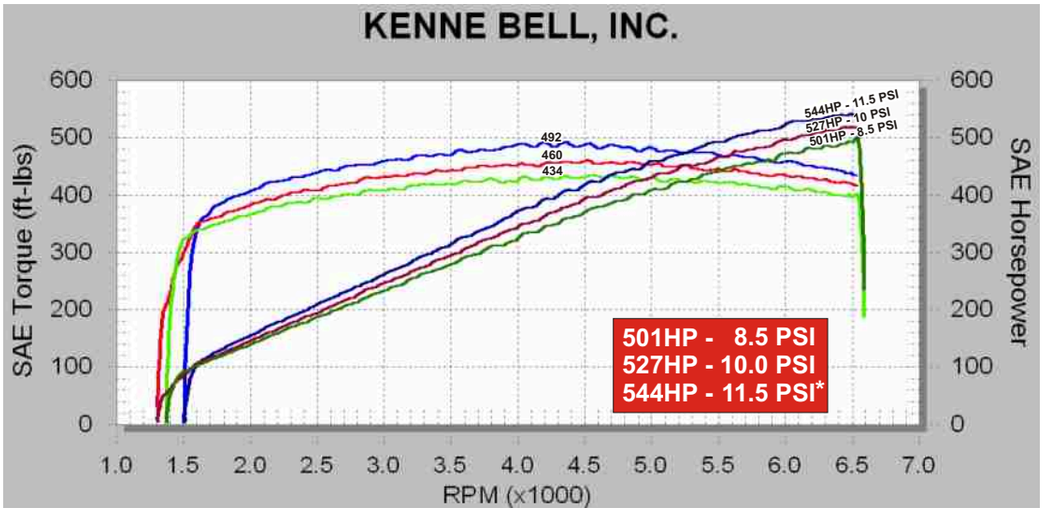
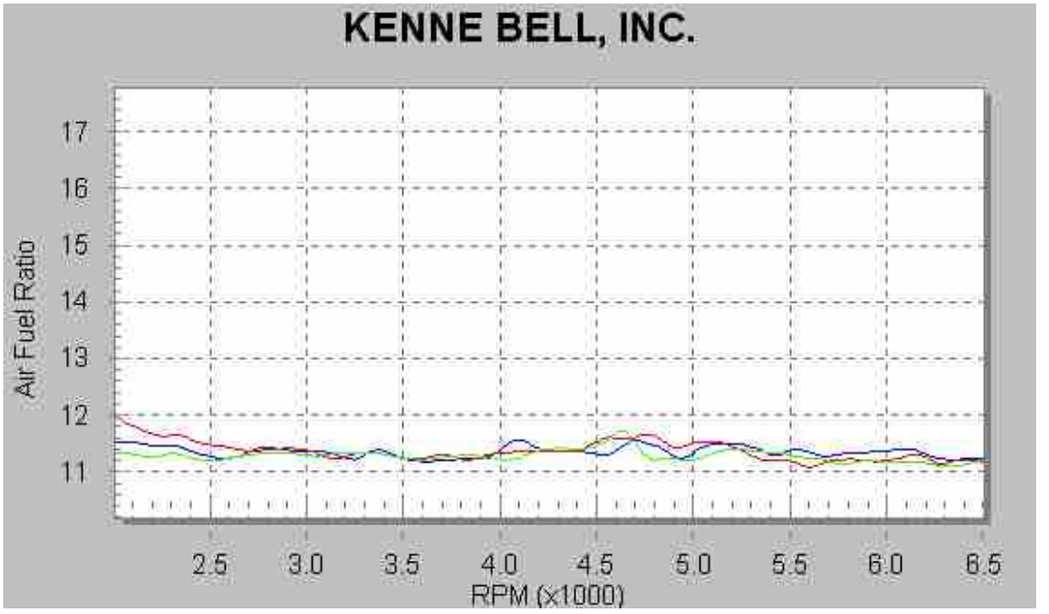


BOOST vs. HP COMPARISON 8.5-11.5 PSI STAGE 1
100% STOCK KENNE BELL SUPERCHARGED '05 MUSTANG GT
REAR WHEEL HORSEPOWER & TORQUE
(DIVIDE BY .85 FOR ENGINE HP & TORQUE)

The best tests are those without variables of any kind. These tests were conducted on the Kenne Bell dyno with our '05 Mustang GT test car. Only the pulley and boost was changed to supply our customers data on the effect of boost/pulley changes on their Mustang. Note: Stage 2 kit will make 21-35HP more with 130mm Throttle Body.

**11.5 psi will require octane booster(approx. +3 octane).*



AIR FUEL RATIO COMPARISON 8.5-11.5 PSI
100% STOCK KENNE BELL SUPERCHARGED '05 MUSTANG GT

You may be surprised to see that the air fuel ratio is the same WITHOUT RE-TUNING, even with HP jumping from 501-535 and boost from 8.5-11.5 psi. Who would want to re-tune every time you change a pulley 1/8"? Fact is, you do not have to re-tune for fuel when increasing boost or HP - at least if it's a Kenne Bell calibrated kit. Also, the timing is already optimized at 25°, so forget about re-tuning or tweaking it either. If you are curious about what effect timing changes have on HP, we've also run those controlled tests at 19°, 21°, 23° and 25° for you. Some things are best left alone, aren't they? We talk a lot about why we are against "custom tuning" our kits. It's simply because it creates so many problems for us and our customers. They are Kenne Bell kits and customers so we can print whatever we feel best guarantees the success of either. We have nothing against competent installers making a profit from 1. the sale of a supercharger 2. the installation 3. a dyno test or 4. repairs. It's the unnecessary re-tuning and modifying of our kits that creates problems for us. However, at some point (see "Maximum Component Ratings") you may choose to go with our MAMMOTH™ 2.8H Kit, add heads, headers, cams, built motor, larger injectors/fuel system, etc. Then a custom tune by a competent dyno shop is in order.

MAX RATINGS COMPONENTS

(No "opinions." Based on actual tests.)

Use as a guide to the maximum HP ratings of the various components. Based on max 6500 engine rpm.

	MAX RATING
• 39 lb Injectors @ 45 lb Delta PSI	**550HP**
• Stock Pump w/ BOOST-A-PUMP™	**600HP**
• Dual Pumps (FRPM 9407GT05)	**600HP**
• Dual Pumps (FRPM 9407GT05) w/ BOOST-A-PUMP™ and 60 or 70 lb. *DO NOT waste your $ on 421L Ford GT pumps (Shelby GT 500 are same flow within 3%).*	**900HP**
• Stock 57mm Throttle Body	**620HP**
• 1000 cfm Stage 1, 2 Supercharger Inlet Manifold Limit *Note: Even if filter, MAF and throttle body are "big," manifold becomes the restriction and limits peak engine HP to 675HP.*	**675HP**
• MAF Meter 90mm	**550HP**
• MAF Meter Kenne Bell 4.5" (needs MAFIA after 800HP) *Note: At 800HP, choose your tuner with caution.*	**800HP**
• Stock Driveshaft	**550HP**
• Stock Clutch	**535HP**
• Stock Engine (our engine failed at 600HP)	**525HP**
• Stock Exhaust (HP will finally begin dropping off at 550HP)	**550HP**
• Stock Headers, Cats, X Pipe (saw NO HP gain *or boost loss at 785HP) **Don't believe it? Have someone else test them.*	**+810HP**
• Built Motor (we've made over 1100HP w/ Sean Hyland aluminum block engine)	**1000HP**
• MAMMOTH™ Inlet System	**581-1200HP**
• Ignition (replace with Kenne Bell BOOST-A-SPARK™)	**15-25 PSI**
• Spark Plugs (replace with Brisk gapped at .025")	**15 PSI**

TIMING & HP (MUSTANG 3V 4.6 '05 UP)

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, 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 air charge temperature, the optimum ignition timing/maximum HP cannot be achieved under all conditions in every vehicle all of the time.

Even the OEM's have 87, 89, 91 and 93-94 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 "not 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 4.6 kits, we decided to rate them at optimum timing (23° or 25°) where all modular motors - Cobra 4V, Lightning 2V, GT 2V (23°) and 3V (25°) - make maximum power. We have explained in detail, with no B.S. tech and dyno tests, why we chose this approach.

We've NEVER had a complaint about the kit not feeling incredibly strong. And always keep in mind that the IAT and ECT sensors retard the timing as temperatures increase thereby providing some protection to the engine, just as Ford intended. Then there's the knock sensors. If we fix or "lock" the timing, this built in protection against detonation is negated. We chose not to eliminate this safety feature and allow the timing to "float." We have no choice but to be conservative with our customers. The Kenne Bell calibration offers both POWER (street) and SHOOT OUT(optional).

We do not recommend any type of "air/fuel 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 approximately 1 psi, power by 16HP and requires 1-1/2 octane. Pulleys are available in 1 psi increments. A pulley change takes 4 minutes. Kenne Bell Pulley Wrench is required to change the pulley.

CAUTION: ***The '05 up Mustang utilizes a drive by wire electronic throttle that interfaces with the mass air meter. ANY change in HP/air flow e.g. a pulley size can affect driveability.***

THE DON'TS

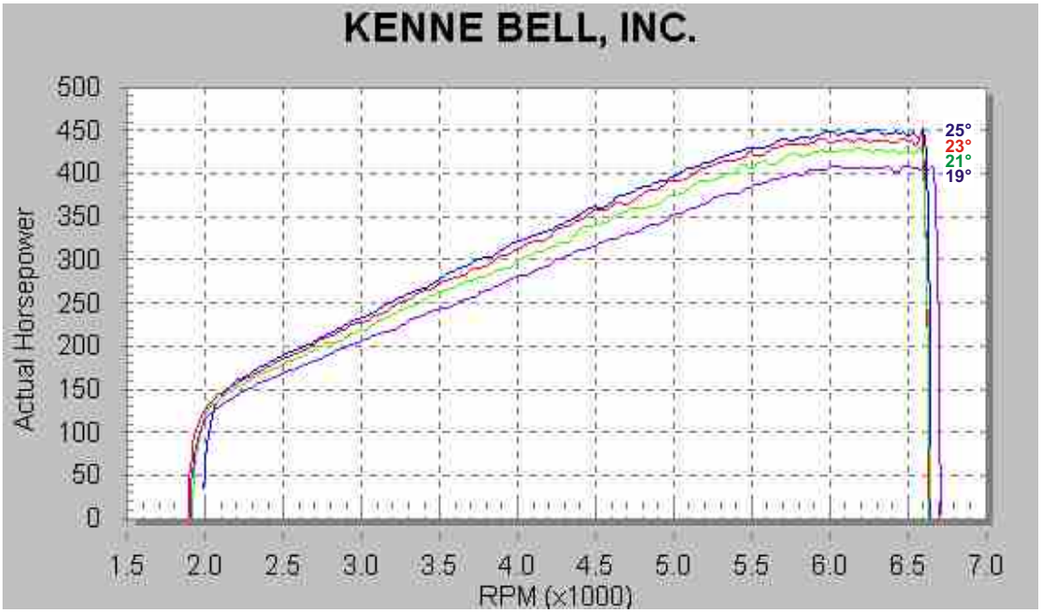
(FOR KENNE BELL 4.6 GT KITS)

Note: *If adding headers, cams, heads to our kits you may require a custom tune. Check with us for a recommendation on an authorized Kenne Bell Tuner.*

① DON"T ever let the engine knock.
② DON'T use an exposed hot air underhood filter. Use Kenne Bell Cool Air Kit only.
③ DON'T use fuel injectors other than Kenne Bell.
④ DON'T use mass air meters 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 non Kenne Bell supercharger pulleys.
⑨ DON'T use water injection, timing adjustors, mass air meter adjusters 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.

References: ***"Octane Boost Guide"*** **Kenne Bell 4.6 Tech Tips,** ***"Jim Bell's Supercharged/Turbocharged Performance Guide" and "What NOT to do."***

IGNITION TIMING vs HP



These tests illustrate the effects of ignition timing on HP. There was no increase in HP beyond 25°. HP will vary 2HP/° in the “sweet range” (25°-23°) and decrease more rapidly at 7HP/° in the 21°-19° range where the 3V has an obvious distaste for retarded timing. 2° of timing retard in this range is 14HP, about the same as 1 psi boost.

HP	TIMING	AFR
444	25°	11.2
439	23°	11.2
424	21°	11.2
409	19°	11.2

KENNE BELL

Tech, Tuning Tips & Dyno Tests

4.6 MUSTANG GT 3V

STAGE 1, STAGE 2, MAMMOTH™

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 it's 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?

AFTERMARKET "HOT AIR" SYSTEMS - Yes, there are many "hot air" underhood systems available for the '05 up Mustang, none of which have been tested or calibrated for our kit. So NEVER use one of them on a Kenne Bell supercharger kit. We only recommend the unique Kenne Bell Cool Air Kit which pulls cool air from under the front bumper and not "hot air" from under the hood.

COOL AIR KITS - Like meters or throttle bodies, the best product is the one 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. Kenne Bell Cool Air Kits are all "cool air suckers" and HP rated, not guessed at.

90MM MASS AIR METER - Meters measure engine air flow and should never be messed with by the inexperienced. We supply a Kenne Bell calibrated 90mm '03 Cobra meter and 93mm filter with our kit. Leave both as is. DO NOT replace or even rotate, relocate, modify or change the meter or inlet or outlet air supply to the meter. It will alter the air flow path through the meter which can dramatically alter the air fuel ratio of the kit. Example: Just removing the filter on a stock Mustang leans the engine out 1 full AF ratio. The Kenne Bell 90mm meter is anchored to the frame with a bracket so it cannot be rotated, relocated or diddled with. The 90mm Cobra meter will "peg" around 550RWHP.

THROTTLE BODY - The '05 up GT throttle body is a rather small dual 575mm. It's an extremely complex "drive by wire" (electronic) version. It uses dual TPS sensors, and the mass air meter coupled with massive calibration for driveability and safety. An aftermarket throttle body can be your worst nightmare if not calibrated and matched to the kit. If a competitors throttle body screws up your Kenne Bell supercharger kit, you are on your own. Don't call us. Call them. The 130mm Kenne Bell Throttle Body used in the Stage 2 Kit increases power 21-68HP depending on power level. This throttle body is the only one we recommend and will come with a Kenne Bell tune.

THROTTLE BODY SPACERS & INLET FANS - No power gains whatsoever according to our dyno.

INLET MANIFOLD (Throttle Body) - The unique design features a radiused plenum behind the throttle body that enhances flow and reduces reversion and noise. The lower reversion level helps meter signal stability.

INTERCOOLERS - We've thoroughly researched and tested the Ford and aftermarket 4.6 intercoolers. The Kenne Bell bar and plate design is very similar to the Ford GT, Cobra and Lightning intercoolers. They are very efficient and best left as is. We data logged a mere .2 psi loss at 600HP. It won't get any better than this. If someone claims they have a better one, ask to see all the data and not just the rhetoric. Intercooling is not new to Kenne Bell. We've been engineering and selling intercoolers since 1987 for the infamous Buick Turbo V6's and then the Syclone/Typhoon. Air to air intercoolers work great - as good as air to water according to our tests. But air to air requires a lot of plumbing and is noisier. And you can't add ice to it for racing as with air to water.

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, when testing our Buick Turbocharged GN's. I personally froze intercoolers with CO_2, NOS, NO_2, Syltherm, and acetone. In our company's 38 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. Run 25% coolant and 75% water (30% coolant and 70% water in cold climates).

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" and BOOST-A-PUMP™ "Pump Tech" on our website. The 4.6 GT, Cobra and Lightning 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, bigger fuel rails, more fuel, etc..." would be better to first 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 4.6 GT, Shelby, Cobra and Lightning fuel lines and rails are adequate for at least 800HP. Believe it.

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. The best method of increasing fuel pressure and flow on a returnless system like the 4.6 GT is with a Kenne Bell BOOST-A-PUMP™. That's precisely what it was designed for. FMU's aren't recommended on the 4.6 GT nor are adjustable regulators or inline pumps. Stay with the stock "returnless" system on the 4.6 GT. 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. The World's Most Powerful Production Musclecar, the Shelby Super Snake is rated at 725HP - and can make 850+HP with

ONLY the Kenne Bell BOOST-A-PUMP™.

FUEL SYSTEM - The 39lb injectors with Kenne Bell BOOST-A-PUMP™ will support 600HP with stock fuel lines and rails. The '05 Mustang uses the Focus pump which delivers 266L/HR in conjunction with our BOOST-A-PUMP™.*Note: Our kit has provisions for a fuel pressure tap.*

BOOST-A-PUMP™ - The Kenne Bell BOOST-A-PUMP™ with the stock "Focus" pump will support up to 600HP and 800HP+ with the Ford FRP dual pump #M-9487GT05 and 60-70 lb injectors, certainly adequate for everything but an all out race car. It only adds fuel under boost. Easy to install (only 3 wires). Also regulates or maintains correct voltage on pump during normal voltage fluctuations and even alternator failure. An ultra reliable and proven product used on all Kenne Bell kits since 1996. *Note: The BOOST-A-PUMP™ actually increases pump life as the cycling (on-off cycles) is significantly reduced.*

FUEL PRESSURE - Leave the fuel lines, rails, pumps, and fuel line stock. The stock fuel pressure is 30 psi (varies slightly with temperature) at idle. From our experience in tuning, the 39lb Cobra injector is about used up at 600RWHP. Although 12.1 is acceptable (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've 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.

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. Contrary to the "myth" that increasing voltage to the pump shortens its life, all high pressure pumps are rated to safely run up to 17.5 volts. Actually, the BOOST-A-PUMP™ can increase the pump life of a returnless system because the pump duty cycle is less.

SUPERCHARGER PULLEYS - Use only Kenne Bell plated steel pulleys. We DO NOT recommend aluminum supercharger drive pulleys or "saw slotting" pulleys for street use. It eats up a belt in one 1/4 mile run. A pulley change on our Twin Screw takes a few minutes (see literature for pulley size availability) and covers a range from 5-25 psi. Expect approx. 12-18RWHP per 1/8" of pulley size.

BELT WRAP - Surface area contact is the key to efficient belt performance. The larger the supercharger, the larger the pulley, the more surface area available to grip the belt. Use the formula: 3.14 x Pulley Diameter = Pulley Circumference for 360 degrees. Example: 2.5"vs.3" pulley. 3.14x2.5="7.85" whereas 3.14x3="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 16-38HP less to drive.

SERPENTINE BELTS - Use Kenne Bell or Dayco only. 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. We use a 6 rib belt on the 4.6 GT kit and offer an 8 rib system for higher boost competition. As compared to other Twin Screws, the Kenne Bell 2.8H uses 5% less engine HP to drive - at the same boost.

IGNITION COILS - Have you ever looked at the massive wiring a CD system requires vs. the 3 wire hook up of a Kenne Bell BOOST-A-SPARK™? 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 the 4.6 GT, Cobra and Lightning. The stock systems won't fire the plugs 100% beyond 15psi.

ENGINE COOLANT - 75% water 25% coolant is best ratio vs. the OEM recommended 50/50 ratio. Coolant is also a higher viscosity and requires more water pump HP to circulate. Water Wetter by Red Line Oil Co. is a coolant additive that can reduce "air bubble insulation" between the engine coolant jackets and the coolant itself. When the 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. If freezing is not a problem, 10% coolant and a bottle of water wetter works well.

SPARK PLUGS - We recommend 1 heat range cooler plug. Brisk plugs are easier to gap and work well on our test cars.

EXHAUST SYSTEMS - Sorry, but we've seen no gain on a 4.6 GT exhaust system up to 550RWHP. We've made 710RWHP with the stock exhaust. We do know that the Bassani cat back system with x-pipe makes 26HP (736 vs 710) but not until 550HP. At 800HP, there's another 30HP. And who can deny exhaust systems sound great. The Bassani is the best we've tested. Cats? I've never seen "high flow" cat(s) ever make any power over a stock cat. Gutted cats? Better do your own test. You won't believe ours.

HEADERS - Headers make very little, if any, power. We saw "0" HP at 800HP on our test car. In our opinion, headers for the 4.6 GT aren't worth the small or "0" peak power gains, expense and the problems that small leaks create.

4.6 GT CHIP TECHNOLOGY - The new 4.6 GT 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 4.6 GT 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 4.6 GT. 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.

The Kenne Bell Flash Tuner/BOOST-A-PUMP™ combo will provide optimum spark and air fuel ratio from 401-500RWHP with 39lb injectors. 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. In our opinion, the 10HP gained from 11-12.5 is not worth the potential problems a leaner mixture can create. The Kenne Bell Flash Tuner has two programs, POWER and SHOOTOUT (optional). It won't get any better than this. SHOOTOUT mode also has a more aggressive spark program (use octane here!). If engine knocks, GET OFF THE GAS.

POWER mode is standard with all kits. Optional dual program with SHOOT OUT is available at additional cost. Traction control light will be on in SHOOT OUT mode as a warning. 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 6-7HP per 1 degree of retard. 1psi of boost is 16HP. The easiest approach is to install a larger pulley and lower the boost-or add octane via mixing or straight 100-105 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.

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. It contains invaluable information and some great comparison tests http://www.kennebell.net/media/articles/SNAKEBITE.pdf

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. On all Kenne Bell kits, the fuel injectors are not ramped but instead shut completely off. Keep supercharger rpm at a minimum by not over-speeding the engine. We don't ever recommend raising the rev limiter. This can result in "overboosting" because of the engine's reduced VE (volumetric efficiency).

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 with an external filter. No underhood “hot air” systems allowed. Example: 6.5" divided by 2.5 = 2.6 ratio x 6000 rpm = 15,600 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 4.6 GT does not need to be revved beyond 6500 through the gears. DON'T OVER REV THE ENGINE. LET THE SUPERCHARGER WORK FOR YOU.

BYPASS VALVE - Billet aluminum to match the billet supercharger. And another Kenne Bell exclusive - the “valet mode” which locks the bypass open and eliminates boost. Great for any wannabee racer who might be driving your car. NEVER deactivate the bypass valve.

BOOST - Expect about 16RWHP 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 degree ambient or charge temperature=1 octane and 1 degree spark advance=1/2-3/4 octane. For more tuning tips see "Jim Bell's Supercharged/Turbocharged Performance Guide." Always remember that boost doesn't hurt an engine. It's the lack of sufficient octane that causes detonation whether the engine is supercharged or naturally aspirated.

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). Again, for street use and pump gas, we recommend 11-11.5 AF ratio. We've seen stock Cobra 42lb/39 lb injectors- depending at what pressure you rate them - make 600HP. The tables below list fuel flow in lbs/hr. for a 42 lb injector at 0psi, 15psi, and 20psi boost. Note how injector flow drops as boost increases and how it increases with fuel pressure. Yes, your 42lb injector flow is actually only 34lbs at 15psi. The flow out of the injector must overcome the manifold boost/back pressure of 15 psi.

	BOOST		
FUEL PSI	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 4.6 GT, Cobra or Lightning. 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.

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. The 4.6 doesn't have billet rods, but always remember what breaks rods. It's high engine rpm. Keep it down to 6500 max. Supercharging actually reduces inertia loading on the rods. And watch the detonation. Detonation increases heat which helps melt the upper ring lands. Forged are stronger and hold up much better under detonation , but cast lived very well in the turbocharged Buick V6's and Syclone V6's at 25psi. Choose your tune carefully and censor the advice you receive."The world is full of experts who speak from inexperience."

CLUTCH - The Kenne Bell '05 Mustang test car experienced clutch slippage at 534RWHP and exactly 499 ft. lbs. The GT clutch is not as strong as the '03 Cobra. We recommend the Centerforce because of the high clamping force vs. easy pedal. With the Centerforce, it's now holding 800 ft. lbs.

GEARS - Stock gears work very well with the Kenne Bell Twin Screw as these superchargers produce more torque at low rpm. Size for size, no other supercharger has a flatter fatter torque curve because no other supercharger makes as much boost in the low and mid range. Our superchargers have different requirements. They don't need low gears and/or high engine revs to generate boost. Gears don't make horsepower! - boost makes HP.
• Best 1/4 mile gear for the 4.6 GT is 3.73's.
• Keep supercharger rpm (drive ratio x engine rpm = supercharger rpm) to 18000 max with a good external cool air kit.
Example: 3.27 x 5500 = 17985 or 3.0 x 6000 = 18000.
• Ratio is determined by crankshaft pulley size divided by supercharger pulley size.
Example: The 4.6 GT engine rpm should be maximum 6500 rpm with a supercharger (2.73 ratio x 6500 = 17745).

TRANSMISSION - The Mustang has a marginal automatic trans. The Kenne Bell Flash Tuner re-calibrates the trans and firms up shifts and keeps shift rpm points from "drifting". *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 4.6. Max shift rpm should be 6000. All you're doing is needlessly over-revving the engine and supercharger.

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 rear end. The next best choice is good old Mobile 1 Synthetic.

OILING SYSTEM - Supercharger doesn't use engine oil. Completely self contained oil supply with a dipstick. No drilling and tapping pan. No oil pressure and oil drain lines. No orifices to clog. Use Kenne Bell oil only.

TENSIONER / REV LIMIT - The '05 up Mustang pulley system does not like to be surged. That's why Ford used a clutch on the alternator. STAY OFF THE REV LIMITER. HITTING IT IS BAD FOR THE TENSIONER, BELT & PULLEYS. The alternative is to raise the rev limiter so you don't hit it. The drawback to this is OVER REVVING THE ENGINE INCREASES INERTIAL LOADING ON THE RODS & PISTONS (see previous REV LIMITER). Get a shift light. Don't change the rev limiter setting about 6000 with stock rods supercharged or non supercharged. Built engines? OK to raise the rev limiter.

CAMS - With the right street cams, expect 20-25HP. Forget playing with the variable cam timing.

IGNITION TIMING / OCTANE / BOOST TUNING - Ideal spark timing is around 25°. For consistency, all our dyno testing was performed at 25° with an AF ratio of 11:1. Changing timing (advancing and retarding) or AF ratio (rich or lean) between runs is confusing and misleading, so we never do it, unless we are doing specific "timing" only tests. Our intent is 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 design a kit for maximum performance. With our 4.6 3V, 1 psi of boost will require approx. 1.5 octane and 1 octane will support 3/4°-1° of additional spark (see "Jim Bell's Supercharged & Turbocharged Performance Guide" for more tuning tips).
http://www.kennebell.net/techinfo/general-info/jimbells-supercharged-perf-guide.pdf
Since 1° timing = 6-7HP 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 25° and 12.5AF ratio. 12.5 will make 10 more HP than 11.0. This kit makes a lot of HP - and cylinder pressure. If there's any doubt about octane level for competition - go overboard and use 100-105 unleaded or a mix. Don't let it knock. The Kenne Bell Flash Tuner is recommended for quick easy timing changes where maximum performance with higher octane (94-105) is being used. Avoid leaded fuel. It'll destroy your cats and oxygen sensors.

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.

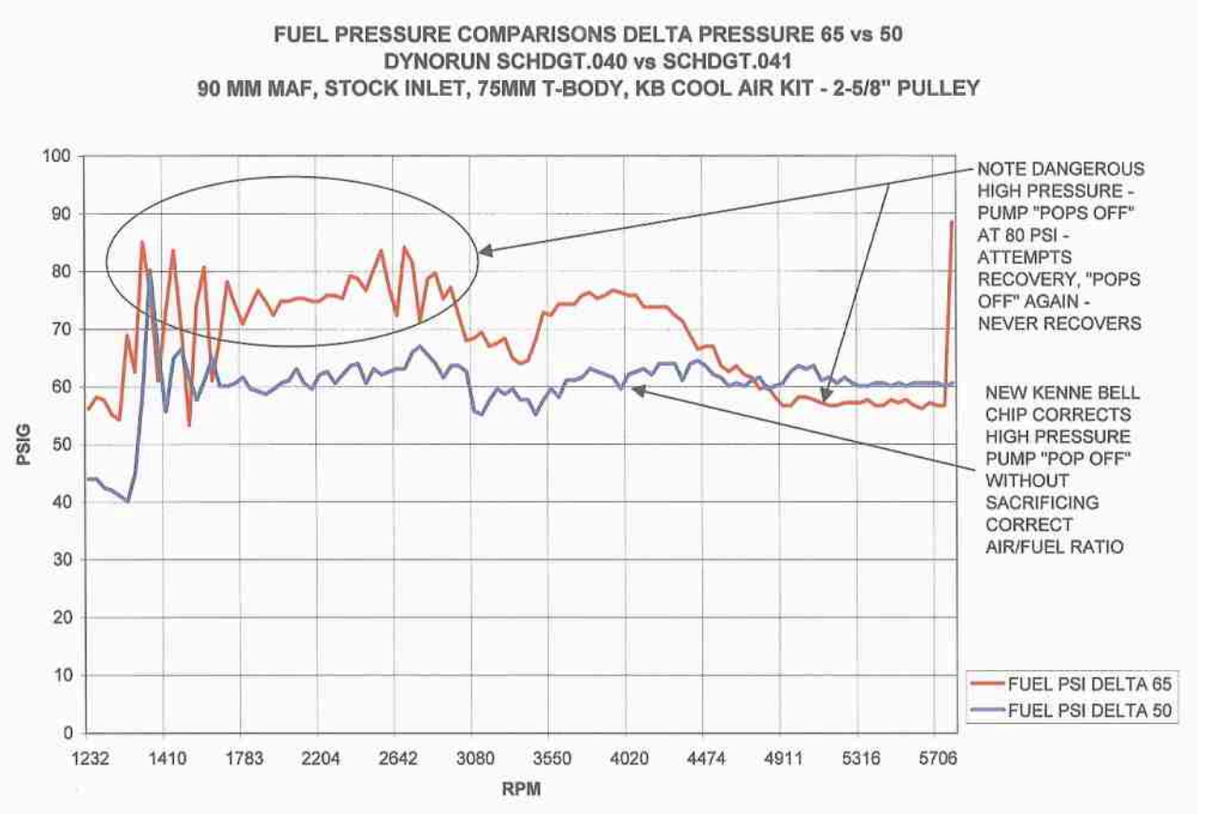
"1 octane will support an increase of 2/3 (two thirds) psi boost, 3/4° (three quarters) timing, 20° ambient temp, 1/2 (one half) point in AF ratio, 1/4 (one quarter) point in compression and 30% humidity."

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**.

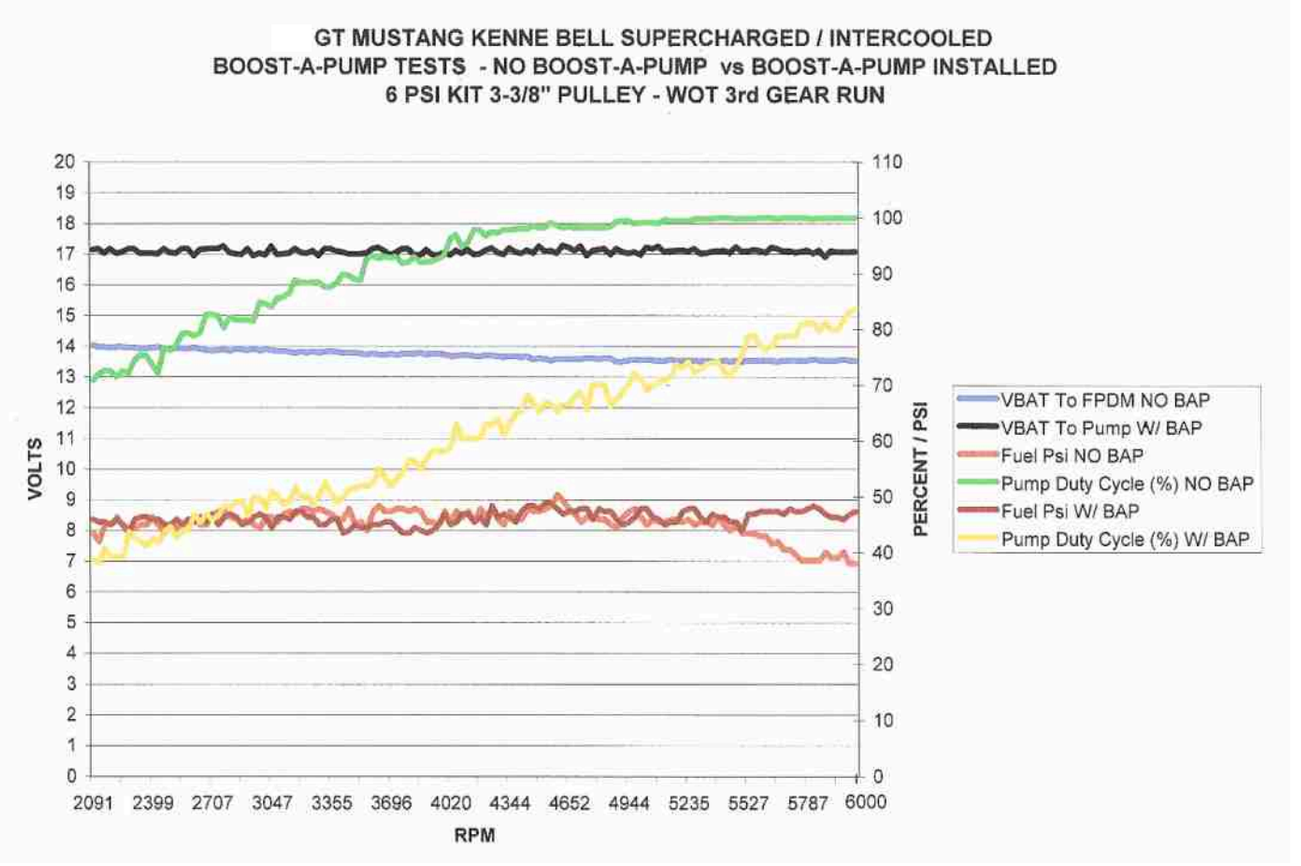
"After attaining IDEAL AF ratio and ignition timing, figure 1° = 7HP and 1 AF ratio = 8HP."

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.

Here's an example of why chip calibration, injectors, mass air meter and fuel pump must work in harmony for the 4.6. This is a dyno run with correct fuel calibration and a chip ***improperly*** calibrated (fuel pressure varies from 55-85 psi and "pops off" at 80 psi). Note how higher fuel pressure is not always better. *Question: Is this what happens when a larger pump is installed in lieu of a Kenne Bell BOOST-A-PUMP™?* Think about it.



RETURNLESS FUEL SYSTEMS - There is an abundance of theories and opinions on these systems. DO NOT let anyone remove or replace your BOOST-A-PUMP™. We believe the Kenne Bell BOOST-A-PUMP™ is unquestionably the best approach to increasing fuel delivery on a Ford returnless system. The Kenne Bell data logged graph below is undeniable proof of what happens to a stock pump and how the BOOST-A-PUMP™ overcomes insufficient fuel delivery. Take the case of our new 4.6 2V Mustang GT kit. We replaced the stock 4.6 19lb injectors with 36's, tapped in on one wire, added the BOOST-A-PUMP™ and supported 507HP with the stock pump. We didn't even raise fuel pressure. And the BOOST-A-PUMP™ had at least another 50HP of capacity left (557HP). So do you really need to drain the fuel, remove the tank, replace the stock pump and add larger fuel lines and rails that aren't necessary? That's a lot of complexity, work and labor cost. Good for the mechanic, but not for you. To help you better understand how the Kenne Bell BOOST-A-PUMP™ works, you may want to study the data logged tests on the 4.6 507HP Mustang. Note: Our Stage 1 and Stage 2 Kits are now equipped with 39 lb injectors (550HP) and is rated at 600HP with the BOOST-A-PUMP™.



PUMP DUTY CYCLE - First of all, note how the stock pump was maxed our at around 4100 rpm with only 6 psi and 351HP. The pump duty cycle (green) is 100%. It's no longer cycling. That means it's all used up. The pump clearly cannot produce any additional fuel. With the BOOST-A-PUMP™ added (yellow), the duty cycle is only 80% and the injector pulse width has backed off from it's 100% duty cycle. Adding our BOOST-A-PUMP™ and 36lb injectors increased HP potential to 507HP.

VBAT (VOLTAGE to PUMP) - The stock pump voltage is 13.5 (blue). The BOOST-A-PUMP™ increases the voltage to 17 volts (purple). That is how we up the stock pump capacity (remember the "myth" about voltage).

FUEL PRESSURE - As can be seen from the comparison between the "Fuel PSI NO BAP (orange)" and "Fuel PSI W/BAP (red)", the stock pump is in real trouble and drops off dramatically at 5500, even with only 6 psi and 351HP. At this point, the EEC is commanding a given 11:1 AF ratio. Both the fuel pump and injectors are at 100% duty cycle. There is insufficient flow from the pump so the pressure drops and the engine leans out resulting in damaged pistons. Needless to say, it would get much worse at a higher power level than 351HP and 6 psi. Fuel pressure would then drop at a lower rpm and lower pressure. Conclusion: Use a BOOST-A-PUMP™ on any modified 4.6 that exceeds 300HP.

OTHER PRODUCTS - A Kenne Bell Flash Tuner is included in all our 4.6 3V kits. It is calibrated to our injectors and should not require any re-calibration up to 550HP or 5 volts. Meter pegs out at 5V. However, Kenne Bell can't possibly have all the answers all of the time about everyone else's products - or how a vehicle or it's components are modified. Case in point: We caution any Kenne Bell customer who changes mass air meters without re-calibrating the chip. In a properly calibrated chip, the mass air meter compensates for the additional power/air flow by increasing injector pulse width (fuel flow). Once the injector is maxed out, it must be upgraded and the chip re-calibrated for the larger injectors. At 600HP, we see the 39 lb Kenne Bell injectors are maxed because the engine begins leaning out from our calibrated 11:1 to 12:1. That is the "tuning limit."

THE LIMITS - The fuel injectors are not the only limiting factor on a stock block 4.6 3V. It's the stock rods and pistons. They simply weren't designed for ultra high horsepower. We recommend H-beam billet rods and forged 8:1 custom forged pistons like the Cobra has chosen. A slightly shorter rod length accompanied by a deeper dish piston that increases swept volume about 10cc would also lower CR a full point allowing 2 more psi boost on a given octane. There are companies who supply "built" short blocks. Check with them on their power ratings. Sean Hyland Motorsports supplies all our Ford test engines.

OCTANE - BOOST GUIDE (4.6 GT KIT)
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 25° 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 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 Torco Octane Booster. It adds 6-7 full octane (91-98) with 32oz in 20 gallons.

MINIMUM FUEL OCTANE	MAXIMUM RECOMMENDED BOOST	
	NON INTERCOOLED	INTERCOOLED
91	5	8
92-94	6	9-10
97 BLEND	8	11
100	10	14
105	12	17

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.

CALIBRATION - Although Kenne Bell kits offer huge performance gains at any rpm, the driveability and factory feel is retained. Kenne Bell does not rely on chip companies for our calibrations. We've done 100% of our cals and tuning in house since 1991 with our own company owned vehicles. The cal (tune) is an integral part of our kit. Expensive "custom tunes" or re-tuning is not necessary or recommended with our kits (see "Do I Need My Supercharger Kit Re-Tuned?").
http://www.kennebell.net/techinfo/general-info/Supercharger_ReTuned.pdf
All our kits are in house calibrated by Kenne Bell. A dual program POWER (Street) and SHOOT OUT (Competition) is optional at additional cost. The "Shoot Out" cal is optimum and stabilized ignition timing that is not retarded by elevated inlet or engine temperatures and 11:1 AF ratio. When in this program, the Traction Control light will be "ON" signifying the need for higher octane fuel. All kits are HP rated at 25° (optimum ignition timing) and 11-11.5 AR ratio. SHOOT OUT requires higher octane fuel to compensate for the aggressive ignition. Note: 1° of ignition advance typically requires 1 octane. 94 octane pump gas can run 3° more timing than 91 octane.

"RETUNING" - There are those who would like you to believe that all Mustangs are "different" and require their re-tuning. Believe what you want, but all Ford produced Mustangs use the SAME basic calibration. If these cars were truly "different" and required individual tuning, then Ford would need thousands of calibrators standing at the end of the assembly lines to re-tune the cars.
"The tuning requirements for an '05 up Mustang are only different if YOU make it different." Jim Bell
The two most common problems created by the "Kit Tweakers" or "Tuners":
① "Tuning" for a mechanical or electronic failure. If the sensor has failed or there is a vacuum leak, FIX IT. Never band aid or tweak the tune. Only idiots do this.
② Inlet system modifications and leaks that affect the engine's meter (mass air flow) readings. Meters control the amount of fuel the engine uses by accurately measuring air flow. Screw up this reading and you've screwed your fuel system. Refer to above Throttle Body, Aftermarket "Hot Air" Systems and 90MM Mass Air Meter and you'll see that some things in Kenne Bell kits are best left alone.

And if your dyno numbers don't match our advertised HP, do not "re-tune." Instead, look for the mechanical problem, installation problem, or for ANY "other" products that are installed on your car. See "Dyno Testing Variables."

There is a point where the meter pegs out (550RWHP), the injectors are maxed (600RWHP) or the pump must be upgraded (600RWHP). At that point, go to 60lb injectors and dual pumps with a BOOST-A-PUMP™. Do not under any circumstances allow a tuner - or anyone - to modify or circumvent (shut off) the built in software safety features of the electronic (drive by wire) throttle. These are safety features built into the Ford PCM that should not be de-activated.

INTERCOOLER (BAR & PLATE) - Our testing indicated the bar and plate type intercooler to be superior to the tube and fin. All Kenne Bell Mustang, GM and Hemi kits use the bar and plate as does the Ford Cobra, Lightning and Ford GT.

4.6 3V ENGINE - In 1996, we designed a kit for the 4.6. The '96-'98 engines were rated at 215-225HP. The '99-'04 was increased to 260HP and then the switch to the 3V in '05 and 300HP. Our kits are now able to increase power up to 277% (775 vs 279RWHP) WITHOUT headers, cams or heads. Today, the 4.6 Mustang is our most popular kit. It's quiet, smooth and will pin you to the seat at ANY rpm. And it won't leave you hanging with having to buy a bigger supercharger if you decide to bump up the power with heads, cams or a pulley change. Check out the Stage 1, Stage 2 and MAMMOTH™ Kit choices/

TROUBLE SHOOTING

3V 4.6 GT

THE ENGINE KNOCKS

Timing too high for fuel octane.
Solution: *① Drop boost 1 psi ② use higher octane fuel.*

Underhood exposed filter.
Solution: *GET RID OF IT.*

Aftermarket mass air meter.
Solution: *GET RID OF IT and get Kenne Bell 90mm and FLASH TUNE®.*

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 one heat range cooler.*

Vacuum leaks.
Solution: *Re-check installation. Vacuum or exhaust leaks - even pinhole leaks - hurt mileage, affect idle and part throttle driveability. Must be diagnosed with a Smoke Tester.*

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. However, timing can and does affect dyno HP numbers.

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 new GT'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 cal “locks” the sensors so they do not retard timing at higher inlet and engine temperatures.

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 Flash Tune 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 higher boost and fuel octane. After 500HP, a new re-calibrated 90mm meter is a must as the meter will be pegged and can no longer calibrate the fuel delivery.

WHAT NOT TO DO

For a more complete list of areas to avoid, see Kenne Bell “What NOT to do” on our website at: http://www.kennebell.net/techinfo/general-info/WhatNotToDo.pdf