**Camshaft Installation Instructions**

A cam is a highly sophisticated, high performance part and requires a little bit of "TLC" during installation and break-in. This instruction sheet (Part #145) has been broken down into several categories so that it will be easy for you to use. Some of the topics may not apply, but all of the information will be very beneficial during your cam installation. For step-by-step visual detail, we recommend that you refer to our 35 minute instructional video, “The Proper Procedure to Install and Degree a Camshaft” (Part #190DVD). If you have any questions or problems at any time during your installation, please do not hesitate to contact the toll free CAM HELP® line at 1-800-999-0853 from 7 a.m. to 8 p.m. Central Time Monday through Friday and 9:00 a.m. to 4 p.m. on Saturday. You can also email us at camhelp@compcams.com

**Important:**

In order for your new COMP Cams® camshaft to be covered under any warranty, you must use the recommended COMP Cams® lifters and valve springs. Failure to install new COMP Cams® lifters and valve springs with your new cam can cause the cam lobes to wear excessively and cause engine failure.

**Installation:**

**Step 1:** Prepare a clean work area, and assemble the tools needed for the camshaft installation. We suggest you acquire an automotive manual to help you determine which items must be removed from the engine in order to expose the timing chain, lifters and camshaft. A good, complete automotive manual will save you time.

**Step 2:** Once the camshaft, lifters and timing chain are exposed, line up the timing marks on the timing gears by rotating the crankshaft (Fig. A). This will position the #1 piston at Top Dead Center (TDC). Next, remove the camshaft timing chain sprocket, the timing chain and the camshaft retaining plate, if equipped. Remove all lifters, and reinstall the cam sprocket to serve as a handle. Slowly and carefully, "roll" the camshaft from the engine. Excessive force is not required. If the camshaft does not come out easily, stop immediately. Look for obstructions, such as a fuel pump rods, distributor gears, etc. Do not force the camshaft. Something is holding it in the block.

**Step 3:** Once the camshaft is out, pull the bottom timing gear off the snout of the crankshaft. In many cases you will need a gear puller to remove the crankshaft sprocket. The bottom gear is usually an interference fit, which may make it difficult to remove without the proper tool. Be careful not to damage the threads in the end of the crankshaft.

**Step 4:** Now is the time to inspect all of the old camshaft related components (timing chain set, distributor gear, etc.) for abnormal or excessive wear. For example, using an excessively worn distributor gear with a new camshaft could result in severe engine damage. We recommend replacing the distributor gear for the best results. It is also critical that the old lifters be properly disposed of and new lifters installed. Your camshaft warranty will be void if old lifters are used.

**Step 5:** Remove your new COMP Cams® camshaft from its packaging. Inspect all lobes and the gear, making sure the camshaft is intact. Next, compare the stamped numbers on the end of the cam with the spec card, making sure this is the correct cam. It is a good idea at this point to lightly wire brush the distributor gear and clean the cam with mineral spirits or an equivalent solvent. Remember, during the installation process, the cleaner you keep your new components, the better chance you have of avoiding any type of failure during break-in.

Using the COMP Cams® Assembly Lube supplied with your cam, coat all lobes and the distributor gear. It is important to coat the lobes completely, yet not excessively. This same rule applies to the distributor gear and the fuel pump lobe (Fig. B). Coat the cam bearing journals with straight SAE 30 or 40 wt. oil. We do not recommend the use of synthetic oils with our cams and lifters during break-in.

**Step 6:** We recommend installing a new COMP Cams® timing chain and gear set for two reasons. First, the old chain is likely to be stretched beyond its service limits. Second, your old timing set, as well as many new ones on the market, may be machined to retard the cam timing. Either of these conditions will detract from the performance your camshaft was designed to deliver. Temporarily install the cam sprocket on the camshaft. The sprocket will again serve as a handle to help “roll” the cam into its bearings. Carefully slide the camshaft into the engine, oiling the bearing journals as it slides into the block (Fig. C). Excessive force is not necessary to install the cam. Take your time. You do not want to scar the camshaft or the cam bearing. Be sure you do not wipe away any of the assembly lube as you install the cam into the block. Once the cam is installed in the block, fully remove the cam sprocket. If your engine was equipped with a camshaft retaining plate, it should be installed at this time. Refer to your engine manual for the proper torque specs for the retaining plate bolts.

**Step 7:** Install the new crankshaft sprocket on the snout of the crankshaft (Fig. D). We recommend using a Crankshaft Timing Sprocket Installation Tool (Part #4789) in conjunction with our Balancer Installation Kit (Part #4920) for all applications having an interference fit crank sprocket.

**Should You Degree Your New Cam?**

It isn’t absolutely necessary to degree the cam for the engine to run efficiently. We grind most of our hydraulic cam series four degrees advanced to make up for all machining tolerances. This will position the cam for the best street performance. However, to ensure maximum performance, we recommend you degree your new COMP Cams® camshaft. The purpose of degreeing a cam is to correct the errors and tolerances in the machining processes of the engine that affect camshaft timing. If you do decide to degree your new cam, we suggest the intake centerline method. It’s simple, quick and efficient.

**Step 8:** Reinstall the cam sprocket temporarily. Check the timing mark alignment in your engine manual. Rotate the crankshaft and camshaft to their proper positions. Our Small Block Chevrolet has a “dot over dot” alignment as shown (Fig. E). Remove the camshaft sprocket, and install the new COMP Cams® chain. Bolt the cam sprocket to the cam, making sure the sprocket is pulled up flush onto the cam (Fig. F). Once again, make sure the timing marks are positioned properly and according to your manual.
Refer to your manual for the proper torque specifications before tightening the camshaft bolt or bolts. We also suggest that thread locker be applied to the threads of the camshaft bolts to assure the bolts remain torqued to the proper specification. This process is very important! Improperly torqued camshaft bolts can loosen and cause severe engine damage. A camshaft bolt locking plate is recommended for Chevrolet 262-400c.i. and 396-454c.i. engines. Ask for COMP Cams® Part #4605.

**Step 9:** Remove your new COMP Cams® lifters from the packaging, and clean the lifters thoroughly in mineral spirits or an equivalent solvent. Remember, in order to protect your camshaft warranty, new lifters must be installed. It is not necessary to “pre-pump” hydraulic lifters full of engine oil prior to installation and valve adjustment. It is actually undesirable to do so as the “pumped up” lifters will cause the valves to open during the adjustment process, rather than positioning the valve lifter plunger in its operating position as it should. “Pre-soaking” hydraulic lifters in a bath of engine oil is a good idea, but is not mandatory. It does ensure that the lifters are adequately lubricated on their outer surfaces prior to installation in the engine. It may also result in a quieter engine start-up as the oil in the bath may displace some air from the lifters’ plunger reservoirs. Coat the bottom of all lifters with the COMP Cams® lube supplied with your cam (Fig. G). Install the lifters, making sure they will fit and rotate freely. Any excess clearance or tight lifters can cause damage to the camshaft and lead to engine failure.

If you are installing either a solid or hydraulic roller cam in your engine, now is the time to check cam end play. For instructions on how to do so, see “Checking Cam End Play” on page 406 of this master catalog. If you are installing a hydraulic or solid flat tappet cam in your engine, this step is not necessary in the majority of engines. This is because the taper ground into the cam lobes of these types of cams pushes the cam into the proper position and holds it there while the engine is running. Checking end play is also unnecessary in engines equipped with cam retaining plates, whether the cam used is a flat tappet or a roller.

**Step 10:** Next, install COMP Cams® Roller Rocker Arms and Pushrods to ensure compatible mating surfaces and long life. Additionally, because of the increased stiffness, accuracy of ratios and roller tip, COMP® Roller Rockers can give you up to an extra 15 to 30 hp over stock or stamped rocker arms. (COMP Cams® Magnum Rockers and pushrods are conveniently packaged in our RP-Kits, see Fig. H). Clean all pushrods thoroughly because most engines oil through the center of them. If the original pushrods are being used, be especially sure they are clean inside and out. Apply a small amount of COMP Cams® lube or equivalent on each end of the pushrod and install into the engine (Fig. I). Clean all rocker arms thoroughly. If the original rocker arms are used, examine each one for excessive wear and replace any that are questionable. Apply a small amount of COMP Cams® lube on all contact areas of the rocker arm. With a clean cloth, wipe the tips of the valves clean and apply COMP Cams® lube on the tip of each valve where the rocker arm will come in contact with it. Also, be sure to check the valve tips for excessive wear.

**Step 11:** Install rocker arms onto the engine (Fig. J). Do not tighten the adjusting nut down before you go through the proper sequence. On engines with shaft mounted adjustable rocker arms, back off all adjusters completely before installation. Make sure the pushrod is in the lifter and the rocker arm seat when making valve adjustments.

For hydraulic lifter adjustment, turn the engine in the normal direction of rotation. When the exhaust valve moves to maximum lift, adjust the intake valve to zero lash with no pre-load. Turn the adjusting nut an additional ½ turn more. Rotate the engine over again until the intake valve reaches maximum lift and is almost all the way back down. Set the exhaust valve to zero lash plus ½ turn.

Adjust the valves on each cylinder in this manner until all valves are adjusted (Fig. K). If your engine has non-adjustable rocker arms, a lifter pre-load of .020” to .040” must be maintained.

See “Non-Adjustable Rocker Arms” for proper pre-load instructions. For mechanical lifter camshafts, follow the same adjustment procedure. Instead of lifter pre-load, use the prescribed valve lash clearance found on the cam specification card. Mechanical valve lash adjustment is recommended at every oil change.

**Step 12:** It is very important to fire the engine as quickly as possible. The only lubrication that the camshaft receives is from oil thrown off the crankshaft so making certain that the camshaft is properly lubricated upon installation will guarantee that it is protected during the critical start-up of your newly-built engine. In terms of oil selection, we recommend oil with the proper level of “ZDDP”, Zinc Dialkyl Dithiophosphate additive fortification. COMP Cams® offers a line of Break-In Oils (see page 272 for part numbers) which have a proprietary formula that includes the proper amount of critical additives, including ZDDP (Zinc & Phosphorus), Molybdenum, detergents and high grade base oil to give you the most optimum oil for the break-in and long-term running of all your carefully chosen performance engine components.

If you have a preferred oil with which you feel comfortable, we strongly recommend the use of COMP Cams® Break-In Oil Additive (COMP Cams® Part #159) during break-in. While this additive was originally developed specifically for break-in protection, subsequent testing has proven the durability benefits of its long term use. This proprietary blend of anti-wear ZDDP fortification, anti-fiction Molybdenum, and extreme pressure additives promotes proper break-in and protects against premature cam and lifter failure by replacing some of the beneficial ingredients that the oil companies have been forced to remove from off-the-shelf oils. See page 272 for more information on COMP Cams® Break-In Oils and Additive.

Once you’ve selected an oil, fill the new oil filter before installing. This allows the engine to achieve oil pressure immediately. Timing the engine properly the first time will be necessary for the engine to start quickly. Rotate the crankshaft in normal crankshaft rotation until the number one cylinder is coming up on the compression stroke. Align the timing mark on the balancer/damper to the recommended factory initial timing setting, making sure that both valves on the #1 cylinder are closed. Install the distributor with the rotor pointing to the #1 plug wire on the cap. The engine should fire up as soon as it receives fuel.
Step 13: Important! As soon as the engine fires, bring the engine rpm to 1500 to 2000 during the first 30 minutes of operation. Slower engine speeds may not supply the camshaft with an adequate amount of oil for the break-in period. Change rpm periodically to direct oil splash to different areas of the camshaft. After the 30 minute break-in period, change the oil and filter again to be sure all contaminants and break-in lube are removed from the engine. If the camshaft you are using requires double valve springs, we recommend removing the inner spring for camshaft break-in.

Checking Cam End Play

Cam end play refers to how much a roller cam is allowed to move back and forth in the engine. Some end play is required to eliminate the possibility of wear occurring as a result of interference between the cam and other engine components. Excessive end play is detrimental as the cam will be misaligned in the lifter bores, causing the roller wheels on the lifters to run on the edge of the lobes instead of the center. If the end play is too large, it can result in the lifter from one cylinder hitting the lobe adjacent to it. Another important effect of cam end play is that as the cam moves back and forth, it advances and retards the ignition timing at the distributor gear.

The proper amount of end play is between .004” and .010”. This can be checked rather easily by using a dial indicator and magnetic base on the front of the engine. Merely push the cam as far back in the engine as possible, zero the indicator on the upper timing gear, and pull the cam as far forward as it will go. The indicator reading will tell you the end play.

In Chevrolet engines, you have to have the front cover in place to check end play since the cover is the forward stop for the roller cam and timing gear combination. Also, you must have a cam button in place to take up the additional space between the gear and front cover. These are typically made of Teflon/ fiber or steel. The steel buttons have a miniature roller bearing built in. All types are available from COMP Cams® in various lengths, depending on the type of front cover you are using.

The Chevrolet front cover makes using the dial indicator technique for end play determination difficult. Some of the front covers have an access hole with a pipe plug to allow a dial indicator extension to go through and contact the upper timing gear. Stamped front covers have no such provision. Therefore an alternate technique that can be used is to gently insert a long screwdriver in one of the lifter bores and carefully pry the cam back and forth using the sides of the lobe in the bore. Do not use excessive force to try and move the cam. Estimate from the lobe in its extreme positions on either side of the bore how much end play exists, and adjust accordingly. If the end play is too large, install some suitable shim material behind the cam button and recheck. If it is too small, carefully remove some material from the back of the cam button, reinstall it in the timing gear, and recheck.

One final note of warning – stamped steel Chevrolet front covers are typically very flexible where the cam buttons contact them. This is detrimental to maintaining a consistent amount of end play. Washers are available to weld inside the front covers to stiffen them. Also, the water pump fits tightly to some front covers and can act as a support. But for most race type roller cam applications we strongly recommend the use of a cast or billet aluminum front cover (Part #210) to eliminate any front cover flex induced change in end play.

Adjusting Valve Lash

On Mechanical Camshafts

All COMP Cams® spec cards have hot lash specifications (operating temperature) that will work for initial start-up. Find yours and by hand, rotate the crankshaft (in the running direction) until the exhaust pushrod begins to move upward, opening the valve. You can now adjust the intake lash by tightening the rocker nut while the proper thickness feeler gauge is inserted between the valve stem and the tip of the rocker. Tighten the rocker nut until there is a slight drag when moving the feeler gauge. To adjust the exhaust valve, rotate the crankshaft until the intake pushrod moves all the way up and goes past the “top” until it is one-half to two-thirds of the way back down. Adjust the exhaust rocker nut (with the proper feeler gauge) using the procedure above. Repeat for all cylinders Note: You may find it easier to set and maintain valve lash using COMP Cams® polylocks.

After setting lash with the engine cold, start it following the break-in procedure described in step 13. After break-in, the engine will be at operating temperature. Due to thermal expansion, the lash will now be looser than it was when the engine was cold. Repeat the entire adjustment process above to ensure proper lash at operating temperature.

Setting Hydraulic Lifter Pre-load

When installing a hydraulic cam, hydraulic lifters, or rocker arms, it is necessary to establish the proper lifter pre-load. Insufficient lifter pre-load will cause excessive valve train noise. Excessive lifter pre-load will cause the engine to idle rough or have low manifold vacuum and can lead to severe engine damage. It is critical to engine efficiency and to the service life of the valve train (camshaft, lifters, pushrods, valve springs, etc.) for the lifters to have the proper amount of lifter pre-load. On any hydraulic lifter camshaft, the ideal lifter pre-load should be .030”. A variance of +/- .010” is acceptable.

Adjustable Rocker Arms

Install the pushrods into the engine. Install the rocker arms, balls and nuts on the rocker studs. Be sure the pushrods are seated properly into the lifter and the rocker arm seats. Turn the engine over by hand in the direction of rotation until the exhaust pushrod just begins to move upward to open the valve. You are now ready to adjust the intake rocker of the same cylinder.

Carefully tighten the nut on the intake rocker arm while spinning the pushrod with your fingertips. You will feel a slight resistance in the pushrod when you have taken up all of the clearance. This is referred to as “zero lash.” Now turn the adjusting nut ½ turn more (Fig. L). Generally, ½ turn on the adjusting nut will provide the suggested .030” pre-load.

Once again, turn the engine in the direction of running rotation until the intake pushrod comes all the way up and almost all the way back down. Now set the exhaust rocker to “zero lash” and add ½ turn. You now have set the pre-load on one cylinder. Repeat these same steps to set the pre-load on each cylinder.

Non-Adjustable Rocker Arms

In situations where you are dealing with non-adjustable rocker arms, a different procedure must be followed. After applying lube, install the push-
rods and torque all rocker arm bolts down in the proper sequence and torque specifications. Rotate the engine by hand in the normal direction of engine rotation until both the exhaust and intake valves have opened and closed completely. Allow a couple of minutes for the lifter to bleed down.

Using the valve cover gasket surface on the head as a reference point, place a mark on the pushrod. It is advisable to use a pencil or scribe to mark the pushrod. The smaller and more defined the mark, the more accurate the measurement. Be sure the reference point you choose for the first mark is easily accessible and easy to duplicate. You will be marking the pushrod twice. It must be from the same reference point and angle for the measurement to be accurate.

Loosen the rocker or rocker shaft bolts. Leave the rockers on the head so they support the pushrods. Be sure the pushrods are standing free in the lifters and do not have any pre-load. Using the same reference point, place a second mark on the pushrod. Make sure the angle and reference point are the same as the first mark.

You now have two marks on the pushrod— one with the assembly bolted into place as the engine will run and the second mark with the lifter unloaded. The distance between these two points will represent the amount of lifter pre-load your engine has.

If you find that the pre-load is not within .020” to .040” range, adjustment will be necessary. The simplest way to accomplish this is by using different length pushrods. These pushrods are available for most engines with non-adjustable rockers. When measuring to find the correct length needed, be sure to include the .030” pre-load that the lifter requires.

If your engine has pedestal style (bolt-mounted) rockers, you can use shims under the pedestal to lessen the pre-load. This method also works with shaft mounted rocker systems. Longer pushrods will be needed for insufficient pre-load.

In most cases, you will only need to check one intake and one exhaust pushrod; however, if your valve stem heights are not equal, you will need to check pre-load on each valve. If this procedure is not followed, it will almost certainly result in a poorly running engine and ultimately engine failure.

Rocker Arm Clearance

Rocker arm clearance must be checked at several places. It is very common with higher lift cams to have the rocker arm contact the rocker stud when the valve is at full open position. Be certain to check this, as lack of proper clearance will cause broken studs, broken pushrods or a worn-out camshaft.

The clearance between the rocker arm and the retainer must also be checked. This problem will be more pronounced when the valve is closed. The retainer is likely to contact the underside of the rocker arm right in the center. Be sure to maintain at least .030” clearance at this point (Fig. M).

When assembling the head, check the retainer-to-valve seal clearance. Sometimes, when you install a high lift cam and a different seal, this distance becomes too small. This will bind the valve train and result in camshaft failure. If the clearance does not measure the total valve lift +.060”, the heads should go to a machine shop and the guides shortened. Pushrod clearance must also be checked, especially when using higher ratio rocker arms. The pushrod seat in the rocker is moved toward the stud in this case, so it must be checked at several different lift points.

Valve Springs

The number one factor in premature failure of a new camshaft is an improper or worn-out valve spring. Either incorrect pressure or an incorrect spring application will lead to a worn-out cam. For this reason, it is highly recommended that the corresponding part number COMP Cams® springs be used in any cam change.

Most aftermarket cams have much higher-than-stock lift. Therefore, the stock valve springs will “coil bind” or “stack” before the cam reaches its full lift. This condition will cause the cam to fail immediately. You should always use the recommended part number spring with a new cam, and check to be sure there is no coil bind. With the valve at full lift, check the clearance between the coils. You need to maintain a minimum of .060” between the coils at this point (Fig. N).

Excessive spring pressures will also lead to early failure. These pressures can be the result of incorrect springs, short valves, improper retainers or many other factors unrelated to the cam or the valve spring. The only way to ensure the correct pressure is to actually check the installed height and pressure.

Coil bind will not usually be a problem when lower lift camshafts are used. However, the Big Block Chevrolet is an exception to this rule. When installing any non-stock cam, it’s recommended to check for coil bind, but it’s imperative that coil bind be checked (see above) on higher lift camshafts. With most COMP® camshafts the valve springs MUST be replaced. Stock valve springs will not have sufficient travel for cams that incorporate additional lift.

Piston to Valve Clearance

Anytime a higher-than-stock lift or duration camshaft is installed, it is important to check piston-to-valve clearance. The High Energy™ series and smaller Magnum Cams, such as the 270H, 280H, 270S or 286AR camshafts, should not have this problem; however, the 292H, 294S, 280AR and larger camshafts may have an interference problem.

COMP Cams® strongly urges you to check the piston-to-valve clearance on the larger street cams and on all race cams. We recommend at least .100” clearance on the intake valve and at least .125” for exhaust valves. If aluminum connecting rods are used, add a minimum of .030” to the suggested clearance figures. Aluminum rods will stretch and expand more than a steel rod.

The easiest and possibly most accurate way to check piston-to-valve clearance is to place strips of modeling clay on top of one piston, then rotate the engine over by hand with the head bolted in place and all of the valve train with valves adjusted. When there is resistance in turning, stop. The piston has probably hit the valve.

A decision must be made to flycut the piston, which will involve completely disassembling the engine, or to exchange the cam for a profile that will fit into your engine. Do not try to operate the engine with less than .100” clearance on the intake and .125” on the exhaust. Costly engine damage will occur.