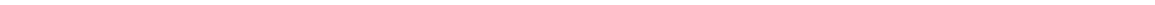


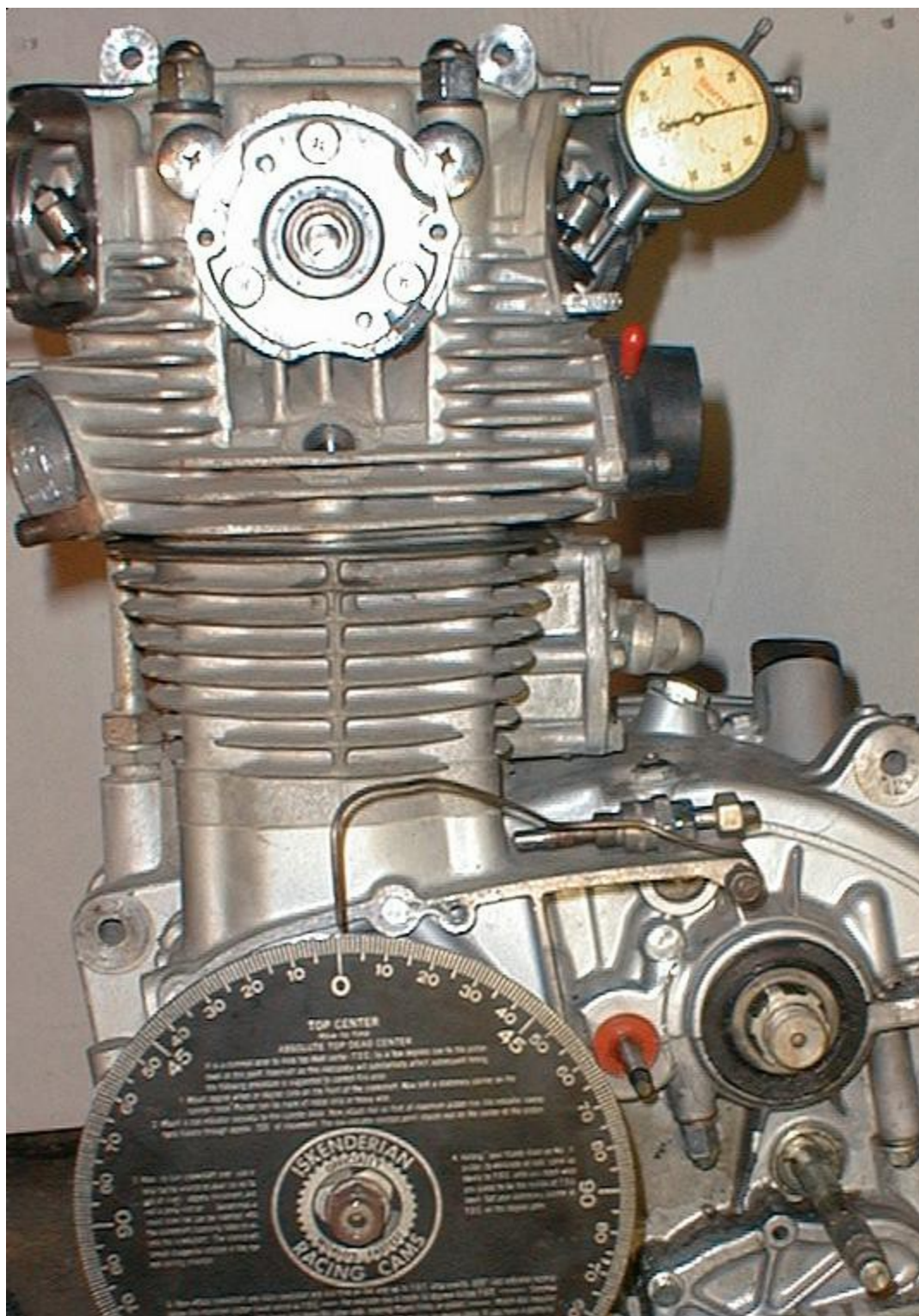
HEAD: Cam Specs

XS 650 Stock Camshaft Specifications

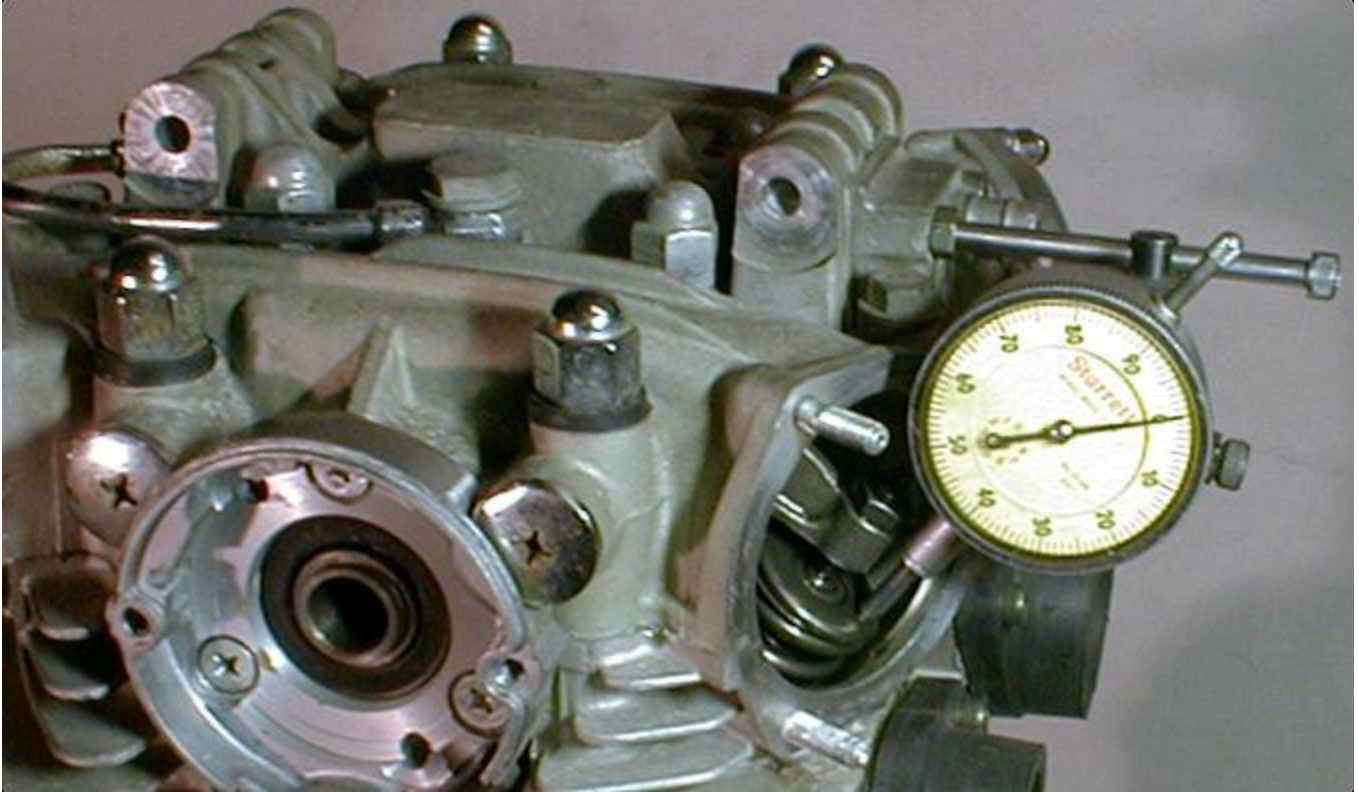
Actual Camshaft specifications from a 1980 XS 650 OEM stock motor with 330 miles on it, it has a perfect original cam chain, cam sprockets, and chain guides.

By: Bob Bertaut





Stock timing mark was off only 1 degree.



Dial indicator mounted up to check the number 1 cylinder intake cam specifications measured at the valve at zero lash.



Positive stop Top Dead Center Indicator made from a 3/8" stud, a couple of 3/8 std. nuts and a 14mm automotive spark plug oil firing adapter.

I checked the stock early and late model (256 / 447) cams "cam lift" with a dial indicator in a head thats off a motor. The 34 tooth 256 cam has .300" lift at the cam and the 36 tooth 447 cam has .314" at the cam.

The stock XS 650 rocker arm ratio is 1.24 to 1.

Both cams have a 1.270" base circle.

So the early 256 cam will have .372" lift at the valve minus the valve lash. I can see it has a little more duration, have not checked one yet.

XS 650 Intake Cam Actual In Motor Specifications.

I.V.O. @ .002" @ 95 degrees B.T.D.C.

I.V.O. @ .004" @ 70 degrees B.T.D.C.

I.V.O. @ .006" @ 50 degrees B.T.D.C.

I.V.O. @ .040" @ 11 degrees B.T.D.C.

I.V.O. @ .050" @ 8degrees B.T.D.C.

Max. Lift @ .000" lash = .388"

I.V.C. @ .050" @ 43 degrees A.B.D.C.

I.V.C. @ .040" @ 46 degrees A.B.D.C.

I.V.C. @ .006" @ 78 degrees A.B.D.C.

I.V.C. @ .004" @ 98 degrees A.B.D.C.

I.V.C. @ .002" @ 124 degrees A.B.D.C.

Stock Intake Cam Lobe Center = 107.5 degrees

Intake Cam Duration @ .002" = 399 degrees

Intake Cam Duration @ .004" = 348 degrees

Intake Cam Duration @ .006" = 308 degrees

Intake Cam Duration @ .040" = 237 degrees

Intake Cam Duration @ .050" = 231 degrees

XS 650 Exhaust Cam Actual In Motor Specifications.

E.V.O. @ .002" @ 127 degrees B.B.D.C.

E.V.O. @ .004" @ 120 degrees B.B.D.C.

E.V.O. @ .006" @ 91 degrees B.B.D.C.

E.V.O. @ .040" @ 44 degrees B.B.D.C.

E.V.O. @ .050" @ 41degrees B.B.D.C.

Max. Lift @ .000" lash = .388"

E.V.C. @ .050" @ 11degrees A.T.D.C.

E.V.C. @ .040" @ 14 degrees A.T.D.C.

E.V.C. @ .006" @ 53 degrees A.T.D.C.

E.V.C. @ .004" @ 71 degrees A.T.D.C.

E.V.C. @ .002" @ 88 degrees A.T.D.C.

Stock Exhaust Cam Lobe Center = 105 degrees

Exhaust Cam Duration @ .002" = 395 degrees

Exhaust Cam Duration @ .004" = 371 degrees

Exhaust Cam Duration @ .006" = 324 degrees

Exhaust Cam Duration @ .040" = 238 degrees

Exhaust Cam Duration @ .050" = 232 degrees

Note the camshaft duration at the valve lash settings of .002", .004", and .006"!

Setting valve lash to the stock cam specs just contributes to reversion and lost compression with these old design dead slow cam lobe opening and closing rates.

For Example: setting the intake valve lash at .002" versus .006" means you have lost 91 degrees of time (45 degrees on the intake opening side and 46 degrees on the intake closing side) the intake valve is just hanging around the valve seat but is still open when it could have opened 45 degrees later, and shut 46 degrees sooner and trapping mixture to burn, there is no flow or other advantage with the slow opening and closing rates that leaves the valves open for 91 degrees a few thousandths off the seat except burned valves, lost mixture and compression. The very small lash settings also leave little time or physical space for oil to get to the cam lobes and rocker arm friction surfaces, and contributes to early wear. Modern camshaft computer designs have changed these opening and closing rates and take into account valve train weight and operating design parameters. (the rocker arm pad radius, forked followers, pushrods etc.)

The Yamaha OEM specs are .006" and .012" for the intake and exhaust respectively on the early motors on the OEM Yamaha micro fiche I have and the OEM Yam service manuals. That's why people think that the early cam works so well. It is because it is another of the ancient old slow opening and closing ramp design cams that waste valve event time to actually open and close the valves. Engines are designed to do work after all. In fact they had to have a compression release when used with the proper lash settings to relieve the much more efficient engine cranking compression gained because of it on the earlier model 650's.

I profile stock and performance cams from the opening to the closing in thousandths per degree every 10° at the crank to check cam profiles at the cam every 5° from opening to closing. Most of the newer design (non symmetrical) cams open the valves faster than they set them down and both speeds are much faster than the old fashioned degree and efficiency eating slow designs of the past. (Some of them are still sold as performance cams today) Only a few companies still sell the same old designs, with their specs changed only by base circle size.

The late XS650 cams set at .002" int. lash are a pure gamble. The stock base circles have runout. Many ask why when turning the motor over the narrow lash setting keeps changing once they have set it, that is why. Base circles get sloppy when cam grinders do not let them spark out on the final passes. So a possible .001" inch or less is not enough open lash in an instant on the long slow sloppy base circle ramps for oil. Not much time to get oil on the valve tips either. People complain of wear there as well. Some cams have slots around the base circle to allow for oil, and others have a hole in the base circle to supply oil directly at that point of lash. Especially important in these low oil pressure ball and roller bearing engines.

XS 650 Camshaft Installation TDC Index Timing

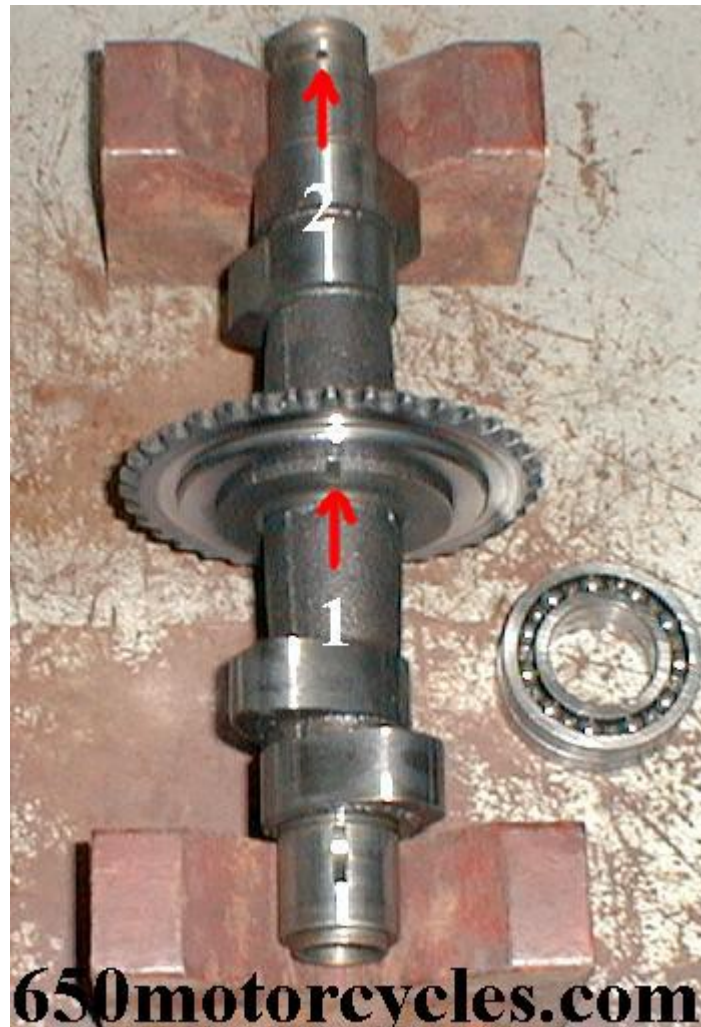
You do not have to cut or open the cam chain to install the cam shaft! It will fit on the sprocket under a brand new cam chain with the pairs of ball bearings removed from each end, the bearings will slide right off each end of the cam. To easily install a new chain and peen type masterlink: [Click Here!](#)



Degree wheel bolts up flat against charging system rotor. Since the XS rotor is keyed to crank I just turn the motor over from the same side by hand with the rotor.



The camshaft is installed with the flat ground factory index notch (white arrow above) on the camshaft (not on the cam sprocket) facing straight up. The motor is on top dead center on overlap on number 1 cylinder (nearest) in the above image. The two visible cam lobes are both up and the rocker arms, if installed would have both the intake and the exhaust valve open on this cylinder. Number 2 cylinder (rear of image) is on TDC on the compression stroke and both the rocker arms are on the cam base circle with both lobes centered and facing down..



I have discovered that you can check your stock cam timing for all years of the XS motor with the motor completely together and even installed in the bike. This can save many people lots of worry and problems. It can be as simple to check as removing a few screws! When the index notch ground into the camshaft is installed in the proper position as shown in both of my above images: (number 1 red arrow) above, and (the white arrow) in the previous image above it, NOTE the small hole for the ignition advancer at red arrow number 2 above is also facing up, and inline with the cam billet index blank!!!! It sticks out of the cam bearing end seal and is visible by removing the right hand camshaft end cover!! If you have points ignition, you have to loosen the ring nut and simply remove the advance mechanism to see the small pin in the index hole. If you have a 1980 or up with stock electronic ignition you have only to remove the two cover screws and look at the hole!!! It should be straight down (or straight up) (IMAGES BELOW) with the pistons at Top Dead Center (TDC)!! Set the TDC mark on the rotor to the TDC mark on the left end of the crank with a 17mm

socket (image below) , have the spark plugs out and see that both pistons are at TDC. It is that simple. This is a BIG problem for many novice engine builders, and now anyone can check the basic cam timing as I have shown here!

Good Luck,

Bob B.



Points Ignition cam index pin above is usually facing down, can be 180 degrees out from a prior incorrect assembly and be facing up and still be OK.



1980 Electronic Ignition Cam Still Has Points Index Pin Hole Above



Rotor TDC mark on TDC "T" on RH side of timing tab plate 1980 and Up.



Stock (standard) piston at TDC (top dead center)

Go-Parts™ Complete Camshaft Degreeing Instructions For Briggs & Stratton™ 5 HP Engines

"Degreeing a cam" describes the process used to verify that a cam is installed properly and aligned to the crankshaft as the engineers intended. Several methods can be used to degree a camshaft, Go-Parts™ explains the "Intake Centerline Method" below. It's quick, easy, and accurate.

Note: Remember that your goal is a hi-performance racing engine, it is in your best interest to follow these instructions. By not following these simple steps, you may reduce horsepower, efficiency, and the performance of your engine.

Note: You can not degree a cam accurately without a degree wheel , a dial indicator , and a fixture to hold the dial indicator.

- ⌚ We will assume at this point that you have installed your camshaft, that the cam gear timing mark and the crank gear timing mark are aligned, and that both valves are closed. (If the marks are aligned and a valve is open, you need to remove the camshaft and rotate it 180 degrees)
- ⌚ Install a dial indicator for checking the height of the intake valve lift. (Always use a checking valve or a new valve when degreeing a cam to insure the absence of valve lash)
- ⌚ Rotate the crankshaft to TDC (top dead center) and install a degree wheel on the crankshaft. Then install the degree wheel pointer aimed at the zero position of the

degree wheel and also align the zero position of the dial indicator to the indicator's needle as a reference point.

- ⌚ **While facing the flywheel side of the engine**, rotate the crankshaft clockwise until the dial indicator reads maximum lift and reset the indicator to zero.
- ⌚ Rotate the crankshaft counterclockwise until the dial indicator reads 0.100"
- ⌚ Rotate the crankshaft clockwise until the indicator reads 0.050".
- ⌚ Record the degree wheel reading.
- ⌚ Rotate the crankshaft further clockwise until the indicator rises to maximum lift and back to 0.050".
- ⌚ Record the degree wheel reading.
- ⌚ Add the two readings from the degree wheel and divide by 2 to find the intake centerline for your setup.
Example: $156 + 46 = 202$, $202/2 = 101$
- ⌚ Compare your intake centerline to the intake centerline listed on your camshaft's spec sheet. (The numbers should be the same although $\frac{1}{2}$ degree either side is an acceptable variance due to crank gear and various other engine tolerances)
- ⌚ If the numbers do not match, there are a few possible reasons:
 - ⌚ you may be reading the degree wheel incorrectly, degree wheels have the low number on the right and the high number on the left. Re-check your degree wheel readings.
 - ⌚ you passed a specific point on the dial indicator and backup up a bit. Doing so may introduce errors. You must start over, do not pass a point and back up.
 - ⌚ the camshaft has been installed incorrectly, re-install the camshaft and try again.
 - ⌚ the crankshaft gear's manufacturing tolerances are at or beyond high or low limits. Gears are available that have multiple timing locations for making adjustment to correct or modify the way a camshaft aligns with a crankshaft.

STOCK CLASSES ONLY

Make Sure Your Stock Class Camshaft Meets WKA/IKF Profile Limits

Improper measurement or installation in stock classes can result in disqualification in post race tech inspections and may cause improper engine performance.

1. With the degree wheel and dial indicator still in place, rotate the crankshaft to TDC.
2. Rotate the crankshaft clockwise until the dial indicator reads 0.050" lift and record the reading on the degree wheel.
3. Continue recording the degree wheel readings at 0.050" lift increments until you reach maximum lift and record it's reading.
4. Keep rotating the crankshaft and record the readings at 0.050" increments as the valve closes until it is back to 0.050" of lift.
5. You should now have a list similar to the following:

Example

Lift	Degrees
0.	3 BTDC
0	12 ATDC
5	31 ATDC
0	56 ATDC
"	Maximum Lift

Your Readings

Lift	Degrees
0.050	
"	BTDC
0.100	
"	ATDC
0.150	

0. 1 0 0 " 0. 1 5 0 " 0. 2 0 0 " 0. 2 3 3 " 0. 2 0 0 " 0. 1 5 0 " 0. 1 0 0 " 0. 0 5 0 "	36BBDC 10 BBDC 10 ABDC 29ABDC
" 0.200 " 0. " 0.200 " 0.150 " 0.100 " 0.050 "	ATDC _____ ATDC Maximum Lift _____ BBDC _____ BBDC _____ ABDC _____ ABDC

6. Perform these steps for the exhaust valve as well as the intake valve, then compare your readings with the ranges in the WKA/IKF Tech Manual to reveal potential inconsistencies and avoid disqualification.

- ⌚ Once you have the correct intake centerline reading, you are finished degreeing your camshaft and will want to set the [valve lash](#) .
- ⌚
