Buell Blast Cam Gear Installation Instructions

1. Both cam gears in each set should be the same grind (B-50 or B-70).

2. Remove fuel tank and engine rocker box top cover. Each rocker arm must be removed in order to remove the pushrod. If you intend to reuse stock pushrods, mark them for reinstallation later.

3. Remove ignition parts and stock cam gears. The outer cam gear case cover will now be used as a gage to check the gear tooth fit for both new cams. Checking the gear tooth fit for your new cams is very important! Do not skip this step!

4. To check the installed fit on your new Blast cams:

a. Install both cam gears in the outer cover for a trial fit.

b. With your fingers, turn the two 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, you may test each of the Andrews Blast cams against the mating stock cam gear so that the tight fitting part can be identified. In other words, a B50 #2 cam gear can be installed in the outer cover and rolled against a stock #1 cam gear. This is one way to identify either cam gear for correct fitment. Cam gears which bind should not be installed without further examination and inspection. Tight or binding gears can cause cam gear damage!

d. Measure the cam gear which fits using a micrometer and two .108" dia. pins. Do the same with the stock cam gear. Note any differences in size.

e. If either cam gear is too tight, Andrews Products can gear hone the teeth to fit correctly.

f. Next, install the cover onto the engine with no pushrods and only the #2 cam gear. Verify that the engine now turns without any binding. If there is no binding, the cam gear backlash is correct and you can continue to reassemble the engine.

g. If the #2 cam drive gear is tight, a smaller pinion gear (from H/D) must be used. (Our catalog also describes a procedure to determine the correct size for a different size pinion gear).

5. Andrews Products has a tooth honing machine which can be used for reducing the size of cam gear teeth for proper fitting to a cam gear cover. If you think your parts need this work done, call for further information. There may be a charge for this type of custom fitting.

6. New cam gears can now be installed. Reinstall gear cover. Make sure that each cam gear has 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.

7. B50 and B70 Buell cams need piston to valve clearance checked. Stock pushrods can be reused since stock size base circles are used on both B50 and B70 cams.

8. Modified engines will usually require custom length pushrods.

9. Andrews Products makes chrome-moly adjustable pushrods (part # 292035) which will simplify this installation. Adjustable pushrods are made in sets of 2 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.

10. 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 allow pushrod adjustment).

11. H/D hydraulic lifters are capable of 6000+ RPM without floating. We are recommending that solid lifters not be used with either Buell cam grinds. B70 cams need .570 minimum valve travel. Checking valve travel and piston-valve clearance is recommended on B50 and B70 cams.

12. Keihin carburetors may need retuning with different size jets for best running.

BUELL BLAST CAM TIMING SPECS

Grind	Timing	Dur	Valve Lift	Spring Travel	Springs	Lift @ TDC
STK W	9.5/25.5	215	.475	COMPARISON	STOCK	.073
	39/11	230	.475	DATA	-	.080
B50	16/32	228	.498	.530	STOCK	.163
	43/15	238	.498	.530	-	.146
B70	22/38	240	.530	.570	ANDREWS	.191
	48/20	248	.530	.570	HI-LIFT	.156

1. Timing specs taken @ .053 cam lift in crank degrees.
2. Valve lift is calculated by multiplying max cam lift by 1.633 rocker ratio.
3. Spring travel figures are listed as the minimum for setting coil bind.

IMPORTANT NOTE:

On first production runs of B50 and B70 cams, the two timing marks which are to be used for cam gear installation have been highlighted with red paint. ***All other timing marks are to be ignored!*** With a clock face for reference and the crankshaft in position for cam gear installation, the mark which lines up with the #1 gear will be approximately at 4:00 o'clock and the mark which lines up with the pinion gear will be located approximately at 7:00 o'clock. The ignition drive key will be near 12:00 o'clock.

ANDREWS PRODUCTS, INC.

EVOLUTION ENGINE CAM INSTALLATION INSTRUCTIONS

Important Notes:

A. EV engines with stock electronic ignition systems automatically adjust ignition spark advance so that engines cannot rev beyond approximately 5200 RPM. To reach higher engine RPMs, either an H/D Eagle ignition module or Sportster ignition module can be installed. These modules also retain the vacuum ignition advance system which is well worth having on any street bike.

B. Camshafts for Shovel engines should not be used in EV80 engines. The two engines have different lifter block tappet angles. Valve timing for Shovel cams installed EV80 engines will not be correct resulting in poor engine performance, possible piston/valve and valve/valve interference.

1. Andrews cam grinds, EV1, EV13, EV23, EV27, EV31, EV3, EV38 and EV46 are made with stock size base circles so stock pushrods will be the correct length. Installing higher lift cams will require adjustable pushrods or longer fixed length pushrods to accommodate cams with smaller than stock base circles (EV5, EV51, EV57, EV59, EV7, EV72, EV79 or bigger cams).

2. Remove fuel tanks and engine rocker box top covers. Each rocker arm must be removed in order to remove the pushrods. If you will be reinstalling the stock pushrods, mark them so they can be replaced into their original locations. Not all stock pushrods are the same length.

3. Remove ignition cover and stock cam. Measure installed length of stock cam and new cam. Cams for 1984-'87 engines should measure 3.025 inches from front face of gear to thrust shoulder surface. Cams for ’88 and later EV engines need to be shimmed to 3.075 (+.050 longer) because of a factory design change in the length of all '88 and later camshafts. Proper end play for installed camshafts is .010 /.015 inches. EV engines use the same shims as shovels. Spacer shims are listed in EV-80 parts books and are available from H/D dealers.

4. To make sure that your new camshaft drive gear will operate quietly, the cam gear to pinion backlash must be correctly set up. Proper backlash is .0000/.0005 for a cold engine. Andrews Products recommends that BOTH the new gear and the original gear be measured as described on the last page of these instructions. If both gears measure within .0005" of the same size, it should NOT be necessary to change gears. If a different size gear is required, Andrews Products has them. Excess backlash will cause gear noise which sounds like loose lifters but will not hurt anything. Insufficient backlash will cause a distinct gear whine and should be corrected since gear tooth damage will result over a short time period.

5. Install new cam, then replace gear cover and ignition parts. When reinstalling rocker arms and adjustable pushrods, the engine should be positioned to TDC (first on front cylinder, then rear) with the intake and exhaust lobes at minimum lift (both valves closed). Engine will now be at the top of the compression stroke for that cylinder (where both pushrods can be adjusted correctly).

6. Now tighten the rocker arm screws evenly until they are firmly seated. If the valve unseats during this sequence, wait 10/15 minutes until the lifter bleeds down before tightening the other rocker arm. Following this procedure will eliminate any chance of valve/valve interference during installation. Andrews Products makes adjustable aluminum pushrods and adjustable chrome moly steel pushrods. Adjustable pushrods will simplify this installation.

7. Adjustable aluminum and steel pushrods are made in sets with 1 long (front exhaust), 1 intermediate (rear exhaust) and 2 short (intakes) rods. To install, adjust pushrod to its' shortest length, then position in the engine with rocker installed. Now lengthen pushrod until all free play is gone. Then adjust pushrod 4-4.5 full turns longer (24-27 flats) and tighten locknut. Wait until hydraulic unit bleeds down and repeat procedure on next pushrod. Pushrod kit part numbers are 292110 for aluminum rods and 292140 for chrome moly steel rods.

8. New EV hydraulic lifters are capable of 6000+ RPM without floating. We are recommending that solid lifters not be used with any of these cams. Also, EV1, EV13, EV23, EV27, EV31, EV3, EV38 and EV46 cams will bolt in without head work. EV35, EV5 and EV51 cams need .560 as minimum valve travel. EV57, EV59, EV7, EV72, EV79 cams need .590 minimum valve travel. Andrews Products titanium upper spring collars are light, strong and will add .050 travel to stock valve springs. With high lift titanium collars, EV5, EV51, EV57, EV59, EV7 and EV72 cams will be much easier to install. Titanium collars are Part# 293110, (includes 4 pcs).

9. Final tuning of carburetors with bigger cams sometimes requires richer jetting. For stock H/D Keihin butterfly carbs #60 slow jets and #165 main jets work well. CV carbs (’89 and later) use slow jets #48 to #50 and 195 main jets. For 1988 and earlier Keihin carbs, an Andrews Products High Flow Accelerator Pump kit will also improve low speed and mid range throttle response. (Part# 269050).

10. All EV23, EV27, EV31, EV3, EV46, EV35, EV5, EV51, EV57, EV59, EV7, EV72, EV79 and EV9 installations may require relieving of the engine case bearing boss to create clearance for the rear intake cam lobe tip. (This is the lobe furthest away from the gear). Clearance can be checked by temporarily removing lifters, installing outer cam cover and SLOWLY rotating engine. If interference is felt or if the rear intake cam lobe tip appears to be touching the engine bearing boss, remove small amounts of aluminum from the bearing boss to relieve the interference. Don't ignore this step!

11. HI-LIFT cams (EV81, EV84, EV88) are intended for highly modified engines and require expert knowledge and experience. Machining of cases is required for these cams also.

NOTE - ENGINES (1990-up): Stock 1990-up H/D cam drive gears have 2 grooves on gear face while 1977-89 gears have only one. All Andrews Products drive gears have 1 groove on cam gear.

Service manuals for 1990 and later engines show different gear tooth measurements for 1990 and later camshaft drive gears than for camshaft drive gears for earlier years. Andrews Products standard size cam gears will be correct for most 1990 and later engines. For a small number of engines having cam gears color coded green or black, an oversize Andrews cam gear (part# 212077) may be needed.

There are 2 basic differences relating to 1990 and later cam gear sizes:

A. The size range of gears from the largest to the smallest has been reduced from .006" to .003". The largest gears are the same size for '77-'89 and 1990-up (green and black color codes).

B. For gear sizes have been listed for .108" pins instead of .105" pins. Measurements with .108" pins are approximately .011" larger than with .105" pins (for the same gear).

EVOLUTION CAM TIMING SPECIFICATIONS

GRIND	TIMING	DURATION	LIFT	SPRINGS	VALVE LIFT (TDC)	SPRING TRAVEL (MIN)
Stock	-06/38	212	.472	STOCK	.062	STOCK
84-87	25/-03	202	.472	-	.078	STOCK
Stock	01/37	218	.495	STOCK	.091	STOCK
88-91	53/-01	232	.495	-	.083	STOCK
Stock	-02/30	208	.472	STOCK	.070	STOCK
92-94	31/-09	202	.472	-	.049	STOCK
EV1	12/34	226	.485	STOCK	.143	.540
	34/12	226	.485	-	.143	.540
EV23	10/30	220	.498	STOCK	.134	.540
	40/08	228	.498	-	.121	.540
EV13	15/31	226	.498	STOCK	.161	.540
	45/13	238	.498	-	.148	.540
EV27	20/36	236	.495	STOCK	.182	.540
	46/14	240	.495	-	.166	.540
EV31	10/46	236	.495	STOCK	.133	.540
	52/08	240	.495	-	.122	.540
EV3	21/37	238	.495	STOCK	.190	.540
	43/15	238	.495	-	.163	.540
EV46	25/41	246	.495	STOCK	.205	.540
	49/17	246	.495	-	.168	.540
EV35	21/37	238	.495	ANDREWS	.190	.560
(1)	52/20	252	.530	-	.190	.580
EV38	21/37	238	.495	ANDREWS	.190	.560
(1)	52/20	252	.500	-	.182	.560
EV51	28/44	252	.510	ANDREWS	.233	.560
	54/22	256	.510	-	.195	.560
EV5	28/44	252	.530	ANDREWS	.240	.580
	52/20	252	.530	-	.190	.580
EV57	26/46	252	.530	ANDREWS	.227	.590
	59/27	266	.560	-	.223	.610
EV59	28/48	256	.560	ANDREWS	.236	.610
	56/24	260	.560	-	.208	.610
EV7	31/55	266	.560	ANDREWS	.249	.610
	59/27	266	.560	-	.223	.610
EV72	30/54	264	.560	ANDREWS	.246	.610
	60/28	268	.560	-	.230	.610
EV79	31/55	266	.560	ANDREWS	.249	.610
	64/32	276	.550	-	.250	.610

(1) *EV35 and EV38 cams differ only in the maximum exhaust cam lift.*

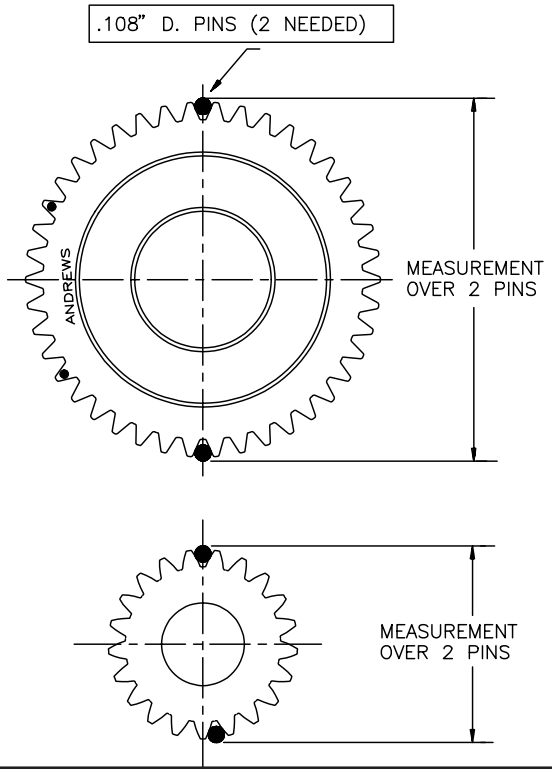
EVOLUTION CAM TIMING SPECIFICATIONS

GRIND	TIMING	DURATION (.053)	DURATION (.020)	LIFT	SPRINGS	VALVE LIFT (TDC)	SPRING TRAVEL (MINIMUM)
EV9	36/60	276		.550	ANDREWS	.274	.590
	64/32	276		.550	-	.250	.590
EV81	32/60	272	306	.610	HI-LIFT	.262	.650
	66/30	276	310	.610	160 LBS	.244	.650
EV84	32/64	276	310	.640	HI-LIFT	.269	.690
	70/30	280	314	.640	160 LBS	.246	.690
EV88	34/70	284	318	.680	HI-LIFT	.288	.730
	76/32	288	322	.680	160 LBS	.264	.730

Cam / Pinion Gear Color Code Chart

Color Codes	HD Part #(1)	Pinion Gear Size(2)	Cam Gear Size(2)	Andrews Sizes *(Cam Gears Only)*
Orange	24040-93	1.4853-1.4850	2.7472-2.7476	2.7455-2.7465 Small size
White	24041-93	1.4849-1.4846	2.7477-2.7481	-
Yellow	24042-93	1.4845-1.4842	2.7482-2.7486	-
Red	24043-93	1.4841-1.4838	2.7487-2.7491	2.7485-2.7491 Standard size
Blue	24044-93	1.4837-1.4834	2.7492-2.7496	-
Green	24045-93	1.4833-1.4830	2.7497-2.7501	-
Black	24046-93	1.4829-1.4826	2.7502-2.7506	2.7495-2.7505 Large size

(1) HD part numbers are for matched sets and shown here for size comparisons.
(2) All sizes listed for measurements with .108" gage pins.



If you need to compare relative sizes of cam or pinion gears for purposes of proper gear pitch sizing, the above table may be helpful. For quiet operation, new cam or pinion gear pitch measurements should be identical or +.0005 larger than old parts. (Assuming that old parts were operating without excess noise).

Andrews Products, Inc.

WARNING!!
CONVERSION CAMS
Will NOT FIT 2007
or LATER ENGINES!

WARNING!!
CONVERSION CAMS
Will NOT FIT 2007
or LATER ENGINES!

Installation Instructions: Conversion cams: Roller Chain Drive to '99-'06 Twin 88 engines

Conversion cam kits
Part numbers and years:

1999-2001 288999
2002-2006 288902

We recommend that you refer to a current '06 Dyna or later factory service manual and follow factory procedures for camshaft removal and replacement.

1. Andrews Products conversion cams operate with 2006 Dyna or 2007 roller cam chain drives and use stock size lobe base circles. Therefore, unless you have modified the cylinder heads, the original stock push-rods will be the correct lengths. If the original pushrods will be reinstalled, removing the fuel tank(s) and rocker boxes will be necessary. Mark the pushrods so they can be replaced in their original locations since not all stock pushrods are the same length.

2. To save installation time by NOT removing fuel tanks and rocker boxes, the stock pushrods can be cut with bolt cutters and then removed in two pieces. EZ-install pushrods can then be installed. They are available in aluminum or chrome moly steel. Andrews Products part numbers for EZ-install pushrods are: 292188 for aluminum and 292088 for steel pushrods.

3. Remove 10 screws holding outer cam cover. When this cover is reinstalled, there is a specific tightening sequence and torque rating for all 10 screws. *VERY IMPORTANT: Overtightening cover screws can cause aluminum engine case threads to strip.*

4. Before proceeding further, put the transmission in 4th or 5th gear. Remove both spark plugs so there will be no resistance from compression pressure. Now turn the rear wheel and align camshaft timing marks. This will simplify installation of new cams.

5. Remove the crankshaft sprocket retaining bolt and the rear camshaft sprocket retaining bolt. Both the crank-shaft sprocket and the rear cam drive sprocket can now be removed. They will be replaced with new sprockets for roller chain cam drive system.

6. Remove the original cams and cam support plate. All four oil pump retaining bolts must also be loosened to permit correct oil pump rotor alignment at the time of reassembly after the cam support plate is in place with the new camshafts. The old cam support plate will be replaced with the new assembly.

7. Converting 1999-2006 silent chain cam drives to the 2007 style roller chains requires new HD parts. Also required are two new Andrews conversion camshafts. ***Andrews Products conversion cam kits include ALL of the required parts.*** Part numbers listed, top of page.

8. A complete listing of required parts appears below.

9. "N" series camshafts from Andrews Products **must be used** for fitting roller chains to earlier engines. *Series "N" cams are similar to 2006 Andrews Dyna cams except that the inner bearing journals are .875 instead of 1.000. Roller chain conversions for '99-'06 engines* ***require*** *.875 diameter inner camshaft journals to fit right engine cases.*

10. The new conversion cams, inner chains and the new '06 type support plate can now be assembled as described in the '06 Dyna HD service manual.

11. Again referring to a factory parts manual, the front cam thrust washer should be 0.100 thick. Figure 2 on page 3 shows the .100 thrust washer assembled on the front camshaft ***with proper end play specified.***

12. With new camshafts in place, the new cam support plate assembly can be reinstalled back into the engine.

Some HD parts are required for conversion cam installation. All of these parts are available as complete kits from Andrews. See top of this page for Andrews part numbers for complete cam kits.

See photo on page 3

HD Part#	Description
26037-06	Oil pump assembly
25355-06	Cam support plate assembly
4741A	Cam Support plate mounting screws; (10 pcs req'd.)
11461	Retaining ring (for front cam)
25683-06	Inner roller chain
39969-06	Inner chain tensioner
4740A	Inner chain tensioner mounting screws; (2 pcs req'd.)
25675-06	Outer roller chain
39968-06	Outer chain tensioner
942	Outer chain tensioner mounting screws; (2 pcs req'd.)
25729-06	Spacer (.100 for cam alignment; use as required)
25731-06	Spacer (.110 for cam alignment; use as required)
25734-06	Spacer (.120 for cam alignment; use as required)
25736-06	Spacer (.130 for cam alignment; use as required)
25737-06	Spacer (.140 for cam alignment; use as required)
25738-06	Spacer (.150 for cam alignment; use as required)
25673-06	Crankshaft pinion shaft sprocket (17 teeth)
25244-99A	Outer cover gasket
25728-06	Stock rear cam sprocket (34 teeth) ***(2002-'06 only)*** *Use of stock '06 sprockets on '99, '00 or 2001 conversion cam installa ions will result in engine alarm light always ON!* Following part ***MUST*** be used wi h all '99, '00, '01 engines)!
216015	Andrews rear cam sprocket part number (34 teeth)

Some of the screws listed above are the same as in earlier engines and they can used again.

WARNING! Conversion cams will not fit '06 Dynas or 2007 and later engines!

13. After a trial assembly, alignment of crankshaft sprocket and cam sprocket positions must be checked and adjusted with shims if necessary. See factory manual for proper procedure. Make sure all timing marks are aligned before proceeding!

14. Installing the new 34T sprocket requires using either the original sprocket spacer or a new spacer from HD if the original is not the correct thickness for your engine. HD makes shims and spacer washers in 6 different thicknesses.
    HD Part numbers are:

25729-06	0.100 inches
25731-06	0.110 inches
25734-06	0.120 inches
25736-06	0.130 inches
25737-06	0.140 inches
25738-06	0.150 inches

VERY important: both cams must have as a **minimum:** .008-.010 end play in cam support plate! See figures 1 & 2 below:

15. When installing sprocket retaining bolts, use Loctite retaining compound to secure the bolt threads. Bolt torque should not exceed 25 ft-lbs for 5/16 x 18 bolts. Bolt torque for splined rear camshafts (3/8 x 24 bolt) should not exceed 35 ft-lbs. Please note that both cam retaining bolts must be rated grade 8. Grade 8 bolts have a 6 pointed star symbol on the top of the bolt heads.

16. Reinstall the outer cam cover with the 10 cover bolts. Cover bolts must be tightened to a torque specification of 90-120 in-lbs. The service manual shows the correct tightening sequence.

17. EZ-install pushrods use 2 long (exhaust), and 2 short (intake) rods. To install, adjust pushrod to shortest length, then position in engine, rocker arm end first. Swing the lower end into lifter. Lengthen pushrod adjuster until all free play is gone. Adjust pushrod 3.5-4 full turns longer (21-24 flats) and tighten locknut. Wait until hydraulic unit bleeds down and repeat procedure on next pushrod. When adjusting pushrods, make sure that cam lobe for that pushrod is on low lift point. Lifter housing covers can be temporarily removed to gain another 1/4 inch of clearance. Short pushrod cover tubes are available from HD. Short pushrod cover tubes make the pushrod adjustment easier. Part numbers are: 17938-83 and 17634-99. You will need 4 of each part number to install a complete set.

18. For engines with stock pistons and stock heads, 12N**, 21N, 26N, 31N, and 37N cams should be able to bolt in without head work. 50N cams need piston to valve clearances and valve to valve clearances checked. 50N, 54N and 55N cams need .620 minimum valve travel and .060 minimum piston to valve clearance. With Andrews Products high lift steel collars (part# 293115; includes 4 pieces), setting valve spring travel for either of these two higher lift cams will be easier. *Andrews collars fit 1999-2003, Heads for 2004-2006 engines use beehive type springs.*
    ***12N cams are similar in specifications and performance to stock 88 cams.*

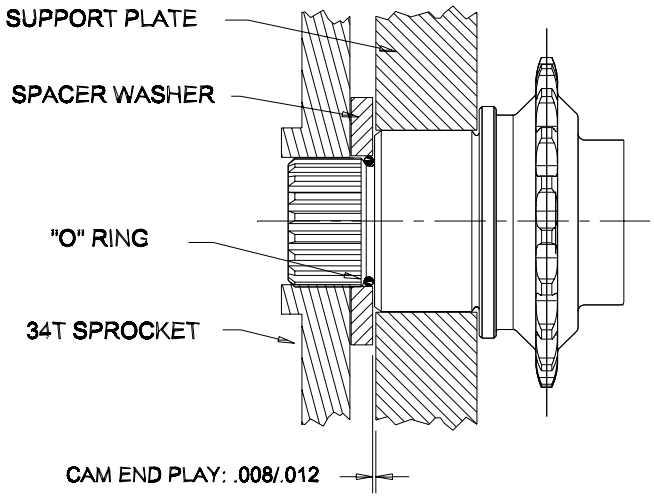


Figure 1: Rear camshaft

Rear Andrews cams manufactured after *July, '06*, do not use an "O" ring to align the spacer washer. To adjust alignment of 34T rear cam sprocket and 17T crankshaft sprocket, HD spacer washers are available in 6 different sizes. Cam end play should be .008/.012 minimum, as shown.

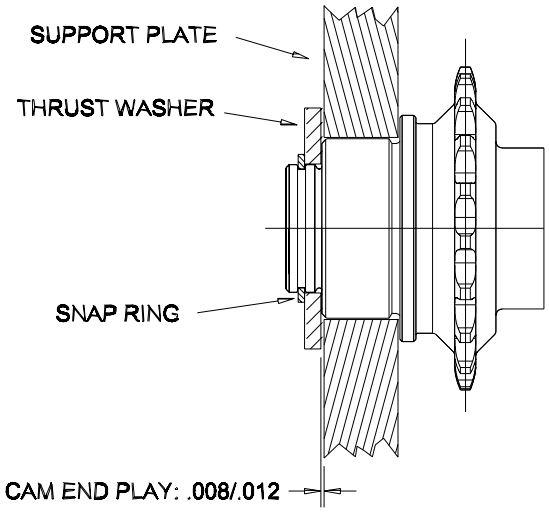


Figure 2: Front camshaft

HD service manuals for '06 Dyna and all later twin cam engines specify a .100 thick thrust washer on the outside end of the front camshaft. Front cam end play should also be .008/.012 minimum.

Conversion parts

Andrews Products: Roller Chain Conversion Camshafts

Andrews#	Grind	Timing*	Duration*	Lift	Springs	TDC Lift	Spring Travel
--------	HD Dyna ('06 fuel inj)	02/34 41/-02	216 219	.473 .473	Stock -	.087 .110	Stock Stock
216812	12N	02/34 40/02	216 220	.489 .489	Stock -	.091 .095	Stock Stock
216821	21N	10/30 40/08	220 228	.498 .498	Stock -	.134 .121	Stock Stock
216826	26N	11/35 41/09	226 230	.490 .490	Stock -	.138 .120	Stock Stock
216831	31N	10/46 52/08	236 240	.510 .510	Stock -	.131 .120	Stock Stock
216837	37N	18/38 46/14	236 240	.510 .510	Stock -	.174 .148	Stock Stock
216854	54N	16/42 43/15	238 238	.555 .555	Hi-lift -	.165 .158	Stock Stock
216850	50N	20/48 54/18	248 252	.510 .510	Stock -	.184 .168	Stock Stock
216855	55N	22/46 52/20	248 252	.550 .550	Hi-lift -	.197 .181	.620 .620
216867	67N	24/48 58/22	252 260	.570 .570	Hi-lift -	.209 .187	.620 .620

*Timing and duration listed for .053 cam lift

IMPORTANT NOTE for 1999 engines.
If you are converting a 1999 engine to new roller chains, please read the following page!

IMPORTANT NOTE for 1999 twin cam engines:

When converting a 1999 engine to new roller chain cams, please note the following!

This page only applies to **early 1999 engines.** To identify the engine as an early 1999, examine the cam support plate as illustrated in the circled area. (figure 1)

If the part number on the left front face of the cam support plate reads: **H-D 25245-99,** the engine is an early 1999.

The part number used on later 1999 engines is: **25245-00**. If your engine is a late '99 (or later), disregard the rest of this page, it is not relevant.

figure 1

Early '99 engines have a different oil supply system than later engines. Note the circled area on the photo (inside engine case to the left of the pinion shaft). (figure 2)

Early '99 engines **do not have** the oil boss shown circled in the photo. For early 99's, it will be necessary to block a matching oil port on the 2007 cam support plate. See figure 3 below.

figure 2

For 2007 cam support plates to operate properly with **early** '99 engines, the circled hole in photo must be permanently blocked. A 1/4 x 20 bottoming tap can be used to cut threads. A **self-locking** socket head set screw will then seal the port. The existing hole is correctly sized for the tap. **Do not drill it larger!** We will send, no charge, set screws (1/4 x 20 x 1/2) if you call us.

After tapping new threads in the support plate, make sure to clean out all metal chips before installing the set screw.

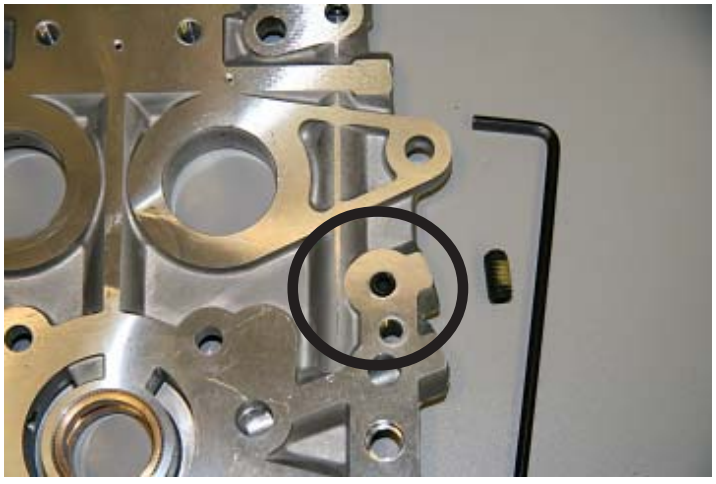


figure3

Calculating Internal Transmission Ratios And MPH

Since we get many questions regarding transmission gear ratios, a table of values for EV-80 transmissions is shown below along with an explanation of how the actual numbers are determined. The internal ratio (in any gear) is a combination of the speed gear ratio and the main drive gear ratio. The numbers below are the numbers of teeth on each mating pair of gears.

GEAR	Main Drive	Speed Gear	Overall Ratio*	% RPM Drop	MPH per 1000 RPM
1 (STK)	32 / 17	31 / 18	3.24	32	6.81
1 (CLOSE)	32 / 17	25 / 16	2.94	25	7.50
2	32 / 17	27 / 23	2.21	27	9.99
3	32 / 17	23 / 27	1.60	23	13.79
4	32 / 17	19 / 29	1.23	19	17.94
5	32 / 17	(DIRECT DRIVE)	1.00	---	22.07

* **Over gear ratios for '94 and later transmissions are different from listed numbers!**

To calculate the internal gear ratio in 1st gear for example, multiply 32 / 17 times 25 / 16;

(32 / 17 x 25 / 16) = 2.94

To calculate the internal gear ratio in 2nd gear for example, multiply 32 / 17 times 27 / 23;

(32 / 17 x 27 / 23) = 2.21

To calculate the internal gear ratio in 3rd gear for example, multiply 32 / 17 times 23 / 27;

(32 / 17 x 23 / 27) = 1.60

To calculate the internal gear ratio in 4th gear for example, multiply 32 / 17 times 19 / 29;

(32 / 17 x 19 / 29) = 1.23

To calculate MPH per 1000 engine RPM: (assuming a 25 inch diameter rear wheel and a stock 3.37 final drive ratio);

(25 x 3.14159) / 12 x (1000 / (3.37 x 60) x (3.0 / 4.4) = 22.07 MPH per 1000 ENGINE RPM (in 5th gear)

To calculate MPH per 1000 engine RPM: (assuming a 25 inch diameter rear wheel and a 2.76 final drive ratio);

(25 x 3.14159) / 12 x (1000 / (2.76 x 60) x (3.0 / 4.4) = 26.95 MPH per 1000 ENGINE RPM (in 5th gear)

To calculate MPH per 1000 engine RPM: (for a 25 inch diameter rear wheel and any final drive ratio);

(25 x 3.14159) / 12 x (1000 / (FDR x 60) x (3.0 / 4.4) = 74.34 / FDR

Or, MPH per 1000 engine RPM = 74.34 /FDR

To calculate MPH per 1000 engine RPM in 3rd gear: Divide MPH in 5th gear by the speed ratio; 1.60

(22.07 / 1.60) = 13.8 MPH per 1000 ENGINE RPM (in 3rd gear)

ANDREWS PRODUCTS, INC.

Sportster Evolution Engine Cam Gear Installation Instructions

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 drive 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. Any 2 adjacent 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 the stock cam gears and new cam gears should be investigated and understood before proceeding.

8. Andrews Products has a gear tooth honing machine for reducing the size of cam gear teeth for proper fitting to a cam gear cover. If you think your cam gear teeth need to be made smaller, call for further information. There may be a charge for this type of custom fitting.

9. New cam gears can now be installed. Reinstall gear cover. Make sure that each cam gear has 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 Titanium upper spring collars for Evolution Sportsters (part# 293110, 4 Pcs). Titanium collars (use with stock keepers) are light, strong and will add .050 extra spring travel to stock valve springs. Titanium 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).

EVOLUTION SPORTSTER CAM TIMING

Grind	Timing	Duration	Valve Lift	Spring Travel	Spring	Lift @ TDC
Stk D	02/41	223	.458	Comparison	Stock	.094
	41/02	223	.458	Data	-	.094
V2	22/38	240	.465	.495	Stock	.180
N2	46/18	244	.440	.470	-	.155
N3**	22/38	240	.465	.495	Stock	.181
	43/11	234	.482	.512	-	.134
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 !
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.

ANDREWS PRODUCTS, INC.

Camshaft Installation Instructions: H/D 74 & 80 Shovel & Pan Engines

a. Drive gears on 1977 and later cams are different! They have a 1.97 dia. groove cut into the gear face. Early and late cams drive gears are not interchangeable. Andrews Products makes both versions.

b. Some shovel engines made to mid 1977 have German inner crankcase cam bearings (H/D part# 9058). If so they will be marked "INA SCE138 GERMANY". They are prone to early failure and can cause camshaft bearing damage. The German parts should be replaced with a Torrington B138 drawn cup needle bearing.

1. Verify that your camshaft is the proper grind by inspecting the stamp on the end of the cam.

2. Remove push rods and engine side cover. Rotate engine to align timing marks before removing old camshaft. Make sure thrust washer (25550-36) and lock washer (25550-57) are removed and accounted for at this time.

3. Measurement between thrust shoulders of new and old cam should be approximately 3.025 inches. If there is a difference, thrust washers of varying thicknesses can be obtained from most H/D dealers. Camshaft end play should be set to .010-.015 inches (.25-.38mm).

4. After reinstalling outer cover (with gasket), remove either tappet block and check camshaft end play to verify that it measures to the recommended .010-.015 inches. Engine should roll freely at this point.

5. On all installations, clearance between the inner engine case and the rear intake cam lobe (closest to the small end) should be checked. Because of possible interference with tip of the rear intake cam lobe some engines will require removing approximately .020 from a casting boss in this area. This can easily done with a small die grinder and a rotary file. Make sure the inner case is clean out after this operation.

7. For cam grinds J, F, A, AB, BH, and #1 head work is normally not required when working with shovelhead motors. J and #1 grind cams are OK to bolt into a panhead motor. NOTE: For some 80 cu.in. motors (’80 &’81) cams having more than .430 lift require valve spring work for correct spring clearance. Andrews Products medium lift collars (part# 276150) will provide .060 extra spring clearance to easily solve this problem.

8. For engines with low compression (8.0 or less), grinds 1, 2 and 3 have big advantages. They will produce much more power and torque at low RPM. However with high compression pistons, pinging could be a problem.

9. If you have oversized valves, valve to valve clearances should be checked for .050 minimum clearance.

10. For all other cams having lifts higher than .485, installed spring heights must be correctly set up. Andrews Products makes springs and collars for correct installation of all drag and other high lift cams up thru a #14.

11. "B", "6","7" and "2" grind cams can be installed without machine work using Andrews Products medium lift upper collars (part# 276150). With stock springs and valves, spring travel should measure to about .510".

12. Cam grinds C, D, M, 9, 10, Z, 3 can be installed without machine work using Andrews Products high lift springs (part# 272110) and high lift alloy upper collars (part# 271100). They will permit cams of .600 lift to be installed with proper spring clearance.

13. Cam grinds S82, S84, and S86 require expert engine building experience and machine work for proper installation. These grinds are intended for all out drags with large displacement, highly modified engines. Spring kits for these cams typically require custom setups to match long stem length valves.

14. Andrews Products makes valve guides for early (thru '79) or late ('80-up) in various oversizes. They are made for "K" line oil seals. "K" line seals do a very good job of reducing oil consumption thru valve guides.

15. We also make superlight alloy pushrods for quiet street use as well as steel pushrods for higher output applications. Both styles are available in extra long length. Front exhaust is longest pushrod, rear exhaust is second longest and the intake pushrods are the two shortest.

16. Tappet adjustments are as per H/D for hydraulics and finger spin tight for solid lifters.

TIMING SPECIFICATIONS —— H/D 74 & 80 CAMS

GRIND	TIMING	DURATION	VALVE LIFT (TDC) SHOVEL	VALVE LIFT (TDC) PAN	SPRING TRAVEL SHOVEL	SPRING TRAVEL PAN	ILIFT SHOVEL	ILIFT PAN
J	21/41	242	.405	.425	.425	.440	.154	.162
	41/21	242	.405	.425	.425	.440	.154	.162
H	37/45	262	.426	.450	.446	.470	.206	.216
	45/37	262	.426	.450	.446	.470	.206	.216
F	16/48	244	.445	.465	.470	.490	.140	.148
	48/16	244	.445	.465	.470	.490	.140	.148
A2**	19/43	242	.450	.470	.470	.490	.156	.164
	50/18	248	.450	.470	.470	.490	.142	.150
AB	21/43	244	.450	.470	.470	.490	.156	.164
	50/26	256	.450	.470	.470	.490	.170	.180
BH	24/52	256	.450	.470	.470	.490	.156	.164
	52/24	256	.450	.470	.470	.490	.156	.164
B2**	26/50	256	.485	.507	.505	.525	.187	.198
	53/25	258	.485	.507	.505	.525	.176	.186
7**	29/53	262	.510	.535	.530	.555	.206	.217
	59/27	266	.510	.535	.530	.555	.186	.196
C	37/61	278	.525	.550	.545	.570	.234	.245
	61/37	278	.525	.550	.545	.570	.234	.245
D	34/66	280	.550	—	.570	—	.220	—
	66/34	280	.550	—	.570	—	.220	—
M	28/56	264	.590	—	.610	—	.210	—
	56/28	264	.590	—	.610	—	.210	—
9	32/64	276	.530	—	.550	—	.222	—
	64/32	276	.530	—	.550	—	.222	—
10	34/70	284	.580	—	.610	—	.230	—
	70/34	284	.580	—	.610	—	.230	—
Z	36/68	284	.590	—	.610	—	.235	—
	68/36	284	.590	—	.610	—	.235	—
14	30/62	272	.600	—	.620	—	.230	—
	62/30	272	.600	—	.620	—	.230	—

***** (New cam grinds introduced in 2008)***

CAMS FOR LOW COMPRESSION ENGINES

1	16/36	232	.427	—	.446	—	.136	—
	36/16	232	.427	—	.446	—	.136	—
2	15/35	230	.490	—	.512	—	.133	—
	35/15	230	.490	—	.512	—	.133	—
3	23/43	246	.514	—	.545	—	.169	—
	43/23	246	.514	—	.545	—	.169	—

CAMS FOR DRAGS AND HIGH PERFORMANCE

S82	32/60	272	.590	—	.650	—	.237	—
	66/30	276	.590	—	.650	—	.220	—
S84	32/64	276	.630	—	.680	—	.241	—
	70/30	280	.630	—	.680	—	.223	—
S86	34/70	284	.660	—	.730	—	.254	—
	76/32	288	.660	—	.730	—	.235	—

Timing specs taken @ .053 cam lift in crank degrees.
Maximum lift calculated for Rocker Ratio=1.50-pan, 1.43-shovel
Spring travel figures are minimums for setting spring travel to coil bind.

ANDREWS PRODUCTS, INC.

IRON HEAD SPORTSTER & XR CAM INSTALLATION INSTRUCTIONS

1. Remove pushrods, ignition parts and right side engine cam gear cover. Note whether shims are present on any of the stock cam gears when removing them. Cam kits for 1984 and 1985 engines with alternators require a # 4 cam gear which looks like the # 1 and # 3 cam gears but unlike earlier Sportster cam gear sets, does not have the generator drive gear.

2. For cams with .490 lift or higher, chamfering top of roller tappet bodies and/or replacing cork seals with "O" rings may provide better oil sealing at base of pushrod covers.

3. Install all 4 new cam gears in the outer gear cover and turn them with your fingers to make sure that they turn freely without binding. You can also install the stock cam gears in the outer cover for a comparison test. Both sets of cam gears should feel about the same when turned by hand. If there is any binding or tightness when performing this test, the new cam gears can be removed (one at a time) and the stock cam gear for that location can be installed until the cam gear (or gears) which cause the tightness or binding are identified. If there is binding in any cam gear, Andrews Products can reduce the size of the cam gear teeth with a National Broach gear tooth honing machine.

4. Andrews Products does NOT recommend installing needle bearings in outer cam covers as replacements for stock bushings. They will not result in more HP and they MIGHT cause cam bearing failure.

5. After installing new cams and reinstalling the cam gear cover for a trial fit, remove tappet blocks so that cam gear end play can be checked. It is important that positive end play exists. Correct end play should be from .010 to .020 inches. If shims are needed to adjust end play, they are available as standard H/D parts. Part numbers are 6769 for .007" shim and 6770 for a .005" shim.

6. With end play on all 4 cam gears set correctly and the cover installed, rotate the engine to make sure that engine rolls freely. Engines from 1977 and later will require additional clearance for both the # 2 and # 3 intake cam lobe tips for cams with .490 or higher lift. The pinion bearing housing must be relieved at two points to clear the tips of the # 2 and # 3 cam lobe. This operation can be done with a rotary file (taking care not to throw metal chips into the engine).

7. Andrews Products makes high lift lower spring collars which will increase spring travel .060 over stock lower collars used on early Sportsters (through 1980). Cams with .450 lift (or less) will bolt in with these collars and stock springs. (Part # 277160).

8. PB+ and Y cams should bolt in without resetting valve spring travel using stock upper spring collars. Alloy collars may require machine work for adequate clearance. For ALL other grinds spring travel must be set to figures listed on the back side of this page as minimums.

9. For PB+, R5, Y, and X cams, stock springs are recommended and should be used! For V9 and BV cams, Manley .500 springs can be used and for AX and DX cams, long stem valves (XR style) and Branch springs are recommended.

10. Andrews Products makes light weight ground steel pushrods for all Sportsters. They are .030 shorter than stock pushrods so reinstallation can be done without "levering in" exhaust rods. Adjust pushrods to "finger spin snug" and then tighten locknuts.Part numbers for steel pushrods are 240040.

11. Andrews Products also makes super light weight aluminum pushrods especially for street motors where quiet operation is important, Part # is 240060. Aluminum pushrods are coated red for easy identification.

12. Final tuning of carburetors with performance cams sometimes requires richer jetting. For stock Keihin carbs, #65 slow jets and #170 main jets are good starting points. An Andrews Products High Flow Accelerator Pump kit will significantly improve low speed and mid range throttle response. Part # is 269050 and it installs easily on 1980-1988 Keihin carbs.

Iron Head Sportster & XR Cam Timing Specifications

Grind	Timing(*)	Dur(.053)	Dur.020)	Max Valve Lift	Springs(1)	TDC Lift(2)
Stock Q	10/32	222	262	.400	.440	.114
(1976-1985)	35/07	222	262	.380	.440	.114
Stock P (note 3)	34/40	254	294	.400	.440	.200
PB+ (4/1 kit)	43/31	254	298	.410	.440	.192
PB+	34/40	254	298	.410	.445	.208
	43/31	254	298	.410	.445	.208
Y	35/47	262	310	.425	.450	.206
	53/29	262	310	.425	.450	.182
R5	33/41	254	306	.445	.470	.209
	43/31	254	306	.445	.470	.200
X	35/55	270	314	.450	.470	.210
	57/33	270	314	.450	.470	.206
V9	32/52	264	311	.490	.520	.207
	52/32	264	311	.490	.520	.207
AX	29/57	266	310	.550	.580	.197
	57/29	266	310	.550	.580	.197
BV	34/58	272	318	.520	.550	.224
	58/34	272	318	.520	.550	.224
DX	38/66	284	333	.550	.580	.241
	66/38	284	333	.550	.580	.241
XR #1	46/58	284	368	.560	.600	.280
	66/38	284	368	.560	.600	.240
XR #2	32/44	256	298	.486	.530	.227
	52/24	256	298	.486	.530	.189

Notes:

(1) Minimum spring travel to coil bind.

(2) Top dead center lift (for checking valve to valve clearance).

(3) (PB+ cam note): 4/1 kit consists of #1 and #4 exhaust cams and should be used only with stock P intakes. If your engine has stock Q cams, all 4 Q cams should be replaced with PB+ cams.

Andrews Products, Inc.

INSTALLATION INSTRUCTIONS

High Flow Accelerator Pump for Stock Keihin Carburetors
(For Stock Keihin Carbs from 1980-1988)

1. Remove float bowl from carburetor. There are four screws holding it in place. It is NOT necessary to remove the entire carburetor from the engine to install your new high flow accelerator pump.

2. Clean any fuel residue from the bowl assembly and remove the stock accelerator pump housing. It is held in place with three screws but one of them already has been removed with the bowl.

3. Position the bowl upside down for drilling a single hole through the bottom as shown in photo.

4. Any drill of approximately 1/16 diameter will be quite satisfactory. The exact location for this hole is already marked with a dimple on the bottom of the float bowl casting as shown in photo below.

5. Feed the drill through until it breaks out into the float chamber. Don't worry if the hole breaks into either a cross drilled passage or through the actual bottom of the bowl. The location is not critical as long as fuel can feed through into the accelerator pump.

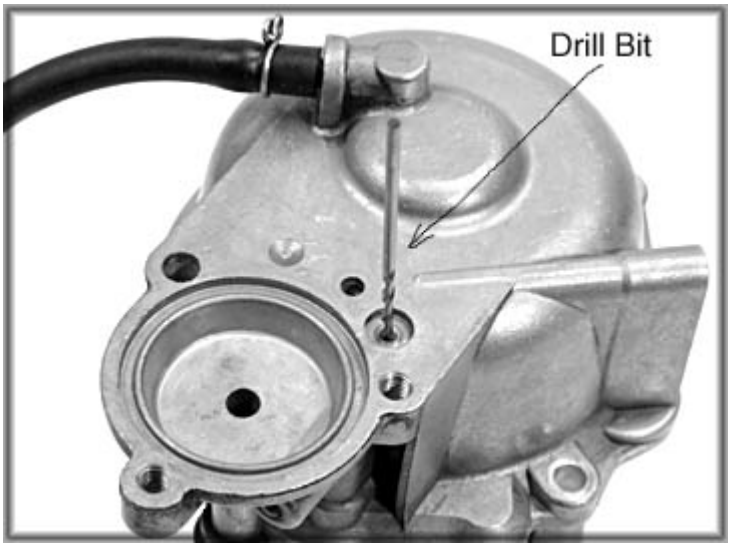
6. Thoroughly clean any drill chips from the bowl. There is a small bypass hole in the bottom of the bowl which does not have to be plugged. Several earlier magazine articles have recommended plugging this hole but there will be no measurable benefit from doing so.

7. Install the new accelerator pump housing onto the bowl with the two shortest screws of the original three. Make sure that the two small "O" ring seals are installed; one into a recess in the pump housing and the second into a recess into he bottom of the bowl casting.

8. If the accelerator pump jet needs to aimed differently, now is the time to do this. With a small adjustable wrench, carefully reposition the pump jet by gently turning it in the bowl casting (it's a press fit).

9. Reinstall the bowl and pump assembly back onto the carburetor body to complete the job. The extra fuel from the larger capacity pump should result in smoother, quicker throttle response especially off idle or at low RPM.

BE CAREFUL WHEN WORKING AROUND GASOLINE!



View of float bowl (upside down) with pump housing removed.
Drill bit is shown after drilling new hole in proper location.

ANDREWS PRODUCTS, INC.

INSTALLATION INSTRUCTIONS:

CLOSE RATIO 1ST GEAR SETS (2.44/1 - 2.60/1 - 2.24/1)
CLOSE RATIO 3RD GEAR SETS (1.35/1)
STOCK RATIO 3RD GEAR SETS (1.23/1)

IMPORTANT: If you are istalling a close ratio 1rst gear and if your transmission was made before 1959, you must obtain a late style mainshaft 3rd gear to complete this installation. If you are also installing a new Andrews Products close ratio or stock ratio 3rd, the new mainshaft 3rd will be the proper length. Andrews Products or any H/D dealer can supply a correct 3rd if you need one (part# 206220 or H/D# 35306-59).

Andrews Products 3rd gear installation instructions appear on the back of this page.

If you are not experienced in disassembly and repair procedures for a hog gearbox, let an H/D dealer or other capable shop do the work. Transmission overhauls require specialized tools and knowledge!

1. Disassemble transmission as covered in H/D service manual.

2. Inspect all the parts for wear and damage, replacing those which are worn beyond their service limits.

3. Clean transmission case and all other parts for reassembly.

4. Check fit of mainshaft cluster gear over mainshaft. The 1-2 cluster gear requires a light press fit the first time it is assembled on a new transmission mainshaft. A hand operated arbor press is recommended for this.

5. With cluster gear assembled onto mainshaft and nut and bearing secured, check 3rd gear end play. This should be done with spacer in place. Recommended 3rd gear end play is (.004 to .017) loose. It is important that the end play be checked and correctly set prior to assembling the mainshaft into transmission case.

6. With mainshaft assembly in place, countershaft gear parts can be assembled. If you are also working with a new close 3rd, turn to the reverse side of this page covering 3rd gears. Before proceeding, make sure that mainshaft 3rd gear retaining lock ring is secure in the mainshaft groove. Use a NEW lock ring.

7. Remove 1st bushing from stock countershaft first gear and slide it into the new countershaft gear. Bushing should have .0005/.0025 clearance in gear and .0005/.0015 clearance over countershaft bearing. It is important that bushing “floats” with correct clearance.

8. Reassemble transmission exactly as covered in H/D service book.

9. Before installing top cover, check to see that all gears are meshing freely and that transmission rolls WITHOUT binding. If there is any binding, determine why and correct before proceeding.

10. Reset shift 1-2 and 3-4 fork positions if necessary and install top cover.

11. Reinstall transmission in bike and fill with 1 ½ pints of oil.

INSTALLATION INSTRUCTIONS FOR CLOSE RATIO 3RD GEAR

Beginning in late 1976, all countershaft 3rd cluster gears use drawn cup needle bearings (instead of trapped rollers) in both ends of the gear. On motorcycles with transmission case serial numbers U-8959 and higher, the countershaft bearings will be the late style drawn cup needles. In addition to this change in end bearings, the actual countershafts are different and therefore NOT interchangeable. For this reason, the early and late style 3rd gears are also NOT interchangeable. (If you really want to change over, new case bushings must be installed also.)

1. Installation of close ratio 3rd gears consists of assembling the new countershaft cluster gear assembly prior to installation into the transmission gearbox.

2. Most bikes made with disc front brakes do not have a speedometer gear in the transmission. However, if you need to use one, press the old speedometer gear off and reinstall it onto the new cluster gear. This can be done on a small arbor or hydraulic press taking care to support the speedometer gear properly while pressing the cluster out of it. The old speedometer gear should fit over the new cluster with no problem.

3. Remove the 2nd gear retaining ring (35810-36), washer (35811-36), stock 2nd gear and bushing from the old cluster and install them on the new cluster. As with the 1st gear, it is important that this bushing also “floats” freely between the gear inner diameter and the cluster gear outer diameter surface.

4. All Andrews Products 3rd gear clusters are made to the same nominal length as stock clusters. Installed end play should be (.007-.012). End play of this gear can be set with different thickness countershaft washers. They are listed by part numbers below. **It is extremely important that this end play be properly set.** (Third gear cluster assemblies which are installed with insufficient end play will almost always experience service failure after only a short operating time. The failure mode will result in severe overheating and seizure of the third gear to the countershaft).

35876-36	.074" thickness
35877-36	.078"
35878-36	.082"
35879-36	.085"
35882-36	.090"
35883-36	.095"
35884-36	.100"

5. At this point the new 3rd cluster assembly is ready for installation into the transmission. Proceed with the instructions on the reverse side at number 8.

NOTE: June 2002: The specifications listed below are shown for reference only. Honda camshafts are no longer manufactured by Andrews Products and we have no exisiting inventory.

ANDREWS PRODUCTS, INC.

TIMING SPECIFICATIONS (CB500 / 550 / 650)

GRIND	TIMING	DURATION(1)	LIFT(2)	LASH
Stock int.	2/32	214 deg.	.292	(timing listed
Stock exh.	37/3	220 deg.	.278	for comparison)
#11	8/40	228 deg.	.315	.004
	40/8	228 deg.	.315	.004
#16	18/46	244 deg.	.350	.004
	46/18	244 deg.	.350	.004

TIMING SPECIFICATIONS (CB500 / 550 / 650)

GRIND	TIMING	DURATION(1)	LIFT(2)	LASH
A	20/40	240 deg.	.345	.004
	40/20	240 deg.	.345	.004
D	19/45	244 deg.	.385	.004
	45/19	244 deg.	.360	.004
K	35/63	278 deg.	.370	.004
	63/35	278 deg.	.370	.004
4	32/68	280 deg.	.400	.004
	68/32	280 deg.	.400	.004

(1) Measured at .050 valve lift.

(2) Max. valve lift at 0 lash.

Note: June 2002: The specifications listed below are shown for reference only. Honda cam shafts are no longer manufactured by Andrews Products and we have no existing inventory.

ANDREWS PRODUCTS, INC.

HONDA 750/900/1100 4 VALVE CAM INSTALLATION INSTRUCTIONS

This sheet supplements shop manuals for 750/900/1100 engines. If you aren't familiar with camshaft work on such engines, Andrews Products suggests reading the appropriate sections in the service manual.

H2 and H3 cams should have adequate piston/valve clearance at TDC. Higher lift cams should always be checked at time of installation.

GRIND	LIFT(l)	DURATION(2)	TIMING(2)	CL ANGLE(3)	LASH
Stock 750	int .310	220 deg.	5/35	105	(listed for
	exh .290	220 deg.	35/5	105	comparison)
H2	int .320	228 deg.	8/40	106	.004
	exh .320	228 deg.	40/8	106	.004
H3	int .340	240 deg.	14/46	106	.004
	exh .340	240 deg.	46/14	106	.004
H4	int .352	244 deg.	14/50	108	.004
	exh .352	244 deg.	50/14	108	.004
H5	int .370	252 deg.	20/52	106	.004
	exh .370	252 deg.	52/20	106	.004
H6	int .360	252 deg.	18/54	108	.004
	exh .360	252 deg.	54/18	108	.004
H7	int .405	262 deg.	23/59	108	.004
	exh .405	262 deg.	59/23	108	.004

(1) Total lift including lash.
(2) Between points .030 off base circle.

(3) For intake cams: Centerline angle is # of degrees of crank rotation from TDC to max open point of intake valve.

For exhaust cams: Centerline angle is number of degrees of crank rotation from max lift of exhaust valve to TDC.

Example: H3 exhaust: (46-14)/2+90=106
Example: H7 intake: (59-23)/2+90=108

NOTE: June 7, 2002: The specifications listed below are shown for reference only. Kawasaki camshafts are no longer manufactured by Andrews Products and we have no existing inventory.

ANDREWS PRODUCTS, INC. (Dec. 1982)

900,1000,GPZ KAWASAKI CAM INSTALLATION INSTRUCTIONS

AT TDC (overlap) IX AND 2X cams should have adequate piston-valve clearance with STOCK pistons. Valve clearance should always be checked when using high compression pistons. Piston/valve clearance (at TDC) should be .030 (.75mm) as MINIMUM settings. Stock valve springs are recommended for IX or 2X cams. Andrews Products springs should be run with all other cams.

GRIND	LIFT	DURATION	TIMING	TDC	CL ANGLE	LASH
IX	in .344	260 deg	24/56	.104	106	.004
	ex .344	260 deg.	56/24	.104	106	.004
2X	in .360	258 deg.	23/55	.109	106	.004
	ex .360	258 deg.	55/23	.109	106	.004
8X	in .410	266 deg.	27/59	.132	106	.004
	ex .410	266 deg.	59/27	.132	106	.004
3X	in .418	282 deg.	37/65	.173	106	.004
	ex .418	282 deg.	65/37	.173	106	.004
4X	in .430	286 deg.	32/74	.160	111	.004
	ex .430	286 deg.	74/32	.160	111	.004
5X	in .435	266 deg.	23/63	.128	110	.004
	ex .435	266 deg.	63/23	.128	110	.004
6X	in .458	274 deg.	26/68	.146	111	.004
	ex .458	274 deg.	68/26	.146	111	.004
7X	in .485	266 deg.	23/63	.134	130	.004
	ex .485	266 deg.	63/23	.134	110	.004
11X	in .452	292 deg.	34/78	.142	112	.004
	ex .452	292 deg.	78/34	.142	112	.004
12X	in .450	278 deg.	29/69	.148	110	.004
	ex .450	278 deg.	69/29	.148	110	.004
13X	in .530	284 deg.	30/74	.169	112	.004
9X	in .500	280 deg.	28/72	.157	112	.004
9Z	in .500	270 deg.	27/63	.160	108	.004
14X	in .500	286 deg.	32/74	.180	111	.004
15X	ex .415	284 deg.	72/32	.153	110	.004

Timing and duration both measured between points .030 off base circle.
TDC is cam lift at TOP DEAD CENTER for LISTED timing.
For intake cams: Centerline angle is # of crank degrees from TDC to max open point of int. valve. Example: 4X int: (74-32)/2+90 = 111

ANDREWS PRODUCTS, INC.

Evolution EV80 EZ-INSTALL pushrods
Installation instructions

TOOLS NEEDED:

Various wrenches and tools for removing gas tanks and rocker boxes (optional).
Wire or clips for holding pushrod tubes up when making final length adjustments.
Pliers for removing pushrod cover tubes securing clips.
Two 1/2 inch open end wrenches.
One 9/32nds open end wrench.

1. Remove existing pushrods. There are two ways to do this. Pick one.

a. Remove gas tanks and also rocker boxes so that stock pushrods can slide out from the top.

b. A faster method of removing stock pushrods is to slide the cover tubes up and cut the stock pushrods with a bolt cutter. This method does not require removing gas tanks or rocker boxes. In this case however, the stock pushrods will not be reusable.

2. If you intend to save the four stock (non-adjustable) pushrods (method a.), they should be identified for future reference since they may all be different lengths.

3. Adjust each new pushrod to its shortest length by turning lower adjuster screw in as far as possible before installation.

4. The two shorter pushrods are intakes, the longer rods are exhausts. EV80 aluminum pushrods are anodized with a purple color while the chrome moly steel rods are silver.

5. Each pushrod can now be assembled into one of the cover tubes and swung into place over the top of the lifter block housing. Now holding the lower adjuster screw (9/32nds wrench), turn pushrod until it is long enough to stay in place before making a final length adjustment.

6. If you have not done so already, remove sparkplugs so engine can be turned over easily. With all four new pushrods in place, rotate the engine so any one cam lobe is positioned at its lowest lift point. Then adjust pushrod tip longer to remove all freeplay. At this point, pushrod will be finger tight in the lifter seat. A 9/32nds wrench can be used to hold the lower adjuster screw while turning the pushrod in order to turn the adjuster screw to a longer setting.

7. When pushrod is snug (seated at both ends), turn the pushrod out (longer) by 4 full turns (or 24 flats on the hex lock nut). Tighten adjuster locknut against the lower tip using two 1/2 inch wrenches. Do not exceed 15 ft. lbs. of torque!

8. If the valve unseated during the final adjustment, wait 10/15 minutes for hydraulic lifter piston to bleed down and seat the valve before adjusting the second valve in that head. Repeat this procedure for each remaining pushrod. With all four pushrods correctly adjusted, engine should turn freely without any binding.

9. Secure all four cover tubes with the spring clips and your installation is complete.

ANDREWS PRODUCTS, INC.

Twin 88 EZ-INSTALL pushrods
Installation instructions

Tools Needed:

Various wrenches and tools for removing gas tanks and rocker boxes (optional).
Wire or clips for holding pushrod tubes up when making final length adjustments.
Pliers for removing pushrod cover tubes and securing clips.
Two 1/2 inch open end wrenches.
One 9/32 inch open end wrench.

1. Remove existing pushrods. There are two ways to do this. Pick one.

a. Remove gas tanks and also rocker boxes so that stock pushrods can slide out from the top.

b. A faster method of removing stock pushrods is to slide the cover tubes up and cut the stock pushrods with a bolt cutter. This method does not require removing gas tanks or rocker boxes. In this case however, the stock pushrods will not be reusable.

2. If you intend to save the four nonadjustable, stock pushrods (method a.), they should be identified for future reference since each pushrod may be a different length.

3. Adjust each new pushrod to its shortest length by turning lower adjuster screw in as far as possible before installation.

4. The two shorter pushrods are intakes, the longer rods are exhausts. Twin 88 aluminum pushrods are anodized with a orange color while the chrome moly steel rods are silver.

5. Pushrod cover tube sets with shorter upper tubes are available from H/D. They are not absolutely necessary but they will make the pushrod installation and final adjustments much easier. Part numbers are: 17938-83 and 17634-99. You will need 4 of each part number to install a complete set of shorter cover tubes.

6. Each pushrod can now be assembled into one of the cover tubes and swung into place over the top of the lifter housing covers. *Removing lifter housing covers will allow intake pushrods to swing in over top of lifters.* Holding the lower adjuster screw with a 9/32 inch wrench, turn pushrod until the adjuster unscrews out far enough to stay in place before making the final adjustment.

7. If you have not done so already, remove both sparkplugs so the engine can be turned over easily. With all four new pushrods in place, rotate the engine so any one cam lobe is positioned at its lowest lift point. Then adjust pushrod tip longer to remove all freeplay. At this point, pushrod should be finger tight in the lifter seat.

8. When pushrod is snug (seated at both ends), turn the pushrod out (longer) 3 to 4 full turns (18 to 24 flats on the hex lock nut). Tighten adjuster locknut against the lower tip using two 1/2 inch wrenches. Do not over tighten the adjuster locknut. (15 ft. lbs. of torque maximum!)

9. If the valve unseated during the final adjustment, wait 10 to 15 minutes for hydraulic lifters to bleed down and seat the valve before adjusting the other valve in that head. Repeat this procedure for each remaining pushrod. With all four pushrods adjusted, engine should turn freely with no binding.

10. Secure all four cover tubes with the spring clips and your installation is complete.

ANDREWS PRODUCTS, INC.

Installation instructions for standard version adjustable pushrods (Evolution engines)

1. **Remove stock pushrods first. This requires removal of gas tanks and also rocker boxes.**
2. **Since stock (non-adjustable) pushrods may be different lengths, they should be identified for future reference.**
3. **Adjust each pushrod to its shortest length by turning tip in as far as possible before installation.**
4. **For EV-80 motors, the two shortest rods are intakes, the longest rod is the front exhaust and the remaining pushrod fits the rear exhaust. EV-80 aluminum rods are gold colored while the chrome moly rods are silver.**
5. **'91-up: EV Sportsters: adjustable aluminum rods are black; chrome moly rods are silver. For '91-up Sportsters, the two short rods are intakes; the longer rods are exhausts;**
6. **'84-'89 EV Sportsters; all four pushrods are the same length.**
7. **With the new pushrods in place (and still adjusted short), rotate the engine so any one cam lobe is positioned at its lowest lift point. Then adjust pushrod tip longer to remove all loose clearance. At this point, pushrod will be finger tight in the lifter seat.**
8. **When pushrod is snug (fully seated at both ends), turn adjustment longer by 3-4 full turns. Tighten locknut using two 7/16 inch wrenches. Do not exceed 15 ft. lbs. of torque!**
9. **If the valve unseated during the final adjustment, wait 10/15 minutes for hydraulic lifter to bleed down and seat the valve before adjusting the second valve. Repeat this procedure for the remaining three pushrods.**
10. **With all four pushrods correctly adjusted, engine should turn freely without any binding**

ANDREWS PRODUCTS, INC.

Installation instructions for adjustable pushrods (Shovel, Pan, Knuckle)

1. **Remove stock pushrods first. This will require removal of cover tubes and retainer clips.**

2. **Adjust each pushrod to its shortest length by turning adjustment tip in as far as possible.**

3. **The two shortest pushrods are intakes, the longest pushrod is intended for the front exhaust and the remaining pushrod fits the rear exhaust.**

4. **With the new pushrods in place (and still adjusted short), rotate the engine so any one cam lobe is positioned at its lowest lift point. Then adjust pushrod tip longer to remove all slack. At this point, pushrod will be finger tight in the lifter.**

5. **The pushrod should now be snug (seated at both ends). For solid lifters, tighten locknut using two 7/16 inch wrenches. Do not exceed 15 ft. lbs. of torque!**

6. **For hydraulic lifters, turn adjustment screw longer by 3.5 to 4 full turns and then tighten locknut.**

7. **Repeat this procedure for the remaining three pushrods.**

8. **With all four pushrods correctly adjusted, engine should turn freely without any binding.**

ANDREWS PRODUCTS, INC.

Installation instructions for adjustable pushrods (Twin 88 engines)

1. **Remove stock pushrods first. This requires removal of gas tanks and also rocker boxes.**
2. **Since all four stock (non-adjustable) pushrods may be different lengths, they should be identified for future reference.**
3. **Adjust each pushrod to its shortest length by turning tip in as far as possible before installation.**
4. **For Twin 88 motors, the two shortest rods are intakes, the longest rod is intended for the front exhaust and the remaining pushrod fits the rear exhaust. Twin 88 aluminum rods are anodized with a blue color while the chrome moly steel rods are silver.**
5. **With the new pushrods in place (and still adjusted short), rotate the engine so any one cam lobe is positioned at its lowest lift point. Then adjust pushrod tip longer to remove all slack. At this point, pushrod will be finger tight in the lifter.**
6. **When pushrod is snug (seated at both ends), turn adjustment longer by 4 full turns. Tighten locknut using two 7/16 inch wrenches. Do not exceed 15 ft. lbs. of torque!**
7. **If the valve unseated during the final adjustment, wait 10/15 minutes for hydraulic lifter to bleed down and seat the valve before adjusting the second valve.**
8. **Repeat this procedure for the remaining three pushrods.**
9. **With all four pushrods correctly adjusted, engine should turn freely without any binding.**

ANDREWS PRODUCTS, INC.
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

Grind	Timing	Duration	Valve Lift	Spring Travel	Springs	Lift @ TDC
Stk D	02/41	223	.458	Comparison	Stock	.094
	41/02	223	.458	Data	-	.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.

NOTE: June 7, 2002: The specifications listed below are shown for reference only. Suzuki camshafts are no longer manufactured by Andrews Products and we have no existing inventory.

ANDREWS PRODUCTS, INC. (Dec. 1982)

SUZUKI 2 VALVE CAM SPECIFICATIONS

AT TDC (overlap) 7S, 1S, 2S cams should have adequate piston-valve clearance with STOCK pistons. Valve clearance should always be checked when using high compression pistons. Piston/valve clearance (at TDC) should be .030 (.75mm) as MINIMUM settings. Stock valve springs are recommended for 7S, IS or 2S cams. High lift springs should be run with all other cams.

GRIND	LIFT	DURATION	TIMING	CL ANGLE	LASH
Srock	in .325	236 deg.	08/48	110	(listed for
	ex .304	232 deg.	46/06	110	comparison)
7S	in .346	260 deg.	22/58	108	.004/.006
	ex .346	260 deg.	58/22	108	.004/.006
1S	in .370	260 deg	22/58	108	.004/006
	ex .370	260 deg.	58/22	108	.004.006
2S	in .390	274 deg.	29/65	108	.004/.006
	ex .390	274 deg.	65/29	108	.004/.006
3S	in .424	280 deg.	27/59	110	.004/.006
	ex .424	280 deg.	59/27	110	.004/.006
4S	in .455	274 deg.	37/65	110	.004/.006
	ex .455	274 deg.	65/37	110	.004/.006
5S	in .490	270 deg.	25/65	110	.004/.006
	ex .490	270 deg.	65/25	110	.004/.006

Timing and duration both measured at .030 checking height off base circle

TWIN CAM 88 - 34T REAR CAMSHAFT SPROCKET:
INSTALLATION INSTRUCTIONS

1. This kit includes one 34 tooth rear cam drive sprocket, one 3/16 drive key and three shims (for properly setting the sprocket spacing on the end of the rear camshaft). Shim thicknesses are: .005, .010, and .020. The sprocket kit (Andrews Products part # 288010) is a direct replacement for the stock sprocket (H/D part # 25563-99) and spacer. Stock spacers are made in five thicknesses; .350, .355, .360, .365 or .370. To set the proper length of sprocket plus shim, combining the shim(s) with the new sprocket will permit length adjustments to match the assembled length of the original stock sprocket and spacer.

2. Remove the 9 bolts holding outer cam cover. When this cover is reinstalled later, note that there is a specific bolt tightening sequence and torque setting for these 9 bolts. Read the H/D manual!

3. Before proceeding further, put the transmission in 4th or 5th gear. With the spark plugs removed (so there will be no compression pressure to fight), position the engine (by turning the rear wheel) so that all camshaft timing marks are properly aligned. This step will simplify reassembly later.

4. Remove the retaining bolts for the 17 tooth crankshaft sprocket and the 34 tooth rear camshaft sprocket. There is a factory tool available which locks both sprockets together and prevents the engine from turning while these bolts are removed (or reinstalled). The tool is a **crankshaft/camshaft sprocket locking tool.** Part number is H/D-42314. It is well worth the cost.

5. Following the factory service manual, the outer chain tensioning shoe must now be retracted. This is most easily done with another H/D tool: **cam chain tensioner unloader with retention pins;** part number H/D-42313. Moving and locking the chain tensioner to a retracted location without this tool will be difficult.

6. Remove the crankshaft sprocket retaining bolt and the camshaft sprocket retaining bolt. Both sprockets and the outer camshaft drive chain can now be removed.

7. Fit the new 34 tooth sprocket and drive key to the keyway on the end of the rear cam. Installing the 3/16 drive key may require hand stoning or filing the key to achieve an exact size on size fit. **The fit of the key into the cam and sprocket keyways should be snug and NOT loose.** If the 3/16 key is too long, it should be cut shorter so that there is no interference with the retaining washer.

8. Both sprockets and the chain can be "trial fitted" to check lateral alignment of the two sprockets. To adjust alignment, there are 3 shims supplied in each sprocket kit; one .005" shim; one .010" shim, and one .020" shim. Andrews Products 34 tooth sprockets are machined to the same length as a stock sprocket with a .350 spacer; (approximately .690 length). For stock sprockets with a .350 spacer, no shim is required. For a .355 spacer, use the .005 shim; for a .360 spacer, use the .010 shim; for a .365 spacer, use the .005 + the .010 shim and for a .370 spacer, use the .020 shim. **(Read H/D service manual on this very important point).**

9. Position the engine so the sprockets and chain can be reinstalled with all timing marks correctly aligned.

10. Install the two retaining bolts with loctite primer and retaining compound. When tightening these bolts, **torque must not exceed 25 ft-lbs.** The crankshaft/camshaft sprocket locking tool will prevent the engine from turning during this operation. Stock H/D bolts and washers are OK but bolts should be grade 8 ratings with shoulders.

ANDREWS PRODUCTS, INC.

Installation Instructions: Chain Drive Cams 1999-2006 Twin Cam (except '06 Dyna)

A. We recommend that you read the factory service manual and follow all proper procedures for camshaft removal and replacement. The procedure for retracting and releasing the two sprocket chain tensions is especially important.

B. Andrews Products makes heat treated, splined 34 tooth sprockets which are longer than stock H/D sprockets. The part number for the Andrews Products sprocket is 288015.

1. All Andrews production Twin 88 cams are made with stock size lobe base circles so stock pushrods will be the correct length. If you are going to use the original pushrods, removing the fuel tank(s) and rocker boxes will be necessary. Mark the pushrods so they can be replaced into their original locations. (Not all stock pushrods are the same length).

2. If you want to save installation time (and not remove fuel tanks and rocker arms), EZ-install pushrods are available from Andrews Products in either aluminum or chrome moly steel. If you are going to use EZ-install pushrods, stock pushrods can be cut with bolt cutters and then removed (in two pieces). Part numbers for EZ-install pushrods are: 292188 for aluminum and 292088 for steel pushrods.

3. Remove the 10 bolts holding outer cam cover. When this cover is reinstalled later, there is a specific tightening sequence and torque setting for these 10 bolts.

4. Before proceeding further, put the transmission in 4th or 5th gear. With spark plugs removed (no resistance from compression pressure), position the engine (by turning rear wheel) so camshaft timing marks are aligned. This will simplify installation of new cams.

5. Following the factory service manual, the outer chain tension shoe must now be retracted. This can be done with H/D tool set (part number H/D-42313, cam chain tension unloader with retention pins).

6. Remove the retaining bolt holding the crankshaft sprocket and the retaining bolt holding the rear camshaft sprocket. This can be done with H/D tool set (part number H/D-42314, crankshaft/camshaft sprocket locking tool). It is well worth the cost.

7. Remove the cam support plate. All four oil pump retaining bolts must be loosened to permit correct oil pump rotor alignment at time of reassembly after the cam support plate is in place.

8. With the cam support plate removed, the interior cam chain tensioner can be retracted and locked with the unloader tool. This retaining lock pin should not be removed until the cam support plate has been reinstalled back into the engine.

9. If you are converting the rear camshaft to a roller bearing, see the diagram on the next page.

10. Fitting new 34T sprockets: Three shims and one "O" ring are supplied in each Andrews 34 tooth sprocket kit. The three shims are; 005", .010" and .020". Andrews 34 tooth sprockets are machined to approximately .690 length. After a trial assembly, alignment of crankshaft sprocket and cam sprocket must be checked and adjusted with shims if necessary. See factory manual for proper procedure. Make sure all timing marks are aligned before proceeding! (See figures 1 and 2, next page).

11. When reinstalling sprocket retaining bolts, use Loctite retaining compound to secure the bolt threads. The sprocket locking tool can be used here. Bolt torque should not exceed 25 ft-lbs for 5/16 x 18 bolts. Bolt torque for splined rear camshafts (3/8 x 24 bolt) should not exceed 35 ft-lbs. Please note that whether your camshaft uses 5/16 bolts (key drive camshafts) or 3/8 bolts (spline drive camshafts), the bolts must be rated as grade 8. (All grade 8 bolts have a 6 pointed star symbol on the top of the bolt heads).

12. Reinstall the outer cam cover with the 10 cover bolts. Cover bolts are to be tightened to a torque specification of 90-120 in-lbs. The service manual shows the correct tightening sequence.

13. EZ-install pushrods are made with 2 long (exhaust), and 2 short (intake) rods. To install, adjust pushrod to shortest length, then position in engine, rocker arm end first. Swing the lower end into lifter. Lengthen pushrod adjuster until free play is gone. Adjust pushrod 3.5-4 full turns longer (21-24 flats) and tighten locknut. Wait until hydraulic unit bleeds down and repeat procedure on next pushrod. When adjusting pushrods, make sure that cam lobe for that pushrod is on low lift point. Lifter housing covers can be temporarily removed to gain another 1/4 inch of clearance. Shorter pushrod cover tubes are available from HD. They will make the pushrod installation and adjustment much easier. Part numbers are: 17938-83 and 17634-99. You will need 4 of each part number to install a complete set.

14. For engines with stock pistons and stock heads, TW21, TW26A, TW31S and TW37B cams will bolt in without head work. TW50 and TW54 cams need piston to valve clearances and valve to valve clearances checked. TW54, TW55 and TW60A cams need .620 minimum valve travel and .060 minimum piston to valve clearance. With Andrews Products high lift steel collars (part# 293115 ; includes 4 pcs), setting valve spring travel for either of these two cams will be easier.

15. Final tuning of carburetors with bigger cams sometimes requires re-jetting. For stock H/D Keihin CV carbs and TW26A or TW37B cams, #48 slow jets and #175 main jets will be a reasonable starting point. When tuning engines, always remember that your personal safety is the most important consideration.

16. Fuel injected engines can benefit from remapping the fuel control which can be done most efficiently with a a dynamomoter.

Andrews Products: Twin Cam 88 Chain Drive Camshaft Timing

Andrews#	Grind	Timing*	Duration*	Lift	Springs	TDC Lift	Spring Travel
--------	Stock (A) 99 (carb)	-02/38 42/-03	216 219	.473 .473	Stock -	.072 .110	Stock Stock
--------	Stock (B) 99 (fuel inj)	02/34 42/-03	216 219	.473 .473	Stock -	.087 .110	Stock Stock
288112	TW12	02/34 40/02	216 220	.489 .489	Stock -	.091 .106	Stock Stock
288121	TW21	10/30 40/08	220 228	.498 .498	Stock -	.134 .121	Stock Stock
288126	TW26A	11/35 41/09	226 230	.490 .490	Stock -	.138 .120	Stock Stock
288131	TW31S	10/46 52/08	236 240	.510 .510	Stock -	.131 .120	Stock Stock
288137	TW37B	18/38 46/14	236 240	.510 .510	Stock -	.174 .148	Stock Stock
288154	TW54	16/42 43/15	238 238	.555 .555	Hi-lift -	.165 .158	.625 .625
288150	TW50	20/48 54/18	248 252	.510 .510	Stock -	.184 .168	Stock Stock
288155	TW55	22/46 52/20	248 252	.550 .550	Hi-lift -	.197 .181	.620 .620
288160	TW60A	24/56 58/22	260 260	.560 .560	Hi-lift -	.205 .192	.620 .620

*Timing and duration listed for .053 cam lift

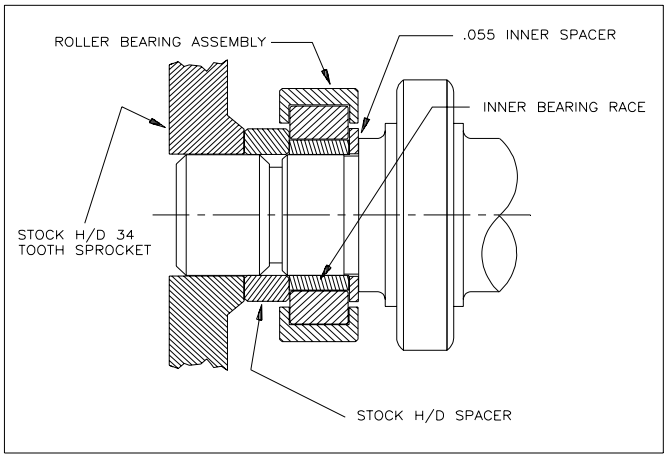


Figure 1

Figure 1 applies to engines with stock H/D 34 tooth drive sprockets and stock H/D spacers.

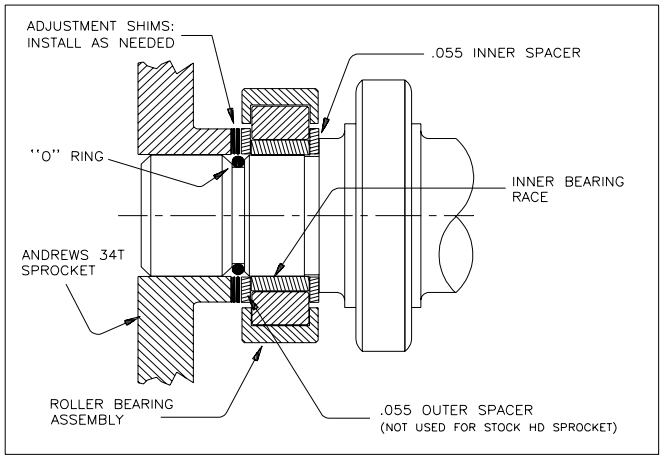


Figure 2

Figure 2 applies to installations with Andrews Products 34 tooth sprockets which uses **two** .055 thick spacers.

IMPORTANT NOTES:

Engines with **stock H/D splined sprockets** should be able to re-use the original sprocket spacer (.230 to .270 long) which was previously installed in the engine.
If you need more shims for a larger range of adjustment, 5 piece packs are available (.287 to .327) from H/D.
The H/D part number for the spacer package is:
25446-99-SUB.

If you are installing an **Andrews Products 34 tooth** steel sprocket, part numbers are:
34 tooth sprocket: 288015
.055 spacer washer: 301130
3 piece shim pack: 301120

ANDREWS PRODUCTS, INC.

Installation Instructions: Chain Drive Cams Twin Cam engines 2007 & up and '06 Dyna

This document applies to all '07 and later twin cam engines and 2006 DynaGlides. Chain drive cams for '99 -'06 engines are different. Cam lifts and durations are listed on page 2. Service manual (part# 99481-07) procedures for camshaft removal and replacement should be carefully followed.

1. Andrews Products 2006 Dyna and '07 and later twin cam engines use stock size lobe base circles for lower lift, bolt in type cams. For these cams the original stock pushrods can be reused. If the original pushrods will be reinstalled, removing the fuel tank(s) and rocker boxes will be necessary. Mark the pushrods so they can be replaced into their original locations since not all stock pushrods are the same length.

2. If you want to save installation time by not removing fuel tanks and rocker boxes, EZ-install pushrods are available from Andrews Products in either aluminum or chrome moly steel. If you are going to use EZ-install pushrods, stock pushrods can be cut with bolt cutters and then removed (in two pieces). EZ-install pushrod part numbers are: 292188 for aluminum and 292088 for steel pushrods.

3. Remove the 10 screws holding outer cam cover. When this cover is reinstalled, there is a specific tightening sequence and torque rating for all 10 screws. *VERY IMPORTANT: Overtightening cover screws can cause thread damage in engine cases.*

4. Before proceeding further, put the transmission in 4th or 5th gear. Remove both spark plugs so there will be no resistance from compression pressure. Turn the rear wheel and align camshaft timing marks. This will simplify installation of new cams.

5. Following the factory service manual, the outer chain tension shoe can be removed.

6. Remove the crankshaft sprocket retaining bolt and the rear camshaft sprocket retaining bolt. The factory camshaft locking tool (part number H/D-47941) is well worth the minor cost.

7. Remove the cam support plate. All four oil pump retaining bolts must also be loosened to permit correct oil pump rotor alignment at the time of reassembly after the cam support plate is in place with the new camshafts.

8. With the cam support plate out of the engine, the inner hydraulic cam chain tensioner assembly can now be removed.

9. As described in factory service manuals, the old cams can be removed from the cam support plate and the new cams installed. If you are familiar with cam changes on '99-'05 engines, the '06 Dyna and all '07 and later cam installation is much simpler.

10. Once the cam support plate and new cams are assembled, the cam plate can be reinstalled back into the engine.

11. Reinstalling the 34T sprocket requires using either the original sprocket spacer or a new spacer from HD if the original is not the correct thickness for your engine. HD makes shims and spacer washers in 6 different thicknesses. Spacer part numbers:

    25729-06 0.100 inches
    25731-06 0.110 inches
    25734-06 0.120 inches
    25736-06 0.130 inches
    25737-06 0.140 inches
    25738-06 0.150 inches

12. According to factory service manuals, the front cam thrust washer should be 0.100.

See diagrams 1 and 2 on next page

13. After a trial assembly, alignment of crankshaft sprocket and cam sprocket positions must be checked and adjusted with shims if necessary. See factory manual for proper procedure. Make sure all timing marks are aligned before proceeding!

14. When reinstalling sprocket retaining bolts, use Loctite retaining compound to secure the bolt threads. The sprocket locking tool can be used here. Bolt torque should not exceed 25 ft-lbs for 5/16 x 18 bolts. Bolt torque for splined rear camshafts (3/8 x 24 bolt) should not exceed 35 ft-lbs. Please note that whether your camshaft uses 5/16 bolts (key drive camshafts) or 3/8 bolts (spline drive camshafts), the bolts must be rated as grade 8. (All grade 8 bolts have a 6 pointed star symbol on the top of the bolt heads).

15. Reinstall the outer cam cover with the 10 cover bolts. Cover bolts are to be tightened to a torque specification of 90-120 in-lbs. The service manual shows the correct tightening sequence.

16. EZ-install pushrods are made with 2 long (exhaust), and 2 short (intake) rods. To install, adjust pushrod to shortest length, then position in engine, rocker arm end first. Swing the lower end into lifter. Lengthen pushrod adjuster until free play is gone. Adjust pushrod 3.5-4 full turns longer (21-24 flats) and tighten locknut. Wait until hydraulic unit bleeds down and repeat procedure on next pushrod. When adjusting pushrods, make sure that cam lobe for that pushrod is on low lift point. Lifter housing covers can be temporarily removed to gain another 1/4 inch of clearance. Shorter pushrod cover tubes are available from HD. They will make the pushrod installation and adjustment much easier. Part numbers are: 17938-83 and 17634-99. You will need 4 of each part number to install a complete set.

17. For engines with stock pistons and stock heads, 21H, 26H, 31H, 37H, 48H and 57H cams should be able to bolt in without head work. 50H cams need piston to valve clearances and valve to valve clearances checked. 54H, 55H, 67H and 60H cams need .620 minimum valve travel and .060 minimum piston to valve clearance.

18. Fuel injection systems used on 2006 DynaGlide engines usually do not need re-mapping due to their advanced control system design but if remapping is necessary, a dynamometer with an engine braking system makes it easier and more efficient.

Andrews Products: All '07 - later & '06 DynaGlide Chain Drive Cam Timing

Andrews#	Grind	Timing*	Duration*	Lift	Springs	TDC Lift	Spring Travel
-------	Stock Dyna	02/34	216	.473	Stock	.087	Stock
	'06 (fuel inj)	42/-03	219	.473	-	.110	Stock
-------	Stk ('07-'08)	-09/25	196	.471	Stock	.048	Stock
		42/-03	219	.474	-	.110	Stock
216321	21H	10/30	220	.498	Stock	.134	Stock
		40/08	228	.498	-	.121	Stock
216326	26H	11/35	226	.490	Stock	.138	Stock
		41/09	230	.490	-	.120	Stock
216331	31H	10/46	236	.510	Stock	.131	Stock
		52/08	240	.510	-	.120	Stock
216332	32H	10/46	236	.570	Hi-lift	.131	Stock
		52/08	240	.570	-	.120	Stock
216337	37H	18/38	236	.510	Stock	.174	Stock
		46/14	240	.510	-	.148	Stock
216348	48H	13/29	222	.548	Stock	.153	.620
		43/15	238	.548	-	.163	.620
216354	54H	16/42	238	.555	Stock	.165	.615
		43/15	238	.555	-	.158	.615
216350	50H	20/48	248	.510	Stock	.184	Stock
		54/18	252	.510	-	.168	Stock
216355	55H	22/46	248	.550	Stock	.197	.620
		52/20	252	.550	-	.181	.620
216357	57H	18/38	236	.560	Stock	.184	.620
		46/14	240	.560	-	.153	.620
216367	67H	24/48	252	.570	Hi-lift	.209	.630
		58/22	260	.570	-	.187	.630
216360	60H	24/56	260	.560	Hi-lift	.205	.620
		58/22	260	.560	-	.192	.620

*Timing and duration listed for .053 cam lift

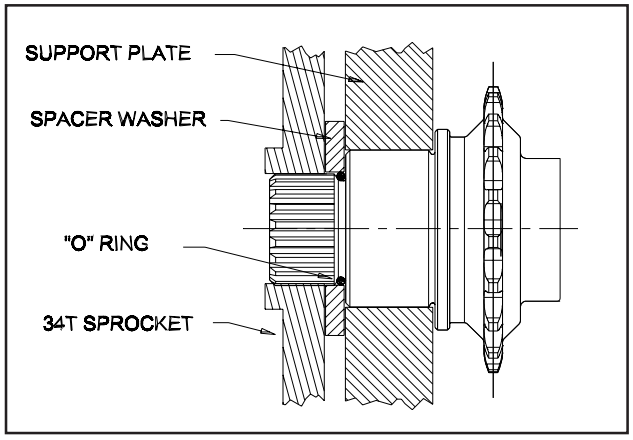


Figure 2: Rear camshaft

Rear camshafts manufactured before July, '06, use an "O" ring as shown to align thrust washer. To adjust alignment of 34T rear cam sprocket and 17T crankshaft sprocket, HD spacer washers are available in 6 different sizes.

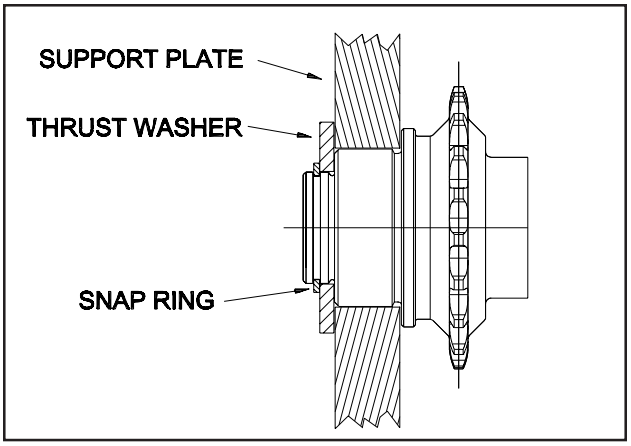


Figure 1: Front camshaft

The '07 service manual and the '06 HD Dyna manual specifies a .100 thick thrust washer on the outside end of the front camshaft.

ANDREWS PRODUCTS, INC.

Installation Instructions: Gear Drive Cams 1999-2006 Twin Cam (except '06 DynaGlide)

A. This documentation applies to 1999-2006 twin 88 engines ***except for 2006 DynaGlides***. Cams for '06 DynaGlides are different. Cam lifts and durations for gear drive cams are shown on page 3 of this document.

B. Andrews Products "G" series cams which use S&S gear drives have ball bearings on both front and rear cams. Since gear drives generate much lower bearing loads than chain drives, there is no need for roller bearings. Also, gear drive cams with roller bearings will make more noise during engine operation.

C. Please refer to the H/D factory Twin 88 service manual section on camshaft removal and replacement. The procedure for retracting and removing sprocket chain tension devices is especially important.

D. S&S camshaft drive gears must be installed with all gear drive cams. Andrews Products part number for gear drives (all 4 gears) is 288908. For a complete description of parts kits, please see bottom of page 2. In addition, an installation parts kit (Andrews Products part# 288901) must be used.

E. It is extremely important that instructions 13 and 16 be carefully followed. **Gear backlash must be correct!**

General Instructions:

1. All Andrews Products 12G, 21G, 26G, 31G, 37G and 50G Twin 88 cams are designed with stock size lobe base circles so the stock pushrod lengths will be correct. If you are going to use the original pushrods, removing the fuel tank(s) and rocker boxes will be necessary. Mark the pushrods so they can be replaced in their original locations. (Not all stock pushrods are the same length). 54G, 55G, 60G and other high lift cams will require adjustable pushrods.

2. If you want to save installation time by not having to remove fuel tanks and rocker boxes, stock pushrods can be cut with bolt cutters and removed in two pieces. Andrews Products EZ-install pushrods can then be installed. Part numbers for EZ-install pushrods are: 292188 for aluminum or 292088 for chrome moly steel.

3. Remove the 10 bolts holding outer cam cover. When this cover is reinstalled, a specific tightening sequence and torque setting for these 10 bolts as shown in a factory service manual must be followed.

4. Before proceeding further, put the transmission in 4th or 5th gear. With spark plugs removed (no resistance from compression pressure), position the engine (by turning rear wheel) so camshaft timing marks are aligned. This will simplify installation of new cams.

5. As noted in factory service manuals, the outer chain tension shoe must now be retracted. This can be done with H/D tool set (part number H/D-42313, cam chain tension arm tool with retention pins).

6. Remove the retaining bolt holding the crankshaft sprocket and the retaining bolt holding the rear camshaft sprocket. There is an H/D tool (part# H/D-42314), crankshaft/camshaft sprocket locking tool that will simplify this task.

7. Remove the cam support plate. All four oil pump retaining bolts must be loosened to permit correct oil pump rotor alignment when the cam support plate is reinstalled with the new camshafts.

8. With the cam support plate out of the engine and both old cams removed, the internal and the external cam chain tension arms and springs can removed from the support plate since they are not used with gear drive cams.

9. If the inner needle case bearings have a lot of miles on them, we recommend replacing both camshaft needle bearings with new Torrington B148 needle bearings. This requires removing the original bearings from the right side engine case and using a correct tool for removal and reinstalling new bearings.

10. Drive gears can now be installed on both front and rear camshafts. *Note that there is a front gear for the front cam and a rear gear for the rear cam.* Gears can be assembled by pressing camshafts into drive gears *with drive keys in place*. ***Note also that the gears must be pressed onto the camshafts with timing marks facing the cam lobes!***

11. Cams with .550 or higher lift may require cutting material from the top of the case bearing boss to clear lobe tips.

12. After drive gears and bearings have been assembled, both camshafts can be installed into the cam support plate. Cam lobe surfaces should be coated with engine oil or assembly lube. ***At this point, timing marks on both cam drive gears must be correctly aligned together!***

Checking cam gear backlash

13. After new cams and gears are installed, backlash for inner cam drive gears (34T) must be checked. Using a wooden rod, press down on the front cam through the exhaust lifter bore and hold the front cam from rotating. Gear backlash can be checked by turning the rear cam back and forth. Some backlash must be present. Recommended operating backlash for cold gears is .0005 to .001. Cams should roll freely with **NO** binding. Cams with 0.000 backlash (too tight) may whine when running. Backlash greater than .002 is too much and can sound like noisy lifters at lower RPM. Either of these conditions must be corrected before continuing. Undersize rear cam gears (33-4272RX-S) or oversize rear cam gears (33-4272RZ-S) are available from Andrews.

14. With the cam support plate assembly in the engine and correct backlash verified, the rear cam drive gear (62T) and the crankshaft drive gear (31T) can be installed, correctly timed and secured with the retaining cap screws. ***Note that unlike chain drive cam installations, there is NO thrust washer installed behind the rear 62T camshaft drive gear.***

15. When reinstalling drive gear cap screws, use Loctite retaining compound to secure the bolt threads. Bolt torque should not exceed 25 ft-lbs for 5/16 x 18 and for rear camshafts (3/8 x 24 bolt) should not exceed 35 ft-lbs. Please note that these bolts ***must be grade 8.*** (All grade 8 bolts have a 6 pointed star symbol on the top of the bolt heads).

Checking pinion gear backlash **(see page 4)**

16. At this point, it is very important that the crankshaft gear (31 teeth) and the rear cam drive gear (62 teeth) be checked for proper backlash. ***Before installing pushrods, rock the rear cam gear forward and backward with your fingers.*** Backlash can be felt as "freeplay" between the two gears. Gear backlash must be checked at four **different** crankshaft positions by rotating the crankshaft 90 degrees and checking the backlash at each position. **Minimum of .0005 to .001 backlash must be present at each position**. Gear mesh must show that some backlash is present.

If checking cam gear backlash as described above shows no backlash, a smaller 31 tooth crankshaft gear MUST be used! This is a very important step; Do not skip it!
Cam gears operating with no backlash can cause gear tooth failure and / or engine damage.

Undersize pinion gear (to increase backlash):
Andrews Part # 33-4160X-S

Oversize pinion gear (to reduce backlash):
Andrews Part # 33-4160Z-S

17. Since the rear cam drive gear is larger than the original chain sprocket, the outer timing cover must be checked for gear clearance. If there is any interference, the inner surface of the cover must be relieved to provide .030" (1/32nd inch) minimum clearance.

18. Reinstall the outer cam cover with the 10 cover bolts. Cover bolts *must be tightened* to a torque specification of 90-120 in-lbs. The H/D service manual shows the correct tightening sequence.

19. EZ-install pushrods are made with 2 long (exhaust), and 2 short (intake) rods. To install them, turn adjuster to the shortest length, then position in the engine, rocker arm end first. Swing the lower end into lifter. Lengthen pushrod adjuster to remove all free play. Lengthen adjuster screw 3.5-4 full turns (21-24 flats) and tighten locknut. Wait until hydraulic unit bleeds down and repeat procedure on next pushrod. When adjusting pushrods, make sure that cam lobe for that pushrod is on the low lift point. Lifter housing covers can be temporarily removed to gain another 1/4 inch of clearance. Shorter pushrod cover tubes are available from H/D. They will make the pushrod installation and adjustment much easier. Part numbers are: 17938-83 and 17634-99. You will need 4 of each part number to install a complete set.

20. For engines with stock pistons and stock heads, 12G, 21G, 26G, 31G and 37G cams will bolt in without head work. 50G cams need piston to valve clearances and valve to valve clearances checked. 54G, 55G and 60G cams need .620 minimum valve travel and .060 minimum piston to valve clearance. Andrews Products high lift spring collars (part no. 293115) will make head setups easier for all high lift camshafts.

21. For engines with new heads, stroked flywheels and/or high compression pistons, the piston/valve and valve to valve clearance must be checked.

22. Tuning engines with new cams may require carburetor re-jetting. For stock H/D Keihin CV carbs and 26G or 37G cams, #48 slow jets and #175 main jets are good sizes to start from.

23. Tuning fuel injected engines with big cams usually requires installation of a Power Commander, Race Tuner or similar setup. This will permit different calibration maps to be used for the fuel injection so fuel mixtures can be correctly set over a wide RPM range.

24. When tuning engines, always remember that your personal safety is the most important consideration.

Andrews Products: 1999-2006 Gear Drive Cam Timing Specifications

Andrews#	Grind	Timing*	CL angle	Duration*	Valve Lift	TDC Lift	Springs	Spring Travel
--------	Stock (A)	-02/38	110.0	216	.473	.072	Stock	Stock
	99 (carb)	42/-03	109.0	219	.473	.110	-	-
--------	Stock (B)	02/34	106.0	216	.473	.087	Stock	Stock
	99 (fuel inj)	42/-03	109.0	219	.473	.110	-	-
288112G	12G	02/34	106.0	216	.489	.091	Stock	.550
		40/02	109.0	222	.489	.095	-	-
288121G	21G	10/30	100.0	220	.498	.134	Stock	.560
		40/08	106.0	228	.498	.121	-	-
288126G	26G	11/35	102.0	226	.490	.138	Stock	.550
		41/09	106.0	230	.490	.120	-	-
288131G	31G	10/46	108.0	236	.510	.131	Stock	.560
		52/08	112.0	240	.510	.120	-	-
288132G	32G	10/46	106.0	236	.570	.131	Hi-Lift	.630
		52/08	112.0	240	.570	.120	-	-
288137G	37G	18/38	100.0	236	.510	.174	Stock	.560
		46/14	106.0	240	.510	.148	-	-
288154G	54G	16/42	103.0	238	.555	.165	Hi-Lift	.615
		43/15	104.0	238	.555	.158	-	-
288150G	50G	20/48	104.0	248	.510	.184	Stock	.560
		54/18	108.0	252	.510	.168	-	-
288155G	55G	22/46	102.0	248	.550	.197	Hi-Lift	.610
		52/20	106.0	252	.550	.181	-	-
288160G	60G	24/56	106.0	260	.560	.205	Hi-Lift	.620
		58/22	106.0	260	.560	.192	-	-
288167G	67G	24/48	102.0	252	.570	.187	Hi-Lift	.630
		58/22	108.0	252	.570	.187	-	-
The following two cam grinds are for highly tuned engines setup for max HP and drags								
288159G	59G	29/57	104.0	266	.590	.238	Hi-Lift	.650
		63/27	108.0	270	.590	.218	-	-
288164G	64G	30/62	106.0	272	.640	.262	Hi-lift	.710
		66/30	108.0	276	.640	-.232	-	-

Timing and durations are listed for .053 cam lift

(Installation requires kits shown on page 4 and one pair of camshafts)

Each of the parts kits listed below can be ordered individually.

Parts Kit 288901
1. 2 # B148 Torrington needle bearings
2. 2 # 6004 Nachi ball bearings
3. 1 # 5100-78 snap ring
4. 1 Cam cover gasket

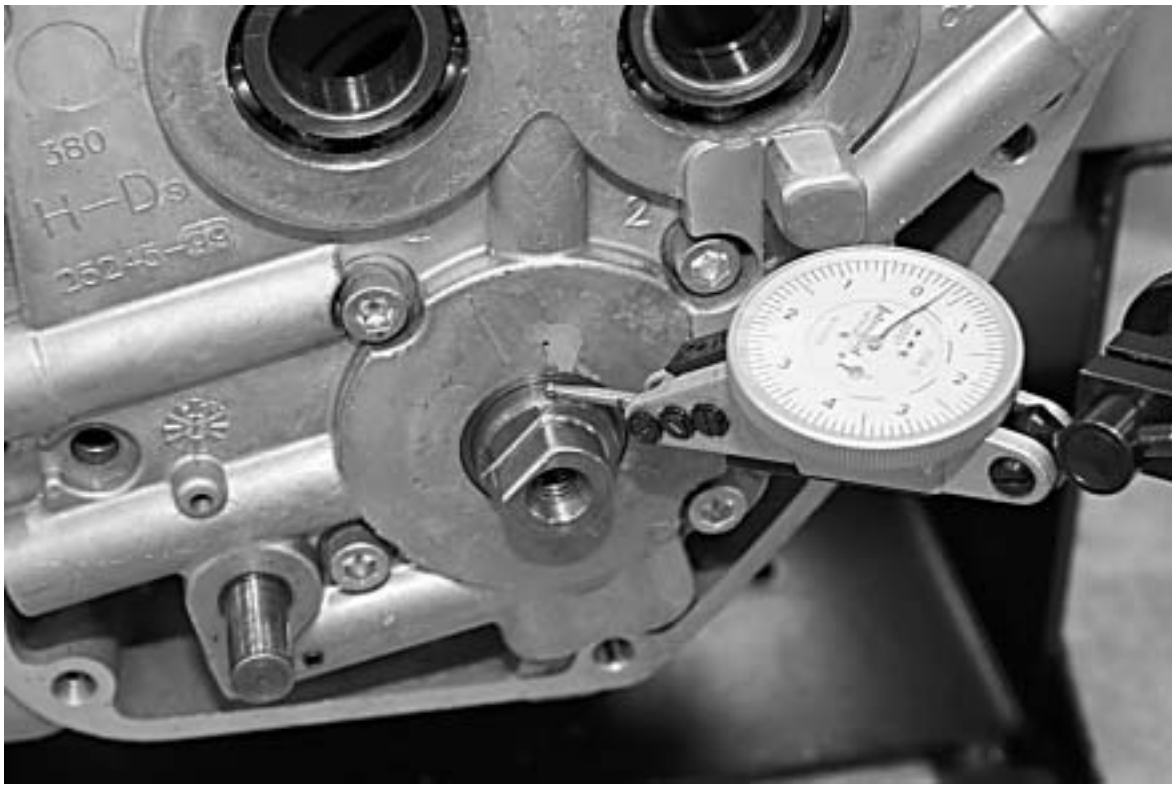
Parts Kit 288908
1. 2 inner cam drive gears
2. 1 crankshaft pinion gear
3. 1 outer cam drive gear
5. 2 grade 8 retaining bolts
6. 1 retaining washer
7. 2 # 404 Woodruff drive keys
8. 1 square drive key

Parts Kit 288903
1. 1 crankshaft pinion gear
2. 1 outer cam drive gear
3. 2 grade 8 retaining bolts
4. 1 retaining washer
5. 1 square drive key

Complete '99-2006 gear drive cam kit ready for installation.

Cover gasket is not shown but is part of kit 288901.

Instrument setup for checking engine pinion shaft runout. If runout is greater than .003 TIR, Andrews Products recommends NOT installing gear drives without first re-truing flywheels to remove excess runout. Cam support plate MUST be installed for this test



ANDREWS PRODUCTS, INC.

Installation Instructions: Gear Drive Cams 2007- up Twin Cam and '06 Dyna Engines

A. This documentation applies to all '07-up twin cam engines and 2006 DynaGlides. Gear drive cams for '99-'06 engines are different. Cam lifts and durations for gear drive cams are shown on page 3 of this document.

B. Andrews Products "HG" series cams and S&S gear drives use plain journal bearings on the front and 1.000 inch drawn cup needle bearings for the rear cam journals. Cams and gears for the newer '06 Dynas and '07- up twin cam engines are NOT interchangeable with gear drive cams for '99-'06 engines using ball bearings.

C. Please refer to the H/D factory service manual for '06 Dynas and all '07-up regarding camshaft removal and replacement.

D. S&S camshaft drive gears must be installed with all gear drive cams. Andrews Products part number for gear drives (all 4 gears) is 216908. For a complete description of parts kits, please see bottom of page 2. In addition, an installation parts kit (Andrews Products part#216901) must be used.

E. It is extremely important that instructions 12 and 15 be carefully followed. **Gear backlash must be correct!**

General Instructions:

1. All Andrews Products 21HG, 26HG, 31HG, 37HG and 50HG Twin 88 cams are made with stock size lobe base circles so stock pushrods will be the correct length. If you are going to use the original pushrods, removing the fuel tank(s) and rocker boxes will be necessary. Mark the pushrods so they can be replaced in their original locations. (Not all stock pushrods are the same length). 54HG, 55HG, 60HG and other high lift cams will require adjustable pushrods.

2. If you want to save installation time and not remove fuel tanks and rocker boxes, stock pushrods can be cut with bolt cutters and removed in two pieces. New Andrews Products EZ-install pushrods (either aluminum or chrome moly steel) can then be used. Part numbers for EZ-install pushrods are: 292188 for aluminum or 292088 for steel.

3. Remove the 10 bolts holding outer cam cover. When this cover is reinstalled later, there is a specific tightening sequence and torque setting for these 10 bolts as shown in a factory service manual.

4. Before proceeding further, put the transmission in 4th or 5th gear. With spark plugs removed (no resistance from compression pressure), position the engine (by turning rear wheel) so camshaft timing marks are aligned. This will simplify installation of new cams.

5. Remove the retaining bolts securing the crankshaft sprocket and the rear camshaft sprocket. The best way to do this is with H/D tool (part# H/D-47941), crankshaft/camshaft sprocket locking tool. Also remove the retaining ring holding the front cam in place. The retaining ring and washer will be used for the new front cam.

6. Remove the cam support plate. All four oil pump retaining bolts must be loosened to permit correct oil pump rotor alignment when the cam support plate with the new camshafts is reinstalled.

7. Both stock hydraulic chain adjuster assemblies can now be removed. Be careful not to lose the pistons and internal springs which are part of the original chain tensioning and oiling system.

8. Oil port covers can be installed over both orginal chain oil ports since the gear drives do not use chain lubricators.

9. Drive gears can now be installed on both front and rear camshafts. Cam gears can be pressed onto each camshaft *with drive keys in place*. Note that there is a front gear for the front cam and a rear gear for the rear cam. ***Also note that the gears are pressed onto the camshafts with the cam gear shoulders facing the cam support plate!***

10. Cams with .550 or higher lift may require cutting material from the top of the case bearing boss to clear lobe tips.

11. After drive gears and bearings have been assembled, both camshafts can be installed into the cam support plate. Cam lobe surfaces should be coated with engine oil or assembly lube. ***At this point, timing marks on both cam drive gears must be correctly aligned!***

Checking cam gear backlash

12. Once the new cams and gears are installed, backlash for inner cam drive gears (31teeth) must be checked. Using a wooden rod, press down on the front cam through the exhaust lifter bore and hold the front cam from rotating. Gear backlash can be checked by turning the rear cam back and forth with your fingers. Some backlash must be present. Recommended operating backlash for cold gears is .0005 to .001. Cams should roll freely with **NO** binding. Cams with 0.000 backlash (too tight) may whine when running. Backlash greater than .002 is too much and can sound like noisy lifters at lower RPM. Either of these conditions must be corrected before continuing. Undersize and oversize rear cam gears are available:
    Undersize rear cam gear part# 33-4287
    Oversize rear cam gear part# 33-4288

13. With the cam support plate assembly now in the engine and correct backlash verified, the rear cam drive gear (62T) and the crankshaft drive gear (31T) can be installed, correctly timed and secured with the retaining cap screws. ***Note that unlike chain drive cam installations, there is no thrust washer installed behind the rear 62T camshaft drive gear.***

14. When reinstalling drive gear retaining bolts, use Loctite retaining compound to secure the bolt threads. Bolt torque should not exceed 25 ft-lbs for 5/16 x 18 and for rear camshafts (3/8 x 24 bolt) should not exceed 35 ft-lbs. Please note that these bolts *must be rated grade 8*. (All grade 8 bolts have a 6 pointed star symbol on the top of the bolt heads).

Checking pinion gear backlash (see page 4)

15. At this point, it is extremely important that the crankshaft gear (31 teeth) and the rear cam drive gear (62 teeth) be checked for proper backlash. ***Before installing pushrods, rock the rear cam gear forward and backward with your fingers.*** Backlash can be felt as "freeplay" between the two gears. Gear backlash must be checked at four **different** crankshaft positions by rotating the crankshaft 90 degrees and checking the backlash at each position. **A minimum of .0005 to .001 backlash must be present at EACH POSITION**. The gear mesh cannot be so tight that there is no backlash present.

If checking cam gear backlash as described above shows no backlash, a smaller 31 tooth crankshaft gear MUST be used! This is a very important step; Do not skip it!
Cam gears operating with no backlash can cause gear tooth failure and / or engine damage.

Undersize pinion gear (to increase backlash):
Andrews Part # 33-4160X-S

Oversize pinion gear (to reduce backlash):
Andrews Part # 33-4160Z-S

16. If backlash is too tight after installing a small gear, pinion shaft runout **must be checked**. See photo, page 4. If the runout exceeds .004, TIR, (**T**otal **I**ndicator **R**eadout) the decision is whether to repair the cause of the runout or not use gear drives.

17. Since the rear cam drive gear is larger than the original chain sprocket, the outer cover must be checked for gear clearance. If there is **any** interference, the inner surface of the cover must be relieved to provide .030" clearance.

18. Reinstall the outer cam cover with the 10 cover bolts. Cover bolts *must be tightened* to a torque specification of 90-120 in-lbs. The H/D service manual shows the correct tightening sequence.

19. End play on both camshafts **after** installation in support plate must be **minimum: .010 - .020.**

20. EZ-install pushrods are made with 2 long (exhaust), and 2 short (intake) rods. To install, adjust pushrod to shortest length, then position in engine, rocker arm end first. Swing the lower end into lifter. Lengthen pushrod adjuster until free play is gone. Adjust pushrod 3.5-4 full turns longer (21-24 flats) and tighten locknut. Wait until hydraulic unit bleeds down and repeat procedure on next pushrod. When adjusting pushrods, make sure that cam lobe for that pushrod is on low lift point. Lifter housing covers can be temporarily removed to gain another 1/4 inch of clearance. Shorter pushrod cover tubes are available from H/D. They will make the pushrod installation and adjustment much easier. Part numbers are: 17938-83 and 17634-99. You will need 4 of each part number to install a complete set.

21. For engines with stock pistons and stock heads, 21HG, 26HG, 37HG and 31HG cams will bolt in without head work. 50HG and 54HG cams need piston to valve clearances and valve to valve clearances checked. 54HG and 55HG and 60HG cams need .620 minimum valve travel and .060 minimum piston to valve clearance. For engines with new heads, stroked flywheels and/or high compression pistons, the piston/valve and valve to valve clearance must be checked.

22. 2006 Dyna engines and all '07-up twin 96 engines have "closed loop" type fuel injection systems which use oxygen sensors in both front and rear exhaust pipes. For highly tuned engines, it may be necessary to use a different fuel injection map but most cam changes with bolt in cams should not require much change. The closed loop injection systems should allow bolt in cams to operate satisfactorily without re-tuning the fuel injection.

23. When tuning engines, always remember that your personal safety is the most important consideration.

Andrews Products: '07-up & '06 Dyna Gear Drive Cam Timing Specifications

Andrews#	Grind	Timing*	CL angle	Duration*	Valve Lift	TDC Lift	Springs	Spring Travel**
--------	Stock	-09/25	110.0	196	.471	.087	Stock	.570
	'07-'08	42/-03	109.0	219	.474	.110	-	-
216312G	12HG	02/34	106.0	216	.489	.091	Stock	.570
		40/02	109.0	222	.489	.095	-	-
216321G	21HG	10/30	100.0	220	.498	.134	Stock	.570
		40/08	106.0	228	.498	.121	-	-
216326G	26HG	11/35	102.0	226	.490	.138	Stock	.570
		41/09	106.0	230	.490	.120	-	-
216331G	31HG	10/46	108.0	236	.510	.131	Stock	.570
		52/08	110.0	240	.510	.120	-	-
216332G	32HG	10/46	106.0	236	.570	.131	Hi-Lift	.630
		52/08	112.0	240	.570	.120	-	-
216337G	37HG	18/38	100.0	236	.510	.174	Stock	.570
		46/14	106.0	240	.510	.148	-	-
216354G	54HG	16/42	103.0	238	.555	.165	Stock	.600
		43/15	104.0	238	.555	.158	-	-
216350G	50HG	20/48	104.0	248	.510	.184	Stock	.570
		54/18	108.0	252	.510	.168	-	-
216355G	55HG	22/46	102.0	248	.550	.197	Stock	.620
		52/20	106.0	252	.550	.181	-	-
216360G	60HG	24/56	106.0	260	.560	.205	.Hi-Lift	.610
		58/22	106.0	260	.560	.192	-	-
216367G	67HG	24/48	102.0	252	.570	.209	Hi-Lift	.630
		58/22	108.0	260	.570	.187	-	-
The following two cam grinds are for highly tuned engines setup for max HP and drags								
216359G	59HG	29/57	104.0	266	.590	.238	Hi-Lift	.650
		63/27	108.0	270	.590	.218	-	-
216364G	64HG	30/62	106.0	272	.640	.262	Hi-Lift	.700
		66/30	108.0	276	.640	.232	-	-

***Timing and durations are listed for .053 cam lift**
**** Spring travels are listed as minimums**

2007 and later engines with new beehive type valve springs have longer valve spring travel than earlier twin cam engines.

Valve travel and piston clearance should always be checked for all engine modifications that incude high compression pistons, head work and/or high lift cams.

(Gear drive cam Installation requires kits shown on page 4 and one pair of camshafts)

Each of the parts kits listed below can be ordered individually.

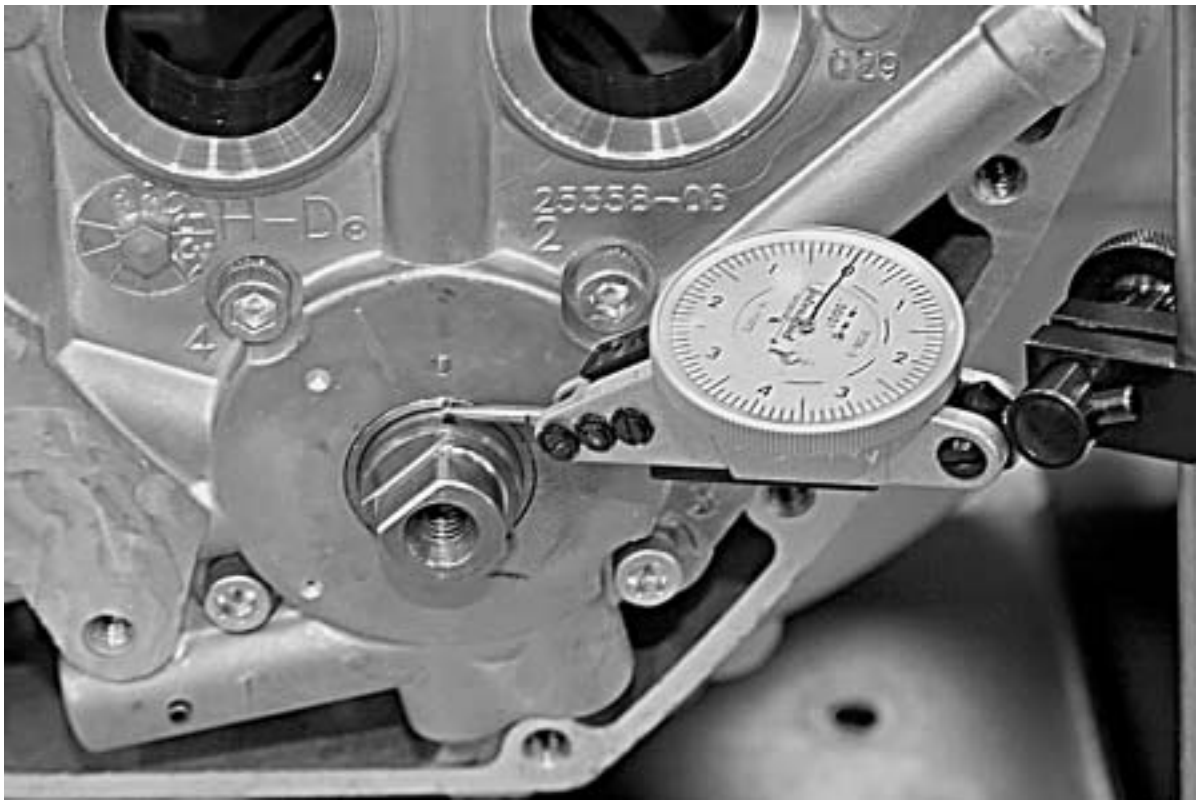
Parts Kit 216901
1. 1 outer oil port cover
2. 1 inner oil port cover
3. (2) INA inner bearings
4. Outer cover gasket

Parts Kit 216903
1. 1 crankshaft gear
2. 1 outer cam drive gear
3. 2 grade 8 retaining bolts
4. 1 retaining washer
5. 1 square drive key

Parts Kit 216908
1. 2 inner cam drive gears
2. 1 crankshaft gear
3. 1 outer cam drive gear
5. 2 grade 8 retaining bolts
6. 1 retaining washer
7. 2 # 404 Woodruff drive keys
8. 1 square drive key

Complete 2007 gear drive cam kit ready for installation.

Instrument setup for checking engine pinion shaft runout. If runout is greater than .003 TIR, Andrews Products recommends NOT installing gear drives without first re-truing flywheels to remove excess runout. Cam support plate MUST be installed for this test



Andrews Products, Inc.

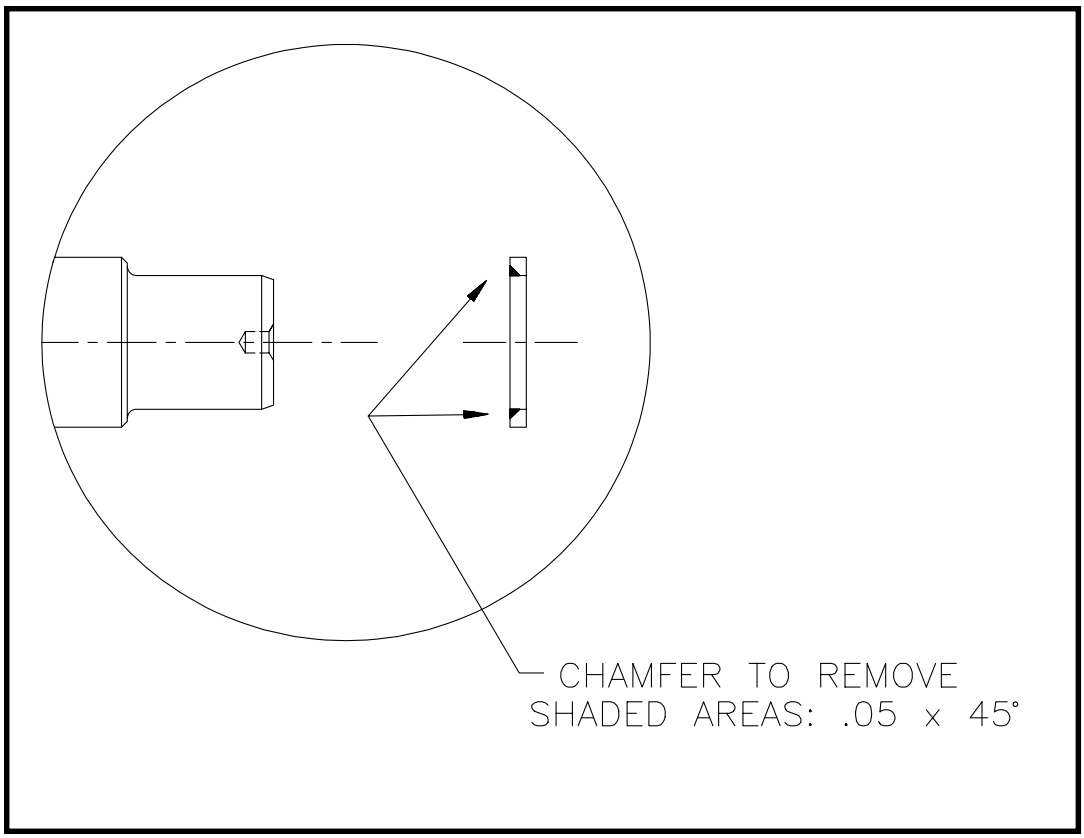
Installation instructions for XL countershaft: Part 259010

1. If your Sportster has an alternator (1984-1989), you will need to use one of the early style first gear thrust washers with the following parts number(s):

   35836-55 (.075 thick)
   35838-55 (.085 thick)
   35839-55 (.100 thick)
   35840-55 (.065 thick)

2. Also, the new Andrews Products countershaft has a fillet radius at the end of the shoulder where the first gear is installed. This fillet radius increases the strength of the shaft but will require that the thrust washer be chamfered so that it fits securely against the shoulder and does not contact the fillet radius.

3. The diagram below illustrates the correct modification to the thrust washer.



ANDREWS PRODUCTS, INC.

Sportster #2 drive gear installation

To install a new #2 drive gear on a 91-99 or 2000-up Sportster, the diagram below shows the correct timing relationship between the ignition drive slot and the pinion timing mark on the #2 drive gear.
The old gear can be pressed off using a small hydraulic press and a 5/8 socket. The new gear can then be pressed on with timing aligned as shown.