

'03 COBRA & LIGHTNING TECH & TUNING TIPS

What should I change first? How much HP can I expect? These are two of the most frequently asked questions we receive.

We're biased, of course, but the Kenne Bell Upgrade Kits are hard to beat. Consider the 16 peak HP and 28HP at 5300 on a Lightning just from the reduced parasitic loss at the stock 9 psi boost level. At 13psi, with no other change, the Kenne Bell increased power by 70HP in tests by 5.0 Mustang and Super Ford Magazine on an '03 Cobra. The "boost drop off" is a big problem with the Eaton's. You can increase boost, but the boost "drops off" and so does the HP at a cost of 10HP per psi, as rpm increases. That's akin to cutting off the air flow to the engine. **And the new "H" Series 2.6H and 2.8H produce up to 56 more HP than the "conventional" Twin Screw. Then there's the MAMMOTH™ 2.8H (See MAMMOTH™ Dyno Tests).**

The Kenne Bell Supercharger Upgrades (2.6H, 2.8H and MAMMOTH™ 2.8H) are unquestionably the best investment for power potential. No other single bolt on or combination of bolt ons, even at more money, can approach the gains of a Kenne Bell Twin Screw Upgrade. One can spend as much money on headers, exhaust, electric fan, etc and make only a fraction of the power these supercharger upgrades will make. However, if the Cobra and Lightning kits are beyond your budget, you can increase the boost of the Eaton with a pulley change, but it will NEVER make as much HP as the Kenne Bell at any boost level. More boost will always make some more power until the supercharger "peaks out" and the boost drops off. And the lower parasitic loss of the Twin Screw guarantees more HP to the rear wheels. You can read about the individual products in the Tech and Tuning Tips. Hopefully the following will provide you a quick overview.

COBRA

All the Tech & Tuning Tips, Tests & Comparisons apply to BOTH the original 2.2L, 2.3L, 2.4L Twin Screws and the new BIG BORE 2.6L, 2.8L upgrades which can be slowed or "pulled down" to match the boost of the smaller displacement 2.2L, 2.3L, 2.4L. See "Pulley/Bost/Ratio/HP Guide" for pulley/boost comparisons.

BASELINE EATON +375HP

See Muscle Mustangs & Fast Fords November '04 Mods for 4V Mods Part 1 http://www.kennebell.net/media/articles/MODS4MODS_COBRApart1.pdf and Part 2 http://www.kennebell.net/media/articles/MODS4MODS_COBRApart2.pdf for engine dyno tests on superchargers and bolt ons.

1. SWITCH CHIP +15HP

First, get the calibration right with the Kenne Bell Switch Chip.

2. COOLAIR KIT +32 -65HP

The next best bolt on is the Kenne Bell Cobra Cool Air Kit. (NEVER use an exposed or shielded underhood filter).

3. CAT BACK EXHAUST, HEADERS, X-PIPE

We don't care what the magazines and others say. Our tests indicate minimal HP gains with the cat back below 600HP and about 10HP with the x pipe at 600HP. Headers are about 5HP.

Now lets go back to a 100% stock Cobra and play with the superchargers (Eaton and Kenne Bell) and pulleys.

4. SUPERCHARGER PULLEY (EATON) +42HP

A 100% stock Cobra with the Eaton produces 375HP at 9psi. Replace the 3.55" pulley with a 3" and HP climbs to 417 with the boost increase. Unfortunately the boost "drops off" from 13psi at 4000 to 10.5psi at 6000.

5. KENNE BELL SUPERCHARGER +114HP

Installing the Kenne Bell Supercharger with a 13psi pulley makes 489HP or a whopping 72 more HP than the Eaton.

6. KENNE BELL SUPERCHARGER AND COOLAIR KIT +156HP

Adding the Kenne Bell Cool Air Kit and assuming the same +42HP as with the Eaton and power jumps to 531HP.

7. SUPERCHARGER PULLEY (KENNE BELL) +29HP

Replace the 13 psi pulley with a 16 psi pulley for 560HP. Pulley combinations are available to 26psi. Note the new 2.8H does not require a larger crank pulley. Think RATIO instead of +2, +4 psi, etc.

8. SUPERCHARGER PULLEY (KENNE BELL) +57HP

Replace the 16 psi pulley with a 19 psi pulley and you have an incredible 617HP 100% stock Cobra with stock exhaust, cats, etc. with only a Kenne Bell Supercharger Upgrade Kit and Cool Air Kit. That is A LOT OF HP! And we aren't the only ones to make this HP. Many of our customers are producing 600+HP on pump gas!

9. OVAL THROTTLE BODY +10HP

No HP at 400, 4HP at 450, 8HP at 500, 10HP at 550.

NOTE: All these tests were witnessed by 5.0 Mustang and Super Ford Magazine. See article reprint "Snake-Bite Hit" March '03 for more information.

Cobra Headers are a nightmare to install and remove. The "long tubes" eliminate the pre-cats which is not 50 State Legal. For what they cost you don't get that much power if any. Then there's the big question. Is any power gain the result of removing the exhaust pre-cats or the headers? We also wouldn't count on any HP with the pre-cats removed. One customer reported no power gain with the 15/8" but was able to "tune" it for 7HP? The question that should be asked "What if you 'tuned' before the headers were installed?" Would the timing and/or fuel mods have made the same 7HP? All our reports say the 1-3/4" don't make more power. We recently tested a Cobra with new headers (no pre-cats), cams & heads and it lost power all the way to 6500. After 6500 it made 9HP. AF ratio and timing were the same for both before and after tests. Here's another controlled test by one of the industry's very best aftermarket product test people. Muscle Mustang & Fast Ford's Richard Holdener. Richard tested our 2.2L kit on his '03 Cobra test engine and made 666HP and 677HP with cat back and x pipe (11HP). Then he removed the exhaust completely and added headers with open exhaust 3" extensions. The headers made 682HP (+5HP). Frustrated with so little gain from headers, a set of 2-1/8" headers off John Mihovetz's car were installed - 50HP. Unfortunately, these larger 2-1/8" - or 2", 1-7/8" etc. are too large for the Cobra chassis. Conclusion: 1-5/8" and 1-3/4" headers are too small.

4. BOLT ON SUMMARY

See the text.

LIGHTNING

Much of the Tech & Tuning Tips, Tests & Comparisons apply to BOTH the original 2.3L Twin Screw and the new BIG BORE 2.6L upgrade which can be slowed or "pulled down" to match the boost of the smaller displacement 2.3L. See "Pulley/Bost/Ratio/HP Guide" for pulley/boost comparisons.

KENNE BELL TWIN SCREW SUPERCHARGER UPGRADES

Our primary goals were to develop a direct bolt on upgrade replacement supercharger for the relatively inefficient stock Eaton 112 supercharger (see catalog and website for comparisons and 3rd party magazine dyno tests). NOTE: All HP and torque numbers are rear wheel. Just bolting on the Kenne Bell Twin Screw in place of an Eaton results in substantial power gains. Power consumption is less, air charge is lower and there's no "boost drop off." But what really matters is "How much will it make on MY engine." 1200HP.

At one time, not too long ago, many assumed the Kenne Bell Twin Screw and Eaton Roots were the same supercharger. Back-to-back tests on the ultra accurate and respected Kenne Bell Dynojet between the Eaton and Twin Screws on a 4.6 Mustang, Lightning and '03 Cobra forever changed the way the automotive industry perceives these products. It is now clear to all that the Twin Screw concept is superior in air charge temperature, parasitic loss, boost and (overall) adiabatic efficiency. Replacing the Eaton supercharger with the Kenne Bell Twin Screw on the Lightning and Cobra is now an accepted and proven practice for anyone desiring more power, performance, and acceleration.

Johnny Lightning's truck made 560RWHP and recorded a best time of 10.59/126 with the Kenne Bell Lightning Supercharger and a stock inlet manifold. Then it made 719HP with the built 9 second motor. This was in 2003. Today it develops over 800HP (No NOS).

Truckin' Magazine comparison tests indicated a whopping 16 peak HP gain at 5300rpm at the same 9 psi boost. When identical pulleys were installed, the Kenne Bell 2.6 made 122 more HP than the Eaton with the same pulley size.

AIR FLOW

As with any other inlet or exhaust component(s) "If there's no restriction, there can't be any gain." Raising HP/air flow in and out of the engine incrementally increases potential restriction and losses. At Kenne Bell, we use special atmospheric pressure sensors to analyze these restrictions. We work with superchargers, manifolds, meters, throttle bodies, heads, exhaust, headers, etc. on a daily basis. We are a R & D and manufacturing company with a rich heritage in vehicle tuning. For example: We mount a sensor behind each component to measure its respective restriction, if any. Imagine a vacuum gauge behind the filter, MAF meter, throttle body, front and rear of the inlet manifold. Is there any better way of monitoring the component restriction?

COOL AIR KITS

Like meters or throttle bodies, the best product is the one proven that registers "0" restriction for the particular application. Equally important is it cannot be exposed to hot underhood air. When will everyone get this right? A 10° increase in inlet temperature will reduce power 1%. It can be 200° under the hood vs. 70° in the fenderwell. Do the math. This is how dynos are calibrated for ambient temperature variations. Otherwise we would all (OEM and aftermarket dynos) be forced to conduct tests exactly at the same temperature. The Kenne Bell Cobra Cool Air Kit is designed specifically for our kits. Johnny Lightning kits work best on Lightnings. The '99 Lightning fenderwell opening was restrictive. Enlarge to the '01 size and upgrade to the '01 and 90mm meter. A recalibrated chip or the '01 EEC is required when making this change. For ultra high HP, see MAMMOTH™ Kits which uses the left side fenderwell.

MAF METERS

There's another saying around Kenne Bell, "There's a size for every application, some are just right, some too small and some too big." Some meters make more power by leaning out the air fuel ratio. If a meter or any other component has "0" restriction, a larger one simply cannot improve performance. However, in the case of meters, it's always best to choose one on the larger side, if it's accompanied by a matching chip for the particular injector slope (the flow at any rpm) and size. The stock 90mm '01 and up Lightning is an excellent meter. It makes 5HP over its '99 80mm counterpart. We modify and use it on many other Ford applications with our Switch Chip®. The next step up is the SCT meter, but it doesn't flow any more air than the stock 90mm. After 500HP, you should be looking at the Kenne Bell 130mm Meter/Filter (1830 cfm vs. stock/SCT 90mm 1387 cfm). At power levels above 500HP, the stock 90mm meter is "pegged" at 5 volts but with the right chip it works just fine. The Kenne Bell 130mm or larger diameter meter is highly recommended after 500HP as the 3.55 90mm stock meter becomes restrictive at this HP level. The stock or SCT 90mm meter flows only 1387 cfm. The Kenne Bell 130mm with matching 130mm filter is 1830 cfm (32% more)

MASS AIR METER SCREEN

We test everything. Another neat feature of the Kenne Bell Cobra Cool Air Kit is that it is designed to be run with or without the mass air meter screen.

- At 500HP, removing the screen increases power 20HP.
- Removing the screen is not a good idea if eliminating the filter.
- Always index your meter. Install it at exactly the same angle.

THROTTLE BODY SPACERS & INLET FANS

No power gains whatsoever according to our dyno.

THROTTLE BODY (COBRA & LIGHTNING)

The "Big Oval" style throttle body flows the most air. The stock "dual" Cobra (IAC passage) and Lightning (no IAC passage) are different. The Lightning manifold accepts either. The Cobra inlet manifold accepts only the stock "dual" throttle body. The Kenne Bell Supercharger Upgrade offers two manifolds, a "dual" (stock) and "Big Oval". The Kenne Bell F2001 "Big Oval" Cobra incorporates the needed IAC passage and is a direct bolt on. The Kenne Bell F2002 Lightning "Big Oval" bolts to the stock Lightning inlet or the new Kenne Bell 2.6L inlet manifold. These throttle bodies don't increase power until 450HP (see literature). The larger oval throttle body was 0HP at 400HP and 4HP at 450HP. Go to a 12" long filter at 400RWHP. For big HP numbers, see the 2.8H MAMMOTH™ Kits.

INTERCOOLER MANIFOLD

Our dyno showed no HP difference whatsoever between the Lightning '99-'00 vs. the '01-'02 discharge manifold. Neither porting or extrude

honing resulted in power gains. Same with the '03 Cobra. These "open" short runner manifolds flow gobs of air in stock form- far more than the head port is capable of flowing.

INTERCOOLERS

'01 and up Lightning is physically larger and flows a little more air than the '99. We've thoroughly researched and tested all Ford and aftermarket 4.6 and 5.4 intercoolers. The '01 design is so efficient we've concluded that it's best left as is. We data logged a mere 1 psi loss at 9 psi (350HP) and only 2 psi at 22 psi (522HP) with 320° in, 106° out and 85° ambient. That's 90% efficiency. The same is true for the Cobra. Leave it as is. It won't get any better than this. If someone claims they have a better one, ask to see all of the data and not just the rhetoric. This is the same basic intercooler design used on the new Kenne Bell 4.6 GT kit.

INTERCOOLER COOLANT

Never run tap water only in an aluminum intercooler or engine, unless your goal is to make it corrode and leak. Water is the best coolant known to man. If you choose to use water only, use distilled water. Coolant will not freeze, even at temperatures below 32°. Put ice cubes in a coolant container and the coolant will read 50°. Touch the probe to an ice cube and it reads 32°. Some say a bottle of Red Line Water Wetter and distilled water is the hot set up.

FUEL SYSTEM OVERVIEW

We speak from experience. Kenne Bell uses a sophisticated one of a kind fuel flow bench capable of testing injectors, pumps, fuel lines, fuel rails, regulators, filters or any other component related to fuel systems or hydraulic engineering. The flow bench, coupled with our dyno, scanners, data acquisition, and other tools allows us to pass on our findings to our customers. We recommend reading "Fuel Pump Tech" & "Fuel Pump Figuring" on our website (<http://www.kennebell.net/media/media-home.htm>). The Lightning and Cobra fuel systems have been extensively tested on the Kenne Bell flow bench and dyno. They are markedly different in operation. Those who spout free advice proclaiming "you need bigger injectors, bigger pumps, adjustable regulator, more fuel, etc..." would be better to first to ask 1. How much power the engine is making? 2. What the AF ratio is, 3. Total timing, 4. Boost, 5. Fuel pressure, and perhaps 6. What kind of fuel system is it? The stock Cobra and Lightning fuel lines and rails are adequate to 700HP, but there's a 7 psi pressure loss in the fuel line between the tank and fuel rail so we'd recommend upgrading to a larger 5/16", 3/8" or 1/2" line. This change reduces the loss to virtually 0 psi.

To summarize, more fuel doesn't necessarily make more HP. Ideal AF ratio always makes best power. Higher fuel pressure always increases fuel flow but is not acceptable at idle on part throttle. Avoid adjustable regulators. The best method of increasing fuel pressure on a returnless system like the Cobra is with a Kenne Bell BOOST-A-PUMP™. It made 704RWHP with the stock pumps, lines, rails and injectors on a 100% stock Cobra. Yes, it works. That's precisely what it was designed for. It may appear that we are overstating the importance of the BOOST-A-PUMP™ and the BOOST-A-SPARK™, but all we're attempting to do is give our customers the benefit of our experience.

FUEL PRESSURE (LIGHTNING)

The Lightning fuel system differs from the Cobra in that it incorporates a regulator. Warning: Leave the regulator, fuel lines, rails, pumps, and fuel line stock. Unlike the Cobra, the Lightning uses it's MAF meter and fuel pressure regulator fuel (1psi boost= 1psi fuel pressure) to regulate. The stock fuel pressure is 45psi at 8psi and 55 at 18psi. The Truckin' Magazine/Muscle Mustangs and Fast Fords Magazine Lightning, tested on our dyno, maintained a safe AF ratio of 11:1 up to 500HP. At 511, AF was 11.3 and at 522 it lit the Horiba at 11.7. From our experience in tuning, that indicates the stock 42lb injector is all done at 500HP. Although 11.7 is acceptable with the right octane (AF ratios of 12.5 make best power and can be used if there is sufficient octane and the MAF meter is accurate). *NOTE: If the HP gain is the result of higher boost, don't forget to allow for that inlet manifold back pressure. Based on our years of testing, we're determined that 10psi of fuel pressure will affect AF ratio 8%. 5psi is 4% etc. To determine the new flow rate of an injector:*

$$\sqrt{\frac{\text{New Pressure}}{\text{Old Pressure}}} \times \text{Old Flow Rate} = \text{New Flow Rate}$$

Again, keep in mind that the boost increase must be subtracted from the injector pressure.

In conclusion, we recommend 60lb injectors and the BOOST-A-PUMP™ at 500RWHP. To be safe you may wish to install the BOOST-A-PUMP™ at 450HP. We'd like to sell you one, but it's not really needed below 500HP.

FUEL PRESSURE (COBRA)

The Cobra uses the latest returnless fuel system (no regulator). It constantly regulates delta fuel pressure to a mere 39psi, even at WOT. The dual 155L pumps are adequate for stock boost, but as boost increases, the added inlet manifold pressure restricts the fuel exiting the injector. Example: At 20psi boost (12psi over stock) the 40 lb/hr injector is only a 20 lb/hr injector (40psi-20psi inlet manifold pressure forcing fuel back into the injector=20psi effective pressure). At 40psi there would be no fuel whatsoever exiting the injector. Adding 8psi of boost drops the injector rating from 42 to 37lbs. At 20psi boost the injector is a 31lb. This 11lbs of fuel lost to the back pressure of boost will feed 168HP! And there is no regulator to increase fuel pressure with boost. Therefore, the best solution is to raise fuel pressure with a BOOST-A-PUMP™ and modify the chip fuel strategies for a safe consistent AF ratio from 8-20psi. This requires a dyno and all the tuning tools. The Kenne Bell SWITCH CHIP® is the answer, it's already calibrated. Stock fuel pressure is 39psi. At 20psi, pressure should be 85psi with the corresponding injector pulse width, pressure calibration, and the Kenne Bell BOOST-A-PUMP™. The BOOST-A-PUMP™ will support up to 700RWHP with the stock pumps and NO OTHER CHANGES. Beyond 700HP, we recommend the D'Agostino Racing fuel system with larger dual 233L pumps, DUAL BOOST-A-PUMP™ and 60-70lb injectors.

IN TANK PUMPS

The Lightning uses the old style fuel system with a regulator. Neither larger pumps or the Kenne Bell BOOST-A-PUMP™ is needed for the Lightning for HP levels to 500HP with stock 42lb injectors. Adding a Kenne Bell BOOST-A-PUMP™/SWITCH CHIP® will supply enough fuel for 900HP with 60lb injectors. Larger "full time" in tank pumps heat the fuel. Remember that fuel begins to boil at 95 degrees. The Kenne Bell BOOST-A-PUMP™ will not heat fuel any higher than a stock pump because it's only activated at boost and WOT. *NOTE: Kenne Bell has*

specialized in fuel systems for 16 years. We have our own fuel flow bench. We developed the BOOST-A-PUMP™ to solve all the inherent problems of larger in tank pumps, inline pumps, and regulators. "Use the fuel only when you need it or you'll heat it." The BOOST-A-PUMP™ is always good insurance. The Lightning pumps supply 254 liters per hour. The BOOST-A-PUMP™ will increase the output to 362 liters.

INLINE PUMPS

Another product whose time has passed. Noise, lag, surging, and fuel heating have plagued this concept for years. We call them "vampire" pumps because they suck the in tank pump dry (down to 0 psi). Use the BOOST-A-PUMP™ for 1-50% more fuel at WOT. It's so easy to install, doesn't heat the fuel (fuel begins to boil at 95 degrees), operates only under boost and eliminates the inline pump pressure "lag"-the last thing you need with a supercharger.

WHY HEAT FUEL?

Why heat fuel? For the 50 yrs I've been around drag strips, the racers use "cool cans" to cool the fuel. I've never seen a "fuel heater," have you? Then don't increase the in tank pump size on systems with a regulator. A regulator controls pressure by relieving, bleeding, or re-circulating it back to the tank. Larger than stock in tank pumps force the regulator to bypass the unnecessary fuel. The added fuel flow through the orifices in the regulator and the return fuel line creates friction, pressure loss, and HEAT. Fuel begins to boil at 95°. The new Shelby compensates for fuel temperatures above 100° by raising fuel pressure. Does that tell you something? Higher temperatures reduce octane. Be smart, not fuelish. Bigger pumps are not necessarily better. In conclusion, design the system so the pump flow more closely matches the engines fuel requirements or simply use the BOOST-A-PUMP™ to increase fuel delivery only when needed. That's why there's a Kenne Bell BOOST-A-Pump™. See "Fuel Pump Figuring" on our website.

SUPERCHARGER PULLIES

The stock Eaton pulley is a nightmare to change and replace and the supercharger itself is rated at only 112cu"/1.86 L. You usually ruin the pulley upon removing it, even with the expensive pulley removal tool. A pulley change on our Twin Screw takes a few minutes (see literature for pulley size availability) and covers a range from 9.5-20psi. Kenne Bell also offers an easy to replace Steel Pulley Conversion Hard Anodized "Cool Crank" Pulley and a Billet Aluminum Pulley Puller for the Eaton. Installation takes approximately 5 minutes. NOTE: Actual pulley boost will vary approx. 1.5psi depending on the inlet system and power level. Less inlet loss means more boost. *USE OF ANY SUPERCHARGER PULLEY OTHER THAN KENNE BELL VOIDS OUR SUPERCHARGER WARRANTY.* And we do not recommend any "saw slot" pulley that chews up a belt in one run and induces additional stresses on the supercharger drive. On decel, pulleys MUST SLIP. Also, no cog belts.

BELT WRAP

Surface area contact is the key to efficient belt performance. The larger the supercharger pulley, the more surface area available to grip the belt. Use the formula: $3.14 \times \text{Pulley Diameter} = \text{Pulley Circumference}$ for 360 degrees. Example: 2.5" vs. 3" pulley. $3.14 \times 2.5 = 7.85$ " whereas $3.14 \times 3 = 9.42$ " (20% more surface area). A good serpentine pulley system design maximizes the degrees of belt wrap around the pulley. And 8 ribs are better than 6 rib belts because the additional ribs provide 33% more surface area. Therefore, the Kenne Bell is easier on belts and can run smaller pulleys than the Eaton because it requires 38HP less to drive (see above). The new 2.6, 2.8 supercharger pulleys are even larger than the 2.2, 2.3, 2.4 so the belt "contact patch" is even better. Never use a cog belt system on our superchargers.

SERPENTINE BELTS

Use Kenne Bell or Dayco. Cross ribbed belts do not work as well as solid rib belts. It takes engine HP to drive any supercharger, whether it is a Twin Screw, Centrifugal, or Roots type. The more efficient the supercharger, the less HP is required to drive it and the less engine HP (parasitic loss) is wasted. For example: at 14.5psi and 695 cfm, the Eaton 112 consumes 84HP at 13000rpm. The Kenne Bell Twin Screw uses only 58HP (30% and 26HP less) and typically requires 2 less belt ribs to drive. Belt width (6, 8 or 10 rib) recommendations should be left to the supercharger manufacturer. Think about 23 psi where the Kenne Bell 2.8H consumes a whopping 56 LESS HP than a conventional Twin Screw.

IGNITION COILS

The concept of one larger coil and a CD ignition is passe. Ford has switched to a "coil over" system with one coil per cylinder. The BOOST-A-SPARK™ concept attaches to the primary coil feed wire and increases energy to the coils from 1-50%, higher than any ignition system available on the market today. It supplies over 2 amps at the plug, 10 times more than the OEM system. And it's a "long spark" and not a "short spark" like CD's. The Kenne Bell BOOST-A-SPARK™ is not necessary below 10psi, but is highly recommended from 11psi and higher on both the Cobra and Lightning. The stock systems won't fire the plugs 100% beyond 15psi.

ENGINE COOLANT

75% distilled water 25% coolant is best ratio vs. the OEM recommended 50/50 ratio. Nothing on this planet cools better than 100% water. Coolant is also a higher viscosity and requires more water pump HP to circulate. We recommend Water Wetter by Red Line Oil Co. which is a coolant additive that can reduce "air bubble insulation" between the engine coolant jackets and the coolant itself. When bubbles are present, they tend to air insulate the liquid from the engine metal, reduce heat transfer, impair the cooling process, and create hot spots which can cause detonation.

SPARK PLUGS

Use NGK TR6 or Denso T20EPR-U plugs gapped at .025". We've run up to 30 psi with these plugs. Forget Iridium plugs. The BOOST-A-SPARK™ is the best insurance against engine misfire and backfire in either a Cobra or a Lightning. *NOTE: Torque plugs to factory specs. DO NOT overtighten. The threads in Ford heads are sensitive.*

HEADERS

Below 600HP, long tubes make very little, if any, power according to tests as well as our customer reports, and they also eliminate the pre-catalytic converters. That isn't 50 state legal. And don't confuse any power gains from removing the pre-cats with header gains. Pre-cat and cat removal will net around 10HP. In our opinion, headers for the Lightning or Cobra aren't worth the small power gains and expense. Headers are also a nightmare to install, particularly on a Cobra. Always keep in mind that any power gain from exhaust (headers, cat back, and cats) is incrementally proportional to engine air flow/HP and reduced back pressure. MM&FF Magazine made only 5HP on an engine dyno at 677HP

(682 vs 677). That may not be what you want to hear or believe. Avoid ANY and ALL header leaks, even pinholes.

'03 COBRA CHIP TECHNOLOGY

The Kenne Bell SWITCH CHIP®/BOOST-A-PUMP™ combo will provide optimum spark and air fuel ratio from 390-617HP with stock injectors, while eliminating the lean (14.7) air fuel ratio and retarded timing from 0-4000 RPM. There are two basic methods of increasing power with a chip-timing and fuel (optimum air fuel ratio). 11:1 is safest but is less power and 12.5 is leaner and best power. The Kenne Bell SWITCH CHIP® has two positions, POWER and SHOOTOUT. Both have the same optimized ignition timing. It won't get any better than this. Fuel AF ratio is set at 11:1 in the POWER mode and 10% leaner 12.1 in the SHOOTOUT mode. Expect up to 20HP in the SHOOTOUT mode but USE WITH CAUTION. 12.1 is LEAN and more prone to detonation (knock). If engine knocks, GET OFF THE GAS.

There are five ways to reduce knock. Retard timing, richen the mixture, increase octane, lower the boost or lower the temperature. Retarding the timing requires reshaping the spark curve so spark advance is reduced after 3500. The downside is that you lose 3-4HP per 1 degree of retard. 1psi of boost is 13HP. The easiest approach is to install a larger pulley and lower the boost-or add octane via mixing or straight 100-103 unleaded. You can "chase" knock and horsepower with a chip by changing fuel and spark curves (richer on top) and spark (retarding at higher rpm). If your goal is to diddle with these curves, go right ahead. We prefer the Kenne Bell approach of ideal fuel and spark calibration at all rpm. Then you juggle pulleys (boost) or octane to control knock. Sound easier? It is.

The Shift Indicator Light (Cobra) is shut off in the Kenne Bell SWITCH CHIP®. It's for economy only and has no effect on WOT shifting. *NOTE: We can only make recommendations and suggestions based on our dyno testing with the Kenne Bell SWITCH CHIP®.* You may wish to have your Cobra custom tuned by the Kenne Bell Installer of your choice. Hopefully, you've read all of our Tech and Tuning Tips and other information and now better understand chip calibration. We would also highly recommend reading the Eaton vs. Twin Screw comparison test "Snake Bite Hit" in the March '03 issue of Mustang 5.0 Magazine (<http://www.kennebell.net/media/media-home.htm>). It contains invaluable information, such as how the stock calibration chip is a dangerously lean 16:1 (45% lean) instead of the preferred 11:1 and some great comparison tests.

REV LIMITERS

NEVER increase engine rpm on supercharged engines. It's higher rpm that through inertia loading places greater stresses on the rods, pistons, and crank. (12.5% increase in rpm increases the loads 50%) Think about that one. Let the supercharger and boost work for you. It increases power incrementally at any rpm. Never overrev the engine and hit the rev limiter. The fuel injectors are not ramped but instead shut completely off. The fuel pumps remain on so there's a big fuel pressure spike. Keep supercharger rpm at a minimum by not over-speeding the engine. Another big concern is the stress loads exerted on the belt drive, idler pulleys and tensioner when the engine abruptly kicks on and off. The supercharger prefers to continue spinning when the engine shuts off. Not good.

SUPERCHARGER RPM

Check the rpm in the 1/4 mile lights and at the shift points. Divide pulley size into crank size and multiply by engine rpm. Keep supercharger to 18000 maximum. Example: 7.5" divided by 3"=2.5 ratio x 6000rpm=15000 supercharger rpm. Use the torque and HP generated by the boost of the supercharger and not engine rpm. If the supercharger rpm at the end of the 1/4 mile calculates as excessive, then raise the gear ratio (lower numeric ratio). The higher engine torque from the supercharger will pull a higher gear. Lightning shift points are best left stock. Cobra does not need to be revved beyond 6000 through the gears.

BOOST

Max recommended street boost is 18 psi. Ambient temp, underhood temp, idling engine temp, "hot air" underhood filters and boost (10° per psi) all affect the air temps the supercharger sees. Expect about 13RWHP per psi boost with the Kenne Bell supercharger. 1.5 octane will support 1psi boost (test conducted by Kenne Bell for Muscle Mustangs and Fast Fords Magazine). 1 AF ratio=2 octane. 20° ambient or charge temperature=1 octane and 1° spark advance=1/2-3/4 octane. For more tuning tips see "Jim Bell's Supercharged/Turbocharged Performance Guide."

NITROUS

We don't recommend any "dry" Nitrous system for a supercharged Cobra or Lightning-especially the Cobra. You're playing with fire. There's no easier way to blow an engine. If you must run Nitrous; 1- use a "wet" system and 2- have it custom tuned on a dyno with an accurate AFM1000 air fuel meter and the necessary tuning software and equipment before you even think about stepping on it. If you have to use this stuff, then add a Kenne Bell BOOST-A-PUMP™ for insurance. And don't forget to monitor fuel pressure.

BUILT ENGINES

Kenne Bell has been around since 1968. We've built our share of engines. Quite often enthusiasts falsely believe that upgraded rods and pistons are necessary when they are not. First of all, leave the Cobra as is. It has all the good stuff. True, the Lightning rods are not the best, but always remember what breaks rods. It's Nitrous and rpm. Keep it down to 5500 max. The Lightning is a strong engine. Supercharging actually reduces inertia loading on the rods. And watch the detonation. Detonation increases heat which helps melt the upper ring lands. Forged pistons melt at about the same temperature as cast or hypereutectic. Forged are stronger and hold up under detonation better, but cast lived very well in the turbocharged Buick V6's and Cyclone V6's, even at 25psi. In our opinion, the rod/piston rating on any ford cast mod motor is 500HP. Go to forged rods and pistons at 500HP.

Choose your chip carefully and sensor the advice you receive."The world is full of experts who speak from inexperience."

GEARS

Stock gears work very well with the Kenne Bell or Eaton, as these superchargers produce more torque at low rpm. Centrifugals with comparatively less boost and torque like lower gears and/or higher stall torque converters. These superchargers have different requirements. They don't need low gears and/or high engine revs to generate boost. Lower gears don't make horsepower! They actually REDUCE RWHP. Example: 3.73 dropped RWHP by 18HP as compared to 3.3's. Oops!

- Best 1/4 mile gear for the Lightning or Cobra is 3.73's. 3.73 and 4.10 are too low for street.

- Keep supercharger rpm (drive ratio x engine rpm=supercharger rpm) to 18000 max. Example: 3.27x5500=17985 or 3.0x6000=18000.
- Ratio is determined by crankshaft pulley size divided by supercharger pulley size.

Example: The Cobra engine rpm should be maximum 6000 rpm with a supercharger (3.0 ratio x 6000=18000). A 3" supercharger pulley with a stock 9" crank pulley is a 3.0 ratio.

All our supercharger pulleys are hi-grade steel to minimize wear and slippage. Aluminum supercharger pulleys void your warranty.

TRANSMISSION (LIGHTNING)

The E40DE is a strong trans. The Kenne Bell SWITCH CHIP is recommended to firm up shifts and keep shift rpm points from "drifting". At higher HP levels, the Kenne Bell Quick Shift Valve #F1011 is recommended to reduce slippage at WOT. *NOTE: As power increases, the trans rpm shift points increase and must be lowered back to the stock shift rpm.* It doesn't help performance to over rev the 5.4. Max shift rpm should be 5200. All you're doing is needlessly over-revving the engine and supercharger. If you plan on upgrading or rebuilding the transmission, the #1 authority on this transmission is www.Injectech@comcast.net

SYNTHETIC OIL

Red Line is the best we've ever tested. We've documented a 15HP gain and 20 degree temperature reduction from synthetic oil. All Kenne Bell superchargers are shipped with Red Line engine oil. It's that good. The next best choice is good old Mobile 1 Synthetic.

IGNITION TIMING / OCTANE / BOOST TUNING

Ideal spark timing is around 23°. Changing timing (advancing and retarding) or AF ratio (rich or lean) between runs is confusing and misleading. Our intent was to illustrate the performance gains of the Kenne Bell supercharger kits with various boost levels. With maximum available pump gas octane varying from 91 (California and Arizona) to 92 in some states and 93-94 in others, it is impossible to standardize on boost levels. 1 psi of boost will require approx. 1.5 octane and 1 octane will support 2° of additional spark (see "Jim Bell's Supercharged & Turbocharged Performance Guide" for more tuning tips). Since 1° timing = 4HP and 1 psi boost = approx. 16HP, octane has a big effect on the maximum HP that can be extracted from these engines. If it knocks, add octane, lower boost or reduce total spark timing - or a combination. If your goal is to make maximum power from this kit and fuel octane is not an issue, then run 23°-25°, 12.5 AF ratio and all the boost the engine will tolerate. 12.5 will make 11 more HP than 11.0. Our kits make a lot of HP - and cylinder pressure. If there's any doubt about octane level for competition - go overboard and use 100 unleaded or a mix until you get it dialed in. Sneak up on the boost. Don't let it knock. The Kenne Bell SWITCH CHIP® is recommended for quick easy timing changes where maximum performance with higher octane (94-100) is being used.

FUEL OCTANE THE KENNE BELL EQUATIONS

We should all appreciate and understand the importance of fuel octane. Unfortunately, because of our laws and politics, the maximum available unleaded pump octane varies from 91-94 depending on the State. Here's the **Kenne Bell Octane Equation**, based on our years of experience, that you may find helpful.

"1 octane will support an increase of 2/3 (two thirds) psi boost, 3/4° (three quarters) timing, 20° ambient temp, 1/2 (one half) point in AF ratio, 1/4 (one quarter) point in compression and 30% humidity."

Also keep this guide in mind when tuning your car. Tuning? Ignition timing and AF ratio are the ONLY methods of increasing engine power. There is no "third" or "secret" dimension. Don't be misled or duped. Tuning is not removing, replacing or modifying parts. Here's the **Kenne Bell Tuning Equation**.

"After attaining IDEAL AF ratio and ignition timing, figure 1° = 4HP and 1 AF ratio = 8HP."

The above equation results may vary somewhat, but they're a good reference point. We're not here to argue or debate anyone's experience. Our goal is to help educate Kenne Bell customers.

LEAN MIXTURES

Example: Yes, there is some power left in your 4.6 by leaning the engine from 11:1 to 13. We made 380HP at 7.0 psi, 3-1/4" pulley and 23° of timing on our non intercooled test car. And we can increase the 405HP at 9 psi to 425HP. Just don't go there unless you have sufficient octane and experience in tuning. We prefer to tune with timing and boost with the AF ratio set at 11-11.5 and avoid leaner 12-13.5 ratios. These "lean" ratios are very risky and generate relatively little power.

FUEL LEVEL

Never operate the vehicle in boost with less than a quarter tank of fuel. Low fuel level can cause the fuel pump to cavitate resulting in low fuel pressure. This can cause detonation that may result in severe engine damage. Get in the habit now and treat a quarter tank as if it is empty.

TRACTION CONTROL (LATE MODELS)

Traction control is a very nice feature to have, although it may cause some very serious problems with your supercharged engine. When the factory traction control system is activated, it will lean the engine considerably and remove ignition advance in an attempt to reduce engine horsepower output. The rear brakes will also be activated to eliminate wheel spin. This, in theory makes for a very sound system. For a supercharged engine, this is not an ideal method. The lean fuel condition may cause detonation resulting in engine damage. Traction control is to be used at the discretion of the driver.

Note: Always consider vehicle weight, Nitrous, boost, transmission (auto or manual), engine mods, tune, fuel, etc., etc., when comparing 1/4 mile times.

COBRA HP SUMMARY FROM MM&FF MAGAZINE ENGINE DYNO TESTS (962HP 2.4L, 1028HP 2.8L)

At Kenne Bell, we are only interested in tests that are controlled, accurate and unbiased. These tests were conducted under controlled conditions on the Westech engine dyno by Richard Holdener, Tech Editor of Muscle Mustangs and Fast Fords Magazine. The following is a

summary of his tests. Reprints of his tests are on our website. Richard's dyno tests of the Cobra engines superchargers and bolt ons are very close to the Kenne Bell chassis dyno tests we've conducted. Use a .85 factor to convert engine to chassis HP.

He began the tests with a stock '03 Cobra engine, installed headers and exhaust and tested it with and without the Eaton supercharger. Next, he tested a throttle body and then increased the Eatons boost to 14 psi. Then he compared the Eaton at 14 psi to the Kenne Bell (+145HP) with identical pulleys. For the final test, he ran the Kenne Bell boost up 3 psi making 703HP with the belt slipping. Richard next removed the headers and exhaust from the 682HP 7.5"x3.25" pulled Kenne Bell and lost a mere 16HP (666HP). The exhaust was re-installed and increased power 11HP (677). The final test was to re-install the headers which produced a relatively small increase of only 5HP (682HP). Where's that 50HP we hear about? Read on. At 26 psi and the Crower cam kit, our test car turned 9.90/142 at legal weight with the stock trans and a Centerforce clutch. According to the time proven and tested Kenne Bell Power Speed Calculator, it takes exactly 820HP to turn 142 mph in the 1/4 mile at 3600 lbs. Earl's car, with the same cam, headers, no cats, exhaust and throttle body made 702HP on our Dynojet (.85x821 engine HP = 706RWHP). Close enough. We believe this is all credible comparison data that our customers will find useful.



962HP 2.4L* COBRA ENGINE DYNO TESTS (1068HP 2.8H* AND MAMMOTH™ MANIFOLD = +146HP)

We're often asked about the HP potential of the Kenne Bell superchargers on a 4.6 4V Cobra. Also HP gains from headers and exhaust. This is the motor out of the Earl's Automotive/Kenne Bell '03 test Cobra - the first manual trans non-nitrous positive displacement street Cobra in the 9's. The street legal Cobra ran 9.93/140.7 at 3500 lbs at the Fun Ford Weekend in Phoenix. It made 700HP and 737 ft lbs SAE - 728HP for those who like the STD correction - and later, another 56HP (756) with the 2.8H. See 2.8H comparison dyno tests. With larger 2-1/8" "dyno" headers, better cams, higher compression and some head porting, it made 962HP engine at 23 psi as tested by Richard Holdener of Muscle Mustangs & Fast Fords Magazines on the Westech engine dyno.

*The BIG BORE™ 2.8H Kit outperforms the other Twin Screws. It won't leave you hanging and hoping for more potential. As compared to the 2.4, the new 2.8H Kit requires 66 less HP to drive at 23 psi and makes 1028HP (962+56=1018HP). MAMMOTH™ Manifold adds another 50HP for 1068HP!

DYNO NOTES

1. Larger than stock fuel rails did nothing for HP or fuel distribution. Neither did the Ford GT Supercar intercooler.
2. 1-5/8" and 1-3/4" headers for the '03 Cobra made 5HP. At this HP level primaries are far too small. Ever hear of anyone running 1-5/8"-1-3/4" primaries on a 600-800HP motor? I ran 1-3/4" on my 1975 231" 200HP Buick V6 NHRA Record Holder.
3. Accufab's 2-1/8" headers made 50HP but are too large to fit on a stock Cobra. Space limitations really limit Cobra HP gains from headers.
4. Ice water through intercooler made 18HP. Bassani exhaust with header collectors made 11HP or 16HP for exhaust and headers.
- 5.

Eaton 112 3.2" pulley = 537HP

Kenne Bell 3.2" pulley = 682HP

+ 145HP Kenne Bell gain w/ same size pulley

MANIFOLD SPACERS & FUEL RAILS

We ran the 762RWHP Earl's motor on an engine dyno and it put out 962HP with a 2.4 and a projected 1028 with the 2.8H. "Spacing up" the supercharger manifold with an aftermarket spacer made zero ("0") HP. One must ask this question. If larger fuel rails and spacers are "supposed" to make more power, where is it? If these products don't make HP at the 900HP level, does anyone really believe they will at 5, 6, 7 or 800HP?

Corrected Torque and Power 22icep2,

