

'99-'01 COBRA / MACH 1 TECH & TUNING TIPS

All the Tech & Tuning Tips, Tests and Comparisons apply to BOTH the original 1.7L Twin Screw and the new BIG BORE 2.1L upgrade which can be slowed or "pulled down" to match the boost of the smaller displacement 1.7L. See "Pulley/Boost/Ratio/HP Guides" for boost comparisons.

PERFORMANCE OVERVIEW

Extensive engineering and testing has been dedicated to this kit. Our objective was to provide our customers with a seat pinning but reliable kit that was upgradeable to the power levels of the '03-'04 Cobra. The full range of dyno tests, HP, boost, pulleys, superchargers, intercoolers, fuel systems, tech & tuning tips, related products (some make HP and others don't), upgrades etc. is thoroughly covered. A stock Cobra makes 366HP to the rear wheels with a maximum boost of 8.5 psi from the Eaton. We dynoed our 5 psi kit at 400HP with a peak boost of 5.5, maximum power for the stock 80mm meter. Timing was 18° at 11.1 AF ratio. Note: Unlike the 4.6 2V, timing increases beyond 18° (up to 24°) made very little power (+3HP) but knocked a little, even on 100 octane. Keep it at 18° or below. Adding the Kenne Bell Cool Air Kit and 90mm Meter increased power to 426 with the reduced inlet restriction raising peak boost 1 psi (6.5 vs. 5.5 psi). May require 92-93 octane. That's 60 more HP than a stock Cobra. For those wanting another 1 psi boost and willing to add the necessary octane, the 3-3/4" pulley raises power to 438, while the 3-11/16" nets 449HP. The 9 psi Intercooled Kit makes 466HP with good fuel, 18° and 11.1 - a whopping 100 more HP than the stock '03-'04 Cobra. At 11 psi, a 3-1/4" pulley and 510HP, higher octane fuel should be used. All else the same, the higher compression ratio of the '99-'01/Mach 1 pistons will not tolerate the boost levels of the lower compression '03-'04 engine i.e. 1 point higher CR reduces allowable boost by 2 psi. +1.5 CR = 3 psi etc. If planning to ultimately run boost levels beyond 13 psi, the 6 rib pulley system must be upgraded to the Kenne Bell 8 rib system with the '03-'04 Cobra dual pumps and gas tank.

INLET SYSTEMS OVERVIEW (COBRA)

We designed 2 entirely new better flowing inlet manifolds- one that accepts the stock throttle body and the other an aftermarket oval throttle body. Get a larger throttle body at 450HP. Our inlet manifold had already made 850 engine HP, so it's more than adequate. That's over 1200 cfm. The one inlet component that is progressively restrictive and undersized is the Cobra inlet filter-canister assembly. The gains are especially high because, as we've said on numerous other occasions, positive displacement superchargers don't like any inlet restriction. Our Cobra Cool Air kit increases power +22HP at 400RWHP. Combine this kit with the Kenne Bell Polished Throttle Body and power is 630 at 19psi. NOTE: The Kenne Bell Cobra Cool Air Kit has the provisions to run either with or without the mass air screen. Leaving it out can increase power by up to 20HP. Leaving it in provides better idle quality. Note: The stock and Big Oval throttle bodies are not interchangeable. Changing a throttle body on a Cobra requires switching manifolds.

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. Kenne Bell Cool Air Kits are all "cool air suckers" and HP rated, not guessed at. Both our Cobra and Lightning Cool Air Kits have "0" loss at 700HP and flow 1000 cfm/700HP with "0" restriction. CAUTION: DO NOT use a Cool Air Kit with the Kenne Bell 5 psi kit unless also using our 90mm meter. The additional power gain (19HP) "pegs" the stock 80mm meter and leans out the engine.

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 80mm is an excellent meter, but it will not calibrate fuel delivery after 400HP and leans the engine out. You must use the Kenne Bell 90mm and Switch Chip® after reaching 400HP (see "A Note Regarding Mass Air Meters with Larger than Stock Injectors"). The very first upgrade to our 5 psi kit should be the Cool Air Kit/90mm Meter combination (26HP).

INLET TUBE

All Kenne Bell kits include a new '03 Cobra throttle body to mass air tube. They flow more air and better fit the throttle body location on our kit. This tube will fit either the stock 80mm or the 90mm Kenne Bell/Ford meter. The '03 supercharged Cobra's were all equipped with the 90mm. Again, maximum HP for the 80mm is 400RWHP. At that power level, the meter "pegs" and no longer calibrates proper fuel delivery. A different Kenne Bell chip is required for the 90mm meter on our kits.

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. There's a big inline fan that claims "35+HP and 31% MPG!?" It was tested by Richard Holdener. It made 2-3HP at very low rpm-not 35!

THROTTLE BODY

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. These throttle bodies don't increase power until 450HP (see literature).

INTERCOOLERS

All else the same, an efficient intercooler allows the engine to run another 3-4 psi of boost. A one point lower compression ratio will allow approx. 2 psi more boost. Therefore, the combined lower CR and intercooler lets the engine run approx. 6 psi higher boost. That combination (8-8.5 CR and intercooler) is used on the '03 Cobra, '99-'01 Lightning, '86-'87 Buick GN, '90-'91 Cyclone/Typhoon etc. Some vehicles, such as the highly successful Buick 3800 V6, use a 6 psi supercharger without an intercooler. It's important to realize that an engine does not have to be intercooled to be powerful and reliable. Thousands upon thousands of OEM and aftermarket supercharger kits have been - and continue to be sold - without intercoolers. Kenne Bell has been actively manufacturing both non intercooled and intercooled kits since the 80's. And we still offer numerous non intercooled kits, including the '99-'01 Cobra. Our '99-'01 Cobra kit is available in non intercooled and intercooled versions. The intercooler may also be added later as an upgrade.

INTERCOOLER COOLING

Kenne Bell was first to test and clarify this industry misconception. Intercoolers DO NOT make more power by cooling the air. That is physically impossible. Surprised? We don't care what the others say or think or read in books. They are wrong. There is no way that lowering the charge temperature after the supercharger with an intercooler, a larger intercooler or ice water can increase HP. For actual third party witnessed tests, see "Miata Madness" in Kenne Bell Tech Tips on our website. Although these tests were run on a Miata, we've also tested Mustangs, Dodges, and GM applications with the same results. Believe the Kenne Bell tests. Read our tech articles. Save your money. Lowering the coolant temperature AFTER a supercharger only allows the engine to run more spark or boost on a given fuel octane. You can't run an ice cooler on the street for very long. That's not practical. Yes, lowering the air temperature BEFORE the supercharger will, of course, increase power 1% for every 10°.

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°. As mentioned before, cooler intercooler fluid does not increase power. We first learned this in 1986, 17 years ago when testing our Buick Turbocharged GN's. I personally froze intercoolers with CO2, NOS, NO2, Syltherm, and acetone. In our company's 35 years of existence there aren't many concepts we haven't tried or tested. One thing is for certain, cooling the air after the supercharger, with no other changes to the engine, will not and cannot increase HP. Use a 75% distilled water/25% coolant mixture.

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 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 for at least 750HP.

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 or 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™. That's precisely what it was designed for. FMU's aren't recommended on the Cobra or Lightning nor are adjustable regulators or inline pumps. Finally, never use a "return system" fuel pump to replace your "returnless system" pump. They do not work. 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. As Diablo Chip dyno operator, Pat Stajdel said after dyno testing Nitrous Pete's Kenne Bell supercharged Cobra, *"We couldn't even dyno test it without the BOOST-A-PUMP™ and BOOST-A-SPARK™. They solved all the fuel and ignition problems, even at 24psi boost."*

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 310lbs/186liters per hour. The BOOST-A-PUMP™ will increase the output to 465lbs/270 liters. That's enough fuel for 930HP. The '99-'01 155L Cobra is upped to 227 liters with the BOOST-A-PUMP™. This is the set up for our 6 psi kit (see "Kenne Bell BOOST-A-PUMP™/Cobra vs. Focus vs. Walbro Fuel Pump Tests" and "BOOST-A-PUMP™ Theory Explained"). Why the discussion on the Lightning? Because the Lightning style return style pumps cannot be used in any '99 up return system Ford. Do not attempt this regardless of what you were told. Use only returnless style pumps.*

INLINE PUMPS

Another product who's 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. And inline pumps will not work on "returnless systems."

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°. 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.

CONVERTING TO A RETURN SYSTEM

In our opinion, you are wasting your money. We've made 750RWHP with an '03 Cobra fuel system. For high HP '99-'01 Cobra's, your best choice is the '03 dual Cobra pump system and gas tank with the Kenne Bell BOOST-A-PUMP™.

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).

PULLEY SYSTEMS

6 rib systems are very common and work very well. One of the reasons the '03 Cobra has an 8 rib is because it drives an Eaton supercharger, which requires more engine power to drive than a Twin Screw. The '99-'01 Cobra kits utilize a 6 rib system up to 12 psi. Above 12 psi, the 8 rib is necessary. Generally speaking, the higher the boost, the more engine power is required to drive the supercharger. Higher boost means a smaller diameter supercharger pulley with less surface area. A simple trick we use is to switch to a larger crank pulley, which allows a larger supercharger pulley with the same boost/pulley ratio. Example: 6.5" x 3.25" = 2:1 ratio. 9" x 4.5" = 2:1. A 4.5" supercharger pulley has 38% more surface area than the 3.25" thereby negating the need for an 8 rib system in some cases. By comparison, an 8 rib vs. 6 rib is 33% greater belt surface area. It's all about pulley surface area. So when running higher boost levels, select the largest crank pulley and think like engineers. Think "ratios" and not +2, +6 etc. to describe pulleys and boost. See "Pulleys/Pulley Puller Tool" for more information. The new 2.1L significantly improves pulley contact area as their pulleys are larger than the 1.7L.

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. After 12 psi, an 8 rib belt system is recommended on the '99-'01 Cobra. Our 8 rib kit includes crank, alternator, water pump, AC and power steering. Never use a "cog belt" style system.

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 Denso T20EPRU or NGK TR6-U gapped at "025". Our BOOST-A-SPARK™ dialed to the "max" position this spark plug combination will fire to +26 psi. Use setting of 25% up to 21 psi. 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.*

EXHAUST SYSTEMS

Sorry but we've seen little or no gain on any '96 up Cobra. Cats? I've never seen a "high flow" cat(s) ever make any power over a stock cat. A cat will typically burn up 10HP on a 300HP engine. Dual cats lower it to 5HP. Run 600HP through duals (300HP per cat) and you're back to a 10HP drop.

HEADERS

Below 600HP, long tubes make very little, if any, power or actually lose 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. Avoid ANY

and ALL header leaks, even pinholes. We never tested headers above the 600HP level, but MM&FF Magazine did and made only 5HP, so like the throttle body that doesn't make power below 450HP, headers and pre-cat removal may make little if any more power below 600HP.

CAMS

Crower Stage 2 or Sean Hyland cams, springs and retainers are the hot set up. Be very careful with cam selection, particularly for a street/strip combination. We've tested some grinds that work very well on the street.

CHIP TECHNOLOGY

The '99 up Cobra is very difficult to dyno test because of all the new variables i.e. boost, fuel pressure, cat modeling, closed-open loop, etc. There are several functions that must be stabilized and monitored for meaningful dyno tests. The '99-'01 Cobra processor is unique. It uses a different strategy and format than earlier Ford processors. What works on the older EEC's doesn't work on the Cobra. Our extensive dyno testing and data logging of air fuel ratio, boost, temperatures, etc. revealed some serious leaning out problems when increasing boost and horsepower with the stock calibration. For example, on the returnless fuel systems, the simple addition of the proven Kenne Bell BOOST-A-PUMP™ increased fuel pressure and fuel delivery (approx. 8% per 10 psi), thereby compensating for the lean out.

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 (increase fuel octane). 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 6HP 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, don't waste your time. 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. And it costs a lot less.

KNOCK SENSORS

The '03 Cobra may enjoy better rods and low compression pistons, but it lacks one very important feature of the '99-'01 - the knock sensor. Knock sensors detect detonation and subsequently retard ignition timing to suppress the knock. Ford utilizes a very sophisticated system that can be calibrated to differentiate normal engine noise from actual knocking or pinging. The entire system must be re-calibrated because of the higher noise level at WOT of the Kenne Bell Twin Screw Supercharger. A new wire harness is included with all kits. This is just another example of the dedicated calibration work we perform on our supercharger chips. To make tuning even more difficult for the average dyno tuner, we relocate the sensors to the heads. Knock sensors protect your engine from detonation. NEVER give them up.

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. Also, this can break belts and damage or destroy pulleys and supercharger drive parts. Keep supercharger rpm at a minimum by not over-speeding the engine. SHIFT @ 6800 MAX RPM.

SUPERCHARGER RPM

Check the engine 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. The Cobra does not need to be revved beyond 6800 through the gears.

BOOST

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."

FUEL INJECTORS (DELTA PRESSURE)

We've said it before. More fuel doesn't make more power by itself. Ideal fuel/air fuel ratio makes the most power (around 12.5-13.0:1). We've seen stock 42 lb injectors make 617HP at 12:1 and 85 psi. The tables below list fuel flow in lbs/hr. for a 42 lb injector at 0 psi, 15 psi, and 20 psi boost. Note how injector flow drops as boost increases and how it increases with fuel pressure. Yes, your 42 lb injector flow is actually only 34 lbs at 15 psi. The flow out of the injector must overcome the manifold boost/back pressure of 15 psi. Note: The stock 42 lb injector is 58 lbs at 85 psi and will support 617RWHP with the Kenne Bell BOOST-A-PUMP™ and SWITCH CHIP®. The 55 lb injectors are rated at 45 psi so keep that in mind IF NOT using the BOOST-A-PUMP™. The stock '99-'01 Cobra uses a 24lb injector. The '03-'04 uses a 42. 42's are O.K. to 550RWHP. After that, upgrade to 55, 60, 64 or 72's, depending on HP and use.

Again, we made 617HP in the 5.0 Mustang Magazine test. The AF ratio held at 11.1 until around 600HP and began leaning to 12.1 at 617HP indicating the injectors were maxed out at 600HP. The only 12.4 ohm injector we recommend for the Cobra is the Siemens Deka

55lb (part# 5255). Use it if you exceed 617RWHP on Cobra. The Cobra requires harness adapters to use the 55lb, but a chip must be used to correct injector size. Kenne Bell also has a 55 lb chip. In October '03, Richard Juliano's 93 octane 18 psi Cobra made 665RWHP with a Kenne Bell chip and 55's.

FUEL PSI	BOOST		
	0 PSI	15 PSI	20 PSI
45	42	34	31
55	46	39	37
65	50	43	41
75	54	48	46
85	58	52	51

NITROUS

We don't recommend any "dry" Nitrous system for a supercharged 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 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.

PISTONS & RODS

The '03 Cobra used Manley low compression pistons and forged rods. These are necessary if attempting to run the higher intercooled boost levels of the '03 Cobra in your '99-'01. They've held up at 900HP in our test engines. A good rule of thumb for maximum boost on an intercooled '03 Cobra with a Kenne Bell Chip and pump gas is 17 psi (94 octane) and 15 psi (91 octane) with 8:1 Cobra pistons. For stock pistons, 6-7 psi (91-94 octane) non intercooled and a 9-10 psi (91-94 octane) intercooled.

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. True, the '99-'01 Cobra rods are not the best, but always remember what breaks rods. It's nitrous, rpm and detonation. Keep it down to 6800 max. A 10% increase in rpm increases the inertia loading on the rods a whopping 40%. The Cobra is a strong engine. Supercharging actually reduces inertia loading on the rods. 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 Syclone V6's, even at 20psi. If running over 9 psi boost, we recommend forged rods and 8-8.5 forged pistons.

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

ELECTRIC WATER PUMP

Can't be used with our kit as the pump is part of the belt loop.

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. Gears don't make horsepower!

- Best 1/4 mile gear for the Cobra is 3.73's.
- 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 6800 rpm with a supercharger (2.65 ratio x 6800=18020). A 2.5" supercharger pulley with a stock 7.5" crank pulley is a 3.0 ratio. 9" crank divided by a 3.0" supercharger = 3.0 ratio.

Kenne Bell offers only hard anodized (a must to prevent belt and pulley wear) crank pulleys. All our supercharger pulleys are hi-grade steel to minimize wear.

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 in the engine, trans and differential. All Kenne Bell superchargers are shipped with Red Line synthetic racing oil. It's that good.

GAUGES

There are two gauges you can't do without, a boost and a fuel pressure gauge. NEVER install a mechanical fuel gauge inside the cockpit. The Kenne Bell Electric Fuel Pressure Gauge is calibrated on our fuel flow bench and is a perfect match for our Boost Gauge.

IGNITION TIMING / OCTANE / BOOST TUNING

Ideal spark timing is around 18-20°. 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 =6HP and 1 psi boost = approx. 13RWHP, 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 20°, 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° = 6HP 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 - up to 20HP. Be very careful with leaner than safer 11.1 ratios. Leaner ratios are more prone to detonation.

OCTANE - BOOST GUIDE ('99-'01 MACH 1 / COBRA)

Always use the HIGHEST FUEL OCTANE AVAILABLE. We recognize that fuel octane varies from State to State. All baseline dyno tests were run at 11:1 AF ratio and 18° timing to avoid confusion. Since the amount of boost an engine will tolerate depends on fuel octane, we vary the boost of our kits slightly with pulley size (see below). Therefore, for 91 octane, pulley size may be 1/8" larger than shown in the dyno tests. This allows us to maximize the kit output/boost for a particular fuel octane rating. If your engine knocks for any reason, GET OUT OF IT! If experiencing detonation, we recommend lowering boost level with a pulley or increasing octane in lieu of retarding timing. It isn't excess timing, boost or lean fuel mixture that damages engines - it's the resulting detonation/knock/ping. See "Jim Bell's Supercharged/Turbocharged Performance Guide"). Note: We only recommend NOS #12007 Off Road (red can) octane booster. One can in 8-1/2 gallons is 2.5 octane.

MINIMUM FUEL OCTANE	MAXIMUM RECOMMENDED BOOST	
	NON INTERCOOLED	INTERCOOLED
91	5	8
92-94	6	9
97 BLEND	8	11
100	10	14

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. Traction control is to be used at the discretion of the driver.

FUEL SYSTEMS (ALL COBRAS)

We've done expensive analysis of the Cobra fuel system. See Kenne Bell BOOST-A-PUMP™/Cobra vs. Focus vs. Walbro Fuel Pump Tests and BOOST-A-PUMP™ Theory Explained. The '99 and up are returnless. If your goal is to waste money with someone who is unable or unwilling to deal with the stock returnless system, then go ahead and replace it with the old fashioned expensive and complex return style system with new fuel line, return line, fuel rails, regulator, pumps - and good luck trying to tune it.

INJECTORS

The '03-'04 Cobra dual pumps with a Kenne Bell BOOST-A_PUMP™ will support 550HP with stock 42lb injectors and 750 with 60lb injectors. 55, 60, 65 or 70's can be installed at any HP level above 550 and the BOOST-A-PUMP™ and stock pumps are adequate. However, chip re-calibrations are mandatory. 42's will get you to 550HP with a Kenne Bell 317L in tank pump replacement (with BOOST-A-PUMP™) and larger 42-65lb injectors. If you're really serious about making over 550HP in the '99-'01/Mach 1, then convert it all to the '03-'04 Cobra and use the dual pumps and gas tank. Again, 55-65lb injectors aor 550-750 and higher.

FUEL LINES & PSI LOSS

See Kenne Bell "Fuel Pump Figuring." At 700HP, we determined that the '03-'04 Cobra has a 7 psi drop between the tank and rails. Replace it with a 3/8" or 1/2" line and dual custom fuel filters. Be aware that the 7 psi, or 5 psi, or 2 psi is not a problem UNLESS the required pressure is 7.5 or 2 psi too low. In other words, if your goal is 65 psi and the pressure at the rail is 65 psi, the loss in the feed line is academic. Who cares if it's 0, 3, 7 or 10 psi. Fuel pressure is only a problem when you can't program enough into the tune or it drops off.

We have fuel friction loss tables to pre-calculate line losses. There is a 3 psi drop from front to rear fuel rails at 700HP. This represents only a 2% (11.22 vs. 11.00) air fuel ratio variance from the front to rear cylinders. Think about this one. The leaner front cylinders (11.22) will actually produce MORE power than the richer 11.1 rear cylinders. We just don't see the value of larger fuel rails below 700HP. However, if you are on the ragged edge of detonation and 2% is a concern, then use larger rails for peace of mind, if nothing else.

HEADS

We've stated that the '99-'01 Cobra has the same power potential as the '03-'04. Yes, the '03-'04 has slightly better intake ports and may make some more HP on a naturally aspirated engine. However, on a supercharged engine, these larger intake ports are not necessary. Keep in mind that the inlet tract is "pressurized" by the supercharger making the air flow that the port and valve see actually lower as the air is compressed. Don't even think about switching heads.

TIMING & HP

One of the most confusing and abused areas in Mustang supercharging is HP ratings. The following will hopefully clear up any misunderstanding about Kenne Bell kit ratings.

Since the beginning, the aftermarket manufacturers of supercharger kits were aware that optimum ignition timing produced the most power. This "optimum" timing is determined by accurate dyno testing, whether it be Kenne Bell, the OEM or a tuner. Everyone's goal, obviously, is to run the engine at this ideal timing without engine knock/detonation. Unfortunately, because of timing variables such as elevation, fuel octane, ambient temperature, humidity, AF ratio, compression ratio, coolant temperature and sensors, the optimum ignition timing/maximum HP cannot be achieved under all conditions in every vehicle all of the time. The '99-'01 peak supercharged HP varies more than any vehicle we've ever tested. We've seen up to 35HP lower than our test cars, so don't expect max advertised HP on all cars.

Even the OEM's have 87, 89, 91 and 92 fuel calibrations. That is precisely why a vehicle calibrated to run on 87 octane can experience HP gains from a "chip" designed to run additional spark with 91 octane. Not exactly rocket science once you put things in perspective. Again, with all else equal, it is ONLY timing and AF ratio that regulate engine HP. That's it. There is no 3rd dimension to power tuning. The old Kenne Bell formula of:

1 OCTANE = .66 psi BOOST (11HP), 1° TIMING (4HP), .5 AF RATIO, 20° AMBIENT, 30% HUMIDITY, 1000' ELEVATION, 15° COOLANT TEMP emanates from years of supercharging experience. It's a great guide and basis for understanding "tuning." To cope with the variations, early 5.0 supercharger kits, for example, utilized a manual adjustable knob to "retard" ignition timing. At that time, no one was that concerned about how this timing retard affected the HP rating of a kit. Rate the kit at "X" HP and let the customer or tuner deal with all the variables by turning the knob down for street use and then up (advanced timing) for racing with higher octane fuel or dyno testing. Otherwise the kit would have to be rated at 300HP at 30°, 284HP at 26°, 268HP at 22° etc. Would all kit manufacturers rate their kits at the same optimum timing - or retarded timing for the worst conditions and lowest octane premium fuel (91 instead of 94)? And when we sold chips with the kits and the tune (timing) was conservative, the dyno tuners criticize the manufacturer for "now knowing what we were doing" or "being conservative." Ford's most complex calibration parameters of the 4.6 changed tuning forever. There are no more retard knobs. Ford now controlled timing. So, with the introduction of our Cobra kit, we decided to rate our kits at optimum timing (18°). We have explained in detail, with no B.S. tech and dyno tests, why we chose this approach.

We do not recommend any type of "timing adjustor" on the mass air meter or anywhere else on the engine nor do we recommend injectors or meters other than those that WE have calibrated for our kits. We are very sorry but it simply is not practical, feasible or cost effective for Kenne Bell to evaluate and test all the meters, injectors, water injection kits and other switches, knobs, adjustors, plates etc. being promoted for the 4.6. When one or more of these products are installed and the system then "doesn't run right," it is Kenne Bell that gets the call for help. Then there's the supercharged engines worst enemy - the hot air sucking (no canister around the filter) exposed underhood filter. Do you think 100°-120° hotter air from these things might affect the IAT sensor and ignition timing - and HP?

PULLEY ADJUSTMENTS

1/8" in pulley size will vary boost 1 psi, power by 16HP and requires 1-1/2 octane. Pulleys are available in 1 psi increments.

2.5° timing accounts for 9HP (4HP per degree).

THE DON'TS

- ① DON'T ever let the engine knock.
- ② DON'T use an exposed hot air underhood filter. Use Kenne Bell Cool Air Kit.
- ③ DON'T use fuel injectors other than Kenne Bell.
- ④ DON'T use mass air meter other than Kenne Bell.
- ⑤ DON'T use chips other than Kenne Bell.
- ⑥ DON'T allow "tuners" to mess with the Kenne Bell calibration.
- ⑦ DON'T use timing or sensor adjustors of any kind.
- ⑧ DON'T use underdrive pulleys.
- ⑨ DON'T use water injection, timing adjustors, mass air meter adjustors etc. - and most important
- ⑩ DON'T REDESIGN THE KIT BECAUSE SOMEONE ELSE SAYS, THINKS OR HEARD YOU SHOULD. ! Kenne Bell engineered the kit and calibrated it. We know it best. Call us if you have a problem or special application.

TROUBLE SHOOTING

THE ENGINE KNOCKS

Timing too high for fuel octane.

Solution: ① Drop boost 1 psi ② use higher octane fuel or ③ have Kenne Bell re-calibrate chip for less timing.

Underhood exposed filter.

Solution: GET RID OF IT.

Aftermarket mass air meter.

Solution: GET RID OF IT and get Kenne Bell 90mm and SWITCH CHIP®.

Air pockets, low fluid or pump not operating.

Solution: Remove plug and check for fluid level. Then start engine, look in plug hole to see if fluid is circulating.

Stock spark plugs.

Solution: Replace stock plugs with Denso U-Groove T2OEPR-U or NGK TR6

Vacuum leaks.

Solution: Re-check installation. Vacuum or exhaust leaks - even pinhole leaks - hurt mileage, affect idle and part throttle driveability.

Insufficient fuel pressure.

Solution: Get a gauge and check it. Should be boost psi +40 psi.

UNDERSTANDING TIMING VARIATIONS

No one can deny that all Kenne Bell Kits make for incredible HP and torque gains at any timing.

The stock IAT and ECT sensors reduce spark when the inlet air temp and/or engine coolant temp readings rise. That is programmed into all Cobra's. On very cold days the sensors advance timing. Although timing may vary, our standard POWER chip calibration locks in the AF ratio at a safe rich 11-11.2. This will not vary until the engine runs out of injector. Note: The SHOOT OUT chip leans out the engine to approx. 12.5. The engine will make more power than advertised but higher octane fuel is required.

CAUTION: POWER LIMITATIONS OF STOCK 80mm METER

The Kenne Bell 9 psi kit will produce up to 400HP at 18° and 11.1 AF ratio. The stock 80mm meter is limited. At 400RWHP, the meter is "pegged" or maxed out at 5 volts and does not supply adequate fuel for the engine. This dangerously lean condition can cause serious engine damage. That means no larger throttle body, SWITCH CHIP®, advanced timing etc. after 400HP with the stock 80mm meter. We refuse to even sell a SWITCH CHIP® for our 9 psi kit with an 80mm meter. SWITCH CHIPS® are available ONLY for the 90mm assembly is running 9 psi. Once the Kenne Bell 90mm Mass Air Meter assembly and chip are added, HP levels may be elevated (see "Tech, Tuning & Dyno Tests").

CAUTION: FUEL INJECTORS

Our kits are calibrated for a specific Kenne Bell fuel injector. The injectors are included in the kit. Use only Kenne Bell supplied injectors.

CAUTION: CHIPS, RE-CALIBRATIONS & "TUNES"

• All kits also include a Kenne Bell chip calibrated or "tuned" specifically for ① the kit ② injectors and ③ meter. DO NOT change them unless consulting us.

• DO NOT have anyone "diddle" with the Kenne Bell calibration unless consulting us first. No secrets here. There are 2 ways to make more power - more ignition timing and leaner AF ratios. We know very well how to do this at Kenne Bell.

• DO NOT use "meter adjusting knobs," "sensor tweakers," larger fuel pumps, chips, "timing adjusters" etc.

If in need of more HP, look first to the Kenne Bell Cool Air Kit, 90mm Mass Air Meter / SWITCH CHIP® and then the Kenne Bell Throttle Body - proven dyno tested parts that make more HP by reducing inlet restrictions (see Kenne Bell Dyno Tests and Tech Tips for more information).