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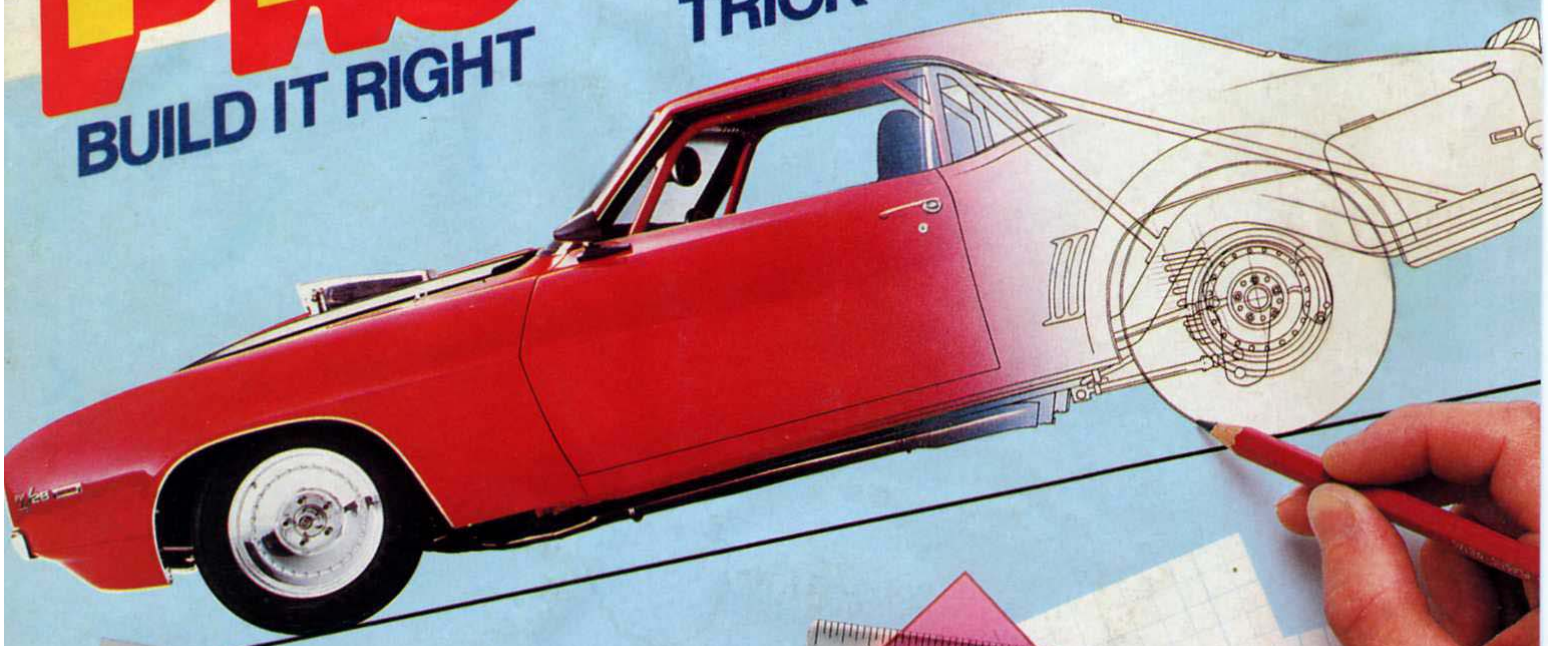
13-SECOND
'87 'STANG

BLUEPRINT FOR

PRO STREET

BUILD IT RIGHT

TRICK TIPS THAT WORK



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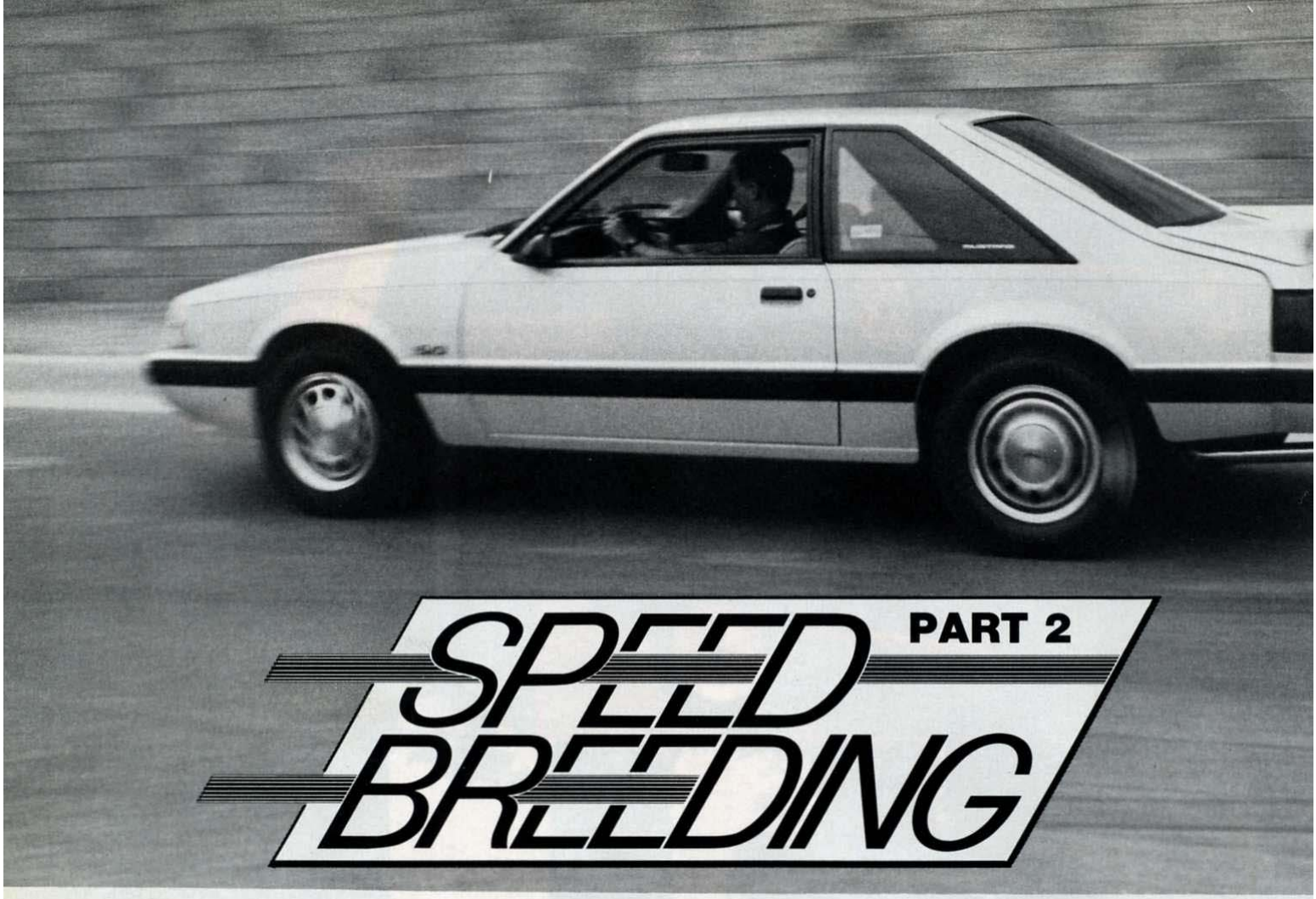


SPEED BREEDING PART 2

POWER COOKIN': COMPUTER-COMPATIBLE EXHAUST AND CAMSHAFT MODS

By Jeff Smith

It's typical human nature to distrust anything new and innovative. Cave men probably weren't real fond of fire at first—until they learned what it could do for prime rib. Lighting the fire under the new generation of computer-controlled performance cars from Detroit can also create waves of rumor and misinformation concerning performance changes for computer-controlled cars.

While many self-proclaimed authorities say there's little that can be done to enhance performance on late-model supercars, the exact opposite is actually the case. As we proved last month with the initial modifications to Chris Kaufmann's 1987 LX Mustang, there is significant room for improvement in these cars—without resorting to exotic high-tech modifications. In the August issue we transformed the '87 Mustang LX 14.54-second stocker into a 13.88-second stormer with the addition of sticky rear tires, 3.55 rear gears, and a set of Kaufmann Products, Inc. (KPI) underdrive pulleys. This month we'll delve into the intricacies of both the camshaft and exhaust systems in an effort to see what pieces can be used to increase power in the injected Ford 5-liter.

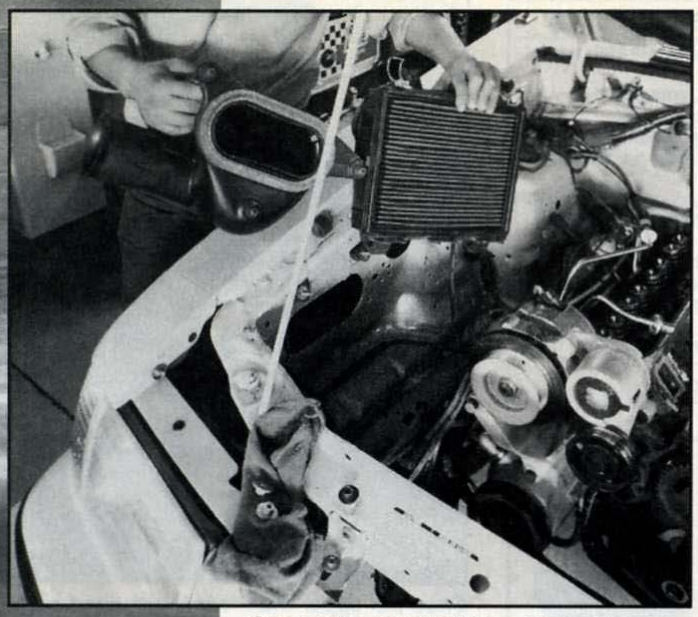
As with any hot street machine, exhaust system improvements can often yield significant increases in performance. However, with '80s emission-controlled cars, other parameters must also be met. While it would be easy to pop off the stock exhaust and bolt on a set of headers and a dual exhaust system, placement of the factory oxygen (O_2) sensor and retention of the stock catalytic converters is essential if we are to remain within the good graces of the law, especially here in sunny Southern California.

Chris and his crew at KPI have experimented with literally dozens of variations on the tubular exhaust system theme. They've come up with a combination that not only improves power, but also positions the O_2 sensor for proper engine operation. If the O_2 sensor is improperly positioned, the computer receives inaccurate feedback information, which will have an adverse effect on engine operation and performance under part-throttle, closed-loop operation.

KPI's new tubular exhaust manifold is designed specifically for the late-model Mustangs, and Chris currently offers two different primary pipe diameters. The first manifold is a 1½-inch primary pipe unit (the same diameter as the stock piece), but is less restrictive than the stock manifolds by eliminating the factory indentations required to clear the exhaust manifold bolts. The second KPI tubular exhaust manifold is a larger 1⅝-inch primary pipe, which tends to shift the torque curve up to a slightly higher rpm level. For this test, Chris has opted for the 1½-inch-diameter manifolds because of the stock nature of the cylinder heads. Once the heads have been tweaked, we will test the larger 1⅝-inch manifolds.

Tubular manifold primary pipe length can also help improve low- to mid-range torque. The production exhaust manifolds vary dramatically in length from 6.5 inches to 17.5 inches. Chris lengthens and equalizes his tubular manifolds to an average of 27.5 inches in an effort to build more power below its 5000 rpm ceiling.

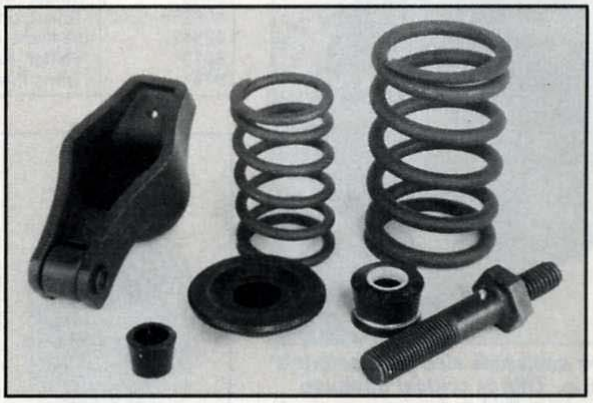
With the KPI tubular exhaust manifolds in place, the stock, dual catalytic converters are positioned as close to the stock location as possible. Aft of the converters, KPI installs a 2½-inch crossover pipe to connect the factory dual exhaust pipes before they plug into a pair of Flowmaster mufflers. The Flowmaster mufflers are slightly louder than the stock Mustang pieces, but reduce the backpressure to a more acceptable lev-



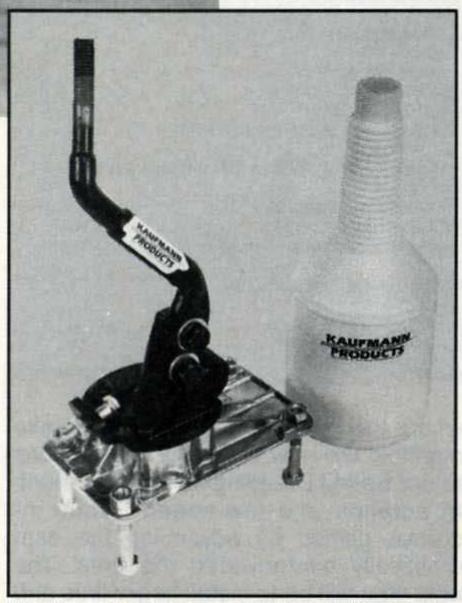
One of the simplest improvements you can make to your injected 1986 or '87 Mustang is to remove the inner fender panel air silencer (left). The air cleaner housing will still bolt to the inner fender panel, but removing the silencer improves air entry to the air cleaner. You may need to construct a baffle to prevent mud and dirt from prematurely clogging the filter.

FAST TIMES
1987 LX MUSTANG

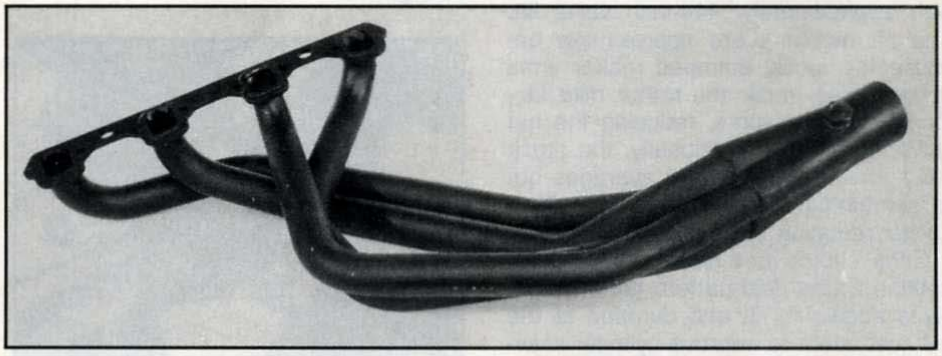
E.T./MPH	CONFIGURATION
14.54/96.56	Stock trim, 4800-rpm shift
14.19/96.87	M/T tires, 3500-rpm launch
13.88/100.33	Added 3.55 gears, KPI pulleys, K&N filter, 104+ Octane Boost
13.53/100.22	Tubular exhaust, Flowmaster mufflers, KPI cam and valvetrain



Chris recommends that when the cam is changed, you should also opt for the entire KPI valvetrain kit, which includes the cam, dual springs, hi-po retainers, screw-in studs, and roller tipped Comp Cams 1.62:1 ratio rocker arms. All of these parts feature KPI's exclusive dry lube coatings (DLC), which reduce heat buildup and decrease wear.

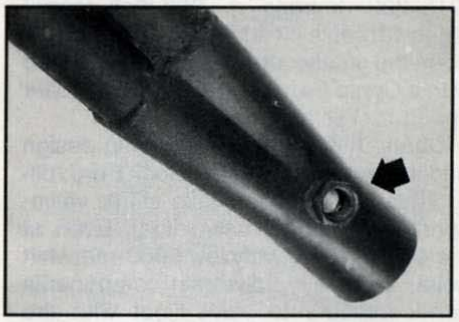


Another simple swap is the addition of a KPI-modified Hurst shifter which dramatically improves shifter operation. Along with the shifter, we also added some of "Dr. Kaufmann's Magic Transmission Elixer." Chris won't say what's in the bottle, but it reduces transmission lube temperature by a solid 15 to 20 degrees.



The KPI tubular exhaust manifolds for the late-model Mustangs can be ordered with either 1½- or 1⅝-inch primary pipe diameters. For this test, Chris opted for the smaller manifolds first.

The camshaft is a Kaufmann-designated dual-pattern Comp Cams hydraulic roller with substantially more lift and duration. Even with additional valve timing, the cam is compatible with the production 5-liter sensors and computer.

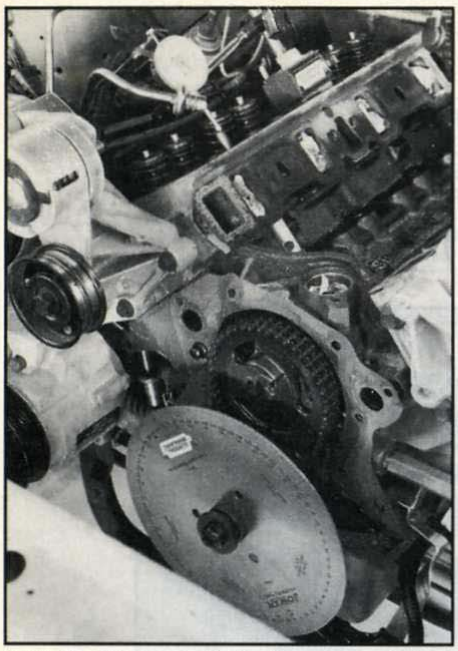


Kaufmann Products has also designed a tubular exhaust manifold for the oxygen sensor-equipped Mustangs. Oxygen sensor placement (arrow) is critical to proper engine operation on computer-controlled cars.

el. Chris warns, however, that you should not attempt to run the engine with open exhaust. The lack of backpressure will cause computer confusion, since a certain amount of backpressure is necessary for the computer to operate normally.

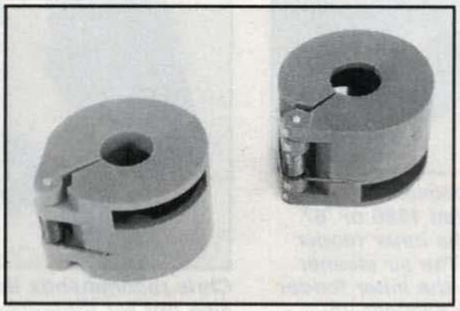
Next on the agenda was a camshaft swap. Here again, just stuffing in a thumper camshaft isn't the way to go, since the computer utilizes manifold vacuum levels as a critical sensor input. Dialing in a long-duration, lopey-idle cam only confuses the computer and creates very poor idle and part-throttle characteristics. Yet despite these apparent roadblocks to performance, KPI's testing of 12 different camshaft profiles has uncovered a camshaft that not only improves power, but does so without creating driveability problems.

Chris decided to retain the hydraulic roller configuration (rather than reverting to a flat-tappet camshaft), but he increased the overall lift and duration figures. The stock roller specs out at 254

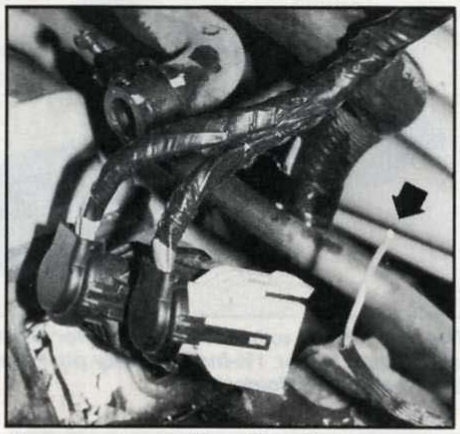


Installing the camshaft also necessitated degreeing it in. This is critical because the cam was installed 2 degrees advanced at 108 degrees, instead of its "straight up" 110-degree position. Note KPI's trick, mount-anywhere magnetic dial indicator base.

PARTS LIST	
PART NO.	**COMPONENT/SOURCE**
9121-OS	Tubular exhaust, 1½-inch w/O_2 sensor, KPI
2201	Camshaft kit, complete w/following parts, KPI
2530	Camshaft, hyd. roller, KPI
2612DLC	Rocker arm, roller tip, coated, KPI
2204DLC	Valvesprings, double, coated, KPI
2205DLC	Retainer, chrome-moly, coated, KPI
2206	Keepers, KPI
2276	Seal, PC style, KPI
2430	Studs, rocker arm, KPI
M-6268-A302	Timing chain and gears, SVO
42543	Mufflers, Flowmaster
8510	Shifter, KPI
8751	Trans fluid, KPI



Unbolting the injection manifold isn't as difficult as it appears. Rather than disconnecting all eight fuel-injectors, the entire fuel rail can be unhooked with a special Snap-On tool also available through KPI.



There are two major wiring harness plugs that disconnect the injection manifold from the car. An orange ground wire (arrow) *can be unbolted from the engine block, but it's easier just to cut the wire and re-splice with spade connectors. Working on the injected 5-liter Ford isn't as complicated as it looks.*

Once the upper manifold is removed and the wiring harnesses unplugged, the lower section can be unbolted and lifted off.

degrees intake and exhaust duration with approximately .444-inch valve lift. The lift numbers are approximate because the stock, stamped rocker arms deflect even under the rather mild factory spring pressures, reducing the net valve lift figures. Additionally, the stock 1.6:1 rocker ratio actually averages out to something closer to 1.53 to 1.55:1, further reducing the net valve lift.

Chris' choice for a camshaft is a Competition Cams dual-pattern grind, which gives additional lift and duration to the exhaust event to improve cylinder scavenging at higher rpm's. The KPI/Comp Cams hydraulic roller specs out at 270/280 degrees of intake/exhaust duration (212/222 degrees at .050-inch tappet lift)—with valve lift figures at .497-inch for both the intake and exhaust—obtained with a Comp Cams true 1.62:1 ratio roller tipped rocker arm.

Due to this cam's radical ramp design and the extremely heavy, stock Ford roller lifter, Chris also installs stiffer valvesprings to prevent valve float. Even at the engine's relatively low 5000-rpm shift point, the heavy valvetrain components can contribute to valve float with the stock valvesprings. According to Chris, it's not necessary to convert to hardened pushrods, but the stock exhaust valve rotators *must* be exchanged for stronger Comp Cams retainers to eliminate coil bind with the stronger springs. An SVO timing chain and gear set are also used in conjunction with the new cam.

Once both the exhaust and camshaft swaps were performed at KPI's Downey, California, shop, we again saddled up the ponycar for a trip to Carlsbad Raceway. After mounting up the Mickey Thompson Indy Profile S/S tires (which were shaved to half-tread depth for better traction) and deflating them to about 22 psi, the Mustang was ready for its first few passes. Advancing the camshaft substantially boosted the low-speed torque to the extent that tire spin with the M/T's was uncontrollable. Switching to a set of 26-inch-tall, 8-inch-wide Goodyear slicks, the car still spun the tires, but by reducing the launch rpm to 2500, Chris was able to wheel the Mustang to a best pass of 13.53 at 100.22 mph.

As often happens with engine combination flogs, we've reached the point where the cylinder heads and the intake manifold are now the major obstructions to our Speed Breeding horsepower hunt. In addition, the low-speed torque increase gained by advancing the cam drastically overpowered the tires. The next step will be to install larger tires and retard the camshaft all the way back to 114 degrees, in order to gain more top-end power and elminate a portion of the tire-spinning torque. But rather than cover these changes here, we'll save those choice bits of power research for next month, when we attempt to push this new-wave runner into the sub-13.50 time zone. Just remember to hang on tight. **HR**

SOURCES

Competition Cams
Dept. HR
3406 Democrat Rd.
Memphis, TN 38118
(901) 795-2400
(Parts available through KPI)

Flowmaster, Inc.
Dept. HR
7768 Sonoma Hwy.
Santa Rosa, CA 95404
(707) 833-6572
(Mufflers available through KPI)

Ford Special Vehicle Operations (SVO)
Dept. HR
17000 Southfield Rd.
Allen Park, MI 48101
(Parts available through KPI)

Kaufmann Products, Inc.
Dept. HR
12400 Benedict Ave.
Downey, CA 90242
(213) 803-5531

Returning once again to Carlsbad Raceway, we were loaded for bear. With a set of Goodyear 8-inch-wide slicks, the Mustang cranked out a stout 13.53/100.22-mph blast. Who says late-model smoggers can't scoot?

CLEANER THINKING

If there is one fault line that runs throughout this entire Mustang muscle-building program, it has to be with the term "emission-legal." It would take a small book to cover all the intricate details of the California Air Resources Board's (CARB) rules concerning the modification of a car equipped with exhaust pollution controls as operated in the state of California. Simply stated, CARB requires that any aftermarket component not designed as a duplicate of the original factory part must have an exemption from CARB in order to be legal for use on emission-controlled cars in California.

Taking this definition in its strictest sense means that the camshaft installed in this Mustang would now make this vehicle illegal in a smog test. However, when we tested the Mustang, it still met the "sniff test" for the California Inspection and Maintenance program for a 1987 Mustang, with both the camshaft and tubular exhaust manifolds in place. Yet just because the car passed the sniffer test does not mean that the emission characteristics have not been altered by the addition of these components—according to CARB.

This is a difficult issue to address because the car still meets the current emission standards and, according to the Bureau of Automotive Repair (BAR) guidelines, the tubular exhaust components added do not eliminate nor render inoperative any emission control device. Therefore, the Mustang should pass the visual test. But technically it fails because the camshaft is not legal for use in a pollution-controlled car—since the cam does not have an exemption.

Confusing? You bet. Now, we're not advocating that you try to slip past your local smog certification station with a bogus car. But this situation does point out just one example of the many gray areas that exist within the smog inspection situation in California. Why should you be concerned with this if you don't live in the earthquake state? Because over 30 other states in this country currently have similar inspection requirements on the books. If the future of late-model supercars involves performance buildups, emission legality is going to become an increasingly important question that will need to be resolved.