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LIGHTNING STRIKES TWICE

Kenne Bell’s new 2.6L Big Screw blower ensures your Lightning continues to strike the competition.

BY RICHARD HOLDENER

The supercharged Lightning and Harley-edition trucks continue to be popular among performance enthusiasts and racers alike despite being out of production with no replacement in the foreseeable future. What’s not to like about a truck equipped with a 5.4L modular motor sporting factory forced-induction?

Naturally the highlight of the 5.4L motor is the fact that it sports a positive-displacement

The new big-bore 2.6L supercharger from Kenne Bell is both larger and more efficient than the factory Eaton Roots blower. In fact, it is both larger and more efficient than the old 2.4L Twin Screw supercharger from Kenne Bell.
supercharger. For a heavy application (not that Lightning-owners use their vehicles for heavy towing), the immediate boost response offered by a positive-displacement supercharger makes for tremendous throttle response and impressive torque production. Stick your foot into the throttle of a supercharged 5.4L Lightning motor, and just watch the boost gauge rip into the fun zone. All that boost means you are also immediately rewarded with a surge of torque, allowing the multi-ton truck to rip off some impressive quarter-mile times, to say nothing of embarrassing some pretty respectable performance street-machines. Here at FPT, the Lightning trucks impressed us in stock trim, but what really makes them great is the way they respond to modifications.

Given the fact that the 5.4L Lightning motor was equipped with a factory supercharger, it only seems natural that the best route to improved performance is with increased boost pressure. True enough, increasing the boost pressure to the 5.4L Two-Valve motor can be accomplished by increasing the blower speed relative to the motor. This is a simple matter of decreasing the size of the blower pulley and/or increasing the size of the crank pulley. Since the amount of airflow supplied by the blower is a function of the size or displacement of the blower combined with the rotor speed, increasing the speed of the blower provides more boost.

As with all good things, there is a limit to just how much you can crank up the boost. Despite the use of a highly efficient factory air-to-water intercooler system, increasing the boost pressure of the Eaton Roots-style blower will dramatically increase the in-let-charge temperature. This substantial and non-linear increase in inlet temperature illustrates the fact that the Roots blower becomes considerably less efficient at elevated boost and blower-speed levels. Eventually you will run into the proverbial brick wall, and the blower will only provide more boost at lower engine speeds but will provide nothing but increased inlet temps (and no extra power) at the top of the rev range.

The cue to the lackluster-boost blues is to replace the Eaton supercharger with a more efficient design. When a manufacturer goes looking to produce thousands of supercharged vehicles, the combination of available power, immediate boost response, and most importantly, cost make the Roots blower very attractive. Unfortunately, the low production cost means little to the performance enthusiast looking to make big power. While the stock Eaton supercharger will provide impressive performance, taking things to the next level requires replacing the Eaton with either a larger Roots blower or better yet, a larger and more efficient twin-screw supercharger.

In order to increase the displacement of its new Twin Screw supercharger, Kenne Bell bored out the blower case and stuffed larger, redesigned rotors, or screws, inside.

In addition to the larger and more efficient supercharger, the 2.6L blower upgrade for the Lightning also came with a revised side-mount inlet manifold.

Before beginning the test, the gang at Kenne Bell drilled and tapped the blower manifold for both boost pressure and inlet charge temperature before the intercooler.

Every time we test with Kenne Bell, we are amazed at the extensive array of data logging equipment. It is absolutely necessary to monitor the air/fuel and timing curves along with all the other pertinent data when comparing different superchargers.
It is tempting to simply state that when it comes to a positive-displacement supercharger, bigger is better, but as always, there is more to the equation than sheer size. It is true that a larger supercharger offers more airflow and boost potential, but that doesn’t mean you should install one of these 2.6L Kenne Bell blowers on the 2.0L Zetec motor in your Ford Focus. Like all blowers, the twin-screw supercharger should be sized according to the motor. This is why Kenne Bell offers more than just one blower size. Their current offerings range from 1.7Ls all the way up to the mammoth 2.8L version destined for the Four-Valve Cobra, 5.4L Shelby, and 5.4L Ford GT motors. Our tests were run on the 2.6L-blower upgrade designed for the 5.4L Lightning motor.

Compared to the stock Eaton Roots-style supercharger, the new 2.6L Twin Screw blower from Kenne Bell offers both increased displacement (and therefore airflow and boost potential) and improved efficiency thanks to the twin-screw design. As an added benefit, they have made the beefy 2.6L blower fit where the smaller Eaton once resided. This was accomplished with a bored blower case and larger screws (not unlike increasing the bore of your motor). The result is a sizable increase in internal blower displacement without much of a penalty in external physical dimensions. Though the case is slightly taller and wider than the original Autorotor blowers employed by Kenne Bell, the change in external dimensions are minor enough to allow the larger blower to fit nicely in the stock engine compartment.

You will notice from these photos that the new 2.6L. Lightning kit also includes a revised inlet manifold. Gone is the top-feed factory inlet system, replaced by a side-mount similar to the kit used on the 4.6L Four-Valve Cobra. Since all positive-displacement blowers are ultra-sensitive to inlet restrictions, Kenne Bell knew that the 2.6L blower would only work well if it had an unrestricted source of intake air. The side-mount inlet is designed to accept a stock or aftermarket (Kenne Bell or Accufab) throttle body.

The increased displacement and inherent efficiency of the 2.6L Twin Screw supercharger makes for an impressive package on paper, but just how would it stack up on the dyno? Having run a number of twin-screw-blower tests in the past (most recently on the now-departed Project RHSC in our sister magazine, Muscle Mustangs & Fast Fords), I knew what to expect when comparing the Twin Screw to the stock Eaton. What I didn’t know was how the new 2.6L blower would stack up against the earlier and smaller 2.4L blower.

Testing the new Kenne Bell 2.6L Lightning blower also gave me the opportunity to run a direct back-to-back test on a ported Eaton.
supercharger. This is one of the tests I hoped to put in my book on Modular performance but was unable to include due to time constraints. While stories purporting the power potential of the ported Eaton superchargers run rampant on the always-accurate Internet, like always I let the dyno illustrate the actual merits of the modifications performed to the stock blower. Porting the stock blower seemed like a good idea on the surface. After all, more flow equals more power, right? As is often the case, the reality turned out to be otherwise.

What started out as a simple test between the stock Eaton supercharger and the new 2.6L Kenne Bell turned out to be a four-blower shootout between a pair of Eaton's and a pair of Kenne Bell blowers. You know how we do it here at FPT: The more blowers we get, the happier we are. The idea behind the test is to compare the ported Eaton, the old 2.4L Kenne Bell, and the new 2.6L Kenne Bell to the baseline runs put down by the stock Eaton supercharger. While this all sounds pretty straightforward, there are many variables to consider when running this kind of test. Lucky for us, the gang at Kenne Bell was nice enough to lend a hand and provide access to their chassis dyno, air/fuel, and data logging equipment. In addition, they also dialed in the air/fuel and timing curves and locked out the effects of the ACT and ECT sensors to ensure we had identical air/fuel and timing values for each of the superchargers. Testing a modern computer-controlled motor on the dyno requires such measures or you can all but throw out the generated data. When just a few degrees of timing can add 10-15 hp, how can you go looking for a power gain of 10 hp when the motor isn’t that repeatable? With full control over the variables, this supercharged 5.4L was dead repeatable run after run.

To illustrate the power differences offered by the different superchargers, we decided to equip each blower with the identical 2.75-inch supercharger pulley. Running the same blower pulley, air/fuel ratio, and timing curve shows just how much more power each blower configuration was really worth. I hate it when someone tells me that you have to speed up the blower in order to take advantage of the modifications. Speeding up the blower will result in more boost, which is almost always going to result in more power. We know more booster speed will deliver more power, but what happens when you just run a back-to-back test at the same booster speed? This really shows the efficiency (or more accurately, airflow potential) of the blower in question.

The first order of business was to run the 5.4L Lightning motor with the stock Eaton supercharger. Equipped with the 2.75-inch

The 5.4L was also equipped with both a Boost-a-Pump and Boost-a-Spark to ensure adequate fuel deliver (for over 500 wheel hp) and a hot spark.

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**Stock Eaton vs. Ported Eaton (2.75 Blower Pulley)**

This was an interesting test, and one that I have wanted to run since completing my book on Modular performance. I have heard much discussion on the “ported” Eaton superchargers but never got a chance to test them on a Lightning or Cobra motor. Though the concept is sound, the application must be spot-on to produce any significant power gains as there is much more to a supercharger than simply airflow (sound familiar?). The inlet and outlet discharge of the supercharger actually rely on port timing to produce effective boost and flow. Alter this timing with porting and you might just upset the balance, the result of which will be a decrease in power.

This is exactly what happened with the ported blower we tested on the supercharged 5.4L in the Harley Davidson truck. Porting the Eaton supercharger actually decreased the power production of the motor from 1,500 rpm all the way to 5,400 rpm. Only past that point did the ported version of the blower improve the power output and only by the slightest of margins. Elsewhere along the curve, the torque production was down by 35-40 lb-ft despite the use of identical 2.75-inch blower pulleys.
blower pulley and factory crank pulley and a modified inlet system (Kenne Bell cold-air), the Two-Valve 5.4L motor produced 385 hp and 456 lb-ft of torque at the wheels with a peak boost pressure of 10 psi. Torque production from the supercharged mod motor exceeded 400 lb-ft from 2,000 to 5,000 rpm. No wonder these Lightning trucks haul ass.

After back-up runs that repeated within a horsepower or two, we swapped out the factory Eaton supercharger for the ported version. The idea behind the porting is to enhance the flow rate of the factory blower. This is especially important when running near the absolute flow limit of the stock supercharger. While it stands to reason that the porting should improve the flow potential of the supercharger, the shape of both the inlet into and discharge out of the Eaton supercharger is critical for boost production.

Much like cam timing in a four-stroke motor, the port timing in the supercharger controls boost production. Haphazardly alter that port timing and you take a serious chance on decreasing rather than improving the flow rate. This is exactly what happened when we tested the ported Eaton supercharger. While the ported supercharger ultimately improved the peak power output by a measly 3 hp, the ported blower actually lost power from idle to 5,000 rpm. Though we registered a slight gain of maybe 5-7 hp past 5,000 rpm, torque production was down by a solid 35-40 lb-ft through most of the rev range. This test clearly illustrates what can happen when the port timing is altered on a Roots blower.

Naturally, we hated seeing a power loss instead of a gain when testing the ported Eaton supercharger, but things were about to look up. As with both the stock and ported Eaton superchargers, the Kenne Bell 2.4L blower was equipped with a 2.75-inch blower pulley (and stock crank pulley). The timing and air/fuel curves remained the same as the two previous blower tests, so the only thing that changed was the installation of the Kenne Bell 2.4L supercharger.

Having run this test before, we expected and were rewarded with substantial power gains over the factory Eaton supercharger. The larger and more efficient Twin Screw supercharger offered a sizable jump in power, from 385 hp and 456 lb-ft of torque to 461 hp and 517 lb-ft. The Kenne Bell Twin Screw blower added not just peak power, but impressive power gains throughout the rev range (1,500-5,500 rpm). Equipped with the Kenne Bell blower, the 5.4L Harley motor

Next up was a ported version of the stock Eaton supercharger. The porting was performed to improve the flow potential of the Roots blower, but care must be taken as the porting also affects port timing.

The ported Eaton was also equipped with the same 2.75-inch pulley, but unfortunately the power output was down from 1,500 rpm to 5,000 rpm compared to the stock blower. Only near 5,400 rpm did the ported blower improve the power output and then only by just a handful of horsepower.

Stock Eaton vs. Kenne Bell 2.4L (2.75 Blower Pulley)

While we have run this test before, the power gains offered by a Kenne Bell Twin Screw supercharger never fail to impress us. Equipping both blowers with the same 2.75-inch blower pulley, the motor was run with the same air/fuel and timing at the same temperature. To further ensure accurate test results, timing and fuel trims based on ECT and ACT were eliminated, and the tranny was locked in gear. This ensured that all power gains were the result of the new supercharger rather than a change in timing and/or air/fuel mixture (as is often the case when running a computer-controlled motor without concern for such variables). Equipped with the stock Eaton supercharger, the 5.4L produced 385 hp and 456 lb-ft of torque at a peak boost level of 10 psi. Replacing the Eaton Roots blower with a 2.4L Kenne Bell Twin Screw resulted in a jump in peak power to 461 hp and 517 lb-ft of torque. Running the same 2.75-inch blower pulley, the more efficient (and larger displacement) Kenne Bell Twin Screw increased the peak boost pressure to 15 psi.
produced a peak boost pressure of 15 psi and managed to exceed 500 lb-ft of torque from 2,900 to 4,500 rpm. As you might imagine, 500 lb-ft of torque is serious business in a street truck, but we were just getting started.

After running the 2.4L twin blower upgrade for the 5.4L, we swapped on the new 2.6L blower system. In addition to the big-bore Kenne Bell supercharger (no longer manufactured by Autorotor), the 2.6L Lightning kit also includes a revised inlet manifold into the blower. Gone is the factory top-feed inlet, replaced by the side intake manifold (similar to the system employed on the 4.6L Cobra kit). Since positive-displacement superchargers are so sensitive to inlet restrictions, Kenne Bell went to great lengths to ensure an uninterrupted supply of air for the larger supercharger. All the design work that went into the new 2.6L blower and inlet system was well spent, as the installation of the new big-bore blower upped the peak power numbers to an amazing 515 hp and 595 lb-ft of torque.

Imagine that: Replacing your stock Eaton (without changing pulley sizes) can provide an extra 130 hp and 140 lb-ft of torque.

Though the peak power gains are impressive, the fact that the new 2.6L blower offered over 100 lb-ft of torque at just 2,000 rpm speaks volumes about how much fun this combination will be on the street.

To further illustrate that the new Kenne Bell Twin Screw is not just bigger but also more efficient, we ran a series of tests on the inlet-charge temperature. The stock Eaton, ported Eaton, and new Kenne Bell 2.6L blower were all configured to produce a peak boost pressure of 10 psi. Running the same boost pressure allows us to data log the discharge temperature. The higher the temperature coming out of the blower, the lower the efficiency. Basically, you want the blower to heat the air as little as possible.

Testing before the intercooler showed that the air exiting the stock blower at 10 psi reached 215 degrees. The ported blower was slightly less at 212 degrees, but the real winner was the Kenne Bell blower at just 185 degrees. Being bigger and better, it looks like Lightning can strike twice with the new 2.6L upgrade kit from Kenne Bell.

Each blower was run with the factory air-to-water intercooler.

Stock Eaton vs. Kenne Bell 2.6L (2.75 Blower Pulley)

While the 2.4L Twin Screw supercharger was indeed impressive, the reason we were here in the first place was to run the new 2.6L blower. When it comes to positive-displacement superchargers, bigger really is better. For each revolution, the positive-displacement supercharger delivers a fixed amount of air. Increase the displacement without decreasing the pumping efficiency and you increase the airflow and boost to the motor. With all the variables accounted for (timing, temperature, and air/fuel all remained identical), the new 2.6L Kenne Bell Twin Screw upped the power output from 385 hp and 455 lb-ft of torque to an amazing 515 hp and 595 lb-ft of torque. Naturally the peak boost rose to 19 psi, further illustrating the tremendous potential of the new Kenne Bell 2.6L blower.
After running the ported stock Eaton supercharger, it was removed to make way for the 2.4L Twin Screw from Kenne Bell.

On went the 2.4L Kenne Bell blower along with the factory intake manifold and dual-blade throttle body.

The Kenne Bell blower was equipped with a 2.75-inch blower pulley to match the previous blower.

Equipped with the 2.75-inch blower pulley, the Kenne Bell upped the power output from 385 hp and 456 lb-ft to 462 hp and 517 lb-ft of torque. Despite the use of the same blower pulley, the boost jumped from 10 psi with the Eaton supercharger(s) to 15 psi with the Twin Screw.

Though larger in displacement compared to the older 2.4L, the new 2.6L blower offered similar external dimensions.

Equipped with the new 2.6L blower (running the same 2.75-inch blower pulley), the 5.4L motor produced 515 hp and 595 lb-ft of torque at a peak boost reading of 19 psi. This new 2.6L is a serious customer indeed.

Inlet Charge Temperature (Before Intercooler)
Stock Eaton, Ported Eaton, Kenne Bell 2.6L

Equipping all three blowers with pulley ratios to produce a maximum of 10 psi of boost, the resulting inlet-charge temperatures really demonstrate the superiority of the new 2.6L Twin Screw supercharger. Despite running near-identical boost pressure readings of 10 psi, the inlet-charge temperature of the stock Eaton Roots blower was 30 degrees hotter (from 185 degrees to 215 degrees) than the new 2.6L Kenne Bell Twin Screw. Note also that the ported Eaton produced hotter inlet temps than the stock Eaton up to 5,300 rpm. This coincides with the rpm where the ported Eaton finally caught up to the stock Eaton in terms of power.

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