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# Popular Mechanics®

MARCH 1991  
VOLUME 168  
NO. 3

## 39 COVER STORY

Find out how the Soviet Union's two hottest jets stack up against America's best.

—PM cover  
illustration by  
Mark McCandlish



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# EDITOR'S NOTES

● Perhaps my favorite magazine in the whole world (except for POPULAR MECHANICS, of course) is *Aviation Week & Space Technology*. To me, this magazine is a minor miracle. The amount of information it contains each week is astounding, the plethora of detail fantastic. And there is never a typo. In fact, I consider it the best-edited magazine in the country. And I read just about everything. So when the opportunity to work with David M. North, *Aviation Week's* managing editor, presented itself, I jumped at the chance. In addition to possessing impeccable credentials as a journalist, North is also an accomplished pilot and has flown just about everything with wings. So it wasn't surprising to me that he was one of the few Westerners invited to fly the Soviet Union's hottest combat jets. Even in this era of East-West détente, this is a rare occurrence. Keep in mind that military aircraft are still classified secrets both in the Soviet Union and here in the United States. To put North's invitation in further perspective, the U.S. has yet to allow anyone from the Soviet Union near any of our combat aircraft. North was allowed to fly the MiG-29 and the Su-27—the two most technically advanced combat jet fighters the Soviets have. We asked him to share his experiences with all of you, and I think you'll find his account of his cockpit time as fascinating as I did. It's this month's cover story on page 39. . . . I would be the first person to defend anyone's right to use public lands for the enjoyment of off-roading, be it in a pickup truck, sport/utility, ATV, snowmobile or dirt bike. But I would be a fool to think that we can allow the lunatic fringe element to run wild anywhere they please with high-powered machinery and low-powered mentality. And I am no fool. There must be limits and controls to protect our wildlife and wild land. Hold on. I am decidedly against the closing of public land for leisure use. However, I do recognize the need for protection of the environment against those who would wantonly abuse our land. Many see this problem as one of freedom versus control. To me, the best solution is self-control. That's why I'm so pleased that POPULAR MECHANICS is a founding member of Tread Lightly!, an organization devoted to preserving the environment in a way that would allow us all to continue to enjoy it. The whole story is in our special section for this issue, which was prepared under the direction of Boating/Outdoors Editor Joe Skorupa and begins on page 73. I urge all of you to read the Tread Lightly section and join us in this very important and very sensible cause. Till next time.



Skorupa and model Kim Collinsworth on location for Tread Lightly photo shoot.

  
Joe Oldham

# Popular Mechanics

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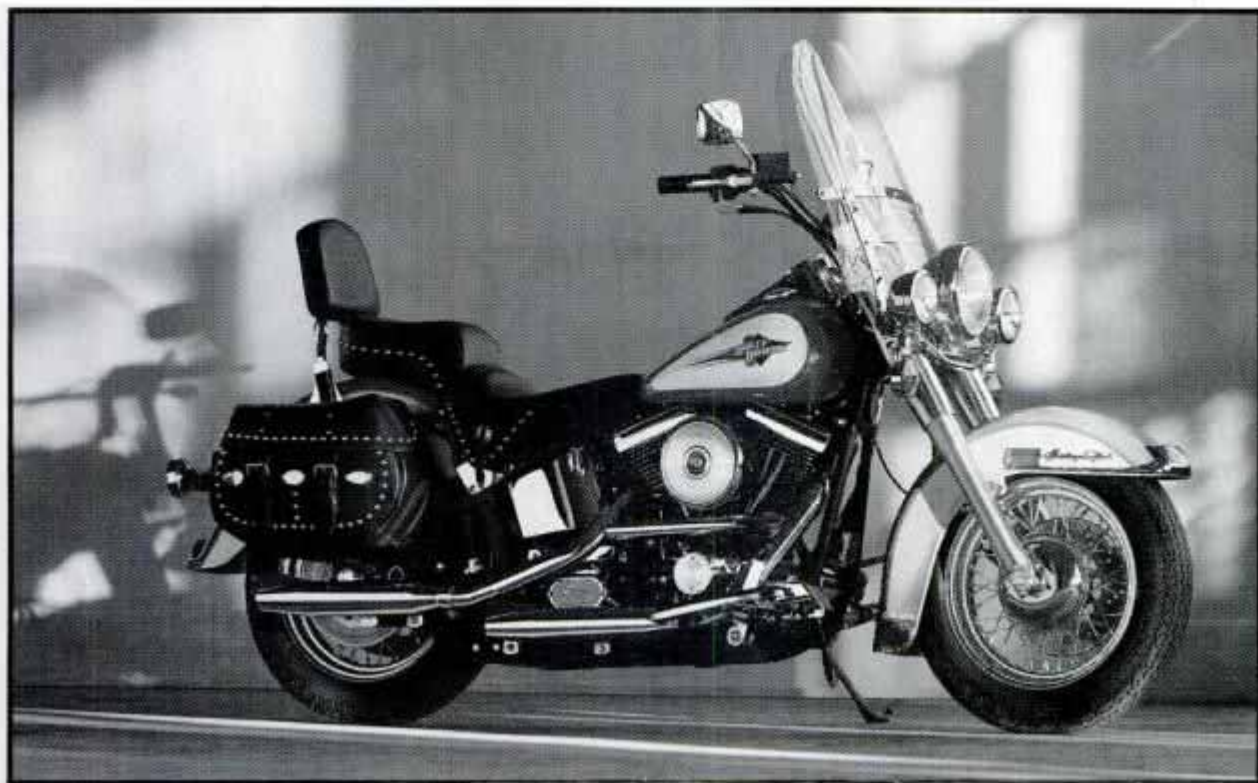
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# At what point does a fender go from mudguard to a work of art?



The least you can ask from any motorcycle is that it works. It starts when you want it to. It takes you where you want to go. It gets you back home again.

A Harley-Davidson®, on the other hand, has to operate on a higher level. It has to reach deeper, to go beyond nuts and bolts, metal and rubber. And so a fender cannot be assigned to the job of merely keeping what's on the road, off of you. It has to appeal to your eye as well as your pant legs. You'll notice that the front fender of the 1991 Heritage Softail® Classic doesn't look a whole lot different from the one on a 1949 Hydra Glide. It's not there simply to pay homage to a day gone by. It's there because true style doesn't age.

Which is also why you don't see the rear suspension. The shocks are mounted beneath the bike to faithfully reproduce the profile of the classic hardtail. As it should be.

This is The Look. A motorcycle drawn in bold strokes. This experience is as close as your nearest Harley-Davidson dealer. It may seem less a motorcycle showroom, than a gallery of two-wheeled sculpture.

And you might never look at a motorcycle the same way again.



**Through and  
Through.**

# Why not use the m



Jonah Bleckman  
Novato, California  
John Deere 14SB  
8 lawns per week



Michelle Yancy  
Tacoma, Washington  
John Deere 14SE  
3 lawns per week  
("It rains a lot.")



Greg Lynch  
Shelbyville, Indiana  
John Deere 14SZ  
10 lawns per week

At John Deere, our walk-behinds are built to meet the extreme demands of those who mow lawns for a living. Which means they're also perfect for those who don't.

They're fast-starting, easy to operate, and surprisingly immune to the kind of punishment that could only be devised by a 15 year old. (In one factory test, we mow over common backyard items like marbles,

combs, bottlecaps and roofing nails.)

Our most popular model, the self-propelled 14SB, features a 5-hp OHV engine, five-speed transmission, and the added safety of our blade-brake-clutch system.

It instantly stops the blade from cutting without killing the engine.

If you'd prefer no exercise



Five-speed transmission lets you go slow around trees, or up to 4.1 mph in wide open spaces.



# ower the pros use?



Steve Hemenway  
Dayton, Ohio  
John Deere 14PB  
4 lawns per week  
("I have tuba lessons.")



Nick Tarantola  
Austin, Texas  
John Deere 14PZ  
9 lawns per week



Gaylan Brown  
Durham, North Carolina  
John Deere 12SB  
7 lawns per week

other than walking, our 14SE replaces the pull start with electric ignition.

And this year, we're introducing two new low-priced models. The 14SZ and 14PZ. They offer 4-cycle engines, easy-off rear baggers, and prices starting at around \$400.

See the full lineup at your John Deere dealer. (Call 1-800-544-2122 for the nearest.)

As always, every model comes with the John Deere money-back guarantee. If you're

not happy after 30 days, we'll give you your money back.

But after all, these are the mowers preferred by people who cut hundreds of lawns each year.

So we're pretty sure you'll like the way yours performs when you cut just one every week or so.



**NOTHING RUNS LIKE A DEERE.®**

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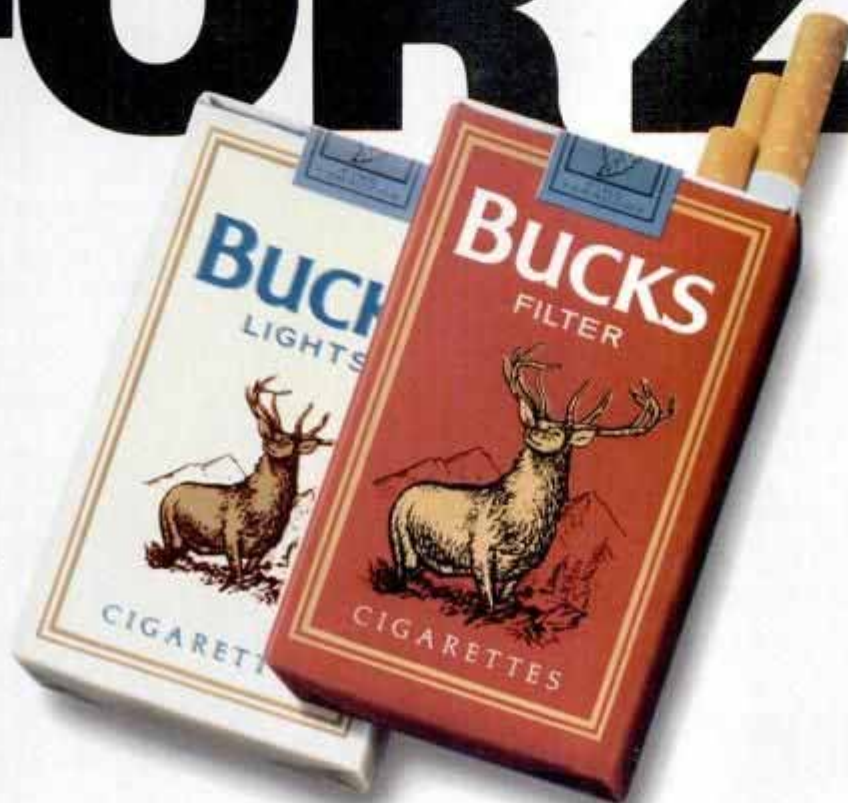
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# LETTERS

## Flying High

The Moller 400 is another great idea doomed to the archives of history. Mr. Moller may have found a new way to satisfy the basics of lift overcoming weight and thrust overcoming drag. However, he must still overcome his greatest obstacle—the Federal Aviation Administration. I recall a Mr. Molt Taylor, circa 1970s, who teamed up with the Ford Motor Co. to put an Aerocar in the sky and in every garage. Mr. Taylor had already received FAA certification on the Aerocar, but when Ford started talking about mass production, the FAA put them out of business.

There is some validity to the FAA's stand. We can't have thousands of these vehicles flying around at one time. The FAA takes credit for making the skies safe through air traffic control. In actuality, the government and the aircraft manufacturers have made the skies safe through economics. They take a \$25,000 craft that was designed 23 years ago and charge \$100,000 each for a limited production.

I think Mr. Moller has a great idea. I would love to have a 400. However, if the 400 ever reaches production, I'll wager the market price will be closer to \$1 million than it is to \$100,000.

Good luck.

CHARLES R. HARPER  
DAVENPORT, IA

The Moller 400 story was very exciting, but also disturbing. As a pilot, I am intrigued by the idea of a \$100,000 aircraft which will perform as the article suggests. This kind of price/performance outstrips most of the current aviation market by a wide margin.

If Mr. Moller is able to get the craft into production, he

will surely sell many of them.

The disturbing part was the suggestion that the Moller 400 would be marketed as an alternative to the automobile. There are several reasons why this idea is entirely impractical, if not impossible.

First, the idea of people flying around with only 2 hours of simulator training is frightening. There is much more to safe piloting than being "familiar with only two controls." No amount of voice-controlled, computer-driven gadgetry will help pilots when their aircraft suffer total electrical failure.

Second, the Moller 400 would probably be licensed as a complex, multi-engine aircraft. Currently, a pilot must have many more than 2 hours of training to be appro-



priately rated to fly an aircraft like the Moller, and I can't see the FAA relaxing these standards so that anyone who can afford a Moller can fly.

Lastly, the national airspace system is already badly overcrowded, and the FAA's plans to update their controller's equipment have gone over budget and have been delayed several times already. The addition of many small, fast aircraft, flown by pilots of question-

able competence could only make matters worse.

On a positive note, I would encourage anyone excited by the article to take flying lessons. I've never had more fun. As your front cover suggests, anyone can fly—provided that they are properly trained.

ERIC D. PAGE  
SEATTLE, WA

Your January '91 cover title, "Anyone Can Fly The Skycar," can be just a bit misleading. The days when people casually drove and flew *without* training and tests were when Russia was still a Czarist empire! It just might be difficult to convince FAA authorities that Skycar can be flown without full flight training. At the least, an owner would have to learn the rules for sharing the sky with ordinary planes and copters, as well as learn to stay away from airports and military areas.

HARRY C. WIERSDORFER  
HAMBURG, NY

As an airline pilot, I read in horror about the Moller 400. I wonder how an already saturated air traffic control system operating at near maximum capacity can handle commuters en route to work? I think the practical applications of this type of device will have to wait until we solve some major long-term issues, namely a total redesign of the nation's air traffic control system. To envision even 500 wealthy citizens streaking to work in any major urban area leaves me with visions of aerial chaos and flaming volators dropping on the citizenry below after the inevitable midair collisions. Let's not do to the sky what we have done to the freeway system.

RAY STARK  
GILBERT, AZ

The Moller 400 would truly be a commuter's dream if it would do all the things the builder wants it to do. But it won't. The PM illustration shows engine-driven vertically mounted fan blades facing the open front of the cowling. These blades will deliver forward thrust at all times. Bending the vanes to divert the exhaust air downward will add vertical thrust, but will cancel the forward thrust. The airplane will not hover. What Mr. Moller may have designed is a very beautiful, very expensive Super STOL aircraft.

C.F. ASHMORE  
TUCSON, AZ

The Moller 400 appears to be a viable alternative to congested motorways. Hats off to Mr. Paul Moller. Please continue to update us on his progress.

CHRISTOPHER BREWER  
DENVER, CO

The Moller 400 Skycar can never fly as described for several reasons:

First, the counterrotating fan blades are wrong and will blow almost nothing in the vanes.

Second, at 420 mph and below, the wing is in the wrong position. There's too much weight ahead of its leading edge, and the craft will crash at this high speed.

Third, in a straight-line flight, the two rear nacelles are at least 40 percent in the shadow of the front ones. This should not be allowed.

Fourth, the ballistic parachute is in the wrong position. The Skycar's belly is too close to the floor.

And fifth, Wankel engines of more than 2 horsepower per pound?

After \$25 million and 25 years of effort to obtain a 40-

(Please turn to page 12)



Mercury Outboards are products of **BRUNSWICKMARINE** © Brunswick Corporation, 1990

## Go after the fish and fry the competition.

For years, people driving Mercury outboards have been the first ones to the fish. Now, the competition's really going to get burned because our entire line has been totally redesigned over the past six years.

You'll get a new feeling of power from every Mercury, from kickers to engines as big as your boat can handle. After all, each one is bred from championship racing stock. That's why three out of the last five years, the winning team on the professional walleye circuit has been powered by Mercury.

If that's the kind of advantage you'd like to have on your side, hit the water with a new Mercury behind you. And sparks are going to fly.

**MERCURY  
OUTBOARDS**

*Set The Water On Fire.*

ft.-high, 3-minute flight is a very poor record. Pity on the 65 people who subscribed to a \$325,000 project with so many flaws.

ELIO B. CASAMASSIMA  
RIVERDALE, NY

## Fast Ferry

This is in response to the ferryboat *Hoverspeed Great Britain* that is being awarded the Hales Trophy. We are certainly not against technical progress, but taking a magnificent trophy, held in the past by great passenger liners, and awarding it to an English Channel ferryboat is ridiculous. The ferry, which made the Atlantic crossing in June, was not in commercial service, carried no passengers and didn't even have sleeping quarters for its 8-man crew. The trophy, once held by such great oceanliners as the *Rex*, *Queen Mary* and *Normandie*, was last won by the SS *United States* in 1952 and has been a centerpiece exhibit in the American Merchant Marine Museum since it opened. It was hoped the beautiful trophy would remain as a historic relic of the now bygone era of the great, fast trans-Atlantic passenger liners.

The museum's board strongly protested the actions of the new trophy trustees saying that their actions violated the intent and wishes of Mr. Hales when he established the trophy and the trust. Unfortunately, the cost of pursuing the matter in an English court was too great for the museum. It was a case where the museum could not afford justice. Mr. Nicholas Bachko, president of the museum board, said that giving the trophy to a ferryboat was like awarding the Wimbledon Cup to a ping-pong player. It is the end of an era.

CAPT. CHARLES M. RENICK, USMS  
EXECUTIVE DIRECTOR  
AMERICAN MERCHANT MARINE  
MUSEUM FOUNDATION

I read with interest Abe Dane's article about the *Hoverspeed Great Britain* and

its so-called breaking of the trans-Atlantic speed record held by the SS *United States*. As far as I'm concerned, the *United States*' 38-year-old record still stands.

A few facts need to be illuminated: 1. The hovercraft does not have a conventional hull as does the *United States*; 2. The Blue Riband/Hales Trophy was to be awarded to *passenger* ships maintaining regularly scheduled trans-Atlantic crossings; 3. The hovercraft's feat was a stunt—a mere publicity gimmick designed to attract attention—whereas the *United States*' record-breaking run lessened the time one spent at sea in the pre-passenger jet-age era.

visions. Now there's a *real* ship worthy of *real* attention!

MARK G. CARBONARO  
MONTEREY, CA

I enjoyed your piece on the SeaCat. Hats off to the brave souls who run the thing. However, my mind is on the other side of the coin.

I'm a small-boat (28-ft. sloop) sailor with 40,000-plus miles at sea and numerous close calls with ordinary 18- to 20-kiloton ships. There is no way a 5 kiloton sailboat is going to move fast enough to avoid being run down by a 50-kiloton ship.

Anything in the mill for a small, cheap, bulletproof transponder or other squawker that would set the alarms ringing on the bridge of the SeaCat before it pounced on a little sea turtle?

R. LANCY BURN  
DAUFUSKIE  
ISLAND, SC

## All-Time Worst

When I read the article on 40 years of PM Owners Reports, I was surprised that the "All-Time Worst" made no mention of GM's X-body cars—in particular, the 1980 Buick Skylark. I've been a driver since 1933. I've owned cars from Model T Fords to Lincolns, Caddys and many others that are no longer with us, such as Studebakers and Terraplanes. But the all-around, stand-

out, brass-bound *worst* was GM's 1980 Buick Skylark.

RAYMOND E. WATSON  
HUDSON, OH

*Our article highlighted the worst cars as rated by owners who participated in the Owners Report of that model. GM's X-cars of the '80s had only average ratings by their owners, but were not the worst cars ever rated.*

## Rattle-Free

Your review on the Pontiac Trans Sport paralleled my own thinking on this vehicle. However, when I read about the rattle you noticed in the sliding door, I

## P.B. DON'T MEAN:



## PRISON BELLHOP

In order to accomplish its feat, the hovercraft carried no passengers, no cargo and no vehicles. Furthermore, it was outfitted with extra fuel tanks to make the crossing at a record-breaking speed. It would have never made it otherwise.

On its record-breaking maiden voyage, the *United States* never ran its engines past 199,000 of its 240,000-shaft horsepower capacity. Put all-out, it could do 43 knots while carrying a full load of cargo and passengers. The ship was designed for 48-hour conversion for trooping and could carry a division of 14,000 men 10,000 miles at top speed without stopping for fuel, water or pro-

decided to write and tell how I solved a similar problem.

I too noticed a rattle coming from what I thought was the sliding door. But, upon further investigation, I found that the shoulder harness next to the door was twisted, causing the metal buckle to vibrate against the door molding. Perhaps, this is what's causing your rattle.

WILLIAM R. McALLISTER  
MARS, PA

### And The Winner Is . . .

I read with interest "Solar Racers Brace For World Challenge" in Tech Update. Unfortunately, your information on the GM Sunrayce USA standings for our entry, the *Viking XX*, and the University of Maryland, were reversed. Western Washington University's entry came in second only 1 hour and 20 minutes behind first-ranked Michigan. The *Pride of Maryland* came in 6 hours behind the *Viking XX*.

CAROLE  
WIEDMEYER  
WESTERN  
WASHINGTON  
UNIVERSITY

### Viper's Sting

I recently saw a Dodge Viper on display at an automobile exhibit and was disappointed to learn that the car is expected to sell for around \$60,000.

This, I was told, is an estimate based on demand, of course. Once again, American car-makers have invented the rich man's toy. If Chrysler wants this car to be the symbol or identification for performance at Chrysler, then build it and price it so more people can afford it. Remember the Mustang? I still see a lot of them around today, and I'm talking about the classics. What ever happened to building cars people can afford and still give performance? The answer is that someone else makes them, not Chrysler.

JOHN COLLINS  
GRAPEVINE, TX

No price has been set for the Dodge Viper. The \$60,000 estimate you were given

was one person's opinion, that's all.

### In The Fast Lane

From here on Jekyll Island, it's a high-speed, 250-mile run to Georgetown, South Carolina. This stretch of waterway is all pine forests and saw grass. It's virtually undeveloped. On your high-speed Intracoastal Waterway run from Miami to New York, you passed Hilton Head Island with several no-wake zones and quite a few signs of development, including marinas, homes, docks and floats. It is people like you—with your high-speed runs—who erode the shoreline, topple valued trees along the shoreline, and produce swells from your

throttle for about 98 percent of the time." Veteran PM readers by now know that all editors in the field strictly follow the rules of the road. If a story doesn't state, "we slowed down when passing through no-wake zones," it's meant to be understood. By the way, any person who builds on a shoreline should expect erosion. It's a function of nature.

### Painting Woodwork

I very much enjoyed the excellent article on painting woodwork and would like to add a few more tips. Rather than cleaning or storing used paint brushes in paint thinner between uses, an easier and more effective method is to wrap the bristle section in foil. Then store the paint brushes in the refrigerator. They may be stored for several days and remain perfectly usable.

I've also found it convenient to have available an 8-ounce plastic bottle, such as an old shampoo bottle, with a 1/16-in. hole drilled in the cap and filled with paint thinner. This is handy when you need to wet a rag to clean up paint spatters and other messes.

E.L. DAHLUND  
LONG BEACH, CA

### Setting Sun

Several times in recent months, your car testers have had some negative things to say about Japanese cars. In fact, you guys were even unenthusias-

tic about the holy of holies—the Honda Accord. I'm glad at least one magazine is finally coming to its senses. I've read for years about how great Japanese cars were. Then I tried several of them for myself, including the highly rated Camry and Accord. Neither could shine the shoes of a Ford Taurus. But they are so reliable, right? Hey, my Chrysler LeBaron GTS has 125,000 miles on it and virtually nothing has gone wrong with it. So how much more reliable could they be? All this groveling over Japanese cars would be almost laughable if it did not have such serious consequences.

ED KAFRISSIN  
HUNTINGTON, NY

**P.B. DOES MEAN**

**LOTS OF REAL PEANUT BUTTER**

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wake that make it impossible for us to stand on our floats.

In addition to these no-wake zones, marinas, homes, docks and floats, there's a bridge connecting the island with the mainland. Just what rule of the road did you apply to your high-speed run as you navigated this area?

You may have enjoyed your trip, but we along the Waterway did not.

JANE PROTHEROE  
HILTON HEAD ISLAND, SC

Speed is relative. Top speed during PM's coastal run, when permitted, was 42 miles per hour. Perhaps a more apt description for the day's run would be "full-

“When you can win over attitudes like ours with a car like this, it’s got to be good. This one is terrific.”

—MOTOR TREND





# INTRODUCING CAPRICE CLASSIC LTZ. MOTOR TREND CAR OF THE YEAR

- Special instrument cluster featuring digital speedometer with analog gauges.
- Sophisticated sport-tuned suspension.
- Highest V8 mileage in its class. EPA estimated MPG city 17/hwy. 26.
- Standard 4-wheel anti-lock brakes and driver's-side air bag.
- 3-year/50,000-mile Bumper to Bumper Plus Warranty.\*

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*Heartbeat*

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**TODAY'S CHEVROLET™**

It happens only once a year. Gathered together are America's best for 1991. Only to be subject to a battery of rigorous tests by "American Motordom's" most honored critics. Tests ranging from acceleration and braking to hours of on-the-road driving.

And when the results were in, enough couldn't be said about the Caprice Classic LTZ.

"The LTZ has a level of power...no other car in its class can match...a well-made driver's sedan." "...a new benchmark in a high-quality, performance-oriented family sedan, destined to be an important car on the American scene." Caprice Classic LTZ. The Motor Trend Car of the Year, and another reason more people are winning with The Heartbeat of America.

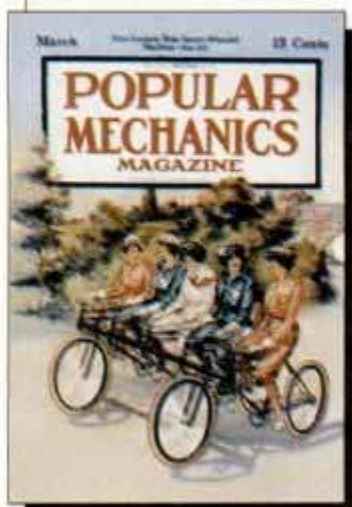


\*See your Chevrolet dealer for terms of this limited warranty. A deductible will apply after 12 months or 12,000 miles. Chevrolet, the Chevrolet emblem and Caprice are registered trademarks of the GM Corp. © 1991 GM Corp. All Rights Reserved. Let's get it together...buckle up.



# TIME MACHINE

75 YEARS AGO: MARCH 1916



## Heptacycle

The 7-wheeler on our cover was the brainchild of a Cleveland bicycle dealer. Some fancy engineering went into the contraption. While all five pedalers contributed to propulsion, only one could steer (an automotive-type steering assembly linked her hands with the twin front wheels). The rear of the vehicle was hinged together to provide independent suspension for each of the back wheels. But the pedaling quintet couldn't top 10 mph without risking a tumble.

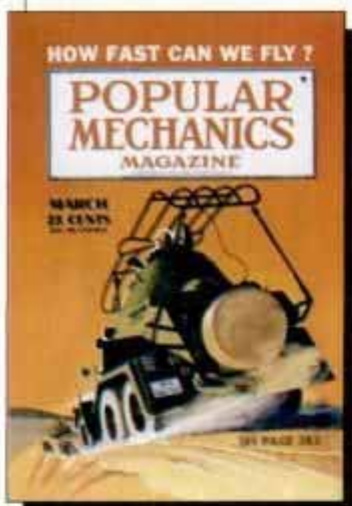
## Gyro Spinoffs

For 60 years the gyroscope had remained a toy, but suddenly, the simple device was revolutionizing transportation. Lawrence Sperry, son of gyroscope pioneer Elmer Sperry, won 50,000 francs from the French government for building the world's first autopilot. Sperry linked four gyros with an air-driven motor that warped wings and shifted ailerons on a biplane to keep the aircraft in level



flight. To keep up with the Germans, the Sperrys were also fitting U.S. and British ships with gyrocompasses and gyrostabilizers.

50 YEARS AGO: MARCH 1941



## Bird Dogs Of The Blitz

The onslaught of Nazi armor in Europe and Africa drew attention to the tactics of tank warfare. Among the ancillary role players who drove the blitzkrieg were Germany's armored radio scout cars. On each car, a frame-like antenna—heavy-duty enough to withstand fire and barge through obstacles—caged the sloping turret. The scouts reconnoitered enemy positions and radioed information back to the ensuing panzer juggernauts.

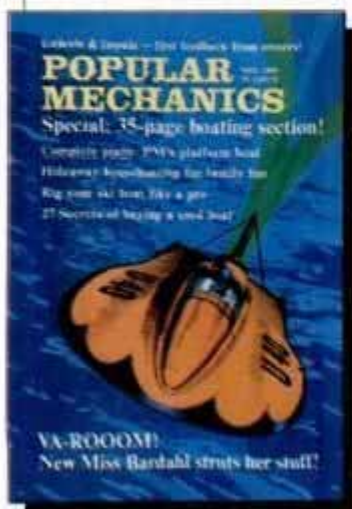


## Jeep Roots

Meanwhile, Army officials were road testing the "command reconnaissance four-four"—a new midget truck 3 ft. high at the cowl, powered

then by a 42-hp 4-cylinder tractor engine. Our editors prophesied conservatively that the scout vehicle might also "prove useful for hauling light freight."

25 YEARS AGO: MARCH 1966



## Thunderboat Lightning

Ron Musson had rooster-tailed his way to 3-straight unlimited hydroplane Gold Cups in the legendary Miss Bardahl. But he wanted something better—something that would hang a left at 100 mph. The all-new 1966 Miss B roared on a rear-mounted Rolls that crouched low in the hull, dropping the boat's center of gravity and allowing quicker turns. From bow to stern, the craft was tailored for lift—even the propeller rose as it

thrashed at 12,600 rpm. But Musson's story has a tragic ending. Three months after the article ran, the boat threw a prop blade during a 170-mph straightaway sprint on the Potomac River. It knifed into the air and shattered, killing Musson.

## Trailer Sailors

In an age of wacky consumer boats, the Trail-Or-Float stood out as a remarkable novelty. Two pontoons, 22 ft. in length each, rode above a 15-ft. trailer during road travel. When it was time to

get wet, a hydraulic system swung the pontoons out for launching, then jacked up the trailer.





A



B



It's time for your car's spring checkup at Kmart.



W. E. Larkins, manager of the Kmart on El Camino Real in Santa Clara, CA says that window tinting will save your car's interior from fading. Shopping at Kmart will keep your budget from doing the same.

**A Pennzoil Motor Oil.** Quality protection since 1889. HD 30, 10W-30 and 10W-40 viscosities. Limit 12 Qts ..... **1.17** ea.

**B AC Delco Duraguard Oil Filters.** Available in popular sizes. For many U.S. and foreign cars and light trucks. **AC Delco — it's like buying time.** Limit 3 ..... **1.99** ea.

**C GE Halogen Headlights.** Single lights H4561, H4656, H5001 and H5006 ..... **4.99** ea. Dual light or bulb H6054, H6024 and 9004BP ..... **9.99** ea.

**D Bosch Platinum Spark Plugs.** Quick starts and top fuel efficiency. 4-packs for many cars, vans and pickups ..... **1.88** ea. 7mm and 8mm spark plug wire sets for many cars at everyday low prices.



C

D

On sale February 24 through March 6, 1991, at U.S.A. Kmart stores.



*Keep your car  
looking good  
inside and out.*



Gary Theut, of New Baltimore, Michigan, spent five years restoring his 1965 Ford Galaxy convertible. The Chesterfield Twp Kmart on 23 Mile Road helps keep it as nice as the day it came off the line.

**STP Auto Care Products.  
Your choice . . . . . 1.37**

- A** Oil Treatment. 15-oz. size.
- B** New Car Oil Treatment. 15-oz. size.
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- D** Lead Substitute. 8-oz. size.
- E** 4-Cylinder Oil Treatment. 15-oz. size.
- F** **STP** Son-of-a-Gun. 20-oz. size. Helps protect and beautify vinyl, plastic, leather and rubber. **2.97**
- G** **STP** Gas Treatment. 12-oz. size. Helps clean carburetor. Improves performance. **1.17**
- H** **Simoniz** Tuff Stuff Multicleaner. 22-oz. size. Effective for cleaning vinyl upholstery, vinyl and plastic floor mats. Home or car use. **1.97**
- I** **Simoniz** Non-Abrasive Liquid Wax. 16-oz. size. Non-Abrasive Paste Wax. 14-oz. size. Your choice **3.47**





◀ Car-Care Tips ▶

Remember, a car cover should never be left on for more than a month unless it's constructed from a breathable fabric. Otherwise damage to the paint and finish can occur. If waxing your car sometimes leaves hard-to-get-at wax deposits around antennas or door handles, use a cotton swab to remove and clean. This will leave a uniform shine without the unsightly white streaks.

**J** Kraco Floor Mats. 4-pc. plush carpeted mat set. Twin front and rear with rubber heel pad. Assorted colors. Model KM904 . . . **12.97**

**K** 72-Spoke Chrome-Plated Wheel Covers . . . **10.00** ea.  
**ABS Plastic Wheel Covers** . . . **5.00** ea.  
 Assorted styles. Available in 13", 14" or 15" sizes.  
 Tire not included.

**L** Poly/Cotton Car Cover. Medium and large. Protection from rain, ice and snow . . . **39.00**  
 XL cover . . . **42.00**

**M** Nylon Car Cover. Medium/large. Protects your car in summer, winter or storage . . . **19.00**  
 XL nylon car cover . . . **22.00**

**N** Allison Ultra Plush Seat Covers. Plush fabric provides soft comfort and perfect fit, fit most high- and low-back bucket seats and bench seats . . . **19.88** ea.

The quality you need,  
 the price you want.



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spring and savings  
at Kmart.*

**A** Jensen AM/FM Stereo Cassette. With auto reverse, seek, fader and presets. Automatic program control. Model CS4500 ..... **119.00**

CS2500 AM/FM stereo cassette. Seek tuning and 18-station preset ..... **99.00**

**B** Audiovox AM/FM Deluxe Cassette Stereo. Electronically tuned, stereo cassette and quartz clock. Model AV952 ..... **89.00**

AMP 760 40-watt graphic equalizer/amplifier ..... **24.00**

**C** Kraco AM/FM Stereo Cassette. With 3-band graphic equalizer and soft-touch presets. Model ET 1080 ..... **89.00**

KPA-100 amplifier. 500 watts per channel ..... **64.00**

**D** Cobra Underdash CB Radio. Compact with squelch, digital read-out, LED signal meter and instant emergency Channel 9. Model C20 ..... **49.00**

**E** Whistler Radar Detector. Compact, full-feature detector with highway/city mode, "pulse protection." Model WH750 ..... **149.00**

Not available in CT and VA.

Radio and CB antennas available at everyday low prices.

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Our firm intention is to have every advertised item in stock on our shelves. If an advertised item is not available for purchase (due to any unforeseen reason), Kmart will issue a Rain Check (on request) for the merchandise (one item or maximum family quantity) to be purchased at the sale price whenever available or will sell you a comparable quality item at a comparable reduction in price.



On sale February 24 through  
March 6, 1991, at U.S.A.  
Kmart stores.

# TECH UPDATE

News Of Tomorrow's Technology Today



TM ILLUSTRATION BY PAUL DANFEE

## Air-Powered EI Train Would Hit 300 Mph

ESSINGTON, PA—Hanging from trolleys that race through guide tubes 35 ft. above the ground, an aerial train could zip from station to station while hugging the curves of existing railroad rights of way.

Conceived by helicopter pioneer Frank Piasecki, these AirTrains would be driven by ducted, variable-pitch propellers—without the heavyweight train equipment normally needed to press wheel against rail. Braking is achieved by reversing propeller pitch.

Overhead, the 10-wheeled tubeway trolleys would roll along five rails, arranged in a nonderailable configuration. Since the rail system doesn't

rely on friction to generate movement and stopping power, the cars can weigh as little as a fuselage. The entire tubeway structure can thus be lighter and cheaper to construct.

To keep passengers comfortable at high speed, an active suspension and aerodynamic canard surfaces would compensate for any bumps in the overhead tubeway. And the strut that links car with trolley would swing on a hinge, banking as the car hit curves.

Mixing proven wheel-on-rail and aircraft technologies, the AirTrain may be a

Editor: Abe Dane  
Assistant Editor: Greg Pope  
Contributors: Mike Dillon, William Siuru

cheap alternative to magnetic levitation for our next-generation ground transport system, Piasecki says.

Prop-driven AirTrain cars, each carrying 90 passengers, follow contours of 20th-century rail lines at 300 mph.

## Highlights This Month

- **Robo-Copter**—Pilotless chopper hops from ship's deck.
- **Mechanical Marathon**—Robots hold their first Olympic Games.
- **Smart Suits**—High-tech tailoring for Moonwalkers.
- **ATF Shootout**—Future fighter prototypes duel for the title.
- **Air Brakes**—Retrorockets soften chute landing.
- **Mussel Machine**—Swimming robot tackles pesky zebra mussels.



## Israel's Unmanned Helicopter

JERUSALEM, ISRAEL—After pioneering in the use of unmanned aircraft for military missions, the Israelis have now taken the next logical step—an unmanned helicopter for naval-reconnaissance use. Named Hellstar, this newest member of their remote-control fleet has been undergoing flight tests since last summer.

Carried aloft by two 20-ft.-dia. rotors, the 10-ft.-high drone will fly

over-the-horizon target-acquisition and missile-aiming missions, freeing up manned choppers for rescue and attack jobs. Hellstar's compact fuselage enables launch and recovery aboard ships as small as 400-ton fast attack craft, such as Israel's missile-carrying *Aliya*- and *Reshef*-class vessels. The coaxial rotor assembly provides the stability to hover on automatic pilot in gusty maritime conditions.

Israel's navy plans to wire the vehicle's control systems directly into bridge combat information centers and run Hellstar missions without adding personnel to vessels. The drone should also allow deck space now taken up by large helicopter platforms to be used for extra guns and other equipment.

**Hellstar (left) undergoes trials. Test vehicle without fairing (far left) bares transmission housing and avionics.**



## See-Through Semi-Sub

SAN DIEGO, CA—Capitalizing on interest in underwater tourism, a semi-submersible ship with transparent subsurface pontoons is scheduled to begin service this month.

The 56-ft. *Maui E-Ticket* has the only semi-submersible hull design approved by the U.S. Coast Guard. It will ply its trade off the Hawaiian island of Maui. Forty-four

**Semi-submersible *Maui E-Ticket* features see-through pontoons for underwater viewing.**

passengers will ride in submerged pontoons paneled with acrylic windows. The ship has a 6½-ft. draft.

The craft's three engines, two of which reside on the passenger pontoons, are fitted with large exhaust mufflers, sound insulation and antivibration mounts. Meanwhile, 10 kilowatts of underwater lighting illuminate the marine environment.

A sister ship will go to sea next year at St. Thomas, Virgin Islands.



## Surround Sound For Pilots

WRIGHT-PATTERSON AFB, OH—Three-dimensional sound may provide a way of getting vital data to a fighter pilot already overloaded with displays.

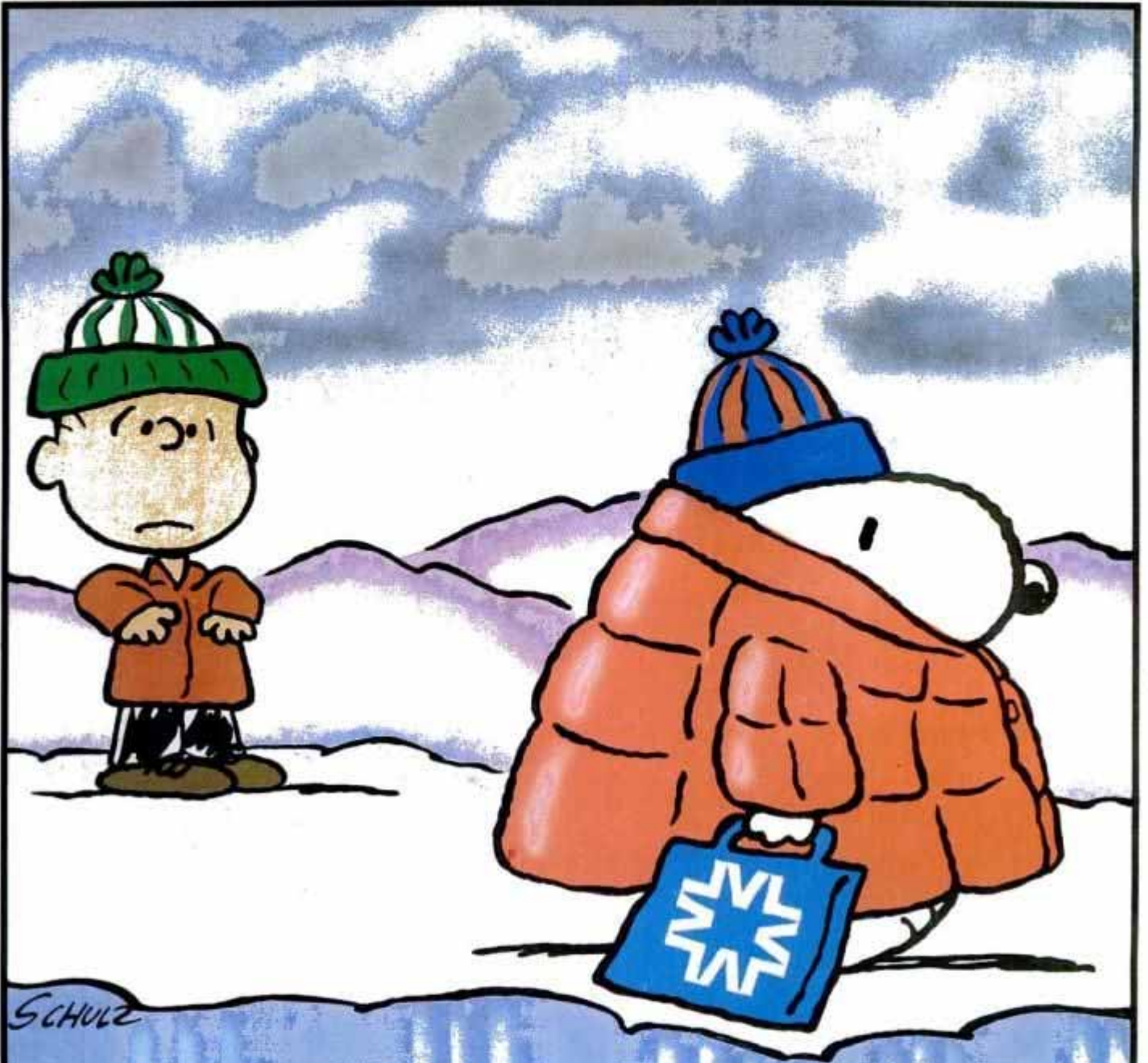
Air Force researchers are measuring the human ability to pinpoint the direction and distance of sound. To that end, they're placing subjects in a geodesic frame outfitted with 272 loudspeakers. Up to 15 speakers at a time can emit audio, which can surge electronically around the sphere to mimic the roll rate

**Geodesic 14-ft.-dia. audio sphere with 272 speakers is Air Force's testbed for 3D sound.**

of an F-16.

Should 3D sound prove a viable medium, engineers plan to build a human-scale sound sphere into a helmet. The device might give third dimension of data to air traffic controllers, who currently must eye a 2D radar screen to track planes that move in three dimensions. In addition, information carried by 3D sound could help a blind person navigate.





YOU CAN NEVER BE TOO SNUG OR TOO SECURE.

...particularly in today's fickle financial climate.

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**MetLife**



## Moonsuits With Smart Heads

HUNTSVILLE, AL—Two independent designers have developed a moonsuit that could plug directly into rovers and other devices to give astronauts voice control over the machinery.

Key to the concept is the combined helmet-upper torso unit. This headpack not only incorporates command and control hardware but

also features in-helmet flat-screen data and video displays. Roomier than current bubble-shaped helmets, the unit has a flat-faceted face mask for better visibility.

Two plugs near the waist allow interface with Moon machines, and midtorso structural extensions can shift the weight of the suits to external machinery.

Griffin-Hudson moonsuit undergoes testing (above left). Suited astronauts (above) would plug into rocket-powered lunar hopper.

Instead of donning the suit piecemeal, the astronaut climbs in through a single rear hatch, a feature which keeps abrasive lunar dust

away from the suit's joints.

The suit's creators have built an engineering model and are continuing hardware trials.

## The Envelope, Please . . .

EDWARDS AFB, CA—The test flights are over. The data are in. Now the Air Force must pick its fighter of

cruised above Mach 1.4 without using afterburners, thanks to twin powerplants that deliver 40 percent more thrust than F-15 engines of the same weight. Pratt & Whitney and General Elec-



YF-23's clipped rhombus wings (above) contrast with YF-22's more classic fighter profile (right). GE's powerplant (below left) is tested, while General Dynamics machine lays composite tape (below right).



the future, a decision at this writing that's scheduled for April 30.

All last autumn, four prototypes—two apiece from competing teams Northrop-McDonnell Douglas (YF-23) and Lockheed-Boeing-General Dynamics (YF-22)—showed their stuff over the Mojave Desert. Each has

tric are vying for the solo engine contract for the planes, and so far, General Electric's engine seems to pack more punch.

The planes also demonstrated high-angle-of-attack maneuvers and low-speed rolls, with the YF-22 using its thrust-vectoring paddles. Observers have noted that the YF-23 appears faster and stealthier, while the YF-22 is more of a high-maneuverability performer. Yet neither of the teams is willing to second those conclusions.



## "Nothing else even comes close"

That's how *BMW Roundel* Magazine described our new ESCORT radar detector. And for good reason. Totally redesigned, it sets the performance standard against which others try to measure up.

In fact, all our radar detectors have earned reputations as the world's finest. *Road & Track* called us the "industry leader in detector technology."

These are the best engineered, best built, best performing radar detectors you can buy. Also delightfully easy to use. Just turn them on and drive. And relax.

### Buy direct from the experts.

We design all our own detectors, from the ground up. We build them in our Ohio factory. And we only sell them directly to you.

Call us toll-free, day or night, and talk to someone who really knows radar detectors. Not a salesperson selling hundreds of different products, from dozens of manufacturers. And if you order before 6:00 pm (Eastern Standard time), we'll even ship the same day.

### PASSPORT

*Pocket-size protection at a great price.*

The very first radar detector to combine high performance with compact size, PASSPORT is the one that everyone has tried to beat.

But "they all fall short of PASSPORT's benchmark design and overall performance package," according to *BMW Roundel*.

"PASSPORT is a winner," says *Car and Driver*, "You won't go wrong with its robust construction, superb ergonomics and well thought-out audible warnings."

More than one million drivers depend on PASSPORT. Now you can too, at a new low price.

### ESCORT

*The performance champion.*

The original ESCORT revolutionized radar detector performance. The all-new ESCORT takes another quantum leap forward, bringing you protection superior to all others.

**Longest warning time.** The secret is Digital Signal Processing (DSP), the same advanced system used by military radar to spot enemy aircraft.

ESCORT picks up radar signals — even distant "instant on" radar — farther away than ever before possible. It uses DSP to sample those signals, 50,000 times a second, and analyzes them with its on-board computer.

Result? A dramatic increase in warning time — as much as ten seconds. Precious extra seconds that give you time to react.

### Big performance. Small size.

The metal case, finished in non-glare black, is small enough to mount unobtrusively on windshield or dash.

### SOLO

*The first radar detector designed for travelers.*

Until now, it's been a hassle to enjoy high-performance radar detection when you traveled and rented cars. But now there's SOLO.

**No power cord.** Unlike any other detector, SOLO is self-powered. There's no dangling power cord. Just clip SOLO to your visor and switch it on.

SOLO is small enough to carry in your shirt pocket. Its magnesium case weighs a mere 5½ ounces. In

your car, it's next to invisible. And it's so convenient you'll never drive without it.

**The secret of SOLO's self-power** is that it uses only 2% of the power required by conventional detectors, to give you 200 hours of protection on a single 9-volt battery.

Yet it's as sensitive as a cord-type, with all the advanced features of the original ESCORT and PASSPORT. And it maintains all its radar warning power over its entire battery life. SOLO is even smart enough to turn itself off if you forget.

### MONEY-BACK GUARANTEE

Call us now to road-test the radar detector of your choice for 30 days. If you're not completely satisfied, return it for a full refund, including shipping.

Order today — Call toll-free

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Call 24 hours, 7 days a week  
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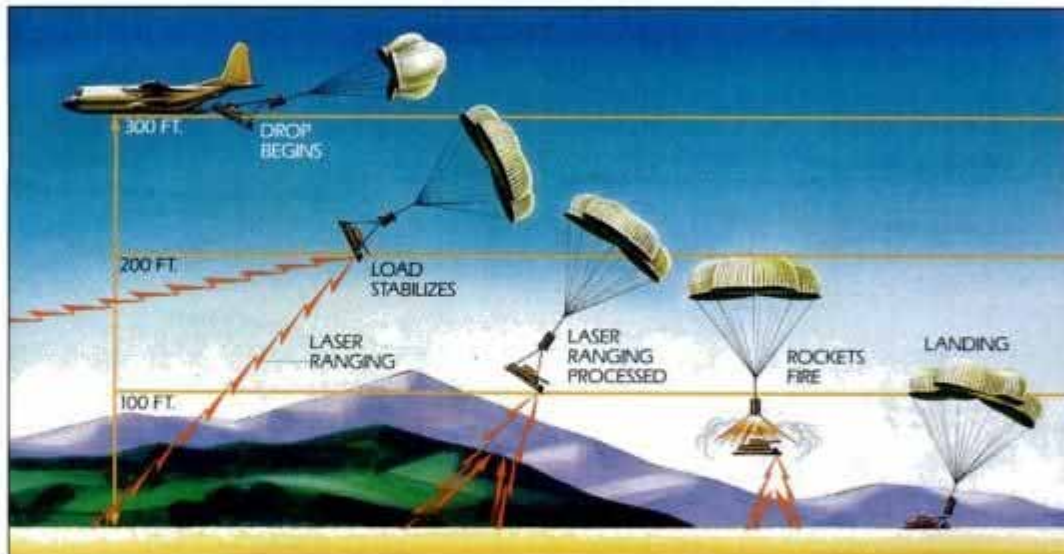
Cincinnati, Ohio 45249

## Parachute Brakes

NATICK, MA—Sweeping in low under enemy radar, a cargo plane must unload several tons of matériel. Yet at such a slim altitude, the parachute may not deploy in time to cushion the impact.

The Army is addressing the problem by developing a platform that's equipped with retrorockets to decelerate plunging payloads.

Once out of the plane, the platform will calculate its own descent speed by continually firing a laser at the ground. A microprocessor will determine the correct altitude to fire the rockets. The aim is to slow impact velocity to 8 ft. per second.



The platform will handle level from planes flying at 130 to 150 knots. Individual system components are currently being tested.

level from planes flying at 130 to 150 knots. Individual system components are currently being tested.

**Payload drops from low-flying cargo plane, monitors descent rate with laser, then fires retrorockets.**

## Mussel Busters

ITHACA, NY—For the past three years, zebra mussels have been playing havoc with America's inland waterways. The inch-long invaders from Europe have colonized intake pipes of electric plants and municipal supplies, choking off water flow.

But utilities, along with Cornell University engineers, hope to fight back with remotely operated robots armed with waterjets.



A likely candidate is the Hyball—an inexpensive, commercially available robot nicknamed "the swimming eyeball." Outfitted with tracks and a miniature waterjet, a Hyball could clean out pipes too narrow for scuba divers (who currently scrape off the mollusks with putty knives).

Cornell is testing the device's ability to maneuver through mussel-bound pipes off the Niagara River.

Rolling on midget tracks, Hyball rigged for mussel fighting blasts mollusks with waterjet.

## Swiss Take World Solar Title

ADELAIDE, AUSTRALIA—An elegant, wing-shaped design executed in Kevlar and carbon fiber by Switzerland's Biel School of Engineering has won the second running of the World Solar Challenge.

After hot-footing it across 1900 miles of Australian outback at an average speed of 40.7 mph, the car finished nearly 9 hours ahead of the next competitor. Average speed was just short of the

41.5-mph record set by the General Motors *Sunraycer* in the first Solar Challenge in 1987.

Japan's Honda team took second place, averaging 34.1 mph. Next came the University of Michigan's catamaran-shaped *Sunrunner*, victor in the GM-sponsored Sunrayce USA held last July.

Sponsored by Switzer-

land's Swatch watch company, the winning *Spirit Of Biel-Bienne II* incorporates a new type of silicon solar cell etched with a laser to increase surface area. The technology promises to make future solar racers cheaper to build than past entrants, which relied on difficult-to-fabricate gallium arsenide crystals.



Sleek shape of *Spirit Of Biel-Bienne II* evolved in Swiss Air Force wind tunnel.

(More Tech Update on page 24)

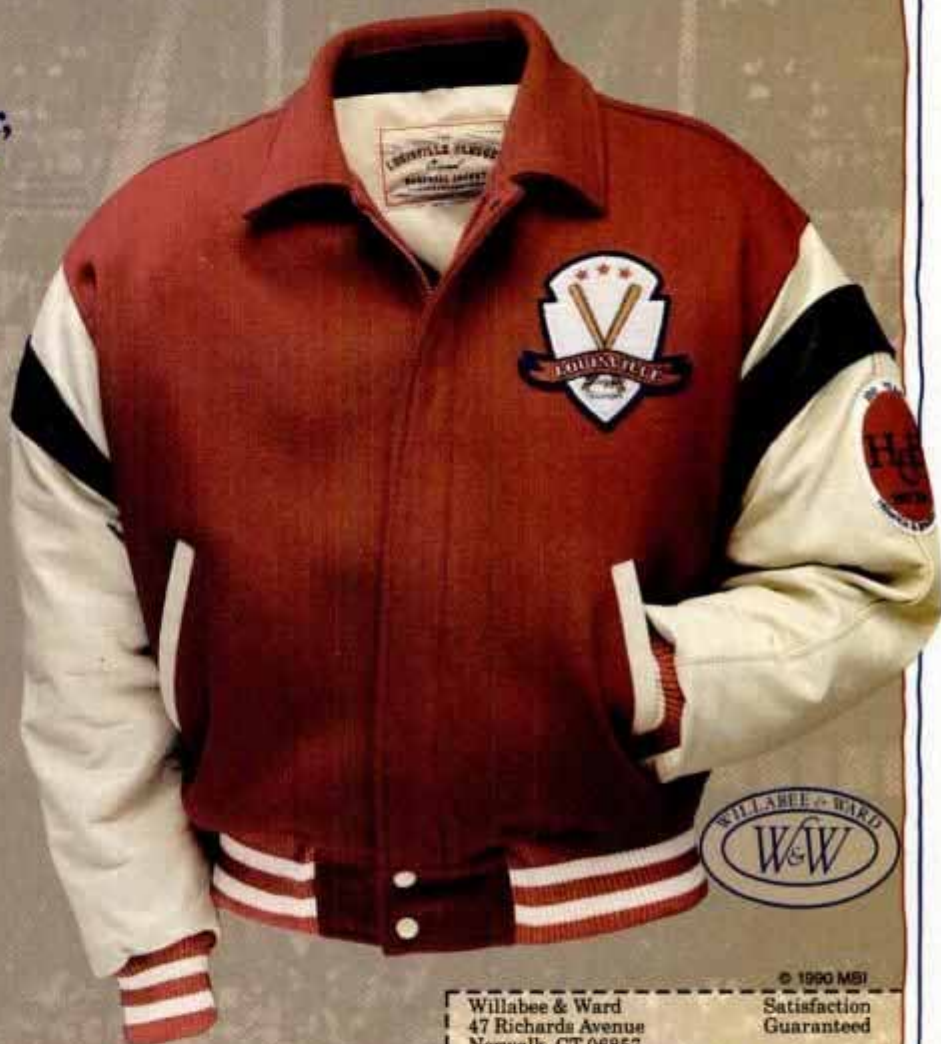
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**"LOUISVILLE SLUGGER"**  
 BASEBALL JACKET

For the first time ever,  
 a Louisville Slugger®  
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612-117

## Instant Chem Shelter

NATICK, MA—The mobile medical shelter has always been a battlefield necessity, and never more so than today with looming threats of chemical and biological warfare. Now, Army engineers are developing a quickly deployable battalion aid station capable of withstanding gas or germs to replace outdated Vietnam-era shelters.

Four soldiers can erect the shelter in less than 20 minutes—unrolling the Teflon-coated Kevlar shell from a HMMWV vehicle, inflating neoprene-coated support-rib tubes and setting up the airlock and environmental control gear. Each shelter



Army's chem-war shelter with airlock deploys from the back of a dedicated HMMWV in less than 20 minutes.



covers more than 300 sq. ft., and two together form a more stationary division

clearing station.

The new shelter isn't scheduled to be operational

until 1995, but rush production for Operation Desert Shield is being considered.

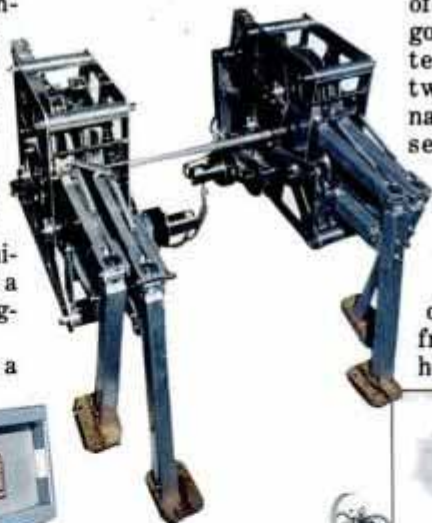
## Robots Go For The Gold

GLASGOW, SCOTLAND—They might not give Carl Lewis a run for his money, but more than 60 robots representing 12 nations gathered here last September and competed gamely for honors in walking, climbing, javelin tossing and other events.

Researchers at the Turing Institute organized the Robotic Olympics to allow more than 100 mechanical and electrical engineers a way to gauge their own progress in the field.

The overall winner was a

Japanese entry called Yamabico, which also won the gold medal in wall-following. But there were some surprises.



A 145-year-old Japanese automaton with wooden gears and clockwork machinery upset two modern robots in the javelin throw. A favored British wall-scaler named Robug II was disqualified during a playoff for the bronze medal because it barged out of its lane and began climbing on top of its

Two-legged and 4-legged walkers (left and above) won gold medals, while Robug II (right) lost the wall climb after fouling its opponent.

Russian competitor.

Specialized entrants vied in a catch-all category called "behavior." Genghis, a diminutive robot designed by the Massachusetts Institute of Technology, captured the gold medal by crawling over telephone books that are twice its height. Genghis narrowly missed winning a second gold in the more-than-2-legged walk, edged by Penelope, a tetrapod from the University of Edinburgh.

Organizers plan a second Olympics two years from now, probably to be held in Japan.



Newtsuit thrusters enhance diver mobility in hard-shell suit.

## Underwater Jet-Pack

NORTH VANCOUVER, CANADA—Engineers continue to blur the line between diver and submersible. For example, designers have added a propulsion system to the Newtsuit—a rigid, multi-jointed diving suit that permits 1000-ft. plunges without decompression. Consisting of four strap-on thrusters, the setup enables divers to "fly" from place to place underwater. The next-generation suit may even include a hard cocoon to enshroud lower torso and legs.



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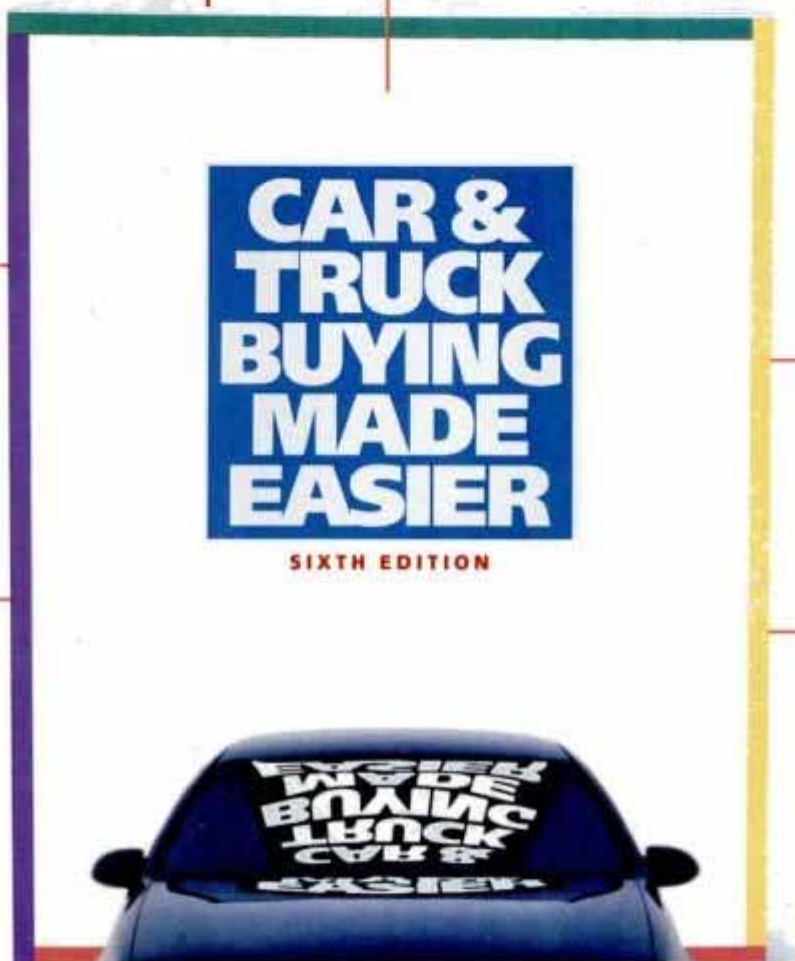
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## OWNERS REPORT

# MAZDA MIATA

Car rates as excellent,  
but dealers draw fire.

BY MICHAEL LAMM, Contributing Editor  
PM Photos by Humphrey Sutton

● From the moment it appeared, Mazda's Miata has been a major hit. No car in recent memory has captured so many hearts in so little time.

The Miata is the result of a handful of Mazda designers, engineers and product planners who thought the time was right to revive an old British concept: the affordable 2-seat sports roadster. Mazda's corporate decisionmakers had enough faith in their sports car enthusiasts to endorse the job, and with a \$13,800 base,

the price seemed to be about right, too.

As it turned out, though, price became the Miata's one and only major area of complaint. Initial demand was so strong that even before the car hit dealer showrooms some entrepreneurs were offering Miatas for as much as \$10,000 over sticker price. Some Mazda dealers joined in the supply/demand frenzy, and a howl went up about dealers gouging their Miata customers.

Accordingly, we expected that when our Owners Report tabulations came in there would be lurid tales of \$30,000 Miatas. However, our survey indicates that the average price paid by Miata buyers was \$17,501. Since *all* of our respondents took delivery of cars with one of two option packages (A or B) and 91.3 percent also ordered—or, to be more accurate, accepted—air condi-

# MAZDA MIATA



tioning, \$17,501 doesn't seem that much out of line.

For the record, option package A consists of aluminum-alloy wheels, power steering, leather-wrapped steering wheel, digital clock and AM/FM/cassette sound system. Package B: all the foregoing, plus power windows, headrest speakers and cruise control.

Package A adds \$1145 to the base price, B an additional \$585 and a/c another \$795. With tax, license, prep and freight charges, it's hard to see much gouging in our survey results.

It's true that not everyone actually wanted either of the option packages or air conditioning, and that dealers and/or the factory simply wouldn't or couldn't supply the cars any other way. There's also no doubt that some dealers did add things like paint sealants, interior prep and body decals that buyers didn't want but had to swallow if they wanted a Miata.



Owners praised layout and quality of interior, but tall drivers found it cramped. Miata's 116-hp dohc 4-valve Four was fine for most, but some drivers wanted more power.

Nevertheless, low price ranked second—behind styling—in factors influencing its purchase. We conclude from this that most of our Miata owners felt they got a good deal.

Still, some buyers did feel they'd been taken advantage of, and singled out Mazda salesmen as the prime offenders. Our survey reveals that dealer sales tactics were rated fair by 23.4 percent of our respondents and poor

by nearly 10 percent, far worse than the industry average.

Dealer honesty fared little better: 17.9 percent judged their dealers fair in this category, 13.2 percent poor.

However, dealer complaints didn't seem to affect the high enthusiasm of the owners for their cars. None of our respondents confessed to choosing the Miata simply because they needed a car. People don't buy sports cars for

## SUMMARY OF 1990 MAZDA MIATA OWNERS REPORTS\*

<b>Total miles driven:</b>	1,274,189	<b>Specific likes:</b>		Good	25.3	Poor	3.7
<b>Purchase price:</b>		Styling	82.1%	Average	0.4	<b>Number of vehicles owned:</b>	
Average	\$17,501	Handling	69.2	Poor	0.0	This car only	17.6%
Range	\$14,500-\$21,500	Convertibility	28.3	<b>Comfort rating:</b>		Two cars	33.2
<b>Average miles per gallon:</b>		Performance	18.3	Excellent	48.2%	Three cars	30.7
In town	26.3	Power	13.3	Good	44.9	Four or more	18.4
On the highway	30.4	<b>Specific dislikes:</b>		Average	5.7	<b>Principal driver:</b>	
<b>Major options:</b>		Insufficient trunk space	25.6%	Poor	1.2	Male	55.2%
Air conditioning	91.3%	No complaints	14.2	<b>Any mechanical problems?</b>		Female	32.6
Option package A	54.3	Insufficient power	9.5	No	88.5%	Equal	12.1
Option package B	45.7	Plastic rear window	7.1	Yes	11.5	<b>Owners' age distribution:</b>	
Limited slip	37.2	Cramped interior	5.7	<b>Types of problems:</b>		Under 29	17.4%
Detachable hardtop	15.0	Noises and rattles	3.8	No consistent mentions		30-49 years	66.4
Compact-disc player	7.3	<b>Suggested changes:</b>		<b>Did you handle repairs?</b>		50-plus	16.2
Automatic transmission	0.9	More power	26.0%	No	88.9%	<b>Would you buy another Mazda?</b>	
<b>Why did you choose the Miata?</b>		No changes	7.1	Yes	11.1	Maybe	52.9%
Styling	77.9%	More trunk space	7.1	<b>Dealer repairs satisfactory?</b>		No	24.2
Price	24.8	More durable paint	5.9	Yes	87.0%	Yes	22.9
Convertibility	24.8	Better rear window	4.7	No	13.0	<b>Based on experience, would Miata be your choice again?</b>	
Performance	14.2	Improved courtesy lamps	4.7	<b>Dealer service rating:</b>		Yes	89.3%
Reputation	13.3	Remote trunk release	4.7	Excellent	41.9%	Maybe	7.4
Handling	12.4	<b>Workmanship rating:</b>		Good	42.6	No	3.3
		Excellent	74.2%	Average	11.8		

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

practical reasons. Nevertheless, the Miata turns out to be a good car, about as troublefree as any car we've ever surveyed: 88.5 percent of our owners reported zero defects. The other 11.5 percent reported problems so trifling and scattered as to form no discernible pattern, which is a far cry from the old British sports cars.

In fact, only the new Lexus has scored better marks in recent times. The one under-hood complaint concerned the oil filter, which is difficult to get at for replacement.

The Miata also scored high marks for workmanship and overall quality: 74.2 percent excellent. There were a few complaints about paint quality, and a number of owners thought their floor mats were too thin. A number of others said the plexiglass rear window becomes creased once the convertible top has been used a few times, and that it also scuffs easily, making rear vision murky, particularly at night. This is a classic failing of plastic rear windows in convertibles.

Handling proved to be one of the most compelling dynamic traits of this rear-wheel-drive sports car. Several owners even compared it to the kind of involvement that goes with riding a motorcycle. This was mitigated by Snow Belt drivers, however, who reported skittishness on slippery winter roads.

Most owners considered the Miata's power output (116 hp) to be adequate. A significant minority—26 percent—suggested adding more oomph.

In its first six months, the Miata was equipped with a 5-speed manual transmission. An automatic transmission option became available later, but since our respondents were drawn from early purchasers, the survey doesn't reflect any experience with the automatic.

Judging by our owners, the Mazda is particularly comfortable for a sports car—provided you're not too tall. Drivers over 6 ft. reported feeling a bit cramped. Cramped also applies to the Miata's trunk, something owners liked least about their cars.

All in all, though, the Miata seems to need very little improvement. Controls and gauges are ideal, according to the owners. The top operates with a flick of the wrist. The shifter snicks easily from gear to gear and feels just right.

The bottom line: Nearly 90 percent said they'd buy the Miata if they had it to do over again. This is an unusually high figure for a small 2-seater, suggesting that the Miata is already generating its own cult following, a phenomenon that comes along maybe once in a generation. **PM**



Miata's jaunty looks and tidy packaging pleased virtually all owners surveyed—almost 80 percent of our survey group rated styling as their principal reason for choosing this car.

## EDITORS REPORT

# Big Fun, Small Package

● For anyone whose youth involved cold winter driving in old British roadsters, the Miata MX-5 looks like some sort of miracle. This car embodies all the qualities that made MGs, Triumphs and Austin Healeys magic—wind-in-the-hair, responsive handling, seductive exhaust noises, the intimacy of a snug 2-seater—with none of their vices.

Miatas start instantly when it's cold and/or damp. They keep out the weather. Their folding tops are easily operated with one hand. They have heaters worthy of the name, and they're wonderfully simple.

It's hard to imagine a better update on the classic roadster concept.

On the other hand, there's always room for criticism. As our Owners Report indicates, for example, there are a few who wouldn't mind more horsepower. Reaction to this minority complaint is mirrored on our own staff. Editor-in-Chief Joe Oldham, an unabashed torque junky who regards the Chevy big-block as one of the highest achievements of Western civilization, dismisses the Miata's performance as wimpy.

However, the majority opinion seems to be that the output of the Miata's 16-valve twin-cam Four is just about right. True, its modest torque does keep the driver rowing around in the 5-speed gearbox, but this is part of the fun of sports car driving, and the precision of the gearbox makes it pure joy to use.

No one here would go so far as to call the Miata truly fast—after all, 150-mph street cars are becoming almost commonplace today—but its performance measures up quite favorably compared to oldtime MG standards. And based on our own Miata experiences, which include a 1-year long-term test, prospective owners can expect bulletproof reliability to be part of the fun. Not to mention excellent fit and finish, inside and out.

Like some of the owners, we have observed a few small flaws. For anyone over 6 ft. tall, the Miata's cockpit slips from the realm of intimate into the narrow confines of cramped.

Cramped also applies to the trunk, which must have been laid out by the same guy who designed the overhead storage bins for the Lockheed L-1011 jetliner.

We've also noticed that comfort begins to fall off sharply in trips of 100 miles or more, and that the noise level inside the car runs a little high for some tastes.

The owners' observation about creases in the plastic rear window is accurate, but this can be prevented by the simple expedient of unzipping the window before operating the top.

But assessed for what it is—an agile 2-seat roadster designed to deliver lots of sports car fun for not much money—we don't think the Miata has an equal on the road today.

—Tony Swan

# WALL TV





## Make your TV picture as large as life.

BY STEPHEN A. BOOTH,  
Contributing Editor

● If television is supposed to be our window on the world, who says it's got to be the size of a porthole? Why shouldn't a home TV screen match the spectacular dimensions of that picture window in your living room wall?

Fact is, you can transform a mundane wall into a TV display that rivals those dramatic views from the bridge of the Starship *Enterprise*. The trick is to project the video image—either onto the wall or from behind the wall.

Your window-on-the-world can span anywhere from 4 to 10 ft. diagonally, but bigness isn't the issue here. It's a matter of perception. There are plenty of big-screen TVs around, both direct-view tube models and projection systems. And although these offer plenty of picture, you'll still perceive the image as coming from a box. This perception changes when the video image is flush with the plane of the wall. Suddenly, it's as though the image were part of the wall or emanating from beyond it. Spectacle and theater is what we're after: the visual impact of an in-the-wall aquarium.

### Master projectionist

At this writing, the King Kong of wall TVs is Mitsubishi's giant 120-in. rear-projection system. Because the viewing screen of the VS-12001 measures 6 ft. high  $\times$  8 ft. wide, it truly qualifies as a wall in itself.

To equal its 48 sq. ft. of viewing area, you'd have to stack three dozen 20-in. sets six high by six across. Actually, though, that wall of tubes would take up less depth than Mitsubishi's monster. Like the Wizard of Oz, the true source of the VS-12001's grandeur is concealed behind the screen. The projection tubes, lenses and mirror that generate the 10-ft. diagonal image occupy nearly 7 ft. of floor space.

You need a very large room to appreciate the view from this electronic picture window—and to accommodate multiple loudspeakers for a surround-sound system that would do

Sharp's LCD projector throws an image onto a screen or wall. Philips' WallVision (inset) is essentially a rear-projection TV flush-mounted with the wall.

the video justice. And, although the construction-savvy TV buff could stud out the false wall and supports for the VS-12001, Mitsubishi considers it a custom-installation job to be performed by the company's dealers. The price of admission to this home theater is about \$20,000, depending on the complexity of the installation. And because the quality of a video image becomes more apparent as image size increases, you'd probably want to purchase a high-resolution video source such as a laserdisc, Super VHS or a satellite television receiver and dish antenna.

## WallVision

Closer to the budget and square footage of the average household is the WallVision rear-projection TV concept from Philips Consumer Electronics. Actually, WallVision is a clever combination of freestanding TV and adapter kit that's designed for in-wall installation.

The three "window" sizes available measure 46, 52 and 61 in. diagonally and are priced at \$3000, \$3300 and \$3700, respectively. The price includes a 50-watt Dolby Pro-Logic Surround Sound system. The depth requirement for wall installation ranges from 30 to 34 in. and includes

the all-important, unrestricted airspace for ventilating the system.

The WallVision kits vary in design but basically include a screen frame for the display and detachable grille for the loudspeaker system. When the TV is in place behind a wall, the frame and grille are affixed to cutouts on the exterior surface to provide a custom-installed, picture-frame look.

Besides the detailed, well-illustrated installation and hookup guide, another component of the standard kit is an airdam, which is essential for controlling ventilation through the TV itself—airflow around the system isn't enough. Philips specifically recommends installation by a WallVision dealer for customers who lack professional construction experience.

Besides the standard kits, WallVision offers optional packages for in-wall installation of large, separate loudspeakers and cabinets that house VCRs, amplifiers and other audio/video components. As with the TV itself, proper ventilation is also required for these equipment cabinets, which come with exhaust fans and airvents.

The WallVision concept is versatile enough to adapt itself to varying configurations of homes and rooms. The customer can create a divider-like,

enclosed interior wall within a large room. The installation guide also shows diagrams for partial or full extension through an exterior wall and for an interior wall extension. One off-beat but interesting layout is a flush-mount, kitty-corner installation. Although the basic WallVision installation is impressive enough—with screen and speaker framed flush—it's even more a tour de force when flanked by the optional loudspeakers and equipment cabinets. These are sized to match the height of the 52-in. screen.

## Against the wall

Both the Mitsubishi and Philips systems use rear projection so that the picture emanates from behind your wall. Sharp's vision of wall TV differs in that a projection module within the room throws the image onto your wall.

Such front-projection systems aren't new, but SharpVision is unique. Others enclose an array of tubes and lenses in either a floor-standing or ceiling-mounted cabinet, and project the image onto a concave screen supported by a frame. Projector and screen must be placed at an exact and fixed distance, for correct focus and convergence.

The SharpVision TV is different in that it looks and operates more like a movie or slide projector. Because it uses flat LCD (liquid crystal display) panels instead of conventional tubes, the projector itself weighs just 30 pounds and measures only about 21 in. long x 10 in. wide and high. Distance from the projector to the viewing surface is not critical because focus is achieved by turning a single lens. This is a zoom lens, so image size can be adjusted anywhere between 20 and 100 in. diagonally. Although Sharp does offer reflective screens that roll up and down by remote control, no special screen is necessary—a bright-white wall will suffice.

All this technology doesn't come cheap. The portable SharpVision XV-100 costs \$3995. Model XV-101T, a ceiling-mount version measuring 7 in. high by about 17 in. square, costs \$4695. Neither model includes a TV tuner or any amplification for the audio—these are projectors, and projectors only. So, like the Mitsubishi system, you'll need video source units and audio amps and speakers to complete your home theater. Better start saving now for next year's Super Bowl. Just think how big that defensive lineman will look when he comes blitzing through your wall, and remember you can make him disappear at the touch of a button. **PM**

## Stacked Television

● You've seen it at department stores, museums, maybe even a disco or a business convention. It's a solid wall of TV sets, maybe 16 or 64 of them, closely stacked in a rectangle. But instead of showing multiple displays of the same image, the electronic wall flickers with a single moving image measuring 9 or 18 ft. diagonally. Except for the telltale lattice pattern formed by the borders of the stacked sets, you might think glassblowing has advanced to the stage where TV tubes are produced in a bell foundry.

Odds are the mammoth display is the handiwork of a company such as New York City's Imtech. The sleight of hand required to distribute a single TV image over multiple video monitors—each one displaying its segment with perfect resolution and without a blown-up, washed-out look—resides in the company's digital processor.

As explained by Imtech, the processor has a memory board for each television in the array. Because a moving TV picture is made up of interlaced scanning lines that update the image 30 times per second, memory and superfast processing are needed to keep the many monitors in sync. That's the

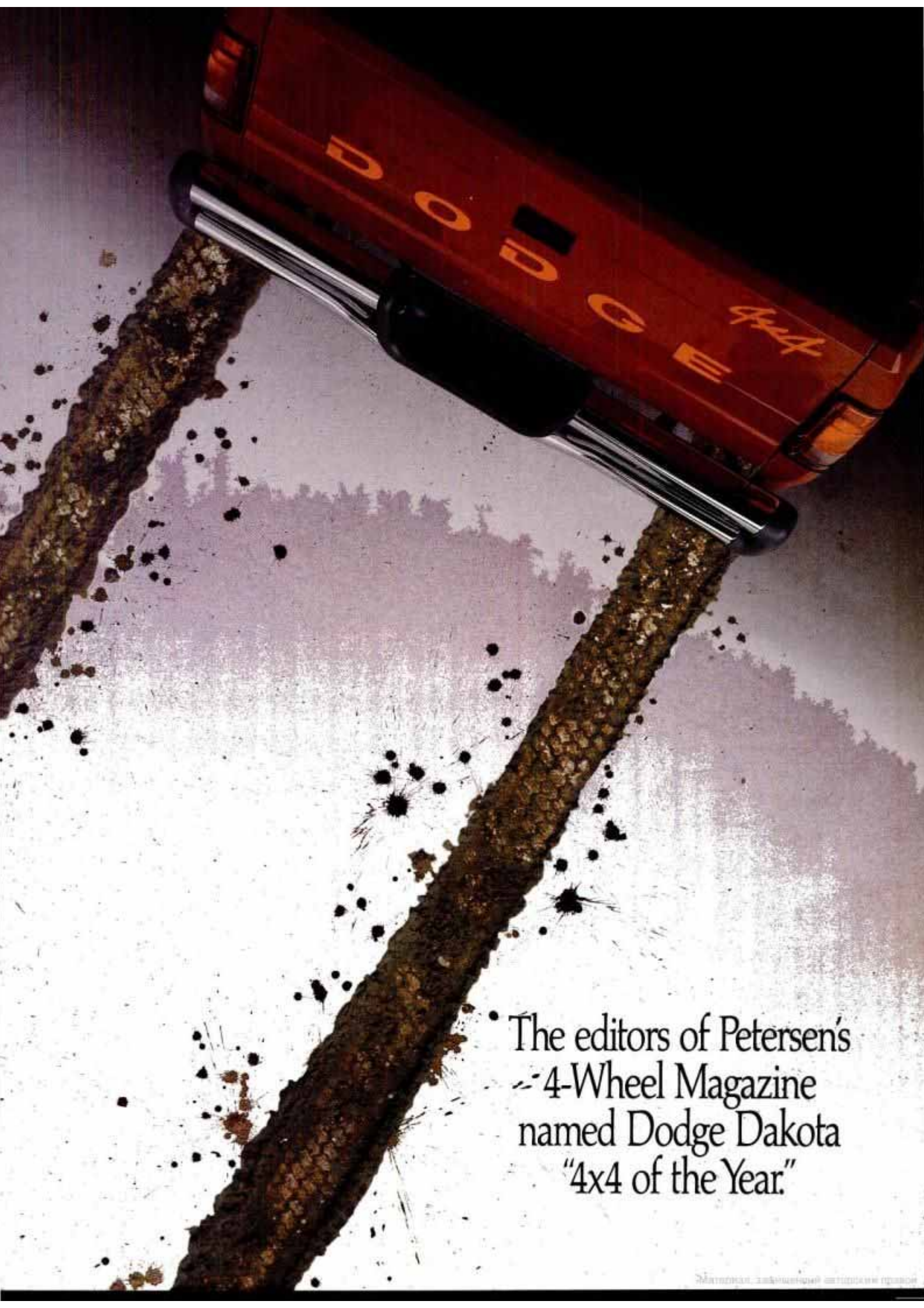


One image spreads across nine TVs.

easy part—it's electronic. Balancing the color, contrast and brightness among four to 64 different sets is strictly manual labor.

"We can assemble a four-by-four array in an hour," says Katy Murphy, Imtech's Northeast regional sales manager. "It might take another 4 to 5 hours to adjust all 16 sets."

Typically, Imtech's video walls are made up of stackable 27-in. monitors from Sony, Barco, Dotronics or Italy's Hantarex. The going price of a 16-piece, 6 x 8-ft. wall is \$50,000, but you can get the increasingly popular 9-set array for just \$30,000. —S.A.B.



The editors of Petersen's  
4-Wheel Magazine  
named Dodge Dakota  
"4x4 of the Year."

# It's the least after dragging it

## Dodge Dakota V-8

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



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

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

### A four day four-wheel drive torture test.

The road to victory took Dakota over 575 miles of

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

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

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



Dodge Dakota 4x4 V-8



# they could do through the mud.

## named "4x4 of the Year."

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



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

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

---

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

---

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

---

Welcome home to Dodge.

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

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# SOVIET SUPER FIGHTERS

We 'road test' the Soviet Union's two hottest jets, the Su-27 and MiG-29, to see how they stack up against America's best.



BY DAVID M. NORTH

● It is a breakthrough for glasnost. Decades of suspicion and secrecy are giving way to a time when front-line Soviet fighters are on

view at airshows around the world. In addition to just looking, a few carefully chosen Westerners have been granted the privilege of flying them. I was the first American to pilot the Sukhoi Su-27 air superiority fighter and one of the first to fly the Mikoyan MiG-29 counter air fighter. The result was a fascinating peek at what the competition was up to throughout the long, dark years of the Cold War, and a new respect for their abilities.

#### **Dateline: Kubinka**

My first flight aboard a Russian fighter occurred early last year, when I was invited to

*David M. North is managing editor of Aviation Week & Space Technology.*

Swift and strong, the Su-27 has no trouble climbing vertically, thanks to high-thrust Lyulka turbofans.

# ★ SOVIET SUPER FIGHTERS



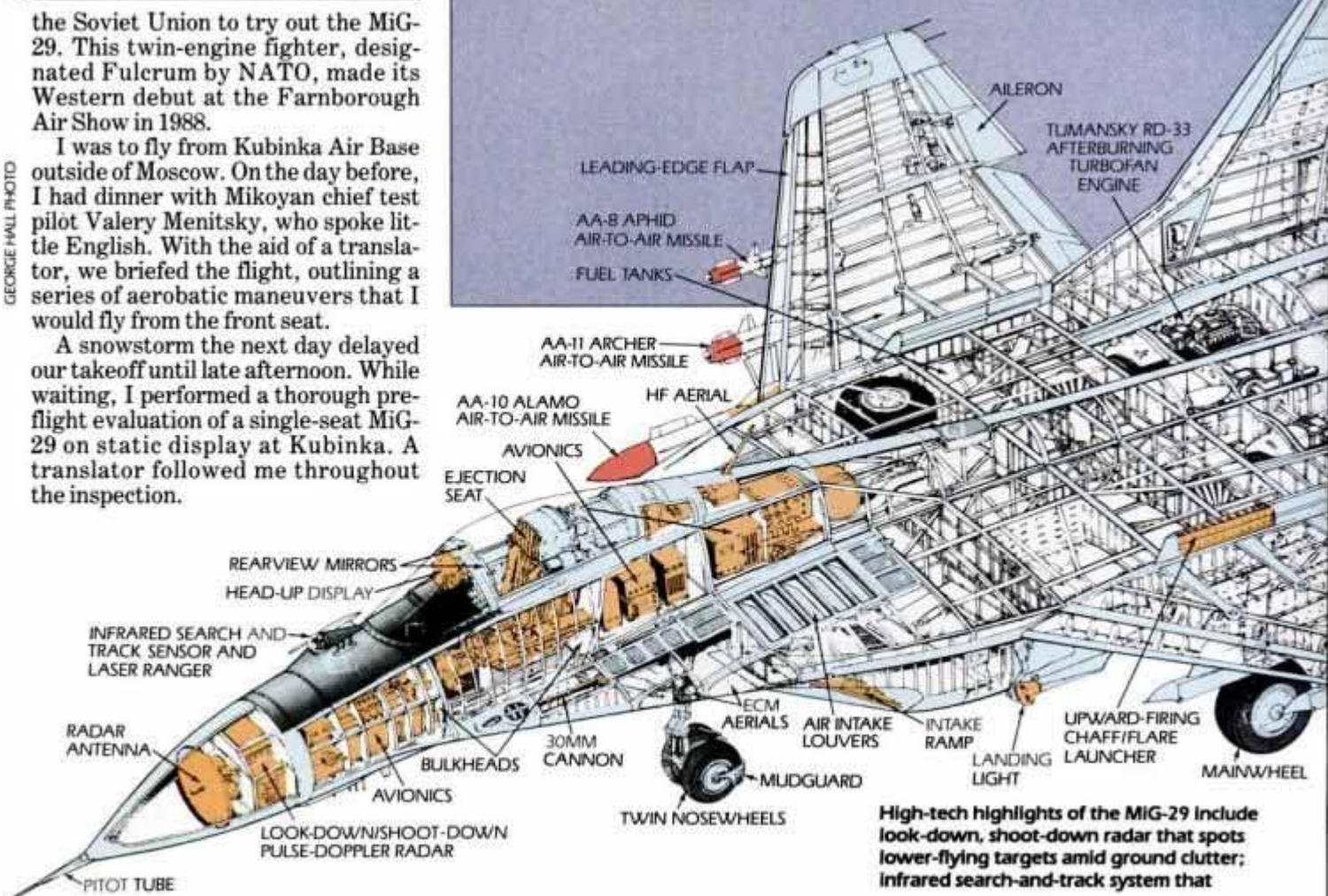
FRED SLUTTER PHOTOS

the Soviet Union to try out the MiG-29. This twin-engine fighter, designated Fulcrum by NATO, made its Western debut at the Farnborough Air Show in 1988.

I was to fly from Kubinka Air Base outside of Moscow. On the day before, I had dinner with Mikoyan chief test pilot Valery Menitsky, who spoke little English. With the aid of a translator, we briefed the flight, outlining a series of aerobatic maneuvers that I would fly from the front seat.

A snowstorm the next day delayed our takeoff until late afternoon. While waiting, I performed a thorough pre-flight evaluation of a single-seat MiG-29 on static display at Kubinka. A translator followed me throughout the inspection.

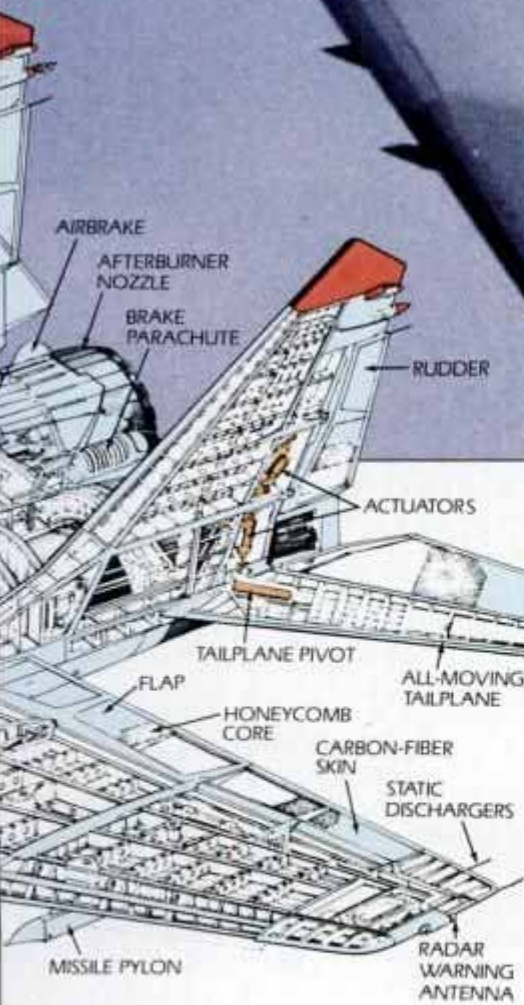
GEORGE HALL PHOTO



## MIG-29

36,600 pounds of thrust provided by twin Tumansky engines lets the MiG-29 fly straight skyward (above left), while superb aerodynamics permit high-G maneuvers. Cockpit instruments (left) are surprisingly primitive, consisting entirely of round dial gauges.

High-tech highlights of the MiG-29 include look-down, shoot-down radar that spots lower-flying targets amid ground clutter; infrared search-and-track system that



### Simple but effective

Current-generation Soviet fighters represent a great stride forward in the use of new technology, particularly look-down, shoot-down radars, infrared search-and-track systems, and improved turbine engines.

At the same time, the planes represent the Soviet design philosophy of building simple and reliable aircraft. Inspecting the outside of the MiG-29 revealed large, welded-steel structures in the airframe. The Soviets use spot-welds without worrying about the pattern. In noncritical areas, such as access panels and landing gear doors, the fasteners were not always flush, and the rivet alignments seemed unimportant.

Such indifference to detail contrasts sharply with the smooth surfaces of the McDonnell Douglas F/A-

18 or the General Dynamics F-16. However, the critical components of both Soviet fighters appeared over-designed, so that close tolerances in manufacturing did not matter.

### Rough and ready

Some accuse the Soviets of stressing quantity over quality, but they fail to consider the design philosophy behind planes such as the MiG-29 and Su-27. These fighters are designed for short-term combat reliability, rather than the Western goal of long-term durability in peacetime. Also, they are designed to be widely dispersed and rapidly employed, not tied to a fixed base. For example, both fighters have mechanisms built into their air intakes to keep them from ingesting debris from unpaved runways.

Cockpit instrumentation is one area where the Su-27 and MiG-29

enables pilot to see without being seen, and above-wing intake louvers that feed air to engines when main intakes close to protect against foreign object damage.

# ★ SOVIET SUPER FIGHTERS



KATSUHIKO TOKUNAGA PHOTO



ROBIN ADIS-HEAD PHOTO



## Su-27

With a rip-snorting 55,000 pounds of thrust on tap, the Su-27 hustles through the sky at up to 1550 mph. High angle of attack maneuvers (left) send vapor billowing over the wings. Cockpit (below left) is nearly identical to MiG-29.

## THE COBRA MANEUVER

Cobra maneuver wows crowds, but also shows the Su-27's deadly aim.



PM ILLUSTRATION BY FRED WOLFF

seem relatively primitive. Both bear similarities to the early Grumman F-14s and McDonnell Douglas F-15s built in the 1970s. Round dial instruments have not yet been replaced by multifunction video displays, and the level of cockpit system integration is well below that found in the F/A-18 or in later versions of the F-16, F-15 and F-14.

It would be misleading to say that this results solely from the Soviets' belief that under combat conditions only simple solutions lead to victory. The Soviets simply do not have the computer technology required for cockpit displays or system integration on par with the latest Western aircraft. This may change in the near future, however. The Mikoyan bureau is flying a MiG-29 with digital flight controls, and both Sukhoi and Mikoyan have fighters flying with multifunction displays installed.

Both Soviet aircraft employ an infrared search-and-track system that the United States is just now perfecting. Unlike radar, infrared sensors emit no radiation, so they can be used



ROBIN ADIS-HEAD PHOTO

Viktor Pougachev gestures to explain the Cobra to author (in cockpit). Russian pilots displayed exceptional skills.

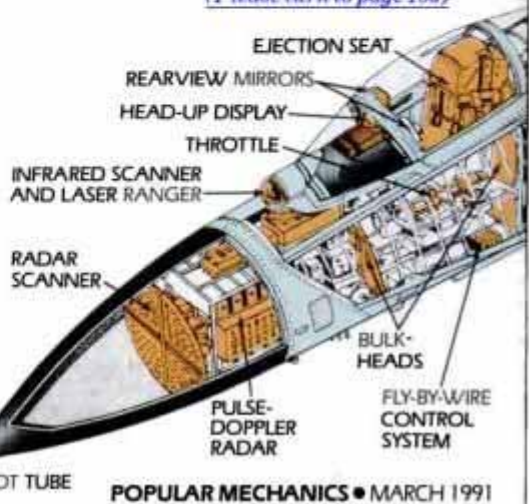
to lock onto a target and launch weapons, without tripping warning receivers aboard the target craft. The F-14D, the first American aircraft with this ability built-in, will not be incorporated into the fleet for another two years.

## Flight of the Fulcrum

Following my preflight check and cockpit checkout in the static display MiG-29, the weather cleared enough for Menitsky to fly the 2-seat MiG-29UB into Kubinka from the still-secret Soviet Zhukovsky flight-test station.

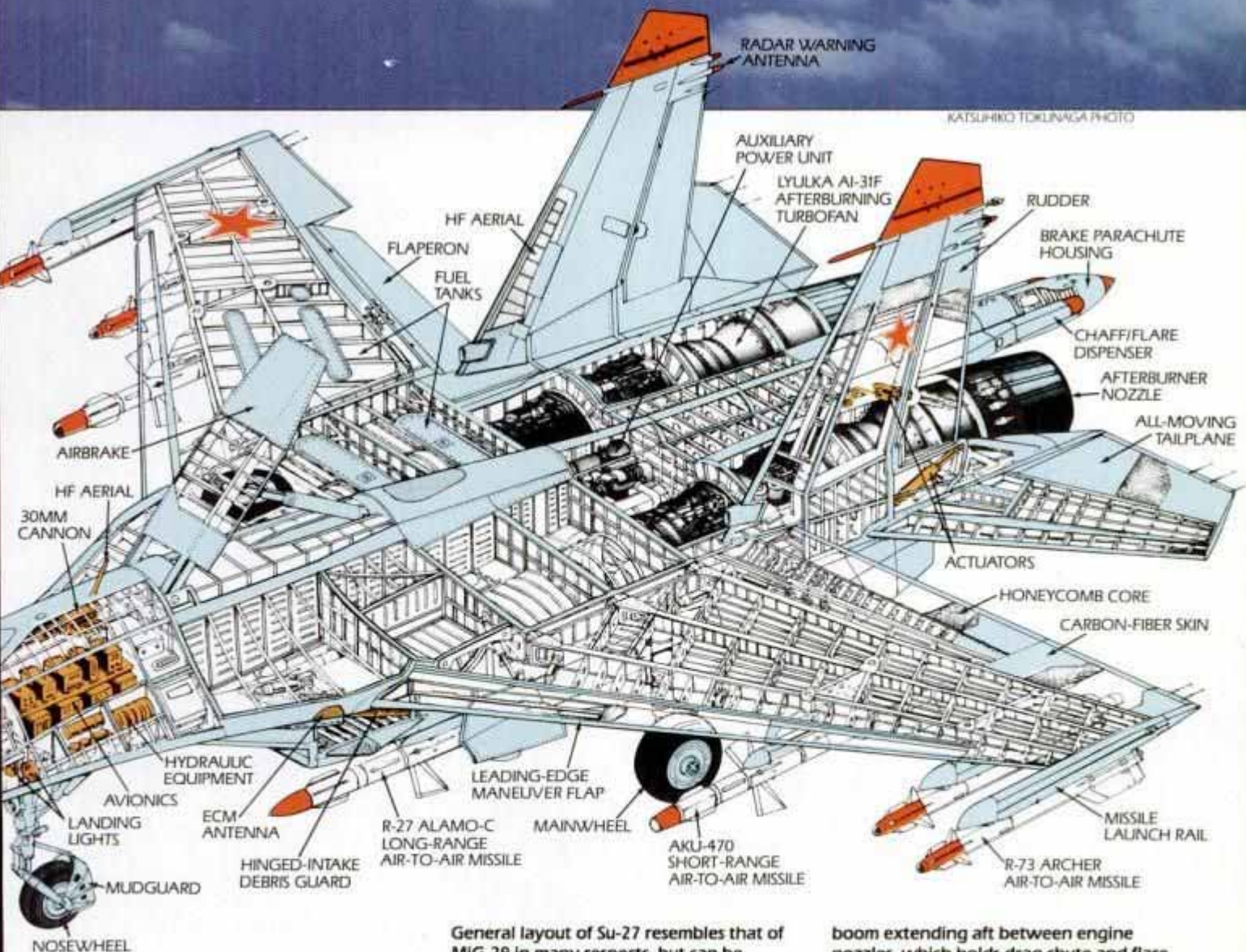
Because it was now late in the day, and the weather was still overcast, it was decided that I would fly from the back seat. I was fitted with Soviet flight gear. The Soviets use a bib-type flight suit with a separate jacket. The G-suit is similar to U.S. designs, but is worn under the flight suit. All in all, the flight gear and Soviet-style helmet fit very well.

Visibility from the front seat of the MiG-29 is excellent, but from the back *(Please turn to page 103)*





KATSUHIKO TOKINAGA PHOTO



General layout of Su-27 resembles that of MIG-29 in many respects, but can be recognized by center-mounted IR sensor, large speed brake behind cockpit, and

boom extending aft between engine nozzles, which holds drag chute and flare dispenser. Large internal fuel storage areas provide 2500-mile range.

PILOT PRESS ILLUSTRATION

# LONG-TERM TEST CARS

One newcomer and one regretful farewell.

● It's been four months since our last report on PM's long-term test fleet, and, as elsewhere in life, there have been changes. Our Eagle Talon TSi and Cadillac Seville STS have departed, and we've added a new Ford Escort GT.

## Ford Escort GT

The all-new for '91 Ford Escort is a car worth getting excited about, though we must say our first few days of driving provided little clue to this.

The platform is the result of a team effort between Ford and Mazda, who have now partnered several products. It's a front-wheel-drive package that comes in three levels of trim, in three different body styles, with two engine and transmission options.

The standard engine is Ford's 1.9-liter sohc Four with sequential multiport fuel injection rated at 88 hp. The GT model is equipped with Mazda's hot-rod 1.8-liter twin-cam 16-valve EFI unit that produces 127 hp.

Naturally, we chose the sporty GT model. The basic GT has a suggested retail price of \$11,063. Our tester was enhanced by a Special Value Option Package that includes rear-window defroster, luxury convenience group (cruise control, power mirrors, map lights) and air conditioner for an additional \$1240. Add \$138 for the premium sound system, and the price tag came to \$12,441.

We took delivery with just 34 miles on the clock, and our initial impression was that the car wasn't very quick. However, its handling was out-

standing—very balanced, very sure-footed and a pleasure to drive quickly in the twisty stuff. Besides the engine's lackluster performance, the transmission—notchy shifting—was our only complaint.

But that was 4500 miles ago, and a lot has changed.

In that short time, the engine has come to life and the shift lever has become light and accurate.

To date, our fuel economy average, accumulated mostly on California freeways, is an impressive 32.1 mpg. Our initial testing recorded 0-60 times of 8.5 seconds and quarter-miles of 16.7 seconds at 83 mph.

We're confident that these figures are already improving, and our affection for the Escort is growing apace. It's a car that, to date, is short on hype, long on value. —Rick Titus

## Chevrolet Caprice Classic

If you like big, comfortable cars, there's a good chance you could love this one. They don't come much bigger or more comfortable these days.

The Caprice's virtues are especially evident on longer trips. The spacious interior has enough leg, elbow, shoulder and every other kind of room to make 900-mile trips a breeze, even for linebacker-sized adults.

About the only complaint we've recorded concerning the interior is the upholstery. Our test car has the standard cloth—drab gray and not very appealing. We wish we'd ordered the leather upholstery option.



Still, the Caprice has a number of nice features. We've been getting a real kick out of the electronic compass display in the rearview mirror, and small-object storage is abundant. A real convenience is the coin/cupholder located above the ashtray.

Another plus is the enormous trunk. It swallowed six huge suitcases brought in by visiting in-laws. When it came time for the holiday feast, 10 grocery bags were also an easy fit.

The best feature of all, though, is the keyless-entry system. You can lock or unlock the doors and trunk from up to 30 ft. away.

One negative: the horn. It's loud enough, if you can get it to blow when you need it. Because of the airbag, the horn buttons are inconveniently situated on either side of the bottom of the steering wheel.

Out on the road, we like the solid, stable feel of the Caprice and the



CHEVROLET CAPRICE CLASSIC





FORD ESCORT GT

smooth power of the small-block 305 V8. Also, the antilock braking system has saved us more than once.

So far, we've put 11,100 miles on the big Chevy and, aside from reservations about the styling, we like it a lot. Fuel economy continues to be acceptable for a big car—just over 17 mpg around New York, over 23 on the open road—and there's still not a squeak or rattle. —Deborah Frank

### Honda Accord EX

Our Accord has traveled almost 12,000 miles, much of it in Jersey-Manhattan commuting. That's a bad environment for both car and driver, with heavy-duty stop-and-go and heavy-duty attitudes to go with it.

But through it all, we've managed to stay unscathed and sane, thanks to the Honda's good road manners.

An automatic transmission is required equipment for keeping a lid on your sanity in this kind of driving. We

have to say that Honda's electronically controlled 4-speed gets a C-plus here—kickdowns are abrupt, and seem to be long in coming.

Fortunately, once the 16-valve engine gets into its powerband, there's plenty of acceleration.

But there's also a fair amount of

noise to go with the power. In spite of its predictable handling and excellent brakes, the Accord is not a car that likes to be pushed.

On the other hand, it's thoroughly pleasant at normal speeds or on the interstate. The interior is plain, functional and clean. The instrument



HONDA ACCORD EX

## LONG-TERM TEST CARS

panel is well laid out and tasteful. It's roomy, too—there's even space for skis (or an assembled PM fifth wheel) when you fold down the rear seats.

It's also fairly frugal—26.6 mpg overall—and solidly reliable.

There are a few complaints. The automatic antenna makes a ratcheting noise when it tops or bottoms out. And the shifter stops at Drive, not Overdrive, en route from Neutral.

The only outright problem, though, is a passive restraint motor that occasionally stalls as it tries to unwind seatbelt from shoulder.

Our opinion continues to be that this is not a car that inspires passions. However, it is certainly dependable, civilized transportation, devoid of bad habits. While that may not kindle passion, it does generate loyalty—far more important when it comes to repeat buyers. —Mike Allen

### Chevrolet Blazer S-10

Since our last report, we've accumulated 8000 hard miles on our Blazer S-10. It's hauled everything from plants to people.

We've worked this vehicle hard at every opportunity, blasting down unpaved roads, overloading it with old lumber, even pulling trailers way over its rated towing capacity. With the exception of some squeaks and rattles, the Blazer has taken everything we've dished out with no signs of wear and tear.

As the Blazer puts on miles, both performance and fuel mileage continue to improve. We're averaging about 22 mpg overall, remarkable in light of the tough driving we've been doing. Except for being noisy under full-throttle acceleration, the 4.3-liter V6



is a responsive and willing performer—except for towing.

Our only other initial complaint about the Blazer was its climate control system, which seemed inadequate. However, that problem has miraculously cured itself. So right now, we have generally good marks for our Blazer S-10. Just don't try to tow the QE2 with it. —Joe Oldham

### Pontiac Trans Sport SE

At this writing, the odometer is nudging the 9500-mile mark, which provides a big clue to the Trans Sport's status with us. Although it lacks power, the Trans Sport's combination of long-haul comfort and adaptability have made it a staff favorite.

Our Trans Sport has been to more New England antique sales than most vehicles see in a decade. It's seen vacation service at Cape Cod, and it even served as a mini motorhome during a 24-hour race. Don't know where I'd have slept without it.

Through all this, the van has performed without a hiccup. Fuel economy varies from 22.6 mpg on the open

road to a so-so 17.8 in the urbs. But the tepid 3.1-liter V6 is smooth and manages to keep up with traffic.

There are a couple of minor problems to report. Tops on this short list is some chassis squeaks that have showed up in the last thousand miles or so. We also have an ultra-slow leak in the left rear tire, and conclude that the cast-aluminum wheel is the culprit.

Finally, the front-seat heater fan packed up a couple days ago. We're glad there's a second fan for the rear of the vehicle, but whether this will be enough to produce real comfort in truly cold weather remains to be seen.

We also wish there was a handle on the rear hatch, which requires pressure through its last few degrees of travel to ensure a tight closure. This means putting your palm flat against the hatch to smack it home—okay if the exterior is clean, messy otherwise.

Still, the Trans Sport's virtues far outweigh these few shortfalls. The removability of the seating continues to surpass anything in the industry, making this mini one of the handiest of its breed. —Tony Swan

### Cadillac Seville STS

At a bit over 9000 miles, our test of the Seville STS was abruptly cut short by a truck that insisted on occupying the same bit of New York City street as our test car. The front end didn't fare too well—one fender resembled a hastily folded road map.

We brought the car to a local dealer for repair and, sad to say, the dealer was not up to the quality levels of the rest of the Cadillac organization. After several tries and several months, our Caddy still wasn't right.

We felt it would be unfair to continue to judge the car in that condition and, instead, decided to terminate the test. Too bad. The 9000 miles we put on this car were enjoyable indeed.

—Joe Oldham



# JOURNAL



## TOOLS

# BASIC MASONRY TOOLKIT

TEXT AND PHOTOS BY  
MERLE HENKENIUS

● Of the many jobs that homeowners are likely to take on themselves, concrete and masonry improvements are among the most frequently avoided. To most of us, these jobs seem just too heavy and unforgiving to tackle alone. And the skills required to get the work done right the first time are often specialized and unfamiliar.

While these reservations may be justified on large projects, most smaller concrete and masonry chores are within just about everyone's reach. With some preparation and the right equipment, jobs like repairing loose brickwork, pouring a walkway slab and even building a concrete-block wall are well within the range of the average do-it-yourselfer's abilities. And, starting off with the right tools can make all the difference between a job well done and a call to a pro to make things right.

The 17 tools featured here will help you handle any masonry or concrete project—large or small. Our collection is made up of professional-grade tools. While the complete toolkit isn't cheap (ours totaled about \$225), buying better quality tools is generally an economical move if you expect to use

them often. With the exception of the trowels, however, you could substitute less expensive equipment. Cheap trowels, by contrast, will leave their signatures on every job. A few years from now, you'll have forgotten the extra dollars paid for a better tool, but the results of an unsatisfactory, inexpensive tool will be around for some time.

Along with describing each tool shown, we offer some basic information on how and when the tools are used. Most of the tools are designed either for concrete work—slabs, walks and driveways—or masonry projects—laying brick or concrete block, or repairing mortar joints. Depending on the kind of projects you're going to handle, you may need all of the tools or you may get by with a selection that suits the job at hand.

**Mortar mixing tub**—When mixing small quantities of mortar or cement with a garden hoe or shovel, a plastic mortar box is a handy piece of equipment. Made of tough, flexible ABS plastic, these seamless tubs are easy to clean—even when the mortar has been allowed to set for too long. The usual size will handle roughly 2-cu.-ft. batches at a time (two bags of pre-mixed concrete).

Larger projects, of course, require a rotating-drum-type mixer or curb-side truck delivery. Electric- or gas-powered rotating-drum mixers can be rented when they're required.

**Concrete finishing float**—When constructing concrete slabs, the concrete is first poured into wooden forms, and then screeded (trimmed level to the top of the form with a 2 × 4 or 2 × 6 board). The next step, after the water settles, is to float the surface with a magnesium or wood hand float. Sweeping the float across the surface will smooth and compact the concrete. It will also draw cement up to the surface for a harder finish. A floated slab of concrete should have an even, but gritty appearance.

When floating, start with a small area. If the surface puddles and appears too smooth, you've started too soon—wait for the slab to dry slightly before trying again. Floating too early will cause crazing or dusting at the surface. Crazing is a condition where the surface develops tiny hairline cracks. Dusting is evidenced by a chalky appearance on the cured surface. Both of these conditions are avoidable if you float the slab at the correct time.

**Edger and groover**—After floating and before the final troweling, edgers and groovers are used to trim the slab perimeter and form control joints. When the concrete begins to set, run an edger around the slab using the inside of the form as a guide. Ideally, the edger should round and compact the slab's edge without puddling or lining the concrete. If the concrete appears too wet, wait awhile and then try again.

Cutting control joints with a groover should be done at about the same point in the process. Keep in mind that control joints are not merely decorative. By cutting a groove across a slab of concrete, the slab is deliberately weakened along that line. Stresses that might ordinarily create a crack along the slab surface will, instead, cause the slab to crack precisely and invisibly in the groove.

It's best to use a deep-blade groov-



**1** After screeding the concrete level with the form, use a hand float to smooth the slab and pull cement to the surface.



**2** When the surface has been floated, compact and round the slab perimeter with an edger. Follow the inside of the form.



**3** Use a groover to cut control joints in sidewalks, drives and outdoor slabs. It should penetrate one-quarter of thickness.



**4** Finish by sweeping a trowel in half circles across slab. Hold the trowel nearly level and use two passes for a smooth surface.

er to make control joints. If you have a shallow groover, use a trowel to cut the groove deeper. A control cut should penetrate one-quarter of the slab thickness. Control joints should be cut about every 40 in. in sidewalks and every 10 ft. in driveways.

**Concrete finishing trowel**—After the edges are trimmed, control joints are added and the concrete begins to set, the surface should be troweled with a good, long finishing trowel. Extra-smooth surfaces require two trowelings, while coarse surfaces may be troweled once and then broomed (drawing a broom across the surface to create a uniform texture). The trowel should glide over the surface in crescent-shaped sweeps and be held in a nearly flat position. As with floating, try a small area first. If you see water puddling behind the trowel, or the trowel leaves distinct edge lines or chatter marks (tiny ripples), then wait a bit longer.

Troweling at the right time is critical, so test the surface often. Ideally, the trowel will smooth the floated sur-

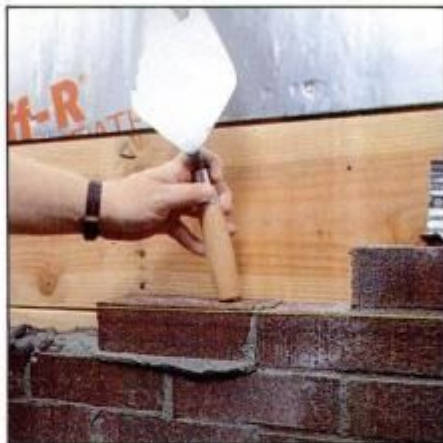
face with two or three passes under medium pressure. Keep in mind that when troweling a large slab, you'll have to average out the entire job around the ideal troweling time. In other words, if it takes 30 minutes to trowel the slab, start when the surface is on the wet side of ideal. Otherwise, the concrete will be too dry to trowel properly when you reach the end of the job.

Avoid adding extra water to the mix in anticipation of the concrete setting before you've finished troweling. Although it may seem like this will provide added time to work, a wetter mix is always weaker than a dryer pour. Instead, you can extend the slab's setting time by wetting the soil bed before pouring the concrete.

If you're going to pour from a truck delivery, it's a good idea to have the driver come prepared with a small bottle of superplasticizer. When added to the mix before pouring, this additive will cause the concrete to work and feel wetter for about an hour, without actually being wetter.



**5** Use mason's trowel to first spread mortar along preceding course. Then butter end of the next brick and set in place.



**6** With the new brick in place, tap it down with the trowel handle and slice away the excess mortar with the trowel edge.



**7** Once the mortar in the joint begins to set, strike each joint with a jointer to form a smooth, compressed seam.



**8** To cut a concrete block, tap the chisel lightly in a line completely around the block until the two halves fall apart.

**Masonry trowel**—The masonry trowel is the workhorse of the mason's trade. With it, you'll butter the ends of bricks and blocks, tap them into place, and even break bricks in two (by striking the brick several times with the trowel edge). For these reasons, a bargain-basement trowel just isn't good enough.

Masonry trowels are available in different sizes. Use a small one for brickwork and a large one for concrete block. If you're only going to buy one, an 8- to 10-in. model is a reasonable compromise. This size may feel a little hefty for smaller jobs, but it will stand the test of time.

**Jointer**—A jointer is a narrow tool designed to fit between blocks or bricks for smoothing and sealing the mortar joints. It's used after the mortar has begun to set, and the most common type leaves a recessed, concave mortar line. Other styles are available for forming V joints or weather joints where the mortar is flush with the lower course, but angled back so it's recessed under the upper course.

The mortar joint in brickwork is often finished with a related tool called a rake. Performing the same job as a jointer, this tool has two wheels and a protruding blade. When run along the joint, the blade trims the mortar to a uniform depth.

**Masonry levels**—Because a perfectly level and plumb wall is the ultimate goal, you'll need to own a level—and use it often. A short torpedo level is useful for leveling individual bricks or blocks, while a 4- to 6-ft. level will keep the wall plumb and true. You won't need to check every block, or even every course of blocks, but you should check regularly to catch any accumulating error in level or plumb.

**Mason's rule**—The mason's rule is a folding ruler that has a variety of spacing marks on its side. These are designed to help determine the number of courses in a wall and the mortar width. When bricking a wall that extends from a foundation to a soffit, for example, the first thing to determine is how many courses of brick will be needed to fill the space. You'll also

need to know about any adjustment in mortar thickness so that the last course ends at the correct height. The spacing indicators printed on a mason's rule make these calculations quick and easy. However, you can do the job with an ordinary tape measure, pencil and note pad.

**Brick line**—The best way to keep each and every course from pitching up or down is to stretch a taut string horizontally along the wall. This string, or brick line, is tied at each end to story poles, usually made on site from 2 × 4s. Each story pole has a mark every 8 in. so that a level line can be stretched across the wall at 1-block intervals.

**Mason's hammer and chisels**—A mason's hammer serves two purposes. It can be used conventionally to drive chisels and nails, or it can be turned over and used as a chisel to break blocks and bricks. However, the break that a hammer makes is fairly crude. To produce a more exact cut, a chisel is used. You'll find a variety of chisels available on the market from 4-in. cold chisels to tooth-edged mortar chisels.

When cutting blocks or bricks, use a cold chisel with a 3- or 4-in.-long edge. However, don't try to do the job in one stroke. Instead, tap lightly in a line all around the block until it breaks evenly. The aim is to create a series of stress cracks that follow the line made by the chisel.

Tooth-edged chisels are used to remove old mortar and clean mortar joints in preparation for tuckpointing.

**Tuckpoint trowel**—Tuckpointing is a method of packing mortar neatly between bricks or building stones. The method is frequently used to restore old masonry walls whose mortar is soft and crumbling.

In a typical situation, the joints are first cut deeper and cleaned with a tooth-edged chisel. Mortar is then placed on a mason's trowel, and the trowel is held against the brick next to the cleaned joint. The tuckpoint trowel is then used to slice off small amounts of mortar and squeeze it into the gap between the bricks or stones.

**Cleanup brushes**—If you do much concrete or masonry work, you'll need at least two cleanup brushes. A soft-bristle acid brush and water will help rinse away mortar and concrete from tools and walls. If brick walls show too much mortar residue, they'll need to be brushed with muriatic acid or a special masonry detergent. Really stubborn bits of mortar and concrete can be brushed from tools and work with a wire-bristle brush. **FM**

OUTDOOR PROJECT

**A BETTER BIN**

Build our compost bin and turn over an old leaf.

TEXT & PHOTOS BY ROSARIO CAPOTOSTO, Contributing Editor

● In this day and age of bloated landfills and restricted curbside trash service, we're all being confronted with the high cost of dealing with waste. And while there are some things we'll always need taken away, leaves, grass clippings, table scraps and most other organic materials can easily stay at home. All we have to do to recycle this waste is be willing to start a compost pile.

Of course, backyard composting facilities often are unsightly arrangements best relegated to a hidden area of your yard. But not so with the version that's shown here, which we designed with help from the folks at the California Redwood Association. It's attractive enough to be prominently located anywhere on your property. And, it's dimensioned to process about 1/3 cubic yards of organic material in each bin, yielding an ample supply of compost for the average garden on a continuing schedule.

**Materials**

The bin is built of redwood—the ideal lumber because of its pleasing appearance and remarkable resistance to decay and insect infestation, particularly termites. Not all redwood will serve the purpose, however. Only the reddish-brown heartwood from the tree's core contains the substances that render it decay resistant. The creamy-colored sapwood that makes up the outer layer of the tree is not insect and decay resistant.

Therefore, try and get Construction Heart grade redwood. If this is unavailable or too expensive, the next best grade is Merchantable Heart grade. Both these grades are suitable for soil-contact applications. The former has knots of varying sizes and minor imperfections. The latter has larger knots, some splits and some manufacturing flaws. Also, request either grade as surfaced, not unsurfaced (rough sawn).

The bin features removable front slats for easy access to the compartments, which are lined on the sides, back and bottom with wire mesh (also known as hardware cloth). This keeps out animals while allowing air to circulate and water to drain. The mesh floor prevents ground-burrowing pests from getting in, but allows beneficial earthworms to migrate up into the pile. The plastic Filon panel lid is extremely durable, keeps the compost from getting soaked when it rains and tends to let through some solar energy—especially in cooler months—to keep the piles warm.

**Frame Construction**

The construction is relatively simple and can be accomplished with a circular saw, an electric drill and several hand tools.

Begin by cutting the 2 x 4s to length for each frame. The top of the frame is pitched down 2 in. across the bin's width. To achieve this pitch, crosscut the tops of the front and rear



frame members at a 3° bevel. Use a crosscutting guide to ensure accurate, smooth cuts (Photo 1).

Assemble the end and divider frames using two 16d common galvanized nails at each joint (Photo 2). Label each frame and position them bottom side up as they will be when assembled. Place the 2 x 6 base members on top of the frames using a scrap block to position them with a 1/4-in. overhang at the ends, front and back (Photo 3).

Hold the frame and base pieces in position with a clamp at each point where the frame and base pieces overlap. Bore the 1/2-in.-dia. holes for the



carriage bolts as indicated in the drawing (Photo 4). Temporarily insert the bolts, then rip and crosscut the bottom mesh nailers to size and attach them to the bottom frame members with 6d galvanized common nails (Photo 5).

### Attach Wire Mesh

Remove the frames from the base pieces to permit the nailing and stapling operations that follow. Start by fastening the nailer strip to the back of each 2 × 4 front vertical member (Photo 6).

Next, cut six pieces of wire mesh 33 in. long from a 36-in.-wide roll. Lay

the mesh across each frame, clamp a strip of wood across it and fold over the mesh so it conforms to the slope of the frame. Use a block of wood to distribute the pressure evenly across the mesh (Photo 7). Finish folding over the edge by placing the mesh on a flat surface and working over the fold with a block of wood and a hammer (Photo 8). This produces a neat exposed edge, free of sharp points that could easily injure even the most careful user.

Use 3/4-in. galvanized staples (also called poultry net nails) to attach the mesh, spacing them 4 in. apart. Attach the mesh to both sides of the di-

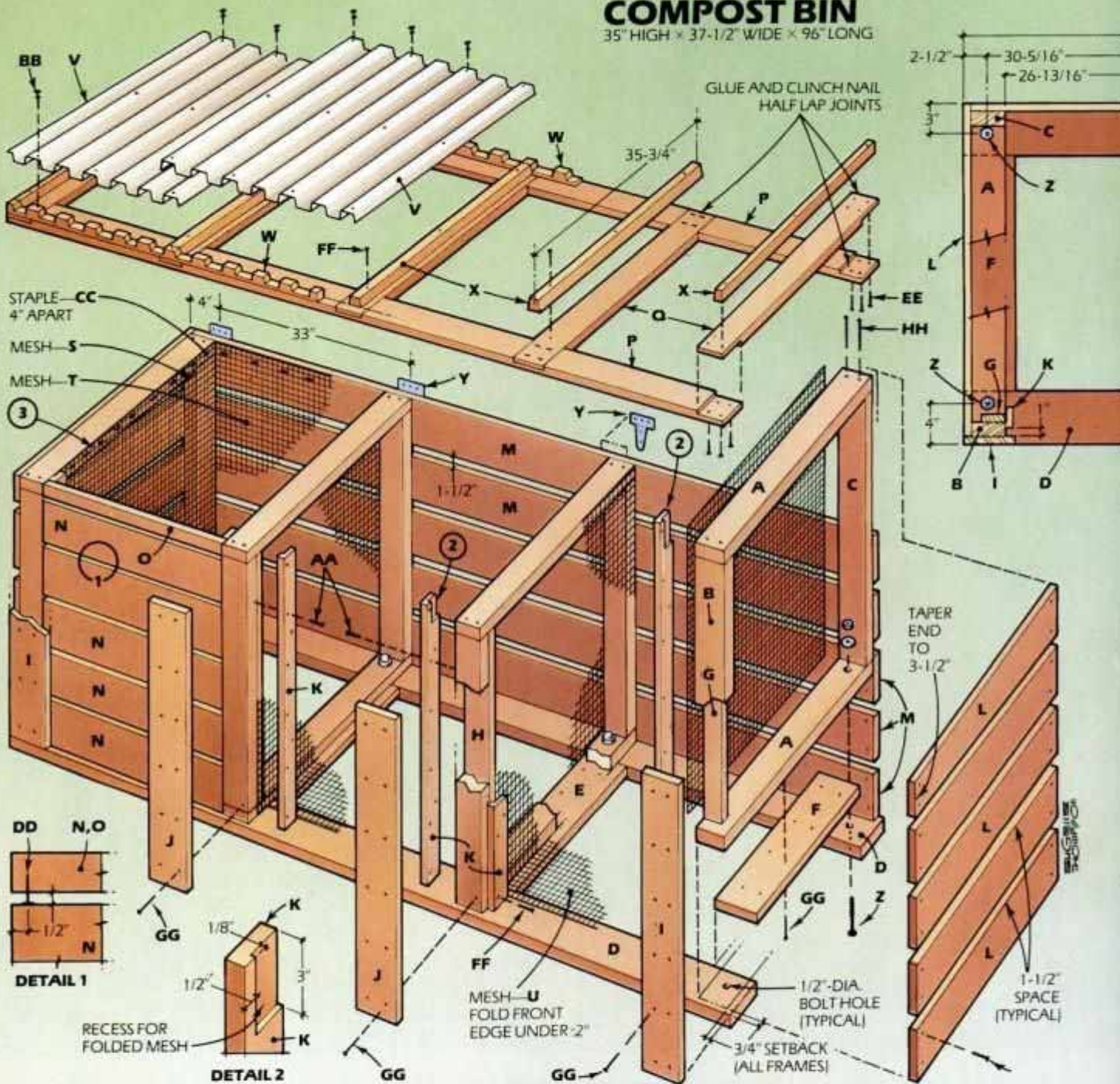
viders. Leave about 1 ft. unstapled at the bottom on one side of each divider frame, so later you can tighten the nut on each bolt that fastens the base pieces to the frames.

Rip and crosscut the rear and front runners to size. Chisel a slight recess at the top of the rear runners to allow them to fit tightly against the frame where the mesh is doubled over. Nail the rear runners on the end frames and on one side of each divider frame,

**Lumber:** California Redwood Association, 405 En-frente Dr., Suite 200, Novato, CA 94949  
**Compost bin design:** Kathleen Bond Bone  
**Technical art:** Eugene Thompson  
**Garden tools and cart:** Ames Lawri and Garden Tools, P.O. Box 1774, Parkersburg, WV 26102

COMPOST BIN

35" HIGH × 37-1/2" WIDE × 96" LONG



where the mesh has been fully attached (Photo 9). Attach the remaining two rear runners with drywall screws after the divider frames have been bolted to the baseboards.

**End Frames**

Bolt the end frames to the baseboards (Photo 10). Prop up the unattached mesh while you tighten the bolts that attach the divider frames to the baseboards (Photo 11). Tighten the nut so the square section of the carriage bolt bites firmly into the baseboards. After the frames are bolted in place, fold

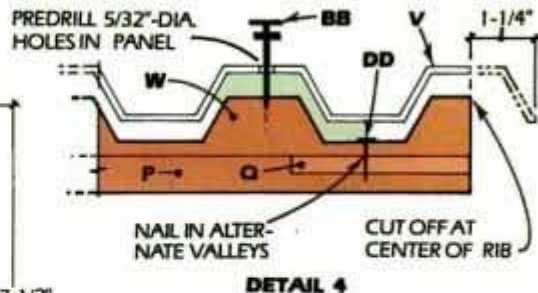
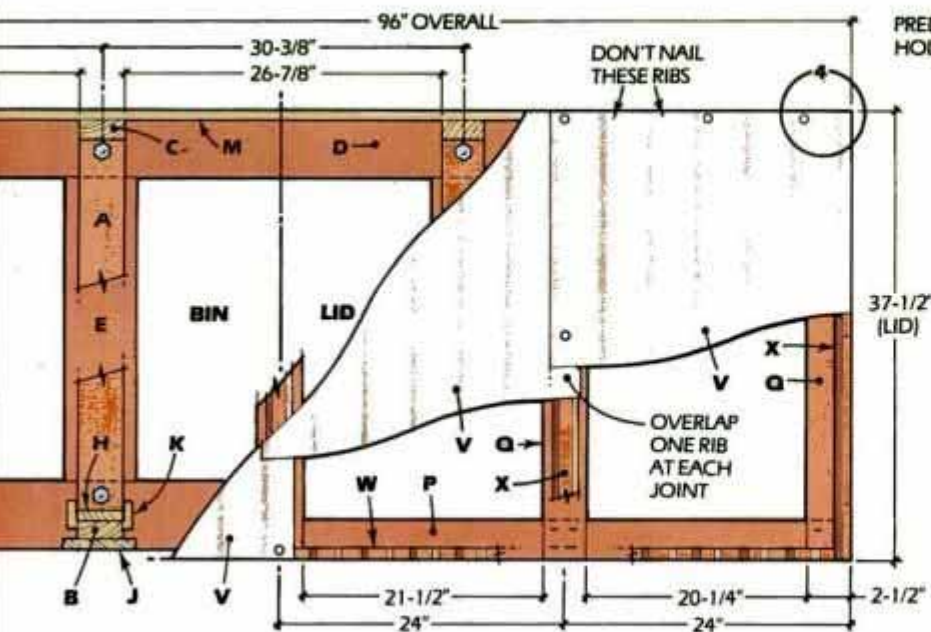


**1** For neat crosscuts, make a T-guide from scrap wood. Run saw's shoe against guide for straight and bevel cuts.



**2** Each frame section is made up of four pieces nailed together and marked with chalk to indicate placement.



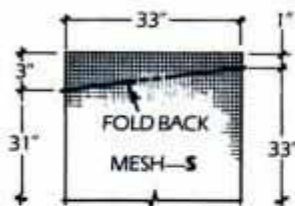
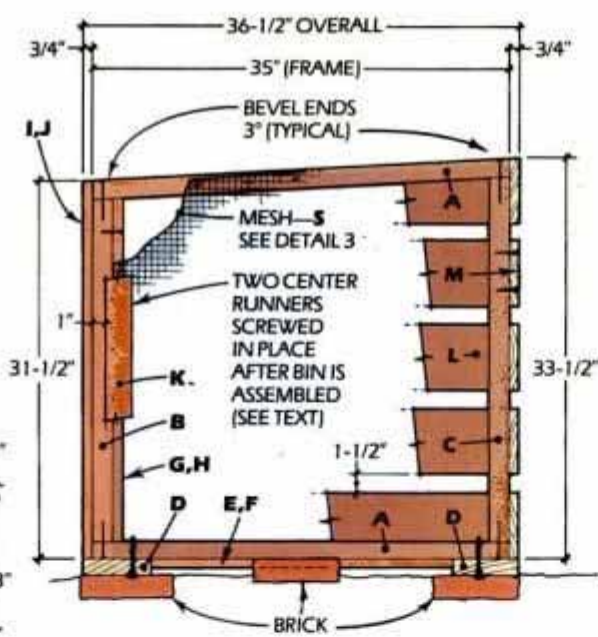
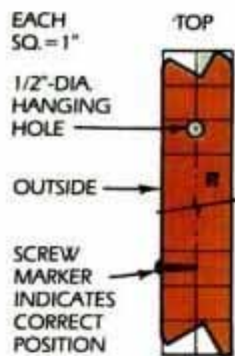


## MATERIALS LIST—COMPOST BIN

(All lumber Construction Heart grade redwood)

Key	No.	Size and description (use)
A	8	1 1/2 x 3 1/2 x 35" (frame)
B	4	1 1/2 x 3 1/2 x 28 1/2" (frame)
C	2	1 1/2 x 3 1/2 x 30 1/2" (frame)
D	2	1 1/2 x 5 1/2 x 96" (base frame)
E	2	1/4 x 5 1/2 x 25 1/2" (mesh nailer)
F	2	1/4 x 4 1/2 x 25 1/2" (mesh nailer)
G	2	1/4 x 2 x 28 1/2" (mesh nailer)
H	2	1/4 x 3 1/2 x 28 1/2" (mesh nailer)
I	2	1/4 x 5 1/2 x 31 1/2" (front runner)
J	2	1/4 x 5 1/2 x 31 1/2" (front runner)
K	6	1/4 x 2 x 31 1/2" (rear runner)
L	10	1/4 x 5 1/2 x 35 1/4" (side slat)
M	5	1/4 x 5 1/2 x 94 1/2" (back slat)
N	15	1/4 x 5 1/2 x 26 1/4" (front slat)
O	3	1/4 x 1 1/2 x 26 1/4" (front slat)
P	25	1/4 x 2 1/2 x 96" (lid frame)
Q	5	1/4 x 2 1/2 x 37 1/2" (lid frame)
R	2	1/4 x 2 x 35 1/2" (lid support)
S	6	33 x 34" wire mesh (divider)
T	3	26 1/2 x 32 1/2" wire mesh (back)
U	3	26 1/2 x 31" wire mesh (bottom)
V	2	26 1/4 x 96" corrugated panel cut to four 37 1/2" lengths (cover)
W	3	6-ft. pieces corrugated redwood molding
X	3	6-ft. lengths vertical redwood molding cut to 35 1/4"
Y	4	3" Tee Hinge, Stanley No. 75-4030
Z	8	1/2"-dia. x 3 1/2" carriage bolt, washer and nut, zinc plated
AA		1 1/2" galvanized drywall screws
BB		1 3/4" aluminum plastic panel nails
CC		3/4" galvanized staples
DD		1/4" nails
EE		3d galvanized common nails
FF		4d galvanized common nails
GG		6d galvanized common nails
HH		16d galvanized common nails

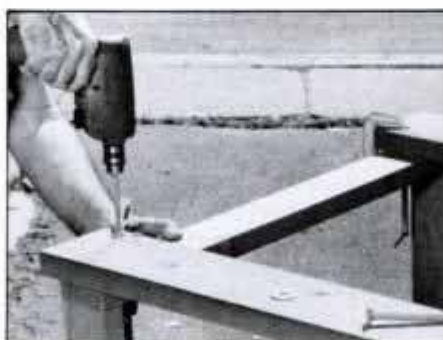
Misc: Plastic resin glue, eight bricks.



### CROSS SECTION



**3** With frame inverted, position the baseboards using a scrap block at edge of frame to gauge 1/4-in. overhang.



**4** Clamp the baseboards to the frames and bore the holes for the carriage bolts that attach the baseboards.



**5** With the frame inverted, attach the mesh nailers to the bottom of each frame using 6d galvanized common nails.

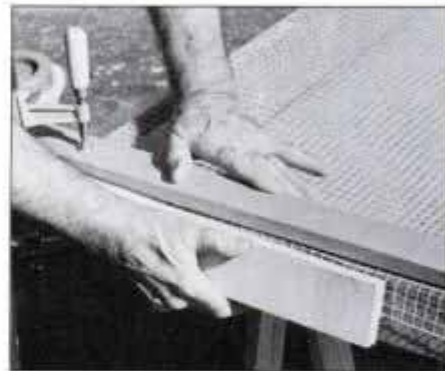
down the mesh on the remaining two divider frames and screw down the last two rear runners. This completes the bin subassembly (Photo 12).

Use the same galvanized drywall screws to attach the side and rear slats. Screws are used in lieu of nails because the free-standing frames tend to bounce if nailed. Use a pair of 1½-in.-wide blocks to gauge the spacing between the side and back slats as you screw them in place (Photo 13).

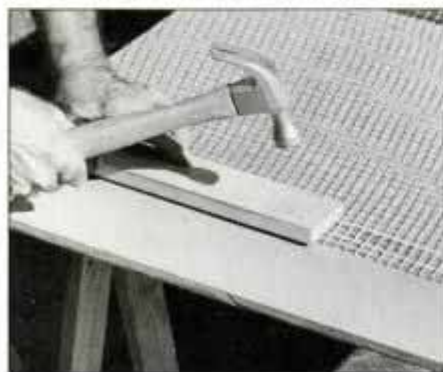
Attach the back mesh pieces after the rear slats are attached. The bottom mesh pieces go on last. Crosscut the drop-in front slats to size. The



**6** Remove baseboards from the frame and attach the front mesh nailers to each frame. Again, use galvanized nails.



**7** Position mesh over frames with overhang at the front. Clamp a board over the mesh and fold it with a block.



**8** Place the mesh on a flat surface and hammer over the fold. It's faster to tap on the block than hammer the mesh itself.



**9** Nail front and rear runners to the frame. The rear runner is notched to accommodate the mesh's fold at the corner.



**10** Bolt end frames to baseboards after mesh is installed. On end frames, bolts are positioned to clear nailers.

## Using The 3-Bin Composter

● Imagine loading up your bagged leaves, grass clippings and piles of brush from your yard, heading to your landfill, and being turned away at the gate by a large sign saying: "Yard wastes are now banned from this landfill." This scenario is happening all across the country. At last count, nearly 20 states have passed or are considering legislation banning yard wastes from landfills because there simply isn't enough room for it anymore. When you consider that food and yard waste account for about a quarter of our nation's garbage, it's not surprising that states and municipalities are setting up programs that encourage one alternative to landfilling it all—namely, composting.

Composting is not only one solution to our solid waste woes, it also is the least expensive and best way to improve that poor excuse for soil that surrounds your house. Compost can loosen clay soil and improve the water-holding capacity of sandy soil. It can supply your plants with nutrients, neutralize soil toxins and metals, and act as a pH buffer so your plants are less dependent on a specific soil pH. No need to buy peat moss and topsoil. Compost does the job of both.

You can build an outdoor compost pile

by simply layering organic materials on the ground. If left alone, in a year or more you'll have compost. Or you can get compost in a matter of weeks with this 3-bin composter. This method requires more of your time and energy than the laissez-faire approach. But you'll be aptly rewarded with a continuous supply of compost to enrich your soil.

### Materials

Collect a variety of organic materials. Leaves, grass clippings, tree and brush prunings, sod, seaweed, garden plants pulled up at season's end, manure, hay, straw, black-and-white newspaper (shredded, minus the colored advertising supplements) and even your kitchen scraps (minus meat, bones and fat) will turn into rich compost. The smaller the pieces of materials, the faster the microorganisms can break them down. So chop up those baseball-bat-sized zucchini from your garden, and rent or borrow a chipper/shredder to cut up any big branches. Avoid all colored paper and all glossy paper because some of the inks contain heavy metals. Pet litter and sewage should be avoided because they contain toxins that a backyard pile cannot eliminate.

When deciding what to add to your pile, consider the needs of the bacteria—the organisms that are doing most of the work of decomposition. They digest organic materials and release bound-up nutrients, and to do this efficiently they need a certain ratio of carbon to nitrogen in the pile. Although impossible to measure exactly, the ratio that works best in the compost pile is approximately 30 parts carbon to one part nitrogen. Sawdust, leaves and other dry, tough, fibrous materials are high in carbon. Manures, grass clippings and green plant vegetation are high in nitrogen. Think of carbon as the food and nitrogen as the digestive enzymes, and add roughly 30 times as much carbon as nitrogen.

Mix your materials on the ground and add them to the first bin. If you cannot mix them first, alternate layers of carbon and nitrogen materials. Your pile will soon tell you if the carbon/nitrogen ratio is out of kilter. If there's too much nitrogen, you'll notice the unpleasant odor of ammonia gas emanating from the pile as the excess nitrogen is released. To remedy this, you can add more well-chopped carbon materials and mix them into the pile. If you have the opposite problem of too much carbon, decomposition slows down. In this case, try mixing

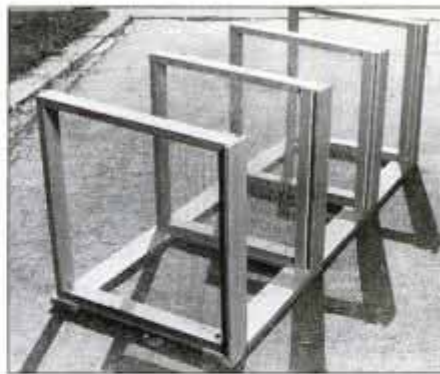
drop-in slats are separated by nails that are driven partially into the edge of each slat. Leave  $\frac{1}{2}$  in. of each nail exposed to provide the needed ventilation gap. To drive these nails to a uniform height, butt a piece of  $\frac{1}{2}$ -in.-thick hardwood against the nail after it has been started. Drive the nail until the head touches the guide block.

## The Lid

Assemble the lid frame with half lap joints. Mark the width of each frame member on the ends of the pieces where appropriate. Set the saw blade to cut a  $\frac{3}{8}$ -in.-deep kerf (half the



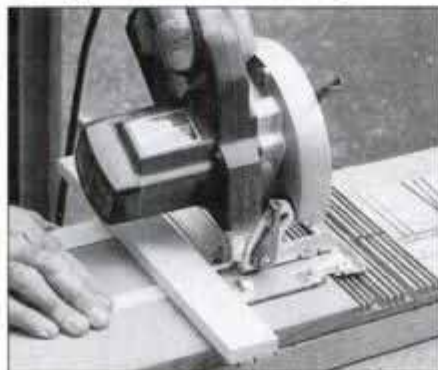
**11** Don't nail mesh at the bottom of the two center frames so you have access to nut. Tighten the nut until bolt digs in.



**12** Complete the structural assembly before attaching the side and back slats and the rest of the wire mesh.



**13** Screw slats to end frames. For correct spacing, support each slat while fastening with  $\frac{1}{2}$ -in.-wide blocks.



**14** Use a T-guide to make the repeated kerf cuts in the lid frame. Kerfs should be no more than  $\frac{1}{4}$  in. apart.



**15** Clean out between the kerfs with a sharp chisel. The overlap's depth equals half the stock's thickness.

in a nitrogen source such as fresh grass clippings, fresh manure or blood meal. If you can't mix the materials easily, make holes in the pile and pour in the nitrogen materials.

## Activators

You may want to add an activator to make sure your pile has the necessary microorganisms. Finished compost, soil and manure are excellent activators. Or you can use commercially available activators, such as Bio-Activator made by Necessary Trading Co. and Compost PLUS made by Ringer, which contain dormant bacteria and fungi. (A suppliers Source List appears on page 56.) These activators come in a powdered form, and a little bit will activate a large amount of compost. They can be sprinkled on top of each layer of materials you add to your pile. Many garden centers carry activators, or you can order directly from the manufacturers.

## Moisture

Microorganisms need adequate moisture to decompose organic matter. Try to keep the materials in your pile as moist as a well-wrung sponge. As you build your pile, sprinkle water on top of each layer, but take care not to saturate. Then reach into your pile every once in a while

and squeeze a handful of materials. If they are too wet, turn the pile to help it dry out. If you need to add more water, insert your garden hose or watering can into the middle of the pile in a few places.

## Oxygen

To stimulate the most efficient bacteria, keep your pile well aerated. The aerobic or oxygen-loving bacteria are 90 percent more efficient at breaking down organic matter than the anaerobic bacteria that take over in a pile devoid of oxygen. Furthermore, anaerobes produce substances that smell like ammonia and rotten eggs.

You can encourage airflow through the bottom of the pile by using bulky materials such as corn stalks for the bottom layer. Commercially available aerating tools cost about \$15 from gardening catalogs, such as Gardener's Supply and Smith & Hawken. In my experience, they work best if the materials in your pile are well chopped. Large, fibrous materials are difficult to lift with the tools.

## Turning

When you turn a pile, you're taking advantage of the intensified microbial activity in the middle of the pile. Once the microorganisms have broken down the materials in the center, their activity

slows, and the pile begins to cool down. Turning materials from the edges of the pile into the center provides additional food for the microorganisms, and as their activity increases, so does the temperature. Thus, turning can help raise the temperature high enough to kill weed seeds and disease organisms (about 150° F). If you want to keep your pile at maximum heating capacity, it's worth investing in a compost thermometer, which is basically a round thermometer face with a long metal probe that reaches into the compost pile. Gardener's Supply and Ringer catalogs carry them for about \$18. Turn your pile whenever your thermometer tells you the temperature in the center of the pile has dropped below about 100° F. When turning no longer raises the temperature, your pile is probably well decomposed and ready to use. Keep in mind that turning is only beneficial up to a point. Turning too frequently can cause a disruption in the process that outweighs any benefit. In a fast-cooking pile, every three days is often enough. In a slower pile, every three weeks may be sufficient. Also remember that you can make compost year-round in moderate climates. But in colder regions, you and the microorganisms can take the winter off.

—Kathleen Bond Borie

thickness of the stock) and, running the saw against a T-guide, cut a series of kerfs no more than  $\frac{1}{4}$  in. apart. Chisel out the waste (Photos 14 and 15). Cut two or more frame pieces at a time during this operation. The combined width makes a more stable base for the saw, as opposed to cutting one piece at a time.

The five crossmembers are attached to the two lengthwise members with plastic resin glue and clinched nails (Photo 16).

The lid is surfaced with four pieces of fiberglass-reinforced plastic Filon panel cut from two 8-ft.-long panels. We used the Cool Rib panel in Cool White color, but other Filon types and colors will work as well. These panels are sold at lumberyards and home centers (BP Chemicals, Commercial Composites, Filon Products, 12333 Van Ness Ave., Hawthorne, CA 92050). The panels are attached to matching corrugated redwood molding that is sold with the panels.

## Lid Assembly

Support the panels while cutting them by resting them atop the corru-

gated redwood molding (Photo 17). Cut two panels at a time. Mark the appropriate length on one panel and fasten a piece of tape across its width. Mark the cutting line on the center of the tape and clamp a fence across the panel to run the saw against. Make the cut with a fine-toothed plywood or crosscut blade. In order to fit the four panels across the 8-ft. length of the lid with a 1-rib overlap, trim off  $\frac{1}{4}$  in. from the first and last rib using tin snips.

Nail the corrugated molding strips to the front and rear of the frame after cutting off the starting end to conform to the trimmed panel. Nail Filon vertical molding strips centered on the crossframe pieces (Photos 18 and 19).

Use aluminum nails with neoprene washers to attach the Filon panels to the moldings (Photo 20). Prebore the nailholes in the panels and the molding with a  $\frac{5}{32}$ -in. bit. Nail the panels as shown in the drawing, and, when this is completed, attach the lid to the bin with four hinges.

We leveled the bin across eight bricks, one under each carriage bolt location. The bricks were slightly re-

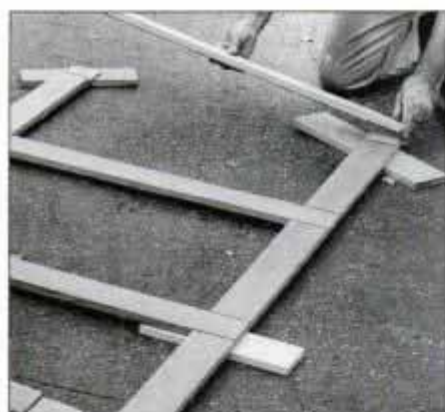
cessed into the soil and checked with a long board and level to obtain a true plane.

In order to prevent the weight of the compost from depressing the bottom mesh and loosening it, a brick was positioned under the center of each bin. Of course, you can substitute any large flat stones for the bricks. Just be sure that the whole unit is relatively level so that the bin's lid will be able to work properly.

Complete the bin by nailing down the back and bottom mesh. The front edge of the bottom mesh is folded like the sides (Photo 21). **PM**

### Composting Supplies Source List

- Alsto's Handy Helpers, P.O. Box 1267, Galesburg, IL 61401
- Gardener's Supply Co., 128 Intervale Rd., Burlington, VT 05401
- Kemp Co., 160 Koser Rd., Lilitz, PA 17543
- Mellinger's, Inc., 2310 W. South Rangen Rd., N. Lima, OH 44452-9731
- Natural Gardening Research Center, P.O. Box 149, Sunman, IN 47041
- Necessary Trading Co., P.O. Box 305, 422 Salem Ave., New Castle, VA 24127
- Nitron Industries, Inc., P.O. Box 1447, 4605 Johnson Rd., Fayetteville, AR 72702
- Ringer Corp., 9959 Valley View Rd., Eden Prairie, MN 55344-3585
- Smith & Hawken, 25 Corte Madera, Mill Valley, CA 94941



**16** Glue together the frame members with water-resistant plastic resin glue. Then, clinch nail the pieces together.



**17** Support the panels on corrugated molding. Mark a cutline with tape and run the saw's shoe against a fence.



**18** Nail the corrugated redwood molding through alternate valleys. Molding is sold with the corrugated panels.



**19** Vertical redwood molding is installed on the frame so it aligns precisely with ridges on corrugated molding.



**20** Prebore clearance holes in panel ridges and molding. Attach panels with aluminum nails that have rubber washers.



**21** Situate the bin on level ground and place a brick at the center of each bin to support mesh. Nail in the bottom mesh.

TOOL TEST

FEIN  
FINISHING  
SANDER

TEXT AND PHOTOS BY  
ROSARIO CAPOTOSTO,  
Contributing Editor

● Conventional pad sanders are great for quickly smoothing broad surfaces in preparation for finishing. Where they fall short, however, is in handling inside corners and working in confined areas—these places must be smoothed by tedious hand sanding. At least that's the way it used to be. Now, there's a unique new tool that solves the problem—the Fein MSx 636 finishing sander.

The most distinctive feature of this tool is its triangular sanding pad, which enables it to reach into corners without damaging adjacent surfaces. Unlike an orbital sander whose pad moves in small circles, the Fein triangular pad oscillates back and forth in 2° arcs at a speed of 20,000 oscillations per minute.

The sander measures 10½ in. overall, and weighs just under 3 pounds. Its lightweight and narrow body make for comfortable handling and good control. The triangular pad measures 3½ in. from corner to corner and has a Velcro surface to accept Velcro-backed sanding sheets. The Velcro system allows you to remove and reinstall a sanding sheet many times. A plain pad is available for use with adhesive-backed, peel-and-stick sandpaper sheets.

We tested the tool in a variety of situations, including the difficult job of sanding the panel of a finished frame-and-panel door down to bare wood. The result was a sharply defined sanded panel surrounded by an unmarked finished frame. The sander also performs well on metal. However, the manufacturer recommends using peel-and-stick sandpaper for continuous metal sanding where the Velcro pad may overheat.

The Fein MSx 636 sander is an industrial-duty German import that's built to last. And, at just under \$300, it's not your off-the-shelf consumer tool. It comes with a metal carrying case, wrenches and 10 sheets each of 60-, 80- and 120-grit Velcro-backed sandpaper. Optional accessories in-



The Fein triangular-pad sander easily sands into corners without marring adjacent surfaces. It comes in a carrying case (inset) with wrenches and Velcro-backed sanding sheets.

clude a regular pad and peel-and-stick sandpaper, and a dust extraction system that includes a perforated sanding pad and perforated sandpaper. While the tool is not a substitute for a regular finishing sander, it's ideal for handling the tricky sanding problems encountered in all phases of custom

and production woodwork, refinishing and auto body work.

The Fein sander is available from Garrett Wade, 161 Avenue of the Americas, New York, NY 10013. For more information, write to Fein Power Tools, Inc., 3019 Carson St., Pittsburgh, PA 15204. **PM**



Pad oscillates back and forth through 2° arc at 20,000 oscillations per minute. Pad can be rotated to utilize entire sheet.



Standard pad uses Velcro-backed sandpaper so sheets can be removed and used again. Peel-and-stick pad and paper also available.



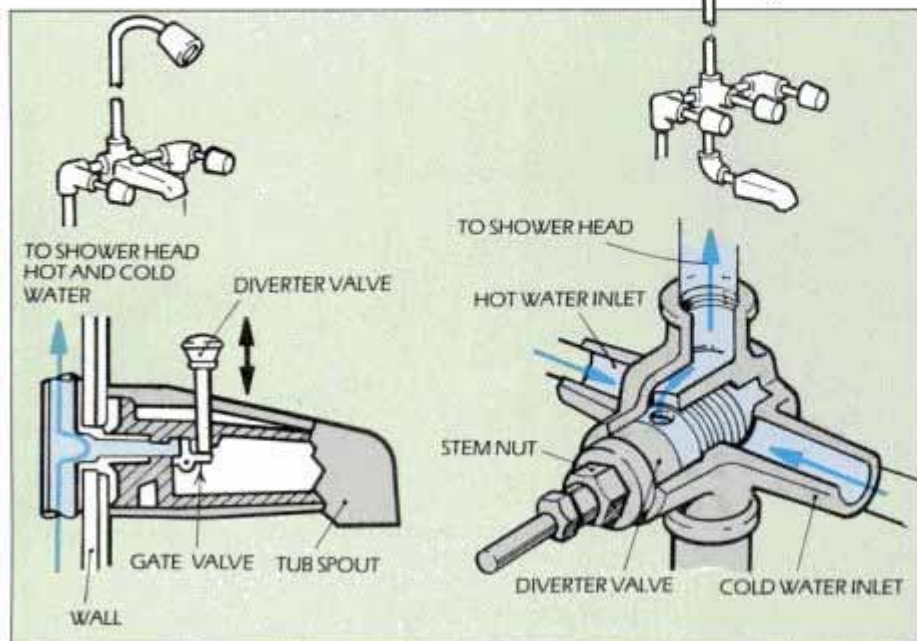
Unique design also permits working in confined spaces such as in between louvers where ordinary sanders can't reach.



Vigorous metal sanding can overheat Velcro pad. Peel-and-stick pad and adhesive-backed sandpaper are recommended here.

# HOMEOWNERS CLINIC

BY NORMAN BECKER, P.E., Contributing Editor



PM ILLUSTRATION BY ED LIPINSKI

Both types of diverter valves can malfunction and cause water to leak from the tub spout while the shower is on. In either case, replace the diverter valve.

## Tub/Shower Diverter

The water pressure in our tub is good. However, when we turn on the shower, some water continues to come out the tub faucet, and the water pressure from the shower head is reduced. How can we correct this problem?

KELLY F. KELLER  
JAMESTOWN, NC

*The problem is with the tub/shower diverter valve. When the valve is functioning properly, all the water should be channeled to the tub or the shower.*

Two common types of diverters are shown in the diagram. In the tub spout diverter, a small gate valve is attached to the base of a plunger shaft located in the spout. It is held in the up position for the shower by water pressure. When the water is turned off, the gate drops and opens the tub spout. To remove it for repair, unscrew the tub spout from the threaded water pipe.

The other diverter works by rotating the valve stem so the parts in the valve body open to either the tub spout or the shower pipe. You can remove the mechanism by unscrewing the stem nut and withdrawing the diverter assembly.

Tub diverter spouts and diverter assemblies cost \$10 to \$15 at plumbing supply stores. Since there are dif-

ferent types and sizes of tub/shower diverters available, take the old one when you go to the store to make sure you get an equivalent replacement.

## UF Foam Insulation

I would like information regarding urea formaldehyde foam insulation (UFFI) in walls. We are thinking of buying a house and are afraid of settling on something not knowing if formaldehyde is present.

MRS. WILLIAM CROWNER  
WOFFORD HEIGHTS, CA

UFFI was installed in most homes during the 1970s, but was banned in 1982 by the U.S. Consumer Product Safety Commission for use in schools and homes. The commission banned the material after reviewing test data that linked formaldehyde fumes to cancer in rats and mice. The ban was later overturned by a U.S. Court of Appeals. By that time, however, most of the contractors installing the material had gotten out of the business.

During and after installation of UFFI, formaldehyde levels decline rapidly (to below .1 parts per million within the first year of the installation). Although people vary in their susceptibility to formaldehyde, most healthy adults would not experience ill effects from exposure below .1 parts per million. And since a house

containing the insulation would probably have had it installed years ago, any vapors from the insulation would probably be negligible.

Formaldehyde is widely used in many other products such as plywood, particleboard, chipboard, plastic laminates, cosmetics, cleaners and paper products. It is possible that the air in a house could have a high formaldehyde concentration from these products.

If you are concerned about this, have the air tested for formaldehyde by a certified lab.

## Sweaty Windows

The windows in my house sweat and produce excessive moisture. Water accumulates on the window sill and literally needs to be dried up with a sponge or rag. This occurs daily in the wintertime. The house is 3 years old, and water damage to the drywall is already visible. Any suggestions to eliminate the moisture buildup would be appreciated.

WAYNE CECIL  
HIXSON, TX

*The condition is obviously the condensation of excessive moisture present in your house. Although I can't determine the exact cause of the problem, I can recommend three possible sources for excessive moisture.*

Many homes with warm air heat have humidifiers mounted on their furnace. If you have one, the unit may be malfunctioning, introducing too much moisture into the airstream.

Another moisture source is a bathroom exhaust fan that vents into the attic, and not outside. The fan may also be blocked, or its outlet in the attic floor may be covered by insulation. The fan should exhaust moisture into a duct that leads to a roof vent or through a sidewall with a rainhood for protection.

A third source is a dirt crawlspace under the house. Moisture from the soil is pulled into the crawlspace, then into the house. In this case, install a vapor barrier of plastic sheeting above the dirt floor and ventilate the crawlspace. There should be at least two vents with a total free area of  $\frac{1}{1500}$  of the crawlspace area. **PM**

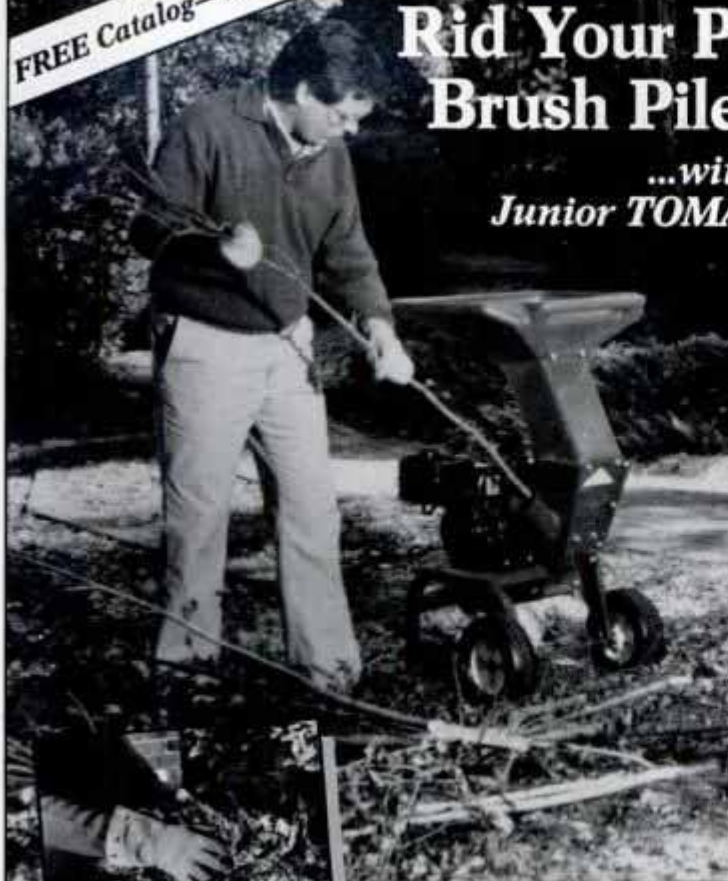
## DO YOU HAVE A HOME-MAINTENANCE OR REPAIR PROBLEM?

Just ask Norman about it. Send your question to Homeowners Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. While letters cannot be answered individually, problems of general interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$5.95 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, NY 10101.

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**TOOL TEST**

**DMT  
DIAMOND  
SHARPENERS**

TEXT AND PHOTOS  
BY THOMAS KLENCK,  
Associate Home  
Improvement Editor

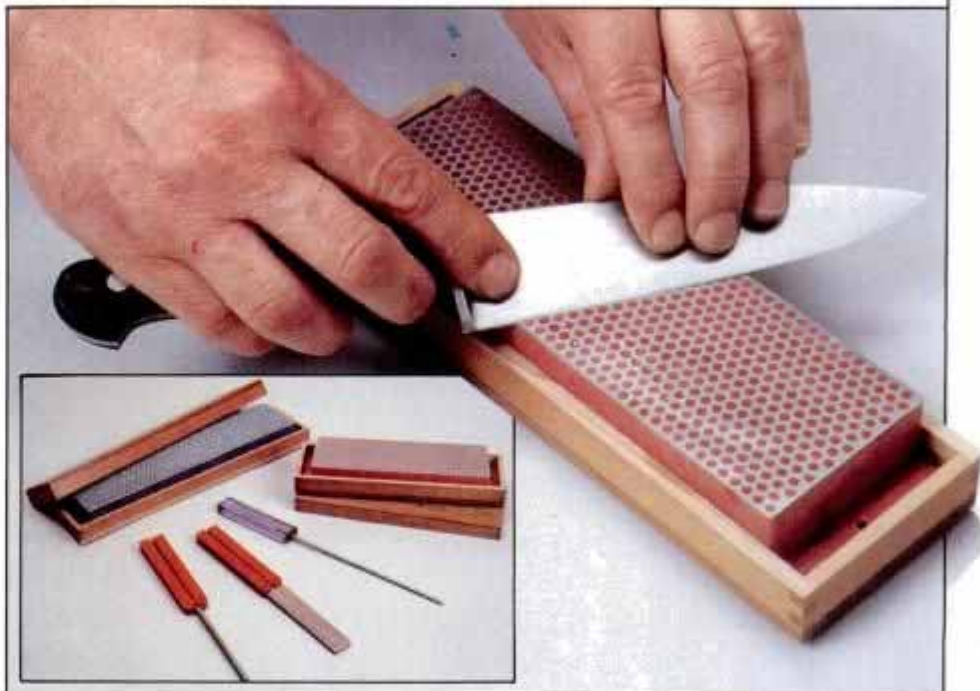
● If you can't afford to buy a new knife or chisel every time the old one gets dull, it might be hard to believe that investing in diamonds can help. The fact is, sharpeners that utilize industrial diamond abrasives are capable of renewing any cutting edge you'll find in the home and workshop—they'll even handle carbide-tipped tools.

Recently, we tried several sharpening products manufactured by Diamond Machining Technology, Inc. (DMT). In many respects, these tools prove far superior to their traditional counterparts. They're available in shapes similar to standard whetstones or in rod-shaped models similar to a butcher's steel or round file.

The DMT diamond hones feature an abrasive diamond-particle surface on a flat steel plate. The diamond grit is embedded in a nickel coating that's electroplated onto the steel. Because the diamond particles are so hard, they stay sharp indefinitely and don't wear away. Unlike ordinary whetstones, diamond sharpeners never need to be flattened or trued.

The steel plate on DMT products has perforations that lock it to a plastic base. The manufacturer claims the small plastic islands that appear through the perforations improve performance and help to clean away the fines, which are particles of steel cut from the sharpened edge (Photo 1). Although we used water to help flush away the fines, diamond sharpeners are also effective when used dry.

Countertop or bench-model sharpeners come in 6-, 8- and 12-in.-long sizes, and are available in three grades: fine (600), coarse (325) and extra coarse (220). Prices range from about \$40 for the 6-in. model to about \$100 for the 12-in. model, regardless of grade. The coarse stone is excellent for lapping the backs of plane irons and chisels, and for shaping bevels (Photo 2). Use the fine stone for final honing and routine sharpening. For a

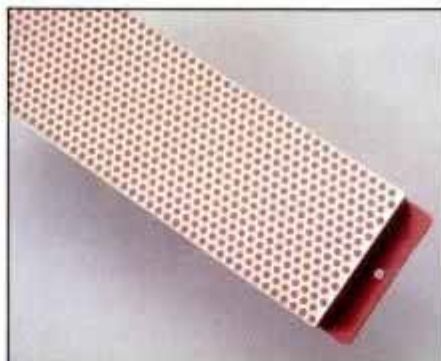


Durable diamond sharpeners are offered in a range of shapes and sizes to suit most home and workshop requirements. Bench models come in a wood case with nonskid feet. Round and flat sharpeners handle a variety of cutting edges, and hone all materials—including carbide.

better edge, finish the job with a traditional, fine water or oil stone. The extra-coarse grade does a fast job on axes and garden shears. DMT claims that the extra-coarse model is even capable of flattening the sole of a met-

al plane. The sharpeners that we tried, however, are not flat enough for this purpose.

For handling knives and other small cutting tools, the same three grades are available in rectangular, 3-



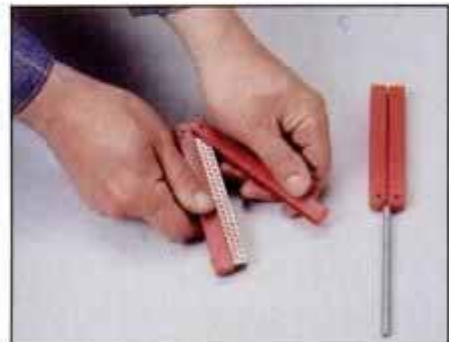
1 Diamond grit is embedded in nickel coating on flat steel plate. Perforations lock plate to plastic base and reduce clogging.



2 Coarse diamond hone shapes plane iron and chisel bevels. Nonwearing surface helps to ensure straight cutting edge on tool.

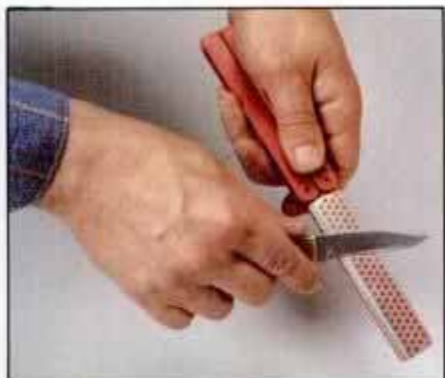


3 High-speed steel and carbide-tipped router bits can be sharpened with industrial diamonds. Hone flat face of cutter.



4 Round and flat Diafold models close to protect the sharpener surface, and then open to provide a convenient handle.





**5** The 4-in.-long pocket-size models handle knives, carving chisels and other small cutting tools. They're available in three grades.

and 4-in.-long pocket sizes. DMT Dia-fold sharpeners (about \$20) feature the 4-in.-size sharpener mounted in a unique case—when it's folded open, it becomes a handle (Photos 3 and 4).

While a diamond stone is durable and cuts fast, another attraction for woodworkers is its ability to hone carbide-tipped equipment. Router bit edges are easily maintained by passing the flat carbide face over the diamond stone (Photo 5). (Avoid honing the bevel edges, or the bit profile may be altered.) An excessively dull or nicked cutting edge will need profes-



**6** Small 4-in. diamond sharpener is handy for touching up faces of dull teeth on carbide-tipped circular-saw blade.

sional help, of course. You can also use a small hone to renew the teeth on carbide-tipped circular-saw blades (Photo 6). Remember to clean gum or pitch from router bits and blades before honing. Again, these hones are only suitable for periodic blade touch-up jobs. To properly sharpen circular-saw blades, send them to a shop that has the right equipment.

Round diamond hones for sharpening kitchen knives come in fine (600) and coarse (325) grits. An extra-coarse, 8-in.-long version is available in  $\frac{1}{32}$ -,  $\frac{3}{16}$ - and  $\frac{9}{32}$ -in. diameters for



**7** Diamond chain-saw file is said to outlast ordinary files. It comes in the extra-coarse grade and in three diameters.

sharpening chain saws (Photo 7).

DMT diamond sharpeners are available through woodworking tool catalogs and hardware stores. These tools won't replace your finest stones, but they are the most durable and fastest cutting sharpeners around. And, with the popularity of carbide-tipped cutters, industrial diamond sharpeners are sure to become a mainstay of most woodshop sharpening systems. For more information, contact Diamond Machining Technology, Inc., 85 Hayes Memorial Dr., Marlborough, MA 01752. **PM**

## BOOK REVIEW

# MORE PROVEN SHOP TIPS

• Devising tips and tricks that make woodworking easier, more rewarding and, quite frankly, a great deal more fun is an important part of my professional woodworking schedule. Therefore, it was with great interest that I opened *Fine Woodworking's* new book titled, *More Proven Shop Tips*.

Picking up where the original *Proven Shop Tips* book left off, this second book continues with a collection of woodworking tips from *Fine Woodworking* magazine's Methods Of Work column—a monthly forum of readers' ideas, hints and advice. The column and book are edited and illustrated by Jim Richey.

If you're a woodworker—amateur or professional—you'll find a wealth of useful information in this book. Each entertaining page presents personal approaches to everyday problems through clear, descriptive drawings and concise, to-the-point text. Nicely organized into specific shopwork categories—such as Measuring and Marking, Gluing and Clamping, Joinery, Tablesaw Jigs and Fixtures, to name a few—the clever tricks, techniques and solutions to problems abound. I found this book to be a good source of ideas on the use of tools and materials, as well as devising useful jigs and fixtures.

*Fine Woodworking's More Proven Shop Tips* (\$7.95) is an 87-page, softcover book published by the Taunton Press. For more information, contact the Taunton Press, Inc., 63 S. Main St., Newtown, CT 06470. —Rosario Capotosto



PM PHOTO BY ROSARIO CAPOTOSTO

**NEW PRODUCTS**

**HOUSE PARTY**

Spring into action with 16 great new home improvement products.

BY ROY BERENDSOHN,  
Assistant Home Improvement Editor

**Wireless**

You can turn on a TV, a table lamp or an appliance with this switch from 50 ft. away—without installing additional wiring—because it works on a radio transmitter. Attach the transmitter switch to the wall (it comes with double-sided tape and screws), plug the receiver into an outlet, and plug the lamp, TV or appliance into the receiver. The switch and receiver are powered by a standard 12-volt battery (included), and the system's radio frequency is coded to prevent interference from outside sources such as radio signals from passing aircraft. It costs about \$30 from hardware stores and home lighting centers. For more information, write to Vantage Technologies, 425 Pleasant St., Fall River, MA 02721.



PHOTO BY ROSARIO CAPOZZO



**Boxed In**

Rubbermaid says it asked consumers what features the ideal toolbox should have, then incorporated those ideas in its new toolboxes. Model 7716 (shown) is made of a blend of two plastic resins, to give it high-impact resistance at high and low temperatures. Its lid closes securely with two large latches, and its recessed handle is

cushioned. The box has two nesting compartmentalized trays that lift out with one handle. The box measures 9 in. high × 10 in. wide × 24 in. long and costs about \$33 at home centers and hardware stores. Other models with different features and capacities are available. Write Rubbermaid Consumer Service, 1147 Akron Rd., Wooster, OH 44691.

**Wainscot Wonder**

This knotty cedar wainscot is designed with homeowner installation in mind. Each kit contains enough



precut ¼-in.-thick tongue-and-groove planks to cover 5½ ft. of wall space. Also included in the kit is a 64-in.-long piece of chair rail and a matching length of baseboard. The pieces assemble to yield wainscot 35½ in. tall. Each kit costs about \$27 at lumberyards and home centers (it costs about \$260 to cover four walls in a 9-ft. × 12-ft. room). For more information, write Georgia Pacific Corp., Dept. PM, P.O. Box 2808, Norcross, GA 30091. A 31-page paneling guide is available from the same address for \$3.

**Looks Like Stone**

Made of polymers, fiberglass and marble chips, these load-bearing columns are designed to look like stone, with a fraction of its weight. They are waterproof and fire resistant, and they need not be primed before painting. Because they are hollow, they can conceal wiring, plumbing and downspouts. They come in a variety of sizes, with plain and fluted exteriors. Sold at lumberyards, a 6-in.-dia. × 8-ft.-tall column costs about \$127, and a 12-in.-dia. × 16-ft.-tall column costs about \$720. For information on these columns and other architectural elements (domes, cornices, moldings), write Focal Point, Inc., P.O. Box 93327, Atlanta, GA 30377.





### Wrenches Need Not Apply

Install plumbing supply lines, without a wrench, solder or solvent, with these hand-tightened CPVC fittings that also allow plastic-to-metal connections. A range of 1/2-in. and 3/4-in. components are available, along with some 3/8-in. fittings. The straight supply valve (top) costs \$6.80, the 1/2-in. female adapter (middle), about \$3.10 (3/4 in., \$3.90), and the 1/2-in. elbow (bottom) costs \$4.10 (3/4 in., \$5.70) at hardware stores. Write Genova Products, Inc., 7034 E. Court St., Box 309, Davison, MI 48423.



### Patio Placement

Place these plastic guides over a bed of sand to help position paving bricks when building a brick-and-sand patio. Smooth the sand bed, lay the guides, place the bricks, then sweep and wash down sand between the bricks. A package of 10 covers 20 sq. ft. and costs \$9.95 plus \$5.50 shipping (regardless of how many packages you buy) from Argee Corp., 9550 Pathway St., Santee, CA 92071.



### Rot Repair

You can fix rotted porch columns, window sills and just about anything made of wood with this new 2-part

compound that consists of a powder and a liquid polymer. You can mix it thin enough to be applied as a primer or thick, like a putty. The compound can be applied over fiberglass mesh for filling large openings. Tools used to apply it are cleaned with water. A 4-pound kit costs \$14 at hardware stores and home centers. Write to Mr. Mac's, 111-F Creek Ridge Rd., Greensboro, NC 27406.



### Paint Squirt

Squirt some of this mildewcide into latex or oil paint, sealant, stain or preservative to prevent mildew from forming on interior or exterior surfaces. Its manufacturer says it is odorless during application and after the paint or coating has cured, and it works on virtually all common surface materials—wood, masonry, drywall, metal. This mildewcide contains no mercury, arsenic or sulfur. A 1-gallon treatment syringe costs about \$4.30,

and a calibrated 5-gallon syringe (shown) costs about \$15 at paint stores or direct from Enviro-Chem, Inc., Stay Clean I/E, P.O. Box 1298, Walla Walla, WA 99362.



### Double Duty

Genie's new 1.5-hp shop vacuum converts into a 2-speed (normal and high velocity) blower by removing the motor unit. As a shop vacuum, it can handle dry material and water. It has a 10-gallon tank with an automatic overflow shutoff and a 12-ft.-long cord. It comes with a 1 1/4-in.-dia. x 6-ft.-long hose, two wands, a floor nozzle, two 20-in.-long blower wands and a crevice nozzle. Covered by a 2-year warranty, the vacuum/blower costs about \$140 at home centers. Write the Genie Co., 3515 Massillon Rd., Uniontown, OH 44685.



### Booster

Drop the Equalizer over an air register in rooms where you want additional heat or cooling. It works by increasing the volume of cooled or heated air entering the room and has neither a heating nor a cooling element. The Equalizer has a thermostatically controlled fan that turns on when it senses air entering it at 92° F (for heating) or 70° F (for cooling). It comes with a 6-ft.-long cord and is UL-listed. It costs \$30 at hardware stores and home centers. Write to Suncourt Manufacturing, 4511 Manhattan Rd., S.E., Calgary, Alberta, Canada T2G4B3.



### Soft Landing

Unlike hard plastic or porcelain bathtubs, these fiberglass tubs are completely covered with a flexible foam cushion, which is in turn covered by an elastomeric skin. The result is a bathtub that weighs about 100 pounds and is soft, somewhat like a sofa. They come in a wide variety of styles and colors. Their optional features include

whirlpool jets, heaters, a water-level sensing device and low-voltage lighting. The soaking bathtub shown measures 20 in. high, 36 in. wide and 60 in. long. It costs about \$2200 without whirlpool jets and about \$2900 with six jets. For more information, in the United States, call (800) Tub Soft (882-7638), and in Canada, call (604) 684-7711.

### Breathe Easier

3M says its new electrostatically charged furnace and air-conditioner filters trap 92 percent of airborne particles, many as small as 1 micron (one thousandth of a millimeter). Many filters trap only 10-micron particles, 3M says. The filter material is a blend of entangled polyolefin plastic fibers and 3M Filtrete. The air can flow more easily around entangled fibers, the company says, unlike adhesive-bound fibers in inexpensive filters. Sold in eight sizes, the filters last three months and cost from \$10 to \$14 at hardware stores and home centers. For more information, write 3M DIY Division, 3M Center, Bldg. 223-4S, St. Paul, MN 55144.



### Retriever

Plug the Cord Central into a duplex outlet and you'll have access to two 6-ft.-long extension cords. Each cord is made of 16-gauge wire, rated to carry 4.5 amps. Unwind the cords as you need them, then tug to unlock them—the cords automatically retract. The UL-listed Cord Central costs about \$22 at department and hardware stores. For more information, write Homestar International, Inc., 4473 Willow Rd., Suite 250, Pleasanton, CA 94566.

### In Control

Control your home's interior lighting and appliances, from anywhere in the house, with the Stanley LightMaker system. Plug in the control panel, then plug the LightMaker module into a wall socket, and plug the lamp into the module. You can dim, brighten or switch the light on or off from the panel. With accessory appliance modules, you can start a coffeemaker or other appliances. The kit comes with a lamp control module and a control panel that handles up to eight lights or appliances.

Extra lamp and appliance modules cost about \$17. A wall and ceiling switch module costs about \$18. Timer controls also are available. The kit costs about \$30 at home centers and hardware stores. Write to Stanley Home Automation at 41700 Gardenbrook, Novi, MI 48050.



### Quiet Please

Leviton says its new controls allow you to manipulate ceiling fan speed without the annoying hum. The company uses electronic filters to prevent the humming, and the controls can be used in new and retrofit installations. They are available in ivory and white and provide low, medium and high fan speeds. Model 6619-I (below left) costs about \$28. Model 6620-W, which also has a 3-way light dimmer, costs about \$46 at hardware stores and home centers. Write Leviton Mfg. Co., Inc., 59-25 Little Neck Parkway, Little Neck, NY 11362.



### No Flash

Wasco says its new E-class skylights need no flashing or caulking. They have built-in flashing, flanges and gaskets to prevent water from penetrating. The skylights attach to the roof deck with snap-on aluminum mounting brackets. They are available in seven square and rectangular sizes with opening or fixed sashes. Options include louvers, bronze and tempered glass, and high-performance insulated glass. Prices range from about \$220 to \$600 at lumberyards. Write Wasco Products, Inc., Residential Division, P.O. Box 351, Sanford, ME 04073.



PM PHOTO BY ROSARIO CAPOFOTOSTO



## HOME IMPROVEMENT **EXTERIOR PAINTING**

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

● Exterior painting has always been a chore that most people dread. The problem with it has very little to do with painting itself. The simple application of the paint is pretty easy. But the preparation is an entirely differ-

ent matter. It takes a lot of time, energy and a willingness to work off ladders for long periods. And, it often involves pitched battles with wasps, bees and other annoying creatures. In the hopes of finding new ways to make

this necessary chore easier, we contacted the folks at the Paint Quality Institute and asked their advice about proper preparation techniques and the best kind of paint for the job at hand.

Because our building was in such bad shape, we knew that hand scraping would be a tremendous chore. And, we didn't want to use heat removal techniques because of the fire danger. So we decided to go the power route. To this end, we obtained a power washer and a clever grinder



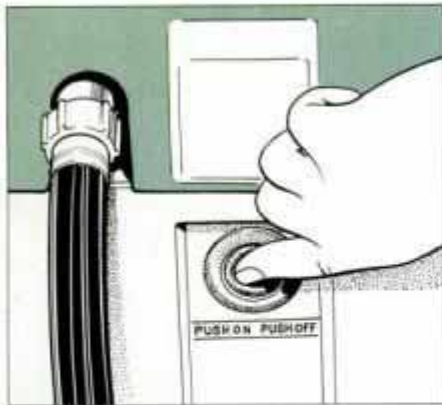
**1** Electric power washer uses high-pressure stream of water to remove paint. Attach to water supply with garden hose.



**2** On washer with reservoir, pour cleaner into reservoir and set mixture control. Washer mixes cleaner with water stream.



**3** Washer units require ground fault circuit interrupters. This model has handy TEST and RESET buttons built into electrical cord.



**4** Power switch is usually located directly on washer. Hold spray wand in safe direction every time power switch is turned on.

designed specifically for removing paint. Then we threw in a simple palm sander and a portable drill outfitted with an assortment of abrasive wheels. We rounded out our tool selection with a couple of hand scrapers, wire brushes, sandpaper galore and an airless power painter for spraying the building once the surface was prepared. With all these tools ready, the input of the Paint Quality Institute in mind, a generous supply of 100-percent acrylic primer and paint on hand,



**5** Beginning at top of building, wash all siding and trim with power washer. Keep wand moving to prevent surface damage.

and a can of insecticide spray within easy reach, we flew into action.

The drawings here show the sequence that seemed to work best for us. We were, however, working on grooved cedar shingles. If you have clapboard, board-and-batten or other types of smooth siding, your work should be easier and go faster. As always, there are no good substitutes for patience and hard work, but power equipment like the units featured here can make the job of exterior



**6** Once building is washed, make any necessary repairs, especially to windows. If old glazing putty is loose, remove it with knife.

painting considerably more enjoyable.

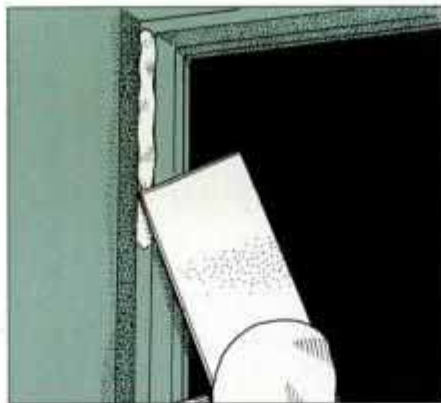
### Power washer

It's always a good idea to wash the exterior of a building before painting to remove any residue that may have collected on the surface. Of course you can do this by hand. But a power washer will not only clean the surface, it can also remove a great deal of loose paint in the process.

For this job we used a John Deere model No. 117 power washer. The



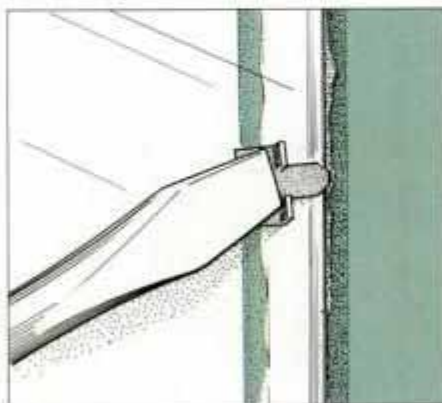
**7** On broken windows, remove any glass fragments and old putty. Then coat sash—where glass will go—with mineral spirits.



**8** Roll out thin rope of glazing putty, then press into sash. Mineral spirits keep wood moist so putty won't dry out too quickly.



**9** Carefully lift glass pane into sash and press into putty. Make sure putty seals entire perimeter of back side of glass.



**10** Install glazing points every 10 or 12 in. around perimeter of glass. To install this type of point, use a flat-blade screwdriver.



**11** For outside perimeter of glass, roll out thicker rope and press into corner between sash and glass. Slightly overfill corner.



**12** Smooth putty in place using stiff putty knife. Dip knife in mineral spirits before each stroke to get smoothest finish.



**13** Once windows are repaired, return to sliding and hand scrape any loose paint that was too stubborn for power washer.

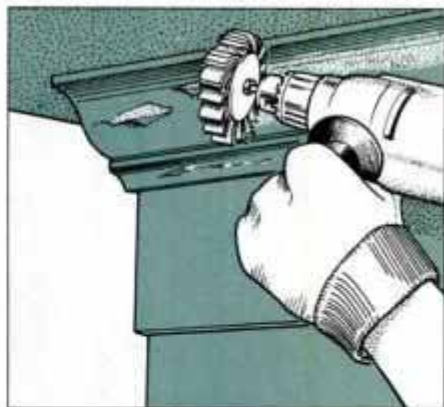
hookup was straightforward and the operation simple. You just attach a garden hose to one end of the unit, plug in the ground fault protected power cord and turn on the machine. It immediately starts pumping a stream of water that you direct with a handheld wand. Generally speaking, power washers are rated by the pressure they deliver. Our model was listed at 750 psi, which seemed to be the minimum pressure you'd want to handle any paint removal chores. Most



**14** Once paint is scraped off, brush exposed areas with wire brush. Brushing loosens paint that scraper blade missed.

experts suggest a washer in the 900- to 1200-psi range to remove paint, but we opted for less pressure because cedar shingles are so soft.

Though power washers are easily rented, if you'd like to have one for other chores around the house, a painting project could help you amortize the cost of buying instead of renting. The unit we used worked very well and sells for about \$450. Other types of washers, in different price ranges, are available from John Deere



**15** On curved surfaces, flat scraper blade doesn't work well. Drill-mounted abrasive flap sander works better.

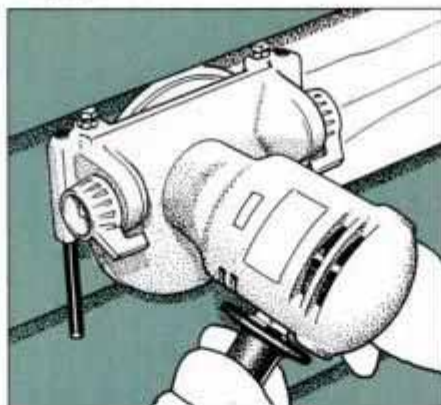
and a host of other manufacturers.

## Grinder

Even though our power washer did remove the bulk of the loose paint, some blistered and cracked areas remained—especially on flat surfaces—that weren't loose enough to scrape off. On these areas we used a Porter-Cable No. 303 grinder with P-C's No. 5041 paint remover attachment. This attachment consists of a rubber-faced metal backer disc surrounded by a



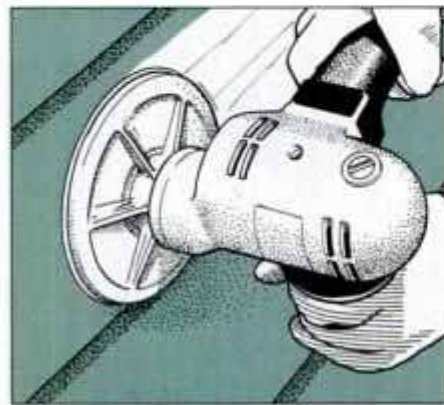
**16** On surfaces where lots of paint has been removed and exposed wood is rough, sand surface smooth with palm sander.



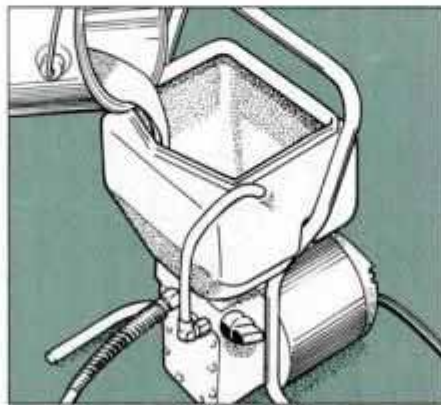
**17** Grinder with paint removal attachment was designed primarily for clapboards but is great on flat surfaces, too.



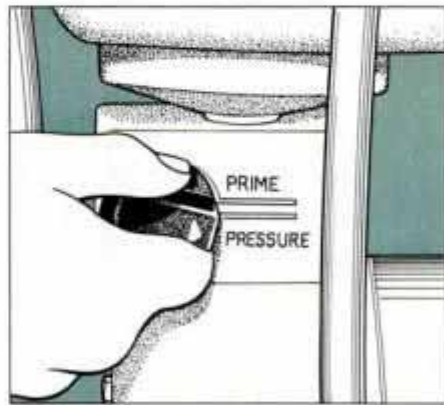
**18** Grinder removes paint smoothly because one side of disc is higher. Side knobs raise and lower side support bars.



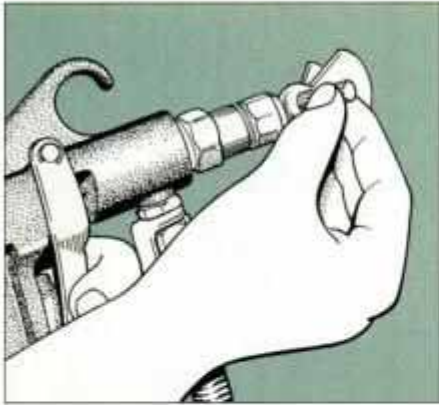
**19** With practice and care, tool can be used without guard. This is especially helpful on large flat surfaces, like door panels.



**20** For big jobs, reservoir on power unit is more convenient. It holds more paint and reduces weight at spray head.



**21** Painter must be primed before work begins. Once priming is complete, pressure is increased for spraying.



**22** Turn adjusting screw on spray head to select spray pattern. For best results, spray pattern should be no more than 10 in.

sturdy guard. The backer disc accepts flat aluminum abrasive discs that have carbide chips bonded to the surface. These discs come in coarse, medium and fine grits, and though they cost about \$6 each, in the long run they are much cheaper to use than standard abrasive discs.

The guard features two adjustable support bars, one on each side of the disc. By setting one bar lower than the other, the leading edge of the disc rides above the paint, while the following edge grinds off the paint. The tool does take some getting used to. But once we mastered it, it removed paint beautifully and left a very smooth surface. The paint does tend to clog the abrasive. But we found that by using two discs, we could put the clogged one in some paint remover while we were using the other. By the time the second was clogged, the first was ready to use.

This tool is designed primarily to remove paint from clapboards, so we tried it on another building. The results were excellent. As you'll see in Drawing 19, we even removed the guard and used the tool freehand. With some practice and patience, you



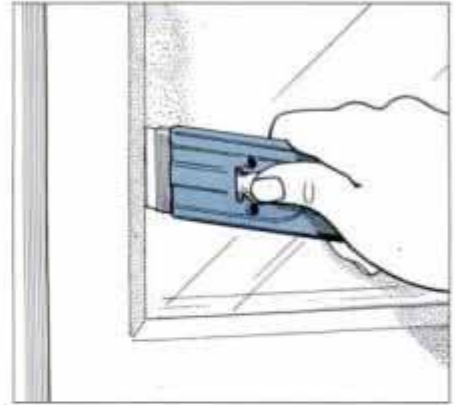
**23** Begin spraying building at top and moving across and down. Keep spray head perpendicular to surface at all times.

can control it easily. This allows you to work on flat but narrow surfaces where the guard would get in the way. The grinder with the paint removal attachment lists for about \$340, but can usually be purchased for much less from mail-order tool discounters. If you do try out this tool, remember to always wear eye protection, a dust mask and heavy gloves when grinding off paint.

### Power painter

The last major piece of power equipment we used had nothing at all to do with preparation. It was Campbell Hausfield's Paint Pro AL1200 airless spray system. Though our building was small, it was in such bad shape that it needed four coats of paint: two coats of primer and two top coats. Spraying all this paint certainly made the job go faster, and it required practically no effort, though it did demand a couple of windless days.

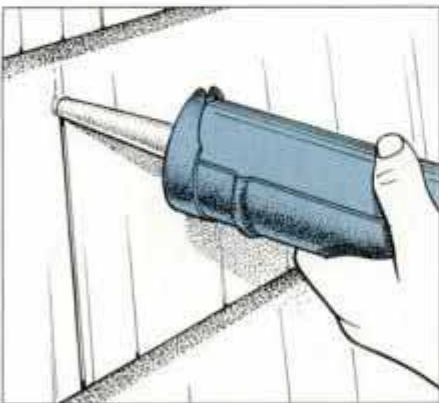
An airless sprayer, as its name suggests, doesn't use compressed air to transport the paint. Instead, it simply forces the paint through a nozzle which atomizes it. Generally speaking, airless sprayers come in two dif-



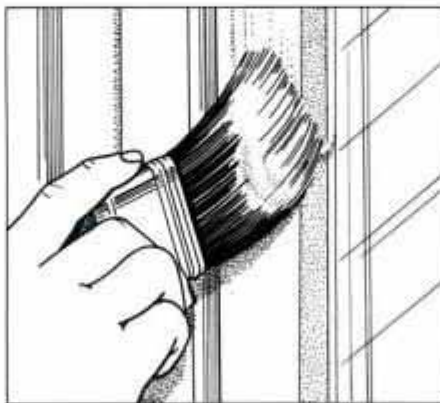
**24** After primer is sprayed, scrape off any splatters from glass before they dry completely. If dry, they're harder to remove.

ferent configurations. The first is the 1-piece version that has the power unit, paint reservoir and spray head all together. These painters tend to be heavy and somewhat difficult to maneuver. The second type is designed like the one shown here. The spray head is separate from the power unit and paint reservoir—it's simply connected by a length of hose. In this design, the spray head is much lighter and more maneuverable, and the paint reservoir usually has a much larger capacity. We found this unit surprisingly easy to use. The spray pattern was very controllable, and all the coats were uniform. One shortcoming with any spray painter is overspray falling on something you don't want painted, for example your neighbor's house or car. For this reason, it's imperative to work on a calm day and make liberal use of drop-cloths.

Like power washers, power painters are common rental items. But you may want to buy one if you have a large house to paint. The model shown here costs about \$350, and it comes with a roller attachment for interior painting. **PM**



**25** Fill cracks in siding, trim, doors and windows with caulk. For best results, apply after surface is primed, but before painting.



**26** Begin painting windows at sash. Be sure to completely cover new glazing putty, allowing paint just onto glass.



**27** Once sash is painted, coat jamb and window trim. After all windows, doors and trim are painted, spray rest of siding.



## APPLIANCE CLINIC

BY STEVE TOTH,  
Contributing Editor

### Switch Fix

I recently purchased a house with a Sears Coldspot refrigerator/freezer, model No. 106.7649346, serial No. S1180561, which has an interior light that doesn't always turn on when I open the door. I replaced the light bulb but found that the problem is the door switch. I can't see any screws to loosen it. How do I replace the switch?

SYE S. TERAUCHI  
WAIPAHU, HI

A replacement light switch is available under Sears part No. 549702. The switch costs about \$3 and can be purchased from any Sears repair parts center or appliance parts store.

To install it, first unplug the refrigerator. Insert a small screwdriver or a putty knife between the right side of the switch flange and the breaker trim. Gently pry down the switch to release the locking tab on the side of the switch. Pull the switch out of the breaker trim, and disconnect the two wires from it. Slide the wires on the new switch, and push the new switch back into the breaker trim until it snaps into place. Plug in the refrigerator and test the switch.

### Cutter/Screen Search

I have an old Schick electric shaver Model 400. I need a cutter and screen. Can you tell me where I can get these parts?

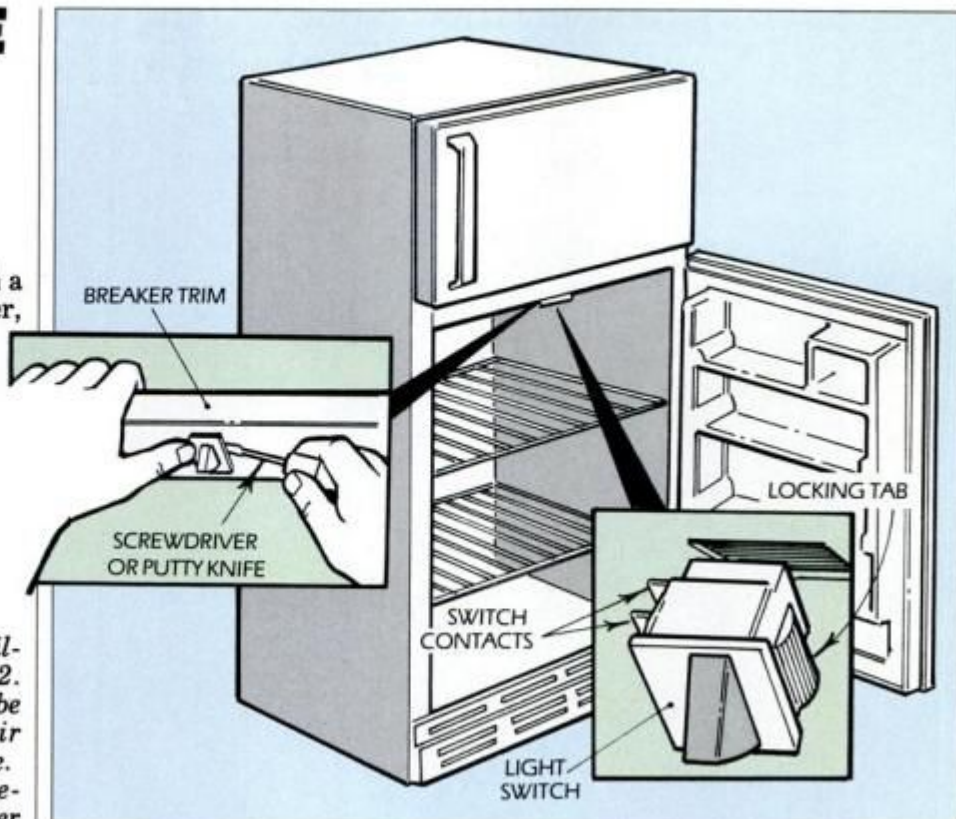
R.F. BLONDELL  
JACKSON, NJ

Norelco bought the electric shaver division of Schick several years ago and sold the shavers under the Schick name until the shavers were no longer manufactured. Norelco has only a small quantity of replacement parts for Schick razors still in stock. The screen and cutter are currently out of stock.

However, Factory Services, Inc. (85 Willis Ave., Mineola, NY 11501) still has a screen and cutter available for your model shaver. It's part No. FR-2 and costs about \$14, plus shipping. Call (800) 237-8699.

### Grate Troubles

I have a Falcon Mark V patio grill Model 5000 that needs a new set of



Pry light switch out of molding above door. Attach wires to new switch and reinstall.

cast-iron grates. I've been told that the Falcon Mfg. Co. in Dallas, Texas, has been sold or has gone out of business, and parts are no longer available. Can you help?

A.J. MINER  
NEVADA, IA

Arkla Products Co., Paragould, Arkansas, bought the Falcon Mfg. Co., and still makes a Falcon grill. The company does not sell parts retail, but they will give you the name, address and phone number of a grill parts distributor in your area. Call the company at (800) 356-3612. A replacement porcelainized cast-iron grate is available for your model grill, part No. 10225-133, for about \$35. You will need to buy two grates to cover the top of the grill.

### Burner Quit

I have a Modern Maid electric stove top, model No. CET30TE2, serial No. 207074. One small burner has quit working. I have been unable to find the parts to fix it. Can you help?

MARY ELLEN BADEAU  
KERSEY, PA

I checked with Caloric/Modern Maid in Topton, Pennsylvania, and they told me the small burner switch for your 25-year-old cooktop is still available as Caloric part No. 45466 (about \$30). Order it from any Calo-

ric or Modern Maid parts distributor. If you have difficulty locating a parts distributor, call Modern Maid at (215) 682-4211. They will help you locate one in your area.

### Down On The Farm

I live in a small farm town where it's nearly impossible to find a repairman who is willing to locate parts for older appliances. I've been trying for more than a year to get a burner control for my Hotpoint range with a 3-in-1 supermatic burner. It's serial No. 1071RIIM871E, model No. KW12.TX0026618.

DOROTHY RICHTER  
GILETT, AR


I contacted GE/Hotpoint, and they tell me that the sensor head for the supermatic burner is still available under GE part No. WB21X5207 (about \$40). Contact the GE/Hotpoint National Parts Center, 5865 Shelby Oaks Circle, Suite 300, Memphis, TN 38134; (800) 822-7255. The part can be ordered by phone with a credit card number or by letter with a check or money order. **PM**

**DO YOU HAVE AN APPLIANCE PROBLEM?** Just ask Steve about it. Send your question, along with the model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. While letters cannot be answered individually, problems of general interest will be discussed in the column.

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Jeep is proud to be a founding member of Tread Lightly, Inc.

SPECIAL SECTION

# TREAD LIGHTLY

**A Guide To Responsible Off-Roading**

**4x4s • Dirt Bikes • ATVs  
Snowmobiles • Mountain Bikes**



PM PHOTO BY RICH COX

**TREAD LIGHTLY**

# TAKING THE

Go off-road, but go easy on the environment.

BY JOE SKORUPA,  
Boating/Outdoors Editor  
PM Photo by Rich Cox

● When I first heard about the Tread Lightly program, I was skeptical. I found it easy to support the overall goal—promoting off-road ethics to protect America's wild country—but difficult to predict success for a program that uses education and voluntary restraint as its only tools.

This was several years ago, and I mentioned my reservations to the program's founder, Cliff Blake, a man

of nearly four decades experience with the U.S. Forest Service. "Well," he told me simply, "if it's done right, it'll work."

Cliff reminded me of two earlier programs developed by the Forest Service—Smokey the Bear and Woodsy Owl—which achieved remarkable results. After a few minutes of conversation, I realized that Tread Lightly was going to change the way people drive in the outback, and that I was going to help.





# HIGH ROAD

## Off-road responsibility

Since that conversation with Cliff, I've taken an active part in spreading the Tread Lightly message in **POPULAR MECHANICS**. And when Cliff's efforts were rewarded recently with the founding of a member-supported, nonprofit corporation, **POPULAR MECHANICS** was among the first corporate sponsors to sign up.

While the theme of the Tread Lightly message—pro-

use, low impact—is easy to grasp, the success of the program rests on how individuals carry it out. In practice, it's more difficult than it sounds. How, exactly, do you tread lightly?

In the following stories, we examine this question and how it relates to 4x4s, dirt bikes, ATVs, snowmobiles and mountain bikes. We identify

problem areas and offer tips to help preserve the natural environment.

As a founding member of Tread Lightly, **POPULAR MECHANICS** urges you to learn all you can about this important new program and to adopt a pro-environmental attitude every time you hit the dirt. Let's keep this land beautiful. Not only for ourselves, but for all who follow. **PM**



Off-road vehicles have potential for both adventure and abuse. For the above gathering, a plan was worked out with the Forest Service that would minimize harm to the environment. As you can see, it didn't prevent anyone from having fun.

**TREAD LIGHTLY**



**4x4s**

# FOLLOW THE OFF-ROAD CODE

When the pavement ends, concern for the environment begins.

BY TOM COLLINS; PM Photos by Rich Cox



Always ford a stream at a designated crossing, like this Dodge Dakota Sport V8. Make steady progress, but avoid excessive speed and splashing.

● By the time we finished the 1987 Camel Trophy run in Madagascar, a huge island off the coast of Africa, my teammate Don Floyd and I had driven hundreds of miles through sand, mud and mosquito-infested jungle. We'd driven over hard-packed washboard in the desert and boulder-strewn passes in the mountains.

As if this weren't hard enough, we were constantly required to perform a series of special tasks, which are integral to scoring this competitive event. There was little time for sleep, and when we reached the finish line in Tolamare, Don and I were operating strictly on desire and adrenaline. But we achieved our goal and tied for first place with a team from Italy.

Since then, I've had many more 4-

wheel-drive adventures, including the 1989 Camel Trophy run through the Amazon Basin in Brazil. This trip, which stayed on Highway 163 during the whole event, was the toughest challenge in Camel Trophy history. The so-called highway was a 1000-mile run in waist-deep red mud.

Interestingly, despite the images one conjures of the famed Camel Trophy run—of vehicles driven through untamed jungle and virgin wilderness—the event is always held on existing roads. Hardened international adventurers and many off-roaders in this country have come to realize that the world's wild places are too environmentally sensitive to blaze new trails off the beaten path.

You don't have to enter the Camel

Trophy event or travel to exotic continents to find challenging 4x4 roads. You can find them in your own backyard if you look hard enough, and many are starting to do just that. More than 1 million 4-wheel-drive vehicles are sold in the U.S. each year. As their numbers grow and off-roading gains popularity, the potential for environmental damage grows, too.

### **Off-highway challenge**

A single vehicle leaving a road to explore untracked territory may not cause much damage, but a problem arises when other 4x4s follow. Soon vegetation is worn away and erosion results. This kind of damage can take hundreds of years to heal, especially in high-altitude and desert terrain.





Use a tree-saver strap, instead of bare cable, to prevent bark damage during winching.

Over the years, I've come to accept the fact that I can't drive my 4x4 everywhere it's capable of going. This doesn't mean I can't go out and have fun. Exploring out-of-the-way places has been an obsession of mine for the past 25 years, and I'm not going to stop now if I don't have to. And I don't have to. All I have to do is drive off-road in a safe, responsible manner, which is the essence of the Tread Lightly message.

The term *off-road*, by the way, is basically a misnomer. In fact, Tread Lightly and various government agencies charged with managing public land prefer to use the term *off-highway*. This emphasizes the point that no vehicle is ever allowed to blaze a new trail off the road on public land. Whatever you call it, the point is to stay on an existing road. This is the first principle of treading lightly—but there is much more.

Whenever I go to off-road races, which are always held on existing dirt roads, I always note that the fastest drivers appear to be going slower than the trailing racers. Tires aren't spinning, there's no fishtailing or sliding, and the brakes aren't locked before going into corners. Smooth, consistent driving wins races.

### Control is key

An experienced driver treats loose or wet surfaces as if he were on ice. The throttle is applied smoothly and released slowly. Steering is precise, and the brakes are used as little as possible. The driver controls the vehicle. He never lets the vehicle control him.

Avoid soft, muddy or snowy roads to prevent inflicting damage. But if you must drive in these conditions, several techniques will reduce your impact on the environment:

- When a section of road offers limited traction, line up the vehicle so that it will take a straight approach. This will allow the differentials to provide equal power to all four axles.
- In deep snow and mud, steady momentum will carry you through. Wildly spinning tires will bog you down. Don't select a gear that's too low for conditions. A low gear will spin the

tires more easily than a high one.

- Proper-fitting tire chains will increase traction in snow, ice and most types of mud. Put them on before you drive into slippery conditions, not after you're stuck.

- Reduce tire pressure to increase flotation and traction in sand and soft soil. This technique will also help on rock and hard snow. Always reinflate tires before returning to the pavement to avoid sidewall damage.

- Use the brakes sparingly when slowing down. Instead, rely on the excellent engine braking available in low range and low gear. This is especially important on steep downhill sections. If the wheels start to skid while engine braking, apply some throttle and corrective steering. Do it smoothly.

- When wheels start to spin, ease off the throttle and allow tires to slow down and regain traction.

- If traction is lost and the vehicle is barely moving, whip the steering wheel quickly from side to side to allow the front tires to hunt for traction.

- Approach a ditch, log or rocky step at an angle. This will allow three tires to push the vehicle past the obstacle with a minimum of tire spin.

- Cross streams only at legitimate fords. Drive slowly and steadily, creating a small bow wave in very deep water. Make sure the vehicle has no fluid leaks to pollute the stream.

### Getting unstuck

Sooner or later, every 4-wheeler gets stuck. It's part of the game. The first thing to try is to rock forward and backward by gently accelerating in Forward and Reverse gears. If this

*(Please turn to page 80)*



Getting stuck is part of off-roading. Use proper tools to get out without damaging terrain.



# TREAD LIGHTLY! ON PUBLIC AND PRIVATE LAND



Protect today's land for tomorrow. You can do this by taking the Tread Lightly! pledge. Here it is.

I pledge to Tread Lightly! by:

- Traveling only where motorized vehicles are permitted.
- Respecting the rights of hikers, skiers, campers and others to enjoy their activities undisturbed.
- Educating myself by obtaining maps and regulations from public agencies, complying with signs and barriers, and asking owner's permission to cross private property.
- Avoiding streams, lakeshores, meadows, muddy roads and trails, steep hillsides, wildlife and livestock.
- Driving responsibly to protect the environment and preserve opportunities to enjoy my vehicle on wild lands.



Tread Lightly! is a program developed by the U.S. Forest Service and the Bureau of Land Management to urge safe, environmentally responsible use of public and private land. It's up to us to prevent damage from occurring and to help keep the backcountry open to all who wish to enjoy it.

To find out what you can do, or to become a member of the new Tread Lightly! organization write to:

**Tread Lightly!**  
P.O. Box 149, Ogden, UT 84402  
Or call: (800) 966-9900

America's wild country is beautiful. Tread Lightly! and help keep it that way.



PHOTO BY RICH COX



Sign indicates area is closed to off-road vehicles. This is the end of the trail. Find a new one.

fails, don't keep spinning the tires. This will only get you stuck even deeper and damage the road.

Experienced off-roaders carry some basic tools for difficult situations, such as a shovel, a jack and a 2 × 2-ft. piece of 3/4-in. plywood. The shovel is used to clear away mud, snow or sand from the undercarriage. It's also used to repair any terrain damage. A jack is necessary to lift the vehicle so you can remove obstacles and to fill in beneath the wheels. The

plywood acts as a base to keep the jack from pushing into soft ground.

Other items to consider are a come-along hand winch, power winch with tree-saver strap, nylon tow strap, old carpet strips to place under tires in sand or ice (standard floor mats can also be used in an emergency), and tire chains.

### Safety first

Knowing your vehicle's limitations is the key to off-road safety. I live near

Aspen, Colorado, and after a snowfall, nearly as many 4x4s are in the ditch as 2-wheel-drive vehicles. Why? Driver overconfidence. Vehicles with 4-wheel drive have great traction in slippery conditions, but many have short wheelbases and can spin out easily. This can happen when you hit the brakes heavily, release the accelerator quickly or oversteer. Most 4x4s that are modified to perform well on rugged terrain—with large tires, lift kits and locking differentials—probably handle worse on the highway than 2-wheel-drive subcompacts.

Here are some common sense safety tips for off-road adventures:

- Don't drive in conditions that make you uncomfortable.
- Travel with two or more vehicles. If one has a problem, another can help.
- Never follow another vehicle too closely. Let lead vehicle clear rough sections before next vehicle follows.
- Get out of 4x4 to assess difficult terrain. Pick a safe line and allow co-driver to guide you through.
- Use a stick to check depth of water and mud. Look carefully for hidden stumps, logs and rocks.
- Get out of vehicle and check to see what's over a steep crest. It may hide a dangerous dropoff.
- Always be prepared for a failed



© 1991 Toyota Motor Sales, U.S.A., Inc.

Don't strain your eyes. This is one of the many wilderness areas in the U.S.—both public and private—that are off-limits to most types of vehicles. It's Toyota's way of reminding you that before you leave the main roads, always

be sure that the area you're entering has been designated "approved" for the vehicle you're driving. Be it a 4x4 truck, a motorcycle, an ATV or even a mountain bike. And when you do travel off road, stay on the established trails

climb. Make sure you can back straight down the hill. Use engine braking to control your descent. Don't use the clutch or turn off the engine of a 4x4 equipped with an automatic transmission.

- Never cross a steep hill at an angle. This can cause a rollover. If you get into a sidehill situation, straighten out as quickly as possible.
- Before you go, check condition of engine belts, hoses, air filter, fluids, tires and the spare.
- Carry a jack, long-handled shovel, tow strap, tire chains, ax, extra food, water, warm clothing, an air supply, jumper cables, extra belts, tape, wire, a siphon hose, fuses, and a wrench, screwdriver, hammer, pliers and other basic tools.
- Keep an eye on the fuel gauge. Make sure you can reach the next fuel stop. Carry extra fuel if necessary.
- When returning to a paved road, stop and check 4x4 for damage. Look for tire cuts, bent steering rods, debris lodged in the undercarriage and mud stuck to the wheels. Correct problems before resuming highway speeds.
- Obtain a map and make sure you stick to authorized 4x4 roads.
- Let someone know your intended route and expected return date.



Some terrain looks impervious to damage, but smooth, precise driving is always required.

● When the trip is over, check fluids and filters. Transmissions, transfer cases, differentials, hubs and brakes may be contaminated with mud and water. Get them serviced if needed.

We are very fortunate in the United States that we are one of the few nations on Earth to have so much public land. In order to hand this legacy down to future generations, we must care for it now. Care includes following the Tread Lightly guidelines. The future of this magnificent land

and the sport of off-roading depends on it. **PM**

*The following companies provided support and assistance for this story:*

- Chevrolet Motor Division, General Motors, 30001 Van Dyke Ave., Warren, MI 48090
- Dodge Division, Chrysler, 1200 Chrysler Dr., Highland Park, MI 48288
- Ford Truck, Ford Motor Co., The American Road, Dearborn, MI 48121
- Jeep-Eagle Division, Chrysler, 1200 Chrysler Dr., Highland Park, MI 48288
- Toyota Motor Sales USA, 19001 S. Western Ave., Torrance, CA 90509
- Warn Industries, 13270 S.E. Pheasant Court, Milwaukie, OR 97222

## CAN YOU SPOT THE TOYOTA 4X4 IN THIS PICTURE?



and show proper respect for the land. That way, those areas that are now open will remain so. And it will give everyone a chance at spotting certain things... even more exciting than a 4x4 truck.

Write to Tread Lightly!, Inc. at P.O. Box 149, Ogden, UT 84402, if you'd like information about which public lands in your area are approved for various types of off-road vehicles.



**TREAD LIGHTLY**



# **DIRT BIKES DO THE RIGHT THING**

Off-road motorcyclists clean up their act.

BY CHARLES PLUEDDEMAN; PM Photos by Rich Cox



Although powerful enough to do spinouts and wild wheelies, the driver of the Kawasaki KDX 200 uses just enough throttle to maintain control at the end of a steep hill climb.



● Bikers beware. The public has you pegged. You may only be a weekend trail rider, but in many people's eyes you're the original wild one in body leathers and a Darth Vader helmet. Your knobby tires rip up what's left of nature. Your exhaust system roars louder than a 747. And a nimbus of pollution spews out of your tailpipe in a thick, choking cloud.

Perception and reality. While the Tread Lightly message is important for all off-road vehicles, it has special meaning for dirt bikes. To protect wild places from motorized damage and to counter popular misconceptions, dirt bikers must tread as lightly on their fellow outdoorsmen as they do on the environment.

#### **Say no to noise**

The most common complaint heard about off-road motorcycles is that they're too noisy. Despite successful efforts by the motorcycle industry to lower noise levels on new motorcycles, many non-cyclists assume that all motorcycles are loud. They don't have to be.

Delivered from the factory, all dual-purpose and enduro motorcycles are equipped with a muffler system that meets the current EPA noise standard of 98 dB-A. In fact, most new dual-purpose bikes (street-legal with off-road capability) produce only 92 dB-A. Enduro bikes (non-street-legal machines used off-road only) are equally quiet. The only noisy bikes made today are motorcross bikes—high-performance racing machines that cannot be legally used on public land.

To tread lightly, motorcycle owners need to resist the temptation to replace the stock exhaust with an aftermarket system. A new sound-of-power pipe, while attractive to some, may be illegal if it exceeds established noise standards. It is an exhaust system like this that produces the nerve-shattering howls that irritate others using public land.

Interestingly, the majority of aftermarket exhaust systems may



Dirt-throwing spinouts leave lasting impressions on the trail and on other outdoorsmen.

create more noise than horsepower. In fact, the chances are good that you'll lose power rather than gain it. Race organizations for dual-sport and enduro events *require* entrants to meet stock noise levels to compete. If these racers can squeeze out the highest levels of performance with stock exhaust pipes, so can you.

An equally important aspect of an off-road exhaust system is the spark arrester. It fits onto the end of the exhaust pipe, and prevents hot particles of carbon and soot from shooting out the pipe and starting a forest fire. Both dual-purpose and enduro bikes are equipped with a U.S. Forest Service-approved spark arrester and conform to EPA noise and exhaust emissions standards. Some older off-road bikes may not have one. If so, buy and install one marked either "U.S. Forest Service Approved" or "Krizman-Type Spark Arrester."

## Trail etiquette

The second most often heard complaint about dirt bikes is inconsider-



This stock exhaust pipe comes with an approved spark arrester. Don't replace it.



On a narrow backcountry trail, ride single file for courtesy and keep to the right.

ate behavior when meeting other trail users—joggers, hikers, bicyclists, horseback riders. Knowing how to interact with others can help improve the image of all motorcyclists. Here are some tips:

- Always be a cautious rider. On wide trails, stay to right and ride single file—there may be others around a blind bend.
- Ride in control for the prevailing trail conditions. Fun is fun, but keep the welfare of others in mind—especially in tight quarters.
- If the trail is dusty, groups of riders should spread out to let the dust settle and improve everyone's visibility.
- Don't be a hot dog. Popping wheelies, spinning out and sending dirt and mud flying aren't impressive to others on the trail. Ride like a pro, and you'll be treated with more respect.

Dirt bikers need to be especially aware of horses. A spooked horse can be dangerous for you and the horseman. If you meet a horse, pull off the trail to the downhill side. A horse will generally balk at passing on this side. Shut off the engine, remove your hel-

met and speak a few friendly words to the rider. This lets the horse know you're human, not a snarling alien. It also makes a good impression with the rider, who may be surprised to learn you're not an alien, too.

When overtaking horses, ride slowly until the rider has a chance to pull the horse off the trail. Wait for him to settle his mount and signal you to pass, then ride by at a slow, steady speed without excessive engine noise.

## Low-impact riding

Like other off-roaders, dirt bikers should strive to limit their impact on the environment. Even in the West, where trails are usually hard and rocky, motorcycles can leave a lasting mark if riders aren't careful. Desert trails, among the most desirable off-road environments, are especially prone to long-term scarring due to the lack of rejuvenating rain.

Here are some low-impact, off-road riding tips:

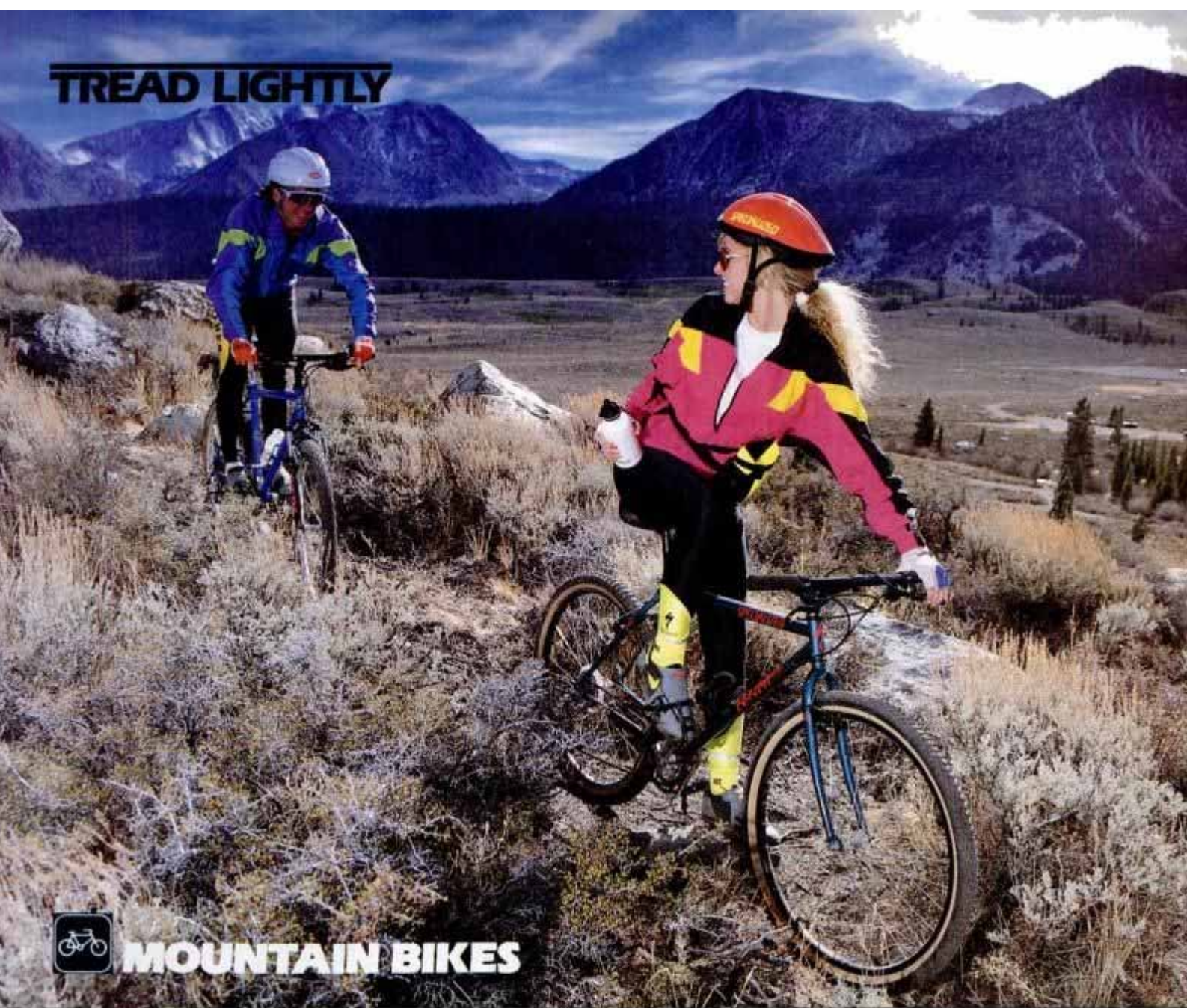
- When riding in mountainous areas, never cut new switchbacks. Cuts on steep inclines often lead to erosion.
- When the earth is soft, due to heavy rain or seasonal runoff, riders need to be extra cautious with knobby tires. Avoid unnecessary wheelspin and stay off trails completely if they're wet with deep mud.
- Drive around richly vegetated meadows and stream banks that are easily scarred by churning wheels.
- Know the boundaries and special rules that apply to your area. If you're unfamiliar with the area, obtain an official trail map. Make sure you don't stray onto private property or areas where off-road motor vehicles aren't permitted.
- Never ride on a closed trail. Never cut a fence. Never blaze a new trail. Doing any of the above will not only make trouble for yourself, but also for those who ride after you.

In preparation for this story, we spent nearly a week in California's Sierra Mountains riding trails and following the principles of Tread Lightly. Rather than restrict our fun, the exercise revealed a new and rewarding perspective. We acted like responsible citizens and were treated as such by everyone we met, including the sheriff at one point.

By treading lightly on the environment, you tread lightly on your fellow man. Both goals are vitally important to the future of dirt biking. **FM**

The following companies provided support and assistance for this story:

- American Honda Motor Corp., 100 W. Alondra, Gardena, CA 90247
- Kawasaki Motors Corp. USA, 9950 Geronimo Rd., Irvine, CA 92718
- Yamaha Motor Corp. USA, 6555 Katella Ave., Cypress, CA 90630



## MOUNTAIN BIKES

# KEEP THE WILD IN THE WILDERNESS

Riding through America the beautiful—and making sure it stays that way.

BY JIM YOUNGS; PM Photo by Rich Cox

● Few thrills match the exhilaration of blasting down a steep, twisty trail on a well-suspended, fat-tire bicycle. But not everyone is so appreciative.

Ten years ago, when mountain biking was in its infancy, outdoorsmen greeted fat-tire bike riders with curiosity. Today, the so-called traditional users—joggers, hikers and equestrians—view mountain bikers as environmental marauders and actively campaign to have them banned from backcountry hiking trails.

While controversy sometimes surrounds decisions regarding the regulation of mountain bikes, all sides

agree that now is the time to give something back to the environment. Mountain bike organizations have been very active in developing guidelines for low-impact, off-road biking. Among their recommendations are:

- Always yield the right of way to nonmechanized trail users. Slow down and pass with care. Be especially careful around horses.
- Control your speed. Approach turns in anticipation that someone may be just around the bend.
- Stay on designated roads and trails.
- Avoid trampling vegetation.
- Don't disturb wildlife or livestock.

Slow down and pass with care on tight trails. Control of speed is critical for human and environmental concerns.

- Know local rules. Check with authorities regarding current trail status for bicycles.
- Plan ahead. Each ride should be determined by your ability, equipment, terrain and weather conditions.
- It's wise not to ride alone. Leave word with someone where you plan to go and the anticipated time of return.
- Avoid muddy trails, excessive braking or shortcutting switchbacks.
- Pick up your bike and walk it around washouts or over fallen trees.

By following the spirit of Tread Lightly, mountain bikers will learn that respect is a 2-way street. By giving it to the environment, they'll earn it from others. **PM**

*The following companies provided support and assistance for this story:*

- Gary Fisher Bicycle Co., 140 Mitchell Blvd., San Rafael, CA 94903
- Specialized Bicycle Components, 15130 Concord Circle, Morgan Hill, CA 95037

## TREAD LIGHTLY

# SNOWMOBILES WINTER WARRIORS CHILL OUT

Snowy trails are frozen, but still fragile.

BY CHARLES PLUEDDEMAN

● The sight of a snow-covered, virgin field was too much for the group of snowmobilers to resist. They located a snowdrift to take them over the fence and spent the next half hour chasing each other around in circles. What they didn't know was that the field was planted with fragile pine seedlings, and now many of them would never grow.

Compared to other off-road vehicles, it might seem that snowmobiles pose the least threat to the environment. But this is deceptive thinking for two reasons: 1. Sensitive plants are just out of sight beneath the snow's surface, and 2. Damage caused by compressed snow doesn't reveal itself until the spring.

While snowmobile damage may not be as immediately visible as marks caused by 4-wheelers, it can be just as severe and longlasting.

### Cold facts

Most marked snowmobile trails run over fire roads or other routes capable of handling vehicular traffic. The reason for this is to minimize the area of densely compacted snow, which can damage underlying plants.

Exploring a new area, which may seem harmless at the time, creates a highly visible set of tracks that others will surely follow. Sometimes, during the course of a season, a false trail gets the same heavy use as a legitimate one.

Many trails owe their existence to the generosity of private owners and public land managers. Abuse of this privilege can result in a permanent closure. So stay on the trail. Don't cut fences, open gates or take advantage of deep snow to go into areas off the beaten path. The future of snowmo-

biling in a given area may hinge on your decision.

### The limits of power

Every season snowmobiles get more sophisticated and more powerful. The average family sled can now top 60 mph with ease. Big-bore sport models can hit 100 mph. While power can be fun, it must be used responsibly.

High-speed running can be hard on a section of trail. This is especially

Fragile plants may be hidden just below a snow-covered surface. Like this Ski-Doo Formula Plus rider, stay on designated trails whose terrain is capable of handling the stress of compressed snow.



true in corners, where power slides throw snow right off the trail. Ease off when going into a tight corner to preserve a deep snow base for those that come after you.

Speed limits, where applicable, are posted for a reason, usually because the trail is tight, twisty and crowded. Obey them. The trail you are riding may be one accident away from being closed by regulators. Save the throttle for a frozen lake or an open field.





Modern snowmobiles are among the quietest off-road vehicles available. An industry noise-level standard of 78 dB-A has done a lot to end complaints. Like other off-road vehicles, sled owners must resist the temptation to tinker with their exhaust systems. Factory pipes are tuned to provide a wide powerband. Loud, aftermarket pipes are strictly for the race course.

One of the pleasures of snowmobil-

ing in remote areas is the chance to view wildlife. But what many people don't realize is that deep snow and lack of food places a severe stress on many animals, especially deer.

A startled deer may waste vital energy running away from what it perceives to be danger. If you spot a deer or other animal on the trail, slow down. Never chase it. The best thing to do is to stop and shut off the engine.

When snowmobiles were first pop-

ularized a couple of decades ago, they quickly earned a reputation for being the outlaws of winter. Since then, they've cleaned up their act, and today, few people think of them this way. The next step is for snowmobilers to learn and apply the principles of the Tread Lightly program. Snowmobilers may not think of themselves in the same category as 4x4s or dirt bikes, but the point is that Tread Lightly is for all outdoorsmen. **PM**

# Fly Fishing and Conservation.



**DR. ERIC PETTINE** ▲  
National Director  
Federation of Fly Fishers

## Fly fishing technique.

Nymph fishing is an excellent way to take trout. Considering that nearly 90 percent of a trout's diet is made up of

aquatic forms of insects, it makes all kinds of sense to present your fly where the fish normally feeds—on the bottom of the stream.

It's easy to find fish in a river or a stream if you just think like a fish for a moment. It isn't all that hard, considering all of God's creatures are more alike than different. We have eyes; so do fish. We need to breathe and eat; so do the fish. We make our home in places where we feel safe and comfortable; so do

fish. Once you accept this idea, it won't be hard for you to pick out a place in any piece of water where a fish will most likely be holding.

## Directions in fly fishing.

There are more people fishing for trout than ever before, but, with the advent of catch-and-release, there are more trout available to the angler. Catch-and-release is not just a regulation on some of our finest waters in this country, it is becoming an ethic in our fishing

community. I can only see our fishing getting better in the future. With more interest in good trout fisheries, we are more able to protect the best of what we have and to develop fisheries like the Green River in Utah, now one of the premier trout fisheries in the world.

There is still a lot of work to do. Any angler who is truly interested in preserving our fine trout fisheries should feel obligated to join organizations such as the Federation of Fly Fishers and Trout Unlimited. Both groups are dedicated to conserving our trout and our streams.

## Fly fishing video.

In the Sportsman's Workshop Video™ Library, members of the Chevy Truck Outdoor Team provide tips and insight. Every time you buy one of these videos, a portion of the purchase price will be used to support Ducks Unlimited's wetlands conservation programs. Thanks to Chevy sponsorship, these videos are only \$9.95. Videos are available at better retailers nationwide, or may be ordered





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\*Based on 1989 light-duty truck registration data.



# The Heartbeat

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**TREAD LIGHTLY**



# **ATV's LIVING RESPONSIBLY**

All-terrain ethics for the go-anywhere workhorses.

BY JIM YOUNGS; PM Photos by Rich Cox



● All-terrain vehicles (ATVs), the motorized mules of the outback, take you where few 4x4s dare to go. Their range nearly equals that of a dirt bike. But unlike motorcycles, 4wd ATVs are beasts of burden that can carry a passenger *and* hundreds of pounds of gear. They're great for backcountry fishermen, campers, hunters and others who want to get away from it all, but still bring a lot of it with them.

While ATVs are the newest and least numerous of the off-road vehi-

cles, their impact is perceived to be large. Rightly or wrongly, the general public keeps a careful eye on what goes on in the world of ATVs. For this reason, ATV riders have a responsibility to embrace the spirit of the Tread Lightly program and prove they're concerned about preserving the wild character of the land.

### **Big foot**

Backcountry trail riders generally like the solid, surefootedness of an

ATV, and, to a large extent, this is the heart of the workhorse's environmental problems. ATV tires, which are exclusively designed for nonpavement use, are big, wide, soft and spongy. While this may sound as if it's beneficial to the environment, in practice the tires cut a wide swath wherever they go. Loads that approach 1000 pounds, counting the machine and driver, exacerbate the problem.

In addition to being wide, ATV tires typically feature an aggressive,



Loaded-down ATVs, with their wide, deep-lug tires, can carve up fragile terrain if the driver isn't careful. Stick to firm ground, like the Kawasaki Bayou and Yamaha Big Bear above, whenever possible.

# TREAD LIGHTLY



Study maps and follow signs to make sure you're on a designated ATV trail.

deep-lug pattern. Combine this with heavy loads, and you have an off-road machine that can quickly carve up a lot of terrain.

The first duty of an ATV rider is to avoid leaving lasting scars on the land. As with other off-road vehicles, always stay on an existing trail. Never blaze a new one. Consult maps to make sure the area you intend to explore is open for ATV use.

But following the spirit of Tread Lightly goes beyond this simple dictum. ATV drivers can tread lightly by steering around muddy stretches in a trail, staying out of meadows lush with vegetation, and keeping off river banks soft with moisture. Be especially alert during the wet spring season and after drenching rains.



Wide, deep-lug ATV tires leave a lasting impression. Drive around soft, wet soil.



Popping a wheelie means you're using excessive power. Keep in control.

## Keep it quiet

As with dirt bikes, a complaint often heard about ATVs is the sound of their exhaust systems. Stock exhaust systems off the showroom floor are designed to comply with all state and federal regulations regarding noise pollution. The simple Tread Lightly message is: Don't fool with the stock exhaust system.

Look at it this way: ATV manufacturers spend thousands of hours and millions of dollars developing exhaust systems that offer optimum performance for your engine. The chances of an aftermarket exhaust system improving your ATV's performance over the wide spectrum of use without losing something from the top or bottom end are extremely slim.

In many cases, changing exhaust pipes merely alters the machine's sound, and in years past this may have been an acceptable goal—but those days are over. Today, the less noise your ATV makes the better. Keep your fellow, nonmotorized outdoorsmen in mind when you modify your machine. The future of the ATV

trail system may depend on it. Remember: Less sound, more ground.

Over the past few years, the U.S. Forest Service and other land management agencies have mandated that ATVs on certain public lands must equip their exhausts with spark arresters. Hot carbon deposits emitted from your engine can pose a forest-fire risk. Nevertheless, no risk is too small to be ignored—especially in the dry Southwest. If your ATV doesn't have a spark arrester, it's your responsibility to install one.

## Riding responsibly

Four wheels in solid contact with the ground can give an ATV rider an artificial feeling of invincibility. ATVs have an easy learning curve, and their simplicity lets beginners become proficient quickly. The first thing to avoid then is developing a cocky attitude and riding too aggressively.

Veteran ATV riders know that to really enjoy the experience you have to be equipped properly—a fitted helmet, eye protection, high boots, gloves, long pants and a long-sleeve shirt or jacket are required.

Never take risks. Know what your vehicle is capable of doing, and stay within those bounds. Courtesy and respect for others on the trail is a matter of safety as well as treading lightly. Pull off the trail and give the right of way to hikers, joggers and especially horseback riders. Horses are easily spooked when forced into close proximity with off-road vehicles, so it's a good idea to shut off your engine and let them pass. This small effort will make you look and feel like a hero.

If you could condense the spirit of the Tread Lightly program into one all-encompassing thought, it would come down to a matter of respect. Respect the environment *and* the rights of others to enjoy it in their own way. The two concepts go hand in hand.

This is especially true for ATVs. If ATV enthusiasts have learned one thing over the past few years, it's that freedom can be taken away. The banning of 3-wheel ATVs was the result of a complex set of issues, but the message is clear. ATV riders must become solid citizens and be above reproach if they want to continue enjoying their sport on public land. The time to take the Tread Lightly message to heart is today. It could make a big difference tomorrow. **PM**

The following companies provided support and assistance for this story:

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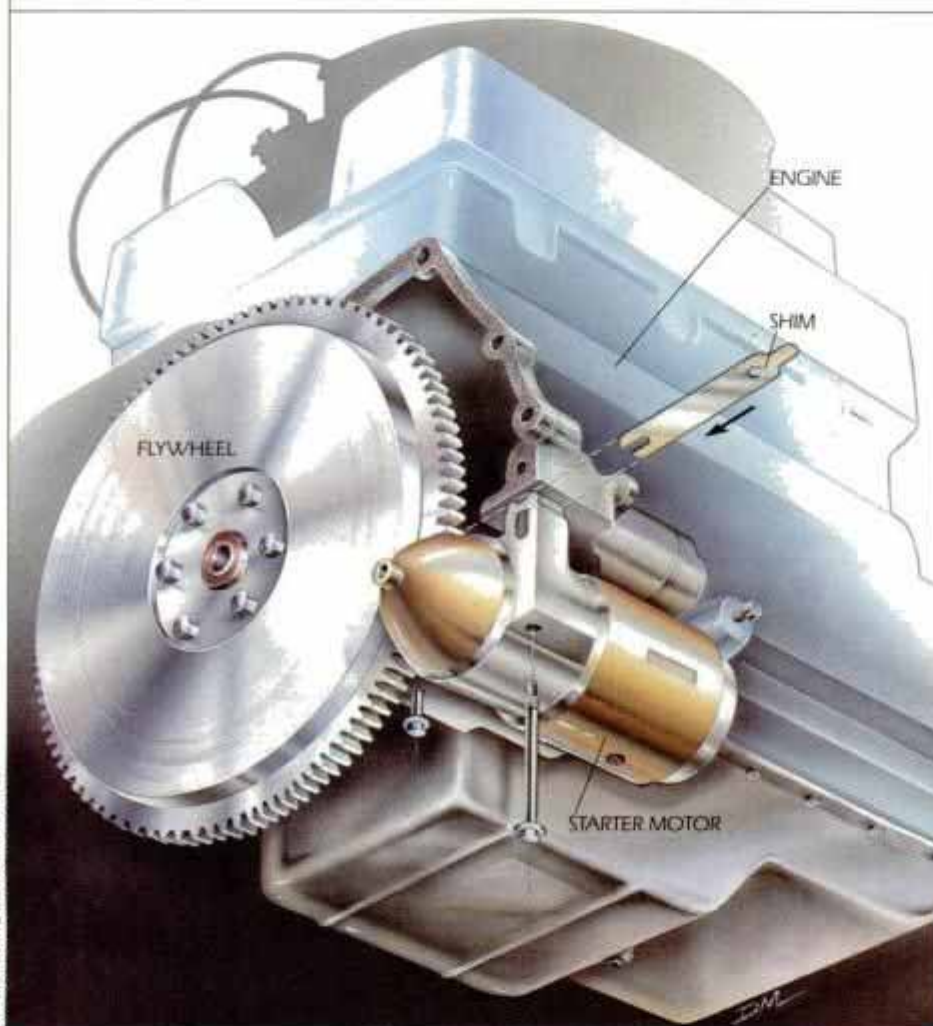
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100-031



# CAR CLINIC

BY MIKE ALLEN, Assistant Automotive Editor



PM ILLUSTRATION BY DONMANNES

## Off To A Bad Start

I replaced the starter motor on my Chevy pickup last summer at about 60,000 carefree miles. Since then, I've replaced the starter again six more times. They never seem to last more than a month or so. This is getting old really fast. I've bought high-quality OEM starters at the dealer and inexpensive rebuilds at the local discount store's auto parts department. It doesn't seem to matter.

JOHN GULLYFOYLE  
AUSTIN, TX

*GM starters, among others, need to be shimmed into proper engagement with the teeth in the flywheel. The liabilities of improperly shimmed starters are noise, chipped flywheel teeth and short starter life. There may not have been any shim on your*

*truck's original starter, or you may have inadvertently dropped it.*

*Some starters will bolt up properly by simply replacing the original shim. Others will need more or less shim thickness. Too thick a shim will make for a noisy, intermittent starter. Too thin a shim, or no shim at all when one's required, will put the starter too close to the flywheel and trash the starter's bushings, which is probably what is happening to yours.*

*Check the flywheel teeth for damage. Get a shop manual and bone up on starter alignment, which is too complex to properly cover in this column. Then try another starter, and shim it properly.*

## Oil Crisis

Last week I took my Chevy pickup to a local gas station for a lube and oil

change. About 10 miles and two days later, I noticed a clattering noise, so I pulled over to check the oil.

There wasn't any oil. No oil filter either. The engine never got warmed up, and all the driving was at low speeds. How can I determine if there is any engine damage?

ROBERT HIVELY  
SAN DIEGO, CA

*The potential for serious engine damage here has little to do with how hard the truck was driven or how warmed up it was when the filter exited. What matters most is how long the engine ran with no oil pressure. You might be able to determine this by checking to see how far behind the filter was when you stopped, and how wide the stream of oil was on the pavement.*

*I would drop the pan and pull a couple of rod caps. This is pretty easy to do and is the only way you can determine quickly whether this truck needs a bearing job.*

*At worst, you'll see bearing metal in the pan. But if there are score marks on the journals, you'll have to make some hard decisions about how bad they are. At the very least, you've probably shortened the life of this engine substantially.*

*The real question, of course, is whether the gas station is going to pick up any of the repair costs. They are going to say you should have noticed the lack of oil pressure and stopped before it started to clatter. I say they are wrong—but after all the smoke clears I'd add a big, bright warning light to the dash to supplement the gauge.*

## Grease Job

I have benefited from Car Clinic for years, and I thought that it was time that I contribute to your column.

Every mechanic knows the frustration of trying to loosen a rusty bleeder screw from a caliper, only to have it break off, requiring caliper replacement. I had to replace two calipers and vowed that I would never have this problem.

So, I used grease on the threads of  
*(Please turn to page 98)*



# What does it take to be the world's best aerobic exerciser?

## It takes a total-body exerciser.

A machine capable of exercising all the major muscle groups in your body, not simply your legs like treadmills exercise bikes and stairclimbers.

## It takes a cardiovascular exerciser.

A machine that utilizes enough muscle mass to readily exercise your heart, not simply specific muscle groups like weight machines.

## It takes a weight-bearing exerciser.

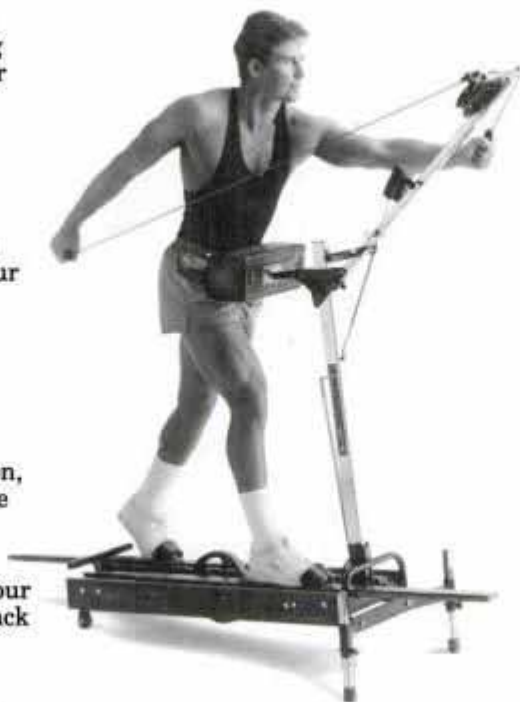
A machine that utilizes the standing position to exercise the joints and long bones of the skeleton, not simply a few muscle groups like sit-down exercisers.

## It takes a safe exerciser.

A machine that can't damage your knees like stairclimbers, or your back like rowers, or throw you off like treadmills.

## It takes a stimulating exerciser.

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the new bleeder screws and plan to do this as part of my regular maintenance. I also used some rubber caps from the rear shocks to hold more grease over the bolts—they fit perfectly.

JEFF TIMLICK  
SMITHVILLE, MO

*You've got the right idea, Tim—but I'm not too sure if I can recommend this procedure.*

*The danger is that the petroleum-based grease will find its way into the piston cavity, much to the detriment of the rubber piston seal. These seals are designed to be immersed in alcohol-based brake fluids, and the petroleum grease may degrade the rubber.*

*I have two suggestions: Start by using a silicone grease, which won't be soluble in the brake fluid. And be careful not to get any grease on the inner few threads.*

*I know, I know—the bleeder screw threads are outside of the valve seat area of the bleeder port. Normally, you wouldn't expect the lubricant to find its way upstream. But if there's enough grease on the bleeder bolt, it might get pushed ahead of the bolt as it's installed.*

*As for the rubber cap, good idea—but there's supposed to be a rubber cap over the bleed screw already, to keep it from getting packed with dirt.*

*And lastly, Thexton makes a neat little repair kit for broken bleeders. This news is too late to help you, Jeff, but other readers might benefit. Just drill out the broken screw, thread the repair insert, with its own bleeder, into the drilled hole and bleed normally. You might even be able to do this without removing the caliper from the car. It's available at any auto parts store.*

### Toe Jam

How much toe-in is needed for older cars with radial tires and rear-wheel drive? I have a 1978 Ford and a 1978 Chevy, and the alignment specifications call for a slight amount of toe-in. Some of the mechanics in town say that these specifications refer to bias-ply tires and that with radials the wheels should be straight ahead with no toe-in. What do you suggest?

ALLAN STEIGERWALD  
PORT ANGELES, WA

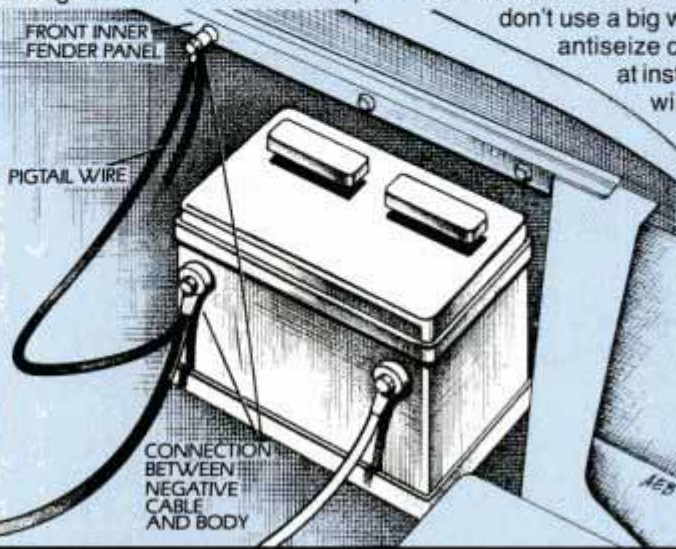
*Unless you've identified a wear problem as resulting from excess toe-in, stick with the recommended settings. Both of your cars came with radials as original equipment. The alignment specifications in the manual are correct in calling for a small amount of toe-in.*

## Don't Short Side-Terminal Batteries

● Aerodynamics play a subtle tune in a car designer's ear nowadays, which may explain the phenomenon of side-post batteries. By putting the post on the side, the battery is shorter by an inch or so, allowing the hoodline to be lower, to cheat the wind a little more. At what cost you ask? Now I have to deal with the inconvenience of side-post batteries, which don't have any place to attach jumper cables, and have teeny boltheads too small for a decent-sized wrench. Bad trade, you say.

Not necessarily. True, jumpstarting is problematic, but there are jumper cables designed for sidewinders. Keep the terminals scrubbed clean of corrosion, and

don't use a big wrench. If you use an antiseize compound or grease at installation, the terminal will easily come apart with a small box wrench or socket when it's time to replace the battery. Use some antiseize on the other end of the cables as well, to promote electrical contact by preventing corrosion, and to make removal easier.



PM ILLUSTRATION BY ADOLPH E. BROTMANN

*Rear-wheel-drive cars with bias-ply tires require toe-in as well, although not necessarily the same setting as for radials.*

### Freezer Burn

The heater on my 1985 Voyager doesn't get very hot. It's been this way since the first day. This is a noticeable flaw during the Colorado winter. Two dealers have said, "Yeah, they don't get very hot," but my daughter is freezing in the back seat.

I've tried cardboard in front of the radiator, as well as unplugging the radiator fan.

ROBERT CIRON  
EVANS, CO

*Plug the fan back in, Robert—it rarely comes on during cold weather anyway, and if it does, your engine is as hot as it's supposed to be already. Cardboard in front of the radiator is a good idea and should help warm up the engine faster—just remember to take it back out when the temperature gets above freezing.*

*First, I'd have a radiator shop confirm that the correct 195° F thermo-*

*stat is installed and that it's working. Then, check the heater core for obstruction, the blend-air doors for proper function, and foreign objects in the hot-air path.*

*This van should put out a nice, hot stream of air, but Chrysler has an option for a rear-seat heater for a reason. It's a long way from the dash vents to the rear seats about 10 ft. back.*

*Retrofitting the OEM rear-seat heater could be done, but it's not cheap. Most RV dealers have accessory hot-water heaters that could be custom installed.*

PM

### SERVICE TIPS

- Protruding seat springs on your '86-'89 Electra or LeSabre may be repaired simply, according to Buick TSB 89-10-24. Remove the seat cover and slit the foam over the protruding wire. Clip off the wire, glue the foam back together, and reinstall the cover.
- If your 1990 5.7-liter Cadillac Brougham is hard to start, misses, stalls or just plain won't start at all, it may defy normal troubleshooting. Replacing the ground screw in the fuel-pump circuit with one that has threads all the way to the head—and torquing it properly—may fix this. TSB T-90-47
- Pontiac TSB 88-1-14 covers the lengthy steps prescribed for eliminating mold growth in the a/c that causes nasty odors. This procedure includes use of some potentially dangerous chemicals, so it may not be wise to attempt it unless you're an experienced a/c technician.

### 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.

# Genuine Toyota Parts. The best part of doing it yourself.

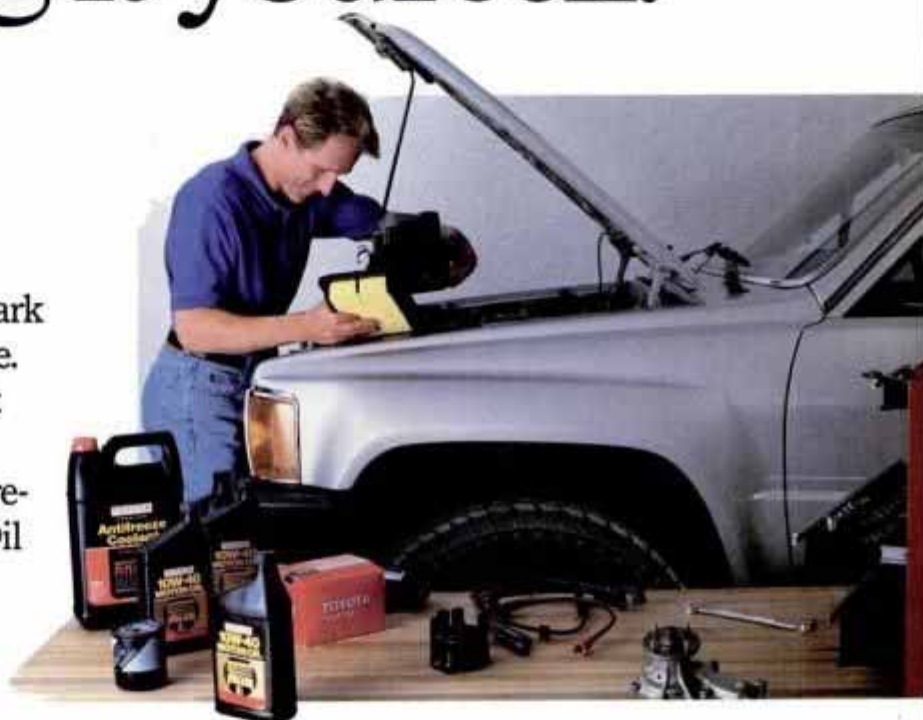
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# REPLICATING A SPIDER'S WEB

BY ABE DANE, Science/Technology Editor



ANIMALS/ANIMALS PHOTO

● Sitting across from me in a cramped office at the U.S. Army's Natick Research, Development and Engineering office is a 29-year-old molecular biologist who has done what for hundreds of millions of years only spiders could do—spin strands of silk far stronger than steel and superior in many ways to synthetic wonder fibers such as Kevlar.

Stephen Lombardy, the real-life Spiderman who has patented the process, says it will be applied in products ranging from lightweight, bulletproof body armor to ultrastrong composites for air- and spacecraft.

The project began three and a half years ago, when the Army decided that biotechnology had matured to the point where it could succeed where earlier attempts at producing useful quantities of spider silk had failed. "The potential of spider silk has been known for centuries," says Lombardy, but, he adds, "spiders won't behave." Unlike silkworms, which were domesticated hundreds of years ago and are happy to sit and spin their lives away, spiders have an inconvenient tendency to eat each other. "You can get a lot of material, but

the feasibility will never be there," Lombardy says.

## Strongest of the strong

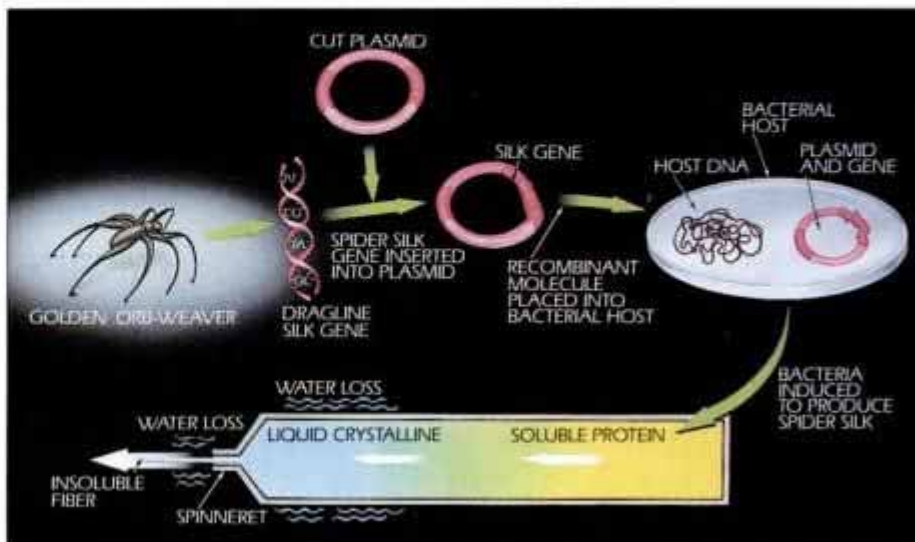
Groundwork for Lombardy's effort was laid in 1967, when a researcher named J. Zemlin did a comprehensive study to find the species of spider that produced the strongest silk. The win-

ner was a member of the orb-weaver family called *nephila clavipes*, or golden orb-weaver. Orb-weavers produce webs in the familiar jagged spiral pattern, resting on spoke-like support lines that radiate out from the center. Although the silk that goes into these webs is strong, the strongest strands orb-weavers produce are what is known as dragline silk. Produced by a separate gland, it is this fiber that the spider uses as a lifeline to suspend itself from high places and to sail on the wind from one site to another.

The silk starts in the ampullate major glands of the spider as a dissolved, protein-based polymer. To make a solid strand, the spider squirts the solution through one of its spinnerets. These narrow orifices exert a high shear pressure on the liquid, forcing water out and orienting the protein crystals into an insoluble fiber.

## Imitating nature

Lombardy's efforts to reproduce this process began with a research scheme worked out with the help of Dr. Dave Kaplan, founder of Natick's biotechnology branch. First, Lombardy would need to find a particular snippet of the spider's genetic material. Upon this strand would be recorded the sequence of amino acids that made up the dragline silk protein. After dissections and a variety of genetic engineering techniques had succeeded in

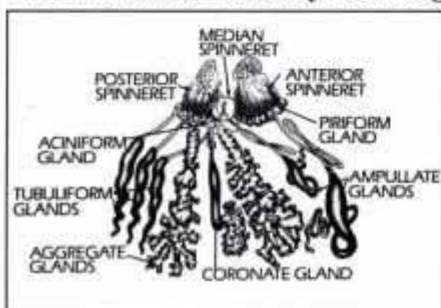


Orb-weaver's web is replicated by placing gene in plasmid, or viral, vector, which plants it in bacterium. Silk synthesized there is purified, then spun.

finding the gene, Lombardy moved on to create the protein it described.

The first step was to insert the gene into a virus with the help of recombinant DNA techniques. The virus then acted as a shuttle, or vector, to carry the gene and inject it into an *e. coli* bacterium. This bacterial host used the sequencing information in the gene to synthesize spider silk protein. Getting more protein was simply a matter of breeding more bacteria.

These are all relatively common steps in the process of genetic engineering. What made this project more difficult than earlier ones, which have produced synthetic pharmaceuticals such as penicillin and insulin, was the lack of existing DNA probes to help identify the gene, and the fact that the DNA segment involved is extremely large and unstable. To Lombardy's knowledge, this project marks the first time that a naturally occurring



**Dragline comes from ampullate glands and is spun through anterior spinneret.**

polymer has been genetically produced. In addition, no existing purification methods would work to separate the silk protein from other bacterial output. So Lombardy had to develop a new one, which he now holds the patent on.

Eager to know if the resulting solution would work, Lombardy conducted an impromptu test. He loaded a syringe with the substance, pushed the plunger and drew away the globule of silk that formed at the tip. To his surprise, a diaphanous strand 4 to 5 centimeters long spilled out.

Possessing all the qualities of natural spider silk—high tensile strength, tremendous elasticity and light weight—Lombardy's product could have any number of uses. It should also be relatively inexpensive to produce compared to regular silk, since there is no need to care for the living worms. The simplicity of spinning the silk may even make it cheaper than synthetics such as Kevlar.

Right now, Lombardy's working to increase the yield of silk and find outside partners to develop spinning technology suited to large-scale operations. He expects it will be three to five years before manufacturing can begin. **PM**



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A bald eagle is shown in flight, its wings spread wide. The eagle's head is white, and its beak is yellow. The background is a gradient of green and blue. The eagle's wings are dark, and the feathers are detailed. The eagle is flying towards the right side of the frame.

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seat it is terrible. Little can be seen above the high instrument panel. A periscope mounted above the canopy is meant to allow the back-seat pilot to see over the nose of the aircraft, but on my flight it was not working.

Following engine start, Menitsky taxied the MiG-29 to the only active runway at Kubinka. He aligned us with the centerline, advanced power to the afterburner setting and said, "Dave fly." We accelerated rapidly down the wet runway. I pulled the stick back approximately one-third, and we lifted off at 124 knots after a takeoff roll of 1100 ft. The gross weight of the aircraft was 33,000 pounds.

The landing gear and flaps were raised quickly as we entered the overcast. I had to remember to depress the latches in front of the throttles to come out of afterburner.

#### **Good old controls**

Operational versions of the MiG-29 use hydraulic servo-operated flight controls, rather than a more-advanced electronic fly-by-wire system. However, the aircraft is capable of roll rates in excess of 250° per second and a pitch rate of 30° per second. That's better than the earlier F-15s and in the same range as the digital fly-by-wire F/A-18 and later versions of the F-15.

I reduced power to idle at about 5300 ft. and pulled back gradually on the stick. The MiG-29 shuddered slightly as it approached an estimated 35° angle of attack, and we slowed to 83 knots. There was pitch and roll control throughout the maneuver, and the nose fell gently through the horizon.

The MiG's high angle of attack ability is similar to that of the F/A-18, the U.S. fighter it most closely resembles in size and number of engines. However, when asked, both Menitsky and Sukhoi chief test pilot Viktor Pougachev said that the first U.S. aircraft they would like to fly is the General Dynamics F-16.

One of the MiG-29 airshow maneuvers that always impresses people is the tail slide. I performed one at approximately 6000 ft., somewhat higher than is normal in display routines. With engines at near idle power, I pulled the nose back to a 75° pitch attitude. We climbed 2600 ft. before the airspeed wound down to zero. Then the aircraft slid backward 500 ft. At that point, I added power and pushed the nose over. I felt I had control of the aircraft throughout the maneuver, and there was not a sign of protest from the engines. Normally, turbine engines are hard-pressed not to stall in backward flight.

We did several other maneuvers, confirming that the MiG-29 has excellent low-speed handling characteristics. The acceleration of the aircraft in military and afterburner power was very impressive—most likely the best of any fighter I have flown.

Menitsky said, "Dave go home," and we started back to Kubinka to perform an instrument landing system approach. During the approach, the combination of poor visibility and unfamiliar instruments caused me to lose my bearings. I said, "Valery fly," and he brought the plane in.

Particularly confusing was the attitude gyro, which consists of a moving drum with pitch markings on it and an aircraft symbol that tilts to show bank. This is unlike most U.S. attitude indicators in which the aircraft symbol stays stationary and a globe moves behind it to show both pitch and bank. The Soviets somewhat jokingly liken the U.S. gyro to our attitude about the world.

#### **Meet the Flanker**

The flight in the Su-27 Flanker was different in many ways. First off, I was given clearance to fly from the front seat with Pougachev in the rear. The flight was in good weather from the Farnborough airport, following the flight routines of last September's Farnborough Air Show.

The Su-27 is a much bigger aircraft than the MiG-29, weighing as much as 66,000 pounds compared with a maximum of 40,000 pounds for the MiG-29. The Su-27 is more aptly compared with the American F-15 or F-14. Cockpit instrumentation is very similar to the MiG-29's, except for the location of the system switches. Engine start and preflight checkout were simple, and within a few minutes we were lining up on the runway.

With the two Lyulka engines set to afterburner, I released the brakes, and 1100 ft. later we lifted off going 135 knots. The Su-27's short-field performance is better than its U.S. counterparts, which generally need about 2000 ft. of runway.

The Su-27 is equipped with a 4-channel analog fly-by-wire flight control system, and the aircraft's response to stick movements was positive and quicker than expected. Once we reached the test area, I performed a few aileron rolls and split-S maneuvers to get the feel of the craft. I then moved on to a half Cuban eight, a low-speed loop and a high-G turn. In all these maneuvers, the Su-27 was rock steady, while displaying the agility of a much smaller aircraft.

Next, Pougachev took over for his  
(Please turn to page 104)

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## SOVIET SUPER FIGHTERS

(Continued from page 103)

renowned Cobra maneuver. He entered at 220 knots and 10,000 ft. The power was set at 85 percent. By pulling back very quickly on the stick, he achieved a 90° pitch attitude while the aircraft was still traveling in the starting direction (see illustration on page 42). I noted that speed had decreased to 83 knots after the maximum pitch was attained. Pougachev routinely achieves a 130° pitch attitude during the Cobra maneuver in the single-seat Su-27, which has its center of gravity farther toward the rear.

Although the Cobra maneuver is not something a pilot would try in actual combat, it is a good indicator of an aircraft's slow-speed maneuverability. It demonstrates that the Su-27's nose can be aimed very precisely.

The rest of the flight was uneventful, and vectors from London Military Control enabled me to spot the airport. I made a standard Navy carrier break at 1000 ft. and 300 knots. I found the Su-27 to be responsive to pitch and roll control and small engine power changes throughout the approach and landing. Touchdown came at 125 knots with a 12° angle of attack. We had used 7400 pounds of fuel during the 1.1-hour flight.

## May the best pilot win

It would be difficult to say whether Soviet or U.S. fighters would have a clear advantage in all cases during combat. I believe that in long- and medium-range combat with Phoenix and AMRAAM missiles, the Western fighters would have the edge with their more reliable detection, identification and radar systems. On the other hand, the Soviet aircraft currently have the edge with an operational passive infrared search-and-track system. When it comes down to close-in fighting with either infrared missiles or guns, the winner between the Soviet-designed aircraft and the Western fighter will depend upon the ability of the pilot.

The Soviets are attempting to rectify what they see as the shortcomings in their aircraft. What they do in aerodynamic design, metallurgy and engines, they do extremely well. Now, they are working to upgrade the avionics in their aircraft to give pilots better situational awareness.

During interviews, top Soviet designers, such as Mikhail Simonov at Sukhoi or Rostislav Belyakov at Mikoyan, have been very open when discussing variants of current fighters. But ask a question about the next generation of fighters in development, and the Red wall comes down. **PM**



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# DETROIT SPY REPORT

BY JIM DUNNE, Detroit Editor



## Fresh-Air Firebird

● For the first time since the launch of GM's current F-car series back in 1982, Pontiac plans to add a convertible to its Firebird lineup.

Like most limited-production rag-tops, conversion work will be handled by a specialty shop—in this case, ASC in Detroit. However, the cars will be sold through Pontiac dealers and carry a full factory warranty.

Shown here in Trans Am trim, the cars will be available with most Firebird options. Engine choices, however, will be limited to GM's 3.1-liter V6 and 5.0-liter small-block V8, the latter with a choice of throttle body on tuned port-injection systems.

Limited production means just that. Pontiac insiders say that only 2000 of the droptop Firebirds will be available during the 1991 model year.

## Flowerpot Turbine Wheel

Those new turbine wheels General Motors is testing for use in turbine engines are related somewhat to common clay flowerpots. The two use similar materials, and they are molded in a similar way. Designed to withstand 2500° F in a turbine engine, the wheels are cast from a mixture made up of common elements like carbon, nitrogen and sand.

The recipe is simple. Mix the ingredients into a powder, add a liquid binder, inject that slurry into a mold, then fire in an oven. The mixture

shrinks as moisture leaves the slurry, and quickly forms a dense, hard material, perfect for the intense heat of the turbine's flame.

In addition to offering 600° F greater heat resistance, the flowerpot wheels are 40 percent lighter in weight than the nickel they replace. They spin up to speed more quickly, cutting response time. And they are made from inexpensive materials.

## 1992 Suburban

A prototype of the 1992 Suburban caught running without its usual disguise panels shows the extent of changes planned for the popular Chevy and GMC highway hauler.

While the front-end styling and cab are closely related to those of the 1991 full-size GM pickups, the passenger compartment and rear end are completely restyled. Gone are the angular lines and slightly curved window glass. Also, glass fits more flush with the sheetmetal. At the rear, the door

and glass form a rounded surface.

A new engine option will be a 6.5-liter turbocharged V8 diesel, a powerplant that's intended to match the light-truck diesels from Ford and Chrysler.

## Chrysler's Automatic Transmission Woes

Originally hailed as a significant technological achievement, the new electronically controlled 4-speed automatic transmission that Chrysler introduced two years ago for its V6 engines has proved troublesome.

The culprit is an oil seal that tends to leak, which can lead to complete failure of the gearbox.

One consequence is that, at times, two drive gears are engaged simultaneously, with predictable results: The car goes nowhere.

Chrysler has already made a running change on transmission currently in production to cure the problem, and is taking care of owners—free of charge—who have encountered problems with cars already on the road.

*(Please turn to page 108)*



Due for introduction as a '92 model, GMC's Suburban features more rounded look, flush glass.

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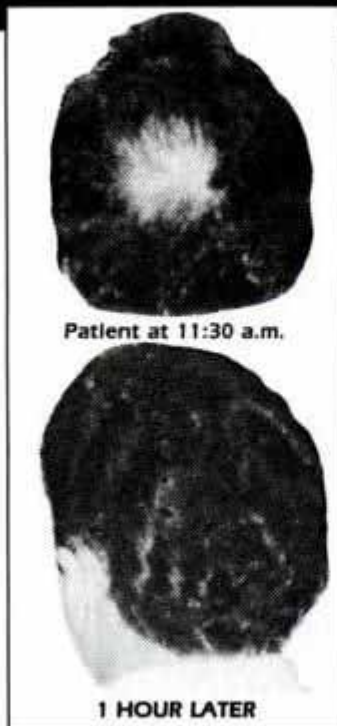
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while the performance option will be a new 3.5-liter dohc 24-valve V6, developed from the 3.3 block.

## Saturn Setbacks

Determined to maintain high quality standards from day one, the Saturn Corp. is having difficulty getting its cars into high production.

Quality control-related delays have set Saturn delivery schedules back by three months or more.

While this policy is likely to pay off in the long run with improved customer satisfaction, it's created short-term embarrassment. For example, dealers in some areas of the United States had no cars to sell for their scheduled grand openings.

One big problem is wind whistle that comes from loose-fitting plastic panels in the body. Another is centered on the car's new 4-speed automatic transmission.

Also, excessive vibration in the new all-alloy engines has been criticized right from the first prototype drives, and Saturn engineers are still sorting that one out.

## 1992 Taurus

Although both Taurus and Sable continue to look contemporary, Ford will perform a major facelift on its midsize sedans next year.

The redesign will be the first the cars have had since their introduction in 1986.

Smaller headlights and more rounded bumpers alter the front appearance. At the rear, taillights are set higher and wrap farther around the corners of the fenders, lending a more integrated appearance to the Taurus and Sable.

These changes are the only ones scheduled until the 1995 model year, when both Taurus and Sable will get completely new bodies.

## V6 Takeover

Look for V6 engines to take over in many of the small cars that now offer

## DETROIT SPY REPORT

*(Continued from page 106)*

### Chrysler's LH Models

While they may look like nothing more than standard Eagle Premier models with fender flares, the bodywork actually covers chassis and running gear for the next generation of Chrysler midsize sedans, code-named the LH.

The modified wheelwells were necessary to accommodate the wider track and longer wheelbase planned for the new front-drive cars.

Chrysler insiders report that the LH sedans will ride on a 113-in.

wheelbase, long for a midsize car. Overall length, however, will be a tidy 194 in. Front-end overhang, in particular, will be limited, consistent with Chrysler's new cab-forward design philosophy.

The new LH sedans are scheduled for introduction as 1993 models, wearing Dodge and Eagle nameplates, and are aimed at the Ford Taurus/Chevy Lumina market segment.

A stretched version wearing Chrysler badges is slated for the 1994 model year.

Home-grown Chrysler Corp. engines will power the new cars. The base engine will be Chrysler's 3.3-liter pushrod V6,



Chrysler is using modified Eagle Premier sedans as test mules for its new LH sedan series, due for 1993. Fender flares and modified wheelwells cover wider track and longer wheelbase of the new chassis.

4-cylinder types.

Ford, for one, is investing in small V6 development that could produce 2.0- and 2.3-liter sizes, displacements assigned solely to Fours up to now.

Two needs come together in this swing to V6s—a call for a smoother running engine and the requirement for better fuel economy.

Yes, the new Sixes will match the Fours in fuel economy. And there's no question that a 6-cylinder wins every time in the quest for smooth, quiet operation.

## Toronado Quattroporte

Get ready to say goodbye to the 2-door Toronado in 1993. Olds plans a 4-door body style for its personal luxury car when the 1994 models are introduced.

When that happens, it's also likely that a new name will be given to the sports sedan. Insiders are betting that Trofeo will be the name to embrace the new line.

Look for this car to be smaller than the new Cadillac Seville, since GM plans to use the Eldorado chassis as its starting point.

Reason for the change to a 4-door body style: Olds wants—and needs—an exclusive, a vehicle unlike any other in GM's lineup.

## MPG At FoMoCo

Ford claims that fuel economy for its cars has improved a bunch in the past 13 years.

Example: The worst economy in today's Ford lineup is the Lincoln Mark VII. It gets 19 miles per gallon on average. That's not much, but nevertheless, it's better than Ford's best fuel miser in 1977, which was the Mercury Bobcat.

## The Pace Of Change

Detroit automakers talk these days about their speed in bringing a new car to market. Product cycle time for some models is now as little as three to four years.

But the recent introduction of two full-size models shows how slowly this process is for some cars.

Chevy's Caprice, for example, has a new body for 1991, precisely 14 years after the car was last updated. Ford's Crown Victoria was in production 11 years before the redesigned 1992 model was unveiled.

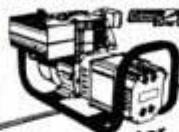
Automakers explain this by saying that their new-product money went to smaller, more popular models. However, the Chevy Caprice and Ford Crown Vic were once the top sellers of all models and are still in strong demand today.

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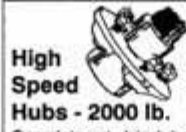
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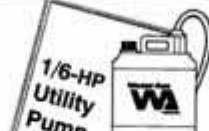
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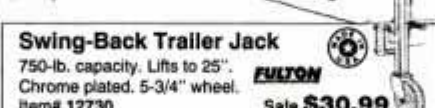
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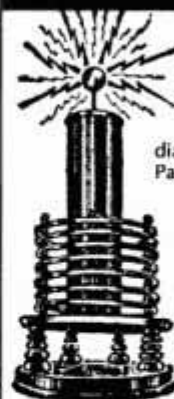


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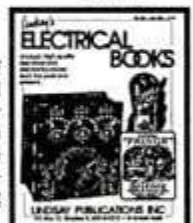


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# REWRITING THE LEGEND

BY TONY SWAN, Automotive Editor



● Longer. Lower. Wider. Faster. The marketing idiom belongs to the '50s, but it could easily be employed to describe the new Acura Legends.

Although it takes a close look to tell the second generation from the original, scarcely a rivet or a weld has escaped redesign, the first since the series was launched five years ago.

Where all this is likely to count most is under the hood. One of the few complaints about the original Legend was milquetoast muscle—its 2.7-liter sohc 24-valve V6 was fine for cruising, but far from nosebleed acceleration.

## 200 hp

Honda addressed this with a new version of the V6—more bore, more stroke, more displacement (531cc), more hp (200 at 5500 rpm) and more torque (210 ft.-lb. at 4500 rpm, versus 162 for the 2.7 version).

There are some interesting technical changes to go with the increased displacement. The 2.7-liter V6 employed a novel valvetrain that used lateral pushrods to run the exhaust valves. The 3.2's setup is more conventional, with rocker arms for each set of valves. Remarkably, Honda has reduced valvetrain reciprocating mass by 15 percent in the process.

Taking a page from the NSX V6, Honda uses direct ignition with a mini coil for each platinum-tipped plug, and the plugs are now angled into the center of the combustion chamber.

Compression has been bumped from 9.0:1 to 9.6:1, requiring premium unleaded fuel, and both cylinder

banks have knock sensors.

Combined with a refinement of the previous variable induction system, the various changes add up to plentiful top-end power and an improved torque curve. Although the new car weighs some 300 pounds more than the original (the price of longer, wider and so on), it's capable of doing the 0-60 dash in less than 8 seconds.

A key element in the longer (wheel-



Legend's new 200-hp 3.2-liter sohc 24-valve V6 mounts longitudinally.

base by 5.9 in., 4.3 in. overall) part of the equation is the engine mounting, which is now longitudinal, rather than transverse. Honda cites better weight distribution (60-40 versus 65-35) for this change, as well as improved control of torque reaction in the drivetrain. The transmission bolts to the rear of the engine.

Although the double wishbone front suspension is familiar, the aluminum front subframe is new, and, with the longitudinal engine, delivers two key benefits. The first—im-

proved noise isolation—is subtle: The original Legend was as quiet as a church on Tuesday. But the second—a 2.3-ft. reduction in the car's turning circle (34.8 ft. versus 37.1)—is welcome.

The new rear suspension—lower A-arms with an upper lateral link and trailing arms—bolts to a steel subframe, and there are antiroll bars at both ends. Steering is rack and pinion, with speed-sensitive variable assist. It's still slow (3.64 turns lock to lock), but high-speed feel is better.

Braking, excellent in the original, is simply superb here. The rotors are 11.1 in. all around, and Honda's anti-lock braking system is standard.

Interior refinements are also subtle, the most obvious being more room. The extra length and width (2.4 in.) add up to tangible improvement in interior volume, particularly in the back seat. Fit and finish are excellent, control layout first rate and driver sightlines virtually unobscured.

## Legendary manners

On the road, the Legend continues to be one of the most mannerly of all luxury sedans, with the welcome plus of more go-power. More wheelbase means even better ride. We'll reserve judgment on handling for a formal road test, though we're willing to say it's still not in the BMW class.

Pricing will run from \$26,800 for the basic sedan to \$34,200 for a maxed-out Coupe. This isn't cheap, but in its class, the new Legend may still be the best buy going. **PM**

# CHECKING OUT A TURBOCHARGER

BY PAUL STENQUIST

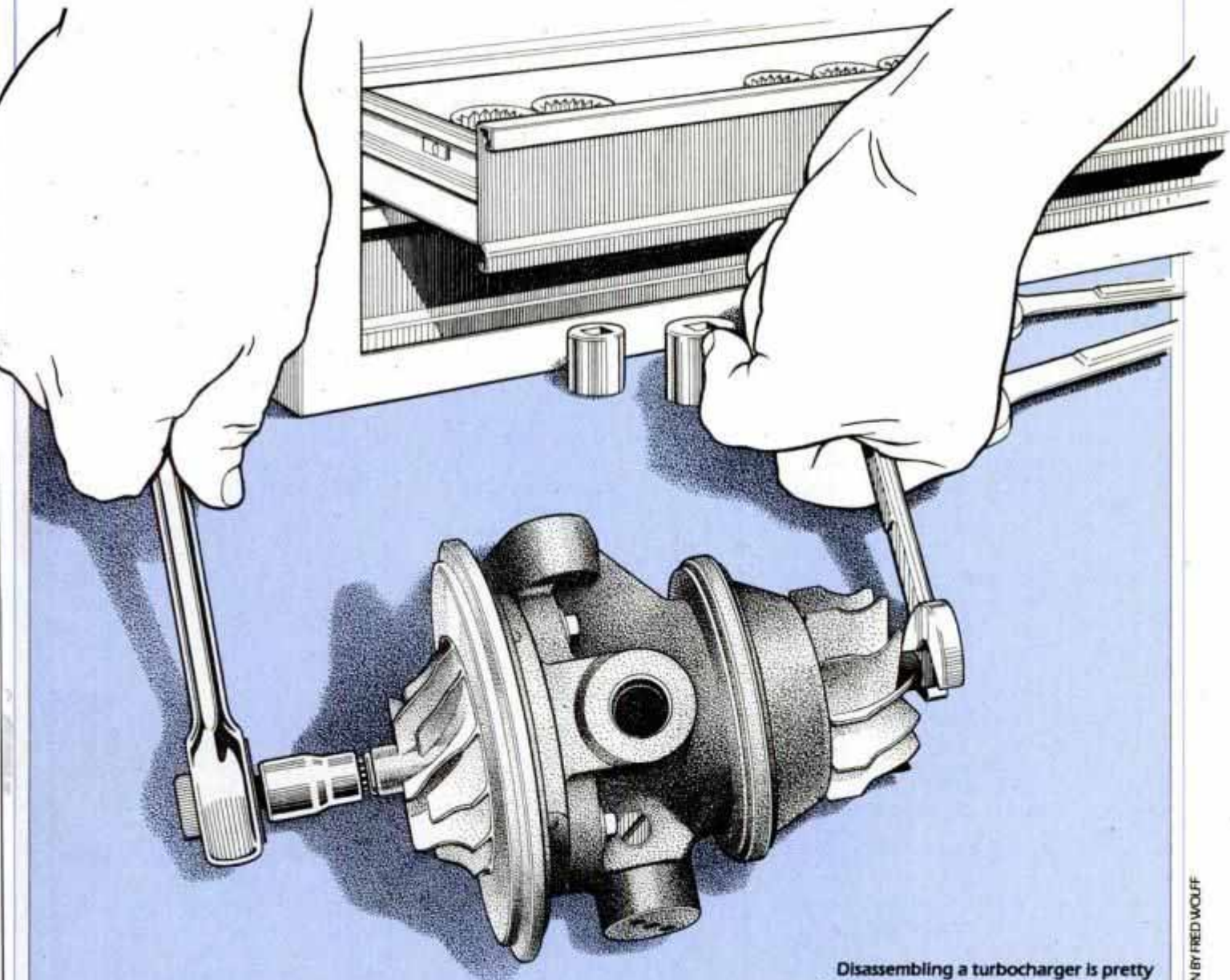
● It's your turn to ferry mother-in-law to her weekly Mahjongg night, and she's running late. Not a problem. You've got a turbo under the hood—just the ticket to make up a few extra minutes.

Suddenly, there's a buzzing noise. Power goes down, and a cloud of blue

smoke goes up in your mirrors. What gives?

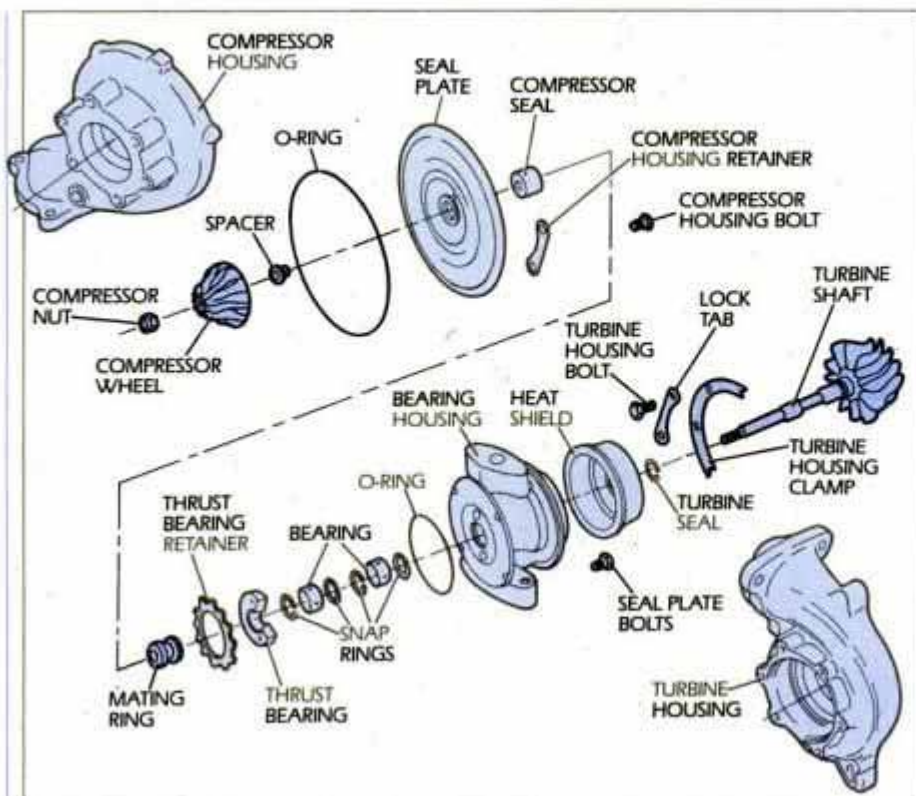
You've blown your turbo. Not only is Mom going to be late, you just *know* this is going to set your bank account back a few dragons. Say as much as \$2000, depending on the manufacturer and the dealer's parts department.

Take heart. All is not lost. In spite of their high-tech basis in thermodynamics, turbos are actually simple creatures. With some respect for the extremely close tolerances involved, it's possible to rescue many blown turbochargers, possibly for less than \$100 and some simple hand labor.



Disassembling a turbocharger is pretty straightforward business—just be careful, as the slender turbine blades are fragile. If you're lucky, you'll be able to use an open-end wrench on the turbine end of the shaft.

PM ILLUSTRATION BY FRED WOLFF



An exploded view of a typical Garrett T3 turbo. Expect to see some minor variations.

## Theoretically

As you nail the throttle, hot exhaust gases rush through the exhaust (turbine) housing, spinning the turbine wheel with energy from the otherwise wasted heat in the exhaust. The turbine wheel is mounted on a shaft that drives a compressor wheel. The compressor takes air in through the air cleaner and pushes it into the intake manifold. This extra air causes intake manifold pressure to be higher than without the extra push.

When the intake valves open, pressurized air rushes into the engine's cylinders while the carb or injection adds fuel to match. And your relatively small powerplant pumps out horsepower more typical of much larger engines.

Turbochargers operate under very taxing conditions. And failures are not uncommon. However, many total failures can be prevented if you recognize the symptoms early and do something about it. There are a number of symptoms that indicate possible turbocharger problems. We'll outline some of them here and then show you how to rebuild a turbocharger.

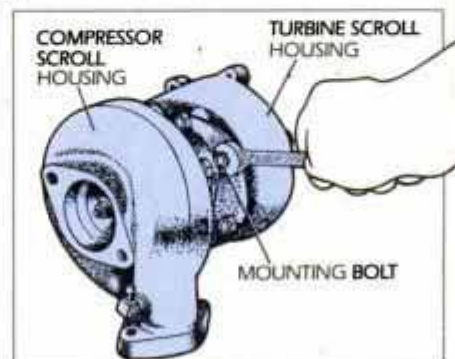
## Low boost

One common turbocharger problem is a lack of boost—first noticed as a loss of engine power at full throttle.

If your car is equipped with a boost

gauge, as most turbocharged cars are, you'll immediately notice any drop in boost pressure. If your car is not equipped with a boost gauge, you can check boost by installing a pressure gauge tap in the intake manifold and routing a hose to the passenger cabin. Then, while driving the car at full throttle under heavy load, check the boost reading on the gauge. If it's significantly less than manufacturer's specs, you have a problem.

Before condemning the turbo, check for a clogged air filter, an obstruction or leak in the duct that joins the turbo's compressor outlet to the intake manifold, an intake manifold gasket leak, a leak or obstruction in the exhaust system, or a wastegate problem.



You'll need an open-end wrench to disassemble the scroll housings.

Wastegate leakage is a common cause of low boost pressure. The wastegate is a device that opens to divert exhaust at a predetermined level of boost to prevent overboosting. Wastegate leaks are usually caused by carbon accumulation around the wastegate itself. A weak or broken return spring or a defective wastegate control canister (wastegate actuator) can cause the wastegate to open too early, preventing full boost.

However, a control canister failure will usually result in overboost. And because overboost can cause serious detonation problems, it could damage your engine. Other causes of wastegate-related overboost include an obstructed hose between the compressor and the control canister, a leaking canister and a canister diaphragm failure.

On a lot of newer applications, the wastegate canister operation is computer regulated by means of a solenoid. If the solenoid fails to open, overboost can result. If the solenoid fails to close and never limits the application of boost pressure to the canister, low boost pressure may be the result.

If you've ruled out other potential causes and the turbocharger seems to be at fault, you can disassemble it to determine the extent of damage and whether or not a fix is practical. Sometimes a loss of boost is merely the result of dirt accumulation on the compressor blades. More often, it's the result of damaged compressor or turbine blades.

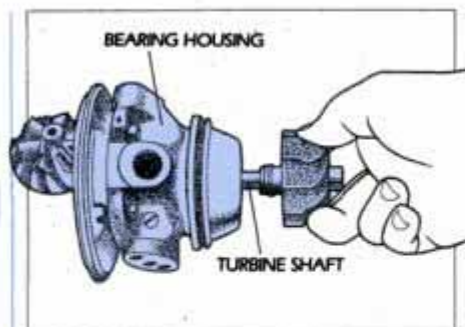
The working parts of the turbo—shaft, compressor, turbine and bearing housing—can sometimes be purchased without the two scroll housings. This assembly is known as a cartridge. If you decide to replace the cartridge, see the rebuild instructions that follow in regard to disassembly of the housings.

If either the turbine housing or the compressor housing is damaged, the turbo can't be rebuilt in the field and should be replaced. In many cases, turbine or compressor failure damages the housings as well.

## Turbo noise and vibration

Strange noises or vibration at the turbocharger usually indicate failure of the turbocharger bearings and/or damage to rotating parts that have caused an out-of-balance condition. In most cases, the damage to the turbo is fairly serious by the time things start shaking and shrieking. A cartridge replacement will usually be necessary





The turbine shaft can be withdrawn once the compressor nut and wheel are removed.

to cure a vibration or noise problem. Sometimes, an accumulation of dirt on the compressor can cause imbalance.

### Exhaust smoke

Perhaps the most common signal of impending turbo failure is a puff of smoke when you first start the car in the morning. This condition can worsen quickly to overall smoking and eventual loss of turbo boost. Smoke is the usual first hint that something is going wrong. And it signals the best time for you to try to do something about your turbo problem. In many cases, total turbo failure will occur within 5000 miles of the time when smoke first appears in the exhaust.

But before you dig into the turbo, consider some other possible causes of smoke. Of course, an internal engine problem can cause smoke. Valve guide wear causes a smoking condition similar to that caused by turbo seal failure, though it rarely comes on all at once.

Even turbo-related smoking may be caused by something other than failed turbo seals. On a diesel, a clogged air filter can lead to pressure considerably below atmospheric on the compressor side of the turbo. This can cause oil to be drawn past the compressor seal. On the other hand, a clogged turbo oil-return pipe can cause excessive oil pressure and eventual loss of oil past the turbo's seals into the intake and exhaust systems.

But the most likely cause of turbo-related exhaust smoke is coking of the turbine shaft due to overheating of the lubricating oil. The abrasive fried oil (coke) grinds away at the turbo's shaft bearings. Once the bearings have worn, the shaft wobbles. This causes failure of the seals that separate the turbine and compressor from the oil-pressurized center bearing housing. Once oil enters the turbine and compressor housings, it's drawn into the intake manifold and exhaust systems.

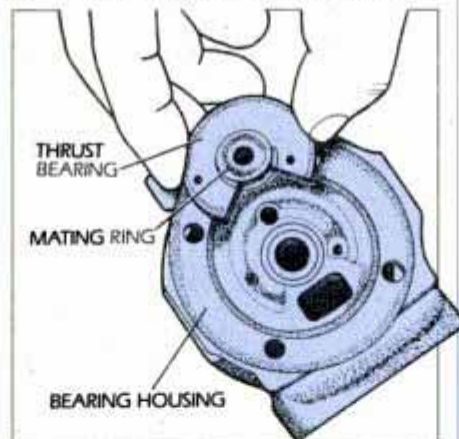
The relatively easy fix for this condition is seal and bearing replacement. A number of aftermarket manufacturers provide replacement parts for passenger-car turbochargers. One that we are aware of (Turbo City, Inc., 1137 W. Katella Ave., Orange, CA 92667; (714) 639-4933), sells a rebuilding kit intended for someone who has never rebuilt a turbo. The kit includes all the seals, bearings, O-rings, thrust plates and gaskets needed to rebuild a turbo, as well as instructions outlining the job.

That same company sells complete turbos and turbo cartridges (the working parts exclusive of the scroll housings). They will also rebuild your turbo for you if you want to ship it to them.

### Turbo rebuild

The rebuild procedure is easy for the experienced driveway technician. The instructions provided with the rebuild kit are fairly good, although one preliminary disassembly step was omitted. (Turbo City tells us they will be correcting this.)

The unit we rebuilt was the Garrett T3, the most common passenger-car turbo in the world. The only other



The thrust bearing (thrust plate) and mating ring can be lifted from the bearing housing.

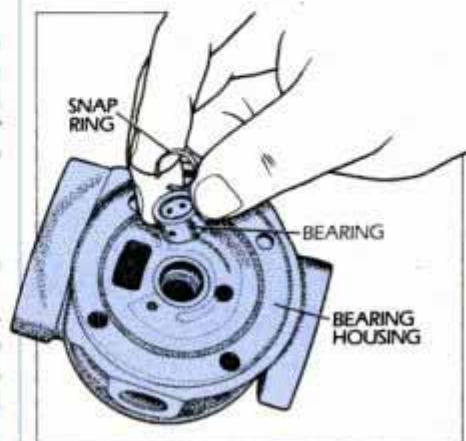
type you're likely to encounter is the Mitsubishi turbo, which is used on Mitsubishis and late-model Chryslers. The Mitsubishi and Garrett turbos are very similar, as are the rebuild procedures.

Before beginning the disassembly of the damaged turbo, we found that a brief examination of the new parts provided in the kit was helpful. This way, you'll recognize the parts you'll be replacing as you remove them.

Before you start to disassemble the turbo, mark the four main sections—turbine scroll, bearing housing,

seal plate and compressor scroll—with a scribe so you can reassemble them in the same relative positions. (This is the step that was missing from our instruction sheet.) Disassembly of the turbo begins with removal of the wastegate control canister or actuator, then the turbine and compressor housings.

Next is removal of the compressor nut from the turbine shaft. This can be tough because the shaft rotates



After removing the snap rings, the bearings will slide out of the bearing housing.

freely in the bearing housing. If you try to jam it by sticking something in the turbine or compressor blades, you'll ruin them. All turbo shafts are manufactured with a hex at the opposite (turbine) end of the shaft, but this is frequently ground away when the turbine shaft and wheels are balanced.

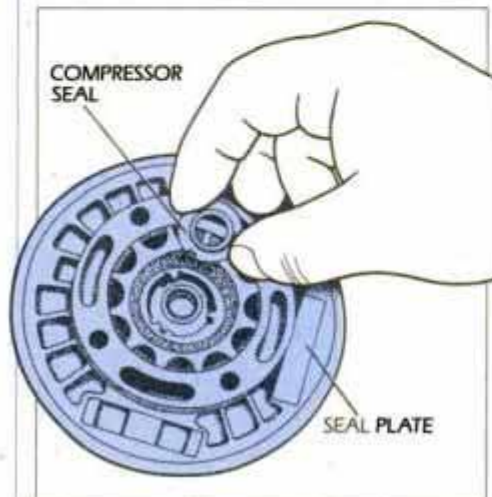
The turbo we rebuilt still had enough of the hex intact to permit restraint of the shaft with an open-end wrench. If you're not that lucky, hold the turbine wheel with a thick towel. If that doesn't work, try wrapping an old V-belt around the turbine wheel a couple of times. Then, hold the belt while you loosen the compressor nut. Turbo City does not recommend that you use an impact wrench, as it can bend the shaft.

The rest of the disassembly process is easy. First, you'll extract the turbine wheel and shaft from the turbine side of the bearing housing. If the shaft is coked, you may have to carefully tap on the compressor end with a plastic mallet. (Our moderately coked shaft came out with a light tap or two.) The compressor spacer will then slip right out of the compressor end of the seal plate. The turbine heat shield can be lifted from the bearing housing on the turbine side.

Next is removal of the seal plate

from the bearing housing, followed by removal of the compressor seal from the seal plate. The compressor seal in our turbo was a multipart drop-in unit. The top piece is simply lifted off the three locators in the housing. The internal part, along with the spring that preloads it, must be rotated until its notches align with the locating teeth in the housing.

Earlier turbos may have a press-in positive seal. Use a vise and socket to



Rotate the positive multipart seal to release it from the seal plate.

remove this type of seal.

Some turbos located upstream from the throttle body, like Saabs and Volvos, may have a dynamic seal that is very similar to the piston-ring-type seal found on the turbine side of the bearing housing.

Turning your attention to the bearing housing, lift off the thrust bearing, the mating ring and the O-ring that you'll find on the compressor side of the bearing housing.

You should use a good pair of snapping pliers to remove two outer snap rings (C-clips), one from each side of the bearing housing. Once these have been extracted, the bearings will slide out.

Finally, remove the turbine seal from the seal groove in the turbine shaft. Make sure you don't nick the edges of the seal groove.

Check all turbo parts for unusual wear. The instructions will point you to several areas of concern: the bearing housing bore, the turbine shaft seal groove, the compressor and turbine blades.

Clean all parts in a glass-beading machine or in cold carburetor dip. If you have neither, your local auto parts store or mechanic will probably be willing to do a cold dip for you. Any good machine shop should have a

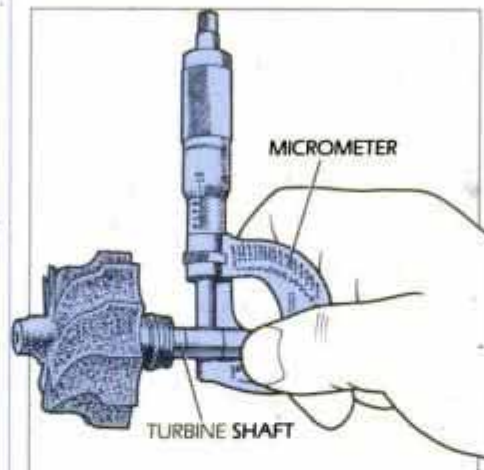
glass-beading machine. This gadget looks like a sandblaster, but uses smooth microscopic glass beads to remove carbon and rust without damaging the metal surface.

If not, you can purchase a moderately sized container of cold-dip cleaner along with a small parts basket at your auto parts store. Just make sure the can is big enough to dunk the housing scrolls. Give all the parts at least a 4- or 5-hour soak. You may have to brush some of the hardened coke deposits, but take care not to get the cold-dip solvent on your hands—it dissolves organic matter.

Before reassembly, check the diameter of the turbine-shaft bearing journals. For a T3, they should measure 0.3997 in. to 0.4000 in. The shaft in our T3 measured 0.3990 in. A call to Turbo City revealed that some previously rebuilt turbos may have 0.0010-in. or 0.0015-in. undersized shafts. Turbo City immediately sent us a set of 0.0010-in. oversized bearings for the rebuild—as they'll do for any customer who discovers an undersized shaft.

Of course, if your turbo has never been rebuilt, it is highly unlikely that it would be fitted with undersized components. The Turbo City bearings, by the way, are bronze severe-service units. The pieces they replace, in most cases, are normal-service aluminum bearings.

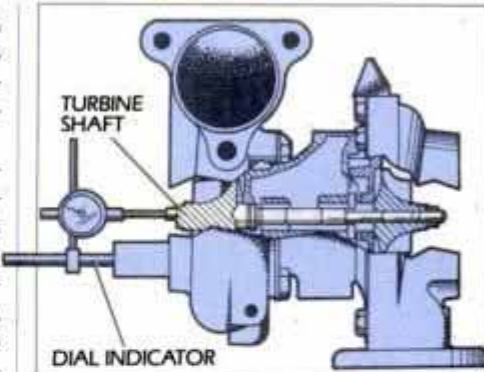
With a 1.0-in. snap gauge and micrometer or vernier caliper, check the



Mike the turbine shaft and compare this measurement to specs in your instructions.

diameter of the bearing housing bore at the point where the turbine seal contacts it. It should measure 0.6220 in. to 0.6223 in. When assembled on the turbine shaft, the diameter of the turbine seal ring (piston ring) should measure 0.709 in. to 0.711 in.

Assembly is basically the opposite



Check assembled end play with a dial indicator along the length of the turbine shaft.

of disassembly. Make sure you coat the shaft and thrust bearings with engine oil. Take care when installing the turbine seal on the turbine shaft. It must fit in the groove and rotate freely. Don't force the turbine seal into the bearing housing. When it is properly centered, it will slide in easily.

Tighten the compressor wheel nut to 18 to 20 in.-lb. plus 90°. When you reassemble the housings, make sure the compressor and turbine wheels do not contact any part of either housing. Install the wastegate actuator bracket before you bolt the turbine housing in place.

When reassembly is complete, you should check some other clearances, including axial end play (0.001 in. to 0.004 in.). Radial bearing clearance (the shaft's up-and-down movement) should measure 0.0030 in. to 0.0065 in. Check radial clearance with a dial indicator. On some turbos you can touch the shaft with the dial indicator's probe through the oil hole in the bearing housing. With the correct new bearings and a shaft that specs out on journal diameter, this measurement should be okay.

After installing your rebuilt turbo on the car, clean the oil inlet line thoroughly. Don't use RTV sealer on the oil inlet line connections—it can clog oil passages.

Change the engine oil. Then, pre-oil the turbo by cranking the engine with the coil wire disconnected. (On GM HEI systems with an integral coil, disconnect the distributor BAT wire while cranking.)

Once the oil pressure has come up, reconnect the ignition and start the engine. Let it idle for 3 or 4 minutes before test driving the car.

To prevent bearing wear in the future, run the engine at idle speed for about 30 seconds before you switch off the ignition. This will prevent loss of oil pressure to the bearings while the turbo is spinning at high speed. **PM**

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My name is Mark Reynolds. I am 34 years old, and in business for myself. My office phone number is 703-450-4780. My accountants name is Everett Callaway, CPA, and he has a copy of my financial statements showing that my net income was over \$200,000.00 last year.

I'm Not bragging, but ten months ago I went from driving an old clunker to owning a new Mercedes. Nine months ago I went from living in a small home in an old neighborhood, to Owning three homes; two are brand new.

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The following information is certified by my accountant who is a CPA in the State of Virginia.

**Bank Deposits for the last two months:**

1st week ..... \$2,898.71  
2nd week ..... \$4,243.00  
3rd week ..... \$3,141.00  
4th week ..... \$5,138.00  
TOTAL INCOME ..... \$15,420.71

1st week ..... \$3,750.72  
2nd week ..... \$2,970.51  
3rd week ..... \$4,941.00  
4th week ..... \$3,340.67  
TOTAL INCOME ..... \$15,002.90

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Here's what some of the people who have just purchased this exclusive money-making program have to say about their success so far .... (Actual letters are on file in my office.)

#### ● I Made \$22,000.00 Dollars.

Every time I think I almost didn't order your Money Making Program, I could kick myself. I made \$22,000.00 dollars using your program. If I had ordered your program the first time I saw your advertisement, I might be \$44,000.00 dollars richer today. But I'm not complaining, I'm glad I ordered it when I did. Thanks for everything.

A.E., Patchogue, New York

#### ● I Made \$25,000.00 in Just 120 Days.

Dear Mark. For years I have been looking for a money making method that can make some real money for a change. Yours finally fits the bill. I made \$25,000.00 in just 120 days. You're the greatest. Thanks.

R.W., Santa Monica, California

#### ● I Made \$27,000.00, And I Feel Great.

My life has been a mess up to this point. I used to sit around the house in an old T-shirt, drink beer, and watch TV all night. I guess I was depressed about being 35 years old and not even having \$500 bucks in the bank. Things are different now thanks to your "money making program." I made \$27,000.00, and the best part about your program is; I feel great about myself. Thanks.

F.L., Loudoun, Virginia

#### ● I Made \$74,000.00

Listen Mark. I don't know why I sent for your money making program in the first place. I think I was curious to see how you made so much money. I have my own business here in California and make over \$100,000.00 dollars a year. But I can tell you, honestly, that your program puts my business to shame. I spent two years of my life building this business; working twelve hours a day. Your Unique Program makes my life a whole lot easier. It's fantastic. I spent 15 weeks applying your methods and made \$74,000.00 dollars. Can you guess what I am going to do with my old business?

S.T., Los Angeles, California

**New Beginners Phone in Every Day From All Across America!**

Here's a sample of today's calls from people using the "unique" money-making program.

- A New York man told me over the phone that he uses the program, on weekends only, to make over \$3,500 a week.
- Another man, from Los Angeles, California started the program part-time. Today he told me on the phone his income just reached \$2,000 a week.
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## OLD HOUSE RESTORATION

# MAIL-ORDER RESTORATION

BY BOB VILA, Contributing Editor



PHOTO BY ROSARIO CAPODOSTO

● Half the battle in restoration work is finding the right products to complement the period look of your home. Sometimes you can find these products locally through classified ads or simply word of mouth. Foraging trips to summer flea markets can also yield excellent results. But often you'll be stymied by all your local sources and will need to turn elsewhere.

As part of my research for past stories, I've accumulated an impressive array of product catalogs featuring all types of hardware, fixtures and other supplies. This month, I'm sorting through these piles to recommend those that I think are especially useful for finding proper period products.

### Historic lighting

Whether your house is Colonial, Early American or Victorian, proper period light fixtures will go a long way toward creating the feel of your home's original era. For those with a house built in the early days of our

country, there are several companies that sell authentic fixtures.

Browsing through the catalog of Hurley Patenettee Manor (464 Old Route 209 Hurley, Kingston, NY 12401; \$3) is a mini-history lesson on handcrafted Colonial and Early American lighting. Within its pages, you'll find many reproductions including candle-burning chandeliers, most of which can be wired for today's electric bulbs. There's also a selection of Bettys (often originally made to hold a burning wick in an oil-filled cup) designed to accommodate candles. Tin and iron candleholders and wall sconces, along with a variety of 18th-century lanterns, give the restorer a wide array of reproduction products to choose from. There's even a selection of brass fixtures found later in the period.

Another fine catalog of late 18th- and early 19th-century lighting reproductions is from Authentic Designs (The Mill Road, West Rupert, VT 05776; \$3). It contains many up-turned-armed chandeliers with either wood-turned or solid-brass centers,

A variety of mail-order sources offer restoration enthusiasts access to hard-to-find products and the convenience of home shopping.

and a selection of brass and wood wall sconces.

For those looking for the more ornate Victorian chandeliers, Victorian Lightcrafters, Ltd. (P.O. Box 350, Slate Hill, NY 10973; \$3) and Victorian Reproduction Lighting Co. (P.O. Box 579, Minneapolis, MN 55458; no charge) offer a variety of fixtures. These include electrified recreations of Victorian gasoliers with their ornately embellished upward-facing arms and glassware covered flame. Early electric chandeliers, with their downward-facing arms, and the popular combination gas and electric fixtures, are also available in different designs and prices. (For a more complete list of period lighting manufacturers, see "Period Light Fixtures," page 48, April '88.)

### Bathroom basics

One of the first rooms many old-house owners long to restore is the bath.

*"Home Again With Bob Vila" is the title of our contributing editor's new TV show.*

Thanks to the manufacturers supplying period fixtures and fittings, it is possible to bring this room up to today's standards while maintaining, and in some cases increasing, its period feel. If you've inherited a remodeled old house bath, replacing a modern tub/shower combination with a clawfoot or balled tub, for example, will do wonders to bring this room back to its proper period. Adding a high-tank toilet with a pull-chain adds a lot more period charm than today's standard commodes. Today's vanities can't match the graciousness of a pedestal sink.

You'll find a wide array of products like these, along with a selection of appropriate faucets and fittings, in the many supplier catalogs devoted to bathroom restoration. This includes items like tub mixer faucets with porcelain hot and cold cross handles, single-hole sink mixer faucets, and porcelain or wood pull-chain knobs for oldtime toilets.

Some of the suppliers in this arena offer both reproduction pieces and original antique fixtures. The stock on hand for the latter, of course, changes constantly. One catalog that features a good mix of reproduction and antique bath fixtures is from Bathroom Machineries (495 Main St., P.O. Box 1020, Murphys, CA 95247; \$3). Besco Plumbing (729 Atlantic Ave., Boston, MA 02111; \$5) also presents a good array of reproduction bath fixtures. When it's time to do something with your old house's bathroom, you'll get a wealth of ideas from manufacturer literature like this. (For a more complete list of bath fixture suppliers, see "Reproduction Bathroom Fixtures," page 32, June '88.)

### Hinges, doorknobs and more

The last two catalogs I've pulled from my collection deal with a variety of period hardware and accessories. Both are full of products to aid the restorer and new homeowner alike. You'll note some overlap in the categories I've already mentioned—period lighting and bath fixtures.

A good source of reproduction hardware, the Ball And Ball catalog (463 W. Lincoln Hwy., Exton, PA 19341; \$5) includes lots of interesting information on the antique reproductions offered within its pages. Unlike some other catalogs, this one is broken down into sections that cover different areas of restoration. Of particular interest to the old-house restorer are the sections on 17th- and 18th-century house hardware and Victorian hardware.

The pages on Early American hard-

ware cover items like cylinder key box locks, iron thumb latch sets and strap hinges, doorknobs and handles, and even blind and shutter hardware. The pages devoted to Victorian period hardware feature a variety of items, including ornate bronze hinges, cast-iron sash locks, cast-brass doorknobs, plates and even a letter slot.

The catalog from Hardware + Plus (701 E. Kingsley Rd., Garland, TX 75041; \$5.50) is divided into several sections that address a myriad of restoration issues.

The one I found most interesting is

devoted to door hardware. The Victorian restorer will find a wide selection of mortise lock sets, ornate lock plates and knobs. Other products include ornate finial-tipped brass hinges, a variety of door knockers spanning several periods, and even a few Victorian twist doorbells. For those reviving the Colonial spirit in their homes, black iron strap hinges, Early American H and butt hinges, and thumb latch sets are just a few of the offerings in this area. (For a more complete list of period hardware suppliers, see "Restoration Hardware," page 42, June '90.)

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## ELECTRONICS

# VIDEO AIDS

BY FRANK VIZARD, Electronics Editor

● Today's palm-sized camcorders are true marvels of technology, but in many cases they lack one feature without which you'll always be in the dark.

The subject, of course, is lights. Sima Products Corp., the Skokie, Illinois, video accessories company, offers a light that can be used on any small camcorder. Called the CamLight 5, this light connects quickly to the camcorder's accessory shoe. If the camcorder does not have an accessory shoe, there's also a lightweight mounting bracket that screws into the tripod socket. The CamLight 5 lists for \$80. With the mounting bracket, list price is \$88.

The CamLight 5 offers 20 watts of illumination from a rechargeable nickel cadmium battery for about 30 minutes. CamLight 5 uses a quartz halogen lamp, and a battery charger is included in the package. Sima can be reached at (708) 679-7462.

You may be more particular about the type of light you want, however. In that case, the VB-1 mounting bracket made by Sunpak may be the answer to your lighting needs.

The VB-1 is designed for camcorders without an accessory shoe. Specifically, this includes the Sony-TR line, as well as the equivalent models from Nikon, Ricoh and Kyocera. The bracket itself measures only 5.1 x 1.8 x 0.6 in. and weighs 2.2 ounces. The bracket attaches between the camcorder body and the battery pack. With this type of bracket, there is a potentially wider choice of lights you can use.

List price for the VB-1 is \$30. Sunpak is located in Hackensack, New Jersey, and can be called at (201) 342-9503.

### Film To Video

You can put your photographs on videotape with an

You can put photos on videotape with Tamron's Fotovix III.



interesting device called the Fotovix III made by Tamron, a company based in Port Washington, New York.

The Fotovix III looks like a microscope from a high school chemistry class and, in fact, operates similarly. The Fotovix III works with either slides or photo negatives. All you do is insert the slides or negatives into a carrier for positioning beneath the device's lens. A video output transfers the image directly to the video input of your videocassette recorder.

The Fotovix III has some features that can make poor photographs look better. You can increase the brightness level to make dark images more visible. The machine also has a 3X zoom lens so you can make a portion of the photograph bigger. Not only is the zoom lens handy for making minute details larger, but it's also a way to preserve the best part of an otherwise poorly shot photograph.

We found the Fotovix III works best with slides. You can record negatives simply by switching from the Positive to the Negative mode at the touch of a button. While the Fotovix III does include a color-adjustment toggle control, it takes a steady hand to get colors true to life. This is not much of a problem when using slides.

Fotovix III also has some interesting applications for the home videomaker. By using this machine, you can mix still pictures with live video. You can also create some nice special effects by creatively using the color-adjustment toggle control and the Positive/Negative switch. For example, if you wanted to visually show the end of the world for your own science-fiction epic, you could end your video with a still picture. You could then either color the image all red or switch to the Negative mode for dramatic effect.



Still images are also more effective when you can blow them up to fill a TV screen. The Fotovix lists for around \$800.

### Easy VCR Programming

Weirdly enough, as videocassette recorders became less expensive over the years, they became harder to program. Even President Bush has alluded to people's inability to program their own VCRs. Now, an easier way to program your VCR is becoming widely available.

The product is called VCR Plus+, and while it is available as an accessory, RCA intends to incorporate VCR Plus+ technology into a number of RCA and GE brand VCRs this year.

By now, you may have seen references to VCR Plus+ in your local television listing. The concept is relatively simple. After each program listing, there is a series of numbers. All you do is punch in the numbers listed for the program into the handheld remote control. Date, time, channel and length of recording time are automatically set. Taping a show becomes a 1-step process.

VCR Plus+ also works for cable TV subscribers since it controls both the VCR and the cable box. This means you can switch between cable channels during an unattended recording, a task otherwise virtually impossible for most cable TV subscribers.

RCA's endorsement of the VCR Plus+, and its acceptance by many leading TV programming guides means the product is here to stay. As an accessory, VCR Plus+ is available from Gemstar, a company located in Monterey Park, California. List price is \$60. Call (818) 282-6648 for a dealer near you.

### Better TV Reception

In those instances when neither an outdoor antenna nor cable television is available, the reception offered by the TV's indoor antenna is woefully inadequate, particularly if you live in a fringe area.

One way to improve TV reception in this situation is to upgrade the quality of the indoor antenna. One product we admire for its looks and for its abilities is the Recoton TV600 Power-Wave antenna.

Listing for \$90, the TV600 uses an amplifier to grab even faint signals. Operation is simple. Just adjust the gain control until the picture is at its clearest. In rural areas, decreasing the gain will help improve reception of distant signals. In urban areas, decreasing the gain will help eliminate problems caused by signal overload.

The circular portion of the TV600 acts as a UHF antenna. The whole antenna swivels 45° front to back and 45° right to left. Use the gain control again to monitor picture quality. Recoton is based in Long Island City, New York, and can be reached at (718) 392-6442.

### Single Speaker

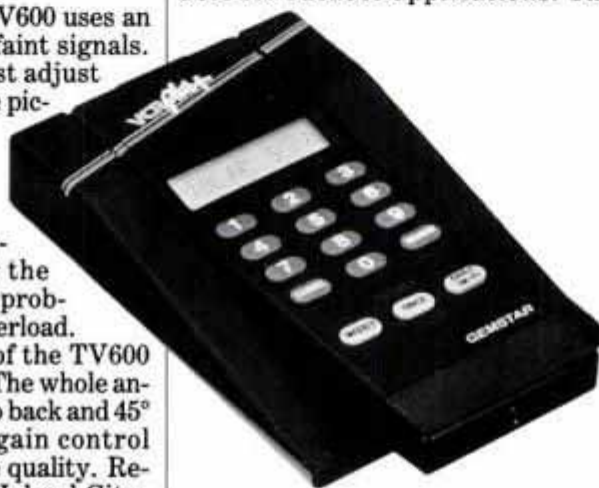
Dolby Pro Logic circuitry calls for the use of a single center-channel audio channel in home theater applications. The problem is that speaker manufacturers generally sell their products in pairs.

One of the first to sell a speaker model singly is Altec Lansing. The Milford, Pennsylvania-based company's Model 66 is a small, 2-way speak-



The Recoton antenna offers better UHF and VHF television reception.

er listing for \$200. The speaker is magnetically shielded so it can sit atop a TV without interfering with picture quality. Model 66 is also sealed inside a weatherproof cabinet so it's suitable for outdoor applications. The



Programming a VCR is as simple as inputting a numerical code. The new device costs \$60.

speaker measures 15¼ × 7⅞ × 7 in. and features generally good specifications.

Frequency response ranges from a low of 45 Hz to a high of 20,000 Hz. The good bass response of this speaker is partly due to the use of two 6-in. woofers. Altec Lansing recommends using at least 10 watts of amplifier power to drive the Model 66. The speaker's peak power handling capacity is 350 watts. **PM**



Altec Lansing's Model 66 2-way speaker is perfect for video applications.

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# Popular Mechanics

## DESIGN & ENGINEERING AWARDS

● We announced the 1991 Design & Engineering Award winners in our January issue. Now we're ready to begin nominations for our 1992 awards.

The POPULAR MECHANICS Design & Engineering Awards are our way of recognizing exceptional new products, new ideas, new innovations and improvements on existing products and ideas. Of course, our pages are filled each month with new products and new ideas. But sometimes, an idea is so good that we feel the need to recognize it in a special way. That's why we created the PM Design & Engineering Awards.

Each year, our editors will review and select their choices for the most significant new products in each of their areas of expertise—cars, boats, outdoors, home improvement, science, technology, electronics, photography. Since we cover so many different areas editorially, to us a "new product" might be as simple as a hammer or as complex as the Space Shuttle. Our award selections will reflect this wide editorial spectrum. The criteria for winning an award will be left up to our editors, each an expert in his own field. It could be a new innovation in materials, a design no one ever thought of before or an improvement on a product that has existed for years. And there is no set number of awards to be given. Our editors will make their selections at the end of the year, and we'll announce our 1992 winners in the February 1992 issue.

Our editors are already on the lookout for possible nominees. But we also invite you to make a nomination. If you'd like to nominate a new product, a new design or just a good idea, please let us hear from you. Call us on the PM Hotlines, write or fax your nominations to the appropriate editor. Be sure to include all pertinent information that will help us decide if your nomination is deserving of a POPULAR MECHANICS Design & Engineering Award.

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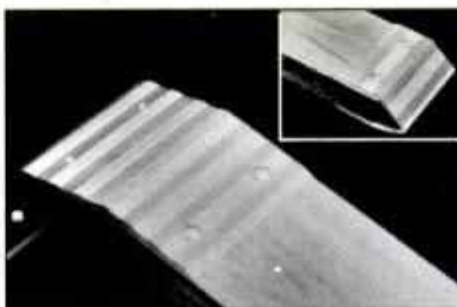
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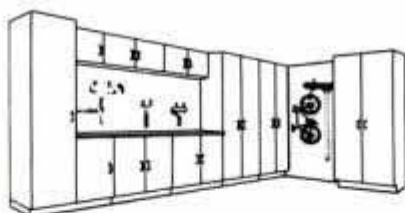
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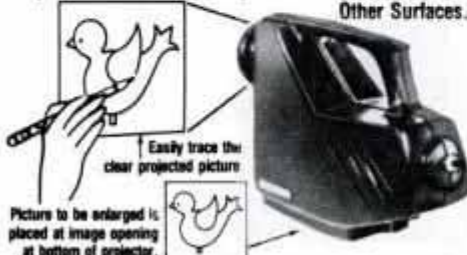


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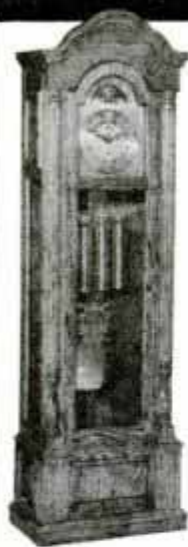
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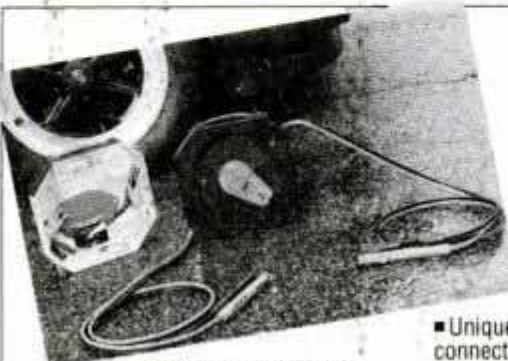
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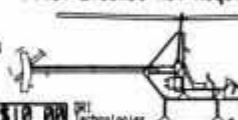
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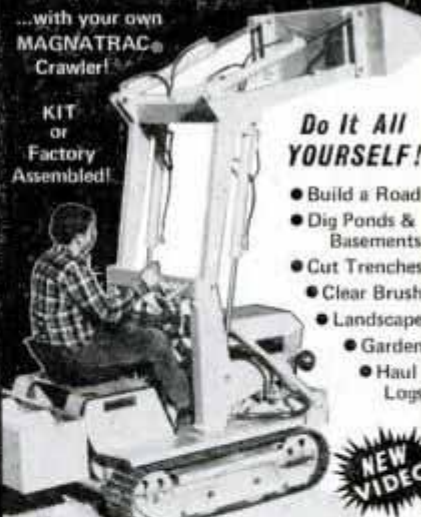
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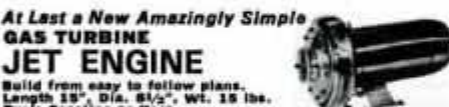
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Like monkey, like man.

If you take cocaine, you run a 10% chance of addiction. The

risk is higher the younger you are, and may be as high as 50% for those who smoke cocaine. (Some crack users say they felt addicted from the *first time* they smoked.)

When you're addicted, all you think about is getting and using cocaine. Family, friends, job, home, possessions, and health become unimportant.

Because cocaine is expensive, you end up doing what all addicts do. You steal, cheat, lie, deal, sell anything and everything, including yourself. All the while you risk imprisonment. Because, never forget, cocaine is illegal.

There's no way to tell who'll become addicted. But one thing is certain.

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(Continued on next page)

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