Playing Taps

A STAYING-COOL GUIDE TO ADJUSTING SOLID LIFTERS

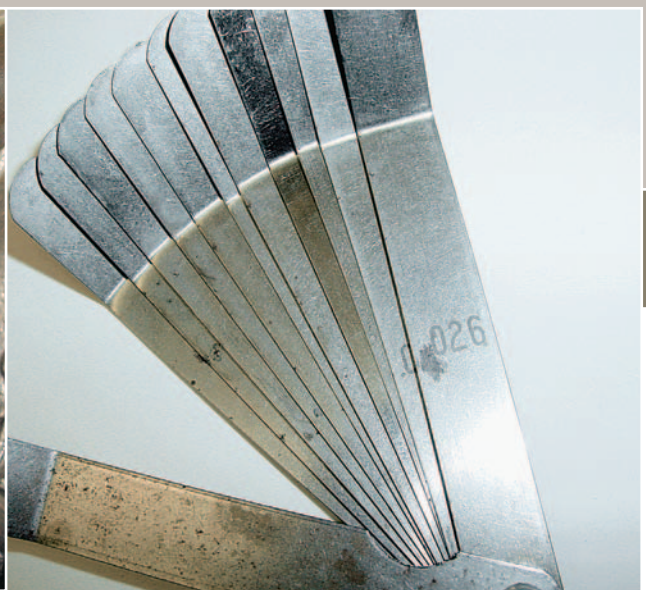
BY JOHN HINCKLEY

Many of us really enjoy the sound (and performance) of solid lifters, but some folks don't look forward to the occasional chore of properly adjusting valve lash, especially with the "30-30" cam used in '64-'65 L-76 (365hp) and L-84 (375hp fuelie) Corvettes (and in '67-'69 Z/28 Camaros), which are specifically noted in the Shop Manual to be set "hot and running." The objectives of this article are to explain why the Shop Manual says to adjust them "hot and running," to offer a proven alternate method of setting them "cold," and to show how variations of this concept can be applied to ANY Chevrolet small-block, solid-lifter cam.

CREDITS AND BACKGROUND: This has been a joint project with other highly knowledgeable Corvette enthusiasts, and I'm indebted to Bill Clupper for his research on the "30-30" cam and his detailed crank angle/cam lift diagram development, and to Duke Williams for his analysis of Bill's data and subsequent work with precision measurement tools in developing the "actual" rocker arm ratios (vs. "design") and applying the results of that work to develop the adjustment concept, and for development of the LT-1 cam crank angle/cam lift data. We used my stock/original '69 Z/28 as the "mule" to prove the concept in the real world, and it has been used since by many Corvette and Z/28 owners with great success. It results in a sweet mechanical "singing" sound, no "clacking." It runs better, sounds better, idle is more stable, and throttle response is crisper. It also eliminates the messy adjustment routine accompanied by hot oil dribbles and smoke, not to mention hot oil burns, as the lash procedure is done on a cold engine.

CAM THEORY: Without getting into a lot of gory detail, let's talk about what makes a solid-lifter cam require lash (clearance) adjustment to begin with. A hydraulic-lifter cam valvetrain runs quietly at zero lash

Clearances should be checked with a feeler gauge between the head of the valve and the rocker arm. Depending on the engine displacement and camshaft used, one of the techniques listed will bring your solid-lifter camshaft into proper adjustment for peak performance.



Feeler gauges are inexpensive but valuable tools. Adjust the rocker arm nut until you feel a slight drag on the feeler gauge. To check your measurement, just double up the appropriate gauge with the .001" gauge and see if it will still fit.

all the time, with the clearances taken up continuously and automatically by an oil pressurized plunger arrangement in the lifter. Once adjusted initially, the valvetrain requires no maintenance. The solid-lifter valvetrain has higher rpm capability due to solid contact between all the components (no variable hydraulic device in the system that can "pump up" at high rpm), but requires occasional adjustment to maintain correct clearance in the system. Correct clearance ensures that the valves always close fully, and that they open fully, regardless of engine temperature and operating conditions, with a minimum of mechanical noise and component wear.

LOBES AND RAMPS: Everyone understands that the rotating cam lobe acts on the base of the lifter and raises and lowers the lifter as the cam rotates, but there's another aspect of the cam lobe that is less understood – the opening and closing "ramps." As the cam lobe starts to move off its "base circle" (the portion of the cam lobe that's circular and provides no lift) and begins to raise the lifter, it does so with a short profile on the beginning of the lobe that raises the lifter more gradually (gently) than the rest of the lobe that accelerates the lifter, and there's a similar "ramp" at the end of the closing side of the lobe as it again approaches the "base circle." The purpose of the opening side ramp is to accelerate the lifter gently until the system clearance is taken up, and the closing side ramp is there so the valve closes on its seat at a lower (gentler) velocity than the main portion of the lobe closing profile provides. The "ramps" on a "30-30" cam are very long, and are .020" high (above the base circle). More on this in a few minutes.

About 80 percent of exhaust-valve cooling is through the seat, but the stem temperature increases also, which causes the stem to grow, thus decreasing running clearance. This is why exhaust ramps are typically higher than intake ramps – to allow for more stem growth and still maintain some running clearance to ensure that the valves close fully. Since the intake valve is cooled by the incoming fresh intake charge, its temperature and clearance will remain more consistent over the entire engine operating spectrum, and they typically have lower ramps.

WHY DOES THE SHOP MANUAL SAY "HOT AND RUNNING"? The valve timing events of the "30-30" cam are quite radical – the most radical small-block cam Chevy ever released for production. They are so radical, in fact, that at TDC (Top Dead Center) in any cylinder, neither the intake nor the exhaust valve is closed; both are still on their ramps. Valve clearances must be adjusted with each lifter on the cam's base circle, and there is no position on the "30-30" cam where any cylinder's intake and exhaust lifters are on their lobe's base circles at the same time. Thus, the requirement to set them "hot and running" is not difficult, but it is very messy. There IS, however, a way we've developed to set them "cold and stationary" – it just takes a little work. More on that shortly.

ABOUT ROCKER ARM RATIOS: The nominal design for small-block Chevy rocker arms assumes that they provide a 1.5:1 ratio; in other words, they multiply every movement of the lifter by 1.5 when that movement is applied to the end of the valve (.100" lifter movement results in .150" valve movement, or "lift"). That's how the "30-30" cam's specified operating clearance of .030" was derived – the .020" high opening ramp on the cam lobe then translates to 1.5 times that, or .030", at the valve. The problem is that the stock rocker arms do NOT provide a true 1.5:1 ratio as the design assumes; they are 1.37:1 at the lash point (beginning of lift), and 1.44:1 at full lift (on the high point of the cam lobe), and never reach the advertised 1.5:1 ratio.

This means a LOT to correct operating clearances. With the actual measured rocker arm ratios and specified .030" clearance, when the lifter is at the end of the .020"-high gentle opening ramp, the valve end of the rocker arm has only moved .0274" (not .030") when the cam really starts accelerating the lifter, and the rocker arm tip hasn't touched the valve yet – when contact IS made .0026" later,

the lifter is at full lobe acceleration (not the gentler "ramp" acceleration), which transmits more shock to the valvetrain as the clearance is taken up and makes more noise (that "clacking" sound). The same is true in reverse on the closing side – the valve is returned to its seat at full lobe velocity, not the gentler "ramp" velocity. This can contribute to valve seat recession, and can cause valve "bounce" at the seat at high rpm.

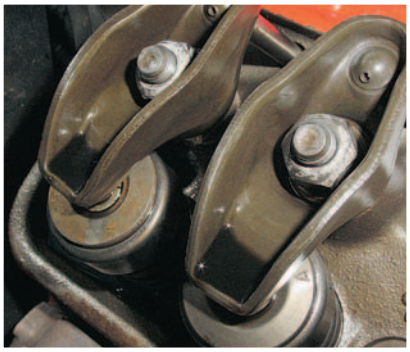
WHAT'S THE SOLUTION? There are two elements to the solution – reduce the operating clearances to counteract the effect of the actual 1.37:1 rocker arm ratio, and adjust the valves in steps. Adjust the intakes at 90° after TDC and the exhausts at 90° before TDC so their respective lifters are fully on the cam's true base circle, not on the ramps. There is virtually no difference in the thermal expansion coefficient between the iron block and heads and the steel valvetrain elements, so they can also be set with the engine cold. We'll set the valve clearances at .026" so the lifters are still on the (gentle) ramp profile when the clearance is taken up while opening, and so the valve is returned to its seat at ramp velocity while closing.

THE PROCEDURE: You can adjust two valves at each 90° crank rotation point, starting at #1 TDC and turning the crank 90° at a time, seven times. Mark your balancer at 90° intervals from TDC, and remove the plugs to simplify turning the crank – you were going to change them anyway, right? Proceed in the following sequence, adjusting the intake valve ("I") and the exhaust valve ("E") as noted:

TDC #1	#8 (E)	#2 (I)
90°	#4 (E)	#1 (I)
180°	#3 (E)	#8 (I)
270°	#6 (E)	#4 (I)
0°	#5 (E)	#3 (I)
90°	#7 (E)	#6 (I)
180°	#2 (E)	#5 (I)
270°	#1 (E)	#7 (I)

Start at #1 TDC, then rotate 90° at a time, setting each specified valve at .026" cold. The rocker arm nut should be tightened until a light drag is felt on the .026" feeler. Verify the clearance by inserting a .001"-thicker feeler – if it won't go, the clearance is correct.

If you like, you can go back after you're done, to each (or any) cylinder's



The rocker arm, pushrod socket and valve head are all lubricated with oil during operation. This is extremely beneficial, until you try to adjust the valvetrain during operation. The hot oil splashes out and can make a mess of your engine bay. By adjusting your valvetrain cold, you eliminate the mess and eliminate your chance of getting burned.

TDC position and check the clearances on that cylinder's two valves, and you'll find that they've closed up to .024", indicating that both valves are still on the ramps at TDC, as I indicated earlier under "Why Does The Shop Manual Say Hot And Running?" Clearances will increase slightly over time – back in the '60s, Chevrolet recommended a lash check at the normal 12,000-mile tune-up intervals.

Camshaft operation is more than an open-and-close case. The lifter, and subsequently the pushrod, rocker arm and valve, accelerate at different speeds throughout their operation. Properly adjusting the valvetrain ensures that they are timed appropriately for each event and helps prolong valvetrain life by utilizing the camshaft's ramps to open and close the valve without slamming the valve shut or hammering the valve head when opening.

WHAT ABOUT THE "097" DUNTOV CAM? The "097" Duntov solid-lifter cam used for SHP (Special High-Performance) engine applications from '57 to '63 was designed for .012" (intake) /.018" (exhaust) clearance with nominal 1.5:1 rocker arms. it was recommended that the intake clearance be tightened up to .008" in a *Corvette News* article in the late '50s for "weekend competition events" for slightly more effective intake duration, and .008" became the factory-specified intake valve clearance in 1963.

Factoring the original .012"/.018" clearances by the 1.37/1.50 rocker ratio correction yields a (rounded) .010"/.015", which are the clearances we recommend for 283s with the "097" Duntov cam; for 327s, the .008" should NOT be factored down, and we recommend .008"/.015" clearances for 327s. Both can be set cold, and you can use either the indexing procedure outlined earlier, or they can be set at only two crank positions (#1 TDC and #6 TDC) as shown below, as the "097" crank angle/cam lift diagram indicates that neither the intake nor the exhaust is on the clearance ramps at TDC of the firing stroke, and the ramps are much shorter than on the "30-30" or later LT-1 cams:

#1 TDC Intakes 1-2-5-7, Exhausts 1-3-4-8
Turn 360° to #6 TDC
Intakes 3-4-6-8, Exhausts 2-5-6-7

WHAT ABOUT THE '70-'72 LT-1 CAM? The original factory clearance spec was .024"/.030" (hot). The LT-1 cam intake lobes were (barely) off the ramps at TDC, but the exhaust is still on its ramp at TDC, so the exhausts should be set at 90° before TDC using the indexing procedure shown for the "30-30" cam. Both intake and exhaust clearances should be factored down by the 1.37/1.5 rocker ratio correction to a (cold) setting of .021" for the intakes and .026" for the exhausts.

THE BOTTOM LINE: Solid-lifter cams are part of the vintage Corvette's high-performance heritage, and are an essential part of the Corvette experience for many of us. Contrary to popular opinion, you don't have to be an ASE-Certified mechanic or a degreed engineer to maintain one. Chevy factory solid-lifter cams were designed with "soft action" (mild ramps and lobe acceleration) to provide both performance and reliability using the same pushrods, rocker arms, valves and springs as the hydraulic cams in the lesser engines of the time, and are essentially bulletproof. All they require is a lash check or adjustment once a season to maintain that "singing" mechanical sound – and now you can do that with no hot-oil mess, with a cold engine, at home. Another "system" de-mystified! ■