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**Sportster Evolution Engine Cam**  
**Gear Installation Instructions**  
**1986 and Later engines**

**IMPORTANT NOTE:** EV Sportster cams for 1991 and later are not interchangeable with earlier EV XL cams. For this reason, Andrews Products '91 and later EV Sportster cams are marked with letter "N". Cams for 1986-1990 engines are marked with a letter "V". Lobe angles and cam gear lengths are different for 1991 and later cam gears.

1. Sportster cam gears for 2000-up are slightly different from '91-'99. The #2 cam drive gears for 2000-up engines have 46 teeth while #2 drive gears for '91-'99 drive gears have only 36 teeth. 2000 style drive gears can be installed on earlier #2 cams to permit correct installation on 2000-up Sportster engines. There are no other differences between '91-'99 and 2000-up Sportster cam gears.
2. Check all 4 new cams to make certain that your set includes a #1, #2, #3 and a #4 cam. All four cam gears in each set should be the same grind (all N4 or N6 etc.). If there are questions regarding this point, call us.
3. Remove fuel tank and engine rocker box top covers. Each rocker arm must be removed in order to remove the pushrod. If you intend to reuse stock pushrods, mark them for reinstallation in their original location.
4. Remove ignition parts, outer cam timing cover and stock cam gears. The outer cam timing cover will be used as a gauge to check the gear tooth fit for all four new cams. Checking gear tooth fitment of your new cam gears **in your stock cover** is very important! Do not skip this step!
5. Cylinder heads for 2004 and later engines are different from earlier Sportsters. For 2004 and later engines, N3 cams will bolt in. ALL OTHER GRINDS will require head modifications for installation.
6. Warning: When upgrading 883 engines to 1200cc, valve clearance pockets in new 1200 pistons may not match the valves in 883 heads! Valve clearances must be checked! Valves on 883 heads are closer together than 1200 heads and therefore require piston to valve clearance checking on all 883 to 1200 conversions.

**CHECKING CAM GEAR TOOTH  
SIZE VERIFICATION**

7. The following steps are covered in Andrews Products catalog (with a nice picture illustration).
  - a. Install all 4 cam gears in cover for a trial fit (see photo in catalog) .
  - b. With your fingers, turn all four cam gears and verify that they roll freely. If there is no tightness, proceed to step f. Note: If you can't turn the gears with your fingers, they are too tight.
  - c. If there is any tightness or binding, remove #4 cam, then #1, then #3, in that order so that the tight fitting part(s) may be identified and measured. Cam gears which bind should not be installed without further examination and inspection. Tight or binding gears can cause cam gear damage!
  - d. Measure any cam gear which shows a tight fit using a micrometer and two .108" dia. pins. Our catalog shows a photo of pins to measure tooth sizes. Next measure a stock cam gear. Note any differences in size.
  - e. Andrews Products makes under or oversized cam gears for some EV Sportster cams. Unused parts may be returned to Andrews Products and exchanged for under or oversized cam gears.
  - f. Next, install the cover on the engine with no pushrods and only the #2 cam gear. Verify that the engine turns without no binding. If there is no binding, the gear backlash is correct. Installation can now proceed.

- g. If the #2 cam gear is tight, a smaller #2 drive gear (from Andrews) can be used or the #2 drive gear from your stock #2 cam can be used by pressing it off the stock gear and onto the new gear. If the stock #2 drive gear is reused, the timing relationship between the lobe tip and timing marks must be correct!
  - h. Pairs of cam gears (1-2), (2-3), (3-4) can be installed in the cover to check for proper backlash by comparing the stock parts (2 at a time) to the new ones.
  - i. Significant differences in sizes between stock cam gears and new cam gears should be investigated and corrected before proceeding.
8. Andrews Products has a gear tooth honing machine to reduce cam gear tooth sizes for proper fitting to a cam gear cover. If your cam gear teeth need to be made smaller, call for further information. There may be a charge for custom cam gear tooth honing.
  9. New cam gears can now be installed. Reinstall gear cover. Make sure that each cam gears have correct end play as per H/D service manual (.012-.020 inches). (Insufficient end play will result in cam overheating and failure of the part).
  10. The following cam grinds are made with stock size base circles so stock pushrods will fit back into original locations. (Stock pushrods for N series cams, 1991-up, are non-adjustable): V2, N2, N3, V4, N4, V6, N6, V8, AND N8.
  11. Cam grinds V9, N9, BV, and NV are ground with smaller base circles so cam lobe tips will clear engine cases. Therefore pushrod lengths for these 4 cam grinds need to be .035/.040 inches longer than stock for the intakes and .015/.020 inches longer for the exhausts. (Engines with milled heads will usually require custom length pushrods).
  12. Andrews Products makes adjustable aluminum pushrods which will simplify this installation. Adjustable pushrods are made in sets of 4 identical length rods. To install, adjust to shortest length, then position in engine with rocker installed. Next, adjust pushrod longer until all freeplay is gone. Then turn adjuster out 4-4.5 full turns (24-27 flats) and tighten locknut. Wait until hydraulic unit bleeds down and repeat procedure on next pushrod. Adjustable black aluminum pushrod kits (4 pushrods) are available as part# 292020. For super rigidity, adjustable steel pushrods are also available (part # 292090, 4 pushrods).
  13. Stock '91-up engines use fixed length (non-adjustable) pushrods. Andrews Products makes both steel and aluminum fixed length pushrods for the 1991 EV Sportsters. (Steel pushrods: part #292095, Aluminum: #292025). For '91 and later Sportster engines, the two shorter rods are intakes and the longer rods are exhausts. For '84-'89 engines all four pushrods are the same length.
  14. If adjustable pushrods are to be installed, it will be necessary to set each pushrod length before installing the outer covers (since the outer covers do not collapse for pushrod adjustment). Or you can use an aftermarket cover kit which will telescope shorter (to permit pushrod adjustment).
  15. New EV hydraulic lifters are capable of 6000+ RPM without floating. We are recommending that solid lifters not be used with any cam grinds **below the V80 series**. V2 or N2 cams will bolt in without head work. V4, N4, V6, N6, V8 or N8 cams need .530 as minimum valve travel. Checking valve travel and piston-valve clearance is recommended on all but V2 and N2 cams.
  16. Constant velocity type Keihin carburetors may run better if the piston return spring force is reduced slightly by removing 1/2 to 1 full spring coil and raising the metering rod up .030 " by installing a .030 shim under the rod snap ring (at the top of the rod). The slow jet can be richened 3 or 4 sizes.
  17. Final tuning of carburetors with bigger cams sometimes requires richer jetting. For stock H/D Keihin butterfly type carbs, #65 slow jets and #170 main jets work well. An Andrews Products High-Flow Accelerator Pump kit will also improve low speed and mid range throttle response on butterfly type Keihin carburetors (1988 and earlier). (Part# 269050).
  18. Andrews Products makes steel upper spring collars for EV Sportsters (part# 293115, 4 Pcs). *This part number is intended for '86-'03 engines*. Steel collars (use with stock keepers) are light, strong and will add .050 extra spring travel to stock valve springs. Steel collars can be installed without any additional head work when using V4, N4, V6, N6, V8 or N8 cams. (But piston clearances still must be checked on N6, V6, N8, V8, N9, V9 and all of the series 80 high lift cams). *Andrews springs and collars fit '86-'03 ONLY*.

## EVOLUTION SPORTSTER CAM TIMING

<u>Grind</u>	<u>Timing</u>	<u>Duration</u>	<u>Valve Lift</u>	<u>Spring Travel</u>	<u>Springs</u>	<u>Lift @ TDC</u>
Stk D	02/41	223	.458	Comparison Data	Stock	.094
	41/02	223	.458		-	.094
V2	22/38	240	.465	.495	Stock	.180
N2	46/18	244	.440	.470	-	.155
N3**	22/38	240	.465	.495	Stock	.189
	43/11	234	.482	.512	-	.132
V4	30/46	256	.490	.530	Stock	.216
N4	52/24	256	.490	.530	-	.189
V6	34/50	264	.500	.530	Stock	.241
N6	56/28	264	.500	.530	-	.212
V8	32/44	256	.490	.530	Stock	.226
N8	56/28	264	.500	.530	-	.212
V9	33/53	266	.555	.600	Andrews	.240
N9	53/33	266	.555	.600	-	.240
BV	35/59	274	.590	.640	Andrews	.260
NV	59/35	274	.590	.640	-	.260
V80	32/60	272	.600	.650	Hi-Lift	.264
N80	66/30	276	.600	.650	(160 Lbs)	.244
V83	32/64	276	.630	.680	Hi-Lift	.267
N83	70/30	280	.630	.680	(160 Lbs)	.248
V87	34/70	284	.670	.720	Hi-Lift	.283
N87	76/32	288	.670	.720	(160 Lbs)	.269

- \*\* N3 cams are specifically designed as bolt in cams for 2004 and later Sportsters only!
1. "N" grind cams apply to '91 - up; "V" cams are '86-'90 engines
  2. Timing specs taken @ .053 cam lift in crank degrees.
  3. Spring travel figures minimum for setting coil bind.
  4. Valve lift is calculated by multiplying max cam lift by a 1.633 rocker ratio.

**Note:** Andrews Sportster collars and springs will only fit 1986-2003; later engines use beehive springs and 7mm valve stems.