order memo and then return to

his customer for a signature—giving the customer all too much time to reconsider the purchase. Rather, Mortensen can print out an order memo with his portable inkjet printer and get the signature before anyone has a chance to say, "I've changed my mind."

But perhaps most emblematic of Mortensen's new way of working is what he's lost in the transition: an office. When he actually shows up in the Pasadena office out of which he's based, he doesn't have a desk and a chair to call his own. Instead, he shares one with another account executive. After all, if he's showing his face at work just one day a week he doesn't need furniture to gather dust the other four.

Welcome to the virtual office (VO). It has no coffee, no water cooler and no receptionist to wave to on the way to your desk. But once untethered from the traditional office, virtual workers enjoy improved



THE VIRTUAL OFFICE



tivity, a more flexible work schedule and less time wasted sitting in traffic. And their employers save money on real estate because they don't have to provide a separate workspace for each of their employees. Not only Pacific Bell, but other companies such as AT&T, Xerox, American Express and the advertising agency Chiat/Day Inc. have embraced variations on the virtual-office idea.

Meanwhile, more technologies are in the works to create electronic environments that substitute for the real thing—virtual workspaces, if you will. One type is videoconferencing: talking face to face with someone who is across the street or across the country. Though videoconferences formerly required hardware costing hundreds of thousands of dollars, soon they could be viable with computer hardware as inexpensive and widespread as CD-ROM drives. Another office on the electronic frontier is an on-screen computer desktop that you can rummage through electronically to find information, the same way that you pick through piles of papers in your office today.

While technology is the key to Rocky Mortensen's virtual office, this new way of working depends on more than a laptop computer, voice mail and a beeper. Many people in the business world have tools of the trade such as these, but they don't have a

High-capacity telephone lines will make videoconferencing commonplace. All you need is a camera atop your computer.

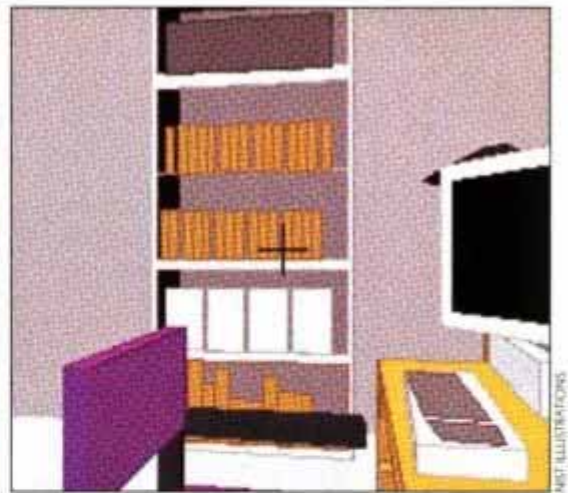
virtual office. What the VO requires is a particular attitude toward working, says Larry Nelson, a Pacific Bell regional sales manager who supervises the office that Mortensen works out of, as well as two others in the Los Angeles area. This type of setup is best for workers who don't need the social amenities of being in an office every day. Also, managers of these workers have to be comfortable about supervising them without seeing them. "Culturally," Nelson says, "it really represents a shift."

Salespeople for AT&T Network Systems supervised out of a New York City office seem even less attached to a conventional office than the Pacific Bell salespeople. In fact, 50 of the salespeople share eight workstations that have been set aside for them. And yet they never overload the office facilities, says Harold Van Woeart, manager of business planning and services for AT&T Network Systems. Van Woeart does acknowledge that virtual-office workers can suffer from feelings of isolation. That's why, he says, they need to gather on a regular basis. "You have to have formal employee events," he says.

Though feelings of loneliness are to

be expected among virtual-office workers, there's no going back to the old way of doing business, says David House, a senior vice president with American Express Travel-Related Services. A manager of the field sales force that persuades businesses to accept the American Express Card, House has 120 salespeople working out of virtual offices, and plans to convert 230 more to the new arrangement. To make it easier for employees to use their home as home base, they have Apple PowerBook portable computers, portable printers, fax machines, a cellular telephone allowance of 100 minutes per month and an allowance of \$1000 for anything that's necessary to set up a home office. Despite these outlays, House estimates that American Express saves more than the \$5500 it would have spent per employee per year on real-estate costs. And because of high employee satisfaction with the virtual workplace, House says, "If I made the reverse decision, I'd have mutiny."

While these companies and others, such as Xerox, have used the virtual-office idea with a sales force that's expected to be on the road much of the time, the advertising agency Chiat/Day has gone virtual with its not particularly mobile staff. Starting last year in its New York and Los Angeles offices, the company eliminated personal offices, according to managing



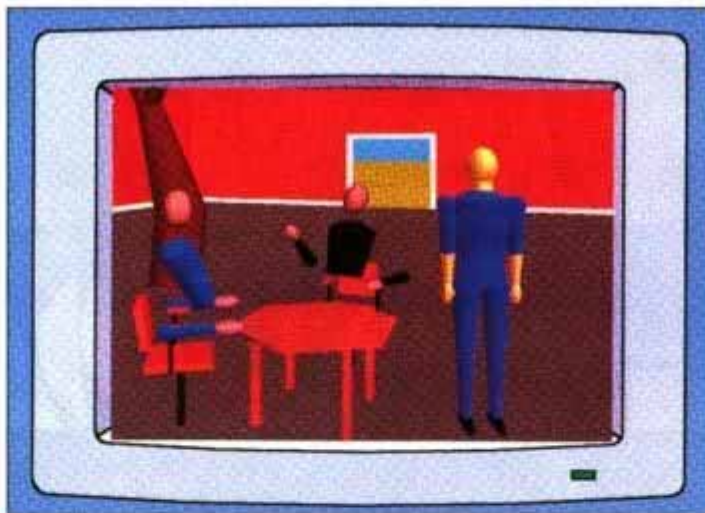
This virtual-office interface would allow you to get information just by clicking on various items in the room, thus making navigation easier.

director Adelaide Horton. When employees show up in the morning, they go to a "company store" where they pick up a cordless phone. Once they enter their extension number into the phone, the company's wireless phone system routes all their incoming calls to them, no matter where they are in the building. Instead of working out of an individual office, they might go to a room devoted to the business of a particular client, to a small project room or to a resource room, such as an editing facility, electronic studio or library. They might hook into Chiat/Day's computer network via a portable computer or via a desktop computer in a communal study carrel. The new arrangement for each person, Horton says, is "really a focus on what I have to do, rather than where am I supposed to go."

But don't people have a basic need, if they're working in an office—and especially if they're in a creative profession—to personalize the space in which they work? Can they live without a space to display a picture of their family, an interesting-looking postcard or a bizarre news item clipped out of the *National Enquirer*? "You still have your locker and the ability to decorate the outside of the mailbox," Horton says. But maybe that isn't enough. Horton says the company is developing an electronic workspace, so that when Chiat/Day employees sit down at any computer in the building they can call up a customized screen arranged and decorated exactly the way they like it.

A whole other type of virtual office has been developed by a project manager at the National Institute of

Standards and Technology (NIST), an agency of the U.S. Department of Commerce. In the prototype developed by Sandy Ressler and others at NIST, a computer user navigates through an office pictured on his or her computer screen to access World Wide Web sites on the Internet. This type of organization is very intuitive, Ressler says, because we tend to organize information spatially in real life. For example, he says, though piles of papers clutter up his office, "I



At this virtual meeting, people remotely control their on-screen representatives using a special sensor jacket that relays body motions.

know that one particular pile is a little more timely than another."

In one incarnation of this type of virtual office, Ressler says you could put a dinosaur figurine on one shelf in your on-screen office. Then, when you clicked on the dinosaur, it could access an electronic dinosaur museum via the Internet. An on-screen office—complete with images of shelves, drawers and files—could be a better "front end" to information than lists, Ressler says, because our memory of 3-dimensional spaces is better than our memory of 2-dimensional ones.

As computers become more powerful and certain telephone technology becomes more widespread, another element of business life—the face-to-face meeting—is going virtual, too. For people who already have a Macintosh or Windows-compatible computer, the cost of setting up as one-half of a videoconference can be less than \$3000—quite a feat, when you consider that a teleconferencing conference room cost \$200,000 in 1987, according to John Walsh, senior vice president, corporate planning and strategy, for Compression Labs, a maker and marketer of videoconferencing systems.

Why do people need computer-based videoconferencing, which allows people to share their image as well as voice and data? Most people gather a majority of information visually, Walsh says. Beyond that, "We operate in some number of cases better when we see a reaction," he says. One of these cases, Walsh says, would be that of a stockbroker explaining investment alternatives to a client in a computer-based videoconference that allowed the broker and client to look at data in a spreadsheet program together, as well as see each other. In such a call, the broker could discern more quickly whether the customer liked a particular alternative just by gauging the client's facial expression.

While a few thousand dollars might be too much to pay for this privilege, Walsh predicts that by the end of the 1990s, personal computers will be so powerful that videoconferencing could be nearly built in. The primary cost will be to put a

COMPARISON TEST



CHEVY VS. FORD

The classic confrontation filters down to the latest SUVs.

BY DON CHAIKIN, Automotive Editor; PM Photos by Greg Jarem

• It's a classic rivalry that dates back decades, nearly to the dawn of automotive time. On dusty ovals, on paved quarter-mile strips, on high-banked super-speedways and at nearly every traffic light in this country, Chevrolets and Fords have gone head to head. Now in the concerned 1990s, the battle is taking place in shopping-mall parking lots, suburban driveways and school loading zones, as the compact sport/utility market boils as a hotbed of competition.

This particular competition, as has been the case with much of the fierce Chevy versus Ford rivalry, is more than simply one between a couple of products in a given market segment. For one thing, Chevrolet arguably created the compact sport/utility market when

it introduced the original S-Blazer back in 1983. For another, over the past few years, the Ford Explorer has been the best-selling vehicle in that market.

And, as the way the world goes, both Chevrolet and Ford have new compact sport/utility vehicles for '95. Naturally, we had to take the new Blazer and the new Explorer and wring them out together.

Both of our vehicles were trimmed better than average, the Blazer coming as a relatively high-line LS version and our Explorer wearing the nearly full-tilt Eddie Bauer garb. Both vehicles had 4wd, V6 engines and automatic transmissions. And since we wanted them to be representative of the heart of this market, both were 4-door models. Due to their slightly different trim levels,



—AGAIN!

the vehicles were within \$5000 in price. Yet despite their head-to-head competition in the marketplace, and regardless of all of their obvious similarities, we found the Blazer and the Explorer to be quite different.

Chevrolet Blazer LS

The old S-Blazer may well have started it all back in 1983, but time and competition had passed it by. Assorted tweaks and facelifts over the past decade helped keep the Blazer in the hunt, but with each passing model year, its age was showing just a mite more.

Well, in one fell swoop, Chevrolet has leapfrogged back to a position in the head of the pack.

Of course, the Blazer shares that position with its kissing cousin, the GMC Jimmy. Since the beginning, the Jimmy and Blazer have shared all their essential dimensions, beneath-the-skin engineering and much of the face that they each present to the public. So the

current Jimmy is equally deserving of any praise heaped here upon the Blazer.

Clearly the first thing you notice that's new about the Blazer is its appearance. Like its engineering, the Blazer's styling is strongly reminiscent of Chevy's recently revamped S-Series pickup truck.

The result is a modern, aerodynamic and gutsy-looking vehicle. More importantly, it's got a squat, tough and seriously stable look. And because one of the most frequently cited reasons for buying a compact sport/utility is the peace of mind that comes from secure all-weather handling, that look is of more than casual importance.

It's also more than a look. The Blazer backs up its stance with nimble, predictable handling. There should be no surprises when Mr. Oblivious backs his Gremlin out of his driveway in front of your Blazer, even if there are several inches of packed white stuff

CHEVY vs. FORD—AGAIN!



CHEVROLET BLAZER LS

SPECIFICATIONS AND DIMENSIONS

MANUFACTURER/ MODEL	BASE PRICE/ PRICE AS TESTED	ENGINE/ DISPLACEMENT (ci/cc)	ENGINE HP, NET/ TORQUE (ft.-lb.)	ENGINE/ DRIVE LAYOUT	TRANS- MISSION TYPE	WHEELBASE/ LENGTH (in.)	TRACK FRONT/REAR (in.)	WIDTH/ HEIGHT (in.)	HEAD-, LEG-, HIPROOM, F/R (in.)	CURB WEIGHT (lb.)/ WEIGHT/HP RATIO (lb./hp)
Chevrolet Blazer LS	\$21,953/ \$26,113	V6 OHV 262/4293	195 @ 4500 rpm/ 260 @ 3400 rpm	front/ 4wd	4-speed automatic	107.0/ 181.2	57.2/ 55.1	67.8/ 67.0	F: 39.5/42.4/52.0 R: 38.8/36.1/51.7	4071/ 20.88
Ford Explorer Eddie Bauer	\$30,000/ \$30,880	V6 OHV 245/4015	160 @ 4200 rpm/ 225 @ 2800 rpm	front/ 4wd	4-speed automatic	111.5/ 188.5	58.8/ 58.6	70.2/ 67.0	F: 39.9/42.4/52.4 R: 39.3/37.7/51.9	4189/ 26.18

1. Times from a steady-state 40 to 70 mph. 2. Best speed achieved while weaving through eight cones 100 ft. apart. Speeds provide index of transient response.

on the street. Just in case Mr. Oblivious doesn't give you enough time to go around him, it's comforting to know that the Blazer has GM's latest ABS-VI disc/drum antilock system. It also has a driver's-side airbag, but let's not worry about that.

All Blazers have an independent wishbone-type front suspension. The 4wd models have torsion bar springs, the 2wd models use coil springs. Combined with the variable-ratio power-assisted recirculating-ball steering, the front wheels simply do what you ask them to do, pretty much when you ask it of them. And straight-line performance is accurate and steady—something that helps boost driver confidence since you don't have to constantly saw at the wheel to keep those front tires pointing straight.

The rear wheels are attached to a solid axle suspended by leaf springs.

With its relatively low center of gravity, wide track and nice wheelbase, the Blazer really does not develop any nasty habits as you put it through its paces. And it rides more like your old Caprice station wagon than like the old S-Blazer. In fact, Chevy's engineers specifically made

the Blazer carlike in its ride and handling. Just to help you understand the philosophy behind the Blazer's design, consider its tires: Of the five different available tire sizes and types, there's only one on/off-road type offered. All the others are all-season passenger-car tires.

One of the bonuses of that carlike ride and lowered center of gravity is a lower step-in height. No stepladders or running boards are needed to get into or out of the Blazer, front or rear. Yet, once seated behind the wheel, you still have the same commanding view of the road that Capt. Kirk has of the "final frontier."

You'll also have as much room around you as Kirk has on the bridge. Along with the new body and stance, the Blazer has more room inside, especially in the rear seat. There's more front headroom, and more hip and shoulder room all around. Cargo room is enhanced, too, now that the spare tire is mounted beneath the body, pickup style. While some die-hard off-roaders mightn't relish the prospect of climbing under to lower that spare when their Blazer is axle deep in mud, the vast majority of owners will ap-

preciate the extra cubic feet behind the rear seat for those sacks of groceries or soccer equipment. Remember, folks, this is the Blazer of the '90s. Hey, the rear cargo opening was created to accommodate a boxed washing machine, okay?

The interior is not only more spacious, it's user-friendly. There are cup holders—front and rear—storage pockets, bins, downright easy-to-read gauges and simple-to-find and use controls. Even sliding from 2wd into 4wd is a shift-lever away.

All 4wd Blazers are equipped with GM's Insta-Trac system, which allows you to shift between 2- and 4-wheel drive at any speed. Though few Blazers should ever need it, there is a 4wd LOW range for climbing very steep grades or slogging through doorsill-height muck.

All Blazers are also equipped with a 4.3-liter V6 engine. The throttle-body injection engine is essentially an improved version of what used to be offered as the Enhanced V6 in the old S-Blazer. Some important but non-radical tweaks—including the use of a new camshaft and hydraulic rollerlifters—help the pushrod engine put



FORD EXPLORER EDDIE BAUER

TEST RESULTS

STEERING RATIO/TYPE	TURNING CIRCLE (ft.)	WHEELS/TIRES	BRAKE SYSTEM FRONT/REAR (in.)	FUEL ECONOMY (MPG EPA city/hwy.) PM TEST	ACCELERATION 0-60 MPH (sec.) ¹ 1/4-MILE (sec. @ mph)	PASSING ² ACCELERATION 40-70 MPH (sec.)	BRAKING 60-0 MPH (ft.)	700-FT. ³ SLALOM MPH	200-FT. ³ SKIDPAD (lateral g)	PM ⁴ SERVICEABILITY INDEX
Variable/Power recirculating ball	38.3	15 x 7-in. alloy/ 235/70R15	Disc/Drum ABS 10.5-in. vented/9.5-in.	16/21 16.4	8.69/ 16.41 @ 82.18	10.9	124	53.9	.74	8
17.0:1/Power rack & pinion	40.4	15 x 6-in. alloy/ 255/70R16 A/T	4-wheel disc ABS 11.36-in. vented/11.22-in.	17/21 13.2	10.49/ 17.46 @ 77.37	11.1	120	55.0	.79	8

3. G-force generated during steady-state travel around a 200-ft. dia. circle. Number is an average of best cw and ccw. 4. Based on 12 basic maintenance functions.

out 195 hp at 4500 rpm and 260 ft.-lb. of torque at 3400 rpm. And it works very well, thank you for asking. In fact, the 4.3-liter V6 is much of what makes the Blazer feel so light on its feet. The torque is there practically from idle, and the V6 winds happily to the power peak before it runs out of breath. But by then you're on the freeway, well past the tanker trucks and, if you're not careful, already in some radar-packing trooper's sights.

All 4-door Blazers have a 4-speed overdrive automatic attached to the engine. Later this year, 2-door versions will be offered with a 5-speed manual. Like the engine, the 4L60-E transmission has been given a thorough massage. And like the engine, it has benefited. Shifts are crisper, better timed and performed with less fuss and intrusion.

The result of all of this is a very practical, easy to use, comfortable and cozy, versatile, all-weather station wagon that happens to be built on a truck's ladder frame and can be had with 4wd and is capable of towing 5500 pounds. We think most folks will be very happy spending time inside a new Chevrolet Blazer.

Ford Explorer Eddie Bauer

Ford may have been late to the 4-door compact sport/utility market when it replaced the archaic Bronco II with the Explorer back in 1990. But it has more than made up for it by selling all of the Explorers it has built since Day One.

And when Ford set about redesigning the Explorer, it took care not to engineer away those features that most people liked—the combination of ride and handling and lots of good, usable interior space.

Rather, Ford set about raising the bar in the field. So the new Explorer boasts such important attention-getters as dual frontal airbags and 4-wheel disc antilock brakes.

Oh, did we mention the new front suspension and resulting new look?

Ford is finally replacing its venerable Twin-I Beam (or more accurately Twin Traction Beam on 4wd vehicles) suspension. Under the hood of the '95 Explorer, 2wd or 4wd, you will find a modern upper and lower wishbone-type suspension. You'll also find a new power-assisted rack-and-pinion steering system. The result of this not-so-minor step into the present is a tidier,

more compact package that allows more room under the fenders for bigger tires—despite the fact that the fenders and the hood are lower, more sloping, more aerodynamic and more stylish than before.

In fact, with a new hood, grille and front fascia to go along with the new fenders as well as complementary taillights, the Explorer is more handsome than the old. Yet it has lost none of the subdued masculinity that has been one of its strong appeals since its introduction.

In fact, despite the lowered front end, the Explorer is as tall—and wide—as it has been. And when parked next to, say, a Blazer, you really notice the Explorer's size. Many buyers really appreciate that added height, equating it with security and a serious take-charge attitude. Despite its height, climbing in and out of the Explorer is still not limited to the Sir Edmund Hillarys of the world, but it is a bit more of a stretch than is the Blazer. And as you make your daily rounds, you'll also find that the Explorer's ride is a bit more trucklike than carlike—certainly not nearly as refined as the Blazer's, but

CHEVY vs. FORD—AGAIN!



Chevy's 4.3-liter V6 is a potent, tractable powerplant.



Blazer has lots of cup holders and Scotchgard-protected seats.

not a tooth-loosener by any stretch.

Yet once inside, there's scads of comfortable room to be found. There's also a newly designed dashboard and instrument panel that should put any Taurus driver to immediate ease. The look is modern, the controls well laid out and the gauges all visible and ergonomically proper.

Of course, key among those controls is the steering wheel. And since that's tied to the new rack-and-pinion gear, it works amazingly well. Despite the Explorer's looming profile, it simply scoots around corners and through traffic with an amazing finesse. The Explorer stays planted and just goes where it should, probably more quickly than most drivers will ever ask it to. And should something unwarranted disrupt your best laid plans, the predictable Explorer just refuses to get upset as it goes around what it's meant to go around. Our test vehicle was equipped with heavy-cleated road tires—hardly the first choice of your average slalom test driver—yet it scooted through the pylons in a very big, very safe and ultimately rather boring hurry. And where slaloms are concerned, boring is good, very good.

The disc brakes at each wheel, compliments of the ABS, were likewise boring in their efficacy as they just stopped the Explorer in a straight line in a minimum of fuss, time and distance.

Unfortunately, while boring is also good for brakes, it's less good for an engine. And with its size, poise and grace, the Explorer seems just a bit shortchanged by its drivetrain. The Explorer, like the Blazer, offers just one engine, a V6. And, like the Blazer, that engine is usually mated to a 4-speed electronically controlled automatic, though it can be equipped with a 5-speed manual. However, the V6 in the Explorer—from Ford of Europe—gives away some displacement to the Chevy, 4.0 liters versus 4.3 liters. It also gives away 35 horsepower and 35 ft.-lb. of torque. The Explorer's performance is more than adequate, really, but it's simply a step behind the Blazer's. Given the fact that the Explorer is hardly a lightweight—about 200 pounds heavier than the Blazer—the difference is felt each time you punch the throttle.

Along with the redesign, Ford is offering a new computer-controlled all-wheel-drive system, Control Trac,

in the Explorer. This system allows you to choose between rear-wheel drive and an automatic front/rear torque sensing and torque-splitting all-wheel drive. There's also a LOW range as part of the all-wheel drive for those times when you just have to keep going.

But like the Blazer, the Explorer's forte is out in the civilized world of (lots of) people and (bunches of) stuff toting, in all kinds of weather.

Like the Blazer, it's a big, easy-to-drive, versatile "station wagon" that's built tough on a pickup truck's separate ladder-type frame and can be had with drive power to both the front and rear axles.

Conclusion

While the differences are clear between them, both the Blazer and the Explorer are excellent vehicles.

The Blazer is a little smaller, has a somewhat more carlike ride and offers a bit more punch when it's punched itself—it also costs a bit less. The Explorer, on the other hand, offers some more room, a more imposing presence and the added benefit of a passenger's-side airbag.

From here, it looks like the great debate goes on.

FM



The Ford's 4.0-liter V6 does the job with a minimum of fuss.



Eddie Bauer-trimmed tester boasts leather upholstery.

COMPARISON TEST

WHO'S THE BOSS?



Browning says its new barrel-tuning system ups the ante for accuracy in deer rifles. We match it against the best in the .270-caliber class to find out.

• For the past 50 years, the gold standard for hunting rifles has been the ability to punch out 1-in. or smaller bullet groups in targets 100 yards away. But now, Browning claims it can substantially improve on this standard with its BOSS (Ballistic Optimizing Shooting System) centerfire rifles, and do it with over-the-counter ammunition.

In the past, serious hunters who wanted to become sharpshooters had to spend hundreds of dollars to tune a retail rifle or thousands to buy a custom-built masterpiece, and then hand-load ammunition that shot well in a particular gun. Browning claims this process is no longer necessary thanks to the BOSS—a com-

BY TODD WOODARD
PM Photos by Joe Giannetti

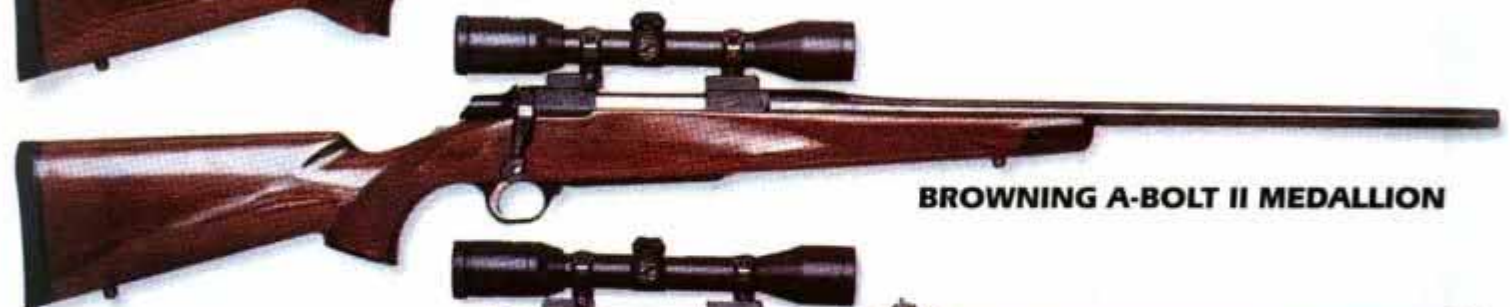
bination of sophisticated barrel bedding, vibration tuning and muzzle-brake compensation.

POPULAR MECHANICS liked the concept of the BOSS design. In fact, we gave it a 1995 Design & Engineering Award (see page 42, Jan. '95). But we wanted to see how it stacked up against similar models from other top riflemakers. We chose the popular .270-caliber rifle and assembled a test group that consisted of the Browning BOSS A-Bolt II Hunter, Browning A-Bolt II Medallion (a non-BOSS model), Remington Model 700 BDL DM, Ruger M77R Mark II and Winchester Model 70 Classic Sporter. Then we headed to a shooting range.

WHO'S THE BOSS?



BROWNING BOSS A-BOLT II HUNTER



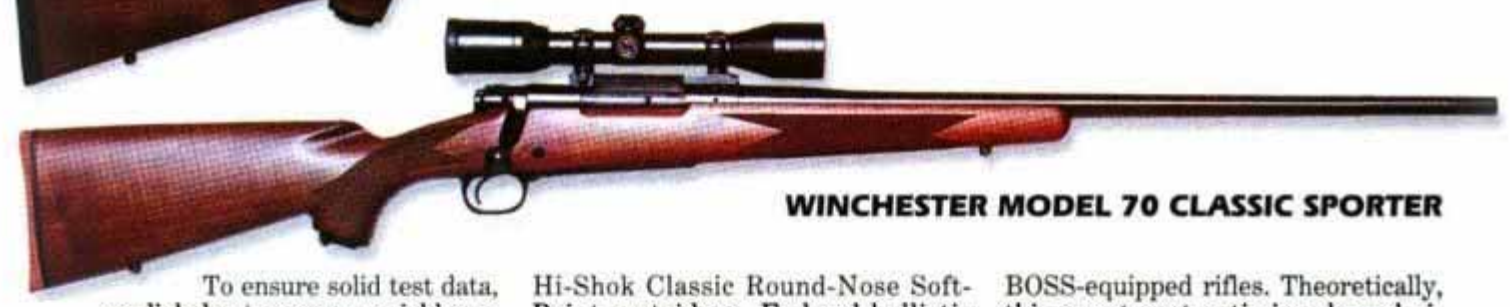
BROWNING A-BOLT II MEDALLION



REMINGTON MODEL 700 BDL DM



RUGER M77R MARK II



WINCHESTER MODEL 70 CLASSIC SPORTER

To ensure solid test data, we dialed out as many variables as possible. Using guns provided by the four companies, we fitted all five with Zeiss Diavari-C 3-9 X 36 T scopes. We shot the guns at Federal Cartridge Co.'s Anoka, Minnesota, plant, using Ballistic Alley No. 3, a 100-yard underground tunnel, for our test.

Additionally, Federal supplied identical lots of three different .270 Winchester cartridges: 130-Grain Sierra Boat-Tail Premium Soft-Points, 140-Grain Trophy Bonded Premium Soft-Points and 150-Grain

Hi-Shok Classic Round-Nose Soft-Point cartridges. Federal ballistic technicians and engineers fired five 3-shot groups for each gun, and the PM test team fired additional groups. Groups were measured with a Mitutoyo Digimatic caliper to thousandths of an inch. Here are the results.

Browning BOSS A-Bolt II Hunter

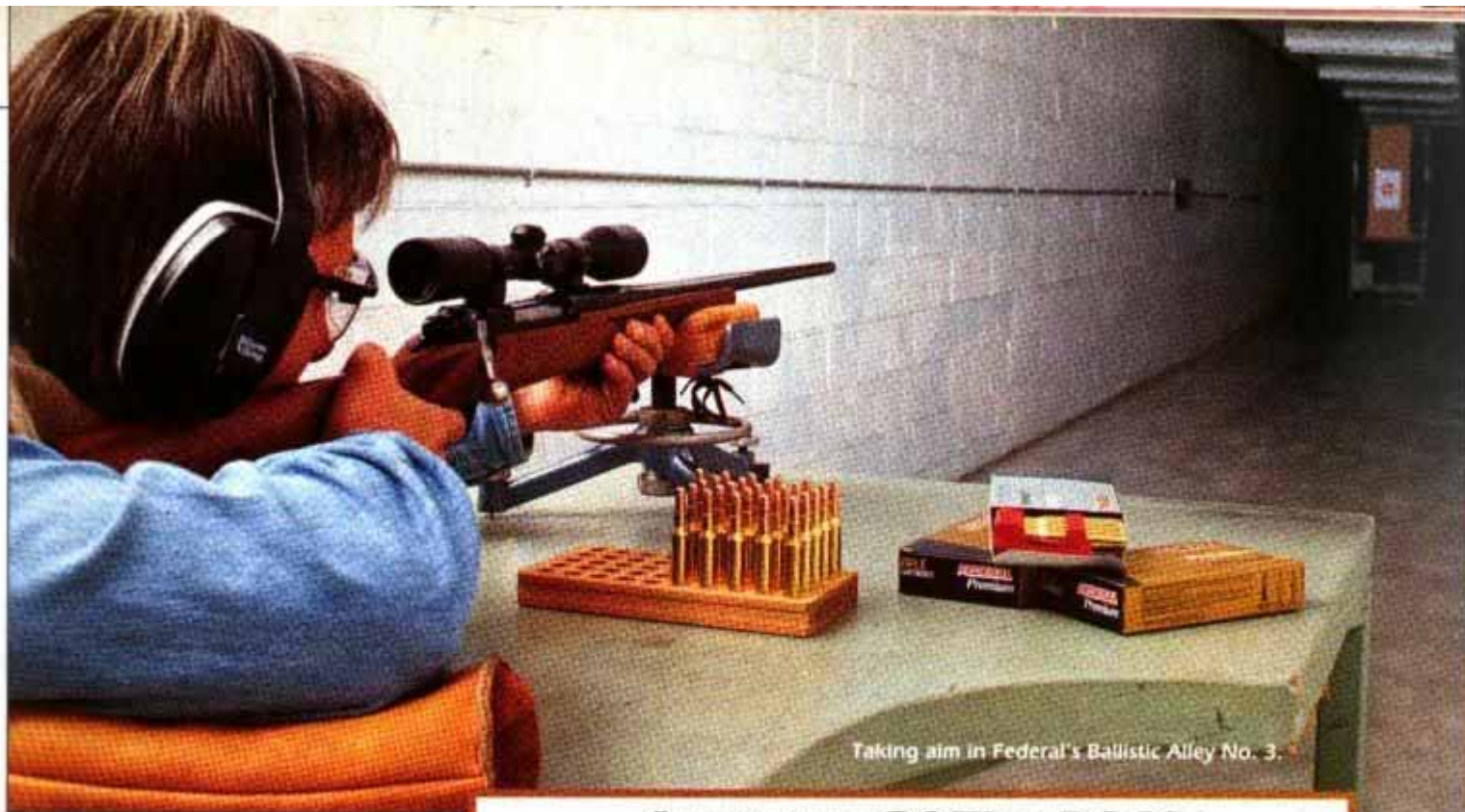
By selecting a setting from 0 to 10 on a screw-in/screw-out muzzle brake, the shooter is able to dial in a particular barrel/bullet sweet spot on

BOSS-equipped rifles. Theoretically, this sweet spot optimizes barrel vibration and leads to improved consistency from shot to shot. To Browning's credit, our testing bears this out, and the BOSS truly lives up to its lofty claims.

The three weights of Federal ammo we shot through the BOSS grouped at an incredible 0.45 in. (130 grain), 0.35 in. (140 grain) and 0.49 in. (150 grain). When we purposefully misadjusted the device—and even removed it—the gun still shot 1-in. and smaller groups. Impor-

SPECIFICATIONS AND DIMENSIONS

MANUFACTURER/ MODEL	PRICE AS TESTED	WEIGHT/ OVERALL LENGTH	BARREL LENGTH/ BARREL TWIST	BARREL & RECEIVER COMPOSITION/ OPEN SIGHTS	MAGAZINE TYPE	MAGAZINE CAPACITY/ BOLT TYPE	STOCK COMPOSITION/ GRIP STYLE	CHEEKPIECE STYLE/ FOREARM STYLE
Browning BOSS A-Bolt II Hunter	\$670	6 1/4 lbs./ 42 3/4 in.	22 in./ 1 in 10	Blued steel/ No	Hinged floorplate w/detachable box	Four/3-lug, 60° throw	Walnut/ Pistol	None/ Rounded
Browning A-Bolt II Medallion (non-BOSS)	\$673	6 1/4 lbs./ 42 3/4 in.	22 in./ 1 in 10	Blued steel/ No	Hinged floorplate w/detachable box	Four/3-lug, 60° throw	Walnut/ Pistol	None/ Rounded
Remington Model 700 BDL DM	\$603	7 1/4 lbs./ 42 1/2 in.	22 in./ 1 in 10	Blued steel/ Yes	Detachable box	Four/Remington Model 700	Walnut/ Pistol	Monte Carlo/ Rounded
Ruger M77R Mark II	\$574	7 lbs./ 42 1/2 in.	22 in./ 1 in 10	Blued steel/ No	Hinged floorplate	Four/Mauser nonrotating extractor	Walnut/ Pistol	None/ Rounded
Winchester Model 70 Classic Sporter	\$595	7 1/4 lbs./ 44 1/2 in.	22 in./ 1 in 10	Blued steel/ No	Hinged floorplate	Five/Mauser claw extraction	Walnut/ Pistol	Monte Carlo/ Rounded



Taking aim in Federal's Ballistic Alley No. 3.

tantly, the brake caused no drop-off in muzzle velocity.

This exceptional performance comes from not only the muzzle-brake device but also a special rubber bedding that suspends the barrel away from the rifle's forearm stock and damps gun-barrel vibration.

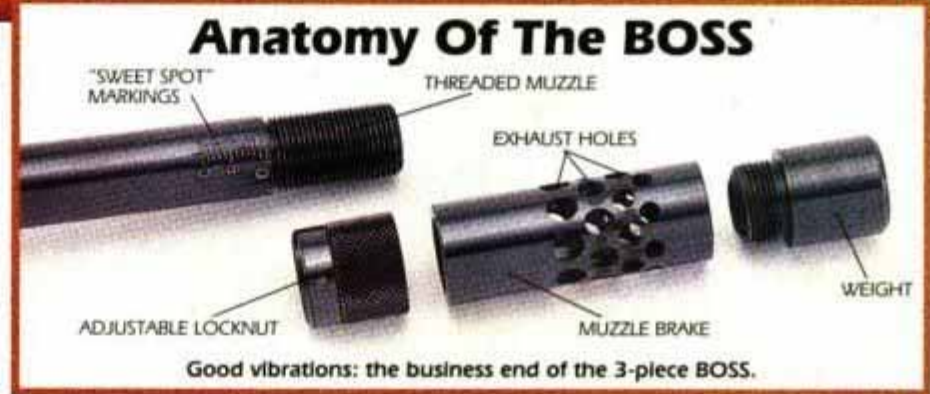
As well as being highly accurate, the rifle has a crisp trigger and a smooth, short-throw (60° rotation) bolt. Its deep grip and forearm checkering provide solid gripping surfaces, though we wish the forearm checkering wrapped under the stock.

Minor nits to pick include the BOSS's dark walnut stock with a high-luster finish, which might flash a warning to wary game, and although the muzzle brake lessened recoil, it also created more ambient noise.

But there's no doubt about it, BOSS-equipped rifles set a new accuracy standard that others will be hard pressed to match.

Browning A-Bolt II Medallion

Without the BOSS, the A-Bolt II Medallion couldn't fire quite as accu-



rately, but it was accurate enough to come in second by averaging bullet groups of 0.89 in. in size. We think the Medallion gained an edge over the other test rifles because, like the Hunter BOSS, it has a free-floating, bedded barrel.

Bedding a rifle to float the barrel away from the stock (which means the barrel only touches the stock at the front of the receiver) is a technique gunsmiths routinely perform to improve poor-shooting rifles. Wooden stocks can warp, because of changes in temperature and humidity, and the barrel, if in contact with it, can vibrate inconsistently.

Though we shot our test rifles in the environmentally controlled Federal facility, the Ruger, Remington and Winchester rifles occasionally strung shots vertically and horizontally as their barrels warmed and cooled. The Browning rifles didn't.

Except for surface cosmetics, the Medallion was the Hunter A-Bolt II's twin. The Medallion's slightly better trim level includes a lightly engraved receiver and magazine floorplate, rosewood grip cap and forearm cap and a highly polished barrel. As a highly accurate hunting firearm, the good-looking Medallion is hard to beat.

(Please turn to page 118)

TEST RESULTS

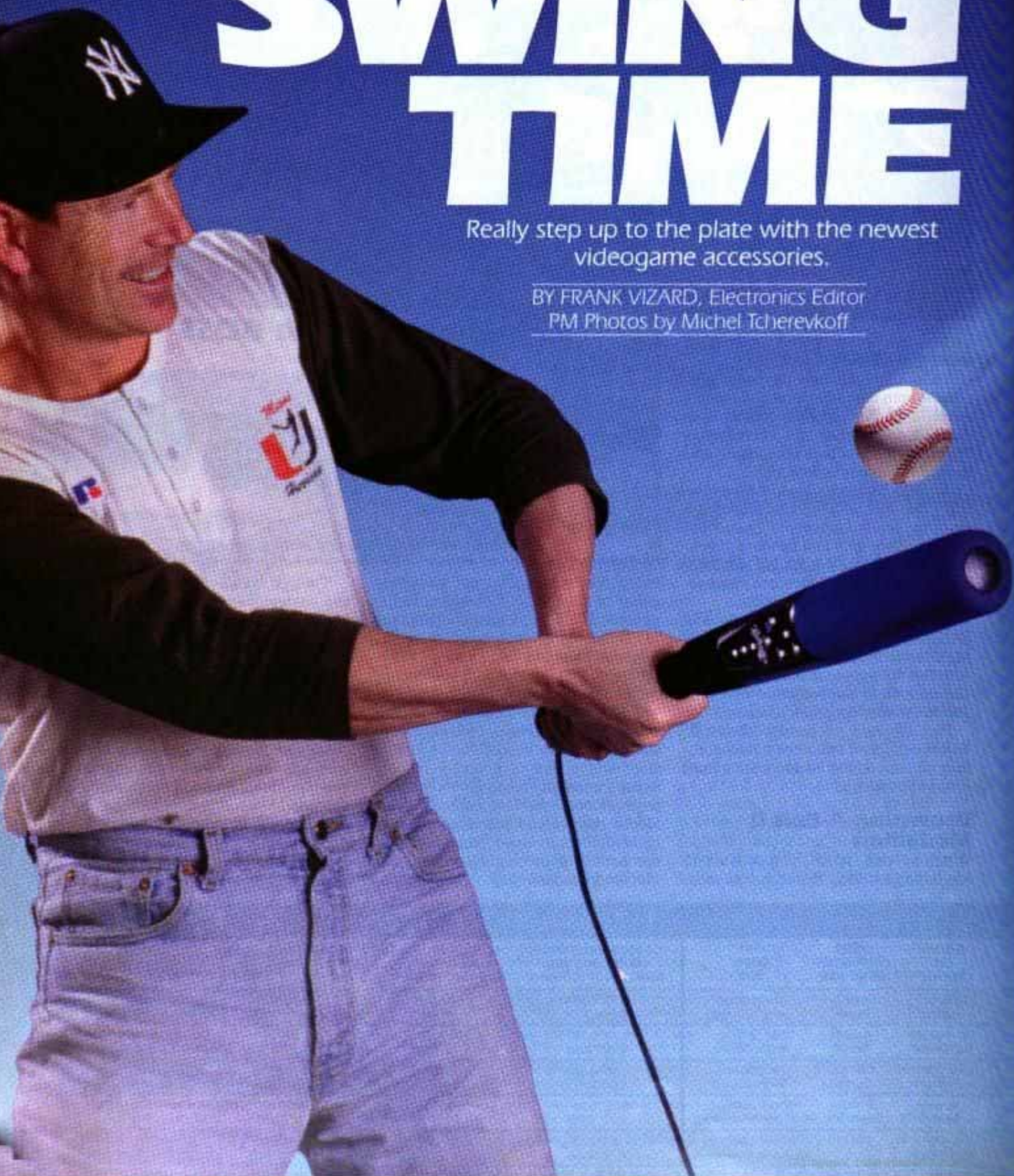
FOREARM CAP/ GRIP CAP	TRIGGER LET-OFF WEIGHT/ TRIGGER CREEP	SAFETY TYPE	130-GRAIN ¹ BULLET GROUPS AVG./MIN./MAX. SIZE/ MEAN VELOCITY (ft./second)	140-GRAIN ¹ BULLET GROUPS AVG./MIN./MAX. SIZE/ MEAN VELOCITY (ft./second)	150-GRAIN ¹ BULLET GROUPS AVG./MIN./MAX. SIZE/ MEAN VELOCITY (ft./second)	OVERALL GROUP SIZE/ EVALUATION
None/ None	4 lbs./ None	Two position, tang mounted	0.45"/0.32"/ 0.60"/2977	0.35"/0.28"/ 0.44"/2898	0.49"/0.24"/ 0.71"/2769	0.43"/Sets a new standard for accuracy
Rosewood/ Rosewood	4 lbs./ None	Two position, tang mounted	0.88"/0.76"/ 0.98"/3058	1.02"/0.86"/ 1.24"/2836	0.76"/0.44"/ 0.92"/2788	0.89"/Outstanding even without BOSS
Black plastic/ Black plastic	5 1/2 lbs./ Some	Two position, tang mounted	1.64"/0.85"/ 2.08"/2983	1.06"/0.63"/ 1.44"/2734	0.87"/0.53"/ 1.49"/2731	1.19"/Respectable overall, classic styling

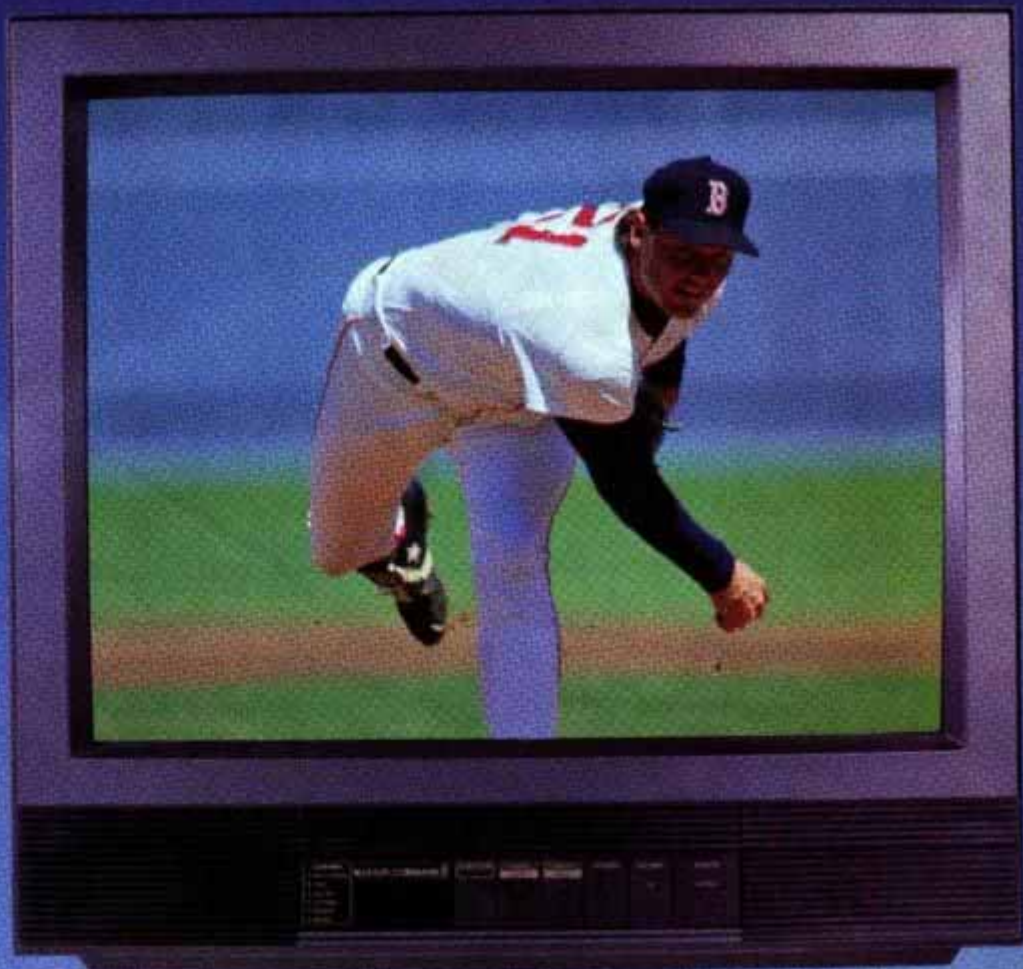
ELECTRONICS

SWING TIME

Really step up to the plate with the newest videogame accessories.

BY FRANK VIZARD, Electronics Editor
PM Photos by Michel Tcherevkoff





● Your palms sweat as you hold the bat because you know just what to expect. Roger Clemens is on the mound and you know he's going to throw a fastball. High heat. Nothing tricky.

Clemens winds up and here comes the pitch. Even though you're expecting it, you're still not prepared for how fast the ball is traveling. The ball is in the catcher's mitt before you can get the bat off your shoulder. You swing anyway, way late. Strike.

You pick up a clue, though. You'd better start swinging just as Clemens is releasing the ball. The next pitch is the same as the first. You swing and miss. Strike two. Your timing was a little better. At least the bat was out there as the ball went by.

Clemens, though, now thinks you'll swing at anything. He wastes one outside. Your impulse is to swing but you pull up. Ball one.

Clemens isn't impressed. So far you've shown him nothing. The heater comes again. You get around but you're still a little late. Somehow, though, you make contact and your heart leaps. But you've only hit a squibbler up the first baseline. Easy out. You're retired, but making contact whetted your appetite. But before your next at bat, you step into the kitchen for a cold soda.

All the action comes courtesy of a videogame on your television, but the realistic at bat is a function of a new

videogame accessory from Sports Science Inc. of Twinsburg, Ohio. The baseball bat is called *Batter Up*. For golfers, there is an electronic club called *TeeV Golf*.

Batter Up basically emulates the standard controller that comes with videogame systems. As you swing through with the bat, a mechanical device inside the blue-padded stubby bat advances the action just as your finger would by pressing a button on the hand controller.

Batter Up, which lists for \$70, has a variety of control buttons that will be familiar to any game user. Of major importance, though, is a set of four compatibility switches. While *Batter Up* works with any baseball videogame, different games require different switch sequences.

If golf is your game, then *TeeV Golf* lets you play indoors but, thanks to a simulated course on a videogame, it makes you feel like you're on the fairway. The electronic club is only 26 in. long but is weighted at the end so it has the feel of the real thing.

Instead of actually hitting a ball, however, what you're doing is lining up an infrared beam that passes over a sensor pad on the floor. How accurately and strongly you swing the club over the sensor determines the flight of the ball. *TeeV Golf* (\$129) is not compatible with every golf videogame so check before you buy.



With *TeeV Golf*, the club passes over a sensor pad, simulating contact with the ball.

OWNERS REPORT

FORD MUSTANG

The newest ponycar prances like the original.

BY MICHAEL LAMM, Contributing Editor
PM Photos by Rich Cox



● On April 17, 1964, the Ford Mustang appeared simultaneously on the covers of *Time* and *Newsweek* magazines and before the public at the New York World's Fair. That day many people fell in love with the car's sporty looks, affordable price and high fun quotient. Also that day, Ford sold 22,000 Mustangs. In the 30 years since then, Ford has put more than 6.1 million Mustangs on the American road.

Ford's 1994 ponycar picks up—and slicks up—a lot of the styling cues that came out on the original. And, not surprisingly, nearly 80% of our respondents told us that it was the Mustang's sporty, neoclassic body design that won their hearts and wallets.

Still young, after all these years

Recalling those innocent days, of course, is also a large part of what the Mustang is all about. A Missouri nutritionist observed, "I had a 1968 Mustang as a teenager. This new one makes me feel young again." And several owners admitted that the car satisfied their "midlife crazies." In all, 18.4% of our respondents had owned Mustangs before, and many still own and regularly drive their older ones.

Besides mimicking the design of the original, the

1994 version also pays tribute to the 1964 engineering. As with the original, the 1994 Mustang again offers 6- and 8-cylinder engines, coupe and convertible body styles and two basic series, the standard Mustang and the Mustang GT. The GT comes with Ford's 5.0-liter V8. The high-performance Mustang Cobra is an option package on the GT. It costs \$4560 additional but hadn't come out before we mailed our questionnaires. Nor had the 1000 Cobra convertible Indy Pace Car replicas.

Mechanically, this 1994 model goes back to 1979 when Ford began building the Mustang on the same platform as the Fairmont. The good news is that Ford engineers have done a lot of upgrading through the years, especially for 1994. The new coupe body is some 60% stiffer in bending and 45% stronger torsionally than the former model's. The GT adds crossbracing from the cowl to the strut towers. Variable and more compliant spring rates, a 20% increase in roll stiffness plus a relocation of the front crossmember for 2" more caster help rid the Mustang of some of its previous bad habits. Ride is more comfortable than in the past, and a number of the owners in our survey remarked that the GT offered a noticeably softer ride than its arch rival, the Chevrolet Camaro Z28.



Cabin boasts modern gauges, dual airbags.



Front comfort is good, rear is minimal.



Owners were closely split: V6 versus V8.



Thoroughly modern

All Mustangs now come with 4-wheel disc brakes, dual airbags, full gauges, center console, 4-way power driver's seat, power-assisted rack-and-pinion steering with a tilt steering-wheel column and a 5-speed manual transmission. The base convertible adds standard power windows, power door locks and a power trunk release.

With the GT you get, in addition, a limited-slip rear axle, foglamps, decklid spoiler, 16-in. alloy wheels and trim differences. The Cobra is essentially a fully dressed GT with a 240-hp V8 (versus 215 hp in the GT), bigger 4-wheel discs, 17-in. alloy wheels with Goodyear Eagle GS-C tires, standard ABS, a/c, suspension tweaks, white dial faces and Cobra-specific trim.

All coupes have split fold-down rear seats, but convertibles don't. Among the options available for non-Cobra Mustangs are antilock brakes, automatic transmission, air conditioning, 17-in. wheels, a hardtop for the convertible and upgraded sound systems, including a compact-disc player.

SUMMARY OF FORD MUSTANG OWNERS REPORTS*

Total miles driven	1,110,275	Handling	43.2	Excellent	70.9%	Yes	21.0
Average miles driven	4143	Engine power	37.7	Good	27.6	What type of trouble?	
Purchase price:		Comfort	24.5	Average	1.5	Transmission	14.3%
Average	\$18,431	Interior styling	16.7	Poor	0.0	Electrical	10.7
Range	\$13,000-\$27,600	Performance	16.3	Control layout:		Shifter	10.7
Why did you choose the Mustang?		Ride quality	16.0	Excellent	74.9%	Engine vibrations	7.1
Styling	79.2%	Specific dislikes:		Good	24.0	Repair it yourself?	
Owned Mustangs before	18.4	Tight rear legroom	20.7%	Average	1.1	No	98.2%
Price/value	14.1	No complaints	15.0	Poor	0.0	Yes	1.8
Handling	11.8	Not enough power	9.7	Instrumentation:		Dealer repairs satisfactory?	
Power	8.2	Trunk could be bigger	6.6	Excellent	76.3%	Yes	68.2%
Overall performance	7.5	Shoulder harness fit	6.0	Good	22.6	No	31.8
Ride quality	6.3	Noises and rattles	4.8	Average	1.1	Dealer service opinion:	
Model choices:		Fuel mileage could be better	4.8	Poor	0.0	Excellent	47.7%
Base Mustang	54.7%	Not enough front legroom	4.8	Driver sightlines:		Good	34.5
Mustang GT	45.3	Suggested changes:		Excellent	56.2%	Average	13.2
Body style choices:		More horsepower	18.5%	Good	35.4	Poor	4.6
Coupe	85.1%	No changes	7.7	Average	6.9	Dealer sales policy:	
Convertible	14.9	More interior space	6.5	Poor	1.5	Excellent	56.9%
Engine choices:		Lower rear decklid	6.0	Overall convenience:		Good	30.0
3.8-liter V6	54.4%	Improve harness comfort	5.4	Excellent	69.7%	Average	10.1
5.0-liter V8	46.5	Offer a more potent V8	4.8	Good	28.8	Poor	3.0
Transmission choices:		Relocate cup holders	4.8	Average	1.5	Number of vehicles owned:	
4-speed automatic	50.9%	More front/rear legroom	4.8	Poor	0.0	This vehicle only	23.0%
5-speed manual	49.1	More trunk space	4.8	Workmanship opinion:		Two vehicles	39.1
Options/Accessories:		Engine power:		Excellent	71.1%	Three vehicles	19.3
Air conditioning	100.0%	Excellent	61.7%	Good	27.1	Four or more	18.7
Cruise control	89.0	Good	35.4	Average	1.5	Principal driver:	
Power windows and locks	88.4	Average	2.2	Poor	0.4	Female	52.6%
Premium sound system	73.5	Poor	0.7	Comfort opinion, front seats:		Male	47.5
Antilock brakes	71.2	Handling:		Excellent	71.3%	Equal	4.0
Keyless entry	65.3	Excellent	78.3%	Good	26.9	Age distribution of owners:	
Alarm system	32.1	Good	19.2	Average	1.8	Under 29	36.8%
Leather seat trim	23.2	Average	2.2	Poor	0.0	30-49	46.5
Avg. mpg, city/hwy:		Poor	0.4	Comfort opinion, rear seats:		50-plus	16.6
3.8-liter V6	21.2/26.6	Braking:		Excellent	23.8%	Based on your experiences, would you buy a Ford Mustang if you had it to do over again?	
5.0-liter V8	16.7/22.1	Excellent	67.8%	Good	27.9	Yes	73.4%
5-speed manual	19.2/24.9	Good	29.7	Average	34.0	Maybe	21.9
4-speed automatic	19.2/24.4	Average	2.2	Poor	14.3	Mechanical trouble?	
Specific likes:		Poor	0.4	Excellent			

FORD MUSTANG



Modern styling picks up and makes the most of styling cues from the original Mustang, including the horse in the grille and cooling slots in the rear fenders.

EDITORS REPORT

Thirty Something

● It's kind of hard to believe, but like most of the people who own one, the Mustang is now more than 30 years old. The reason that it may be hard to appreciate that the Mustang is entering its fourth decade is because the car, like its owners, continues to exhibit the exuberance and panache of youth. And the current Mustang, introduced as a 1994 model, may be truer to the original Mustang's forever-young concept than any of the many iterations of ponycars since that original back in '64.

Like the original, the current Mustang is a well-balanced package of quick acceleration, nimble handling, head-turning good looks and plenty of comfort for two—the third, and, omigod, the fourth, pay the price for creating the crowd. Despite its popularity, this car was never about crowds, though, either inside the passenger compartment or in being a part of one.

This car is for one person, with or without his or her favorite other, escaping from the crowd, even if only during a long, slow-moving traffic-choked commute. And the Mustang allows you to do that by injecting you with instant youth. You get behind the wheel of a Mustang, and you're transported to the fun, carefree and less-stressful days that for many of us and for many Mustang owners (note that two-thirds of our respondents are more than 30 years old) are long gone.

And the current Mustang doesn't deliver this youth through blinding,

teary-eyed power like some of those that went before it. Of course, that fact probably disappoints a number of Mustang fans, especially those folks who think that the Mustang should be Ford's Camaro-eating rocket-sled. Sorry, but it's just not.

Oh, there's more than ample go under the hood, with the 5.0-liter V8, that is. (We personally don't really consider a V6-powered Mustang more than a cute commuter.) Of course, we definitely prefer the Cobra version that benefits from improved breathing among other engine tweaks for 25 more horsepower than standard. The Cobra also comes with a 5-speed manual, which is, in our opinion, the kind of transmission you need in a ponycar.

In addition to the power and the 5-speed, the Mustang's handling makes a monumental contribution to the Mustang's youth-producing elixir. The car is nimble without being darty, responsive and—unlike all of those front-drive sporty coupes—steerable with the throttle. Yes, you can still hang the tail out there and keep it there under power, balancing throttle and steering inputs, just like the old days. Just like the big boys.

But the Mustang has not lost any of its responsibility in its drive for eternal youth. The car has 4-wheel discs, with antilock the smart option. On the Cobra, those brakes are massive, by the way, with 13-in.-dia. rotors in front and 11.65-in. rotors in the rear. Naturally there are dual airbags, just in case.

—Don Chaikin

Is Six enough?

Though our surveyees were closely split, slightly more than half chose the base Mustang with the 3.8-liter V6. They were nearly evenly divided between the 5-speed manual and the 4-speed automatic transmission. The V6 engine is the same one used in the Taurus/Sable, Thunderbird/Cougar and Lincoln Continental, and it delivers 145 hp and 215 ft.-lb. of torque. In general, owners of the 3.8 V6 felt that acceleration and passing power were ample at highway speeds but a little sluggish off the line. A few V6 owners suggested making the supercharged 3.8-liter V6 from the Thunderbird Super Coupe available. Even some V8 owners wished aloud for more horsepower, now available in the Cobra.

The Mustang received excellent reviews in the area of handling. A Maryland service engineer noted, "Nice, small package that handles great. Gives plenty of warning when it's going to understeer and recovers by just letting off the gas for an instant." The 17-in. wheels and wide 245/45ZR tires, though, created lots of road noise.

Front-seating comfort was judged excellent by 71.3% of our respondents, but rear seats were deemed suitable for kids and pets only. A number of drivers suggested making the trunk larger and getting rid of the rear seats altogether. Not that many complained about the trunk. There's plenty of volume and more with the seatbacks folded. A few owners felt the trunk opening should be bigger, and a few more complained about poor rear vision because of decklid height, particularly with the spoiler.

Workmanship was judged good to excellent by 98.2% of our surveyees, and most agreed that Ford had indeed ranked Quality Job 1. In fact, owners of the convertibles said their cars were remarkably silent, considering that ragtops are always noisier than hardtops.

We heard a few gripes about paint sags and a louder gripe about the black plastic wiper grille cracking and having to be replaced under warranty. But only 21% mentioned true mechanical problems. Of those who did mention them, 14.3% had to bring their cars back for rough-shifting automatic transmissions, 10.7% cited electrical maladies and 7.1% noted engine roughness at idle.

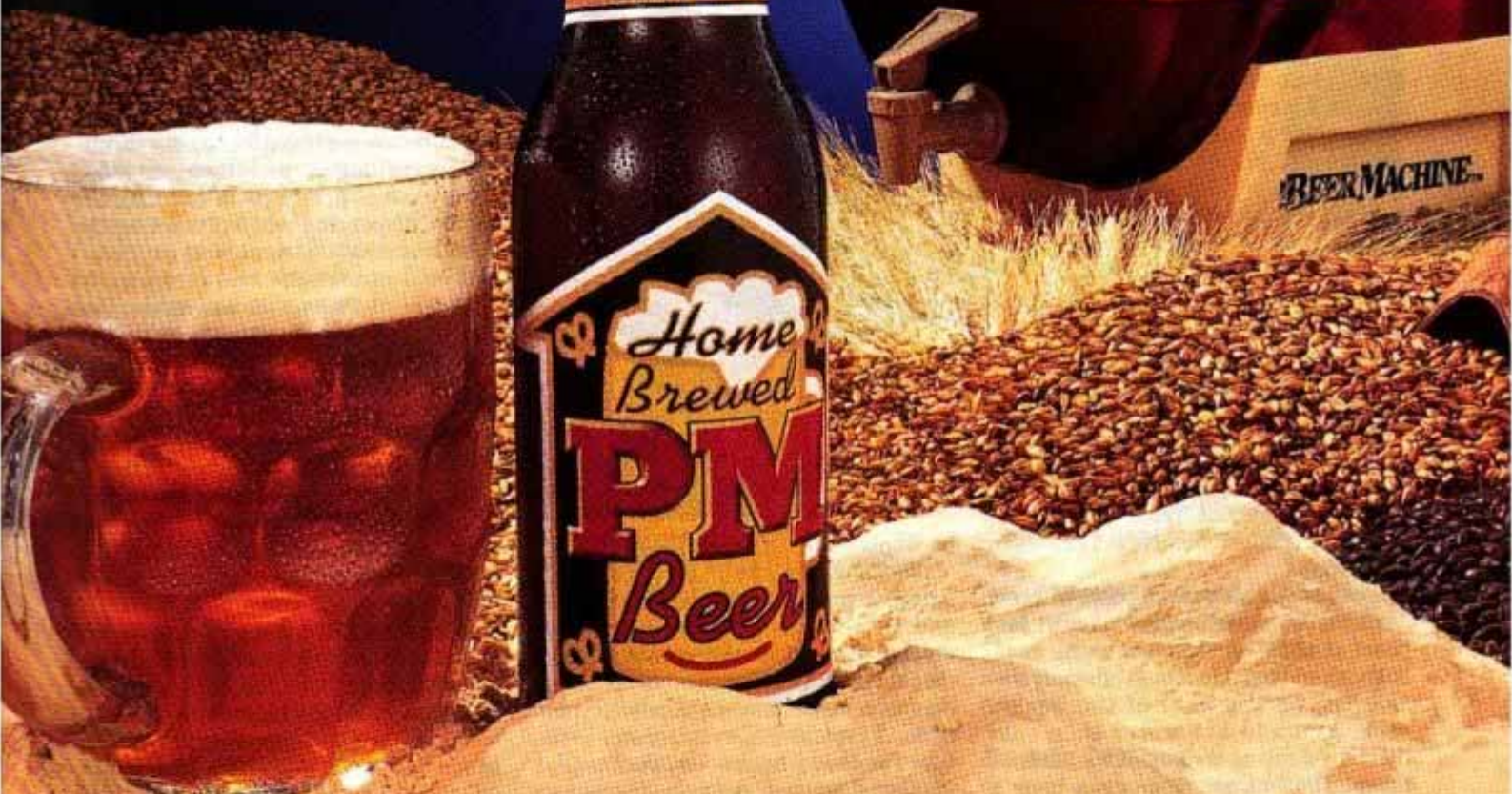
All these complaints, however, were drowned out by the enthusiastic shouts that Mustang owners heaped on their cars. "Mustang is a best buy dollar for dollar," said a Kentucky teacher who paid \$13,300 for her standard coupe. And a Michigan driver summed it up by saying, "It's just a beautiful car!"

BREW BY YOU

Kits make beermaking easier, but how's the taste? We make our own to find out.

BY STEPHEN A. BOOTH,
Contributing Editor
PM Photos by Spencer Jones

BEER SCIENCE



• George Washington did it. So did Thomas Jefferson. Samuel Adams got so good at it he went pro. Today, increasing numbers of Americans are taking their cue from these founding fathers and brewing their own beer at home.

Some historians say civilization began when nomadic hunter-gatherers learned they'd have to stay put while a batch of beer was brewing, then decided to stay put awhile longer. Maybe so, but there's no doubt that home brewing today accounts for a lot more men spending a lot more time in the kitchen. Since 1979, it has been legal to brew 200 gallons a year for household consumption. Home brewing didn't begin by that act of Congress—though sin taxes on the store-bought suds probably have given it a boost. Suppliers of homebrewing gear tell *POPULAR MECHANICS* that sales grew 25% last year alone.

Our interest piqued, PM shopped around for home-

brewing gear, and among the many variations we found four basically distinct systems. We bought the goods by mail order, just as you might, and went at it with no previous experience (brewing, that is) and no special assistance from the suppliers.

What we learned is that first-time brewers will have no hassles with these systems. The ingredients are prepackaged and premeasured to yield a certain quantity of beer. They're virtually foolproof, as long as you follow the directions—especially regarding sanitary practices.

Each of the four methods requires a different level of effort and presents varying opportunities for creativity and sophistication. We'll get to the varying results later—for the meantime, effort is the operative word.

You can brew a beer at home that will taste as good or better than anything you can buy. You can make just about any style of beer, and it'll be entirely natural, including the carbonation—no chemical additives or

BREW BY YOU

preservatives. In most cases, after your initial outlay for hardware, it'll cost less to make quality beer than to buy it. But you'll be supplying the time and the labor.

Much of your sweat-equity goes into cleaning—the actual brewing is no heavy lifting. No shortcuts here: Every maker of home-brew gear stresses that sanitary materials and a clean workplace are essential to successful brewing. If you like the smell of beer you're going to have to learn to like the smell of bleach. Better invest in some good shoes, too, because as a brewer you'll spend a lot of time on your feet. You can't sit down at this job until the testing part. Here's what we learned.

In the bag

There was a guy in high school who kept trying to make the beer version of Fizzies in chemistry class—just drop the tablet in water and presto! He's still there trying. Meanwhile, the simplest of the home-brew systems is simply a bag. Just add water—and wait.

It's called the BrewSack, manufactured by BrewKing in Kirkcaldy, Scotland, which has been making malt extracts for a century. The BrewSack is available from mail-order houses in three flavors: a golden lager, a dark porter and a traditional English "bitter" ale. We ordered the porter and bitter, each for \$39 plus \$6 shipping from *The Wine Enthusiast* catalog, Pleasantville, New York (800-356-8466).

That \$45 buys you 20 pints of brew once you've added water (yours) and yeast (theirs). A syrup of malt, hops and other ingredients is already inside the plastic liner of the burlap sack. You add hot water then cold through a cap at the top of the sack. A tap at the bottom dispenses beer a month later.

The beer ferments for a week at room temperature (65° to 75° F), and gas inflates the sack to basketball rigidity. After three more weeks of conditioning in a cooler location (50° to 60° F), it's drinking time. The bag will still be as stiff as a board. Brew-King suggests that if you move the sack, let the contents settle a day or two before dispensing. It also suggests that you dispense into a pitcher the first time, as the beer is likely to



The 2.6-gallon Beer Machine is easily assembled. Note the CO₂ dispenser, which lets you vary the amount of carbonation.

be lively under all that pressure.

The sack is about 2 ft. tall and, when expanded, nearly a foot deep and 15 in. wide. To keep it upright, stationary and at the recommended drinking temperature (even the 55° F common in Britain) is almost impossible. A typical U.S. refrigerator is too cold for these beers—assuming that you have a spare refrigerator or can create the proper space in the family fridge. Even so, you'd have to remove the sack long enough for the beer to actually warm to 55° F.

Bottom line: The BrewSack is fine for Britain or wherever home temperatures are cool by U.S. norms. But the concept doesn't travel well. The sack isn't reusable, so at \$2.25 a pint it ain't cheap. If you buy it, plan around a cookout or other bash where it's easy to soak up 20 pints in one session.

Instant keg

A simple brewing system that makes more sense for typical households is The Beer Machine from The Great American Micro Brewery, Blaine, Washington (800-663-BREW). You just combine water, beer mix and yeast in the barrel-shaped device and in less than three weeks, you're tapping cold beer from your fridge.

Unlike BrewSack, The Beer Machine is reusable. The 2.6-gallon (20 pints) keg consumes just a bit more shelf space than a spring-water dispenser of the same capacity. Once you get past the \$80 to \$100 ante, cans of beer mix cost about \$20, which works out to a buck a pint or 75 cents per 12-ounce bottle.

Bottling, though, isn't necessary. The Beer Machine is both brewery and draft-beer dispenser. It's a charming bit of engineering, with front-facing tap and a CO₂ dispenser. The latter lets you add more carbonation to the brew, according to your taste, or helps equalize pressure in the keg for easy dispensing while protecting the beer from any taste-robbing oxygen.

You'll appreciate the elegance of the design when you assemble The Beer Machine—about an hour's work including cleaning. Gaskets and press-fit clamps seal the keg and secure its external parts. Take special care when assembling and installing the top-mounted pressure relief valve. If you don't, you'll either have flat beer or you'll be crying over spilled beer. We had no problems.

Once the sanitized machine is assembled you add room-temp water, a canned syrup of brewing ingredients and a packet of supplied yeast, then install the pressure cap. The company offers eight different styles of beer—we made a pilsener. Fermentation takes about six days at a consistent 68° to 72° F range. After this, pop The Beer Machine in the fridge for 10 more days before sampling.

Barrels of beer

The Beer Machine comes with an excellent video that supplements its manual. So does the Micro Brew (about \$70; 800-876-BREW). This system represents a compromise for those who must bottle beer in order to store it, but who don't want to get into exotic brewing, and who'll be satisfied producing 2.6 gallons of beer (about



ONE HOUR
SANITIZE



ONE HOUR
BREWING

ONE
HOUR
CLEANUP



ONE WEEK PRIMARY
FERMENTATION
IN VESSEL (68° F)

ONE HOUR
SANITIZE
BOTTLES

ONE
HOUR
CLEANUP

ONE WEEK SECONDARY
FERMENTATION
IN BOTTLE (68° F)

Pick a free time for brewing with conventional ingredients and equipment. For first-timers, sanitizing, brewing and bottling might take longer. Heed the manufacturer's directions for primary fermentation (usually a week) and bottle conditioning.

28 bottles, 12-ounce size) at a time.

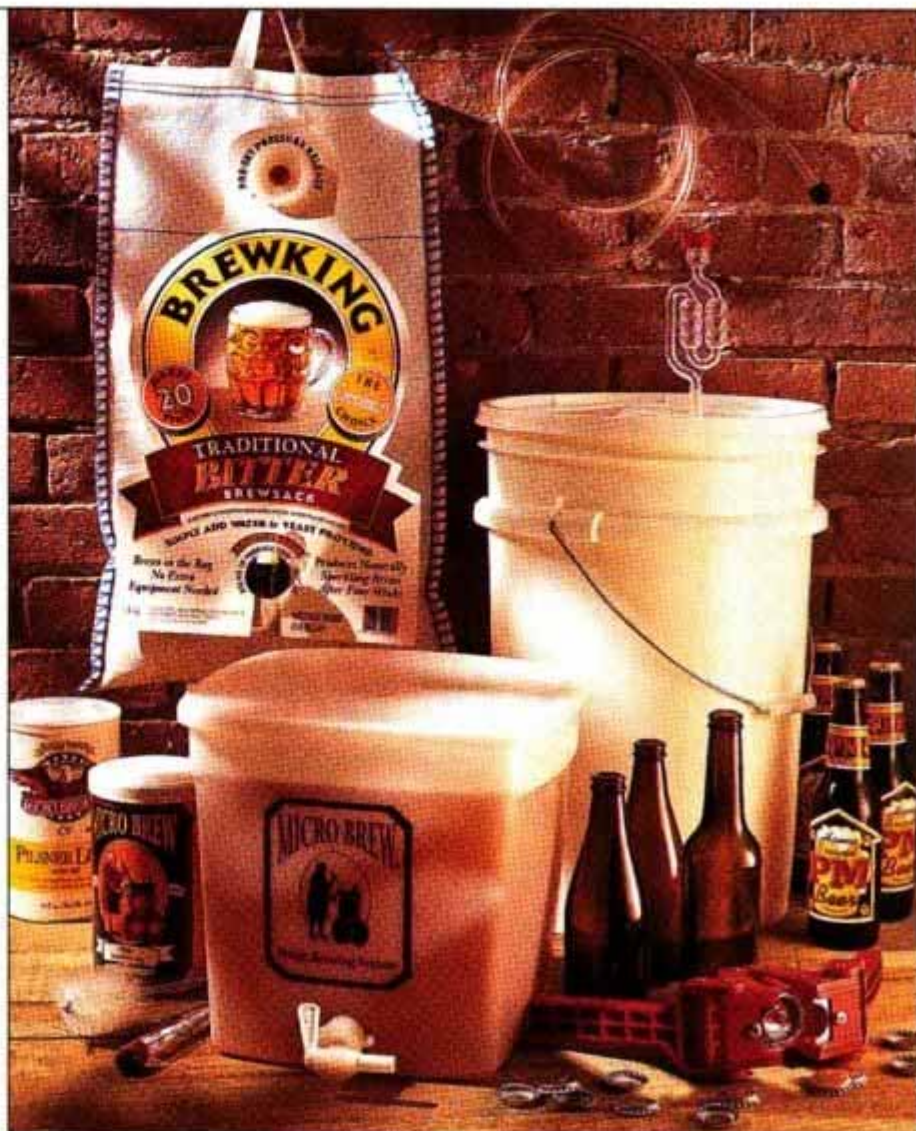
Like The Beer Machine, the Micro Brew system comes with canned mixes and yeast packets for several styles of beer (beer's a generic term that includes lagers, ales, stouts and others). Because you'll be bottling, the system comes with caps, a capper and labels.

You don't get a siphon because you won't need it. Micro Brew's square, plastic fermenter has a tap at its base. You mix water and the canned ingredients, following the instructions. After a week of fermentation at room temperature, you tap the mix into bottles (yours) that you prime with sugar (yours), then cap them and store at the same room temp for three weeks. Just before drinking, you chill the bottles. After bottling, you can start up another batch. There are six styles to choose from (we brewed the Olde London Ale). Price is reasonable, about 50 cents a pint.

Micro Brew simplifies and downsizes the usual, generic brewing equipment. Traditional kits include a 7-gallon fermenter that yields about 5 gallons of beer. It'll have a tight-fitting lid with an airlock device that lets excess gas escape while keeping damaging oxygen out. Most of these kits include a hydrometer, which essentially tells you when the fermentation is complete and it's safe to bottle. Cleaning materials and bottling supplies round out the picture.

You can make a greater range of beer styles with these basic kits—including styles such as stout and others that go beyond canned ingredients to use actual dry grains, malts and hops. This will involve boiling, straining and other steps that really make you feel like you're brewing. If your feet don't tell you, your nose will. Ventilation is strongly advised.

There are lots of retail and mail-order sources for traditional brewing kits. Ours came from *The Wine Enthusiast*, but a far greater selection of materials and ingredients can be had from Erie, Pennsylvania-based Bierhaus International (814-833-7747), and at much lower prices. A look at the Bierhaus catalog will open your eyes to the inspired range of brewing you can do. The traditional kits are more labor intensive, but they are the standard against which the others must be



Brewing kits generally come with all the ingredients you'll need to make beer, including the bottle capper. You'll have to supply the bottles.

measured. We chose an Irish Stout from True Brew.

As for bottles, unless you buy the special plastic ones, use dark glass and only the type meant for crimped caps—never the twist-off type.

Your natural beer will leave a sediment in the bottle. You must rinse this instantly after pouring, or it will form a cement-like deposit that will harm future bottlings. Accordingly, a must-have accessory for home brewers is a water-jet bottle washer that attaches to sink faucets (about \$10).

As for getting beer into a bottle, we suggest you get a shut-off clamp for your siphon. This 35-cent item beats trying to stop the flow of beer by squeezing the hose between thumb and forefinger.

If you become serious about

home brewing, you might want to invest in a heavy-duty bench capper. Meanwhile, capping with the typical 2-lever hand models supplied is easy once you get the knack.

Bench testing

It was a brave group of volunteers that assembled to test the fruits of our labor. Each had extensive hands-on experience with all of the various beer styles, familiarity with mass-produced microbrewery and homemade beers, but no brewing expertise. To judge the beers, PM adapted the 20-point scale drafted by the Underground Brewers Club, described in Patrick Baker's *The New Brewer's Handbook*.

This method evaluates aroma, appearance, condition (carbonation) and

(Please turn to page 119)



TWO TO EIGHT WEEKS
CONDITIONING
IN BOTTLE (50° F)



NORTH HOCKEY LEAGUE NEWS



JETS WIN JUNIOR CROWN!

The Powderhorn Jets captured the Junior League Title Saturday with a 4-2 victory over the arch rival Bearcats at Central Ice Rink. Forward Mark Canniff scored the winning goal with 2 minutes remaining in the



March 8rd. The Winner will go on the National Junior Championship in Minneapolis on March 15th. Mark Canniff was chosen MVP by the coaches in the district tournament. He has scored 6 playoff goals and

digital

DECcolorwriter 120ic

ELECTRONICS

COLOR MY WORLD

New, affordable printers let you go from computer to paper in vivid color.

BY REBECCA DAY; PM Photo by Brian Kosoff

• Add color and it will cost you. At least that's the way it has traditionally been with computers, whether you're buying a color monitor for your PC or splurging for a color laptop. Look for color in a printer, though, and you just might be surprised at what you can get for under \$700. These days, a good printer can give you living color at a price you can live with, too.

Color printers come in three basic varieties.

At the high end of the market are laser printers. In these machines, a laser creates an attraction on certain areas of a photosensitive surface that in turn attracts toner. The toner is transferred to paper, heated and fused, thus creating an image. Color laser printers are prohibitively expensive but offer the best quality and speed. The blacks are blacker and there are no fuzzy edges on letters or lines.

Next are inkjet printers. These printers use a thermal process to spray ink droplets onto the paper to form images. The spraying process tends to leave slightly fuzzy edges, but improvements are making inkjet printing closer to laser printing all the time.

And finally, dot-matrix printers use pins that strike a multicolored ribbon to print on paper. The least expensive and oldest technology in printing, dot-matrix models tend to reveal individual dots, are noisy, require lengthy periods to print and use tractor-feed paper. Whereas laser and inkjet printers can reproduce any color, dot-matrix printers are limited to the six primary and secondary colors, and black.

If you're a heavy user, then you'll probably go the laser route—primarily for the faster printing speed that laser printers provide. Speed is the primary difference between laser and inkjet printers when it comes to printing color. Most budgets—especially for home and small-office



DEC COLORWRITER 120ic



страниц, энциклопедия

COLOR MY WORLD



Canon's BJC-600e printer uses an innovative bubble-jet form of inkjet printing. The machine is bundled with software offering advice on color selections.

use—will allow for high-quality inkjet printers

but not laser. You are more willing to wait a couple of minutes to print in color if it means saving a couple of grand at the cash register.

Inkjet color printers come in 3- and 4-color versions. Three-color versions offer cyan, magenta and yellow but no black. To create black, these printers mix the three colors, which can result in weak black reproduction. Most of the other types of 3-color printers use a separate cartridge for printing text, and you switch cartridges depending on what you plan to print. Cartridges that aren't being used should be kept in their original storage so that they don't dry out.

Four-color printers offer the same three colors plus black, which produces a deep, true black. The Epson Stylus color printer, for example, includes both monochrome and color cartridges, which are installed at the same time and use the same print head. There's no cartridge-swapping involved—you select the proper cartridge for the application through the printer driver.

Hewlett-Packard sees color as the way of the future, and now all HP DeskJet printers offer color either as standard or as an option. The new DeskJet 540 (\$365) for PCs and the DeskWriter 540 (\$365) for Macintosh computers, for instance, are monochrome printers that offer color capability for buyers who don't want to be locked out of color in the future. Both printers can be outfitted with a color upgrade kit for \$49.

Hewlett-Packard's ColorSmart technology uses object identification to recognize text, graphics and photographic content separately and is said to select the optimal color or grayscale

tone for each print element. Resolution is 600 x 300 dpi (600 dots per horizontal inch and 300 dots per vertical inch) in monochrome mode. The company claims its Resolution Enhancement technology ensures crisp edges. Output speed is four pages per minute in text mode and 1½ minutes per page in color mode.

It's important to confirm which specs you're reading—color or monochrome—when you're comparing printing muscle. Also, print speed will vary depending on the complexity of the page you're printing and whether or not you choose a fine-print setting.

"Most of the printers in the \$300 price range print at three pages per minute in monochrome," according to Dave Rogers, a marketing manager at Digital Equipment Corp. (DEC), "and more like 3 minutes per page in color." DEC's model 120ic offers color out of the box, and DEC claims it's the lowest-cost color inkjet printer available. Suggested retail price is

\$355. The company also offers a color option for its DEC Colorwriter 110ic printer. The upgrade kit sells for \$44, and



the printer costs \$319.

Canon printers use bubble-jet technology, a form of inkjet printing that uses tiny print heads perforated with dozens of minuscule nozzles. When charged with electricity, the ink in the nozzles forms bubbles, which force out an ink droplet. The company's BJC-600e prints at 720 dpi in monochrome and 360 dpi in color. Color print speed is one page per minute. List price is \$549.

Hewlett-Packard, the Star Micronics SJ-144 (\$499) and others also use thermal inkjet technology, but Epson uses a piezoelectric technology, which uses mechanical vibrations—rather than heat—to shoot ink onto paper. Epson Stylus technology uses one permanent monochrome print head and two permanent color print heads, which are vertically laminated. Epson claims the Stylus heads are 100 times more powerful than conventional heads, which are based on a single disk. The result is better control of the placement of dots and, thus, uniform, consistent coverage.

At a list price of \$699 and a street price of just under \$500, the Epson Stylus printer is at the high end of the price and performance spectrum.

At the other end of the spectrum are dot-matrix printers. Panasonic's KX-P2135 offers a quiet printing mode, 360-dpi resolution, seven letter-quality and three draft fonts. List price is \$299.

Print quality also varies according to the type of paper used. High-gloss, highly reflective paper produces better prints in terms of crisp outlines and color saturation. Paper costs go up from 2 cents a page for monochrome paper to 12 to 15 cents a page for color.

You also have to consider the cost of the ink. With many monochrome cartridges you can simply refill the print head for about \$5 when your print starts to fade. With a color printer, though, you have to junk the whole cartridge when one color goes or else the color mix will be thrown off. A replacement cartridge costs \$28 to \$30.

Most people these days want the option of being able to print in color, but inkjet color printing may not always be the best choice if you require detailed shading or professional-quality text. For the majority of users, though, inkjet quality is more than sufficient and adding color capability

covers all the bases. **PC** **MAC**

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HOME&SHOP JOURNAL

HOME IMPROVEMENT

Installing A Hot Water Dispenser

*The most efficient and economical way
to get hot water fast.*

TEXT AND PHOTOS BY MERLE HENKENIUS

● Instant soup may be fast, but only after you've heated the water on your stove top. Even microwave ovens take a minute or so to do the job. If you really want instant soup—and coffee, tea, hot cereals and just about anything else that uses small quantities of hot water—you're in the market for a hot water dispenser.

Instant hot water dispensers deliver water that's at least 50° F hotter than that served up by your water heater, at a rate of up to 60 cups an hour. And, the daily operating cost is roughly equivalent to that of using a 40-watt light bulb. You'll find several brands on the market, with models ranging from \$90 to \$170. For our installation, we chose an In-Sink-Erator model H-770 (Emerson Electric Co., 4700 21st St., Racine, WI 53406).

The heart of a hot water dispenser is a small tank that contains a heating element. The faucet, when turned on, feeds water from the tap to the tank where it's heated to its thermostatic limit. When the faucet is again turned on, cold water from the supply tube enters the tank, pushing heated water

up through a second tube and through its spout.

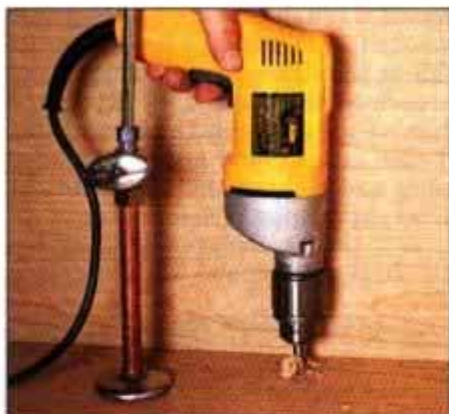
Hot water dispensers are easily installed in the fourth deck hole of a kitchen sink. We removed a leaky spray hose from the fourth hole in our sink to make room for it.

To bore a new hole in a stainless-steel sink, use a 1¼-in. holesaw, though an electrician's knockout punch would make a cleaner cut. If you have a porcelain or enameled sink, you may be able to bore a hole through the counter next to the sink and position the dispenser's spout over the sink basin. Be sure to place the faucet well back, however, so that dangerously hot water is kept beyond the reach of small children.

You'll need at least 20 pounds of static water pressure. Your water supplier will be able to tell you what the pressure is in your neighborhood.

Your electrical hookup will depend, in large part, on local code requirements, and an electrical permit may be required. While it is possible to pull power from a small appliance circuit, keep in mind that many kitchen circuits are already hard-pressed. ©1987 авторским правом





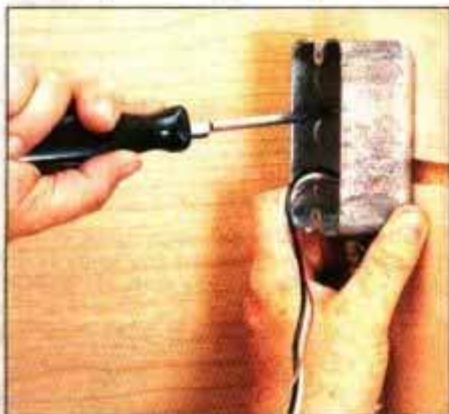
1 Bore a 1/8-in. hole through the cabinet and floor, into the basement. Feed cable from the panel through this opening.



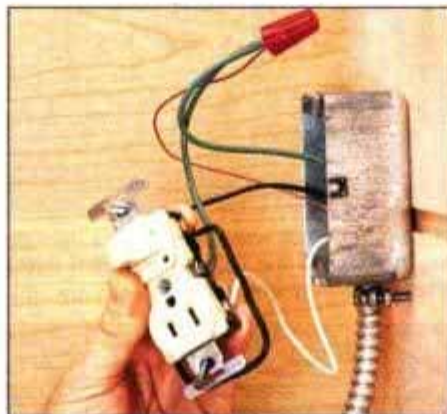
2 Strip about 10 in. of sheathing from the cable. Then strip 1/8 in. of insulation from the end of each wire.



3 Feed the wires through the flexible conduit and connect the conduit to a metal duplex box with a box connector.



4 Mount the duplex box to the cabinet wall near the tank location. Use wood screws or coated drywall screws.



5 Run a jumper from switch to receptacle. Join black circuit wire to brass terminal and neutral wire to the silver terminal.



6 Install the switched receptacle in the box and fasten the cover plate. Do not plug in the unit until it's charged with water.

Under-The-Sink Wiring

Many codes stipulate a dedicated circuit for the dispenser, or, at the very least, that it share a circuit with another dedicated appliance such as a food disposal. Most codes also require that a circuit terminating inside the sink cabinet must be switched. This can be accomplished with a switched receptacle, a 2-gang box where one side contains a receptacle and the other side houses a single-pole switch, or separate switch and receptacle boxes.

We opted for a dedicated 15-amp circuit with a grounded, switched receptacle. Assuming that there is basement access, start by boring a 1/8-in. hole through the sink base-cabinet floor and down through the subfloor (Photo 1). Then, pull 14/2 (with ground) cable between the service panel and cabinet. Feed the cable into the cabinet and strip roughly 10 in. of sheathing from it (Photo 2).

Encase the wiring within the cabinet in conduit. The easiest choice is flexible conduit, pushed several inches

through the hole in the cabinet floor. Join the receptacle box to the conduit with a box connector (Photo 3). Then, mount the box to the cabinet wall using wood screws or coated drywall screws (Photo 4).

To wire a switched receptacle, connect the black (incoming) hot wire to the brass hot terminal on the switch and the white neutral wire to the silver terminal on the receptacle. Then, run a black jumper wire from the other switch terminal to the brass receptacle terminal (Photo 5).

To ground the receptacle and box, join the circuit ground wire with two green pigtails, using a twist connector. Then fasten one pigtail to the green terminal on the receptacle and the remaining pigtail to the metal box, using a grounding clip or grounding screw. Finally, mount the cover plate and turn the switch to the OFF position (Photo 6).

At this point, you can complete the electrical circuit at the panel, but we chose to install the dispenser first, rather than cart tools back and forth.

Installing The Unit

First, install a self-piercing saddle valve on the cold water supply riser. A self-piercing saddle valve allows you to tap into the water piping without shutting off the water. If your code doesn't allow this fitting, or if your waterlines are made of galvanized iron, you'll need to shut off the water, drill the tap hole in the pipe wall and install a saddle valve over the hole.

Fasten the saddle valve to the riser,

using a screwdriver to tighten it down (Photo 7). To pierce the riser with a self-piercing saddle valve, thread the tap clockwise all the way, then back it out all the way, allowing water to flow through the valve. Make sure to place the valve high enough on the riser to reach the new faucet's factory-installed supply tube. Then, screw the heater unit's hanger bracket to a cabinet wall and hang the heater on the bracket (Photo 8).

If you're removing an old spray hose from the fourth sink hole, use a basin wrench or small adjustable wrench to thread the hose from its faucet port. Then loosen the jamb nut securing the spray's deck fitting and remove the assembly (Photo 9). Wrap Teflon tape around a 1/8-in. threaded plug and tighten the plug into the faucet spray port (Photo 10).

With the deck hole ready, straighten the faucet tubing and feed the tubing



7 Mount the self-piercing saddle valve on the cold water riser pipe by drawing up the saddle bolts evenly.



8 Screw the hot water dispenser's mounting bracket to the cabinet wall and hang the tank on the bracket.



9 Disconnect the old spray hose at the faucet port. Then, loosen the spray hose jamb nut and lift out hose and deck fitting.



10 To seal the faucet port, wrap Teflon tape around a 1/8-in. threaded plug and then tighten it into the faucet port.



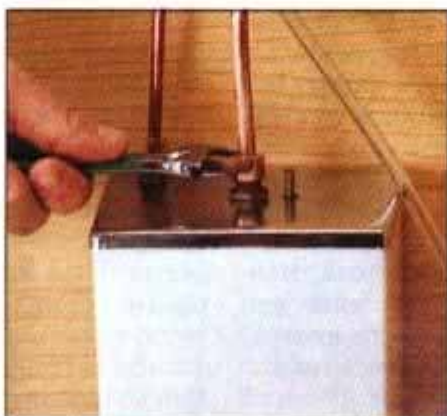
11 Straighten the supply tubes attached to the heater faucet and insert through the sink's deck hole from above.



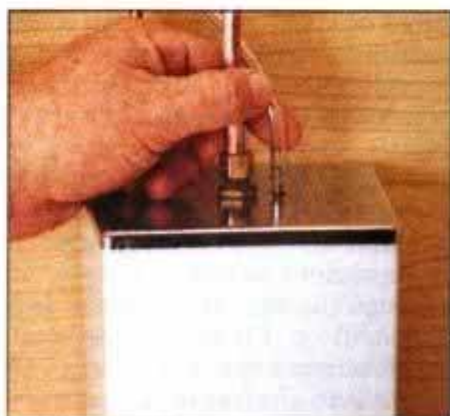
12 Use the factory-installed fastening screw and mounting washer to fix the water-heater faucet in the hole from below.



13 To connect the water supply, slide the saddle valve's compression nut and ferrule onto the supply tube. Lubricate and tighten.



14 Fasten the two remaining copper tubes to the tank with compression nuts and ferrules. Don't overtighten the nuts.



15 Slide the plastic tube over its copper tank nipple and secure it with a spring clip or hose clamp.

through the sink's deck hole (Photo 11). While a helper holds the faucet in position from above, slide the slotted, mounting washer onto the factory-installed fastening screw and tighten the assembly in place (Photo 12).

With the faucet secured, carefully bend its 1/8-in. supply tube to meet the port of the saddle valve. Then, slide the valve's compression nut and ferrule onto the supply tube and insert the tube into the valve port (Photo

13). Lubricate the ring and threads with liquid soap or petroleum jelly and tighten the nut hand-tight, plus two full turns with a wrench.

If your plumbing system is plagued by water-borne sediment, you may wish to turn the water on at this point and bleed a cup or two through the faucet into a container. Otherwise, leave the water off until you make the heater tank connections.

With the supply tube connected,

you'll see two remaining copper tubes and a plastic tube extending from the faucet. One copper tube supplies cold water to the tank, and the other supplies hot water to the faucet. The plastic tube leads to the expansion tank. Trim all tubes to length.

Make the copper connections with compression fittings, identical to the one on the saddle valve (Photo 14). Secure the plastic tube to the tank nipple with a wire clip or clamp (Photo 15).

Connecting To Power

If working within the service panel seems beyond your reach, it may be. If you complete the rest of the installation yourself, a quick service call by a licensed electrician to install a new circuit breaker and make the connections won't cost that much.

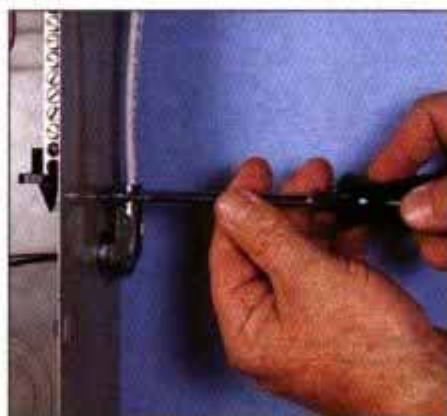
If you decide that you can do the work yourself, take a few simple precautions. To begin, always shut off the main disconnect switch before opening the panel. From here on, touch only one metal surface at a time with the screwdriver while grasping only the handle. Whenever possible, use only one hand. Also, avoid touching the panel cabinet while working inside the panel.

After throwing the main disconnect to the OFF position, remove the screws securing the panel cover and pull the cover free. Next, punch out one of the available knockout plugs in the side or top of the panel and install a box connector. Strip about 18 in. of sheathing from the cable and feed it through the connector. Then tighten the screws that bind the cable to the connector (Photo 16).

Attach the white neutral and bare wire ground to the neutral/ground bus, or to the separate neutral and ground buses if your panel is so equipped. Just cut the wires to length, trim about 1/8 in. of insulation from the neutral wire and feed each under an available lug on the appropriate bus. Finally, tighten these lugs firmly with a straight-blade screwdriver (Photo 17).

To connect the hot side of the circuit, strip 3/8 in. of insulation from the black wire and tighten it under the terminal screw on a 15-amp breaker. Then, without touching the hot-bus bar, hook the back end of the breaker over its panel tab and press the slotted front end over its hot-bus prong (Photo 18).

Next, break a slot from the face of the panel cover (Photo 19) and replace the cover. Finally, turn on the new breaker and main disconnect switch.



16 Install a box connector in one of the panel's knockouts and secure the cable with the connector's fastening screws.



17 With main switch off, secure the white and bare wires under terminal lugs on the neutral/grounding bus. Tighten firmly.



18 Secure the black, hot wire under the lug of a 15-amp breaker. Then press the breaker onto its hot-bus prong.



19 Use pliers to twist a breaker-slot plate from the panel cover. Then, replace the cover and energize the panel.

Charging The Dispenser

As with any appliance containing an electric heating element, don't turn the power on before filling the tank completely. Energizing a dry element will cause it (or its one-time fuse) to fail in a matter of seconds.

To properly charge the system, turn the self-tapping saddle valve in completely, then out completely. With the water on, hold the faucet open. After about one minute, water will purge all air from the tank and begin flowing through the spout.

When you're sure the tank is fully charged, plug in the unit and turn on the switch inside the cabinet. It will

take roughly 15 minutes to heat the first tankful of water. During this time, you should expect some steaming, hissing and rumbling. When the heater shuts off, carefully bleed the hot water and steam through the faucet, then allow the unit to reheat. You may need to repeat this procedure several times before the system settles into steady operation.

The model we installed is preset to heat the water to 190° F. On this model, the temperature can also be adjusted up or down. Those living in high altitudes may need to turn the temperature down slightly to keep the water from boiling.

Homeowners Clinic

BY NORMAN BECKER, P.E.,
Contributing Editor

Heated Driveway

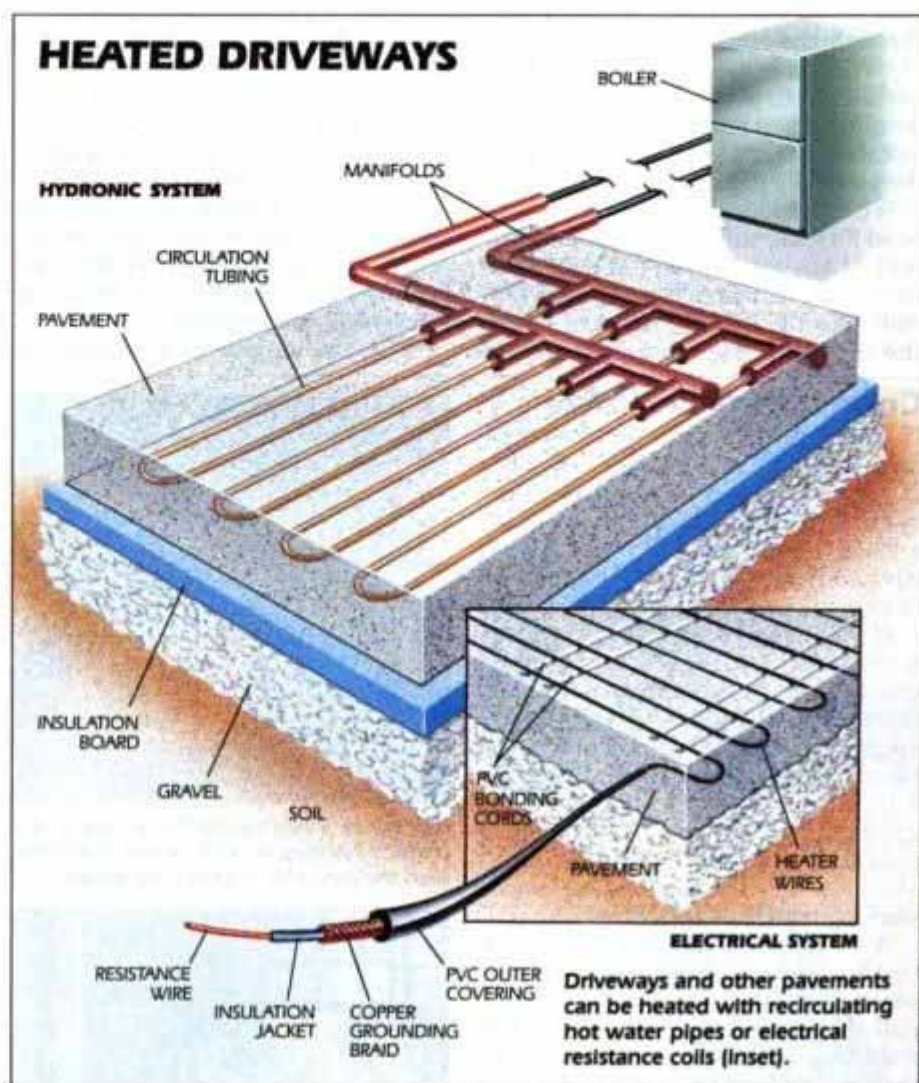
I recently bought an older home that has a 20-ft.-wide × 100-ft.-long gravel driveway. I plan on having either a concrete or an asphalt driveway installed, and I would like the new driveway to incorporate some type of heating system to melt snow and ice. Can you recommend a do-it-yourself system that would not be too expensive to install or operate? It would have to be durable and maintenance-free.

DENNIS B. LADDEN
MARTINSVILLE, NJ

There are two types of built-in systems for melting snow on a driveway—electric and hydronic. Both are expensive to install and neither is a do-it-yourself project. Because of the equipment involved in a hydronic system, the installation cost is greater than an electric system. However, the operating cost for an electric system is generally greater than that of a hydronic system.

With regard to troublefree service, both systems will normally provide troublefree service as long as the asphalt or concrete driveway is not disturbed or damaged.

The tubing in a hydronic system may be constructed of copper, plastic or rubber and will range in diameter from 1/2 in. to 1 in., depending on the flow requirements. The tube coils are connected to a boiler, and a pump circulates an antifreeze solution through the coils. For more information on hydronic systems for melting snow, you can purchase the Snow Melting Calculation & Install-



Driveways and other pavements can be heated with recirculating hot water pipes or electrical resistance coils (inset).

tion Guide, No. S-40, for \$9.50 (\$3.75 shipping) from the Hydronics Institute, 35 Russo Place, P.O. Box 218, Berkeley Heights, NJ 07922.

The electric snow-melting system uses insulated resistance wires spaced on a predetermined pattern. The wires are attached to each other with polyvinyl chloride (PVC) bonding cords to form a mat. The mats come in various widths and lengths. The installation contractor can make the

mat fit curved areas by cutting the PVC bonding cords. The system can be activated with an ON/OFF switch or an automatic control that monitors temperature and moisture. Depending on the amount of electrical service to the house and the power requirements of the snow-melting system, it may be necessary to upgrade the home's electrical service.

Easy Heat Inc. manufactures electrical equipment for melting snow

Popcorn Ceiling Care

● Letters regarding the care and repair of "popcorn" textured ceilings are regular items here at PM. Depending on where in the country you live, this ceiling treatment may also be known as cottage cheese, California or carpeted. The texture is derived from a spray-applied paint that has polystyrene plastic foam particles mixed in. The particles give the coating a texture and help hide ceiling imperfections. Pores in the surface help it hide dust and soot.

We recently found a company, Sprayed Textures Unlimited, that makes products

to clean and repair textured ceilings and also offers a free brochure for PM homeowners.

For example, it surprised us, but the company strongly recommends against painting a popcorn ceiling. Apparently, paint seals the surface and diminishes its ability to hide smoke and dirt. The company sells a cleaner, but it recommends spot cleaning with bleach and water.

There isn't room to list the brochure's 10 tips or the company's cleaning and repair products, which range in price from \$5 to \$20. You can get this information yourself, however, by sending a business-size self-addressed stamped envelope to: Sprayed Textures Unlimited, 1518 Hwy. 138, Wall Township, NJ 07719. —Roy Berendsohn



on driveways. Its engineering department indicated that it would be willing to help with the layout of materials for your snow-melting system. Contact: Easy Heat Inc., 31977 U.S. 20 E., New Carlisle, IN 46552; (800) 537-4732.

Painting Galvanized Metal

I need advice on how to paint galvanized metal siding. The siding has not been painted since it was installed in 1969. What would be the best type of paint to use, latex or oil? Or should I try an automotive enamel? The building is a garage, and I would like its color to match other buildings on the property.

CARL CRAMER
NO ADDRESS GIVEN

I'd recommend using latex paint. It's easy to work with, and the brushes and rollers can be cleaned in soap and water. Benjamin Moore paint has a primer that is formulated for galvanized metal. It is called Iron Clad Galvanized Metal Latex Primer, product code No. 155-00. Since the metal siding has been exposed to dirt and dust for 25 years, it's important to clean it thoroughly and follow other surface preparation instructions that are listed on the can label. The topcoat over the primer can be either latex or oil. Choose the type that can be tinted closest to the color of the other buildings. Also, make sure the topcoat is a Benjamin Moore product—it's always advisable to use a primer and topcoat from the same manufacturer.

For more information, write Benjamin Moore & Co., 51 Chestnut Ridge Rd., Montvale, NJ 07645.

Aluminum Wiring

I have a home with aluminum wiring. Am I endangering myself and my family by hooking up copper outlets to

Getting It Back Together

● Taking things apart is easy. Putting things back together the right way is where repairs can get a little tricky. Here are a few tips to help you find your way back.

A Polaroid camera can provide a photographic record of parts before they are disassembled. Although these cameras will not shoot a clear picture of small parts, they work well on large parts and assemblies. They are also handy in repairs involving wires with numerous colors.

Using a Polaroid in a repair requires that you do several things. Use it only if there is good light and only where you can see clearly. It's good repair practice to use a shop vacuum to remove dust and lint from inside appliances before beginning a repair, but it's crucial if you hope to provide a photographic reference.

As with shooting any kind of photograph, you must steady the camera. Don't try to photograph a part while holding back a bunch of wires. Finally, what you can't record with a photo, you should sketch.

—R.B.



APPLIANCE CARE TIP



ILLUSTRATION BY GEORGE BETHICK

these wires? If so, how can I remedy the situation and safely connect to the aluminum wires?

TOM KARAFFA
GOLDEN, CO

Between 1965 and 1973, aluminum wiring was used to install electrical branch circuits in about 1.5 million homes. Subsequent fires in some of those homes were found to be caused by a faulty aluminum wire connection at an outlet. As a result, the U.S. Consumer Product Safety Commission (CPSC) had research conducted that showed that homes using aluminum wires manufactured before 1972 are 55 times more likely to have one or more electrical connections reach "fire hazard condi-

tions" than homes wired with copper.

The solution to this problem is to "pigtail" a length of copper wire to the end of the aluminum wire, and then make the connection with the outlet, switch or other device using the copper wire. Initially, electricians made these connections using a twist-on pressure device called a wire connector. But wire connectors are no longer recommended because a substantial number of them overheated in laboratory tests.

The method for repairing the aluminum wire fire hazard, as recommended by the CPSC and Underwriters' Laboratories, is to make the pigtail connection using the Copalum crimp method, developed by Amp Inc., P.O. Box 3608, Harrisburg, PA 17105; (800) 522-6752. This repair uses a crimped connector. The connection is covered with heat-shrink insulation.

For more information on repairing aluminum wiring, write to the U.S. Consumer Product Safety Commission, Washington, DC 20207. Ask for pamphlet No. 516. **PM**

DO YOU HAVE A HOME-MAINTENANCE OR REPAIR PROBLEM?

Just ask Norman about it. Send your question to Homeowners Clinic, Popular Mechanics, 224 W. 57th St., New York, NY 10019. While letters cannot be answered individually, problems of general interest will be discussed in the column.

BUZZWORD

● A pressure-balancing valve can reduce the likelihood of being scalded in the shower. The valve is sometimes called an anti-scald valve and is a single-handle type that replaces the standard mixing valve. The benefits of a pressure-balancing valve become apparent once you know how scalding in a shower occurs. A standard mixing valve simply mixes hot and cold water. When someone elsewhere in the house

Pressure-Balancing Valve

flushes a toilet, it decreases the amount of cold water entering the mixing valve. This results in a blast of hot water on the person showering. A pressure-balancing valve senses the drop in cold water pressure and compensates by decreasing the amount of hot water flowing through the valve. Also, as an added safety precaution, your water heater temperature should be set no higher than 120° F.

—R.B.

HOME IMPROVEMENT

How To Build A Retaining Wall

Clever new concrete blocks make it easy.

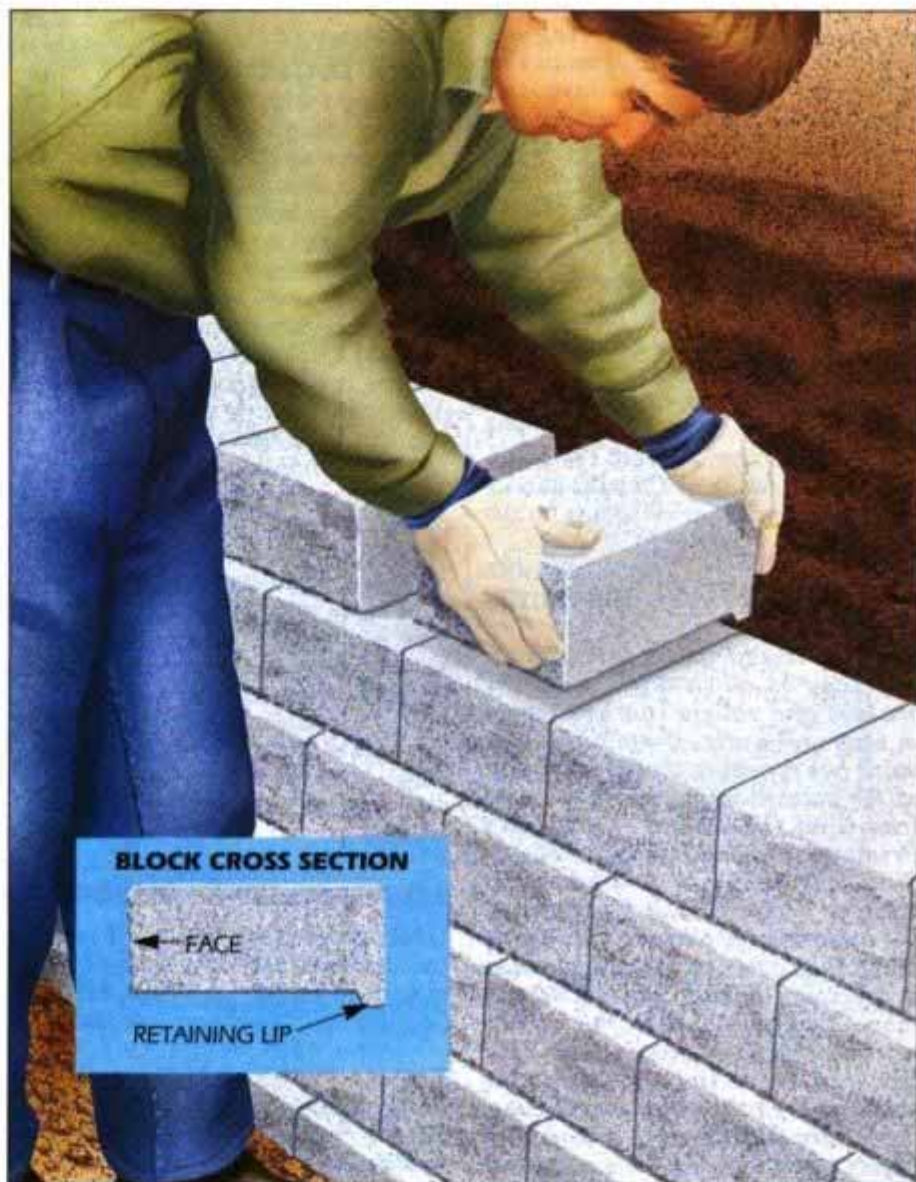
BY STEVEN WILLSON,
 Home Improvement Editor
 PM Illustrations by
 George Retseck

● Retaining walls are a real staple of the landscape business. Not only can they solve a wealth of erosion problems but they can also lend a lot of character to otherwise uninspired grounds. And a decent, serviceable wall can be made out of a wide range of different materials to suit just about anyone's personal taste. We've all seen our share of concrete, concrete block, brick, stone, log and even railroad-tie walls. And many of these still look wonderful after years of great service. But, unfortunately, many of them don't look so wonderful. In fact, it can seem that for every wall you see in good condition, you've seen at least two that are failing. Some are cracked, some are crumbling and some are leaning so far they seem to defy gravity.

One of the biggest troubles with traditional retaining walls is that they are difficult to build well, especially for the inexperienced worker. It's relatively easy to erect a wall that looks good when you're done. But it's quite another to have the same wall look good in three months and still another for it to look good after a cold, hard winter.

A better idea

The construction difficulties normally associated with retaining walls have all but disappeared with the invention of today's simple interlocking block systems. Several are on the market and each has a slightly different method of interlocking and a somewhat different palette of colors. (We used the Aztech Wall System designed by Block Systems Inc., St. Paul, Minnesota.) But their similarities far outnumber their differences. All are made of cast concrete with a single block weighing about 20 to 30 pounds. All are designed to be laid up dry, so no mortar and no mortaring



These stacking blocks are relatively small, measuring only 5 x 7½ x 12 in., and are designed to be laid up dry. The finished wall functions as a whole because each block has a retaining lip on the bottom edge that prevents it from moving.

skills are necessary. And finally, because the blocks aren't joined together with mortar or by other means, hydrostatic pressure cannot build up behind the wall because the water simply seeps through the cracks between the blocks.

All these advantages wouldn't be worth much if the blocks were ugly. But they aren't. The exposed sides of the blocks are heavily textured, which is the result of the block being cast and then broken at the factory. The irregularity this causes lends an authentic stonelike appearance to the wall when it is finished. Is it authentic enough for everyone? Who knows. But one way to find out if you like it is to visit a masonry supply yard where various blocks are on display. And don't be satisfied with just looking at an individual block. It's much better

to see a whole wall. If the supply house doesn't have the blocks on display, ask for some locations where they know the blocks have been installed and take a ride by to see if you like the results.

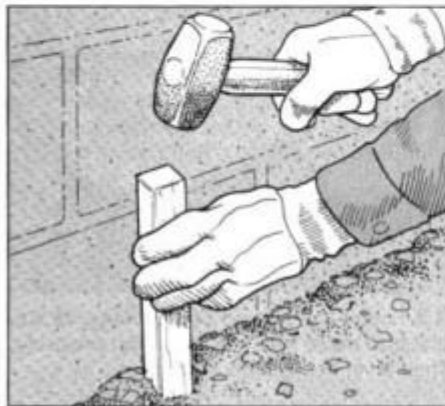
Like many things that are a better idea, the manufacturers aren't giving these blocks away. Prices vary, but we paid about \$1.75 per block for our job and that included a good discount for buying in volume. If you want to build a small wall of only 100 blocks or less, expect to pay at least \$2 a block, delivered.

Getting started

Once you've determined exactly where you want your wall, lay out the location with a mason's string. This string will not only serve to keep your excavation straight but it will also

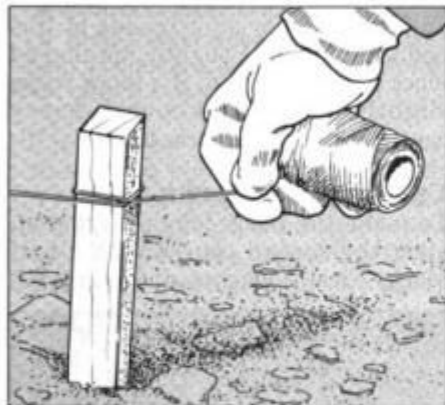
supply you with a reference point to check each block and each course to make sure it is level.

Drive a stake at each end of the wall location (Fig. 1) and hang a line between both stakes (Fig. 2). This line should be about 4 to 6 in. away from the finished face of the wall. These extra inches provide room for digging without disturbing your reference line.



1 Begin by locating the best position for the wall, then drive a stake at each end to firmly support some mason's string.

If your new retaining wall is to be perpendicular to a foundation wall, like ours is, then you should check the line for square before proceeding. One of the best ways to do this is by simply placing a framing square against the wall and the string (Fig. 3). Adjust the string as neces-

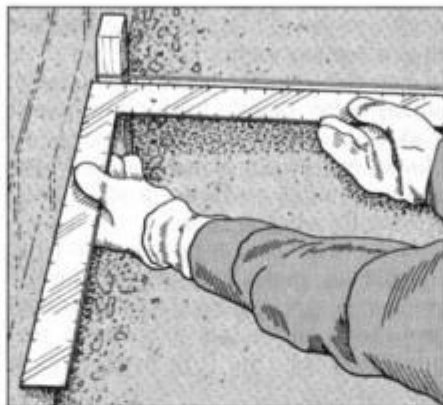


2 Tie the mason's string around one stake and then stretch it out and loop it over the other stake. Pull the string tight and knot it.

sary to achieve a square location.

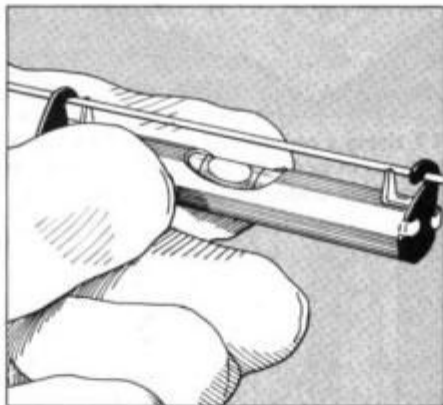
You also have to check the line for level. Hang a lightweight line level on the string near the middle of the span and check the reading (Fig. 4). Remember, for the line level to be as accurate as possible, you should have the line pulled very tight.

Once you're satisfied that the line is square and level, proceed with the ex-



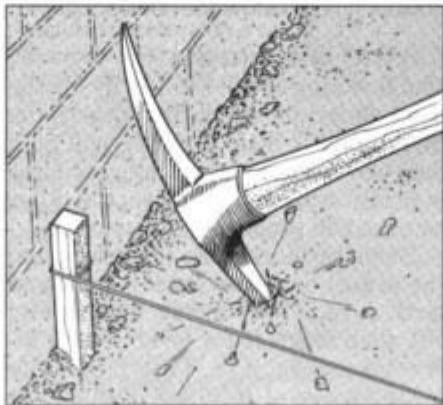
3 If the retaining wall is to be perpendicular to the foundation wall, check the string for square using a framing square.

cavation. If your wall is going to be relatively short (no more than 24 in. high), then you have to install only one course of block below the finished grade to prevent the wall from moving out over its lifetime. But if you



4 Hook a line level onto the string at the middle of the line and check for level. Make any adjustments before proceeding.

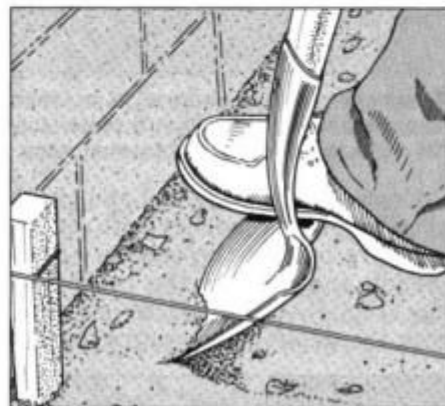
want to go higher, like we did, then plan on burying two courses below grade for increased stability. Because our blocks were 5 in. thick and we wanted to put 4 in. of gravel in the trench before we installed any blocks,



5 Begin by breaking the soil with a pick. Stand on the same side of the string as the pick to avoid hitting the string.

we had to make our trench 14 in. deep. Using this method, a lower wall would require a 9-in.-deep excavation.

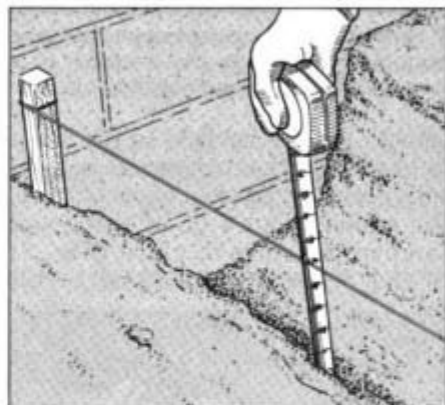
Keep in mind that most of these block systems stipulate a height limit between 36 and 48 in. You can use these blocks for higher walls, but such walls must be designed by an engineer and require extensive reinforcement, which defeats much of the purpose of using them in the first place.



6 Once the soil is loose, remove it with a shovel. Throw the soil on the uphill side of the trench to reduce backfilling work later.

Excavation

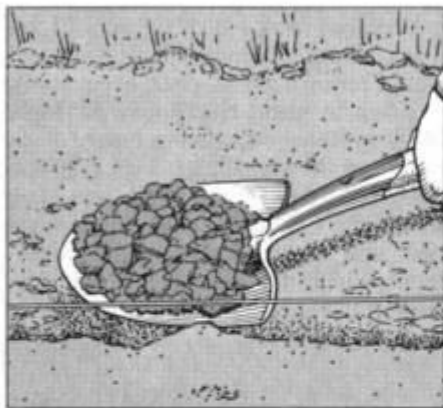
Digging a trench—especially a long one—with a pick and a shovel is just about no one's idea of a good time. They say it builds character, but the people saying that aren't usually the ones who are doing the digging. Still, it must be done and if it's done with



7 Periodically check the progress of your excavation by holding a tape on the bottom of the trench and against the string.

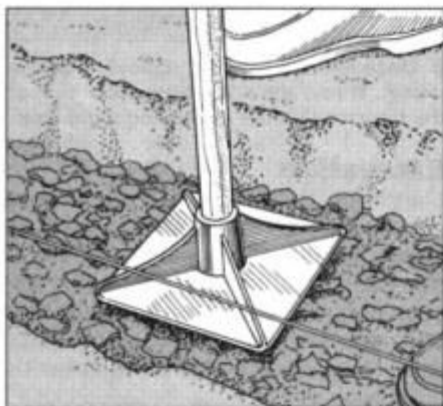
some care, everything that comes later will work out easier.

Begin with a pick (Fig. 5), making sure to avoid hitting the reference line while you work. Continue loosening the soil for several feet and then remove the soil with a shovel (Fig. 6). Throw the excess soil on the uphill side of the string to make the backfilling process easier later.



8 Remove soil to a depth of 14 in. Then rake the bottom of the trench reasonably flat and add a 4-in. layer of crushed stone.

Continue removing soil and check your progress regularly with a tape measure held at the bottom of the trench and against the reference line (Fig. 7). When you are satisfied with the depth of the entire trench,



9 Firmly tamp the crushed stone along the bottom of the trench. Use a tamper or a simple piece of plywood nailed to a 2 x 4.

smooth out the surface so it's fairly uniform and then cover the bottom with gravel or crushed stone (Fig. 8). We added about 4 in. of stone and tamped it firmly in place (Fig. 9) to give a nice firm base that is still

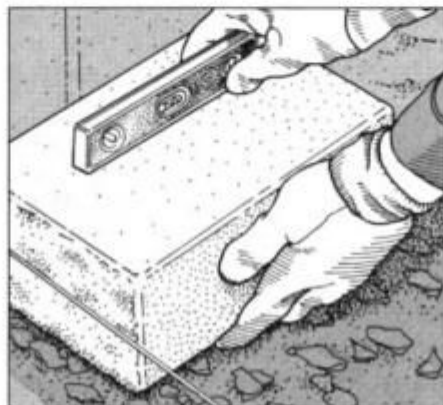


10 Begin the first course by placing a full block in the trench. Rock the block back and forth until it's seated firmly.

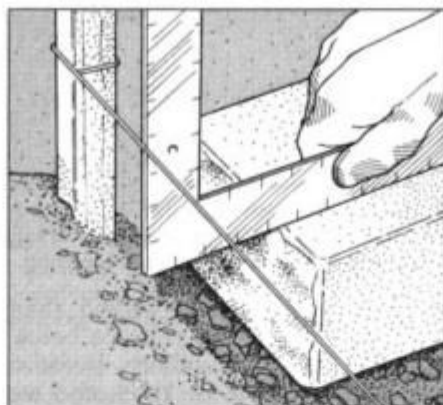
very porous. This allows any water to drain away easily.

You can also use sand for the base, which many people prefer because it makes leveling the first course of blocks easier. In areas where water drainage isn't an issue, a sand base is actually a better idea.

Once the trench is prepared for the blocks, make sure to check your reference string for square and level one more time. It's extremely important that this line be accurate and stable.



11 Using a torpedo level, check the block for level in both directions. Add or remove stone from under the block until it's level.



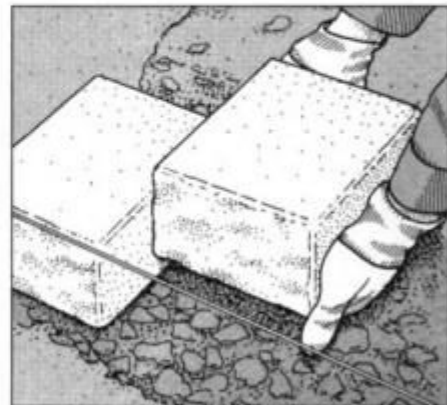
12 Once the first block is properly installed, use a framing square to establish how far it rests below the reference line.

Laying the blocks

The first course of blocks is by far the most important and laying it takes the most time. A little patience will go a long way because once the first course is firmly seated in the base, the other courses will practically fly up.

Begin by placing the first block into the gravel or stone. Rock it back and forth until it feels firmly seated (Fig. 10), then check it for level in both directions (Fig. 11). This may take awhile to level in place because, at first, removing or adding stone underneath will seem pretty awkward. But eventually it will start moving along.

Once the first block is in place, put a framing square on top of the block and slide it over till the other leg hits the string (Fig. 12). By reading this leg of the square, you can establish the depth of the block relative to the string and then make sure



13 Lower the second block alongside the first and make sure the two align precisely. Then level the second in place.

that all ensuing base blocks are installed to the same depth.

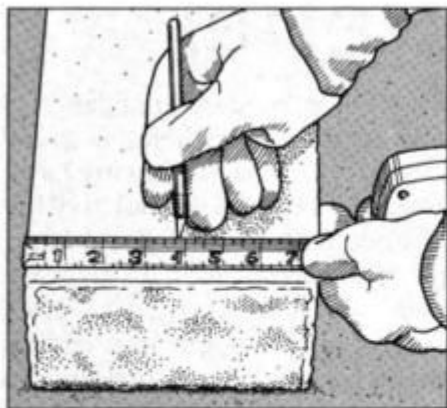
Lower the second block into place and push it against the first (Fig. 13). Align both back edges, and then check for level and for depth. When satisfied, continue on with the other blocks. It's a good idea to level the entire course, every three or four blocks, with a 4-ft. level (Fig. 14). This will tend to average out any minor differences in level between the blocks. Remember it makes more sense to undertake minor adjustments at this point than to let a slightly misaligned block go uncorrected. If a block rocks slightly on the first course, every course above it will rock, too.

Cutting the blocks

To make the block joints staggered, start the second course with a half block. First, measure and mark the



14 Repeat the same installation process for the third block, and check your progress across all three using a 4-ft. level.



15 Begin the second course with a half block. Start by marking the centerline on all four sides using a soft-lead pencil.

centerline of the block on all four surfaces (Fig. 15). Then draw centerlines between these marks using a straightedge and a soft-lead pencil (Fig. 16).

Once all the lines are drawn on the



16 Draw the centerline around the block using a pencil and framing square. For the best results, accuracy is important.

block, score each with a mason's chisel and a mechanics hammer (Fig. 17) or a ball-peen hammer. Remember to always wear eye protection when cutting these blocks because the concrete chips can fly

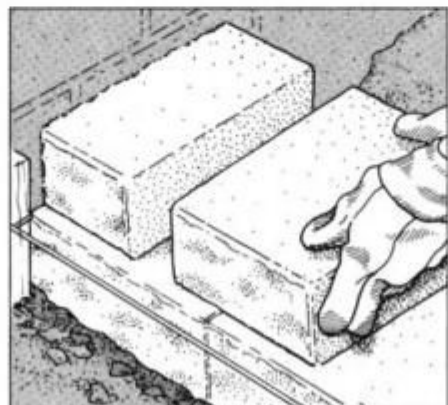


17 Using a mechanics hammer and mason's chisel, score all the cutlines. Then break the block in half with a single blow.

in totally unpredictable directions.

With all four edges scored, simply strike the block along the scored line and it should break. The process does take a little practice, and along the way you can end up ruining quite a few blocks before you finally get the hang of it. But eventually, the cutting goes quickly.

Once the half block is cut, slide it in place, making sure that the bottom retaining lip bears fully on the upper



18 Slide the half block in place, making sure its lip bears fully against the beveled edge of the block below.

beveled edge of the blocks in the first course. Then continue adding the remaining blocks to the second course (Fig. 18).

Finishing up

With all the blocks in place, backfill the trench, both in front of the blocks and behind them, with more gravel or stone (Fig. 19). Tamp the fill firmly in place (Fig. 20), and then add some topsoil to the front of the wall so the grass will grow. Also fill behind the wall, preferably with soil that has a lot of stone or gravel in it. The more stone and gravel, the

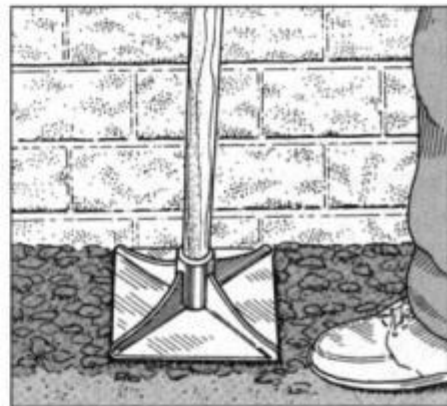
21 Getting the best finished appearance on outside corners takes a little work. For each course, three blocks must be cut. Begin by cutting blocks A and B into $\frac{3}{4}$ units. Place A in the normal block position against the last course block. Then remove the bottom lip from block B and place it at the corner of the course. Finally, take a full block (C) and remove enough of the lip so the block will fit properly in the space remaining. Alternate the position of these blocks on ensuing courses.



19 Once blocks are installed, lock the first two courses in place by filling the trench in front and back with crushed stone.

better your drainage and the less likely that the drainage spaces between the blocks will clog.

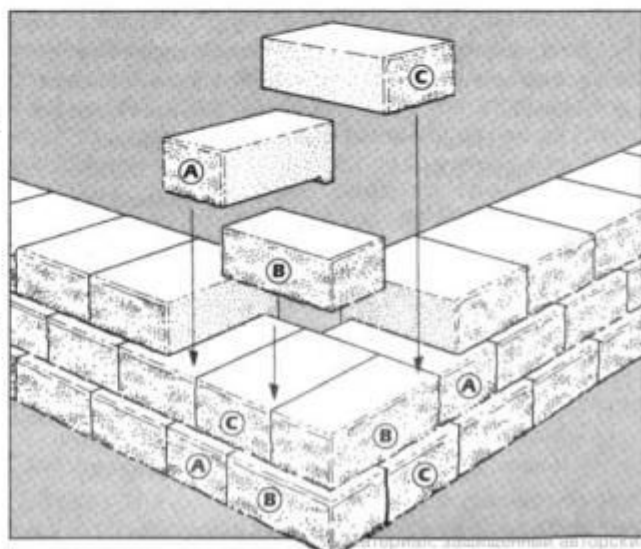
On this job we just built a couple of straight walls to solve an erosion problem. But if you need to make an



20 Firmly tamp the crushed stone in place and cover it with topsoil. Then add backfill behind the wall, tamping as you go.

outside corner in your wall, the process is simple (Fig. 21). Just make sure to stagger the corner blocks in each course.

FM



Natural Prostate Relief

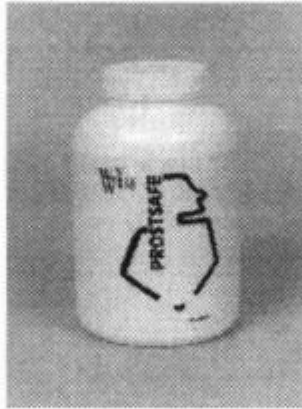
It's a natural fact. If you are a male over 40 and don't already suffer from a prostate gland disorder, the odds are 2 to 1 that you will before you are 59. By the age of 65, most American men have enlarged prostates.

As the years pass, mild discomforts can become disabling. Today, prostate surgery is the second most commonly performed surgery in men over age 65! Surgical complications can include total loss of bladder control and sexual dysfunction.

Prescription drugs may halt the swelling, but rarely ends the suffering. Like many prescription drugs, they have side-effects, like weak erections and low sex drive.

Many doctors feel that prostate disorders can be treated or prevented by giving the prostate gland the nutrition it lacks.

Recent scientific research has shown how to remedy the underlying problems associated with prostate disorders--safely and effectively. These results have been published in the *British Journal of Clinical Pharmacology*, the *American Journal of Gerontology* and papers from the *National Cancer Institute*. They reveal that several vitamins, minerals and natural herbs can dramatically shrink the prostate and improve urinary performance in older men.



The most modern application of these healthy ingredients is found in **ProstsafE** from Whitewing Labs. **ProstsafE** is the nutritional "tool kit" for men with prostate problems, and those who wish to prevent them. It is a mixture of zinc, serenoa serrulata, ginseng, certain amino acids, bee pollen and vitamins A, B-6 and E. Working as a team, these ingredients have been scientifically proven to shrink a swollen prostate.

Our customers have said
ProstsafE helps to:

Halt the endless trips to the bathroom during the night!

Stop that burning sensation during or after urination!

Prevent uncontrollable wetting!

Improve bladder control!

Empty bladder completely!

Sustain erections and enhance virility!

Please a concerned wife!



Dr. Michael Rosenbaum, M.D. says "ProstsafE supplies essential vitamins, minerals and herbs needed to nourish and maintain a healthy prostate."

For as little as a dollar a day, that seems like inexpensive insurance against deadly prostate disorders. If for some reason you are not satisfied, just return the unused portion within 30 days for a full refund.

The reasons why men over 40 use **ProstsafE** are clear. If you are looking for relief, order **ProstsafE** today.

"Now I get a good night's sleep without getting up every two hours to urinate."

-- Mr. C. Hussy
Cleburne, TX

"ProstsafE has stopped the burning after urination."

-- Mr. C.E. Black
Barboursville, WV

"I empty my bladder and have a good stream of urine with no strain."

-- Mr. S.J. Hymel
Houma, LA

"I previously encountered discomforts such as bladder urgency. These problems are now completely absent."

-- Mr. B. Doser
Holland, MI

"This is a little personal but, how can I say, I am more virile."

-- Mr. G. Howard
Cleveland, OH

"...and in the sex department, my wife thanks you."

-- Mr. G. Sawin
Lynwood, WA

Whitewing Labs, Dept 115
17939 Chatsworth St., Suite 408, Granada Hills, CA 91344

PS1 1 month supply of ProstsafE only \$34.95 plus \$4.50 S&H

PS2 2 month supply only \$59.95 (Save \$9.95) plus \$4.50 S&H

PS6 6 month supply only \$119.95 (Save \$89.75) plus \$4.50 S&H

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WOODWORKING

Power Miter Saw

How to turn your portable circular saw into a fast, accurate mitering machine.

TEXT AND PHOTOS BY ROSARIO CA'POTOSTO,
Contributing Editor

● Framing crews have them. Finish carpenters have them. You'll find one in nearly every professional woodworking shop, and even the well-equipped do-it-yourselfer has one for weekend projects. The tool is a power miter saw—a hybrid that combines the consistency and accuracy of a good miterbox with the power and speed of a circular saw.

These tools don't come cheap, though. And if you consider that buying one duplicates the motor, housing and blade of the circular saw you already own, it's easy to think twice before getting out the checkbook.

However, you can build your own power miter saw out of plywood and some easy-to-find hardware. Our design cuts 45° to the left and right, and

has stops at the most common cutting angles. We based our power miter saw on the Porter-Cable model 368-1, 8¼-in. circular saw. This provides a cutting capacity of 1½ × 6½ in. at 90°. If you have a different saw, cutting capacity may vary and you might have to modify some construction details.

Unlike commercial power miter saws that are spring loaded to keep the power head in the raised position, the circular saw in our version rests on the base. In operation, you simply lift the saw, insert the workpiece and then lower the saw to make the cut. The blade-guard lever is lashed to the rear of the base. In this way, the blade guard retracts for the cut in the low position and returns to cover the blade when the saw is raised.

The Pivoting Platform

Begin by cutting two pieces of plywood to 17 × 24 in. for the base and turntable support. Cut another piece to 18¼ × 24 in. for the turntable top. Lay out the pivot centers on all three pieces. Place pivot points 8¼ in. from the back edge on the base and turntable support, and position the turntable top pivot point 7 in. from the back edge. Center all pivot points from side to side.

Mark centerlines at 90° and 45° on all the pieces (Photo 1). These lines will help to orient the pieces later on. Use a beam compass to draw the circular outlines. Then lay out the turntable arm (Photo 2).

It's best to cut the circular shapes on a bandsaw with a circle-cutting jig.

Bore $\frac{3}{16}$ -in. holes at the pivot centers for the circle-jig pivot pin. Then, bore a $\frac{3}{4}$ -in. access hole centered at the intersection of the turntable circle and the arm layout lines as shown in the Turntable Detail in the drawing (right).

Make the two straight cuts up to the circle to define the arm. Position the panel on the bandsaw circle jig so the blade is in the $\frac{3}{4}$ -in. access hole. Then make the stopped circular cut from the access hole to the opposite straight cut of the arm. When the cut is finished, plug the access hole with a $\frac{3}{4}$ -in. dowel and trim flush.

Then, cut the full circle to produce the turntable support. Don't discard the cutoffs from the turntable support and turntable—you'll use these to make adjoining members (Photo 3).

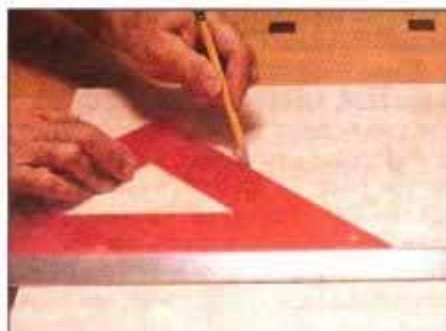
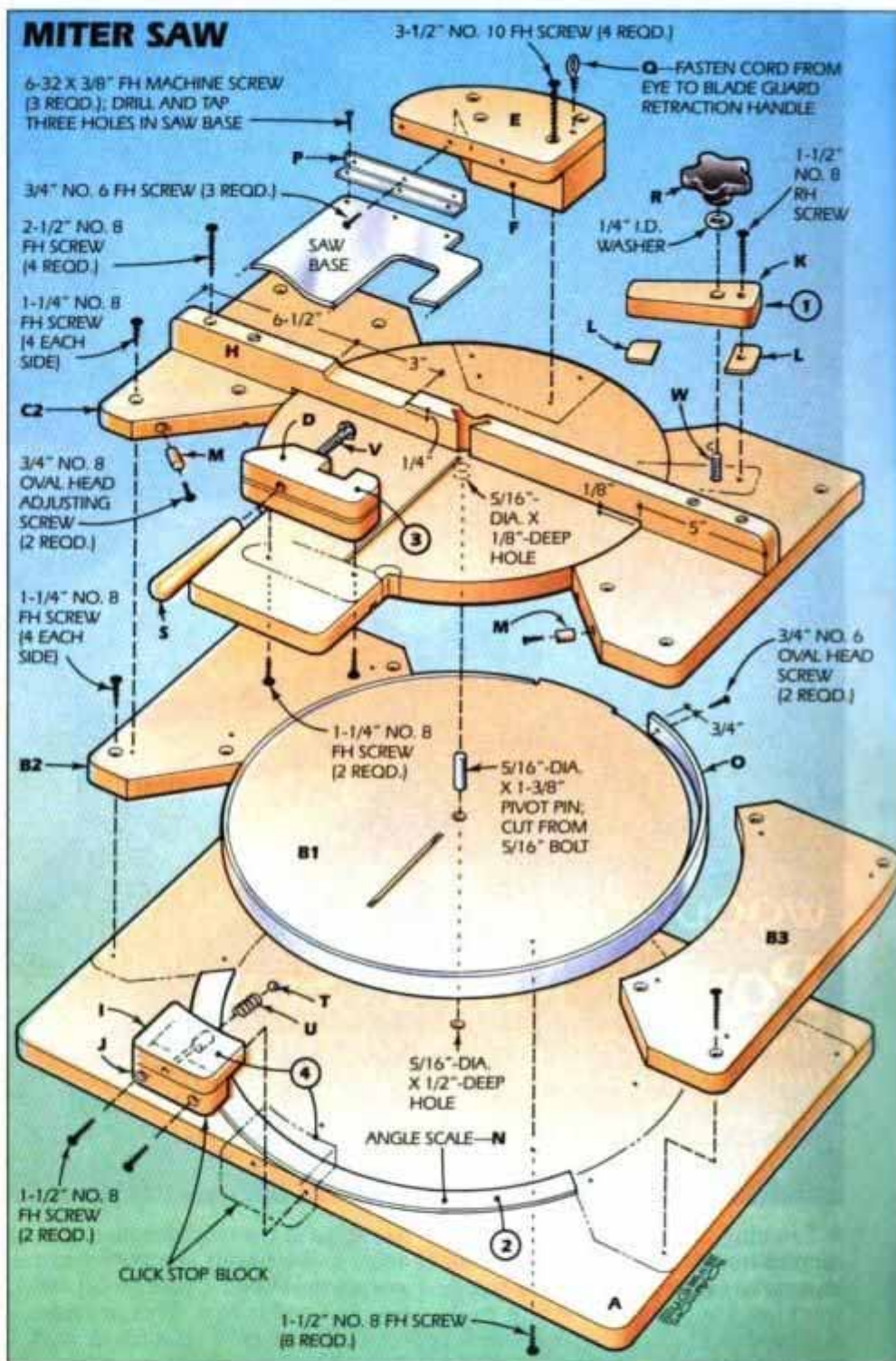
Insert a snug-fitting nail through the pivot holes in the turntable members, align their centerlines and drive in a few nails to keep the parts from shifting (Photo 4). Then, bore screw-holes from the bottom face of the turntable support for joining the pieces and temporarily install a few screws (Photo 5). Bore the $\frac{1}{16}$ -in.-dia. blind hole for the pivot pin from the bottom of the turntable support. Also, bore the corresponding blind hole in the base.

Separate the two turntable pieces and make the setback cuts for the aluminum ring as indicated in the Base And Turntable Support Detail. Cut the aluminum bar to 44 in. and bore screw-holes at each end for $\frac{3}{4}$ -in. No. 6 screws. Butt one end of the aluminum bar in one of the setback cuts and make sure the bottom of the aluminum is flush with the bottom of the turntable support. Then, bore a screw pilot hole into the plywood edge.

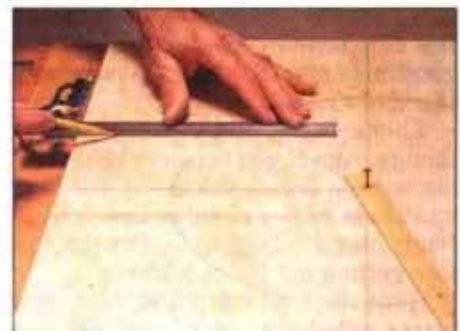
Apply contact cement to the wood and the aluminum. Screw the first end into the setback cut and gradually bend the aluminum around the turntable base (Photo 6). When the bend is complete, bore a pilot hole for the second screw and secure the free end. Because nominal $\frac{3}{4}$ -in. plywood is slightly less than $\frac{3}{4}$ in., file the bar flush with the wood surface in the setback-cut area (Photo 7).

Use the cutoffs from the turntable base and turntable to make the retainers and spacers that fit up against each side of the two circular turntable components.

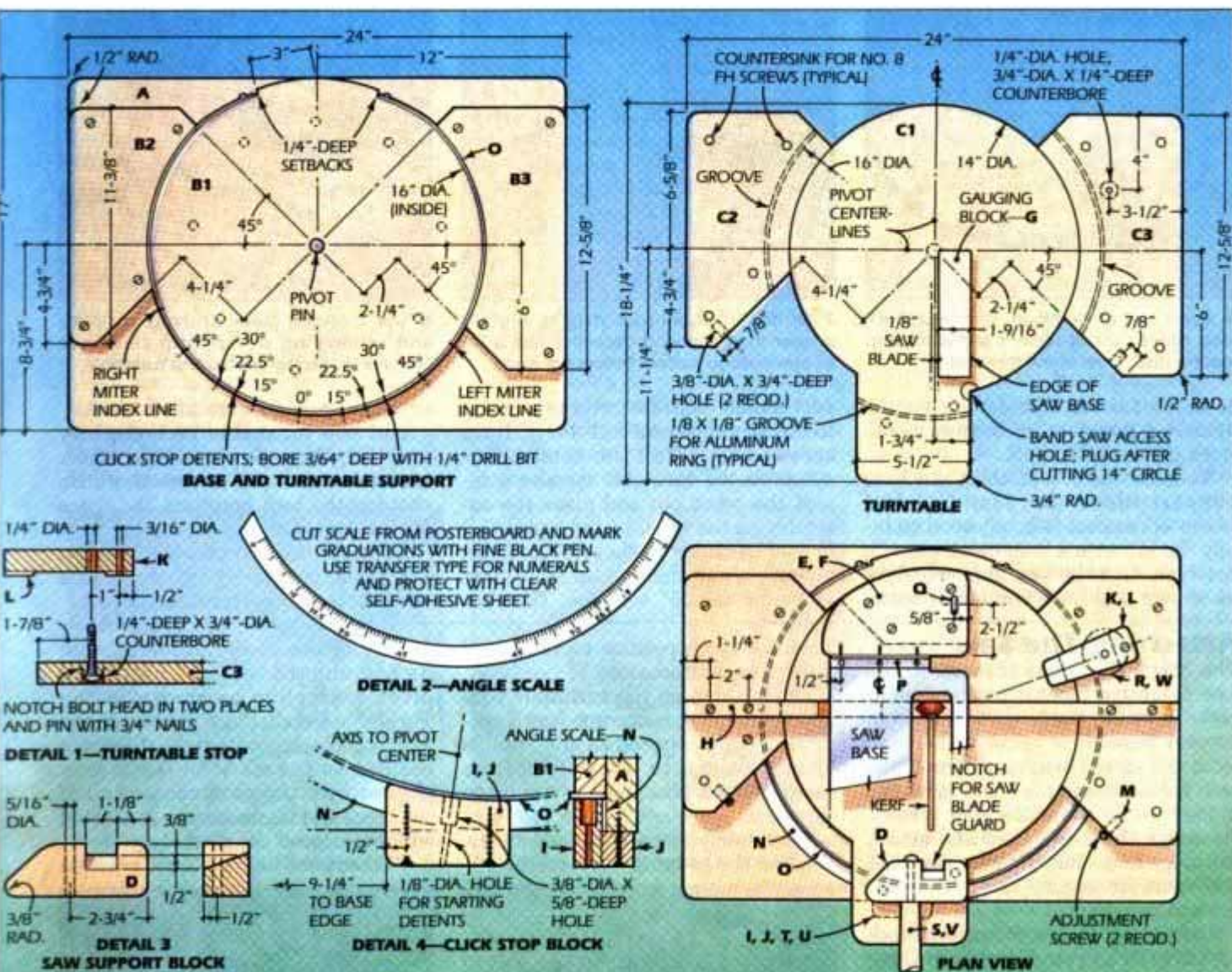
Next, cut curved clearance grooves in the bottom of the two retainers (C2, C3) and the turntable arm to match the projecting aluminum bar. Use a router with a template guide bushing and a $\frac{1}{8}$ -in. straight bit or veining bit



1 Use a triangle to mark the 45° and 90° centerlines on the turntable pieces.

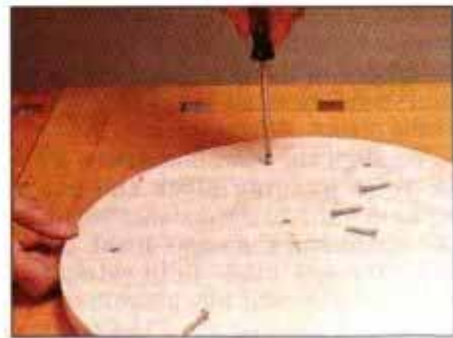
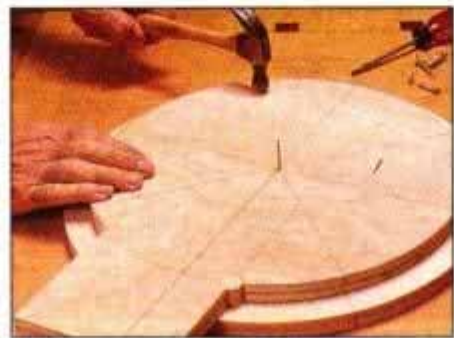


2 Lay out the circular pieces and mark the arm outline on the top turntable piece.



MATERIALS LIST—POWER MITER SAW

Key No.	Size and description (use)	J	1	3/4" x 3/4" x 8" hardwood (click-stop block)	* Cut B1, B2 and B3 from one piece 3/4" x 17" x 24"
A	1/4" x 17" x 24" plywood (base)	K	1	3/4" x 1 1/4" x 4 1/2" hardwood (turntable lock)	** Cut C1, C2 and C3 from one piece 3/4" x 18 1/2" x 24"
B1*	1/4" x 16"-dia. plywood (turntable support)	L	2	3/8" x 1" x 1 1/2" plywood (spacer)	*** Laminate 1 1/2" from two pieces nominal 3/4" plywood and one piece 1/2" plywood
B2*	3/4" x 6 1/2" x 11 1/2" plywood (spacer)	M	2	3/8"-dia. x 3/4" dowel (plug)	¹ Birch plywood (typical, 3/32" thick)
B3*	3/4" x 6 1/2" x 12 1/2" plywood (spacer)	N	1	8" x 16" white posterboard (scale)	² Available from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, MN 55374
C1**	3/4" x 14" x 18 1/2" plywood (turntable)	O	1	1/4" x 3/4" x 44" aluminum bar	
C2**	3/4" x 7" x 11 1/2" plywood (retainer)	P	1	1 1/2" x 4 1/2" hinge	
C3**	3/4" x 7" x 12 1/2" plywood (retainer)	Q	1	3/4" screws	
D***	1 1/2" x 1 1/2" x 5" plywood (saw support block)	R	1	1/4"-20 5-star knob (No. 715481) ¹	Misc: 3/16"-dia. x 2" bolt; 26 1 1/2" No. 8 fh screws; 2 1 1/2" No. 8 fh screws; 4 2 1/2" No. 8 fh screws; 4 3 1/2" No. 10 fh screws; 1 1 1/2" No. 8 rh screw; 3 3/4" No. 6 fh screws; 2 5/8" No. 8 oval head screws; 2 3/4" No. 6 oval head screws; 6-82 x 3/8-in. machine screws; self-adhesive clear plastic sheet; transfer-type numerals.
E	3/4" x 4" x 7" hardwood (saw mounting block)	S	1	3/4"-18 post handle (No. 81505) ¹	
F***	1 1/2" x 3 1/2" x 6" plywood (block support)	T	1	3/4"-dia. steel ball	
G***	1 1/2" x 1 1/2" x 6 1/2" plywood (gauging block)	U	1	3/16" O.D. x 3/4" spring	
H	3/4" x 1 1/2" x 24" hardwood (fence)	V	1	3/4"-20 x 2" carriage bolt and washer	
I	3/4" x 2" x 3" hardwood (click-stop block)	W	1	3/4"-18 x 2 1/2" carriage bolt	



3 Cut circular pieces with a bandsaw or sabre saw and circle-cutting jig.

4 Drive a nail through the pivot holes of turntable pieces, align centerlines and tack.

5 Fasten turntable pieces with screws driven from bottom of turntable support.

PHOTOGRAPH BY EUGENE THOMPSON



6 Screw end of aluminum strip in setback area. Apply contact cement and wrap strip around disc. Then screw free end.



7 Width of aluminum strip is slightly greater than plywood thickness. Use a file to trim flush to surface in setback areas.



8 Use a router, guide bushing, template and veining bit to cut strip clearance grooves in retainer pieces and turntable.

to make the cut. Guide the router against a template made from 1/4-in.-thick plywood (Photo 8).

To make the 1 3/16-in.-thick saw base support block (D), laminate two pieces of nominal 3/4-in. plywood (actually 23/32 in.) with a 1/8-in.-thick piece in between. Cut the saw support block as shown and bore the hole for the

post-handle bolt. Secure the support to the turntable arm with 1 1/4-in. No. 8 screws and install the handle. Reassemble the turntable members, insert the pivot pin and place the assembly on the base. Install a plug (M) in each retainer as shown. The plugs accept screws that act as adjustable stops for the 45° settings. Then se-

cure the spacer and retainer blocks.

Cut the turntable lock slightly oversize, then glue two 1/8-in.-thick spacers at each end as shown. Finish shaping the lock and bore the holes for the screw and the knob bolt.

Sand all the pieces with 220-grit sandpaper and apply two coats of a satin varnish or polyurethane finish.

Attaching The Saw

The hinge that joins the saw to the saw mounting block must be free of play. To attach the hinge to the circular saw base, first remove the base from the saw. Then, mark the hinge hole positions and bore and tap holes in the base for the 6-32 x 3/4-in. screws. Resecure the saw's base and attach the hinge to the base. If your saw base is too thin for tapping, use nuts, washers and bolts.

Laminate the saw mounting block support (F) as you did when making the saw base support block to achieve the 1 3/16-in. thickness. Then, make the hardwood saw mounting block (E) and attach it to the support block with screws as shown. Bore and countersink holes for attaching the assembly to the turntable. Don't bore the pilot holes in the turntable yet.

For the miter saw to function properly, two conditions must be met. First, the center of the blade must be aligned with the centerline of the pivot. Second, when the blade is fully extended and the saw mounted, the intersection between the fence-side periphery of the blade and the turntable surface must be at the center of the pivot.

To align the saw, laminate a 1 3/16-in.-thick gauging block and cut it equal in width to the distance between the blade and the edge of the base. With the saw blade fully extended, hold the gauging block against the blade and position it so the bottom front corner aligns with the periphery of the blade. Then use a pencil to

mark the block position on the top of the saw base (Photo 9).

Draw a line on the turntable parallel to the pivot centerline (see Turntable Detail), spaced to the right a distance equal to the width of the gauging block plus one-half the blade thickness.

Completely retract the saw blade. Position the gauging block on the off-

set line drawn on the turntable, with its end aligned with the horizontal pivot centerline as shown in the Turntable Detail. Place the saw on the gauging block, and adjust the saw's position so the mark on the base is aligned with the pivot-center end of the block and the base edge is aligned with the edge of the block.

Without shifting the saw, position



9 With saw blade extended, align corner of 1 3/16-in.-thick gauge block with blade edge. Then, mark block position on base.



10 After placing saw and gauge block on turntable centerlines, tape free leaf of hinge to saw support. Remove hinge from saw.



11 After securing hinge to saw mounting block, refasten it to saw base. Angled mounting block provides workpiece clearance.



12 Secure mounting block and check that blade is square to centerline. Butt fence against square and install.

the saw mounting block to butt against the free leaf of the hinge. Once it's in place, tape the leaf to the block (Photo 10).

Remove the hinge from the saw and mark the screw centers on the mounting block. Bore pilot holes and attach the hinge first to the block, then to the saw base (Photo 11).

Position the saw and mounting

block using the gauging block for alignment. Then mark the mounting-block screw centers on the turntable and attach the mounting block. Adjust the blade for maximum depth of cut. Tilt up the saw, turn it on, then lower it to cut the kerf in the turntable.

Next, cut the hardwood fence to size as shown and bore and countersink the screwholes. Temporarily tape

a drafting square to the turntable so it's butted against the blade (Photo 12). Then, align the fence against the square and secure it with screws. Turn on the saw and lower it to make the initial clearance cut in the fence. Then, make a series of cuts between the 45° left and 45° right miter positions to scoop away the blade clearance recess in the fence.

Finishing Touches

Make the angle scale out of white posterboard. Use a shopmade beam compass and fine felt pen to mark an 8½-in.-radius accent line. Then, press a razor knife into the beam at an 8½-in. radius and cut the outer edge of the scale (Photo 13). Shift the knife for an 8¼-in. radius and cut the inner

edge. Cut the scale to fit between the retainer blocks and secure it with contact cement.

To mark the graduations, first make an index guide block by cutting one edge of a small piece of wood to match the radius of the turntable base. Trim an adjacent edge so it extends geometrically to the pivot cen-

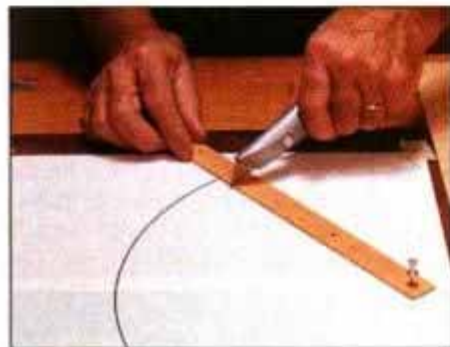
ter. Place a protractor on the turntable and tape it to the fence so it's centered on the pivot centerline. Slide a piece of paper under the protractor and tape it to the turntable. With the turntable at the 0° position, make an index mark on the paper at the 90° mark on the protractor. Then, use a knife to scribe the right and left miter index lines on the aluminum ring as shown on the Base And Turntable Support Detail.

Rotate the turntable counterclockwise until the index mark on the paper aligns with the 45° mark on the protractor. Then, line up the edge of the index guide block with the index mark on the aluminum ring and mark a line on the posterboard scale with a felt pen. Finish the scale by rotating the turntable in 1° increments and transferring each position to the scale (Photo 14). Then, repeat the process on the opposite side of the scale. Use transfer type to define the 0°, 15°, 22½°, 30° and 45° positions on both sides of the scale (Photo 15).

Cut the click-stop block to size and trim one edge to match the turntable-base radius when the block is positioned 9¼ in. from the base left edge (see Detail 4). With the block in position, mark the spring-hole axis so it extends to the pivot center as shown. Then, bore a ⅛-in.-dia. hole through the block on this axis. If possible, use a drill press for accuracy.

Secure the block to the base. Use the ⅛-in. hole to guide your drill in starting the detents in the aluminum at the standard miter positions (Photo 16). Then, remove the block and use a ¼-in. bit in a handheld drill to enlarge the detents slightly. Bore the ⅜-in.-dia. spring hole in the click-stop block as shown. Reinstall the block with the spring and ¼-in.-dia. ball in place (Photo 17).

Finally, install a screweye in the top of the saw mounting block, in line with the saw's blade-guard lever. Then, secure the lever to the eye with a stout cord and check that the guard retracts properly as the saw is lowered (Photo 18). Finally, install the turntable lock and knob:



13 Use a shopmade beam compass to cut the posterboard scale. Press a razor knife into the beam and pivot to make cut.



14 Tape protractor to fence. Mark on paper shows turntable angle. Align marks on scale with index scribed on aluminum.



15 For a professional look, add transfer type at common miter settings. Then, apply clear, self-adhesive plastic to scale.



16 Use ⅛-in. hole in click-stop block to guide drill in starting detents. Place a detent at common miter settings.



17 After enlarging detents with ¼-in. bit, enlarge click-stop block guide hole to accept spring and ¼-in.-dia. steel ball.



18 Tie string from screweye to guard lever. Adjust it so blade guard retracts properly as the saw is lowered.

NEW PRODUCTS

Growing Season

Great new gardening products.

BY ROY BERENDSOHN, Assistant Home Improvement Editor



Wide Range

This sprinkler waters in a square pattern from 36 sq. ft. to 2500 sq. ft. and is designed to evenly distribute the water throughout the pattern. That way, you don't have to over-water the outside of the pattern to get adequate water at its center. The sprinkler's drive mechanism is enclosed for durability, and it makes it safer to use around playing kids. Also, the drive mechanism's durability is increased because it is water lubricated, says the manufacturer. It costs about \$32 at hardware stores, home centers and lawn-and-garden centers. Write Rain Bird, 7590 Britannia Court, San Diego, CA 92173.

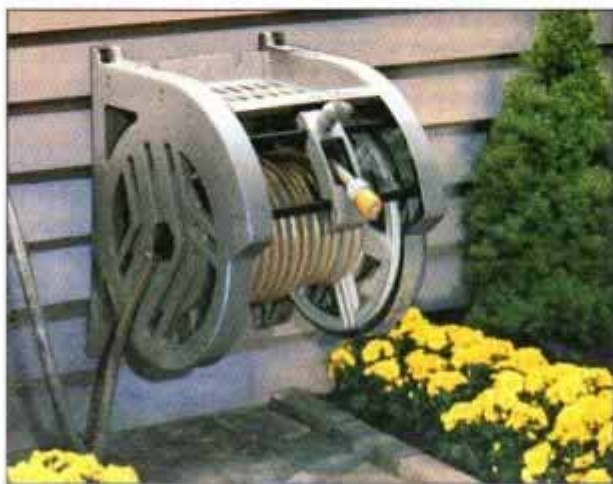


On A Roll

MulchPlus is wood mulch on a roll. It consists of recycled wood fibers bonded to a polypropylene plastic weed-inhibitor mat. The product is available in two rolls: 40 in. wide x 9 ft. long (\$10) or 40 in. x 25 ft. (\$23). To position plants on the sheet, use a pair of scissors to cut out a flap so you can put the plant in the soil below. The product allows air and water to enter while inhibiting weed growth, according to its manufacturer. The mat is available with bark chips, cedar or pine chips. The rolls are sold at lawn-and-garden centers, home centers and through gardening catalogs. For more information, write Conwed Fibers, P.O. Box 357, Riverside, NJ 08075, or call (800) 366-1180.

Rugged Reel

We thought this wall-mounted polyethylene hose reel was worth a mention because it's more substantial than most and provides a slotted shelf for watering tools. It takes 225 ft. of 3/4-in.-dia. hose or 300 ft. of 1/2-in.-dia. hose. The reel comes with the necessary hardware to mount it to wood siding and also features a 3/4-in.-dia. leader hose with a quick-connect fitting.



The reel costs about \$40 at home centers and discount stores. Write Suncast Corp., 701 N. Kirk Rd., Batavia, IL 60510, or call (800) 846-2345.



Standing Room Only

Suppose your outdoor storage space is limited and you have just a handful of garden tools and a garbage can that you want to keep out of the weather. You probably don't need or want a full-blown garden shed, but maybe this plastic snap-together shed is right for you. It measures about 32 in. deep x 52 in. wide x 77 in. tall and has a cover that is curved downward to shed water. Its other worthwhile features are lockable doors and molded grooves to accept shelves. It costs about \$300 to \$325 and can be assembled without tools. It's sold at hardware stores and home centers. For more information, write Rubbermaid, 1147 Akron Rd., Wooster, OH 44691.

Standing Tall

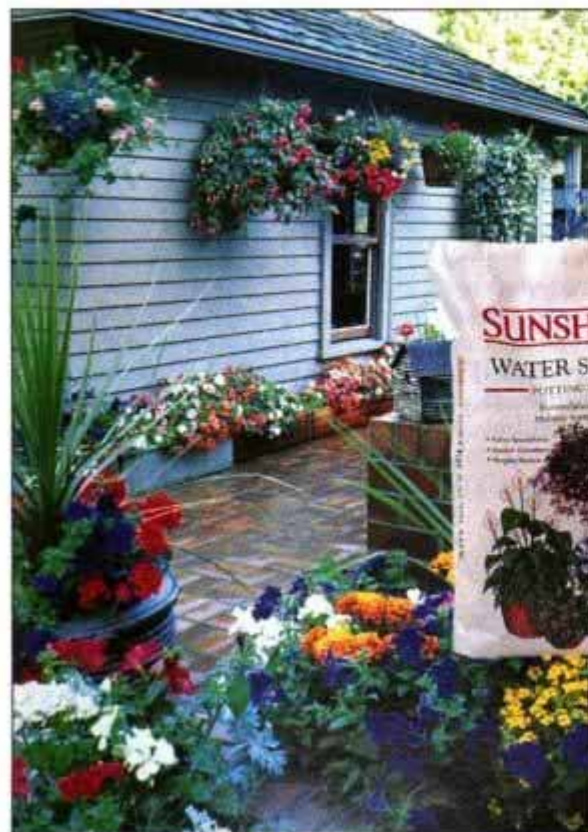
Compared to other tall fescue varieties, Mirage requires fewer mowings to keep looking neat, says Scotts. The grass is a low-growing dwarf tall fescue that is supposed to grow well in most areas of the United States. The seed produces a dark green and fine-blade leaf that is hardy enough to handle a variety of soils. A 3-pound bag (about \$10) can oversee about



1300 sq. ft. It's sold at lawn-and-garden centers, hardware stores and home centers. Write The Scotts Co., 1411 Scottslawn Rd., Marysville, OH 43041, or call (800) 543-8873.

April Showers

Here are two inexpensive ways to get your feet wet in small-scale irrigation: a micro-sprinkler kit designed to water 1000 sq. ft. of space and a drip-irrigation kit to handle 200 sq. ft. The sprinkler kit costs about \$30 and the drip irrigation kit, about \$20. Both kits use plastic components, so the parts resist corrosion from water or gardening chemicals. The kits are designed to save a substantial amount of water compared to using a hose or other methods. The drip irrigator, for instance, is designed to save up to 60% of the water other methods would require. The kits accomplish this by delivering a precise amount of water and reducing runoff and excess evaporation. Both kits have 50 ft. of 1/2-in.-dia. polyethylene tubing and a variety of fittings like hose couplings and goof plugs. The drip irrigator kit has 22 drippers and 50 ft. of 1/4-in.-dia. tubing. The micro-sprinkler kit has 26 sprinkler heads that spray water in full and partial circle patterns. The kits are sold at lawn-and-garden centers and home centers. For more information, write DIG Corp., 130 Bosstick Blvd., San Marcos, CA 92069, or call (800) 322-9146.



For Peat's Sake

More than one container plant has bitten the dust because its owner forgot to water it for a couple of days. Now Sunshine Water Saver Potting Mix can help bring a plant through a brief dry spell. It consists of Canadian sphagnum peat and water-holding polymer granules. The mix has a cell structure that allows air to get to the plant's roots, the manufacturer says. It's sold in 8-, 25- and 80-quart packages (\$3, \$6 and \$9) at lawn-and-garden centers, hardware stores and home centers. Write Attn: Marketing Dept., Sun Gro Horticulture, 110-110th Ave. N.E., Bellevue, WA 98004.



Tough Customer

Think of this utility cart as a wheelbarrow on steroids. Its manufacturer says its 10-cu.-ft. tray can hold up to 500 pounds. Where a conventional wheelbarrow uses a single front tire, this cart has two 2-ply 16-in.-dia. pneumatic tires mounted on a solid-steel axle. The polyethylene tray is secured to hardwood handles with steel straps. It costs about \$240 at hardware stores, home centers and farm stores. Write Ames, P.O. Box 1774, Parkersburg, WV 26102.



Take A Seat

The Grass Hopper is a combination plastic seat and toolbox that rolls on 7-in.-dia. wheels. To get at the 6-in.-deep storage compartment, you just flip the seat back. To carry it, just grab the molded-in handle on the end and take it—it weighs about 6 pounds. The Grass Hopper costs about \$20 to \$25 at hardware stores and home centers. Write Step2 Corp., 10010 Aurora-Hudson Rd., P.O. Box 2412, Streetsboro, OH 44241.



Pump-Free Spraying

To pressurize this sprayer, connect a garden hose to the tank fitting. As the tank fills, it is pressurized. The connection between the pump and fitting is made with a coupling that threads to a hose. The coupling comes with the sprayer. A 2.5-gallon PumpLess sprayer costs about \$28 at hardware stores, lawn-and-garden centers and home centers. Write Dept. PM, H.D. Hudson Mfg. Co., 500 N. Michigan Ave., Chicago, IL 60611.



Good Bugs

Along the lines of fighting fire with fire, Sudbury beneficial nematodes are tiny parasitic insects that don't harm crops or grass but seek and destroy the larvae and pupae of ground-dwelling, crop-destroying insects. A nematode enters the body of a larva or pupa then releases bacteria that kill the creature. The nematodes reproduce using the creature's body for as long as it provides a suitable environment. When the host's body no longer is suitable, the nematodes move on to find another host. The nematodes will not harm people or beneficial garden insects, like ladybugs, the manufacturer says. There are three types of nematode treatment: one for gardens and orchards, one for lawns and one for controlling fleas. The product comes in granule form and is mixed with water and applied with a watering can, hose-end sprayer or pump sprayer. With adequate soil moisture, a treatment lasts about four weeks, and a container (\$15) treats 3200 sq. ft. The product is sold at lawn-and-garden centers. Write Sudbury Consumer Products, P.O. Box 34820, Phoenix, AZ 85067.



From The North

This Scandinavian-design greenhouse measures 1½ ft. deep x 3 ft. wide x 5 ft. high, and is designed to be affordable (\$200 to \$260) and durable. It's made of aluminum channels and ribbed polycarbonate panels. It features one sliding door and a fixed panel. The shelves are optional. The door rides on grooved plastic guides that run on a U-shaped channel. This way, the door can slide freely despite debris that falls into the door channel. The ends of the door channel are open, so it can be hosed clean. The Juliana greenhouse is sold at home centers, lawn-and-garden centers and through gardening catalogs. Write GardenStyles, 275 Market St., Suite 521, Minneapolis, MN 55405, or call (800) 576-5618.

High-Tech Hose

Aquapore says its sprinkler hose is durable because it is made from a tough mixture of polyethylene and recycled tires. These materials are blended with an ultraviolet inhibitor so the hose resists the damaging effects of sunlight. Its manufacturer says it is far more crack resistant than vinyl sprinkler hose. Another neat feature: Its holes are drilled with laser beams. The process ensures a precisely formed hole that helps the hose produce a uniform mist over its length. It is sold in 25- and 50-ft. lengths, for about \$10 and \$15 at lawn-and-garden stores, home centers and hardware stores. Write Aquapore Moisture Systems, 610 S. 80th Ave., Phoenix, AZ 85043.



Rolling Lawns

The idea behind this product is this: roll up your sleeves and unroll a nice lawn. It consists of grass seed bound to a biodegradable mat made from wood chips and kenaf, a hemp-like plant. To use it, till the ground as you would for seeding, cut the mat to fit the area and keep it moist. The mat protects the seed from birds and erosion. According to the manufacturer, in most areas of the United States, the product will produce grass in five to 20 days. The rolls come in 25-sq.-ft., 50-sq.-ft. and 80-sq.-ft. sizes (about \$10, \$15 and \$20 respectively). It's sold at hardware stores, lawn-and-garden centers and home centers. Write Advance Seed Co., P.O. Box 488, Fulton, KY 42041, or call (800) 626-3392.



Iron Workhorse

We tried this mattock and tiller and found it's useful around the garden and durable enough to stand up to rocks without damage. The tool has a 16-in. handle and weighs about 2 pounds, so it can be swung with one hand like a hammer. Its mattock blade is about 2 in. wide x 2 3/4 in. long, and its tines are 4 1/4 in. long, making either end of the tool long enough for light groundbreaking in a flowerbed. The tool's head is held to the hickory handle with a rectangular tapered eye, so the handle does not have to be wedged to hold the head. It costs about \$12, and is part of a line of lightweight ductile iron landscaping tools sold at hardware stores and home centers. Write V&B Manufacturing Co., P.O. Box 268, Walnut Ridge, AR 72476.

Lawn Food

Toro's organic fertilizers are designed for lawns in a range of conditions, from those that take a beating from foot traffic and high-stress seasonal changes

blade, making it stiffer and better able to stand up to drought and foot traffic. The Premium Care formula provides a substantial dose of nitrogen while adding materials to slow down

its release, ensuring a sustainable green color throughout the season and preventing leaching into groundwater. Toro says that the fertilizers are absolutely safe to apply because they are made without animal or recycled municipal wastes. The components are similar to those used in livestock feed, and

will not burn a lawn the way incorrectly applied synthetic fertilizers can. An 18.8-pound bag of either product costs about \$10 at Toro dealers. Contact: The Toro News Center, 1401 W. 76th St., Suite 420, Minneapolis, MN 55423.

Down On The Farm

If your yard and garden work is large scale, check out the Carry-All Cart. It's proportioned to handle a large pile of produce or haul a pair of rectangular garbage cans standing side by side. Its 300-pound capacity comes from several heavy-duty features, such as a 3/4-in.-dia. solid-steel axle and 20-in.-dia. semi-pneumatic tires on ball-bearing wheels. The cart costs about \$100, and this includes the cost of the tool holder mounted on the cart's front. The cart is sold at farm supply stores, home centers and lawn-and-garden centers. For more information, write Agri-Fab, P.O. Box 500, Sullivan, IL 61951.



to ones in gentle climates and situations. For example, the Intensive Care formula gives the grass a high dose of potassium. According to Toro, this improves water flow through the grass

Space-Age Gardening

Even though it looks like a ray gun, the only thing this gun shoots is water. Melnor says the spray gun is industrial grade because of its solid-brass nozzle and stem, stainless-steel locking clip, plus heavy-duty internal seals, washers and springs. Its body is molded plastic for a more comfortable grip and to better insulate your hand from the water temperature, which usually is a factor only when spraying in cool weather. Turn the spray gun's nozzle to adjust the water stream from a mist to a jet. It costs about \$23 at hardware stores and home centers. For more information, write Melnor Inc., 1 Carol Place, Moonachie, NJ 07074.



Circle Around

TreeCircle is a 36-in.-dia. sheet of polypropylene weed-control fabric that is pre-cut for ease of installation around a tree trunk. Mark out the area around a tree and remove the grass or other growth. Install the TreeCircle around the tree, and spread 3 to 4 in. of mulch on top of it. If you want to install plants through the fabric, cut an X-shaped slit for each plant and pull the plant through.



TreeCircle's manufacturer says the material is porous enough to allow air and water to pass, yet it blocks weeds from forming deep roots. A package of two circles costs about \$2.50 at lawn-and-garden centers and home centers. Write Reemay, 70 Old Hickory Blvd., P.O. Box 511, Old Hickory, TN 37138.



No-Turn Composting

The manufacturer of this compost bin says it works without aerating the pile with a pitchfork. The key to the system is the perforated air tubes that you insert horizontally as the compost is stacked. When the compost is ready, unhook the pin connectors that hold the bin wall closed and flex the bin open to reveal a 14.8-cu.-ft. bale of compost. The bin is made of recycled plastic, and costs about \$100 at lawn-and-garden centers and gardening catalogs. Write to Gardener Equipment Co., P.O. Box 106, 167 Kindt St., Juneau, WI 53039. **FM**



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CAR CARE

CAR CLINIC

BY MIKE ALLEN,
Associate Automotive Editor

All Pumped Up

I bought a new car a year ago, for the first time in 20 years. I took it to the dealership for service last week and wanted to remind the mechanic to be sure to grease the suspension. Imagine my surprise when he told me there were no grease fittings anywhere on my car, and that no modern car has grease fittings.

JOHN SCULLIMORE
BATON ROUGE, LA

Your mechanic is almost right, John. There are a few vehicles around with grease fittings—mostly light trucks, but a few passenger cars as well. Tie-rod ends and ball joints nowadays are “lubed for life” at the factory. Supposedly, the seals are good enough to keep the dirt out and the grease in for the life of the vehicle.

Maybe, maybe not. The inner construction of tie-rod ends leaves some room for a reservoir of grease—but eventually even that will dry out.

Some replacement parts have grease fittings, even if the original equipment did not. If you're really of a mind to, you can drill and tap the joints you have now and add grease fittings. This can be done without removing the parts from the car.

One other thing: I've found that filling my grease gun with high-quality synthetic wheel-bearing grease lasts longer than using a less expensive chassis grease. The cartridges you can buy for most grease guns have the less expensive spread in them.

If you immerse your vehicle in water, fresh or salt, to ford streams or launch a boat from a trailer, it's important to grease the suspension immediately to displace any water that snuck in past the seals.

Well-Preserved

I read in a motorhome magazine about a fuel stabilizer to pour into the tank to prevent fuel breakdown



and prevent gumming. Is there any deteriorating effect to fuel-system components like with alcohol-based additives?

EDWARD MOE
LIBBY, MT

There are a number of these preparations on the market, and although I haven't tried them all, the several I have used have been terrific. I use them in boats, motorcycles, lawnmowers, chain saws, generators and any gasoline engine that sits for more than a month or two—including my race car. I've never had any

problem. In fact, the incidence of fuel-system-related problems around my shop has gone way down. I rarely have to rebuild the carb on the lawnmower to get it started in the spring, or use half a can of starting fluid on the generator to get it started after six months in storage.

Read the directions on the label and use the correct concentration of stabilizer. Mix thoroughly, and run the engine for a few minutes to get the stabilizer up to the carb.

These stabilizers can be found at most auto parts stores or marinas,

PH ILLUSTRATION BY DON MAYER

CAR CARE

but I bought a case of them at a Wal-Mart store last month.

A Real Lube Job

I'm interested in extending the life of my engine. I was thinking about one of those electrical pumps that you turn on to pump oil through the block before starting the engine. I also know they make these for turbo-charged engines, and I was wondering if this type would work even though I have no turbocharger. Specifically, I was wondering if the buildup of oil and pressure could damage anything.

ERIK KRISTINSSON
SAN MARCOS, CA

There have been a number of electric post-lubers for turbo engines over the years. The idea is to provide oil flow to the turbo bearings to keep them cool after shutdown, mostly to prevent the oil from carbonizing from the intense heat.

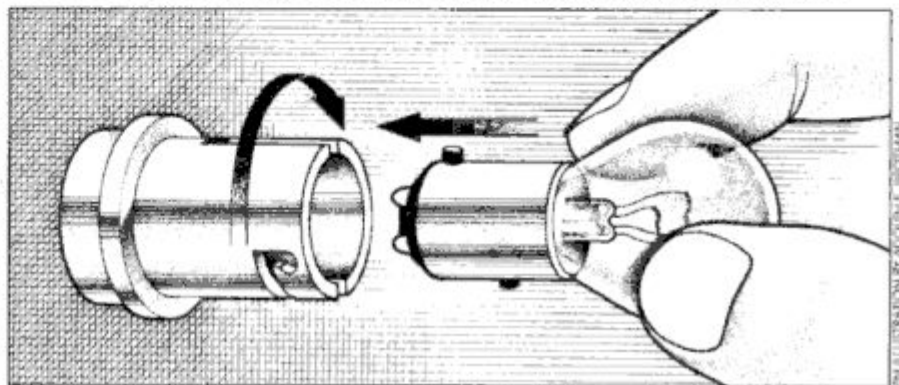
This type of pump has a timer that runs it for several minutes after the engine has shut down. Obviously, this won't provide any oil pressure at startup. Besides, the small pump adequate for cooling won't

An Illuminating Change

● I had some friends ask me for help with their taillights last week. They'd burned out a bulb and had someone put in a new one. Of course this happened while they were out on the road, and they were in such a hurry they took the pump jockey's word about whether the replacement worked or not.

The nice state trooper who stopped them a hundred miles later was kind enough not to write them a ticket, but only after they showed him the receipt for the new bulb with the ink barely dry.

The pump jockey had jammed a single-filament bulb into the socket. Two-filament bulbs, usually found on domestic cars, have one filament for the running lamps and another for the brake/turn-signal. If you look at the bulb, you'll see the pins that hold the bulb in are staggered vertically, to match the slots in the socket. Single-filament bulbs have pins that line up vertically.



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CAR CARE

move any appreciable amount of oil.

With a cold engine, the requirements for enough pump capacity to push cold oil in sufficient quantity are prodigious. It would take a large electric motor and a lot of energy to move more than a token amount of oil. So I don't recommend them.

There have been several accumulator-style oil prelubers on the market. These use a large—several quarts—reservoir to capture pressurized oil when the engine is running. Then you can turn a valve or actuate a solenoid-operated valve to release the oil a few seconds before engine start. The downside to this is the possibility of having a lot too much or a lot too little oil in the crankcase if everything doesn't work the way it's expected to.

Foggy, Foggy Nights

My husband used Armor All on the vinyl top of his car and it rained soon after. The protectant ran down onto the windshield and now we can't get it off. We've tried everything, and the greasy film makes it difficult to see, especially when it's raining.

DONNA RAY
PORTLAND, OR

Portland is not a good place to live when you can't see how to drive if it's raining. Start by buffing the protectant off with a towel to remove the excess. Reserve the Armor All for the interior of the car and plastic pieces on the exterior downstream of the windshield.

Clean your windshield with mineral spirits from the hardware store. There's probably some protectant hiding in the trim and gasket around the window, so you may have to repeat this procedure several times. Use a clean cloth to mop up the mineral spirits—not the one you used to clean up the protectant on the roof or you'll just contaminate the windshield again. Once the windshield is clean, clean, clean, apply a couple of coats of Rain-X. Clean the windshield wiper blades with mineral spirits as well—although you may have to replace them. The Rain-X will make the biggest difference, however. **PM**

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

● Pontiac has a service bulletin forbidding any diagnostic procedure that calls for piercing the insulation on any of the high-voltage ignition wiring. Some aftermarket ignition analyzers suggest piercing the insulation to measure secondary voltage. This procedure is highly likely to cause misfire.

● If you're replacing the engine or body computer on a GM car, you'll notice a Mylar strip inside the connector. Do not remove this strip, as the removal process may bend the pins. Simply insert the connector and the Mylar strip will slide down to the bottom, where it will cause no harm.

● Some 1992-94 Buick Skylarks, Olds Achievas and Pontiac Grand Ams may have a leak into the wiring harness pass-through to the dashboard. This leak may corrode electrical connections to the ECM, causing a no-start or poor running condition. The fix is to reseal the pass-through area with a urethane sealer and retape the harness to keep moisture from this area.

FROM FRONT...



SATURN MAT SHOWN

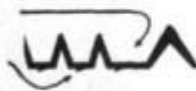
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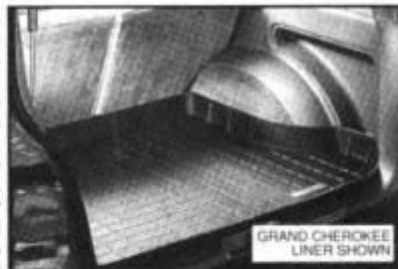


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SATURDAY MECHANIC

FINDING ENGINE KNOCK

BY JOHN DECKER

● You're waiting in the drive-up line at the bank, all the better to redeem some of your hard-earned cash from the vault. But as you inch your way to the teller window, your engine misses so badly that it either stalls or has to be held at high idle with your right foot. The teller sends you a note through the

pneumatic tube, "Sir, you forgot to endorse this check, and please get your car fixed—I can't hear a thing." It's off to the garage instead of the beach.

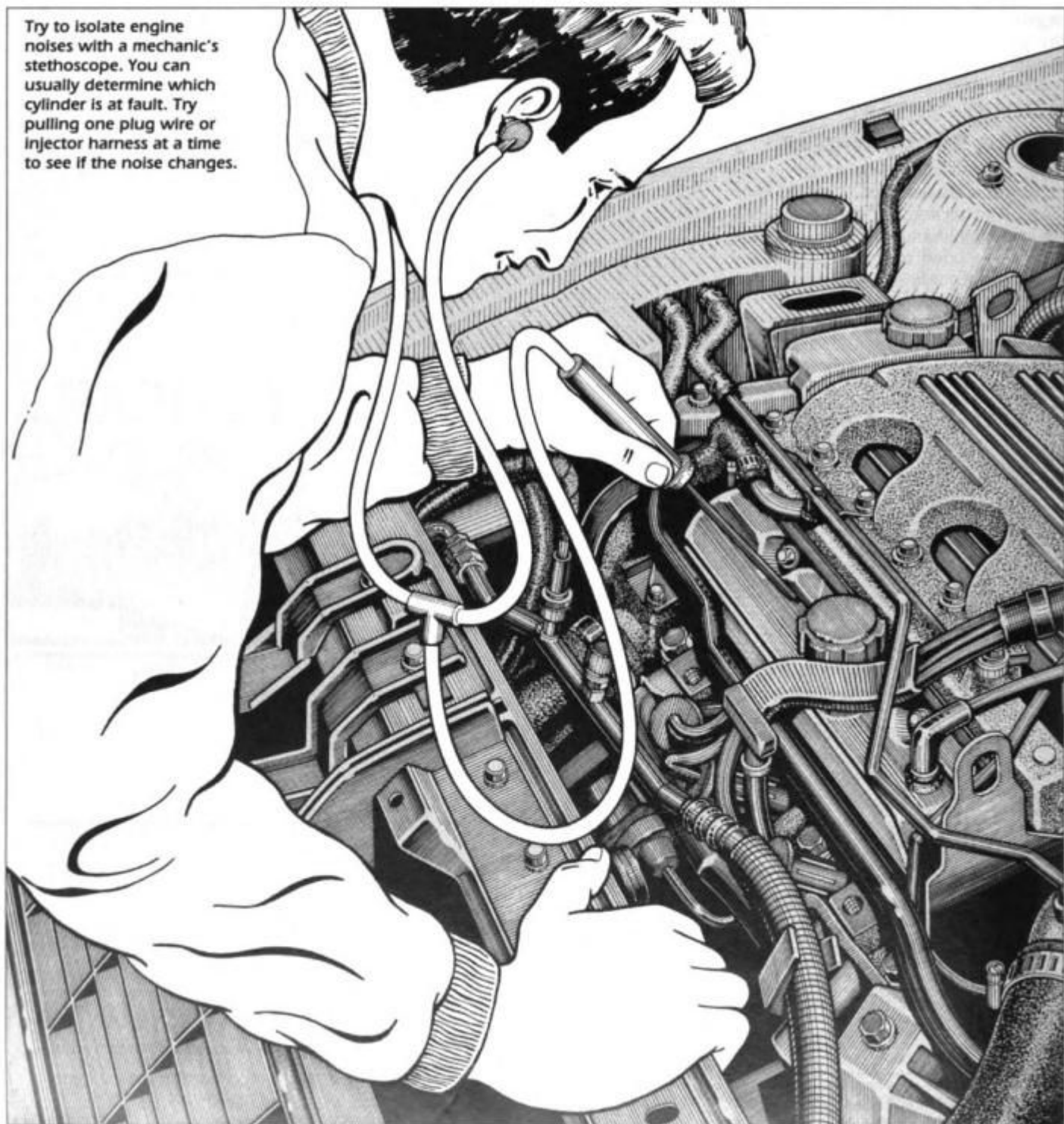
Days later, you're at the end of your rope. Above idle, the engine purrs like a kitten. But below 2000 rpm, there's a steady miss in the No. 4 cylinder.

You've checked everything you can think of. Spark, compression and the fuel injector to that cylinder are working just fine. Yet the miss remains.

Complete engine testing

Many people—even mechanics—think that the beginning and end of

Try to isolate engine noises with a mechanic's stethoscope. You can usually determine which cylinder is at fault. Try pulling one plug wire or injector harness at a time to see if the noise changes.



CAR CARE

internal engine diagnosis lie in using a compression tester. But the truth is that many internal engine problems (such as a weak valve spring, for instance) are not revealed by compression testing alone.

"A weak valve spring is easy to spot, if you use a vacuum gauge," said Dave Hakim, an engine and fuel-system specialist with Federal Mogul Corp. "Connecting the gauge to the intake vacuum would reveal normal vacuum at idle. But when a valve spring is bad, the vacuum needle would fluctuate rapidly between 12 and 24 in. when you raise the rpm."

You can diagnose most internal engine problems using a vacuum gauge, a compression gauge and a leakage tester. And you can usually get to the root of mysterious internal engine noises by being a good listener.

Engine noises

The most common source of engine noise comes from the valvetrain. The noise—usually a clicking or tapping at half the engine's rotating speed—is caused by excessive clearance between components or a bad hydraulic lifter. On camshaft-in-block engines, you can isolate valvetrain noises by briefly running the engine with the valve cover off and pressing on each valve rocker with the end of a hammer handle. When the pressure from the handle removes the clearance, the noise disappears and you've found the problem.

Diagnosing valvetrain noises is more difficult on overhead-cam engines because you can't run them with the valve cover off.

Running the probe of a mechanic's stethoscope along the length of the valve cover with the engine running should allow you to isolate the noisy valvetrain component. If you don't have a stethoscope, use a long screwdriver as a probe and listen by placing your ear against the handle.

Other internal noises include main- and rod-bearing knocks, wrist-pin noise and piston slap. A main-bearing knock has a deep metallic sound and is usually loudest

when the engine is under load. If the knock is because of a failed bearing, low oil pressure may accompany the sound. Connecting-rod noises have a lighter rapping sound under light engine load. Disconnecting the spark plug to the offending cylinder usually results in a marked decrease in the noise. Piston slap, caused by excessive piston-to-cylinder wall clearance, causes a dull rattle. Disconnecting the spark plug makes it go away. Wrist-pin noise usually gets louder when the spark plug is disconnected.

Keep in mind that there are many external engine noises that can mimic internal noises, such as a loose fly-

wheel or broken flexplate. Drivebelt pulleys can also cause noise, which can be isolated by running the engine briefly with the drivebelts removed.

Vacuum testing

A good manifold vacuum gauge costs only about \$20, yet it can quickly tell you a lot about what is going on in an engine. A vacuum gauge can reveal how well the valves are working, whether the piston rings are sealing adequately or whether camshaft timing is retarded.

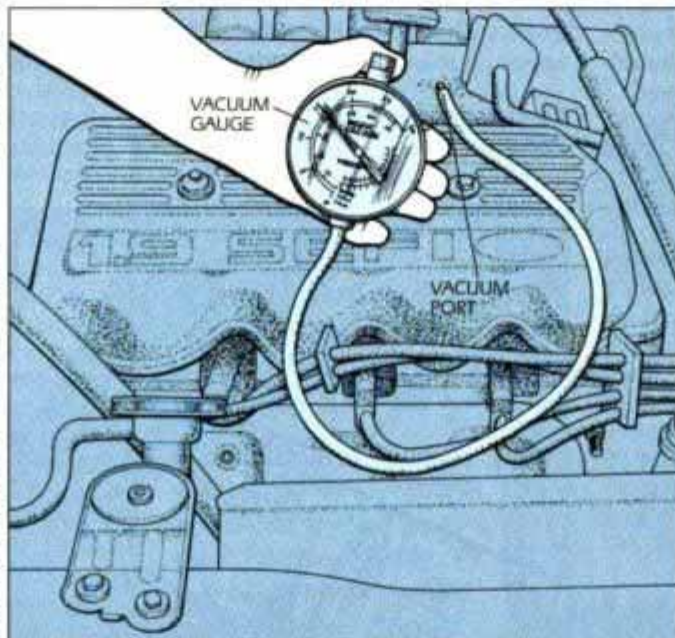
To perform a manifold vacuum test, begin by connecting the vacuum gauge to an adequate source of intake-manifold vacuum.

On most engines it's easiest to tee the gauge hose into a vacuum hose such as the hose that runs from the intake manifold to the vacuum brake booster. With the gauge connected, start the engine and let it warm up to operating temperature. On most properly running engines, the gauge will hold steady between 15 and 20 in. If the needle fluctuates at idle, it indicates that one or more valves are leaking. Doing a compression test or an engine leak-down test will reveal the leaking valve or valves.

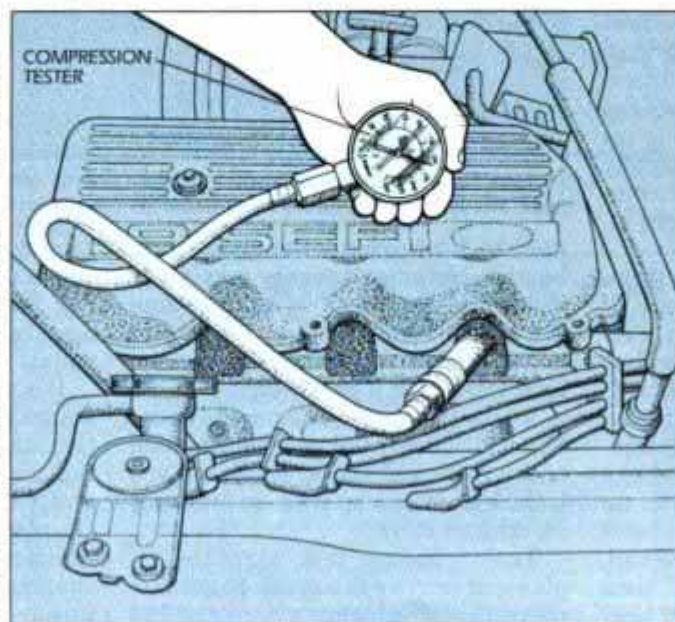
A slightly low vacuum-gauge reading, along with a slight flutter of the gauge, may indicate that the valve guides are worn. On engines without overhead camshafts, you can verify guide and seal conditions by removing the valve cover(s) and squirting engine oil on the tops of the valve guides while the engine is running. If the vacuum-gauge reading increases and blue smoke starts to appear from the tailpipe, it's a good indication that the valve guides are worn.

If the vacuum reading fluctuates between 5 and 7 in., it indicates that valve timing is excessively late. A skipped tooth or excessively worn timing chain or belt are all likely causes.

To check for weak or broken valve springs, increase engine speed to 2000 rpm. If the gauge needle fluctuates between 12 and 24 in. and the fluctuations increase as engine speed increases, the



With low, rapidly pulsating vacuum, this engine probably has valve guides that are worn out.



An engine with good compression will show readings on the gauge within a 20-pound spread or less.

CAR CARE

valve springs are weak. If the fluctuation is irregular, it's likely that one valve spring is weak or broken.

If intake vacuum appears normal in the above tests and the engine oil is in good condition, you can do a quick test to determine piston-ring sealing. To do this, bring the engine speed up to 2000 rpm, then let the throttle snap closed. If the vacuum reading jumps 5 in. or more over the normal reading, it indicates that the piston rings are in good condition.

Compression testing

A compression test can reveal a lot about an engine's internal condition, but only if it's performed properly. Many people mistakenly do compression tests with old diluted oil, the engine cold or with the throttle closed.

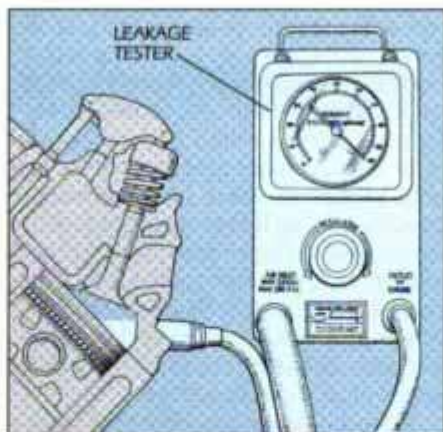
Begin by warming the engine to normal operating temperature. Then, use compressed air to blow all the spark-plug wells clean before removing the spark plugs.

Disable the ignition, then connect the compression gauge to the No. 1 cylinder, according to the instructions supplied with the gauge. Have an assistant hold the throttle wide open while cranking the engine over until five complete compression strokes have been completed (as indicated by pulses on the gauge). Record the compression readings on the first and fifth strokes. Repeat the process for each cylinder.

A cylinder has good compression if it achieves two-thirds of its total compression on the first stroke and reaches the minimum factory compression specification by the fifth stroke. If the compression reading is low on the first stroke and builds with following strokes but doesn't reach minimum compression, the piston rings are probably not sealing well. If the gauge reading remains low on all five strokes, it usually indicates a leaking valve. Low compression in two adjacent cylinders indicates a blown head gasket.

If all engine cylinders achieve proper compression, then you're done. If any of the cylinders had low compression, however, you'll have to confirm the cause by doing a "wet compression test." Squirting oil into combustion chambers with low readings temporarily improves sealing of the piston rings. If compression goes up 5% or more when you repeat the compression test, then the rings are bad. If compression stays the same, then the compression leakage is most likely from the valves.

Keep in mind that a wet test won't



A leakage tester can pinpoint which cylinder is bad and where the leakage is.

work on horizontally opposed Volkswagen, Porsche and Subaru engines.

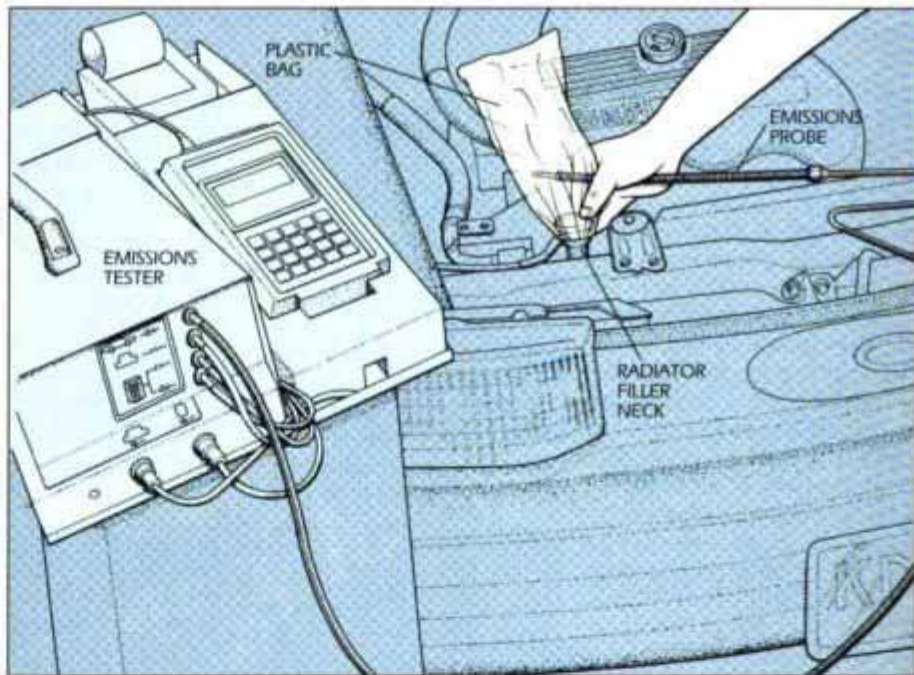
Leakage testing

Long favored by professional racing mechanics as the most accurate

dead center (TDC) on the compression stroke. Install the fitting from the leakage tester in the No. 1 spark-plug hole, then connect an air-compressor line to the tester. Pressurize the cylinder and note the percentage of leakage on the gauge.

An engine in great shape will have cylinders with 5% to 10% leakage. An engine with 20% leakage is still in pretty good condition. If the engine has a cylinder with more than 30% leakage, however, you should isolate the cause.

You can do that by listening for escaping air while the combustion chamber is pressurized. If the sound comes from the intake manifold, the problem is a leaking intake valve. From the exhaust manifold, it's a leaking exhaust valve. If you hear air escaping from the oil-filler cap opening, the problem is with piston sealing. You can even look for bubbles in the en-



To look for combustion leakage into the cooling system, hold a bag over the radiator filler. The emissions probe should show no CO₂ when the engine is running.

method for testing an engine's combustion-chamber sealing, a cylinder leakage tester works by pressurizing the combustion chamber with compressed air and then measuring the total leakage as a percentage.

A leakage tester, which costs about \$50, will not only tell you the condition of the rings and valves, it can tell you if the leak is coming from an intake or an exhaust valve.

To do a leakage test, warm the engine and remove the spark plugs. Remove the air cleaner and block the throttle wide open. Rotate the engine so the No. 1 cylinder is at exact top

engine coolant at the radiator cap to check for a blown head gasket. And, like the compression test, high leakage readings between cylinders equals a head gasket leak.

It's also possible to find head gasket leaks at the local emissions inspection station. Warm the engine and ask the mechanic to place the emissions tester's exhaust probe in a plastic bag. By placing the plastic bag over the radiator opening while the engine is running, the probe will be able to pick up any exhaust gases that are leaking from the combustion chamber into the cooling system.

PH

THE VIRTUAL OFFICE

(Continued from page 65)

camera on the computer, he says.

Essential to the growth of videoconferencing is the growth of ISDN (Integrated Services Digital Network), a technology that, in its basic form, allows users to send 128 kilobytes per second of data over standard phone lines. That's almost 10 times the capacity of modems commonly in use today. Availability of ISDN varies greatly by region within the United States, though, and because of incompatibility of equipment purchased by different local phone companies, ISDN subscribers can't always be sure that they'll be able to communicate with ISDN subscribers in other areas. Seamless ISDN communications across the country should be possible early next year.

As useful as today's videoconferencing systems are, they lack one important thing. "They cannot provide the feeling of togetherness," says Tohei Nitta, president of Mitsubishi Electric Research Laboratories (MERL).

Though hard-nosed executives might say "So what?," Nitta believes that what you feel at a meeting is as important as the business transacted. When you have an interesting business get-together in the flesh, you memorize the scene and you can recall the picture two years later, he says. But you're less likely to have an emotional connection with other people in a videoconference, when the people you're meeting with are visible only as a series of faces on your TV or computer screen.

To add an emotional element to videoconferences, MERL has developed a system providing a common ground for everyone in attendance: a virtual conference room. What appears on all the conferees' screens is an animated picture depicting everyone in the same room, perhaps sitting around a table.

"We meet on the screen just like a TV drama," Nitta says. Existing now in a simplified demonstration form, the recently patented system will take several years to perfect, Nitta says. To work correctly, the system will need software tools so that each participant in the conference can manipulate his virtual representative to express appropriate physical gestures and emotional expressions. For input hardware, one choice has been a special jacket with sewn-in position sensors that can relay the position of one's torso and forearms—and another glued to one's headset for determining the position of one's head. Easy to use, sure, but you may look a little silly to the real people passing by your desk. **PM**



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Total proceeds benefit Stafford Volunteer Fire Department



MOTORSPORTS

NASCAR Goes Truckin'

BY JIM McCRAW



● You have to hand it to the guys at NASCAR. They know a good idea when they hear one, and they heard one in September 1993, when a group of veteran California off-road racers consisting of Frank Vessells, Jim Venable, Jim Smith and Dick Land-

series of real races, there will be a 20-race series in 1995 known as the Craftsman NASCAR SuperTruck Series, with a \$500,000 points fund that is going to be pursued by some of motor racing's biggest names.

The series will run on everything from $\frac{3}{8}$ -mile bull-rings like Tucson Raceway, site of the official opener, to the 2.5-mile road course at Sears Point in California, running coast-to-coast in 16 states.

And if the safety and aerodynamic properties of the big V8 haulers prove out, they may race on superspeedways—like Daytona and

Talladega—in the future.

In its first year, the NASCAR SuperTruck Series will be combined with other races such as Winston Cup, Busch Grand National, Southwest Tour, Northern Tour, Winston West, and other NASCAR divisions. However, in some cases the SuperTruck event will be the feature race of the weekend.

You know the names

A big part of the fan excitement in NASCAR SuperTruck racing will be seeing familiar names on unfamiliar trucks. Richard Childress, owner of the No. 3 Goodwrench Lumina that has been the ride of 1994 Winston Cup champion Dale Earnhardt, has built a showpiece Chevy truck for driver Mike Skinner.



Walker Evans has his Dodge Ram on the pavement, belching fire.

field flew from the West Coast to Daytona Beach, Florida, to meet with NASCAR boss Bill France Jr.

The left-coasters proposed a whole new race series featuring full-size pickup trucks with V8 engines—Fords, Chevys and Dodges—running against each other. The truth be known, the desert racers wanted a crack at the NASCAR regulars on equal terms. Bill France and his colleagues agreed that it was certainly worth a try.

So after a 4-race experimental series last summer, and this winter's



World of Outlaws' Sammy Swindell is now inside an F-150.



Richard Childress can build Chevy race trucks, too.



Schrader's front end, just like his cars.

Winston Cup veteran Kenny Schrader has finished building two AC-Delco trucks. P.J. Jones, the IMSA road-racing champion in a Toyota and son of Parnelli Jones, will drive a Ford for off-road veteran Frank Vessells. IndyCar standout Robby Gordon will drive the Ultra Custom Wheels entry of Dick Landfield. Former PM racing team member Tommy Archer has four Ford F-150s under construction. Busch Grand National rookie Robby Benson Jr. will wheel a new Chevrolet. Veteran IMSA and IndyCar driver John Paul Jr. will drive a truck for the Momo Wheels team. Sammy Swindell, who made his name a household one in many parts of the country thanks to the World of Outlaws' open-wheel modified racing, will drive the Channellock Tools Ford. And Walker Evans, the dean of off-road racers, will drive a Dodge Ram for American Racing Equipment and the Barbary Coast Casino.

In fact, NASCAR has received more than 275 inquiries about the new series, and at this writing has already assigned 96 of the 110 available truck numbers to seriously interested and officially registered teams.

The rules are familiar

The rules for NASCAR SuperTruck are similar to Winston Cup rules. The trucks are required to run full roll cages, 22-gallon fuel cells, and use stock bodies, which must conform to NASCAR templates. Minimum weight is 3400 pounds, ready to race (same as Winston Cup cars for 1995) with a minimum right-side weight of 1530 pounds. Minimum wheelbase is 112 in. Front airdams must have 3.5 in. of ground clearance and be approved by NASCAR. And non-adjustable rear spoilers must be 57 in. wide, 6 in. tall and 78 in. from the back

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most of the chassis are mass-produced by companies like Hutcherson-Pagan, in Charlotte, North Carolina, along with BSR-Hess Racing. Like the Thunderbird, Lumina and Grand Prix cars of Winston Cup, the trucks are pretty much identical underneath their distinctive skins.

With all the color, speed and sound of Winston Cup cars, and with all 20 races televised live on TNN in 1995, these new SuperTrucks could quickly shove aside the Busch Grand National series as the second most popular form of stock car—er, vehicle—racing in the country.

of the truck cab. The trucks are required to have stock cargo beds and tailgates, which must be covered with aluminum sheet.

Only American small-block V8 engines between 350 and 358 cu. in. may be used, with a single Holley 4150-series 4-barrel and mandatory dry-sump oiling systems for safety. Power will be limited by a strictly enforced 9.5:1 compression ratio, compared with the 15:1 limit used by Winston Cup engines. Tires are limited to 13.2-in. width on 9.5-in.-wide x 15-in.-dia. wheels.

Just as in Winston Cup racing,



Remington Model 700 BDL DM

As with the Winchester and Ruger, the Remington Model 700's down-range performance suffers somewhat in comparison to the new standard set by the Browning BOSS. With two of the three Federal rounds, the Remington shot 1-in. groups and with the third, it printed 1.5-in. groups. For most deer hunters, that's more than sufficient.

Aside from respectable accuracy, this rifle has some other things going for it. Its classic styling is one that many outdoorsmen prefer—white-

line spacers setting off the black butt plate, grip cap and forearm cap. It has deep and sharp skip-line checkering that provides excellent grasping surfaces on the grip and forearm. And operationally, it was refined overall, but with only a hint of trigger creep that some hunters might prefer to smooth out at a gunsmith shop.

Ruger M77R Mark II

Nearly a match to the Browning Medallion is the Ruger M77R Mark II, which consistently shot groups in the 1-in. range, a satisfactory down-range performance in a hunting rifle.

Cosmetically and operationally, the Mark II is one of the test's best firearms. Its straight stock is a beautifully grained light walnut, accented by a low-sheen finish and sharp, deep checkering on the grip and forearm. Its stainless-steel bolt and bolt handle give it a distinctive appearance, and operation was very smooth.

On the downside, the test rifle had a trigger that suffered from substantial creep before firing. The problem can be fixed at a gunsmith shop, and although it will be an additional expense, the improvement will turn a solid firearm into a superior one.

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Winchester Model 70 Classic Sporter

Most hunters would be happy to own a gun that shoots groups measuring under 1.2 in., which is what the Winchester Model 70 Classic Sporter did. They also would be glad to have the Sporter's smooth-operating Mauser claw extraction-style bolt (also found on the Ruger), which harks back to the famous pre-'64 Winchesters that many hunters cherish. So, there is much to like about the Classic Sporter.

Its appearance, like the Ruger's, is restrained but attractive, particularly the stock's low-sheen finish, which shows off the walnut's straight grain. And unlike the other rifles, it has no shiny components or surfaces to prematurely alert game.

In sum, if this gun were fitted with a BOSS device and shot ½-in. groups, it might be a better pick than the Browning Hunter. Guess what? Winchester (which, like Browning, is part of U.S. Repeating Arms Co. and is owned by Giat Industries Inc.) will begin to offer three Winchester rifles with the BOSS feature sometime in '95.

Many hunters, particularly in the East where 100-yard shots on deer are considered long, will not be able to take advantage of the accuracy gains the Browning BOSS delivers. For these hunters, standard bolt actions from Browning, Ruger, Winchester and Remington will provide exceptional accuracy with the right loads. The best advice we can offer is to shop around for a good deal and buy a model that fits your needs and tastes.

But for the deer or elk hunter who shoots across canyons in the West—or for the hunter who simply appreciates cutting-edge precision—the Browning A-Bolt II Hunter with BOSS is a cut above the rest in terms of raw accuracy. It's light, reasonably priced, mechanically sound, easy to operate, tastefully trimmed out and about twice as accurate as its competition. In short, the Browning BOSS hits the bull's-eye, and so will you when you fire one.

taste. Beers scoring 14 or more points are superior, and 12 to 14, very good. Ratings between 12 and 6 points cover good through marginal. A brew below 6 points is considered faulty. We modified the test to also judge the home brew versus other beers of its type.

BrewKing's Traditional Bitter (13 points) won't be to everyone's taste, but it's a good example of the "bitter" served on draft in British pubs. This style is very tart, and lacks the foamy head and bubblyness Americans associate with light-colored brews. It's not for guzzling but goes well with food.

The Olde English Porter from BrewKing (6 points) was flat-out faulty, as in flat. There was plenty of gas in the bag, but no carbonation or head on this dark ale. Whatever the problem of chemistry was, taste was nonexistent. Porters vary widely in flavor, but nothing here even hinted at that style.

Another odd chemical reaction accounts for the shocking disappointment with Micro Brew's product. We'd admired everything about the system, all the way up to the clear, tawny color, tight head and lively carbonation of the Olde London Ale (5 points). Instead of something resembling the classic Bass Ale—we got root beer.

That describes the overpowering smell and taste (though there was no soda-pop sweetness). But why?

The Micro Brew kit also includes ingredients and directions for home-made root beer. This bonus is a concentrated extract in a plastic bottle, enclosed in a plastic bag, and the fragrance is obvious when you open the shipping box. Our guess is that this aroma must have permeated the plastic of the fermenter. No smell was evident after cleaning and sanitizing, but perhaps it had permeated to such a degree that alcohol leached more contaminant from the plastic during fermentation. The brew was undrinkable, and gets points only for its appearance.

Appearances can deceive, and our initial impression of The Beer Machine put it in the gimmick category with crock pots and breadmakers. We can't wait to make another crock of Pilsener Light (17 points). Light here describes body and character, not calories. This pale, golden brew is fresh, dry and smooth. The frothy head, restrained carbonation and slight maltiness reminded us of the easy-quaffing draft lagers of Berlin.

For the record, we first tapped The Beer Machine without adding CO₂ and found its natural carbonation just right, with a picture-perfect head. Per the instructions, eventually we had to

use CO₂ to get pressure for dispensing. Expect to use three cartridges of CO₂ per barrel.

The Beer Machine proved the easiest way to brew yet yielded superior results second only to the more labor-intensive traditional brewing kit. True Brew's Irish Stout (18 points) was worth every drop of effort but the judging was the most difficult.

The most famous "dry" stout is Dublin's Guinness, but it would be unfair to use this as a standard because Guinness is unique even among Irish stouts. The yeast alone is different from any other. The Irish Stout com-

pared well to another Irish brand, Murphy's, from Cork.

The rich, cream-thick head clung to the glass all the way to the end of the clear, espresso-dark pint. Body was full, no wateriness, and the taste was right-on—a balance of toasty malt and hoppy dryness. All agreed that at 10 weeks old, the stout was a tad sweeter and a bit more carbonated than commercial brews.

On the other hand, 10 weeks may be a bit longer than many thirsty throats may want to wait. If that's the case, then the speedy Beer Machine is the better thirst quencher. **FM**

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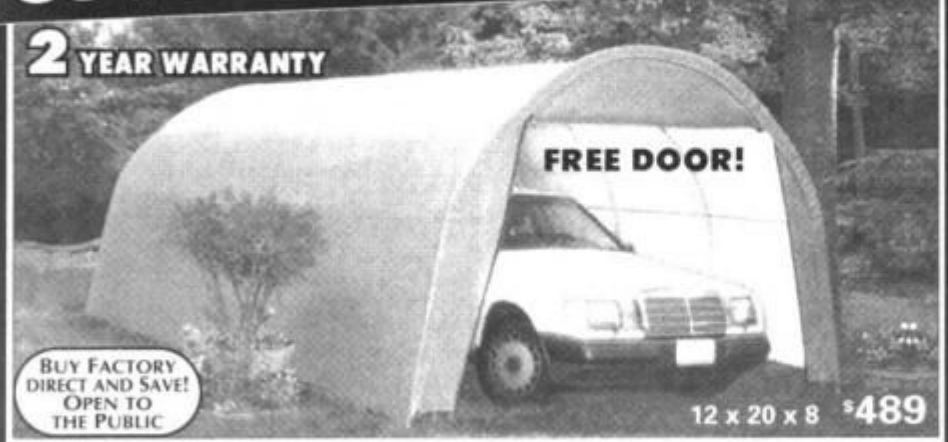
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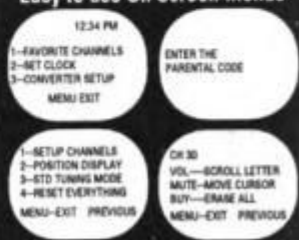
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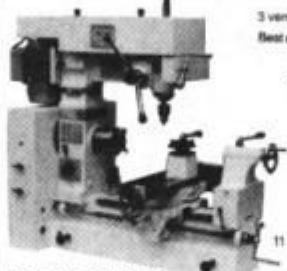
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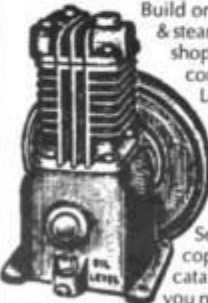
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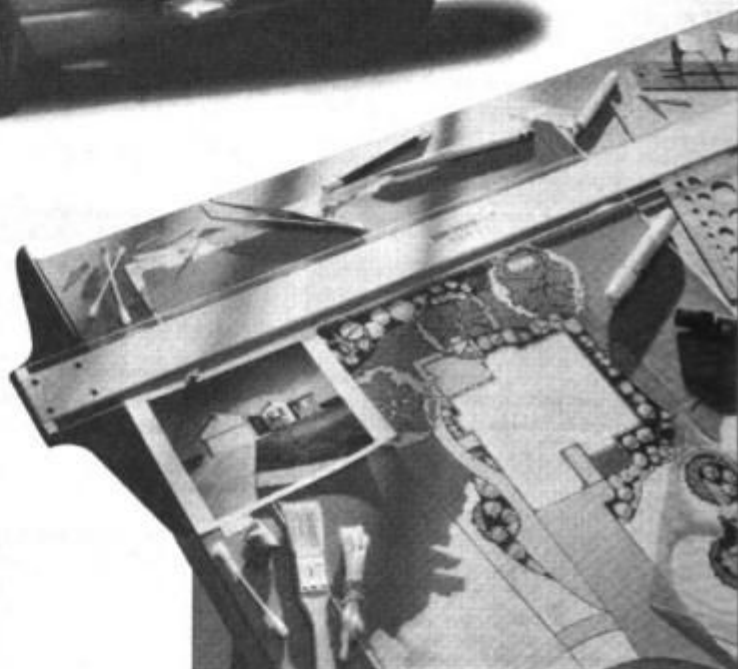
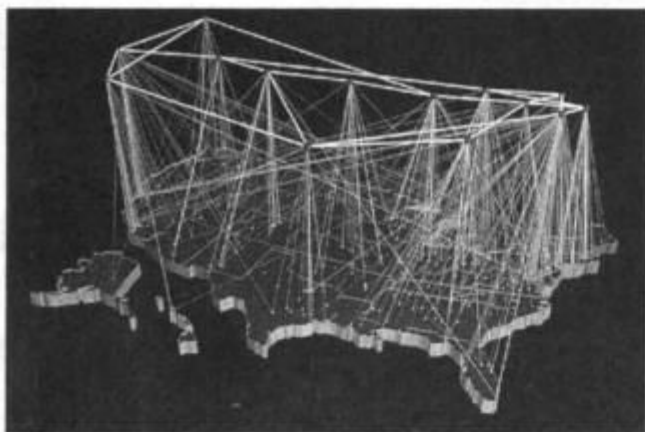
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