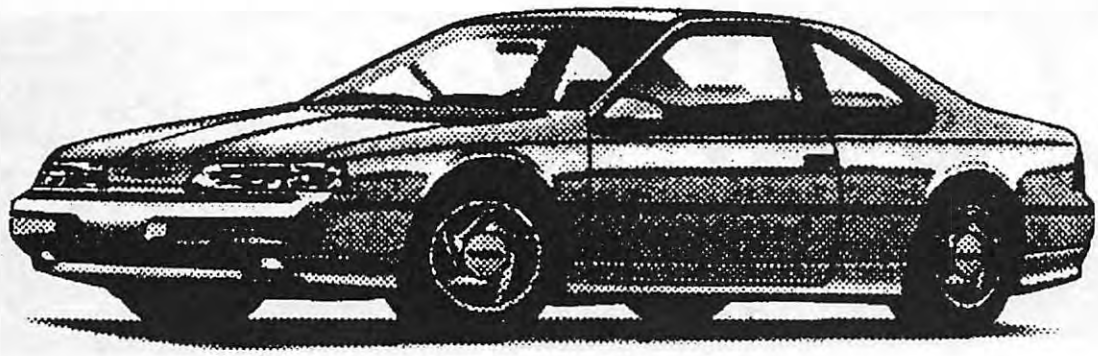
CHARGIN' THUNDER

VOLUME I **MARCH 1996**

THE OFFICIAL NEWSLETTER OF THE SUPER COUPE CLUB OF AMERICA



Bill Hull
President & Editor

"A man who doubts he will succeed is defeated even before he begins his task."

"For God so loved the world that He gave His one and only Son, that whoever believes in Him shall not perish but have eternal life."

- John 3:16

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From The Editor & President

Since its introduction in 1989, the Thunderbird Super Coupe has been both highly praised but also overlooked as a world-class automobile. The Super Coupe won Motor Trend's coveted "Car of the Year" award in 1989, only two years after the Thunderbird Turbo Coupe won the same award in 1987. Every automotive magazine at the time praised Ford's new entry into world wide touring coupe competition. The Thunderbird Super Coupe's looks, handling, power, overall performance, and quality were rated first-class. Sales were brisk for the first two years ('89 and '90), then fell off in '91, '92, and '93. A new face-lift and mechanical improvements in 1994 failed to bring Super Coupe sales back to profitable levels, so Ford dropped the option after the 1995 model year. Only 50,000 or so of the great cars were built altogether, elevating them to true "collector car" status after their production run ended in 1995. In my opinion, the MN12 chassis Thunderbird was a classic automobile upon its introduction in 1989, and the Super Coupe in particular will soon reach "cult car" status, such as the early model big-block Mustangs and Shelbys.

The Thunderbird is Ford Motor Company's banner carrier in Nascar racing (they don't race Mustangs, Taurus' or Crown Vic's on Sunday). Literally millions of Nascar fans watch the Ford Thunderbird do battle with the best the "General" has to offer week after week, while at your local Ford dealership one has to settle for a Plain-Jane 3.8 V-6 or an anemic (although High-Tech) 4.6 overhead cam V-8. Plans for a four-cam, four-valve 4.6 V-8 SVT Thunderbird are presently dead in the water, as Ford believes the market and profit for such a car are not there. Therefore, due to the lack of a suitable replacement for the Super Coupe in the present Thunderbird line, the 89-95 cars represent the high-water mark for the model, including all Thunderbirds from '55 to present.

Being in the prime of my life at the age of fifty (yes, folks, there is hope after 49!), and growing up during the horse-power crazed years of the '60's and '70's, I've seen alot of changes in the automobile. I have personally owned a '61 Corvette (270 HP dual-quad, 4-speed, 4:11 rear), a '64 GTO Tri-Power, 4-speed, 3:90 rear), a '68 Z-28 (4:10 rear, 4-speed, close-ratio), a hopped-up 302 '72 Maverick (young married with new child), a highly modified '79 Mustang Cobra 302, and a '76 Mercury Cougar with a professionally built 460 (C-6 and 4:10 rear). Note: As I grew older and wiser, I switched brand allegiance from Bow-ties to Blue ovals!

When the Thunderbird went truly world-class in 1989, I immediately loved the car. I had always considered a car with less than eight cylinders fit only for little old ladies and 97 pound weaklings. Even after reading and hearing about the 3.8 Super Coupe, I went down to my local Ford dealership (Brady-Bushey) intent on ordering a '91 Mustang GT, but after my first drive in a '91 Super Coupe, I was hooked. I ordered my Black/Black Super Coupe with every available option and after waiting six long weeks, I was there when they backed it off the car-hauler. Life for me has not been the same since that day.

My goal in starting a club specifically for The Thunderbird Super Coupe is two-fold: 1. The car deserves a first-class club of its own. Just because the majority of the motoring public is ignorant or fickle does not mean the Super Coupe is any less of an automobile. With the help of you equally-admiring members, I believe we, as a club, can give this wonderful car the respect it deserves. 2. Organizing a club for the Super Coupe gives me a chance to share my love for the car with others of like mind and to exchange ideas and technical knowledge. Judging from the enthusiastic response I have received over the telephone during the past few weeks, I am sure the Super Coupe Club of America will be a success.

Super Ford magazine plans to do a feature article on my '91 Super Coupe in the very near future. Weather has postponed the proposed meeting of my modified '91 Super Coupe with Rod Short (photographer and contributing editor to Super Ford) for two weekends in a row. Weather permitting, we plan to meet at Virginia Motorsport Park dragstrip on Saturday, March 23 for a few timed runs down the quarter-mile and a photo-shoot. The feature article itself has been cleared for publication with Super Ford and should appear in the June or July issue. Won't it be great to see something other than a Mustang in a major Ford magazine?!?

I hope this introduction is just the beginning to a successful and active club for the Super Coupe. I under

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stand the Taurus SHO Registry has been in existance for about five years and is growing strong with over 5,000 members. The Thunderbird Super Coupe deserves at least the same recognition; you, the members, will determine if the Super Coupe receives it.

Bill Hull
Editor & President

P.S. Our next quarterly newsletter I hope to have published in the form of a magazine. I would appreciate any suggestions for the name of our club magazine.

My 1991 Super Coupe

Following is a list of modifications I have done to my '91 Super Coupe:

1. K&N air filter
2. C&L mass air body with custom air sampling tube (the folks at C&L really know their stuff!)
3. BBK 70mm Throttle Body
4. Magnuson Products "S" Supercharger w/matching inlet plenum (ported to 70MM) w/SVO Pulley
5. Modified (raised and enlarged) supercharger adapter air outlet
6. Custom intercooler tube (supercharger to intercooler)
7. Spearco high-capacity intercooler with manually switched Flex-A-Lite Fan
8. Extrude-honed inter-cooler tube, intake manifold, and intake manifold adapter
9. Custom short-tube headers 1-5/8" primaries, 2-1/4" outlet
10. Custom 2-1/4" dual exhaust system with high flow cats and Walker Dynomax mufflers
11. Balanced, Blueprinted and o-ringed .030 over short-block with hardchromed and cross-drilled crank; '94 SC rods and pistons w/ARP High Strength Head Studs
12. Crane cam; Part #HR-208/294-13 lift .509; duration 206 @ .050; Crane dual springs, titanium retainers, hardened keepers, hardened push-rods, Omega 1:73 fully adjustable roller-rockers
13. Professionally ported and air-flowed heads with 1.80 intake and 1.60 exhaust valves (stainless, swirl-polished, undercut stems and back-cut heads)
14. Baumann AOD shift kit
15. Cervini fiberglass ram-air hood and rear wing. (Beautiful fit and finish, very functional)
16. Cougar 16/7 alloy rims with 255-50-16 B.F. Goodrich T/A's
17. 4:10 Motor Sport rear gears
18. 38 lbs/hr. Lucas Flow-matched injectors
19. Car Tech boost controlled fuel management unit
20. SVO 155lph Fuel Pump
21. Auto Specialties Underdrive Pulleys
22. Griffin High Capacity All Aluminum Radiator

*NOTE: Together with the exhaust system on the Super Coupe, the supercharger adapter air outlet (the part that bolts to the top of the blower and connects to the inter-cooler tube) is very restrictive, even on a stock engine. Ford must have intended these things to act like "governors" to limit output on these engines, because they do a good job of it! After noticing the small orifice inside the supercharger air outlet (about the size of an egg) and the reduced neck where it connects to the inter-cooler tube, I called the manufacturers at Eaton. One of the engineers

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there told me the air outlet adapter was necessarily low and therefore restrictive because of the low hoodline of the Thunderbird (a design sacrifice to the stylists). Notice the same part on the BBK Instacharger for Mustangs is both higher and the outlet tube is larger and of full disameter, because hood clearance was a non-factor.

I spent over $400 having my air outlet adapter modified (1" spacer plate sectioned and welded on; extra aluminum welded all around the neck, CNC bored at a machine shop, ported and polished by your editor). I consider this a must, especially on modified engines, otherwise any improvements in front of, or behind this restriction are much less effective. When I modified my air outlet adapter on my then midly modified engine (2 years ago), my E.T. dropped 2 tenths, my speed jumped from 94 mph to 96. 70 mph in the quarter, and best of all, I could feel the difference! Fortunately, Magnuson Products, is developing a raised and enlarged replacement part which they hope to have ready soon. Due to high design and production costs on custom items like this, the larger the volume, the lower the per unit costs. Magnuson products would like to know how much interest there is in this unit - he predicts a beginning production run of 50 units would result in a per unit cost of approximately $200-$250, much less than I paid for my custom one-at-a-time piece! Let Jerry Magnuson or Bob McGinnis at Magnuson Products know what the demand for this part will be, or call me at Club headquarters and I'll start a talley. - ED.

I have used only Mobil 1 synthetic products in my engine, transmission, and rear-end since I bought the car new. These synthetic products really make a difference in performance and longevity.

I have drag-raced my Super Coupe to substantiate improvements as I modify each individual item (a computerized open-air test lab, if you will). Racing on stock 225-60-16 Gatorbacks (major traction problems), my E.T. and speed went from a stock 15.92 @ 89 mph to a best 14.23 @ 96.70 mph. Since the last time I raced, I have added wider tires, Magnuson blower, BBK throttle body Spearco inter-cooler, shift-kit, Crane cam and big-valve heads, bigger injectors and fuel pump.

Even with the stickier T.A. tires, I will be severely traction limited but still espect to run in the 13's at over 100 mph - I'll find out when *Super Ford* magazine does their photo shoot - Stay Tuned!

Many thanks are in order to Ronnie and Donnie Hoy of Ronnie's Auto Service, Charlottesville, Virginia for the outstanding workmanship on my Super Coupe. They are a full-service auto center, specializing in hard-to-do projects no one else in town will tackle. They installed my headers, custom exhaust system, cam, heads, Eibach springs, SVO fuel pump, Cartech fuel management unit, and many other things too numerous to mention. They have allowed me to use their shop and tools to work on my Super Coupe when the weather outside was cold and wet. In my many years of dealing with auto repair shops, I have never met two mechanics with more honesty or know-how, or with more patience with demanding customers like me! With the possible exception of the engineers that designed them, Ronnie and Donnie know the Super Coupe inside and out better than anyone in the country. If you live anywhere near Virginia, want to make your Thunderbird *really fly*, and want the work done right the first time at a fair price, call Ronnie or Donnie at (804) 295-0513. They both race Super-Pro cars - making cars go fast is their business and their hobby!

Thanks also to Donnie Walker of Donnie Walker's Auto Parts and Machine shop for the excellent work setting up my heads and short block. Also for the many tips and advice on my project cars through the years. The guys at Donnie's store call me "The Ford Doctor". If this is true, Donnie is a "Brain Surgeon" by comparison! Donnie stocks many aftermarket parts as well as factory replacement parts for any foreign or domestic car or truck. He offers same-day delivery service on performance parts and tires. A long-time drag racer, Donnie campaigns one of the fastest Super Pro drag cars in a three-state area, telephone (804) 971-4061.

Also, thanks to Tony Simpkins, Shop Foreman at Brady-Bushey Ford. I have picked his brain on many occasions. In addition to being the most knowledgeable technician at Brady-Bushey, Tony teaches auto mechanics at Piedmont Virginia Community College. He has never failed to impress me with his knowledge, skill, and patience when dealing with me. If Tony doesn't know the answer to one of my questions, which is rare, he takes the time to find out the answer for me. Tony is Honorary Crew-Chief on my Super Coupe.

Bill Hull, *Editor*

Mark Hasenyager
1962 E. Buena Vista Dr.
Tempe, AZ 85284
(602) 839-1088

March 7, 1996

Dear Bill,

I'm glad you started a club for 'SC owners. I have a '90 SC that I bought used in 1992 with 32,000 miles on it. It's been my daily driver ever since and has provided me with great driving pleasure. I like the car so much that I am planning to keep it even though it now has 87,000 miles on it. I am not a drag racer, but am a race and sports car enthusiast. I am a 26 year old software engineer early in his career with limited time and a limited budget. However increasing the performance of my car has become a hobby that I plan to continue. I look forward to exchanging ideas and information about our cars, and gaining better access to performance parts that club membership can provide.

The following is a description and list of modifications for my car:.

1) Remove air silencer inside left front fender / custom ram air (sort of - not closed system just feed cooler air from outside to air filter.
2) Installed conical air filter K&N type (I used a Gold Rush filter which is larger and flows better, and includes a venturi that smooths air flow into the mass air body.
3) Advanced timing 6 degrees using sensor ring inside dampener that signals the crankshaft sensor using stock timing marks. Tried a Hypertech computer chip, but it didn't work out for me so I advanced timing using the sensor. I will detune it to 4 degrees of advance so the car isn't so sensitive to different grades of fuel. This sets the initial timing to 14 degrees which seems to be the best.
4) Overdrive pulley for the supercharger from Auto Specialties.
5) Underdrive pulleys for accessories from Auto Specialties.
6) Larger mass air body. Tried bored out stock (Auto Specialties) and Vortec/C&L MaxFlow 73mm using stock sensor.
7) Better flowing exhaust. I decided to have a custom exhaust built using 3" tubing (not stainless-steel) with a glass-pack muffler/resonator in the middle and using Dynomax super turbo mufflers. The exhaust follows along the stock routing and reuses the Y-bends from the stock cats. The mufflers exit in a Y formation with 2.5" tubing, getting rid of the 90 degree bends.
8) AOD shift kit (Baumann) and SVO transmission cooler.
9) 3.27 stock rear gears. Will possibly go to 3.55 or 3.73 when the differential needs to be rebuilt using Auburn 31 spline components. Or stay with the 3.27 and install a wide ratio AOD kit.
10) Spearco Intercooler
11) HRE 505 17"x8" custom wheels with Goodyear 245/45/ZR17 GSC tires.
12) Baer Racing 13" front disk brakes that fit within the 17" wheels using '92 hubs.
13) Tokico illumina adjustable shocks and variable rate springs that lower the car by 2".
15) Stock 197 thermostat tried a 180 but the car gets too hot.

Parts that I own but have not installed yet:

16) BBK 1523 70mm throttle body (meant for '94 Mustang) to be matched to the inlet plenum. Need to reuse the stock throttle body linkage assembly and remove the coolant hose.
17) Precision Industries 9.5" torque converter and one piece input shaft (will be installed soon).

Modifications which I plan to do when it's time to rebuild my engine:

18) '94 Supercharger with Magnuson "S" modification, and '94 intake manifold
19) Work on cylinder heads, custom cam grind ?, and headers (if I can find some).
20) Slight overbore and potential increase in compression.

I am currently saving money and planning for a rebuild of my engine. I would appreciate any suggestions you could give me about the modifications I should perform when I have the engine rebuilt. I would like to get some headers before that time comes around which I think will be when my car is in the 93,000 mile range. My supercharger is leaking lubricant, the engine blows smoke under full boost, and the maximum boost reaches 10 lbs while it would reach 15 before. My car has a miss at cold idle, and seems to be running lean due to a possible intake manifold leak. While it doesn't have the power it used to, it still runs strong and I can live with it for a while longer. Since the engine is difficult to work on I will wait for the rebuild before I do any further modifications. I have never dragged the car but when the car was running its best, 0..60 times were less than 6 seconds and I estimate it would run in the 13's in the quarter mile. The greatest challenge is keeping the tires from breaking loose even when launching from idle. The car's got gobs of torque, and I love it. Thanks for starting the club,

Sincerely,

Mark Hasenyager

Letters

This letter was sent to TIX by Bill Evanoff. I felt members would enjoy the information. Thanks to Bill for letting us reprint it in our newsletter.

Dear Paul,

I received the last two issues back in the spring and have enjoyed digging into the information provided inside them quite alot! I received some valuable information through the Thunderbird Club Center mentioned in #237, have purchased several items through Scott Performance Products, and most of all, have enjoyed talking to and sharing ideas with other exchange members.

I bought my bright red/5 speed 1990 SC in October of 1989 and it recently rolled over 30K miles still looking like new. I am a Manufacturing Process Engineer at Fords Cleveland Engine Plant #1 (Home of the 5.0L engine) and the employee contacts available to me have been invaluable to working out the little problems I have had with the car. Currently I am trying to solve a quirk with my security alarm. Question: How long have most SC owners clutches lasted?

The combination of performance and ride/comfort can't be matched for the price we paid for our Thunderbirds. My car went through the 1/4 in 15.52 @ 90 mph stock. This equals or bests all of the magazine article figures that flourished after the cars introduction. Today with the addition of a 3.55 rear gear, larger mass air flow sensor, Spearco intercooler and K&N filter, the time has dropped to 15.20 @ 92 mph. I fully realize my next step must be a free flowing exhaust for further improvements. Some of my purchases have not proved beneficial because of the existing exhaust. A properly modified car is not a bunch of parts thrown together but rather a thought out system of parts designed to complement each other. The filter and MAFS (intake improvements) need the exhaust, and the larger intercooler requires air flow which is hampered in its current location. An electric fan is in the works for extra intercooler air flow. The Spearco unit does look very impressive and always brings alot of questions when the hood is raised on cruise nights. Is it worth the money? I doubt it.

I am definitely NOT an advocate of the smaller blower pulley that is a very popular item with SC owners. The smaller pulley puts the head gaskets in a state of near failure if high boost is maintained for any length of time. Many gasket failures have occurred because of these pulleys. If an aftermarket pulley is found on a blown engine by the repairing dealer, the customers warranty is voided. Ford modified the head gasket for the 1994 model year to solve this issue.

I have seen several of the 40'th anniv. specials you mentioned in #235. Sharp cars! The #166 wing nuts are still being used by many cars still today, including the new Mustang.

Other ideas/thoughts you and your readers may find interesting:

- Ford now has tubular exhaust manifolds (headers) as standard equipment on the 1996 3.8L engine. I am working with a friend in Dearborn to see if the pierce point of the 1996 design is the same as prior year standard and SC 3.8L's with cast iron exhaust manifolds. I have heard of SC owners

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paying big bucks for custom manifolds.

- The current design MN-12 is now scheduled to go through model year 2000 1/2. Prior plans for 1997/98 have been scrapped. The SVT model is scheduled for the spring of 1996 and price is expected to be approx. $28,500.

- The rear end center section I have for my car is from a Mark VIII. The Mark center section is all aluminum compared to cast iron on MN-12s (weight savings). Lets begin acquiring these from our sister cars that may have had an accident. FYI - I performed the swap of the center section on my car. Most do-it-yourselfers will find this swap about an eight hour or less job with the right tools. As usual, the time to perform is related to your level of familiarity with the job. I do not recommend setting up new gears yourself. Hire a pro. I also agree with you about the new seals for the half shafts that are required to prevent leakage! On the SC, a 23 tooth speedo gear is required with the 3.55 ratio. The 23 tooth gear has a 2 mph error at 60 mph. My local dealer had an aftermarket gear for $15. Ford only makes up to a 21 tooth gear because the teeth become too thin for longevity.

- SC owners can enlarge their throttle bodies approx. 4 mm by disassembling the throttle position sensor (TPS), idle air bypass solenoid and the spring loaded "flapper" valve. Have a machine shop bore out the step located deep inside the mouth of the body. Cost would be minimal (Similar to #224).

The T.B. housing for the SC and the 1994/95 Mustangs are identical. Even the TPS and idle solenoid between the two are identical. Only the linkage hookups are different. As another alternative, I believe one of the 65 or 70 mm Mustang aftermarket throttle bodies could be used by retrofitting the SC linkage.

- Maintenance tip: Changing/bleeding brake fluid is obviously recommended every two to three years, but 5 speed owners also need to change their brake fluid in their hydraulic clutches. The small reservoir is located next to the brake master cylinder and the bleeder valve is located on the drivers side of the transmission housing about four inches above where the clutch hydraulic line enters the transmission. Bleeding is accomplished the same as how one does the brakes. Ford heavy duty brake fluid is recommended for both brakes and clutch systems.

Continue the excellent work and if I can ever help you or other members find some information or get some contacts for you at Ford please call at 216-676-6981 (W) or 216-331-7402 (H). Enclosed is a check for the next issue.

Regards,

Bill Evanoff

LETTERS

Here are some letters from other readers and club members ...

• ***Robert DeGrilla from Orlando, Florida (407) 876-0369 writes about his '93 Super Coupe:***

Install Superchip, blower overdrive pulley, Baumann shift kit, K&N air filter and Robert uses Amsoil synthetic lubricants in both his crankcase and transmission. The shift kit was the single most effective improvement. Robert's SC is Oxford white with black leather interior. His windshield has been tinted and mobile phone installed. It has the original Firestone Firehawk tires (18,000 miles); traction not too good. Also has K40 sonarader/ laser detector (built-in front, rear, and sides. K40 pays all tickets for the first year.).

Roberts Questions:

1. What are other easy E.T. bolt-on's? (See enclosed parts list. ED.)
2. What are the best tires for "street"?
3. Does anyone else have a gas filler door that comes open on full acceleration?
4. Anyone that has cooling/running hot problems? (Yes, see tech article on cooling)

• ***Tom Wilhelm from Gahanna, Ohio (614) 478-8482 writes about his '90 Super Coupe:***

His car is Bright Red, black cloth interior, Auto. He has made no engine or suspension mods as of now, but he has installed an audio system and sound deadening material.

• ***David Nelson from Pekin, Illinois (309) 346-0372 (eves) or 477-2274 (days) writes about his '95 Super Coupe 5-speed:***

He has installed Flow Master exhaust, K&N air filter, C&L mass air meter, Pulleys, and is looking for Headers.

• ***Paul Olcott from Berkshire, New York (612) 657-8319 writes:***

Dear Bill,
Please find enclosed my check for $25.00 to join your Super Coupe club. My car is a Red 1990 with Black interior that is stock at the present time. I will be sending you a picture as soon as I get it out of storage. I really look forward to your newsletters and parts lists to help me build my car. When you get a chance, would you send me a list of the modifications you have made to your car and where you found the parts? (Both questions answered in newsletter, parts and modifications list also found in newsletter. ED.) I also have a couple of other questions for you. What is the stock amount of boost my car should produce? (Stock boost between 10-12 psi, ED.) I haven't really pushed my car, but it seems to produce approximately 7 psi, but my friends say that their cars produce almost 10 psi and also is Ford the only place to find adjustable shocks to fit my car? (See parts list in newsletter, ED.) Thank you for all your help, and I'm really looking forward to being a member of the Club.

Yours truly, Paul Olcott

We want to hear from you! Please send your questions, comments, etc. to us at
2239 Banbury Street • Charlottesville, Virginia 22901

BLOWER PULLEYS - HEADERS

I have in my possession five different blower pulleys. Measurements are given below:

1. 94-up stock - circumference 10.38"
2. 89-93 stock - circumference 10"
3. SVO Motorsport - circumference 9.5"
4. Autospecialties - circumference 9.07"
5. S&S Enterprises - circumference 8.75"

Although over-drive pulleys for the SC are one of the most commonly used after-market bolt-ons, the consensus among those most knowledgeable about these products (not those that sell them!) is they dangerously overstress a stock engine, particularly head gaskets. On a stock engine, with the very restrictive exhaust system, turning the blower faster only overheats the incoming air, causing damaging detonation. Although they do produce more boost on the boost gauge, much of the boost is exhaust back-pressure showing up as boost. Admittedly, they still generate more power, but at the risk of major engine damage which is not covered by FoMoCo warranties.

Airflow through a forced-induction engine such as the Super Coupe must be judged both by quantity and quality. A smaller quantity (lower boost levels) of air that is cooler, therefore denser, is superior to higher boost levels of super-heated air. Many SC owners have been referred to me by Paul Cornell at TIX and also by Scott's Performance Products over the past two years. They ask for my opinion on how to make their SC's run faster. Invariably, I recommend more rear-end ratio first (most bang for the buck); secondly, I recommend exhaust improvements. Only after improving exhaust-flow, do I recommend intake improvements.

Many of you have inquired about the availability of custom headers. Currently, a quality manufacturer of stainless steel short-headers is developing a product for the SC which should be available soon. He needs twenty prepaid orders to be able to produce these headers so they can be affordable (somewhere in the $450-$500 range). The last price quote I received from JBA (who produced the headers on my car) and to my knowledge, the only source for these headers at this time was $1,200; again quantities of 20 or more. Some SC owners have reportedly paid over $2,000 for a set of JBA headers on a one-at-a-time basis.

The manufacturer who is developing the shorty-headers I have previously mentioned also may develop a complete exhaust system (head to exhaust tip) for the SC. I'll notify Club members as soon as these products become available.

Bill Hull, Editor

SYNTHETIC LUBRICANTS: STEALTH PERFORMANCE AT A BARGAIN PRICE

Us Old-Timers remember the rumors about 100 mile-per-gallon carburetors whose patents were bought up by major oil companies. Super fuel atomizers, magnetic fuel ionizers, and crankcase additives promising more power, mileage, and longer engine life have come and gone. The skepticism resulting from these various "miracle" products has no doubt caused many motorists to shy away from any product labeled either "new" or "synthetic".

Synthetic is defined by Webster as anything "produced artificially, especially by chemical means; also: not genuine". I can testify to the fact that synthetic lubricants are the genuine article, folks, which leaves the first definition the one of our focus. Synthetic lubricants have been in use since World War II (the Germans developed them because their crude oil supplies were increasingly being cut off, but most importantly, conventional mineral oil

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wouldn't flow in the severe cold on the Eastern front). Synthetics do allow an engine to produce more power thru reduced frictional and pumping losses. Synthetic oils also reduce engine wear and improve gas mileage, often substantially. Their molecular structure is superior in every way compared to mineral-based oils. Remember the thick, black, gooey stuff that shot out of the ground when Jed Clampett shot at the rabbit on The Beverly Hillbillies? We are told mineral-based oils derive from decayed organic matter (dead dinosaurs and vegetation, etc.). No amount of refining can alter the basic molecular make-up of mineral oils to the point they can out-perform synthetic molecules custom made in the laboratory.

Synthetic lubricants are composed of molecules that are uniform in weight and shape, giving them higher resistance to heat than mineral-based lubricants. Synthetics have a much higher heat of vaporization (more than 600 degrees F, compared to conventional oil, which begins evaporating at temperatures as low as 350 degrees F.) Try this test: Borrow your wife's muffin pan and candy-making thermometer; fill several of the cavities in the pan with different brands and weights of your favorite conventional oils as well as any full-synthetic brand and fire up the good old gas grill. You will find after a few short minutes the conventional oils start smoking and will soon start burning -- synthetics will not! This added stability at high temperature means your fire-breathing 3.8 SC won't burn as much oil or produce as much sludge or varnish deposits inside your engine.

Friction reduction is another important quality of synthetics. The uniform length of synthetic oil polymers allows them to more easily slide over one another, making them extremely slippery. This allows your engine to work more efficiently resulting in free horse-power and increased mileage (often in the 5% range).

The most critical feature of all however is the higher film strength synthetics offer. Film strength is what allows your oil to stay together, (the oil molecules aren't pushed away from each other or away from metal to metal surfaces). Film strength of any full-synthetic motor oil is six times greater (3,000 psi) than conventional motor oil (500 psi). Film strength is important in another way - cold start protection. Regular mineral-based oil will not remain as a boundary layer (a uniformly thin coating) on metal surfaces when an engine is turned off. Mineral oil drains off parts and out of passage ways into the oil pan. Synthetic motor oil, on the other hand, will remain on engine parts and coat them uniformly because of its high film strength and greater heat affinity (it adheres better to hot metal parts).

Also, because of its higher heat of vaporization, the synthetic can reduce engine wear when you engine is not being lubricated well, (which can be several minutes in cold climates after starting the engine). Because synthetic oil molecules are inherently more stable by design, they do not need as many additives (which are themselves "synthetic", i.e., man-made), as conventional oils. Viscosity improvers, anti-foam, anti-gall, anti-sludge additives, etc. can make up as much as 25% of a quart of conventional oil.

The extreme film strength and slipperiness of synthetics allows one to use a lower viscosity oil (5-30 instead of 20-50) which reduces oil pumping losses while still offering superior protection to vital engine parts. On a cold winter morning, the benefits of a quicker flowing oil can be quite pronounced! Which would you rather try sucking through a straw, water or molasses? If you enjoyed the muffin-pan/gas grill test, try this next simple test. After the wife has slipped off the bed, stick several different weights and brands of conventional oil, as well as any synthetic brand in the deep-freeze overnight. Pour this cold oil through a funnel or other constant orifice into a quart Mason jar. Measure the time it takes the various oils to pour out of their containers into the Mason jar with your watch. If this simple, yet scientific, test doesn't convince you of the superior cold-flow abilities of

Continued on Page 10

Continued from Page 9:

the synthetic vs. conventional oil, go back and try the gas grill test again! Besides, what would you rather have flowing through your high-tech 3.8 SC's engine, Professor Air-Heads finest products or a rotten Tyrannosaurus Rex and the ferns he ate a billion years ago!?!

I have been using Mobil 1 synthetic products in all of my vehicles since 1986, (ATF, gear oil, as well as motor oil). I have personally visited Mobil Oil's headquarters in Falls Church, Virginia and talked to their engineers. Being a major oil company and sponsors of the Mobil Oil economy runs of bygone years, they certainly have the resources to develop and produce a superior product, and have been for years. Most of the other major oil companies have gotten on board with their own synthetic line of lubricants, mostly to keep up with the growing trend towards synthetics but also out of necessity as oil performance requirements have become increasingly rigorous (from SE or SH in just a few, short years). I prefer Mobil 1 because it has proven to be superior in every way to any conventional oil I ever tried. Mobile 1 is also widely available and competitively priced.

Further testimonial to the superior nature of Mobil 1 oil is the use of this product by Callaway Corvettes, the Shelby turbo cars from Chrysler Corporation and some of the new Bow-ties (Camaro and Corvettes from the factory). My source at Mobil Oil told me even GM Goodwrench synthetic oil and Ford's own brand of synthetic oil sold by dealers is re-labeled Mobil 1.

The widespread (although not widely publicized) use of synthetic products by most major racing teams is further proof of the outstanding qualities of these oils. A source at Valvoline told me Mark Martin uses 0-20 weight synthetic oil for qualifying (good for only 4-5 laps) and the same 10-30 Valvoline synthetic oil which can be purchased at your neighborhood auto parts store for the actual race. If Jack Roush trusts synthetics in his mega-buck racing engines, it's good enough for me! Nuff Said!!

Bill Hull, Editor

SCHEDULE OF EVENTS

Lord Willing and if the creek doesn't rise, I plan to rent a vendor booth at the following events. Club specialty items (t-shirts, hats, etc.) and aftermarket performance parts will be on display and for sale at special event prices. Club trophies will be awarded for the fastest SC, best appearing SC, and Super Coupe traveling the longest distance. Let's have a large contingent of Super Coupes at this these events; support the Super Coupe Club and have some fun!

April 20-21	5.0 Civil Wars - Sponsored by *Super Ford* magazine and Holcomb Motorsports Inc., Rockingham Drawway, Rockingham, NC
April 27	East Coast Ford and 5.0 Shootout 1 - 75-80 Drag-a-Way, Monrovia, Maryland
May 4-5	Fun Ford Weekend - Bristol International Dragway, Bristol, Tennessee
May 18	Spring Ford Day 75-80 Drag-a-Way, Monrovia, Maryland
May 25-26	National Muscle Car Association - Atlanta Drawway, Commerce, Georgia
June 7-9	Carisle ALL-FORD Nationals, Carlisle, Pennsylvania
June 21-23	Ford Motorsports Nationals, Maple Grove Raceway, Mohnton, Pennsylvania
June 29-30	National Muscle Car Association - Virginia Motorsports Park, Petersburg, Virginia

EATON CORPORATION APPOINTS MAGNUSON PRODUCTS AS IT'S ONLY OFFICIAL REPRESENTATIVE OF EATON SUPERCHARGERS FOR SALES, SERVICE AND AFTERMARKET APPLICATIONS

Magnuson Products has been appointed by Eaton Corporation as the only official rebuilder of Eaton supercharger products in North America. Eaton Corporation is a major OEM supplier of superchargers as evidenced by their use on Ford Thunderbird, Mercury Cougar XR-7, Buick Park Avenue and Riviera, Oldsmobile 98, Pontiac Bonneville, Aston Martin Vantage, and DB-7. Eaton has been developing superchargers for the original equipment markets since 1982 and selling them in that market since 1988.

Additionally, Magnuson Products has been appointed as the sole distributor for promoting and distributing Eaton superchargers and supercharger components to the aftermarket in North America. Working independently and with other qualified aftermarket organizations, Magnuson Products will continue the work begun by Eaton. In this new position, Magnuson Products will supply Eaton superchargers and supercharger components to and assist others in packaging the Eaton supercharger for aftermarket applications.

Jerry Magnuson (former Magnacharger Designer/Builder) brings 30 years of supercharging experience to these ventures and will be available to assist you in your applications. Magnuson Products will initially offer four sizes of Eaton superchargers (M45, M62, M90 & M112) that will be appropriate for engine sizes 50 cu. in. to 400 cu. in. Parts and service will be available on a one or two day turnaround.

For more information on sales and service, please contact Magnuson Products, 3172 Bunsen #K, Ventura, CA 93003 (Tel. 805-642-8833).

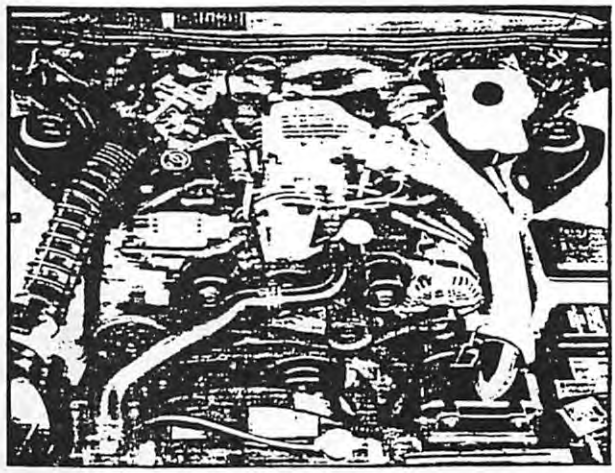
Our first business responsibility is service on all Eaton Supercharger products, including by-pass valves, manifolds and other support items.

We service all the assemblies separately and can supply them that way, or as complete superchargers. Complete means the front cover assembly (nose drive), rotating groups (rotors, gears, bearing plate, bearings and seals timed up) and rotor case (case with rear bearings). All rebuilds reflect the newest Eaton technology as far as parts are concerned. For instance, all rotor groups starting in 1994 have coated rotors, so if we service a 1989 SC Thunderbird supercharger, it will have the upgraded coated rotors.

Ford has used the Eaton M90 supercharger on Thunderbird SC models since 1989. Note: 1989 through 1993, first generation. . . 1994 through 1995, second generation.

GM - Buick 3.8 V6 has been using an M62 Eaton Supercharger since 1992 on special models, first generation. It was upgraded in 1994, second generation.

Note To Thunderbird SC Owners: We have special trade in allowances on your old superchargers. Ask us about upgrades and special equipment. Call us for details. Telephone number: (805) 642-8833.



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From May 1995 *SUPER FORD* Magazine

Thunderbird Blower Build

We find more efficiency — and an affordable alternative to costly replacement — for the Super Coupe blower

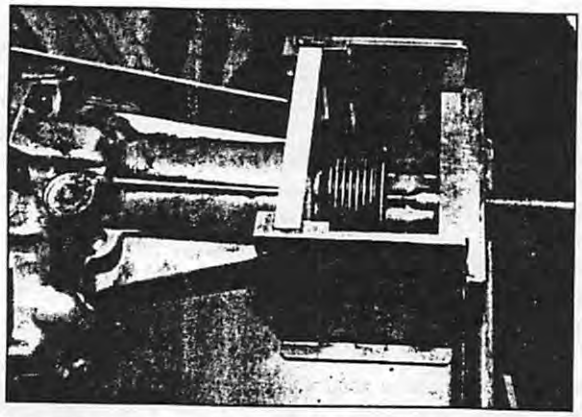
text and photography by Isaac Martin

As this blower-packed issue illustrates, it's been raining superchargers around here. Along with our BBK/Eaton story on page 28, we spent a day at Magnuson Products, authorized Eaton supercharger representative for sales, service and aftermarket applications.

Jerry Magnuson has three decades of blower experience, including building his own line of roots superchargers that was used on everything from nitro drag bikes to big-block trucks. You may remember his Magnacharger line, especially the V8 units. They were unique in that he cast two blower housings at an angle to get a large enough blower. He sold his blower line to B&M awhile back, but now has the Eaton franchise to service. This is a good thing for Thunderbird SC owners who are looking for an upgrade. As Jerry says, having the Eaton account is like "being the Maytag repairman," as the robust OEM superchargers rarely break, and don't loosen up until they've given well over 100,000 miles of service, so finding someone familiar with the blowers is practically impossible.

Like all good hot rodders, Jerry is offering more than simple Eaton rebuilding. He has a few tricks he can play on the M90 Eaton, including cleaning up the case for improved airflow. Also, when it comes time to rebuild that Super Coupe engine, Jerry can upgrade the earlier M90 blowers — the '89-'90 units — to the later, better-breathing style.

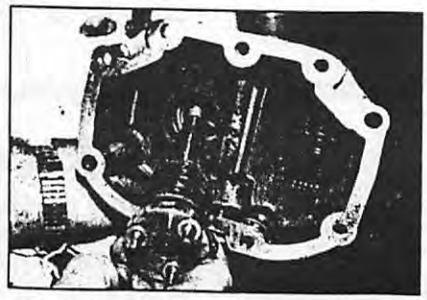
While supercharging is rarely inexpensive, Jerry can also help in a major way with the cost. A '90 SC blower assembly from Ford, part number FOSZ-6F066-A, is a mere $2560 for the entire unit. This, of course, is the only way Ford services the blower. Not that Eatons are likely to need rebuilding, but as time passes, more SCs will accumulate mileage and could benefit from freshening. At $2600 out the door for the blower plus whatever goes into the engine, such freshening probably translates into buying a different vehicle and casting the old SC into outer darkness.



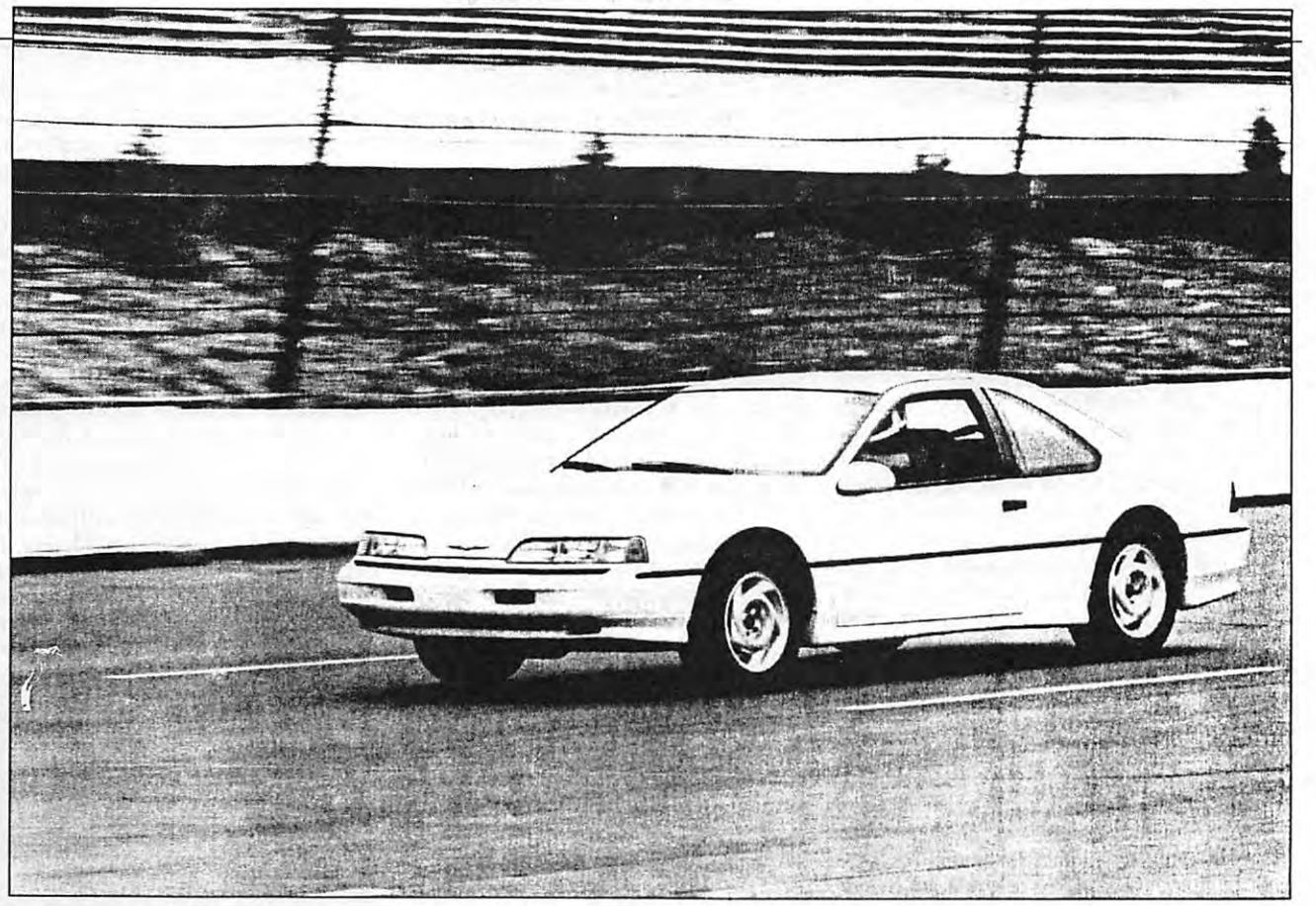
Removing the drive pulley is simplified by using this special fixture to hold the blower in place. This is important, because otherwise you could damage the housing nose.

Magnuson's prices are far saner than Ford's. A rebuilt assembly has a suggested $995 list, plus a $325 core credit. Flow modifications are optional for an additional $200, and they are performed only on the latest case ('94-'95) with the rectangular opening. A new Ford unit is $1625 from Magnuson. Basically, the modifications smooth airflow around corners to help blower effi-

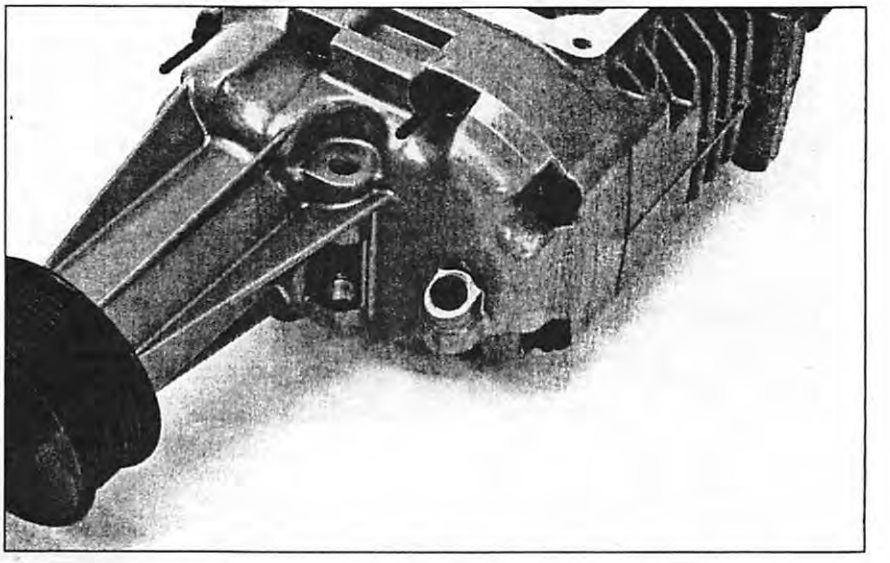
With the nose off, a snap ring retainer is undone, using small needle-nose pliers. This releases the retaining disk. Pressing the driveshaft out of the blower case nose is next.



After pressing them free, the driveshaft and pin drive are removed from the other side. All these items are replaced with new parts.

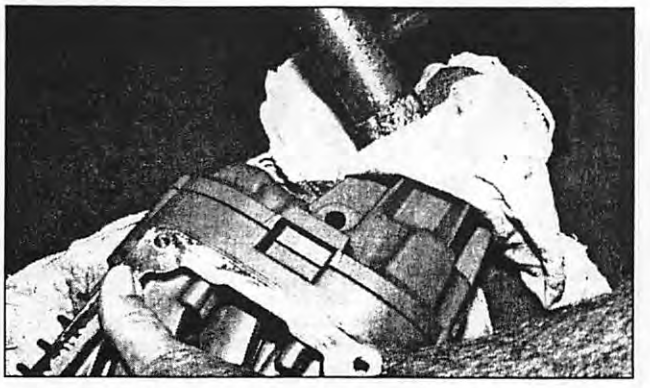


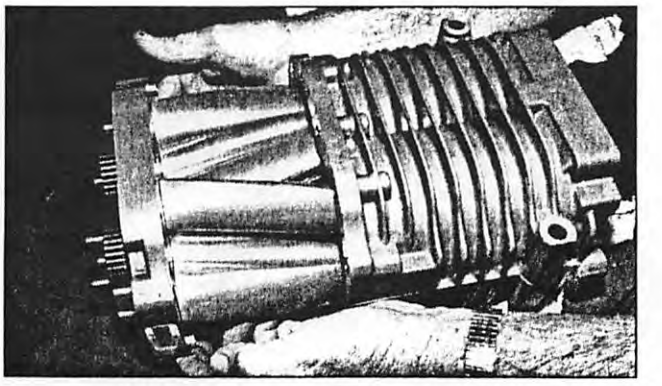
Blower disassembly begins by draining the lubricant in the reservoir through the front access plug. It's a special lubricating oil developed by Eaton and can be reused. Now unscrew the retaining bolts.



(Bottom left) To break the seal between the snout and the body, tap the snout gently with a soft-faced mallet, until the two halves break free.

(Bottom right) Using a special jig, the rotor pack is pushed out from the rear of the blower body. It's replaced in the rebuilding process, in fact, ultimately the only components reused by Magnuson are the blower case and nose.





ciency and power at high rpm. Thus Jerry can make sprucing up a Super Coupe economically feasible, plus add a bit more power along the way. We've detailed the M90 overhaul and modifications in the photos.

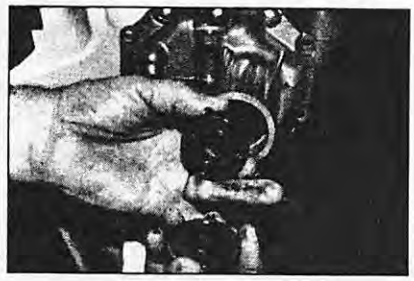
In case you are wondering about the upgraded Super Coupe blower Ford SVO was offering, it is no more. It too was an Eaton, boasting Teflon-coated rotors and a slightly smaller blower pulley. Priced in the stratosphere alongside its regular production counterpart, the SVO blower was never a hot seller and was quietly dropped. Thus Jerry is the only game in town we've heard of for tweaked SC blowers.

Besides covering the Eaton build, we also picked Jerry's brain on roots blowers in general. With the 5.0 market awash in centrifugal blowers, the roots design has fallen out of many enthusiast's minds. Thought old, noisy and inefficient, the roots actually has plenty of life left in it. Eaton's betting on it — $50 million they've spent on building a line of OEM-level roots blowers to meet car maker's performance, durability, quiet operation and compact engine packaging demands. A large OEM supplier, Eaton has determined the market for relatively inexpensive, torque-enhancing forced induction will grow tremendously, and has invested accordingly.

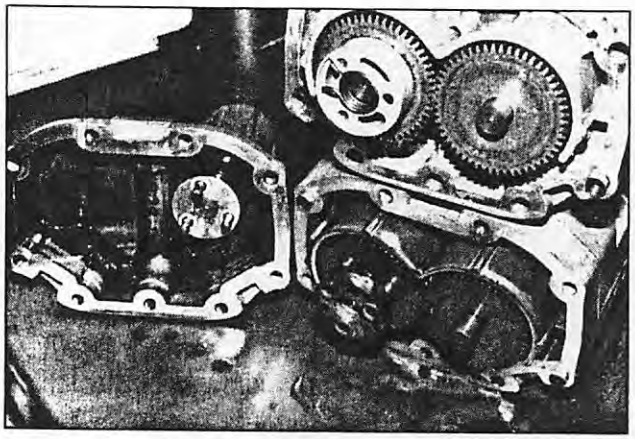
Starting with clear computer screens, Eaton has produced a four-blower family, the M45, M62, M90 and M112 (there are larger units, but they're not likely to see automotive production). The numbers denote the cubic inch displacement of air produced by one rotor revolution. The T-Bird SC engine uses the M90. Not only is Eaton's blower used on the Thunderbird SC, they're also installed under the high-priced hoods of other Ford products, like the Jaguar XJR and Aston Martin DB-7.

Ford abandoned turbocharging for supercharging for a variety of reasons. First is the premise that with smaller engine displacements, particularly if CAFE requirements are jacked up, forced induction is the one way to deliver performance. Another supercharger virtue involves maintenance-free durability, particularly important when dealing with drivers who only lift the hood when the car stops dead. Because it's crank-driven, a supercharger is better suited to street use thanks to immediate delivery of low-speed torque. By comparison, turbochargers suffer from turbo lag and typically offer peaky power outputs, rather than a broad plateau of supercharged torque.

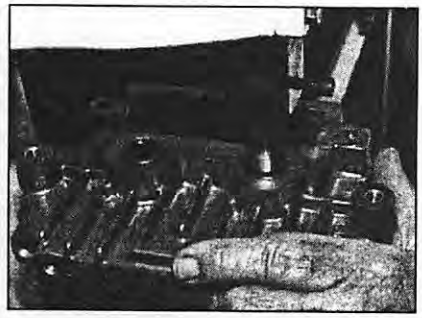
Mechanically, the compact Eaton is a roots-style, positive-displacement blower with two tri-lobed rotors twisted in a 60-degree helix to reduce noise and improve volumetric efficiency. Eaton's design has patented features, like slots in the top of the housing to reduce noise. Helix rotors and special inlet and outlet port geometry combine to produce a smooth discharge flow which further reduces noise. The Eaton also has a bypass valve, which recirculates supercharger airflow under non-boost conditions; considering the engine is under boost only 5 to 10 percent of the time, the engine operates largely under vacuum. As for the long haul, the Eaton package passes 500-hour durabili-



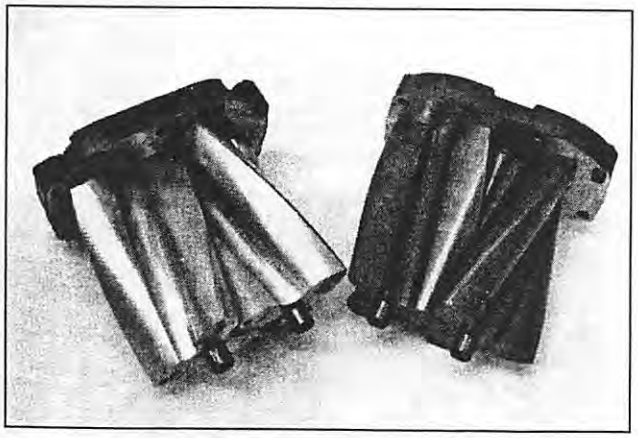
Up front, a retaining disk and shaft support bearing are removed from the case.



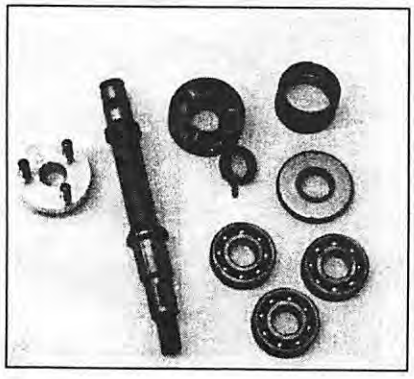
These are early and late blower drive isolators. Below is the early ('89 - '90) style solid coupling, using only a phenolic plastic isolator for the pin drive. On top is the later ('91-on) torsional isolator to further isolate rotors from blower drive vibrations, during engine speed changes, and to minimize noise. For maximum performance, you may want to retain the solid coupling, as high-rpm swings stress the isolator spring.



The rear rotor shaft support bearings are pressed out of the case and replaced by a new set. Needle bearings are used in this location, and they are lubricated by a special grease developed by Eaton.



Originally, Eaton rotors ('89-'93, left) were just bare aluminum. Replacement rotors ('94 and newer, right) are now epoxy-coated. The epoxy-coated rotors offer high lubricity and less frictional wear. Plain aluminum rotors needed larger clearances, whereas the epoxy coated rotors reduce clearance and yield improved pumping efficiency.



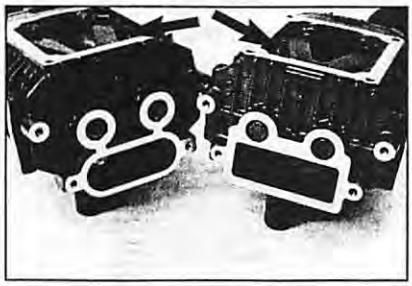
Magnuson's rebuild kit includes all new bearings, driveshaft, torsional spring isolator and pin drive. If you have an early-style blower rebuilt, the isolator is automatically replaced with the quieter torsional style.

ty tests and OE 100,000-mile vehicle requirements.

As Jerry explains, the involute rotors allow more compressor displacement, and improved sealing management, with very little air carry back to the inlet tract. He adds the Eaton has high adiabatic efficiency for a roots blower. Adiabatic is a comparison of air temperature rise between inlet and outlet air from a blower and the power used to create the boost. As air is compressed, heat is generated, reducing engine performance. A 25-degree inlet air temperature increase costs approximately 10 horsepower. So, the smaller the temperature gain, the more power you get. An M90, with a 2.5:1 drive ratio, has a 65-percent adiabatic efficiency between 1600 and 2400 engine rpm. In other words the higher the adiabatic percentage, the better. Of course, you can't forget intercooling, used on the T-Bird SC, which further reduces boost temperature.

Blowers can also be considered in terms of volumetric efficiency, and like engine VE, this percentage is a comparison of actual inlet flow compared to the blower's theoretical displacement. According to Eaton, the M90 with a 2.5:1 drive ratio has a volumetric efficiency of 83 percent for 10 lbs of boost at over 4000 engine rpm.

Jerry also offered some additional performance observations to dispel old roots



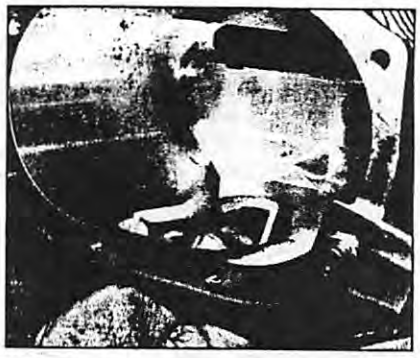
The supercharger cases also differ. On the left is the early case, identified by the oblong opening, and on the right is the later rectangular opening. The oblong opening measures 4 x 1.437-inch and yields a 4.319 square inches of opening. A slotted rectangular case measures 4.250 x 1.500-inch for 6.375 square inches. The slots on top of the case (ARROWS) are for noise control. Also remember that as the rotors turn, air is forced up the sides of the case and not squeezed between the rotors.

falsehoods. Spinning a blower harder may get more boost, but that doesn't automatically mean more power. In the case of the Eaton, it's not a high pressure device. As he explains, it's pretty good at 11 or 12 lbs of boost, but it's dynamic at 8 lbs. The basic principle is high volume, low pressure. When you start moving out of that area, you're defeating the purpose of a roots blower.

Jerry also talked about overall system efficiency. In other words, bolting a blower on makes power, but if the throttle body is restrictive, or the cam is mismatched, you won't get as much power as you could. In his opinion, people make the presumption

Magnuson's optional flow modifications begin with beveling the case's air intake edge. The area is coated with machinist's dye and then the width of the bevel is scribed with a set of calipers.

that if the supercharger is efficient, the engine is efficient. Yet air intake to exhaust system efficiency is by far the controlling performance medium. Improve the engine's induction and exhaust, and you'll get more power per lb of boost. In the case of the Thunderbird SC (and Cougar XR-7) installing a larger diameter throttle body and opening up the exhaust would be good places to start. Together, you probably would see lower boost, yet increased per-

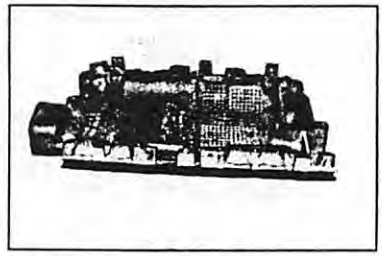


Material is first removed with a die grinder, then it's polished with a cartridge roll. The radius is then checked with a template for consistency. Before grinding, tape is placed to cover the rear rotor shaft needle bearings, since any metal filings would be most unwelcome.

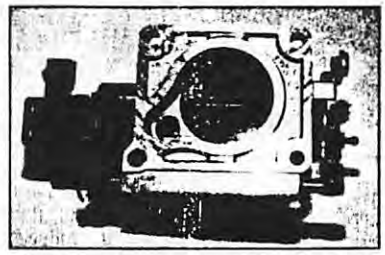
formance. That's because some of the boost showing on the stock engine is really back pressure holding the inlet air up. Free up the exhaust and the restriction goes down. More air will flow through the engine at a reduced pressure. Thus boost goes down while power goes up.

That's the theory. For Eaton blower nuts and bolts, follow us through the rebuilding process. Along the way we'll show how to identify early and late blowers and how Magnuson Products improves high-rpm performance.

In the case rear, it's machined for rotor clearance and leaves a squared-off end (left, ARROW). Magnuson bevels it off to produce a smooth exit for the air (right). What do these modifications deliver? According to Jerry, power increases are noticeable at high blower speeds, where airflow picks up. The mods also deliver a bit more adiabatic efficiency.



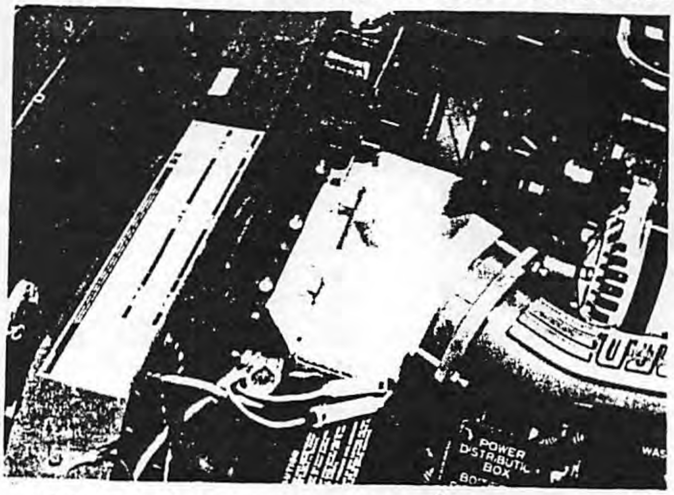
This is a 3.8 supercharged intake manifold which the blower sits on. Pressurized air enters the rear opening. The manifold interior forms a giant plenum where the air enters the head ports.



This is the rear of a 63mm SC throttle body. If it were larger in diameter, you could pick up some power, just like a larger diameter throttle body helps a supercharged 5.0. The trouble is, no one makes a larger diameter throttle body for the SC engine.

Here's a completed blower, ready for a long performance life. The M90 is compact, measuring 7.55 inches wide, 5.40 inches tall, and overall length from the case rear to mid-pulley is 16.35 inches.

SPEARCO HI-PER FLOW INTERCOOLER SYSTEMS & ACCESSORIES



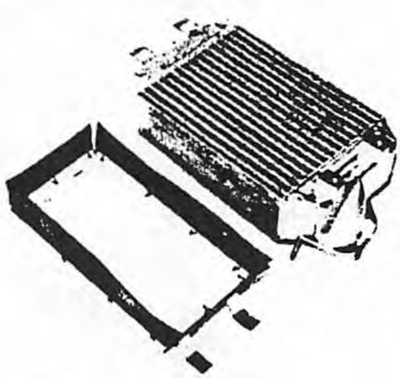
INTERCOOLER UP-GRADE SYSTEM
3.8L T-BIRD SUPER COUPE

Get a quick 7% increase in maximum power at 5,000rpm and as much as an 11% increase at 3,500 rpm with this new intercooler and inlet air duct assembly from Spearco. The components are easily installed in about two hours with simple hand tools. This presents by far the easiest, quickest and most cost-effective method of power improvement for this vehicle with no increase in boost pressure. This system provides cooler air charge which reduces thermal load on the engine and eliminates detonation.

This intercooler core assembly and special air duct is a drop-in replacement for the small Ford unit. The core has a 22% larger face area and 48% more mass area or cubic size. In addition to being much more effective than the stock unit, it weighs about 3 lbs. more, which contributes to improved heat sink characteristics.

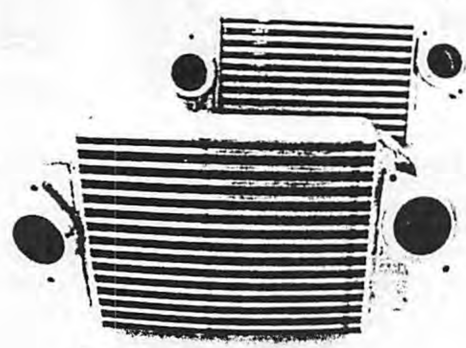
All of this is accomplished with a 9% reduction in charge pressure drop. During testing, at 10PSI boost, we measured compressor discharge temperature as high as 310° which makes a high performance intercooler very important at stock boost levels and essential at higher boost levels when the compressor is speeded up or a high capacity supercharger is installed . In these cases, compressor discharge temperatures can reach as high as 375° and the use of this high efficiency intercooler is even more beneficial.

Part Number 2-425 $649.00



Left: Spearco Intercooler Assembly and Air Duct.

Right: Comparison of Spearco core assembly to stock core assembly.



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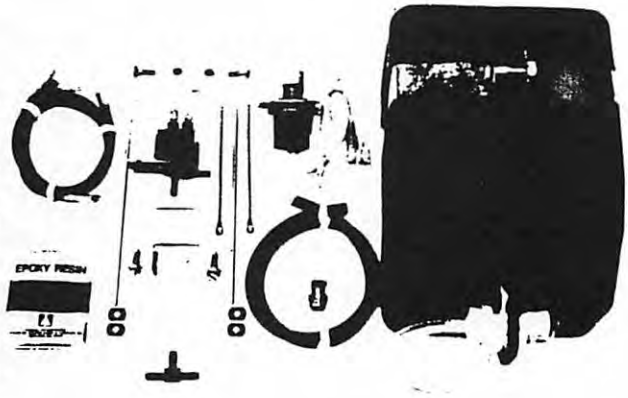
INTERCOOLER OPTIMIZER — Spray Cooling System for Intercoolers



SPEARCO'S proven, 16 year technology in water injection has now been focused on an evaporation cooling spray system to greatly improve the cooling performance of any intercooler system. Injecting a controlled quantity of water into the air entering an engine results in charge air cooling as the water is evaporated and flashes to vapor. The same is true as water is sprayed over the ambient air side of an intercooler. Technically, the cooling takes place by evaporation and convection. The cooling effect can be very pronounced on a hot, dry day and basic physics shows us that for every pound of water evaporated, approximately 1,050 BTU of heat is absorbed. Since our reservoir holds .95 gallon or approximately 8.2 pounds, this equals 8,610 BTU!!

For comparison, lets look at a typical 2.5L turbo, intercooled engine. At maximum rpm and load the intercooler will be rejecting approximately 900 to 1,100 BTU/Minute. It is then easy to see that, even if we get less than ideal spray and coverage of the intercooler, we can anticipate increased intercooler performance during these periods of maximum power by 25% to 35%. Depending on charge temperature and other factors, this can reduce the charge temperature another 45° to 65° F. A large reduction with a resulting power increase!!!

This system features a small, 12V pump and motor which supplies water at 19PSi to a special, wide-angle spray nozzle for maximum intercooler coverage. This pump and a solenoid valve are triggered by a boost pressure switch and the solenoid valve prevents drip or loss of water if the reservoir is mounted above the level of the nozzle.

Part Number 2-2200

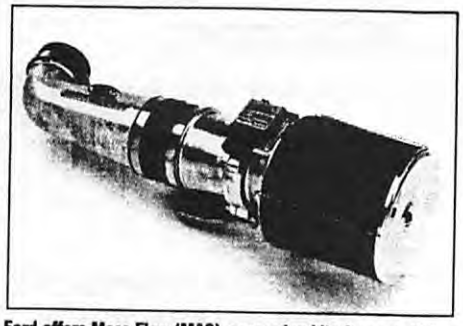
Complete system includes detailed instructions applicable to all intercooled vehicles with the choice of four different spray nozzle mounting methods.

Part Number 2-2200 Intercooler Optimizer **$120.00**

SPEARCO
PERFORMANCE PRODUCTS, INC.
14664 Titus Street · Panorama City, CA 91402 · (818) 901-7851 · FAX 818-785-4362

Reprinted from Car Craft - March 1996

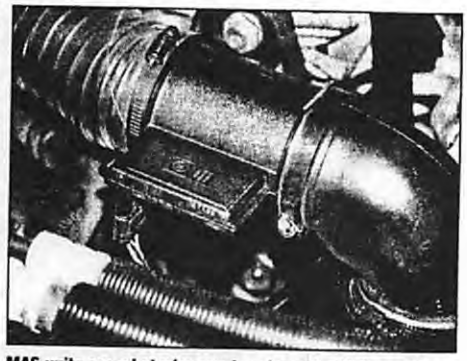
Speed Density vs Mass Flow



Ford offers Mass Flow (MAS) conversion kits for early '86-'89 5.0L Speed Density-equipped Mustangs (M-9000-A51 for manual cars and M-9000-B50 for automatics), that allow the computer to be self-tuning for any reasonable hardware change.

There are two main types of electronic port fuel injection systems: Speed Density and Mass Flow (MAS). A Speed Density system does not measure airflow directly. Instead, the computer calculates airflow by measuring rpm (speed) and manifold vacuum (load), then refers to a preprogrammed table to determine airflow. A significant degree of computation is required, because the computer must also compensate for the density (pressure and temperature) of the incoming air to correctly calculate the amount of fuel required (hence the name "Speed Density"). The computer also utilizes the EGO sensor's interpretation of the engine's rich/lean condition to correct its airflow calculations before determining the necessary injector pulse width.

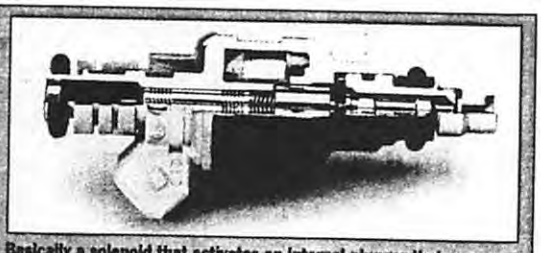
By contrast, Mass Flow fuel injection is more accurate, because it actually measures airflow instead of calculating it. This allows the fuel injection to compensate for moderate engine-content changes (like a cam swap or different cylinder heads). A Speed Density system cannot adapt as easily, since its fuel map hasn't been programmed to understand or acknowledge changes. On the other hand, the MAS unit costs more, is harder to package in non-stock installations, and the factory MAS itself becomes an airflow restriction in high-horsepower applications.



MAS units use a hot-wire sensing element, which provides an output voltage reading proportional to the incoming air mass. The computer uses this signal to accurately determine airflow.

GM's Tuned Port Injection systems used on 5.0L and 5.7L V8s started out with Mass Flow metering in 1985 and converted to Speed Density in 1989. Buick Turbo V6 EFI models were all MAS systems. GM LT1s were Speed Density from 1992 to 1993, converting to MAS metering in '94-'96. Ford used Speed Density in '86-'88, switching to mass flow on '88 California cars and all '89-'92 cars. TBI systems are all Speed Density systems, as are most aftermarket port injection systems, such as those manufactured by ACCEL/DFI. However, aftermarket systems are user-reprogrammable, typically with a standard IBM-type laptop computer.

How Injectors Work



Basically a solenoid that activates an internal plunger that opens a precision orifice, an electronic fuel injector will deliver excellent performance without clogging if you always run a name-brand fuel with proper detergents. Dirty fuel or poor fuel quality is the primary cause of injector clogging.

Electronic fuel injectors are basically simple solenoids that move an internal plunger when their magnetic windings are energized by the application of voltage. A sized orifice is opened when the plunger is activated, allowing pressurized fuel to flow through the opening created. The critical element is the injector's ability to maintain linear fuel flow from very narrow pulse widths to very wide pulse widths, so that the dynamic range of fuel delivery remains accurate for any given rpm and load requirement.

An injector's metering orifice is designed to disperse pressurized fuel in a cone-shaped spray pattern (typically 15-30 degrees) to achieve optimum fuel atomization. Most modern injectors now have recessed or shrouded orifices designed to resist the formation of fuel deposits and subsequent clogging.

Originally, electronic injectors used a pintle design that was subject to deposits and clogging. Lucas and Tomco currently offer pintleless disc-plate injectors that are said to be resistant to clogging, and current AC-Rochester Multec injectors (now available through MSD) feature an atomization-enhancing six-hole director plate that narrows the spray pattern to a 10- to 15-degree cone. Injector performance can deteriorate after 50,000 miles, hence replacement may be necessary to maintain top performance. Before replacing injectors, try cleaning them. It may save you a lot of money.

How To Select Fuel Injectors

Electronic fuel injectors must be able to satisfy the fuel needs of an engine both at wide-open throttle and at idle. If an injector is too large, the result will be soggy bottom-end performance; if too small, the engine may lean out at high rpm with disastrous consequences. Injectors do not remain constantly open, but instead repeatedly pulse open and closed in milliseconds. The percentage of time an injector is open is called the "duty cycle." A 100-percent duty cycle means the injector is open full time; this isn't good, because if injectors are operated at maximum capacity for any length of time, they may overheat, resulting in unstable flow and often a permanent shift in the injector's flow rate. You should hold maximum duty cycle to between 80 and 85 percent. If a large enough injector isn't available for an extremely high-horsepower application, run two smaller injectors per cylinder.

Optimum injector size can be determined by the following equation:

$$\frac{(BHP \times BSFC)}{\text{Number of injectors} \times 0.8} = \text{injector size (flow rate)}$$

Here, "BHP" is observed maximum brake horsepower, and "BSFC" is the engine's "Brake Specific Fuel Consumption." In the absence of dyno data, typical BSFC for a normally aspirated (unblown) engine will be 0.45; for a turbocharged or supercharged application, use "BSFC=0.55." The scaler "0.8" adjusts the calculated injector size to produce the fuel necessary for peak power at 80-percent duty cycle.

Flow rating is calculated at a specific fuel pressure, typically 43.5 psi. Injector flow rate changes if the supply pressure is varied. The equation to convert the static flow of an injector is:

$$Q_2 = \sqrt{\frac{P_2}{P_1}} \times Q_1$$

where:

Q_2 = New fuel rate

Q_1 = Original fuel flow rate

P_2 = New fuel pressure

P_1 = Original fuel pressure

Increasing fuel pressure usually improves fuel atomization, but it also makes the injector work harder when opening and slows down its response time. Drastically raising fuel pressure also shortens injector life and adversely affects the optimum cone-shaped spray pattern. Generally, it is safe to raise the fuel pressure no more than 10 to 15 percent. Remember that a stock ECM usually requires recalibration when injector or fuel psi changes are made.

Finally, there are two types of fuel injectors and corresponding ECM drivers used: saturated and peak-and-hold. Saturated injectors have a higher electrical resistance (12-16 ohms) than peak-and-hold injectors (2-5 ohms). An ECM capable of supporting a peak-and-hold injector can support a saturated injector, but not vice versa—the additional amperage required to operate the peak-and-hold injector can destroy a saturated injector's ECM driver. An injector's resistance can be measured with an ohmmeter across its two terminals.

Electronic Fuel Injector Types

Type	Resistance (ohms)	Application	Cost	Current (amps/injector)
Saturated	12-16 ohms	O.E.M. cars	Low	0.75-1 amp
Peak & Hold	2-5 ohms	Racing and some O.E.M.	High	6 amps

Injector Response Time

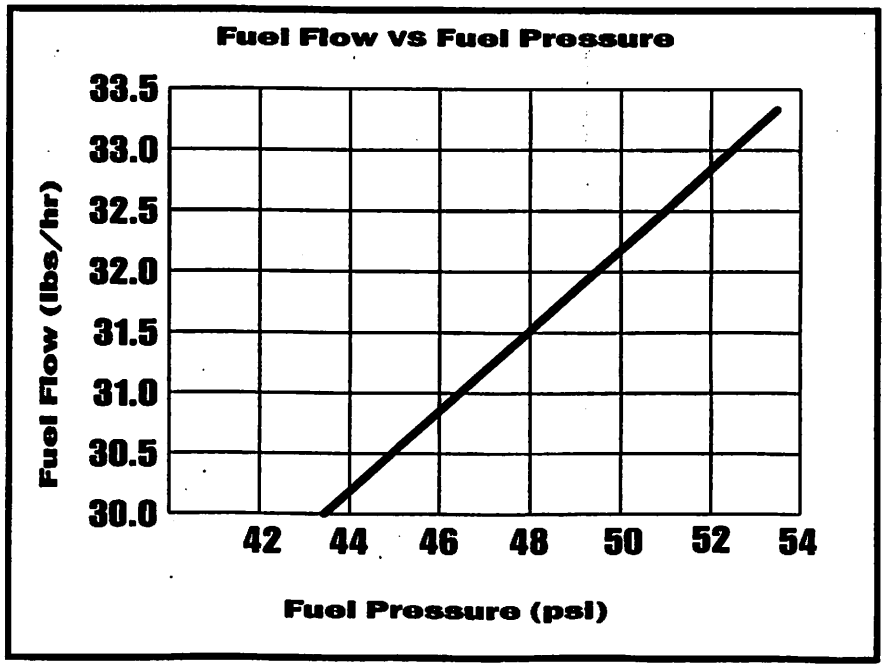
Type	Response Time (milliseconds)	Dynamic Range	Can driver use both types?
Saturated	2 ms	Low	No
Peak & Hold	1.5 ms	High	Yes

Typical Stock Injector Flow Ratings

Note: All flow rates and theoretical max horsepower supported assume 80-percent duty cycle; 0.45 BSFC for unblown engines and (a conservative figure for factory cars) 0.55 BSFC for blown engines; and 43.5 psi fuel pressure. Actual stock fuel pressures may be lower.

Mfg.	Engine	Rating (lbs/hr)	Max Hp
Ford	5.0L V8 HO		
	Exc. '95 Cobra	20	284
	'95 Cobra	24	341
	2.3L L4 SOHC Turbo		
	'83-'84	33*	192
	'85-'88	38*	221
	3.8L V6 Super Coupe		
	'89-'94	31	271
	'95	35	305
GM	3.8L Buick V6 turbo	27	236
	4.3L Syclone/ Typhoon V8 turbo	30	262
	5.0L V8 TPI	19	270
	5.7L V8 TPI	22	313
	5.7L V8 DOHC (LT5)	22†	626
	5.7L V8 LT1	25	356

*3/1 peak-and-hold type; all others 12v saturated type.
†Two injectors per cylinder.



This graph (derived from the accompanying formula) illustrates the linear increase in fuel-flow rate on a 30 lbs/hr injector when fuel pressure is raised from the rated pressure of 43.5 psi. Note that a 10-psi increase in fuel pressure only nets a 3.27 lbs/hr flow increase.

Jul	88	Car & Driver	1989 Thunderbird	PREVIEW
Oct	88	Motor Trend	1989 SuperCoupe	ROAD TEST
Oct	88	Car & Driver	1989 SuperCoupe	ROAD TEST
Nov	88	Motor Trend	Top 10 Issue	FEATURE
Nov	88	New Car Guide 1989	1989 Thunderbird	REPORT
Nov	88	Consumer Guide	1989 SuperCoupe	ROAD TEST
Dec	88	Road & Track	1989 SuperCoupe	ROAD TEST
Dec	88	Collectible Automobile	1989 SuperCoupe	ROAD TEST
Dec	88	Road & Track (G T Issue)	1989 SuperCoupe	ROAD TEST
Jan	89	Motor Trend	Car of the Year Nominees	FEATURE
Jan	89	Motor Trend	1989 Cougar XR 7	ROAD TEST
Jan	89	Motor Trend	50 Years of Mercury	FEATURE
Feb	89	Motor Trend	1989 SuperCoupe	ROAD TEST
Feb	89	Motor Trend	Car of the Year Selection	FEATURE
Mar	89	Car & Driver	1989 SuperCoupe	ROAD TEST
May	89	Motor Trend	Car of the Years	OVERVIEW
Jun	89	World of Wheels	1989 SuperCoupe	ROAD TEST
Jul	89	Fabulous Mustangs & Exotic Fords	1989 Cougar	REPORT
Jul	89	Super Ford	1989 SuperCoupe	REPORT
Sep	89	Automobile Quarterly	1989 SuperCoupe	ROAD TEST
Nov	89	Fabulous Mustangs & Exotic Fords	1989 SuperCoupe	ROAD TEST
Nov	89	Car Buyer's Guide	1990 Thunderbird	REPORT
Jan	90	Super Ford	1989 SuperCoupe	MODIFIED
Mar	90	Super Ford	1990 35th ANNIVERSARY	REPORT
Apr	90	Sports Car International	1990 SuperCoupe	ROAD TEST
Jun	90	Super Ford	1990 SuperCoupe	MODIFIED
Jul	90	Fabulous Mustangs & Exotic Fords	1990 SuperCoupe	REPORT
Jul	90	Automobile Magazine	1990 35th ANNIVERSARY	REPORT
Aug	90	Mustang Illustrated	1990 35th ANNIVERSARY	REPORT
Sep	90	Motor Trend	1990 SuperCoupe	REPORT
Oct	90	Motor Trend	1991 Thunderbird V8	ROAD TEST
Dec	90	Road & Track (Special)	1991 Thunderbird	REPORT
Dec	90	Super Ford	1990 35th ANNIVERSARY	REPORT
Dec	90	Sports Car International	1990 SuperCoupe	REPORT
Jan	91	Motor Trend	1991 Thunderbird V8	MODIFIED
Jan	91	Mustang Monthly	1991 Thunderbird V8	MODIFIED
Apr	91	Road & Track	1991 Thunderbird V8	ROAD TEST
Aug	91	Sports Car International	1991 Thunderbird V8	ROAD TEST
Aug	91	Super Ford	1991 SuperCoupe	MODIFIED
Sep	91	Sports Car International	1991 SuperCoupe	ROAD TEST
Sep	91	Mustangs & Fords	1991 SuperCoupe	MODIFIED
Aug	92	Super Ford	1991 SuperCoupe	MODIFIED
Feb	93	Edmunds' Used Car Guide	1989 SuperCoupe	REPORT
Mar	93	Mustangs & Fords	1991 Thunderbird V8	MODIFIED
Jun	93	Car & Driver	1993 SuperCoupe	REPORT
Oct	93	Super Ford	1994 Thunderbird V8	REPORT
Oct	93	Motor Trend	1994 Thunderbird V8	REPORT
Oct	93	Car & Driver	1994 Thunderbird V8	REPORT
Feb	94	Motor Trend	1994 Thunderbird V8	ROAD TEST
Feb	94	Canadian Used Car Guide	1989 Thunderbird	REPORT
Feb	94	Road Report 1994	1994 Thunderbird	REPORT
Aug	94	Super Ford	*** Thunderbird	REVIEW

THANKS TO: STAN BISSON, PO BOX 1167, CAMROSE ALBERTA , CANADA, T4V 1X2, 403 / 679 - 0124

MORE THUNDER COMING FOR FORD'S BIG 'BIRD

Hot-rodders who've longed for a sport coupe that's more aggressive and less expensive than Lincoln's luxurious Mark VIII, take note. Under the watchful eyes of Ford's Special Vehicle Engineering group, Roush Industries has developed a high-performance variation of the 4.6-liter DOHC Modular V-8 engine for the limited-production Thunderbird variant.

Originally planned for release in April 1996, this hard-charger will now arrive as a '97 model, although its introduction date will be moved forward if certain obstacles can be overcome. At the top of the fix-it list is a projected $29,000 sticker price. Ford hopes to lower that figure by several hundred dollars at least, sufficient to warrant a run of approximately 2000 vehicles.

The free-breathing 32-valve Modular V-8 has received several functional upgrades for this application. A unique oil-pan baffle has been installed to permit sustained high-rpm operation without any danger of oil starvation. Also on hand is a custom intake manifold that better facilitates the flow of air/fuel mixture to the cylinders. The problem is, the Romeo, Michigan, plant, where the engines are to be built, is so completely automated that these two improvements raise the costly specter of more than a little hand assembly. Exactly how much will directly impact the car's bottom line.

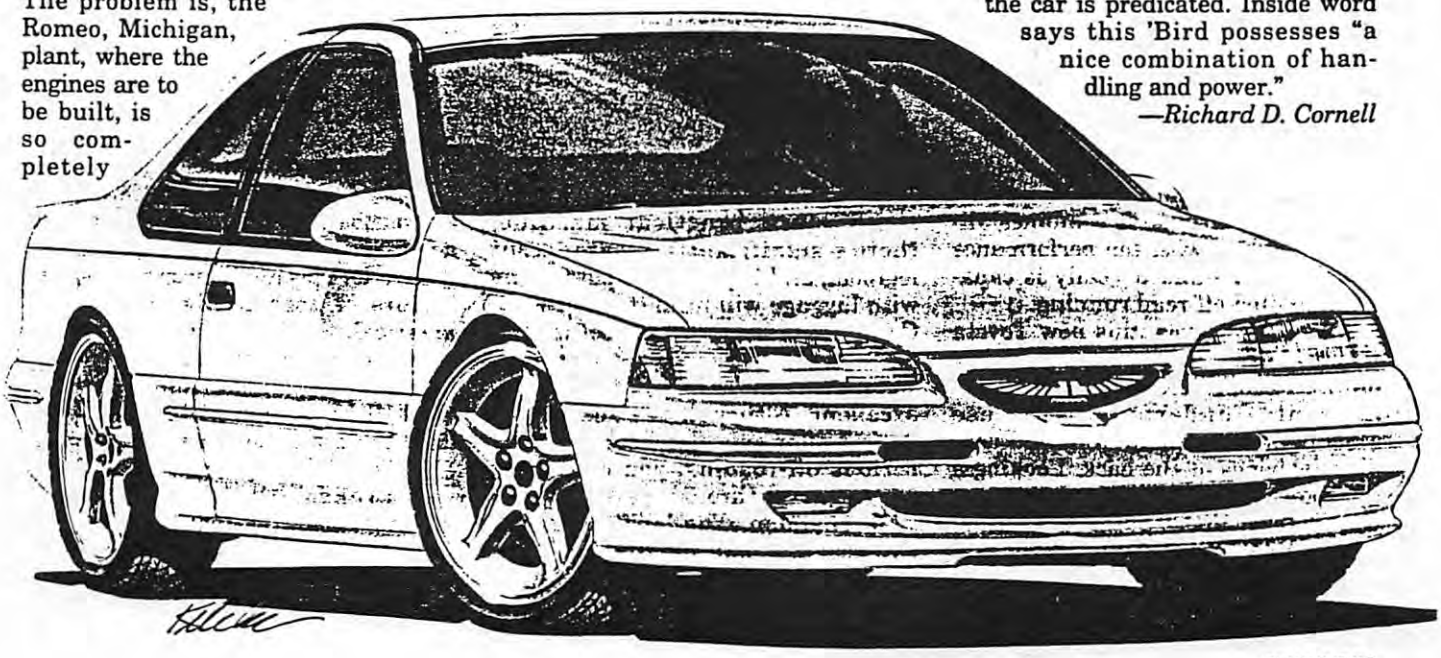
Ford needs this thundering 'Bird for a variety of reasons. Along with being the only midsize rear-drive high-performance coupe to wear the blue oval, it's the firm's sole NASCAR entry. The halo effect a winning race car has on showroom activity can't be denied; that alone provides a strong incentive to find a cost-effective way to get this new 'Bird on the street. Likewise, prospective buyers have a strong incentive to want to see it happen. The car will sport some subtle but meaningful variations to the front-end and rear-deck configurations. (Street versions will also carry subtle side cladding to further distinguish them from lesser T-bird offerings.) These changes may be hard to discern with the naked eye, but the wind tunnel sees them in spades.

While specific estimates for engine output haven't been released, expect something in the neighborhood of 300 horsepower and 300 pound-feet of torque. That should be more than enough to make this an extremely civilized car around town, and one that's also capable of effortless triple-digit cruising.

Although the fairly deep 3.73:1 rear axle ratio has projected fuel economy on the bubble, at press time it was still the cog of choice. If it survives the cut, off-the-line acceleration should be vigorous, to say the least. The rev range will be controlled through a Tremec five-speed manual transmission.

The use of some excellent parts already on the shelf will further contribute to the cost-reduction regimen. Look for the 17-inch five-spoke alloy wheels, 225/45ZR17 rubber, and massive vented disc brakes from the Mustang Cobra R to anchor the corners. Ford plans to make the suspension modifications in-house, and the potential for rear-axle hop will likely require some stiffer underpinnings. But spring rates, shock valving, anti-roll bars, and bushings will be in keeping with the spirited but silky *modus operandi* on which the car is predicated. Inside word says this 'Bird possesses "a nice combination of handling and power."

—Richard D. Cornell



DUANE KUCHAR

DRIVER'S SEAT

by Tom Wilson

It's hardly a secret Ford Special Vehicle Engineering has worked on a 4.6 Four-Valve V8 Thunderbird. Graced with a five-speed manual transmission, 3.73 rear gears along with the super chassis and appearance tweaks, the SVE T-Bird is, was, or at least should be, quite a car. We don't have definitive details on the project, but they aren't difficult to presume, and the jungle telegraph has been clattering away with superlatives on the car for several months now.

It is also no great cognitive feat to divine the sort of a car a four-cam T-Bird would be. Because the Thunderbird and Mark VIII Lincoln share the same chassis, and the Mark VIII comes with the Four-Valve already, the basic concept is already in front of us. Remove some pork, as the T-Bird has to weigh less than the luxo Mark, and things look better. The 3.73 gears would perk things up, and likewise, the Mark VIII's oily smooth but unbalanced air-bag suspension would be replaced in favor of conventional coil springs and premium shocks. This should tame the nose-diving Mark VIII handling, yet retain the excellent ride we've always appreciated from the superb, independent rear-suspended MN12 chassis. We'd all appreciate SVE's brakes, wheels and tires, too. In short, you'd have a fire-breathing Mark VIII in Ford trim — not a bad thing at all, and fitting use of an industry-leading rear-drive platform.

It is also no great cognitive feat to divine the sort of a car a four-cam T-Bird would be.

As always, the malefactor in this so far pleasant story is money. As the market for such a car is limited, and the pieces we're talking about found mainly at the premium end of the price spectrum, our final flash of no-brain intuition is such a car would cost a bit more than the now-discontinued Thunderbird SC. Too expensive, so the rumors go, to be viable. We haven't a clue of SVE's price targets or how far off the proposal is, but I wager all but the most rabid T-Bird types would be put off by the cost of a special 'Bird with all the trimmings. Building interesting cars at affordable prices continues as the greatest challenge to the enthusiast engineer.

It's also whispered the hopped up T-Bird was, now get this, too good. This sounds like the half-baked delusions traditionally found orbiting the water cooler looking for a soft mind, but given the inevitable interdivision rivalry between Ford and Lincoln-Mercury, the L-M folks understood a high-market highwayman in Thunderbird clothing could stealing their Mark VIII thunder. This was clearly a practical problem for the SVE Thunderbird, but we hope it wasn't a political one.

By the way, SVE has not worked their stuff on a Mark VIII because the Mark is a Lincoln, and SVE/SVT vehicles are Fords, sold through special Ford dealers. It wouldn't do to sell a Lincoln at a Ford dealership, which is both understandable, and too bad. A pumped-up Mark VIII would be a great car, and strong medicine for the Northstar Caddy.

One argument against an SVE Thunderbird is the poor sales of the recently-departed Thunderbird SC. Demand for the muscle-bird was minuscule in its final years, a reality tough to counter when championing a hot-rodded T-Bird. However, a four-cam Thunderbird would fare differently for several reasons. First, a silky Four-Valve that revs like sparkling diamonds gushing along in a stream of deep blue water is in direct contrast to the shuddering black anvil of torque that was the SC's blown V6. As much fun as we had blasting away behind the V6, it always had a rough edge buyers must have found disturbing.

Likewise, the SC didn't have the ride, handling or braking we surmise an SVE 'Bird would enjoy, nor would it have the exclusive cachet SVE automatically brings with it. Furthermore, and I hate to say this, the last SC's suffered along with the rest of the Thunderbirds with that multi-nostril nose. Ugly is the only word I can give it, and I'm sure the wheels and sheetmetal SVE had in mind would provide the necessary freshening and beautification.

From my distant vantage point I can only hope Ford produces an SVE Thunderbird someday. The project is currently on ice, but it seems a natural outlet for SVE's mix of exclusivity, polite street manners and increased performance, plus, the Southeast could prove a ready market because Winston Cup has bred the Thunderbird into a sporting natural. And, as we just noted, because SVE won't be augmenting a Mark VIII, and Lincoln has introduced a Mark VIII LSC that isn't enough for our teenage lust, an SVE Thunderbird appears the only prospect in the high-end coupe arena. Intraoffice politics shouldn't be allowed to kill such an image-builder, and we would hope the costs could be made to heel.

SF

IF YOU WANT AN SVT THUNDERBIRD WRITE TO:
TIM BOYD, MANAGER
SPECIAL VEHICLE TEAM
PO BOX 490
DEARBORN, MI 48121

THUNDERBIRD INFORMATION EXCHANGE
8421 EAST CORTEZ ST. SCOTTSDALE AZ 85260
602-948-3996
NOV 1994

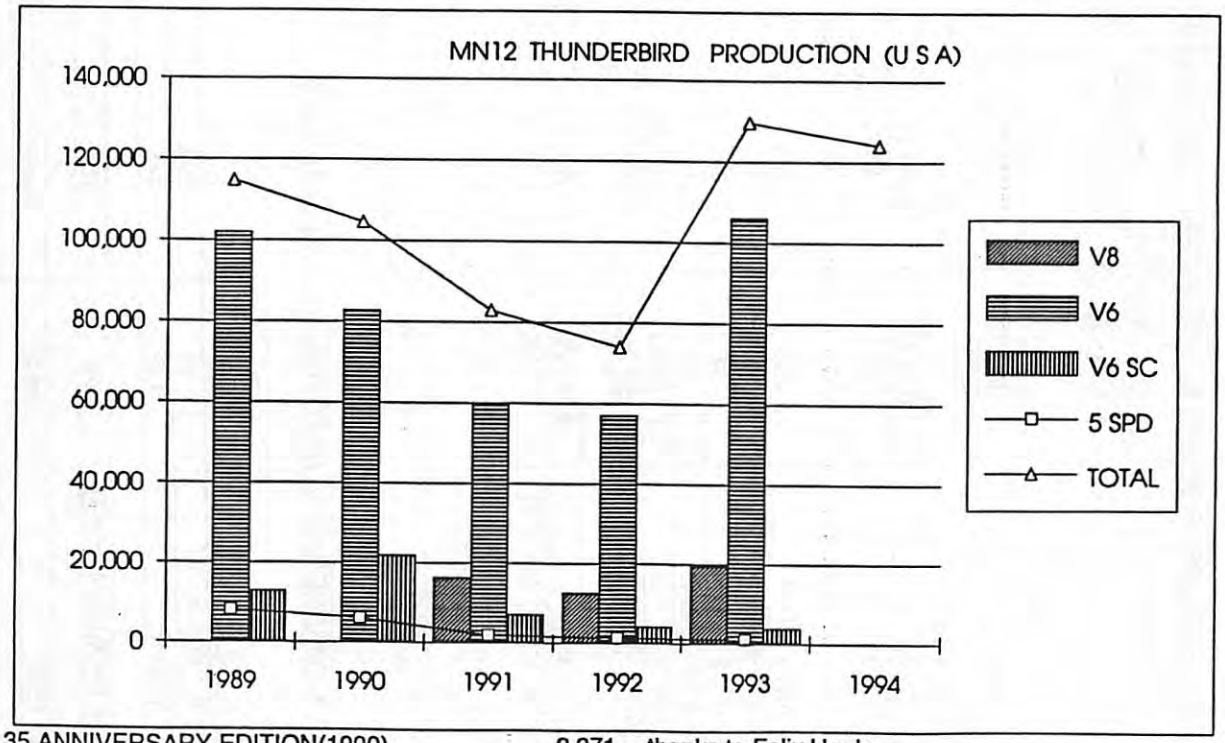
PRODUCTION STATISTICS

SOURCE: AUTOMOTIVE NEWS

NORTH AMERICAN PLANT LOCATION: LORAIN,OHIO USA FOR US&CANADA

ALL MN12	1989	1990	1991	1992	1993	est.1994
TBIRD V8	0	0	16,232	12562	19587	
V6	102,059	82,636	59,543	57119	106234	
V6 SUPERCHGD	12,809	21,966	7,039	4212	3891	
5 SPEED MAN.	8,041	6,067	1,905	1,256	1038	
TOTAL TBIRD	114,868	104,602	82,814	73,893	129,712	124061
COUGAR	102,275	76,467	63,701	49,254	79,700	73282
MN12 YEARLY TOTAL	217,143	181,069	146,515	123,147	209,412	197,343
CUM TOTAL		398,212	544,727	667,874	877,286	1,074,629

THUNDERBIRD	V8	V6	V6 SC	5 SPD	TOTAL
1989	0	102,059	12,809	8,041	114,868
1990	0	82,636	21,966	6,067	104,602
1991	16,232	59,543	7,039	1,905	82,814
1992	12,592	57,119	4,212	1,256	73,893
1993	19,587	106,234	3,891	1,038	129,712
1994					124,061
cumulative total	*48,411*	*407,591*	*49,917*	*18,307*	*629,950*



35 ANNIVERSARY EDITION(1990) 3,371 - thanks to Felix Ugale
SPORT OPTION (1991) PEP 152A 2,976 - thanks to Sandra Notarianni
SPORT MODEL (1992) 7,074 - thanks to Sandra Notarianni

PRODSTAT.XLS

THUNDERBIRD INFORMATION EXCHANGE

8421 EAST CORTEZ ST. SCOTTSDALE AZ 85260

602-948-3996

COMPARISON OF REAR WHEEL DRIVE INDEPENDENT REAR SUSPENSION COUPES - 1991 SPECS. (IF AVAIL.)

	THUNDERBIRD SUPER COUPE	THUNDERBIRD 5.0 V8 SPORT	CONTINENTAL 1993 MARK VIII	MERCEDES 1990 560 SEC	BMW 850I	LEXUS SC400
1991 PRODUCTION	7,039	16,232 V8	N.A.	1,753 US	2,326 US	5,378
WHEELBASE	113.0	113.0	113.0	112.2	105.7	105.9
WEIGHT	3,767	3,750	3,750	3,915	4,123	3,575
PASSENGER	5	5	5	4	4	4
MSR PRICE	$22,046	$18,611	$37,399	$82,900	$78,500	$39,400
OA LENGTH	198.7	198.7	206.9	199.2	188.2	191.1
WIDTH	72.7	72.7	74.6	72.0	73.0	70.5
ENGINE LITERS	3.8	5.0	4.6	5.6	5.0	4.0
CONFIG/#CYL	V6	V8	V8	V8	V12	V8
#VALVES	12	16	32	16	24	32
COMPRESSION:1	8.2	9.0	9.8	9.0	8.8	10.0
HP@RPM	210@4000	200@4000	280@5500	238@4800	296@5200	250@5600
TORQUE@RPM	315@2600	275@3000	285@4500	287@3500	332@4100	260@4400
TIRE SIZE	225/60VR16	215/65R15	225/60R16	205/65VR15	235/50R16	225/55R16
TRANS TYPE/STD(OPT)	5M(4A)	4A	4A	4A	6M(4A)	4A
FINAL DRIVE RATIO	2.73	3.08	3.07	2.47	2.65	3.92
EPA MPG - MAN.	17 24 5M				12 19 6M	
EPA MPG - AUTO.	17 23 4A	17 24 4A	18 25 4A	17 21 4A	12 18 4A	18 23 4A

PERFORMANCE DATA - ROAD TEST INFO AS AVAILABLE

0-60	7.4	9	7.6	7	7.3	6.9
1/4 MILE E.T.	15.9	16.7	15.8	15.5	15.6	15.2
1/4 MILE M.P.H.	92	85.4	93.0		93.0	
TOP SPEED	140	145	130	145	155	150
STOP FROM 80MPH (FT)	247	255	270	267	259	264
R&T TEST	Dec-88	Apr-91	Dec-92	Jul-86	Jun-91	Jul-91

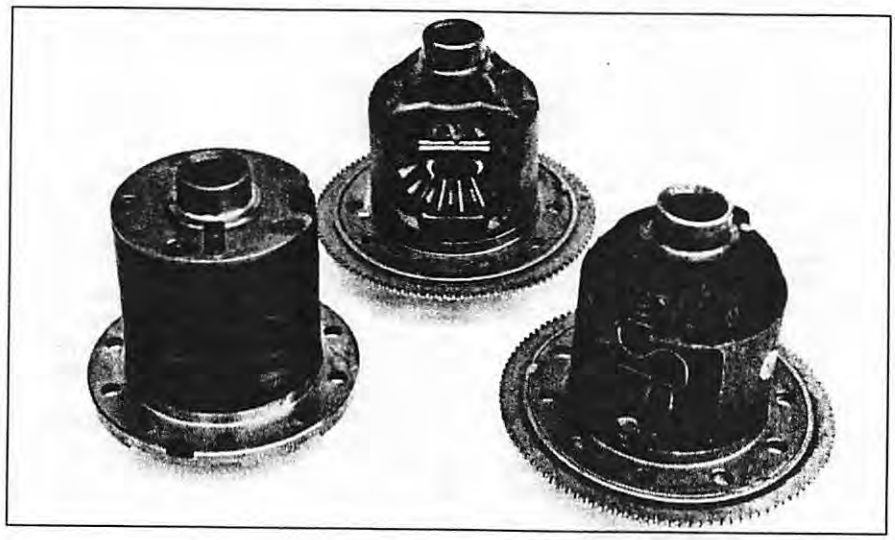
SOURCES: ROAD&TRACK, AUTOMOTIVE NEWS

SPECOMPL.XLS MAY 1994

What's the Diff?

A gripping look at clutch and cone style limited-slip differentials

text and photography by Isaac Martin



Rearends on cars can be very mysterious. You know that power from the spinning driveshaft enters in the front and exits the sides turning the wheels. But how is power diverted to the wheels during turns and when you mash the accelerator?

All those phenomena are related to the differential, located in the rearend housing and bolted to the ring gear. Our mechanical excursion will center on clutch-style differentials, characterized by Ford's Traction-Lok differential used on Fox-bodied cars and cone-style differentials, using the popular AuburnGear differential as the example.

What does a differential do? First, it allows a car to turn a corner smoothly. For example, in a right turn, the right wheel travels in a shorter arc than the left wheel, which must rotate faster to cover the greater distance of a larger arc. If the wheels were solidly attached to a common axle shaft, they would have to slip or spin as they went around the turn.

Now if the vehicle were going in a straight line, the differential gears don't turn in respect to the ring gear carrier. But in a turn the differential gears rotate to make up the difference in wheel speed as they travel through uneven arcs and a smooth turn is the result.

But what happens when one wheel is on a slippery surface and the other on a dry surface? The conventional, or open differential, transmits torque to the wheel with the least resistance. The result is one wheel spins, while the other sits motionless. A limited-slip differential is the cure.

Summed up, a limited-slip uses some sort of friction inside the differential to overcome the natural tendency to send all the power to the unloaded tire. Thus a limited slip delivers some torque to the high traction wheel, which is enough to get the vehicle unstuck in an off-road application, or drive the car straight on the dragstrip. It also maximizes the available tire footprint on a road racing car, increasing acceleration out of the turns.

As for driving straight down the highway, the limited slip is just like an open differential in that both tires are turning equally, and receiving equal torque. Of course, the limited slip's bind on the side gears "locks up" the differential in a way, so the limited slip car will begin differential action later than a car with an open rearend.

Limited slips are exactly what the doctor ordered for street and road racing cars. Dedicated drag cars can use a spool, which is simply a solid disc replacing the differential carrier. A spool offers no differential action whatsoever, and thus transmits equal torque to both wheels at all times. On any car that has to turn corners on pavement, street or road race cars, a spool promotes understeer because the outside rear tire in a turn is loaded more than the inside, yet gets equal power from the engine, and thus the car ends up with asymmetrical thrust, so to speak. Thus that outside rear tire pushes the front end to the inside of the corner, the very definition of understeer. A limited slip allows some slippage during cornering, but also efficiently uses the available traction by giving some power to the outside wheel. Thus it is the answer to corner-turning vehicles.

In the dirt, a limited slip is also highly desirable, and is in fact mandatory if the vehicle is ever to be used on the pavement. However, for pure dirt applications, a spool

can be used, because the loose dirt surface allows the necessary slippage between tire and ground with little penalty in tire wear or rolling resistance.

Open differentials as commonly sold by Detroit allow the inside tire to spin when cornering hard, so they're bad news in any performance application.

In the clutch style limited slip such as the Ford Traction-Lok, there's a clutch pack of friction discs and spacers stacked over externally splined side gears. Between the side gears and their clutch packs is a large, S-shaped spring. The spider gears force the side gears apart as torque is applied to the rear end. The side gears press on the clutches which in turn locks them to the ring gear carrier. The action essentially locks each axle to the rotating ring gear carrier which forces them to rotate at the same rate of speed. As torque decreases, the side gears and clutch packs relax which allows each axle to again rotate independently.

The cone-style differential differs by utilizing metal cones in place of the clutch packs at the side gears. Short, stiff preload coil springs exert side force on the side gears and cones. The cones have a coarse spiral thread, to provide a lubrication passage. In the case of the AuburnGear design, cones constitute a torque biasing differential, meaning that the high-traction wheel will always get relatively more torque to turn it.

We spoke to the professionals at Ramjet Rear End Repair to get some tips on Ford's Traction-Lok cone-type diff. The basic problem is that the clutch packs wear, and as they wear, the efficiency of the differential action decreases. In this regard, the cone style differential is superior, because its metal-to-metal contact is more durable.

Talking about limited-slip differentials in general, Ram Jet explained that for long life, it's important that the rear tire circumference be within 1/4-inch of each other. Otherwise, the differential senses the car is turning almost constantly, because the smaller tire has to roll faster to keep up, so the clutch pack (or cones) is slipping continuously, accelerating wear.

Like any mechanical device containing moving parts, lubrication is critical for trouble-free performance, so the proper differential fluid is important. (Besides the differential, lubricating the high pressure ring and pinion is critical, of course.) Ramjet recommends a multi-weight 80W-140 GL-5 rating gear lube and that can be either petroleum-based or synthetic. They also suggest adding a friction modifier, like Sta-Lube's Equi-Torque. Ford also sells their own friction modifier, too.

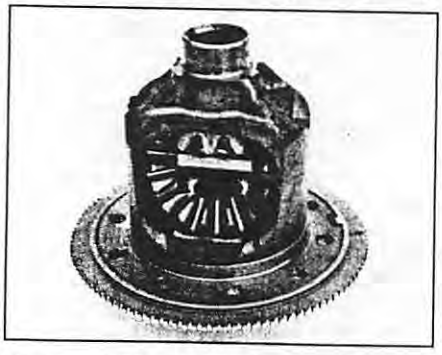
Now the clutch pack is more susceptible to chatter, if for no other reason, due to the all the surfaces involved. One solution for a tighter pack would be to install a stiffer S-spring, but none are offered for Traction-Lok units. Ramjet also explained that you could add extra friction plates to achieve a tighter clutch pack, but on the cars they've tried that on, they've come back soon after with chatter complaints.

To get the inside details on a cone-style differential, we spoke to the engineers at AuburnGear. This design offers increased performance and durability, when ultimate differential performance is desired.

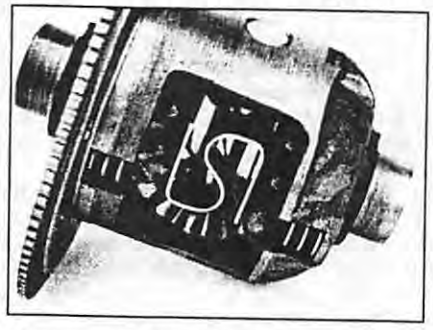
Unlike the factory cast iron differential housing, the Auburn unit is a ductile steel casting. This gives increased strength, so the structure doesn't warp around like so much wet spaghetti under load. That also means the unit lasts longer because the pieces stay in better alignment, and thus don't concentrate wear in one area.

Another good indication of durability for the Auburn is reflected in testing in police and highway patrol cars. Auburn says their differential performs well after 100,000 miles of such heavy-duty use, and in the arena of motorsports competition, Auburns have survived 24 hours of endurance racing in IMSA's Firestone Firehawk series.

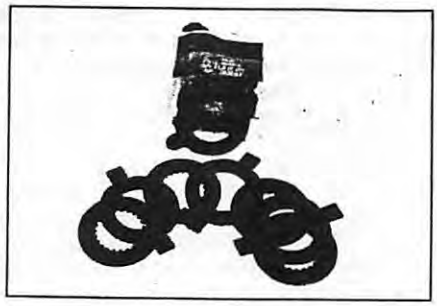
AuburnGear also offers a Pro Series differential, a step above their High Performance Series. The Pro Series offers stiffer springs and heavy duty retainer to increase the threshold before the unit begins differential action. This translates into more even torque delivery between the drive wheels. Auburn recommends the Pro Series for high-muscle applications such as supercharged 5.0s, or pickups where weight and wheel-chocking off-road ruts and rocks can generate



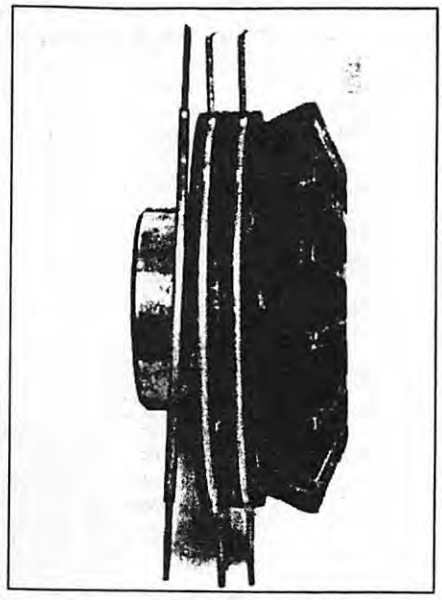
There is nothing mysterious about your basic, open style differential. Just looking at the housing shows that the word performance wasn't in the design description. Don't let the toothed gear scare you. It's used on applications utilizing anti-lock brakes. For conventional brake systems, the gear can be tapped off the housing flange.



To quickly identify an 8.8-inch Traction-Lok differential, look for the clutch packs located in the housing sides, plus the locating tabs can be seen in the differential housing slots. Generating the pressure against the packs is the S-spring, located between the side gears. It's another fast visual clue you're looking at a Traction-Lok.



Traction-Lok clutch packs are replaceable, and there have been two types over the years. Spread out here is an early style pack, identified by their square locating tabs (PN E2AZ-4947-A). These have been upgraded with rounded locating tabs (PN F3AZ-4947-A) seen at the top center. According to Ramjet Rear End Repair, the square tabs seem to break more often, while the rounded tabs are more durable. Also note the internal splines that match the side gear external splines. This package is for one side only; for a complete differential, you need two sets.



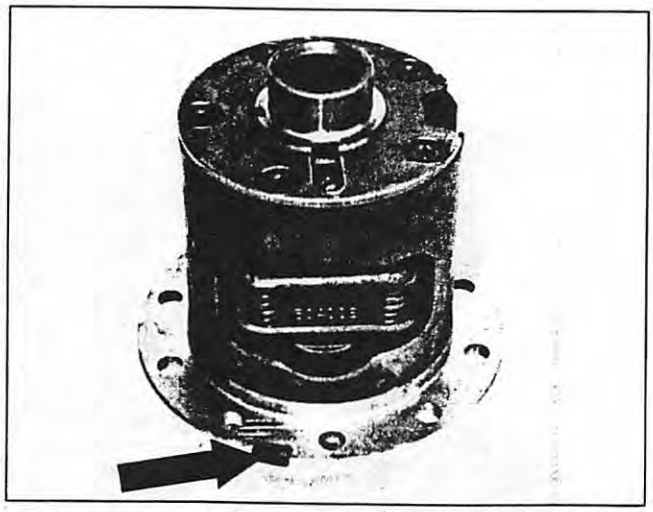
Here's a clutch pack assembled on a side gear. This illustrates how chatter can occur, because there are so many components moving and thus wearing. To make a tighter Traction-Lok clutch pack, you could add more friction discs, but it's not recommended as you'll end up with a chattering rear axle.

What's the Diff?

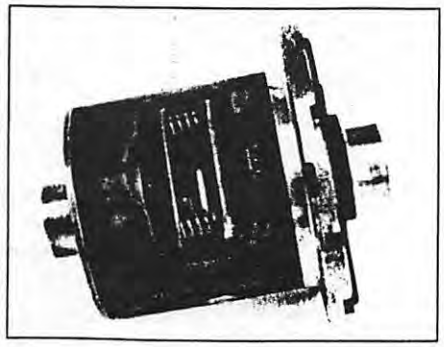
axle-straining loads.

Auburn also offers differential maintenance kits, such as replacement springs and retainers. After a year, they explained, the springs can lose some tension, and as the side gears rotate, some material can be removed from the retainers. Also, they offer spider gear replacements, because the spider gear takes the primary load, so if any thing fails first, most likely it's the spider gears.

AuburnGear's lubricant recommendation is a 80W-90, GL-5 lube with a friction modifier, if needed. If you use a separate modifier, first drive the car to see whether or not the unit chatters and a modifier is needed. If the unit does chatter, signifying high friction in the limited slip mechanism, a friction modifier can help. Instead of pouring in the entire four ounce container, add one ounce and see if chatter is eliminated. If not, add a second ounce. The goal is to add an optimum amount of modifier, because too much can reduce the differential's efficiency, due to



The AuburnGear differential starts as a ductile steel casting. There are a couple of design features to note. Increased material thickness, compared to the factory case, adds strength. Another is the locating indentation (arrow) permitting the installation of the toothed ring gear for anti-lock brake applications. Although the differential housing is bolted together, all the internal parts come out through the side window. Auburn doesn't recommend unbolting the case. A good tip is to make sure the cone is re-installed on the same side of the differential it came out of.



There are two springs here and three on the other side, which push against the retainers, providing the pre-load against the cones. Spider gears are 30 percent larger than stock for greater strength. Additionally, the extra-large flange reduces load induced deflection. Auburn offers differentials to fit both 28- and 31-spline Ford axles.

the reduced friction created by the modifiers.

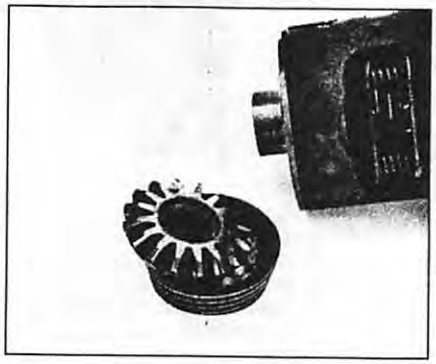
As a wrap up, it helps to know what axle you've got in your car. Under nearly all Fox bodies such as the Mustang, Mark VIIs and pre-current Thunderbirds, is a 7.5 or 8.8-inch rear axle, although under some early cars Ford installed wimpy 6.5-inch rear ends.

The 7.5 and 8.8 inch Traction-Lok axles both used a clutch pack design to accomplish the limited-slip differential action. This axle family is considered an integral carrier rearend, because the differential is part of the carrier, unlike the 9-inch, which used a removable carrier.

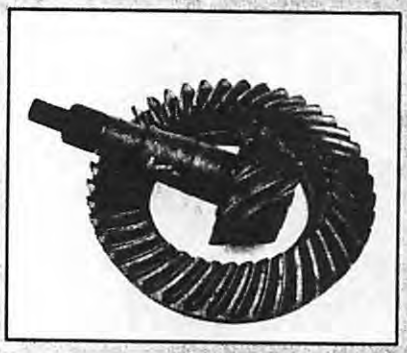
For a performance application, get rid of the 6.75-inch axle, because it has no performance value. Besides, it's a bolt-in snap to upgrade to a 7.5 or 8.8-inch unit, which has all sorts of ratios and 31-spline axles available for it.

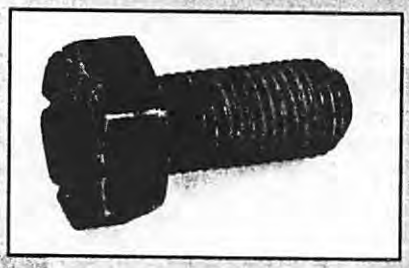
The Mustang SVO and Thunderbird Turbo Coupe had 7.5-inch axles and until 1985, 5.0L Mustangs, had 7.5-inch Traction-Lok rearends. In 1986 and later ponies, it was replaced by the 8.8-inch unit, and the '87-'88 Turbo T-Birds received the 8.8-inch too.

The 7.5-inch appears to be good for all-round street use. If you see drag racing with increased power in your car's future, you should consider moving up to the 8.8-inch rearend, considered by Ford to be 35 percent stronger than the 7.5. Finally, if you see a lot of drag racing and severe driving, particularly with a modified 5.0L, then the Auburn cone style differential is the way to go for long life.



In Auburn limited slips, pressure between these cones and machined surfaces in the differential housing provide the necessary friction. Spring pressure is exerted against the sidegears, pushing the cones tighter against the machined differential housing surfaces. This is where the slippage occurs during differential functioning, and of course the wear, too. The spirals on the side gears allow for lubricant circulation. The two cones provide increased surface area and are less likely to chatter compared to clutch packs.





***Don't** overlook ring gear bolts that attach the ring gear to the differential housing. You should use a thread locking compound for a secure fit. Replacement Ford bolts have compound already in place.*

What's a Gear Ratio?

Besides the differential, a rear axle has a ring and pinion gear and the number of teeth on both determine the ratio. Knowing that number is important, because the gear ratio influences a car's performance character. Take the number of teeth on the ring gear (say 30) and divide by the number of teeth on the pinion (say 10) and the ratio is 3.00:1.

High and low gear ratios provide different emphasis on performance. A low numerical ratio, like a 2.73 or 3.08:1 yields slower acceleration but offers higher top speed and economy. On the other hand, a numerically high ratio, like a 4.10:1 will be terrific at acceleration, but top speed is limited and economy compromised because of high engine rpm at cruising speeds.

We talked to the Ford Motorsport technical assistance Hot Line, (313) 337-1356, to get their suggestions on ratios for comfortable street/strip use. For mostly street driving, on five-speed cars they suggested the 3.55:1 gears (Motorsport PN M-4209-G355) and for AOD equipped models 3.73:1 ratio (PN M-4209-F373).

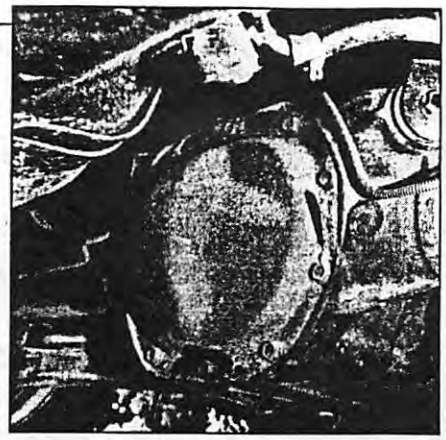
Suppose you up the ante with more power for a hot street car that sees a lot of quartermile times. Then they suggest 4.10:1 gears (PN M-4209-G410) for the automatic and 3.73:1 for the five-speed (PN M-4209-F373).

To determine your ratio, check the vehicle certification label on the drivers door and above the word axle will be a code. The most popular Mustang Traction-Lok codes are:

LETTER	RATIO
E	3.27:1
M	2.73:1
Z	3.08:1

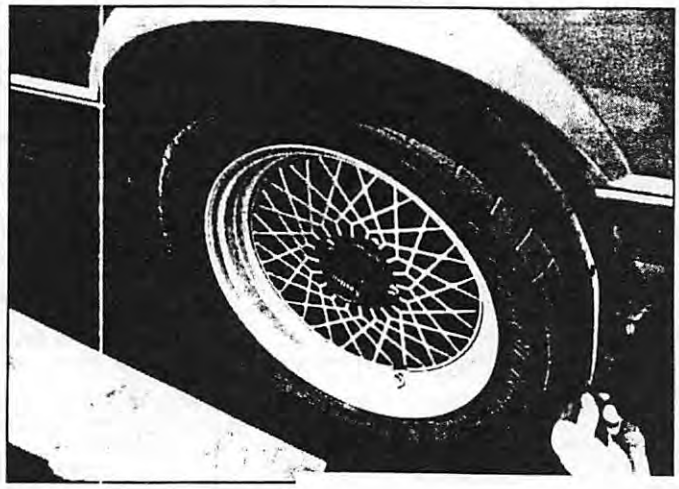
If there's a number instead of the letter, that means the axle is a conventional differential. If your car still has the axle identification tag intact, the ratio will be stamped on it. If it's a Traction-Lok, the ratio number will have an L in it.

What's the Diff?



How can you tell what size axle your Fox car has? The 7.5 inch rearend has rounded sides on the cover (left). An 8.8-inch axle has a rear cover with straight sides on it (right). We couldn't find one to show, but there are two ways to identify a 6.75-inch rear axle. If the cover is off, it'll have a two-piece differential case. Otherwise, remove a brake drum to see if there is an outer bearing retainer behind the axle flange. If you ever need to install the rearend cover, Ford recommends a bead of silicone to seal it to the rearend housing.

For long differential life, you should measure the circumferences of the rear tires and they should be within 1/4-inch of each other. Tires of different circumferences causes the differential to slip as if the car were turning, even while driving straight down the highway. The result is rapid clutch pack or cone wear. This condition can also be created by under-inflated tires or driving for long periods on a space-saver spare tire.

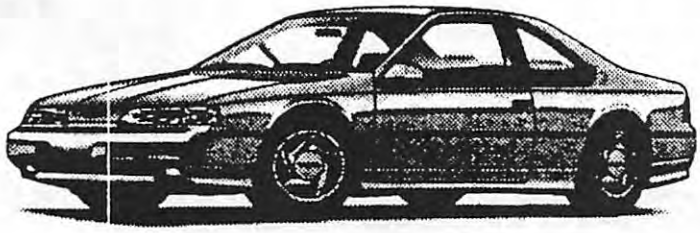


Sources:

Auburn Gear Inc.
Dept. SF
Auburn Dr.
Auburn, IN 46706
(219) 925-3200

Ramjet Rear End Repair
Dept. SF
8783 San Fernando Rd.
Sun Valley, CA 91352
(818) 768-3824

Super Coupe Club of America

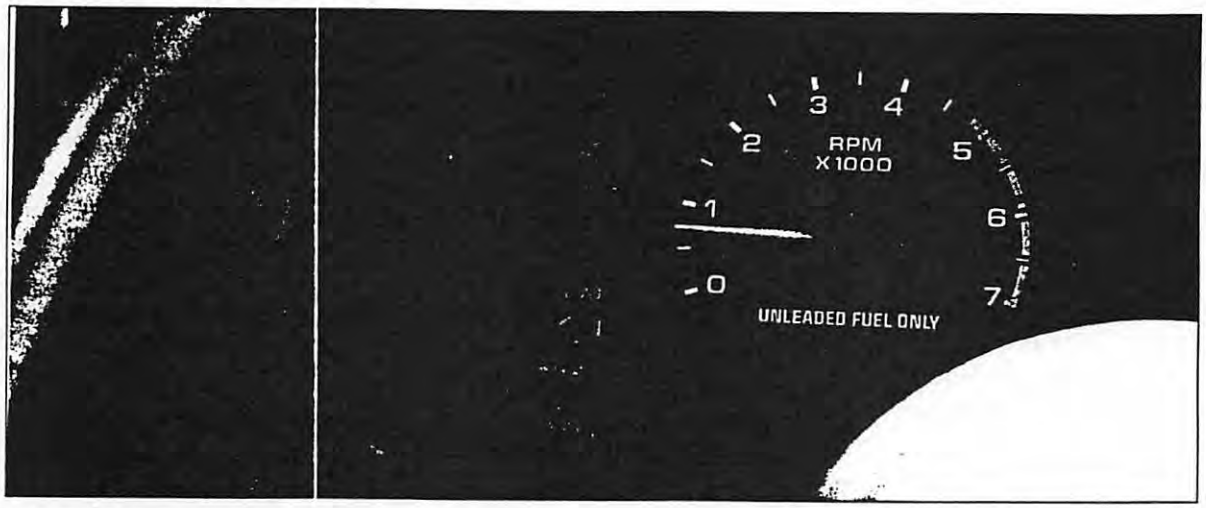


From the Editors of MUSCLE MUSTANGS and FAST FORDS magazines
This article will help Super Coupe owners also.

KEEPIN' COOL

If your Mustang is too hot to handle, these chillin' tips will make your 5-liter the coolest thing around.

By John Hunkins
PHOTOGRAPHY BY THE AUTHOR



We know most of you don't think of engine cooling as being glamorous. In fact, the 5-liter's cooling system usually ends up on the bottom of the priority list when it comes to engine modification. It's just supposed to do its job quietly and let all the pretty parts up top get all the attention.

Eventually, after being overtaxed and neglected, the temp gauge goes through the roof, the radiator boils over, and engine detonation sets in. What a way to treat an engine, especially after dumping thousands of dollars on heads, intake, cam, exhaust, blower, nitrous, ad nauseam.

So it's mid-July, you're stranded on the interstate with the hood up, your pride and joy is puking green stuff all over the shoulder of the road, and vacationing yuppies are zooming by in air-conditioned Volvos, patting themselves on the back for not buying American. Your cooling system now has your undivided attention.

Why did your cooling system start messing up after you threw all those parts on it? It wasn't the parts, it was the extra heat created by the extra horsepower. Remember, power is created by heat, which is created by fuel and air. It's not magic, just physics (thermodynamics, to be exact).

Thankfully, bringing your cooling system up to par isn't all that complicated or expensive. As a bonus, you'll probably see an increase in performance as well. Here are the areas you'll want to concentrate on.

COOLANT

Coolant is the lifeblood of your cooling system. It carries the heat away from the engine into the radiator. What qualifies as a good coolant anyway? Believe it or not, antifreeze is a horrible coolant.

Its purpose is to elevate the boiling point of the coolant during the summer and provide freeze protection (lower the freezing point) during winter and corrosion protection all year round. Transferring heat from the engine to the radiator, however, is not one of its strong points.

A 50/50 mix of water and antifreeze is usually recommended by

A half-bottle of Red Line Water Wetter with a 10- or 20-percent antifreeze/water mixture will lower your coolant temp 10-20° F over a 50/50 antifreeze/water mixture. Red Line makes a liquid version of Water Wetter; however, it doesn't contain rust- and corrosion-inhibitors, like the crystal form does.

antifreeze and auto manufacturers. (Hey, they want to sell the stuff, right?) For comparison, a 50/50 mix of water and antifreeze has about half the heat transfer capability of pure water.

We've found that an 80/20 mixture of water and antifreeze provides adequate freeze/boil/corrosion protection, but much better heat transfer. In addition, we recommend Red Line Water Wetter. This crystalline additive improves the heat transfer capability of coolant, and provides corrosion protection.

Inside your engine block and cylinder heads, the boundary layer between the coolant and the metal gets so hot that the coolant changes to a vapor, which clings to the metal in the form of tiny bubbles (like the bottom of a boiling pan). This layer of tiny bubbles acts as an insulator that keeps heat from migrating into the coolant. Water Wetter prevents these boundary layer vapor bubbles from forming, drastically increasing cooling potential.

In warm climates like Southern California, Florida, Texas and parts of the Southwest, 100 percent water (distilled) and Red Line Water Wetter are all that you need. With 100 percent water, a bigger radiator cap (18 psi) will elevate the boiling point to around 256° F without the use of antifreeze.

Whether you use Water Wetter or antifreeze or both, change your coolant once a year. The anti-corrosive additive will become depleted after this time. This is particularly important in coolant systems that contain aluminum (the 5-liter Mustang's intake manifold and water pump).

Radiator Cap

Here's an item that never gets a second thought. Your radiator cap is responsible for keeping your cooling system pressurized. It's supposed to elevate the boiling point of the coolant, but if its rubber seal is compromised or the spring is weak, pressure won't be maintained. Replacing the cap every so often will prevent premature boil-over.

A cap with a higher pressure rating will elevate the boiling point of the coolant a bit. This, however, is not a panacea for a poorly functioning or over-taxed cooling system. With a high-pressure cap, make sure the rest of the system can safely handle the pressure. Replace worn-out hoses and clamps, and pressure-test the system if you use a high-pressure cap.

Water Pump Pulley

Remember that underdrive water pump pulley you put on three years ago? The mother lode of quick, cheap horsepower sounded great when your stock 5-liter was being kicked silly by every Grand National that came along. In fact, it was a pretty good idea, but that was when your motor was stock and your cooling system had plenty of margin.

If your modified 5-liter is having trouble keeping cool and

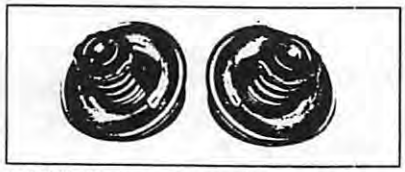
A stock '86-93 water pump pulley is on the left, and the '93 Cobra pulley is on the right. If you've got an underdrive water pump pulley and you're having cooling problems, get rid of it and try something smaller. The Cobra unit works well with superchargers or aluminum heads, which make lots of excess heat.

you've still got one of these flying discs on your water pump, get it outta there. Reinstall the stock pulley, or even a '93 Cobra pulley (which is smaller than stock). This will speed the flow of coolant to and from the radiator and, ironically, give you more power.

Thermostat

Here we go again; the great thermostat debate. If you've got the stock 191° F thermostat and are having trouble keeping cool, change to a 180° unit. This will lower coolant temperature about 10° provided your coolant, radiator, fan, water pump and cap are up to par.

If you've got a 180° thermostat that's been in for a while, it might need changing. They've been known to stick open, closed or halfway. There is a school of thought that says if a 180° cap is good, then a 160° cap is better. It



A 180° thermostat can lower engine temperature another 10°, provided everything else is in working order. With the exception of colder climates, a 160° unit will only make the engine run hotter. This is because it stays open all the time and won't allow coolant to stay in the radiator long enough to cool. In street cars, thermostats need to cycle open and closed to be effective.

just ain't so. What happens is that the 160° piece stays open all the time and your coolant doesn't stay in the radiator long enough to cool down. In other words, hot coolant goes right back into the engine. Thermostats work best when they have the opportunity to cycle open and closed. This goes for drilled-out thermostats and open restrictors, too.

Hoses

While not a cause of overheating, an old radiator hose, coolant transfer hose or heater hose can stick you into the wall or leave you stranded in short order. Replace old, worn-out hoses before they break. A sign of imminent failure is when the hose swells or puffs out near the clamp.

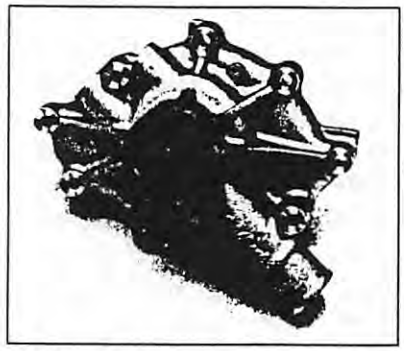
Underhood Ventilation

Modified engines that produce large amounts of underhood heat—blowers and turbos, most notably—can benefit from an aftermarket hood. Many designs have attractive scoops, ducts or elevated cowls to remove hot air from the engine compartment.

Make sure you get one with adequate protection from the elements, however. We've seen a few that let too much moisture into critical areas, such as around the throttle position sensor on top of the throttle body.

Water Pump

While not common on HO 5-liters, water pump failure can occur. If you'd like to upgrade from the stock piece, Edelbrock has just released a high-capacity, reverse-flow aluminum water pump for serpentine belt 5-liters.



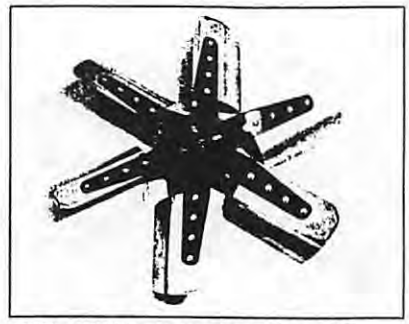
Edelbrock's new reverse-flow water pump for late-model 5-liters has a computer-designed impeller that can increase flow up to 20 percent.

The Edelbrock unit features a computer-designed impeller that flows up to 20 percent more coolant than a stock water pump.

Radiator Fan

Heat transfer from the radiator to the atmosphere is aided by the movement of air across the radiator by the fan. The stock fan is a thermostatic clutch unit that spins faster when heated, slower when cool. After years of use, the clutch may wear out, reducing its effectiveness. Many Mustangers elect to replace the stock fan with non-stock units, which may or may not fit their applications.

One of the most effective aftermarket fans for 5-liters is Flex-A-Lite's 1500 Series reverse-



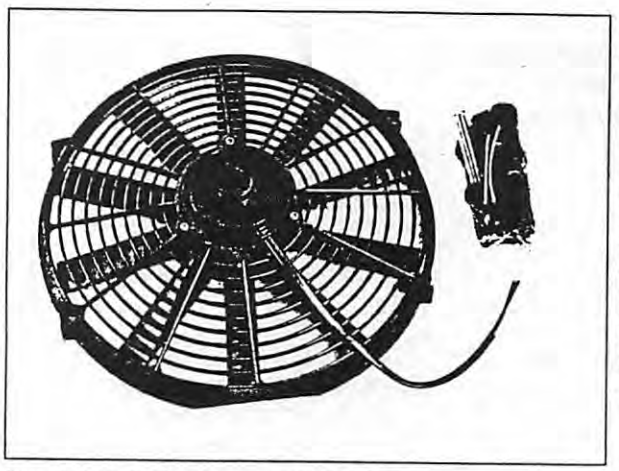
A Flex-A-Lite reverse-rotation 1500 Series flex fan will move more air through your radiator than a truckload of electric fans. Just make sure to use the stock radiator shroud. Some centrifugal supercharged cars, however, won't be able to use one because of belt clearance. For Mustang applications, make sure you get a fan-extension kit that contains spacers and longer bolts.

rotation fan. This lightweight unit features high-pitch flexible blades that move twice as much air as the stock unit. This is an ideal choice for street-driven cars that suffer from heat buildup at idle and low speed. Note: The fan blades on the 1500 Series are too deep for use with centrifugal superchargers because of blower belt interference.

Electric fans are often substituted for the mechanical fan for race-only applications. For sustained street use, however, electric fans, even the high-speed variety, won't begin to move the same amount of air as a properly operating mechanical fan.

Furthermore, high-speed electric fans cause excessive battery drain if the charging system (alternator) and battery have not been upgraded to handle the extra load. A swap to electric fans is often tied to new cooling system problems. If this applies to you, try switching back to the mechanical fan or a Flex-A-Lite 1500 Series.

The stock radiator shroud plays an important part in engine cool-



For street supercharged 5-liters that can't use the 1500 Series flex fan, a 14-inch high-speed pusher fan on the front of the radiator in conjunction with the stock mechanical fan and shroud will work. You'll have to trim a small section of the bumper support to make it fit.

ing. It is popular to remove the fan shroud for weight reduction and engine access. This should be done only on race-only vehicles. The shroud creates an effective pressure drop between the front and rear of the radiator, ensuring that the rotating fan pulls cool air through the radiator rather than just whipping up the air in the engine compartment.

If the shroud interferes with modifications like a centrifugal blower belt or radiator hose, trim it away, keeping as much of it as possible. When installing a larger radiator, the shroud becomes even more important because radiator thickness is increased. This is because it's harder for the fan to draw air through a thicker radiator.

If you still need to move more air, we recommend installing a 14-inch high-speed electric pusher fan on the front of the radiator to complement the mechanical fan. Some trimming of the inside bumper support will be required. A heavy-duty alternator and thermostatic switch should also be installed if street use is planned.

Radiator

A larger-capacity radiator *may* provide more cooling as long as the fan shroud is intact, and the fan, water pump, thermostat and coolant are all working properly. As you drive at speed on the open highway with the engine warmed up to operating temperature, your water temperature gauge should indicate the natural cooling capacity of your system. If the temperature settles at or below your thermostat's rating, your radiator is already large enough.

If this is the case and you're still having cooling trouble at idle and low vehicle speed, a bigger radiator won't help—your cooling problems are elsewhere. On the other hand, if your highway cruise coolant temperature is greater than your thermostat's rating, you can definitely benefit from a bigger radiator. Three- and 4-core radiators are commonly available, and come in brass and aluminum.

Here's a comparison of the stock radiator with a 4-core brass radiator from BBK. A larger radiator will give you more cooling capacity on the street, but make sure you need one first. Check the natural cooling capacity of your system on the highway (top gear) with the engine warmed up. The gauge will rest on the system's natural capacity at speed (60 mph). If the indicated temp is fine, you don't need a larger radiator. Drag cars should use a smaller radiator to reduce weight and shorten cool-down time in the pits. A large radiator will take longer to cool.

Brass is heavier but dumps heat better and is more resistant to corrosion. Aluminum has the weight advantage and is more prevalent. Both work fine.

Special thanks is due to Chris Horyn for his technical assistance in preparing this story.

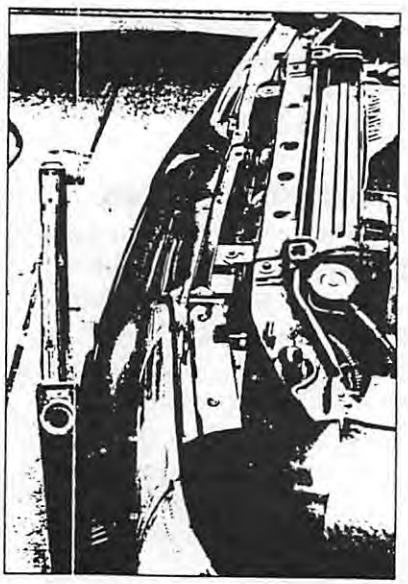
SOURCES

BBK Performance
1611 Railroad St.
Corona, CA 91720
909/735-8892
3-& 4-core radiators

Edelbrock
2700 California St.
Torrance, CA 90503
310/782-2900
aluminum high-flow water pump

Flex-A-Lite
Box 9037
Tacoma, WA 98409
800/851-1510
flex fans and electric fans

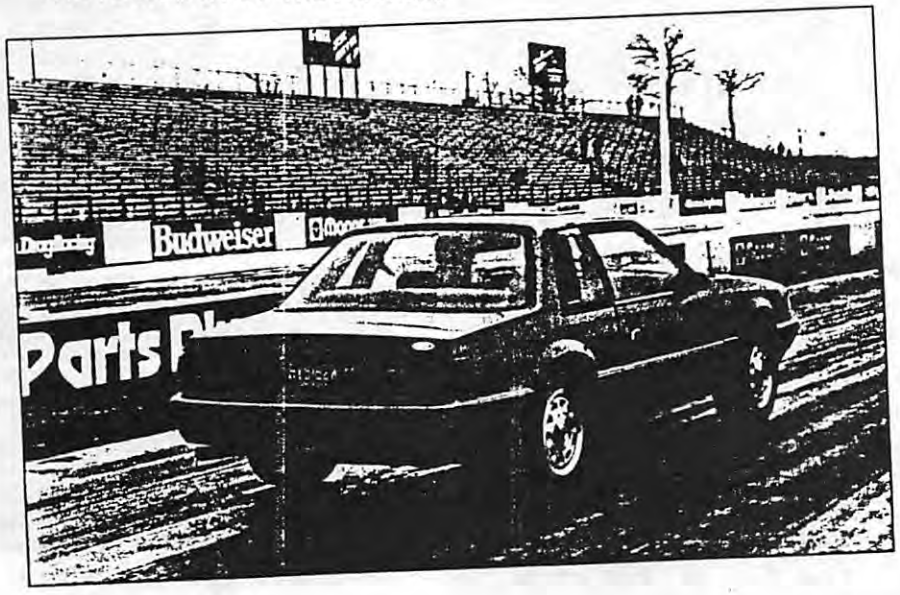
Red Line Synthetic Oil Corp.
3450 Pacheco Blvd.
Martinez, CA 94553
510/228-7576
Red Line Water Wetter



SHIFTY BUSINESS

With the right choice of parts, AOD-equipped Mustangs can run just as quickly as 5-speed cars. We show you that it's less expensive than you think.

By John Hunkins
PHOTOGRAPHY BY THE AUTHOR



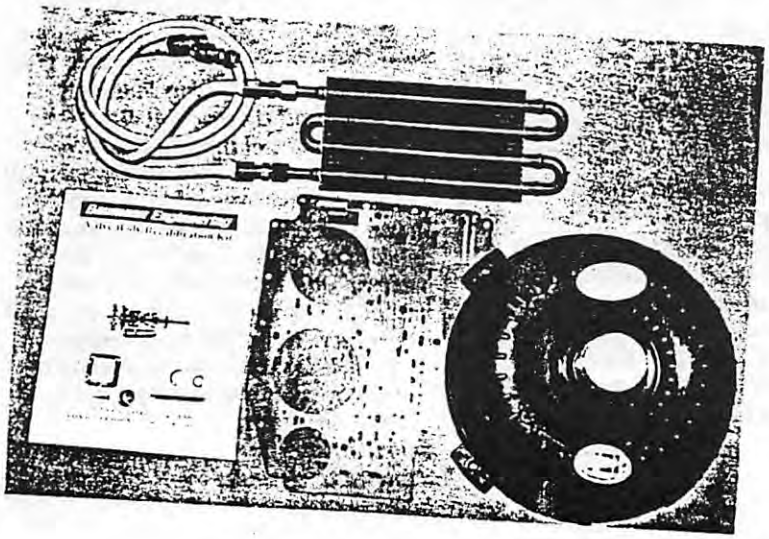
For serious high-performance applications, most 5-liter enthusiasts write off Ford's automatic overdrive (AOD) transmission as an unreliable slug. We'll be the first to admit that the AOD's reputation, as well as its design, is in need of improvement.

In stock form, an AOD-equipped Mustang is at a serious disadvantage to 5-liters equipped with the T-5. Most manual-transmission Mustangs are a good half-second faster (at least) in a quarter-mile contest than comparably equipped AOD cars.

Most AOD owners quickly become frustrated with this state of affairs. To pay more for something that offers less performance is a bitter pill to swallow, especially when reduced reliability under severe-duty racing conditions is an issue.

Because so little is known about the AOD, most Mustang racers switch to either a manual gearbox or a C-4 automatic. This has caused the AOD to be perceived an outcast even more.

Don't lose heart, though, because there's a light at the end of the tunnel. Ford's AOD transmission was designed for many pur-



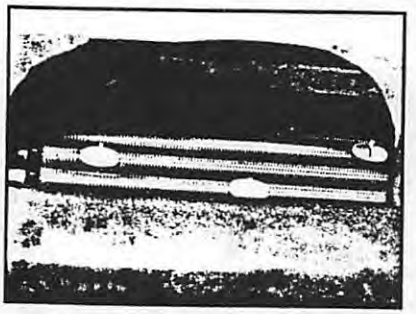
Our prescription for AOD-equipped 5-liter Mustangs: auxiliary transmission cooler, valve body recalibration kit, heavy-duty torque converter and synthetic ATF.

poses, one of which is to provide smooth shifts for little old ladies in Lincoln Town Cars. What isn't commonly known is that the AOD transmission has a strong basic design and can be vastly improved with only a few modifications at relatively low cost. For less than $800 (including a TCI converter and labor), you can get the modifications we outline here. They include an auxiliary transmission cooler, a valve body shift kit, a torque converter and synthetic lubricants.

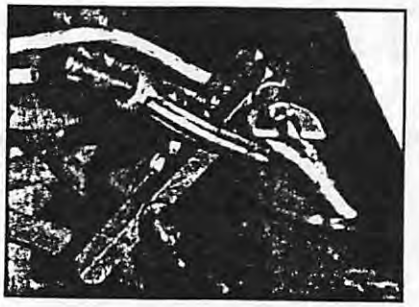
Auxiliary transmission cooler

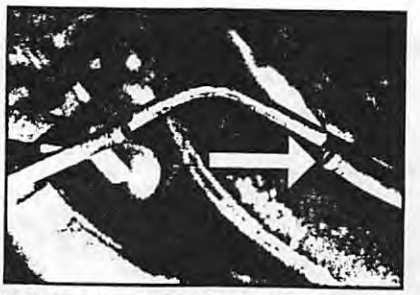
In an automatic transmission, the engine's torque is completely transferred through a fluid coupling. Except during lockup, the ATF (automatic transmission fluid) is the sole conduit for all this energy. This tremendous hydraulic pressure generates a lot of excess heat, much of which must be eliminated or else serious damage can occur. At the very least, transmission service life is reduced as a result of internal friction and fluid breakdown.

Because the stock transmission cooler in the 5-liter Mustang is so small (it's nothing more than a single crossover conduit at the bottom of the stock radiator), transmission durability and performance can be greatly increased with the addition of an auxiliary transmission cooler.

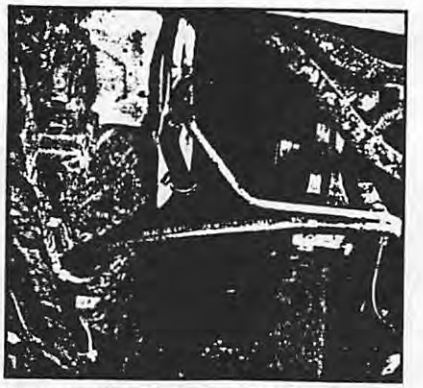


Auxiliary transmission cooler is attached to front of radiator with supplied tie straps. Try to locate the cooler in the air stream as much as possible to gain the maximum cooling benefit.





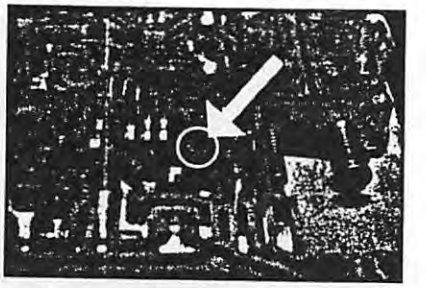
To install our auxiliary transmission cooler, we sectioned the return line leading back to the transmission from the radiator with a pipe-cutting tool. To create a lip for the necessary hose clamps (remember, the fluid is under very high pressure), use a flaring tool. The finished flare looks like this (arrow).



Because of extreme pressure and temperature, always use the properly rated line. Note that the lines are safely tied to the radiator support so they won't drag on the ground.

According to Stanley Poff, director of motorsports at TCI, an auxiliary transmission cooler can reduce transmission fluid temperature by 30-40° F in a 5-liter drag application. The results are reduced chemical breakdown of the ATF (which eventually causes heat-related component failure) and improved consistency.

Simply put, if you expect to subject your 5-liter to heavy engine loads such as in drag racing or trailer pulling, install an auxiliary transmission cooler. At an average



The Baumann Engineering shift kit is one of the most thorough AOD kits available. Many of the modifications require enlarging or drilling new holes in the valve body separator plate. Shown here is the orifice (extra hole drilled) needed to eliminate control pressure cutback, a feature of the AOD that detrimentally drops transmission line pressure to the apply clutches and bands. The small rubber plug is also part of the control pressure cutback elimination (arrow). Some of the other Baumann kit orifice modifications are designed to eliminate the overlap time between gears by causing a quick, precise shift.

cost of well under $100, it's cheap insurance. They're available from TCI, Moroso, B&M and Kool Klutch.

Valve Body Shift Kits

Much of the bad rap the AOD carries is a result of sloppy factory shift calibration and premature band failure. A modified 5-liter engine typically makes power in an elevated rpm range that is well above the factory-calibrated shift points. An engine that has its highest average power in the 4500- to 6000-rpm range is going to fall flat on its face if the transmission shifts at 4700 rpm. Most available shift kits (including the one from Baumann Engineering) let you adjust the shift points to optimize engine power.

"No big deal, so I'll shift manually," you might say. Unfortunately, it's not as simple as that. *How* a shift occurs is just as important as *when* it occurs. Unlike a manual transmission, where the box is in either one gear or the other, an automatic is temporarily in two gears at once during a shift. This overlap—the difference in rpm between the two gears—causes lots of internal friction, which comes right out of your pocket in the form of lost horsepower and accelerated transmission wear.

Why did Ford design the AOD like this? Remember the little old lady in the Lincoln? Shift overlap creates a very smooth, seamless transition between gears. You wouldn't want Granny's dentures to pop out on a hard 2-3 shift, would you?

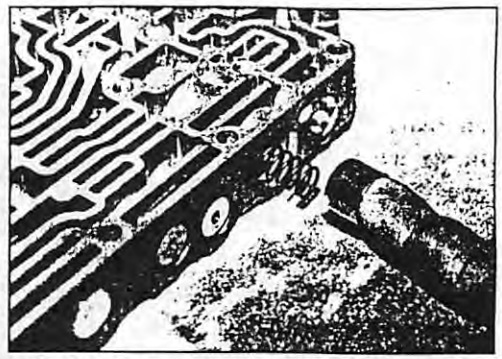
Fortunately, there's an easy fix for this. (No, we're not talking about Polident.) A valve body recalibration kit (like the one we used from Baumann Engineering) reduces the amount of time the AOD is caught in both gears, improving shift feel, increasing transmission durability, and reducing horsepower-robbing friction. When used by itself, the Baumann kit is good for a solid .20-second reduction in ET. Not bad for $55.

Besides Baumann Engineering, AOD shift kits are available from TCI (part No. 436000), Art Carr (part No. 21000) and Ford Motorsport (part No. M-7101-F).

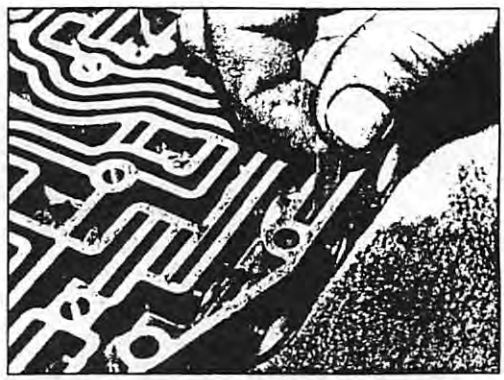
Torque Converters

The torque converter is probably the least-understood component in an automatic transmission. It is comprised of three important parts: the turbine, the impeller and the stator. The two larger parts, the turbine and the impeller, are the two big halves inside the doughnut-shaped converter. The impeller is the half attached to the engine via the flywheel and is the "pump" that forces fluid, by means of angled fins, into the turbine (the driven half that feeds the power to the transmission).

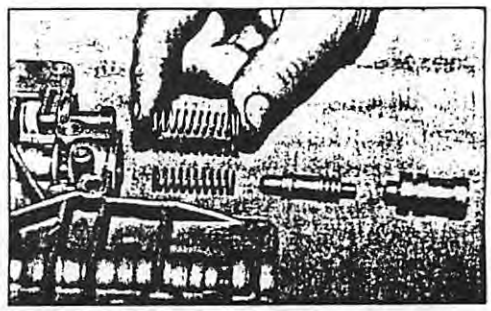
It's actually the fluid that transfers the engine's torque from the pump (impeller) to the turbine (attached to the transmission). During acceleration, there is no mechanical link like the clutch in a manual transmission. The fluid travels across the space from one half to the other. The greater the space between the blades in the impeller and the turbine, the



Shift feel for the 1-2 gear change is selected by removing one of the accumulator valves and reassembling it with the copper spacer shown here. Three choices are available to vary shift feel.



The Baumann Engineering kit employs a spacer and various combinations of shims to adjust full-throttle shift points. The T.V. limit valve is removed to receive a spacer. Shims are then installed (shown). The thickness of the shims controls the full-throttle shift rpm. Some versions of the AOD don't allow the 2-3 shift point to be as high as the 1-2 shift point (as was the case for us). Our shim combination raised the 1-2 shift to 5600 rpm and the 2-3 shift to 5100 rpm.



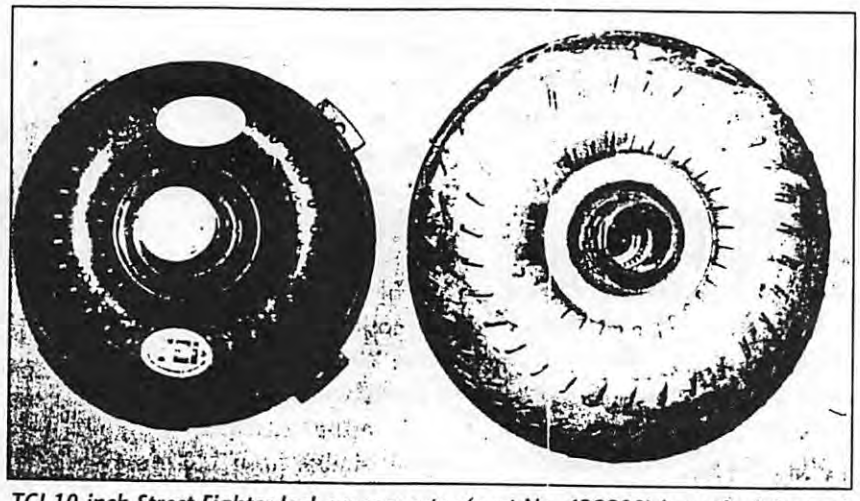
The installation of this slightly stronger throttle valve spring will help improve light to moderate throttle shifts in earlier transmissions. This also eliminates buzzing throttle valve resonance at idle.

greater the slip (stall). A "loose" converter (more gap) will give you a higher stall speed (allowing the engine to work more in its rpm range when launched), but will also be less efficient.

The gap between the blades of the impeller and the blades of the turbine is not the only factor determining stall speed. The shape, quantity, angle and construction of the blades on the impeller, turbine and stator also determine stall speed and torque multiplication. Obviously, there is a fine science to torque converter construction. That old cliché "You get what you pay for" definitely applies here, so be careful whom you call. Beware of claims that seem too good to be true. In most cases, cheap converters that have been merely "loosened" to increase their stall speed will rob you of horsepower and durability.

Because Ford's AOD transmission is of the lockup variety, the transmission input shaft design is a weak link in the powertrain. Here's why. In order to improve fuel economy, once the turbine half approaches around 90 percent of the impeller half's speed (it never can actually get to 100 percent because of the inherent inefficiency of fluid coupling), the two halves lock up by means of a second shaft running through the center of the input shaft (third gear and overdrive). Older automatic transmission designs are of the single-shaft variety (fuel efficiency wasn't an issue back then), so they can handle more torque. Because they didn't have two radially concentric shafts, one inside the other, they were stronger.

Our TCI Street Fighter converter (part No. 432800) is of the lockup variety. Unlike the stock converter, however, the turbine input shaft



TCI 10-inch Street Fighter lock-up converter (part No. 432800) is on the left; stock converter is on the right. Smaller diameter reduces the centrifugal force of the fluid and produces a higher stall speed. TCI's steel turbine input shaft increases torque capacity a lot over the stock cast-iron shaft. TCI converter also has brazed fins for added strength, and Torrington bearings (instead of thrust washers) for improved durability.

We recommend chasing the threads with a tap before installation so that the bolts will go in easier when you're under the car.

spline is constructed of steel rather than cast iron. According to TCI, the steel construction bumps the torque capacity of this converter up to around 450 lbs.-ft. This brings a weak point in the AOD torque path up to par with what the rest of the transmission can handle.

Some manufacturers (such as Art Carr) also offer converters that convert your transmission from lockup to non-lockup. The added strength of a single input shaft can handle just about anything. This, however, requires a companion transmission input shaft.

Furnace brazing is another term bandied about in torque converter circles. This means that the fluid-directing fins in the impeller and turbine have been much more strongly attached to the shell that holds them. Normally, the fins are held loosely in place (usually by a

dimple in the shell with the corners being bent around a small slot). The force of the fluid on the fins can alter their shape (reducing efficiency and changing the converter's performance) or, even worse, break or bend them. A good brazing job makes the converter much stronger.

Stator design can also improve performance. The stator stabilizes and redirects fluid flow as it passes from the turbine back into the impeller. A good converter builder will often alter the angle or number of the stator blades to change torque multiplication at launch.

The diameter of a converter partially determines the stall speed of a converter by controlling the centrifugal force of the fluid as it rotates inside. Larger converters generate more centrifugal force sooner than smaller converters, causing them to "flash" at a lower rpm.

A common misconception is that the converter's size is the sole determining factor of stall speed. Actually, converter size, engine torque, stator design, turbine-to-impeller clearance and turbine/impeller fin design all determine stall speed. Ask a reputable converter builder to recommend a converter for you. Be prepared to provide information regarding type of use, rear-end gearing, engine horsepower and torque, and vehicle weight.

In addition to TCI, Art Carr, Transmission Specialties and B&M also make converters for AOD drag racing and street use.

Synthetic ATF

We've said it before and we'll gladly say it again. If you're not using synthetic lubes, we want you in the lane next to us.

Because of the tremendous temperature, pressure and friction in an automatic transmission, it is a prime candidate for synthetic ATF. A synthetic ATF prolongs drain intervals and is practically free of the chemical breakdown common to mineral-based ATFs. An added benefit to synthetic ATF is that you'll experience less horsepower loss from friction. Synthetics are just better—period.

Overdrive Servos

According to Baumann Engineering, the AOD transmission uses one of three overdrive band servos (A, B or C). Early, pre-1985 AODs are equipped with the smaller C servo, while most '85-later AOD-equipped Mustangs have the B servo, which provides a 30-percent increase in band application force over the C servo.

For most street and strip applications, the B servo is fine. However, if you expect to use overdrive in harsh conditions (such as police pursuit or heavy highway towing), use the A servo (which has 16 percent more overdrive band application force than the B servo). The A servo is the largest overdrive servo available for the AOD transmission, and is found only in Thunderbird Super Coupes and '92-later trucks. This is not all that crucial in drag racing, however, because overdrive is not used.

The Results

We baselined our '89 LX test car in October '92. At the time, it was equipped with stock Gatorbacks, a Borla stainless-steel exhaust system, a 65mm throttle body and a 77mm Pro-M mass air meter. We ran 15.19/90 as a baseline.

With our new auxiliary transmission cooler, Baumann valve body recalibration kit, TCI torque converter and Mobil synthetic ATF, we ran 14.78 at 93 mph. We managed better than a .40-second improvement, and that came after the sun had melted away an early-morning snowfall, which reduced traction.

Traction was not a major problem when the car was baselined, but it became quite a limiting factor after these modifications. In particular, the 10-inch converter raised the stall speed enough to blow the tires away when more than one-third throttle was used in first gear. With a set of 8.5-inch Mickey Thompson slicks, we've lowered our ET to 14.64 without any other modifications. We've subsequently added a Kenne Bell 5-lb. Whipplecharger kit, lowering our ET even more to 13.17 at 104.5 mph. So far, our AOD modifications have saved our tranny from the fate suffered by so many stock AODs behind blowers: shattered converters and burned clutches and bands.

Special thanks to Blaine Akerley, Marcel Bolduc and Ron Brooks of Lewiston Transmission in Lewiston, Maine, for their assistance with this installation.

SOURCES

Baumann Engineering & Design
Box 63
Clemson, SC 29633
803/654-1380

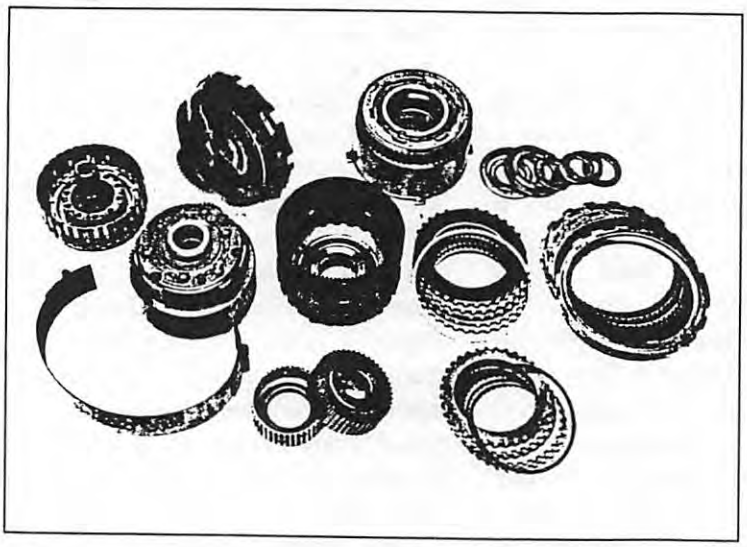
Lewiston Transmission
29 Blake St.
Lewiston, ME 04240
207/784-7221

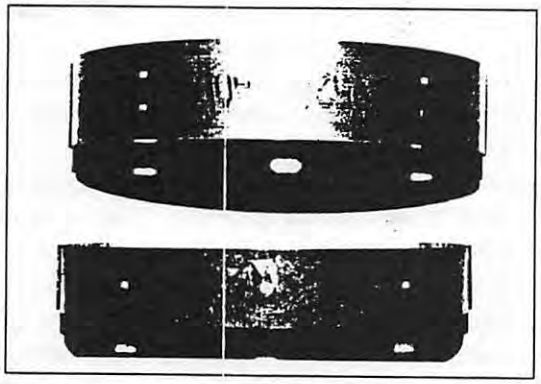
TCI Automotive
One TCI Drive
Ashland, MS 38603
601/224-8972

GEARING UP FOR BATTLE

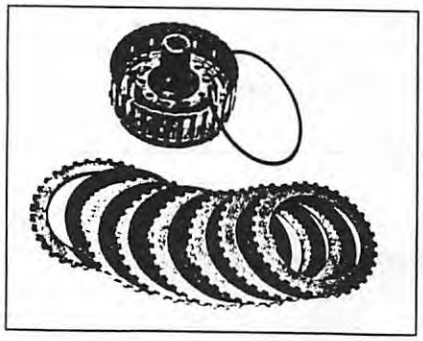
Ford Motorsport's new wide-ratio AOD gear set can help automatic Mustangs even the score with their T-5 counterparts.

By Al Agostine Jr.
PHOTOGRAPHY BY JOHN HUNKINS

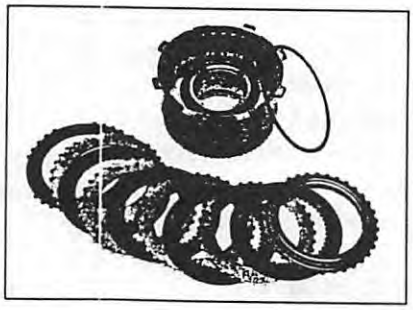




The Achilles heel of the AOD is its flimsy stock overdrive band. A heavy-duty 2-inch overdrive band replaces the stock 1 1/2-inch one. This helps increase clamping force around the drum, and reduces slippage and excess heat. Although not active under full throttle, the heavy-duty overdrive band is helpful for towing applications and high-speed police pursuit.



The AOD is widely known to have an insufficient number of clutches for high-performance duty. This heavy-duty, low-inertia, 6-plate high clutch assembly provides increased frictional surface area and increased torque.

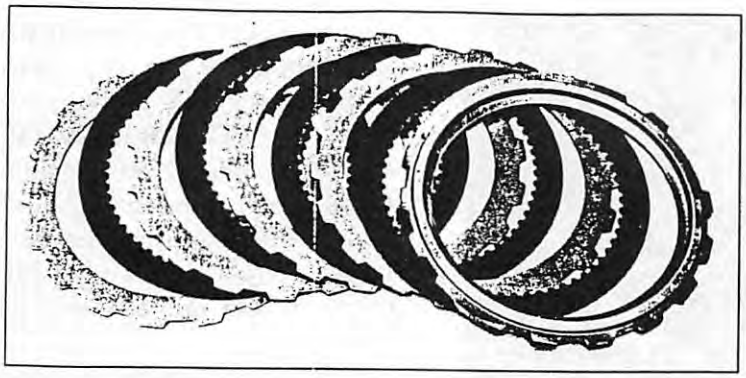


This 6000-rpm one-way clutch is balanced, providing a smoother ride at high rpm. (Note ground-off "tab" at the top of the drum.)

In the arena of 5.0-liter Mustang drag racing, it is generally accepted that, given the same combination of parts, a T-5-equipped car will be quicker and faster than an AOD-equipped car.

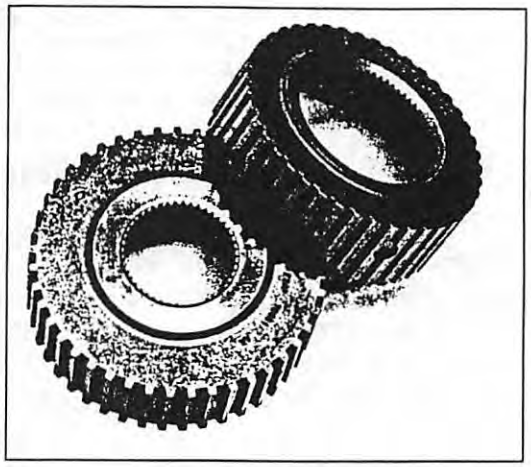
To fully understand why, we must briefly follow the history of the AOD and examine its performance shortcomings.

Ford introduced the 5.0-liter Mustang equipped with an AOD

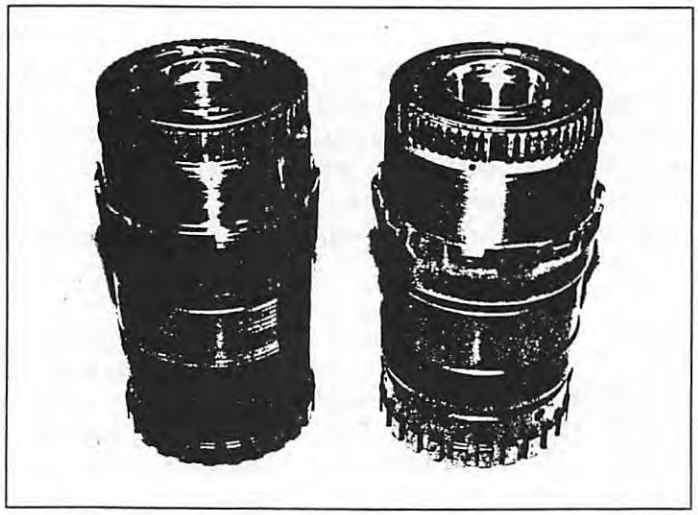


The more clutches, the better. So if they'll fit inside the transmission housing, install them. Here, the heavy-duty, 4-plate intermediate clutch replaces the weaker 3-plate intermediate clutch. This increases the frictional surface area and reduces slippage and heat.

Pat Barrett installs the new components into the AOD housing. The transmission is being supported vertically to ease in the stacking assembly of internal components. This is much easier than installing them horizontally, and it helps prevent damage to the internal components.



Forward clutch life has proven to be a real concern in AODs. The forward clutches deteriorate due to insufficient lubrication and cooling. The improved-lube forward clutch hubs increase lubrication through increased-diameter trans fluid transfer orifices.



If you take from one place, you have to add to another. The stacked heights of the two rotating assemblies (stock left; wide-ratio, right) are the same, even though the components are of different heights.

passenger-car transmission in the mid-'80s as an alternative for those who prefer not to row through gears in traffic. In day-to-day use, the AOD provides its owner with reliable, quiet, fuel-efficient service. But unlike its GM counterpart, the Turbo Hydra-matic 700R4 (and its descendant, the updated R4L60E), the AOD just isn't a performance-oriented unit.

When GM originally designed the 700R4 for use in the Corvette,

as well as in the Camaro/Firebird, it recognized that the need was different from that of a passenger car. Fuel economy, engine displacement (torque output) and in-

An increased-capacity transmission pan is a good idea in any high-performance AOD Mustang. The increased volume of transmission fluid lowers operating temperatures and increases clutch life. The large-capacity Motorsport pan here has been discontinued but is the same as the non-chromed full-size Bronco pan.

tended acceleration dictated the use of aggressive gear ratios and a higher-stall-speed torque converter. The AOD that Ford installed in the late-model Mustang is little more than a recalibrated and slightly beefed-up standard passenger-car transmission originally designed with fuel economy in mind.

Ford figured incorrectly (even though you bought a 5.0-liter Mustang) that the owner was not con-

Playing The Numbers Game

To fully appreciate the performance potential of Ford Motorsport's AOD wide-ratio upgrade kit, we compare the gear ratios of a stock T-5, a stock AOD and a wide-ratio-equipped AOD.

	Stock T-5	Stock AOD	Wide-Ratio AOD
1st	3.35	2.40	2.84
2nd	1.99	1.47	1.55
3rd	1.33	1.00	1.00
4th	1.00	—	—
OD	0.68	0.67	0.70

When you multiply the transmission gear ratio(s) by the rear axle ratio, you come up with the total combined starting-line gear ratio. This number is proportional to the total driveline torque output and determines how quickly your car gets moving off the line.

Stock T-5

1st	2nd
3.35 x **2.73** = 9.14	1.99 x **2.73** = 5.43
3.35 x **3.08** = 10.31	1.99 x **3.08** = 6.12
3.35 x **3.27** = 10.95	1.99 x **3.27** = 6.50
3.35 x **3.55** = 11.89	1.99 x **3.55** = 7.06
3.35 x **3.73** = 12.49	1.99 x **3.73** = 7.42
3.35 x **4.10** = 13.73	1.99 x **4.10** = 8.15
3.35 x **4.30** = 14.41	1.99 x **4.30** = 8.56
3.35 x **4.56** = 15.28	1.99 x **4.56** = 9.07

Stock AOD

1st	2nd
2.40 x **2.73** = 6.55	1.47 x **2.73** = 4.01
2.40 x **3.08** = 7.39	1.47 x **3.08** = 4.53
2.40 x **3.27** = 7.85	1.47 x **3.27** = 4.81
2.40 x **3.55** = 8.52	1.47 x **3.55** = 5.22
2.40 x **3.73** = 8.95	1.47 x **3.73** = 5.48
2.40 x **4.10** = 9.84	1.47 x **4.10** = 6.03
2.40 x **4.30** = 10.32	1.47 x **4.30** = 6.32
2.40 x **4.56** = 10.94	1.47 x **4.56** = 6.70

Wide-Ratio AOD

1st	2nd
2.84 x **2.73** = 7.75	1.55 x **2.73** = 4.23
2.84 x **3.08** = 8.75	1.55 x **3.08** = 4.77
2.84 x **3.27** = 9.29	1.55 x **3.27** = 5.07
2.84 x **3.55** = 10.08	1.55 x **3.55** = 5.50
2.84 x **3.73** = 10.59	1.55 x **3.73** = 5.78
2.84 x **4.10** = 11.64	1.55 x **4.10** = 6.36
2.84 x **4.30** = 12.21	1.55 x **4.30** = 6.67
2.84 x **4.56** = 12.95	1.55 x **4.56** = 7.07

These are significant numbers! Remember, in drag racing, gear ratios are everything.

Whenever you lower your gear ratio, it has the same effect as lightening your car or increasing your power-to-weight ratio. As you remember from Physics 101, the lower the gear ratio, the easier it is for your engine to do "work" on your car.

After studying the gear ratio charts, you'll notice that a big bump in gear ratio for an AOD car doesn't give it the same benefit as the same bump in ratio for a T-5 car.

As you can see, the stock AOD is at a considerable disadvantage when it comes to total combined starting-line gear ratio, and hence, total driveline torque output. You are rarely in danger of over-gearing a stock AOD-equipped Mustang for the drag strip, especially when compared with the very low first and second gears of a T-5 transmission.

Example:
Total 1st gear ratio:

Stock AOD	2.40 x 4.10 = 9.84
Stock T-5	3.35 x 3.55 = 11.89
Wide-Ratio AOD	2.84 x 4.10 = 11.64

Obviously, the new wide-ratio AOD upgrade kit will get you in the same ballpark as a stock T-5.

For comparison, in order to achieve the same total combined starting-line gear ratio as the wide-ratio upgrade kit, a stock AOD would have to go up to a 4.88 gear, which is neither available for the stock 8.8-inch rear nor practical for highway use.

Example:
Stock AOD 2.40 x 4.88 = 11.71
Wide-Ratio AOD 2.84 x 4.10 = 11.64

Lockup vs. Non-Lockup

The stock AOD lockup torque converter is great for fuel economy but leaves a lot to be desired in the performance department. During lockup, the third gear and overdrive clutch packs are locked to the converter to prevent slippage. Unfortunately, torque multiplication in third gear is lost, and your Mustang's performance suffers.

An aftermarket high-stall-speed lockup torque converter (such as those made by TCI) will offer improved acceleration in first and second gears and maintain the fuel economy of the stock lockup function. However, it retains fuel economy at the cost of third-gear acceleration.

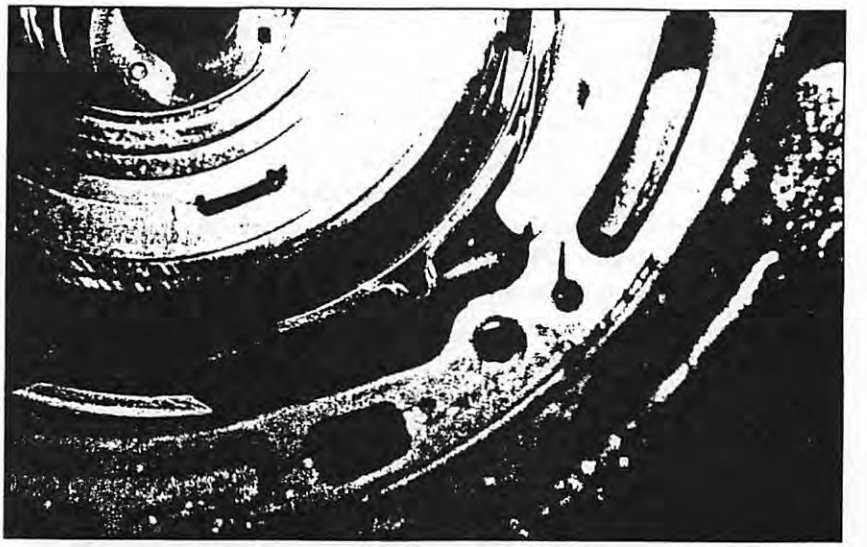
A non-lockup torque converter (like those made by Art Carr) is not locked up. As a result, the 2-3 and 3-OD shifts will be made without excessive rpm drop, and torque multiplication will be enhanced.

By machining off the splines on the inner input shaft, the Art Carr kit does not "lock up" into the torque converter housing. This is the same principle as the non-lockup torque converter design of years ago, such as in the C-4 and C-6 automatic transmissions.

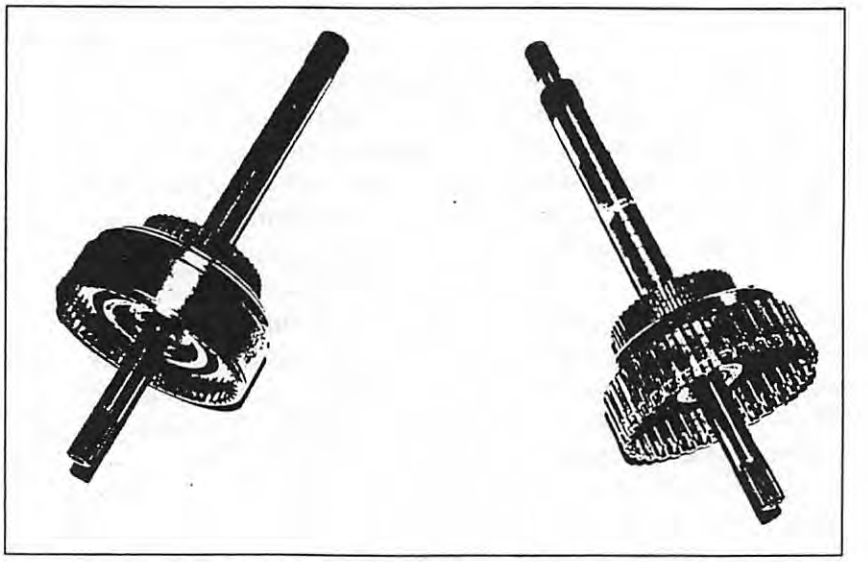
While this may not be the most efficient in terms of fuel economy, the torque multiplication in third gear is gained and your Mustang's performance improves.

An aftermarket high-stall non-lockup torque converter offers improved acceleration in all gears. However, it sacrifices the lockup function, so gas mileage suffers.

Obviously, it's a trade-off. If all-out performance is what's important to you, then a non-lockup converter and transmission input shaft kit is the way to go. Those who want increased performance and a degree of economy should go for a high-performance lockup-style converter—but this will be at the expense of third-gear torque multiplication.—A.A.



An easy, low-cost upgrade for the AOD is the installation of an A overdrive servo from the Thunderbird Super Coupe. The piston is substantially larger and increases the clamping force of the overdrive band considerably. This increases overdrive band life because it limits slippage on the 3-OD shift. In this photo, you can see how the point on the shaft end of the servo pushes the overdrive band around the clutch drum.



The inner input shaft on the right is the stock AOD. This is splined for the stock-style lockup converter. This shaft is a weak link in the AOD and is prone to breakage in high-horsepower applications. The inner input shaft on the left is an Art Carr 300M alloy-billet unit. Its splines are machined off for use with the Art Carr 10-inch high-stall non-lockup torque converter.

cerned with performance because he bought an AOD instead of a T-5. Obviously, all automatic transmissions are not created equal.

When Borg-Warner designed the T-5, it realized the importance of performance. The way to better performance (in spite of lower torque ratings and higher fuel economy standards) was through the utilization of lower gear ratios (higher numerically) in the transmission.

The AOD has basically the same gear ratios (with the exception of overdrive) as the earlier C-4s and C-6s. However, the AOD does not provide the "deeper" first and second gear ratios necessary for quicker acceleration (as do the 700R4 and R4L60E).

Enhancing the AOD's drag-racing disadvantage is its low-stall-speed converter. Remember, the T-5 manual transmission utilizes a clutch that acts like an "unlimited/variable-stall-speed torque converter"; you release the clutch pedal at whatever rpm you choose. This is considerably more effective at accelerating a Mustang from a standing start than a stock AOD low-stall-speed torque converter.

Ford Motorsport's soon-to-be-released AOD wide-ratio upgrade kit helps bridge the gap between the AOD and the T-5 (see "Playing The Numbers Game," page 24). The AOD wide-ratio upgrade kit will improve the acceleration of any AOD Mustang. Stock-motored, radical naturally aspirated or forced-induction 5-liters can all benefit from the increased torque multiplication.

In addition to improved gear ratios, the AOD wide-ratio upgrade kit includes high-rpm caged needle pinion bearings for increased durability under high-rpm racing conditions. It also provides a heavy-duty, low-inertia, 6-plate high clutch assembly as well as low-inertia reverse clutch assemblies for increased frictional surface area, lower weight, decreased inertial "drag" and increased torque over the stock assemblies.

A heavy-duty 2-inch overdrive band is also included. This helps increase clamping force around the drum for less slippage under load. As a result, heat-related failure is also reduced. The stock intermediate one-way clutch is replaced with a more accurately balanced 6000-rpm intermediate one-way clutch. This vibration-reducing feature increases thrust bearing life among other things.

The heavy-duty 4-plate intermediate clutch replaces the stock 3-plate intermediate clutch. This increases the frictional surface area and aids in reducing slippage and heat. To improve lubrication and reduce heat in the forward clutch assembly, a revised Mark VIII forward clutch hub is included. This piece has larger-diameter transmission fluid orifices to promote better heat transfer.

New needle bearing thrust washers and improved support washers are included. These provide tighter internal tolerances for smoother, quieter operation and increased durability.

If you're unable to wait for this kit to be available through your Ford Motorsport dealer, all of the parts can be obtained from Level 10 Performance Transmissions or your local Lincoln-Mercury dealership. Because of limited availability, have a valid Mark VIII VIN when ordering these parts from an L-M dealership.

As a benefit, all the parts in the wide-ratio kit have been field-tested in the $40,000, 2-ton Lincoln Mark VIII. As such, the upgrade kit is reliable, quiet and refined. Those towing trailers will find the wide-ratio kit a blessing due to its increased torque multiplication.

Follow along as Pat Barrett of Level 10 Performance Transmissions installs the AOD wide-ratio upgrade kit in an '88 Mustang GT.

SOURCES

Ford Motorsport Performance Equipment
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Level 10 Performance Transmissions
188 Rte. 94
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AOD wide-ratio parts and installation

Baumann Engineering
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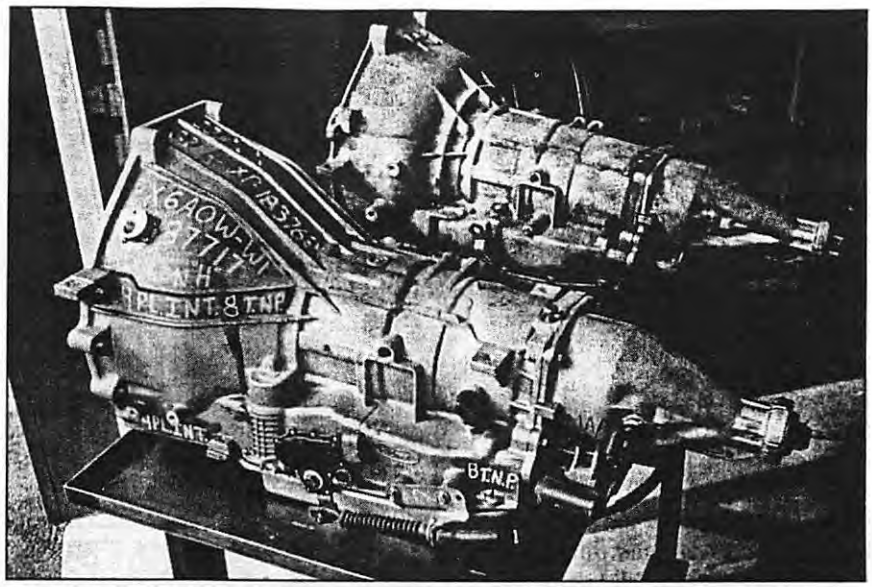
AOD tech

Art Carr Transmissions
10575 Belcher River Ave.
Fountain Valley, CA 92708
714/962-6655
converter, trans input shaft kit

MM&FF and Level 10 Transmissions dive headfirst into Ford's electronic overdrive transmission to add performance and reliability.

AOD-E UPGRADE

By Evan J. Smith
PHOTOGRAPHY BY THE AUTHOR



Here it is, folks, the AOD-E in the foreground as it sits quietly next to an earlier AOD transmission. Easy giveaways on the E unit are the extra webbing on the bellhousing and the electronic switches on the body of the trans.

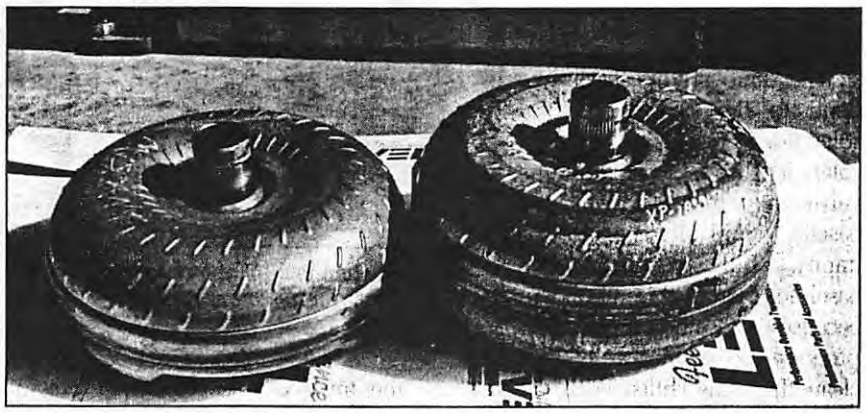
Ford's automatic overdrive transmission, or AOD, has been the only auto trans available in the 5.0 Mustang since the fuelie version has been in production.

Though it's done the job for many a 5.0 owner on the strip and on the street, it did take some time before its potential was realized as a performance unit, even though some will never consider it as such.

With the introduction of the SN95 Mustang, Ford Motor Company made some changes to the AOD in the form of electronic controls and a few internal modifications. The new unit found in all automatic-equipped '94-95 Mustang GTs is called the AOD-E.

Like its predecessor the AOD, the E-version will need a few modifications before being used as a performance piece. Though the AOD was never known for great strength, the AOD-E makes it seem indestructible by comparison. Throw any serious horsepower at it and the E is likely to start throwing parts back at you. Also, if you install anything steeper than a 3.55 cog in the rear, it will confuse the EEC-IV so much the trans won't know whether it wants to upshift, downshift or order a pizza.

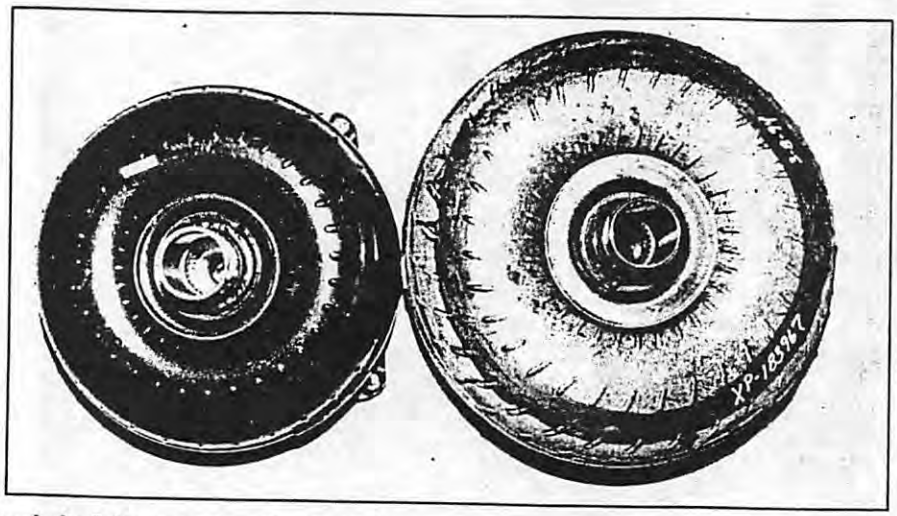
Fortunately, all is not woe. We contacted Ford automatic transmission expert Pat Barrett of Level 10 Transmissions (Hamburg, N.J.), and he agreed to show us exactly what modifications are needed to beef up the E and how they are performed.



These are the AOD (left) and AOD-E torque converters. It's easy to see that the '94-95 version is taller, wider and, therefore, heavier than the older converter.

On the outside, the AOD-E is visibly different from the earlier version. It won't take an experienced transmission rebuilder to notice the electronic connectors and hardware that are on the AOD-E. Also, the bellhousing features more webbing, and the case (or main housing) is larger than that of older AODs.

Bill Kessler, the shop foreman at Level 10, removed the AOD-E from a customer's street/strip Mustang to perform the needed upgrades. After removing the unit from the car, Bill



Level 10 recommends upgrading to an Art Carr torque converter for severe street or drag strip duty. The Art Carr unit is smaller, weighs only 18 lbs., and will make a stock Mustang quicker by a few tenths in the quarter. The beauty of this converter is that it can be used with no other modifications (no special input shaft needed), so the cost-vs.-performance gain is in the ballpark for the average Mustang owner.

unbolted the torque converter and we instantly noticed the first difference. The converter in the AOD-E is much larger and heavier, by some 10 lbs., compared to the 30-lb. weight in earlier AOD transmissions. The larger converter case is needed because of the electronic lockup clutch that is housed in the unit. The lockup feature is nice for those seeking improved gas mileage, but the extra weight exacts a serious performance penalty.

Next, Bill removed the trans pan and the filter, which exposed the valve body. The valve body directs the transmission fluid to the proper place within the transmission to control upshifting and downshifting, and it absorbs a certain amount of heat in the trans as well.

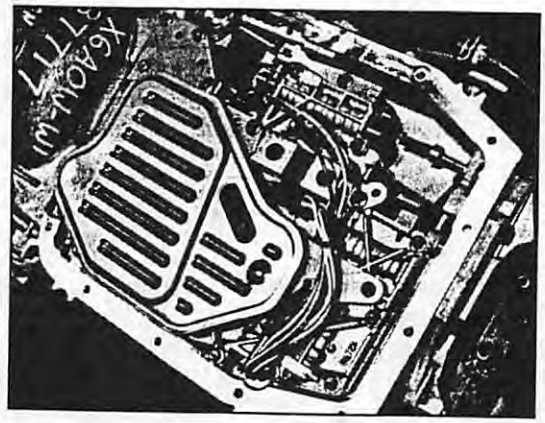
The first modification was done to the pressure control solenoid. This is the black solenoid that is located in the valve body, and it controls the baseline fluid pressure in the tranny. Bill explained that baseline pressure is important because the amount of fluid pressure determines how hard and clean the trans shifts. With the stock baseline pressure, it's likely the trans will slip after engine modifications are made. To increase the baseline pressure, Bill removed the solenoid from the valve body and then turned the Torx screw 3/4 of a turn clockwise. This will raise the pressure and make the shifts firm and quick.

Unlike older AOD units, the electronically controlled '94-95 transmissions have to be fooled into making more baseline pressure through this solenoid. Remember that bigger is not better, and that more than 3/4 of a turn can damage the trans because the extra pressure causes more resistance and that equals heat—transmission-damaging heat.

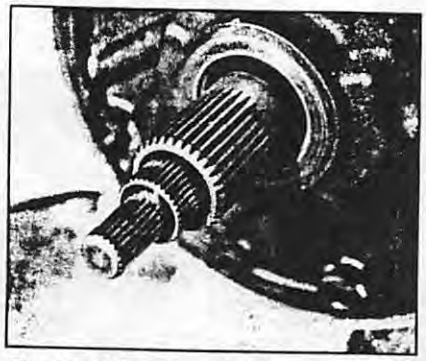
The second modification in the valve body was made to the first-to-second-gear accumulator spring. Here, the factory spring was simply replaced for a stiffer and slightly longer spring. This, along with the pressure increase, will help the trans upshift a bit harder because the soft factory spring absorbs the shock of the gear change and actually "calms" the shift. The stiff spring resists the movement of the actuator piston and makes the shift happen faster and with more authority.

The next step involved the installation a stronger pressure regulator spring. Much like the spring in the one-to-two accumulator, the pressure regulator spring is stiffer to help increase baseline pressure.

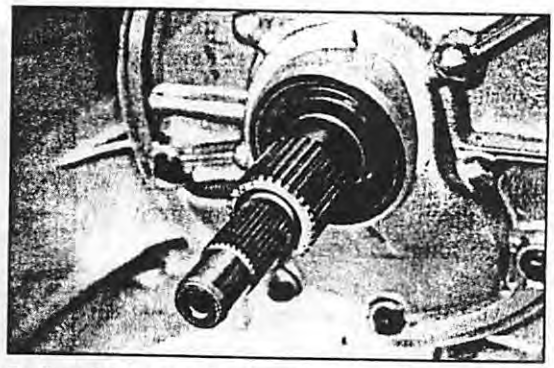
Bill finished the valve body modification by drilling the second- and third-gear feed holes in the valve body separator plate. This was done to increase the volume of fluid that will be flowing from the increased pressure. The increase in volume results in a larger hit of fluid against the clutch packs as it is fed on each of the upshifts.



With the pan removed, you can see the filter and the wiring that are attached to the valve body.

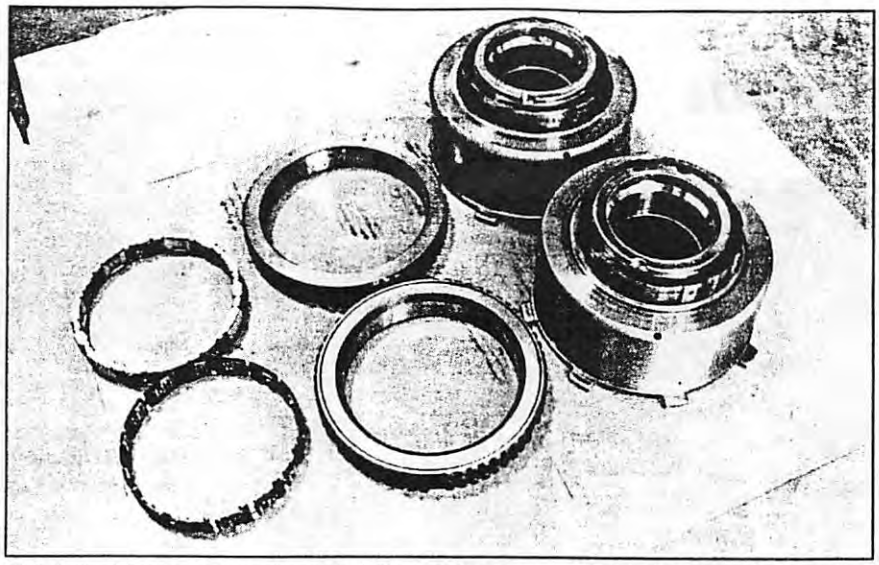


The AOD-E features a 3-spline input shaft to work with the lockup torque converter.

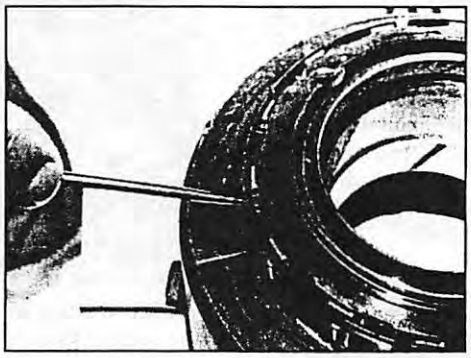


Earlier AODs have a 2-spline input shaft, like the one pictured here.

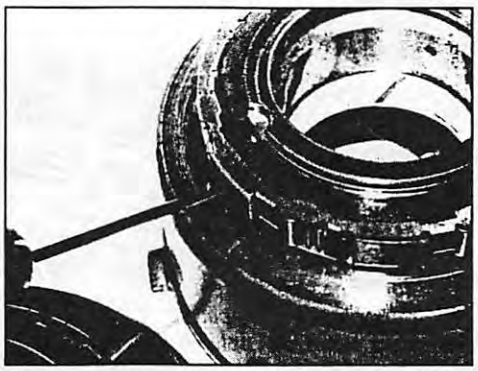
Internally, Level 10 changes various components to add strength to the AOD-E. Bill removed the front pump and disassembled the guts of the unit. He replaced the reverse input hub with a similar unit that has a 14-element sprag setup, as opposed to the 7-sprag setup on the stock factory hub. The extra sprags double the holding power of the hub in second gear. Along with the extra sprags, Level 10 replaced all the clutch bands with Raybestos Blue Plate Special clutches. These clutches have three times the gripping strength of the stock clutch-



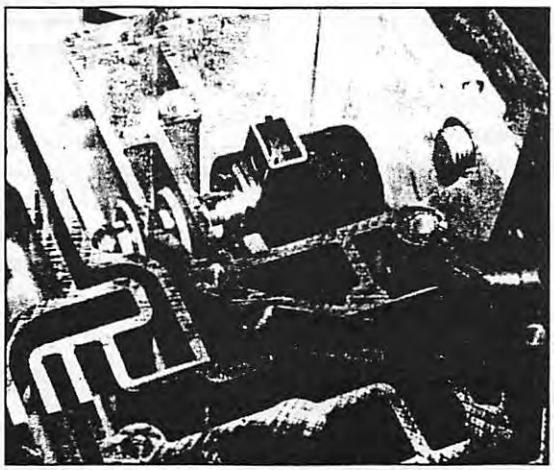
This is the 14-sprag reverse input hub (bottom) as compared with the factory hub setup.



Bill Kessler of Level 10 points to one of the sprags on the 14-sprag ring. When shifting into second gear, the sprags ride up each ramp and then they lock and hold the hub



The sprags on the stock hub are larger and look stronger than the heavy-duty unit, but they are not. The stock sprags have a reduced contact patch and therefore don't have the same amount of holding power.



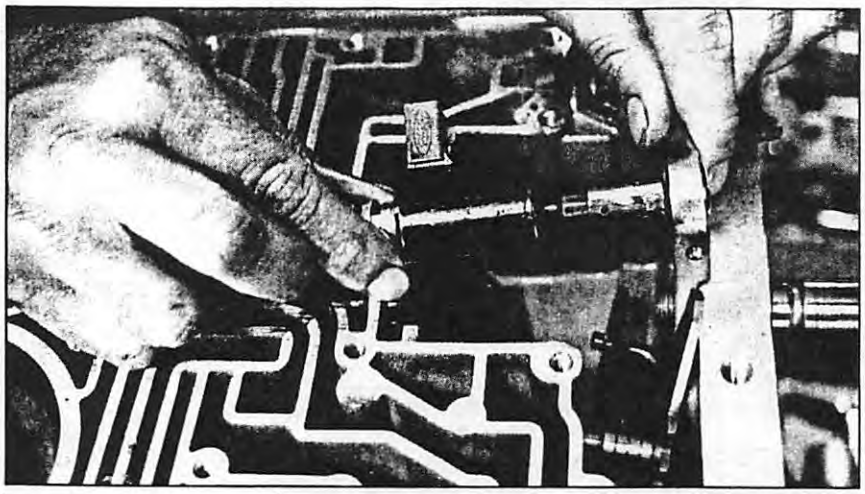
This is the pressure control solenoid that controls baseline fluid pressure in the AOD-E transmission.

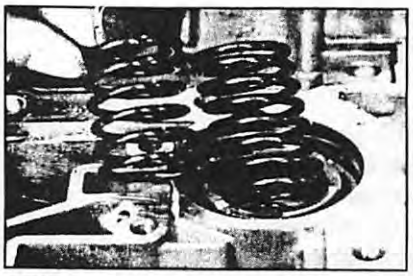
es so they grab better and last longer.

An added bonus in the Level 10 kit is the adjustable pressure control module that is installed in the cockpit of the car. It's adjustable from the driver's seat, so the driver can increase or decrease the baseline pressure for different driving conditions. After the internal modifications to raise baseline pressure, it can be tailored from inside the car with just the turn of a knob. There are three settings, from standard driving to high performance, and they control just how hard the transmission upshifts. Under normal cruise, just dial the knob to the standard boost position for smooth shifts, then crank it up at the track for firm, crisp upshifts.

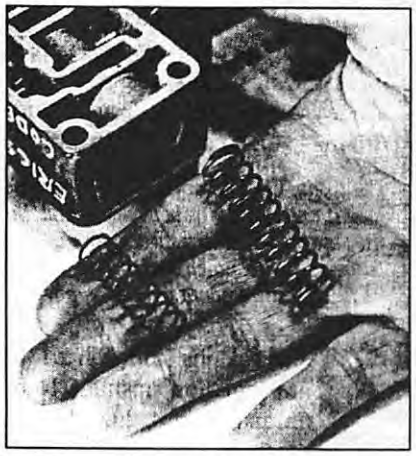
With the Level 10 kit installed, Mustang enthusiasts can feel free to stomp on the gas without the dreaded transmission slippage that has become commonplace in the world of the AOD-E. The Mustang GT in question feels much improved and is now

AOD-E Upgrade



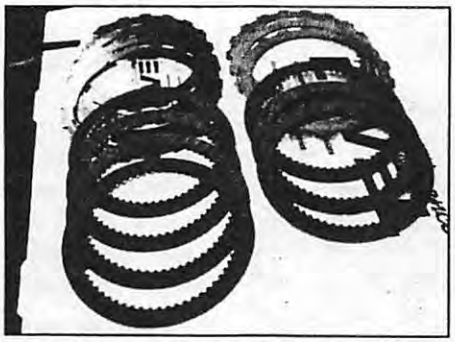


Bill Kessler replaces the spring that controls the first-to-second accumulator piston. The stronger spring (right) resists movement of the fluid, and upshifts will be improved.

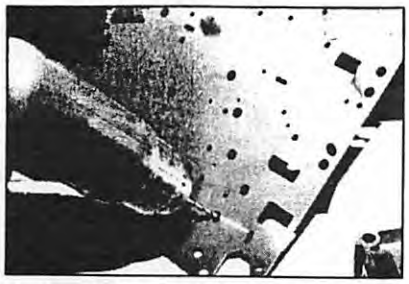


Level 10 also changes the pressure regulator spring in the valve body to help increase baseline pressure.

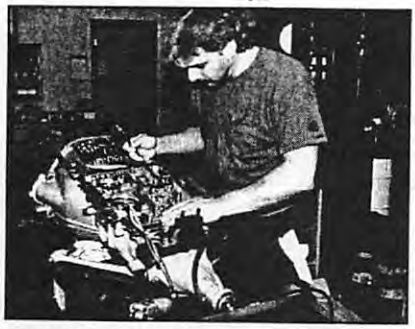
To increase the baseline pressure in the AOD-E, the pressure control solenoid must be adjusted. Remove the solenoid from the valve body and turn the Torx screw counter-clockwise 3/4 of a turn. This will give you the additional line pressure that is needed for quick, crisp shifts.



At left are the Raybestos Blue Plate Special clutches; the stock clutches are on the right. The aftermarket clutches feature three times the gripping strength of the stock pieces. Not only will they make the transmission shift better, but they'll help it live longer, too.



In this photo, you can see the separator being drilled. The enlarged holes will increase fluid volume and provide a larger hit of transmission fluid against the clutches for better upshifts.



Bill Kessler is seen here replacing the pressure control solenoid in the AOD-E.

Level 10 includes this Pressure Riser control switch, which is installed in the cockpit of the car. After installation, the driver can adjust the amount of baseline pressure, which controls how hard the transmission shifts.

ready for a supercharger, nitrous or anything else the owner plans to throw at it. Level 10 claims that it should take up to 750 horsepower reliably.

To rectify the problems that arise from 3.73 or (numerically) higher gear ratios, Level 10 offers a reprogrammed EEC-IV processor known as the Super Power Train Computer. Though it's somewhat pricey ($798), there's no other solution in town. And we all know how well AOD cars respond to 3.73 and 4.10 gears. Basically, they should be standard equipment! Among the computer's other benefits are raised shift points (by 200 rpm) and easy installation.

The kit can be purchased from Level 10 or it can be installed right in the shop in North Jersey. By maintaining the overdrive option, Mustang owners can have their horse and beat it, too, when it comes to street and strip performance. Gas mileage isn't sacrificed; therefore, more rear gear can be installed for better performance. If you're not a drag strip junkie, the upgrade will enhance the life of your transmission, even under normal use because the shifts will be crisp and clean, which eliminates the clutch slip that makes heat and kills automatic transmissions.

SOURCE

Level 10 Transmissions
188 Rt. 94
Hamburg, NJ 07419
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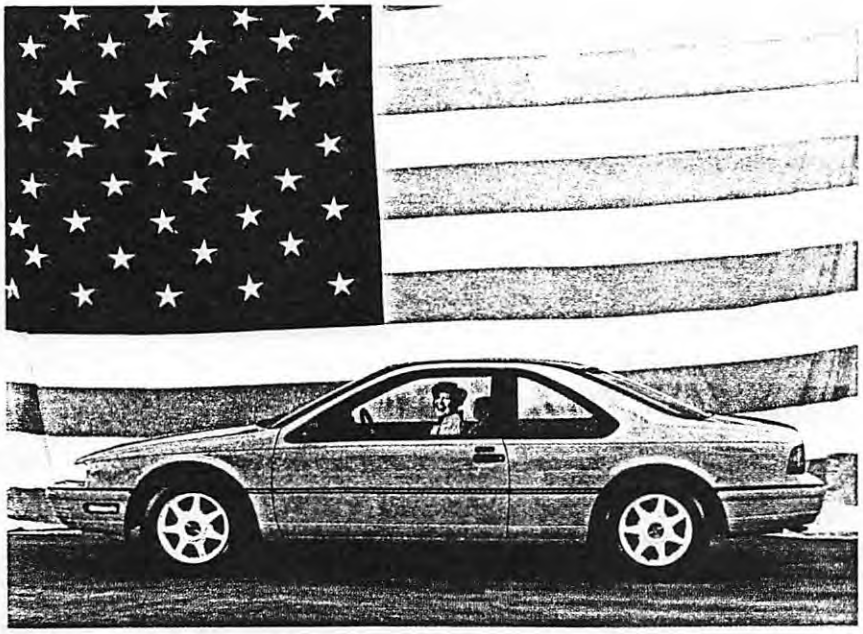

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MAGNECOR 8.5mm Metal Core Spiral Wound Plug Wire Set - Manufacturers of plug wires for NHRA & NASCAR - Outlast factory wires 3-1 -- delivers more spark	$ 89.00

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K&N Conical Filters - attaches directly to Mass Air Body - must remove stock air filter housing top	7" - $26.95 9" - $32.95
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AUTO SPECIALTIES 3-piece Underdrive pulley set - 25% Crank, 29% Water Pump Underdrive, 3" alternator 1000RPM Charge - Nitride treated; these pulleys really help, a must with 3.73 - up gears to slow down engine accessories	$144.50
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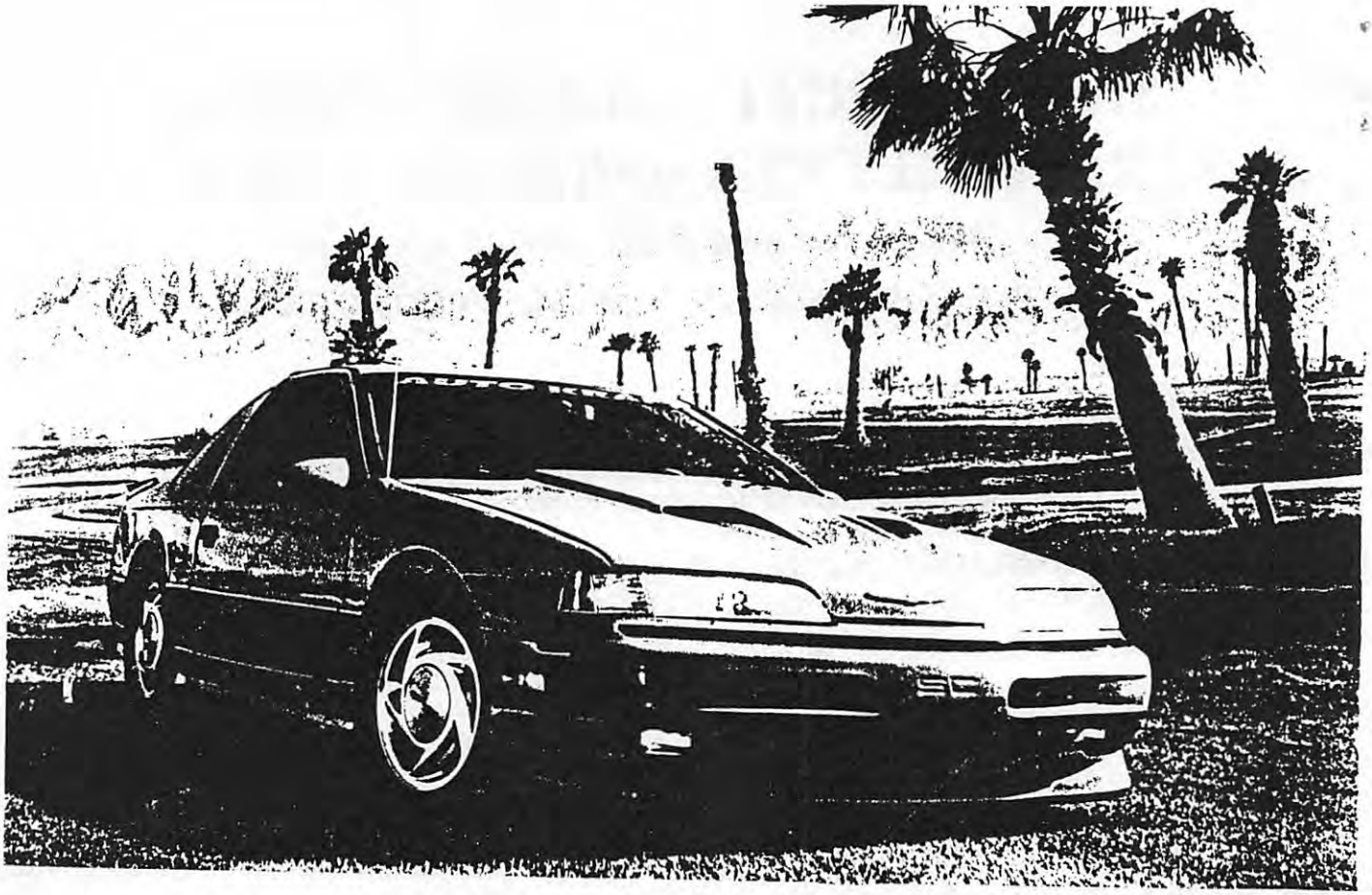

GRIFFIN High Capacity All Aluminum Radiators Direct Fit — Call for Prices

Crane Cams and Roller rockers and other valve train parts
Call Butch at (419) 562-0163 or Gordon Johnstone at (904) 258-6174

CARTECH Boost - controlled fuel management unit - easily installed, fully adjustable, increases fuel rail pressure up to 100 psi. Works with stock fuel pressure regulator - a must for modified cars, cheap insurance for stock engines — $199.00

SVO drop-in replacement high capacity fuel pumps with screen
Stock fuel pump ratings: 89-93: 88 lph / 94-95: 125 lph
110 lph-$79.00
155 lph-$89.00
190 lph-$129.00

SVO FUEL INJECTORS - Set of 6
Factory Injector Ratings: 89-93 - 30 lb/hr • 94-95 - 35 lb/hr
30 lb/hr-$189.00
36 lb/hr-$209.00
38 lb/hr-$269.00
42 lb/hr-$329.00

EXTRUDE HONED Inter-cooler Tubes, intake manifold, I/C tube to intake adapter, and throttle body to supercharger inlet plenum — Call for Prices

EXHAUST SYSTEMS

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TRACKING PROUCTS - "True Dual" Mandrel-Bent aluminized cat-back exhaust systems; follows factory routing

Cat-Back Dual 2 "- Ready for Mufflers of Choice — $495.00
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Note: Borla, Flowmaster, Dynomax, Cat Back Systems - All use single 2-1/2 Tail Pipe - Not True Dual Systems.

DRIVE LINE

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MOTORSPORT Ring Gear & Pinion Sets 3.08 to 4.56 includes shims & lube, most bang for the buck for these heavy birds — $179.00

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POLYGRAPHITE Sway Bar Bushings	$25.00/pair
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PERFORMANCE SUSPENSION TECHNOLOGY High Performance Polygraphite Rear Bushing Sets - Maintain rear axle alignment during hard acceleration or cornering 8/$79.00

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CERVINI Ram Air Hood (89-93) beautiful fit and finish, functional $380.00

CERVINI Rear Deck Wing - easy to mount, looks great $225.00

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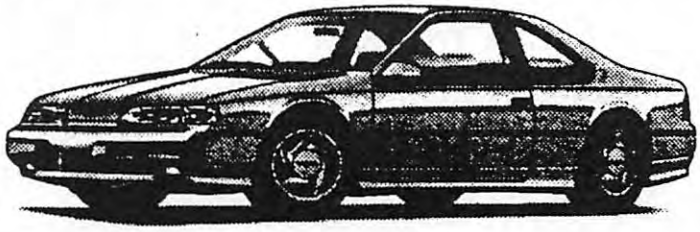

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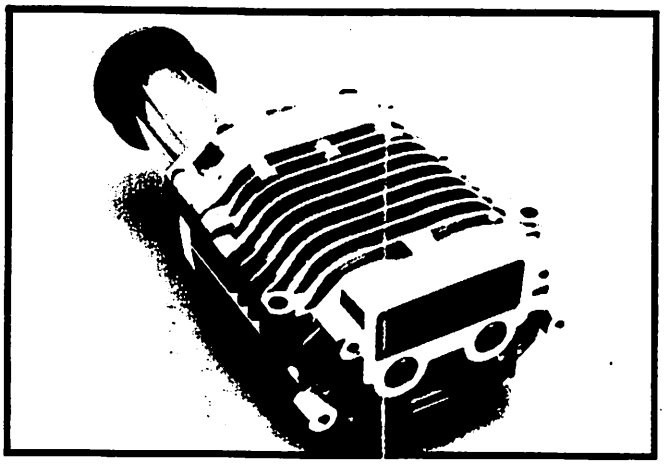
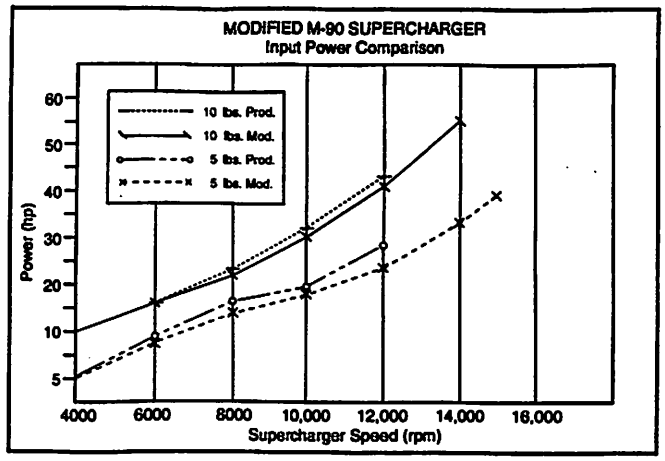
FOR THE PERFORMANCE MINDED ENTHUSIAST

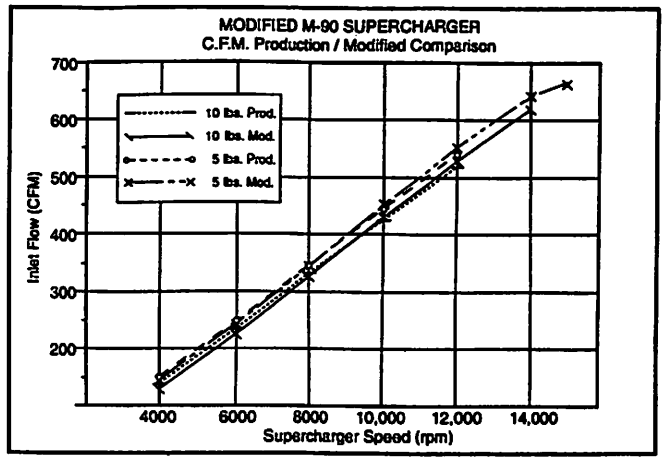
Try our high flow case with super modifications that gives better flow and higher output. For Ford product we take a '94-'95 high flow housing, massage all the flow areas of the inlet and outlet, and get more C.F.M. and blower speed than stock while the temperature and input horsepower come down. This all leads to better overall efficiency.

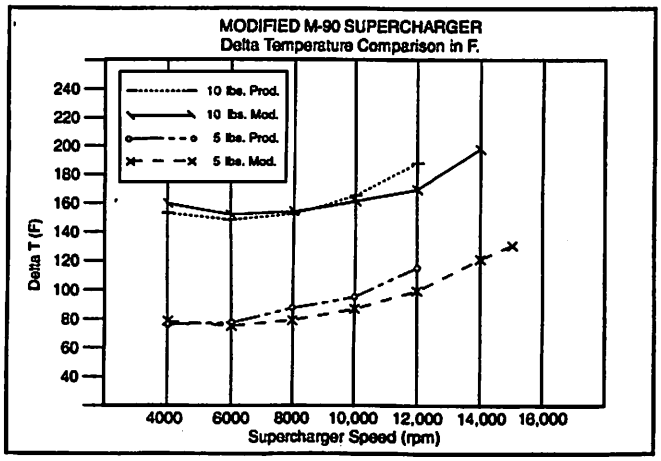
Ford and Mercury owners, with '89-'93 models wanting more power, may take advantage of upgrading their units by bolting on a '94-'95 high flow case and intake manifold. This gives about 18 h.p. Combine this with an "S" modification and you are looking at 25 to 30 h.p.

"S" modifications may be made to all Eaton Superchargers on the outlet side. Intake modifications are selected as to "type" on all others. Call for pricing on th s super improvement.









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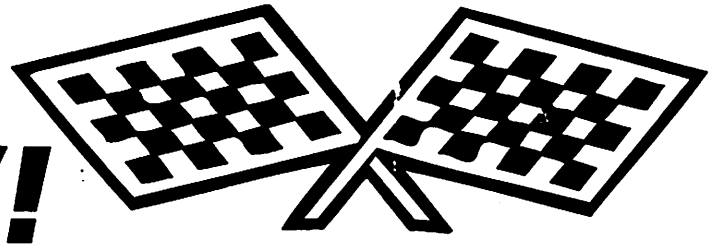

LATE-BREAKING NEWS BULLETIN!

On Saturday, March 23, Rod Short (photographer and contributing editor to *SUPER FORD* Magazine) did a photo shoot of my Super Coupe. Rod said that the feature article about my SC probably would not make the newsstands until the September issue, due to the ninety day advance publication schedule of the magazine.

I made one run down the quarter-mile so Rod could take some action photos; also so I could get a current E.T. and speed for myself and you club members. The weather was ideal except for a 25 mph head wind. My SC ran 13.50 @ 101.6 mph on stock TA radials (24 lbs. air pressure) in spite of the head wind. (See time slip at right). The car ran so much faster than the last time I had raced it (due to the addition of the Magnuson blower, BBK throttle body, and Spearco inter-cooler), I actually ran out of gear at the end. I crossed the finish line taching 5600 RPM, about 500 RPM past my power-peak, (even with the Crane cam). I truly believe the car would run low 13's at 105 mph with better tires, different gears, and no headwind. Still 13.50 @ 101 mph is outstanding performance for a 4000 lb. car with driver, proving what we all already know about the SC: they are a great car stock, but with improvements they *REALLY WILL FLY!*

Bill Hull, Editor

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S/C

---------	LEFT	RIGHT
Car # ...	652	340
Class ...		
Idx/Rec..		
Ov/Un ...	13508	11953
DIAL ...		
R/T ...	.669	.720
60' ...	2.001	1.749
330 ...	5.649	4.922
660 ...	8.687	7.602
MPH ...	80.93	91.10
1000 ...	11.297	9.949
1/4 ...	13.508	11.953
MPH ...	101.62	112.02

Right 1st 1.504
Rnd # TO 137/136

4/D c.i. PLYMOUTH DUSTER

..... CompuLink System IIIp