

Subject: Ford 4.6L/5.4L 3 Valve engine cam phasers (VCT), how they work, their limitations and how COMP Cams® uses them to make more power

What are cam phasers?

Ford's cam phasers are specially designed, computer-controlled cam gears that have the ability to adjust camshaft position (centerline – advance or retard) while the engine is running. They are used on all 2005 and newer, Ford 3 Valve Modular engines. Since the Modular 3V engine uses two camshafts, one phaser is required for each camshaft - two cam phasers per engine.

How do they work?

Engine oil is pressure fed through a series of passageways in the cylinder heads and camshafts, then out into the cam phasers. The engine computer controls a pair of solenoids that adjusts this oil flow through a series of chambers inside the cam phaser. Located inside these chambers are vanes, attached to a free-floating central hub. The hubs are directly attached to the camshafts, and as oil is allowed into and out of these chambers, the position of the cam can be retarded up to 60 crankshaft degrees.



Why did Ford use cam phasers with this engine?

Ford's primary reason for using cam phasers was to increase the engine's efficiency by reducing its pumping losses during part throttle cruise conditions. Basically, when the cams are retarded 20-40 degrees during part throttle engine operation, it takes less power to turn the engine over. This not only helps to increase the engine's fuel efficiency, but an additional power benefit is also realized. The variable cam phasers allow the camshafts to be adjusted to the proper position for maximum power during wide-open throttle operation regardless of the current engine rpm. This results in an engine that makes more torque and horsepower and extends the high rpm power-band by an additional 800-1000 rpm.

Why should I modify the cam phasers with COMP's Cam Phaser Limiter Kit (#5449)?

If there is a downside to the cam phasers as designed by Ford, it is that they cover a wide range of timing movement. Since the cams can theoretically be retarded by up to 60 degrees, the piston-to-valve clearance is very tight, limiting us to fairly small aftermarket performance cam profiles with very little overlap - not the best conditions for making maximum power or achieving an aggressive idle sound.

What does the COMP Cams® Cam Phaser Limiter Kit do?

COMP's Cam Phaser Limiters replace the stock plates on the backside of the factory cam phaser. The COMP Cams® Cam Phaser Limiter Plates are made with posts that extend into the cam gear's oil chambers – in contrast to the flat plate used by the factory. These posts take up the excess volume that would normally be used by the factory cam gear for extended phaser timing movement. By installing COMP's Cam Phaser Limiters, the cam design choices open up, allowing you to install big, powerful camshafts and retain safe piston to valve clearances. At the same time, by keeping up to 20 degrees of phaser movement available, all of the wide-open throttle benefits of the cam phasing can be retained, since the normal maximum retard the cams see at wide-open throttle is only around 9 degrees.

Why can't I just reprogram the ECU to limit cam phaser movement?

Since Ford's factory engine computer is fully programmable, the question arises as to why you can't simply program in cam phaser limitations and not bother with mechanically limiting the cam phasers? Theoretically you could do that, but a problem arises if something happens that would cause the engine's rpm to shift faster than the cam phaser controls can react. For example, if you ever missed a shift, broke a driveline part, did a clutch dump on a sticky set of slicks, or anything that could, for a split second, cause the cam phasers to get out of their programmed limits, the valves could crash into the pistons. By mechanically limiting the maximum movement of the cam phasers, total engine safety is assured regardless of the performance level/specs offered by the camshaft.

Why can't I just mechanically pin/lock the cam phasers?

While you certainly can do that, you are basically taking a step back in terms of making maximum power with your engine. If you lock the camshaft phasers in place, you will typically lose at least 20 hp or 20 ft. lbs. of torque, depending on the degree settings for your camshafts. The main reason so much power is lost is due to the fact that when you lose the ability to retard the cams at high engine speeds, there is a tremendous reduction in power producing airflow. The VCT (variable cam timing) technology is an incredible step forward in delivering both optimum torque and horsepower – a combination performance cam designers have always dreamed about. Why would you pass up the added performance this technology affords by locking it out?

What is included in the COMP Cams® Cam Phaser Limiter Kit?

The Cam Phaser Limiter kit is a fully engineered solution for your engine. Included in the kit are two cam phaser limiter plates, special tools for factory cam phaser disassembly and easy-to-follow, step-by-step photo instructions that not only cover installation but proper engine tuning guidelines.

**Do I have to reprogram my computer after installing the Cam Phaser Limiter Kit?**

Yes, you **MUST** have your engine's computer reprogrammed for the engine to operate properly after installing the COMP Cams® Cam Phaser Limiters. Upon initial engine start up, the Ford factory computer does a diagnostic sweep test of the cam phasers. If the computer cannot get the cam phasers to reach their programmed maximum limit, an error mode occurs. The engine will continue to run in the "limp mode" and the cam phasers will not function properly. The guidelines for reprogramming are simple; just make sure that the maximum retard amount entered for any of the cam phaser tables in your tuning software does not exceed 20 degrees.

What camshaft profiles has COMP Cams® developed for the Phaser Limiters?

The Cam Phaser Limiter Kit unlocks the door to safely use much more powerful camshaft grinds. COMP Cams® spent a tremendous amount of engineering effort and dyno time to develop these designs for maximum power, torque and reliability. Three stages of cams are currently available for naturally aspirated engines, as well as three additional stages of cams specifically designed for blower-equipped engines. Along with these premier camshaft sets, a complete line of valve springs and retainers are available that round out the matched performance component package.