Does a variable-cam mod motor really need performance cams? You'll be surprised at the power that can be gained!

Back to Bolt-Ons

Making 500-plus horsepower by camming a naturally aspirated Coyote crate engine

BY RICHARD HOLDENER » PHOTOS BY THE AUTHOR

LOOKING back at the two previous installments of "Mods for 5.0L Coyote Mods," we see that the Four-Valve motor has come full circle. Starting with a 5.0L Coyote crate motor (PN M-6007-M50) and complete Controls Pack from Ford Racing Performance Parts, we first applied a few simple bolt-ons, then went whole-hog in Part 2 with boost from a Kenne Bell supercharger.

The FRPP crate motor was essentially a stock 5.0L destined for a '11 Mustang GT. The Controls Pack included ECU and wiring harness, MAF and air intake system, factory airbox, OBD-II diagnostic port, drive-by-wire throttle, and a complete calibration.

« Our bolt-on bonanza started with a quartet of Comp Cams. The dual-pattern Stage 2 NSR cams (PN 191100) featured a 0.492/0.453 lift split, a 228/231 duration split at 0.050, and adjustable lobe separation angle. Swapping four cams may sound intimidating, but the instructions provided by Comp Cams make the cam swap a no-brainer.

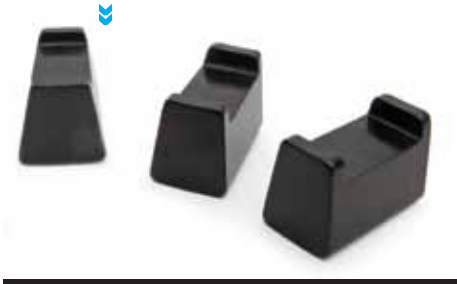
Run on the dyno in as-delivered trim, the motor produced 448 hp and 405 lb-ft of torque. Headers increased this to 462 hp and 411 lb-ft, while a small shot of Zex nitrous pushed things to 554 hp and 540 lb-ft of torque. Adding the supercharger resulted in 704 hp and 549 lb-ft of torque at just under 10 psi of boost. Equipped with the KB, the killer Coyote was impressive indeed, but off it came to make way for our trip back to bolt-ons.

Given the impressive performance of the 5.0L Coyote, we decided to get our hands dirty and dig into the hard parts, namely the camshafts. Unlike previous Four-Valve mod motors, the Coyote was blessed with variable cam timing on both the intake and exhaust cams. The previous 4.6L Three-Valve also featured variable cam timing, but the intake and exhaust were not adjustable independently. The ability to advance and retard cam timing greatly improved average power production, but the factory Coyote cams were still on the mild side for maximum power.

Knowing the stock heads flowed nearly 300 cfm, it seemed like the Coyote was begging for wilder cam timing to take full advantage of all that wonderful airflow. Leafing through the Comp Cams catalog, we came across the perfect set for our otherwise stock motor.

Not wanting to change valvesprings, we selected a set of (PN 191100) Stage 2 NSR cams (no springs required) that offer a 0.492/0.453 lift split, a 228/231 duration split at 0.050 and a 126-degree lobe separation angle (with cams fixed—this was obviously adjustable). These compare to a 0.472/0.433 lift split, 211 degrees of duration (both intake and exhaust) and a 131-degree

The NSR cams require phaser limiters, which provided physical stops to limit the amount of cam travel offered by the variable cam system. Limiting the cam phasing by 50 percent provided the necessary piston-to-valve clearance.



LSA for the stock cams.

There has always been a certain apprehension among enthusiasts when it comes to cam swaps on mod motors. The overhead design has many spooked, but the reality is that it is no different (or difficult) than a cam swap on a conventional motor. The installation instructions provided by Comp for both the phaser limiters and NSR cams made things even easier—even for the first timer (which we were).

Though we had plenty of experience with mod motors, this was our first adventure ripping into a new Coyote. Installation of the Stage 2 NSR cams required use of phaser limiters. The limiters were needed to reduce the amount of cam phasing from 50 degrees to 25 degrees. The reason for limiting the adjustable cam timing was to maintain proper piston-to-valve clearance. The clearance is not an issue with mild factory cams, but the system limits how aggressive you can go on cam timing with aftermarket performance grinds. The majority of the variable cam timing is done at idle, cruise, and part-throttle, as cam adjustment at WOT is considerably less than the available 50 degrees. Thus, the phaser limit-

Our test mule was a Coyote crate motor supplied by Ford Racing Performance Parts. FRPP also supplied the Controls Pack that included the necessary components to get the crate motor running. After adding long-tube headers from American Racing Headers, the 5.0L produced 462 hp and 411 lb-ft. This served as our baseline for the cam test.

Off came the factory damper, Meziere electric water pump, and front cover to allow access to the timing chains, tensioners, and cam phasers.

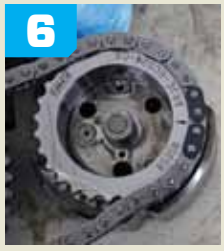
These are the magic cam phasers that allowed the cams to rotate independently of the sprockets. The three center bolts secured the phasers to the cams, while the outer Torx bolts secured the cover plates on the phasers.

It was necessary to remove the cover plates to install the phaser limiters. Note the small spring and star-shaped plunger. Make sure not to lose these when removing the cover plates and that they are in place after installation of the limiters.

The kit included four phaser limiters, one for each head. The limiter was installed in the opening between the inner and outer sections of the phaser directly below the star-shaped plunger (arrow).

ers allow 5.0L Coyote owners to run performance cams with increased lift and duration without fear of piston-to-valve contact. It was (of course) necessary to adjust the software to reflect the limited cam travel, but SCT software allowed us to dial in all of the many variables on our modified test motor.

Check out the photos for details on the install, but note it was much



After installation of the limiters, the two phasers (for each side) can be removed as a pair, including the secondary chain. The detailed instructions describe where the cams and crank sprocket should be positioned before removal. After removal of the three retaining bolts (per cam) and depressing the tensioner (easier with two people), the pair of phasers were removed as one complete unit. Note the timing marks on the sprocket and secondary chain as well as the cam dowel. Installation was very easy.

With our cam phasers off, we slowly removed the cam towers, then with all the bolts loose, we used the electric gun to spin them the rest of the way off. They must be removed a half turn at a time to evenly release spring tension from the cam and towers.

With the towers removed, off came the factory cams. Though equipped with variable cam timing, the stock cams were pretty tame.

less difficult than we imagined. Once equipped with the new cams, we employed the SCT software to dial in the air/fuel mixture, and ignition and cam timing. Given the complexity and sheer number of drop-down menus on the factory computer, great care must be taken to ensure repeatable back-to-back runs. Ignition timing changes (for instance) required changes to every one of the 32 different ignition tables. The data logging was a valuable tool to ensure both cam and ignition timing remained constant for all of the testing.

After swapping the cams, the motor fired up instantly (always a good sign), then (after tuning) produced 498 hp and 441 lb-ft of torque. That represented gains of 36 hp and 31 lb-ft of torque, though the cams sacrificed small torque losses (15 lb-ft) below 3,900 rpm. Given our limited dyno time, it is possible that we may have been able to tune some of those losses back out, but even those were a small price to pay for the impressive gains through the rest of the rev range.

After running the cam test, it dawned on us that the Coyote was still equipped with a stock airbox. Given that an air intake is usually one of the first modifications made to a

Prior to installation of the Comp NSR cams, we liberally coated them with assembly lube.

As with removal, the cam towers were installed slowly, a half turn at a time, then torqued in place using the instructions supplied with the cams. It should be noted that the cam-tower bolts were one-time use and designed to be replaced (don't tell Ford-we reused the old ones).

The new cams featured the necessary indicators for the cam position sensors. After installation of the cams, on went the cam phasers (one bank at a time) followed by the timing chains and tensioners.

Once the phasers were in place, we lined up the crank and cam sprockets with the appropriate (colored) links on the timing chain.

It was necessary to depress then lock the tensioners prior to installation. Using a vice, we employed a small Allen wrench to lock the plunger in place.

Here is a shot of the completed cam install with the phasers, timing chain, and tensioners all in place. After rotating the motor to ensure everything was happy and in its proper place, we installed the front cover, damper, and water pump.

new 5.0L Mustang, it seemed only natural that we replace the stocker on our killer Coyote. JLT Performance was kind enough to supply an air intake system for the new Mustang.

The air intake featured a molded plastic air tube that easily out-flowed the stock box thanks to a sizable change in inside diameter, a gentle radius, and use of a free-flowing air filter. The combination was easy to

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Cam installation required programming to optimize performance. A big thanks goes to Ken Christley at Kenne Bell for his help. Once the tune was finalized, it was supplied to the hand-held unit for loading in the factory computer. The X3 Power Flash from SCT was also used to data log the variables during each run. That data was used to facilitate further tuning.

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Run with the new Comp Stage 2 cams, the 5.0L Coyote produced 498 hp and 441 lb-ft of torque—up from 461 hp and 410 lb-ft. Those are serious gains from a simple cam swap.

install, but required tuning for optimized performance. Once installed, the motor produced 515 hp and an amazing 450 lb-ft of torque (an impressive specific torque output given the displacement).

Having bested the 500hp mark in normally aspirated trim, we starting thinking about what it might take to reach 600 hp. After all, we have ported heads, wilder cams, and even different intake manifolds yet to try. After that, we look forward to more boost with a turbo system, then possibly a forged rotating assembly, and even an increase in displacement. Stick around—our Killer Coyote is just getting started.

Sources

Comp Cams
901/795-2400
ww.compcams.com

Ford Racing Performance Parts
www.fordracingparts.com

JLT Performance
575/335-1940
www.jlttruecoldair.com

SCT
407/774-2447
www.sctflash.com

> **Once installed, the motor produced 515 hp and an amazing 450 lb-ft of torque.**

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Next up was a new air intake from JLT Performance. The air intake system featured a molded intake tube, high-flow air filter and the necessary couplers and clamps for installation. The molded intake tube even featured provisions for the factory PCV hoses.

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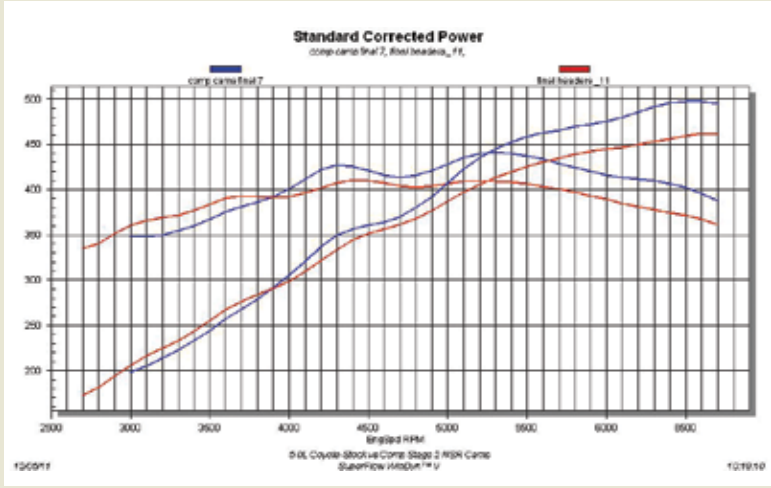
Airflow testing indicated that the stock 80mm throttle body flowed 957 cfm compared to just 772 cfm for the factory air inlet system. If anything was restricting the airflow, it was definitely the air intake system. Given the change in tube diameter from stock to JLT, it was necessary to alter the MAF scaling to properly tune the engine. After dialing in the air/fuel, we were rewarded with 515 hp and 441 lb-ft of torque. That is serious power from a stock 5.0L equipped with cams, headers and an air intake.



FORD RACING 5.0L-STOCK VS. COMP STAGE 2 CAMS

The graph illustrates that the Comp Stage 2 cams offered some serious power gains. The cam swap increased the power output from 462 hp and 410 lb-ft of torque to 498 hp and 441 lb-ft of torque. There was a slight drop in power below 3,900 rpm, but we feel tuning may have reduced or eliminated the losses altogether. The big gains from 4,000 rpm to 6,700 rpm (and beyond) more than offset the small losses.

STOCK VS. JLT AIR INTAKE

After swapping the cams, we realized that the factory air box was still in place. We suspect the gains offered by the cams may have been even greater had we installed the air intake first. Regardless, installation of the JLT air intake in place of the factory air box netted sizable gains for such a simple bolt on. The JLT air intake improved the power output from 498 hp and 441 lb-ft to 515 hp and 450 lb-ft of torque. How cool is a 5.0L motor that pumps out over 500 hp (normally aspirated)!